Manual for pgf-PeriodicTable 2.1.5

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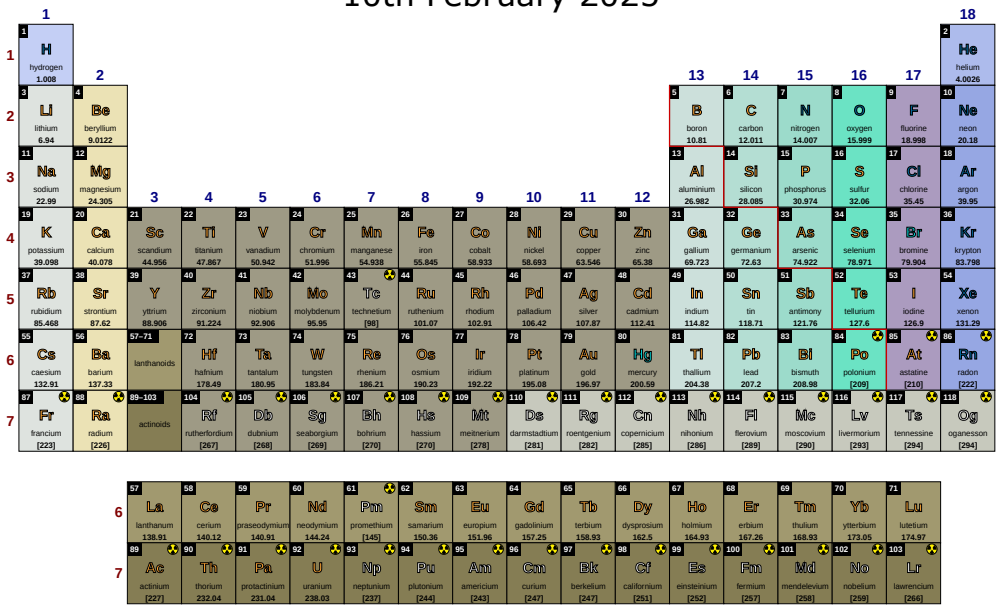


\pgfPT[show title=false,show legend=false]

Abstract

The purpose of this package is to provide the Periodic Table of Elements in a simple way. It relies on pgf/TikZ to offer a full or partial periodic table with a variety of options and displaying the desired data. The data available, from all the actual 118 elements, is: atomic number, element name, chemical symbol, relative atomic mass, standard relative atomic mass, radioactivity, atomic radius (empirical), covalent radius, ionic radius, first ionization energy, electronegativity (Pauling), electroaffinity, oxidation states, melting point (in Kelvin and Celsius degrees), boiling point (in Kelvin and Celsius degrees), electron distribution, electronic configuration (increasing n and increasing $n + \ell$), density, specific heat capacity, thermal conductivity, lattice structure, lattice constants (a, b, c and c/a ratio), discovery year, discovery country and visible range spectral lines. It is possible to get the Periodic Table in different languages: English, French, German, Portuguese (from Portugal and from Brazil), Spanish, Italian and translations provided by user contributions – currently in Dutch and Chinese.

Contents

Getting started

Installation

pgf-PeriodicTable is placed under the terms of the LaTeX Project Public License, version 1.3 or later (http://www.latex-project.org/lppl.txt). pgf-PeriodicTable loads and requires the TikZ and fontenc or fontspec (at least v2.7h – 2020/02/03) packages.

You need to put the package files (pgf-PeriodicTable.sty & *friends*) in a location where PDFLaTeX, LuaLaTeX or XeLaTeX can find them. According to the TDS conventions this may be a subdirectory named *tex/latex/pgf-PeriodicTable/* or *tex/latex/misc/* in your (site specific) installation tree (insert your appropriate directory delimiter instead of /, if needed).

Package loading and options

If you are using PDFLaTeX, LuaLaTeX or XeLaTeX you can just simply include the style file without any option via the \usepackage command, \usepackage{pgf-PeriodicTable}

It can also be loaded with a comma separated list of *options* to select the desired default language, to use Devanagari or Mandarin numerals in the Atomic Number, Periods and/or Groups or to fix the interaction with the beamer class.

Language Option

There are six *built-in* languages – English, French, German, Portuguese (from Portugal and Brazil), Spanish and Italian. The default language used in the package may be selected at package loading:

```
\usepackage[language flag]{pgf-PeriodicTable}
```

The language flags available are:

- ✓ **en** for English (default),
- ✓ **fr** for French,
- ✓ **de** for German,
- ✓ **pt** for Portuguese (Portugal),
- ✓ **br** for Portuguese (Brazil),
- ✓ **es** for Spanish and
- ✓ **it** for Italian.

A *user language* can also be chosen as default language loading the package with the following option syntax:

```
\usepackage[userlang=<ISO 639-1 CODE>]{pgf-PeriodicTable}
```

The user language ISO CODES available are:

- ✓ **nl** for Dutch,
- ✓ **zh** for Chinese (simplified).

Anyone who wishes to contribute with translations for use in this package can go to the pgf-periodictable project page.

Note that the *built-in* languages are always available for the languages option of the \pgfPT command, but the *user language* is only available if loaded with the package.

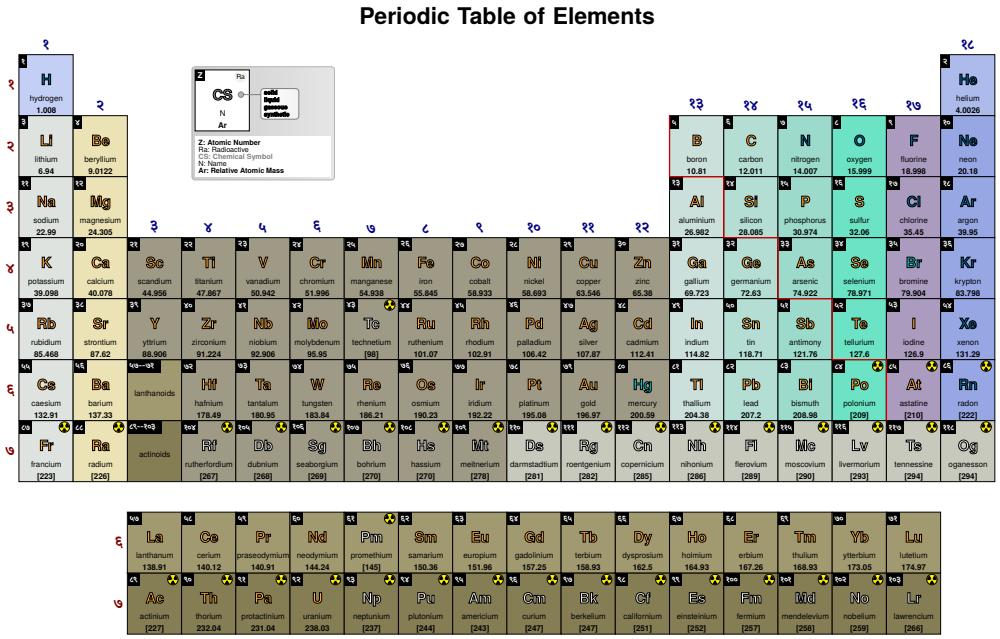
Devanagari numerals

It is possible to get some numbers in the Periodic Table with Devanagari numerals: the atomic number and the numeration of periods and groups. To get this feature enabled the package must be loaded with the option *numerals* set to **dvn**:

```
\usepackage[numerals=dvn]{pgf-PeriodicTable}
```

This option requires the XeLaTeX engine to typeset the document.

```
% \usepackage[numerals=dvn]{pgf-PeriodicTable}
                                        \pgfPT
```



It is also possible to load a font for the Devanagari numerals using the following command:

```
\pgfPTdvnfont[font options]{font name}
```

The default font is *Eczar*.

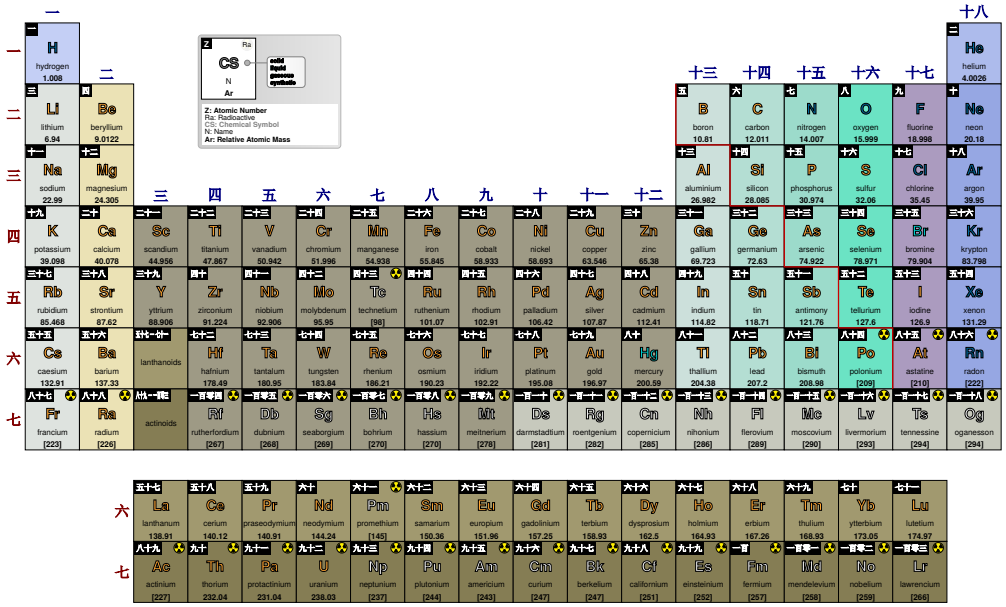
Mandarin numerals

To get some numbers of the Periodic Table with Mandarin numerals (the atomic number and the numeration of periods and groups) the package must be loaded with the above option *numerals* set to **zh**:

```
\usepackage[numerals=zh]{pgf-PeriodicTable}
```

This option works with the XeLaTeX and LuaLaTeX engines to typeset the document and requires the `zhnumber` package, which is automatically loaded.

```
% \usepackage[numerals=zh]{pgf-PeriodicTable}
                                    \pgfPT
```



As with the Devanagari numerals, the following command loads the specified font for the Mandarin numerals:

\pgfPTzhnumberfont[font options]{font name}

For backwards compatibility (up to v2.1.4) the previous \pgfPTzhfont command now points to \pgfPTzhnumberfont, so older documents do not need any changes.

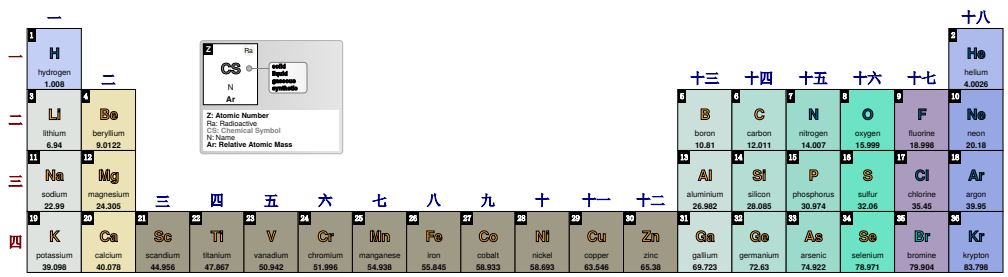
The default font is *BabelStone Han* (since v2.1.5) loaded with the *AutoFakeBold=4* option. For details on installing this font, see the Chinese (zh) subsection below.

It is also possible to enable or disable the numbers shown in Mandarin with the command:

\pgfPTzhnumber[<true|false>]{comma separated list}

The list can have Z for the atomic number, per for the period numbers and gr for the group numbers. At package loading, with this option, they are set to true.

```
% \usepackage[numerals=zh]{pgf-PeriodicTable}
                                \pgfPTzhnumber[false]{Z}
                                  \pgfPT[Z list={1,...,36}]
```



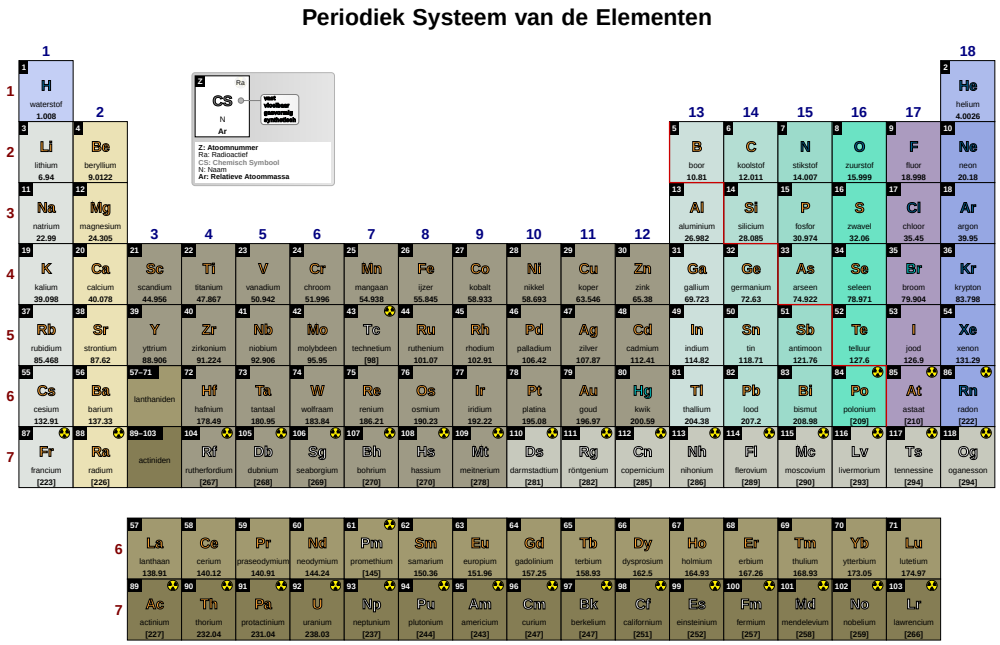
User languages

User languages are provided by user translations. They are only available if passed as an option when loading the package. In addition to the *built-in* languages, the chosen language is the only one available and becomes the default language for the Periodic Table.

Dutch (nl)

The Dutch language is loaded by:
`\usepackage[userlang=nl]{pgf-PeriodicTable}`

```
% \usepackage[userlang=nl]{pgf-PeriodicTable}
                                        \pgfPT
```



Chinese (zh)

The Chinese language is loaded by:
`\usepackage[userlang=zh]{pgf-PeriodicTable}`

> The default font is *BabelStone Han* **which is not available in TeX Live**.
> It can be downloaded for free from the BabelStone website:
> https://www.babelstone.co.uk/Fonts/Han.html

The use of a font which is not included in the TeX Live software distribution, nor in common Operating Systems, circumvents the missing Ideographs for the most recent elements – from rutherfordium to oganesson. The BabelStone Han has all of them as can be seen in the following table:

	BabelStone Fonts	*Windows 10 & Windows 11 Fonts*				
ELEMENT	**BabelStone Han**	**SimSun**	**SimSun-ExtB**	**Microsoft YaHei**	**Microsoft JhengHei**	**MingLiU-ExtB**
hydrogen	氢	氢	□	氢	氫	□
...	...	...	□	...	...	□
lawrencium	铹	铹	□	铹	铹	□
rutherfordium	𨧀		𨧀	𨧀	□	□
dubnium	𨨏		𨨏	𨨏	□	□
seaborgium	𨭆		𨭆	𨭆	□	□
bohrium	𨬭		𨬭	𨬭	□	□
hassium	𨭉		𨭉	𨭉	□	□
meitnerium	钑	钑	□	钑	钑	□
darmstadtium	鿍		鿍	鿍	□	鿍
roentgenium	轮		轮	轮	□	□
copernicium	鿔	鿔	□	鿔	鿔	□
nihonium	鿭	鿭	□	鿭	□	□
flerovium	铁		铁	铁	□	铁
livermorium	钫		钫	□	□	钫
tennessine	砬	砬	□	砬	□	□
oganesson	氪	氪	□	氪	□	□

	TeX Live 2024 Fonts					
ELEMENT	**FandolSong**	**FandolFang**	**FandolHei**	**FandolKai**	**AR PL SungtiL GB**	**AR PL KaitiM GB**
hydrogen	氢	氢	氢	氢	氢	氢
...	...	...	...	...	...	...
lawrencium	铹	铹	铹	铹	铹	铹
rutherfordium	𠀀	𠀀	𠀀	𠀀		
dubnium	𠀀	𠀀	𠀀	𠀀		
seaborgium	𠀀	𠀀	𠀀	𠀀		
bohrium	𠀀	𠀀	𠀀	𠀀		
hassium	𠀀	𠀀	𠀀	𠀀		
meitnerium	𠀀	𠀀	𠀀	𠀀		
darmstadtium	𠀀	𠀀	𠀀	𠀀		
roentgenium	𠀀	𠀀	𠀀	𠀀		
copernicium	𠀀	𠀀	𠀀	𠀀		
nihonium	𠀀	𠀀	𠀀	𠀀		
flerovium	𠀀	𠀀	𠀀	𠀀		
livermorium	𠀀	𠀀	𠀀	𠀀		
tennessine	𠀀	𠀀	𠀀	𠀀		
oganesson	𠀀	𠀀	𠀀	𠀀		

Glyphs available in BabelStone Han font and in some Windows and TeX Live fonts.

To use the BabelStone Han it is necessary to download it, unzip it and install the extracted font file:

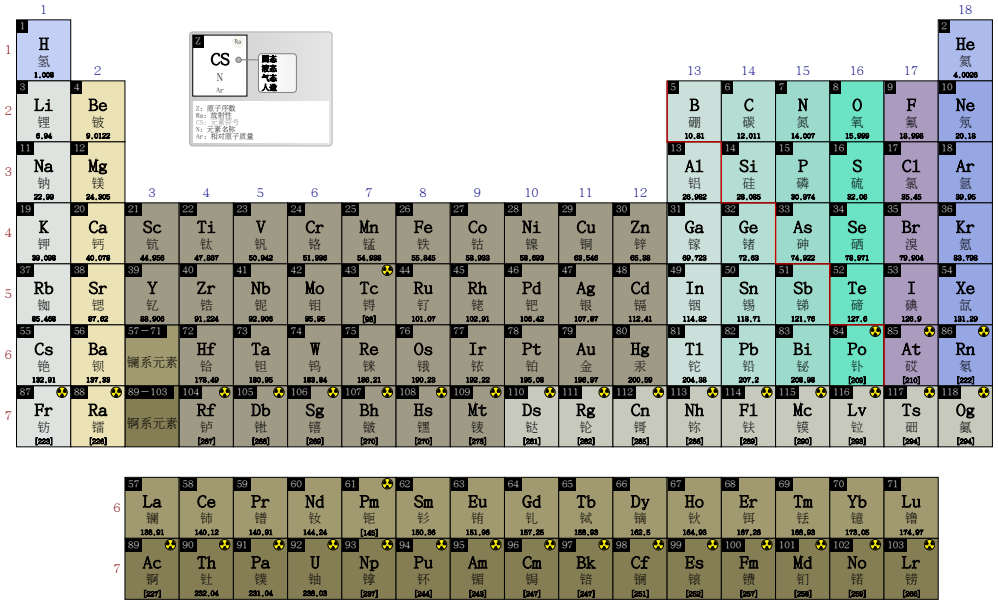
- for Windows users, just right click on BabelStoneHan.ttf and choose install for all users. This can also be done in Windows Settings → Personalization → Fonts.
- for Linux users, open the Linux Terminal and type sudo apt install fonts-BabelStoneHan.ttf
- for macOS users, just copy or drag the font file (BabelStoneHan.ttf) into /Library/Fonts or double-click on BabelStoneHan.ttf to open the preview window. Click on Install font button at the bottom of the preview window.

Make sure the BabelStone Han font is *visible* to the XeLaTeX or LuaLaTeX engines.

If you do not want to install this font on your operating system, you can place it in the truetype fonts folder in the TeX Live distribution and *Update filename database* in the TeX Live manager. After that, the font will be known only by the filename BabelStoneHan.ttf instead of its name, BabelStone Han.

```
% \usepackage[userlang=zh]{pgf-PeriodicTable}
\pgfPT
```

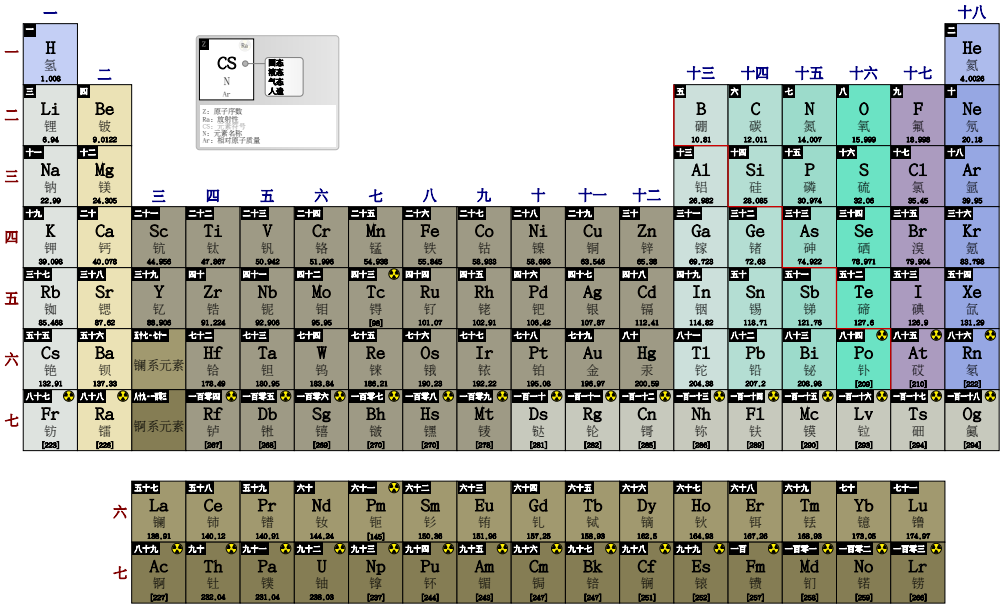
元素周期表



To get the Periodic Table with the atomic number and the period/group numbers in mandarin numerals load the package with the correponding options:

```
% \usepackage[userlang=zh,numerals=zh]{pgf-PeriodicTable}
\pgfPT
```

元素周期表



When the Chinese language is loaded four extra commands are defined:

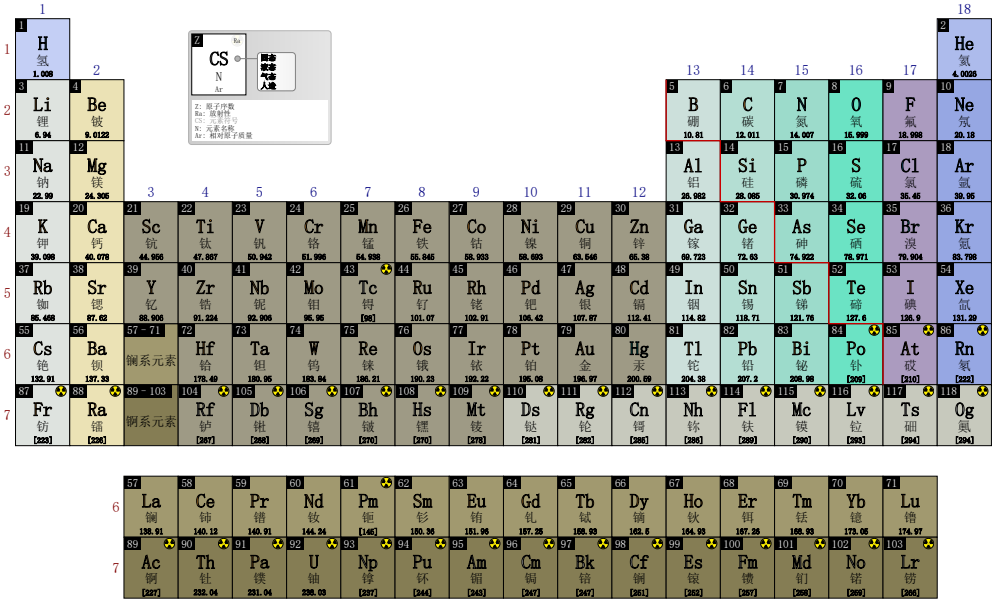
- \pgfPTzhFontFeatures can be used to set font features for the loaded Chinese font (set by the font option). For more details see the fontspec package documentation.
- \pgfPTzhtextfontSS is used to set the font for the elements meitnerium, copernicium, nihonium, tennessine and oganesson (Z=109, 112. 113, 117 and 118).
- \pgfPTzhtextfontSSB is used to set the font for the elements rutherfordium, dubnium, seaborgium, bohrium, hassium,darmstadtium, roentgenium and flerovium (Z=104, 105, 106, 107, 108, 110, 111 and 114).
- \pgfPTzhtextfontLv is used to set the livermorium (Z=116) font.

The defaults for some features of the Periodic Table are also changed:

- the name font is switched from \tiny to \footnotesize.
- the CS font is switched from \small\bfseries to \large.
- the title font is switched from \Large\bfseries to \LARGE.
- when not using the Chinese numerals (loaded with the option numerals=zh) the Z font is switched from \tiny\bfseries to \scriptsize, as well the Z padding is changed from 0.25ex to 0ex.

```
% \usepackage[userlang=zh]{pgf-PeriodicTable}
\pgfPTzhtextfontSS{SimSun}% font for Z={109,112.113,117,118}
                % meitnerium, copernicium, nihonium, tennessine, oganesson
\pgfPTzhtextfontSSB{SimSun-ExtB}% font for
                % Z={104,105,106,107,108,110,111,114}
                % rutherfordium, dubnium, seaborgium, bohrium, hassium,
                % darmstadtium, roentgenium, flerovium
\pgfPTzhtextfontLv{SimSun-ExtB}% font for Z=116
                % livermorium
\pgfPT[font=SimSun]
```

元素周期表



Interaction with other packages

fontspec

To correctly set the font in each cell contents the command \fontspec must be used. For example if you want to use *Arial* for the name font, it must be set using name font=\fontspec{Arial}\selectfont.
All other font selection commands, *e.g.*, \large, \itshape, are used as usual. For example if you want to use *Arial* in *large* size and *bold* weight for the name font, then you type name font=\large\bfseries\fontspec{Arial}\selectfont or name font=\fontspec{Arial}\large\bfseries\selectfont.

ragged2e

Using `\usepackage[document]{ragged2e}` and `\usepackage{pgf-PeriodicTable}` together, the Periodic Table will be completely fractured and out of the page.

Solution:

Use a local group: {\justifying\pgfPT}

beamer

beamer, pgf-PeriodicTable and PDFLaTeX in combination have an issue: the `\textsc` fails to produce the correct small caps. The error given is:

```
Font shape 'T1/cmss/m/sc' undefined
(Font) using 'T1/cmss/m/n' instead on input line ...
```

To avoid this, the pgf-PeriodicTable package can be loaded with one of the following options:

beamer which loads the lmodern package, setting small caps compatibility with beamer via 'lmodern' package.

```
% \usepackage[beamer]{pgf-PeriodicTable}
```

beamer* which sets small caps compatibility with beamer via T1 cmr fonts.

```
% \usepackage[beamer*]{pgf-PeriodicTable}
```

beamer** which sets small caps compatibility with beamer via T1 cmr fonts and loads the silence package to suppress small caps font substitution warnings.

```
% \usepackage[beamer**]{pgf-PeriodicTable}
```

The data

The data available in pgf-PeriodicTable was mainly compiled with selected and filtered data from Wikipedia, taken from November 2021 to July 2022.

acronym	description	unit	remarks (compiled from @date)
Ar	Relative Atomic Mass		(Wikidata @09/jan/2022)
Arstar	Standard Relative Atomic Mass		STANDARD ATOMIC WEIGHTS 2021, Commission on Isotopic Abundances and Atomic Weights, © **CIAAW, 2007–2022** (**https://ciaaw.org/impressum.htm**)
radio	Radioactivity		(gperiodic-3.0.3, Dec 26 2018)
R	Atomic Radius	pm	Calculated (Wikidata @04/jul/2022)
Rcov	Covalent Radius	pm	Single bond, Wikidata @04/jul/2022)
Rion	Ionic Radius	pm	(Wikidata @04/jul/2022)
Ei	First Ionization Energy	$kJ \cdot mol^{-1}$	(Wikidata @04/jul/2022)
eneg	Electronegativity (Pauling)		(Wikidata @04/jul/2022)
eaff	Electroaffinity	$kJ \cdot mol^{-1}$	(Wikidata @04/jul/2022)
O	Oxidation States		(Wikidata @09/jan/2022)
Tmelt	Melting Point	K	at standard pressure (Wikidata @21/dez/2021)
TmeltC	Melting Point	°C	at standard pressure (Wikidata @21/dez/2021)
Tboil	Boiling Point	K	at standard pressure (Wikidata @21/dez/2021)
TboilC	Boiling Point	°C	at standard pressure (Wikidata @21/dez/2021)
eDist	Electron Distribution		(Wikidata @01/nov/2021)
eConfign	Electronic Configuration (increasing n)		(Wikidata @01/nov/2021)
eConfignl	Electronic Configuration (increasing $n + \ell$)		(Wikidata @01/nov/2021)
d	Density	$g \cdot dm^{-3}$ for gases $g \cdot cm^{-3}$ all other physical states	physical state at 25°C, 1 atm (Wikidata @01/nov/2021)
Cp	Specific heat capacity	$J \cdot mol^{-1} \cdot K^{-1}$	at 25°C and 100 kPa (Wikidata @20/nov/2021)
kT	Thermal Conductivity	$W \cdot m^{-1} \cdot K^{-1}$	at 25°C (Wikidata @21/nov/2021)
ls	Lattice Structure		(Wikidata @20/dez/2021 and University of Bielefeld)
lsa	Lattice constant: a	pm	(University of Bielefeld @21/dez/2021)
lsb	Lattice constant: b	pm	(University of Bielefeld @21/dez/2021)
lsc	Lattice constant: c	pm	(University of Bielefeld @21/dez/2021)
lsca	Lattice c/a ratio		Calculated from available data and rounded to two digits
DiscY	Discover Year		(Wikidata @22/dez/2021)
DiscC	Discover Country		(Wikidata @22/dez/2021)
spectra	Visible range spectral lines		Elements spectrum made with \pgfspectra. See the pgf-spectra manual for more details

The utilization of the *acronyms* will be explained in Designing cells with \pgfPTbuildcell.

The commands

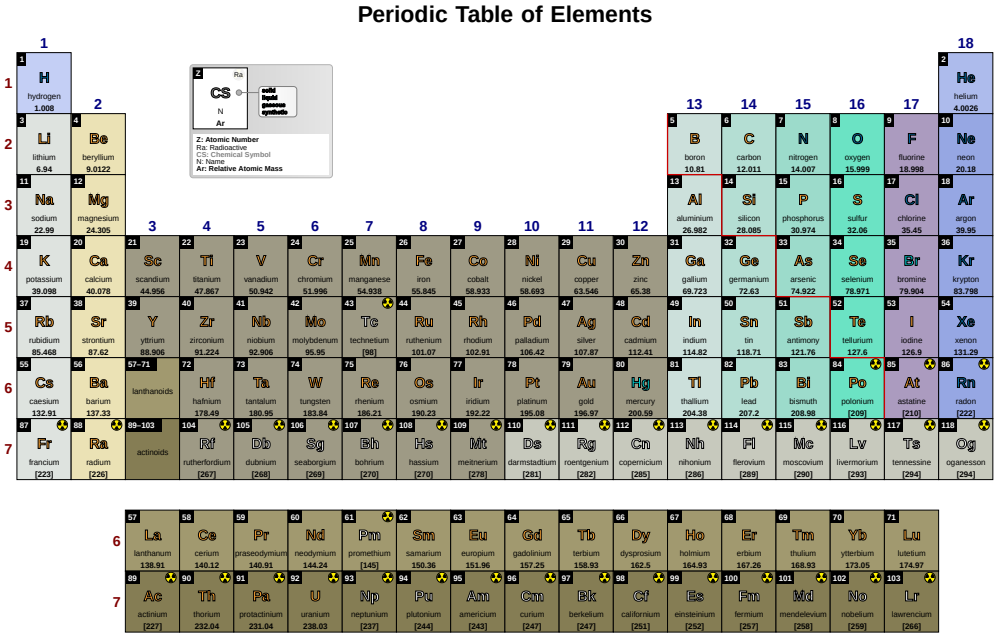
The commands to achieve the Periodic Table of Elements are:

- \pgfPT or \pgfPT[options list] – draws a full or partial graphical Periodic Table controlled by the optional keys.
- \pgfPTstyle[options list] – sets the global style for the Periodic Table.
- \pgfPTresetstyle – resets the style for the Periodic Table with the default values.
- \pgfPTbuildcell(nrows,ncolumns)[entries] – builds the contents of each cell in the Periodic Table.
- \pgfPTresetcell – resets the cell to its default layout.
- \pgfPTbuildcellstyle{name}(nrows,ncolumns)[entries] – builds the contents of each cell in the Periodic Table and stores it in a named style.
- \pgfPTpreviewcell or \pgfPTpreviewcell[scale factor] – preview the last unnamed built cell with an optional scale factor. If no cells have yet been built, the default cell is shown.
- \pgfPTpreviewcellstyle{name} or \pgfPTpreviewcellstyle[scale factor]{name} – preview the named builded cell with an optional scale factor.
- \pgfPTnewColorScheme[trailing color]{name}{color list} – makes a color scheme to fill the cells along the Periodic Table.
- \pgfPTnewZlist{name} – create a user defined atomic numbers (Z) named list.
- \pgfPTsetLanguage{language flag} – globally change the default language.

► Utilization of \pgfPT

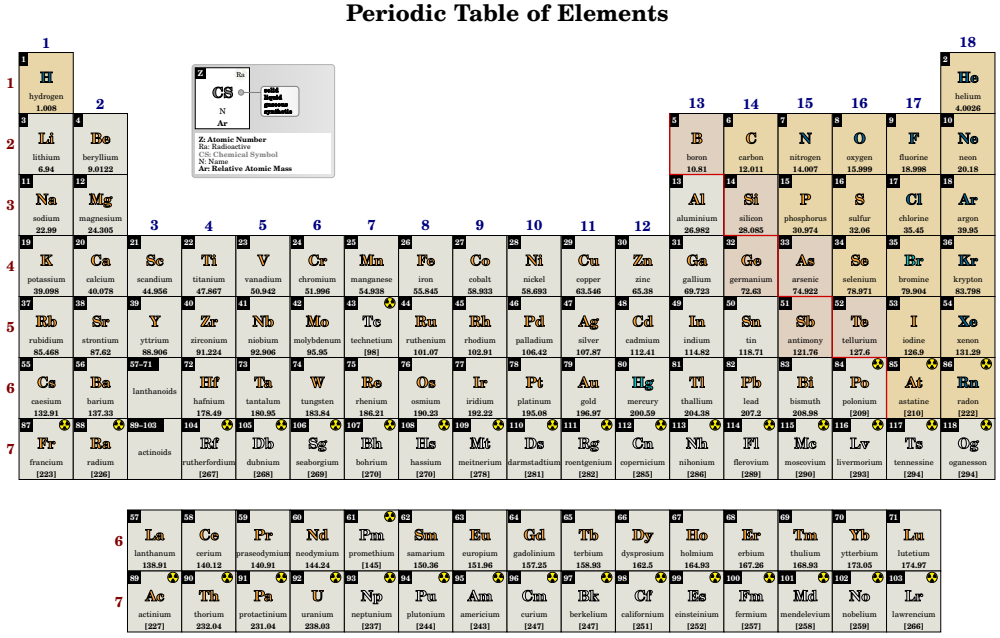
Use this command to draw the Periodic Table of Elements in the language selected at package inclusion (\usepackage[language flag]{pgf-PeriodicTable}):

```
\pgfPT
```



This command can also be used with options – as described in section Options for \pgfPT: creating a «Periodic Table» – to modify, for instance, the font of the Periodic Table or the colors of the cells:

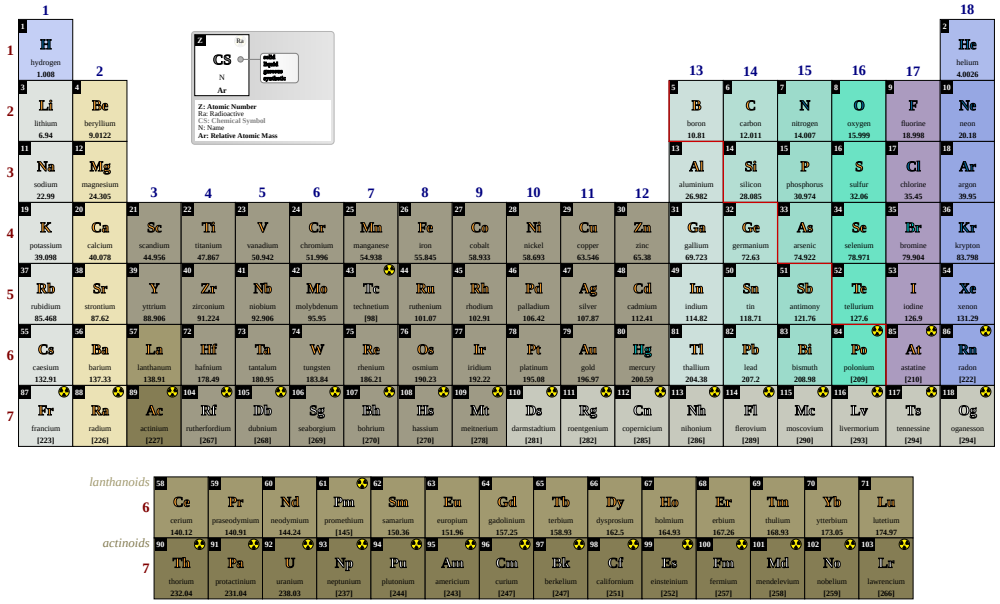
```
\pgfPT[font=pnc,back color scheme=pgfPTMNM]
```



► Utilization of \pgfPTstyle[options list]

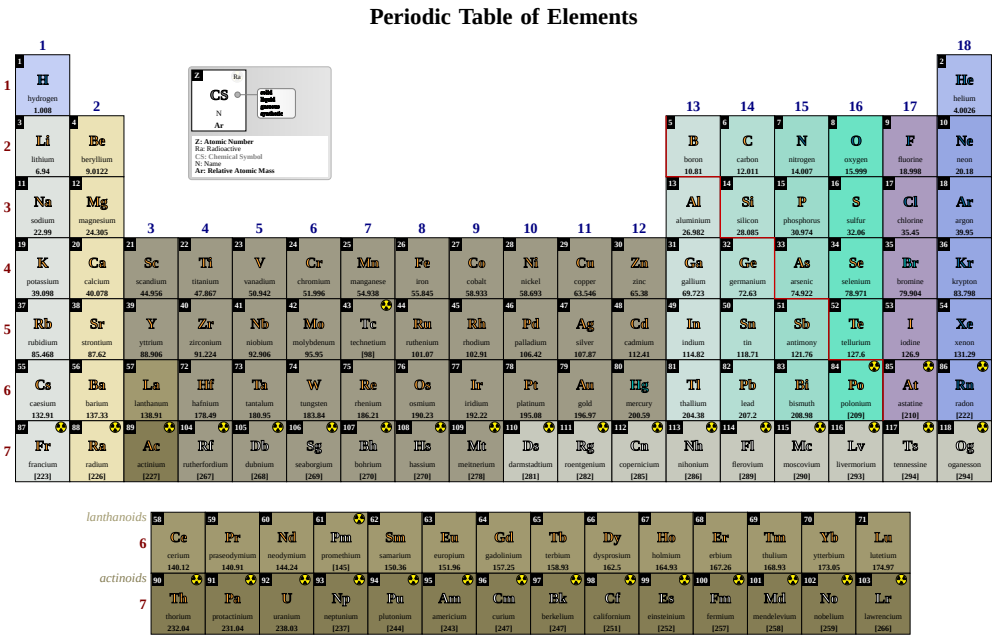
This command globally sets a style for the Periodic Table:

```
\pgfPTstyle[font=ptm,IUPAC=false,show title=false]
\pgfPT
```



It is possible to locally override the *global style* defined:

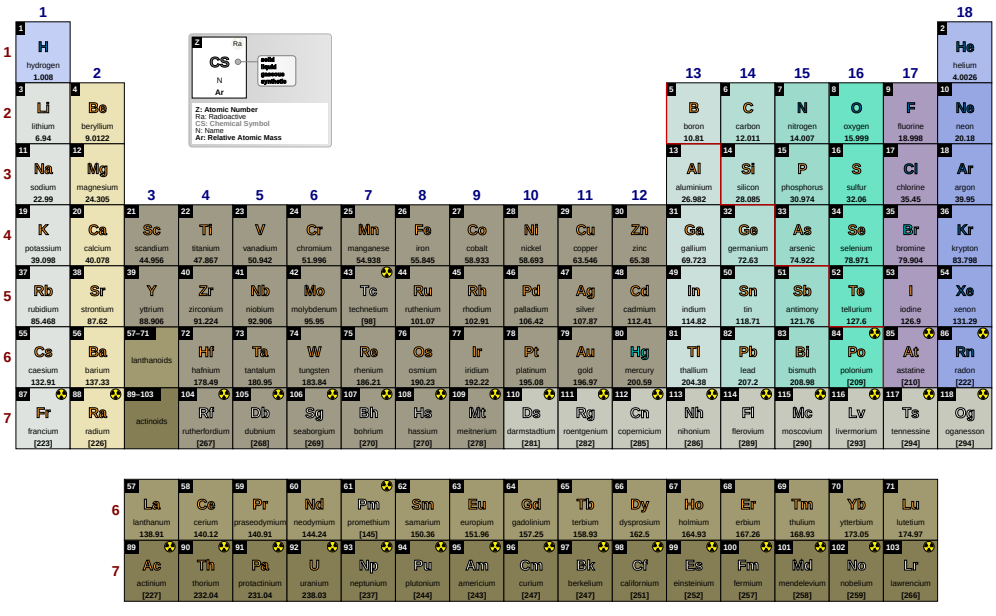
```
\pgfPT[show title]
```



► Utilization of \pgfPTresetstyle

This command resets the style used in the Periodic Table to default values:

```
\pgfPTresetstyle
\pgfPT
```



► Utilization of \pgfPTbuildcell(nrows,ncolumns)[entries]

With \pgfPTbuildcell it is possible to customize the *elementar* cell of the Periodic Table. Each cell is built on the given *number of rows* and *number of columns*. After that, each *entry* is constructed according to the structure row;column;what or initial row-final row;initial column-final column;what.

✓ The first *syntax* – row;column;what – puts «what» in the «row» row and in the «column» column with the height of one row and the width of one column:
– for example, 1;1;Z puts the atomic number Z in row 1 and column 1, witch actually corresponds to a box anchored to the top left corner of the cell and that *goes* below and to the right of that corner.

✓ The second *syntax* – initial row-final row;initial column-final column;what – puts «what» from «initial row» to «final row» with the height of final row − initial row + 1 and from «initial column» to «final column» with the width of final column − initial column + 1. It is important to keep in mind that when using this syntax the *row* and *column* could have any value between **1** and **number of rows** and **number of columns**, respectively.
– for example, 1;1-2.1;Z puts the atomic number Z in row 1 with the height of one row and from column 1 to *column* 2.1, with the width of 2.1 × column. Note that in this example the two *syntaxes* are mixed up.

The **default cell** of the Periodic Table is constructed with the command:

```
\pgfPTbuildcell(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-2.5;CS),(4;1-3;name),(5;1-3;Ar)]
```

► Utilization of \pgfPTresetcell

The \pgfPTresetcell resets the cell to its default layout.

► Utilization of \pgfPTbuildcellstyle{name}(nrows,ncol...)[entr...]

The \pgfPTbuildcellstyle command works like \pgfPTbuildcell, but stores the cell style under the name provided. It is only used when called via the cell style passed as an option to \pgfPT. Otherwise it remains unavailable, unlike the \pgfPTbuildcell command which immediately affects the cells of the Periodic Table.

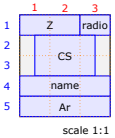
► Utilization of \pgfPTpreviewcell

The main purpose of this command is to show the built cell for *debugging*.
With \pgfPTpreviewcell you can preview the last unnamed built cell with an optional scale factor. If no cells have yet been built, the default cell is shown.

```
\pgfPTpreviewcell
```

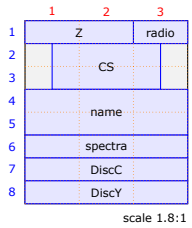
Using the last cell built
The build command:

```
\pgfPTbuildcell(5,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;Ar)]
```



```
\pgfPTbuildcell(8,3)% 8 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4-5;1-3;name),
(6;1-3;spectra),(7;1-3;DiscC),(8;1-3;DiscY)]
                                    \pgfPTpreviewcell[1.8]
```

Using the last cell built
The build command:
\pgfPTbuildcell(8,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4-5;1-3;name),(6;1-3;spectra),(7;1-3;DiscC),(8;1-3;DiscY)]



► Utilization of \pgfPTpreviewcellstyle{name}

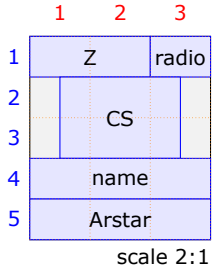
This previews a *named* cell, again with the optional scale factor.

```
\pgfPTpreviewcellstyle{myname}
```

User style **myname** *doesn't exist!* ()

```
\pgfPTbuildcellstyle{myname}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;Ar*)]
                                    \pgfPTpreviewcellstyle[2]{myname}
```

User style **myname**
The build command:
\pgfPTbuildcell(5,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;Ar*)]



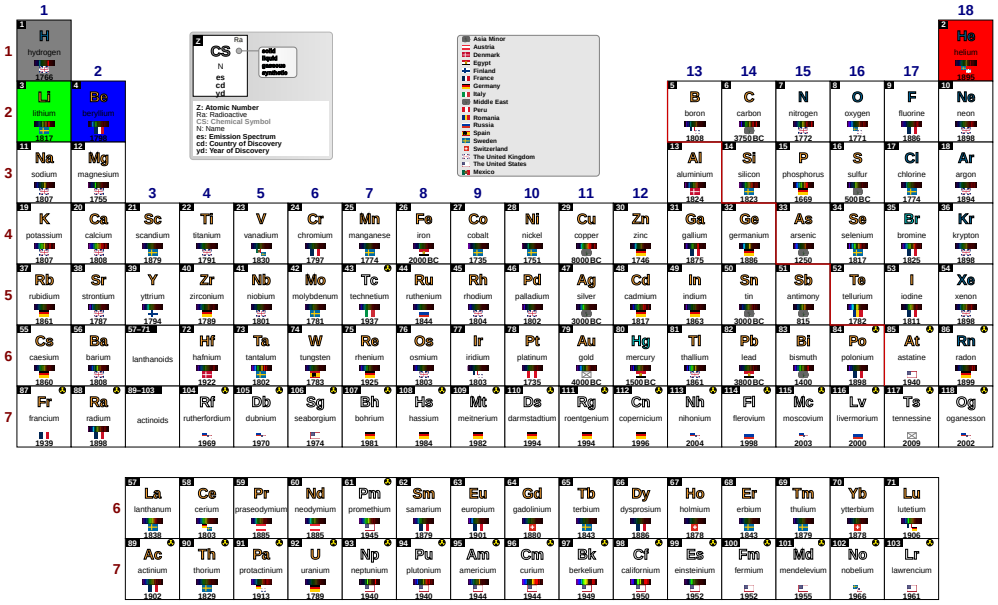
► Utilization of \pgfPTnewColorScheme{name}{color list}

Use this command to create a *color scheme* for cells in the Periodic Table. It has two mandatory arguments – name and color list – and an optional argument – trailing color.

The name is used to identify the *color scheme*. The color list is a comma-separated list of red, green and blue values written as r/g/b, defined in ascending order of Z and starting at Z=1. The optional argument trailing color is appended to the end of the list and is used for all cells starting from this point on. It also has the form r/g/b and its default value is 1/1/1 (white).

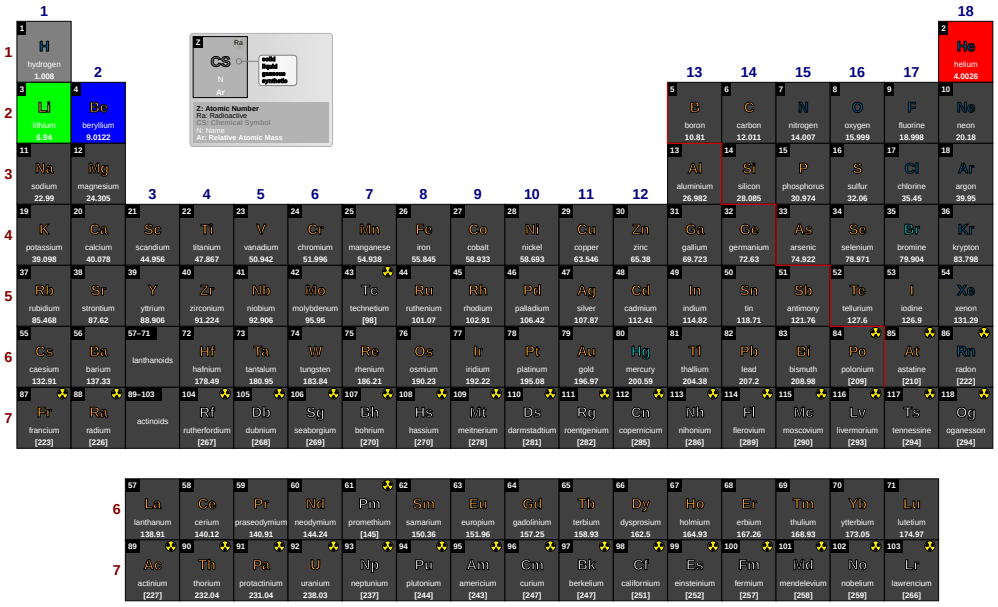
```
\pgfPTnewColorScheme{myname}{.5/.5/.5,1/0/0,0/1/0,0/0/1}
\pgfPT[back color scheme=myname]
```

Periodic Table of Elements



```
\pgfPTnewColorScheme[.25/.25/.25]{myname}{.5/.5/.5,1/0/0,0/1/0,0/0/1}
\pgfPTresetcell
\pgfPT[back color scheme=myname,name color=white, Ar color=white,legend back color=black!30]
```

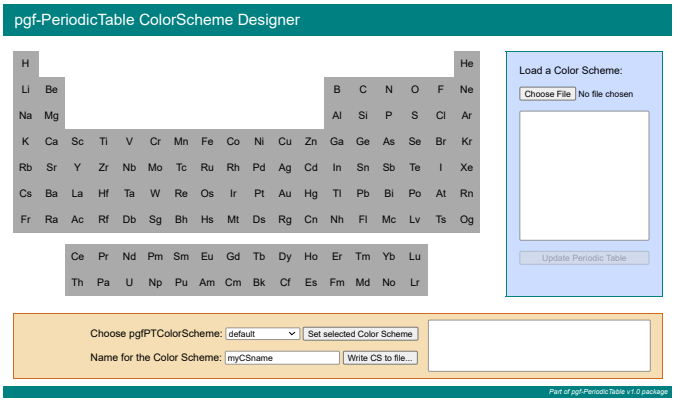
Periodic Table of Elements



There are a few *color schemes* predefined:

- ✓ **pgfPTdefault**, the default built-in color scheme, which is loaded if no value is passed to the back color scheme key.
- ✓ **pgfPTSoft**, a soft color pattern for cells, differentiating metals, non metals, semimetals, lanthanides and actinides.
- ✓ **pgfPTJmol**, a color scheme based upon Jmol: an open-source Java viewer for chemical structures in 3D.
- ✓ **pgfPTCPK**, a color scheme that is based upon the colors of the popular plastic spacefilling models which were developed by Corey, Pauling and later improved by Kultun.
- ✓ **pgfPTRasmol** and **pgfPTRasmolNew**, two color schemes based upon the computer program RasMol.
- ✓ **pgfPTWikipedia**, a color scheme built on the Periodic Table of Elements available at Wikipedia.
- ✓ **pgfPTMNM**, a color pattern which distinguishes between **M**etals, semimetals and **N**on **M**etals.
- ✓ **pgfPTPS**, a color scheme depicting the **P**hysical **S**tate at room temperature.
- ✓ **pgfPTRadio**, a two color color scheme showing the radioactivity of the elements.
- ✓ **pgfPTBlocks**, a four colored color scheme showing the *s*, *p*, *d* and *f* blocks of the Periodic Table.

Writing a color scheme can be painstaking work, so a *script* is provided for that:



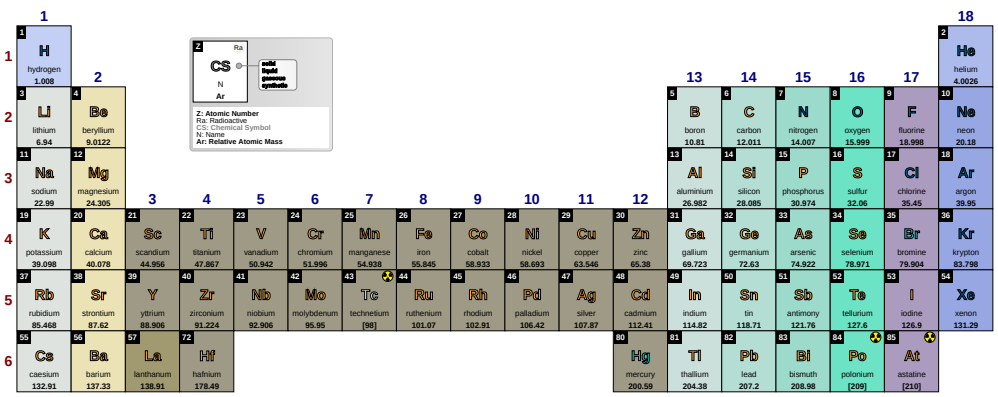
pgfPTcolorSchemes.html

▸ Utilization of \pgfPTnewZlist{name}

This command makes a user defined atomic numbers' list with the provided name. The list can be anything that the \foreach loop, defined in the TikZ package, can understand.

For more information on how to use \foreach loop refer to the section *Repeating Things: The Foreach Statement* in the pgfmanual.

```
\pgfPTnewZlist{myZlist}{1,...,57,72,80,81,...,85}
\pgfPT[Z list=myZlist,IUPAC=false]
```

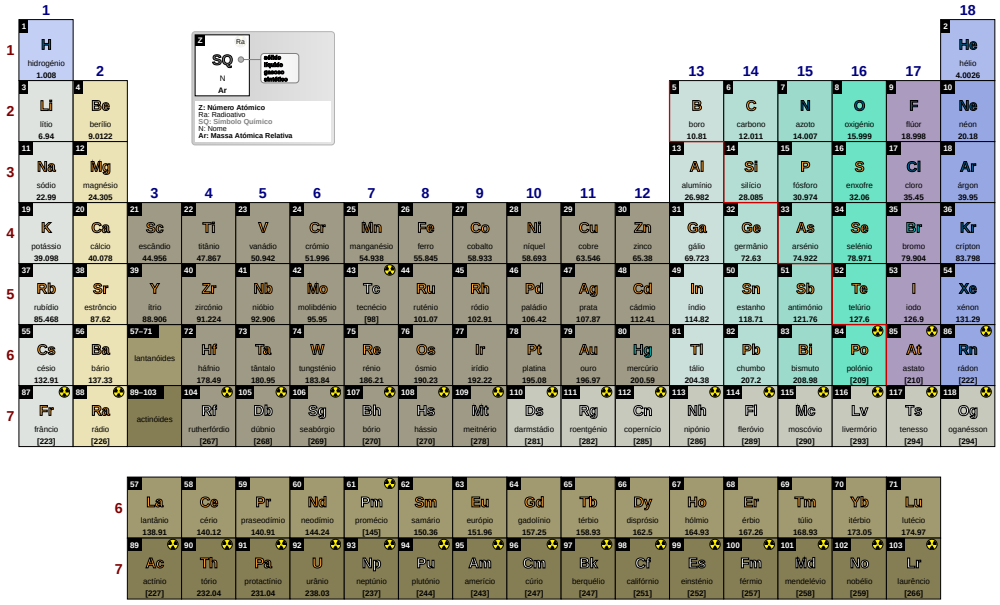


► Utilization of \pgfPTsetLanguage{language flag}

This command globally changes the default language of the Periodic Table. If a user language has been loaded, the corresponding ISO 639-1 code can also be used as a language flag.

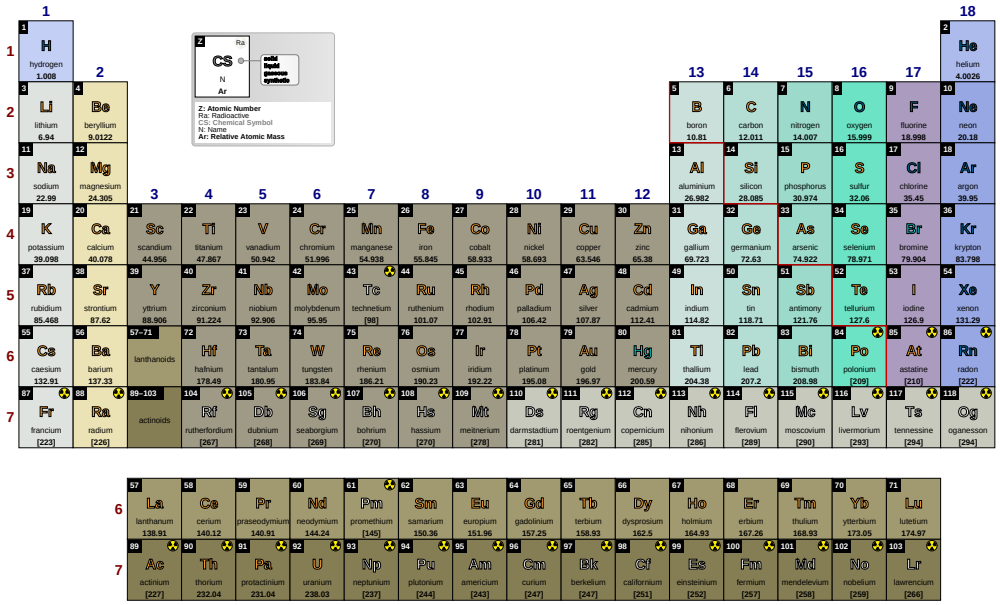
```
\pgfPTsetLanguage{pt}
\pgfPT
```

Tabela Periódica dos Elementos



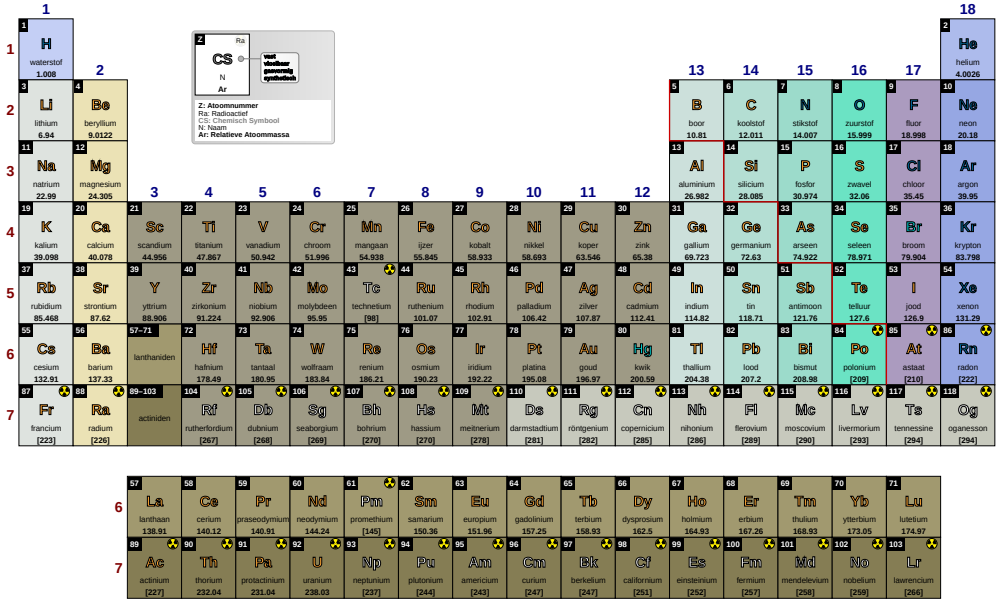

```
\pgfPTsetLanguage{en}
\pgfPT
```

Periodic Table of Elements



```
% \usepackage[userlang=nl]{pgf-PeriodicTable}
                                \pgfPTsetLanguage{nl}
                                \pgfPT
```

Periodiek Systeem van de Elementen



Options for \pgfPT: creating a «Periodic Table»

For the commands \pgfPT and \pgfPTstyle there are a set of options available to draw the Periodic Table or any portion of the Periodic Table, as described below.

The list of options is a comma separated list of any of the following elements:

- a 'key' or a 'key=value' pair,
- a 'style' or a 'style=value' pair,
- a *pseudo style* with a proper syntax: 'style={key 1=value 1, key 2=value 2, … , key n=value n}', where none of the '*keys*' are mandatory.

The options *can be divided* in two subsets, one that affects the *appearance* of the *entire* Periodic Table, the other that concerns the *contents* of each cell of the Periodic Table.

✠ Periodic Table options: keys, styles and *pseudo styles*

The following options and styles are used to *control* the Periodic Table *as a whole* in various aspects, such as the cell width or cell height, which elements are displayed (Z list), whether the title or legend are shown – show title or show legend – among others.

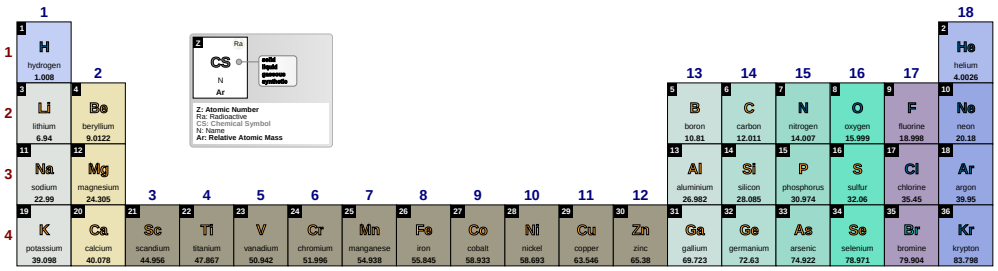
➠ General layout

Z list default: *all*

Set's the list of the elements to display in the Periodic Table. It could be a name or a comma separated list of atomic numbers (see below), which in turn supports *the dots notation* as explained in the section *Repeating Things: The Foreach Statement* in the pgfmanual.

(changed in v2.1.5)

\pgfPT[Z list={1,...,36}]



The possible name is one of the following:

✓ **built-in**:

- ▷ 'all' is equivalent to Z list={1,...,118}, *i.e.*, all known elements.
- ▷ 's', 'p', 'd' or 'f', for the elements in the corresponding blocks.
- ▷ 'sp', 'spd', for the elements resulting from merging the corresponding blocks.
- ▷ 'lanthanoids' or simply 'La', for lanthanoids †.
- ▷ 'actinoids' or 'Ac', for actinoids †.
- ▷ 'G1*', 'G1', … , 'G18', which are used, respectively, for the elements of *group 1 without hydrogen*, *group 1*, … , *group 18*.
- ▷ 'P1', … , 'P7', 'P6*', 'P7*', which are used, respectively, for the elements of the 1^{st} *period*, … , 7^{th} *period*, 6^{th} *period and lanthanoids* †, 7^{th} *period and actinoids* †.

† *Depending on the value of the IUPAC key, the Lanthanum or Actinium are or are not included.*

✓ any **user defined** name via \pgfPTnewZlist{name}{list}

Since v2.1.5 the Z list supports a new syntax which makes possible to get *empty* cells *anywhere* in the Periodic Table. The Z list can be:

✓ a list of numbers – Z list={1,...,118} or Z list={1,2,3,4,5,6,11,12,13,14,15,16}.

✓ a list of numbers preceded with a star – Z list=*{1,...,5,9,10,...,24} or Z list=*(options){1,...,5,9,10,...,24}.

▷ Z list preceded only with a star:
It is used to draw the cells skipped in the list without information, but with the atomic number and filling.

```
\pgfPT[Z list=*{1,...,5,9,10,...,18}]
```

Periodic Table of Elements

▷ Z list is preceded with a star followed by options:
It is used to draw the cells skipped in the list without information, with what is shown and how it is shown controlled by the options. There are only two options available – hide Z and back color=<color> – which can be used separately or as a comma separated pair in any order.

```
\pgfPT[Z list=*(hide Z){1,...,5,9,10,...,18}]
```

Periodic Table of Elements

```
\pgfPT[Z list=*({back color=white}){1,...,5,9,10,...,18}]
```

Periodic Table of Elements

```
\pgfPT[Z list=*({hide Z,back color=white}){1,...,5,9,10,...,18}]
```

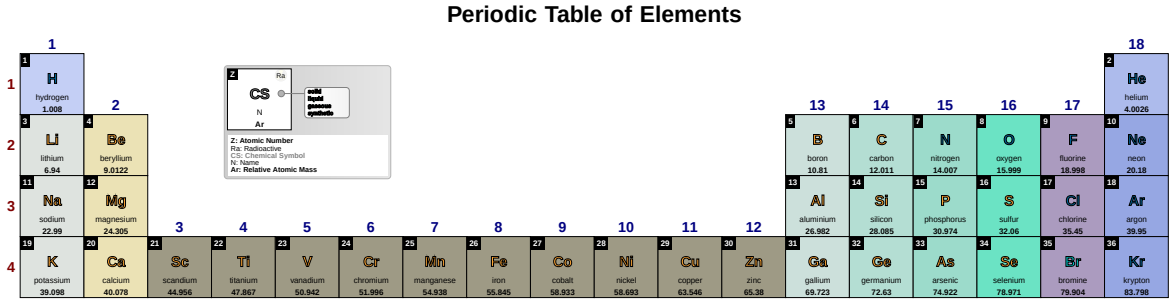
Periodic Table of Elements

The *starred* version of the Z list can be used as an alternative or a complement to the Exercise layout mode of the Periodic Table.

cell width default: *34pt*

Sets the width of each base cell of the Periodic Table.

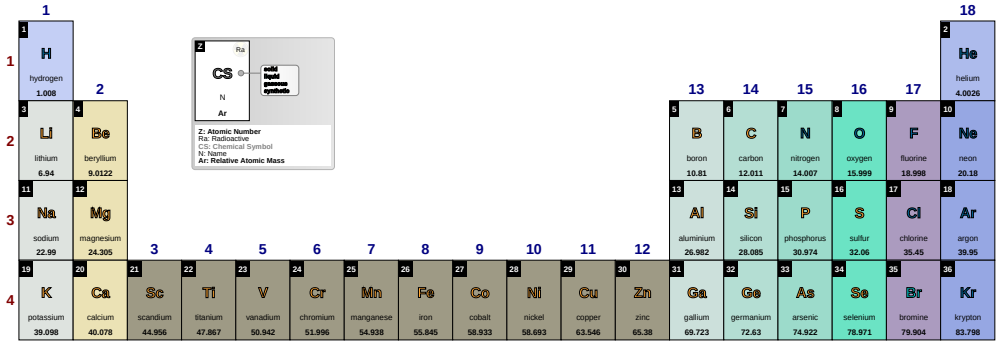
```
\pgfPT[Z list={1,...,36},cell width=40pt]
```



cell height default: *38.25pt*

Sets the height of each base cell of the Periodic Table.

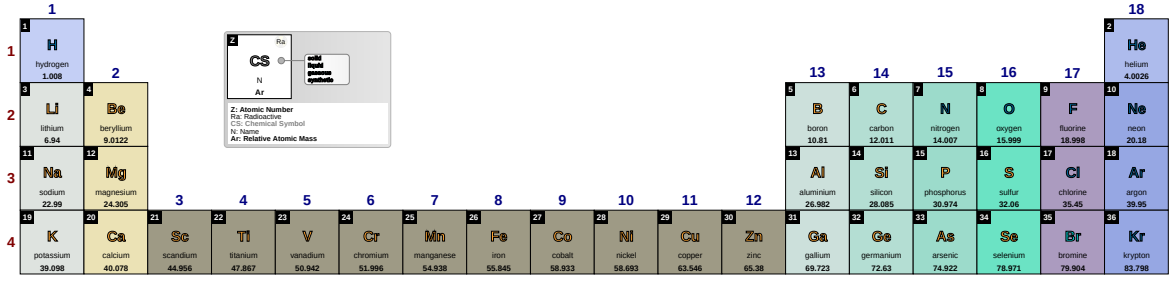
```
\pgfPT[Z list={1,...,36},cell height=50pt]
```



cell size default: *38.25pt*

Style to set both the width and the height of each base cell of the Periodic Table.

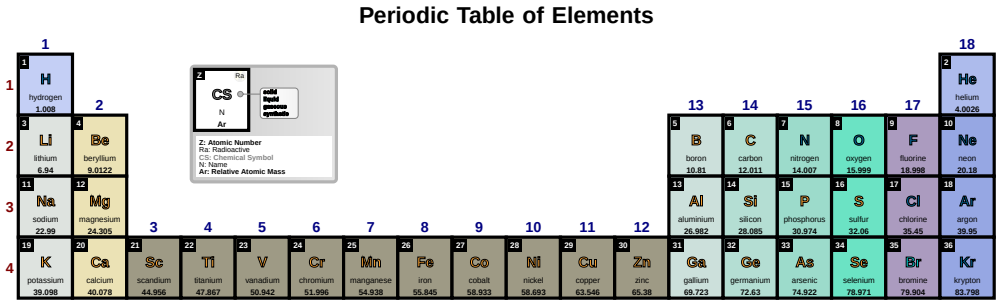
```
\pgfPT[Z list={1,...,36},cell size=40pt]
```



cell line width default: *0.4pt*

Sets the width of the line surrounding the base cell of the Periodic Table.

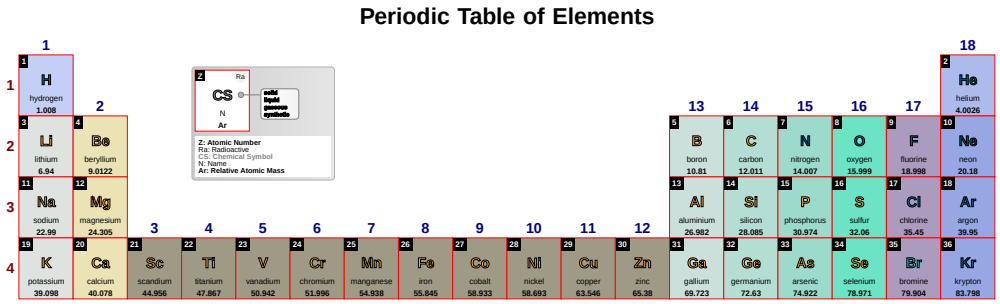
```
\pgfPT[Z list={1,...,36},cell line width=2pt]
```



cell line color default: *black*

Sets the color of the line surrounding the base cell of the Periodic Table.

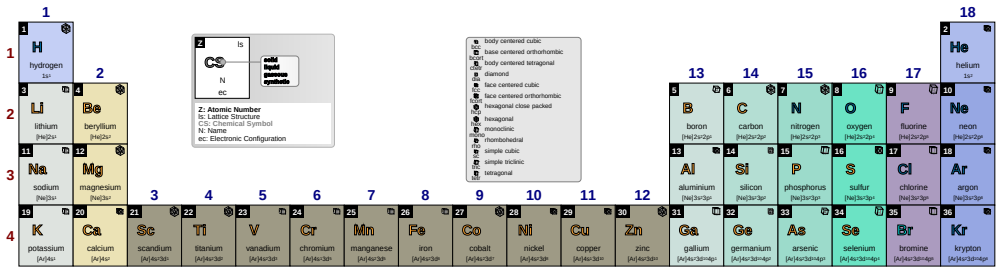
```
\pgfPT[Z list={1,...,36},cell line color=red]
```



cell style default: *{}*

Loads a named cell style, built via \pgfPTbuildcellstyle, to use as a layout for each cell of the Periodic Table.

```
\pgfPTbuildcellstyle{myname}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;ls),(2-3;1.5-2.5;CS),(4;1-3;name),(5;1-3;eConfignl)]
\pgfPT[Z list={1,...,36},cell style=myname]
```

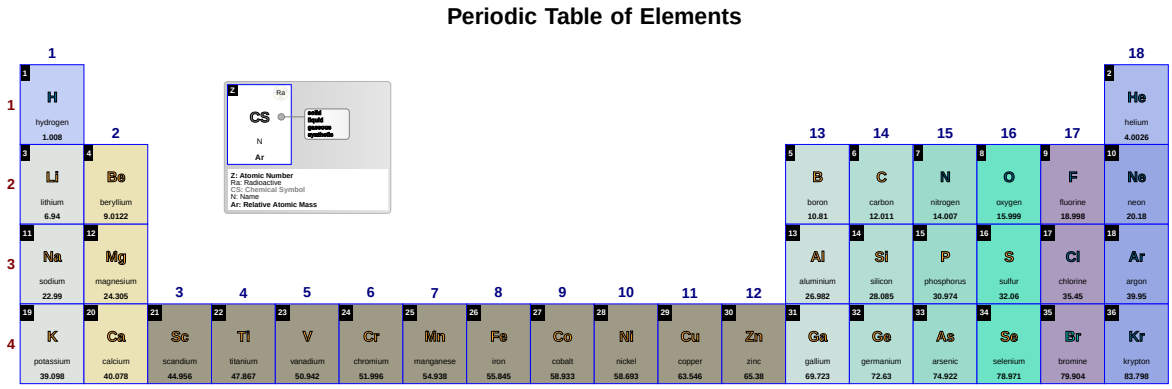


cell default: *{w=34pt,h=38.25pt,lw=.4pt,lc=black}*

Pseudo style to set the cell **w**idth, the cell **h**eight, the cell **s**ize, the cell **l**ine **w**idth, the cell **l**ine **c**olor and/or the cell **style**. None of the *keys* – w, h, s, lw, lc and style – are mandatory.

USAGE: cell={w=<length>,h=<length>,s=<length>,lw=<length>,lc=<color>,style=<name>}

```
\pgfPT[Z list={1,...,36},cell={w=40pt,h=50pt,lw=.6pt,lc=blue}]
```



font default: *phv (pdfLaTeX); TeX Gyre Heros (XeLaTeX or LuaLaTeX); BabelStone Han (for Chinese)*

Sets the font family, via the proper LaTeX *font name*, to use in the Periodic Table.

When pdfLaTeX is used to typeset the Periodic Table the *default* font is *phv*, *i.e.*, the Helvetica font. In this case the value of the font key can be any LaTeX *font name* known to the local LaTeX installation.

When XeLaTeX or LuaLaTeX are used to typeset the Periodic Table the *default* font is *TeX Gyre Heros*, a closest alternative to Helvetica font. In this case the value of the font key can be any *font name known to your Operating System or LaTeX distribuition* and with LuaLaTeX it can also be any *font name available in your TEXMF tree*.

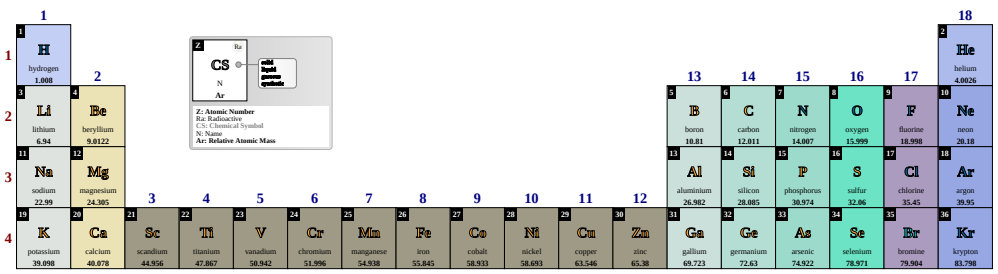
If the Chinese language is loaded the default font is BabelStone Han. See Chinese user language for more details.

See LaTeX *font names* below or the fontspec documentation for further details.

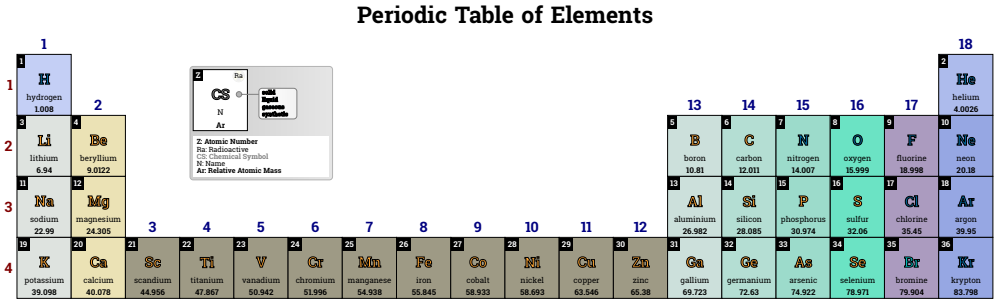
(changed in v2.1.5)

Examples with pdfLaTeX:

```
\pgfPT[Z list={1,...,36},font=ptm]
```



```
\pgfPT[Z list={1,...,36},font=RobotoSlab-TLF]
```



LaTeX *font names*:

✓The LaTeX font names commonly available in LaTeX distributions are:

– **Serif fonts**

- ▷ cmr – Computer Modern Roman
- ▷ lmr – Latin Modern Roman
- ▷ pbk – Bookman
- ▷ bch – Charter
- ▷ pnc – New Century Schoolbook
- ▷ ppl – Palatino
- ▷ ptm – Times

– **Sans Serif fonts**

- ▷ cmss – Computer Modern Sans Serif
- ▷ lmss – Latin Modern Sans Serif
- ▷ pag – Avant Garde
- ▷ phv – Helvetica

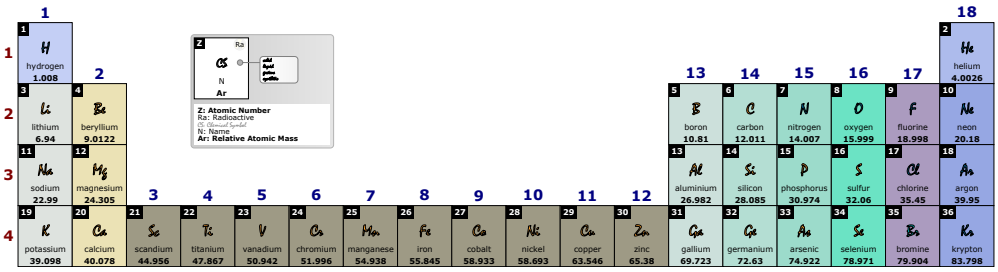
✓There are other fonts available to LaTeX that require installation of the corresponding packages:

- ▷ the roboto package provides the following fonts:
  - Roboto-TLF – Roboto tabular lining
  - Roboto-LF – Roboto proportional lining
  - Roboto-OsF – Roboto proportional oldstyle
  - Roboto-TOsF – Roboto tabular oldstyle
  - RobotoSlab-TLF – RobotoSlab proportional lining
  - RobotoSlab-OsF – RobotoSlab proportional oldstyle
  - RobotoSlab-TOsF – RobotoSlab tabular oldstyle
  - RobotoMono-TLF – RobotoMono proportional lining
- ▷ the frcursive package provides the *frc - French Cursive* font.
- ▷ the miama package provides the *frm – Miama Nueva* font.
- ▷ ...

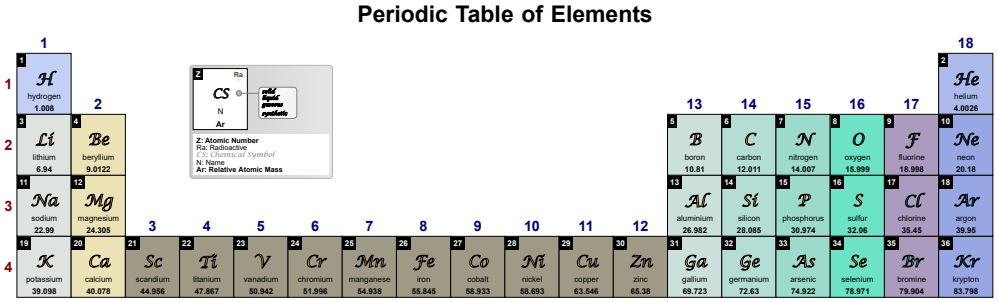
For more information about fonts visit the TUG Font Catalogue

Examples with XeLaTeX or LuaLaTeX:

```
\pgfPT[Z list={1,...,36},font=Verdana,CS font=\fontspec{Mistral}\selectfont]
```



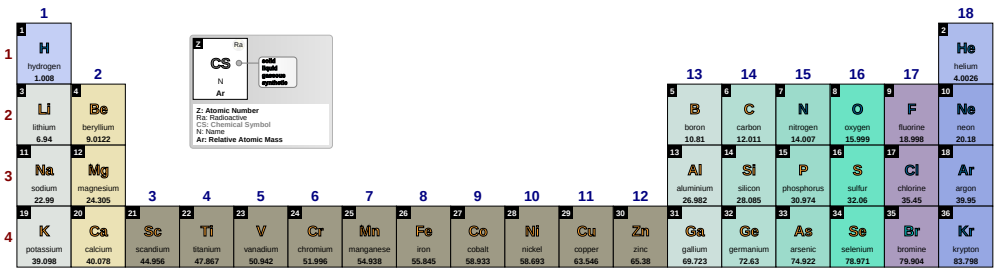
```
\pgfPT[Z list={1,...,36},font=Arial,CS font=\fontspec{LCALLIG.TTF}\selectfont]
```



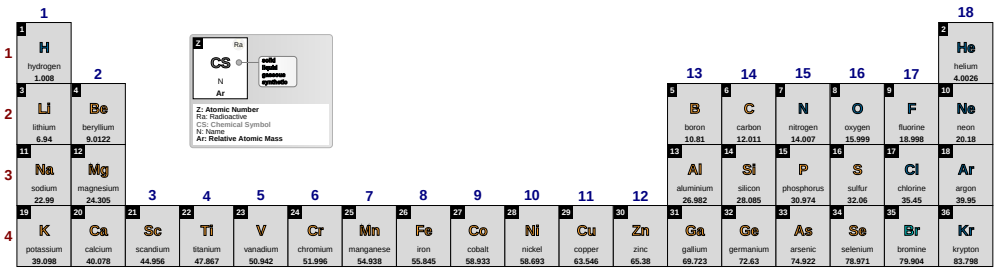
back color default: *white*

Sets the background of each cell of the Periodic Table. It only takes effect if the back color scheme key is set to solid

```
\pgfPT[Z list={1,...,36},back color=black!15]
```



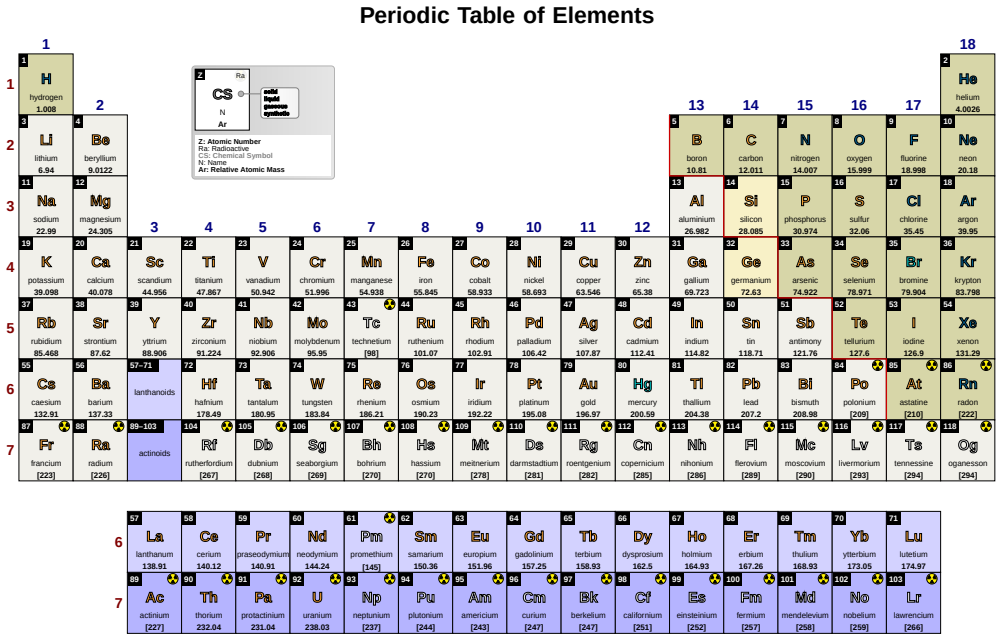

```
\pgfPT[Z list={1,...,36},back color scheme=solid,back color=black!15]
```



back color scheme default: *pgfPTdefault*

Sets a named back color scheme for the Periodic Table.

```
\pgfPT[back color scheme=pgfPTSoft]
```



The possible name is one of the following:

✓ **built-in**:

- ▷ 'pgfPTSoft', a soft color scheme that distinguishes metals, non metals, silicon and germanium, lanthanoids and actinoids.
- ▷ 'pgfPTJmol', is the color scheme used in the computer software Jmol: an open-source Java viewer for chemical structures in 3D.
- ▷ 'pgfPTCPK', is the color scheme of the popular color convention for distinguishing atoms of different chemical elements in molecular models. The scheme is named after the CPK molecular models designed by chemists Robert Corey and Linus Pauling, and improved by Walter Koltun.
- ▷ 'pgfPTRasmol', is the color scheme used in the computer software RasMol, a program for molecular graphics visualization originally developed by Roger Sayle.
- ▷ 'pgfPTRasmolNew', is a color scheme used in RasMol with revision of CPK colors made by C. Chigbo (RasMol 2.7.3).
- ▷ 'pgfPTWikipediaII', is the color scheme based on the most recent (November 2020 to present) Wikipedia Periodic Table of Elements.
- ▷ 'pgfPTWikipediaI', is the color scheme based on the previous (until October 2020) Wikipedia Periodic Table of Elements.

  The higher the number on Wikipedia, the more recent the color scheme.
  For backwards compatibility (and also for simplicity) pgfPTWikipedia points to pgfPTWikipediaII.

- ▷ 'pgfPTMNM', is designed to show **M**etals and **N**on **M**etals in two different colors, showing also the semi-metals in a third color.
- ▷ 'pgfPTPS', is designed to show the **P**hysical **S**tate of the elements at normal temperature and pressure (NTP) in different colors.
- ▷ 'pgfPTRadio', is designed to show the **R**adioactive elements in one color and the non radioactive elements in another color.
- ▷ 'pgfPTBlocks', for showing the elements in each block of the Periodic Table with the same color.
- ▷ 'solid', to show the background of each cell of the Periodic Table with the same color specified by the key 'back color'.

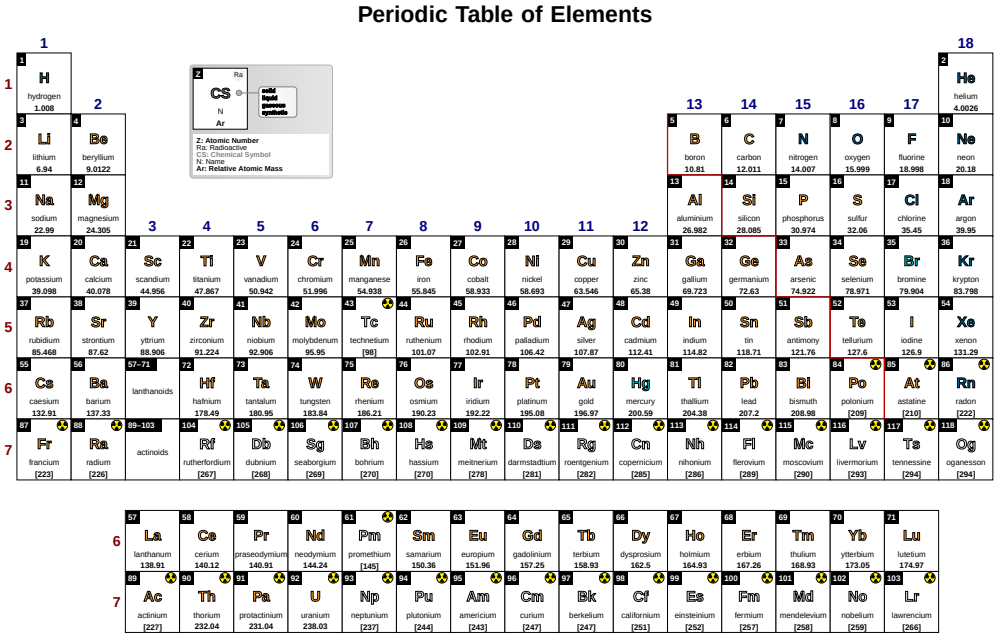
✓ any **user defined** name via \pgfPTnewColorScheme{name}{color list}

It is possible to set the back color scheme key with the built-in names using the following styles:

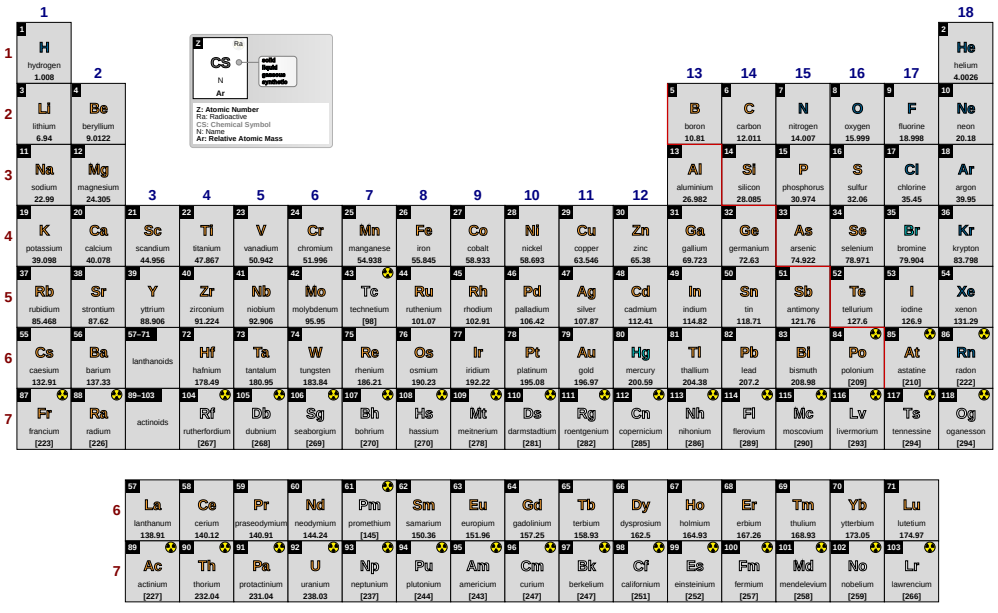
csSolid default: *white*

A style equivalent to back color scheme=solid,back color=#1

```
\pgfPT[csSolid]
```



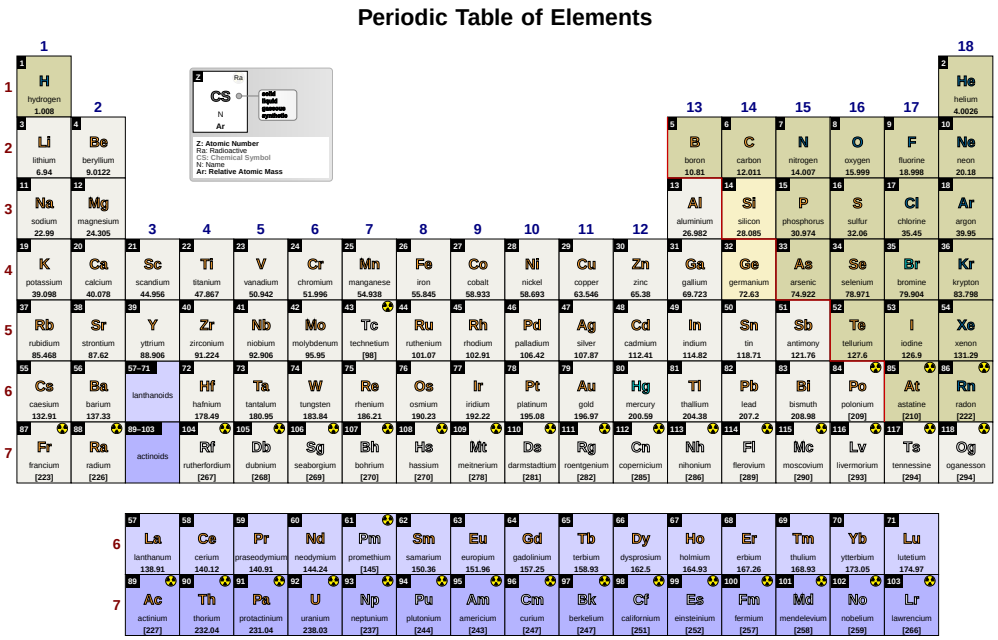

```
\pgfPT[csSolid=black!15]
```



csSoft *no value*

A style equivalent to back color scheme=pgfPTSoft

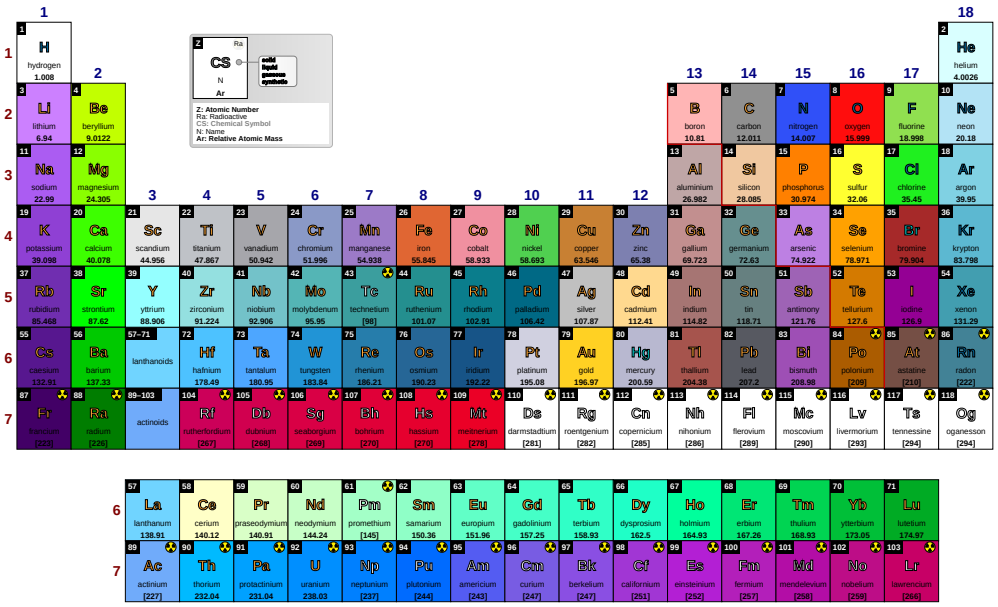
\pgfPT[csSoft]



csJmol *no value*

A style equivalent to back color scheme=pgfPTJmol

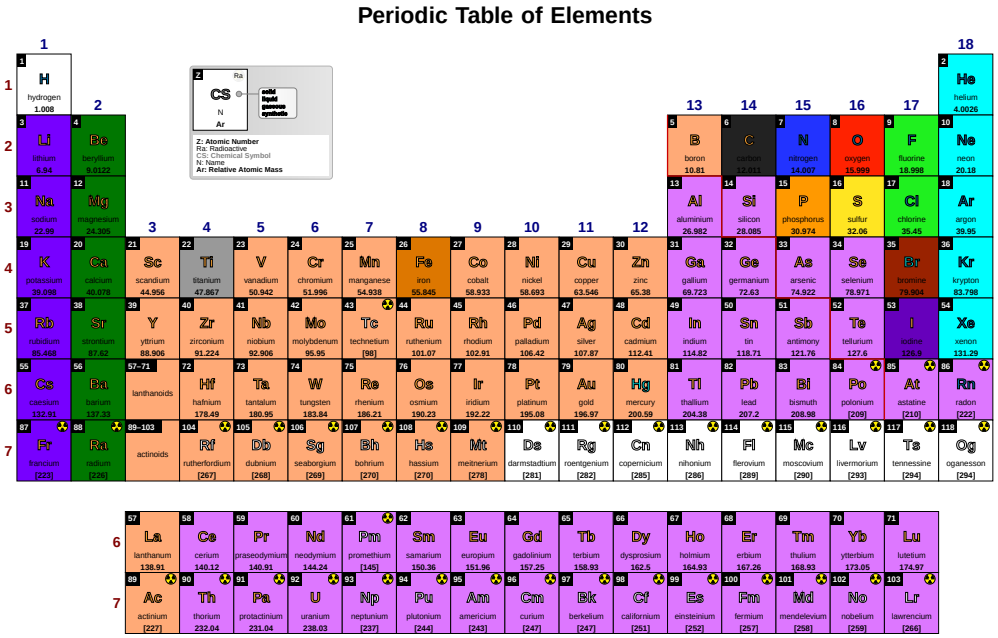
\pgfPT[csJmol]



csCPK *no value*

A style equivalent to back color scheme=pgfPTCPK

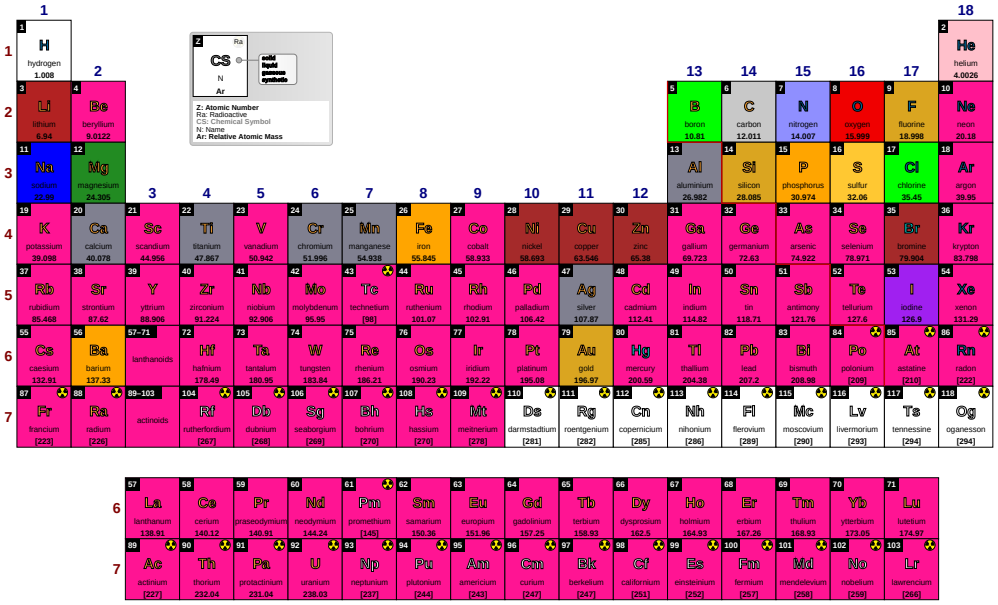
\pgfPT[csCPK]



csRasmol *no value*

A style equivalent to back color scheme=pgfPTRasmol

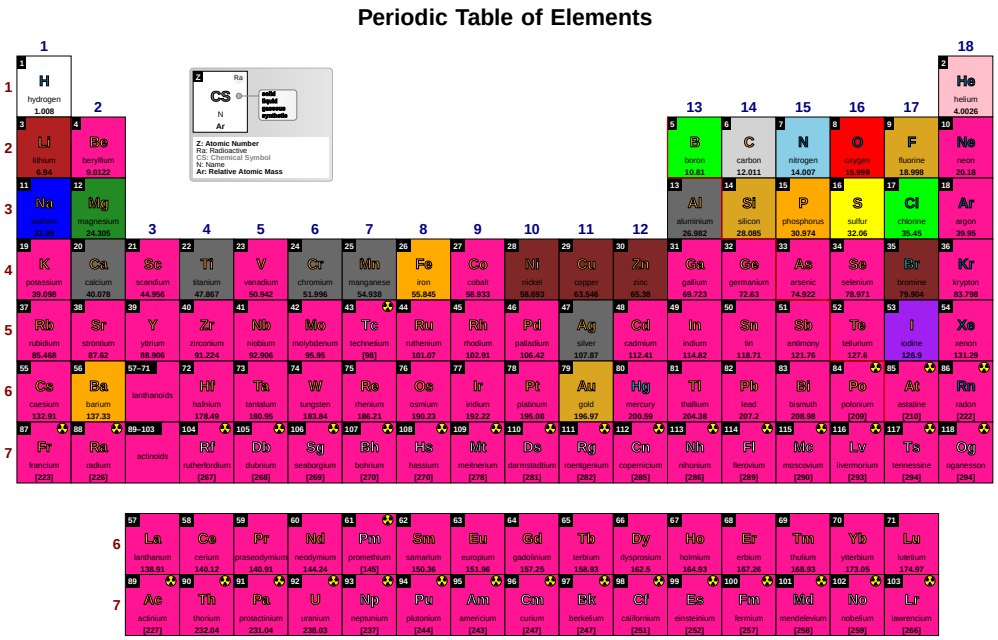
\pgfPT[csRasmol]



csRasmolNew *no value*

A style equivalent to back color scheme=pgfPTRasmolNew

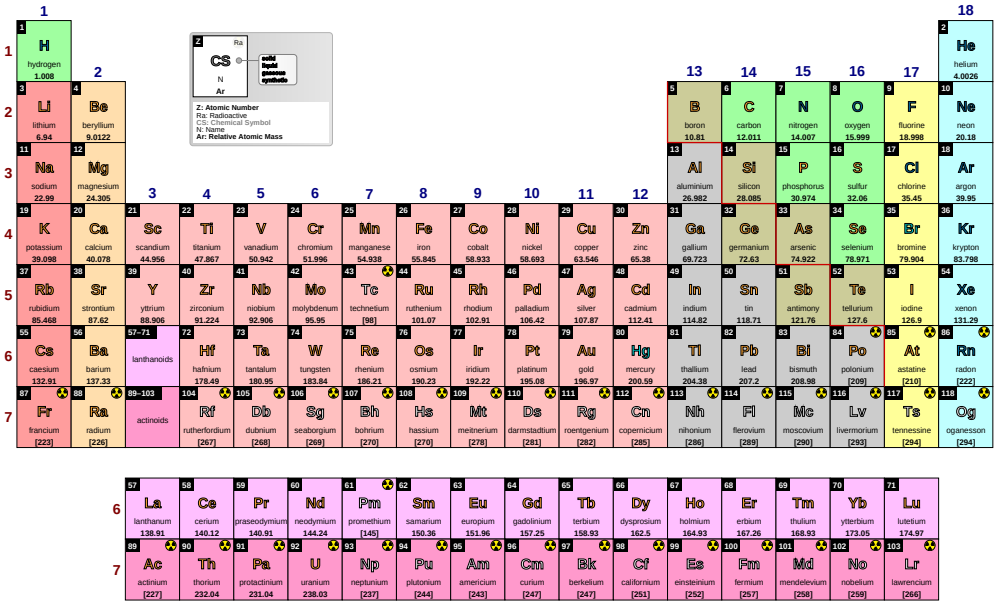
```
\pgfPT[csRasmolNew]
```



csWikipedia *no value*

A style equivalent to back color scheme=pgfPTWikipediaII

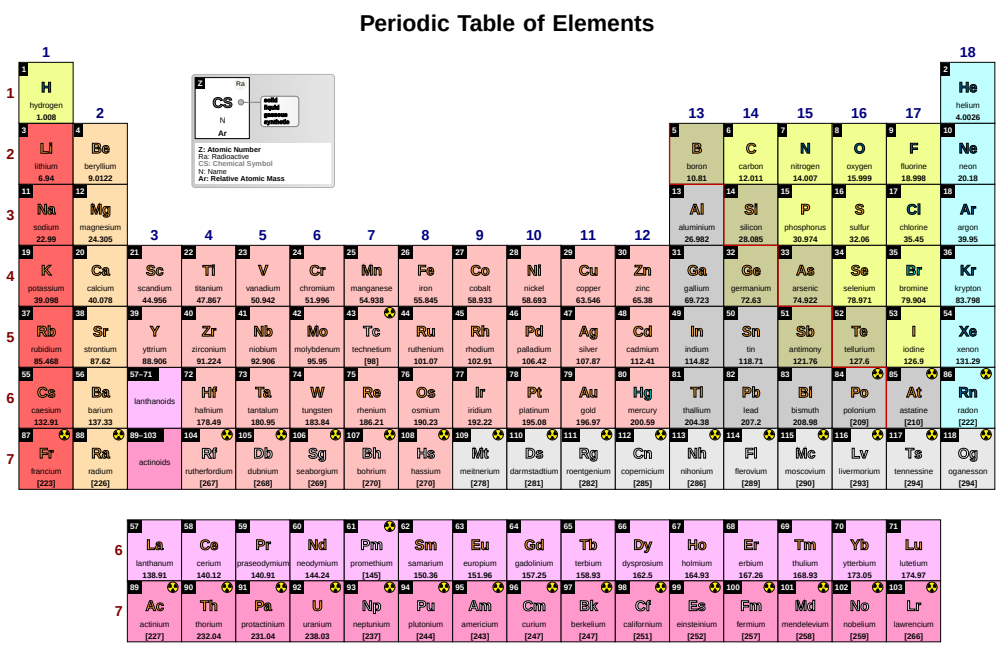
```
\pgfPT[csWikipedia]
```



csWikipediaI *no value*

A style equivalent to back color scheme=pgfPTWikipediaI

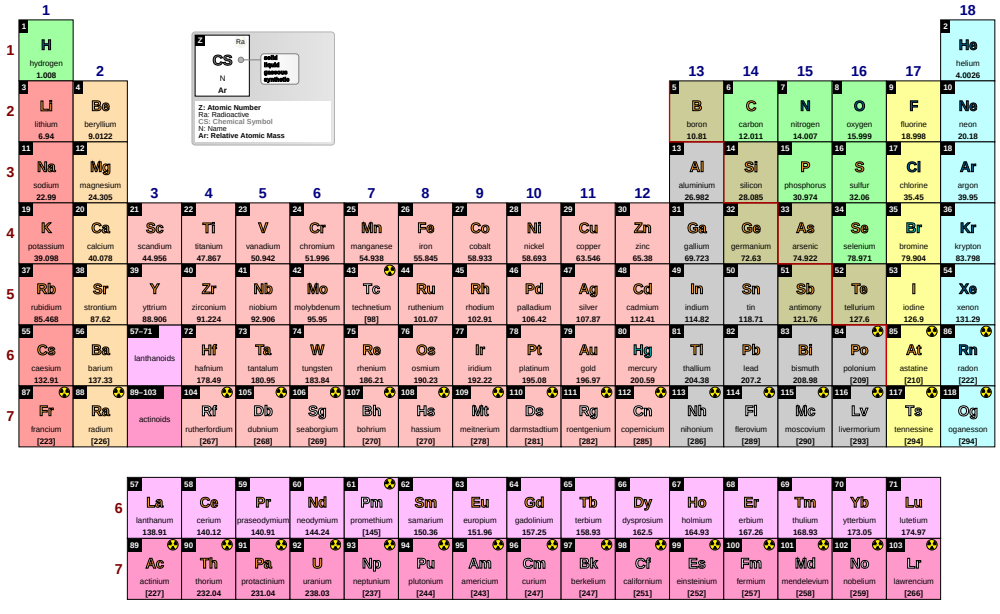
```
\pgfPT[csWikipediaI]
```



csWikipediaII *no value*

A style equivalent to back color scheme=pgfPTWikipediaII

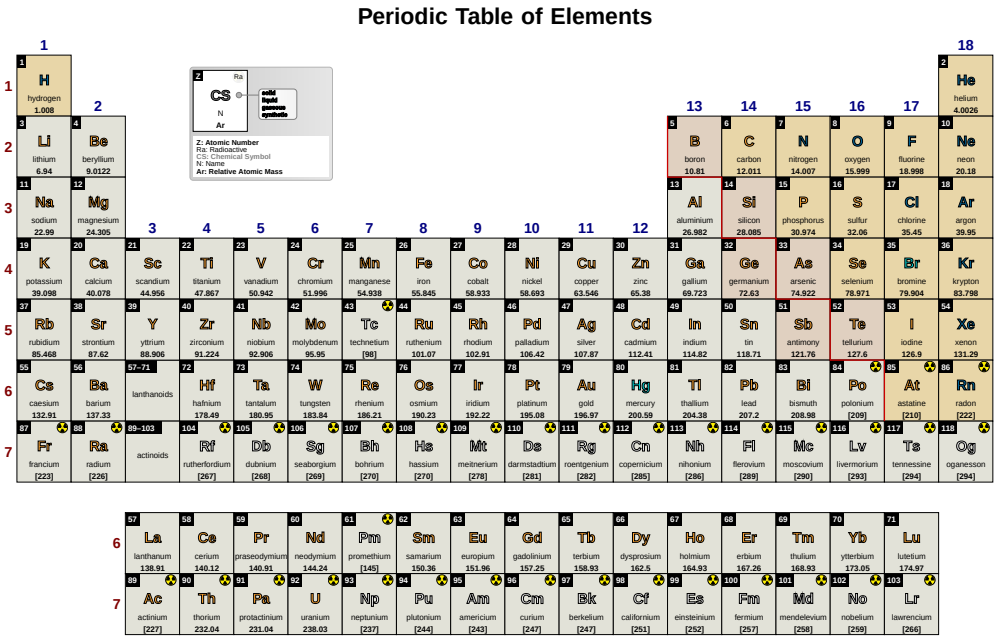
```
\pgfPT[csWikipediaII]
```



csMNM *no value*

A style equivalent to back color scheme=pgfPTMNM

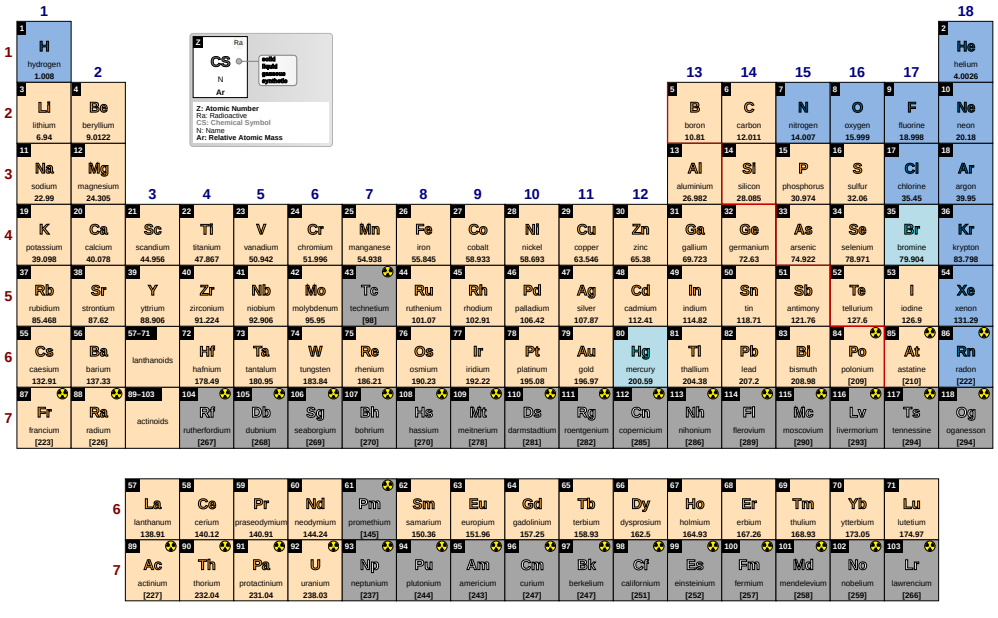
```
\pgfPT[csMNM]
```



csPS *no value*

A style equivalent to back color scheme=pgfPTPS

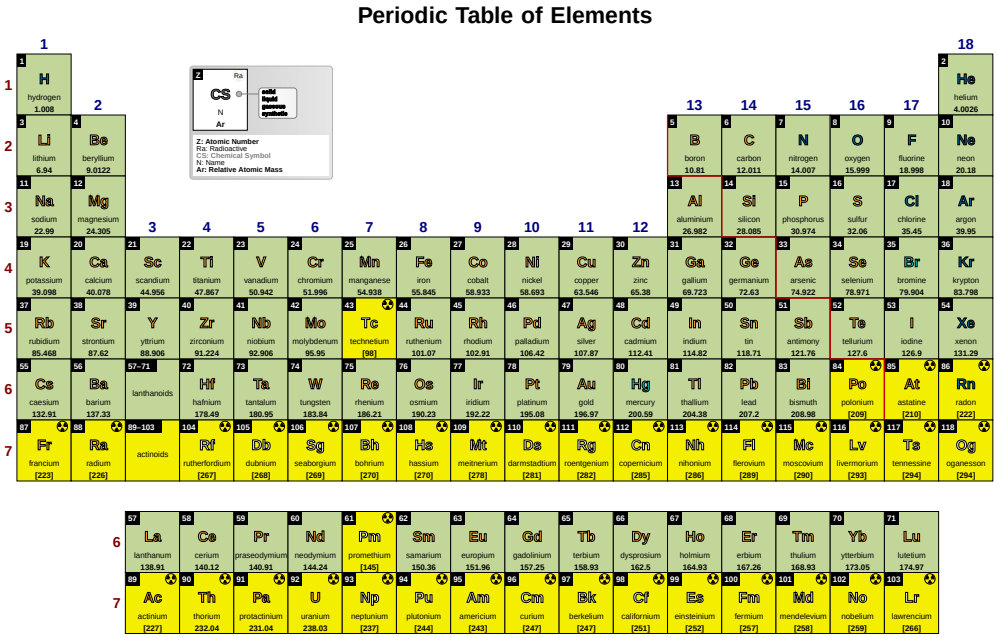
```
\pgfPT[csPS]
```



csRadio *no value*

A style equivalent to back color scheme=pgfPTRadio

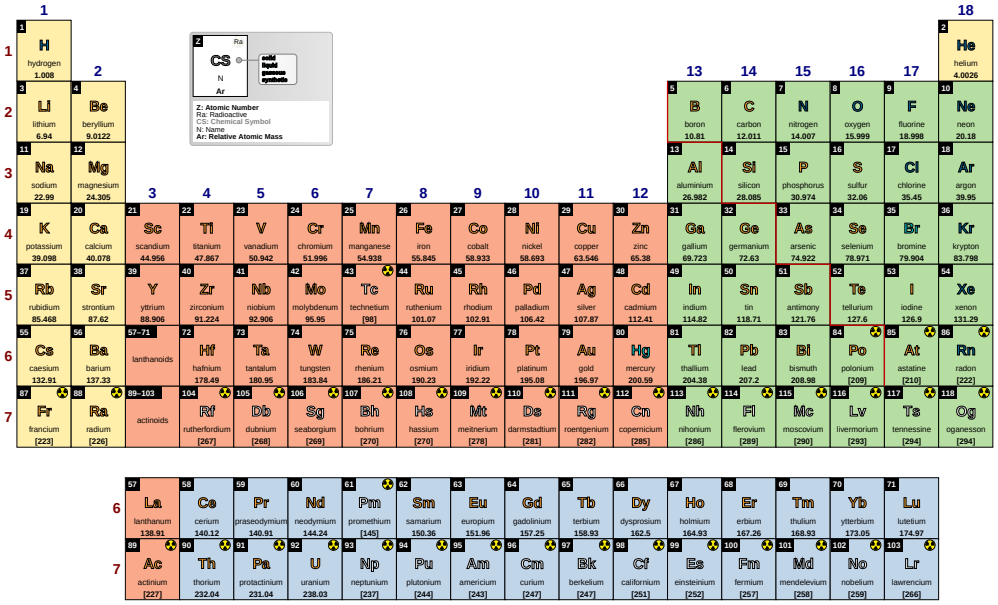
\pgfPT[csRadio]



csBlocks *no value*

A style equivalent to back color scheme=pgfPTBlocks

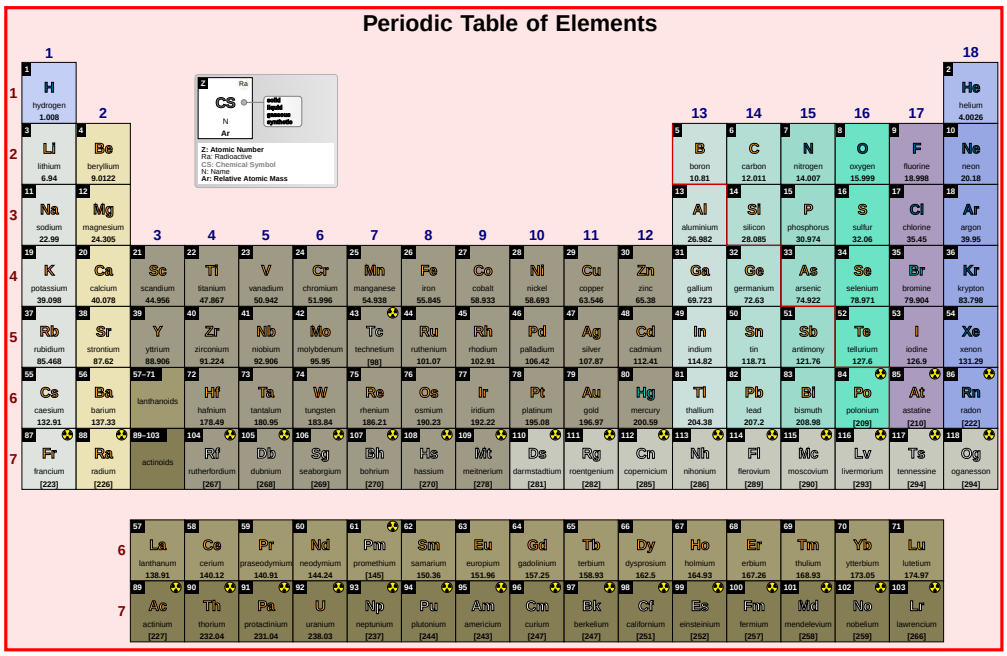
\pgfPT[csBlocks]



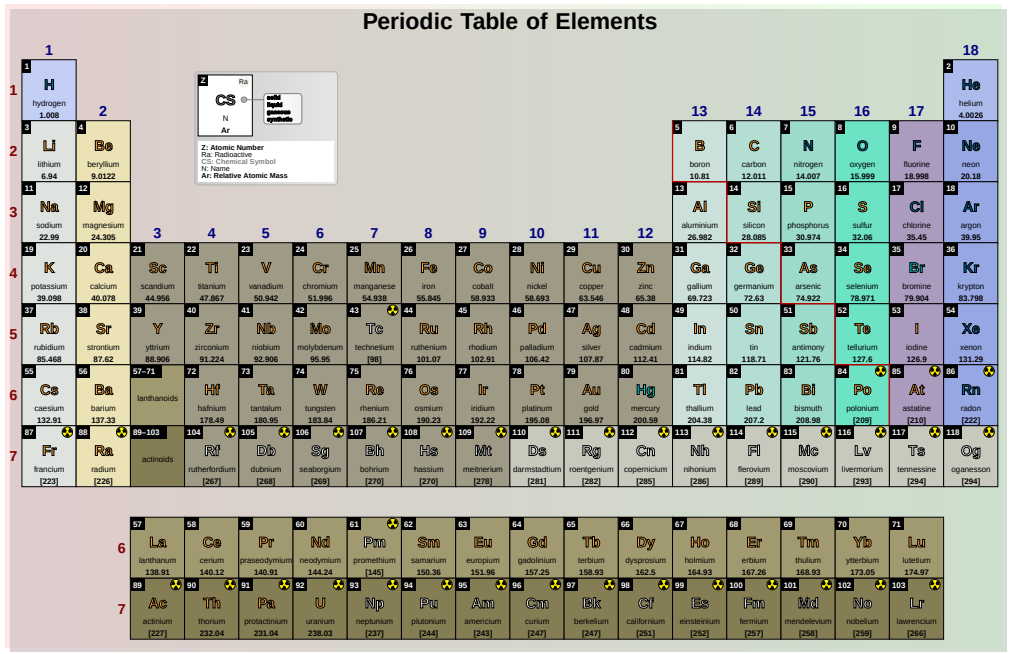
background default: {}

A style to set the background of the Periodic Table, built with any of the TikZ keys that can be applied to a path construction.

```
\pgfPT[background={draw=red,line width=2pt,fill=red!10}]
```



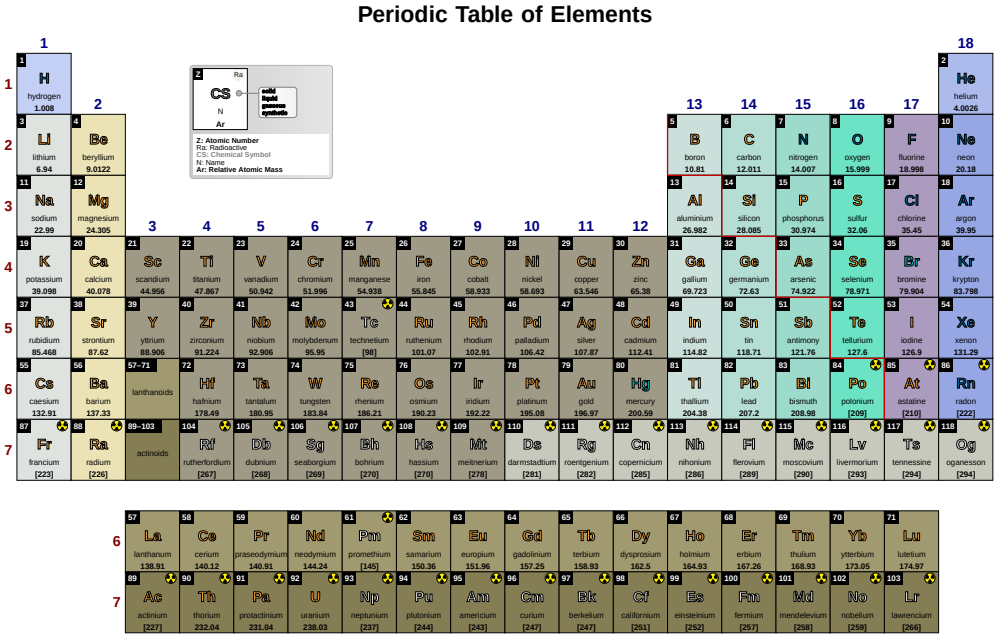

```
\usetikzlibrary{shadows}
\pgfPT[background={left color=red!10,right color=green!10,postaction={drop
shadow={left color=red!10,right color=green!10}}}]
```



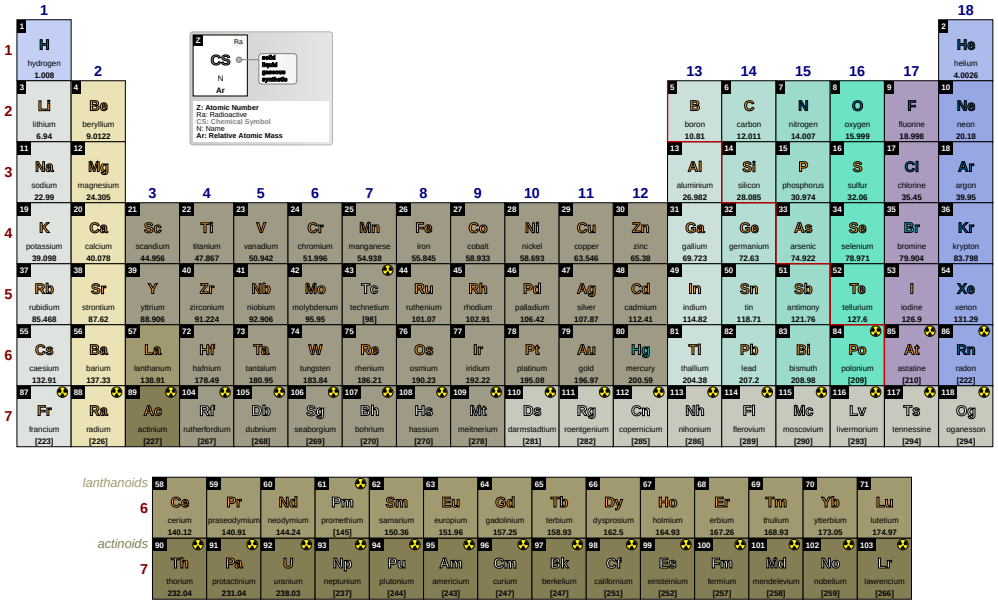
IUPAC default: *true*

When set to true draws the periodic table with *lanthanum* and *actinium* appended to block f and the labels *lanthanoids* and *actinoids* are placed at group 3, substituting *lanthanum* and *actinium*. When IUPAC is set to false, *lanthanum* and *actinium* are shown in group 3 and the labels *lanthanoids* and *actinoids* are place near the *f block* (if the key show label LaAc is set to true).

\pgfPT



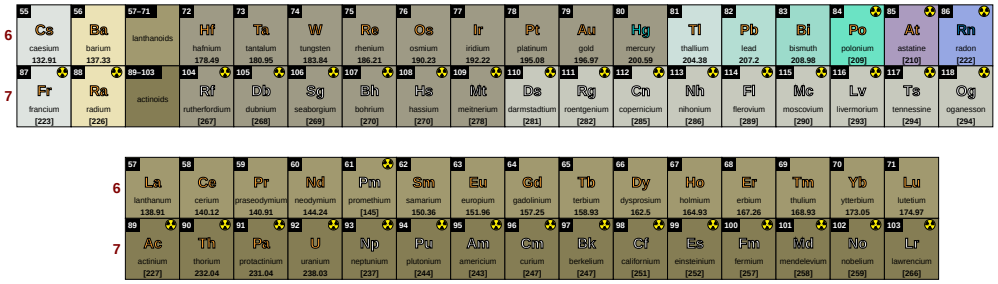
\pgfPT[IUPAC=false]



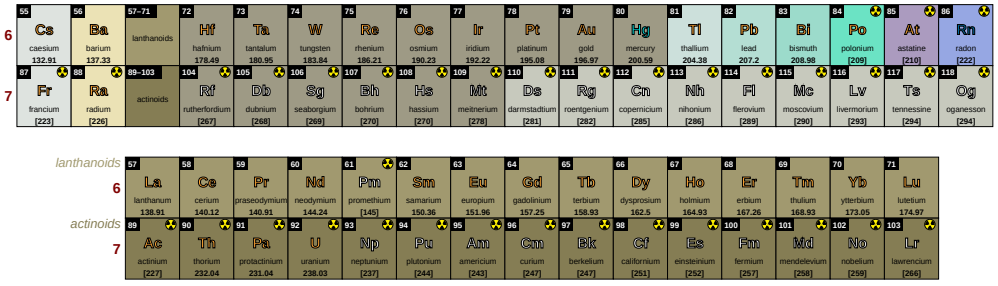
show label LaAc default: {}

Determines when the labels 'lanthanoids' and 'actinoids' are shown (true) or not shown (false) near the f block. When the IUPAC key is set to true, the default behavior is to show the labels and when the IUPAC key is set to false, the default behavior is to hide the labels. This *default behavior* **can be overridden by this key** setting it to true, to show the labels, or to false to hide them, independently of the value of the IUPAC key.

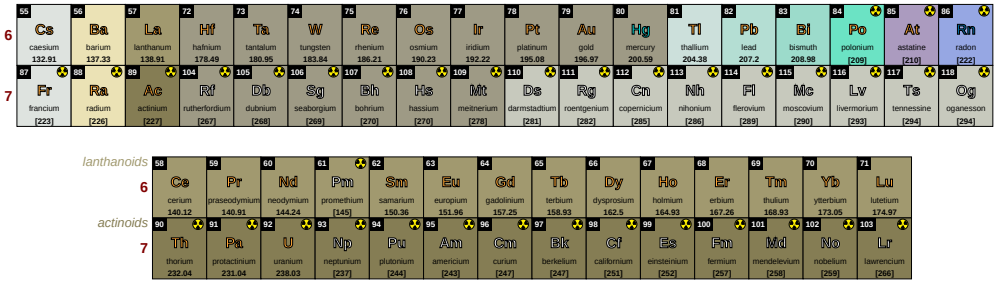
```
\pgfPTnewZlist{myZlist}{55,...,118}
\pgfPTstyle[show title=false,show legend=false,show group numbers=false]
\pgfPT[Z list=myZlist]
```



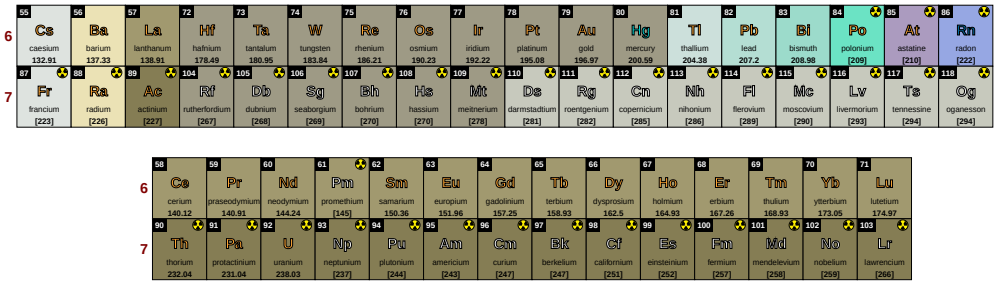
```
\pgfPT[Z list=myZlist,show label LaAc=true]
```



```
\pgfPT[Z list=myZlist,IUPAC=false]
```



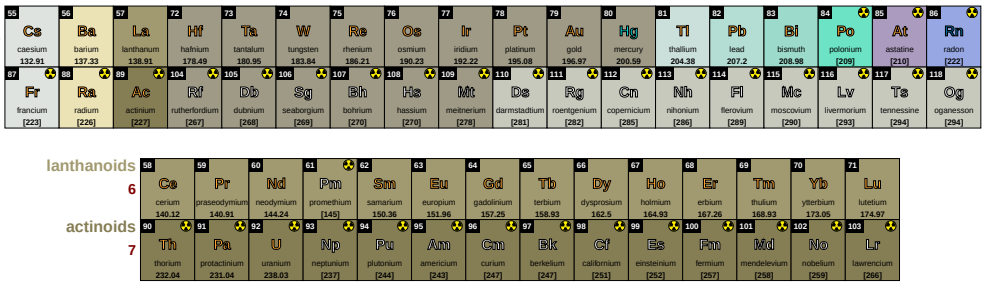
```
\pgfPT[Z list=myZlist,IUPAC=false,show label LaAc=false]
```



label LaAc font default: *\footnotesize\itshape*

Sets the font for the labels 'lanthanoids' and 'actinoids'.

```
\pgfPT[label LaAc font=\bfseries,Z list=myZlist,IUPAC=false]
```



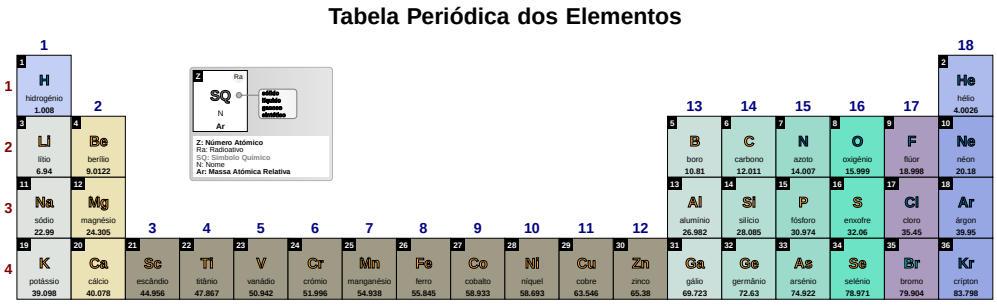
```
\pgfPTresetstyle
```

languages default: *{}*

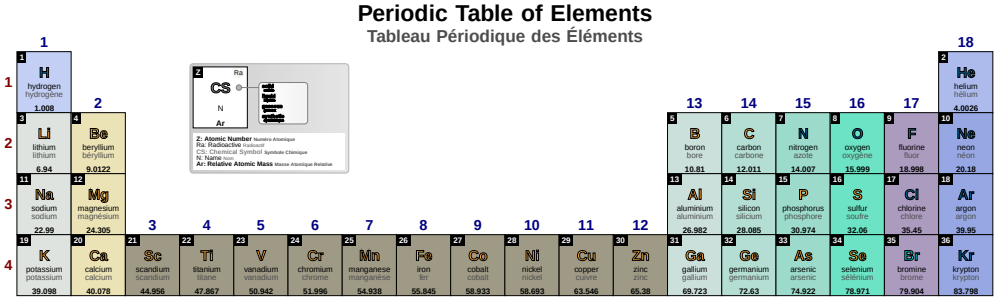
Sets a language list to use in the Periodic Table. It is a comma separated list of language flags: 'pt', 'en', 'fr', 'de', 'it', 'es' or 'br'. If a user language has been loaded, the corresponding ISO 639-1 code can also be used as a language flag. *This key locally overrides the default language, that is, the language loaded at package inclusion*.

(changed in v2.1.0)

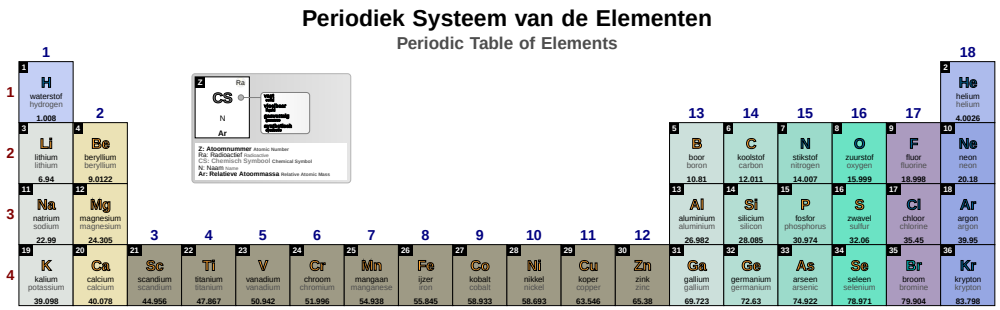
```
\pgfPT[Z list={1,...,36},languages=pt]
```



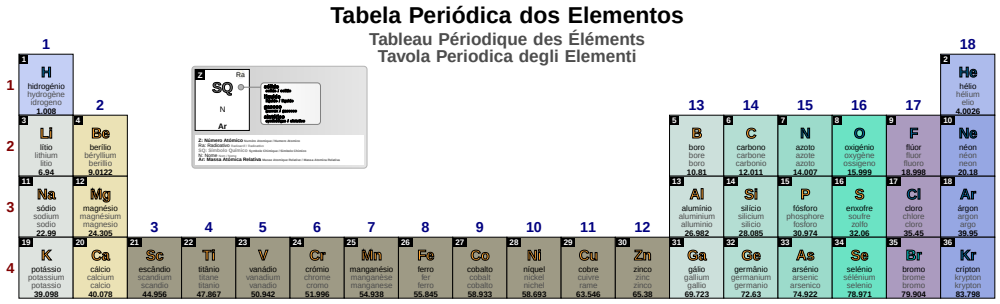

```
\pgfPT[Z list={1,...,36},cell style=pgfPT2lang,languages={en,fr}]
```



```
% \usepackage[userlang=nl]{pgf-PeriodicTable}
\pgfPT[Z list={1,...,36},cell style=pgfPT2lang,languages={nl,en}]
```




```
\pgfPT[Z list={1,...,36},cell style=pgfPT3lang,languages={pt,fr,it}]
```

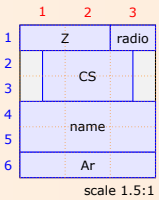


When using a set of languages, space to accommodate the names in each cell must be provided by building a suitable cell - typically one cell row per language. The cell styles used in the two examples above are built-in and serve this purpose.

✓ *Built-in style* **pgfPT2lang**

The build command:

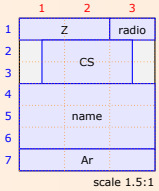
```
\pgfPTbuildcell(6,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4-5;1-3;name),(6;1-3;Ar)]
```



✓ *Built-in style* **pgfPT3lang**

The build command:

```
\pgfPTbuildcell(7,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4-6;1-3;name),(7;1-3;Ar)]
```

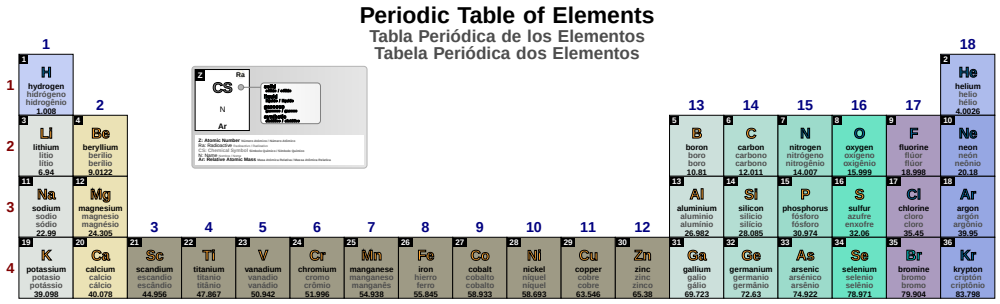


Also, the space for the title should be taken into account – if using more then three languages, the legend must be *turned off*, otherwise the title overlaps the legend.

other languages font default: *\tiny*

Sets the font used in *other languages*, *i.e.*, the languages started at the second entry of the list provide to the languages key.

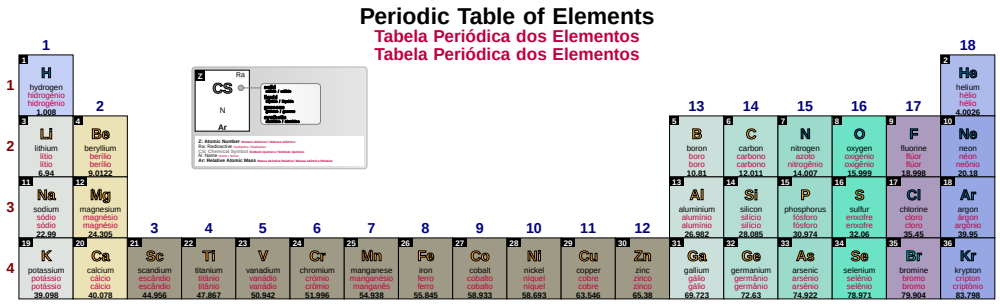
```
\pgfPT[Z list={1,...,36},cell style=pgfPT3lang,languages={en,es,br}, other languages font=\tiny\bfseries]
```



other languages color default: *black!70*

Sets the color of the font used in *other languages*.

```
\pgfPT[Z list={1,...,36},cell style=pgfPT3lang,languages={en,pt,br}, other languages color=purple]
```

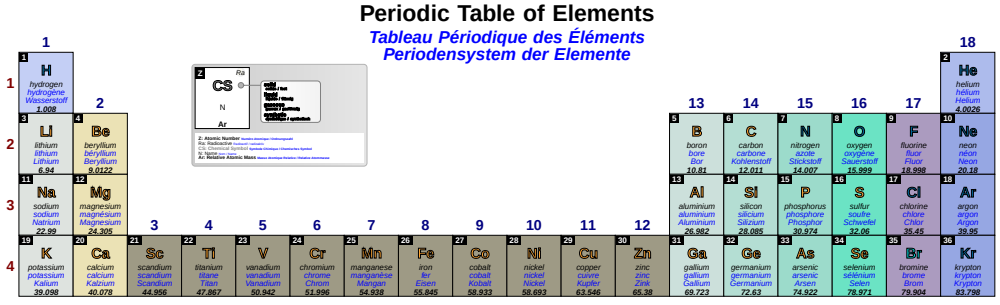


other lang default: *{f=\tiny,c=black!70}*

Pseudo style to set the keys: other languages **f**ont and/or other languages **c**olor. None of the *keys* – f and c – are mandatory.

USAGE: other lang={f=<font commands>,c=<color>}

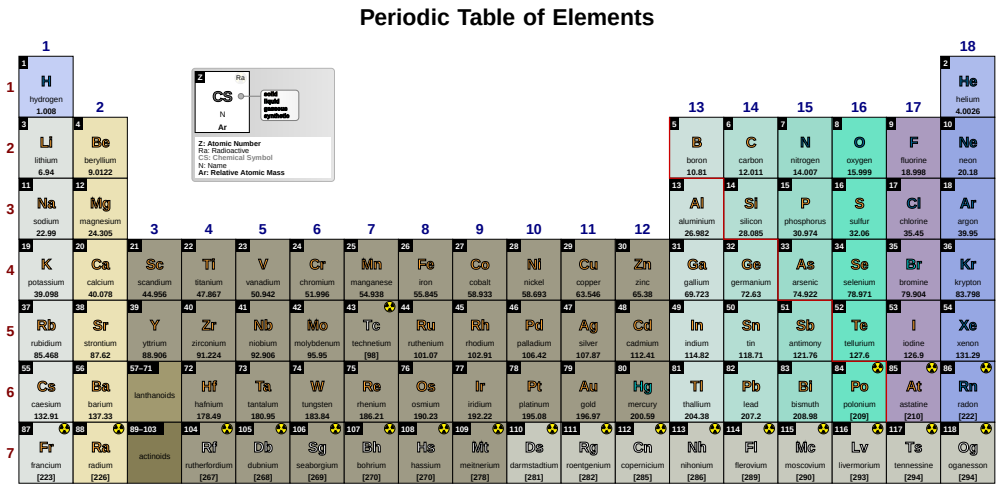
```
\pgfPT[Z list={1,...,36},cell style=pgfPT3lang,languages={en,fr,de}, other lang={f=\tiny\itshape,c=blue}]
```



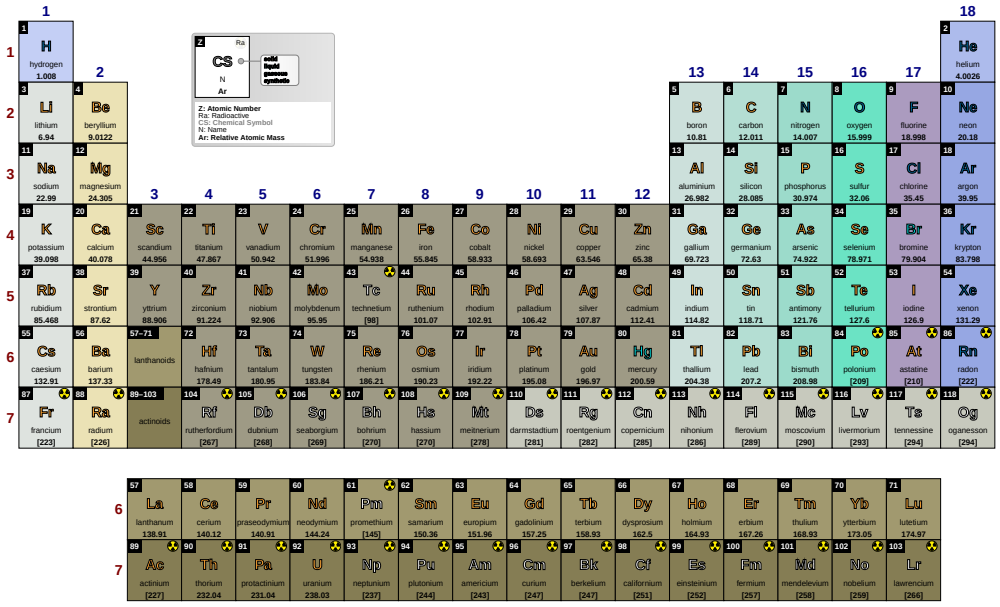
show MNM line default: *true*

If set to true a line separating metals from non metals is shown in the Periodic Table. The line starts at the upper left corner of the cell of boron (2nd period, group 13) and ends at the lower right corner of polonium (6th period, group 16). If set to false no line is drawn.

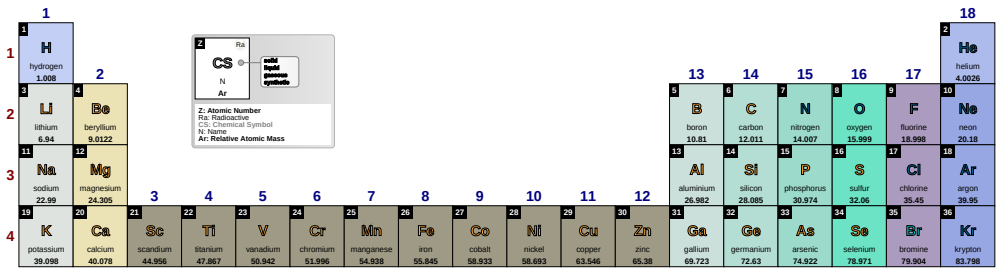
\pgfPT[Z list=spd]



\pgfPT[show MNM line=false]



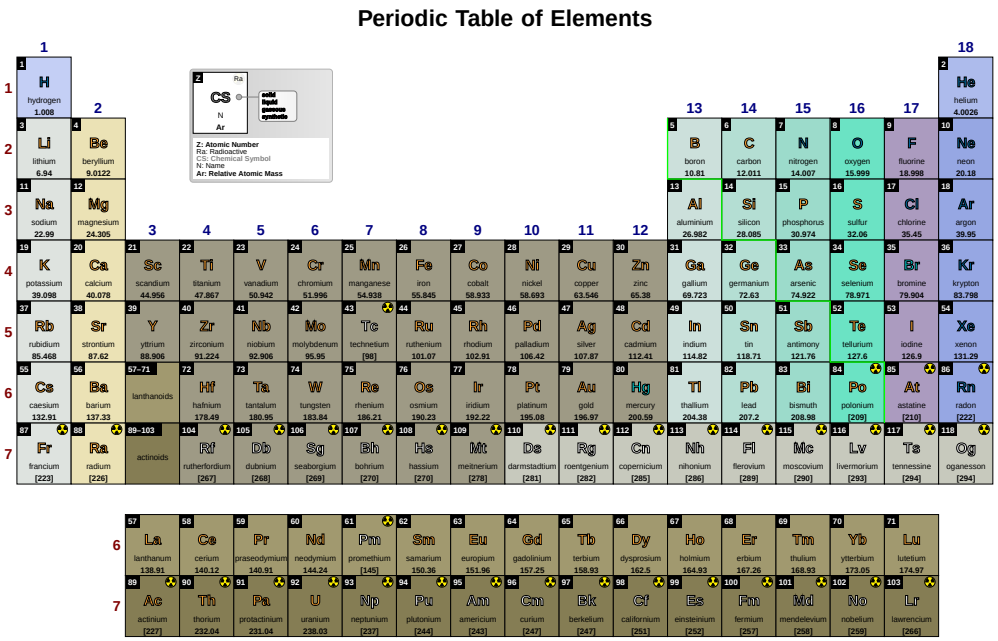
\pgfPT[Z list={1,...,36}]



MNM line color default: *red!80!black*

Sets the color of the *MNM line*.

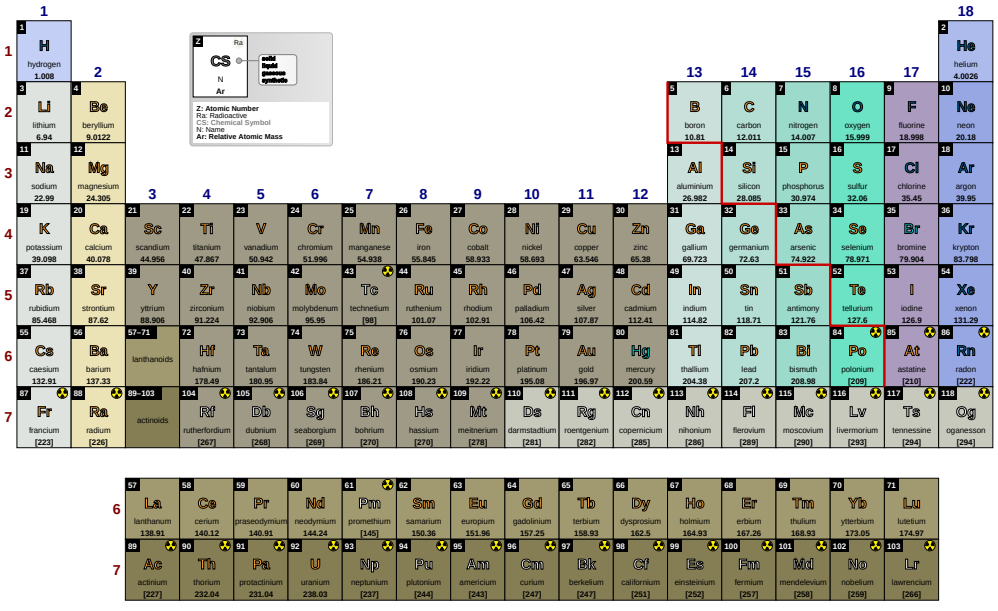
```
\pgfPT[MNM line color=green]
```



MNM line width default: *.8pt*

Sets the width of the *MNM line*.

```
\pgfPT[MNM line width=1.5pt]
```

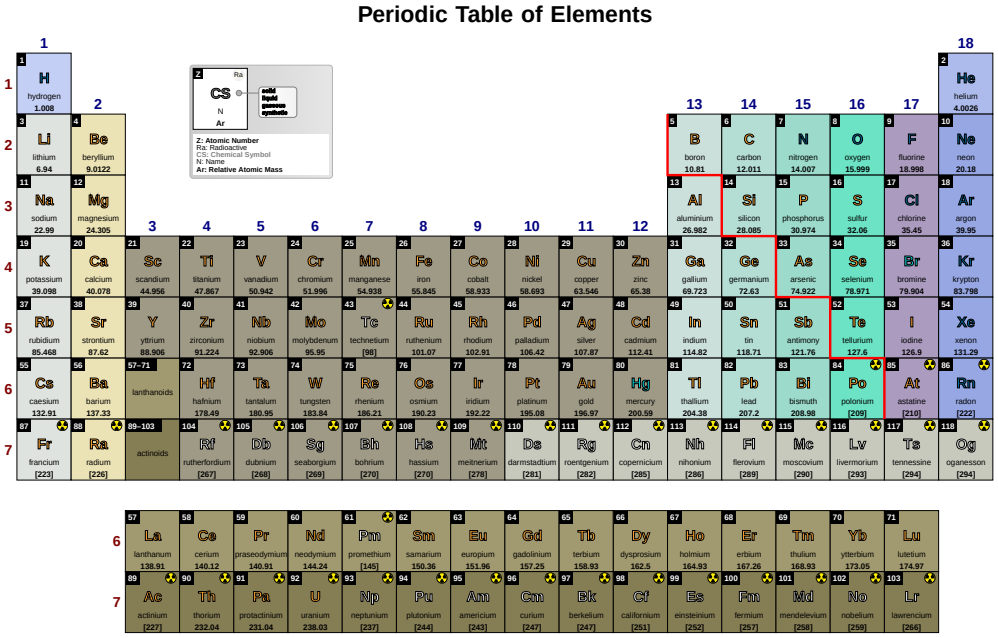


MNM default: *{c=red!80!black,w=.8pt}*

Pseudo style to set the *MNM line* **c**olor and/or **w**idth. None of the *keys* – c and w – are mandatory. The key show MNM line is set to true.

USAGE: MNM={c=<color>,w=<length>}

```
\pgfPT[MNM={w=1.5pt,c=red}]
```

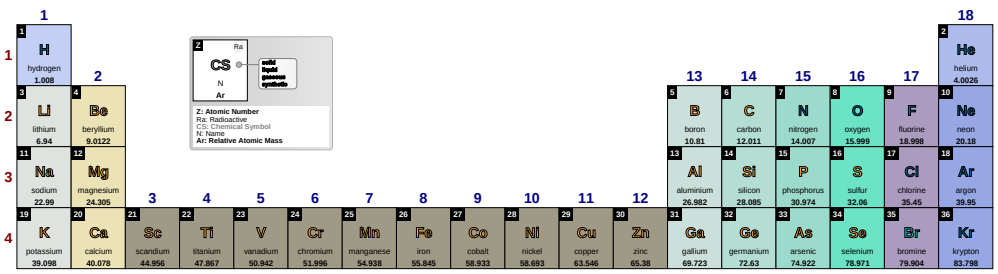


➠ Title and Legend

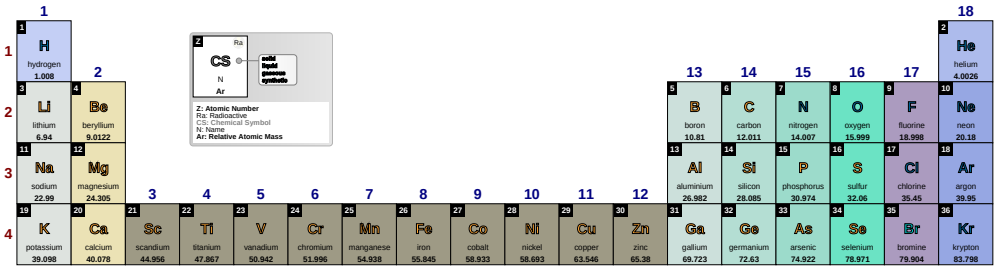
show title default: *true*

When set to true the title is shown, otherwise the title (Periodic Table of elements) is not shown.

```
\pgfPT[Z list={1,...,36}]
```



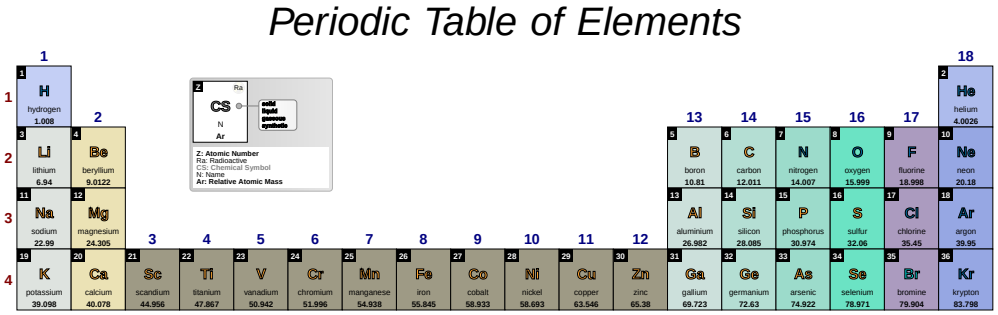
```
\pgfPT[Z list={1,...,36},show title=false]
```



title font default: *\Large\bfseries*

Sets the font used in the title.

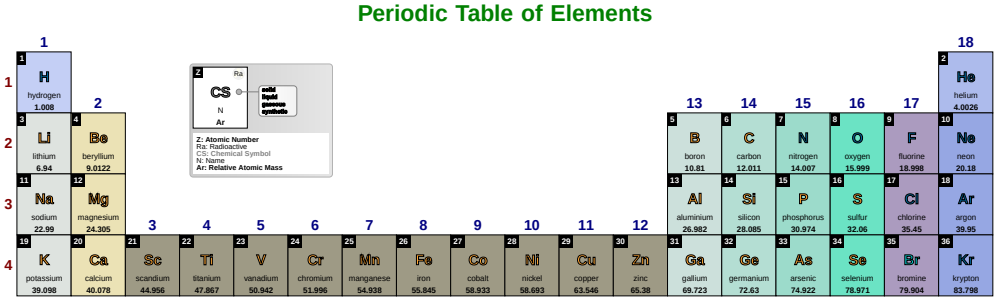
```
\pgfPT[Z list={1,...,36},title font=\Huge\itshape]
```



title color default: *black*

Sets the title color.

```
\pgfPT[Z list={1,...,36},title color=green!50!black]
```

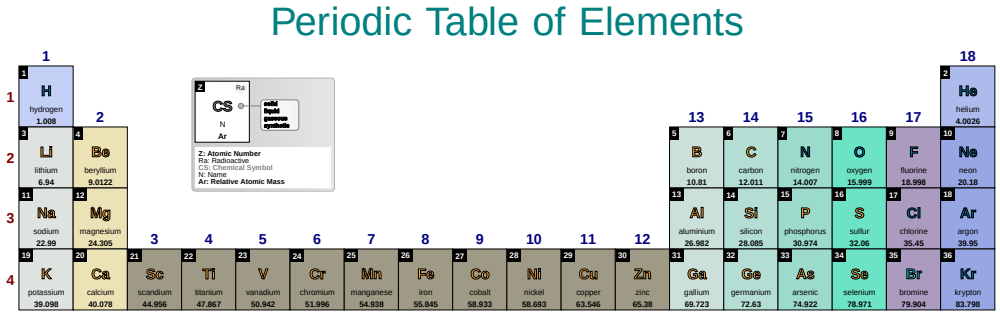


title default: *{f=\Large\bfseries,c=black}*

Pseudo style to set the keys: title **f**ont and/or title **c**olor. None of the *keys* – f and c – are mandatory. The key show title is set to true.

USAGE: title={f=<font commands>,c=<color>}

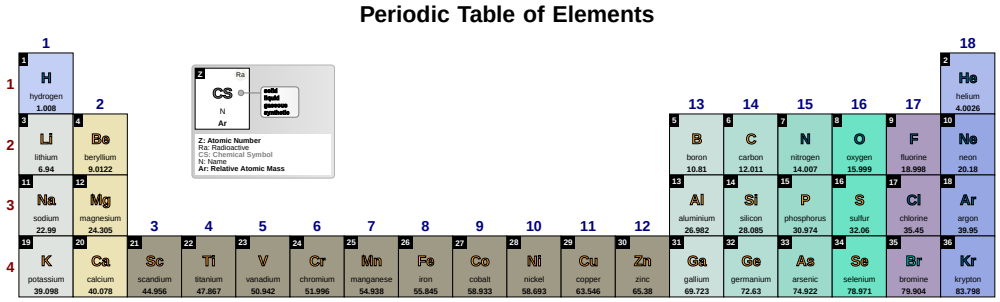
```
\pgfPT[Z list={1,...,36},title={f=\Huge,c=teal}]
```



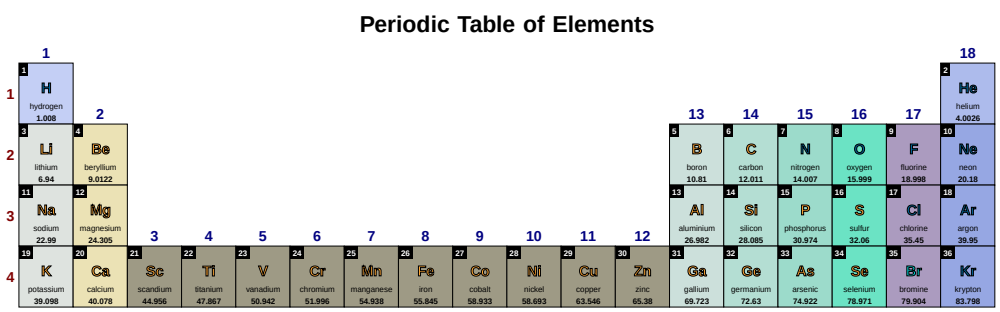
show legend default: *true*

When set to true the legend is shown, otherwise it is not shown.

```
\pgfPT[Z list={1,...,36}]
```



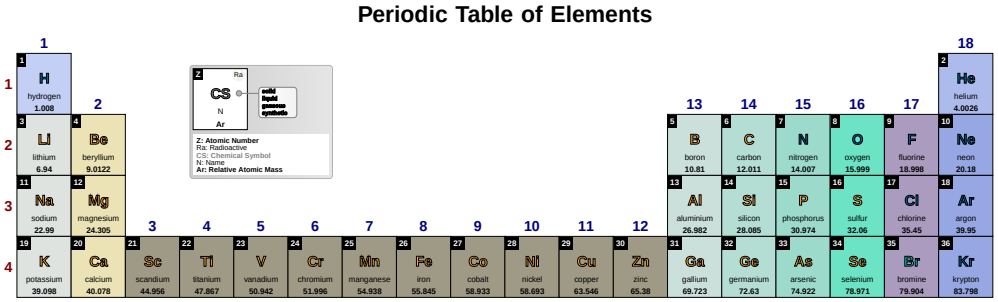

```
\pgfPT[Z list={1,...,36},show legend=false]
```



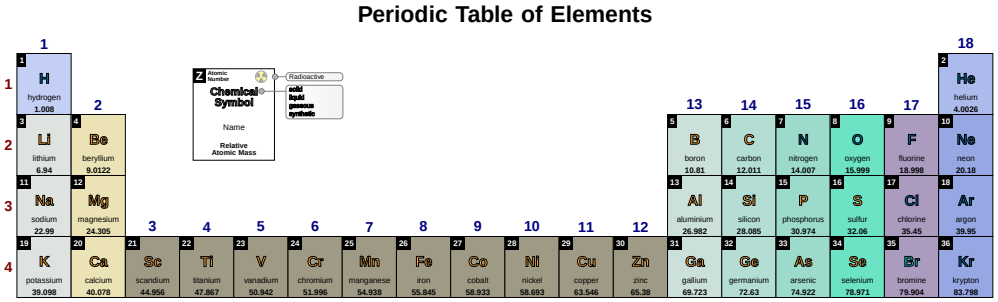
legend acronyms default: *true*

When set to true, the legend consists of a cell using acronyms for its contents and the corresponding descriptions below that cell. When set to false, only the cell is displayed with the descriptions in place of the acronyms. In the latter case, the description font size is automatically adjusted to the available box, which can *spoil the appearance of the whole caption*, depending on the described content.

```
\pgfPT[Z list={1,...,36}]
```




```
\pgfPT[Z list={1,...,36},legend acronyms=false]
```

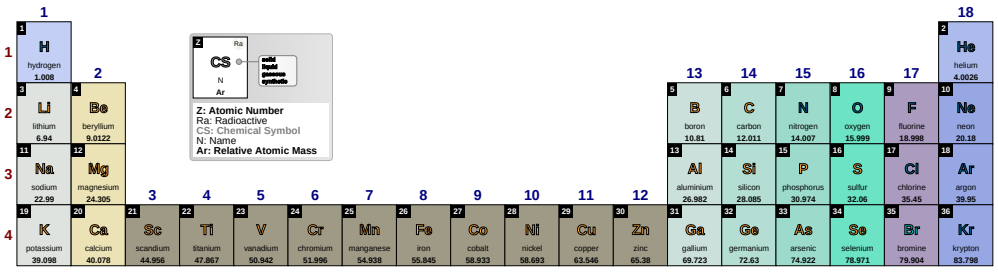


legend acronyms font size default: *document font size*

Sets the font size of the text used in the legend acronyms description. It must be a valid TEX dimension and *it only works when the key legend acronyms is set to true*.

(new in v2.1.5)

```
\pgfPT[Z list={1,...,36},legend acronyms font size=14pt]
```

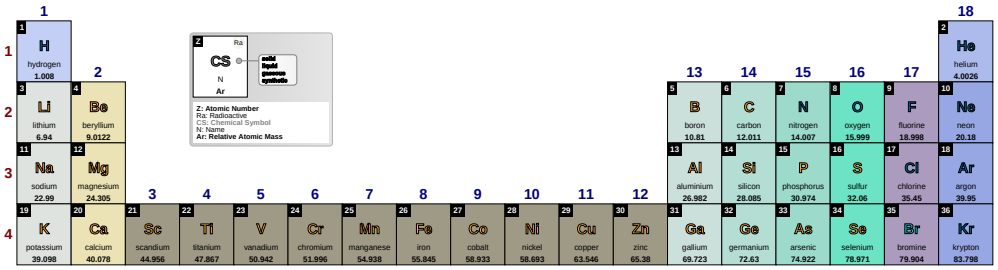


legend box default: *left color=black!20,right color=black!10,draw=black!30*

Style to define the appearance of the box around the legend, legend pins and acronym descriptions, built with any of the TikZ keys that can be applied to a path construction. *It only works when the key legend acronyms is set to true.*

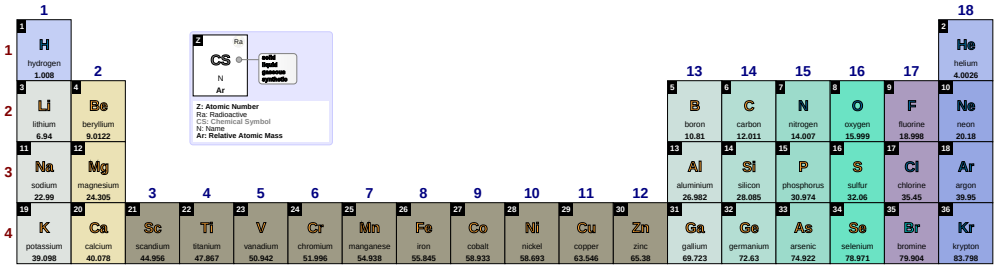
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements



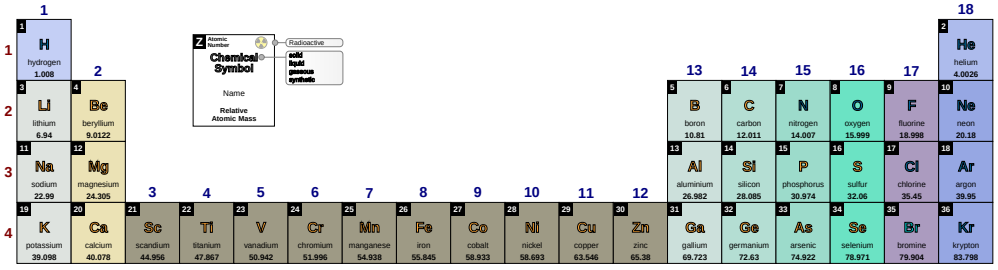
```
\pgfPT[Z list={1,...,36},legend box={draw=blue!20,fill=blue!10}]
```

Periodic Table of Elements



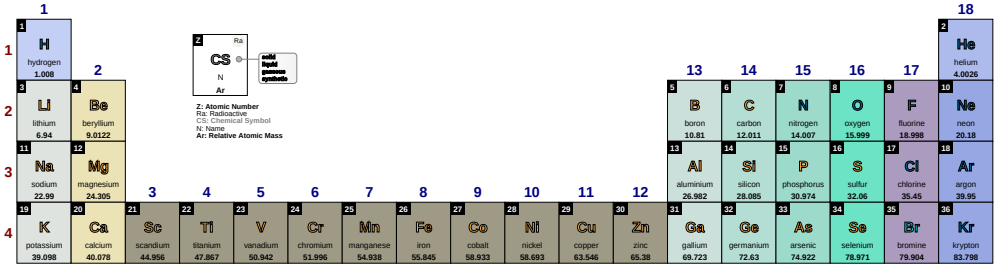
```
\pgfPT[Z list={1,...,36},legend box={draw=blue!20,fill=blue!10,legend acronyms=false}]
```

Periodic Table of Elements



```
\pgfPT[Z list={1,...,36},legend box={}]
```

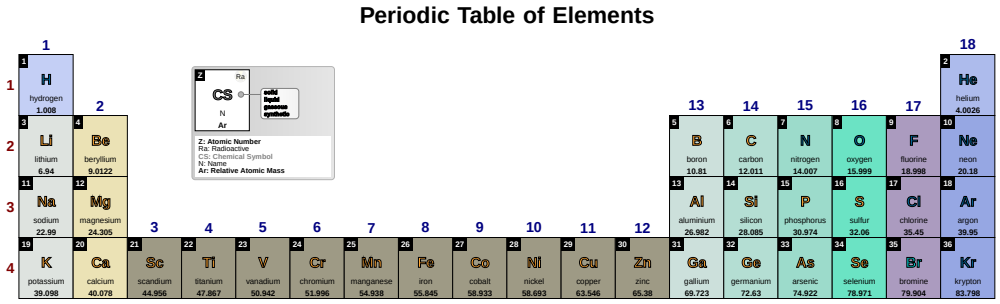
Periodic Table of Elements



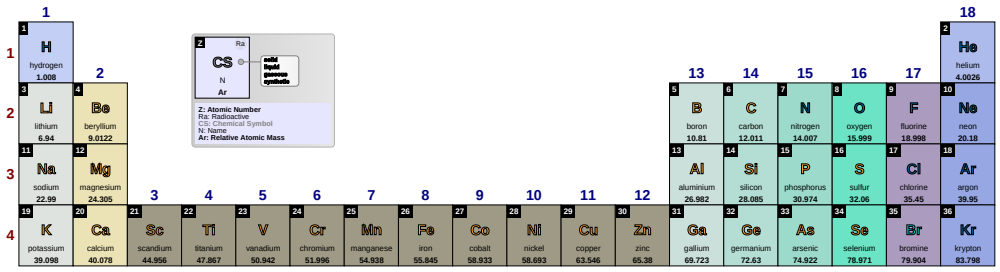
legend back color default: *white*

Sets the legend background color.

```
\pgfPT[Z list={1,...,36}]
```



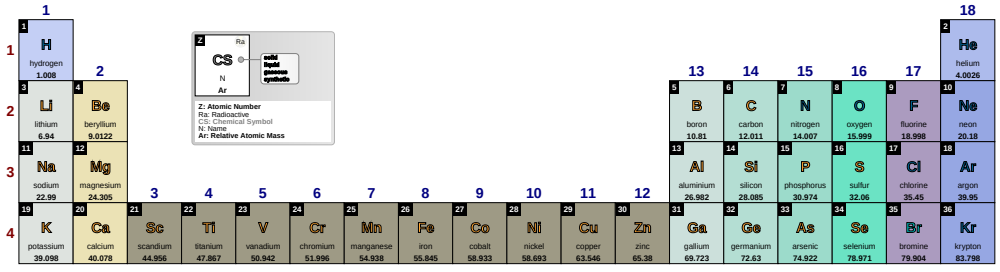

```
\pgfPT[Z list={1,...,36},legend back color=blue!10]
```



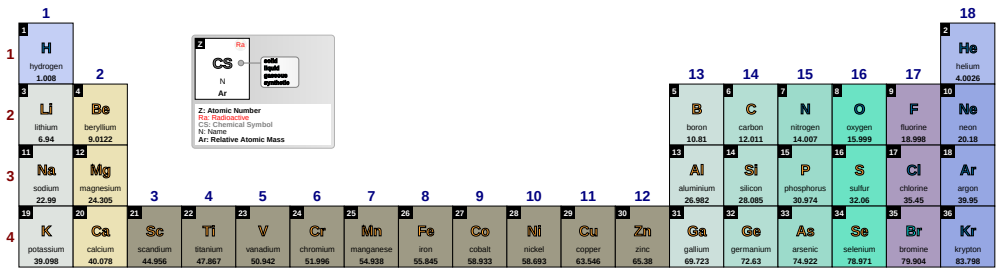
legend radio color default: *black*

Sets the color of the radioactivity acronym and corresponding description.

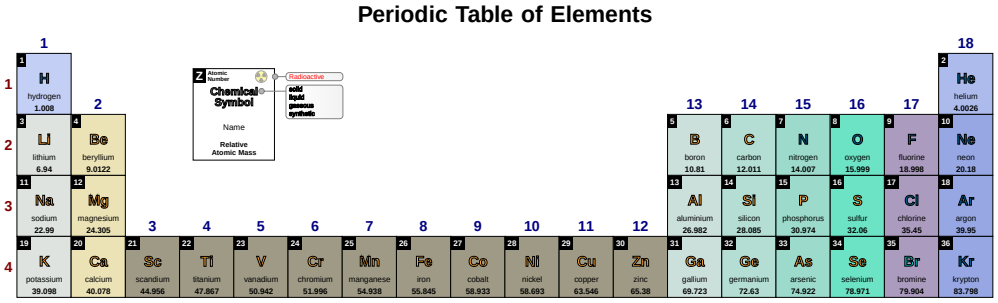
```
\pgfPT[Z list={1,...,36}]
```




```
\pgfPT[Z list={1,...,36},legend radio color=red]
```



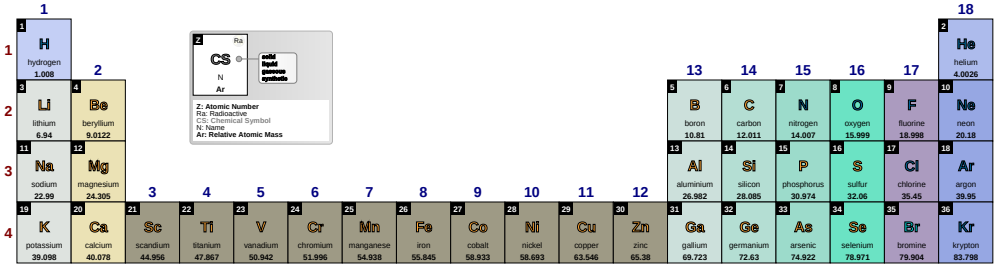
```
\pgfPT[Z list={1,...,36},legend radio color=red,legend acronyms=false]
```



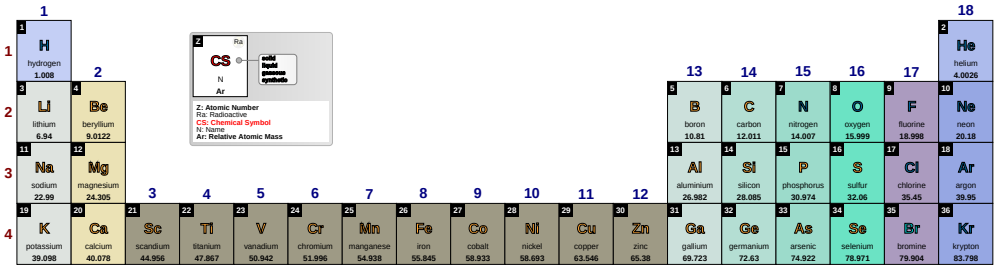
legend CS color default: *black!50*

Sets the color of the Chemical Symbol acronym and corresponding description.

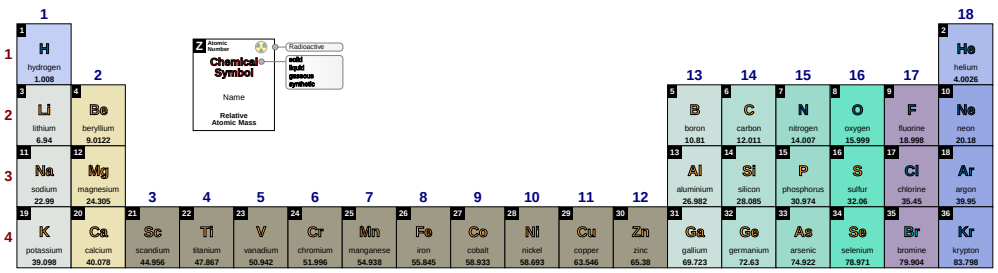
```
\pgfPT[Z list={1,...,36}]
```




```
\pgfPT[Z list={1,...,36},legend CS color=red]
```



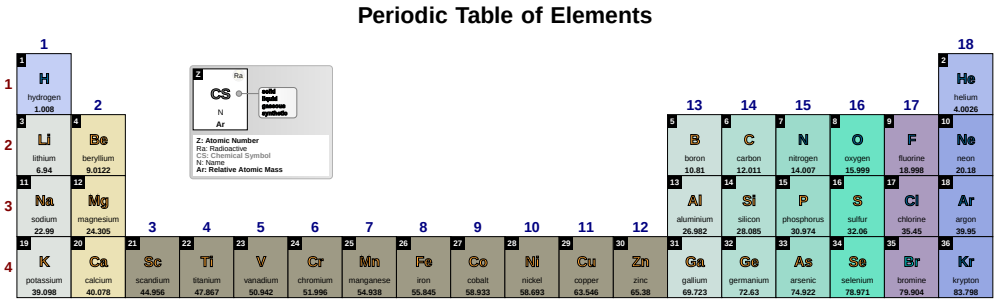

```
\pgfPT[Z list={1,...,36},legend CS color=red,legend acronyms=false]
```



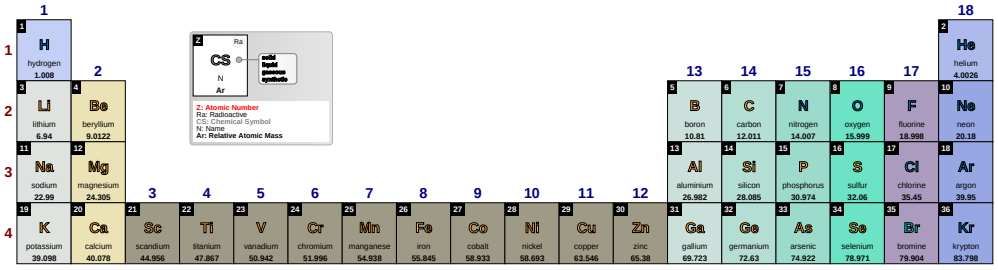
legend Z color default: {}

Sets the color of the atomic number description (only applies when the key legend acronyms is set to true.)

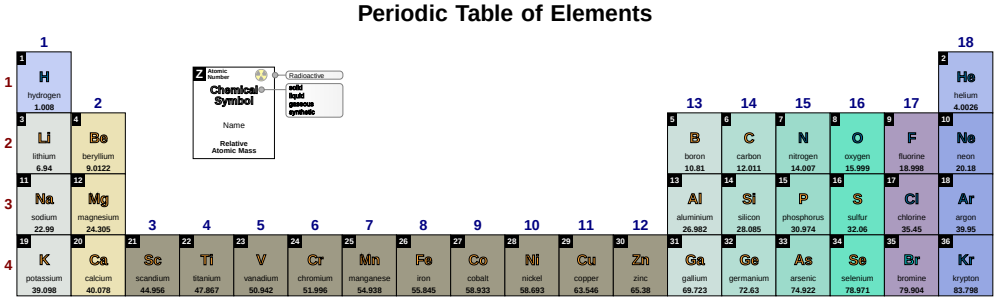
```
\pgfPT[Z list={1,...,36}]
```




```
\pgfPT[Z list={1,...,36},legend Z color=red]
```



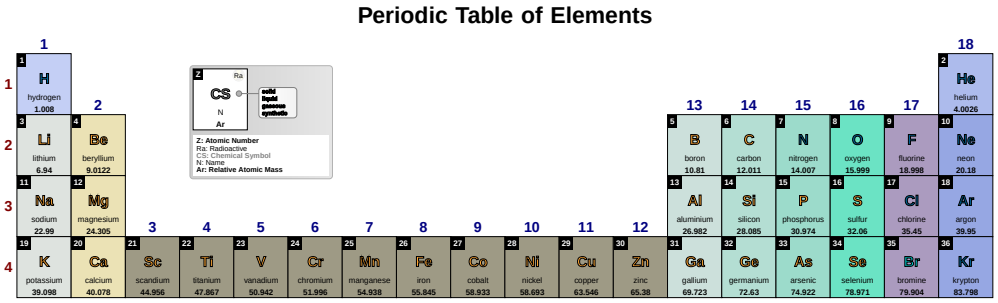

```
\pgfPT[Z list={1,...,36},legend Z color=red,legend acronyms=false]
```



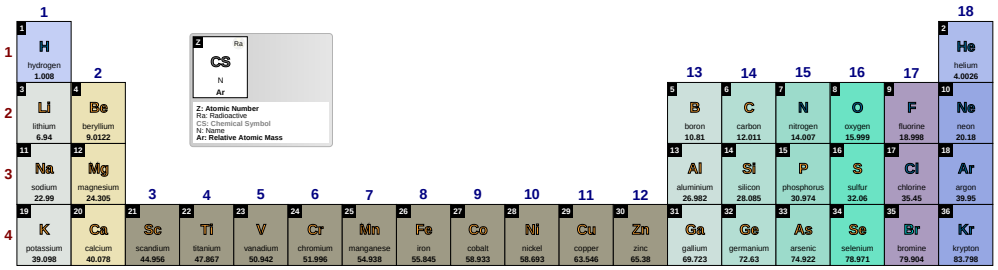
show legend pins default: *true*

When set to true the legend pins are shown, otherwise they are not shown.

```
\pgfPT[Z list={1,...,36}]
```



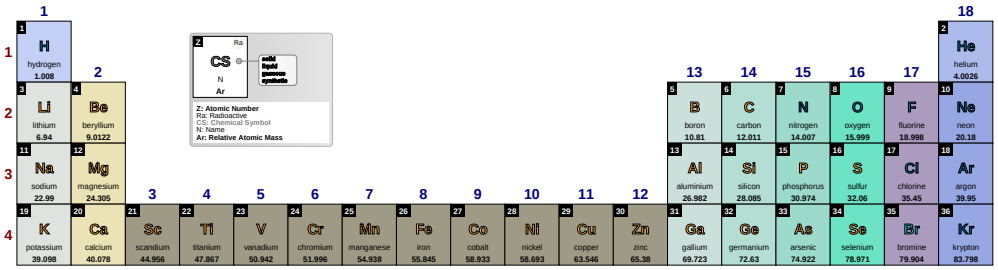

```
\pgfPT[Z list={1,...,36},show legend pins=false]
```



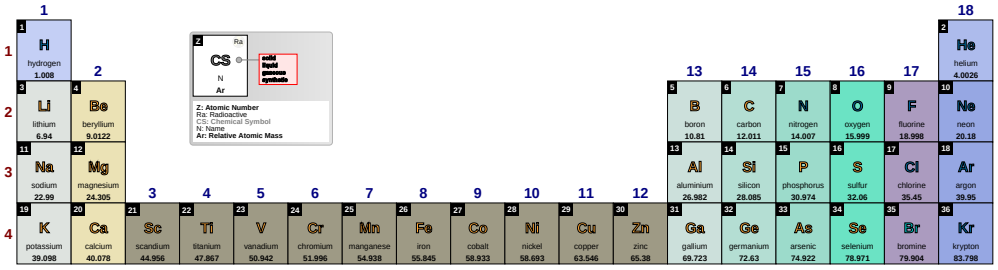
legend pins default: *{line width=.05pt,rounded corners=2pt,right color=black!5, left color=white,draw=black!50}*

Style to define the appearance of the legend pins, built with any of the TikZ keys that can be applied to a path construction.

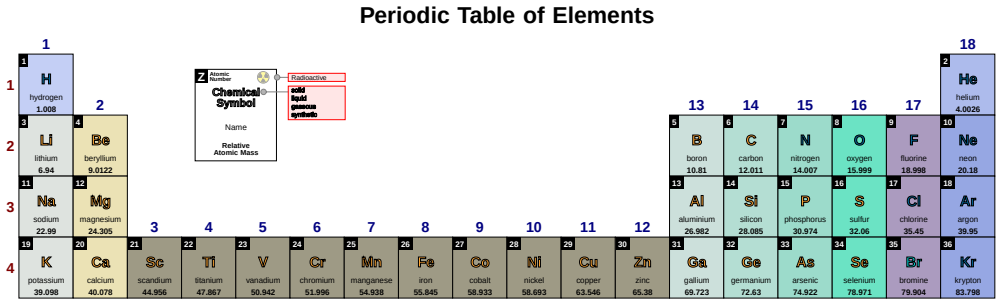
```
\pgfPT[Z list={1,...,36}]
```




```
\pgfPT[Z list={1,...,36},legend pins={draw=red,fill=red!10}]
```



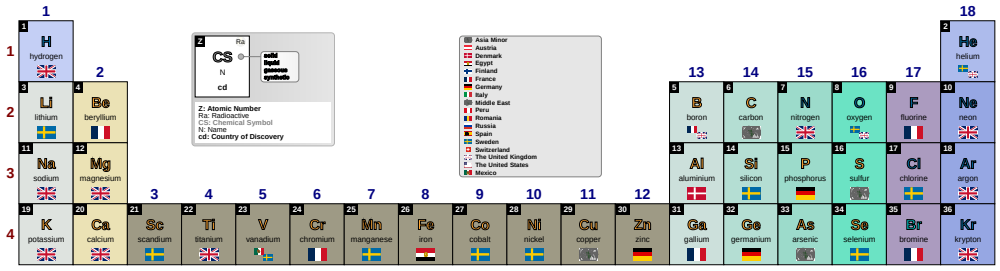
```
\pgfPT[Z list={1,...,36},legend pins={draw=red,fill=red!10},legend acronyms=false]
```



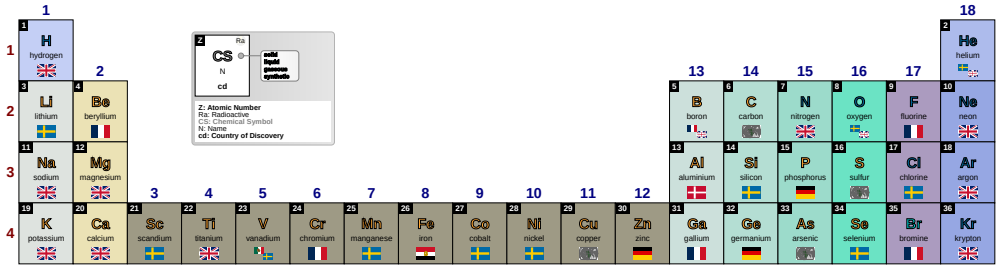
show extra legend default: *true*

When set to true the extra legend is shown, otherwise it is not shown.

```
\pgfPTbuildcellstyle{myname}(6,3)% 6 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5.25-6.75;1-3;DiscC)]
\pgfPT[Z list={1,...,36},cell style=myname]
```



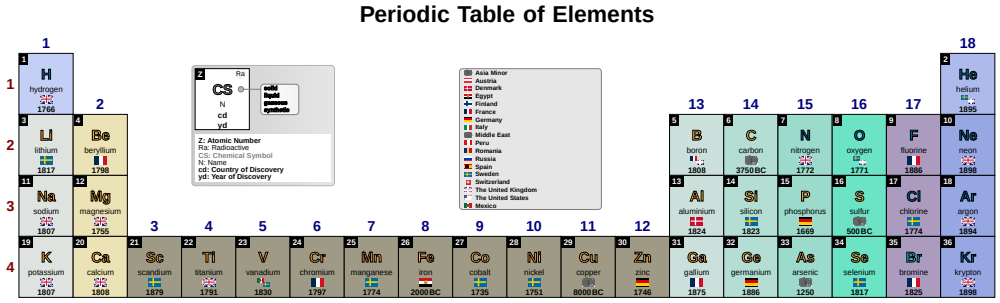

```
\pgfPT[Z list={1,...,36},cell style=myname,show extra legend=false]
```



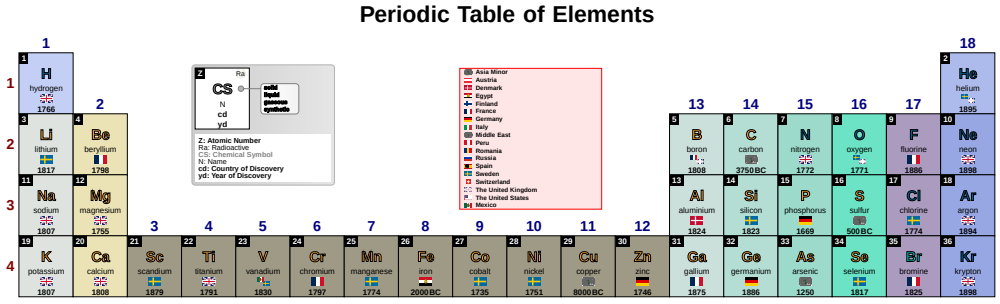
extra legend default: *{draw=black!50,fill=black!10,line width=.05pt, rounded corners=2pt}*

Style to define the appearance of the extra legend, built with any of the TikZ keys that can be applied to a path construction.

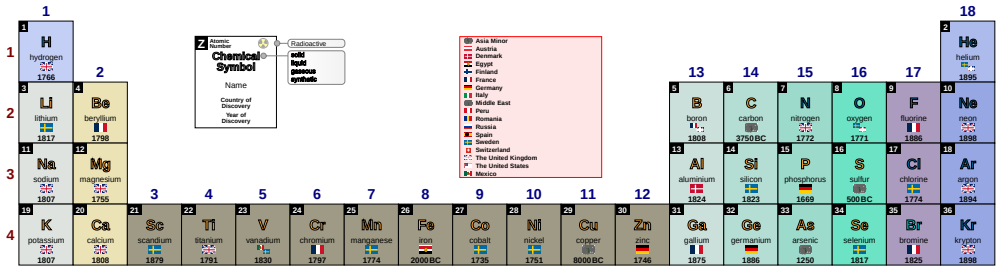
```
\pgfPT[Z list={1,...,36},cell style=pgfPTdisc]
```




```
\pgfPT[Z list={1,...,36},cell style=pgfPTdisc,extra legend={draw=red,fill=red!10}]
```




```
\pgfPT[Z list={1,...,36},cell style=pgfPTdisc,legend acronyms=false,extra
legend={draw=red,fill=red!10}]
```



legend default: *{bc=white,pins=true,extra=true,acro=true}*

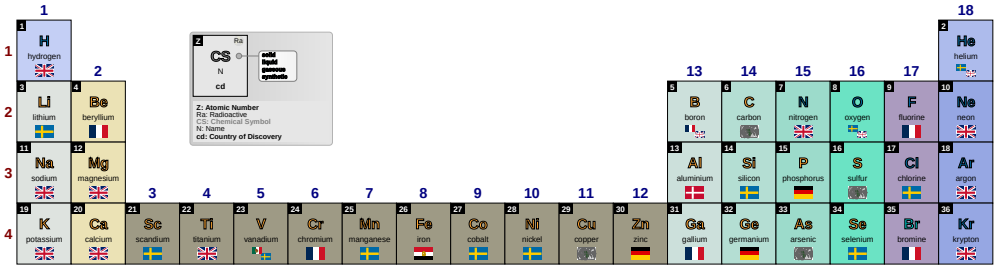
Pseudo style to set the keys: legend **b**ack **c**olor, show legend **pins**, show **extra** legend, legend **acro**nyms, legend **radio** color, legend **CS** color, legend **Z** color, legend **pins** (**style**), **extra** legend (**style**) and/or legend **box** (style). None of the *keys* – bc, pins, extra, acro, radio, CS, Z, pins style, extra style and box – are mandatory. The key show legend is set to true.

USAGE:

```
legend={bc=<color>,pins=<true|false>,extra=<true|false>,acro=<true|false>,
        radio=<color>,CS=<color>,Z=<color>,pins style=<tikz path keys>,
        extra style=<tikz path keys>,box=<tikz path keys>}
```

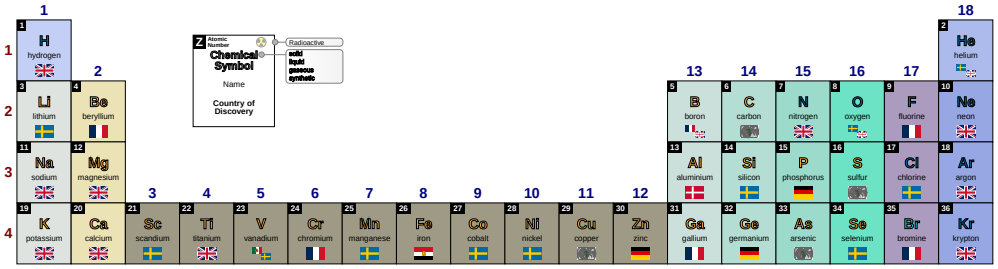
```
\pgfPT[Z list={1,...,36},cell style=myname,legend={bc=black!10,extra=false}]
```

Periodic Table of Elements




```
\pgfPT[Z list={1,...,36},cell style=myname,legend={acro=false,extra=false}]
```

Periodic Table of Elements



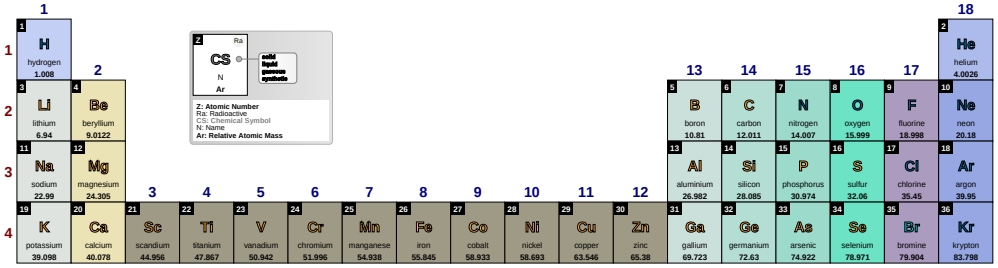
➠ Periods and Groups

show period numbers default: *true*

When set to true the period numbers are shown, otherwise they are not shown.

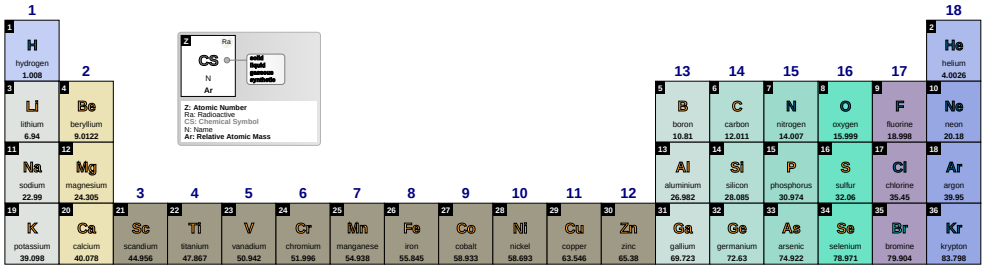
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements




```
\pgfPT[Z list={1,...,36},show period numbers=false]
```

Periodic Table of Elements

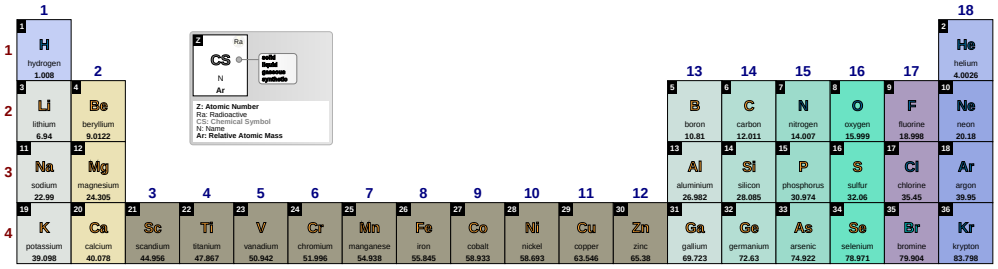


show group numbers default: *true*

When set to true the group numbers are shown, otherwise they are not shown.

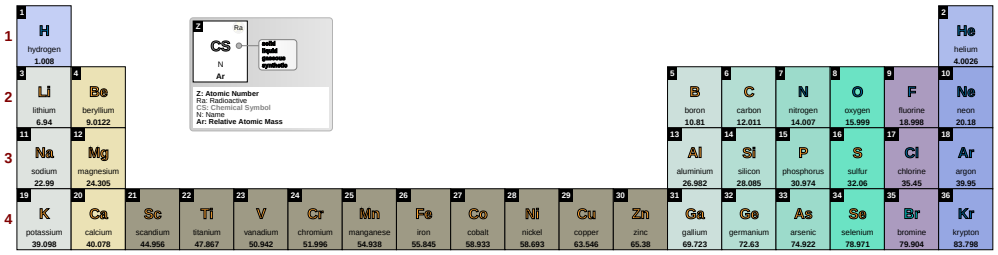
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements



```
\pgfPT[Z list={1,...,36},show group numbers=false]
```

Periodic Table of Elements



group numbers default: *arabic*

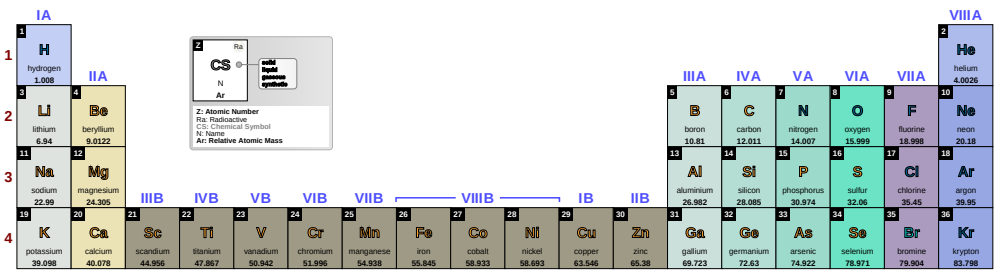
This key controls how group numbering is displayed:

- ✓ **arabic**: group numbers are shown in arabic numerals as recommended by IUPAC since 1988.
- ✓ **CAS**: group numbers are shown in Roman numerals and 'A' or 'B' suffix. This is an older naming scheme, used by the Chemical Abstract Service (CAS), more popular in the United States.
- ✓ **IUPAC**: group numbers are shown in Roman numerals and 'A' or 'B' suffix. This is an older naming scheme, used by IUPAC before 1988, more popular in Europe.
- ✓ **CAS***: combines the option CAS and arabic. Roman numerals and 'A' or 'B' suffix are above the group and the arabic numerals above them.
- ✓ **IUPAC***: combines the option IUPAC and arabic. Roman numerals and 'A' or 'B' suffix are above the group and the arabic numerals above them.

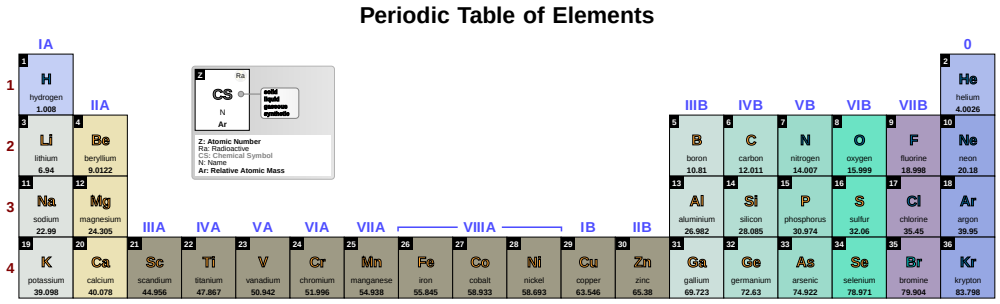
(new in v2.1.1)

```
\pgfPT[Z list={1,...,36},group numbers=CAS]
```

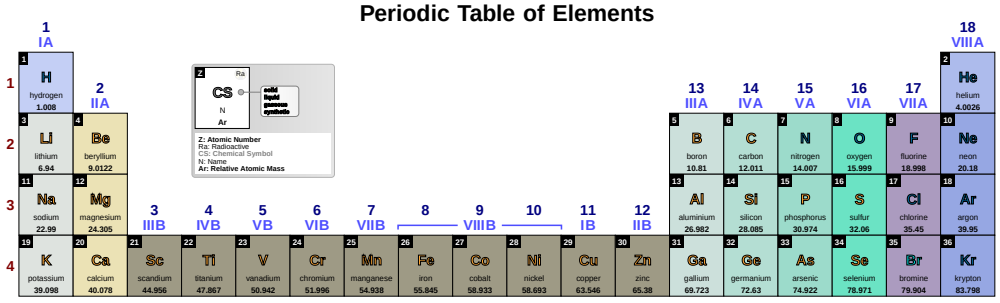
Periodic Table of Elements



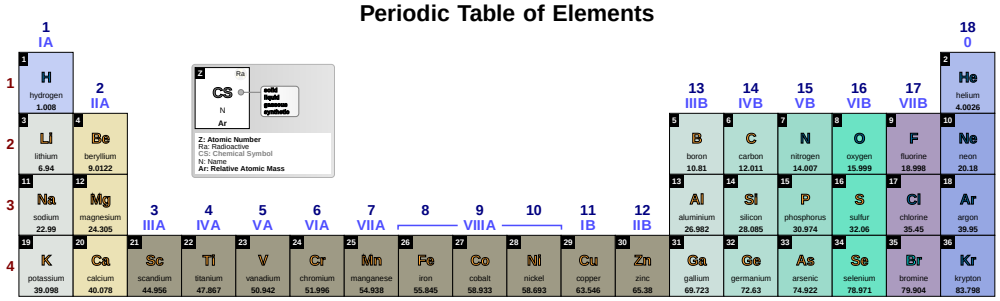
\pgfPT[Z list={1,...,36},group numbers=IUPAC]



\pgfPT[Z list={1,...,36},group numbers=CAS*]



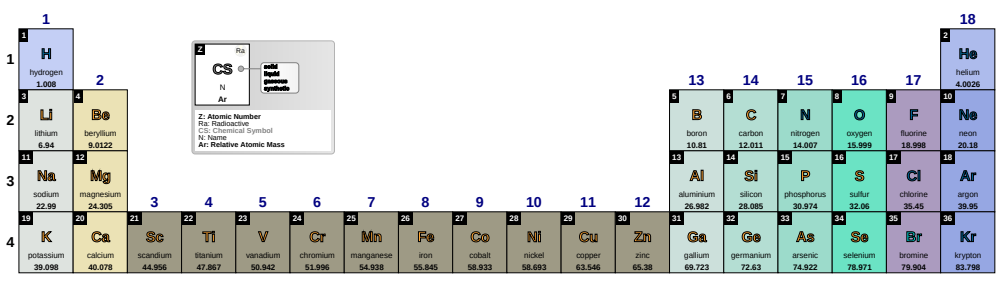
\pgfPT[Z list={1,...,36},group numbers=IUPAC*]



period label color default: *red!50!black*

Sets the period label color.

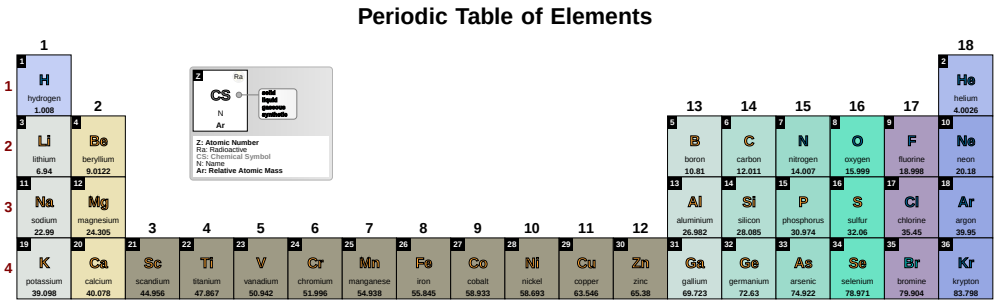
\pgfPT[Z list={1,...,36},period label color=black]



group label color default: *blue!50!black*

Sets the group label color.

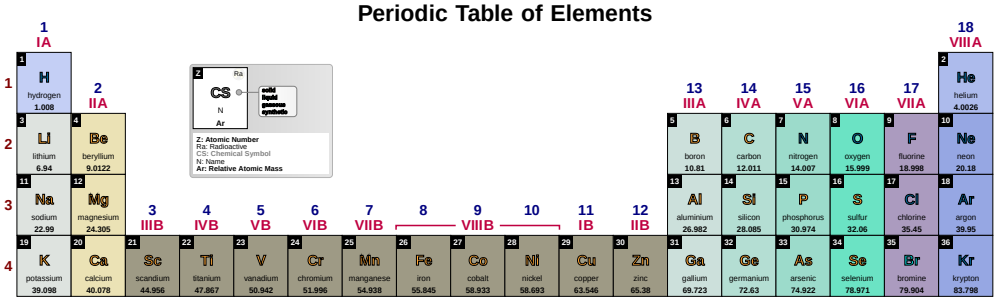
```
\pgfPT[Z list={1,...,36},group label color=black]
```



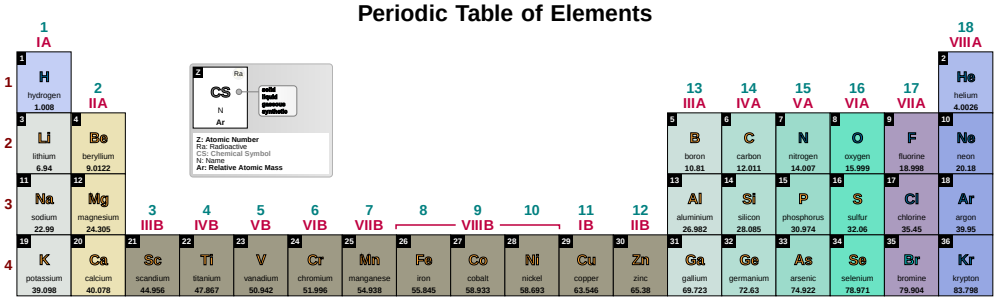
Roman label color default: *blue!70!black*

Sets the Roman group label color. *(new in v2.1.1)*

```
\pgfPT[Z list={1,...,36},group numbers=CAS*,Roman label color=purple]
```



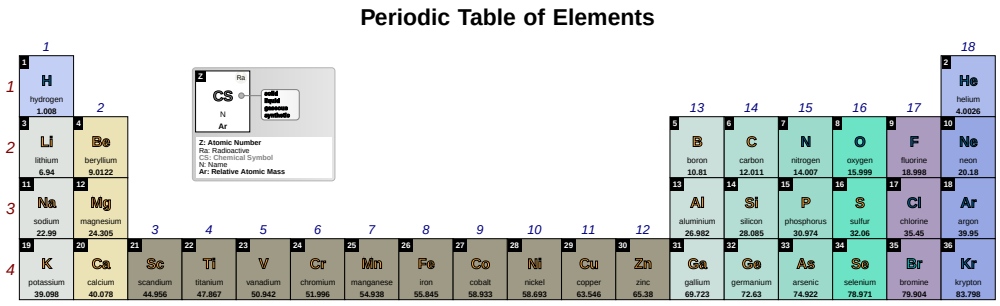

```
\pgfPT[Z list={1,...,36},group numbers=CAS*,Roman label color=purple, group label color=teal]
```



label font default: *\small\bfseries*

Sets the label font.

```
\pgfPT[Z list={1,...,36},label font=\itshape]
```

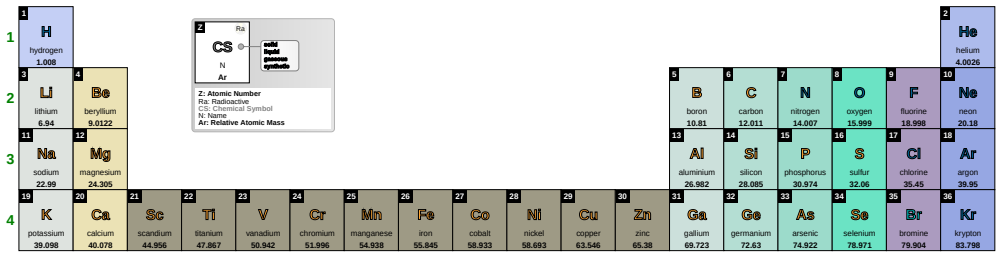


per default: *{gr=true,c=red!50!black,f=\small\bfseries}*

Pseudo style to set the keys: show **gr**oup numbers, period label **c**olor and/or label **f**ont. None of the *keys* – gr, c and f – are mandatory. The key show period numbers is set to true.

USAGE: per={gr=<true|false>,c=<color>,f=<font commands>}

```
\pgfPT[Z list={1,...,36},per={gr=false,c=green!50!black}]
```

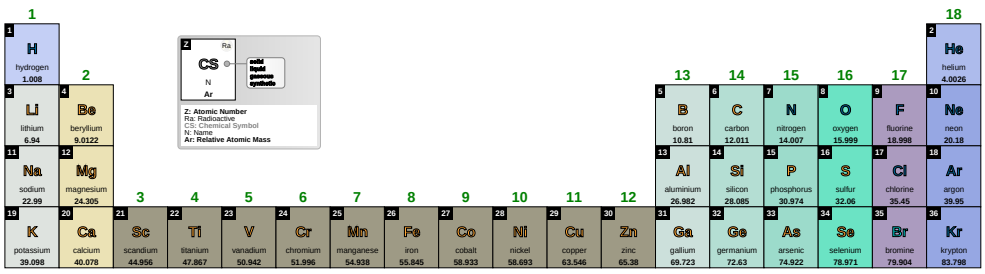


gr default: *{per=true,c=blue!50!black,f=\small\bfseries}*

Pseudo style to set the keys: show **per**iod numbers, group label **c**olor and/or label **f**ont. None of the *keys* – per, c and f – are mandatory. The key show group numbers is set to true.

USAGE: gr={per=<true|false>,c=<color>,f=<font commands>}

```
\pgfPT[Z list={1,...,36},gr={per=false,c=green!50!black}]
```

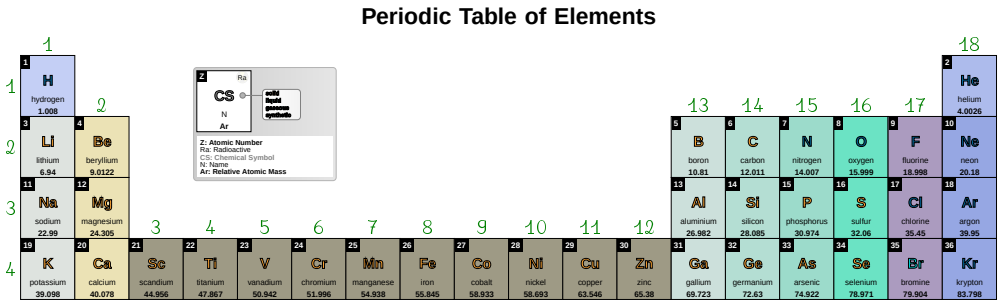


per+gr default: *{pc=red!50!black,gc=blue!50!black,f=\small\bfseries}*

Pseudo style: use **c** to set both keys group label color and period label color with the same color; use **pc** to set period label color, **gc** to set group label color and/or **f** to set label **f**ont. None of the *keys* – c, pc, gc and f – are mandatory. The keys show period numbers and show group numbers are set to true.

USAGE: per+gr={c=<color>,pc=<color>,gc=<color>,f=<font commands>}

```
\pgfPT[Z list={1,...,36},per+gr={c=green!50!black,
f=\fontfamily{frc}\selectfont\normalsize\bfseries}]
```

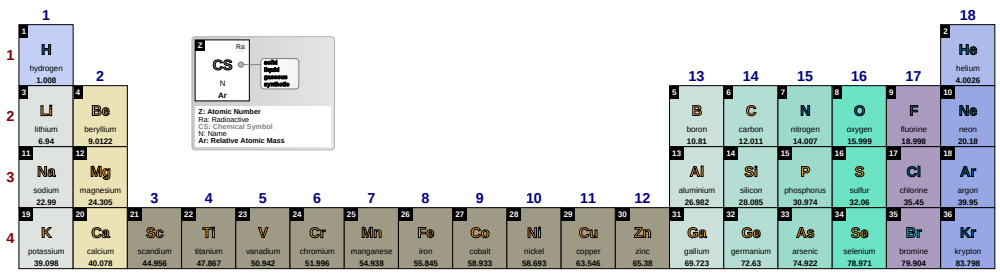


➠ Blocks and Families

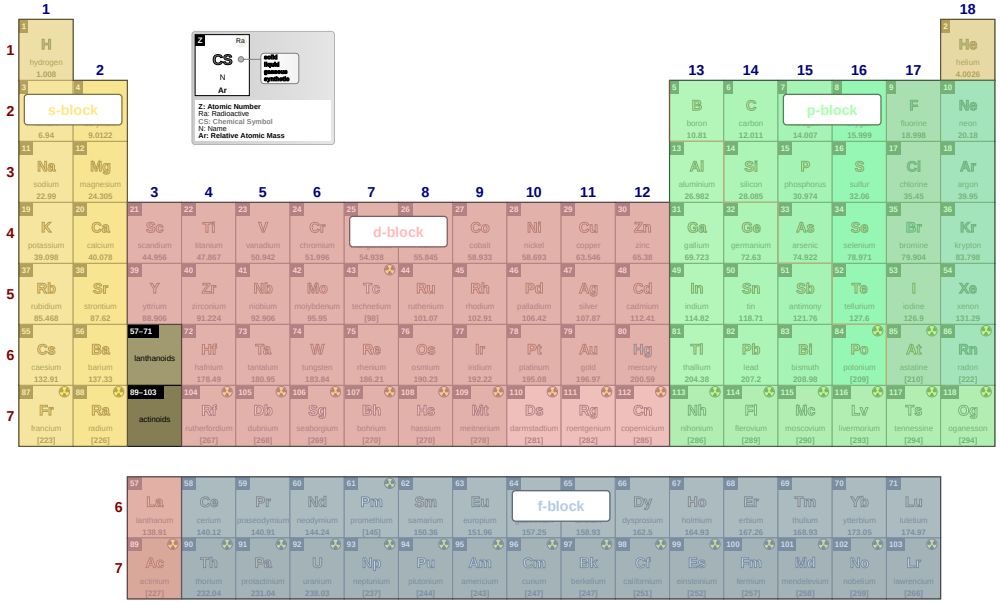
show blocks default: *false*

When set to true the blocks s, p, d and f are drawn overlaying the Periodic Table and their labels are shown. *Note that blocks are only shown when the Z list contains, at least, all elements of blocks s, p and d.*

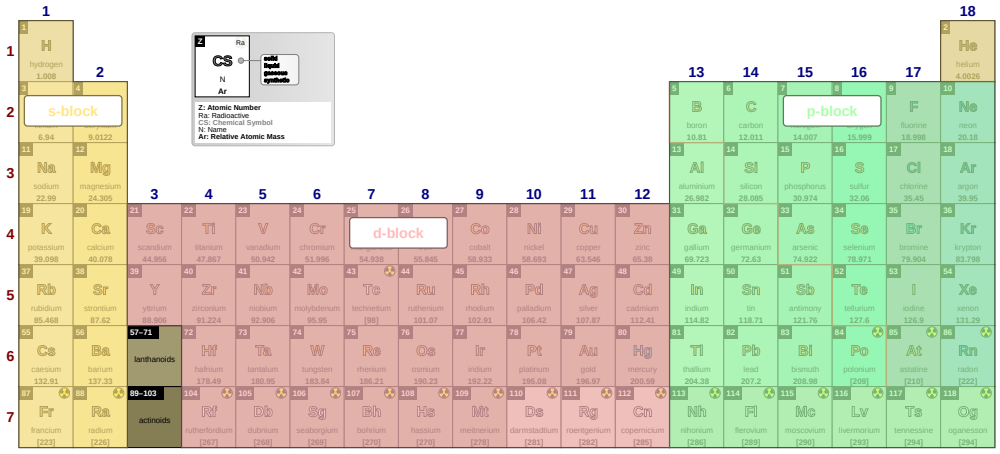
```
\pgfPT[Z list={1,...,36},show blocks=true,show title=false]
```



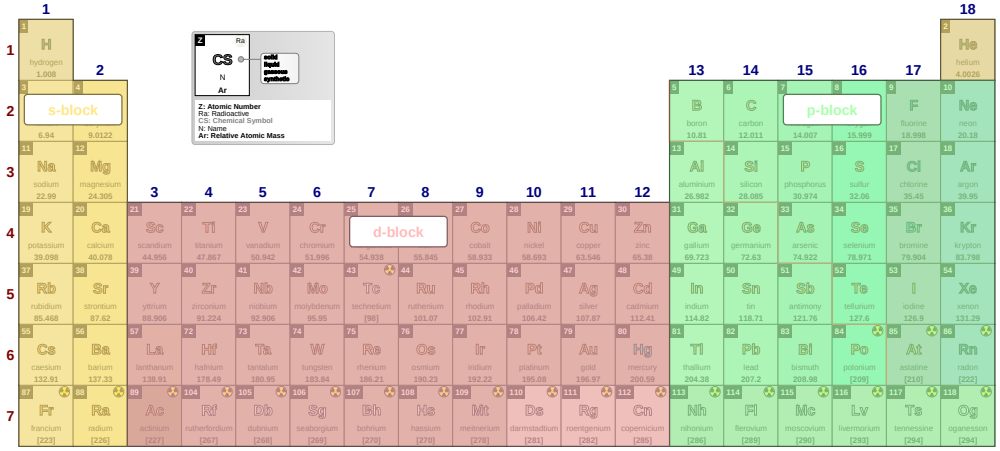
\pgfPT[show blocks,show title=false]



\pgfPT[Z list=spd,show blocks,show title=false]



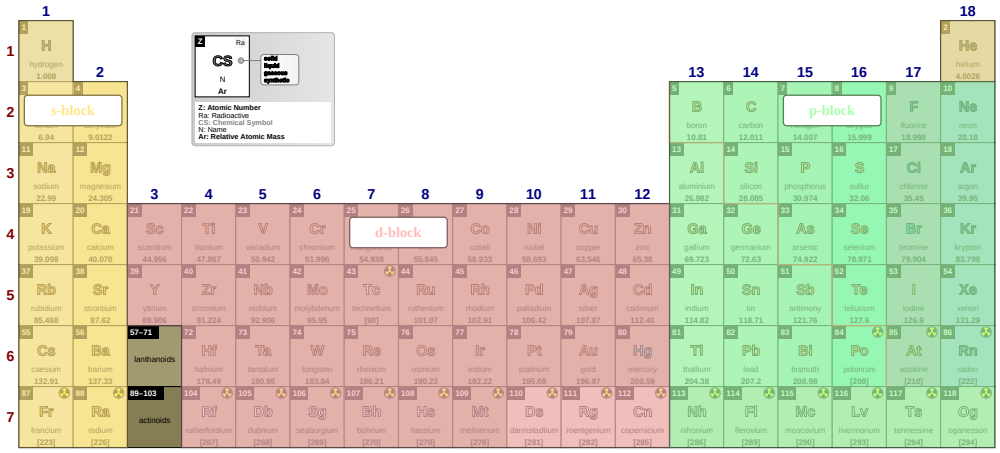
\pgfPT[Z list=spd,show blocks,show title=false,IUPAC=false]



blocks font default: *\small\bfseries*

Sets the font used in the block labels.

```
\pgfPT[Z list=spd,show blocks,show title=false,blocks
font=\small\bfseries\fontfamily{ptm}\selectfont]
```



s block color default: RGB: 255,231,132

Sets the block s color.

s block font color default: *{}*

Sets the s block label font color. If no color is provided, the s block color will be used as the font color.

s block line width default: *0.8pt*

Sets the width of the line surrounding the s block.

p block color default: RGB: 170,255,172

Sets the block p color.

p block font color default: *{}*

Sets the p block label font color. If no color is provided, the p block color will be used as the font color.

p block line width default: *0.8pt*

Sets the width of the line surrounding the p block.

d block color default: RGB: 255,187,187

Sets the block d color.

d block font color default: *{}*

Sets the d block label font color. If no color is provided, the d block color will be used as the font color.

d block line width default: *0.8pt*

Sets the width of the line surrounding the d block.

f block color default: RGB: 177,203,228

Sets the block f color.

f block font color default: *{}*

Sets the f block label font color. If no color is provided, the f block color will be used as the font color.

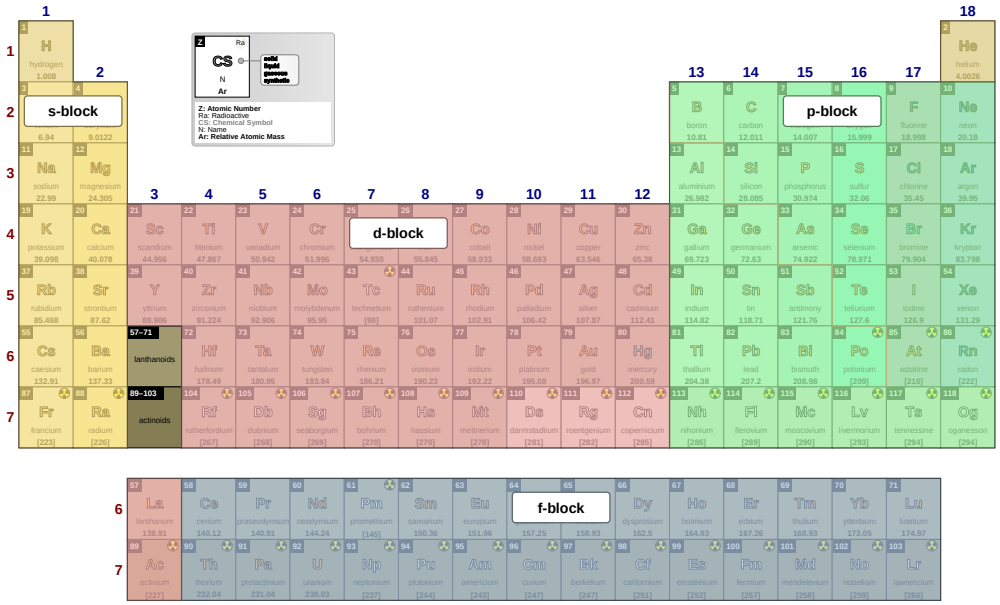
f block line width default: *0.8pt*

Sets the width of the line surrounding the f block.

blocks font color default: *black*

Style to set a common color for the labels of s, p, d and f blocks. The key show blocks is set to true.

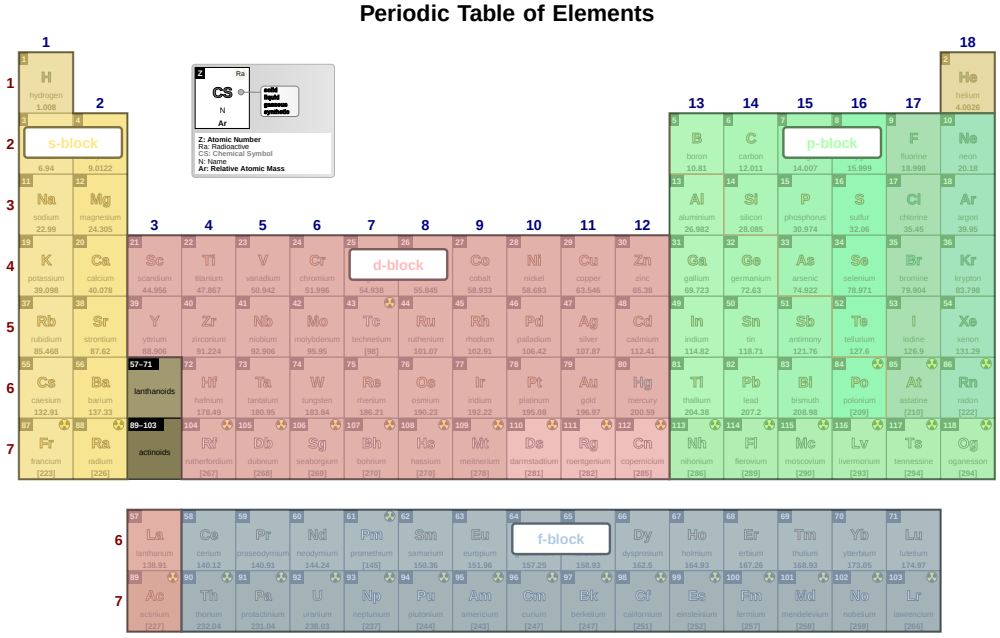
```
\pgfPT[blocks font color,show title=false]
```



blocks line width default: *0.8pt*

Style to set a common width of the lines surrounding the s, p, d and f blocks. The key show blocks is set to true.

```
\pgfPT[blocks line width=1.5pt]
```



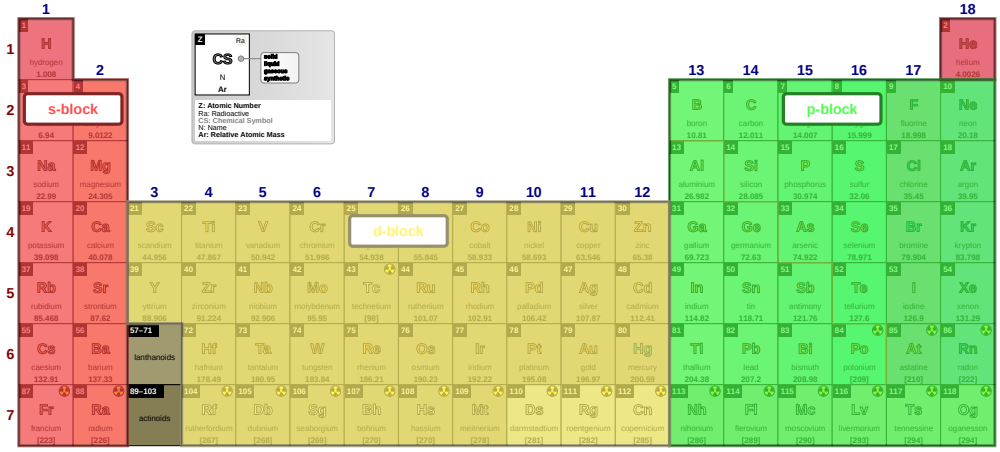
blocks default: *{sc=blocos,pc=blocop,dc=blocod,fc=blocof,lw=.8pt,font=\small\bfseries}*

Pseudo style to set the keys: block **s** color, block **p** color, block **d** color, block **f** color, the common **l**ine **w**idths of the blocks, the **s** block **l**ine **w**idth, the **p** block **l**ine **w**idth, the **d** block **l**ine **w**idth, the **f** block **l**ine **w**idth, blocks **f**ont, **s** block **f**ont **c**olor, **p** block **f**ont **c**olor, **d** block **f**ont **c**olor and/or **f** block **f**ont **c**olor. None of the *keys* – sc, pc, dc, fc, lw, slw, plw, dlw, flw, sfc, pfc, dfc and ffc – are mandatory. The key show blocks is set to true.

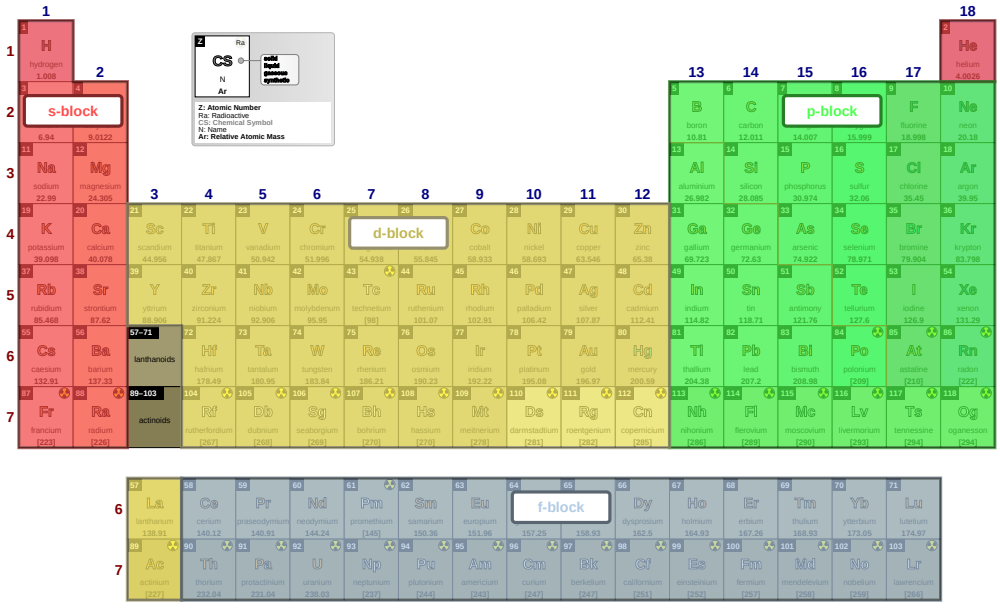
NOTE:
The colors provided to the color keys of the blocks – sc, pc, dc and fc – could be any defined color via the command `\definecolor` or by *mixing* colors, using, for instance, the syntax `color1!value!color2` or `color1!value`, as explained in the xcolor package documentation.

USAGE:
```
blocks={sc=<color>,pc=<color>,dc=<color>,fc=<color>,lw=<lenght>,
        slw=<lenght>,plw=<lenght>,dlw=<lenght>,flw=<lenght>,f=<font commands>,
        sfc=<color>,pfc=<color>,dfc=<color>,ffc=<color>}
```

\pgfPT[blocks={sc=red!70!white,pc=green!70!white,dc=yellow!70!white,lw=2pt}, show title=false,Z list=spd]



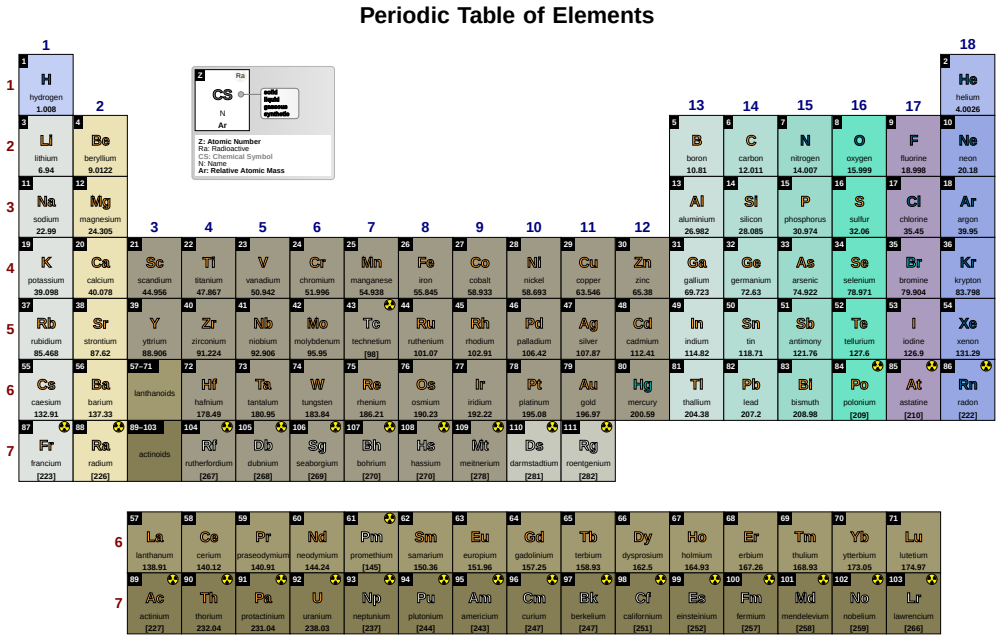
\pgfPT[blocks={sc=red!70!white,pc=green!70!white,dc=yellow!70!white, dfc=yellow!70!black,lw=2pt},show title=false]



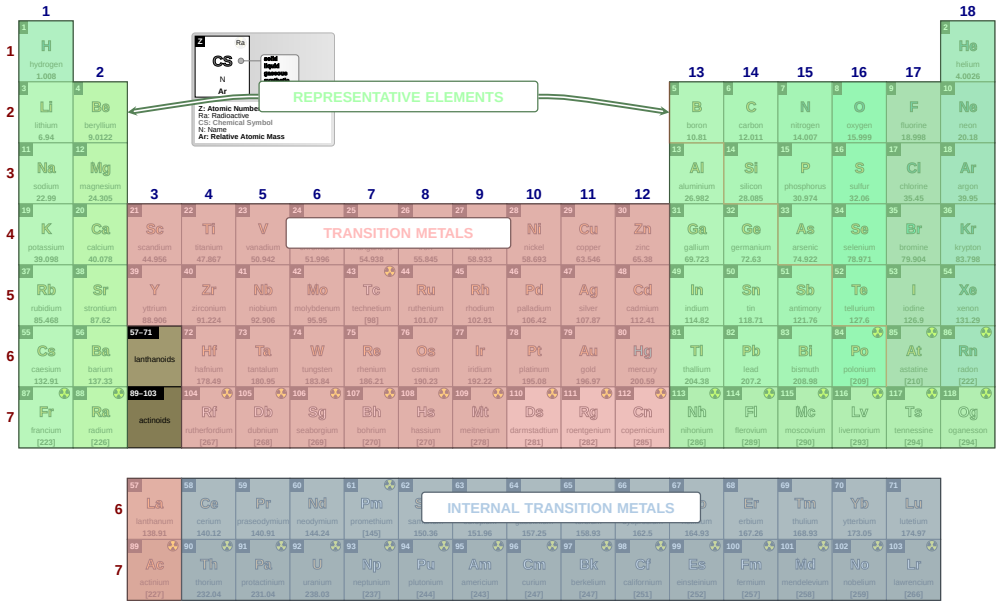
show families default: *false*

When set to true the main families – representative elements, transition metals and internal transition metals – are drawn overlaying the Periodic Table and their labels are shown. *Note that families are only shown when the Z list contains, at least, all elements of blocks s, p and d.*

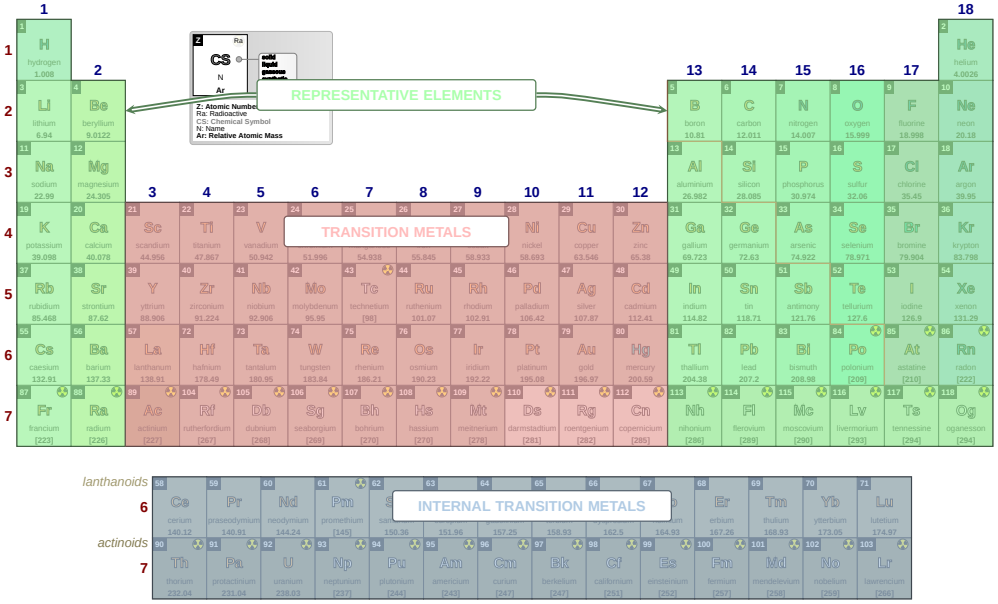
```
\pgfPT[Z list={1,...,111},show families]
```




```
\pgfPT[show families]
```



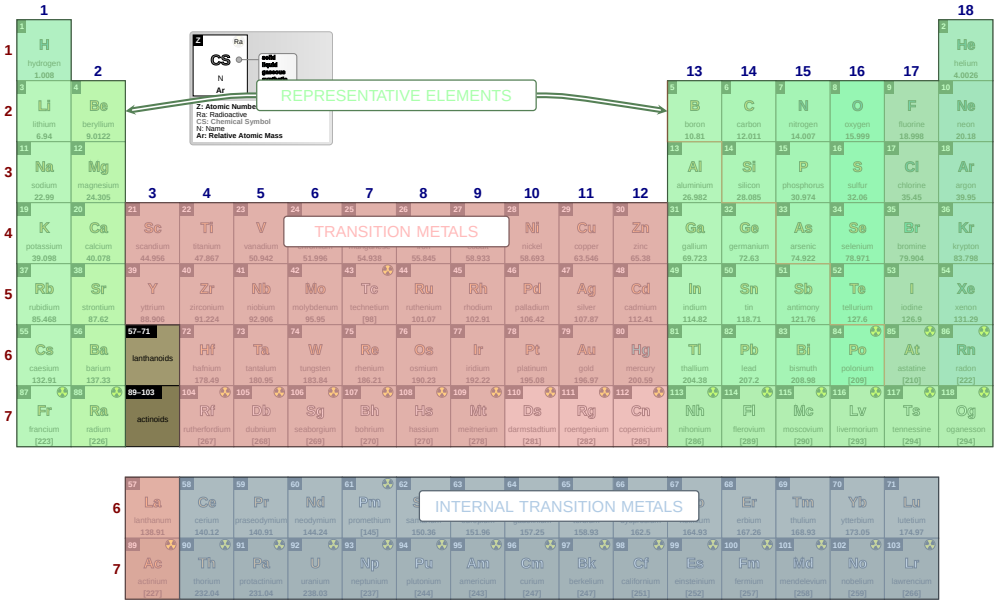
\pgfPT[show families,show title=false,IUPAC=false]



families font default: *\small\bfseries*

Sets the font used in the family labels.

\pgfPT[show families,show title=false,families font=\normalsize]



r family color default: *RGB: 170,255,172*

Sets the representative elements *block* color.

r family font color default: *{}*

Sets the representative elements *block* label font color. If no color is provided, the r family color will be used as the font color.

r family line width default: *0.8pt*

Sets the width of the line surrounding the representative elements *block*.

tm family color default: RGB: 255,187,187

Sets the transition metals *block* color.

tm family font color default: *{}*

Sets the transition metals *block* label font color. If no color is provided, the tm family color will be used as the font color.

tm family line width default: *0.8pt*

Sets the width of the line surrounding the transition metals *block*.

itm family color default: RGB: 177,203,228

Sets the internal transition metals *block* color.

itm family font color default: *{}*

Sets the internal transition metals *block* label font color. If no color is provided, the itm family color will be used as the font color.

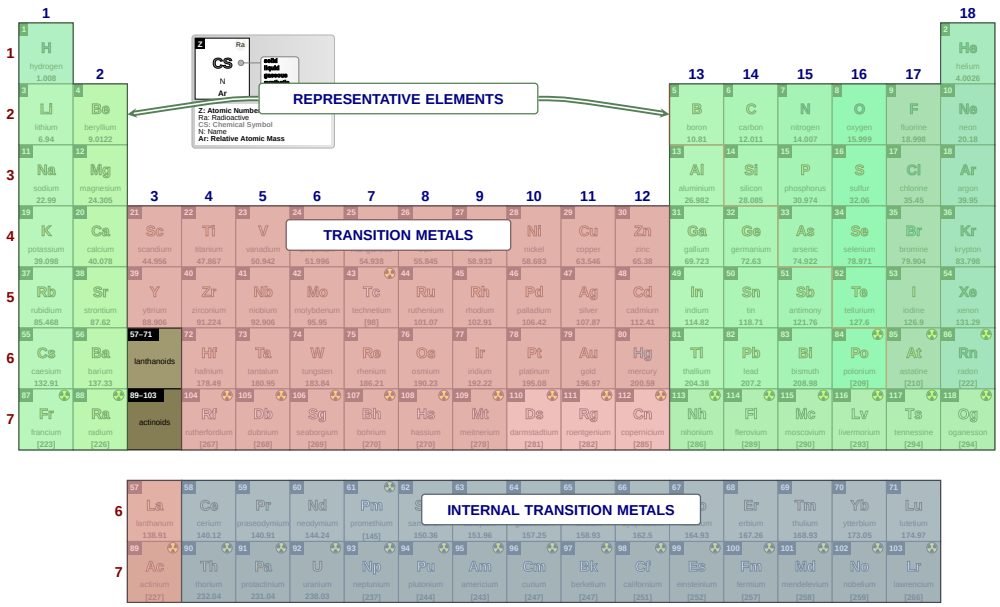
itm family line width default: *0.8pt*

Sets the width of the line surrounding the internal transition metals *block*.

families font color default: *black*

Style to set a common color for the labels of representative elements, transition metals and internal transition metals *blocks*. The key show blocks is set to true.

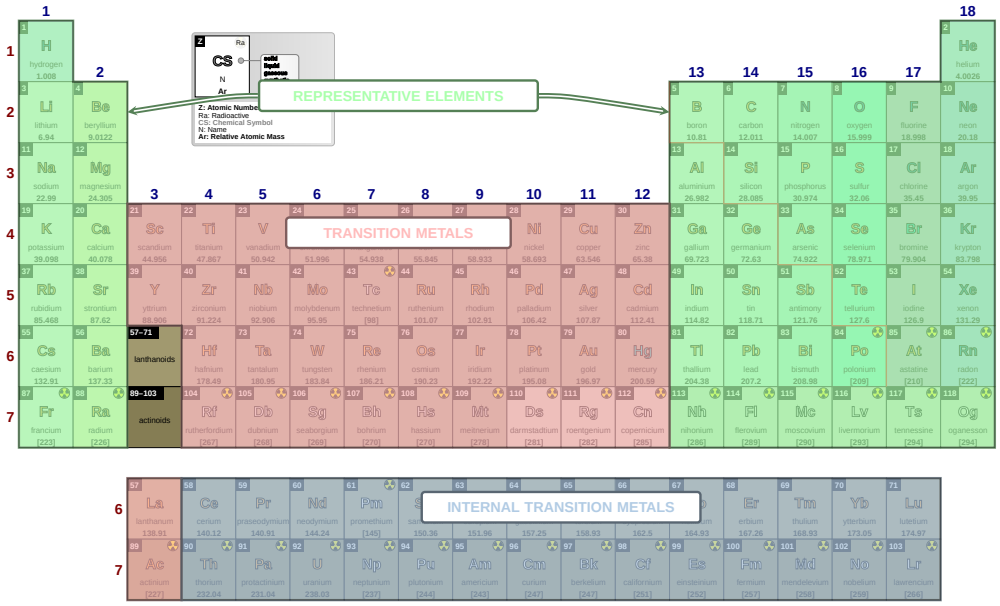
```
\pgfPT[show title=false,families font color=blue!50!black]
```



families line width default: *0.8pt*

Style to set a common width of the lines surrounding the representative elements, transition metals and internal transition metals *blocks*. The key show families is set to true.

```
\pgfPT[show title=false,show families,families line width=1.5pt]
```



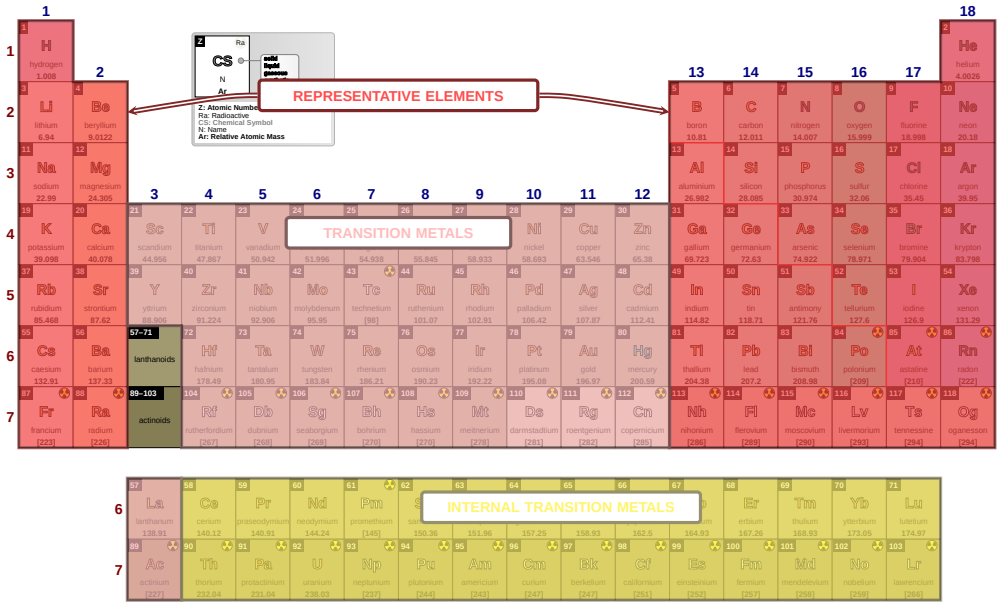
families default: *{rc=blocor,tc=blocot,ic=blocoi,lw=.8pt,f=\small\bfseries}*

Pseudo style to set the keys: **r** family **c**olor, **t**m family **c**olor, **i**tm family **c**olor, the common **l**ine **w**idths of the families, the **r** family **l**ine **w**idth, the **t**m family **l**ine **w**idth, the **i**tm family **l**ine **w**idth, the families **f**ont, **r** family **f**ont **c**olor, **t**m family **f**ont **c**olor and/or **i**tm family **f**ont **c**olor. None of the *keys* – rc, tc, ic, lw, rlw, tlw, ilw, f,rfc, tfc and ifc – are mandatory. The key show families is set to true.

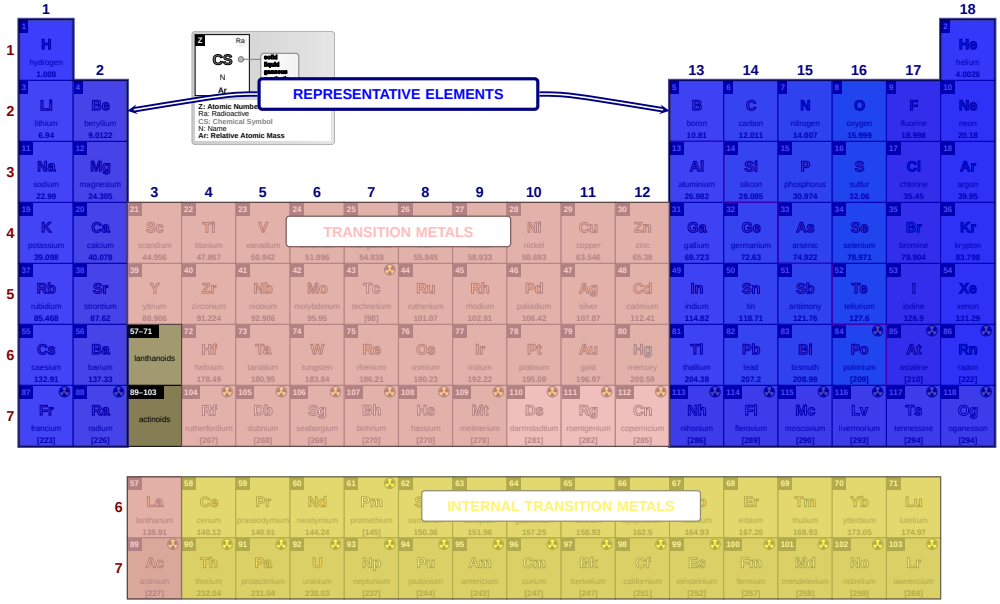
NOTE:
The colors provided to the color keys of the families could be any defined color via the command `\definecolor` or by *mixing* colors, using, for instance, the syntax `color1!value!color2`, as explained in the xcolor package documentation.

USAGE:
families={rc=<color>,tc=<color>,ic=<color>,lw=<lenght>,rlw=<lenght>,
tlw=<lenght>,ilw=<lenght>,f=<font commands>,rfc=<color>,
tfc=<color>,ifc=<color>}

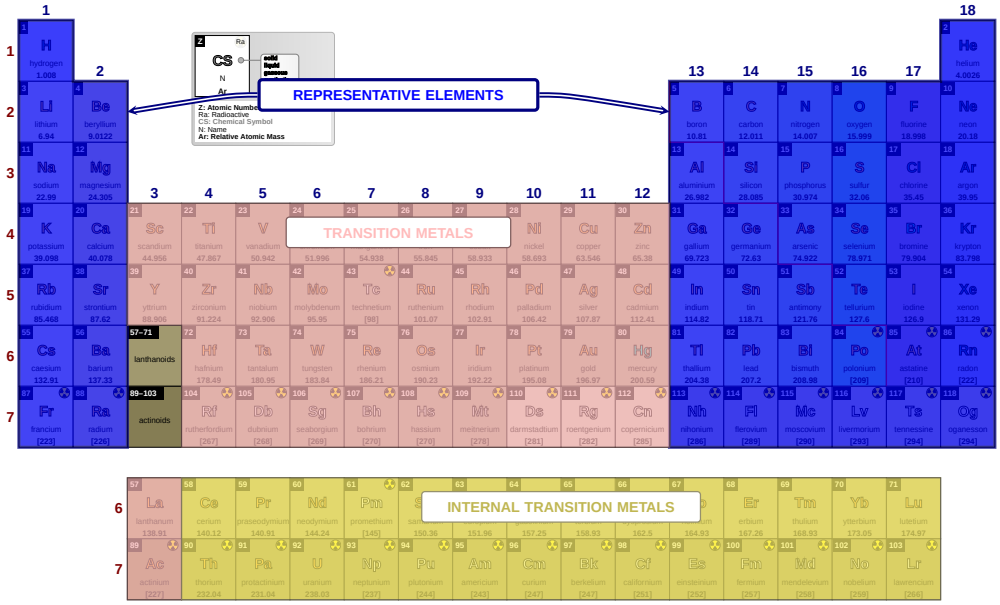
```
\pgfPT[families={rc=red!70!white,ic=yellow!70!white,lw=2pt},show title=false]
```



\pgfPT[families={rc=blue,ic=yellow!70!white,rlw=2pt},show title=false]



\pgfPT[families={rc=blue,ic=yellow!70!white,rlw=2pt,ifc=yellow!70!black},show title=false]



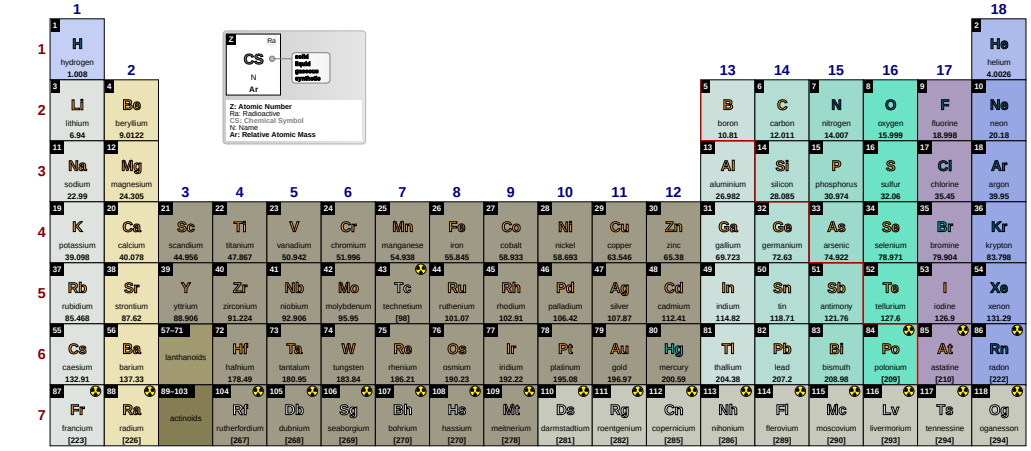
➠ Periodic variations

show periodic variations default: *false*

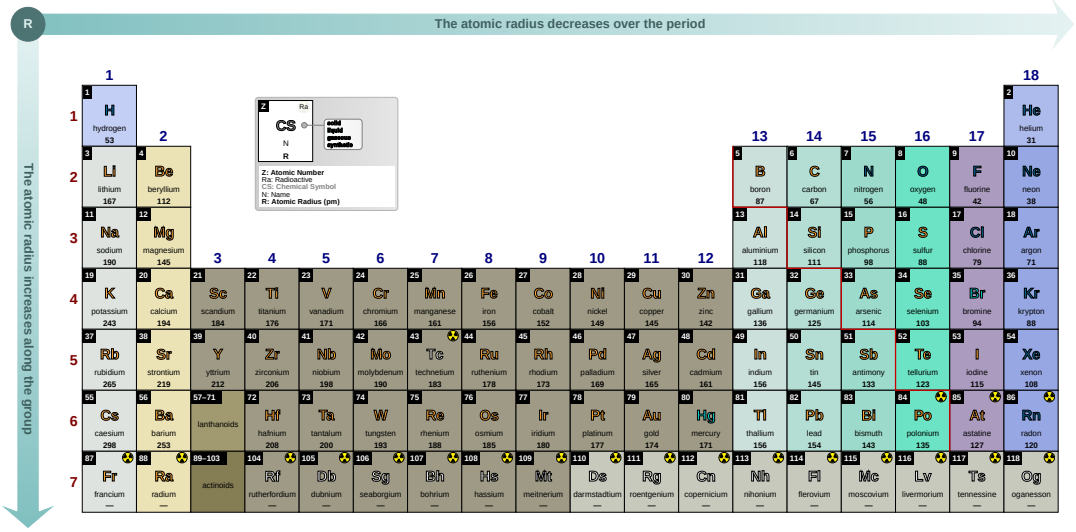
When set to true the periodic variations – for atomic radius, ionization energy and/or electron affinity – are shown with two *arrows*. One horizontal arrow is placed at the top of the Periodic Table for the variation over the period and the other vertically to the left of the Periodic Table for the variation over the group.

NOTE:
The variations are only shown when the *base cell* of the Periodic Table contains the atomic radius, the ionization energy and/or the electron affinity. If none of them is present setting this key (show periodic variations) has no effect.

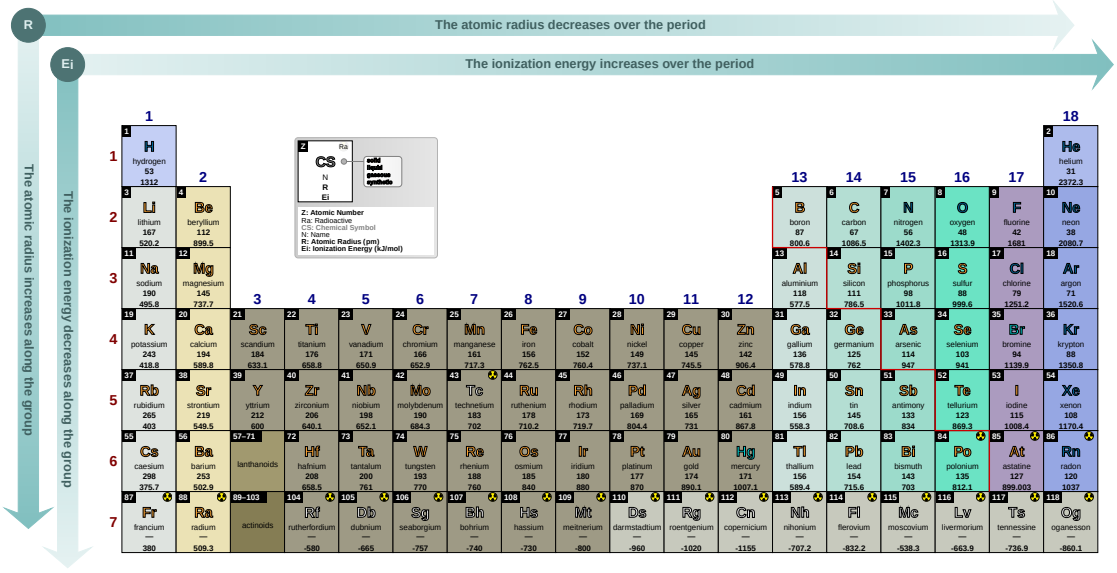
```
\pgfPTstyle[Z list=spd,show title=false]
\pgfPT[show periodic variations]
```




```
\pgfPT[show periodic variations,cell style=pgfPTR]
```



\pgfPT[show periodic variations,cell style=pgfPTREi]

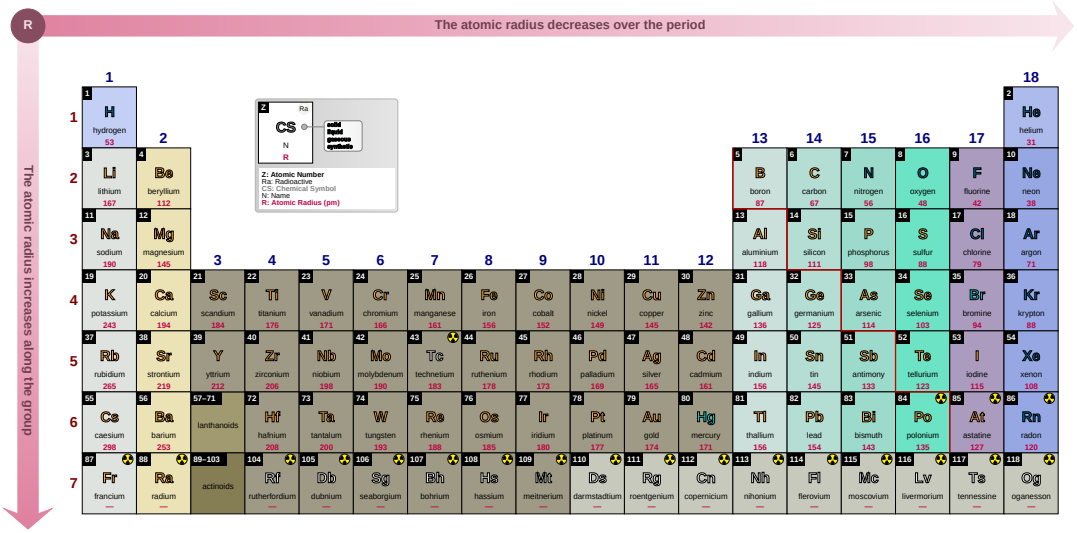


varR color default: RGB: 128,191,191

Sets the color used in the filling of the *arrows* for the atomic radius variations.

NOTE:
The color provided to varR color could be any defined color via the command `\definecolor` or by *mixing* colors, using, for instance, the syntax `color1!value!color2`, as explained in the xcolor package documentation.

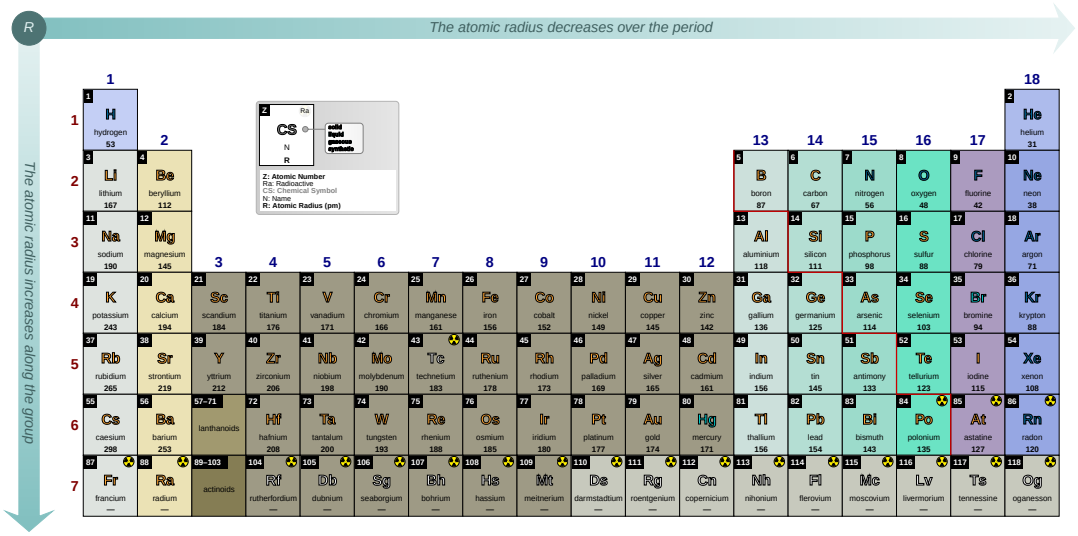
\pgfPT[show periodic variations,cell style=pgfPTR,varR color=purple!50!white,R color=purple]



varR font default: *footnotesize\bfseries*

Sets the font for the text displayed inside the arrow, describing the variation of the atomic radius.

\pgfPT[show periodic variations,cell style=pgfPTR,varR font=\small\itshape]



varR font color default: *(value of varR color)!50!black*

Sets the color of the text showing the atomic radius variations displayed inside the corresponding arrows.
See the note in varR color.

varEi color default: *RGB: 128,191,191*

Sets the color used in the filling of the *arrows* for the ionization energy variations.
See the note in varR color.

varEi font default: *\footnotesize\bfseries*

Sets the font for the text displayed inside the arrow, describing the variation of the ionization energy.

varEi font color default: *(value of varEi color)!50!black*

Sets the color of the text showing the ionization energy variations displayed inside the corresponding arrows.
See the note in varR color.

vareaff color default: *RGB: 128,191,191*

Sets the color used in the filling of the *arrows* for the electron affinity variations.
See the note in varR color.

vareaff font default: *\footnotesize\bfseries*

Sets the font for the text displayed inside the arrow, describing the variation of the electron affinity.

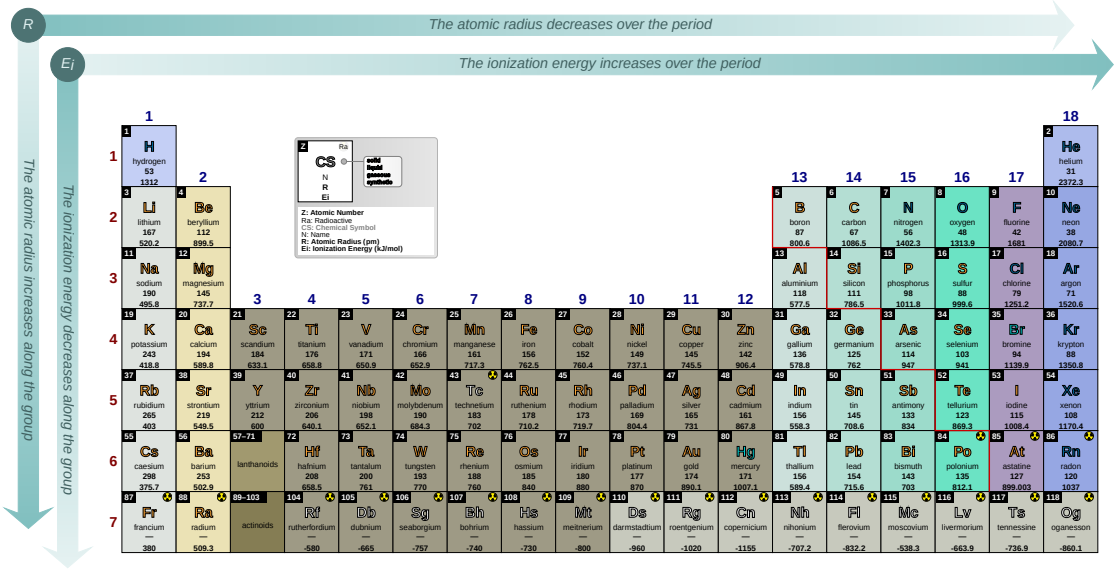
vareaff font color default: *(value of vareaff color)!50!black*

Sets the color of the text showing the electron affinity variations displayed inside the corresponding arrows.
See the note in varR color.

var font default: *\footnotesize\bfseries*

Style to set a common font for the variations along the Periodic Table.
Setting var font=<font commands> is equivalent to setting {varR font=<font commands>, varEi font=<font commands>,vareaff font=<font commands>}.

\pgfPT[show periodic variations,cell style=pgfPTREi,var font=\small\itshape]

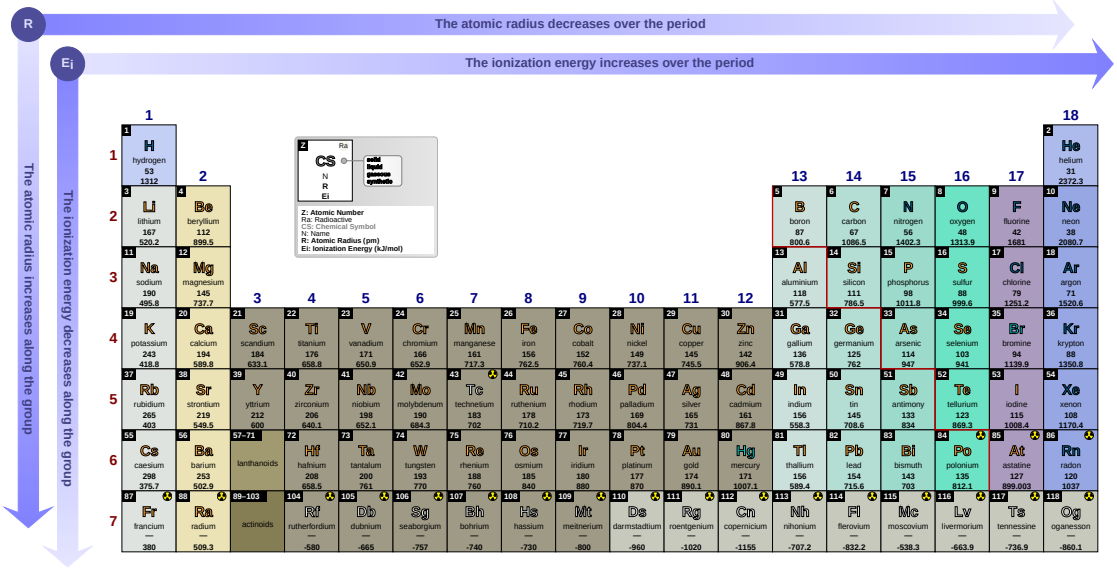


var color default: RGB: 128,191,191

Style to set a common color for the variations along the Periodic Table.
Setting var color=<color> is equivalent to setting {varR color=<color>,varEi color=<color>, vareaff color=<color>}.

NOTE:
The color provided to var color could be any defined color via the command `\definecolor` or by *mixing* colors, using, for instance, the syntax `color1!value!color2`, as explained in the xcolor package documentation.
Keep in mind that setting the variations colors also changes the default text colors for them.

\pgfPT[show periodic variations,cell style=pgfPTREi,var color=blue!50!white]



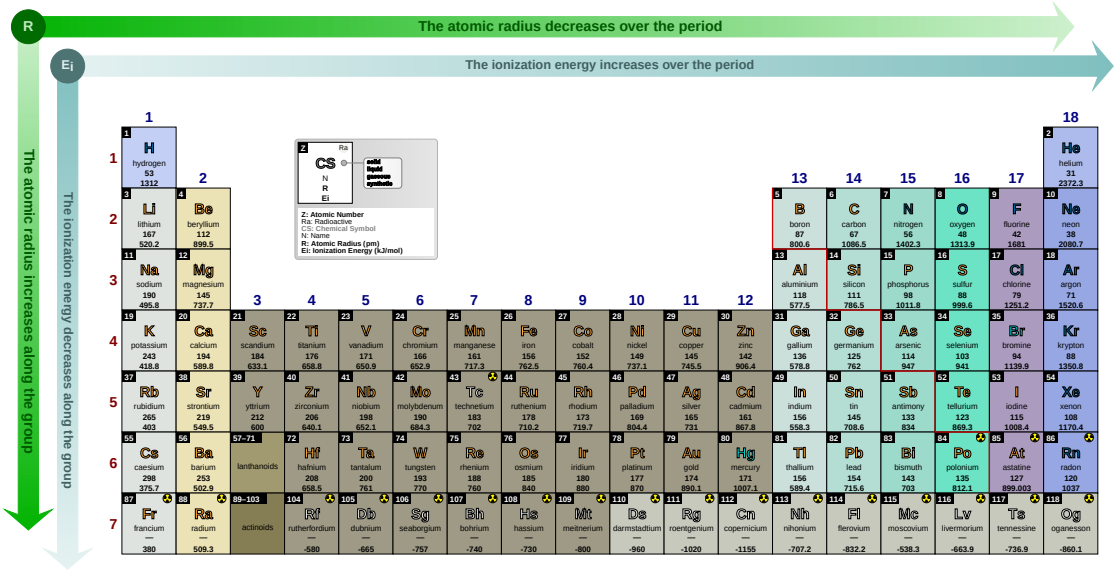
varR default: *{c=colorvariations,f=\footnotesize\bfseries}*

Pseudo style to set the keys: varR **c**olor, varR **f**ont and/or varR **f**ont **c**olor. None of the *keys* – c, f and fc – are mandatory.

NOTE:
The color provided to varR color could be any defined color via the command `\definecolor` or by *mixing* colors, using, for instance, the syntax `color1!value!color2`, as explained in the xcolor package documentation.

USAGE: varR={c=<color>,f=<font commands>,fc=<color>}

```
\pgfPT[show periodic variations,cell style=pgfPTREi,
varR={c=green!70!black,f=\small\bfseries}]
```



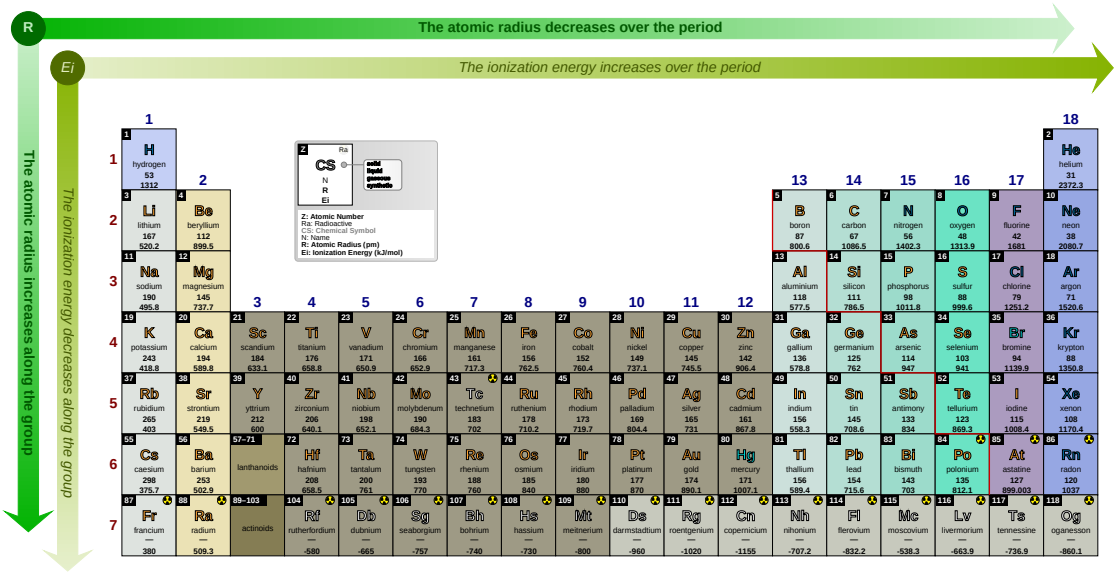
varEi default: *{c=colorvariations,f=\footnotesize\bfseries}*

Pseudo style to set the keys: varEi **c**olor, varEi **f**ont and/or varEi **f**ont **c**olor. None of the *keys* – c, f and fc – are mandatory.

NOTE:
The color provided to varEi color could be any defined color via the command `\definecolor` or by *mixing* colors, using, for instance, the syntax `color1!value!color2`, as explained in the xcolor package documentation.

USAGE: varEi={c=<color>,f=<font commands>,fc=<color>}

```
\pgfPT[show periodic variations,cell style=pgfPTREi,
varR={c=green!70!black,f=\small\bfseries},
varEi={c=lime!70!black,f=\small\bfseries}]
```



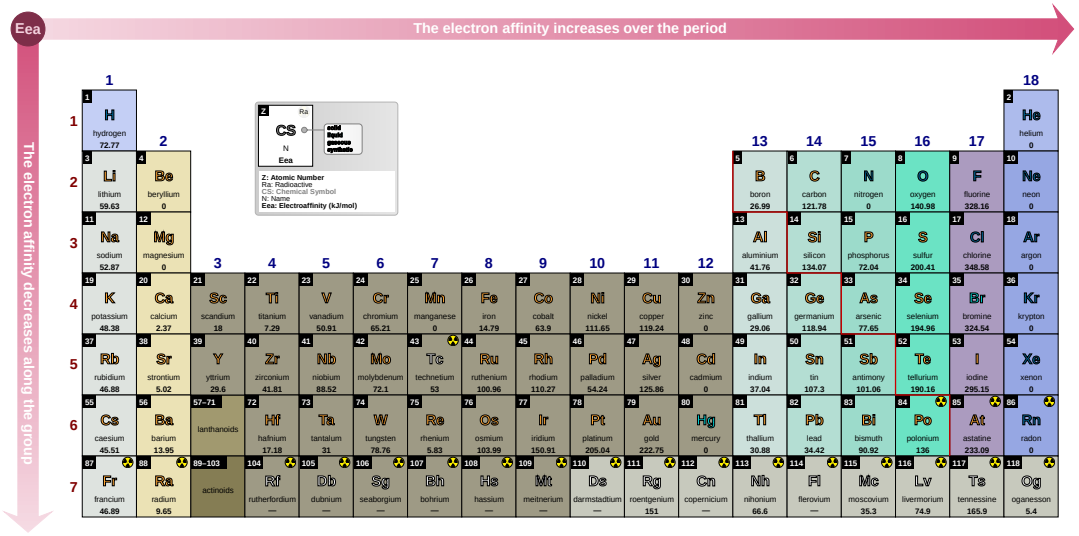
vareaff default: *{c=colorvariations,f=\footnotesize\bfseries}*

Pseudo style to set the keys: vareaff **c**olor, vareaff **f**ont and/or vareaff **f**ont **c**olor. None of the *keys* – c, f and fc – are mandatory.

NOTE:
The color provided to vareaff color could be any defined color via the command `\definecolor` or by *mixing* colors, using, for instance, the syntax `color1!value!color2`, as explained in the xcolor package documentation.

USAGE: vareaff={c=<color>,f=<font commands>,fc=<color>}

```
\pgfPT[show periodic variations,cell style=pgfPTeaff,
vareaff={c=purple!70!white,f=\small\bfseries,fc=white}]
```




```
\pgfPTresetstyle
```

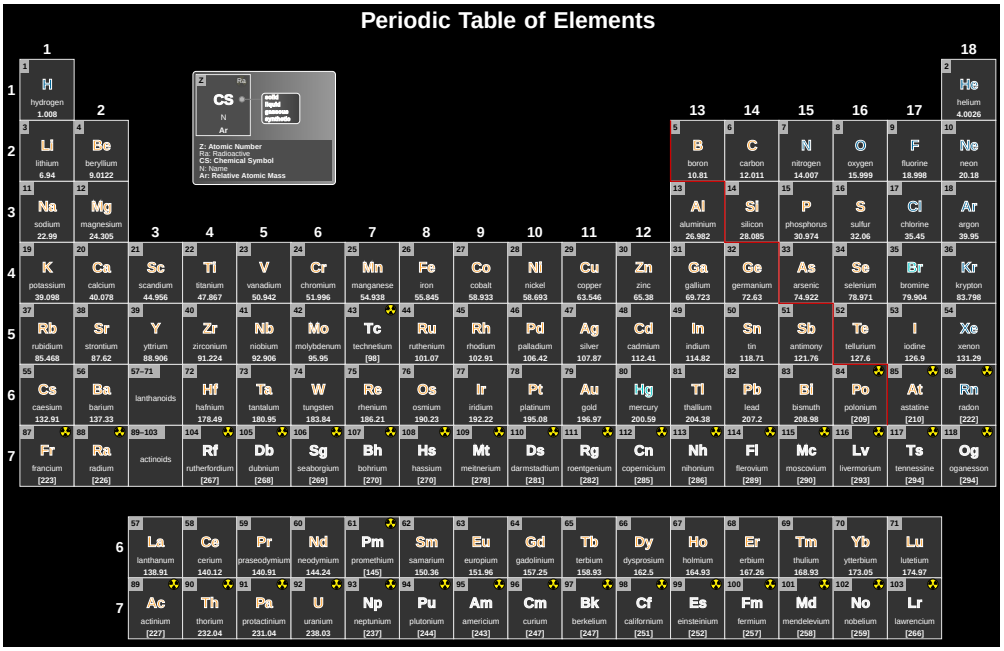
➠ Dark mode

dark mode default: *no value*

Style to change the overall appearance of the Periodic Table to a dark mode suitable for on-screen viewing.

***This style sets the following keys with the values**:*
back color scheme=solid, back color=black!80, cell line color=black!10, CS outline color=white, cell color=white, Z backcolor=black!30, Z color=black, background={fill=black}, varR font color=black!20, varEi font color=black!20, vareaff font color=black!20, per+gr={c=white}, title color=white, other languages color=black!40, legend={bc=black!70,radio=white,CS=white,Z=white,pins style={draw=white,right color=black!75, left color=black!60,line width=.05pt,rounded corners=2pt},extra style={draw=white,fill=black!70,line width=.05pt, rounded corners=2pt},box={left color=black!70,right color=black!40,draw=white}}

```
\pgfPT[dark mode]
```



➠ *Exercise layout*

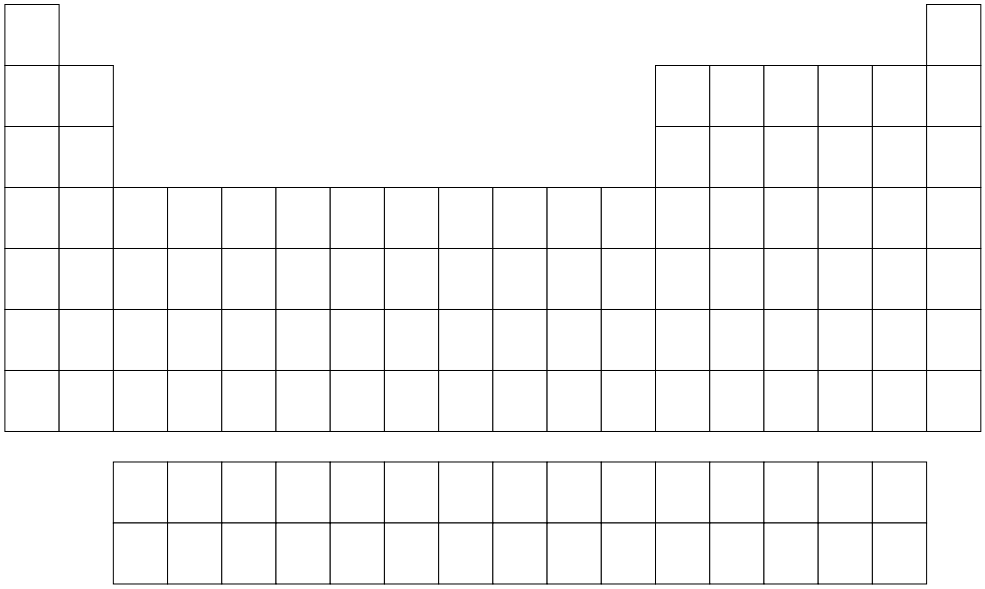
The keys described in this section enable the *exercise layout* of the Periodic Table, *i.e.*, in this mode the *structure* of the Periodic Table is drawn, but there are only a few contents available in the cells.

only cells default: *false*

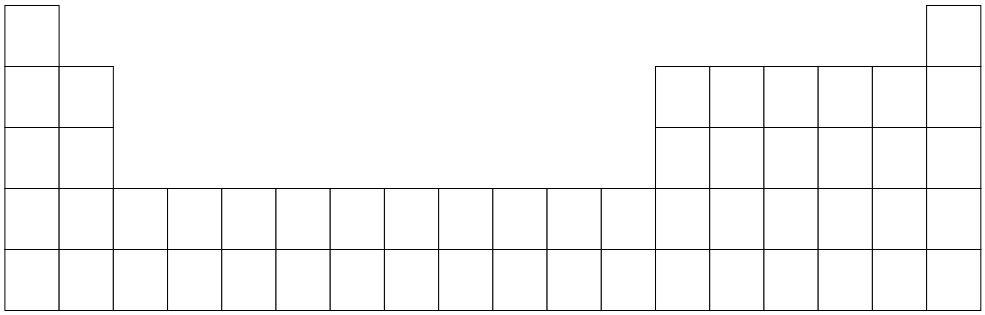
When set to true the Periodic Table is drawn with only the cells without any contents.

NOTE:
The following keys are also set: back color scheme=solid, show title=false, show period numbers=false, show group numbers=false, show legend=false, show MNM line=false

\pgfPT[only cells]



\pgfPT[Z list={1,...,54},only cells]

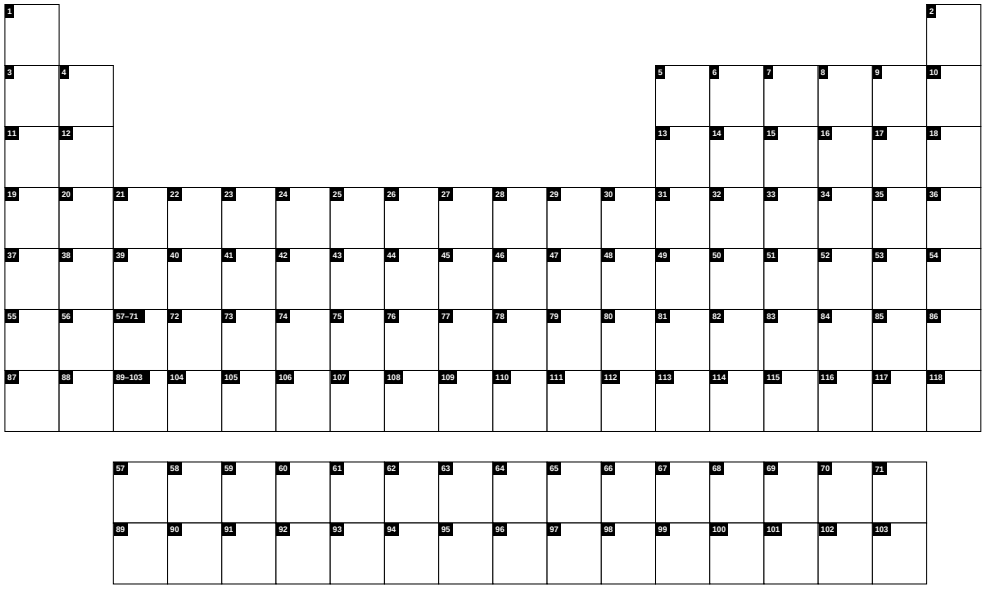


only cells plus Z default: *false*

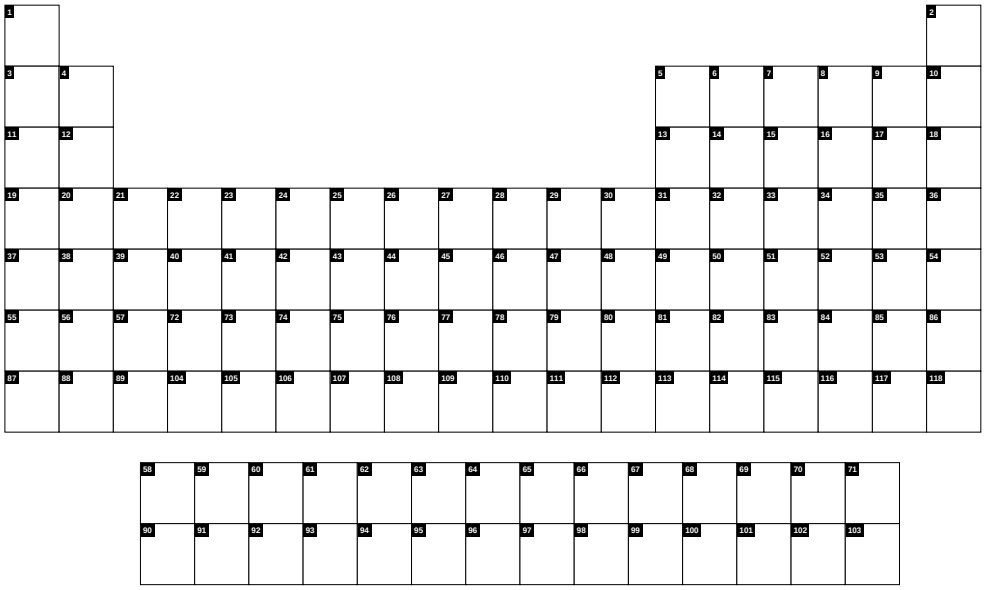
When set to true the Periodic Table is drawn with only the cells without any contents, except the atomic number (Z).

NOTE:
The following keys are also set: back color scheme=solid, show title=false, show period numbers=false, show group numbers=false, show legend=false, show MNM line=false

\pgfPT[only cells plus Z]



\pgfPT[only cells plus Z,IUPAC=false]

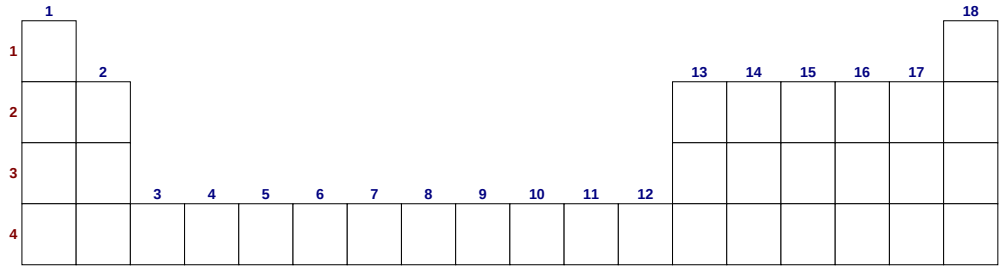


only cells with periods and group numbers default: *false*

When set to true the Periodic Table is drawn with only the cells without any contents. The period and group numbers are shown.

NOTE:
The following keys are also set: back color scheme=solid, show title=false, show legend=false, show MNM line=false

\pgfPT[Z list={1,...,36},only cells with periods and group numbers]

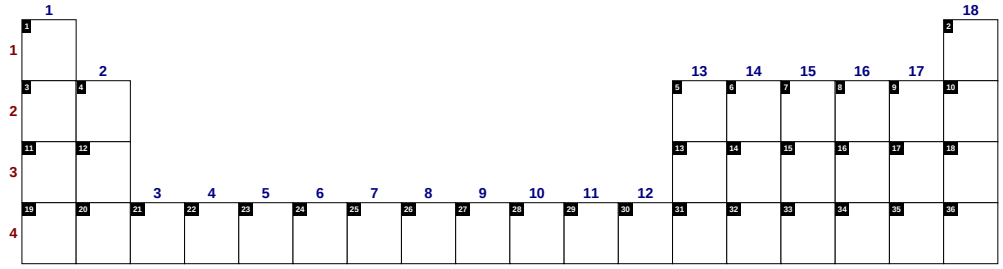


only cells with periods and group numbers plus Z default: *false*

When set to true the Periodic Table is drawn with only the cells without any contents, except the atomic number (Z). The period and group numbers are shown.

NOTE:
The following keys are also set: back color scheme=solid, show title=false, show legend=false, show MNM line=false

\pgfPT[Z list={1,...,36},only cells with periods and group numbers plus Z]



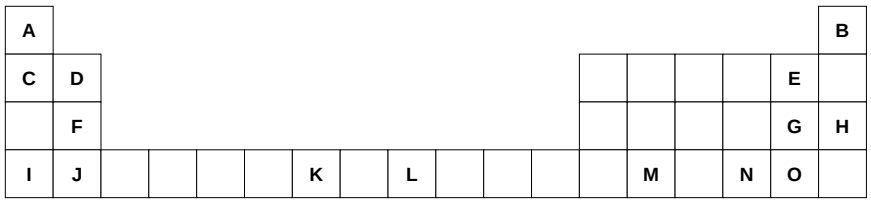
Z exercise list default: *{}*

Sets the list of atomic numbers to display as letters instead of their chemicals symbols.

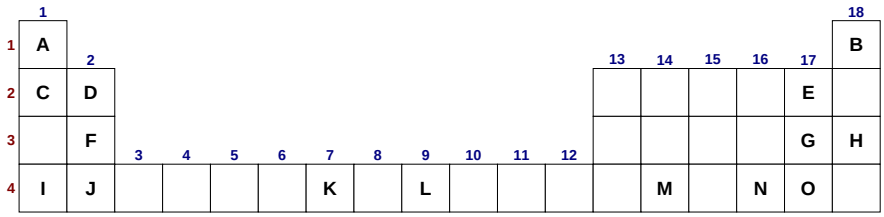
NOTES:

- ✓ When values are provided to the Z exercise list and none of the above *exercise layout* is set, the *exercise layout* only cells is used.
- ✓ The line dots – ... – notation is not available in the *Z exercise list*, mainly to avoid *errors* on the desired list. For example {1,...,4,8,...,16} is expanded by the `\foreach` statement of TikZ to {1,2,3,4,8,15} instead of {1,2,3,4,8,9,10,11,12,13,14,15,16}. For achieving that purpose it must be typed {1,...,4,8,9,...,16}. Since the goal of *Z exercise list* is typing only a list of specific elements, it will often be easier to type element by element.

\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87}, cell size=3em,Z list={1,...,36}]



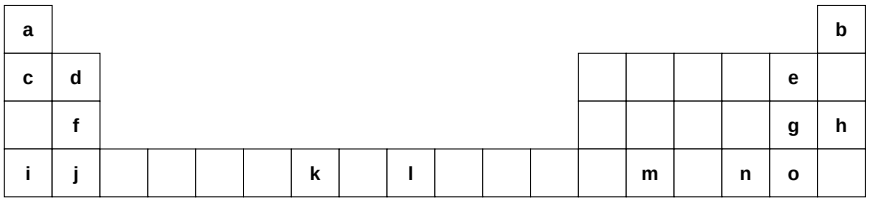
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87}, cell size=3em,Z list={1,...,36},only cells with periods and group numbers]



exercise list in capitals default: *true*

When set to true the *letters* are typed in capitals, otherwise they are typed as lowercase letters.

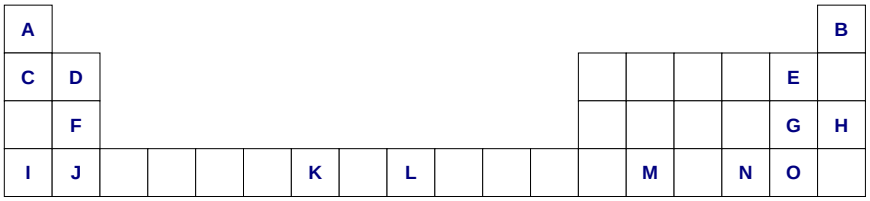
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87}, cell size=3em,Z list={1,...,36},exercise list in capitals=false]



exercise list color default: *black*

Sets the color of the displayed *letters* in the *exercise layout*.

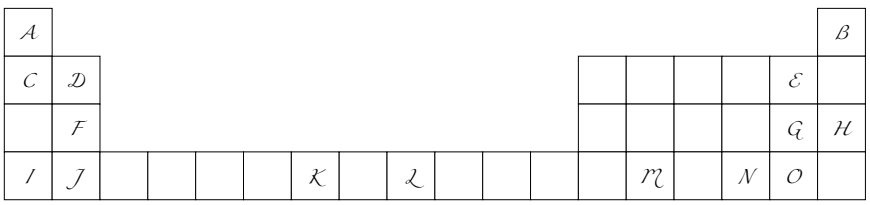
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87}, cell size=3em,Z list={1,...,36}, exercise list color=blue!50!black]



exercise list font default: *\bfseries\large*

Sets the font of the displayed *letters* in the *exercise layout*.

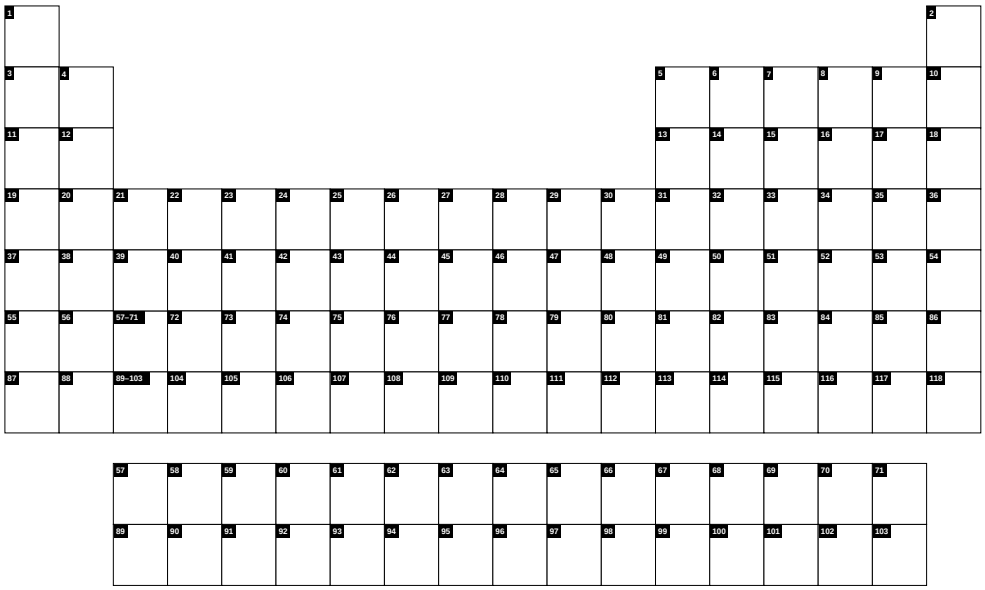
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87}, cell size=3em,Z list={1,...,36}, exercise list font=\fontfamily{fmm}\selectfont]



cells+Z *no value*

Style to set the key only cells plus Z to true.

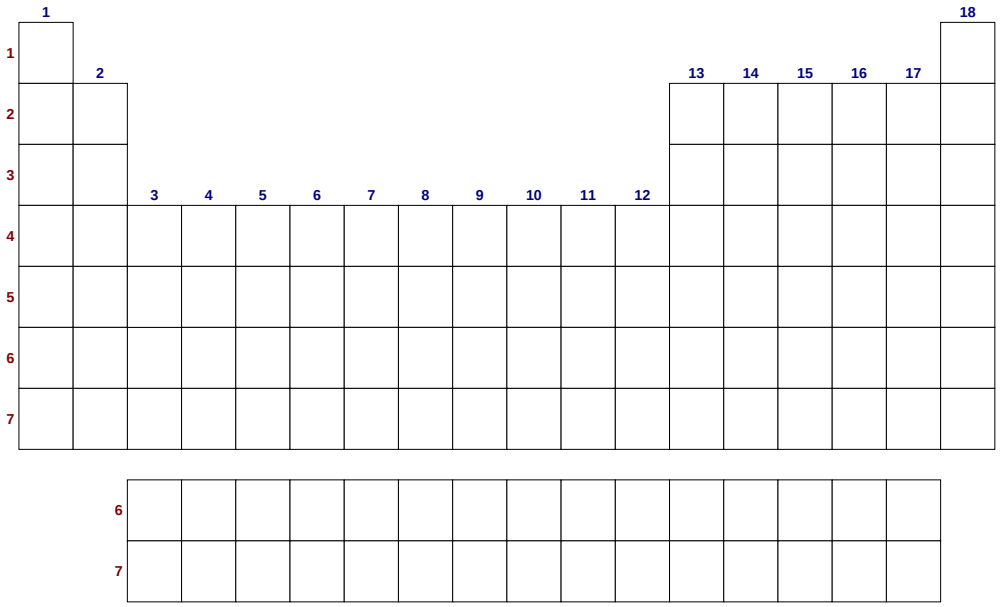
```
\pgfPT[cells+Z]
```



cells+p+g *no value*

Style to set the key only cells with periods and group numbers to true.

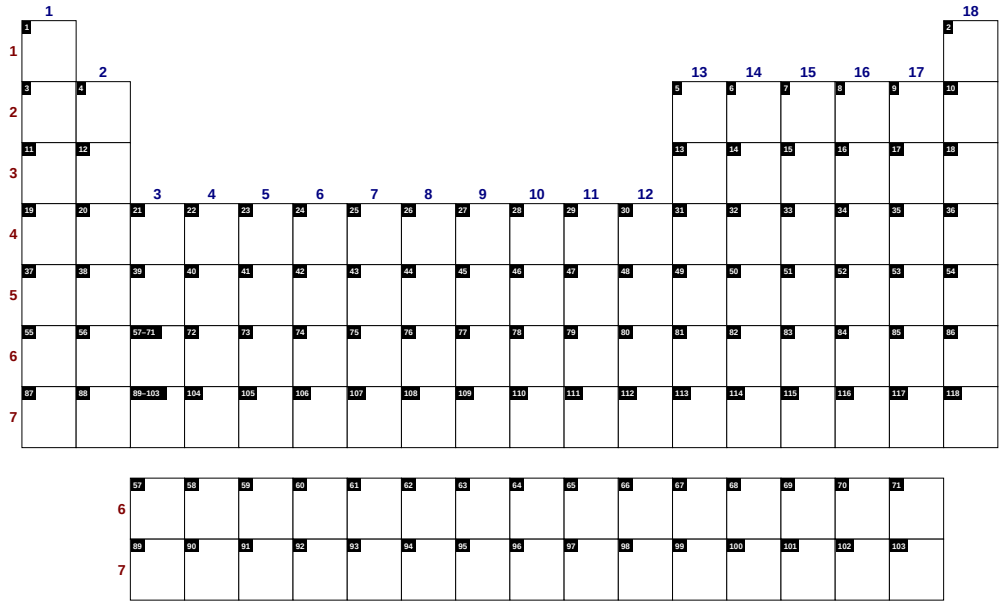
```
\pgfPT[cells+p+g]
```



cells+p+g+Z *no value*

Style to set the key only cells with periods and group numbers plus Z to true.

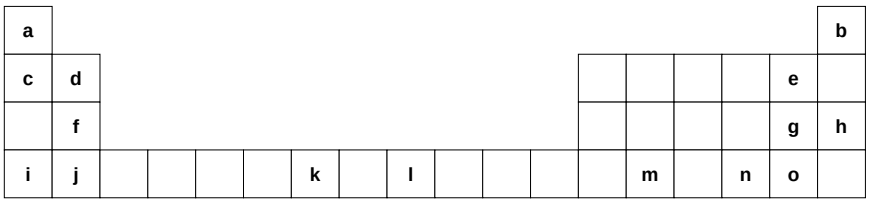
```
\pgfPT[cells+p+g+Z]
```



exnocaps *no value*

Style to set the key exercise list in capitals to false.

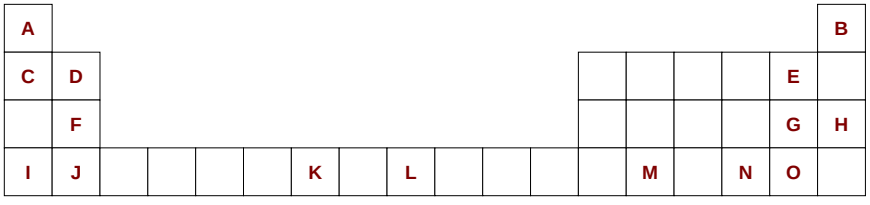
```
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87},
cell size=3em,Z list={1,...,36},exnocaps]
```



exColor default: *black*

Style to set the key exercise list color.

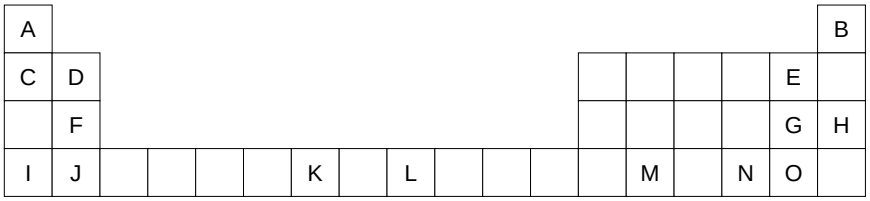
```
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87},
cell size=3em,Z list={1,...,36},exColor=red!50!black]
```



exFont default: *\bfseries\large*

Style to set the key exercise list font.

```
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87},
cell size=3em,Z list={1,...,36},exFont=\Large]
```

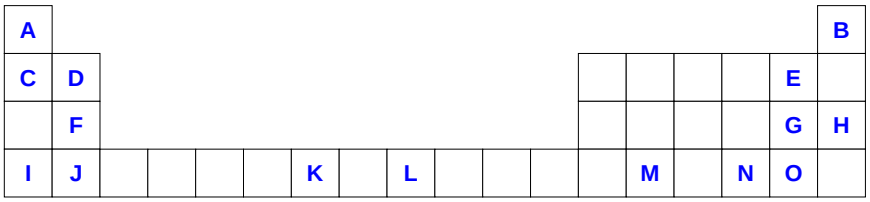


ex default: *{caps=true,c=black,f=\bfseries\large}*

Pseudo style to set the keys: exercise list in **cap**itals, exercise list **c**olor and/or exercise list **f**ont. None of the *keys* – caps, c and f – are mandatory.

USAGE: ex={caps=<true|false>,c=<color>,f=<font commands>}

```
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87},
cell size=3em,Z list={1,...,36},ex={c=blue,f=\Large\bfseries}]
```



✠ Cell contents options: keys, styles and *pseudo styles*

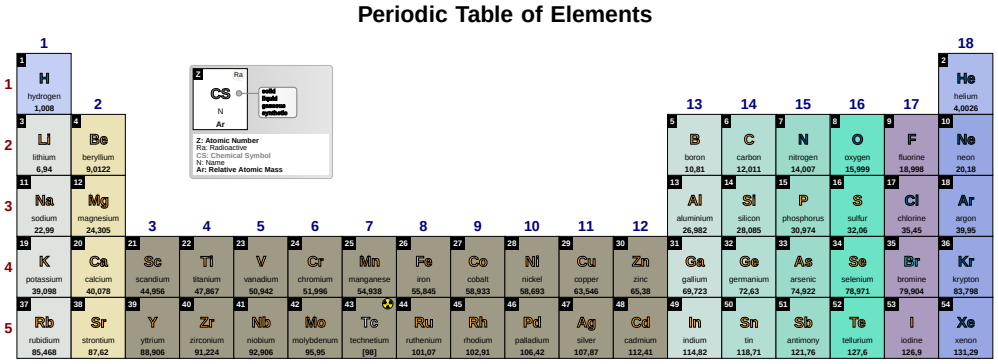
The following options and styles are used for customizing the contents available in each individual cell of the Periodic Table, like the *fonts* or the *colors* used in the shown contents.

➠ *Decimal separator in numbers*

decimal separator default: .

Sets the decimal separator in the numeric values of quantities. *If the separator character is a comma it must be provided between curly braces – {,}.*
Note that the decimal separator key is used to perform a direct replacement of the dot with the specified character. Therefore, there is no validation and any character can be used as a decimal separator (usually a dot or a comma). *(new in v2.1.5)*

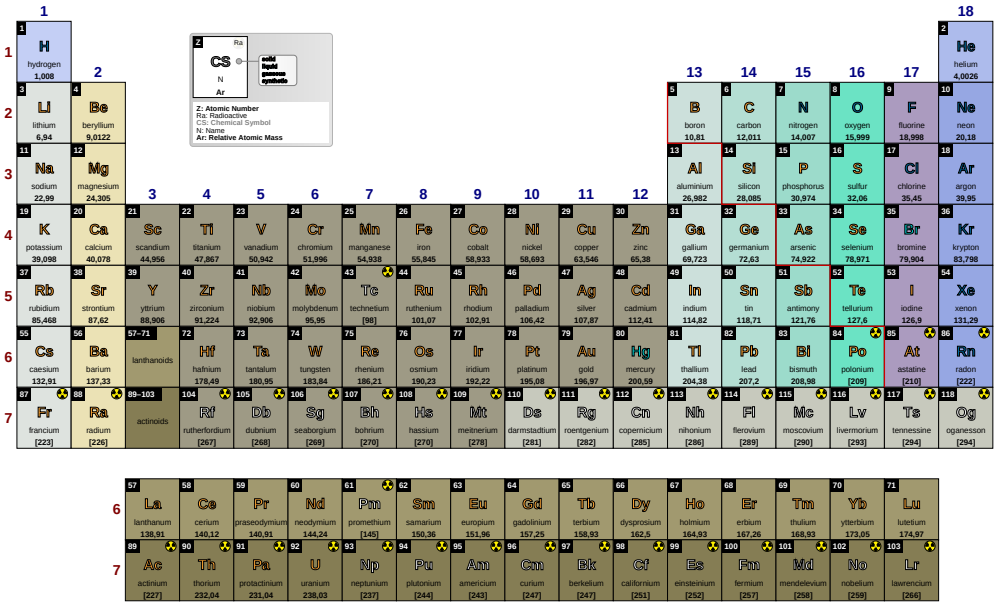
\pgfPT[Z list={1,...,54},decimal separator={,}]



comma separator default: *no value*

A style equivalent to decimal separator={,} *(new in v2.1.5)*

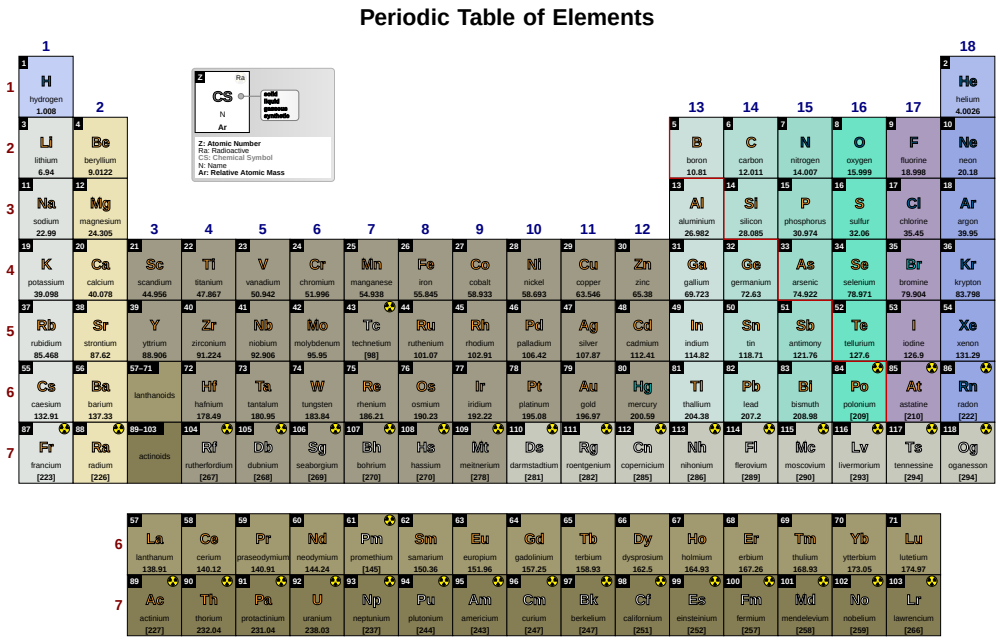
\pgfPT[comma separator]



dot separator default: *no value*

A style equivalent to decimal separator=. *(new in v2.1.5)*

```
\pgfPT[dot separator]
```

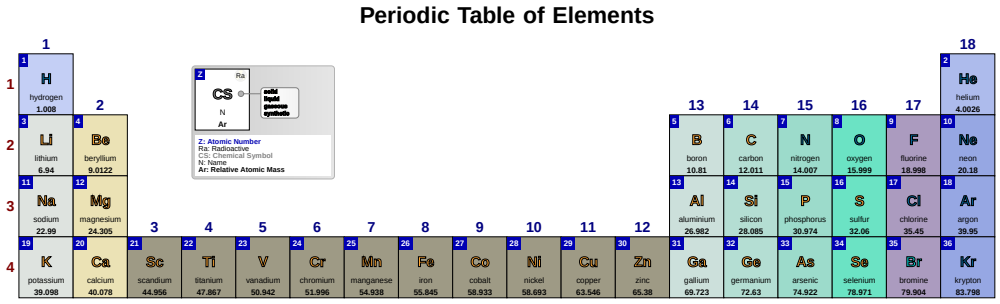


➠ The atomic number

Z backcolor default: *black*

Sets the background color of the box where the atomic number is displayed.

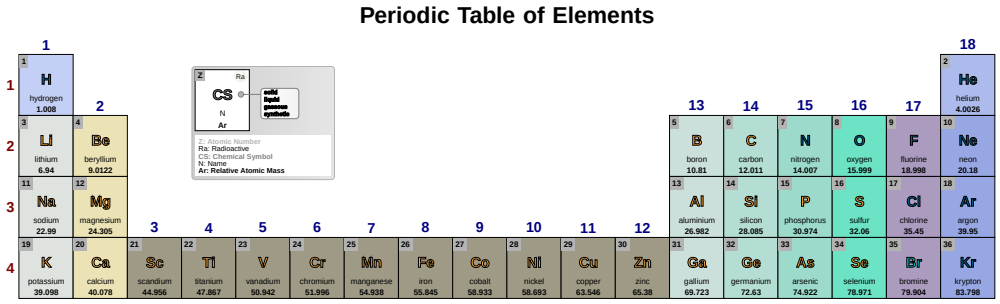
```
\pgfPT[Z list={1,...,36},Z backcolor=blue!70!black]
```



Z color default: *white*

Sets the color of the atomic number.

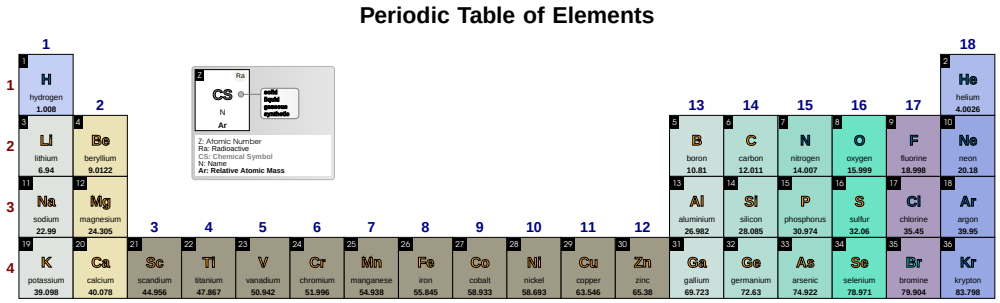
```
\pgfPT[Z list={1,...,36},Z backcolor=black!30,Z color=black]
```



Z font default: *\tiny\bfseries*

Sets the font of the atomic number.

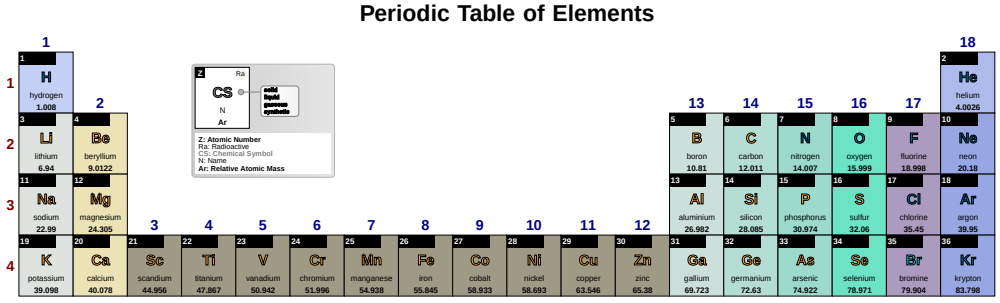
```
\pgfPT[Z list={1,...,36},Z font=\fontfamily{pag}\selectfont\tiny]
```



Z use box width default: *false*

If true, the width specified in the constructed cell is used, otherwise, the *natural* width of the box containing Z value is used.

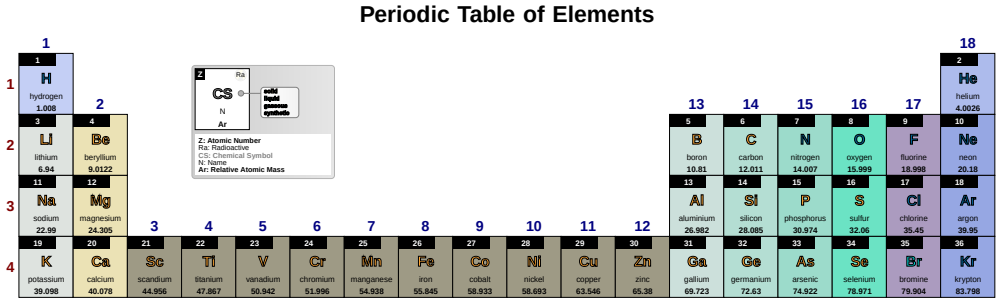
```
\pgfPT[Z list={1,...,36},Z use box width]
```



Z align default: *left*

Sets the alignment of the atomic number value to *left*, *center* or *right* with respect to its containing box. It only takes effect when Z use box width is true.

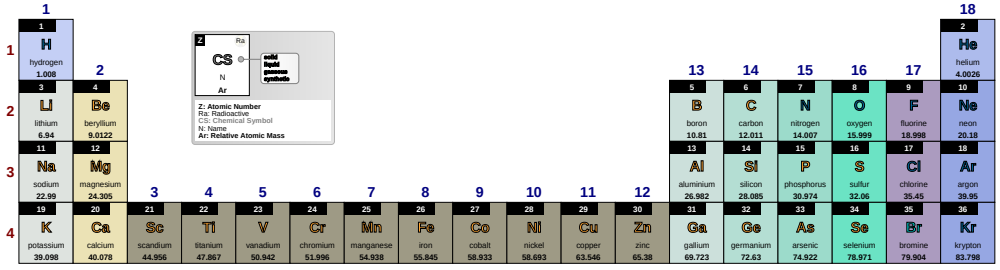
\pgfPT[Z list={1,...,36},Z use box width,Z align=center]



Z padding default: *0.25ex*

Sets the padding between the atomic number value and the box that contains it. It only takes effect when Z use box width is true.

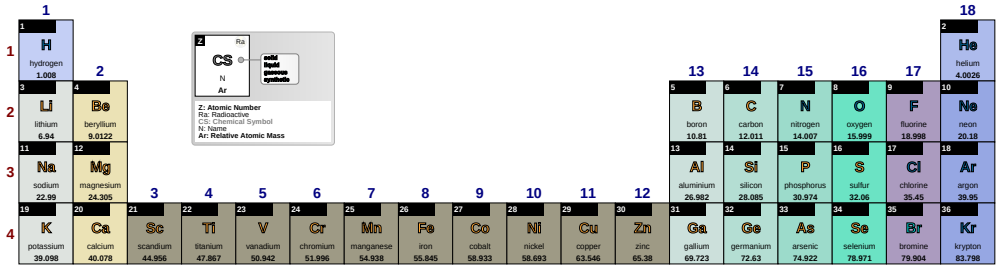
\pgfPT[Z list={1,...,36},Z use box width,Z align=right, Z padding=1em]



Z box *no value*

Style equivalent to Z use box width=true.

\pgfPT[Z list={1,...,36},Z box]

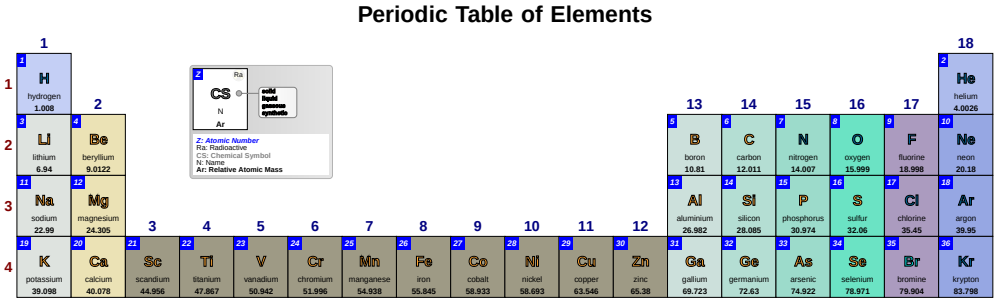


Z default: *{bc=black,c=white,f=\tiny\bfseries,boxwd=false,align=left,pad=.25ex}*

Pseudo style to set the keys: Z **b**ack**c**olor, Z **c**olor, Z **f**ont, Z use **box wid**th, Z **align** and/or Z **pad**ding. None of the *keys* – bc, c, f, boxwd, align and pad – are mandatory.

USAGE: Z={bc=<color>,c=<color>,f=<font commands>,boxwd=<true|false>, align=<left|center|right>,pad=<length>}

```
\pgfPT[Z list={1,...,36},Z={bc=blue,f=\tiny\bfseries\itshape}]
```

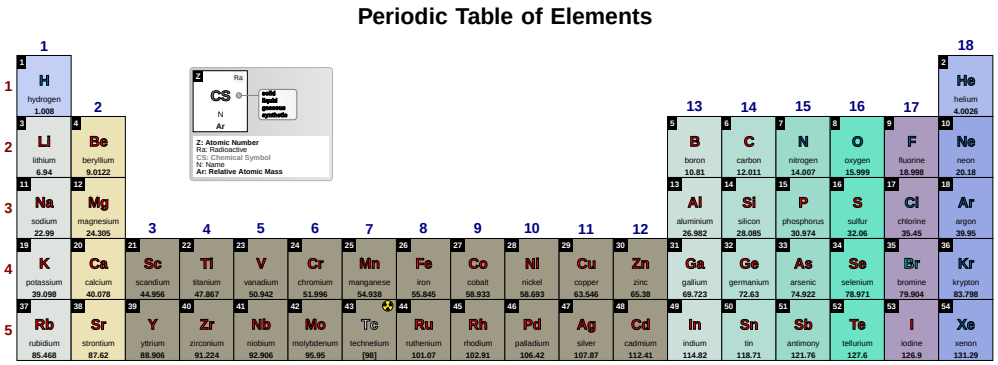


The chemical symbol

CS solid default: RGB: 255,166,51

Sets the color of the chemical symbol for elements that are in the solid state at normal temperature and pressure (NTP).

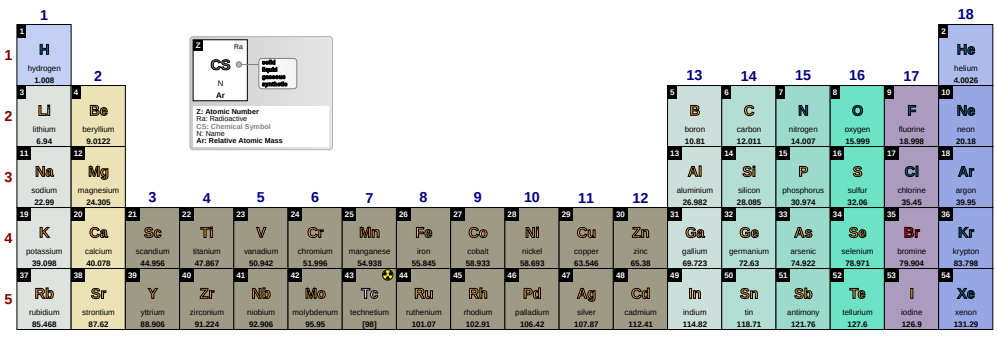
```
\pgfPT[Z list={1,...,54},CS solid=red]
```



CS liquid default: RGB: 0,204,204

Sets the color of the chemical symbol for elements that are in a liquid state at normal temperature and pressure (NTP).

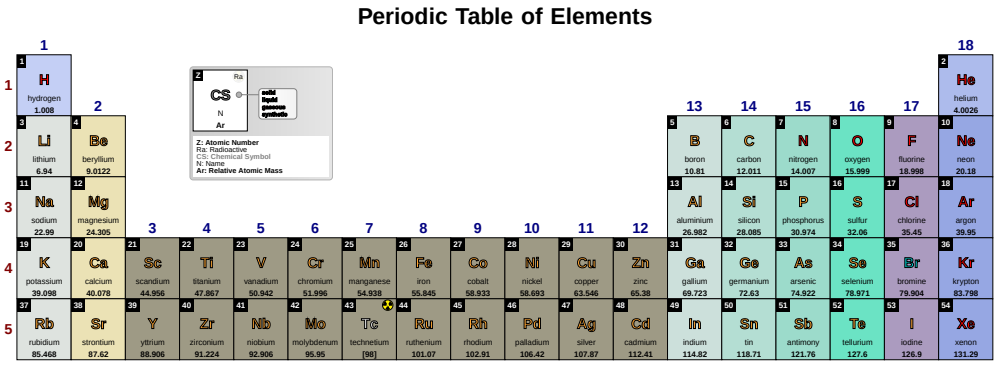
```
\pgfPT[Z list={1,...,54},CS liquid=red]
```



CS gas default: RGB: 0,102,153

Sets the color of the chemical symbol for elements that are in a gaseous state at normal temperature and pressure (NTP).

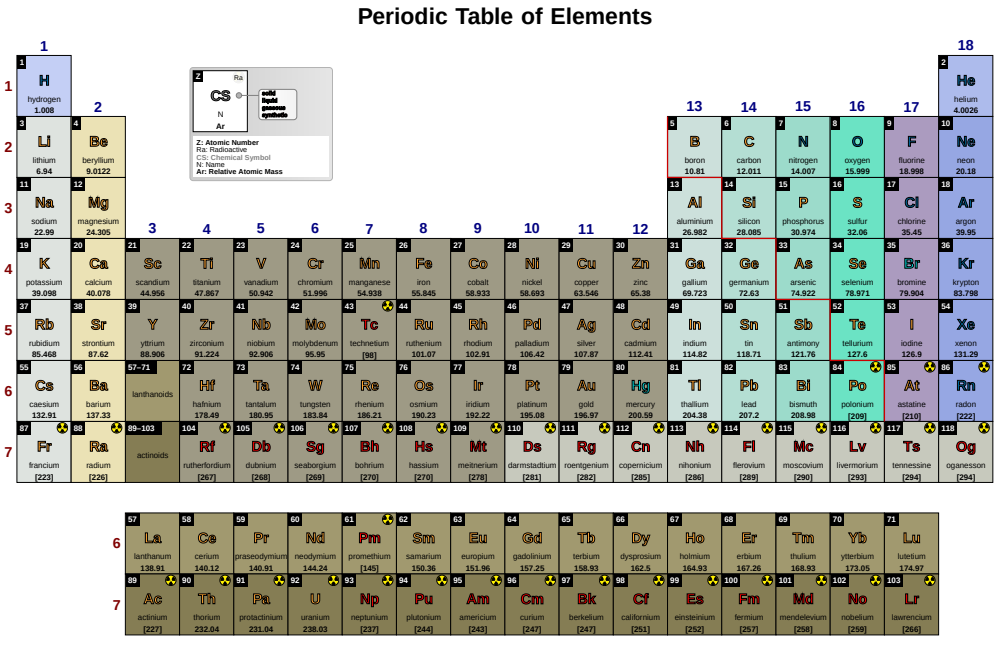
```
\pgfPT[Z list={1,...,54},CS gas=red]
```



CS synt default: RGB: 236,236,236

Sets the color of the chemical symbol for elements that are synthetic.

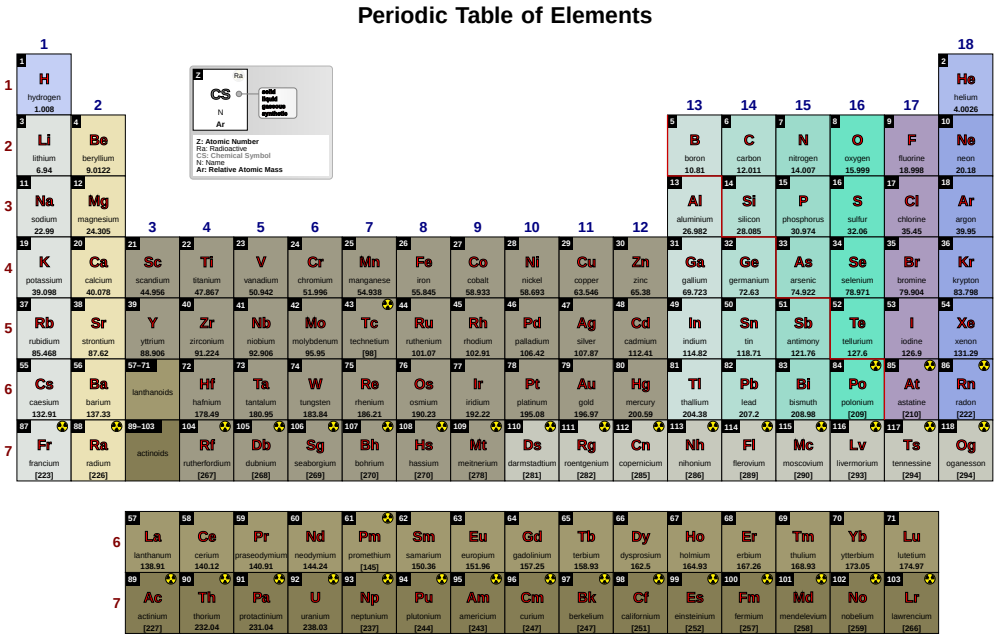
```
\pgfPT[CS synt=red]
```



CS all default: *black*

Style to set a common color to the chemical symbols, equivalent to CS solid=<color>, CS liquid=<color>,CS gas=<color>,CS synt=<color>.

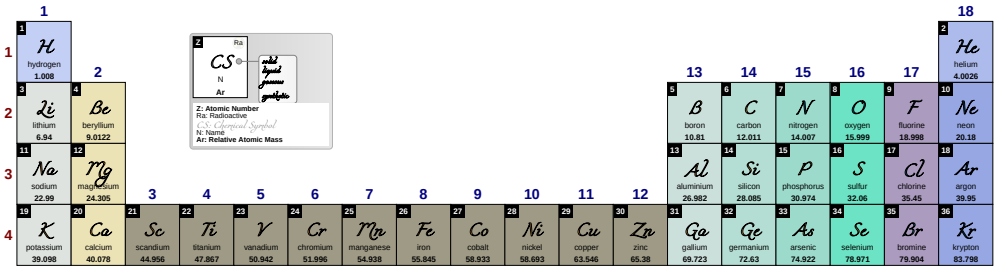
\pgfPT[CS all=red]



CS font default: *\small\bfseries*

Sets the font for the chemical symbol.

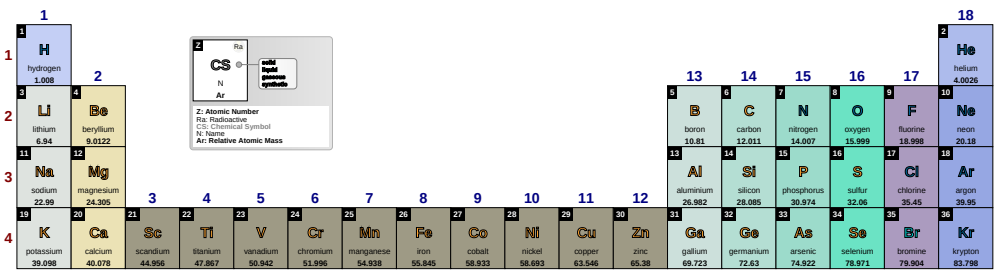
\pgfPT[Z list={1,...,36},CS font=\small\fontfamily{fmm}\selectfont]



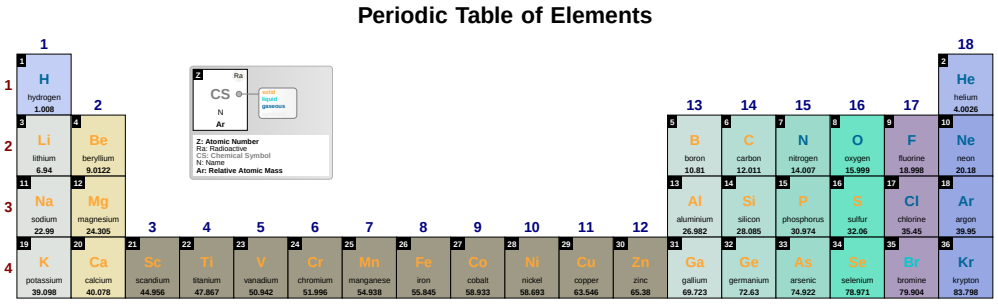
CS render mode default: *fill and outline*

Sets the chemical symbol render mode. Available modes are fill, outline or fill and outline.

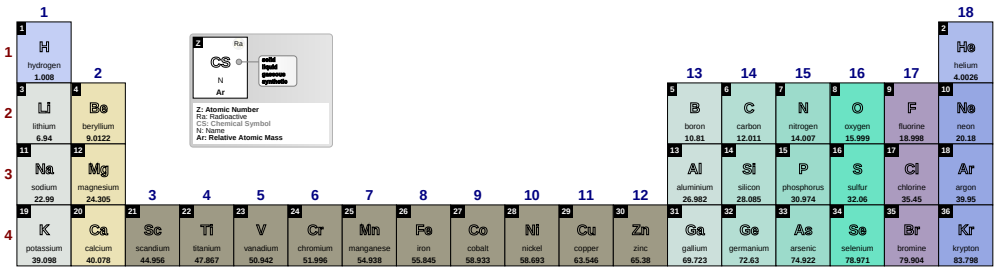
\pgfPT[Z list={1,...,36}]



\pgfPT[Z list={1,...,36},CS render mode=fill]



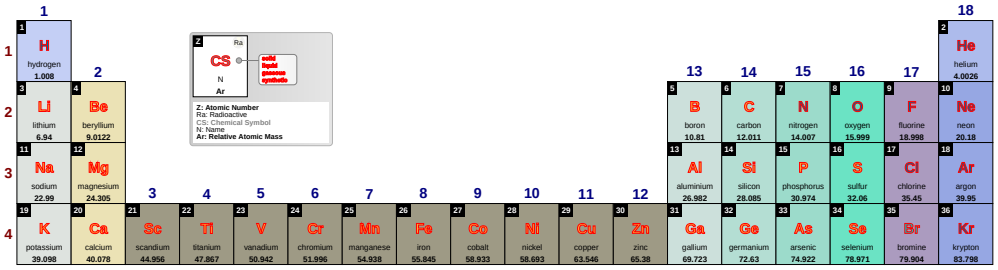
\pgfPT[Z list={1,...,36},CS render mode=outline]



CS outline color default: *black*

Sets the outline color for the chemical symbol.

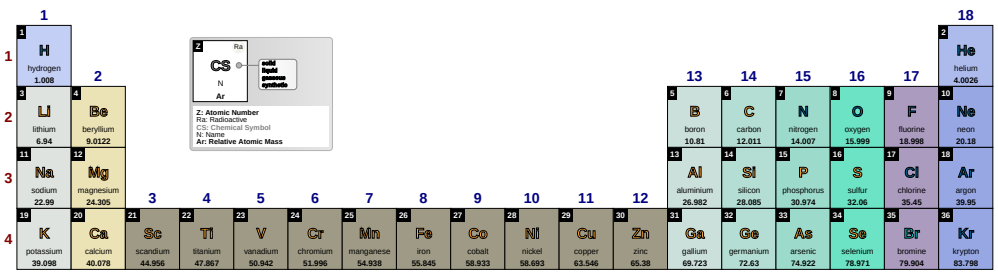
\pgfPT[Z list={1,...,36},CS outline color=red]



CS outline width default: *0.05*

Sets the outline width of the chemical symbol. It is any positive numerical value **without dimensions** (1.0 is roughly 1.0pt).

\pgfPT[Z list={1,...,36},CS outline width=.2]

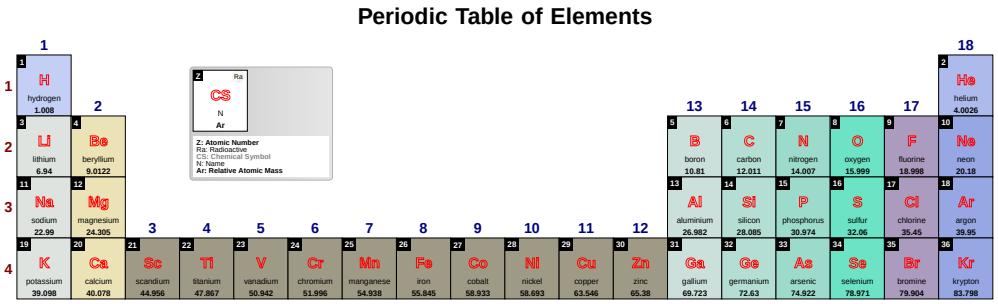


CS default: *{r=fill and outline,c=black,w=.05,f=\small\bfseries,s=solido,l=liquido, g=gasoso,sy=sintetico}*

Pseudo style to set the keys: CS **r**ender mode, CS **o**ut**l**ine **c**olor, CS **o**ut**l**ine **w**idth, CS font, CS **s**olid, CS **l**iquid, CS **g**as and/or CS **sy**nt and/or the style CS **all**. None of the *keys* – r, olc, olw , f, s, l, g, sy and all – are mandatory.

USAGE: CS={r=<fill|outline|fill and outline>,olc=<color>,olw=<positive numerical value> f=<font commands>,s=<color>,l=<color>,g=<color>,sy=<color>,all=<color>}

```
\pgfPT[Z list={1,...,36},CS={r=outline,olc=red,olw=.4},show legend pins=false]
```

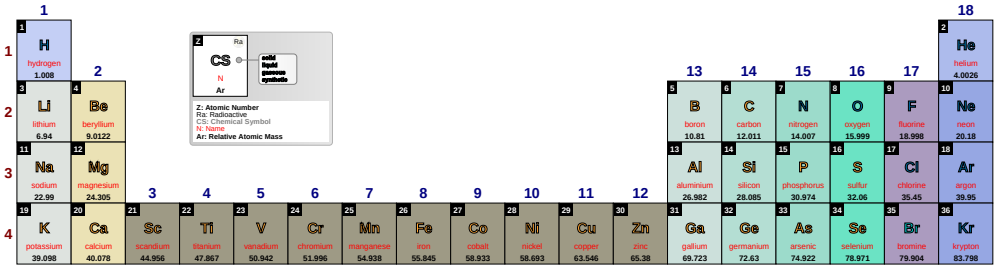


The name

name color default: *black*

Sets the color of the element name.

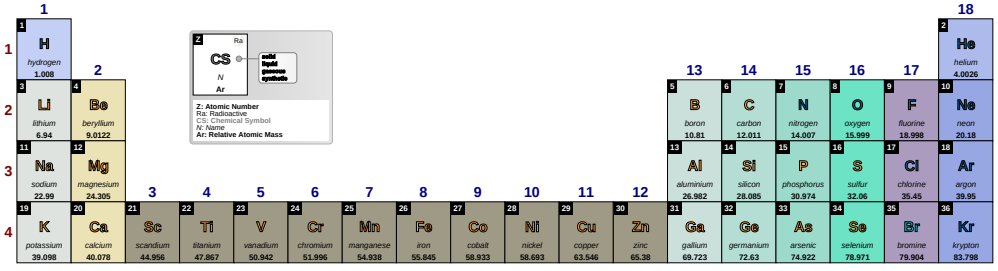
```
\pgfPTstyle[show title=false]
\pgfPT[Z list={1,...,36},name color=red]
```



name font default: *\tiny*

Sets the font of the element name.

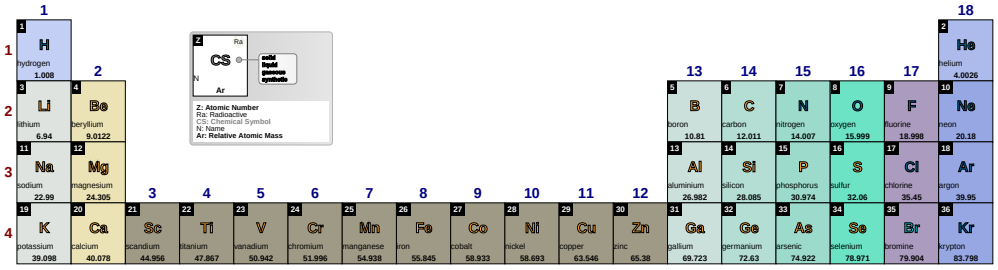
```
\pgfPT[Z list={1,...,36},name font=\itshape\tiny]
```



name align default: *center*

Sets the alignment of the element name to *left*, *center* or *right* with respect to its containing box. *(new in v1.0.1)*

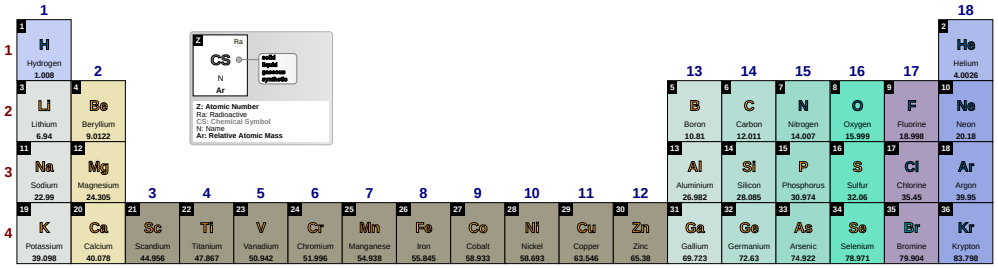
\pgfPT[Z list={1,...,36},name align=left]



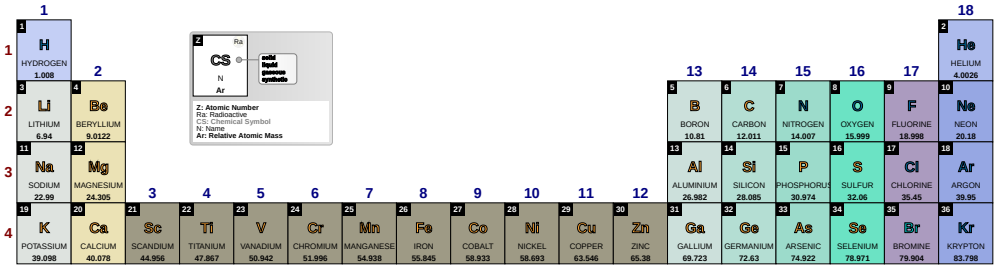
capitalize element names default: *false*

If set to true the first letter of the name of the elements is a capital letter (except in German where names start with a capital letter since version 2.0.1). If set to TRUE the whole name of the elements is in capital letters *(changed in v1.0.1)*

\pgfPT[Z list={1,...,36},capitalize element names=true]



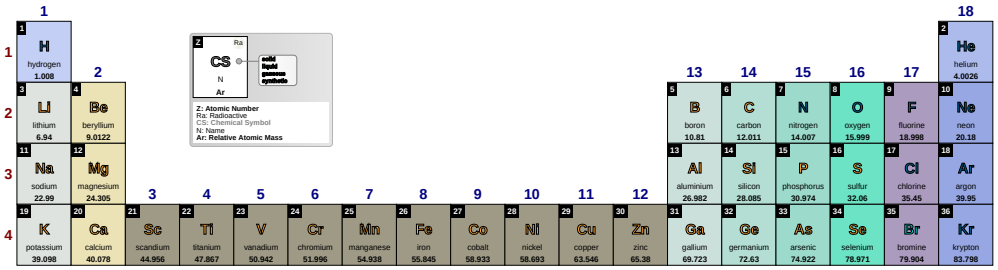
\pgfPT[Z list={1,...,36},capitalize element names=TRUE]



name *no value*

A style equivalent to capitalize element names=false

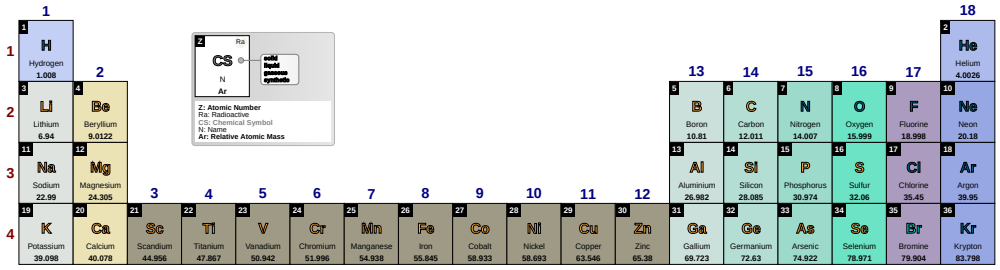
\pgfPT[Z list={1,...,36},name]



Name *no value*

A style equivalent to capitalize element names=true

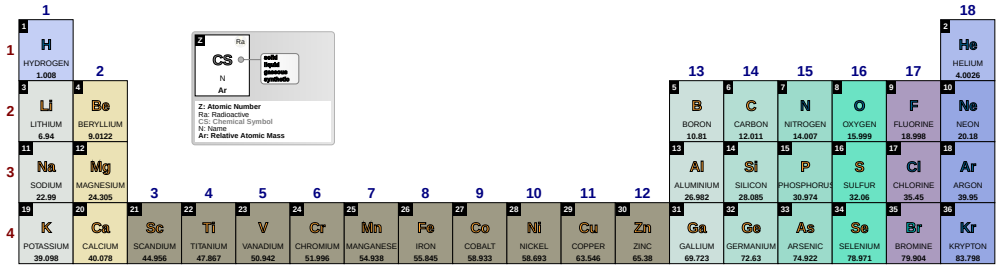
\pgfPT[Z list={1,..,36},Name]



NAME *no value*

A style equivalent to capitalize element names=TRUE *(new in v1.0.1)*

\pgfPT[Z list={1,..,36},NAME]

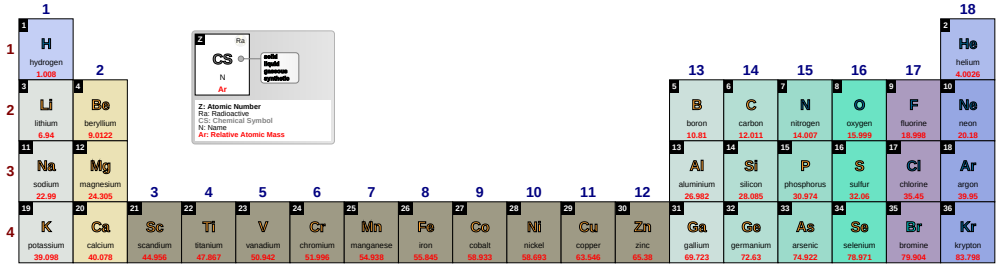


➠ The atomic weight

Ar color default: *black*

Sets the relative atomic mass color.

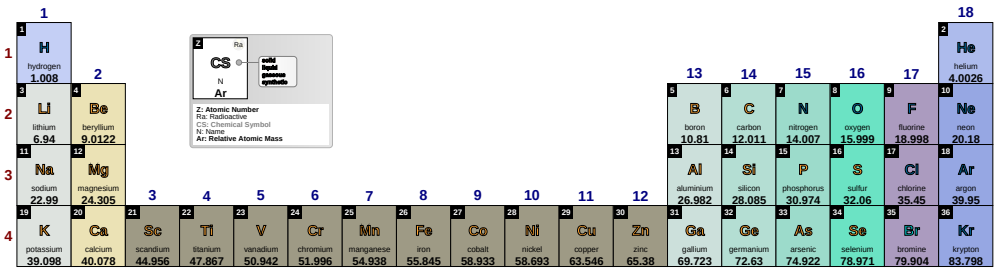
\pgfPT[Z list={1,..,36},Ar color=red]



Ar font default: *\tiny\bfseries*

Sets the relative atomic mass font.

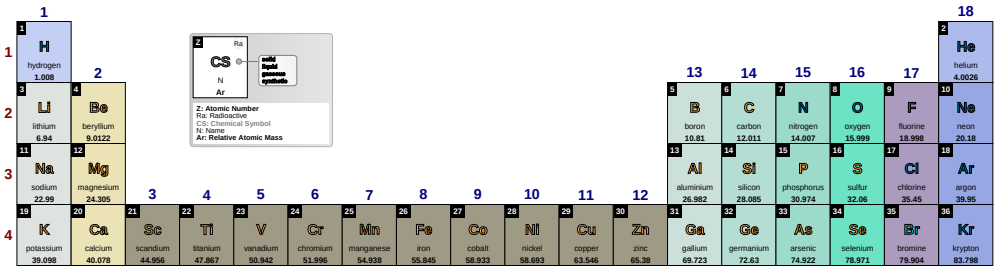
```
\pgfPT[Z list={1,...,36},Ar font=\scriptsize\bfseries]
```



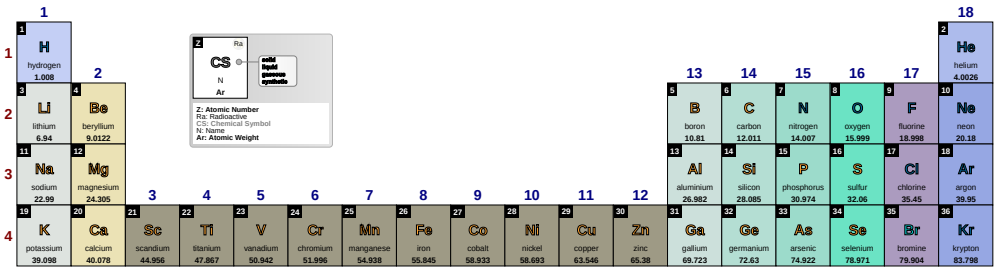
Ar label default: *m*

Sets the label to be used within the relative atomic mass description. When set to 'm' the term mass is used and when set to 'w' the term weight is used, resulting in *Relative Atomic Mass* and *Atomic Weight* labels respectively.

```
\pgfPT[Z list={1,...,36}]
```



```
\pgfPT[Z list={1,...,36},Ar label=w]
```

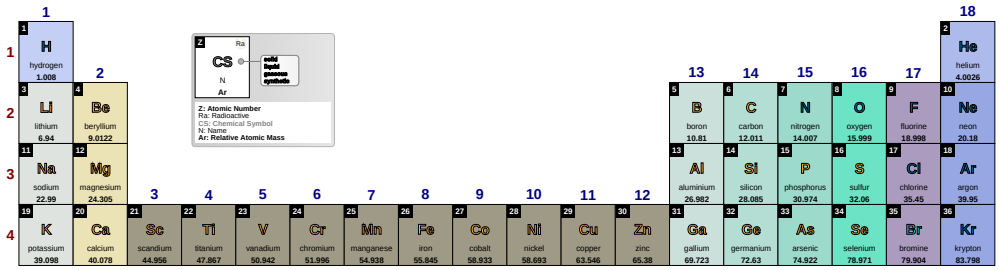


Ar precision default: *-1*

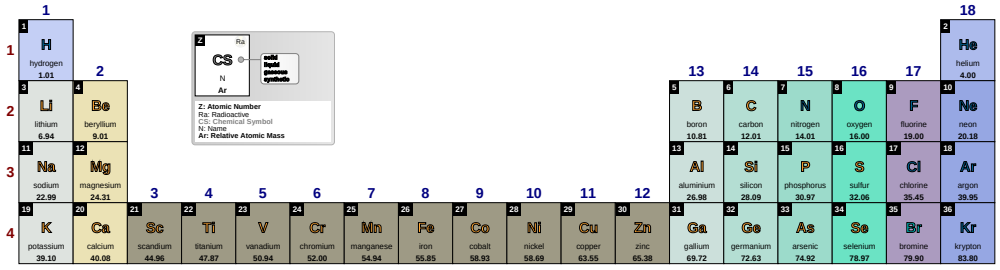
Sets the relative atomic mass precision, *i.e.*, the decimal places displayed in the relative atomic mass value, performing the respective rounding, without zero padding the value.

NOTE:
Rounding is performed over the relative atomic mass data values witch actually have a maximum of 4 decimal places. So giving this key a value of -1 (the value of relative atomic mass as-is) or 4 has the same effect.
Therefore the values provided to this key should be any integer between -1 and 3, i.e., -1, 0, 1, 2 or 3. Any other integer provided will be processed as -1.

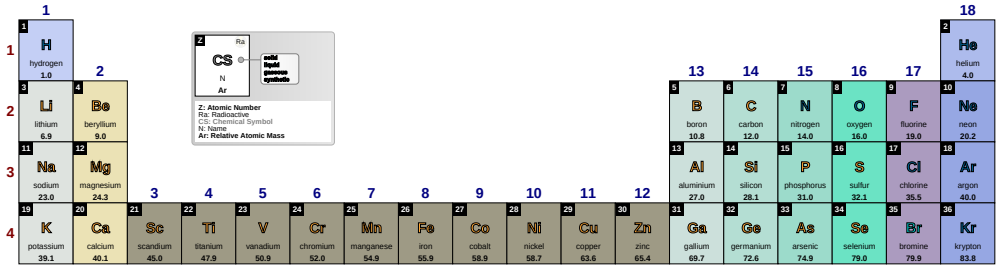
\pgfPT[Z list={1,...,36}]



\pgfPT[Z list={1,...,36},Ar precision=2]



\pgfPT[Z list={1,...,36},Ar precision=1]

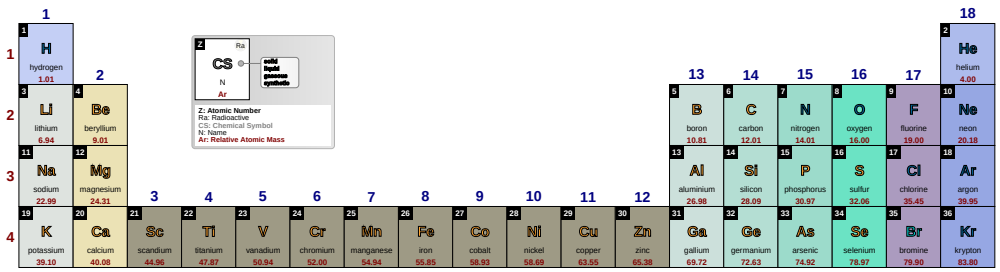


Ar default: *{c=black,f=\tiny\bfseries,l=m,p=-1}*

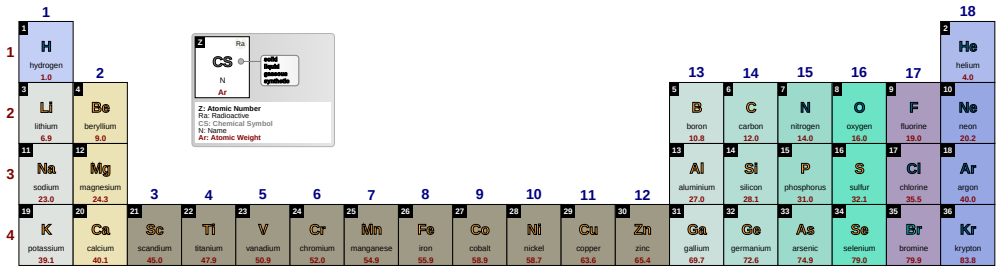
Pseudo style to set the keys: Ar **c**olor, Ar **f**ont, Ar **l**abel and/or Ar **p**recision. None of the *keys* – c, f, l and p – are mandatory.

USAGE: Ar={c=<color>,f=<font commands>,l=<m|w>p=<integer value>}

\pgfPT[Z list={1,...,36},Ar={c=red!50!black,p=2}]



```
\pgfPT[Z list={1,...,36},Ar={c=red!50!black,p=1,l=w}]
```



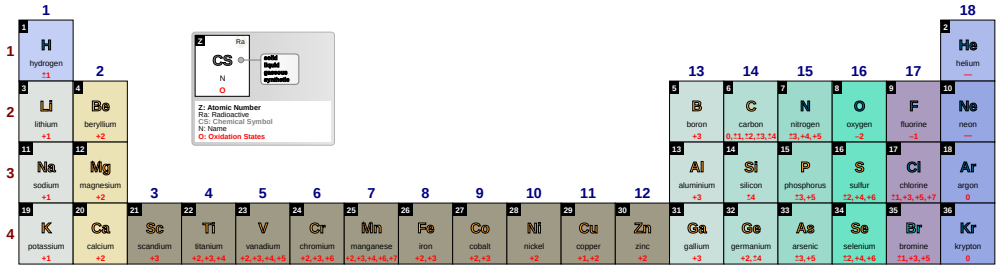
➠ The oxidation states

O color default: *black*

Sets the color of the oxidation states.

```
\pgfPTbuildcell(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;O)]
```

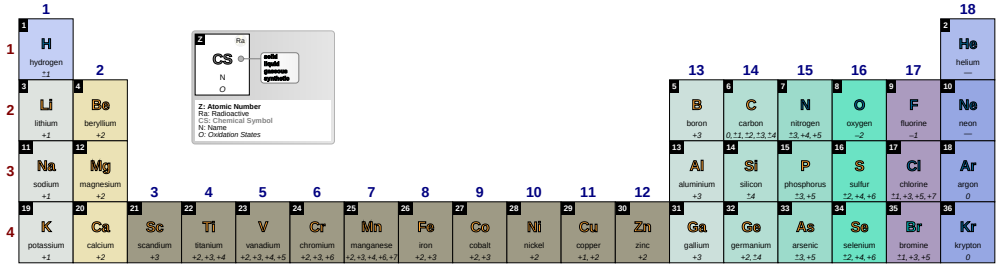
```
\pgfPTstyle[show title=false]
\pgfPT[Z list={1,...,36},O color=red]
```



O font default: *\tiny\bfseries*

Sets the font of the oxidation states.

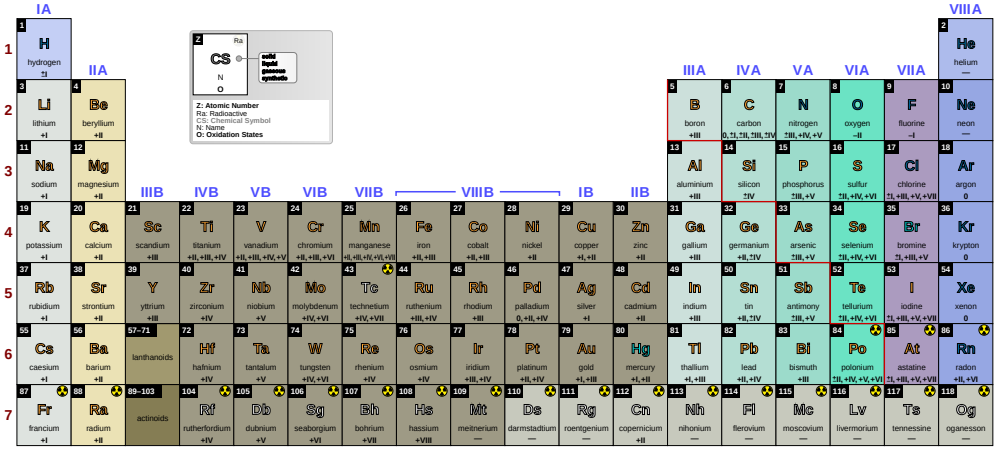
```
\pgfPT[Z list={1,...,36},O font=\itshape\tiny]
```



O Roman default: *false*

When set to true the oxidation states are displayed in Roman numerals, otherwise they are displayed in arabic numerals. *(new in v2.1.1)*

```
\pgfPT[Z list=spd,O Roman,group numbers=CAS]
```

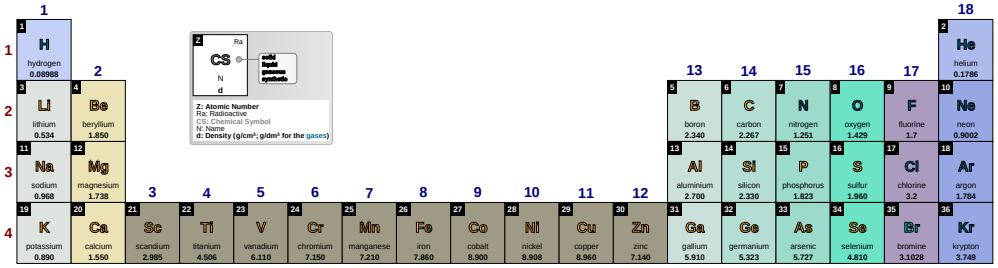


The density

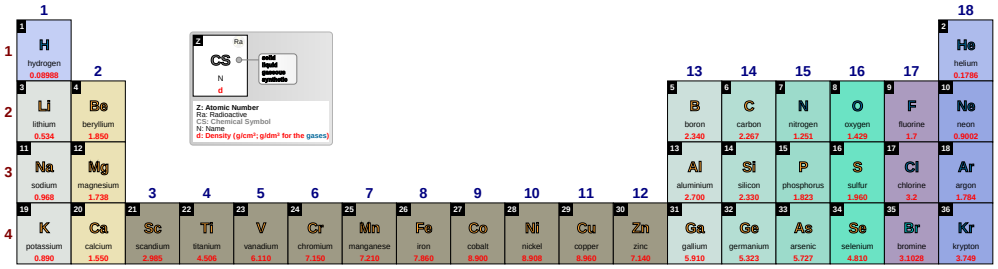
d color default: *black*

Sets the density value text color.

```
\pgfPTbuildcellstyle{myd}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;d)]
\pgfPT[Z list={1,...,36},cell style=myd,show title=false]
```



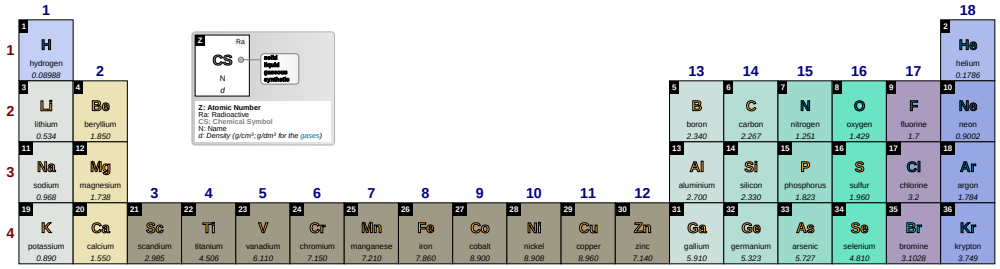
```
\pgfPT[Z list={1,...,36},cell style=myd,show title=false,d color=red]
```



d font default: *\tiny\bfseries*

Sets the density value text font.

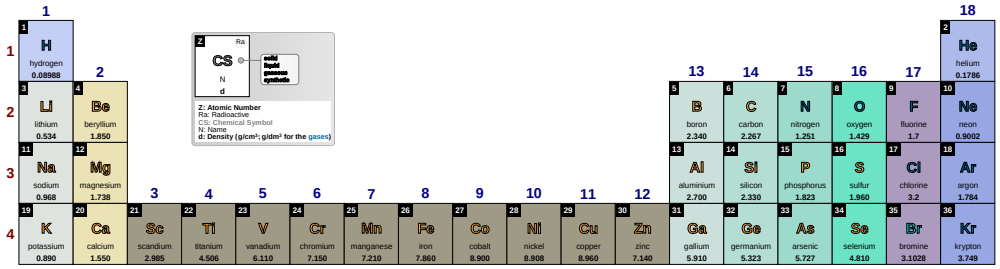
```
\pgfPT[Z list={1,...,36},cell style=myd,show title=false,d font=\tiny\itshape]
```



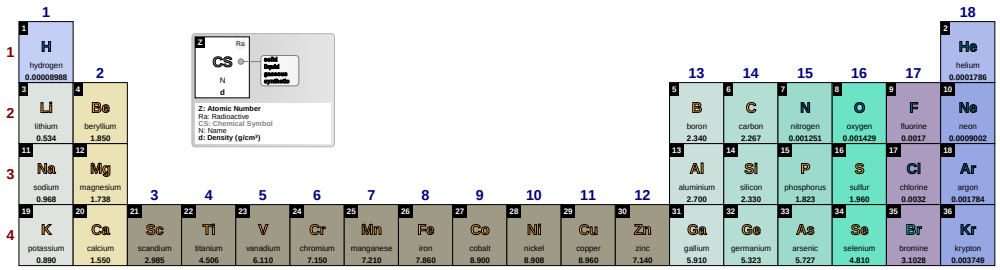
d unit default: *both*

Sets the unit for the density of the elements. The two possible values to this key are g/dm3 (g/dm^3), g/cm3 (g/cm^3) and both (g/dm^3 for elements in the gaseous state and g/cm^3 for all other elements). *(new in v1.0.1)*

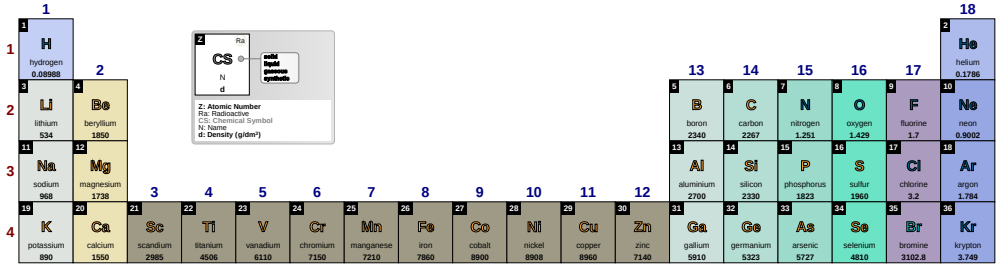
```
\pgfPT[Z list={1,...,36},cell style=myd,show title=false]
```



```
\pgfPT[Z list={1,...,36},cell style=myd,show title=false,d unit=g/cm3]
```



```
\pgfPT[Z list={1,...,36},cell style=myd,show title=false,d unit=g/dm3]
```

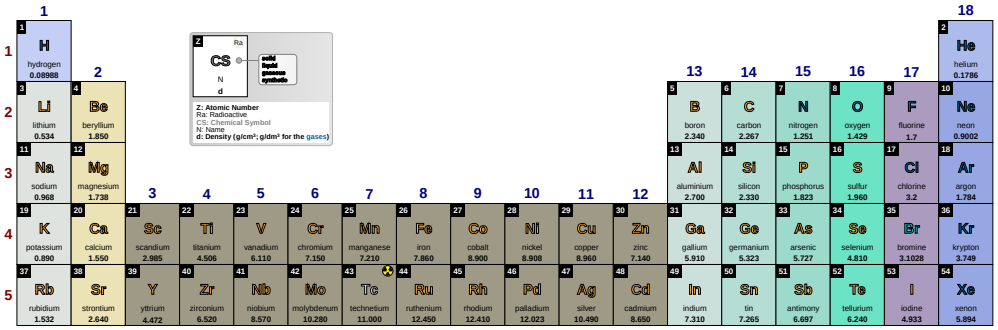


d precision default: *-1*

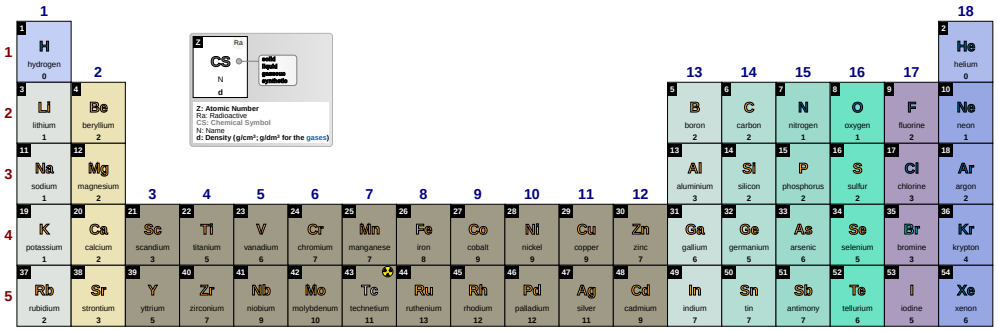
Sets the density precision, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

NOTE:
Rounding is performed over density values witch actually have a maximum 5 or 8 decimal places, when the values are in g/dm^3 or in g/cm^3, respectively.. So giving this key a value of -1 (the value of the density as-is) or 5 or 8 has the same effect.
Therefore the values provided to this key should be any integer between -1 and 4 (g/dm^3) or 7 (g/cm^3). Any other integer provided will be processed as -1.

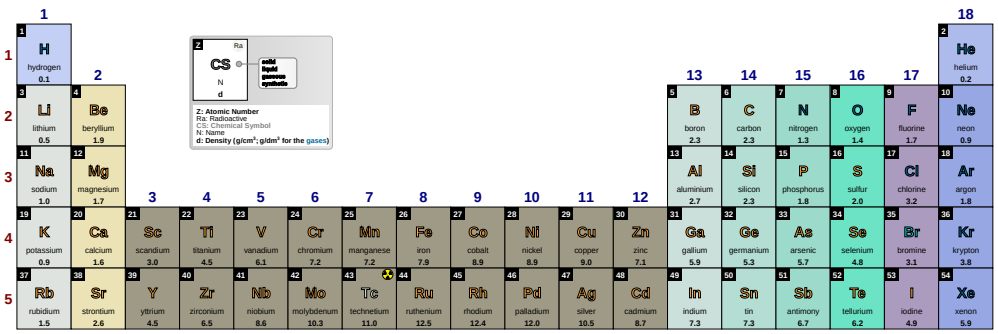
```
\pgfPTstyle[Z list={1,...,54},cell style=myd,show title=false]
\pgfPT
```



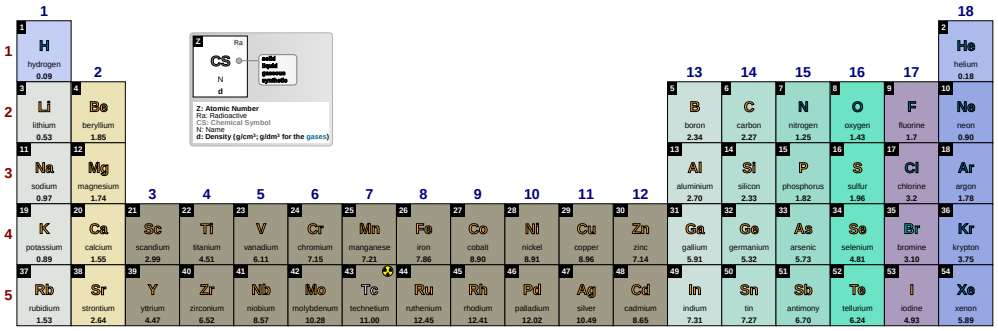

```
\pgfPT[d precision=0]
```



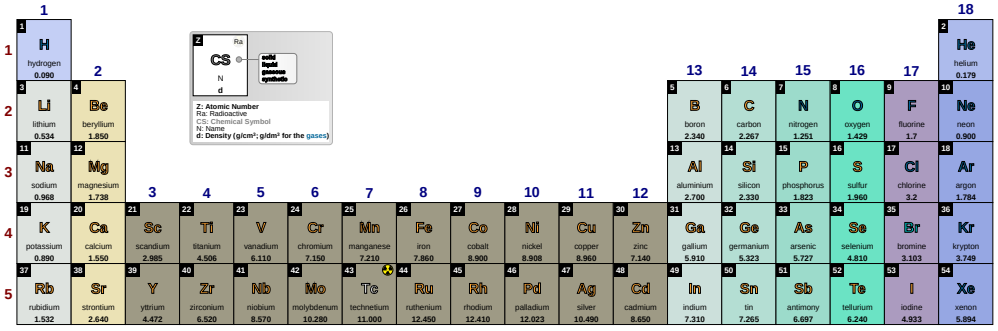

```
\pgfPT[d precision=1]
```



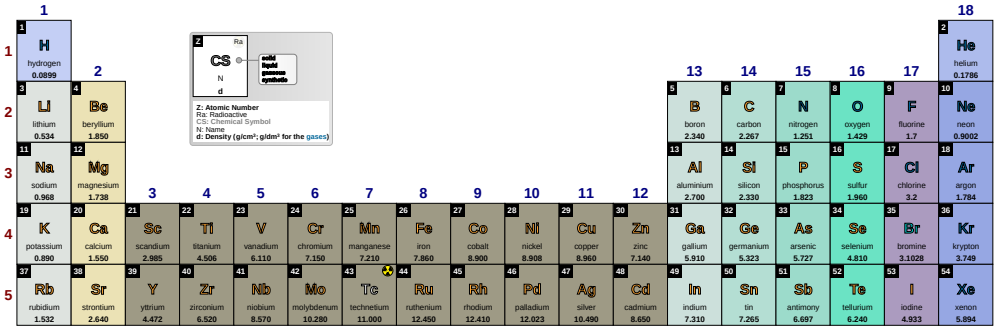
\pgfPT[d precision=2]



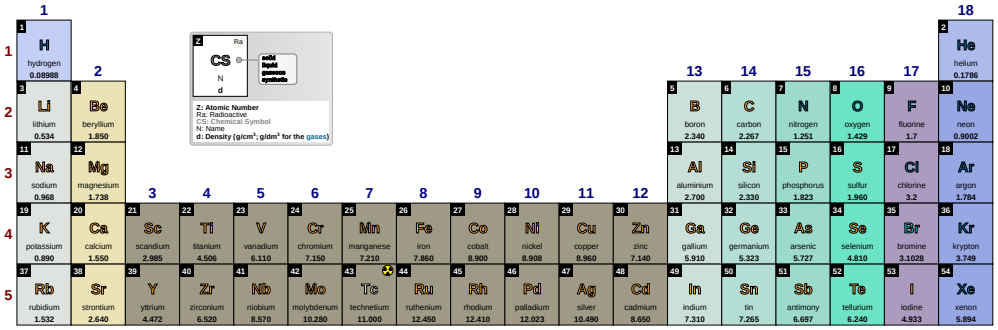
\pgfPT[d precision=3]



\pgfPT[d precision=4]



\pgfPT[d precision=5]

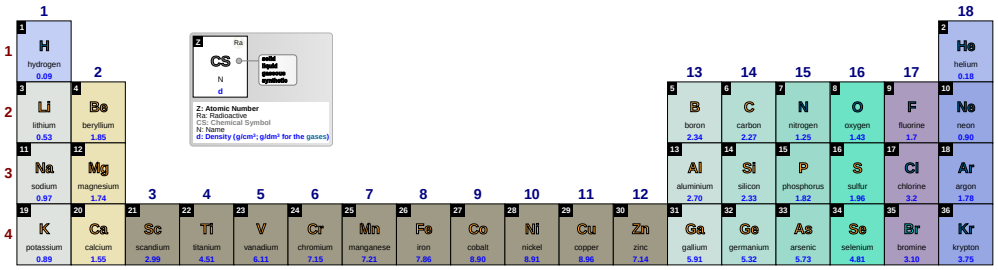


d default: *{c=black,f=\tiny\bfseries,p=-1,u=both}*

Pseudo style to set the keys: d **c**olor, d **f**ont, d **p**recision and/or d **u**nit. None of the *keys* – c, f, p and u – are mandatory. *(new in v1.0.1)*

USAGE: d={c=<color>,f=<font commands>,p=<integer value>,u=<pm|A>}

```
\pgfPT[Z list={1,...,36},cell style=myd,show title=false,d={c=blue,p=2}]
```

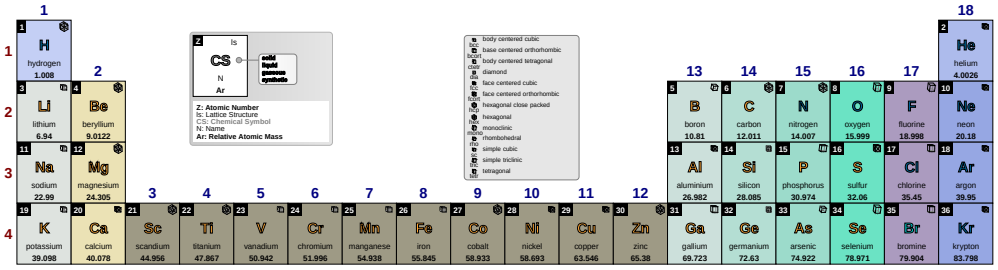


➠ The lattice structure

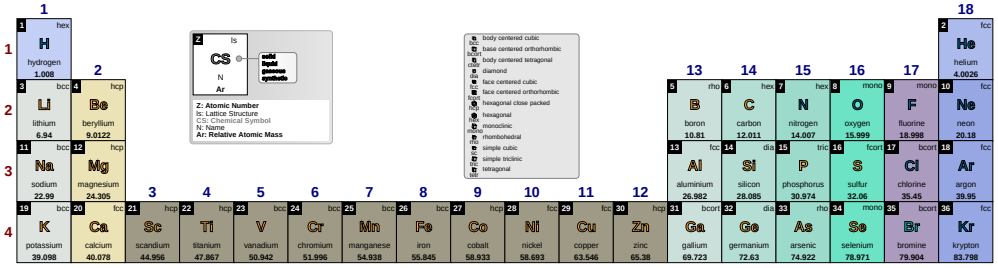
ls default: *fig*

Sets what is displayed for the lattice structure: a figure (fig) or text (txt) or both (fig+txt or txt+fig).

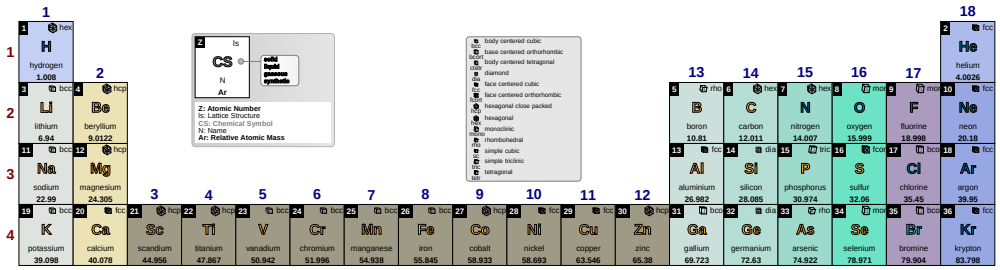
```
\pgfPT[Z list={1,...,36},cell style=pgfPTls]
```



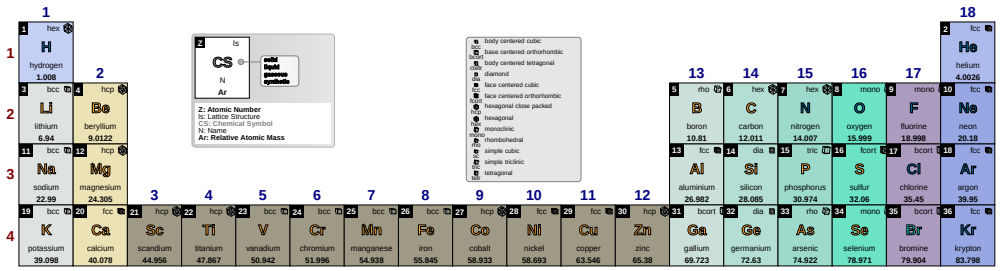
```
\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls=txt]
```



\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls=fig+txt]



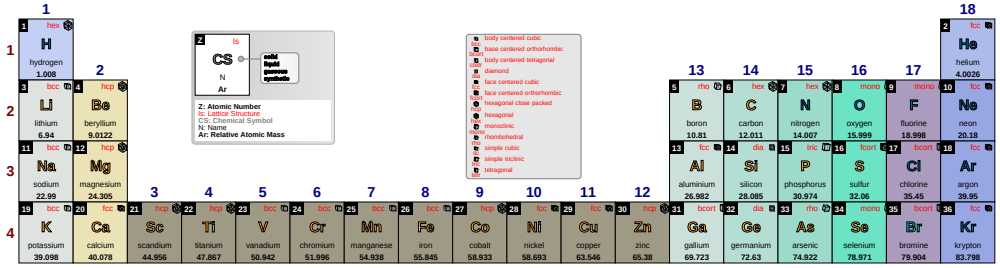
\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls=txt+fig]



ls color default: *black*

Sets the lattice structure text color.

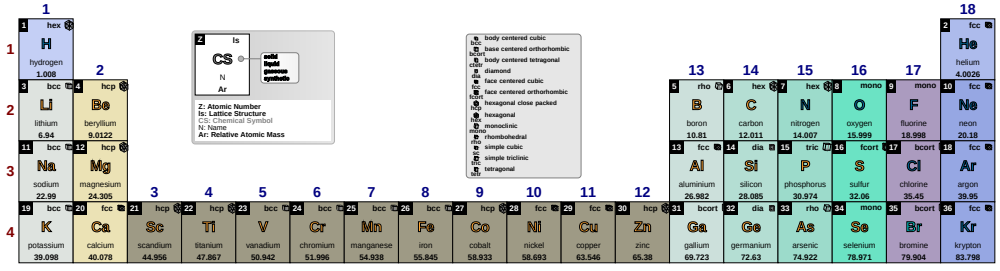
\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls=txt+fig,ls color=red]



ls font default: *\tiny*

Sets the lattice structure text font.

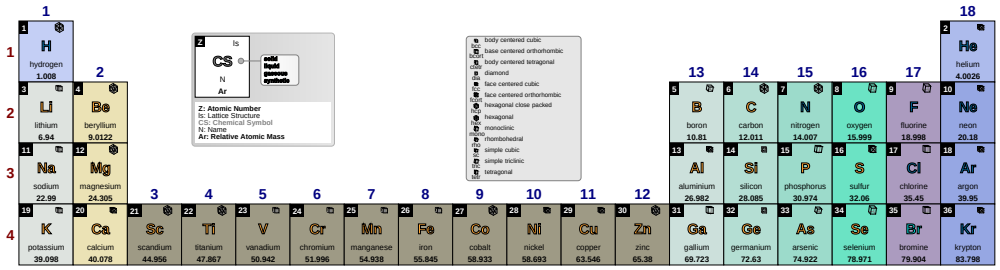
\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls=txt+fig,ls font=\tiny\bfseries]



ls align default: *right*

Sets the alignment of the lattice structure to left or center or right.

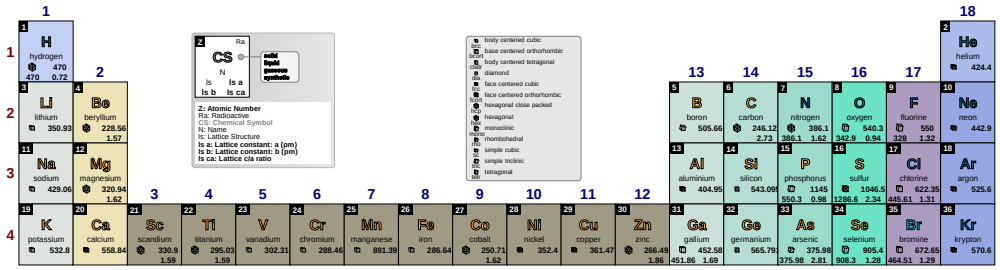
```
\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls align=center]
```



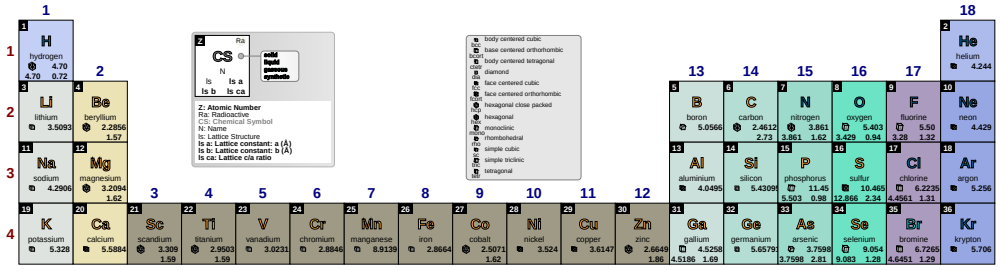
ls unit default: *pm*

Sets the unit for the lattice structure constants: a, b and c. The two possible values to this key are pm (picometers) and A (Å – angstroms). *(new in v1.0.1)*

```
\pgfPTbuildcellstyle{myls}(6,3)% 6 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-2.5;ls),(5;2.5-3;lsa),
(6;1-2.5;lsb),(6;2.5-3;lsca)]
\pgfPTstyle[Z list={1,...,36},cell style=myls,show title=false,ls align=center]
\pgfPT
```



```
\pgfPT[ls unit=A]
```



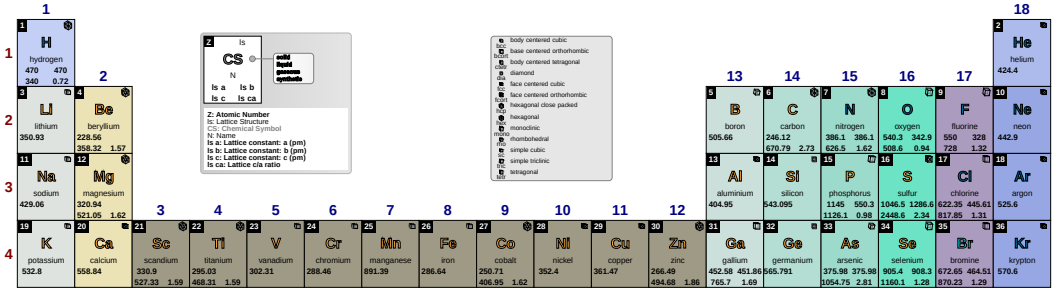
ls precision default: *-1*

Sets the lattice structure constants - a, b, and c - precision, as also the lattice c/a ratio, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

NOTE:
Rounding is performed over the constants data or c/a ratio values witch actually have a maximum of 2 or 4 decimal places, when the values are in picometers or in angstroms, respectively. So giving this key a value of -1 (the value of the constants or c/a ratio as-is) or 2 or 4 has the same effect.
Therefore the values provided to this key should be any integer between -1 and 1 (pm) or 3 (Å). Any other integer provided will be processed as -1.

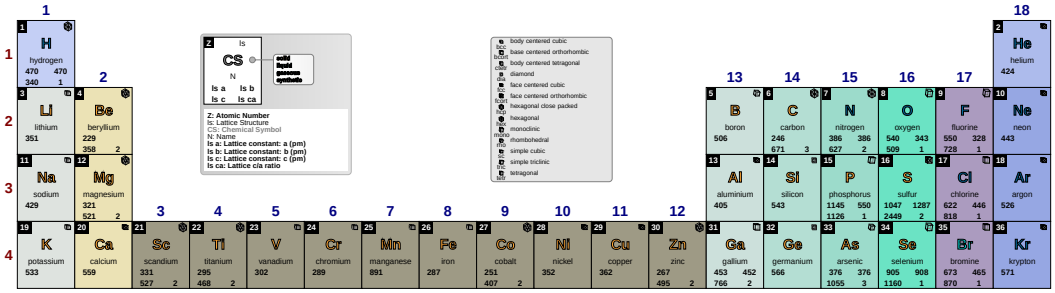
```
\pgfPTbuildcellstyle{myls}(6,3)% 6 rows by 3 columns
[(1;1-2;Z),(1;2-3;ls),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-2.5;lsa),
(5;2.5-3;lsb),(6;1-2.5;lsc),(6;2.5-3;lsca)]
\pgfPTstyle[Z list={1,...,36},cell={w=36pt,h=42pt,style=myls}]
\pgfPT
```

Periodic Table of Elements



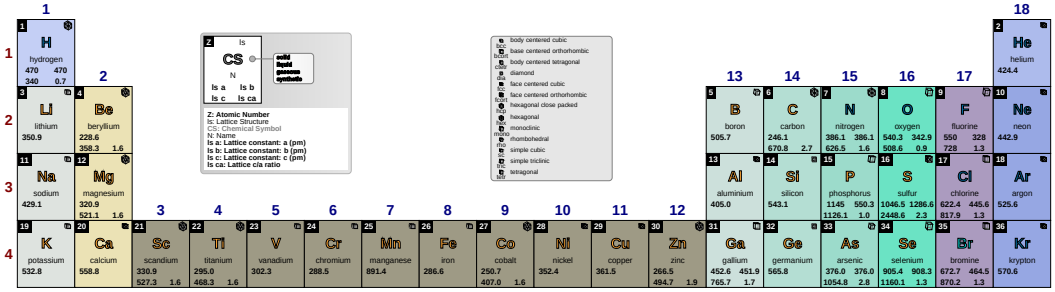
```
\pgfPT[ls precision=0]
```

Periodic Table of Elements



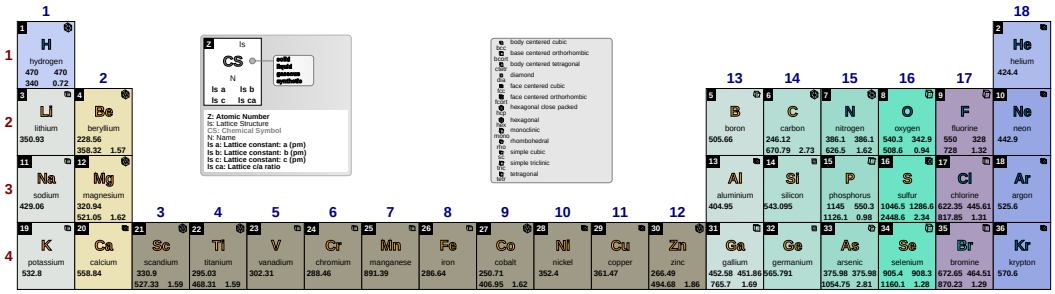
```
\pgfPT[ls precision=1]
```

Periodic Table of Elements

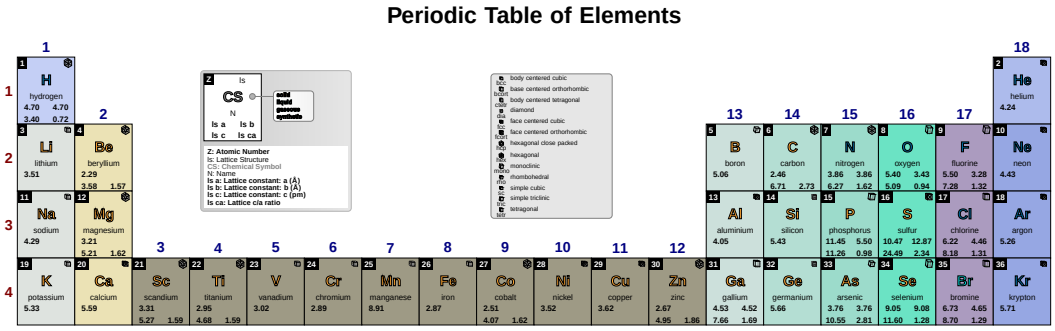


```
\pgfPT[ls precision=2]
```

Periodic Table of Elements



```
\pgfPT[ls precision=2,ls unit=A]
```

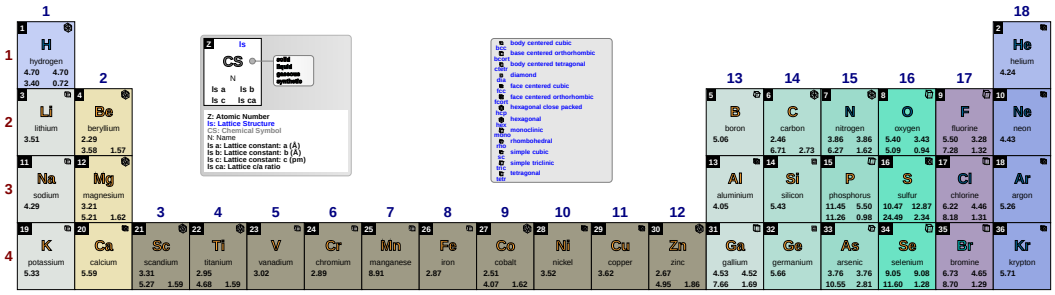


lat default: *{ls=fig,c=black,f=\tiny,align=right,p=-1,u=pm}*

Pseudo style to set the keys: **ls**, ls **c**olor, ls **f**ont, ls **align**, ls **p**recision and/or ls **u**nit. None of the *keys* – ls, c, f, align, p and u – are mandatory. *(new in v1.0.1)*

USAGE: lat={ls=<fig|txt|fig+txt|txt+fig>,c=<color>,f=<font commands>, align=<left|center|right>,p=<integer value>,u=<pm|A>}

```
\pgfPT[Z list={1,..,36},lat={c=blue,f=\tiny\bfseries,u=A,p=2}]
```

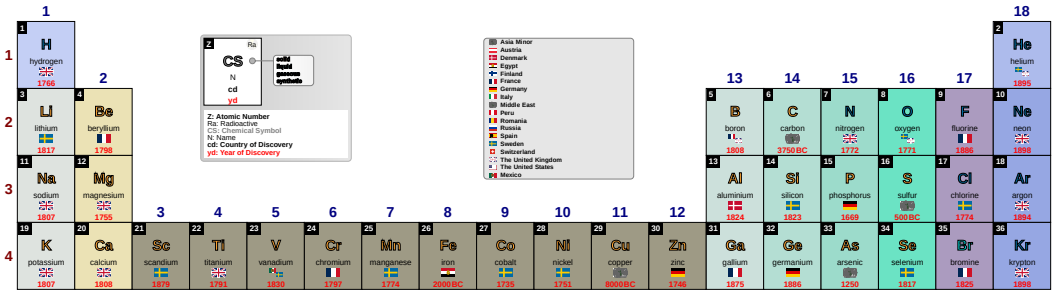


➠ The year of discovery

DiscY color default: *black*

Sets the color of the discovery year.

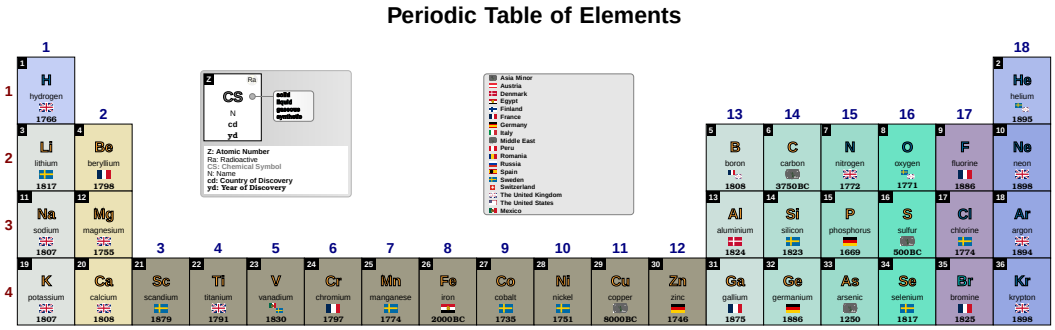
```
\pgfPT[Z list={1,..,36},cell style=pgfPTdisc,DiscY color=red]
```



DiscY font default: *\tiny\bfseries*

Sets the font of the discovery year.

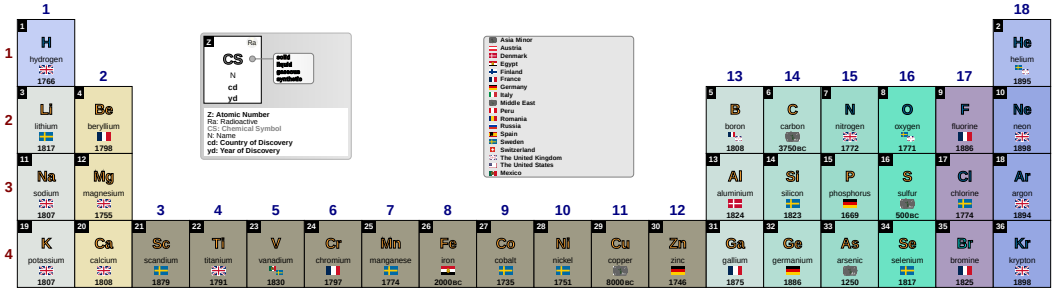
```
\pgfPT[Z list={1,...,36},cell style=pgfPTdisc,DiscY
font=\fontfamily{pbk}\selectfont\tiny\bfseries]
```



DiscY BC scale default: *1*

Sets the font factor scaling for the Before Christ (BC) acronym in the year of discovery.

```
\pgfPT[Z list={1,...,36},cell style=pgfPTdisc,DiscY BC scale=.8]
```



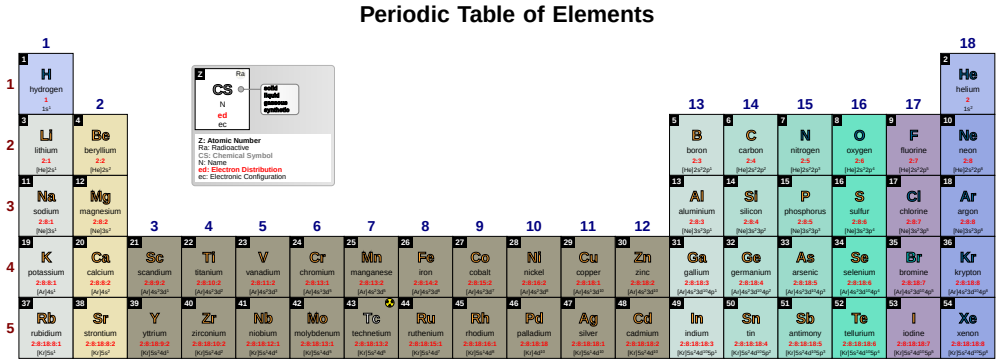
➠ *The electron distribution*

```
\pgfPTbuildcellstyle{electron}(6,3)% 6 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),
(5;1-3;eDist),(6;1-3;eConfignl)]
```

eDist color default: *black*

Sets the electron distribution color.

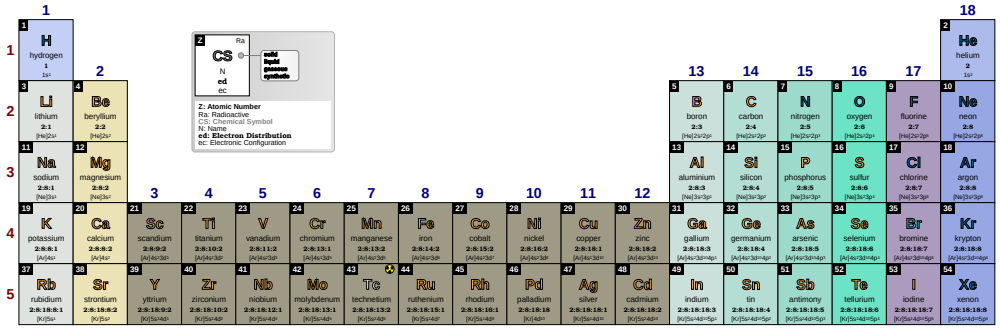
```
\pgfPT[Z list={1,...,54},cell style=electron,eDist color=red]
```



eDist font default: *\tiny\bfseries*

Sets the electron distribution font.

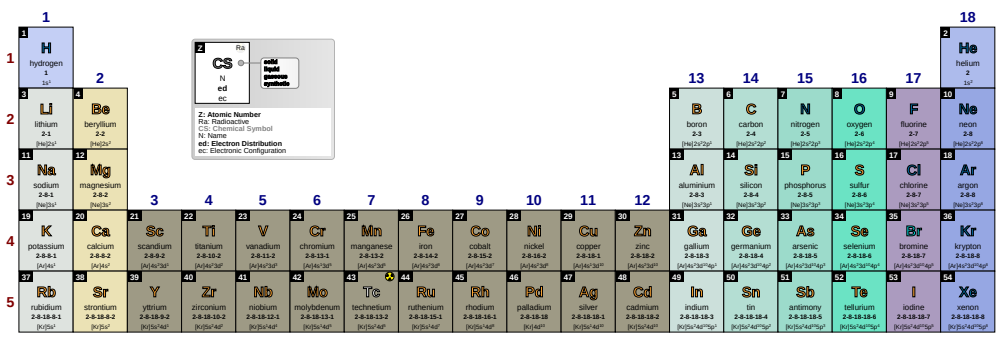
```
\pgfPT[Z list={1,...,54},cell style=electron,eDist
font=\fontfamily{pbk}\selectfont\tiny\bfseries]
```



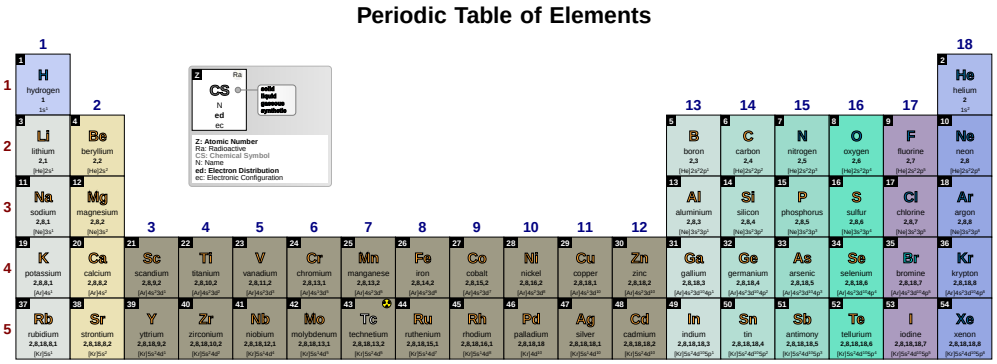
eDist sep default: *:*

Sets the separator character between energy levels in electron distribution. *If the separator character is a comma it must be provided between curly braces – {,}.*

```
\pgfPT[Z list={1,...,54},cell style=electron,eDist sep=-]
```



```
\pgfPT[Z list={1,...,54},cell style=electron,eDist sep={,}]
```



➠ *The other contents*

For all the *other contents* available for the cells of the periodic table, two keys can be set: <content name> color and <content name> font.

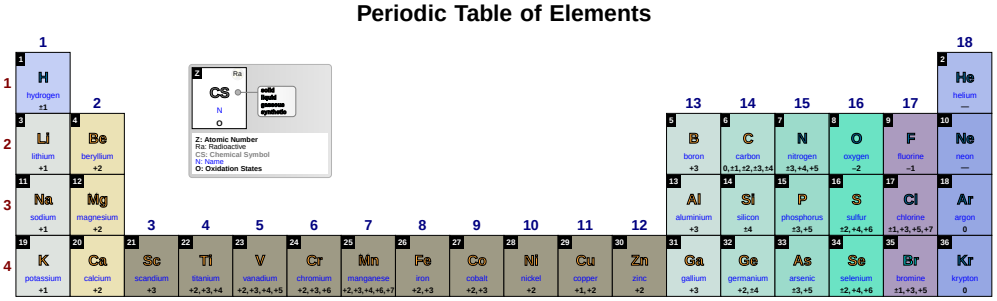
The <content name>'s list:

- ✓ **R**: atomic radius
- ✓ **Rcov**: covalent radius
- ✓ **Rion**: ionic radius
- ✓ **Ei**: first ionization energy
- ✓ **eneg**: electronegativity (Pauling)
- ✓ **eaff**: electroaffnity
- ✓ **Tmelt**: melting point (Kelvin)
- ✓ **TmeltC**: melting point (Celsius degrees)
- ✓ **Tboil**: boiling point (Kelvin)
- ✓ **TboilC**: boiling point (Celsius degrees)
- ✓ **eConfign**: electronic configuration (increasing n)
- ✓ **eConfignl**: electronic configuration (increasing n+ℓ)
- ✓ **Cp**: specific heat capacity
- ✓ **kT**: thermal conductivity
- ✓ **lsa**: lattice constant – a
- ✓ **lsb**: lattice constant – b
- ✓ **lsc**: lattice constant – c
- ✓ **lsca**: lattice c/a ratio
- ✓ **DiscC**: country of discovery
- ✓ **spectra**: visible range spectral lines

<content name> color default: *black*

Sets the <content name> color.

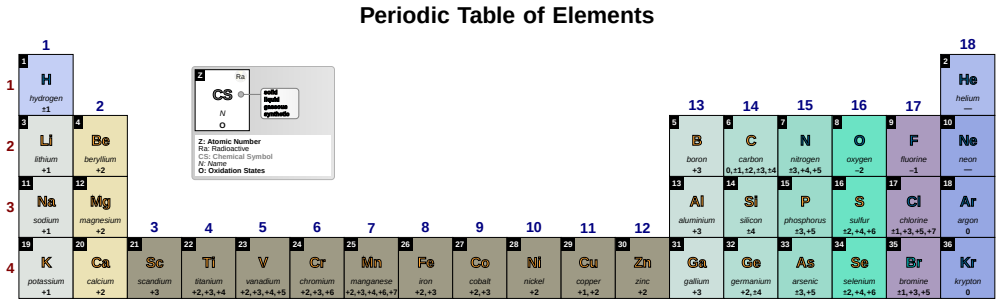
```
\pgfPT[Z list={1,...,36},name color=blue]
```



<content name> font default: *\tiny\bfseries*

Sets the <content name> font.

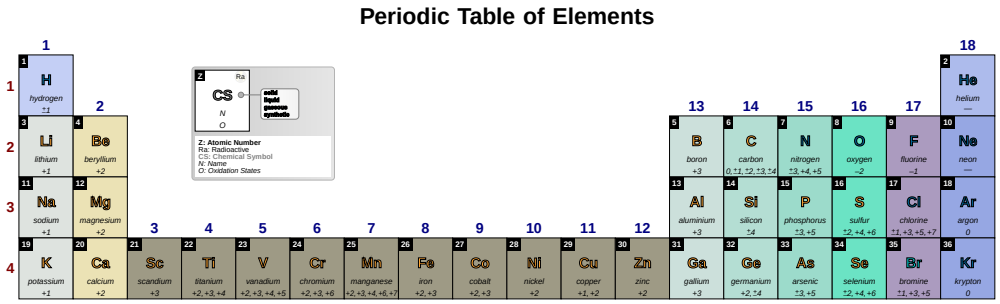
```
\pgfPT[Z list={1,...,36},name font=\tiny\itshape]
```



cell font default: *\bfseries\tiny*

Style to set the font for all cell contents, except for the Z and Chemical Symbol fonts.

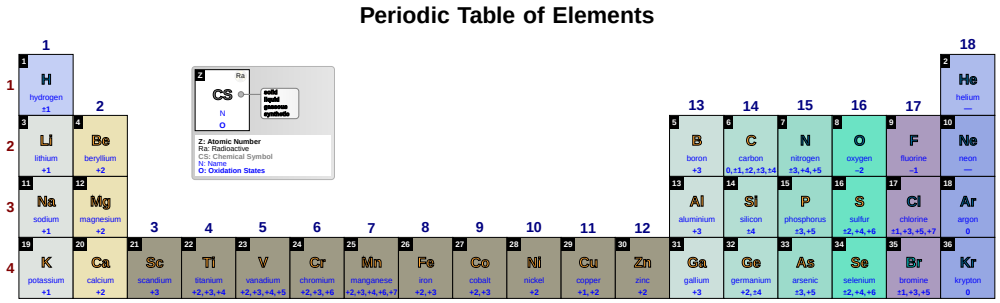
```
\pgfPT[Z list={1,...,36},cell font=\tiny\itshape]
```



cell color default: *black*

Style to set the color for all cell contents, except for the Z and Chemical Symbol colors.

```
\pgfPT[Z list={1,...,36},cell color=blue]
```



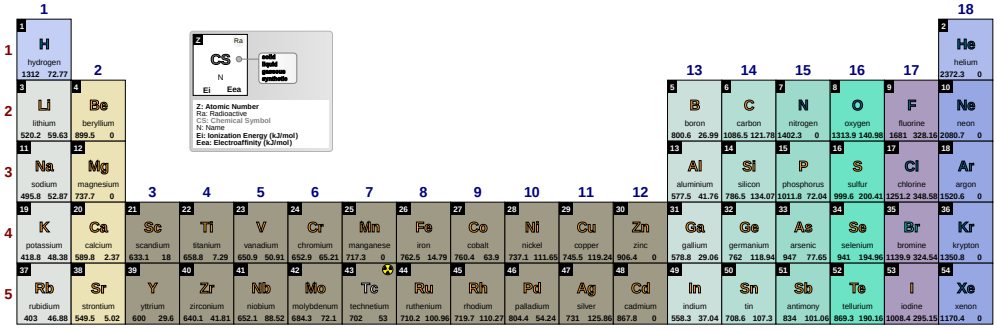
The precision of the *other contents*, which have numerical values, can also be set by a key. *Atomic radius, covalent radius, and ionic radius all have integer values, so precision does not apply to them*.

E precision default: *-1*

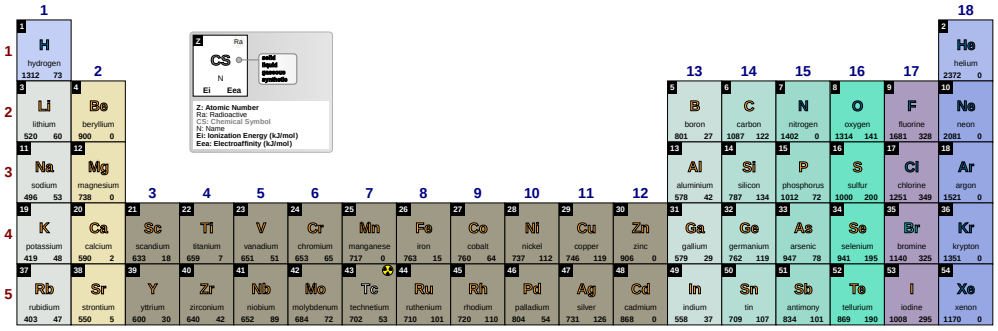
Sets the first ionization energy and the electroaffnity precision, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

NOTE:
Rounding is performed over energy values witch actually have a maximum of 3 decimal places. So giving this key a value of -1 (the value of the energy as-is) or 3 has the same effect.
Therefore the values provided to this key should be any integer between -1 and 2, i.e., -1, 0, 1 or 2. Any other integer provided will be processed as -1.

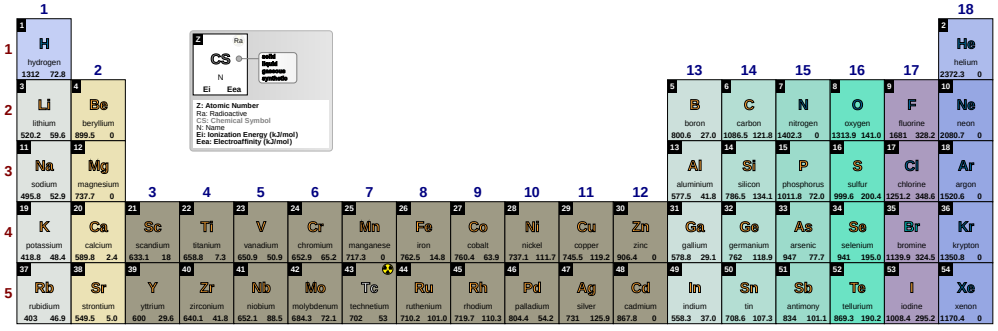
```
\pgfPTbuildcellstyle{myE}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-2.5;Ei), (5;2.5-3;eaff)]
\pgfPTstyle[Z list={1,...,54},cell style=myE,show title=false]
\pgfPT
```



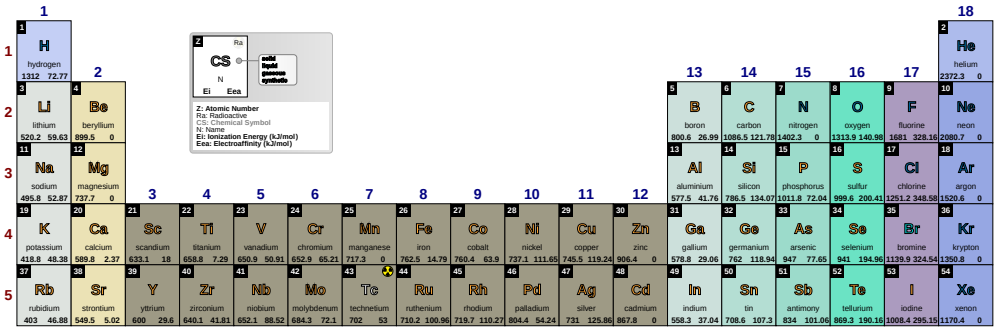
```
\pgfPT[E precision=0]
```



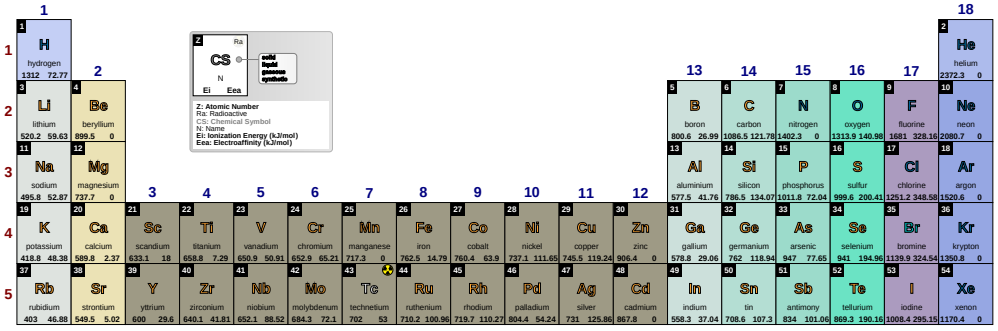
```
\pgfPT[E precision=1]
```



\pgfPT[E precision=2]



\pgfPT[E precision=3]

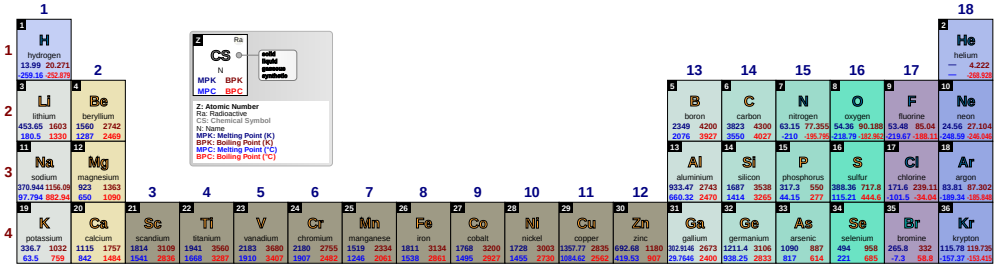


T precision default: *-1*

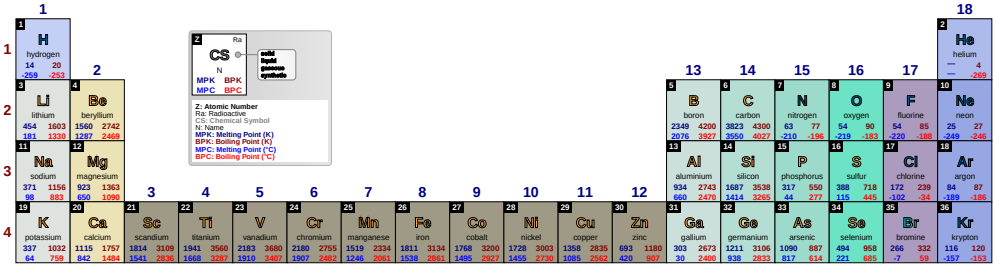
Sets the melting point an boiling point precision, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

NOTE:
Rounding is performed over melting or boiling point values witch actually have a maximum, respectively, of 4 or 2 decimal places. So giving this key a value of -1 (the value of the melting or boiling point as-is) or, respectively, 4 or 2 has the same effect.
Therefore the values provided to this key should be any integer between -1 and 3 or 2. Any other integer provided will be processed as -1.

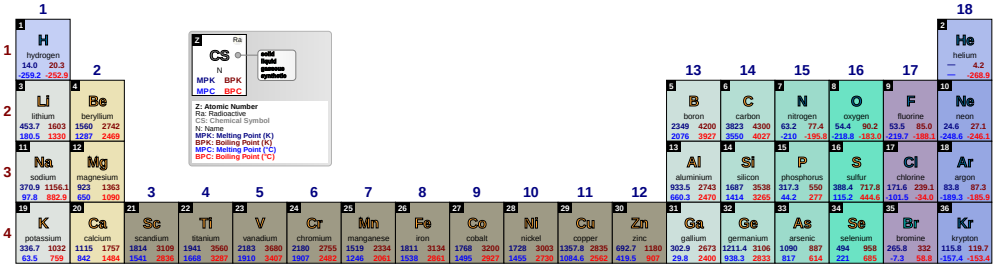
```
\pgfPTbuildcellstyle{myT}(6,3)% 6 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-2.5;Tmelt),
(5;2.5-3;Tboil),(6;1-2.5;TmeltC),(6;2.5-3;TboilC)]
\pgfPTstyle[Z list={1,...,36},cell style=myT,Tmelt color=blue!50!black,TmeltC
color=blue,Tboil color=red!50!black,TboilC color=red,show title=false]
\pgfPT
```



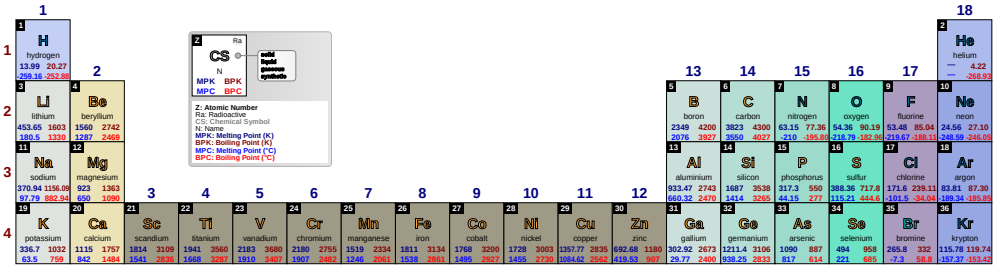
\pgfPT[T precision=0]



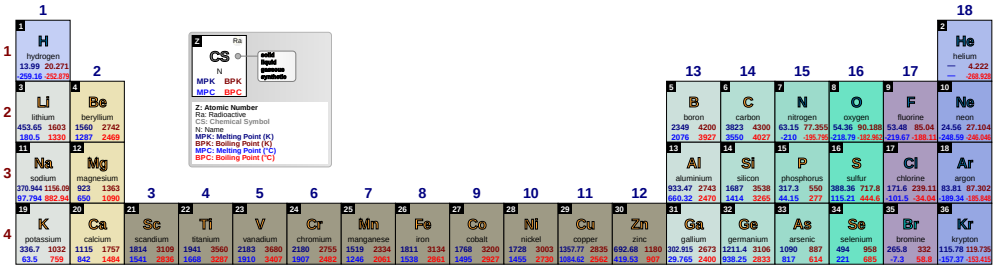
\pgfPT[T precision=1]



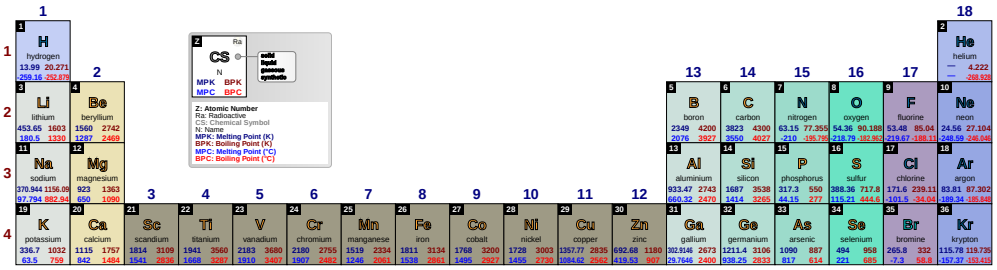
\pgfPT[T precision=2]



\pgfPT[T precision=3]



\pgfPT[T precision=4]



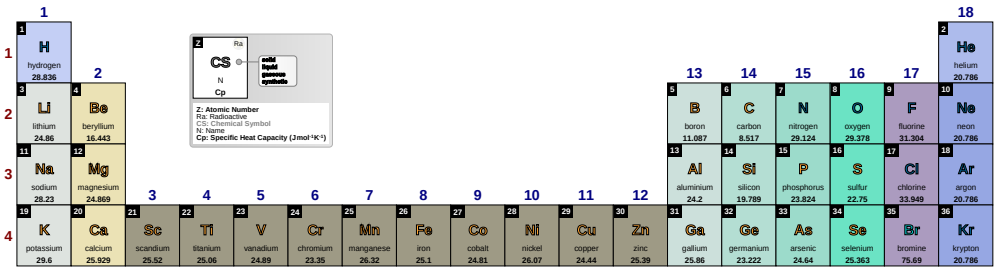
Cp precision default: *-1*

Sets the specific heat capacity precision, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

NOTE:
Rounding is performed over density values witch actually have a maximum 3 decimal places. So giving this key a value of -1 (the value of the melting or boiling point as-is) or 3 has the same effect.
Therefore the values provided to this key should be any integer between -1 and 2. Any other integer provided will be processed as -1.

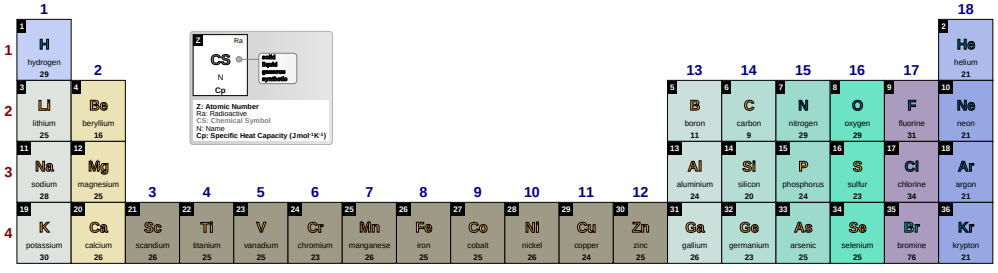
```
\pgfPTbuildcellstyle{myCp}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;Cp)]
\pgfPTstyle[Z list={1,...,36},cell style=myCp]
                                        \pgfPT
```

Periodic Table of Elements



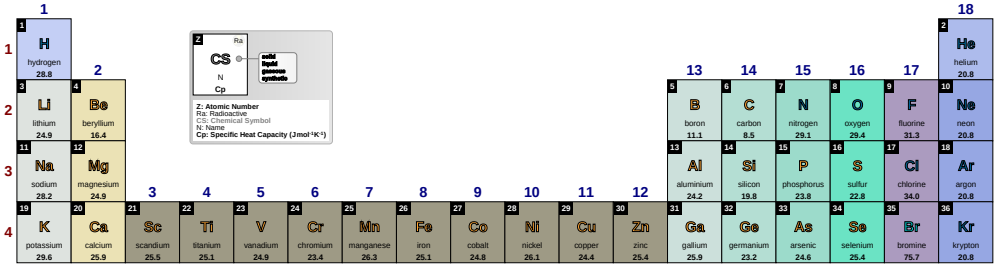

```
\pgfPT[Cp precision=0]
```

Periodic Table of Elements

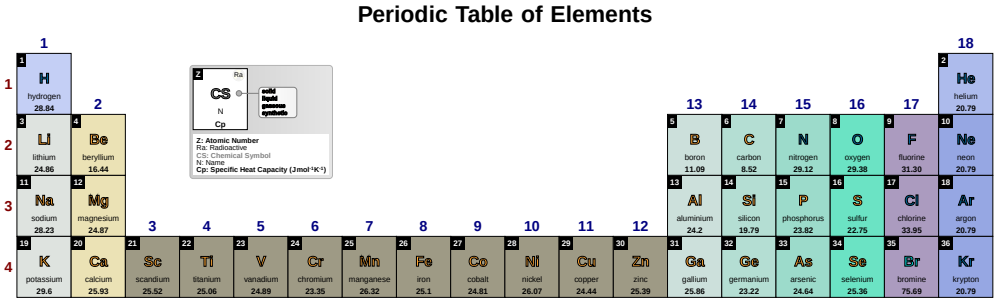



```
\pgfPT[Cp precision=1]
```

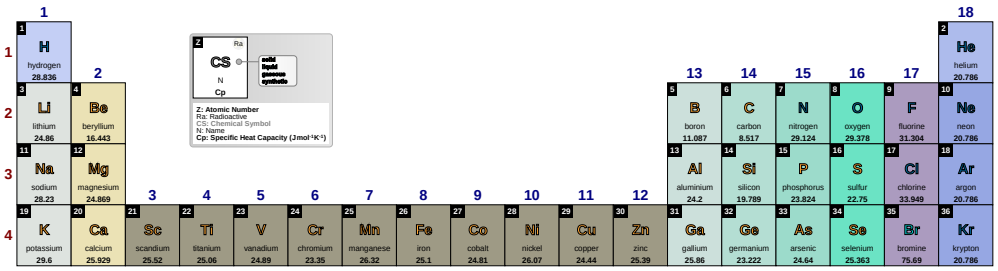
Periodic Table of Elements



```
\pgfPT[Cp precision=2]
```




```
\pgfPT[Cp precision=3]
```

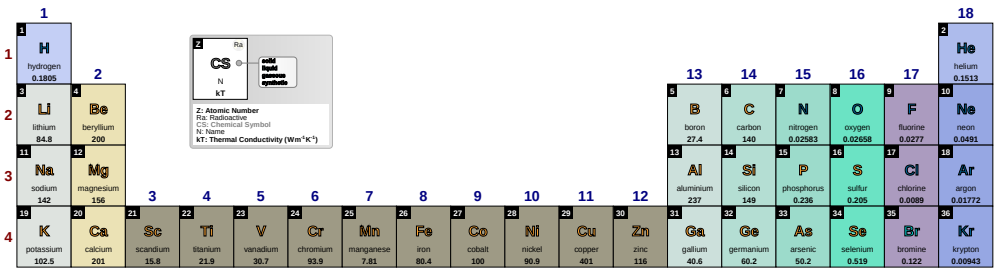


kT precision default: *-1*

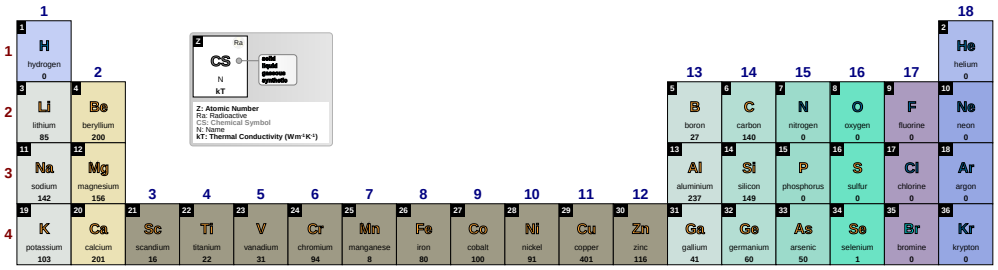
Sets the thermal condutivity precision, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

NOTE:
Rounding is performed over density values witch actually have a maximum 5 decimal places. So giving this key a value of -1 (the value of the melting or boiling point as-is) or 5 has the same effect.
Therefore the values provided to this key should be any integer between -1 and 4. Any other integer provided will be processed as -1.

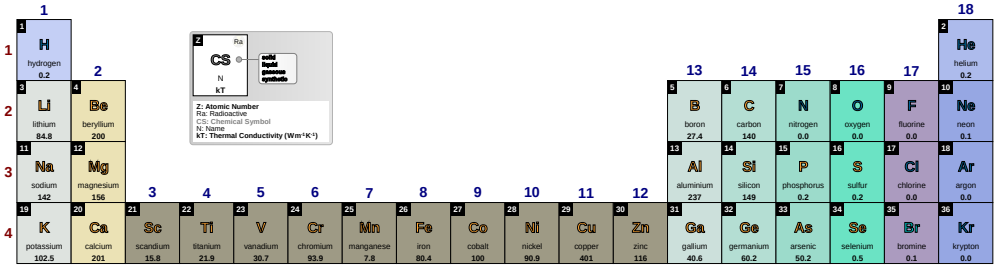
```
\pgfPTbuildcellstyle{mykT}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;kT)]
\pgfPTstyle[Z list={1,...,36},cell style=mykT,show title=false]
                                                    \pgfPT
```



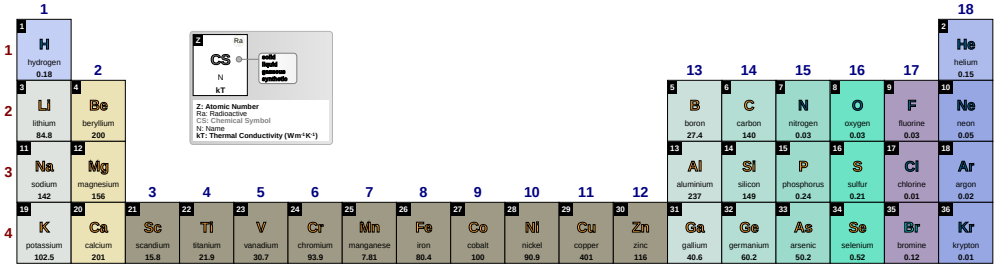
\pgfPT[kT precision=0]



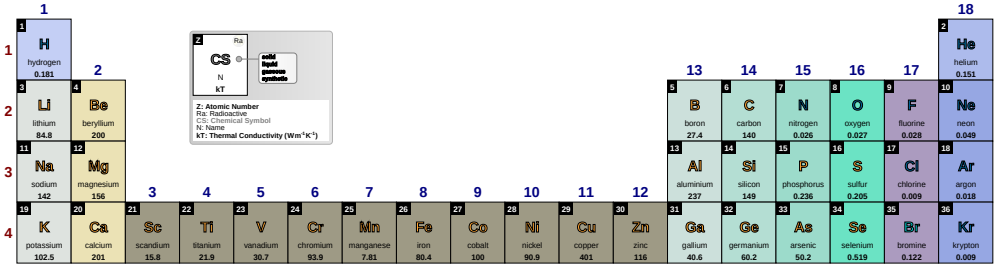
\pgfPT[kT precision=1]



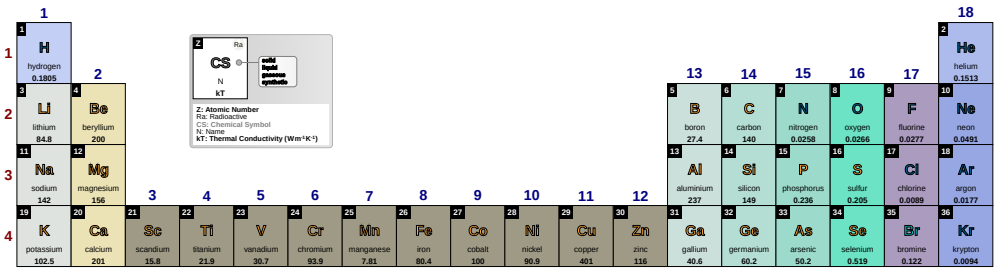
\pgfPT[kT precision=2]



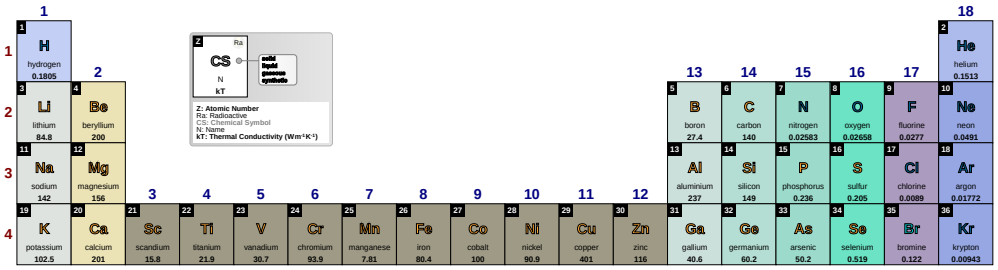
\pgfPT[kT precision=3]



\pgfPT[kT precision=4]



\pgfPT[kT precision=5]

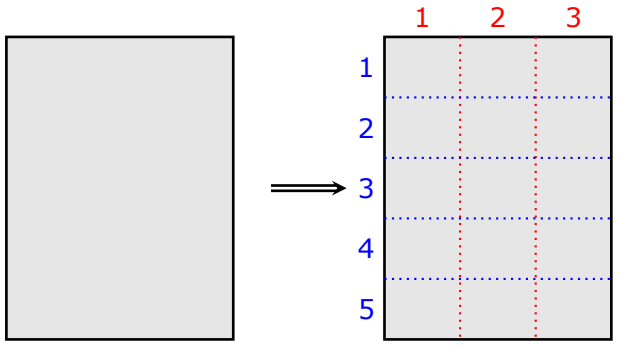


\pgfPTresetstyle

Designing cells with \pgfPTbuildcell

To start designing the *base cell* of the Periodic Table it is necessary to keep in mind that each cell will be split into **n** rows and **k** columns.

As a running example, 5 rows and 3 columns will be used:

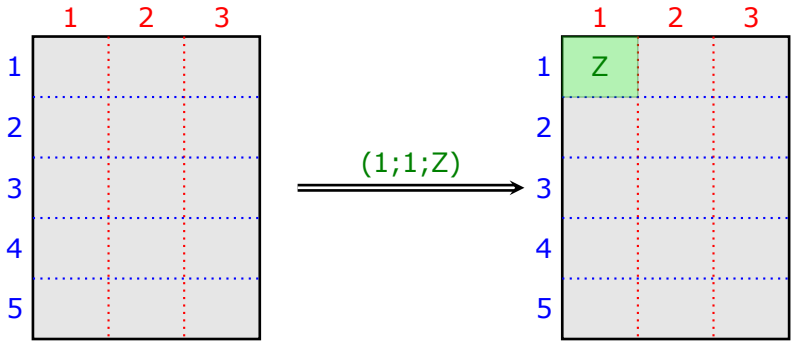


The next task is to assign contents to the cell by typing *trios* with the structure

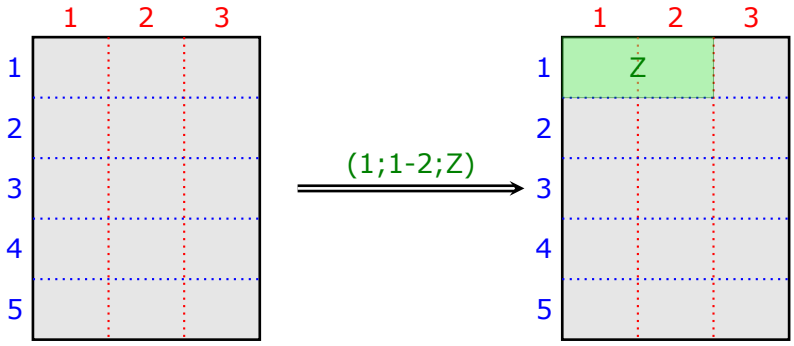
- **(row;column;content)**
- or **(start row-end row;start column-end column;content)**
- or a combination of both.

The available **contents** are: Z, name, CS, Ar, Ar*, radio, R, Rcov, Rion, Ei, eneg, eaff, O, Tmelt, TmeltC, Tboil, TboilC, eDist, eConfign, eConfignl, d, Cp, kT, ls, lsa, lsb, lsc, lsca, DiscY, DiscC and spectra.

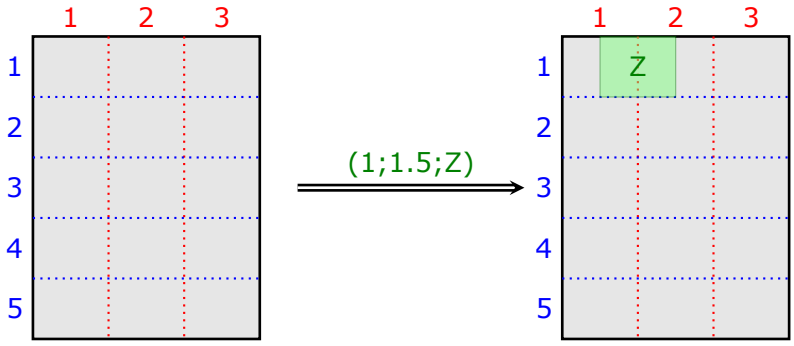
Assigning, for instance, (1;1;Z) will show the atomic number in the first row and in the first column,



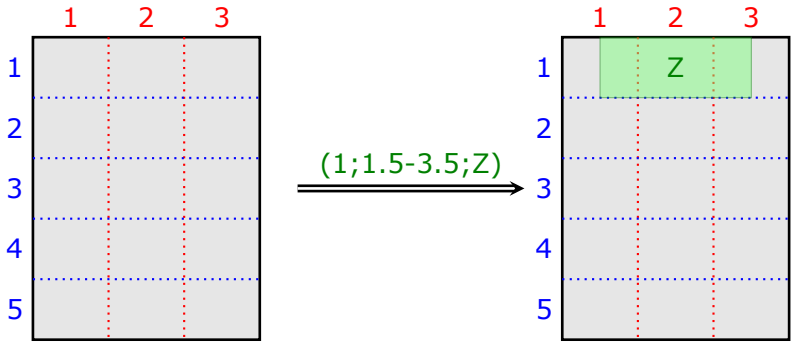
while the assignment (1;1-2;Z) will show the atomic number in the first row and filling the first and second columns,



It is also possible to start at a *fraction* of a line or column. If it is intended to start a line at the middle of the first column the value used should be 1.5, which means that the start value is at the half (*0.5*) of the first column (*1*), observing that *1.5* is *0.5* plus *1*:



As in the second example above it is possible to end up in a specified *fraction* of a line or column:



The row, column *syntax*

Both lines and columns share the same syntax, where n is any integer between 1 and the number of rows and f is the fractional part of any number between 0 and 1:

(1) If only the row number n is provided the *content* is placed at the row n .

(2) If the row number n is provided followed by a dot and a number f, the *content* is placed at the fraction f of the row n.

(3) If the start row n_s and the end row n_e are provided separated by a dash, *i.e.*, n_s-n_e, the *content* is placed filling all the rows from n_s to n_e.
The dot notation described in **(2)** *can be used both on* n_s *and* n_e.

(4) All of the items above apply to columns in the same way.

✠ The cell contents

- ✓ **Z** – the atomic number of the elements.
- ✓ **name** – the name of the elements.
- ✓ **CS** – the chemical symbol of the elements.
- ✓ **Ar** – the relative atomic mass (atomic weight) of the elements.
- ✓ **Ar*** –the standard relative atomic mass (standard atomic weight) of the elements.

- ✓ **radio** – radioactivity of the elements. If the element is radioactive the figure ☢ is placed in the cell, otherwise nothing is shown.
- ✓ **R** – the atomic radius of the elements. The atomic radius shown is the calculated radius and is expressed in picometers.
- ✓ **Rcov** – the covalent radius of the elements. The covalent radius shown is for single bonds and is expressed in picometers.
- ✓ **Rion** – the ionic radius of the elements. The radius shown is the effective ionic radius in picometers.
- ✓ **Ei** – the first ionization energy of the elements, measured in $\mathrm{kJ \cdot mol^{-1}}$. All data from rutherfordium onwards is predicted.
- ✓ **eneg** – the Pauling electronegativity of the elements.
- ✓ **eaff** – the electroaffinity (electron affinity) of the elements, measured in $\mathrm{kJ \cdot mol^{-1}}$. Estimated negative values have been replaced by zero, since the negative ions formed in these cases are always unstable (they may have lifetimes of the order of microseconds to milliseconds, and invariably autodetach after some time).
- ✓ **O** – the common oxidation states of the elements.
- ✓ **Tmelt** – the melting point, in Kelvin, of the elements.
- ✓ **TmeltC** – the melting point, in degrees Celsius, of the elements.
- ✓ **Tboil** – the boiling point, in Kelvin, of the elements.
- ✓ **TboilC** – the boiling point, in degrees Celsius, of the elements.
- ✓ **eDist** – the electron distribution of the elements.
- ✓ **eConfign** – the electronic configuration, in increasing n (principal quantum number), of the element, corresponding to the *spectroscopic* order of orbital energies, that is, the reverse of the order in which electrons are removed from a given atom to form positive ions.

  ***Note**: the short version of the electronic configuration is used, i.e., [previous noble gas]remaining electrons. For example, for scandium it is:* [Ar]$3d^1 4s^2$
- ✓ **eConfignl** – the electronic configuration, in increasing sum of n and ℓ (azimuthal quantum number), of the element, following the order based on the Madelung rule.

  ***Note**: the short version of the electronic configuration is used, i.e., [previous noble gas]remaining electrons. For example, for scandium it is:* [Ar]$4s^2 3d^1$
- ✓ **d** – the density of the elements, in the corresponding physical state, at 25°C and 1 atm.
- ✓ **Cp** – the specific heat capacity of the elements in $\mathrm{J \cdot mol^{-1} \cdot K^{-1}}$ at 25°C and 100 kPa.
- ✓ **kT** – the thermal conductivity of the elements in $\mathrm{J \cdot m^{-1} \cdot K^{-1}}$ at 25°C.
- ✓ **ls** – the lattice structure of the elements at 1 bar and mostly at 25°C.
- ✓ **lsa** – the lattice constant a of the elements in picometers at 1 bar and mostly at 25°C.
- ✓ **lsb** – the lattice constant b of the eligible elements in picometers at 1 bar and mostly at 25°C.
- ✓ **lsc** – the lattice constant c of the eligible elements in picometers at 1 bar and mostly at 25°C.
- ✓ **lsca** – the lattice c/a ratio of the eligible elements at 1 bar and mostly at 25°C.
- ✓ **DiscY** – the discovery year of the elements.
- ✓ **DiscC** – the discovery country or in, a few cases, region (Middle East or Asia Minor) of the elements.
- ✓ **spectra** – the emission spectrum of the elements. The spectrum is only shown if available. The spectra are pre-built using the package pgf-spectra via the commands:

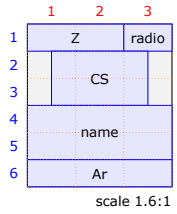
```
\pgfspectraStyle[back=visible40,line width=1pt,width=180pt,height=45pt,%
                 relative intensity,relative intensity threshold=.375,%
                 brightness=.5,charge=all,Imin=.125,gamma=1]
\foreach \SQ in {H,He,(...),Bi,Po,Rn,Fr,(...),Es}% Z=1,2,(...),83,84,86,87,(...),99
         {%
         \pgfspectra[element=\SQ]%
         }%
```

✠ Built-in cell styles

There is a set of *built-in* cell styles that could be used for the described purposes:

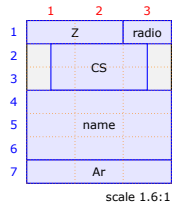
✓ **pgfPT2lang** – a cell layout to use with the name in two languages.

Built-in style **pgfPT2lang**
The build command:
\pgfPTbuildcell(6,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4-5;1-3;name),(6;1-3;Ar)]



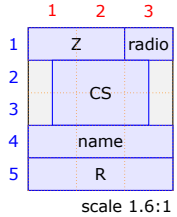
✓ **pgfPT3lang** – a cell layout to use with the name in three languages.

Built-in style **pgfPT3lang**
The build command:
\pgfPTbuildcell(7,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4-6;1-3;name),(7;1-3;Ar)]



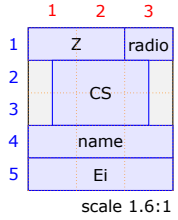
✓ **pgfPTR** – a cell layout to display the atomic radius and its periodic variations (if of course the show periodic variations key is set to true).

Built-in style **pgfPTR**
The build command:
\pgfPTbuildcell(5,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;R)]



✓ **pgfPTEi** – a cell layout to display the first ionization energy and its periodic variations (if of course the show periodic variations key is set to true).

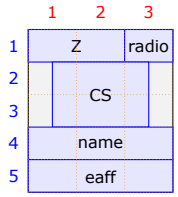
Built-in style **pgfPTEi**
The build command:
```
\pgfPTbuildcell(5,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;Ei)]
```



scale 1.6:1

✓ **pgfPTeaff** – a cell layout to display the electron affinity and its periodic variations (if of course the show periodic variations key is set to true).

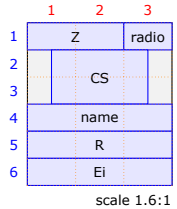
Built-in style **pgfPTeaff**
The build command:
```
\pgfPTbuildcell(5,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;eaff)]
```



scale 1.6:1

✓ **pgfPTREi** – a cell layout to display the atomic radius and first ionization energy and their periodic variations (if of course the show periodic variations key is set to true).

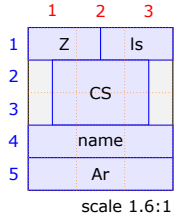
Built-in style **pgfPTREi**
The build command:
```
\pgfPTbuildcell(6,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;R),(6;1-3;Ei)]
```



scale 1.6:1

✓ **pgfPTls** – a cell layout to display the lattice system.

Built-in style **pgfPTls**
The build command:
```
\pgfPTbuildcell(5,3)%
[(1;1-2.5;Z),(1;2.5-3;ls),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;Ar)]
```

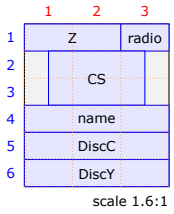


scale 1.6:1

✓ **pgfPTdisc** – a cell layout to display the discovery country and discovery year.

Built-in style **pgfPTdisc**
The build command:

```
\pgfPTbuildcell(6,3)%
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;DiscC),(6;1-3;DiscY)]
```



Designing color schemes

There are three ways to make a new color scheme:

- with the command \pgfPTnewColorScheme
- using the *script* in the file pgfPTcolorSchemes.html
- with the commands provided by the colorschemes library (see the libraries section).

✠ Designing a color scheme with \pgfPTnewColorScheme

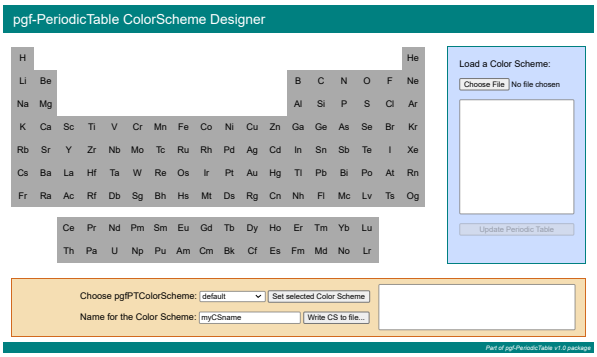
This command provides a way to set the cell background color of each of the 118 elements of the Periodic Table. *If the intention is to set the background color for all of them, it is highly recommended to use the file pgfPTcolorSchemes.html*, unless the trailing color begin at a small atomic number.

Despite that, this command can always be used taking into account:

1. It has the form \pgfPTnewColorScheme[trailing color]{name}{color list} where:
   - the first argument (enclosed by square brackets) is optional. If provided, the specified trailing color will be used, otherwise the default color (white) will be used as trailing color.
   - the second and third arguments are mandatory and specify, respectively, the color scheme name and the color list.
2. The name is any name made up of letters (only the characters a,…,z and A,…,Z).
3. The color list is a comma-separated list where each entry has the format r/g/b, representing the red, blue and green values, between 0 and 1, of the color: the first entry of the list will be the background color used in the cell of the element with atomic number 1, the second entry, the background color of the cell of the element with atomic number 2, and so on.

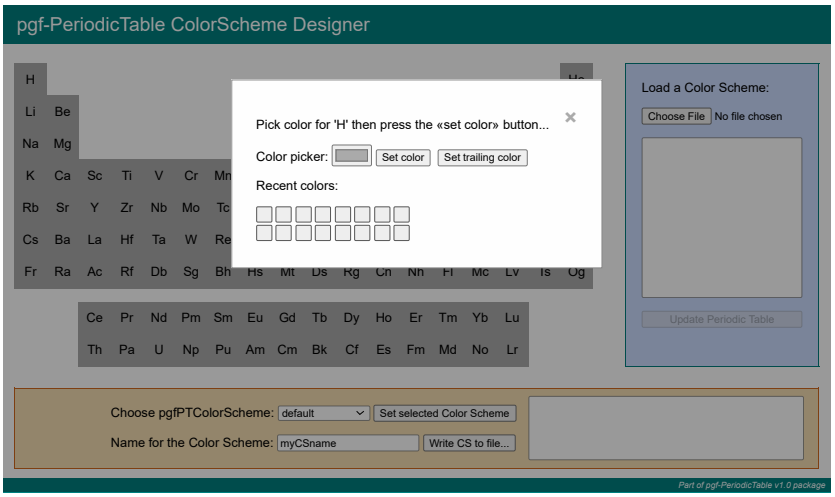
   If the color list has ten entries, these entries will set the background colors of the elements with atomic numbers from 1 to 10. For the following atomic numbers, greater than or equal to 11, the trailing color will be used in the color background.

✠ Designing a color scheme with pgfPTcolorSchemes.html



The pgfPTcolorSchemes.html *designer* is an *html* file with a little *javascript* code to perform the task of building a color scheme to use with the back color scheme key associated with the \pgfPT command.

The Periodic Table of the Elements is displayed on the page and clicking on an element opens a color dialog:



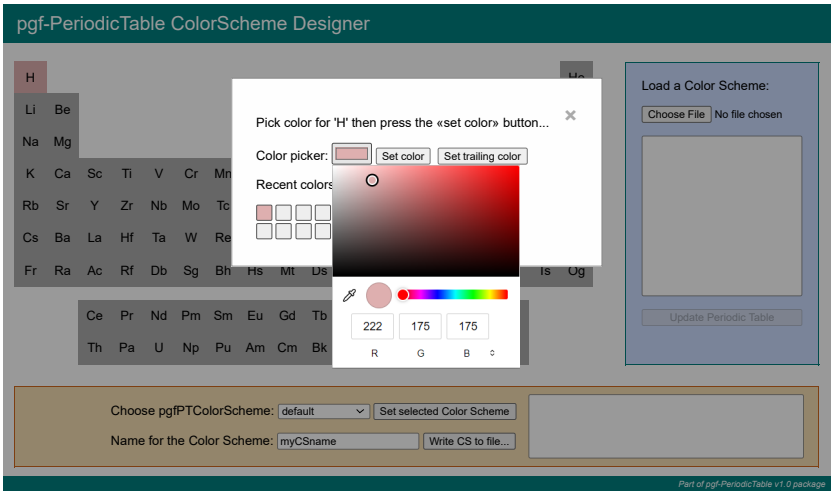
Pick color for 'H' then press the «set color» button...

Choose pgfPTColorScheme: default

Name for the Color Scheme: myCSname

No file chosen

Clicking on the Color picker: ■ button opens a color dialog, where there is the possibility to choose the desired color or manually enter one color using one of the three models available (RGB, HSL or HEX):



Pick color for 'H' then press the «set color» button...

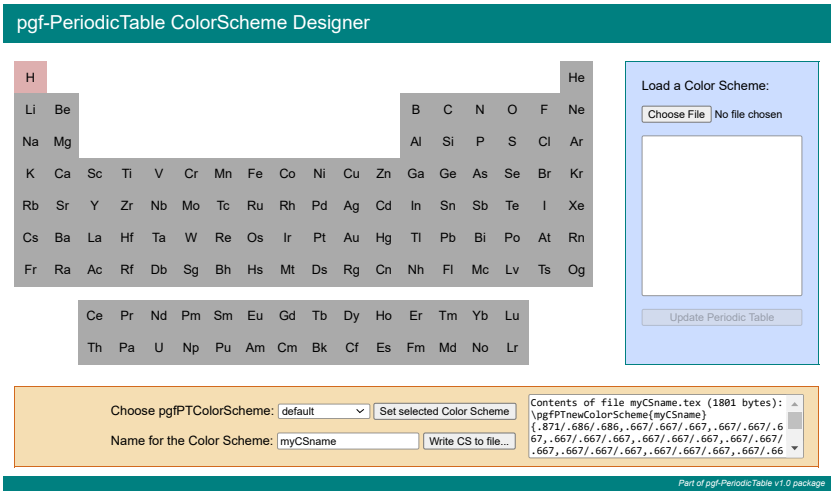
R 222 G 175 B 175

Choose pgfPTColorScheme: default

Name for the Color Scheme: myCSname

No file chosen

After changing the desired colors it is possible to save the color scheme in a file by clicking on Write CS to file...:



Choose pgfPTColorScheme: default

Name for the Color Scheme: myCSname

No file chosen

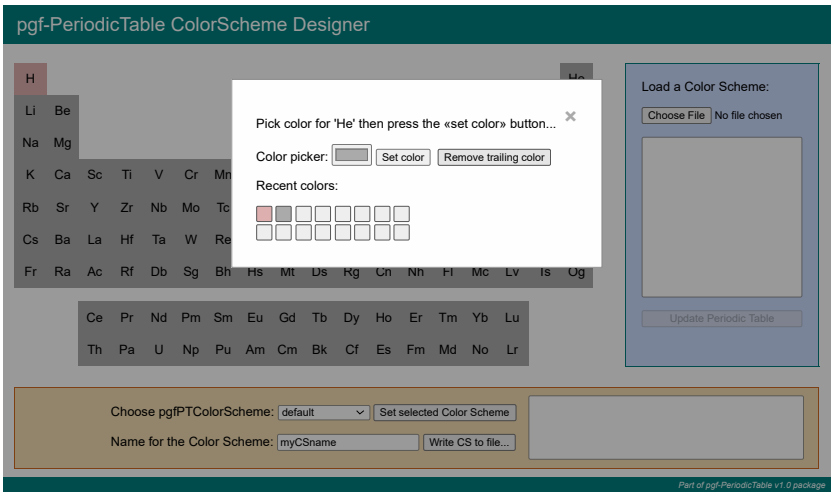
```
Contents of file myCSname.tex (1801 bytes):
\pgfPTnewColorScheme{myCSname}
{.871/.686/.686,.667/.667/.667,.667/.667/.6
67,.667/.667/.667,.667/.667/.667,.667/.667/
.667,.667/.667/.667,.667/.667/.667,.667/.66
```

To use a color scheme saved in a file there are two possible ways:

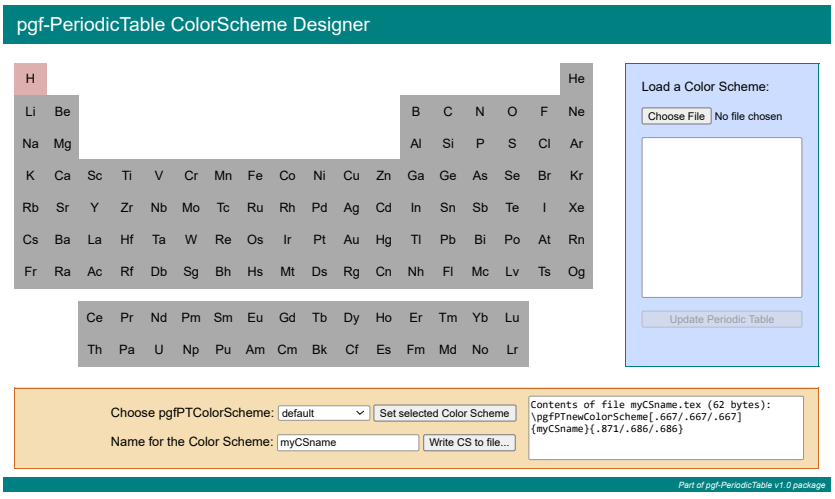
- loading the file in the working document via the \input LaTeX command, for instance, \input{myCSname.tex}.
- or by opening the file and copying and pasting its contents into the working document.

In either case, the operation can be performed at any location in the document, but before the named color scheme is used.

Note that in the previous example there is only one color that has been defined (for hydrogen). In that case, it is useful to set the trailing color in helium by clicking in Set trailing color (which automatically changes to Remove trailing color). After that only the hydrogen and helium are clickable, all the other elements are locked to click:

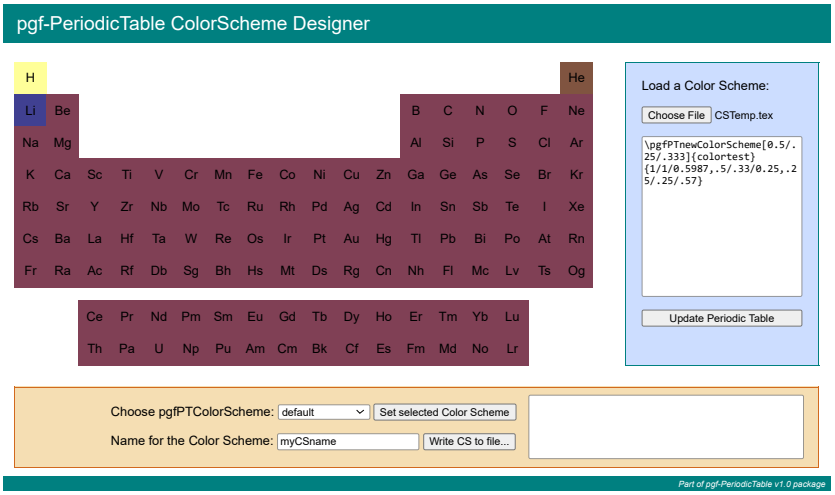


Then the saved color scheme will have the optional trailing color and the size will be smaller as only the color codes of the changed elements are stored:

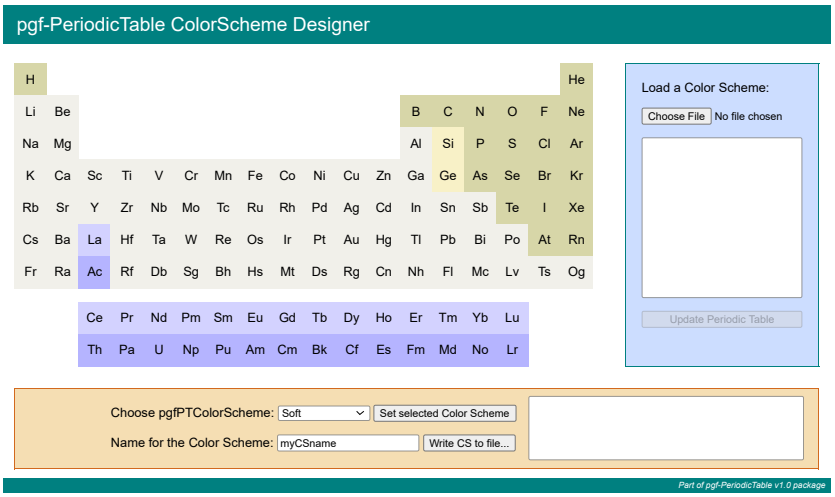


To remove the trailing color click on the last enabled element (in the above case helium) and then click on Remove trailing color. After that, all elements can be clicked again.

It is also possible to load a color scheme saved to a file by clicking on Choose File and then clicking on Update Periodic Table for the color scheme to take effect:



Finally its possible to load a built-in color scheme by choosing a named *pgfPTColorScheme* in the corresponding combo box and then clicking on Set selected Color Scheme:



All the operations described are always available.

Libraries

In this part the library packages are documented. They provide additional commands to extend the capabilities provided by this package out of the box. The libraries are not loaded by default since many users will not need them.

▸ Color Schemes Library

pgf-PeriodicTable Library colorschemes

USAGE: \usepgfPTlibrary{colorschemes}

This library extends the features provided by the command \pgfPTnewColorScheme. It defines a set of commands that automatically generate a new color scheme.

- \pgfPTGroupColors{name of the new color scheme}{list of colors,options}
- \pgfPTPeriodColors{name of the new color scheme}{list of colors,options}
- \pgfPTCScombine[proportion,mode]{name of the first color scheme,name of the second color scheme,name of the new color scheme}
- \pgfPTCSwrite[filename]{list of color schemes names}

Color arguments for this library's commands can use both the base package syntax – namedColor or namedColorA!##!namedColorB<!##><!named...> – or any color model supported by the `xcolor` package[a] using the *special syntax* *[model:values], *e.g.*, *[rgb:.5;.2;.3] or *[cmyk:.5;.2;.3;.3] or *[HTML:5FA287]. **The values for the individual color components of a color specified this way must be separated by semicolons instead of commas**, except for the HTML, Gray and wave color models as explained in the `xcolor` package.

[a] See Table 3: Supported color models on page 10 of the documentation of xcolor v2.14 2022/06/12

\pgfPTGroupColors[default group color]{name of the new color scheme}{list of colors,options}

This command **creates a Color Scheme** with the name name of the new color scheme. **Group colors** can be configured in three different ways:

- **setting the colors one by one**, using the *key=value* mechanism in the list of colors. For example:

```
\pgfPTGroupColors{name of the new color scheme}%
{G1=red,G2=red!50,G3=orange,<...>,G18=blue,options}
```

This will set the specified color for each group. If no color is specified for a group, default group color will be used.

NOTE: default group color is initially set to white.

- **defining a gradient** using the keys left color=<color>, middle color=<color> and right color=<color> as the list of colors. Note that all the keys are optional, but at least one of them is required. This produces a gradient starting from group 1, with *left color*, to group 18, with *right color*. If the *middle color* key is used then the gradient starts at group 1 with *left color*, goes to the middle position of the groups (between groups 9 and 10) with *middle color* and ends at group 18 with *right color*. For example:

```
\pgfPTGroupColors{name of the new color scheme}%
{left color=red,right color=blue,options}
```

defines a gradient from red (group 1) to blue (group 18).

- **defining a custom gradient** as the list of colors by using the *key=value* mechanism inside the gradient key. For example:

```
\pgfPTGroupColors{name of the new color scheme}%
{gradient={G1=red,G4=red!50,G18=blue},options}
```

defines a gradient from red (group 1) to red!50 (group 4) and to blue (group 18).

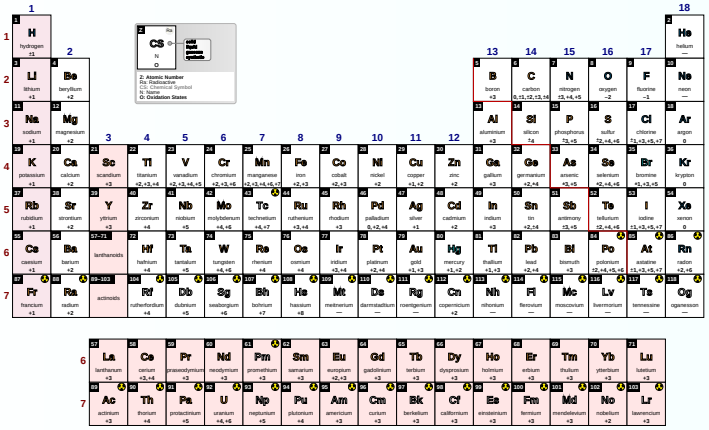
The options available to this command are:

- H=<color>, sets the color of the *hydrogen* cell. If not set, group 1's color will be used. If set, the color of the *hydrogen* cell won't be affected by period blending.
- La=<color>, sets the color of the *lanthanum* cell. If not set, group 3's color will be used.
- Lanta=<color>, sets the color of the *lanthanoids* cells. If not set, *lanthanum*'s color will be used.
- Ac=<color>, sets the color of the *actinium* cell. If not set, group 3's color will be used.
- Actin=<color>, sets the color of the *actinoids* cells. If not set, *actinium*'s color will be used.
- period blending={color=<color>, percentage=<positive or negative integer>, mode=<add|sub|linear>}, performs a *mode* blend over the periods up to the specified percentage with the provided color.

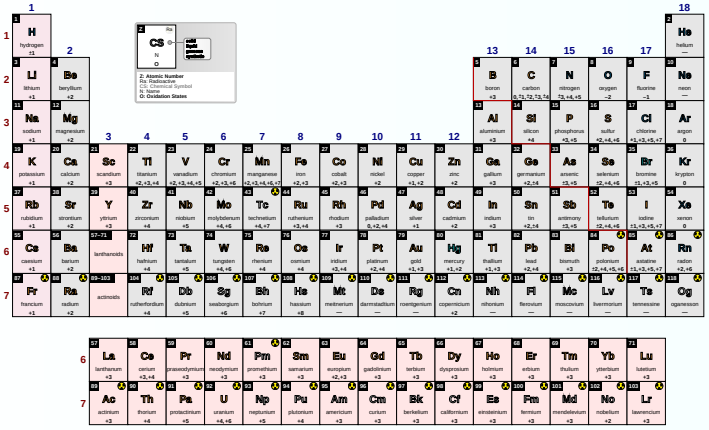
NOTES:

- percentage refers to how much of the color, in total, was mixed over the 7 periods. For example 60% adds 10% to each period: P1▶0% ⇝ P2▶10% ⇝ P3▶20% ⇝ ... ⇝ P7▶60%. If the percentage is positive, the mixing is done in descending order (from P1 to P7); if the percentage is negative, the mixing is done in ascending order (from P7 to P1).
- The mode's values are add for *additive* blending, sub for *subtractive* blending and linear for *linear* blending (as in the `xcolor` package).
- **If period blending is used without further options** all the default values are used, so period blending is equivalent to period blending={color=white,percentage=60,mode=linear}.
- None of the keys color, percentage and mode are mandatory. If omitted the default value is used.

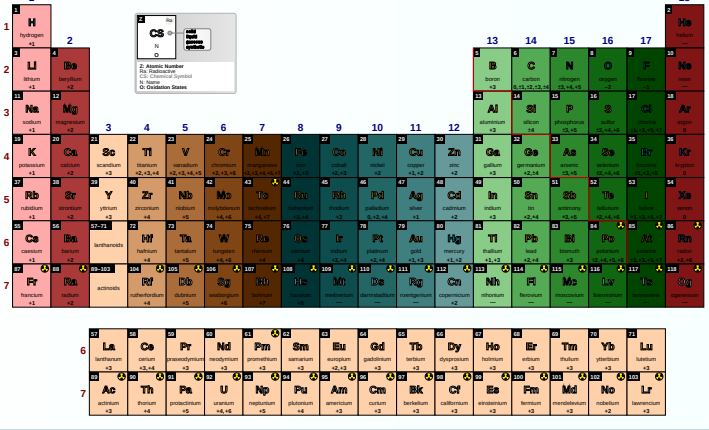
```
\pgfPTGroupColors{example}{G1=purple!10,G3=red!10}
\pgfPT[back color scheme=example,show title=false]
```



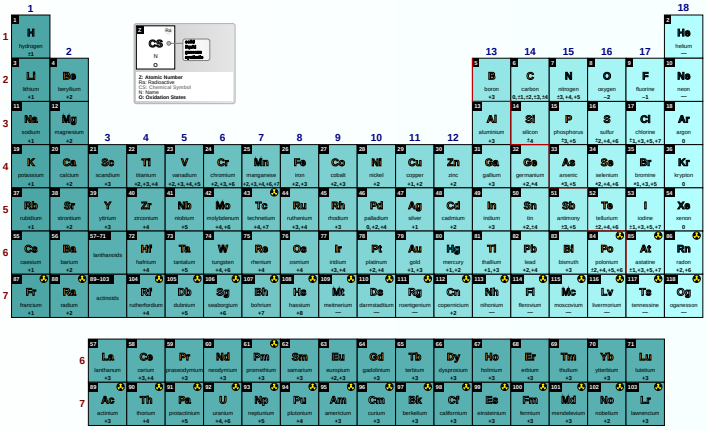
```
\pgfPTGroupColors[black!10]{example}{G1=purple!10,G3=red!10}
\pgfPT[back color scheme=example,show title=false]
```



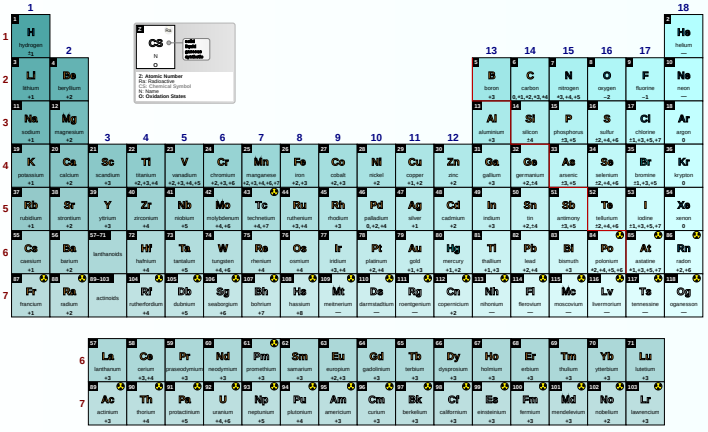
```
\pgfPTGroupColors{example}{G1=*[HTML:FFAAAA],G2=*[HTML:AA3939],
G3=*[HTML:FFD1AA],G4=*[HTML:D49A6A],G5=*[HTML:AA6C39],
G6=*[HTML:804515],G7=*[HTML:552700],G8=*[HTML:003333],
G9=*[HTML:0D4D4D],G10=*[HTML:226666],G11=*[HTML:407F7F],
G12=*[HTML:669999],G13=*[HTML:88CC88],G14=*[HTML:55AA55],
G15=*[HTML:2D882D],G16=*[HTML:116611],G17=*[HTML:004400],
G18=*[HTML:801515] }
\pgfPT[back color scheme=example,show title=false]
```



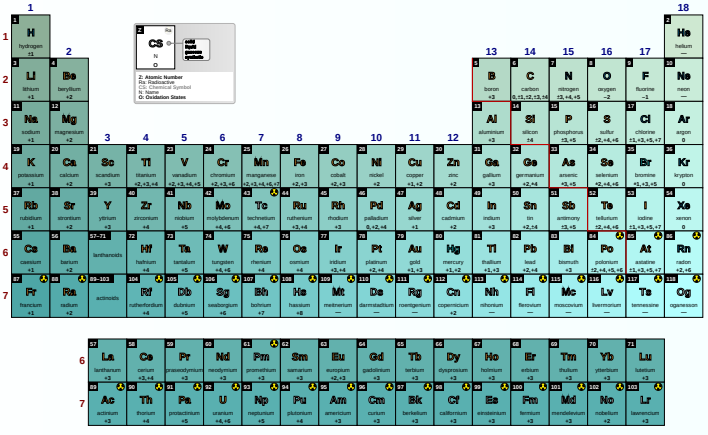
```
\pgfPTGroupColors{example}{left color=teal!70,right color=cyan!30}
\pgfPT[back color scheme=example,show title=false]
```



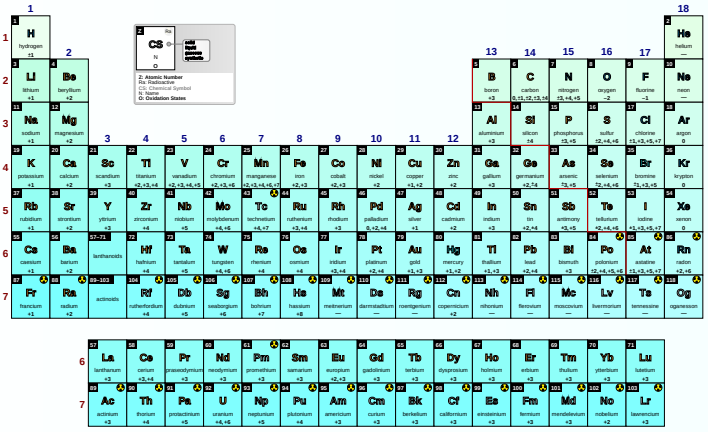
```
\pgfPTGroupColors{example}{left color=teal!70,right color=cyan!30,period blending}
\pgfPT[back color scheme=example,show title=false]
```



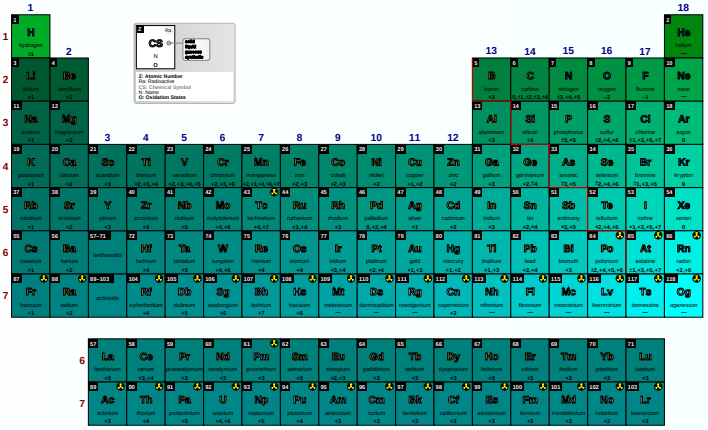
```
\pgfPTGroupColors{example}{left color=teal!70,right color=cyan!30,
period blending={color=orange!50,percentage=-40}}
\pgfPT[back color scheme=example,show title=false]
```



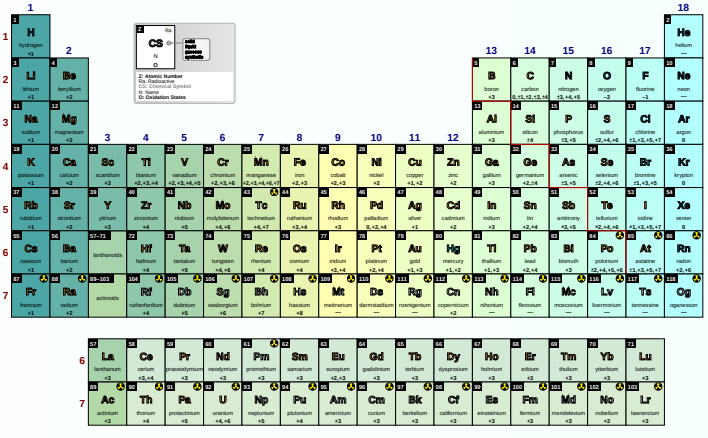
```
\pgfPTGroupColors{example}{left color=teal!70,right color=cyan!30,
period blending={color=orange!50,percentage=-40,mode=add},
H={*[cmyk:.071,0,.055,.035]}}
\pgfPT[back color scheme=example,show title=false]
```



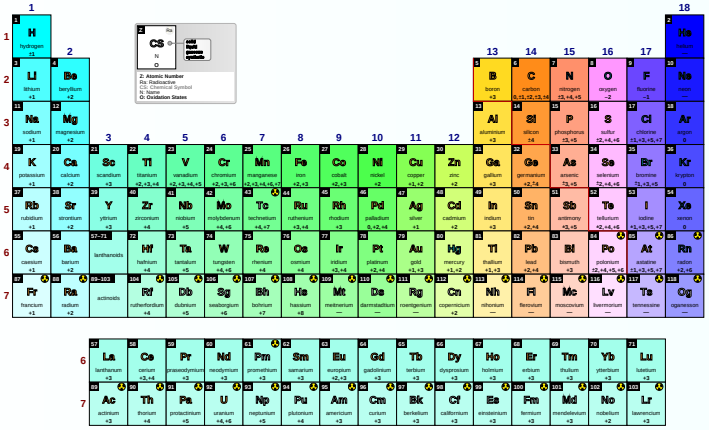
```
\pgfPTGroupColors{example}{left color=teal!70,right color=cyan!30,
period blending={color=orange!50,percentage=-40,mode=sub},
H=*[cmyk:.071;0;.055;.035]}
\pgfPT[back color scheme=example,show title=false]
```



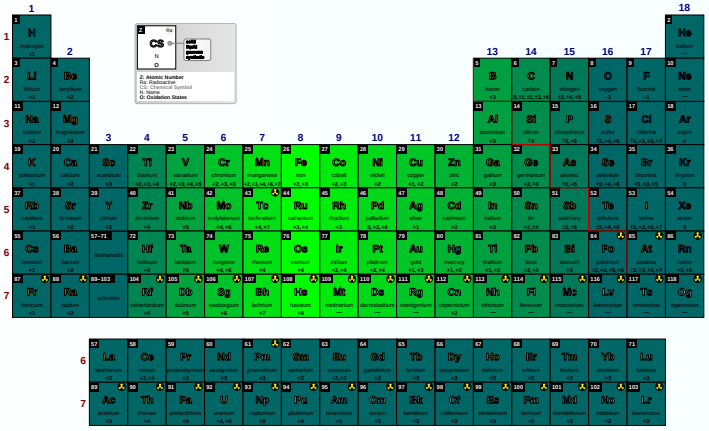
```
\pgfPTGroupColors{example}{left color=teal!70,middle color=yellow!30,right
color=cyan!30,La=teal!70!yellow!50,Ac=teal!60!yellow!50,
Lanta=teal!70!yellow!50!white!50,Actin=teal!60!yellow!50!white!50}
\pgfPT[back color scheme=example,show title=false]
```



```
\pgfPTGroupColors{example}{gradient={G1=teal!50!black,G2=teal,G10=green,
G14=orange,G18=blue},period blending={mode=add}}
\pgfPT[back color scheme=example,show title=false]
```



```
\pgfPTGroupColors{example}{gradient={G3=teal!80!black,G16=teal!80!black,
G8=green}}
\pgfPT[back color scheme=example,show title=false]
```



Note: the group numbers can be specified in any order and the gradient can start or end in any group. *In this example, the smallest group number is 3 and the greatest is 16, so the gradient is built from group 3 to group 16 and the colors from group 1 to 3 are equal to group 3's color, just like the colors from group 16 to 18 are equal to group 16's color.*

```
\pgfPTPeriodColors[default period color]{name of the new color scheme}{list of
colors,options}
```

This command **creates a Color Scheme** with the name name of the new color scheme. **Period colors** can be configured in three different ways:

✓ **setting the colors one by one**, using the *key=value* mechanism in the list of colors. For example:

```
\pgfPTPeriodColors{name of the new color scheme}%
{P1=red,P2=red!50,<...>,P7=blue,options}
```

This will set the specified color for each period. If no color is specified for a period,

default period color will be used.

NOTE: default period color is initially set to white.

✓ **defining a gradient** using the keys top color=<color>, middle color=<color> and bottom color=<color> as the list of colors. Note that all the keys are optional, but at least one of them is required. This produces a gradient starting from period 1, with *top color*, to period 7, with *bottom color*. If the *middle color* key is used then the gradient starts at period 1 with *top color*, goes to the middle position of the periods (period 4) with *middle color* and ends at period 7 with *bottom color*. For example:

```
\pgfPTPeriodColors{name of the new color scheme}%
{top color=red,middle color=yellow,bottom color=blue,options}
```

defines a gradient from red (period 1) to yellow (period 4) and from yellow (period 4) to blue (period 7).

✓ **defining a custom gradient** as the list of colors by using the *key=value* mechanism inside the gradient key. For example:

```
\pgfPTPeriodColors{name of the new color scheme}%
{gradient={P1=red,P3=red!50,P7=blue},options}
```

defines a gradient from red (period 1) to red!50 (period 3) and to blue (period 7).

The options available to this command are:

✓ H=<color>, sets the color of the *hydrogen* cell. If not set, period 1's color will be used. If set, the color of the *hydrogen* cell won't be affected by group blending.

✓ La=<color>, sets the color of the *lanthanum* cell. If not set, period 6's color will be used.

✓ Lanta=<color>, sets the color of the *lanthanoids* cells. If not set, *lanthanum*'s color will be used.

✓ Ac=<color>, sets the color of the *actinium* cell. If not set, period 7's color will be used.

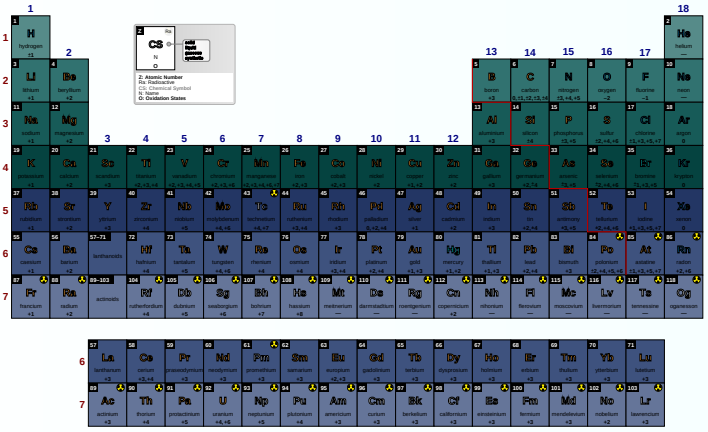
✓ Actin=<color>, sets the color of the *actinoids* cells. If not set, *actinium*'s color will be used.

✓ group blending={color=<color>, percentage=<positive or negative integer>, mode=<add|sub|linear>}, performs a *mode* blend over the groups up to the specified percentage with the provided color.

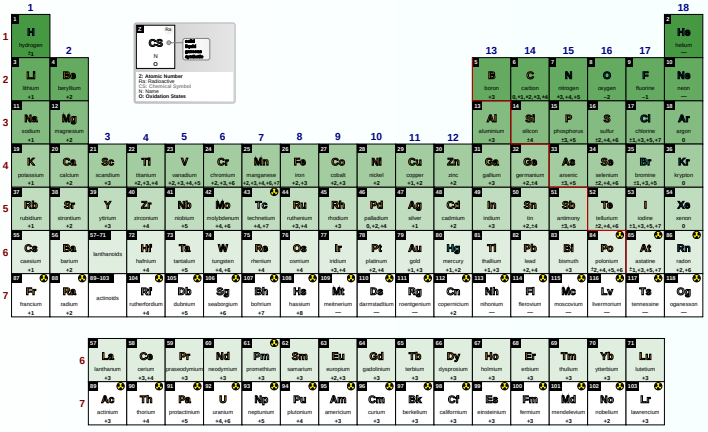
NOTES:

- ✓ percentage refers to how much of the color, in total, was mixed over the 18 groups. For example 68% adds 4% to each period: G1▶0% ⇝ G2▶4% ⇝ G3▶8% ⇝ ... ⇝ G18▶68%. If the percentage is positive, the mixing is done from left to right (from G1 to G18); if the percentage is negative, the mixing is done from right to left (from G18 to G1).
- ✓ The mode's values are add for *additive* blending, sub for *subtractive* blending and linear for *linear* blending (as in the `xcolor` package).
- ✓ **If group blending is used without further options** all the default values are used, so group blending is equivalent to group blending={color=white,percentage=68,mode=linear}.
- ✓ None of the keys color, percentage and mode are mandatory. If omitted the default value is used.

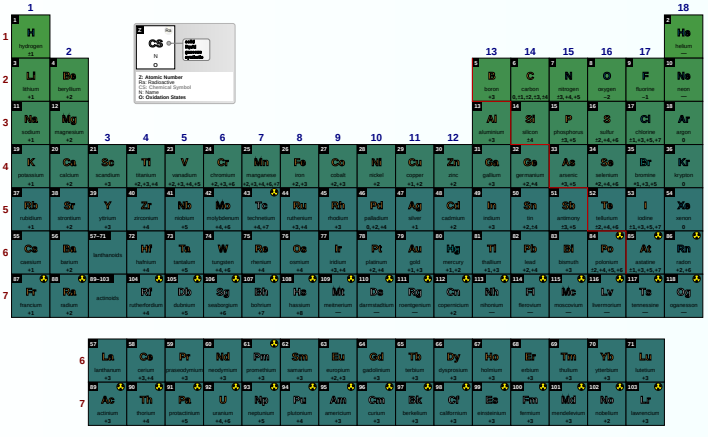
```
\pgfPTPeriodColors{example}{P1=*[RGB:86;139;137],P2=*[RGB:49;114;112],
P3=*[RGB:23;91;88],P4=*[RGB:5;67;64],P5=*[RGB:35;54;100],
P6=*[RGB:62;82;126],P7=*[RGB:101;117;153]}
\pgfPT[back color scheme=example,show title=false]
```



```
\pgfPTPeriodColors{example}{top color=*[Hsb:117;.57;.6]}
\pgfPT[back color scheme=example,show title=false]
```



```
\pgfPTPeriodColors{example}{gradient={P1=*[Hsb:117;.57;.6],
P5=*[Hsb:178;.57;.45]}}
\pgfPT[back color scheme=example,show title=false]
```



```
\pgfPTCScombine[prop1:prop2,mode]{name of color scheme one,name of color scheme two,name of the new color scheme}
```

This command **combines two named Color Schemes** and merges the result into a new Color Scheme with name of the new color scheme.
For example \pgfPTCScombine{myCSA,myCSB,myCSC} adds the color scheme myCSA to the color scheme myCSB and their sum will be available as the color scheme myCSC.

NOTE: if the Color Schemes have different sizes (*i.e.*, different number of colors), the last color from the color scheme that ends first will be used until the other color scheme also ends.

The optional parameters [prop1:prop2,mode] are for controlling how the two Color Schemes are combined:

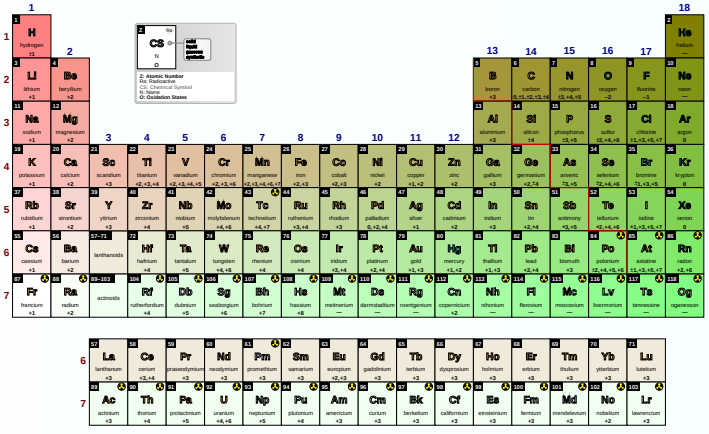
- ✓ The first parameter – prop1:prop2 – controls the proportions used to mix the color schemes: prop1 parts of name of color scheme one and prop2 parts of name of color scheme two. Both prop1 and prop2 must be integer values between 1 and 999.

  NOTE: default proportion is 1:1.
  For example, 1:4 *will mix each color in the ratio of 1 to 4, i.e., the nth-color from the first color scheme is used as 1/5 of the mixed color and the nth-color from the second color scheme is used as 4/5 of the mixed color*.

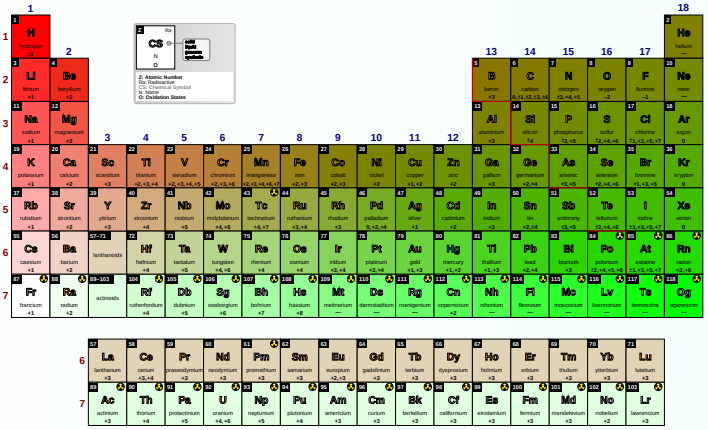
- ✓ The mode refers to how the colors are mixed: use add for *additive* mixing, sub for *subtractive* mixing and linear for *linear* mixing (as in the `xcolor` package).

  NOTE: default mode is linear.

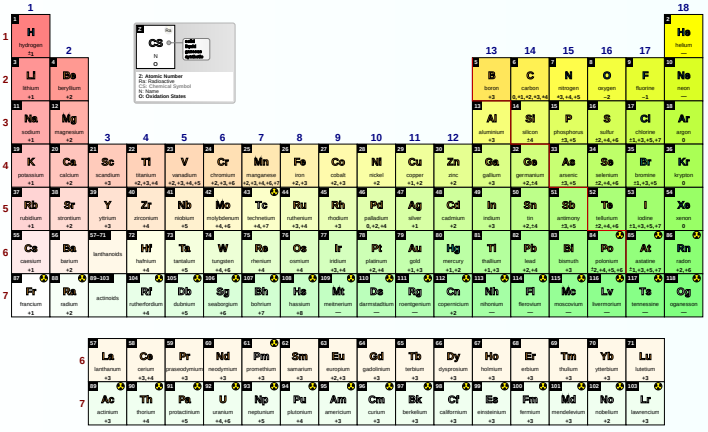
```
\pgfPTPeriodColors{period}{top color=red}
\pgfPTGroupColors{group}{right color=green}
\pgfPTCScombine{period,group,mix}
\pgfPT[back color scheme=mix,show title=false]
```



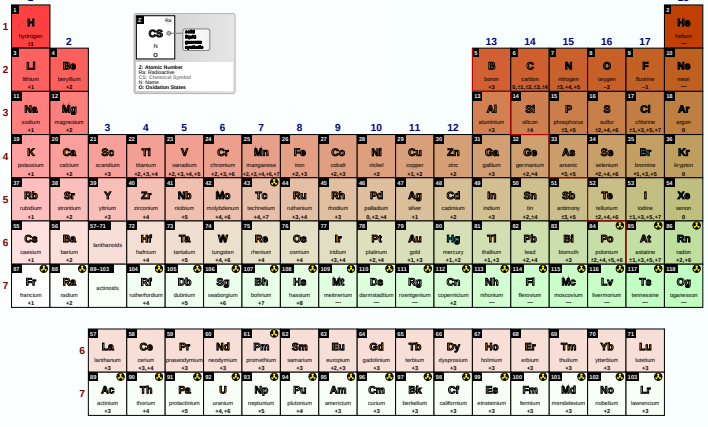
```
\pgfPTCScombine[sub]{period,group,mix}
\pgfPT[back color scheme=mix,show title=false]
```



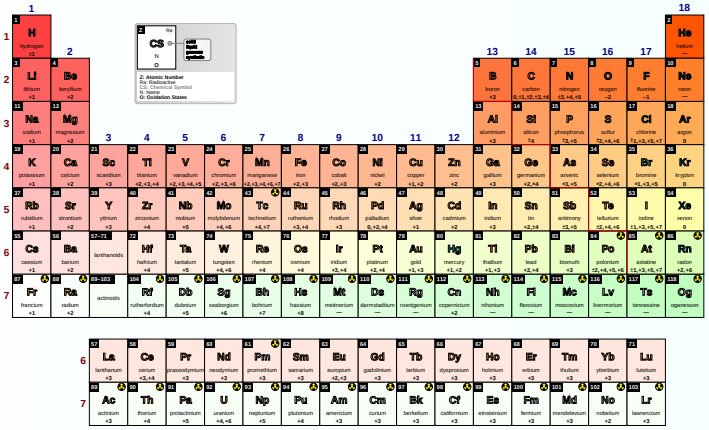
```
\pgfPTCScombine[add]{period,group,mix}
\pgfPT[back color scheme=mix,show title=false]
```



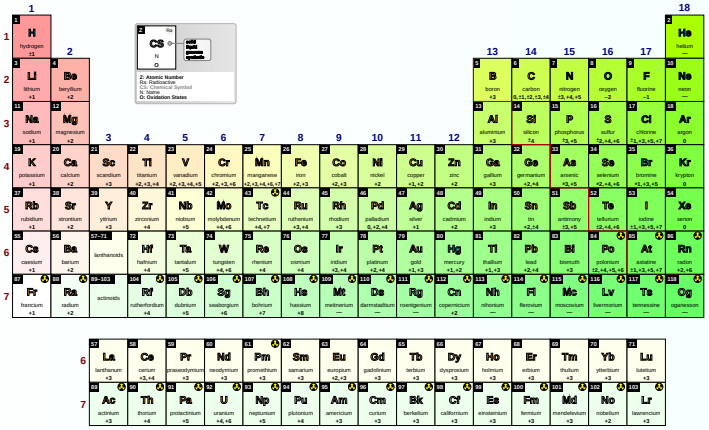
```
\pgfPTCScombine[3:1]{period,group,mix}
\pgfPT[back color scheme=mix,show title=false]
```



```
\pgfPTCScombine[3:1,add]{period,group,mix}
\pgfPT[back color scheme=mix,show title=false]
```

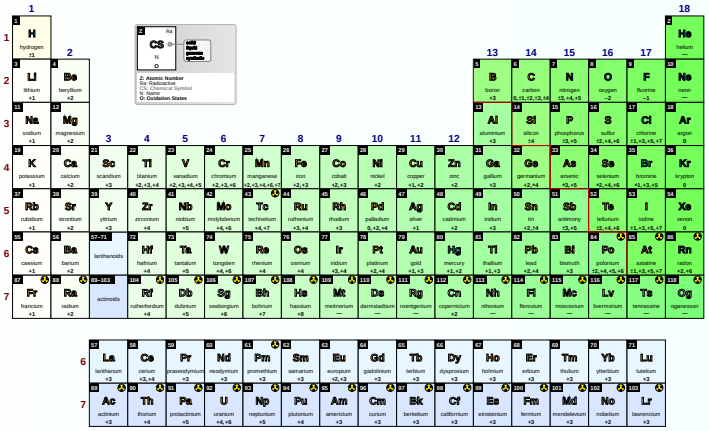


```
\pgfPTCScombine[add,2:3]{period,group,mix}
\pgfPT[back color scheme=mix,show title=false]
```

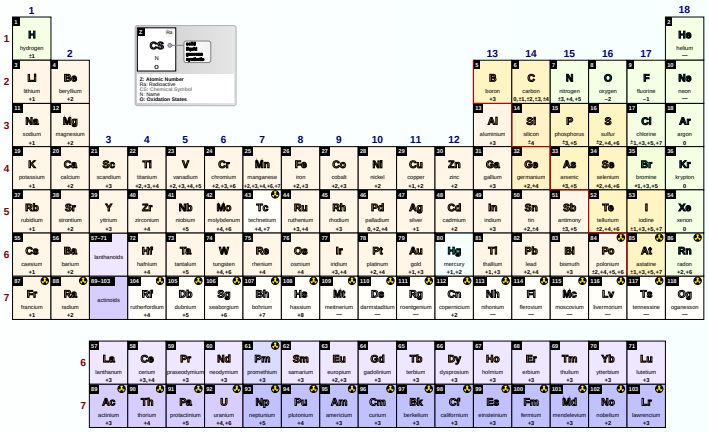


Built-in color schemes can also be mixed:

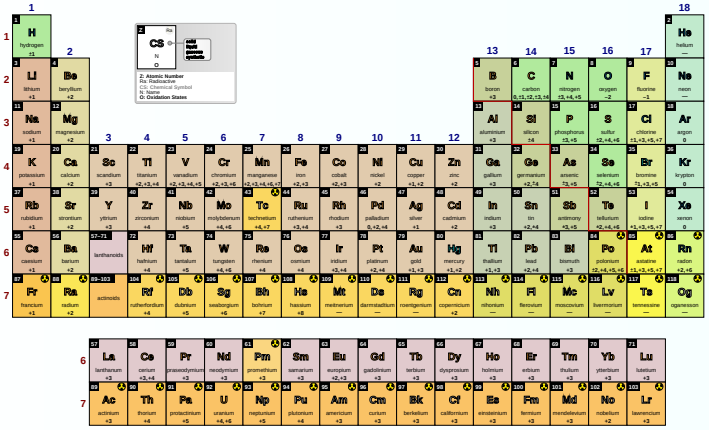
```
\pgfPTCScombine[add]{pgfPTSoft,group,mix}
\pgfPT[back color scheme=mix,show title=false]
```



```
\pgfPTCScombine[add,3:1]{pgfPTSoft,pgfPTPS,mix}
\pgfPT[back color scheme=mix,show title=false]
```



```
\pgfPTCScombine[add]{pgfPTRadio,pgfPTWikipedia,mix}
\pgfPT[back color scheme=mix,show title=false]
```



```
\pgfPTCSwrite[filename]{list of color schemes names}
```

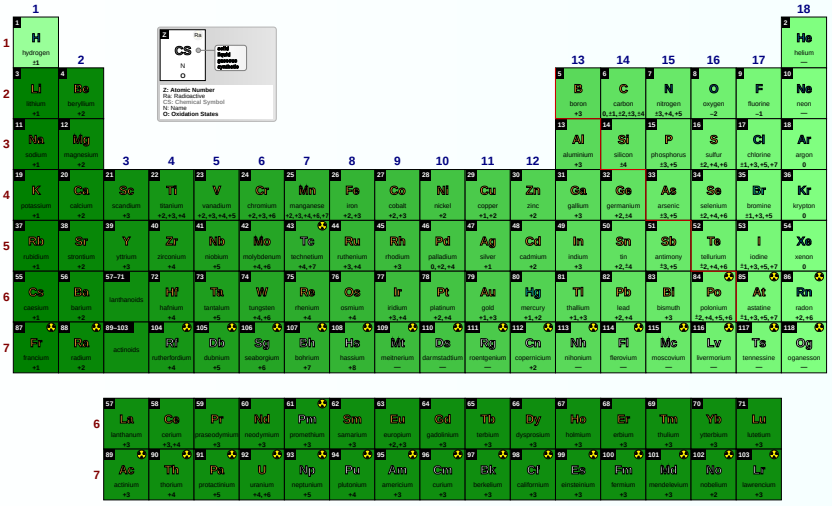
This command **writes the provided Color Schemes to a file** for later use without loading this library. It has a mandatory argument, the list of the color schemes names to be written and an optional argument, the filename. If no filename is provided the first name on the list of the color schemes names is used.
For example, `\pgfPTCSwrite[myGroupColors]{myGroupGradGreenToRed,myGroupGreens,myGroupGradYellowToRed}`, *will create (or overwrite), in the current working directory, a file with name* `myGroupColors.tex` *with the following contents*:

```
\pgfPTnewColorScheme{myGroupGradGreenToRed}{0/1/0,...
\pgfPTnewColorScheme{myGroupGreens}{0/1/.1,...
\pgfPTnewColorScheme{myGroupGradYellowToRed}{1/1/0,...
```

After that, it's possible to use `\input{myGroupColors.tex}`, anywhere in any document (in the same working directory). The named color schemes defined in the loaded file are now available for use as usual:

```
\pgfPTPeriodColors{myGroupGradGreenToRed}{gradient={G1=green!50!black,
G18=red!30!black},H=green!40!white}
\pgfPTPeriodColors{myGroupGreens}{gradient={G1=green!50!black,
G18=green!50!white},H=green!40!white}
\pgfPTPeriodColors{myGroupGradYellowToRed}{gradient={G1=yellow!50!white,
G18=red!30!black},H=yellow!40!white}
\pgfPTCSwrite[myGroupColors]{myGroupGradGreenToRed,myGroupGreens, myGroup-
GradYellowToRed}
```

```
%\usepgfPTlibrary{colorschemes}
\input{myGroupColors.tex}%
\pgfPT[back color scheme=myGroupGreens,show title=false]
```



Tips & Tricks: inspired by user questions

In this section a list of selected user questions and the corresponding answers can be found, hoping it can be useful to anyone using this package.

Control overall width of table

Is there a simple way to set the periodic table to text width, column width, etc.?

Yes, there is. It can be done using the \resizebox command provided by the graphicx package (and also by the graphics package). For example:

```
\resizebox{\linewidth}{!}{\pgfPT}
```

or

```
\resizebox{\linewidth}{!}{\pgfPT[show title=false]}
```

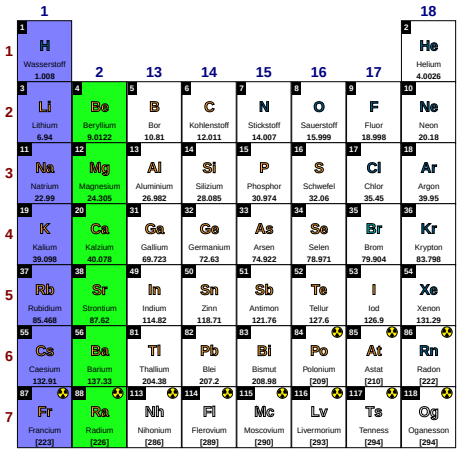
will produce a Periodic Table with the width of the current \linewidth, whatever is its value (the text width, the column width, the width of a minipage,...), and with the proper scaling of its height.
There is no need of loading the graphicx package since pgf-PeriodicTable loads the tikz package, which in turn loads the graphicx package.

Compact Periodic Table

Is there a way to put groups 1 and 2 really next to group 13 to 18? That would make the whole thing more compact. I sometimes need just the representative elements for teaching purposes.

Although it is not common usage, it can be done:

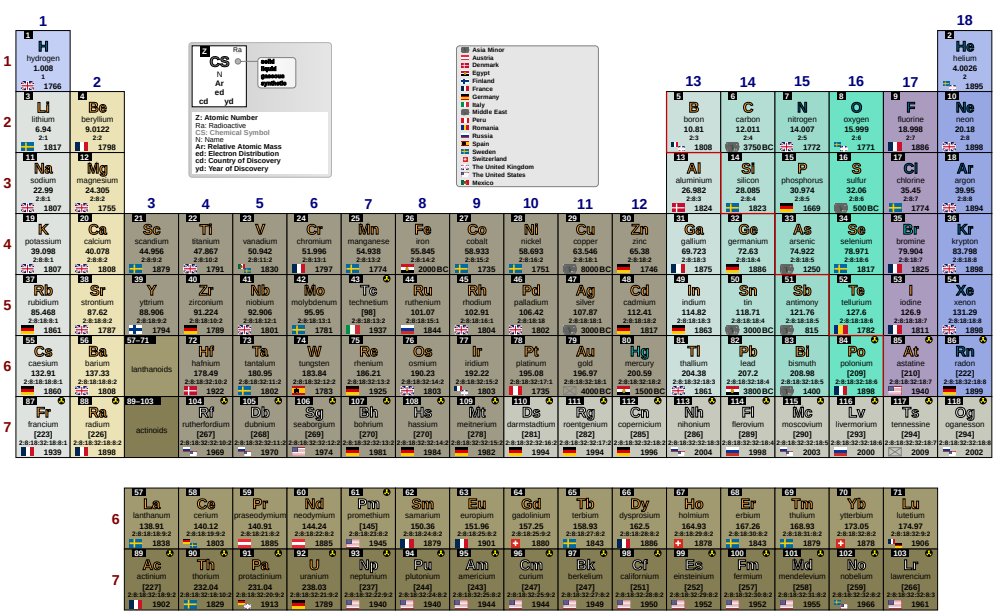
```
\documentclass[border=10pt]{standalone}
\usepackage{pgf-PeriodicTable}
\usepgfPTlibrary{colorschemes}
\pgfPTGroupColors{example}{G1=blue!50!white,G2=green!90!white}
\pgfPTsetLanguage{de}
\begin{document}
% \pgfPTstyle[show title=false, back color scheme=example,show legend=false]
% \pgfPT[Z list = G1]\foreach \n in {2,13,14,15,16,17,18} {%
%                     \pgfPT[show period numbers=false,Z list = G\n]%
%                     }% make sure there are no spaces between \pgfPT
% or
% \pgfPTstyle[show title=false,show period numbers=false,back color scheme=example,
%           show legend=false]
% \pgfPT[show period numbers,Z list = G1]\pgfPT[Z list = G2]\pgfPT[Z list = p]% make
%                                         sure there are no spaces between \pgfPT
% or
   \pgfPTstyle[show title=false,show period numbers=false,back color scheme=example,
             show legend=false]
   \pgfPT[show period numbers,Z list = s]\pgfPT[Z list = p]
\end{document}
```


1 18
1 H Wasserstoff 1.008
2 He Helium 4.0026
2 3 Li Lithium 6.94
4 Be Beryllium 9.0122
5 B Bor 10.81
6 C Kohlenstoff 12.011
7 N Stickstoff 14.007
8 O Sauerstoff 15.999
9 F Fluor 18.998
10 Ne Neon 20.18
3 11 Na Natrium 22.99
12 Mg Magnesium 24.305
13 Al Aluminium 26.982
14 Si Silizium 28.085
15 P Phosphor 30.974
16 S Schwefel 32.06
17 Cl Chlor 35.45
18 Ar Argon 39.95
4 19 K Kalium 39.098
20 Ca Kalzium 40.078
31 Ga Gallium 69.723
32 Ge Germanium 72.63
33 As Arsen 74.922
34 Se Selen 78.971
35 Br Brom 79.904
36 Kr Krypton 83.798
5 37 Rb Rubidium 85.468
38 Sr Strontium 87.62
49 In Indium 114.82
50 Sn Zinn 118.71
51 Sb Antimon 121.76
52 Te Tellur 127.6
53 I Iod 126.9
54 Xe Xenon 131.29
6 55 Cs Caesium 132.91
56 Ba Barium 137.33
81 Tl Thallium 204.38
82 Pb Blei 207.2
83 Bi Bismut 208.98
84 Po Polonium [209]
85 At Astat [210]
86 Rn Radon [222]
7 87 Fr Francium [223]
88 Ra Radium [226]
113 Nh Nihonium [286]
114 Fl Flerovium [289]
115 Mc Moscovium [290]
116 Lv Livermorium [293]
117 Ts Tenness [294]
118 Og Oganesson [294]

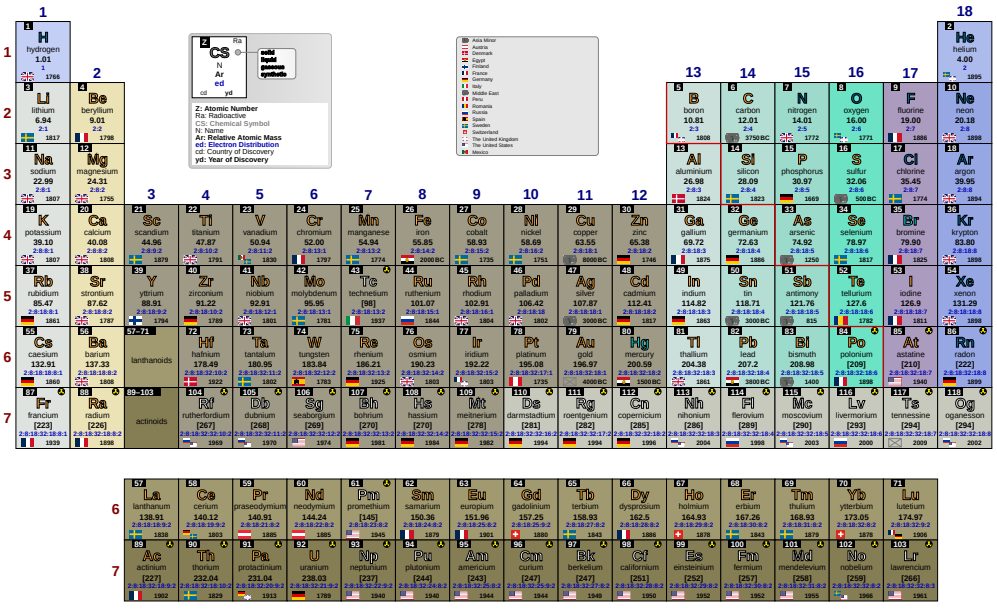
A few more examples

The following examples could be used for students or for any other purposes.

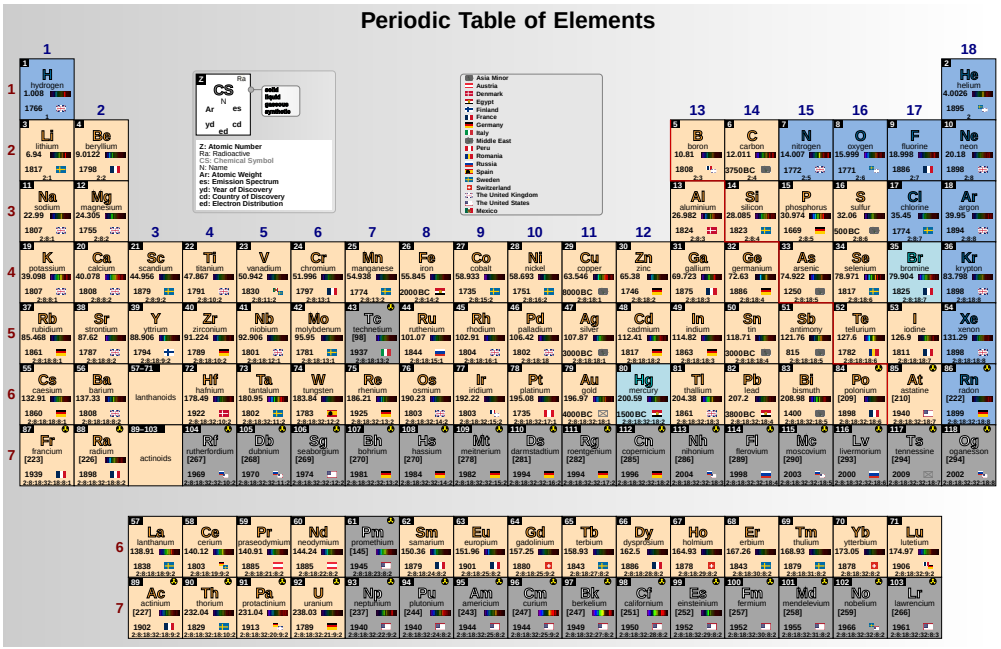
```
\pgfPTbuildcell(8,3)% 8 rows by 3 columns
[(1;1.4-2.8;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4.2;1-3;name),
(5.4;1-3;Ar),(6.5;1-3;eDist),(7.55-8.95;1-2.25;DiscC),(7.55-8.95;2.25-3.8;DiscY)]
\pgfPT
```



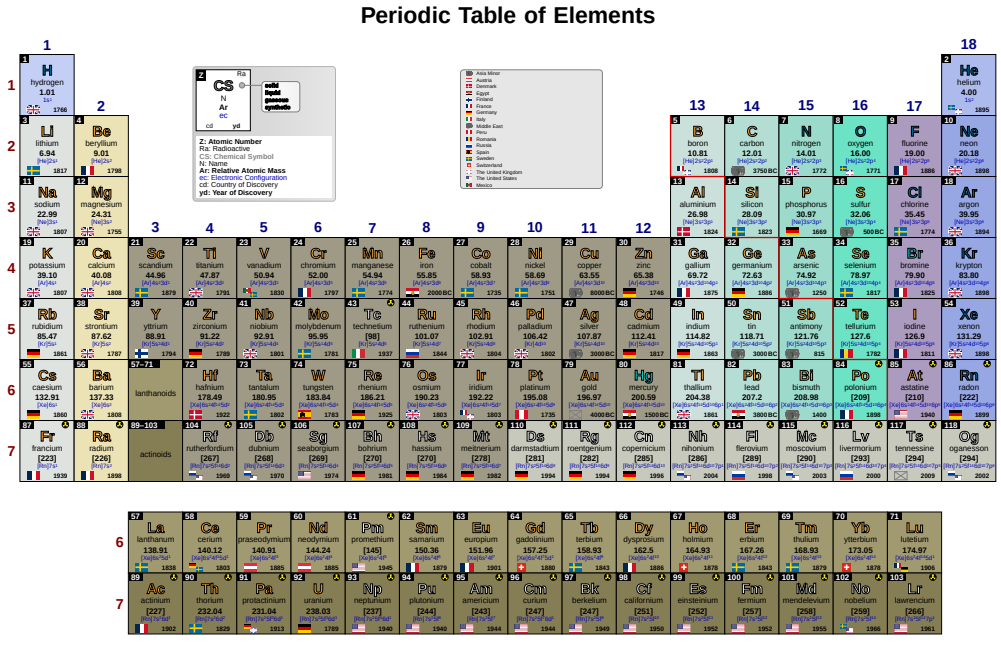

```
\pgfPT[eDist color=blue!70!black,Ar precision=2,DiscC
font=\fontsize{4}{4}\selectfont,DiscY font=\fontsize{4}{4}\selectfont\bfseries]
```



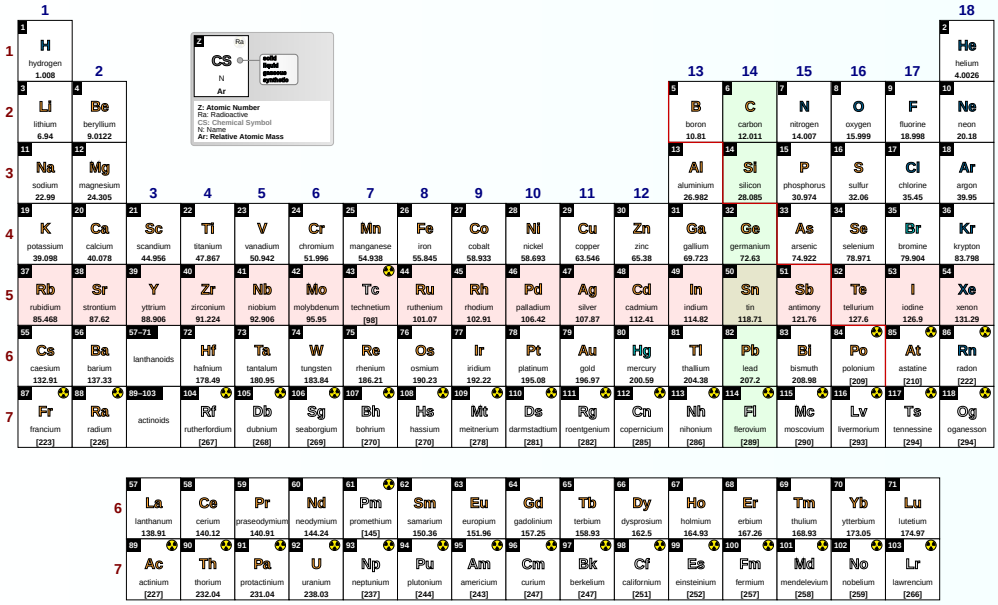
```
\pgfPTbuildcell(8,3)% 8 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1-3;CS),(4;1-3;name),(5;1-2.5;Ar),(5;2.5-3;spectra),
(7;1-2.5;DiscY),(7;2.5-3;DiscC),(8;1-3;eDist)]
        \pgfPT[csPS,Ar label=w,background={left color=black!20}]
```




```
\pgfPTbuildcell(8,3)% 8 rows by 3 columns
[(1;1-3;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4.2;1-3;name),(5.4;1-3;Ar),
(6.5;1-3;eConfignl),(7.55-8.95;1-2.45;DiscC),(7.55-8.95;2.45-3;DiscY)]
        \pgfPT[eConfignl color=blue!70!black,Ar precision=2,DiscC
    font=\fontsize{4}{4}\selectfont,DiscY font=\fontsize{4}{4}\selectfont\bfseries]
```



```
\usepgfPTlibrary{colorschemes}
\pgfPTPeriodColors{period}{P5=red!20}
\pgfPTGroupColors{group}{G14=green!20}
\pgfPTCScombine{period,group,mix}
\pgfPT[back color scheme=mix,show title=false]
```



In the Periodic Table, a row is called a **period** and a column is called a **group**.

Representative elements: element families

For the ***representative elements*** (groups **1**, **2** and **13** to **18**) it is common to speak of families that reflect their common characteristics. So we have **the families**:

GROUP **1**: **Alkali metals**

► *lithium, sodium, potassium, rubidium, cesium and francium.*

The atoms of these elements **have** only **one valence electron**.

- ✓ They react violently with water to form hydroxides.
- ✓ They have a silver-gray color, with the exception of cesium, which has a golden hue.

GROUP **2**: **Alkaline earth metals**

► *beryllium, magnesium, calcium, strontium, barium and radium.*

The atoms of these elements **have two valence electrons**.

- ✓ Their oxides remain solid at high temperatures and form alkaline solutions.
- ✓ They react violently with water to form hydroxides.
- ✓ When they burn, they have reddish flames, excluding barium, which presents a greenish flame.

GROUP 1**3**: ***Boron*** **group**

► *boron, aluminium, gallium, indium, thallium and nihonium.*

The atoms of these elements **have three valence electrons**.

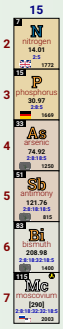
- ✓ Boron is a metalloid and the other are metals.
- ✓ Boron, aluminium, gallium, indium and thallium are often used as p-type silicon dopants.
- ✓ Aluminium is the third most abundant element in the Earth's crust (7.4%)

GROUP 1**4**: ***Carbon*** **group**

► *carbon, silicon, germanium, tin, lead and flerovium.*

The atoms of these elements **have four valence electrons**.

- ✓ Carbon is a non-metal, silicon and germanium are metalloids, and tin and lead are metals.
- ✓ Silicon and germanium are used in semiconductors.

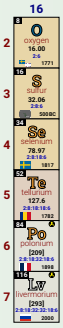


GROUP 1**5**: **Pnictogens**

► *nitrogen, phosphorus, arsenic, antimony, bismuth and moscovium*.

The atoms of these elements **have five valence electrons**.

- ✓ Nitrogen and phosphorus are non-metals, arsenic and antimony are metalloids and bismuth is a metal.
- ✓ Phosphorus, arsenic, antimony and bismuth are often used as n-type silicon dopants.
- ✓ Diatomic nitrogen is the main constituent of the Earth's atmosphere (78%).



GROUP 1**6**: **Chalcogens**

► *oxygen, sulfur, selenium, tellurium, polonium and livermorium*.

The atoms of these elements **have six valence electrons**.

- ✓ Oxygen, sulfur and selenium are non-metals, tellurium is a metalloid and polonium is a metal.
- ✓ Diatomic oxygen is the second constituent of the Earth's atmosphere (21%).

GROUP 1**7**: **Halogens**

► *fluorine, chlorine, bromine, iodine, astatine and tennessine*.

The atoms of these elements **have seven valence electrons**.

- ✓ They are extremely reactive elements, as they are very electronegative.
- ✓ Fluorine is able to *attack* inert substances, including the heavier noble gas atoms.

GROUP 1**8**: **Noble gases**

► *helium, neon, argon, krypton, xenon, radon and oganesson*.

The atoms of these elements have the valence shell fully filled, which corresponds to **eight valence electrons**, with the exception Helium, which has only one shell and, consequently, has **two valence electrons**.

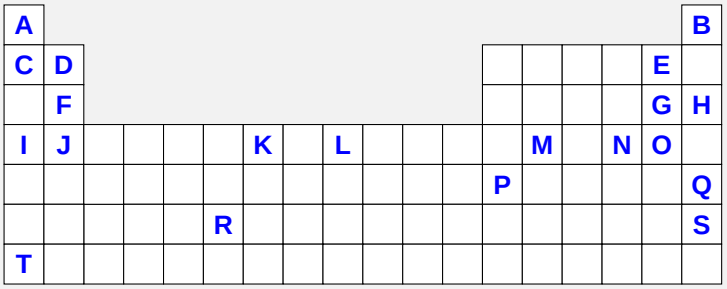
- ✓ They are extremely inert elements, that is, they do not react with other elements, as they are the most stable elements in Nature.

For the source of this example please see the file pgf-PeriodicTableManual_Examples.tex

EXERCISE:

In the following scheme of the Periodic Table, the positions of some chemical elements are represented by letters:

THE LETTERS DO NOT CORRESPOND TO THE CHEMICAL SYMBOLS OF THE ELEMENTS.



Using the letters shown:

1. identify group 2 elements of the Periodic Table.
2. identify the elements of the 2nd period of the Periodic Table.
3. identify group 17 elements of the Periodic Table.
4. identify the elements of s-block.
5. identify the elements of p-block.
6. identify the elements of d-block.
7. identify the metallic elements.
8. identify the non-metallic elements.
9. identify the transition metals.
10. identify the alkaline earth metals.
11. identify the noble gases.
12. tell which element belongs, simultaneously, to the 4th period and to group 14.
13. identify the representative elements that tend to generate positive ions.
14. indicate an element that forms binegative ions.
15. indicate the halogen whose mononegative ion has the largest radius.
16. write the chemical formula of the compound formed by the elements **F** and **O**.
17. identify, justifying, the element with the largest atomic radius.
18. identify, justifying, the element with the lowest 1st ionization energy.

For the source of this example please see the file pgf-PeriodicTableManual_Examples.tex

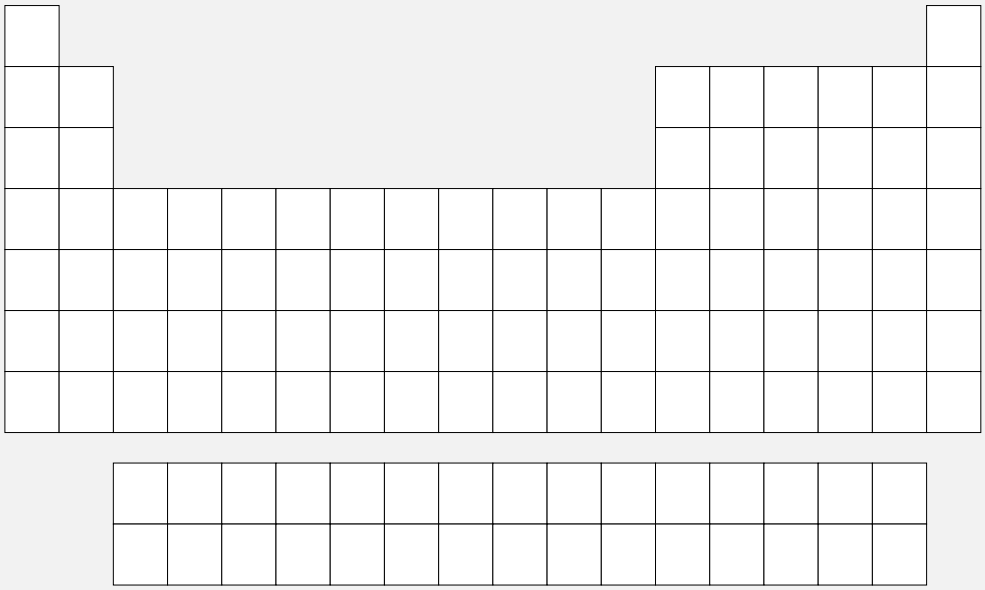
EXERCISE:
Using the following notation,

X for the elements in the gaseous state (NTP),

○ for the elements in the liquid state (NTP) and

△ for the synthetic elements,

fill in the following Periodic Table:



For the source of this example please see the file pgf-PeriodicTableManual_Examples.tex

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STYLES