Manual for pgf-PeriodicTable 1.0.0

Hugo Gomes
hugo.parelho@gmail.com

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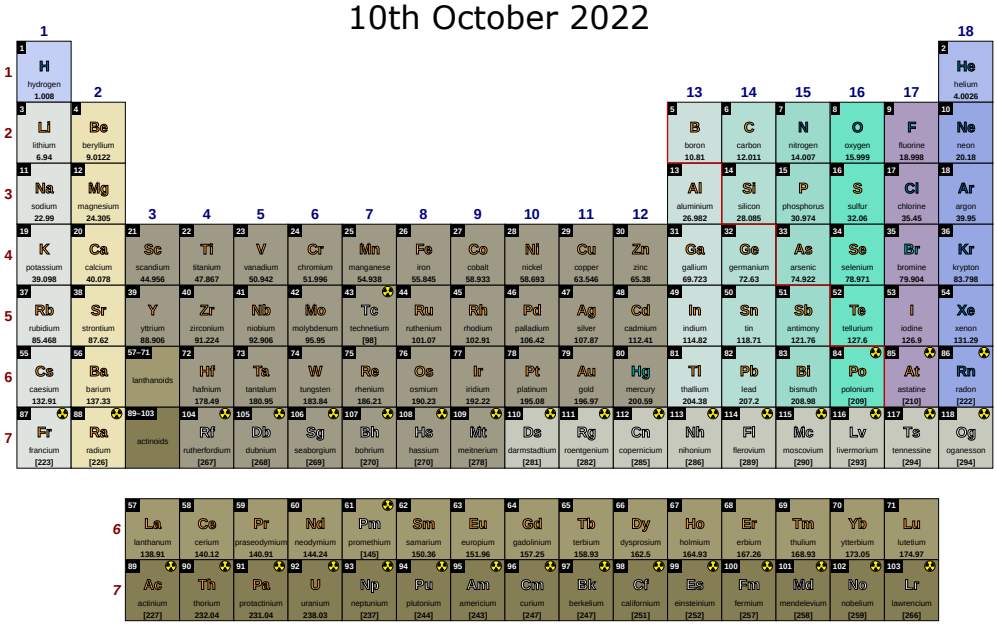

\pgfPT[show title=false,show legend=false]

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 (empirycal), covalente 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 distribuition, electronic configuration (increasing n and increasing $n+\ell$), density, specific heat capacity, thermal condutivity, 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 six languages: English, French, German, Portuguese (from Portugal and from Brazil), Spanish and Italian.

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Installation and usage

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 only requires the TikZ package.

You need to put the package files (pgf-PeriodicTable.sty & *friends*) in a location where PDFLaTeX 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).

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

It can also be loaded with *one option* to select the desired language:
`\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.

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	Covalente 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)
eConfign	Electronic Configuration (increasing $n + \ell$)		(Wikidata @01/nov/2021)
d	Density	$g \cdot dm^{-3}$	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

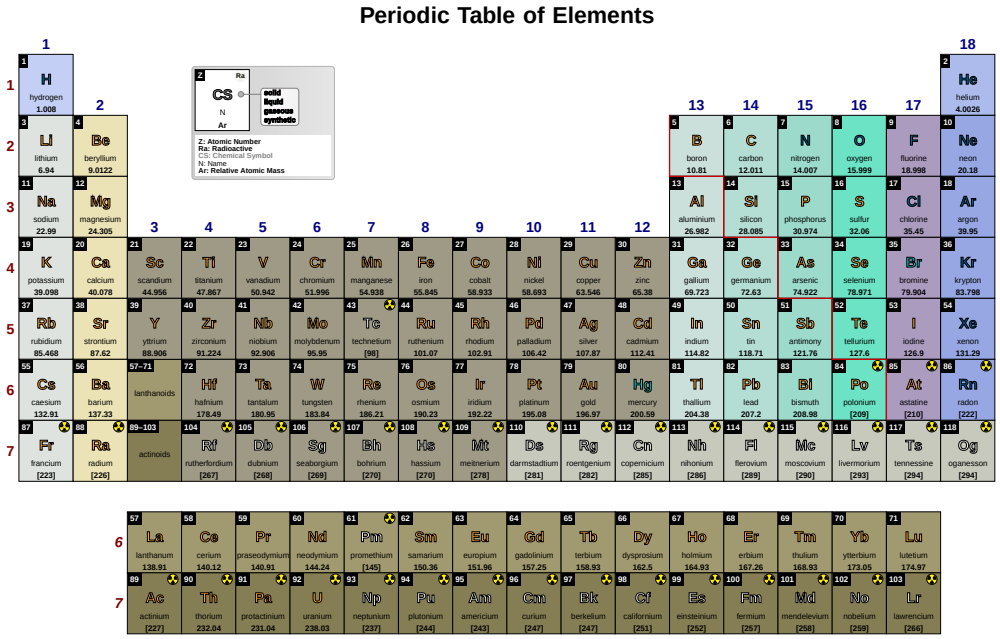
The commands to achieve the Periodic Table of Elements are:

- \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.

► Utilization of \pgfPT

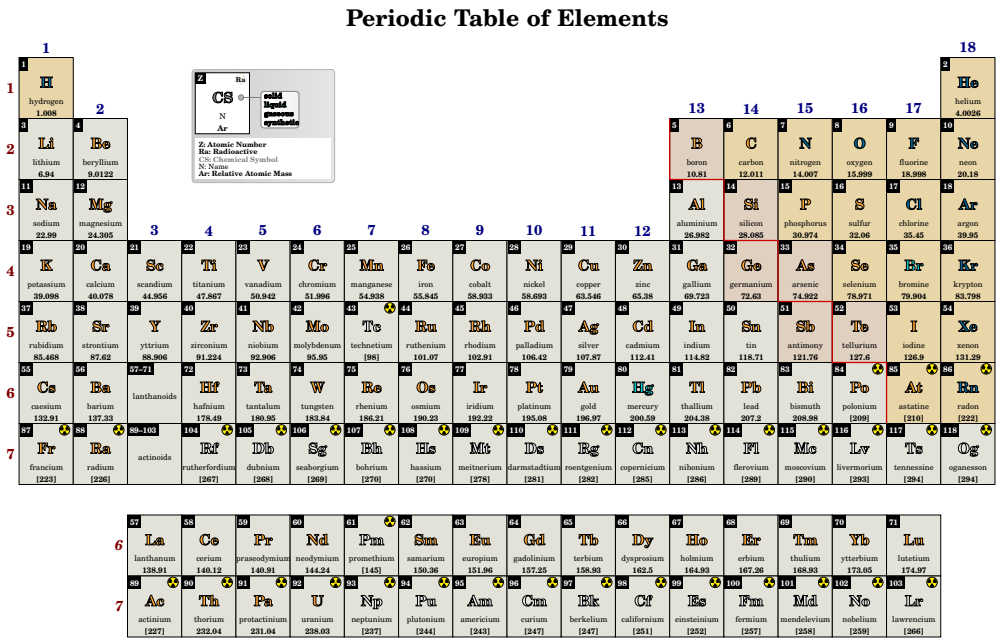
Use this command to draw the Periodic Table of Elements in the language selected at package inclusion (`\usepackage[language flag]{pgf-PeriodicTable}`):

```
\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:

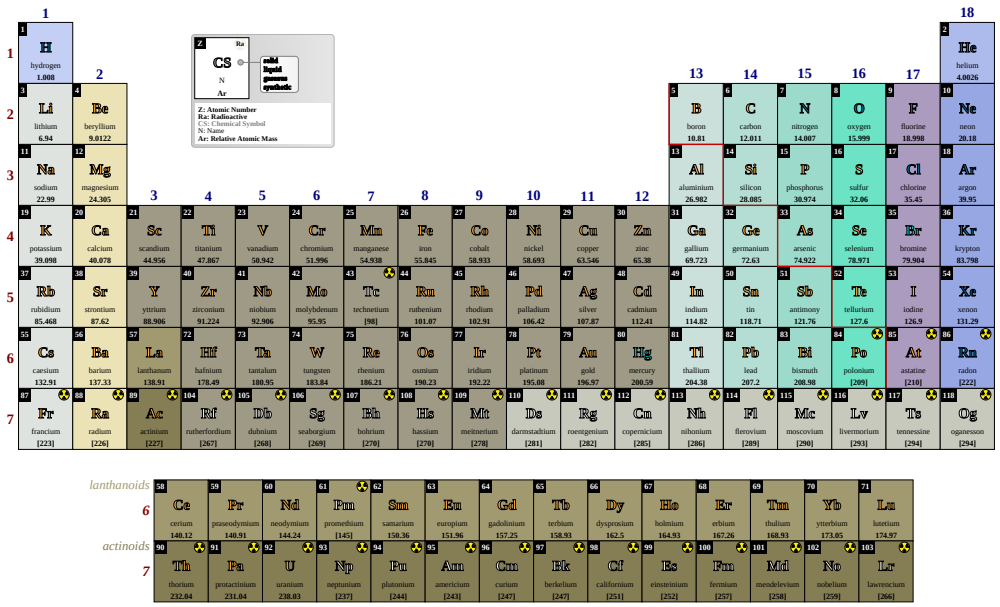
```
\pgfPT[font=pnc,back color scheme=MNM]
```



► Utilization of \pgfPTstyle[options list]

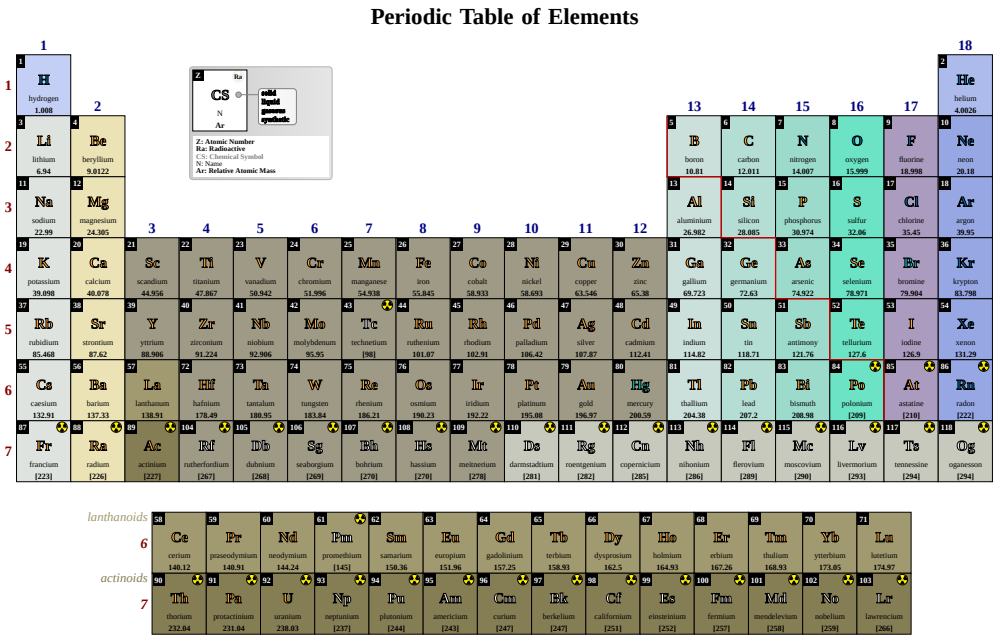
This command globally sets a style for the Periodic Table:

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



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

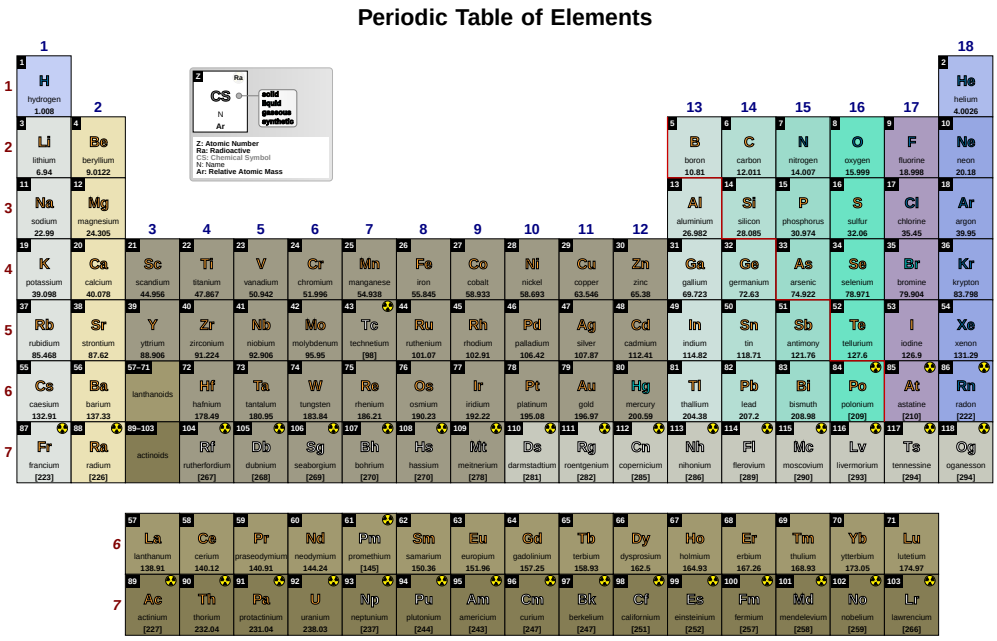
```
\pgfPT[show title]
```



► 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 $\text{row} - \text{initial row} + 1$ and from «initial column» to «final column» with the width of final $\text{column} - \text{initial column} + 1$. 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 $2.1 \times \text{column}$. 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...]

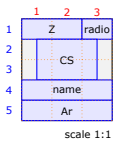
The \pgfPTbuildcellstyle command works like \pgfPTbuildcell, but stores the cell style under the name provided. It is only used when called via the cell style passed as an option to \pgfPT. Otherwise it remains unavailable, unlike the \pgfPTbuildcell command which immediately affects the cells of the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

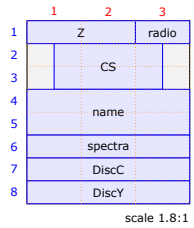
```
\pgfPTpreviewcell
```

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}

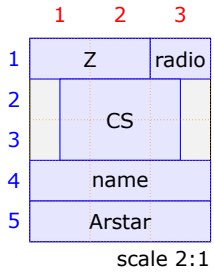
This previews a *named* cell, again with the optional scale factor.

```
\pgfPTpreviewcellstyle{myname}
```

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

```
\pgfPTbuilcellstyle{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*)]

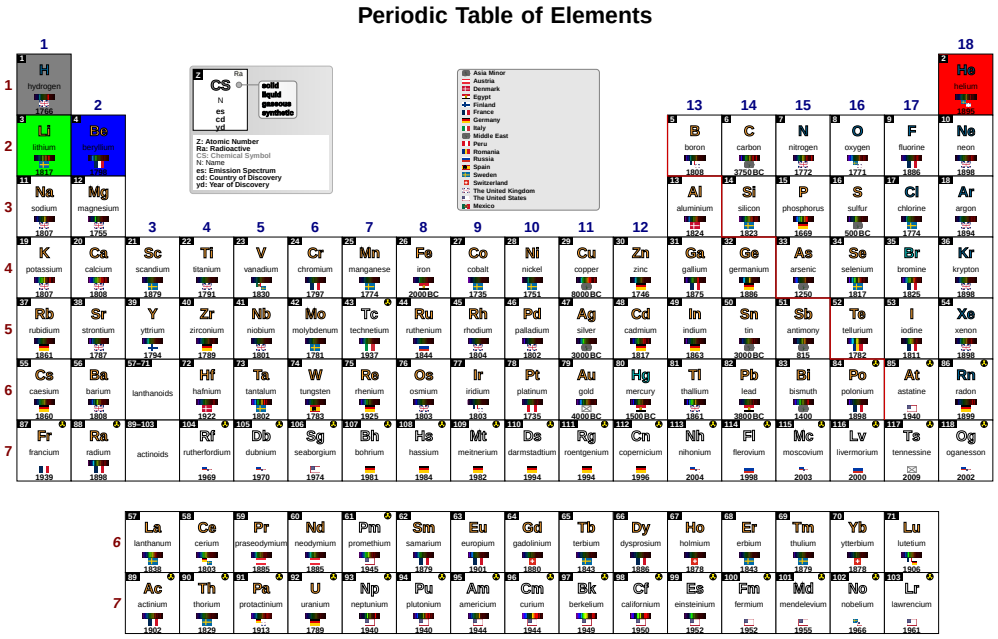


► Utilization of \pgfPTnewColorScheme{name}[color list]

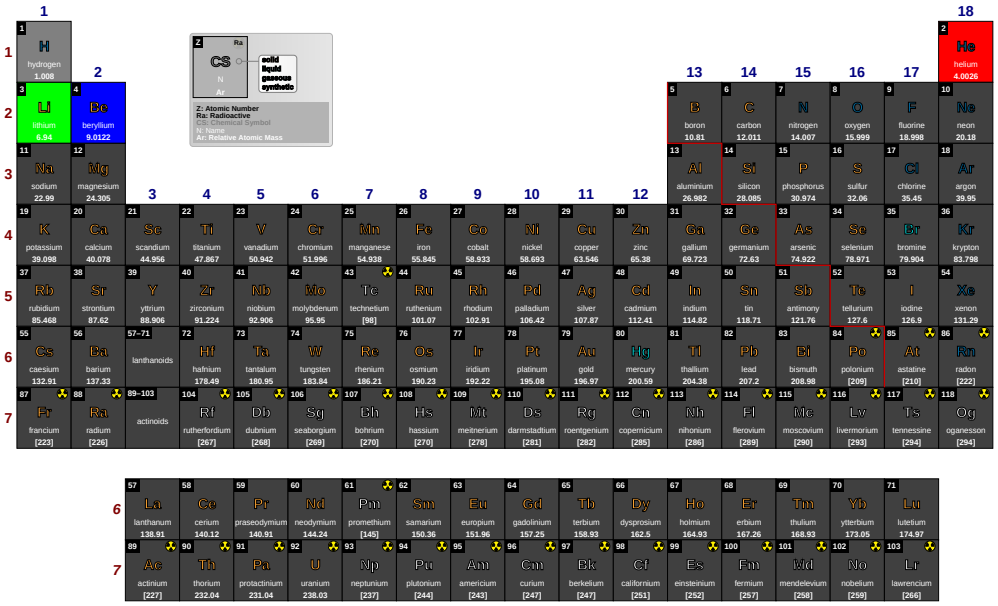
Use this command to create a *color scheme* for cells in the Periodic Table. It has two mandatory arguments – name and color list – and an optional argument – trailing color.

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]
```



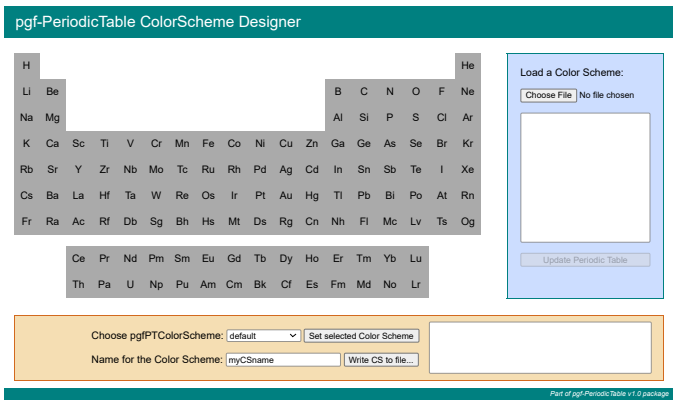

```
\pgfPTnewColorScheme[.25/.25/.25]{myname}{.5/.5/.5,1/0/0,0/1/0,0/0/1}
\pgfPTresetcell
\pgfPT[back color scheme=myname,name color=white, Ar color=white,legend back color=black!30]
```



There are a few *color schemes* predefined:

- ✓ **default**, the default built-in color scheme, which is loaded if no value is passed to the back color scheme key.
- ✓ **Soft**, a soft color pattern for cells, differentiating metals, non metals, semimetals, lanthanides and actinides.
- ✓ **Jmol**, a color scheme based upon Jmol: an open-source Java viewer for chemical structures in 3D.
- ✓ **CPK**, 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.
- ✓ **Rasmol** and **RasmolNew**, two color schemes based upon the computer program RasMol.
- ✓ **Wikipedia**, a color scheme built on the Periodic Table of Elements available at Wikipedia.
- ✓ **MNM**, a color pattern which distinguishes between **M**etals, semimetals and **N**on **M**etals.
- ✓ **PS**, a color scheme depicting the **P**hysical **S**tate at room temperature.
- ✓ **Radio**, a two color color scheme showing the radioactivity of the elements.
- ✓ **Blocks**, 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:



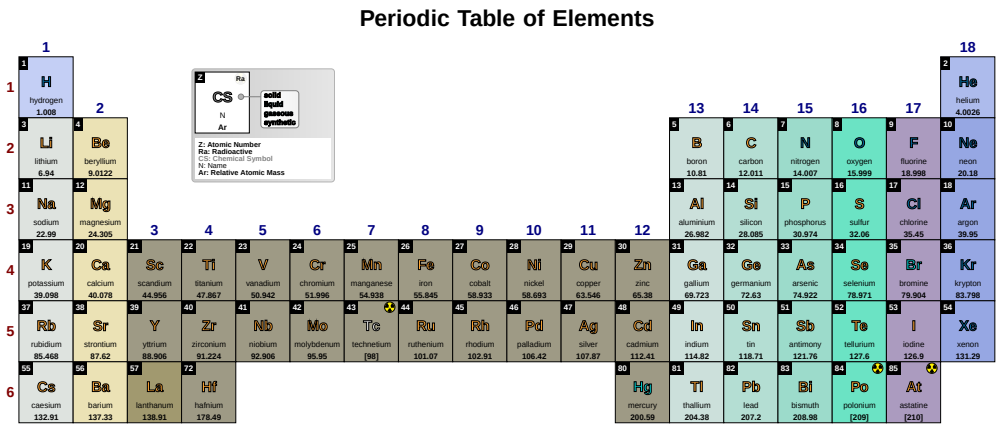
pgfPTcolorSchemes.html

▶ 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]
```



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*

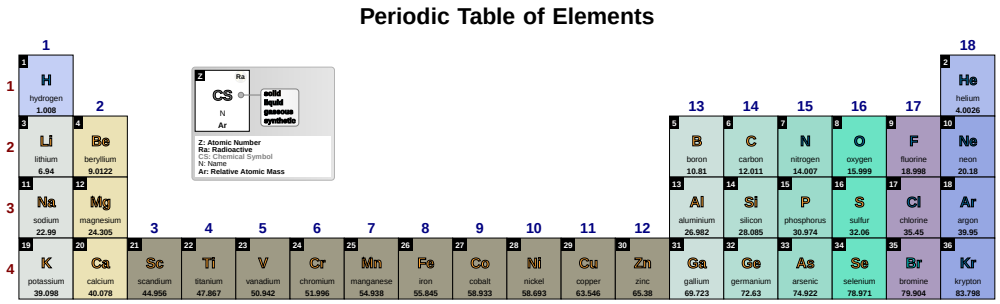
The following options and styles are used to *control* the Periodic Table *as a whole* in various aspects, such as the cell width or cell height, which elements are displayed (Z list), whether the title or legend are shown – show title or show legend – among others.

➠ 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, which in turn supports *the dots notation* as explained in the section *Repeating Things: The Foreach Statement* in the pgfmanual.

```
\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 *1st period*, … , *7th period*, *6th period and lanthanoids* †, *7th period and actinoids* †.

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

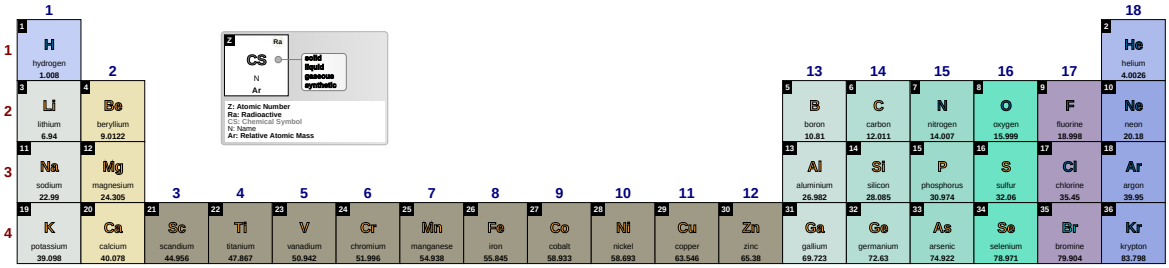
✓ any **user defined** name via \pgfPTnewZlist{name}{list}

cell width default: *34pt*

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

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

Periodic Table of Elements

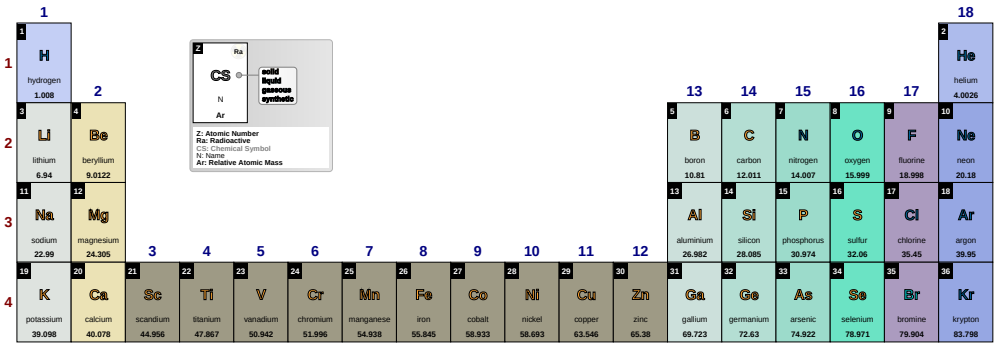


cell height default: *38.25pt*

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

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

Periodic Table of Elements

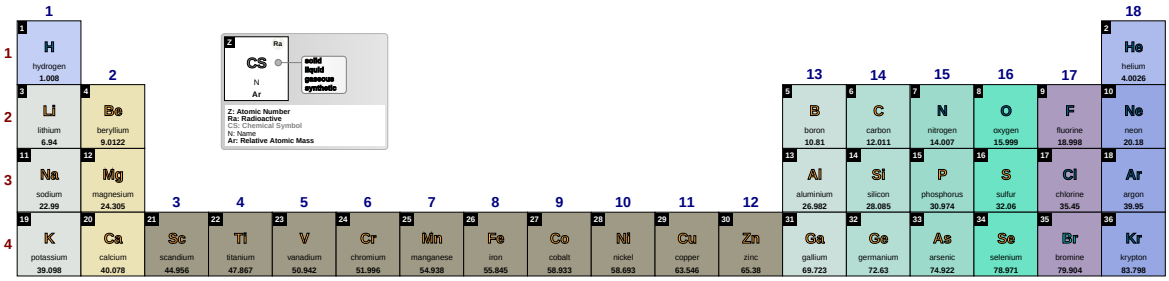


cell size default: *38.25pt*

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]
```

Periodic Table of Elements

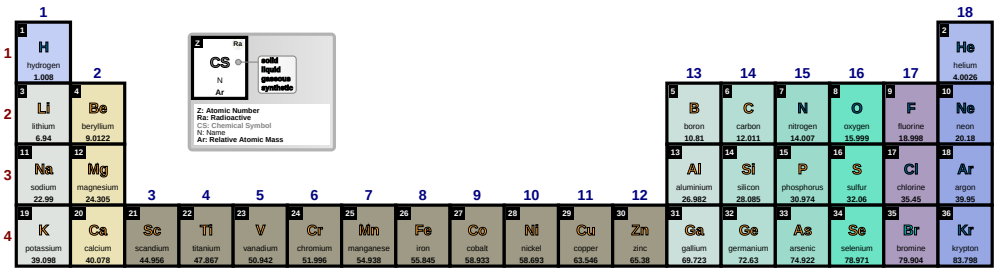


cell line width default: *0.4pt*

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

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

Periodic Table of Elements

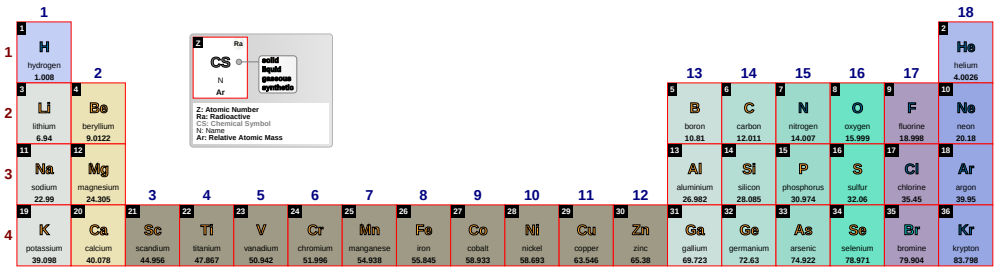


cell line color default: *black*

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

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

Periodic Table of Elements

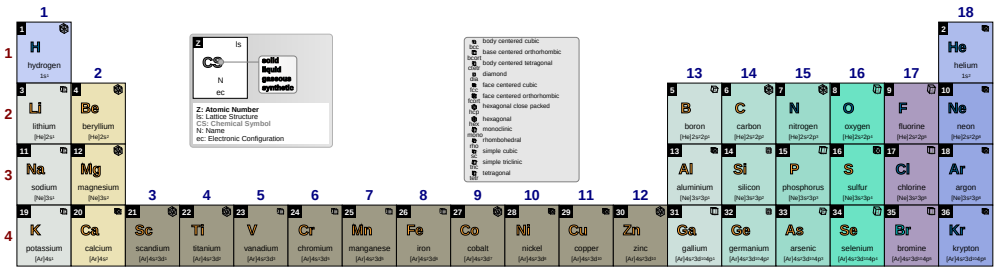


cell style default: *{}*

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

```
\pgfPTbuilcellstyle{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]
```

Periodic Table of Elements



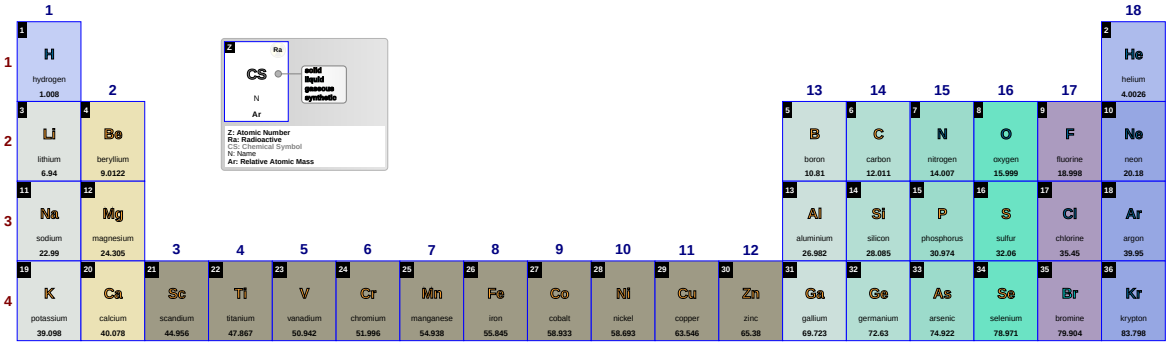
cell default: *{w=34pt,h=38.25pt,lw=.4pt,lc=black}*

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}]
```

Periodic Table of Elements



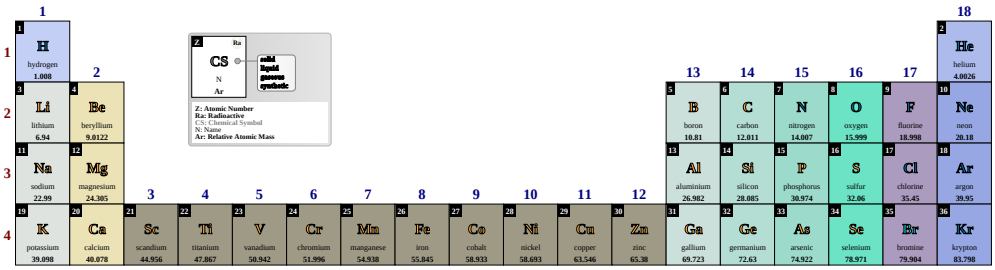
font default: *phv*

Sets the font family, via the proper LaTeX *font name*, to use in the Periodic Table. The *default* font is *phv*, *i.e.*, the Helvetica font. The value of the font key can be any LaTeX *font name* known to the local LaTeX installation.

See LaTeX *font names* below for further details.

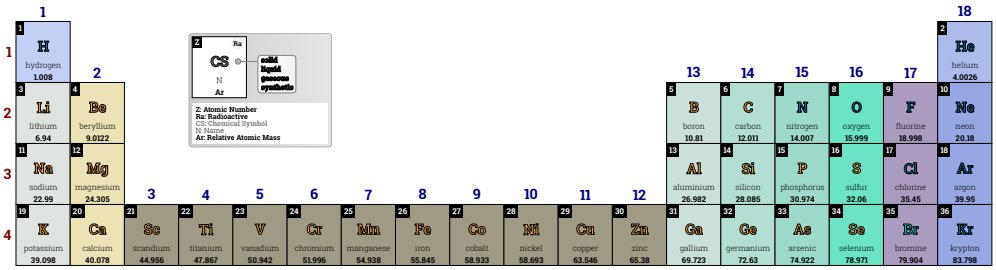
```
\pgfPT[Z list={1,...,36},font=ptm]
```

Periodic Table of Elements



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

Periodic Table of Elements



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 frrr – Miama Nuera font.

▷ ...

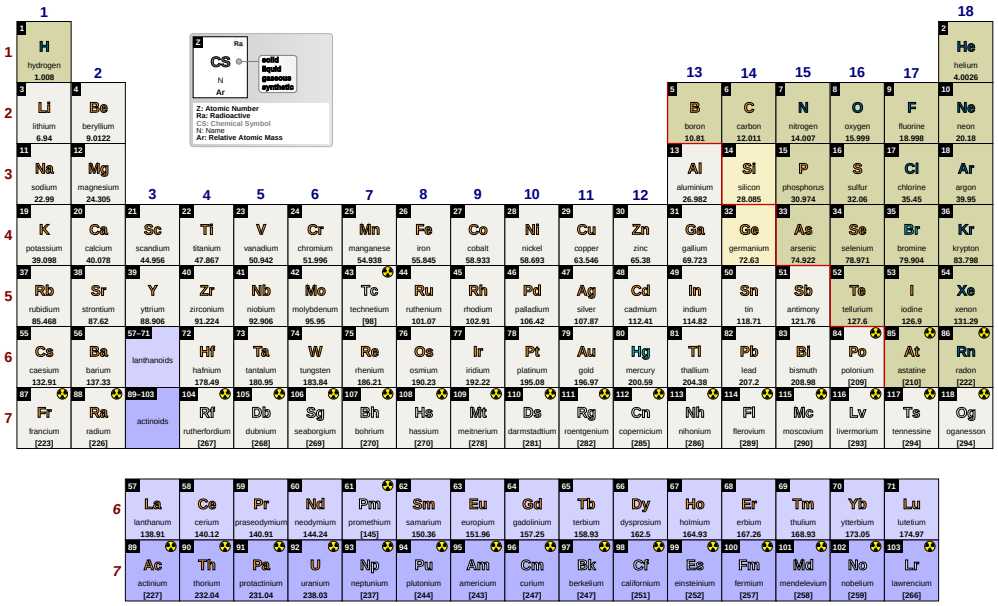
For more information about fonts visit the TUG Font Catalogue

back color scheme default: *default*

Sets a named back color scheme for the Periodic Table.

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

Periodic Table of Elements



The possible name is one of the following:

✓ **built-in**:

- ▷ 'Soft', a soft color scheme that distinguishes metal, non metals, silicon and germanium, lanthanoids and actinoids.
- ▷ 'Jmol', is the color scheme used in the computer software Jmol: an open-source Java viewer for chemical structures in 3D.
- ▷ 'CPK', 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.
- ▷ 'Rasmol', is the color scheme used in the computer software RasMol, a program for molecular graphics visualization originally developed by Roger Sayle.
- ▷ 'RasmolNew', is a color scheme used in RasMol with revision of CPK colors made by C. Chigbo (RasMol 2.7.3).
- ▷ 'Wikipedia', is the color scheme based on the Wikipedia Periodic Table of Elements.
- ▷ 'MNM', is designed to show **M**etals and **N**on **M**etals in two different colors, showing also the semi--metals in a third color.
- ▷ 'PS', is designed to show the **P**hysical **S**tate of the elements at normal temperature and pressure (NTP) in different colors.
- ▷ 'Radio', is designed to show the **R**adioactive elements in one color and the non radioactive elements in another color.
- ▷ 'Blocks', 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'.

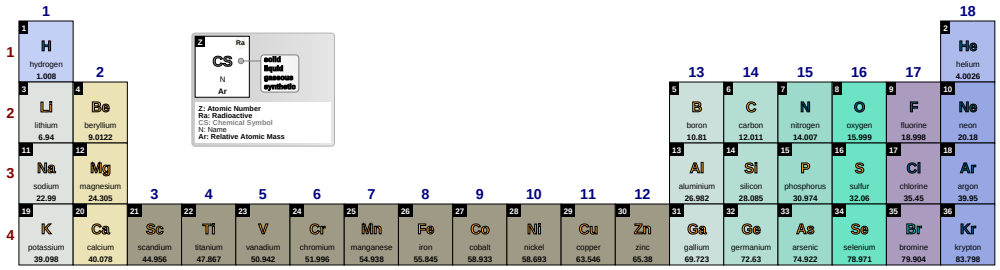
✓ any **user defined** name via \pgfPTnewColorScheme{name}[color list]

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

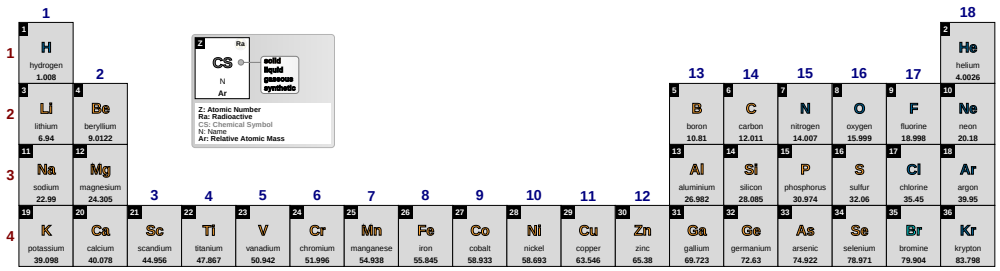
```
\pgfPT[Z list={1,...,36},back color=black!15]
```

Periodic Table of Elements




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

Periodic Table of Elements

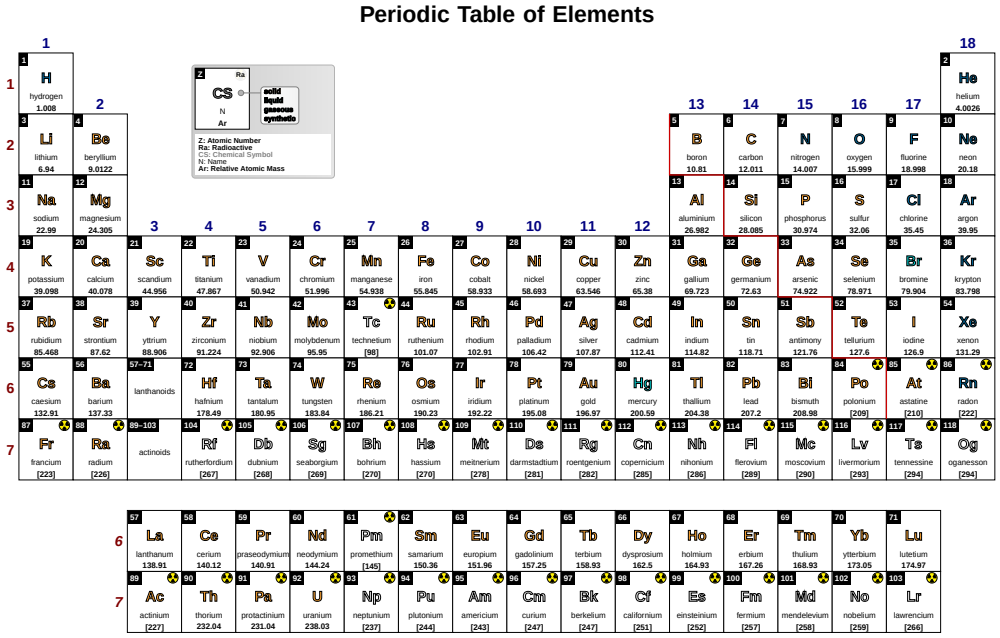


It is possible to set the back color scheme key with the built-in names using the following styles:

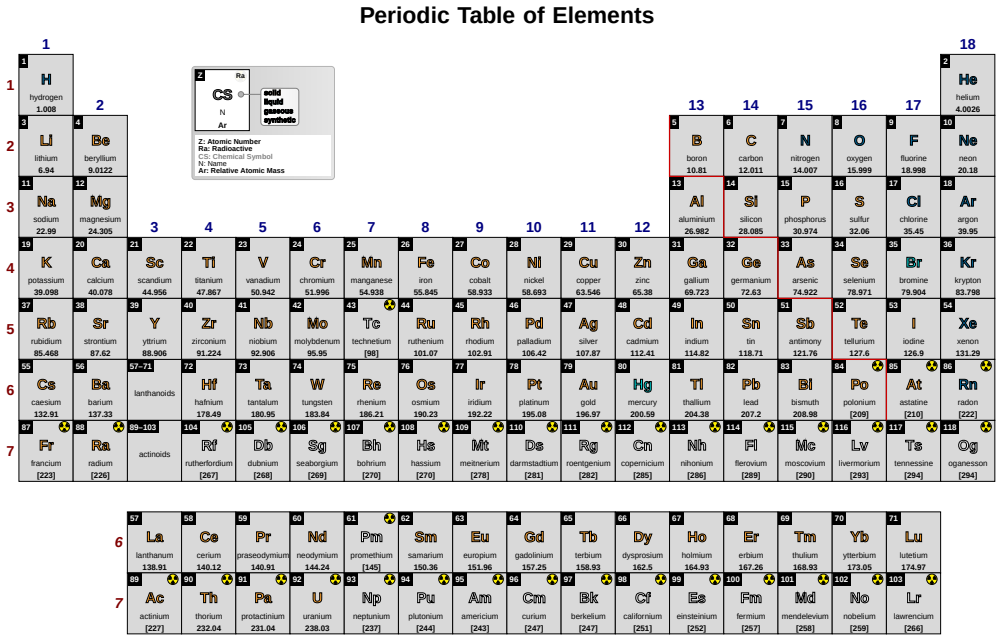
csSolid default: *white*

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

```
\pgfPT[csSolid]
```



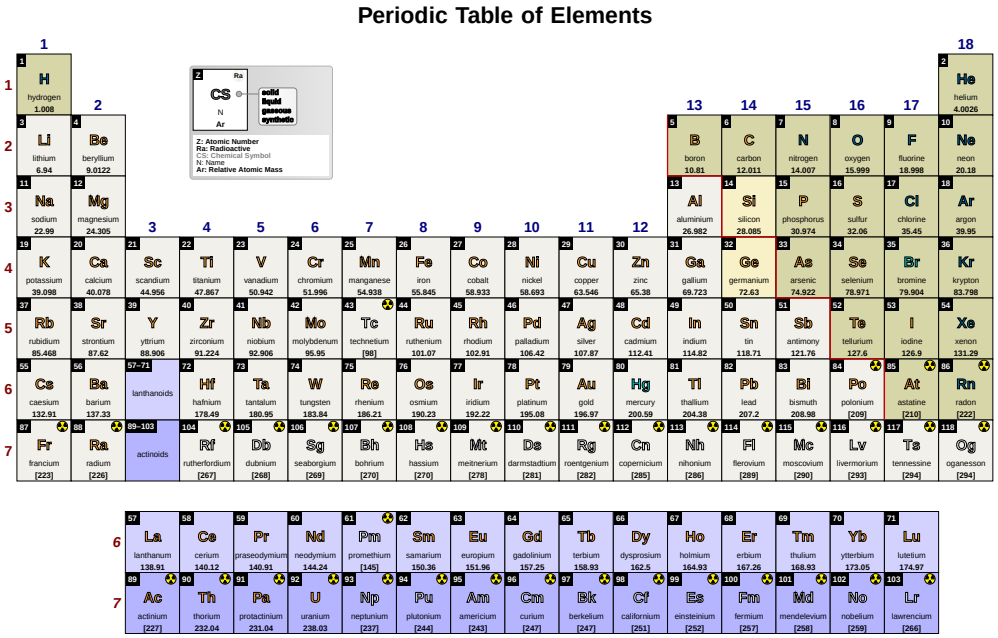

```
\pgfPT[csSolid=black!15]
```



csSoft *no value*

A style equivalent to back color scheme=Soft

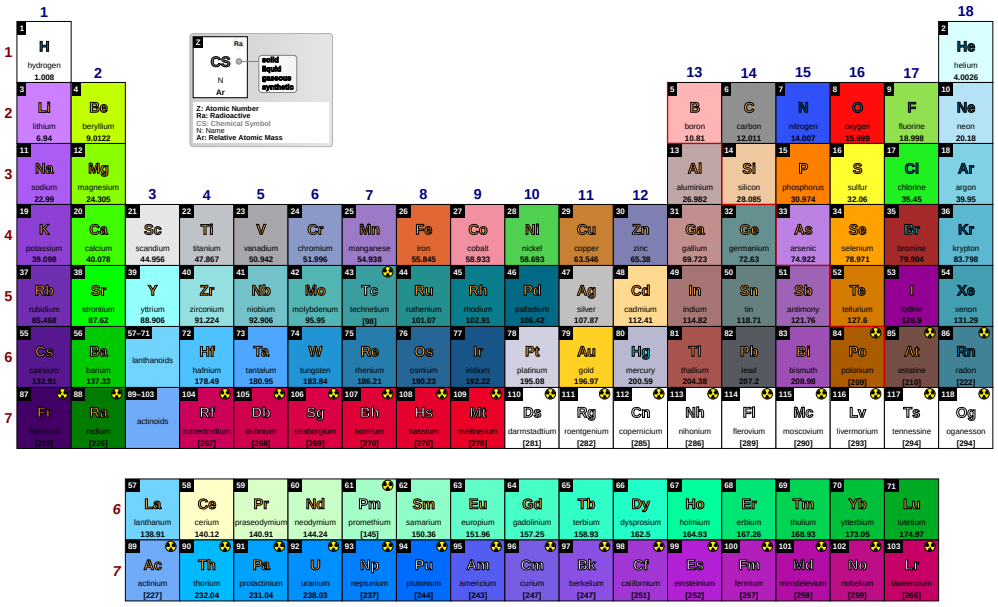
```
\pgfPT[csSoft]
```



csJmol *no value*

A style equivalent to back color scheme=Jmol

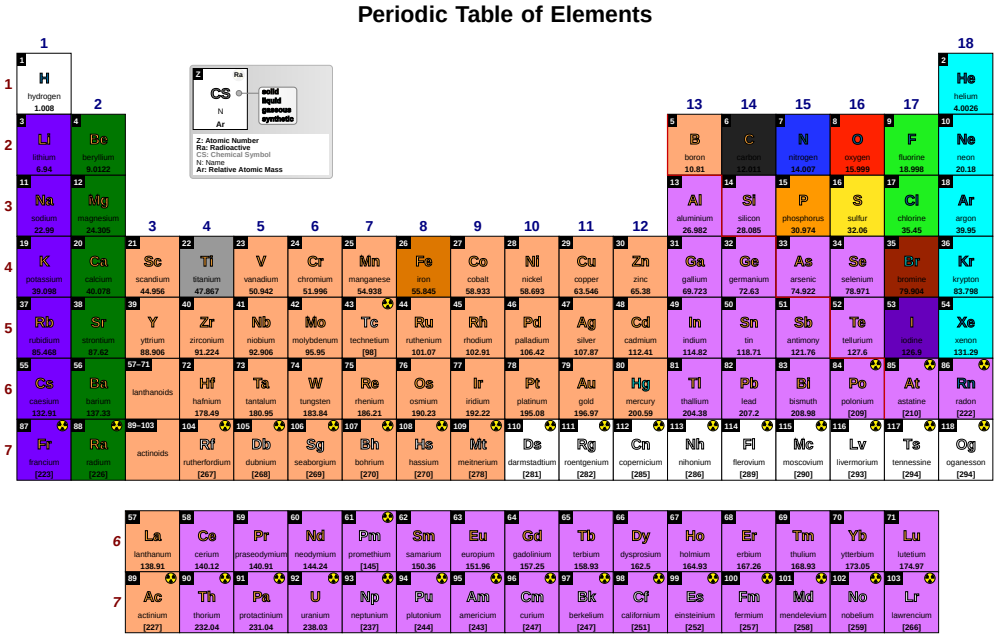
```
\pgfPT[csJmol]
```



csCPK *no value*

A style equivalent to back color scheme=CPK

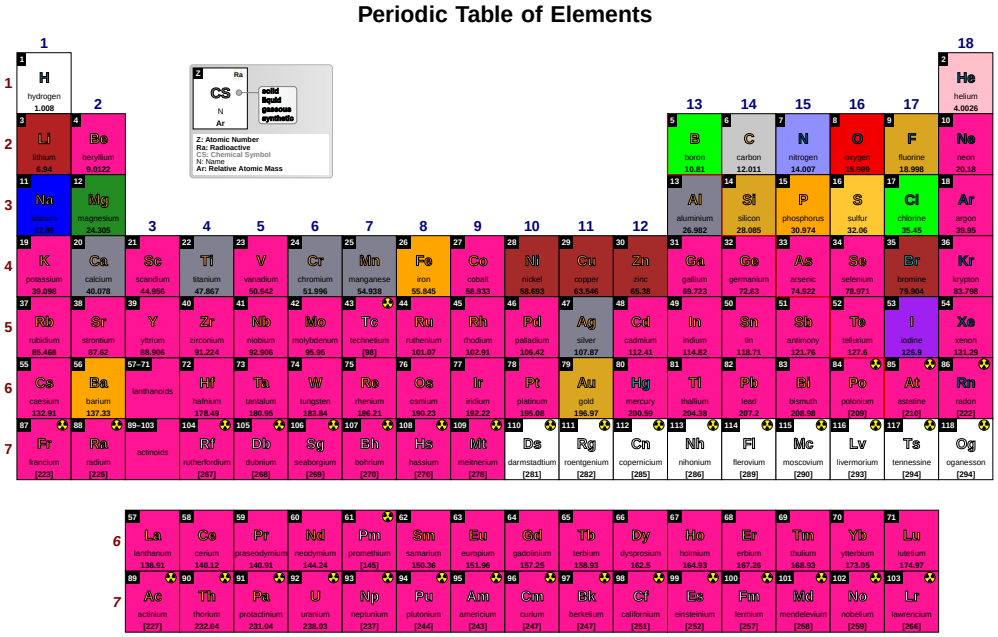
```
\pgfPT[csCPK]
```



csRasmol *no value*

A style equivalent to back color scheme=Rasmol

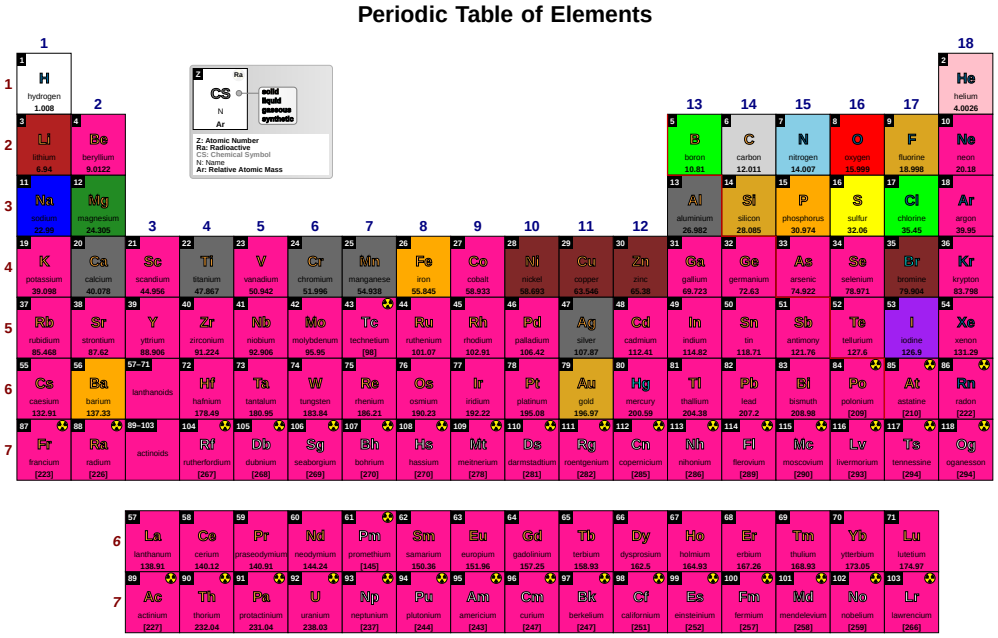
```
\pgfPT[csRasmol]
```



csRasmolNew *no value*

A style equivalent to back color scheme=RasmolNew

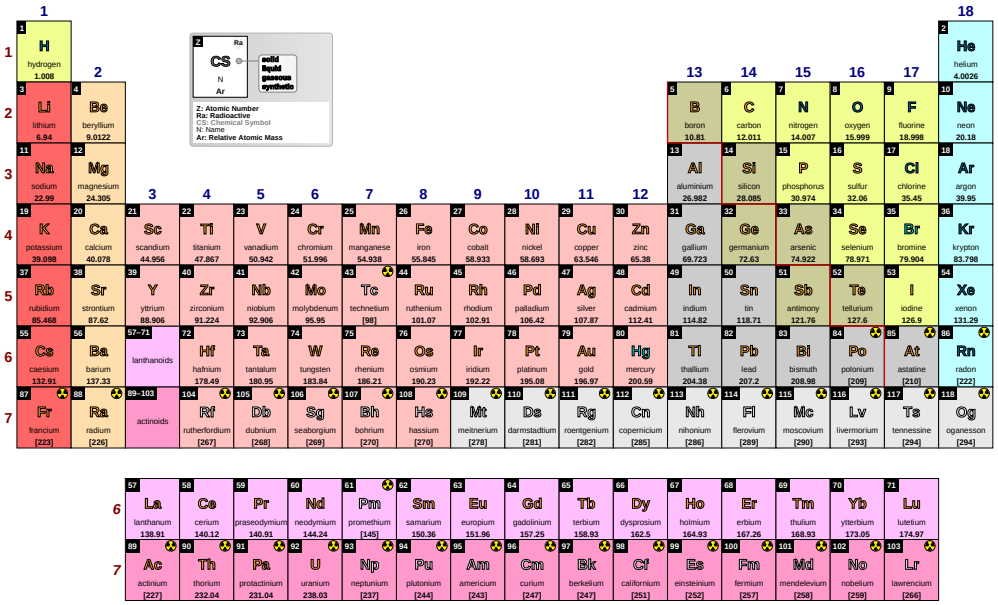
```
\pgfPT[csRasmolNew]
```



csWikipedia *no value*

A style equivalent to back color scheme=Wikipedia

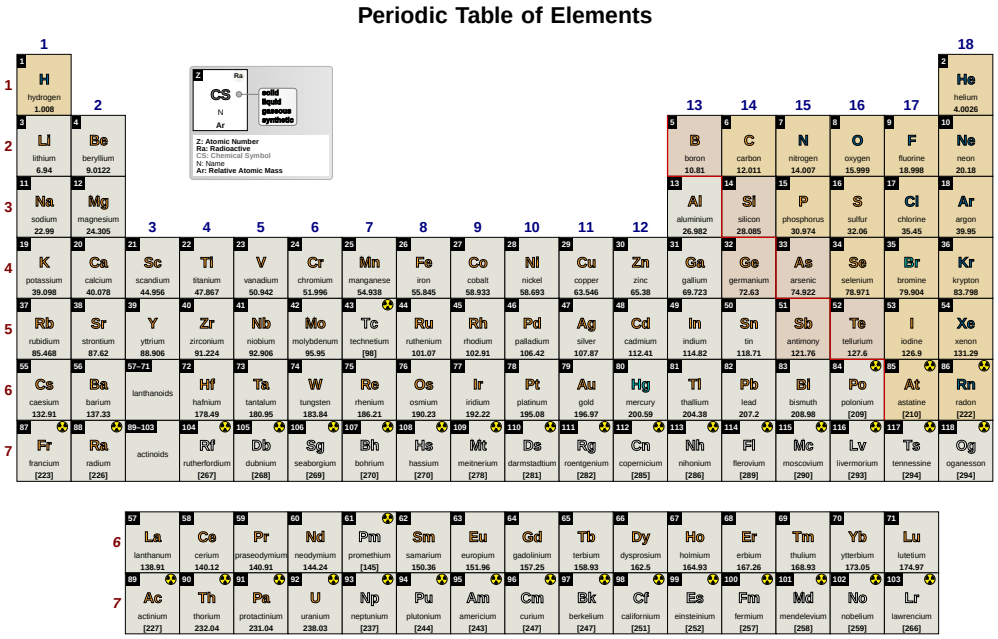
```
\pgfPT[csWikipedia]
```



csMNM *no value*

A style equivalent to back color scheme=MNM

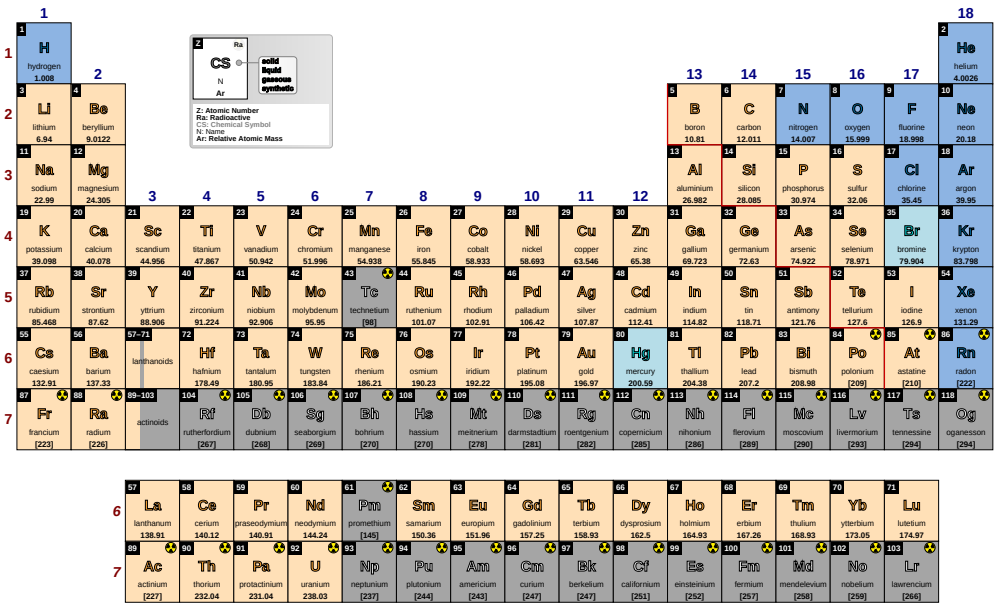
```
\pgfPT[csMNM]
```



csPS *no value*

A style equivalent to back color scheme=PS

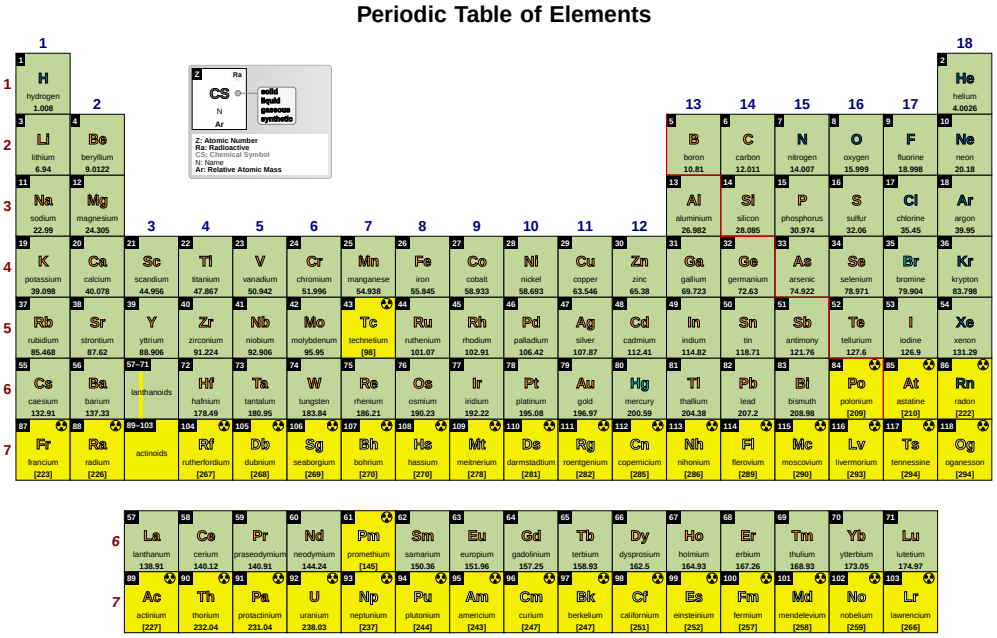
```
\pgfPT[csPS]
```



csRadio *no value*

A style equivalent to back color scheme=Radio

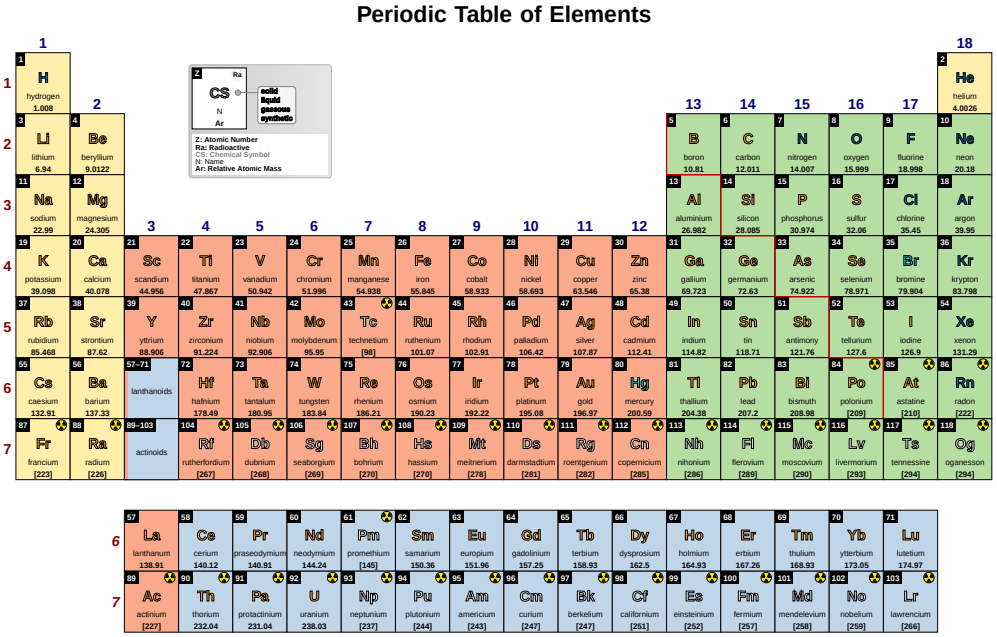
```
\pgfPT[csRadio]
```



csBlocks *no value*

A style equivalent to back color scheme=Blocks

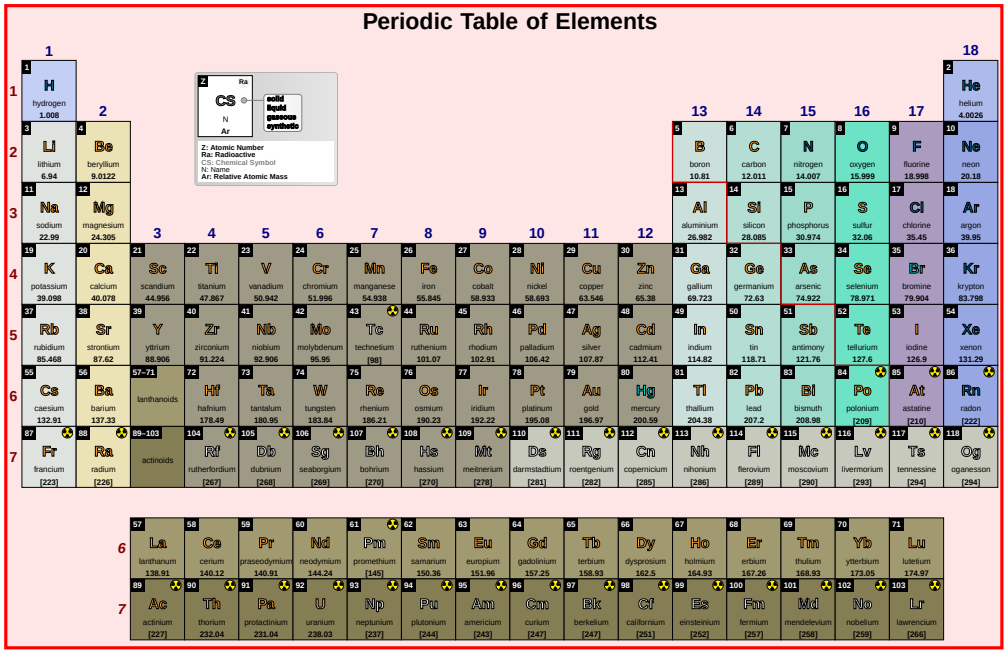
```
\pgfPT[csBlocks]
```



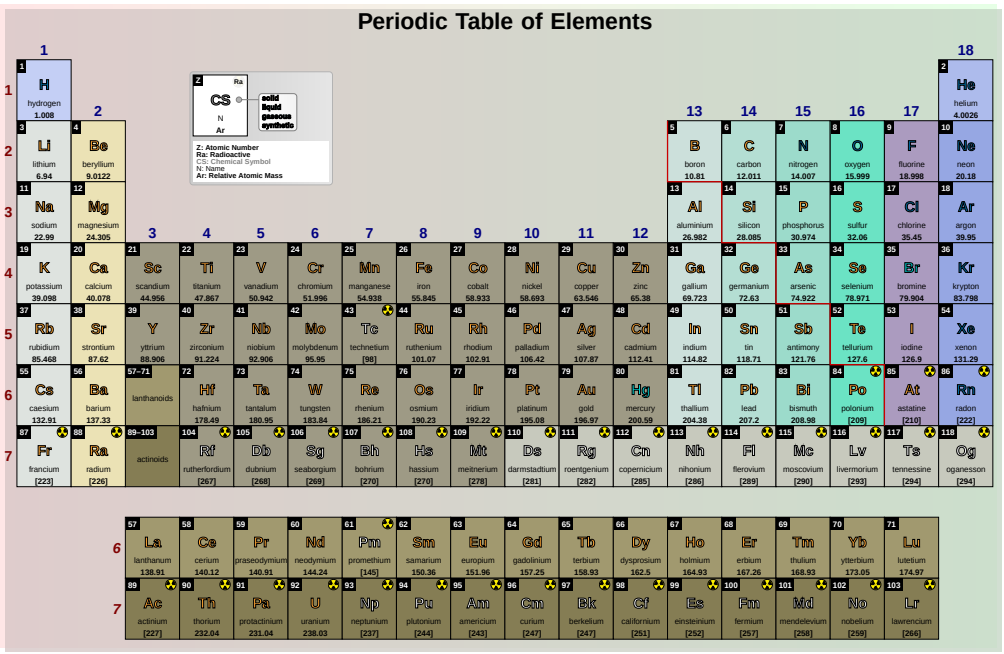
background default: {}

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}]
```



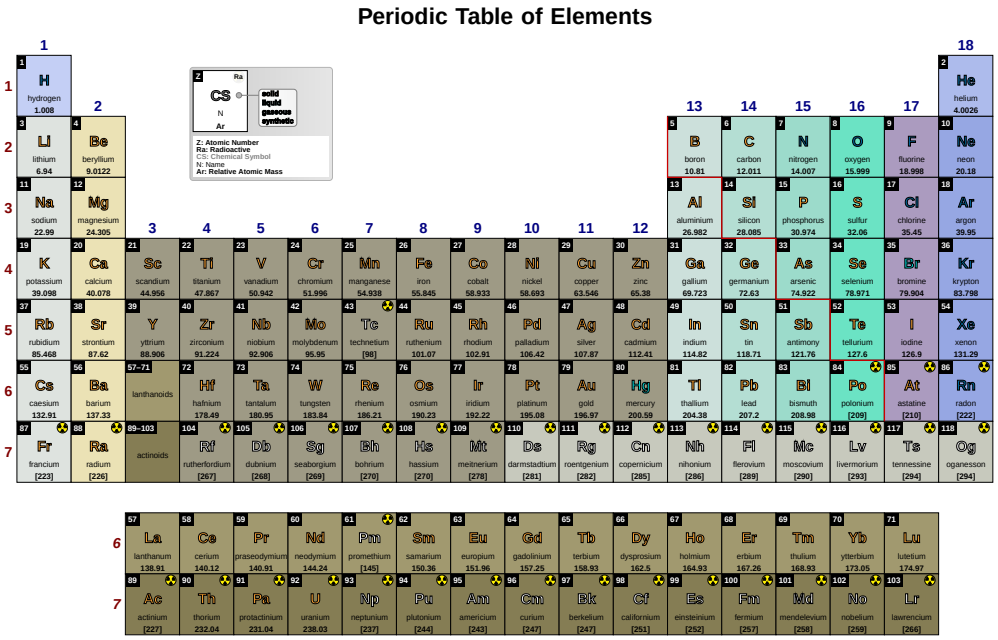

```
\usetikzlibrary{shadows}
\pgfPT[background={left color=red!10,right color=green!10,postaction={drop shadow={left color=red!10,right color=green!10}}}]
```



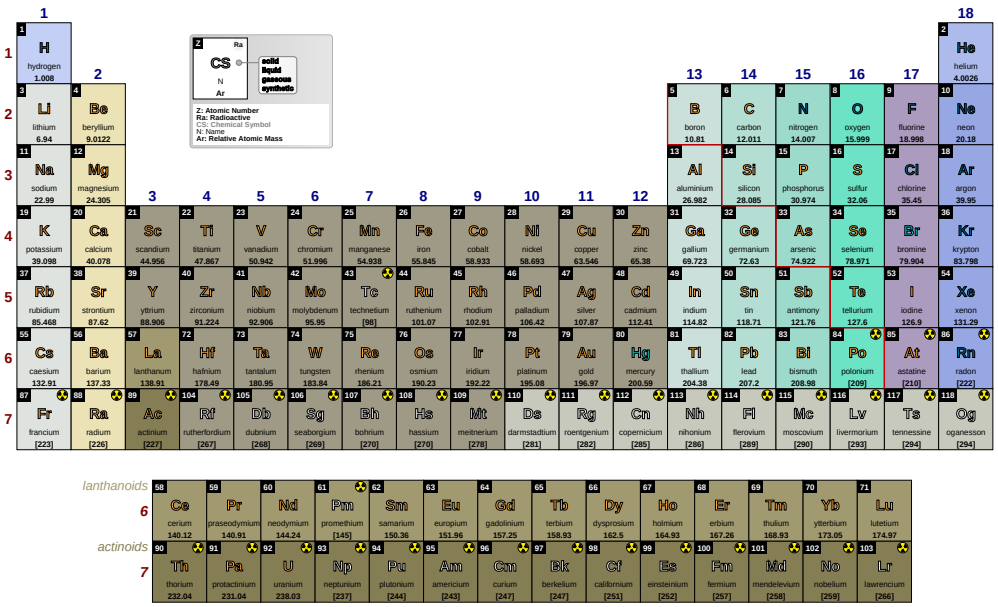
IUPAC default: *true*

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



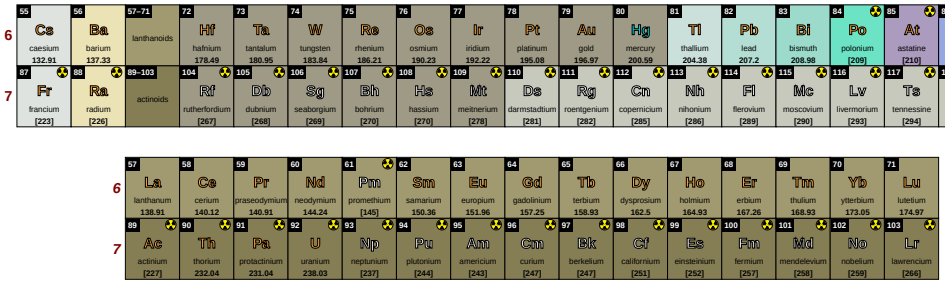
\pgfPT[IUPAC=false]



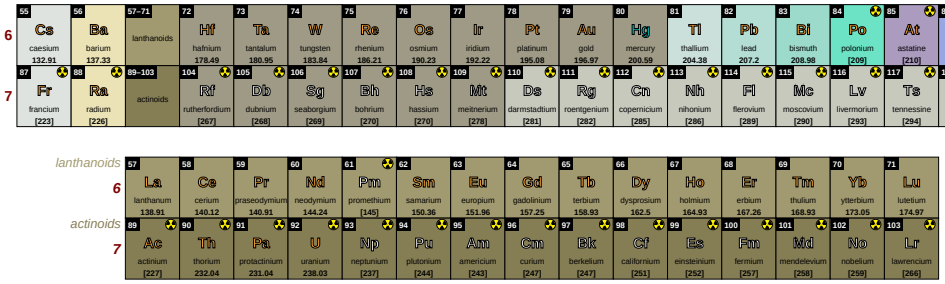
show label LaAc default: {}

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.

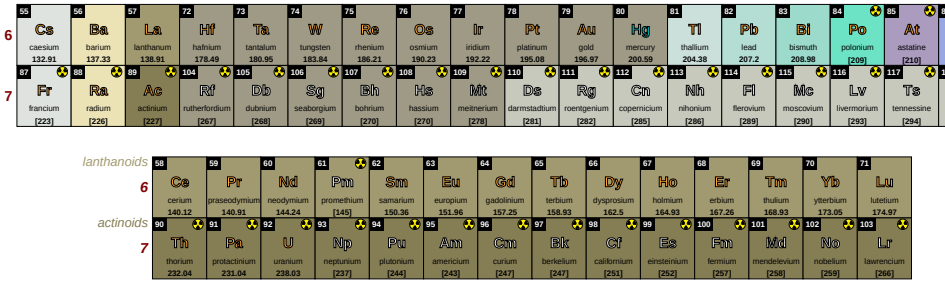
```
\pgfPTnewZlist{myZlist}{55,...,118}
\pgfPTstyle[show title=false,show legend=false,show group numbers=false]
\pgfPT[Z list=myZlist]
```



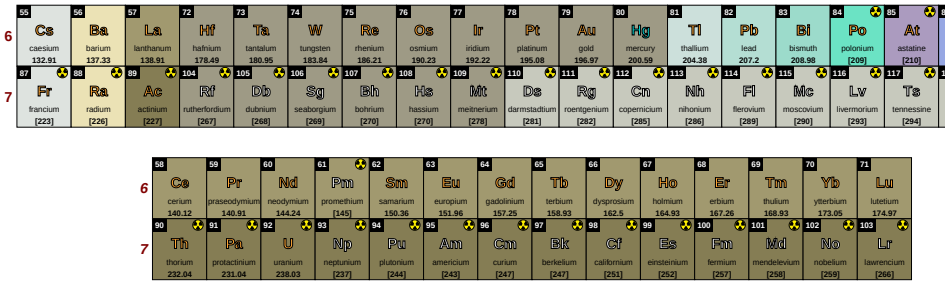
```
\pgfPT[Z list=myZlist,show label LaAc=true]
```



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



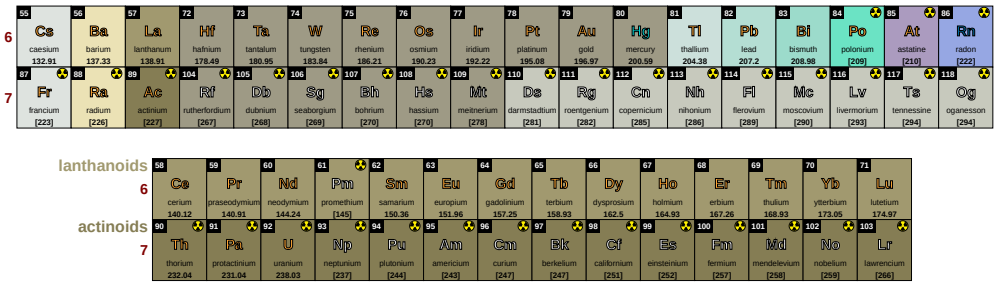
```
\pgfPT[Z list=myZlist,IUPAC=false,show label LaAc=false]
```



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]
```

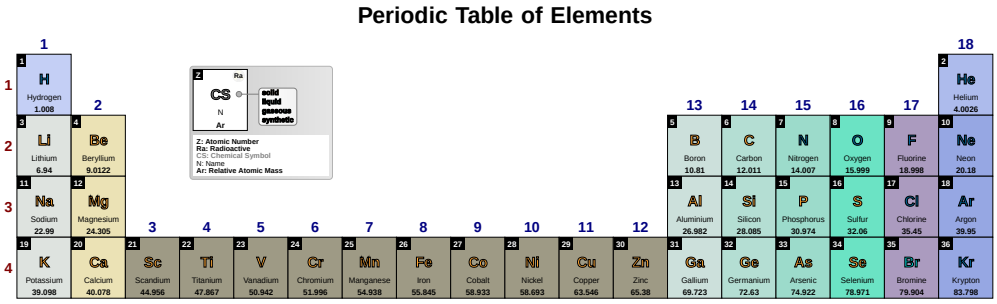



```
\pgfPTresetstyle
```

capitalize element names default: *false*

If set to true the first letter of the name of the elements is a capital letter

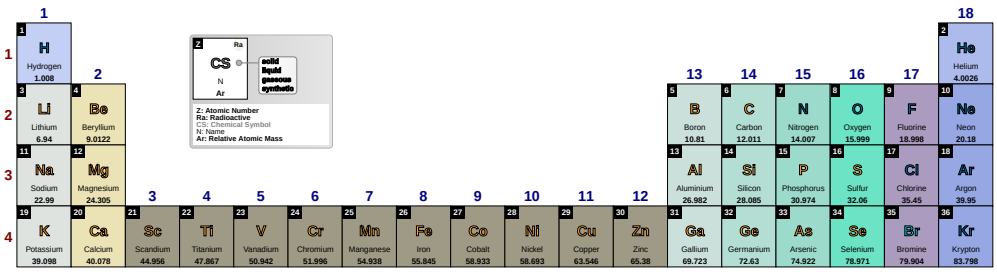
```
\pgfPT[Z list={1,...,36},capitalize element names=true]
```



Name *no value*

A style equivalent to capitalize element names=true

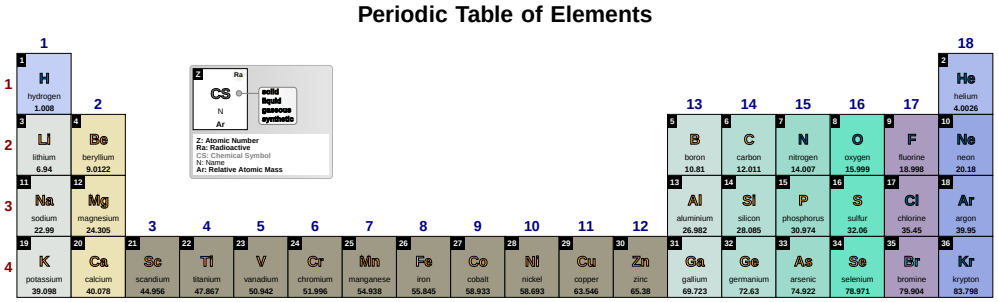
```
\pgfPT[Z list={1,...,36},Name]
```



name *no value*

A style equivalent to capitalize element names=false

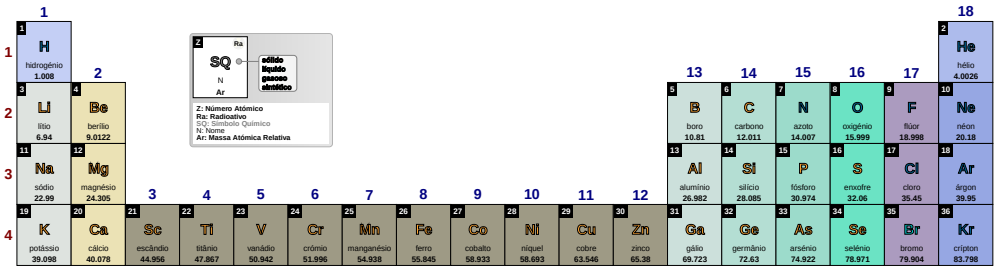
```
\pgfPT[Z list={1,...,36},name]
```



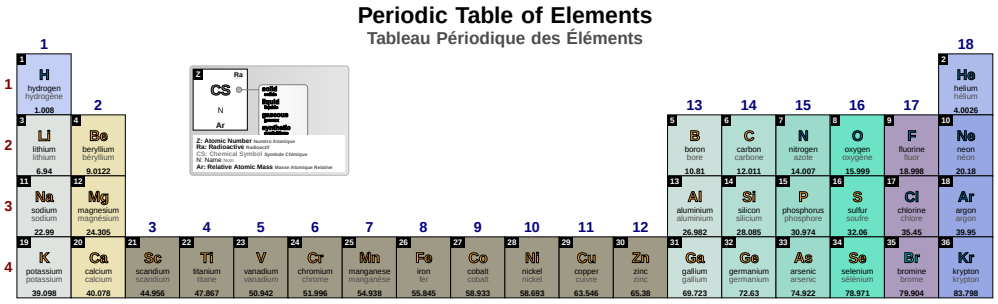
languages default: {}

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'. *This key overrides the default language, that is, the language loaded at package inclusion*.

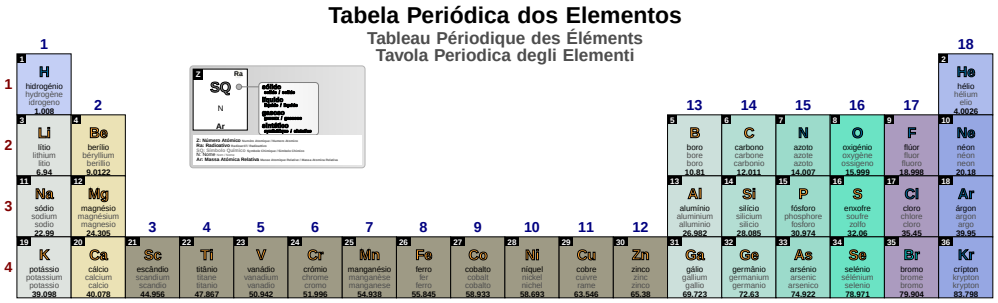
```
\pgfPT[Z list={1,...,36},languages=pt]
```




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



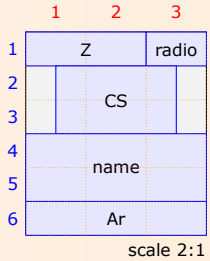

```
\pgfPT[Z list={1,...,36},cell style=pgfPT3lang,languages={pt,fr,it}]
```



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.

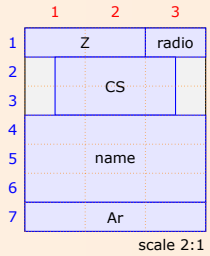
✓ *Built-in style* **pgfPT2lang**

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)]

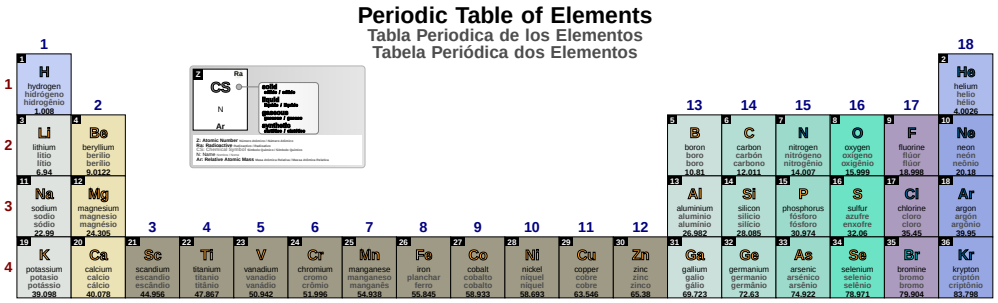


Also, the space for the title should be taken into account – if using more then three languages, the legend must be *turned off*, otherwise the title overlaps the legend.

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.

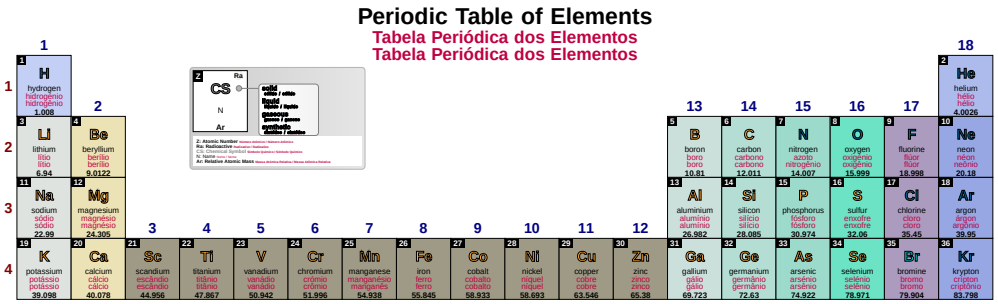
```
\pgfPT[Z list={1,...,36},cell style=pgfPT3lang,languages={en,es,br}, other languages font=\tiny\bfseries]
```



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]
```

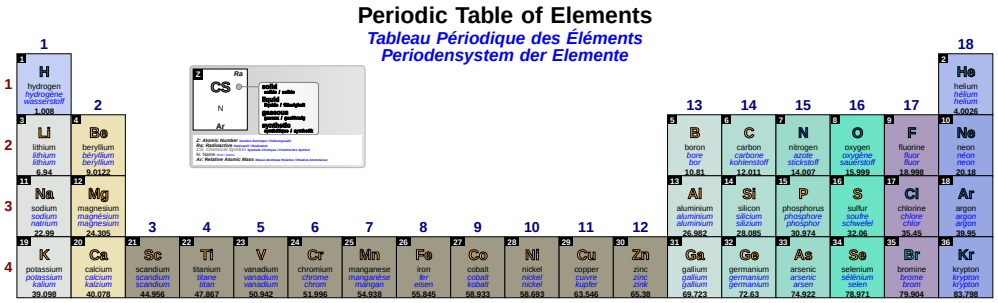


other lang default: *{f=\tiny,c=black!70}*

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>}

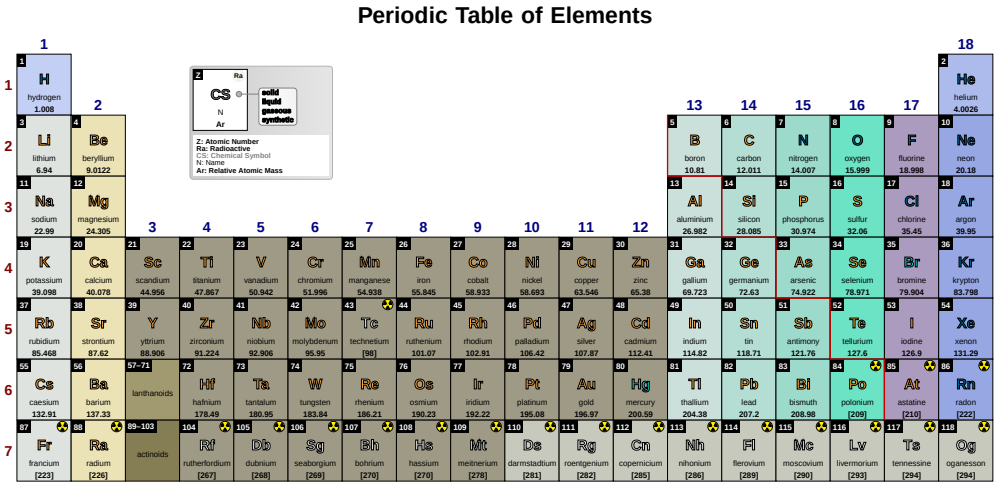
```
\pgfPT[Z list={1,...,36},cell style=pgfPT3lang,languages={en,fr,de}, other lang={f=\tiny\itshape,c=blue}]
```



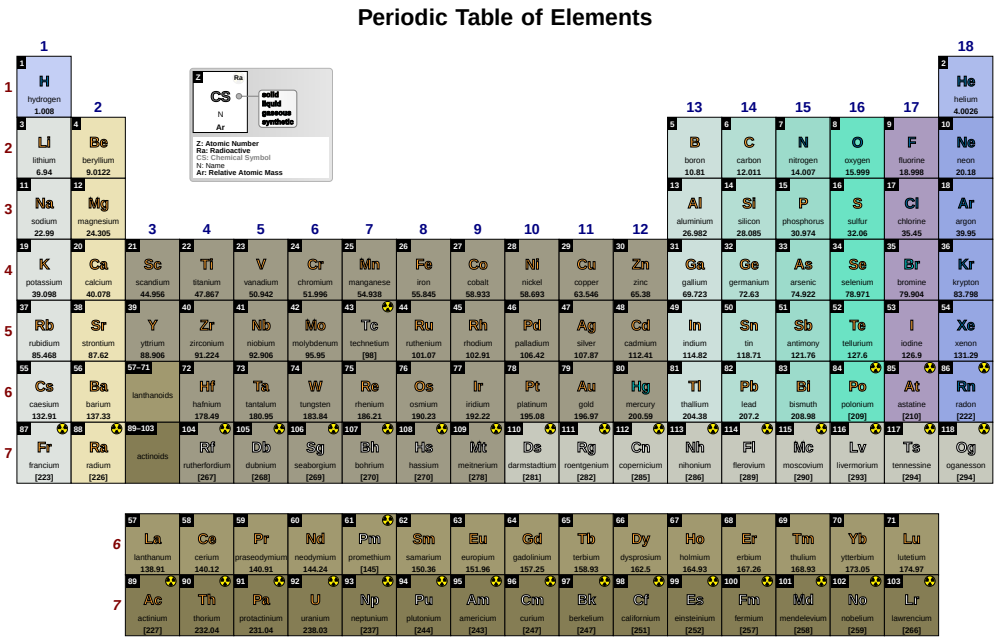
show MNM line default: *true*

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]
```



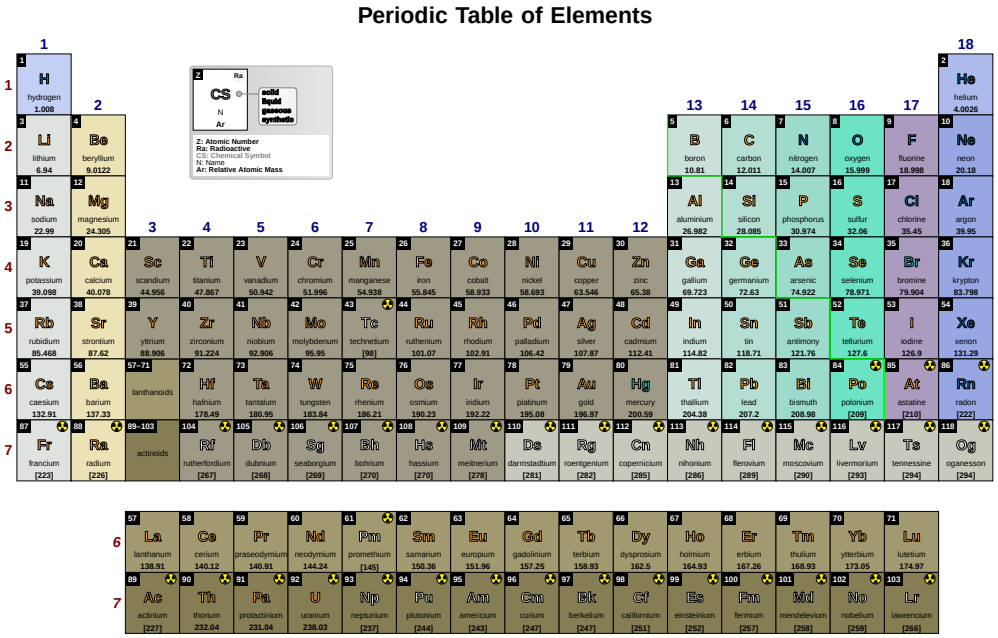
\pgfPT[show MNM line=false]



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

Sets the color of the *MNM line*.

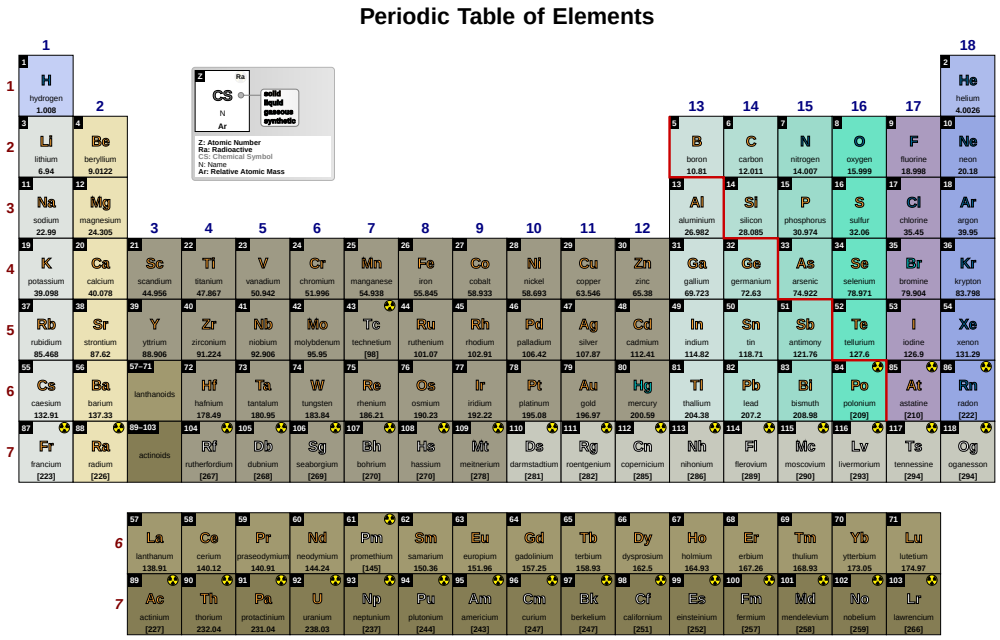
\pgfPT[MNM line color=green]



MNM line width default: *.8pt*

Sets the width of the *MNM line*.

\pgfPT[MNM line width=1.5pt]

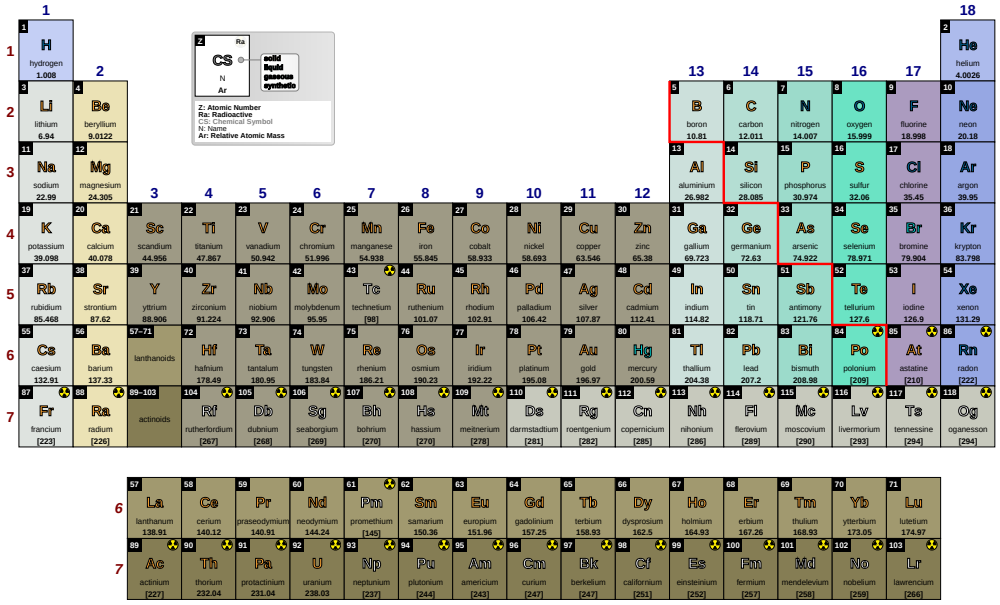


MNM default: *{c=red!80!black,w=.8pt}*

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}]
```

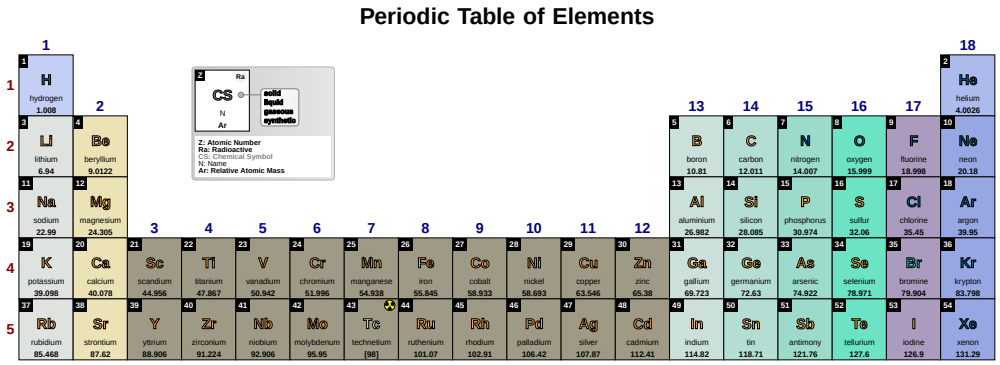


➠ Title and Legend

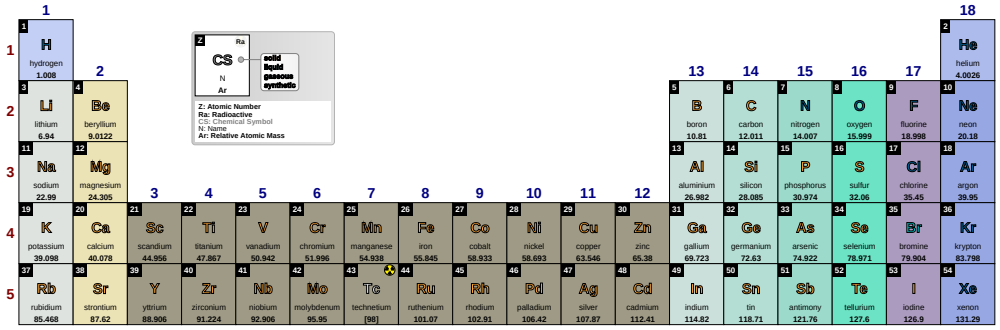
show title default: *true*

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

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



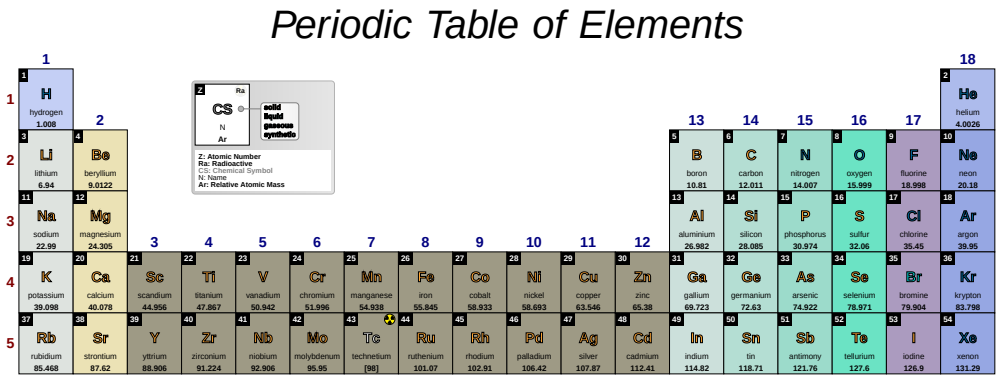

```
\pgfPT[Z list={1,...,54},show title=false]
```



title font default: *\Large\bfseries*

Sets the font used in the title.

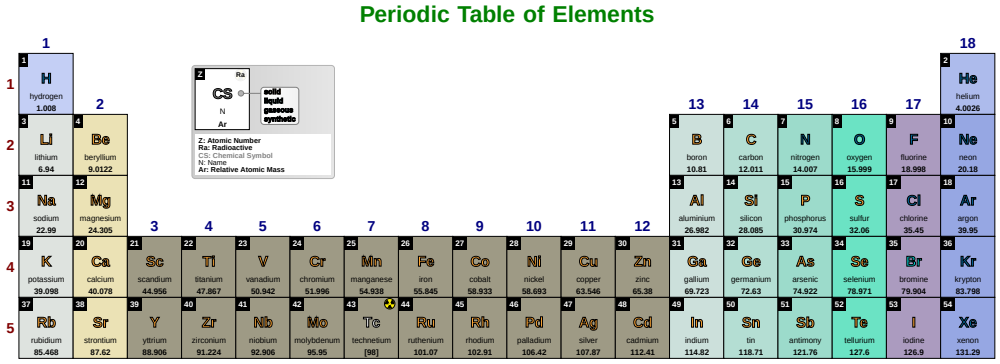
```
\pgfPT[Z list={1,...,54},title font=\Huge\itshape]
```



title color default: *black*

Sets the title color.

```
\pgfPT[Z list={1,...,54},title color=green!50!black]
```

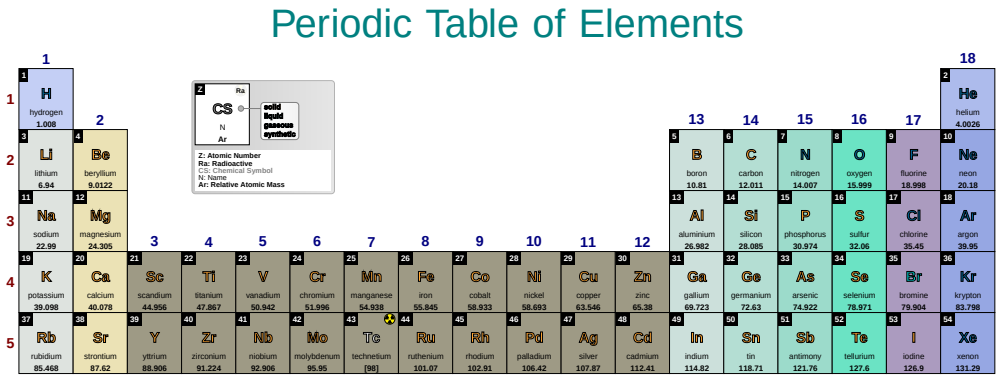


title default: *{f=\Large\bfseries,c=black}*

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>}

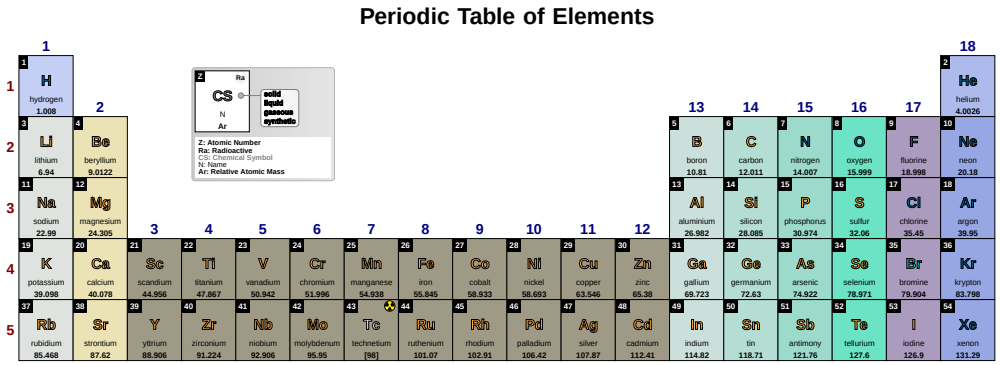
```
\pgfPT[Z list={1,...,54},title={f=\Huge,c=teal}]
```



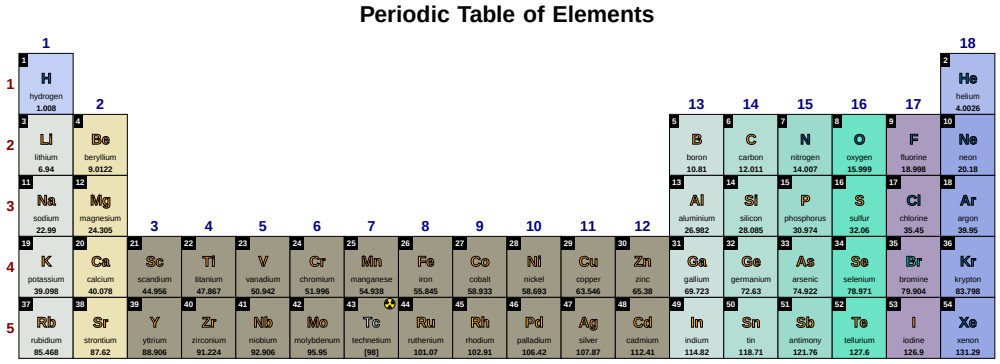
show legend default: *true*

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

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



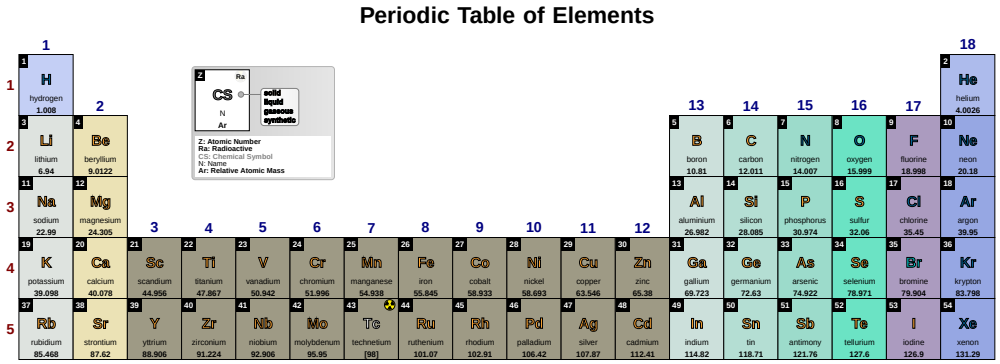
```
\pgfPT[Z list={1,...,54},show legend=false]
```



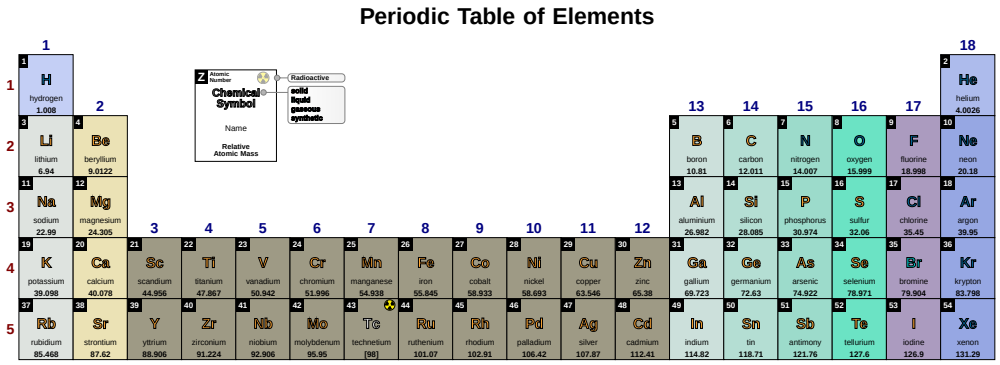
legend acronyms default: *true*

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,...,54}]
```




```
\pgfPT[Z list={1,...,54},legend acronyms=false]
```

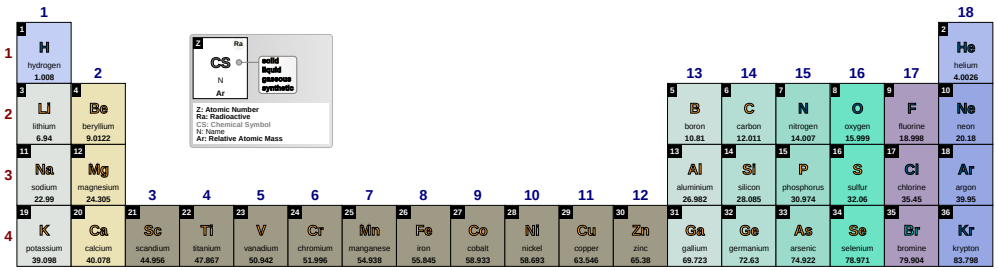


legend box default: *left color=black!20,right color=black!10,draw=black!30*

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.*

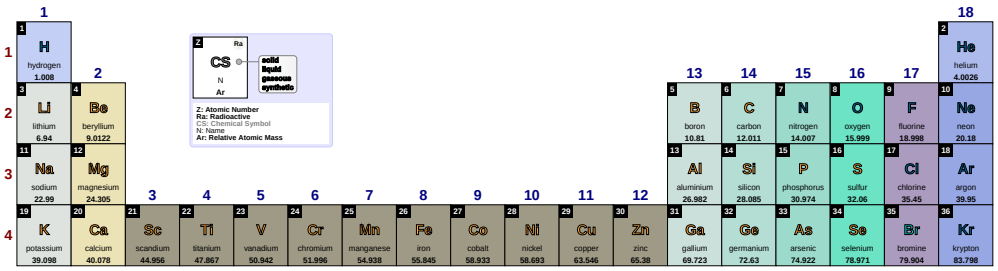
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements



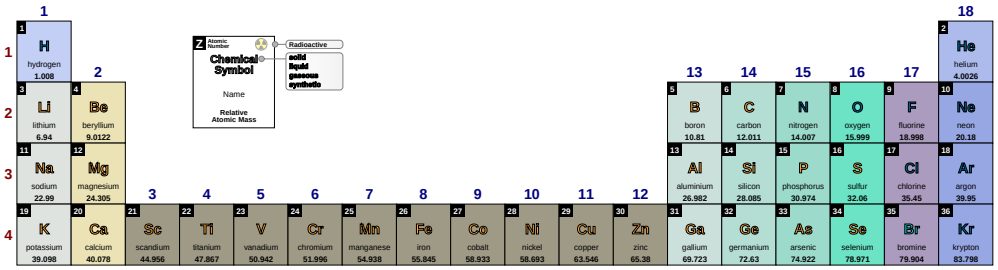

```
\pgfPT[Z list={1,...,36},legend box={draw=blue!20,fill=blue!10}]
```

Periodic Table of Elements



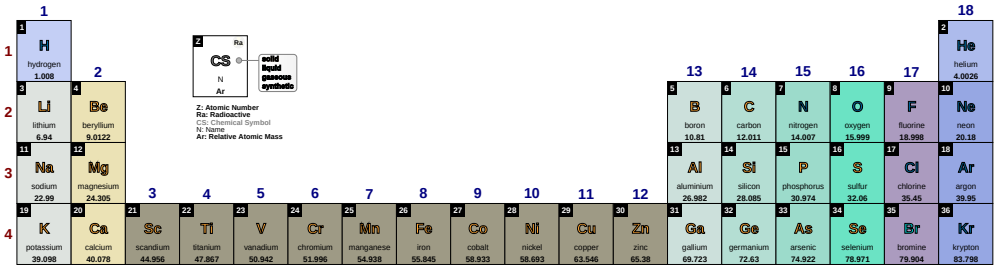

```
\pgfPT[Z list={1,...,36},legend box={draw=blue!20,fill=blue!10,legend
acronyms=false}]
```

Periodic Table of Elements




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

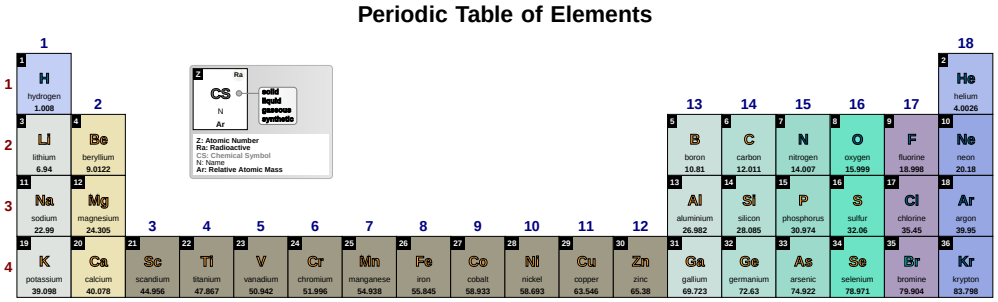
Periodic Table of Elements



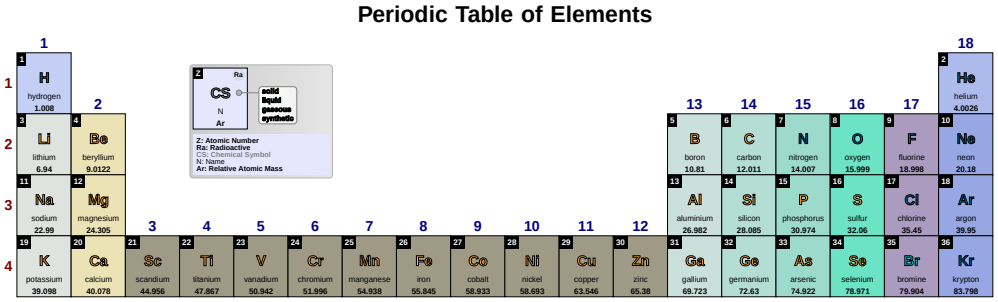
legend back color default: *white*

Sets the legend background color.

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



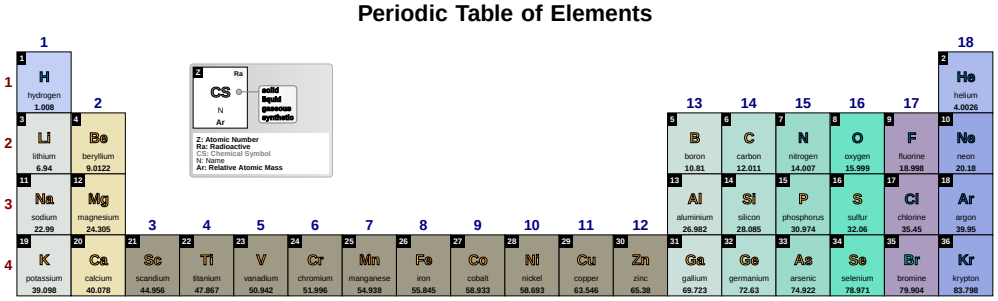

```
\pgfPT[Z list={1,...,36},legend back color=blue!10]
```



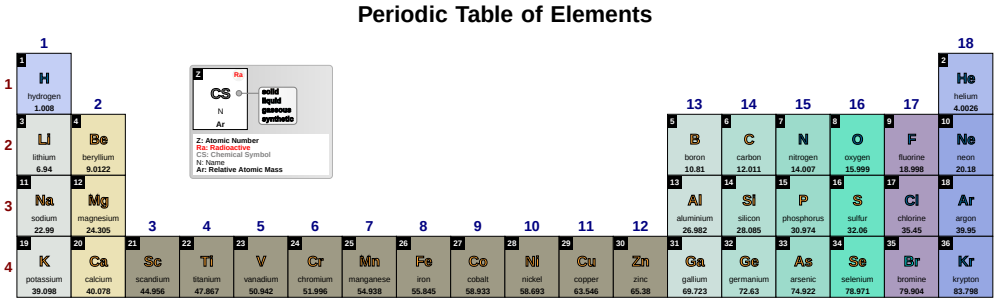
legend radio color default: *black*

Sets the color of the radioactivity acronym and corresponding description.

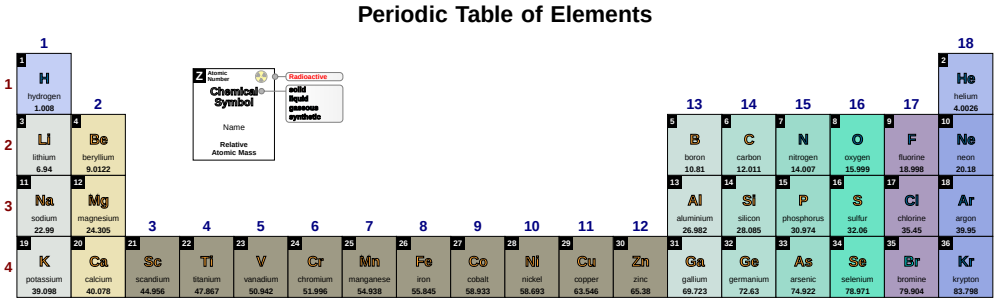
```
\pgfPT[Z list={1,...,36}]
```




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



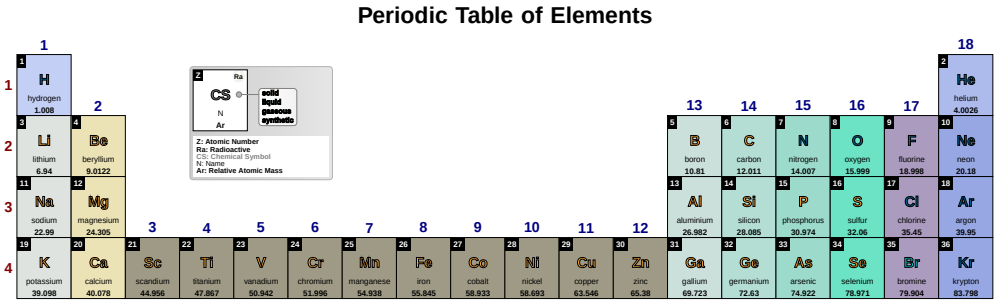
```
\pgfPT[Z list={1,...,36},legend radio color=red,legend acronyms=false]
```



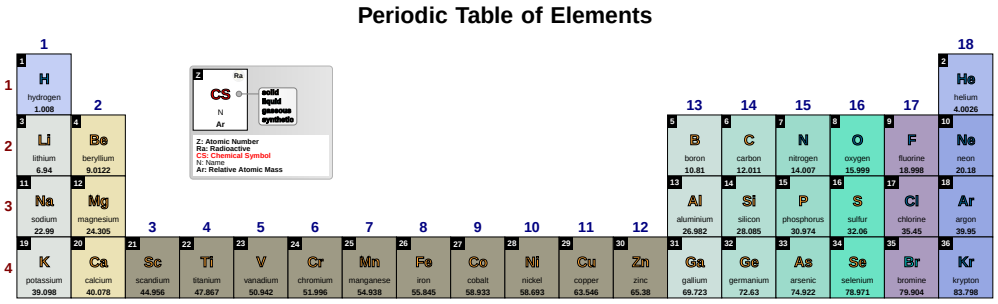
legend CS color default: *black!50*

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

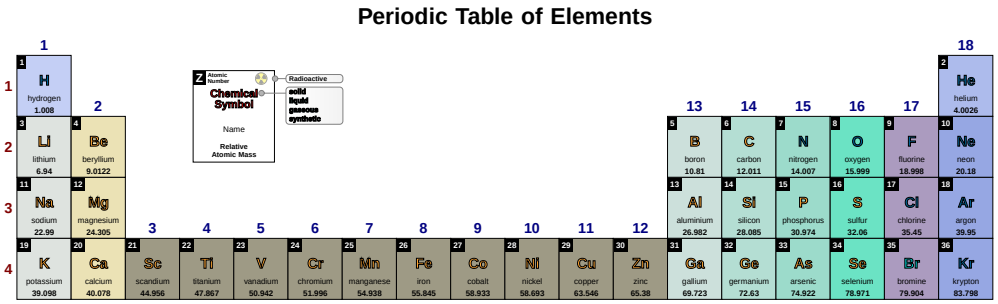
```
\pgfPT[Z list={1,...,36}]
```




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




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

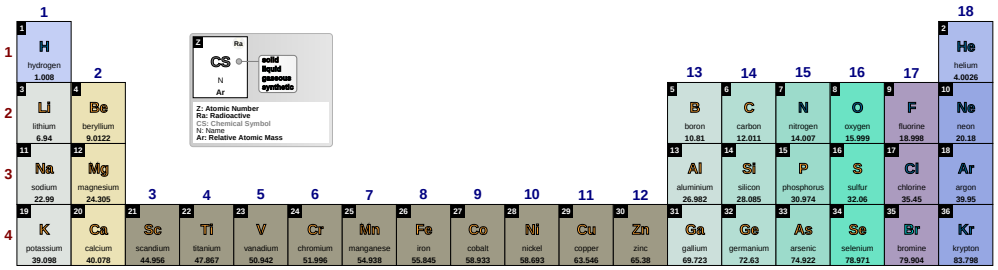


legend Z color default: *{}*

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

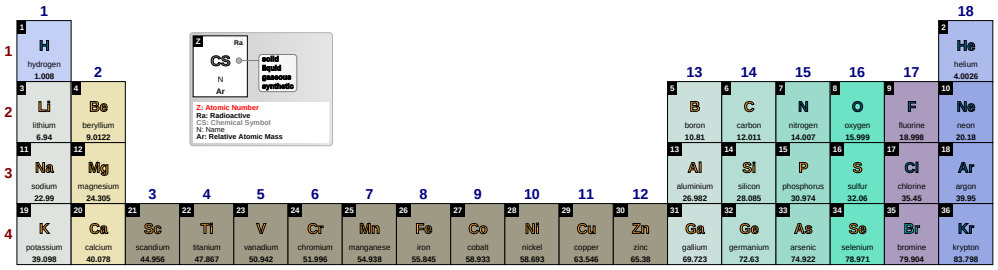
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements



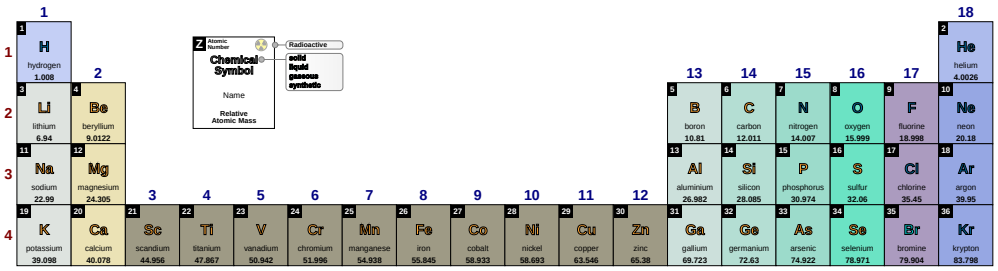

```
\pgfPT[Z list={1,...,36},legend Z color=red]
```

Periodic Table of Elements




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

Periodic Table of Elements

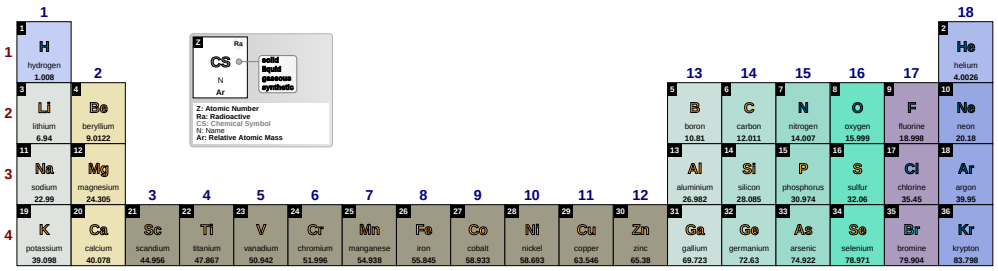


show legend pins default: *true*

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

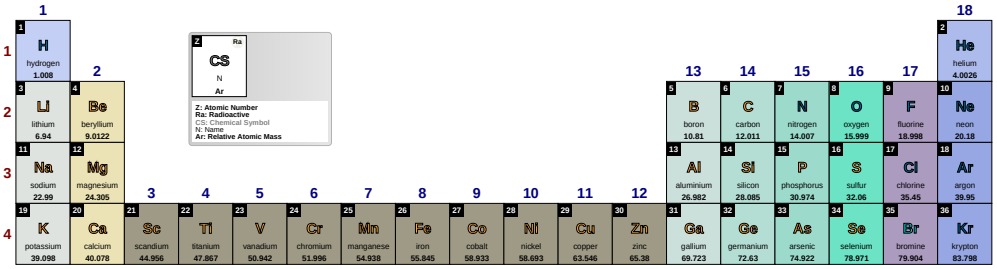
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements



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

Periodic Table of Elements

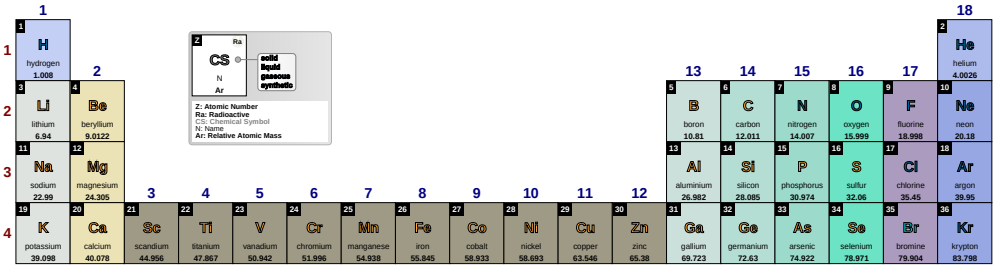


legend pins default: *{line width=.05pt,rounded corners=2pt,right color=black!5, left color=white,draw=black!50}*

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

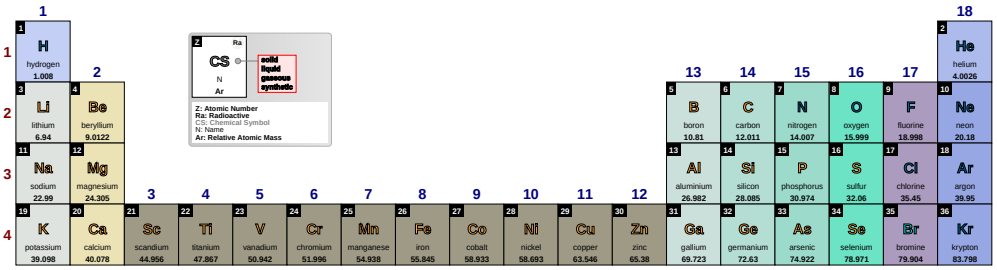
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements



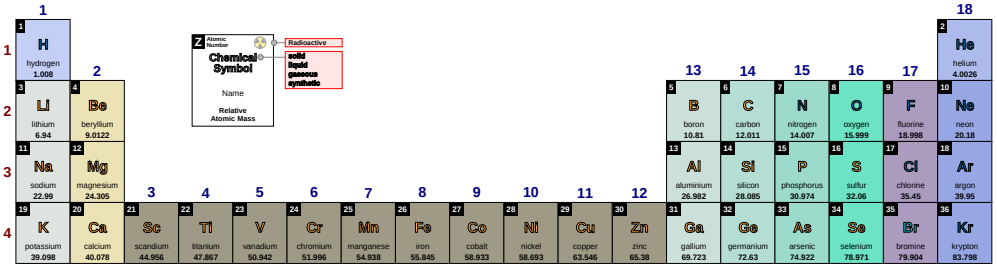

```
\pgfPT[Z list={1,...,36},legend pins={draw=red,fill=red!10}]
```

Periodic Table of Elements




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

Periodic Table of Elements

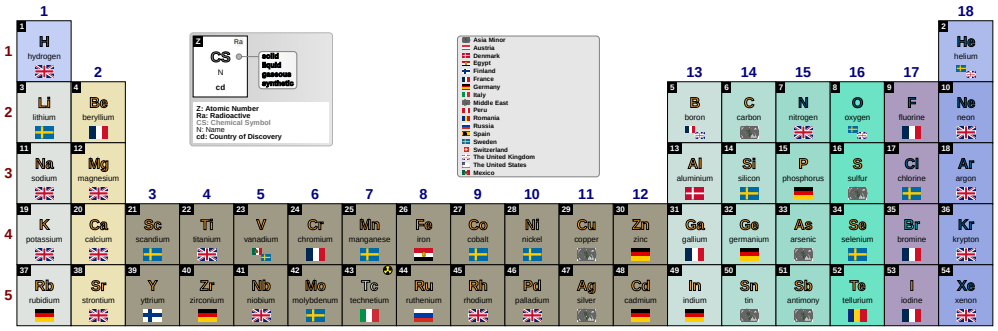


show extra legend default: *true*

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

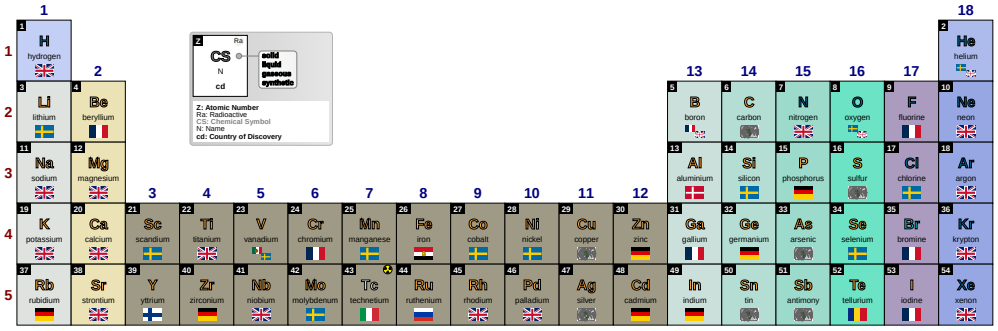
```
\pgfPTbuilcellstyle{myname}(6,3)% 6 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5.25-6.75;1-3;DiscC)]
\pgfPT[Z list={1,...,54},cell style=myname]
```

Periodic Table of Elements



```
\pgfPT[Z list={1,...,54},cell style=myname,show extra legend=false]
```

Periodic Table of Elements

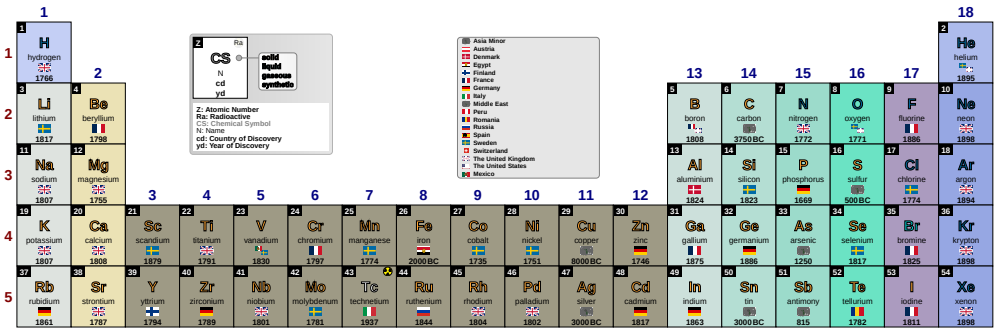


extra legend default: *{draw=black!50,fill=black!10,line width=.05pt, rounded corners=2pt}*

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

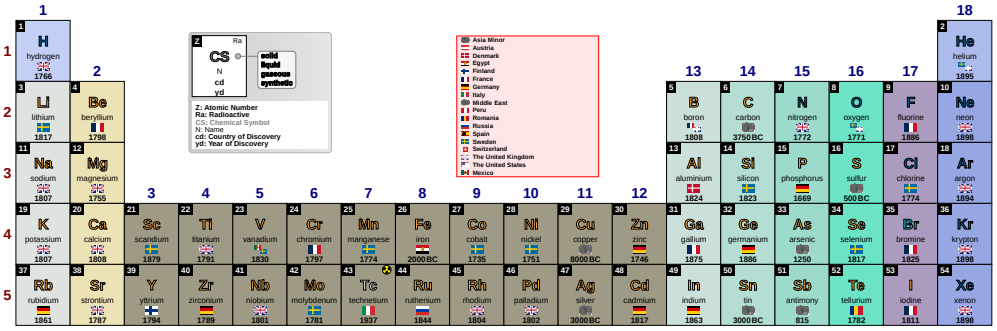
```
\pgfPT[Z list={1,...,54},cell style=pgfPTdisc]
```

Periodic Table of Elements



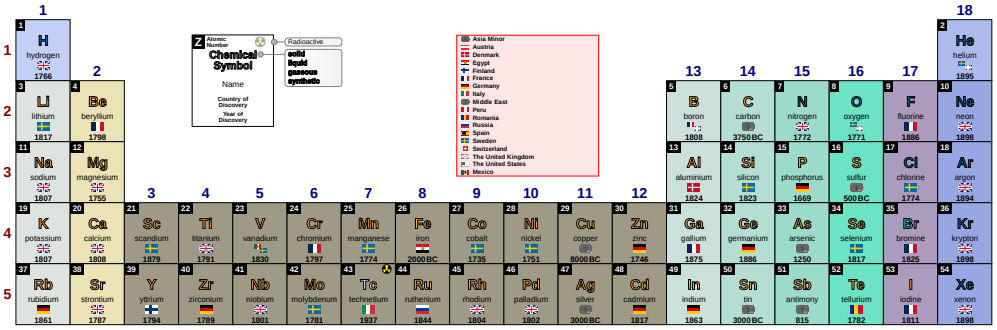
```
\pgfPT[Z list={1,...,54},cell style=pgfPTdisc,extra legend={draw=red,fill=red!10}]
```

Periodic Table of Elements



```
\pgfPT[Z list={1,...,54},cell style=pgfPTdisc,legend acronyms=false,extra legend={draw=red,fill=red!10}]
```

Periodic Table of Elements



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

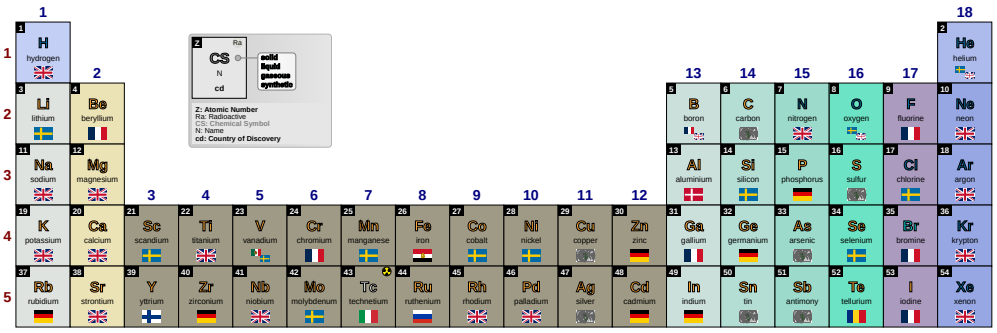
Pseudo style to set the keys: legend **b**ack **c**olor, show legend **pins**, show **extra** legend, legend **acro**nyms, legend **radio** color, legend **CS** color, legend **Z** color, legend **pins** (**style**), **extra** legend (**style**) and/or legend **box** (style). None of the *keys* – bc, 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>}
```

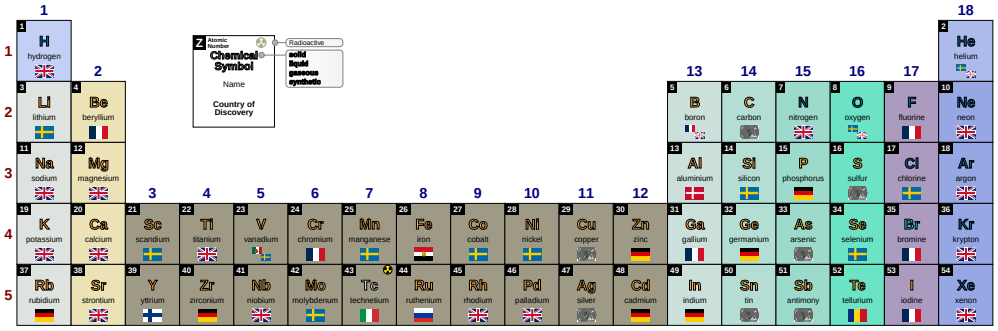
```
\pgfPT[Z list={1,...,54},cell style=myname,legend={bc=black!10,extra=false}]
```

Periodic Table of Elements



```
\pgfPT[Z list={1,...,54},cell style=myname,legend={acro=false,extra=false}]
```

Periodic Table of Elements



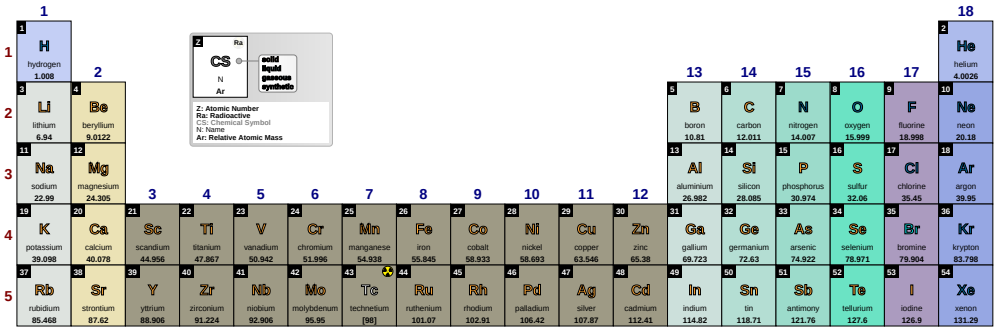
➠ Periods and Groups

show period numbers default: *true*

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

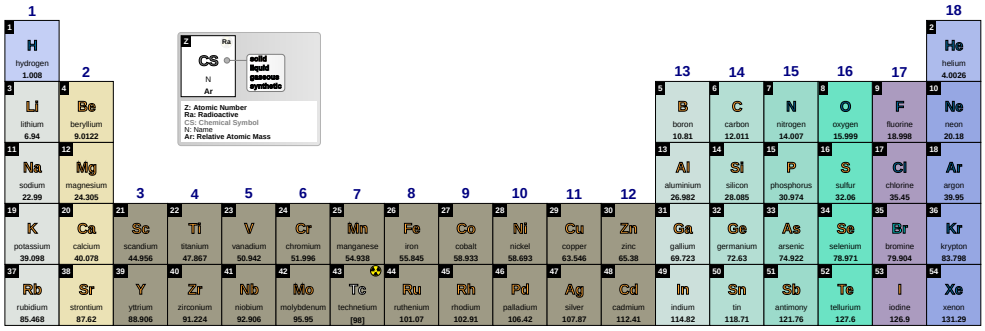
```
\pgfPT[Z list={1,...,54}]
```

Periodic Table of Elements



```
\pgfPT[Z list={1,...,54},show period numbers=false]
```

Periodic Table of Elements

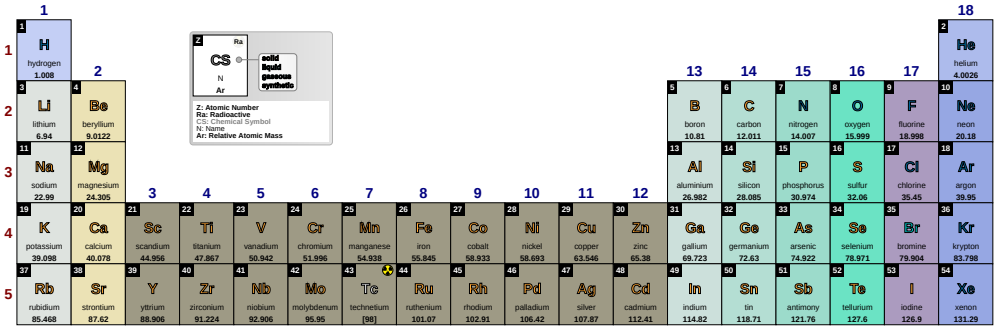


show group numbers default: *true*

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

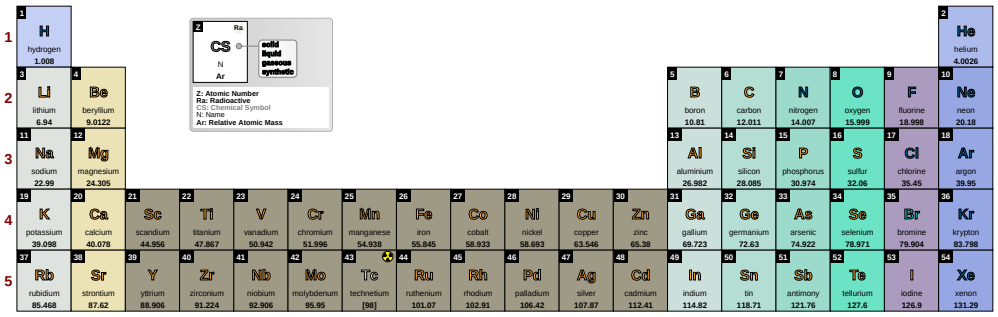
```
\pgfPT[Z list={1,...,54}]
```

Periodic Table of Elements




```
\pgfPT[Z list={1,...,54},show group numbers=false]
```

Periodic Table of Elements

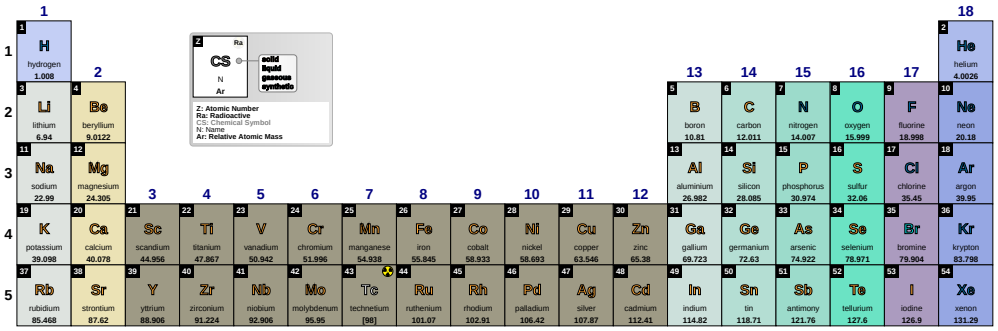


period label color default: *red!50!black*

Sets the period label color.

```
\pgfPT[Z list={1,...,54},period label color=black]
```

Periodic Table of Elements

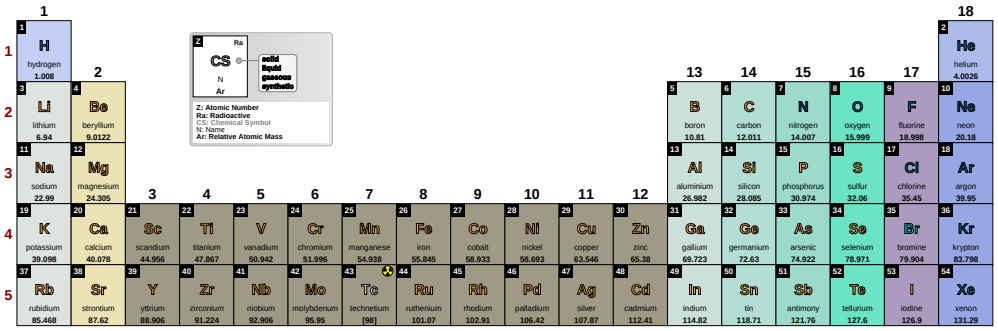


group label color default: *blue!50!black*

Sets the group label color.

```
\pgfPT[Z list={1,...,54},group label color=black]
```

Periodic Table of Elements

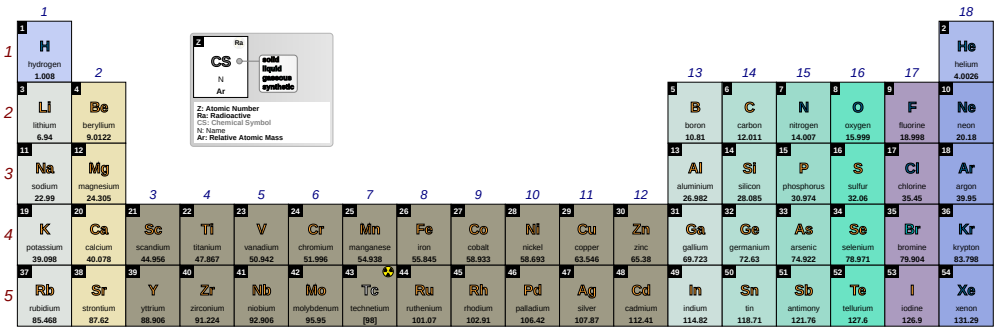


label font default: *\small\bfseries*

Sets the label font.

```
\pgfPT[Z list={1,...,54},label font=\itshape]
```

Periodic Table of Elements



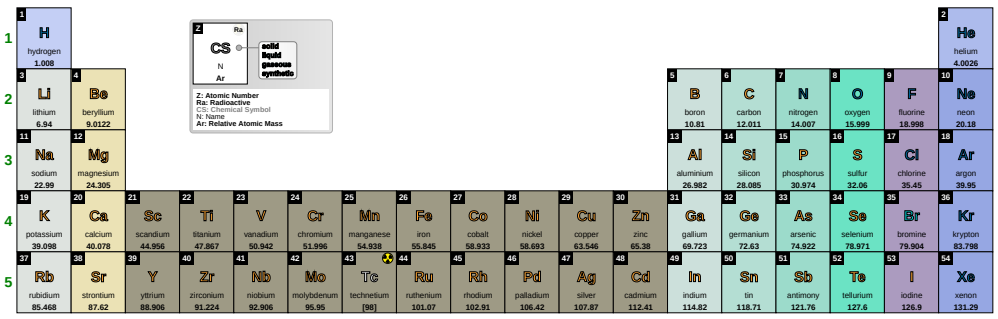
per default: *{gr=true,c=red!50!black,f=\small\bfseries}*

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,...,54},per={gr=false,c=green!50!black}]
```

Periodic Table of Elements



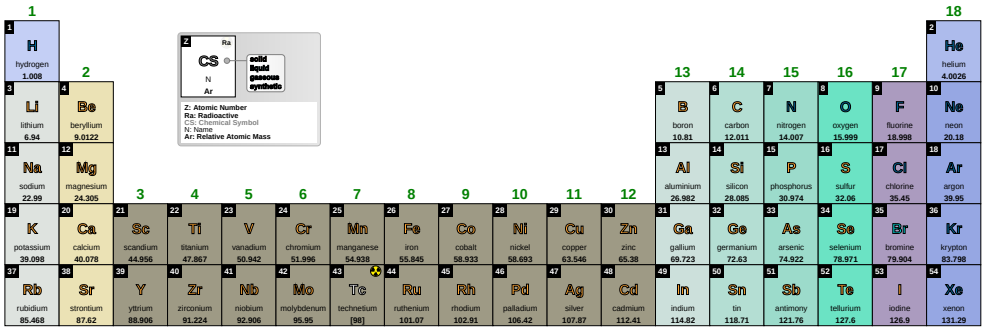
gr default: *{per=true,c=blue!50!black,f=\small\bfseries}*

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,...,54},gr={per=false,c=green!50!black}]
```

Periodic Table of Elements



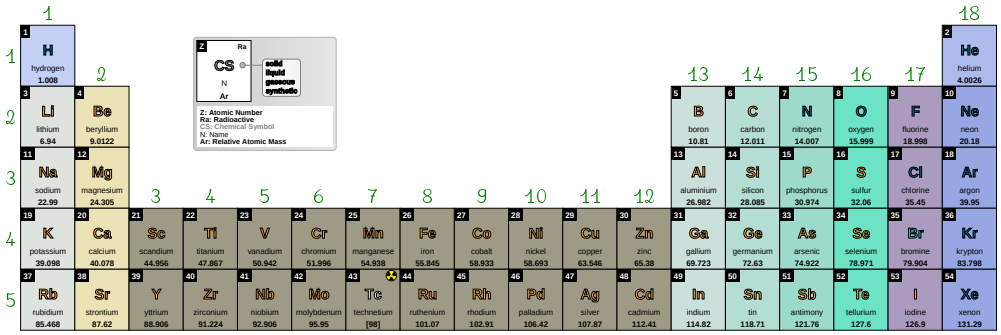
per+gr default: *{pc=red!50!black,gc=blue!50!black,f=\small\bfseries}*

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,...,54},per+gr={c=green!50!black,
f=\fontfamily{frc}\selectfont\normalsize\bfseries}]
```

Periodic Table of Elements

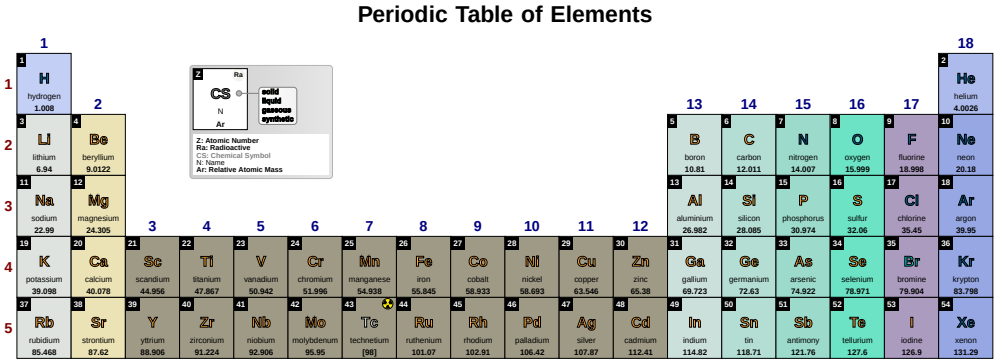


➠ Blocks and Families

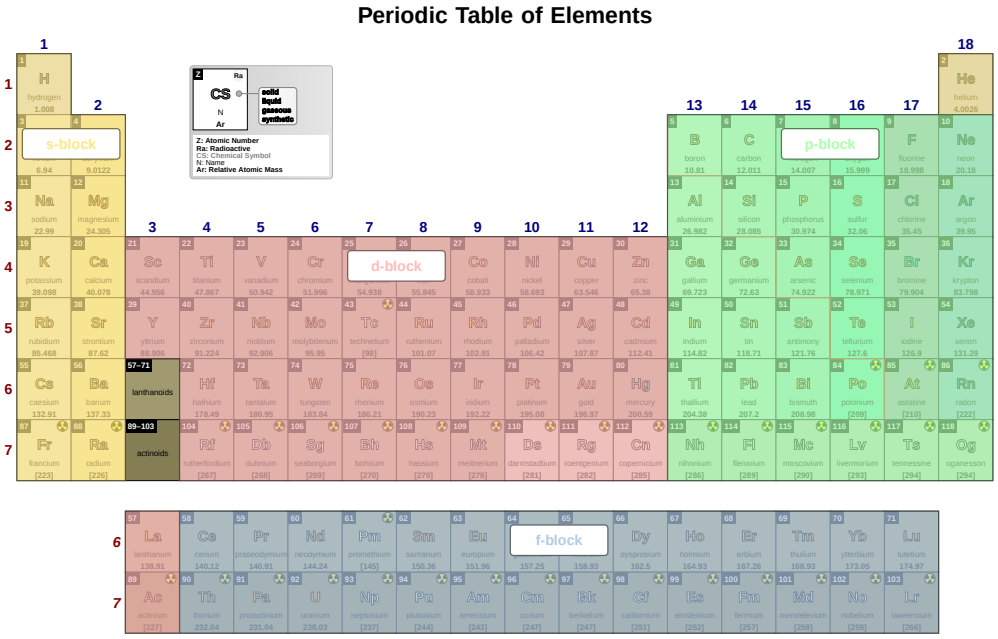
show blocks default: *false*

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.*

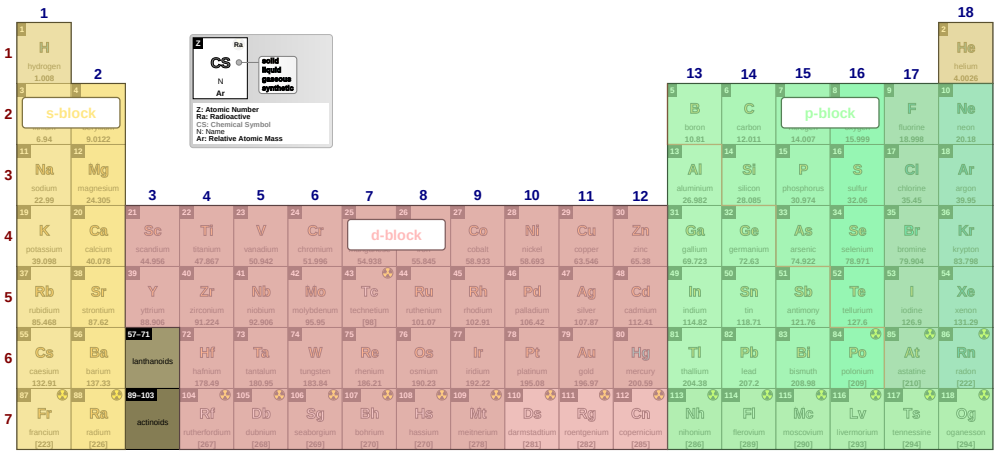
\pgfPT[Z list={1,...,54},show blocks=true]



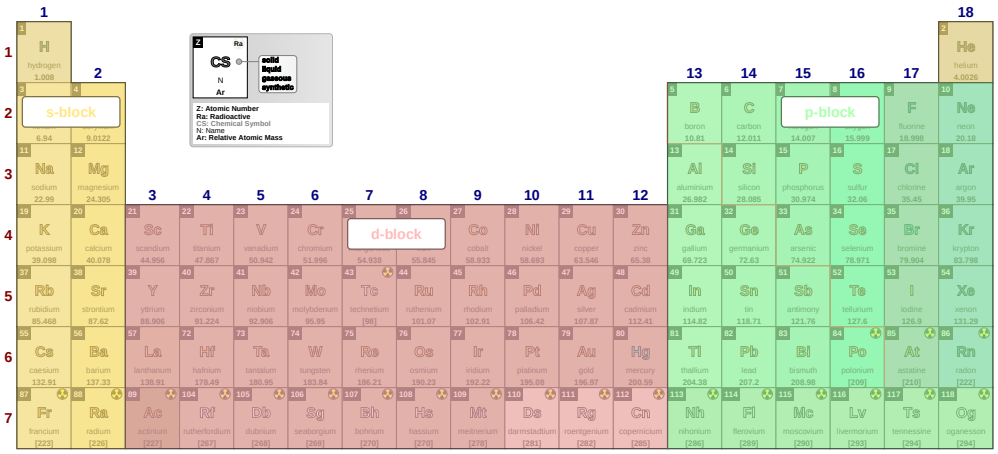
\pgfPT[show blocks]



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



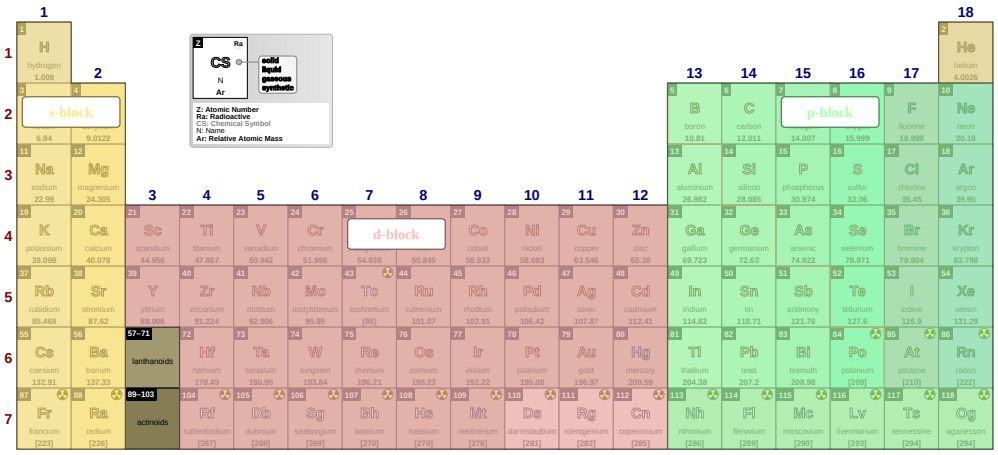
```
\pgfPT[Z list=spd,show blocks,show title=false,IUPAC=false]
```



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.

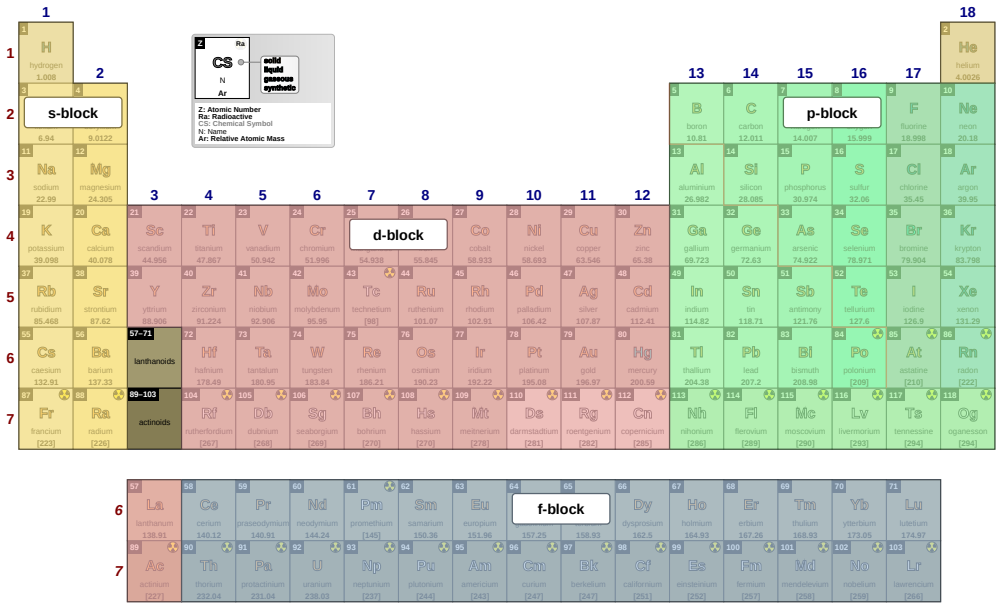
f block line width default: *0.8pt*

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.

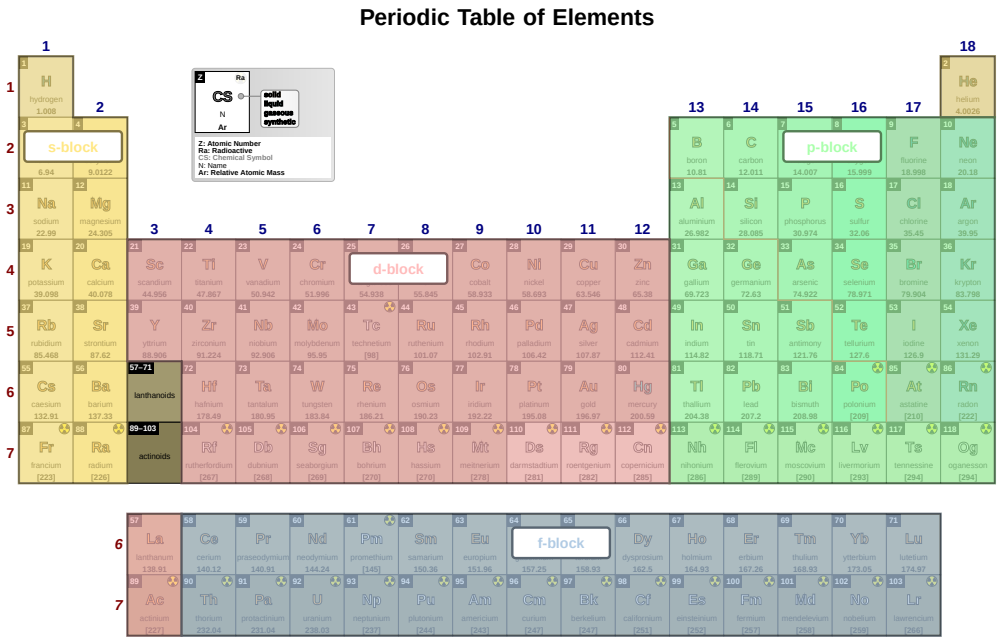
```
\pgfPT[blocks font color,show title=false]
```



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]
```



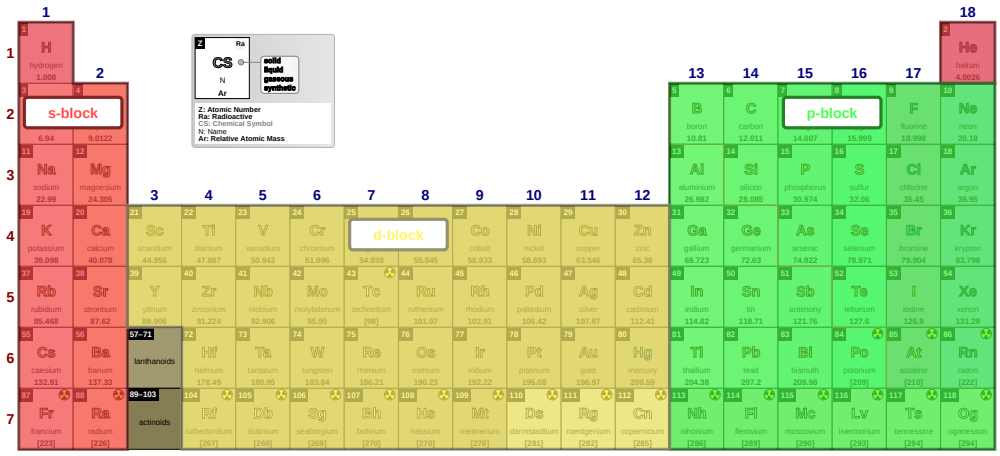
blocks default: *{sc=blocos,pc=blocop,dc=blocod,fc=blocof,lw=.8pt,font=\small\bfseries}*

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.

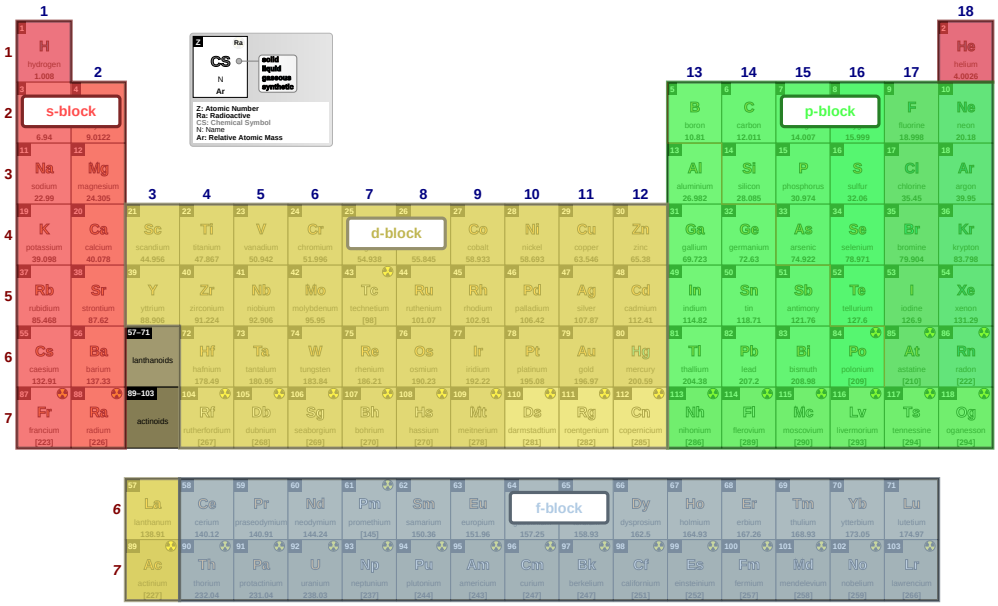
USAGE:
```
blocks={sc=<color>,pc=<color>,dc=<color>,fc=<color>,lw=<lenght>,
        slw=<lenght>,plw=<lenght>,dlw=<lenght>,flw=<lenght>,f=<font commands>,
        sfc=<color>,pfc=<color>,dfc=<color>,ffc=<color>}
```

```
\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}]
```

Periodic Table of Elements

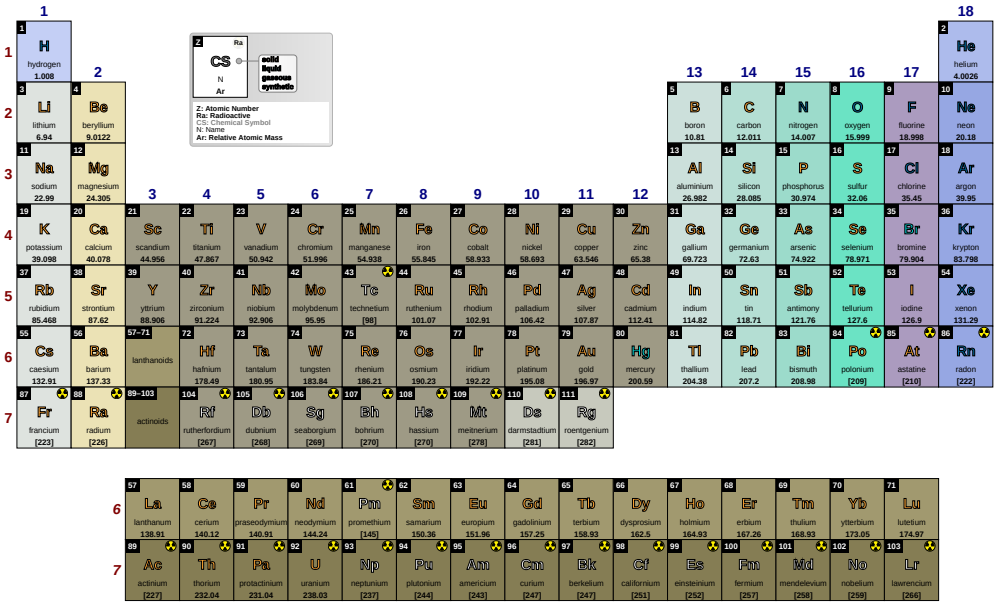


show families default: *false*

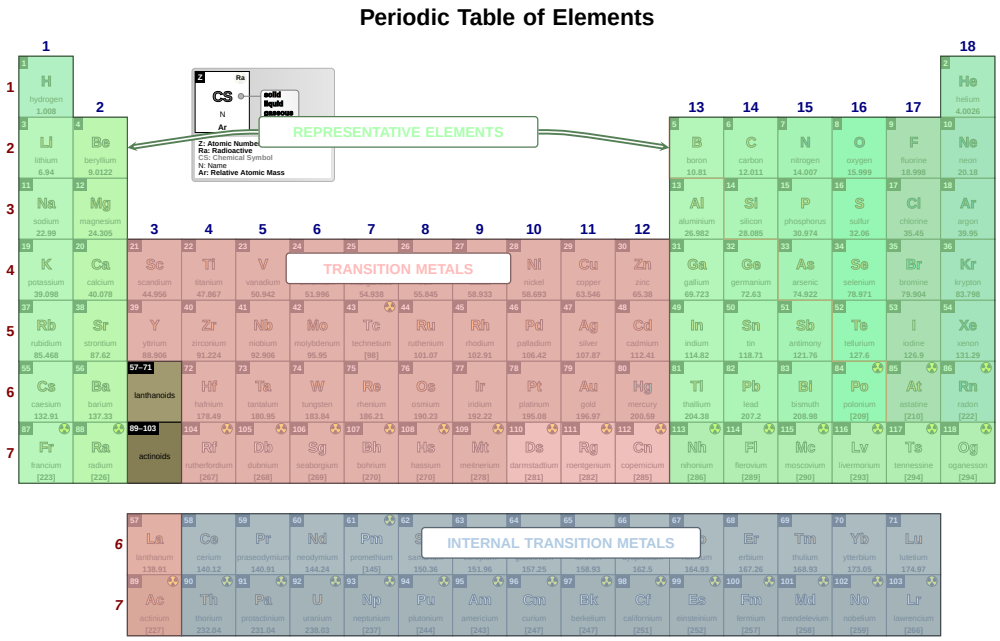
When set to true the main families – representative elements, transition metals and internal transition metals – are drawn overlaying the Periodic Table and their labels are shown. *Note that families are only shown when the Z list contains, at least, all elements of blocks s, p and d.*

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

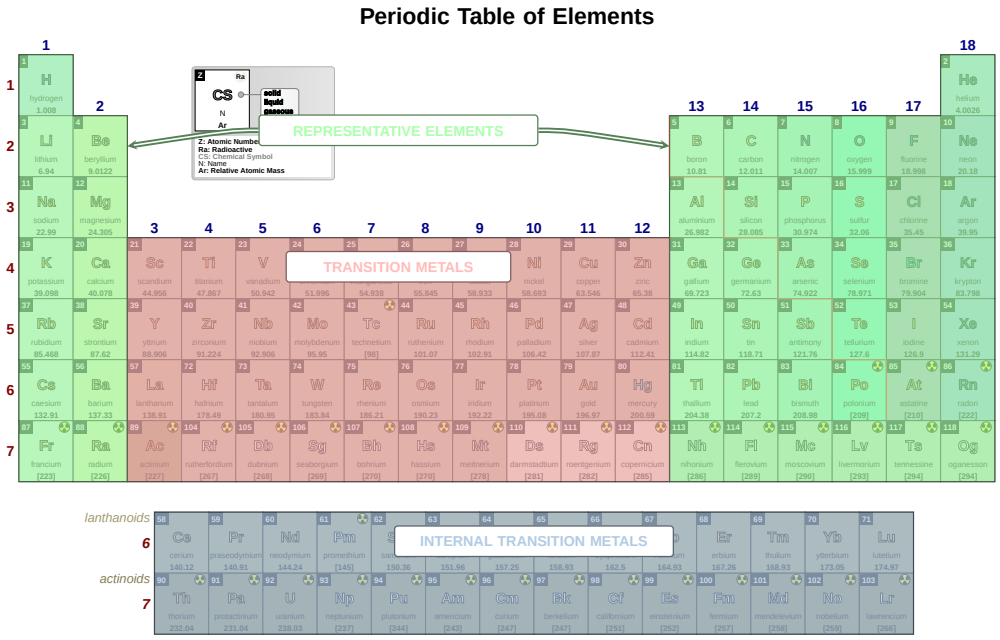
Periodic Table of Elements



\pgfPT[show families]



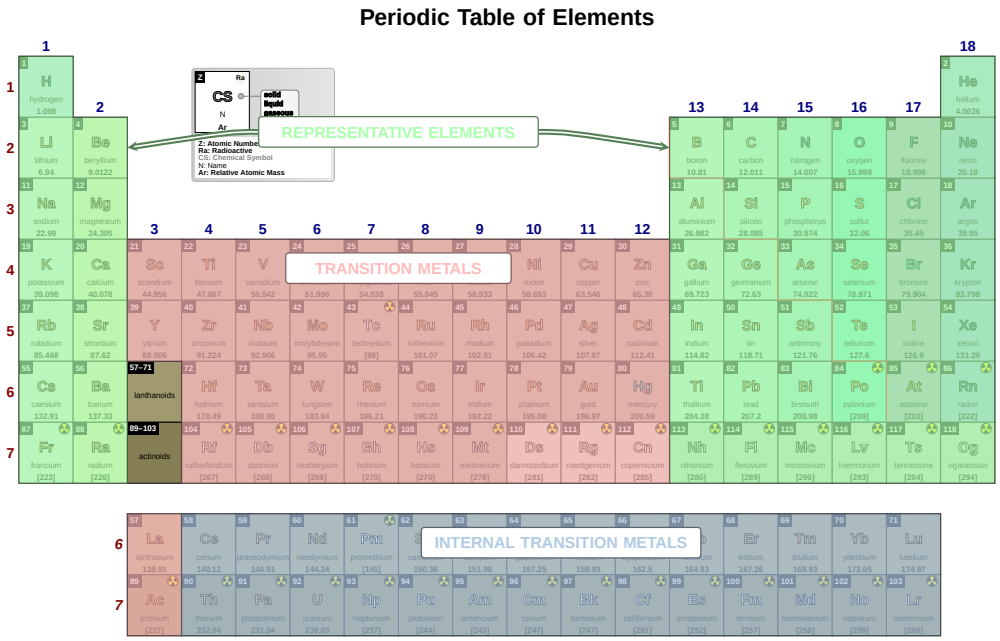
\pgfPT[show families,IUPAC=false]



families font default: *\small\bfseries*

Sets the font used in the family labels.

```
\pgfPT[show families,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.

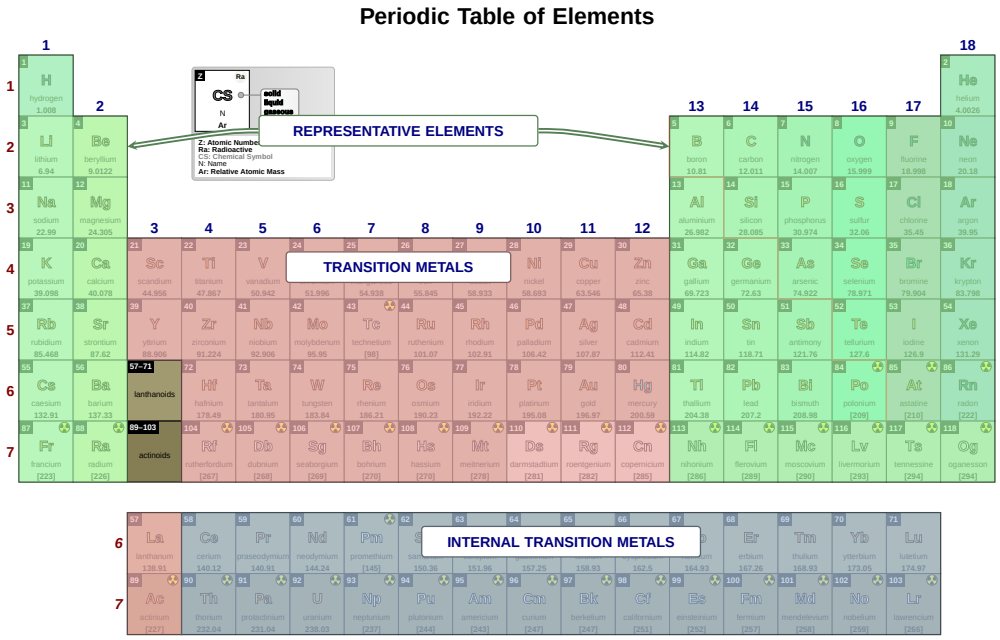
itm family line width default: *0.8pt*

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.

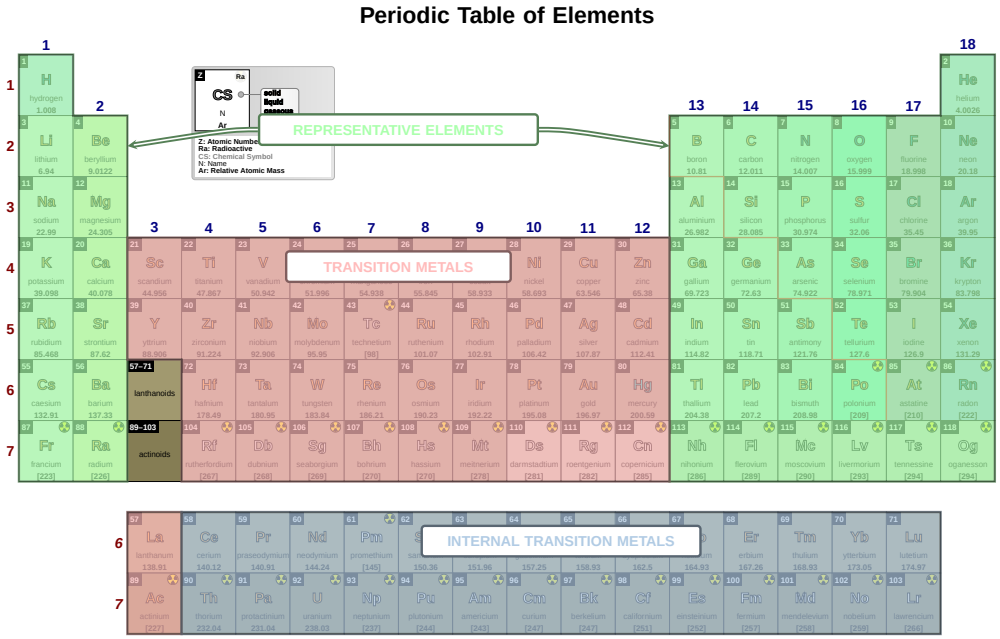
```
\pgfPT[families font color=blue!50!black]
```



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 families,families line width=1.5pt]
```



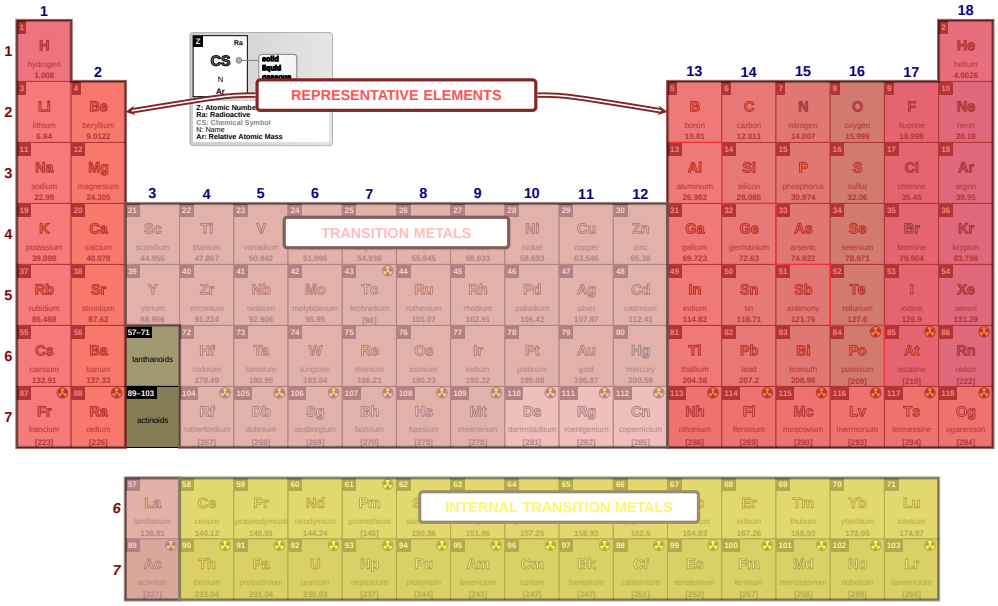
families default: *{rc=blocor,tc=blocot,ic=blocoi,lw=.8pt,f=\small\bfseries}*

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.

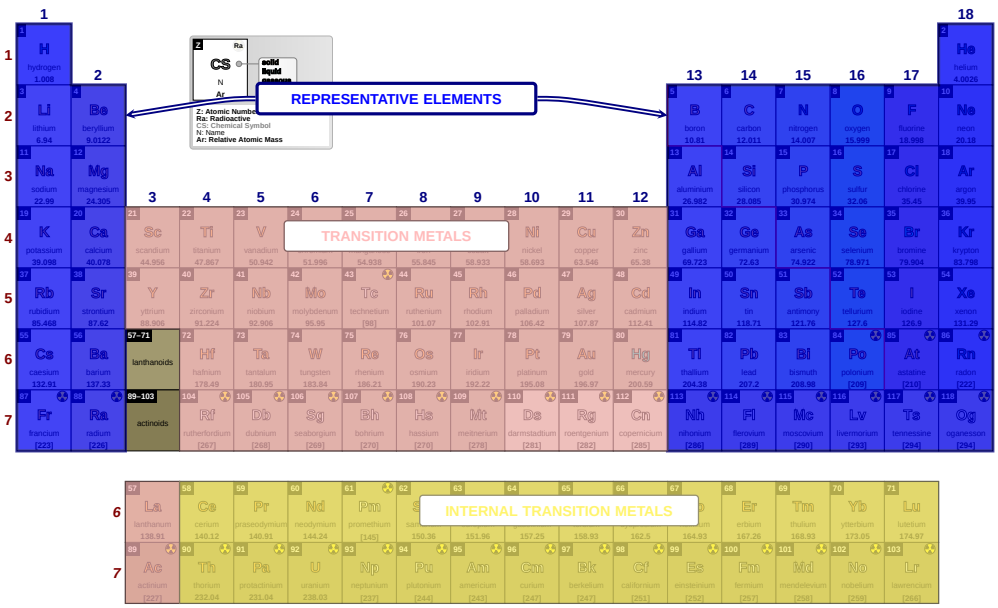
NOTE:
The colors provided to the color keys of the families could be any defined color via the command `\definecolor` or by *mixing* colors, using, for instance, the syntax `color1!value!color2`, as explained in the xcolor package documentation.

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>}
```

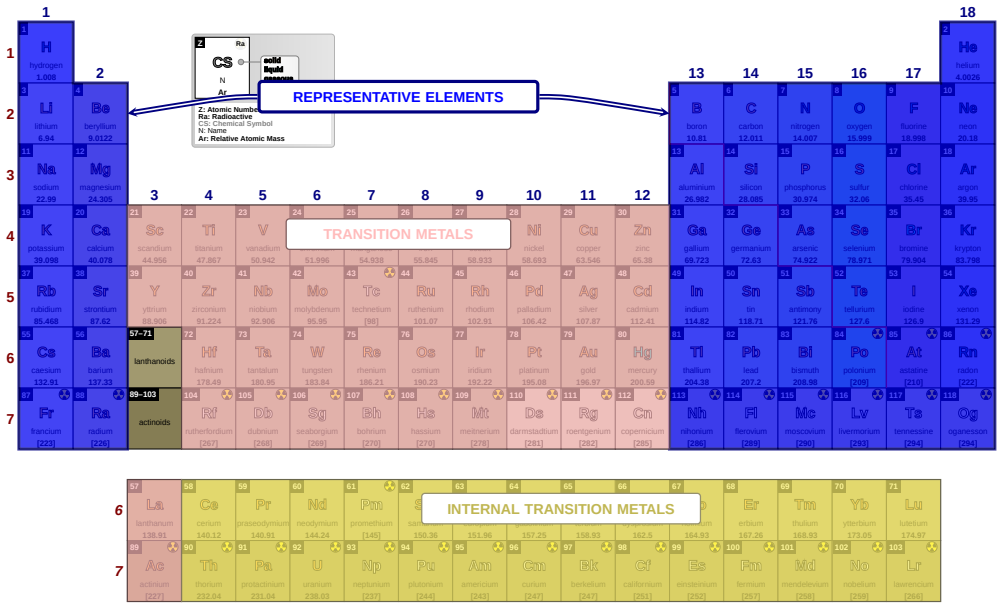
\pgfPT[families={rc=red!70!white,ic=yellow!70!white,lw=2pt},show title=false]



\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]
```



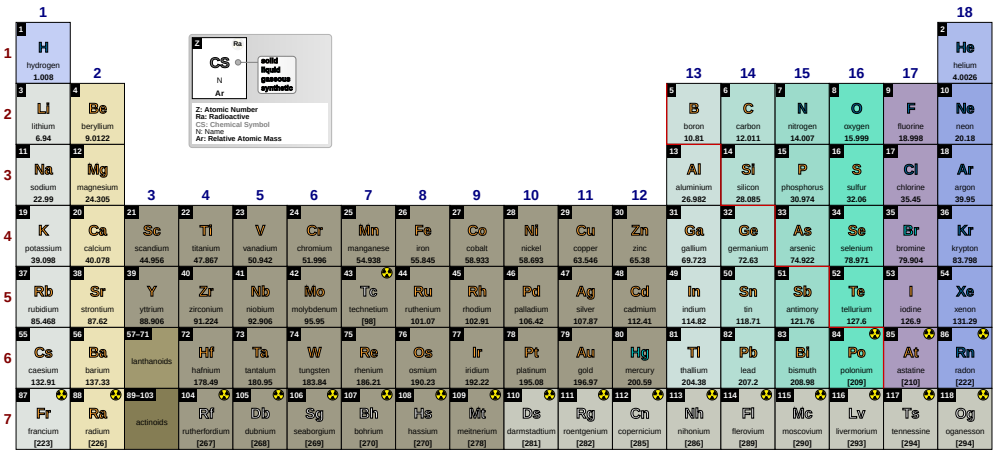
➠ Periodic variations

show periodic variations default: *false*

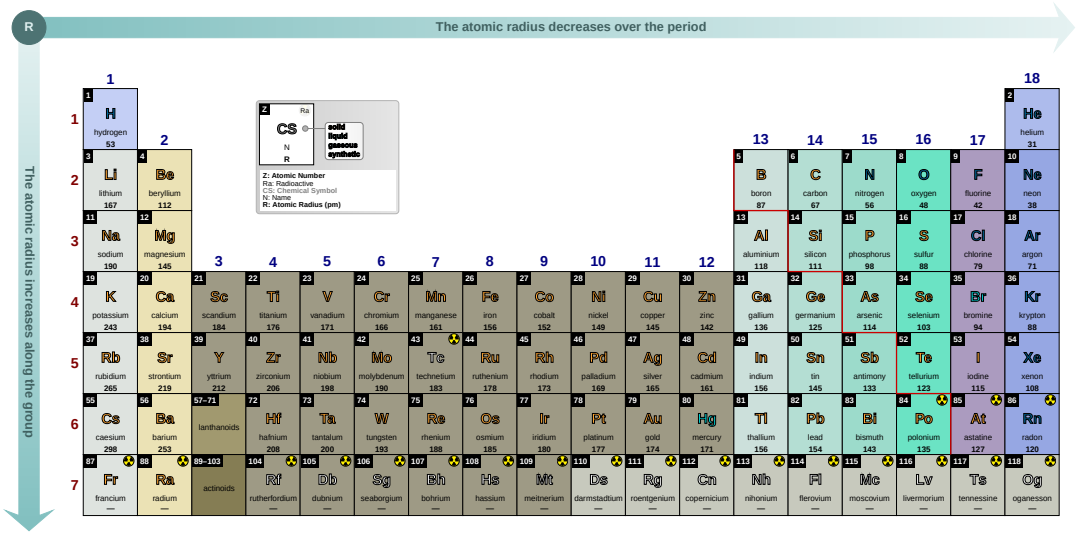
When set to true the periodic variations – for atomic radius, ionization energy and/or electron affinity – are shown with two *arrows*. One horizontal arrow is placed at the top of the Periodic Table for the variation over the period and the other vertically to the left of the Periodic Table for the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

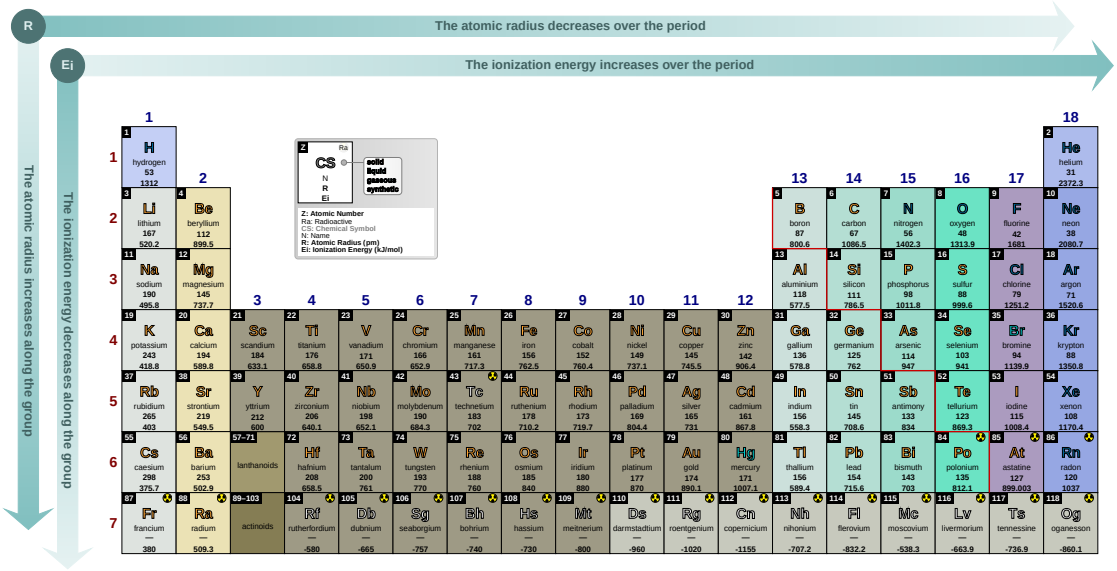
```
\pgfPTstyle[Z list=spd,show title=false]
\pgfPT[show periodic variations]
```



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



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

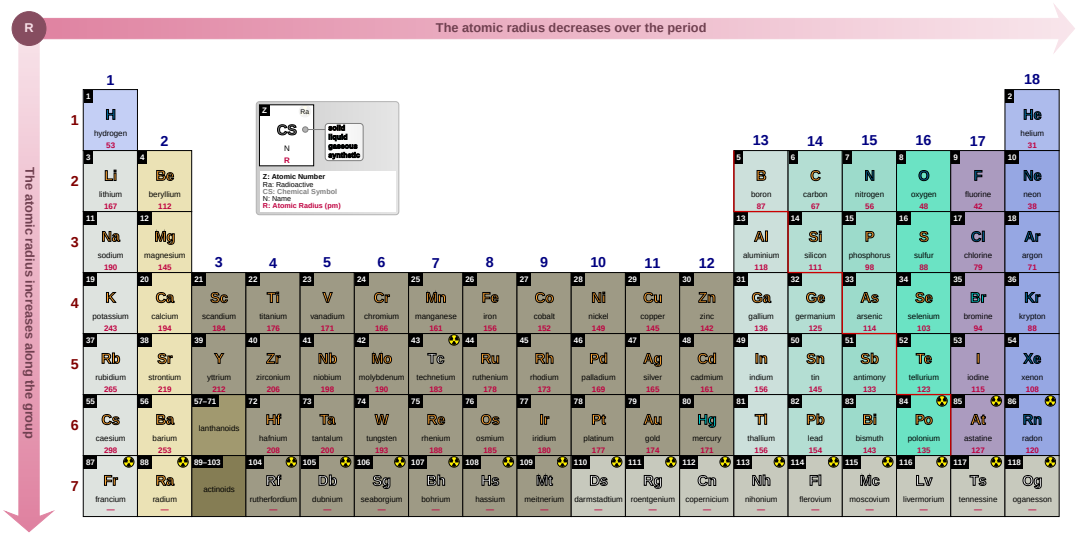


varR color default: *RGB: 128,191,191*

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.

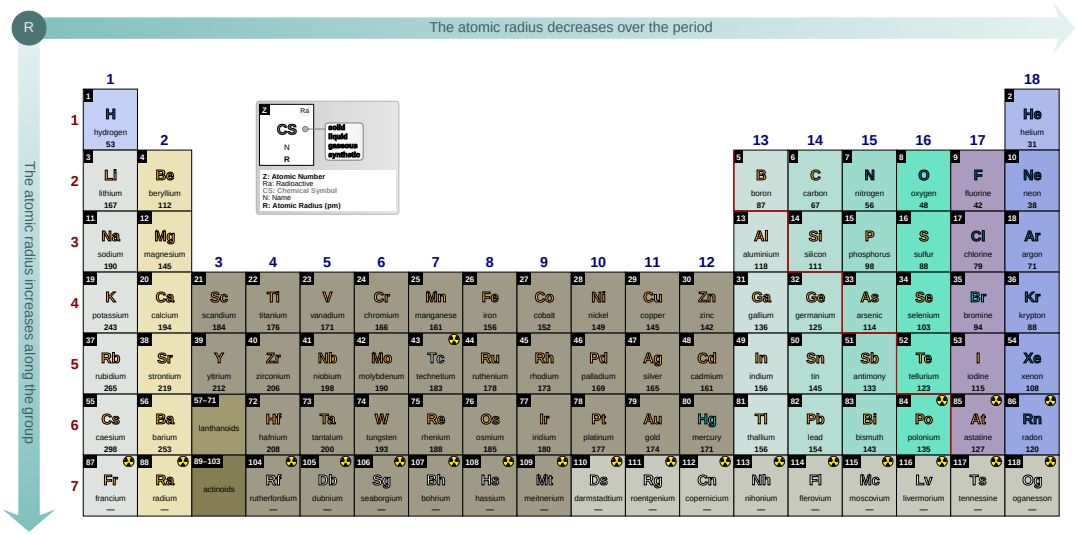
\pgfPT[show periodic variations,cell style=pgfPTR,varR color=teal,R color=purple]



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.

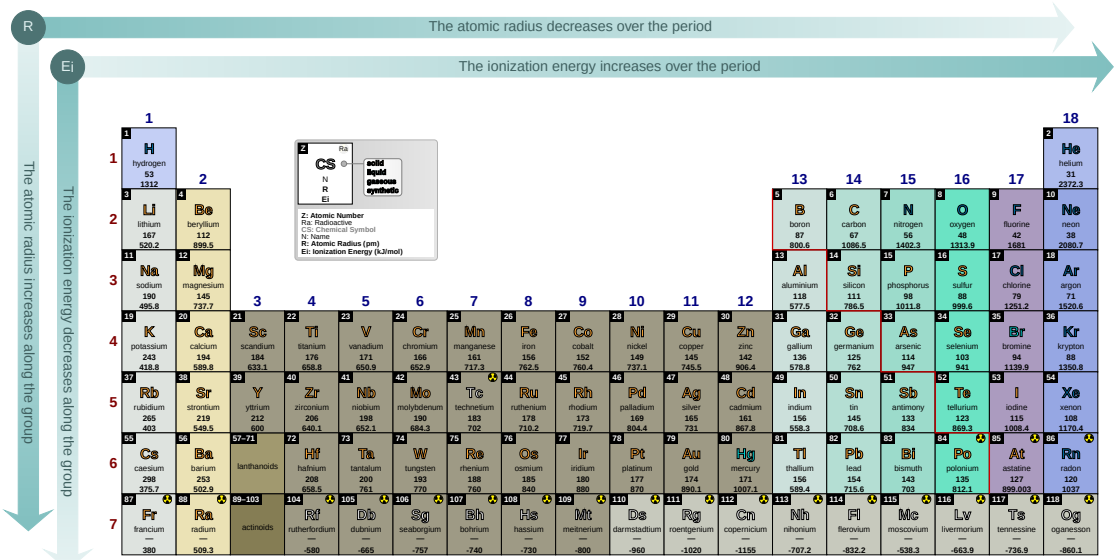
vareaff font color default: *(value of vareaff color)!50!black*

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]
```

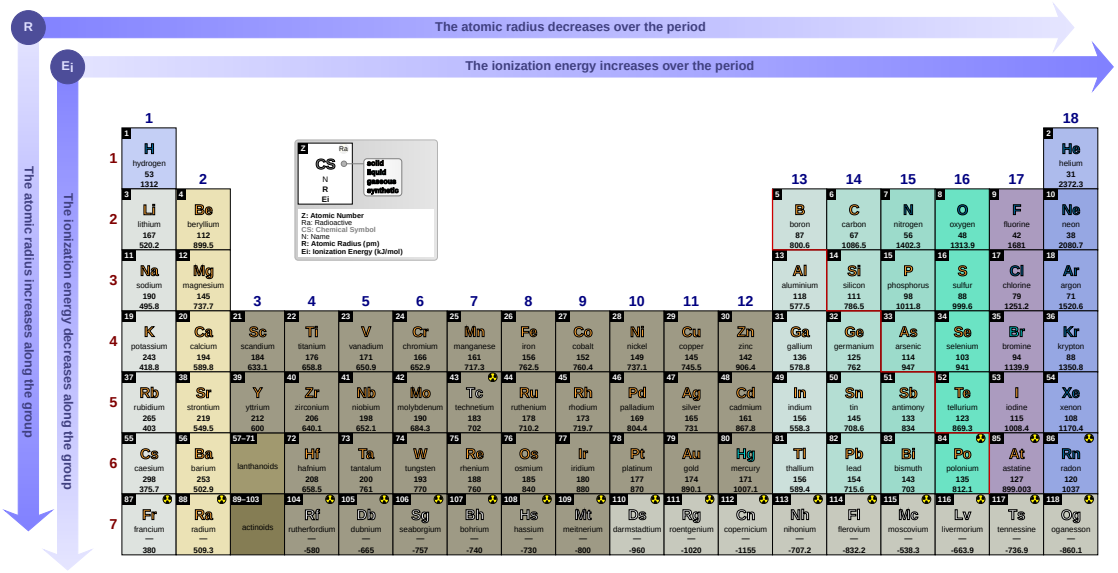


var color default: *RGB: 128,191,191*

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]



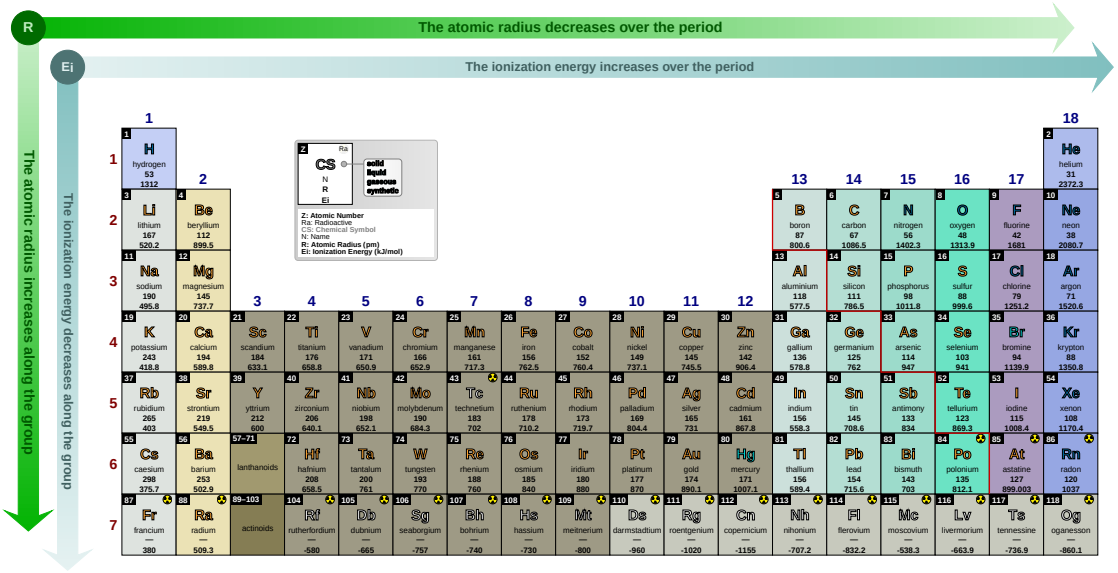
varR default: *{c=colorvariations,f=\footnotesize\bfseries}*

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}]



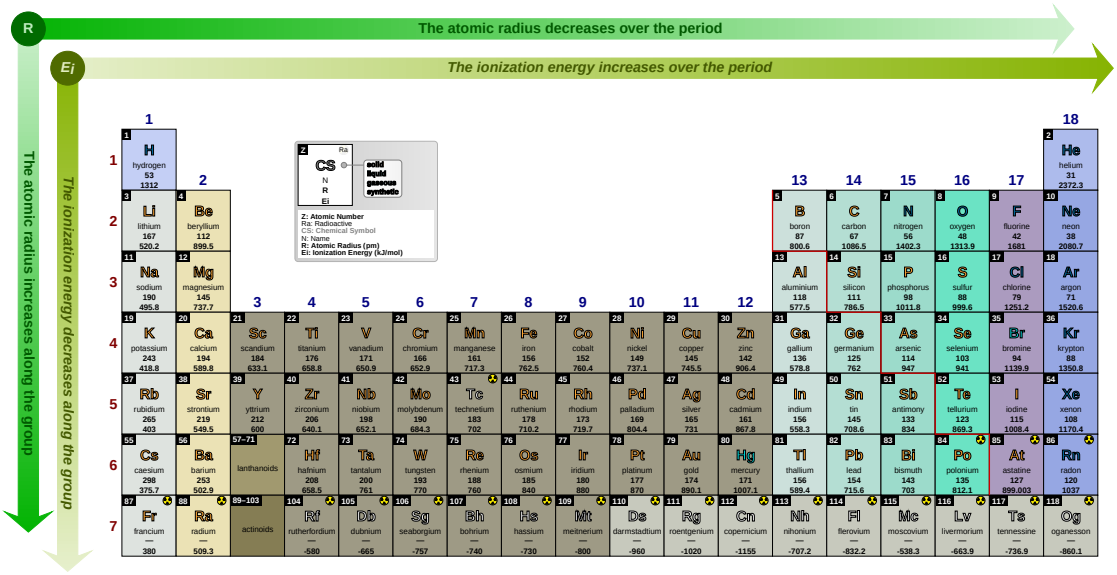
varEi default: *{c=colorvariations,f=\footnotesize\bfseries}*

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}]
```



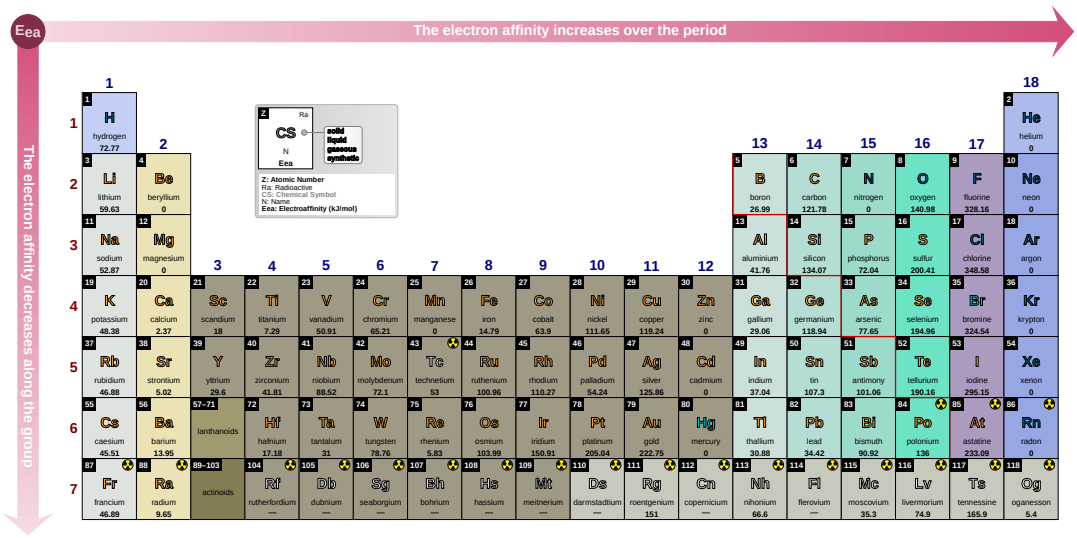
vareff default: *{c=colorvariations,f=\footnotesize\bfseries}*

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

NOTE:
The color provided to vareff 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: vareff={c=<color>,f=<font commands>,fc=<color>}

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



\pgfPTresetstyle

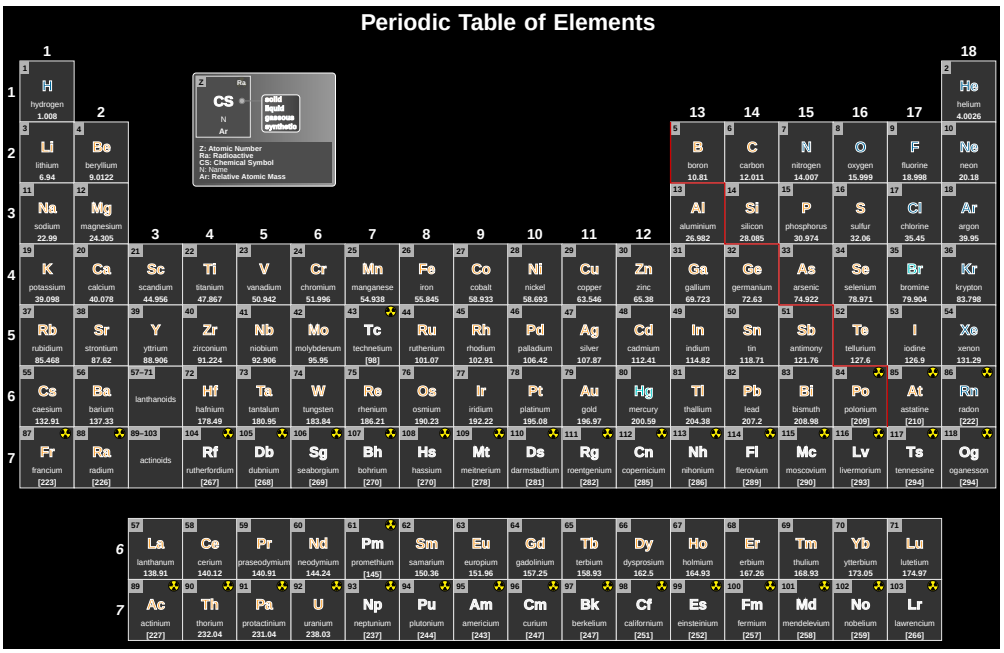
➠ Dark mode

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*

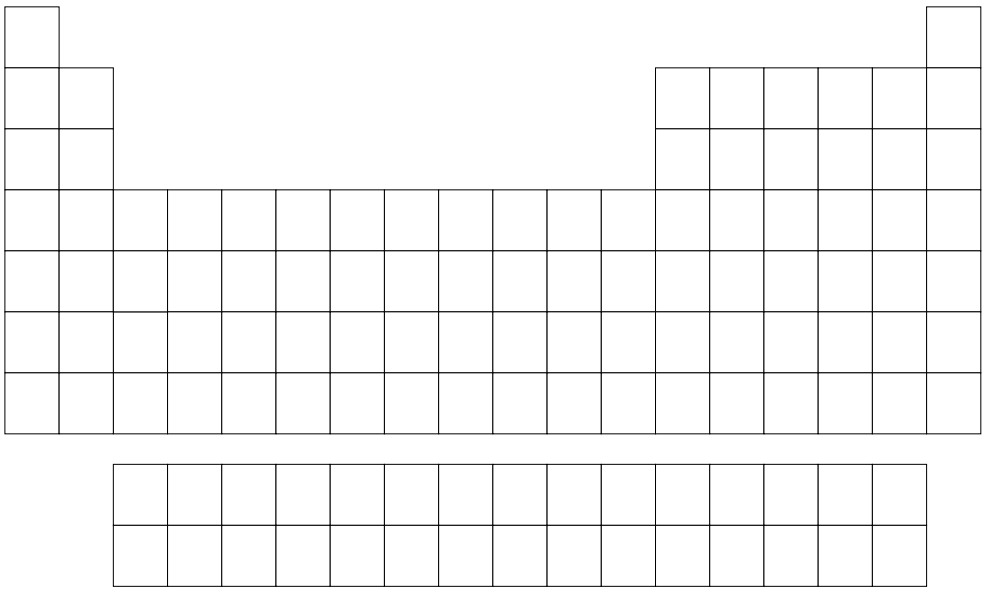
The keys described in this section enable the *exercise layout* of the Periodic Table, *i.e.*, in this mode the *structure* of the Periodic Table is drawn, but there are only a few contents available in the cells.

only cells default: *false*

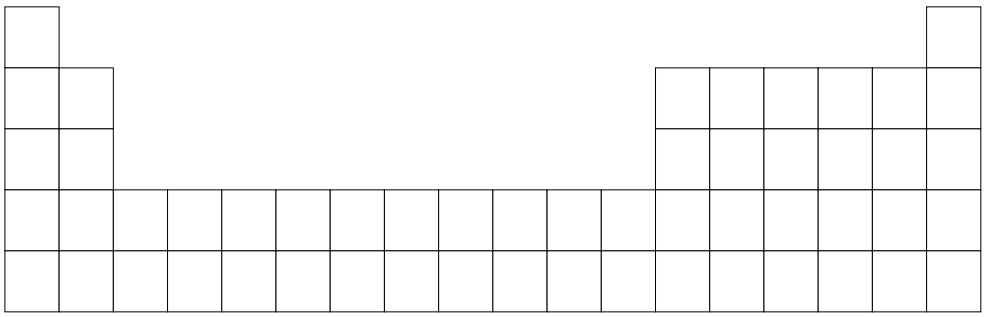
When set to true the Periodic Table is drawn with only the cells without any contents.

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]

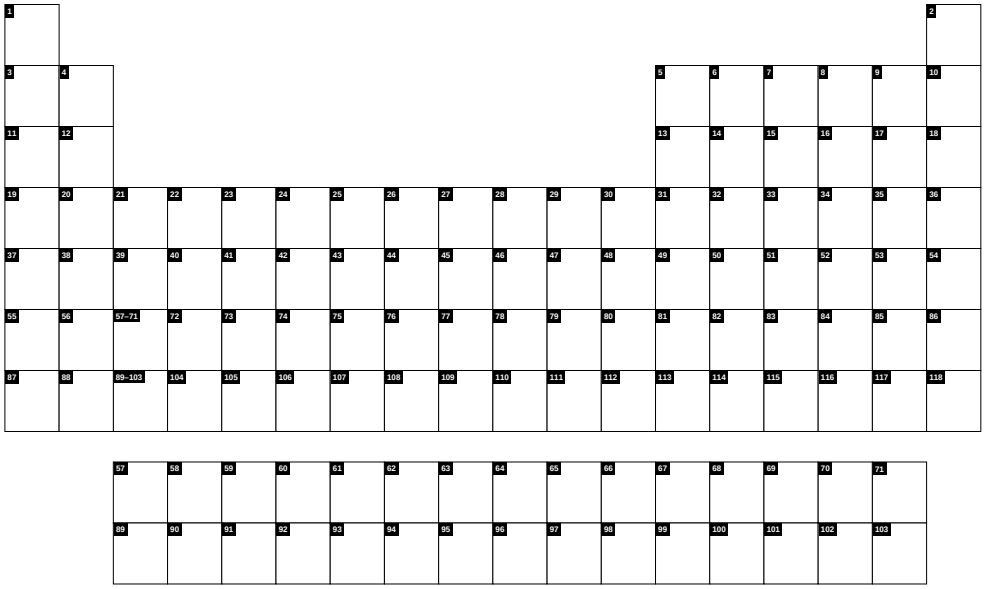


only cells plus Z default: *false*

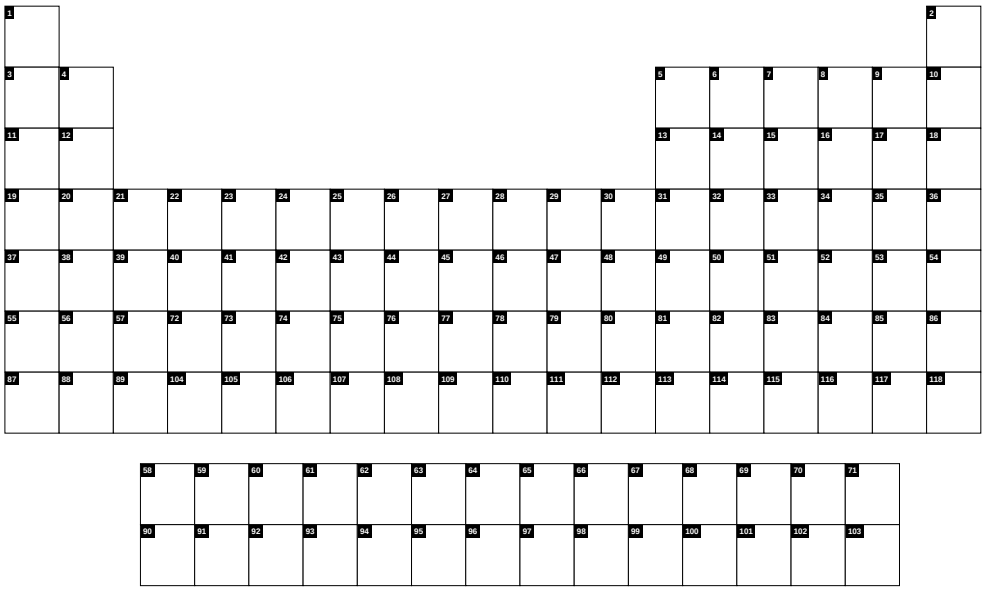
When set to true the Periodic Table is drawn with only the cells without any contents, except the atomic number (Z).

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]

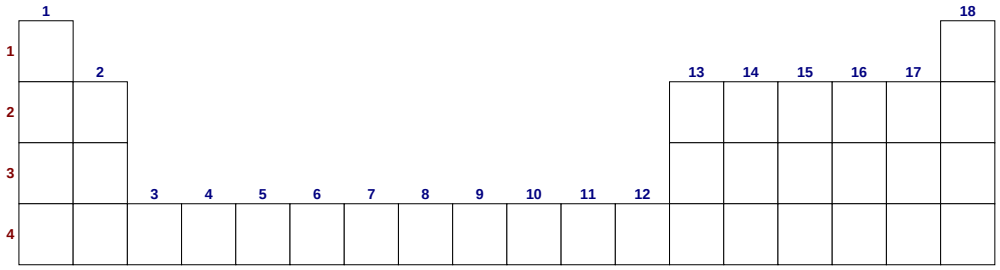


only cells with periods and group numbers default: *false*

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]

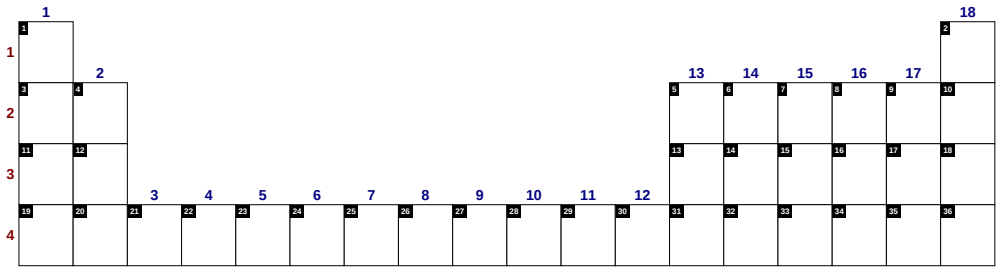


only cells with periods and group numbers plus Z default: *false*

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]



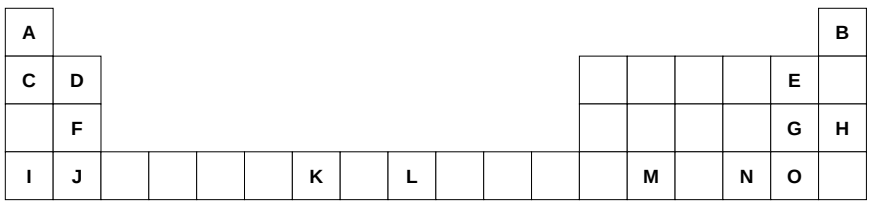
Z exercise list default: *{}*

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

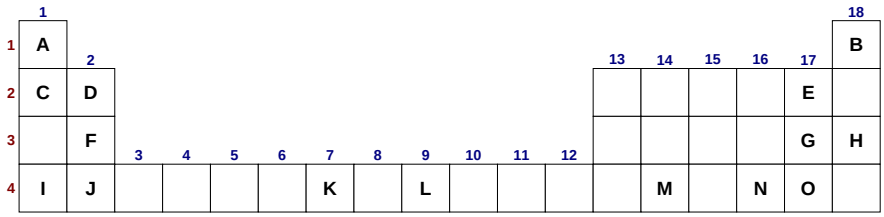
NOTES:

- ✓ 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}]



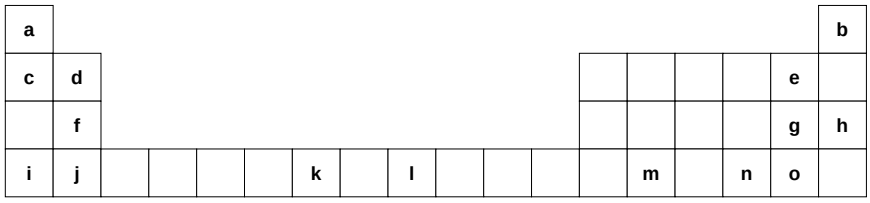
```
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87},
cell size=3em,Z list={1,...,36},only cells with periods and group numbers]
```



exercise list in capitals default: *true*

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

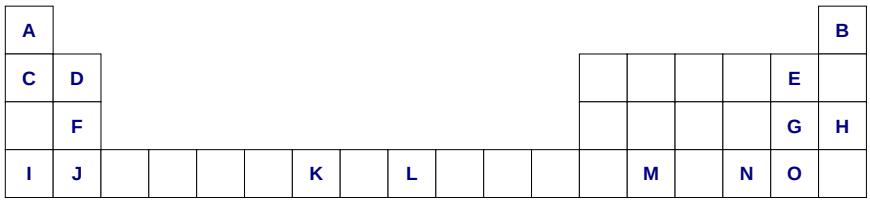
```
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87},
cell size=3em,Z list={1,...,36},exercise list in capitals=false]
```



exercise list color default: *black*

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

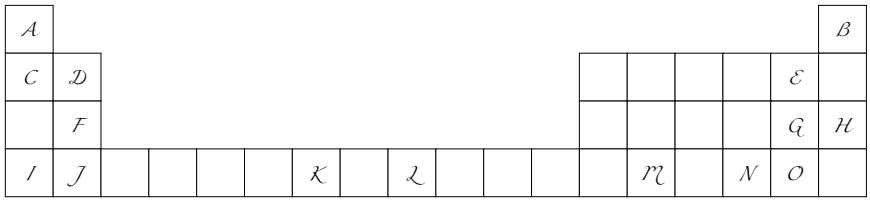
```
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87},
cell size=3em,Z list={1,...,36}, exercise list color=blue!50!black]
```



exercise list font default: *\bfseries\large*

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

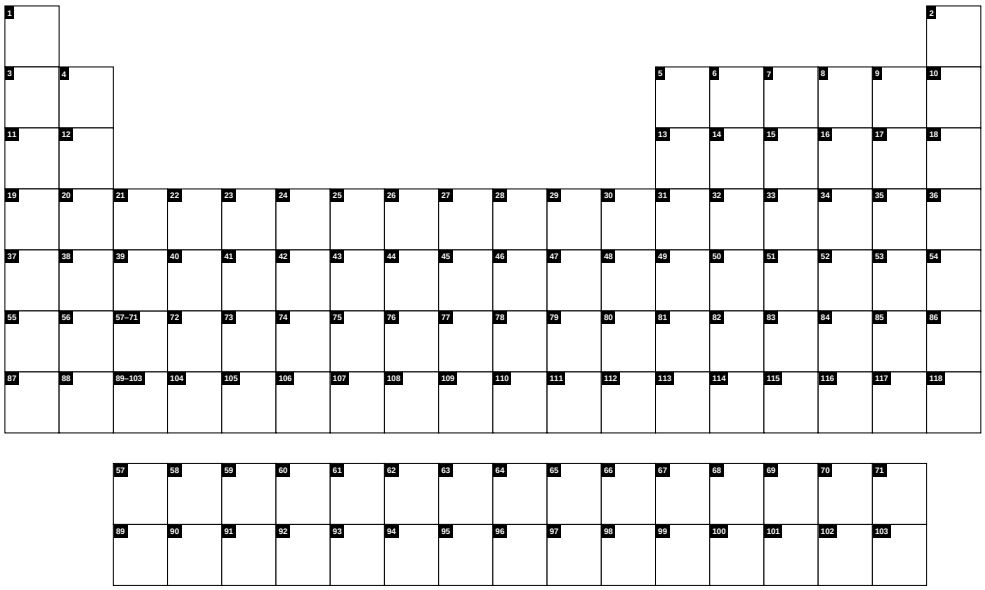
```
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87},
cell size=3em,Z list={1,...,36}, exercise list font=\fontfamily{fmm}\selectfont]
```



cells+Z *no value*

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

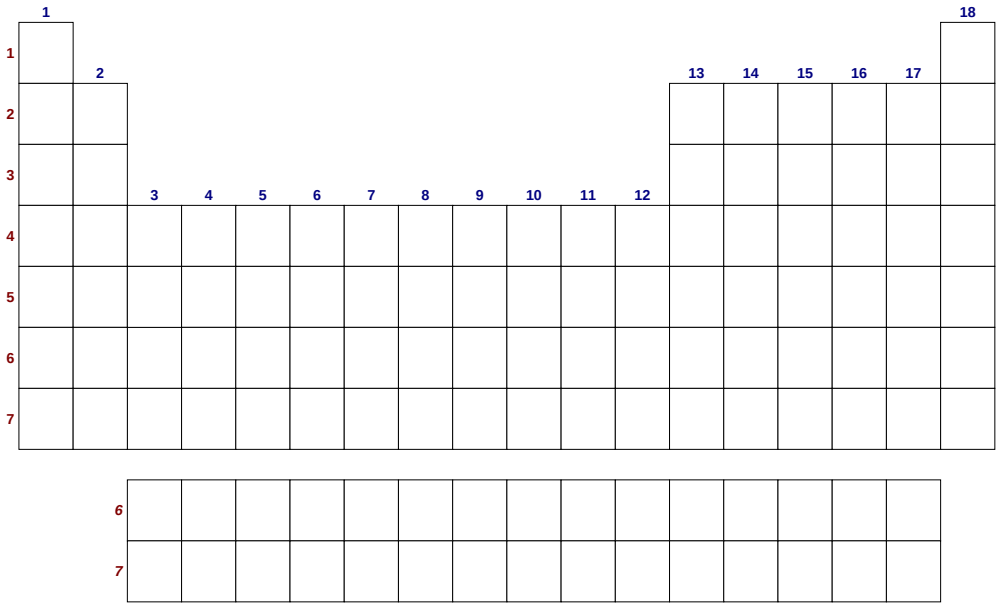
```
\pgfPT[cells+Z]
```



cells+p+g *no value*

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

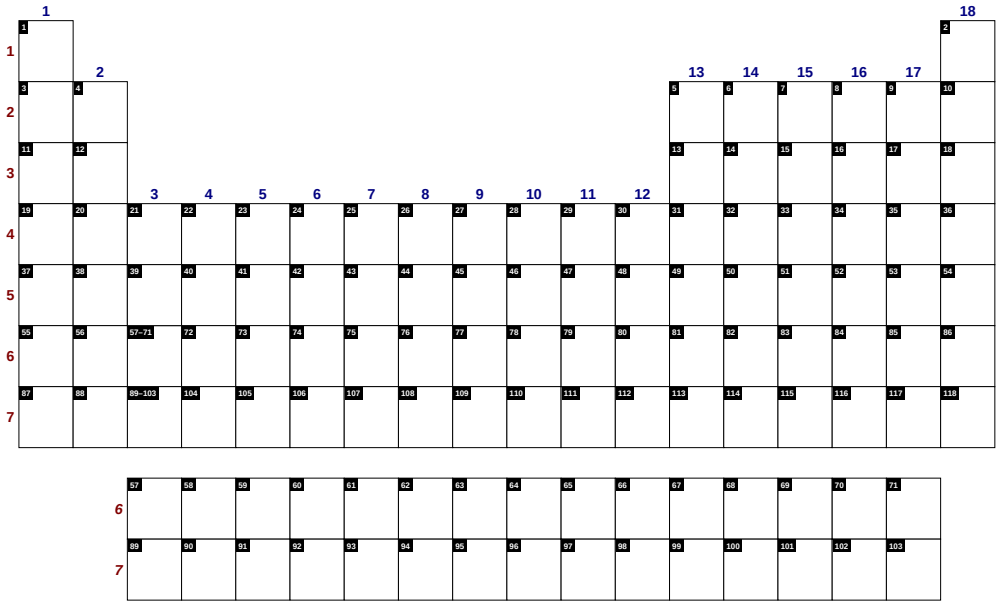
```
\pgfPT[cells+p+g]
```



cells+p+g+Z *no value*

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

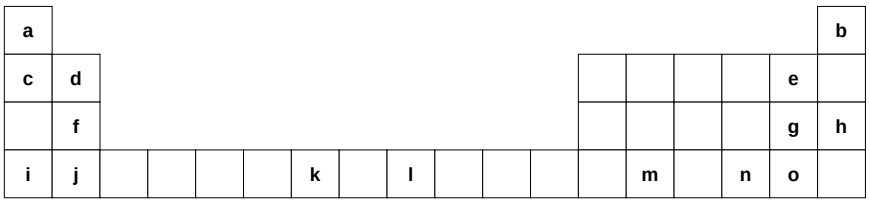
```
\pgfPT[cells+p+g+Z]
```



exnocaps *no value*

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

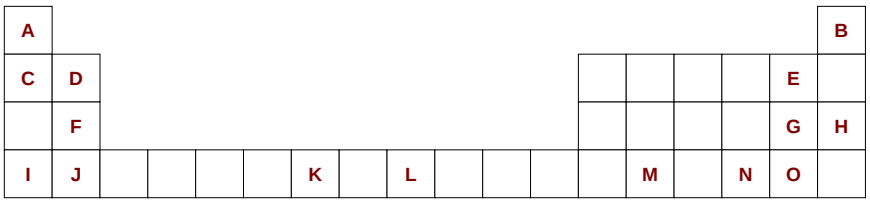
```
\pgfPT[Z exercise list={1,2,3,4,9,12,17,18,19,20,25,27,32,34,35,49,54,74,86,87},
cell size=3em,Z list={1,...,36},exnocaps]
```



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]
```

A																	B
C	D															E	
	F															G	H
I	J					K		L					M		N	O	

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

Pseudo style to set the keys: exercise list in **cap**ital**s**, 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}]
```

A																	**B**
C	**D**															**E**	
	F															**G**	**H**
I	**J**					**K**		**L**					**M**		**N**	**O**	

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

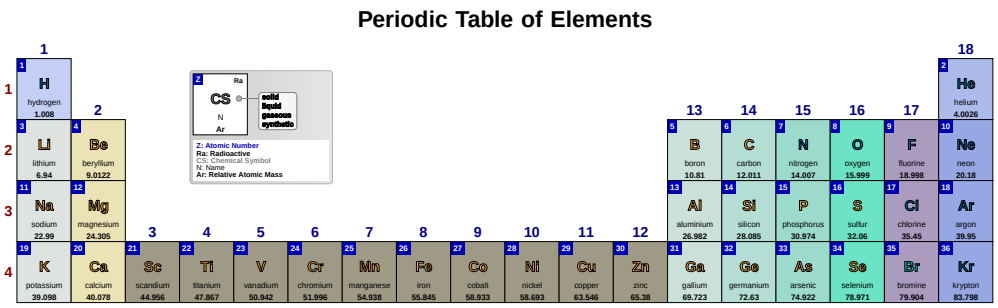
The following options and styles are used for customizing the contents available in each individual cell of the Periodic Table, like the *fonts* or the *colors* used in the shown contents.

➠ The atomic number

Z backcolor default: *black*

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

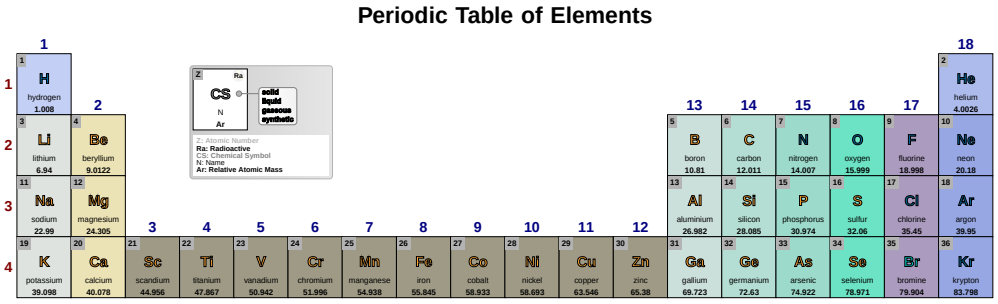
```
\pgfPT[Z list={1,...,36},Z backcolor=blue!70!black]
```



Z color default: *white*

Sets the color of the atomic number.

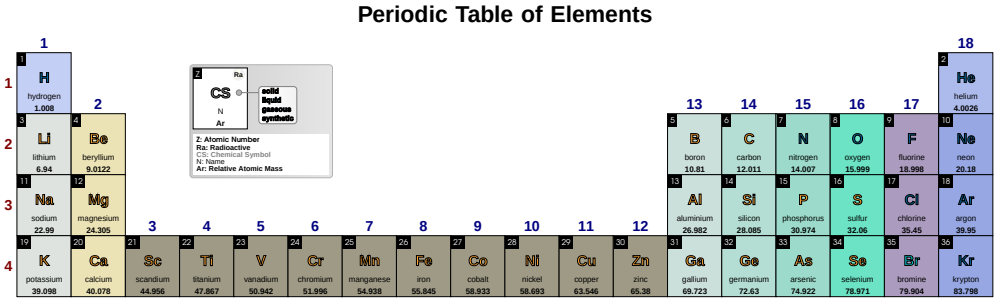
```
\pgfPT[Z list={1,...,36},Z backcolor=black!30,Z color=black]
```



Z font default: *\tiny\bfseries*

Sets the font of the atomic number.

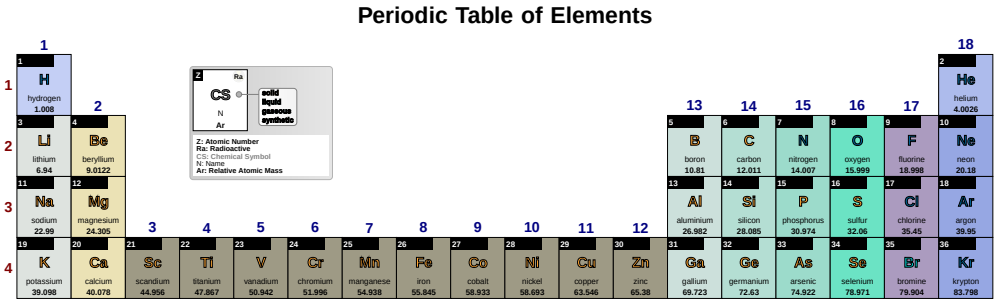
```
\pgfPT[Z list={1,...,36},Z font=\fontfamily{pag}\selectfont\tiny]
```



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]
```

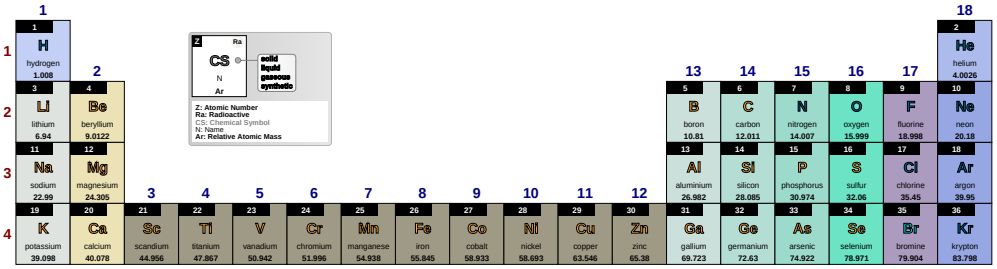


Z align default: *left*

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]
```

Periodic Table of Elements

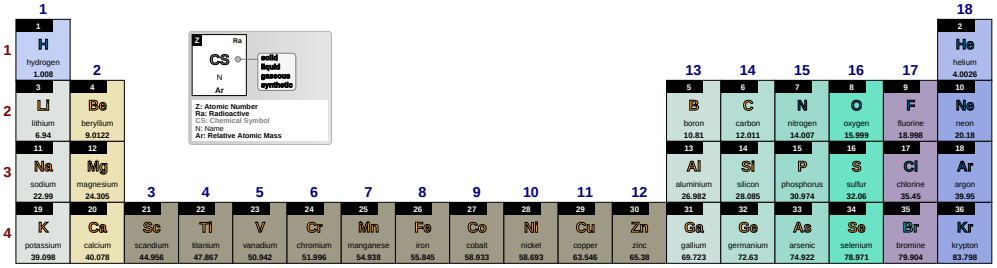


Z padding default: *0.25ex*

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]
```

Periodic Table of Elements

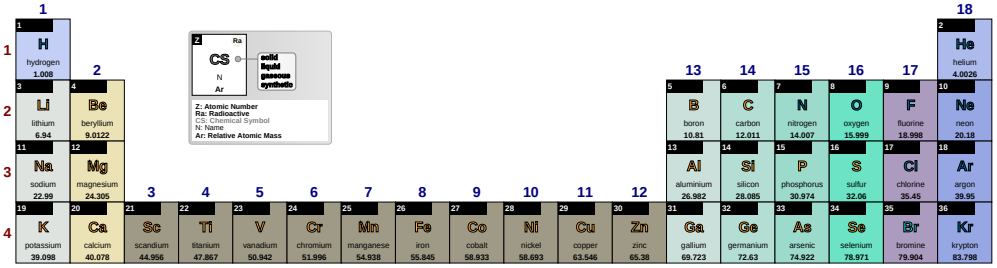


Z box *no value*

Style equivalent to Z use box width=true.

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

Periodic Table of Elements

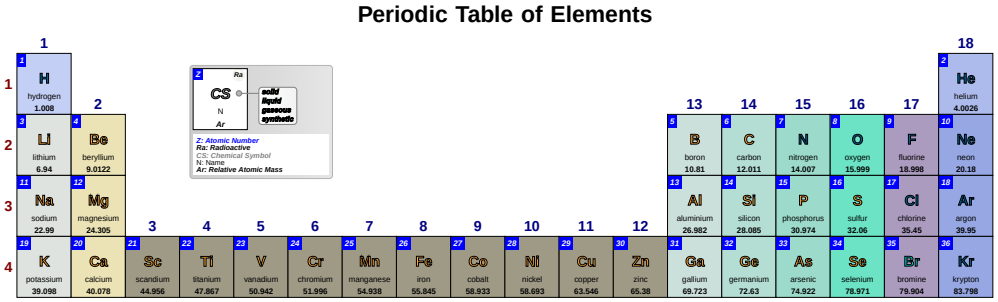


Z default: *{bc=black,c=white,f=\tiny\bfseries,boxwd=false,align=left,space=.25ex}*

Pseudo style to set the keys: Z **back**color, Z **c**olor, Z **f**ont, Z use **box wid**th, Z **align** and/or Z **pad**. 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}]
```

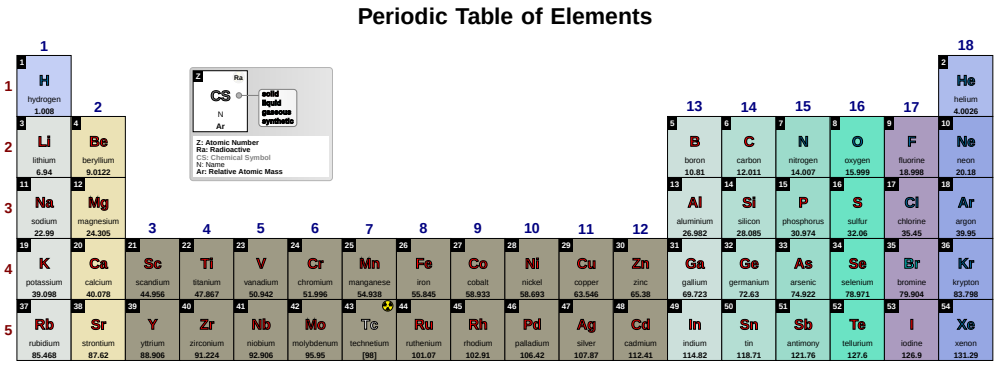


➠ The chemical symbol

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).

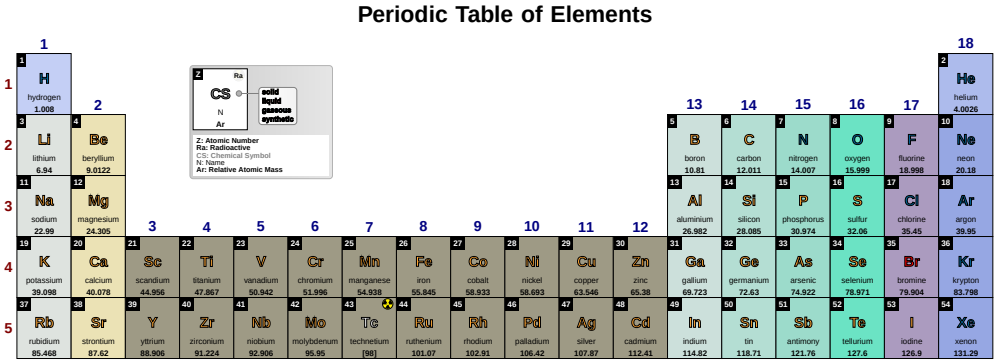
```
\pgfPT[Z list={1,...,54},CS solid=red]
```



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).

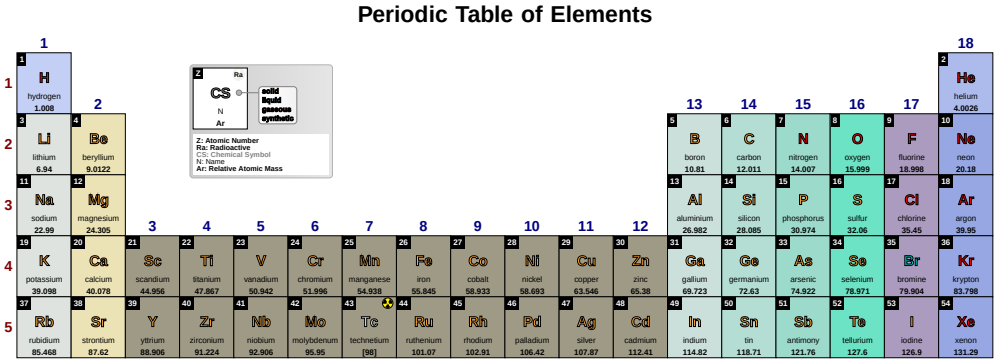
```
\pgfPT[Z list={1,...,54},CS liquid=red]
```



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).

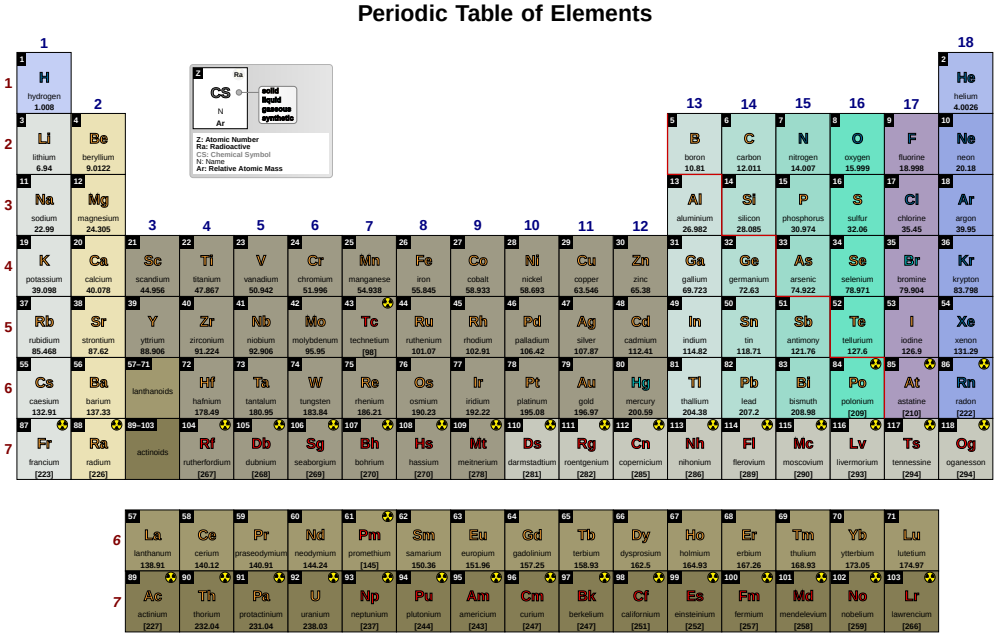
```
\pgfPT[Z list={1,...,54},CS gas=red]
```



CS synt default: *RGB: 236,236,236*

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

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

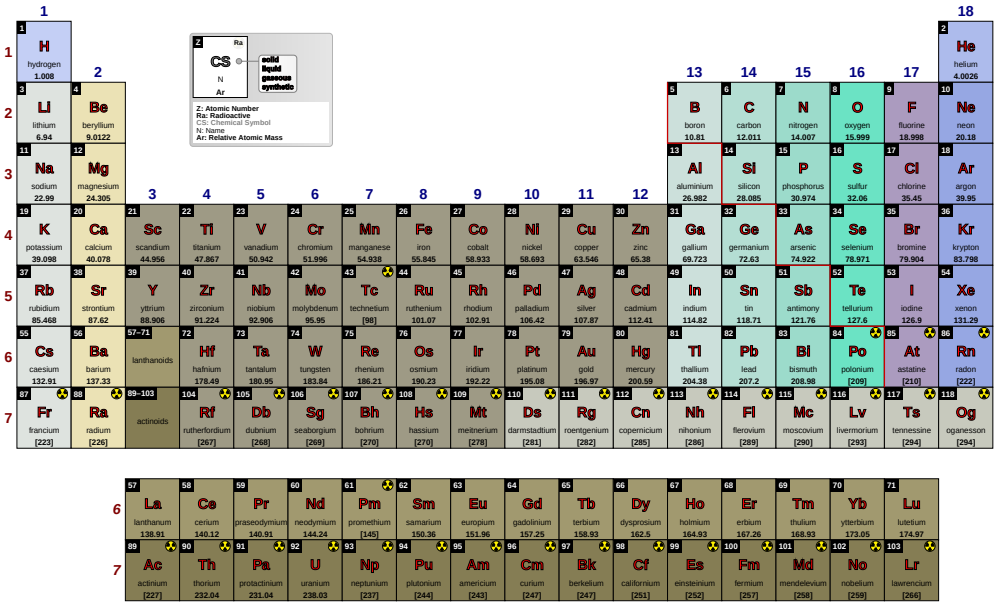


CS all default: *black*

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]
```

Periodic Table of Elements

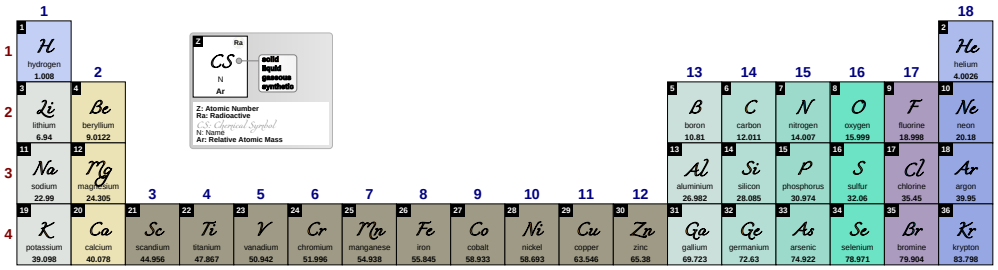


CS font default: *\small\bfseries*

Sets the font for the chemical symbol.

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

Periodic Table of Elements

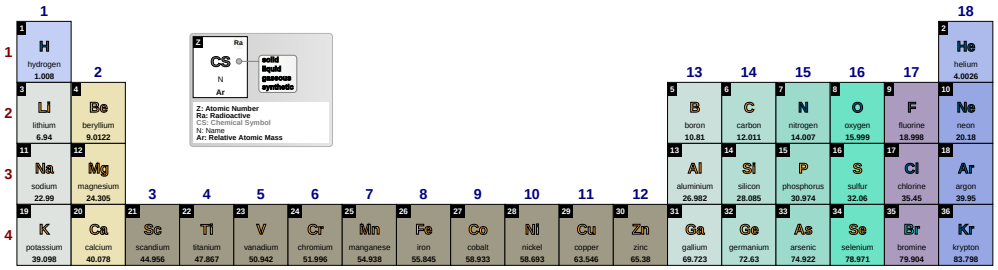


CS render mode default: *fill and outline*

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

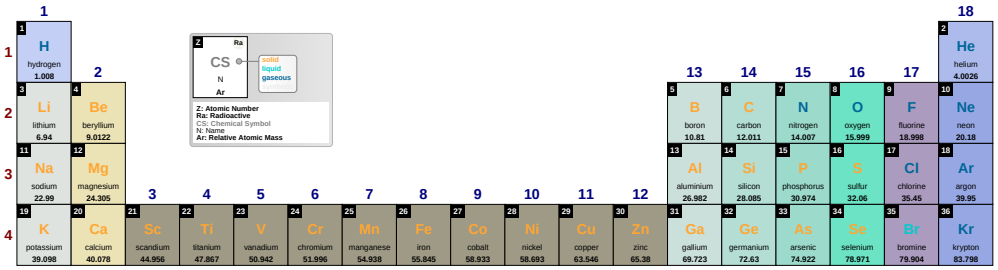
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements



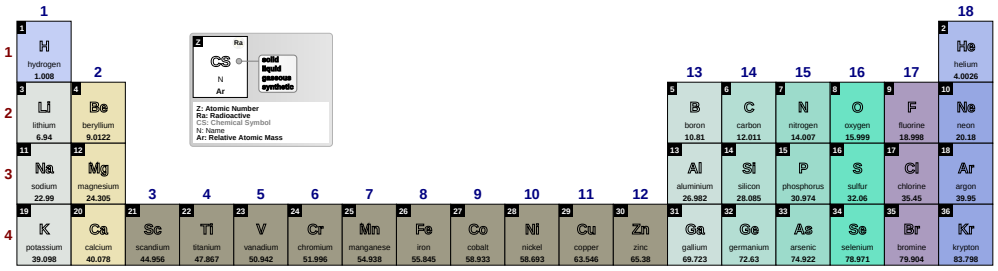
```
\pgfPT[Z list={1,...,36},CS render mode=fill]
```

Periodic Table of Elements



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

Periodic Table of Elements

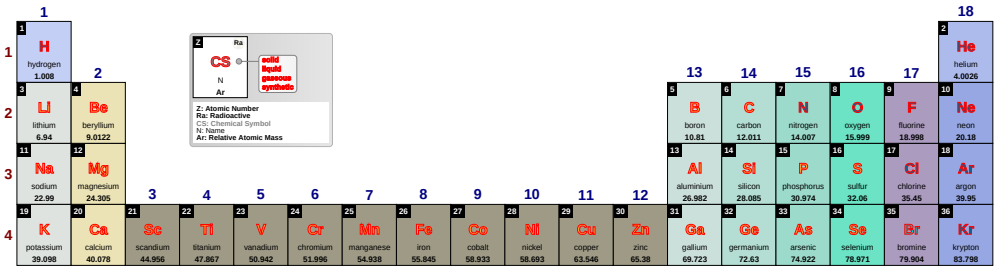


CS outline color default: *black*

Sets the outline color for the chemical symbol.

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

Periodic Table of Elements

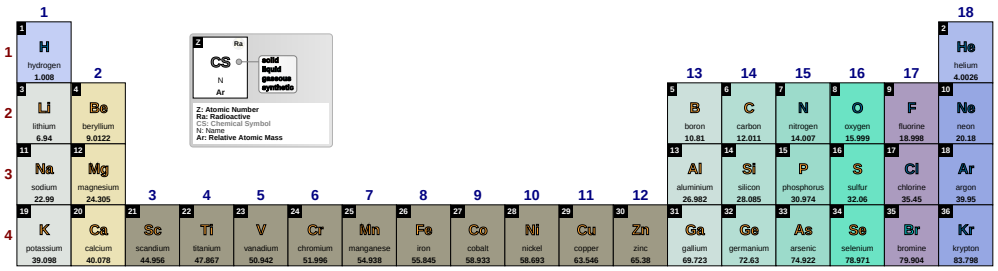


CS outline width default: *0.05*

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]

Periodic Table of Elements



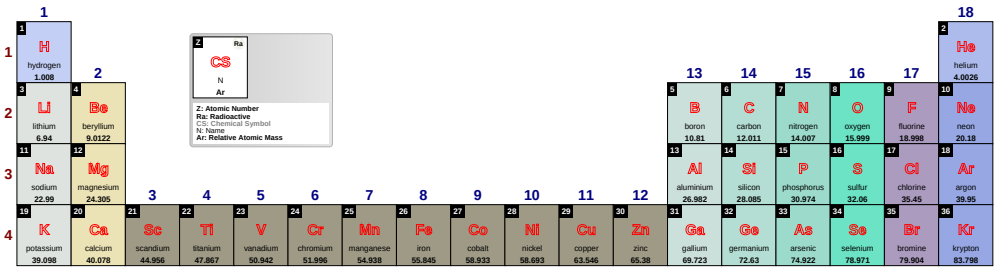
CS default: *{r=fill and outline,c=black,w=.05,f=\small\bfseries,s=solido,l=liquido, g=gasoso,sy=sintetico}*

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]
```

Periodic Table of Elements



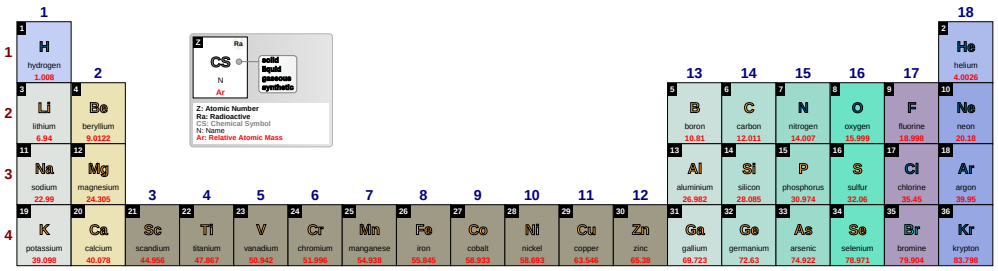
➠ The atomic weight

Ar color default: *black*

Sets the relative atomic mass color.

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

Periodic Table of Elements

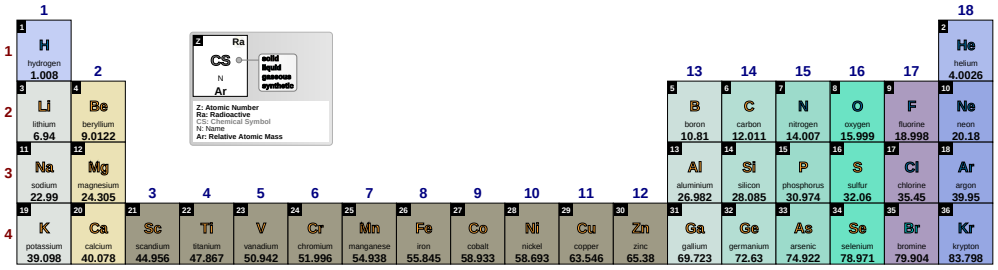


Ar font default: *\tiny\bfseries*

Sets the relative atomic mass font.

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

Periodic Table of Elements

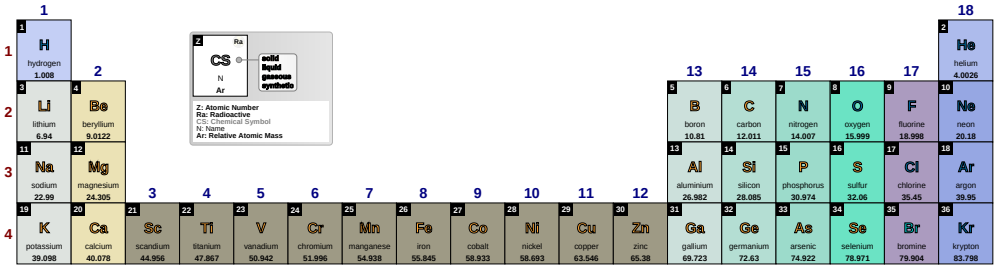


Ar label default: *m*

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.

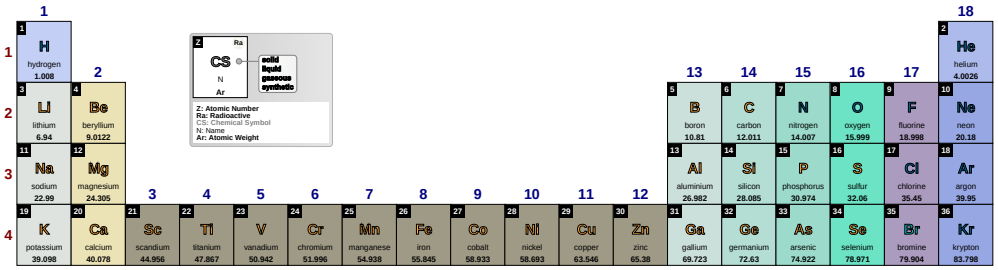
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements




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

Periodic Table of Elements



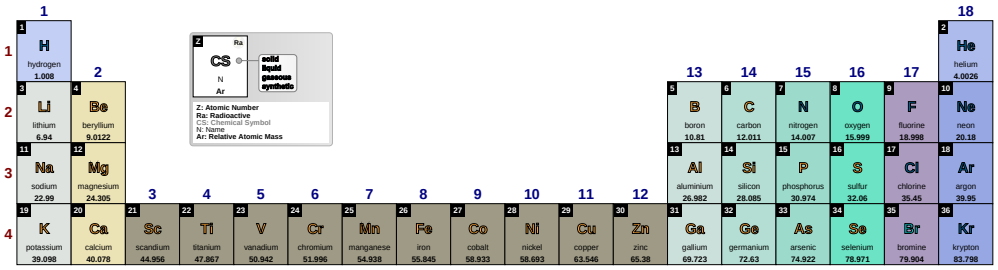
Ar precision default: *-1*

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.

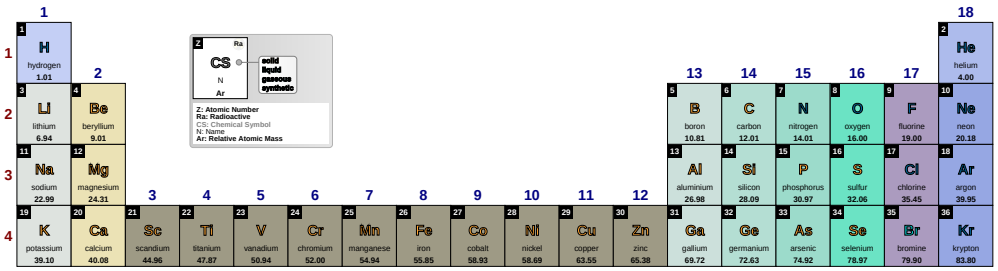
```
\pgfPT[Z list={1,...,36}]
```

Periodic Table of Elements



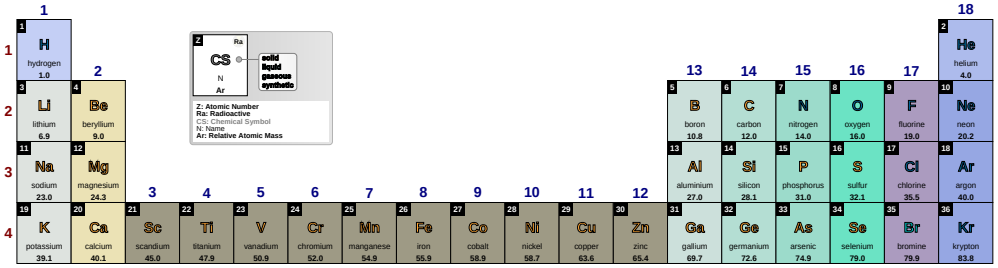
```
\pgfPT[Z list={1,...,36},Ar precision=2]
```

Periodic Table of Elements




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

Periodic Table of Elements



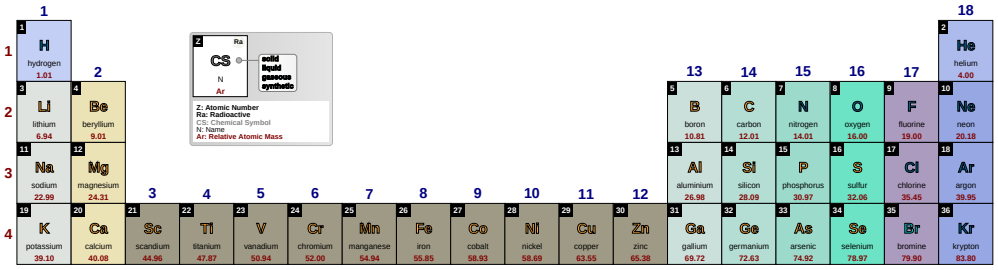
Ar default: *{c=black,f=\tiny\bfseries,l=m,p=-1}*

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>}

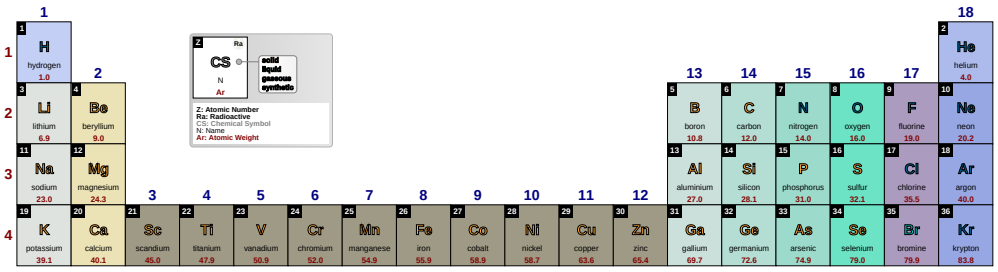
```
\pgfPT[Z list={1,...,36},Ar={c=red!50!black,p=2}]
```

Periodic Table of Elements




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

Periodic Table of Elements



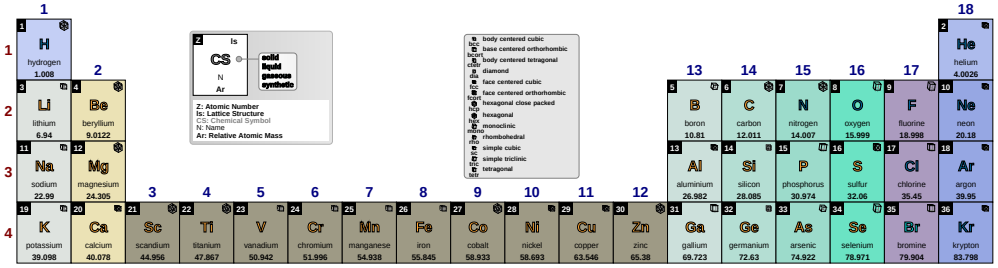
➠ The lattice structure

ls default: *fig*

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

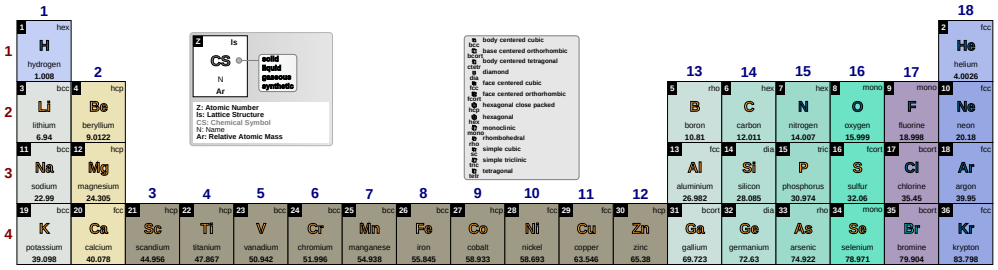
```
\pgfPT[Z list={1,...,36},cell style=pgfPTls]
```

Periodic Table of Elements



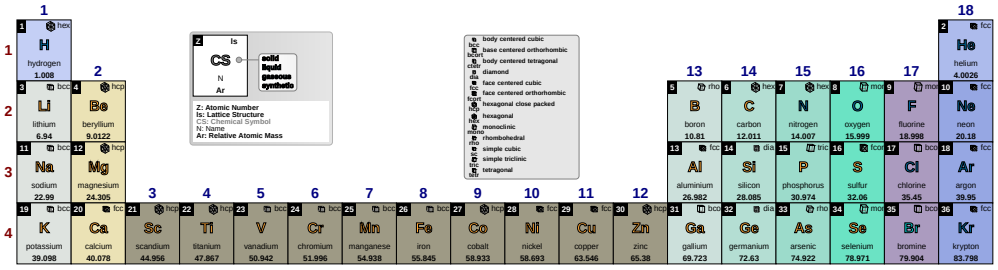
```
\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls=txt]
```

Periodic Table of Elements



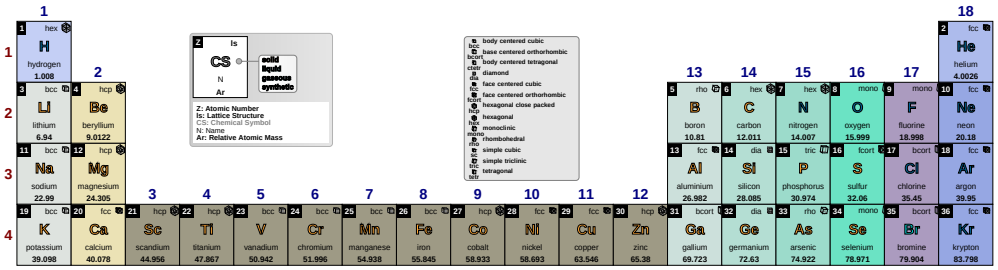
```
\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls=fig+txt]
```

Periodic Table of Elements



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

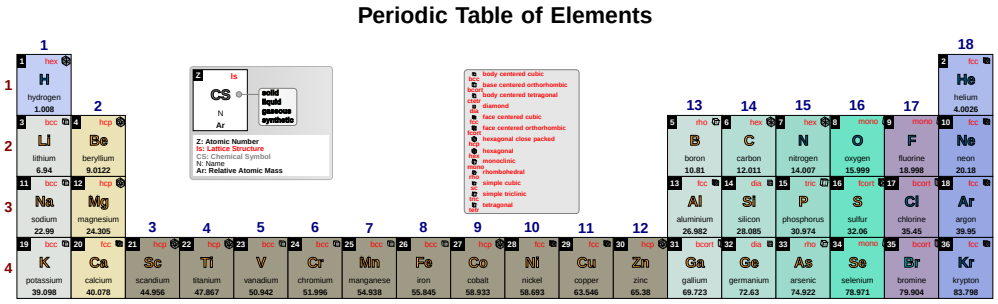
Periodic Table of Elements



ls color default: *black*

Sets the lattice structure text color.

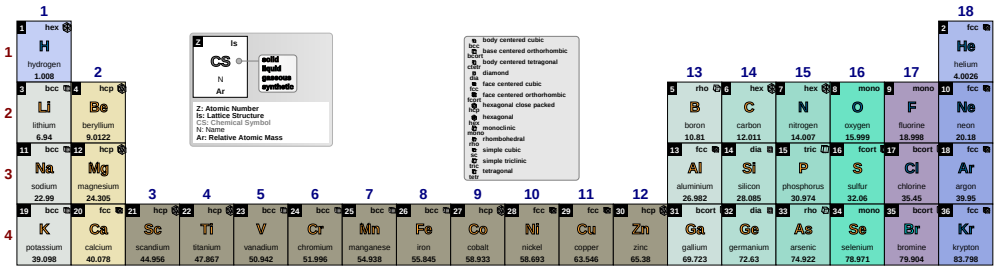
```
\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls=txt+fig,ls color=red]
```



ls font default: *\tiny*

Sets the lattice structure text font.

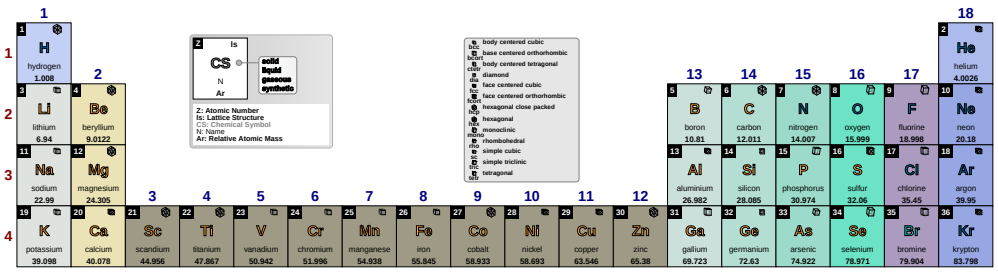
```
\pgfPT[Z list={1,...,36},cell style=pgfPTls,ls=txt+fig,ls font=\tiny\bfseries]
```



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]
```

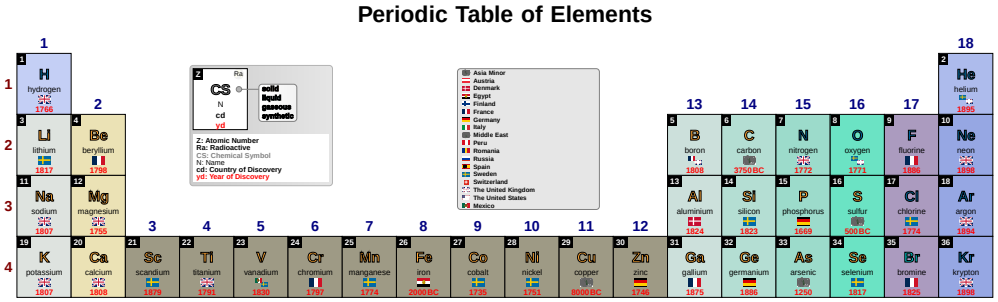


➠ The discovery year

DiscY color default: *black*

Sets the discovery year color.

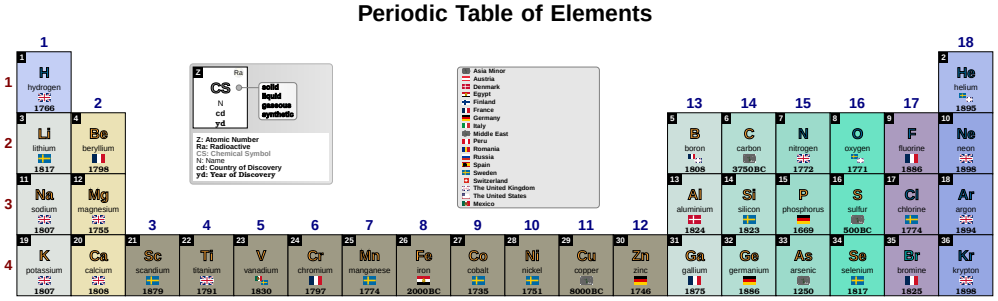
```
\pgfPT[Z list={1,...,36},cell style=pgfPTdisc,DiscY color=red]
```



DiscY font default: *\tiny\bfseries*

Sets the discovery year font.

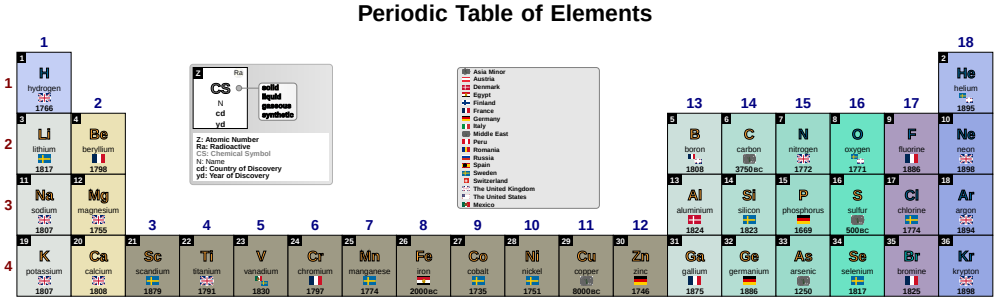
```
\pgfPT[Z list={1,...,36},cell style=pgfPTdisc,DiscY
font=\fontfamily{pbk}\selectfont\tiny\bfseries]
```



DiscY BC scale default: *1*

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

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



➠ *The electron distribution*

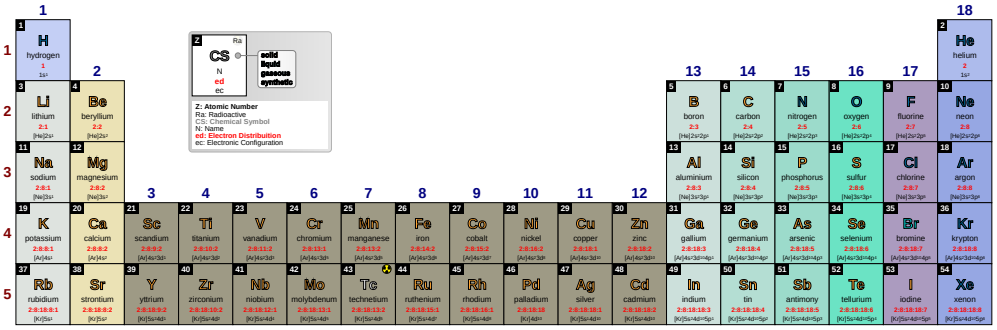
```
\pgfPTbuilcellstyle{electron}(6,3)% 6 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),
(5;1-3;eDist),(6;1-3;eConfignl)]
```

eDist color default: *black*

Sets the electron distribution color.

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

Periodic Table of Elements

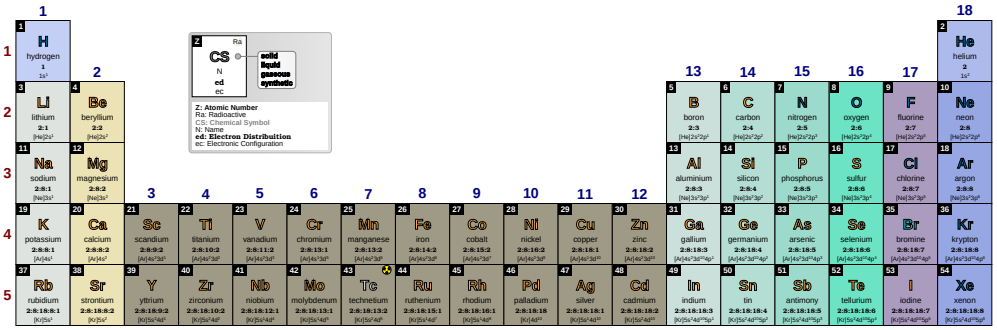


eDist font default: *\tiny\bfseries*

Sets the electron distribution font.

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

Periodic Table of Elements

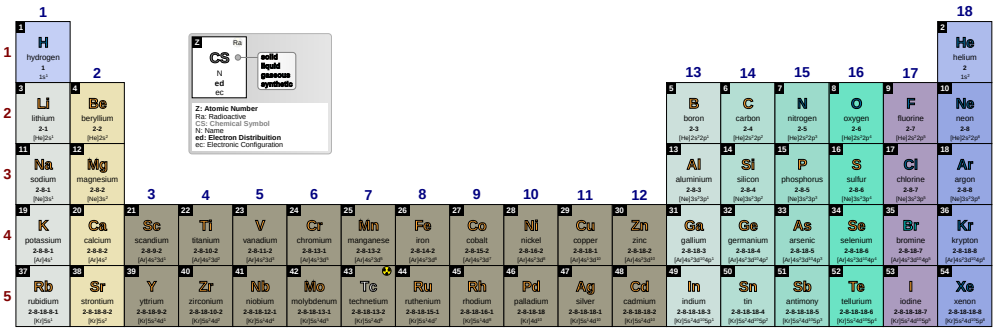


eDist sep default: *:*

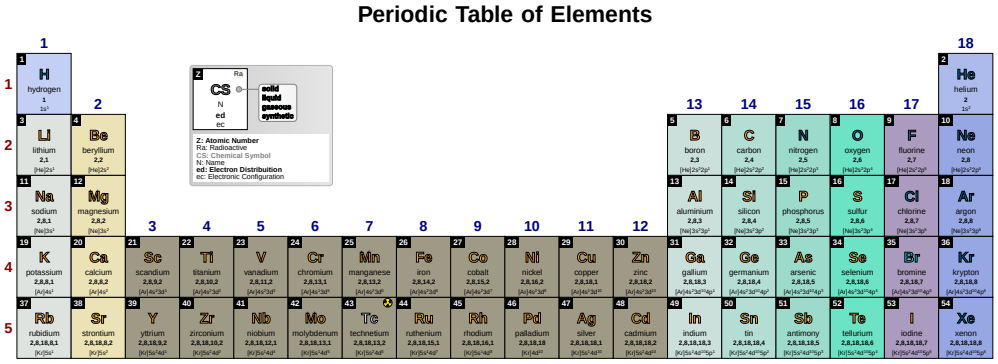
Sets the separator character between energy levels in electron distribution. *If the separator character is a comma it must be provided between curly braces – {,}.*

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

Periodic Table of Elements



```
\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.

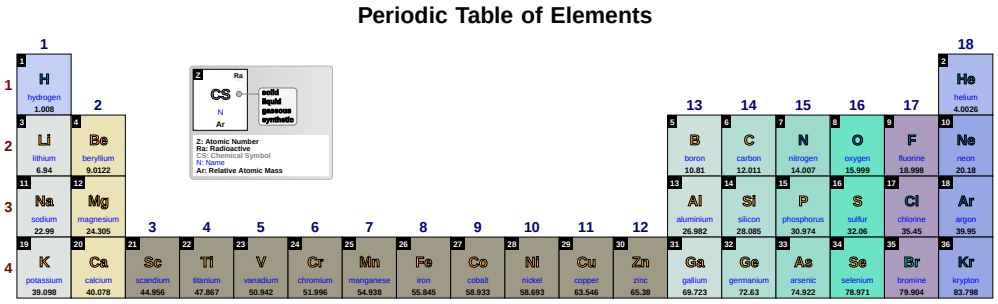
The <content name>'s list:

- ✓ **name**: element name
- ✓ **R**: atomic radius
- ✓ **Rcov**: covalente radius
- ✓ **Rion**: ionic radius
- ✓ **Ei**: first ionization energy
- ✓ **eneg**: electronegativity (Pauling)
- ✓ **eaff**: electroaffnity
- ✓ **O**: oxidation states
- ✓ **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)
- ✓ **d**: density
- ✓ **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**: discover country
- ✓ **spectra**: visible range spectral lines

<content name> color default: *black*

Sets the <content name> color.

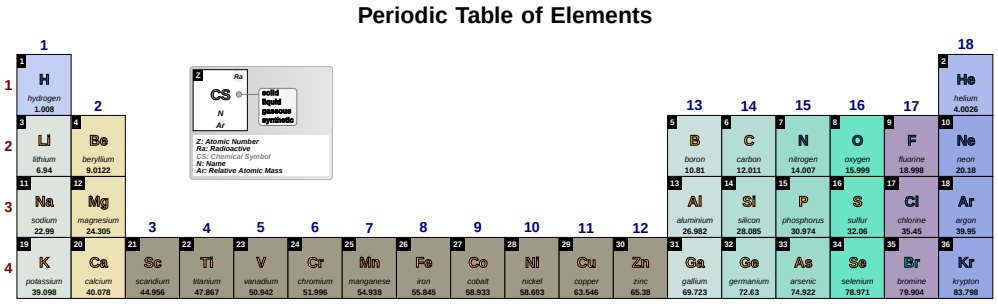
```
\pgfPT[Z list={1,...,36},name color=blue]
```



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

Sets the <content name> font.

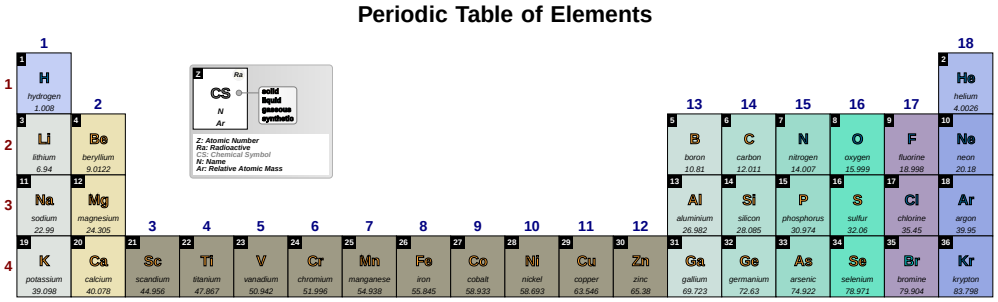
```
\pgfPT[Z list={1,...,36},name font=\tiny\itshape]
```



cell font default: *\bfseries\tiny*

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

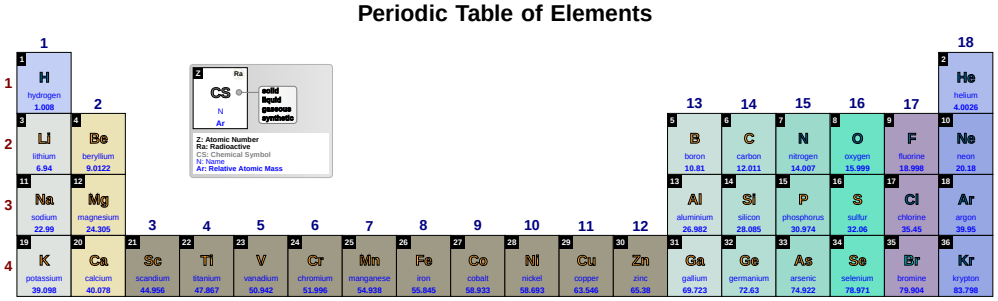
```
\pgfPT[Z list={1,...,36},cell font=\tiny\itshape]
```



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]
```



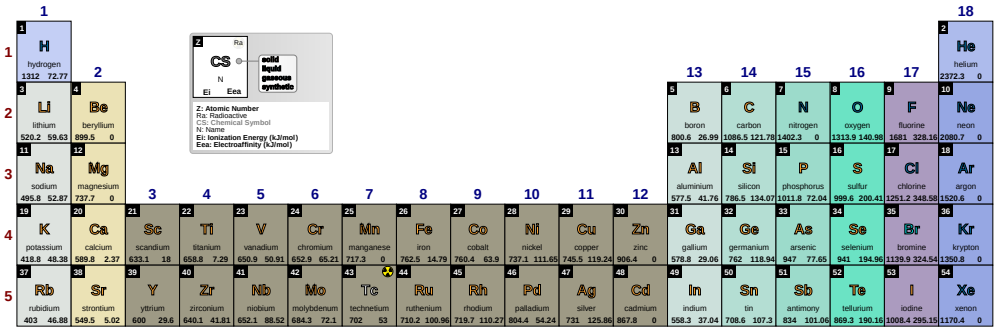
The precision of the *other contents*, which have numerical values, can also be set by a key. *Atomic radius, covalent radius, and ionic radius all have integer values, so precision does not apply to them*.

E precision default: *-1*

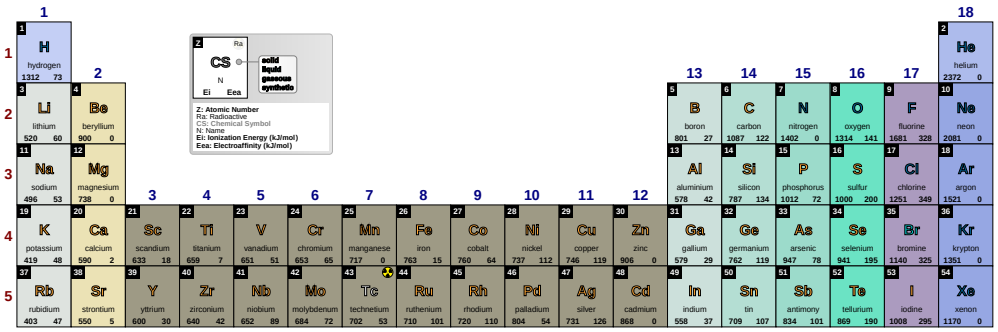
Sets the first ionization energy and the electroaffnity precision, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

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.

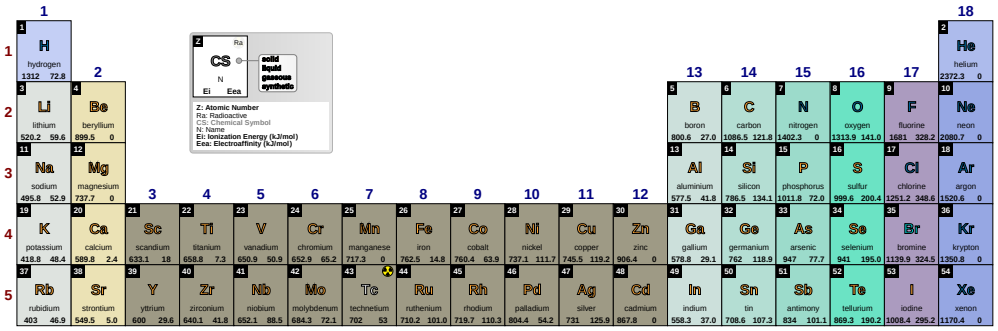
```
\pgfPTbuilcellstyle{myE}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-2.5;Ei), (5;2.5-3;eaff)]
\pgfPTstyle[Z list={1,...,54},cell style=myE,show title=false]
\pgfPT
```



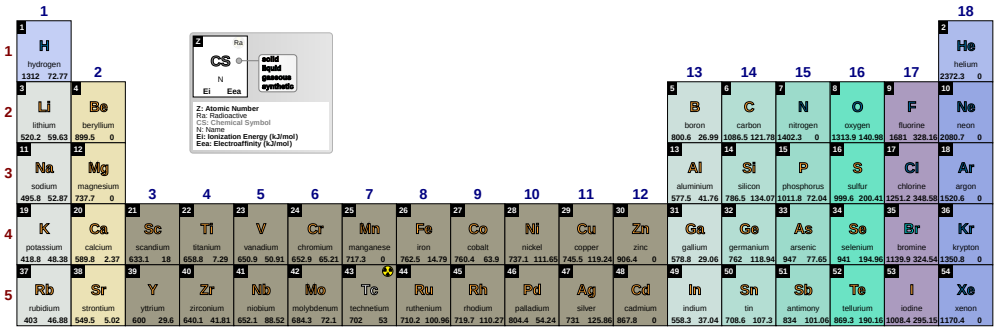
```
\pgfPT[E precision=0]
```



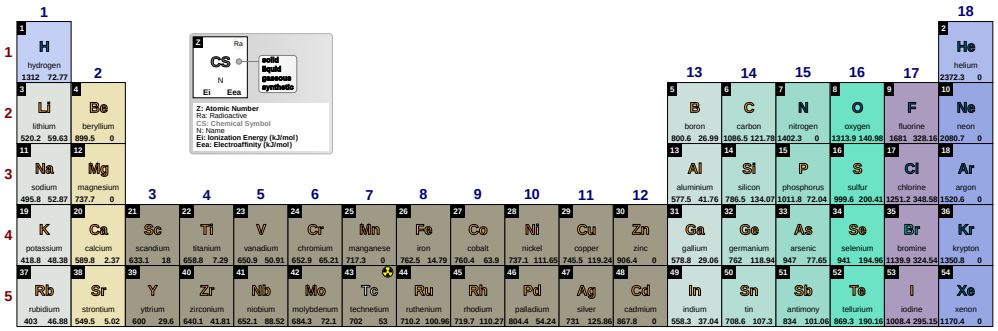
```
\pgfPT[E precision=1]
```



\pgfPT[E precision=2]



\pgfPT[E precision=3]

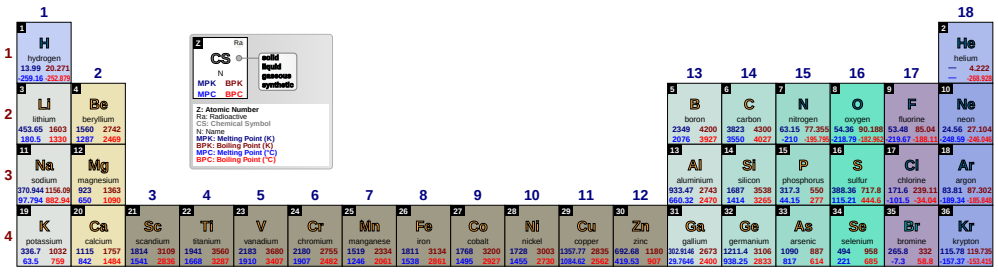


T precision default: *-1*

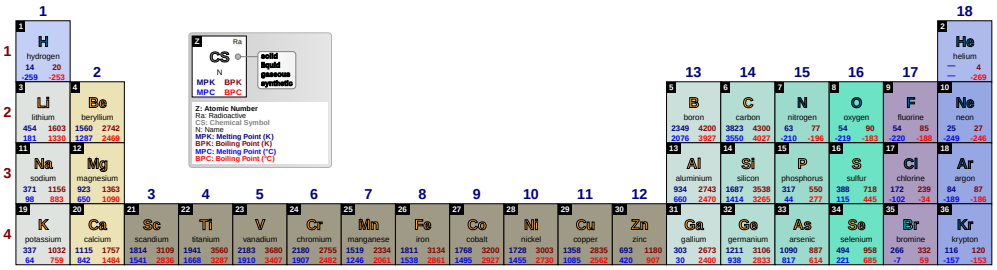
Sets the melting point an boiling point precision, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

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.

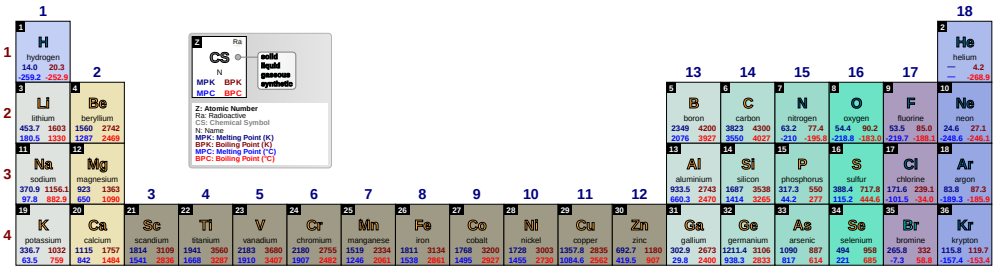
```
\pgfPTbuilcellstyle{myT}(6,3)% 6 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-2.5;Tmelt),
(5;2.5-3;Tboil),(6;1-2.5;TmeltC),(6;2.5-3;TboilC)]
\pgfPTstyle[Z list={1,...,36},cell style=myT,Tmelt color=blue!50!black,TmeltC
color=blue,Tboil color=red!50!black,TboilC color=red,show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



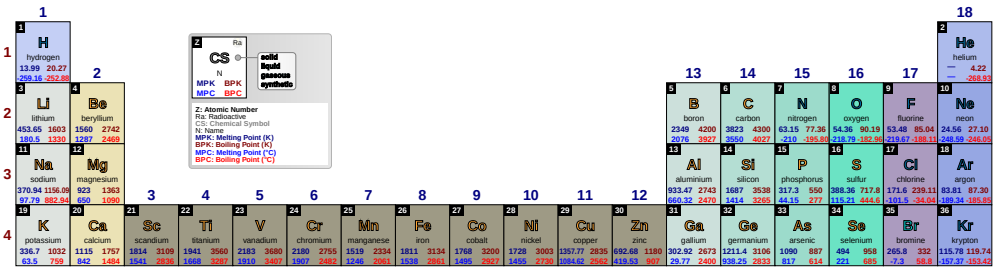
\pgfPT[T precision=0]



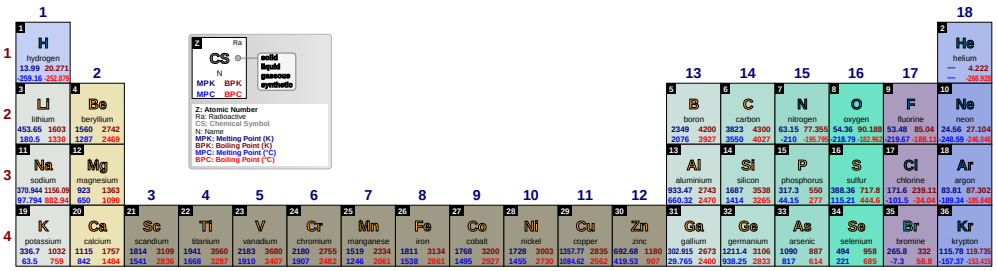
\pgfPT[T precision=1]



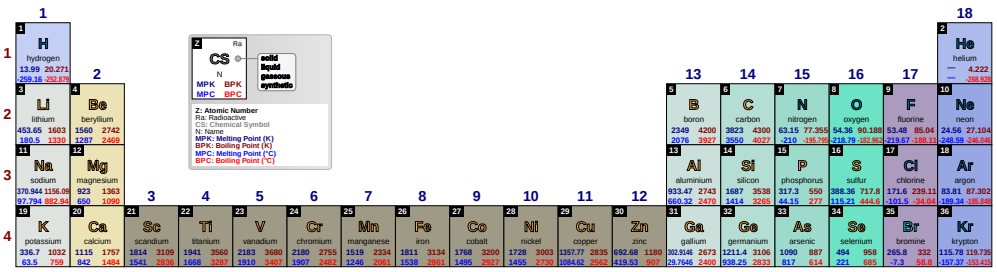
\pgfPT[T precision=2]



\pgfPT[T precision=3]



\pgfPT[T precision=4]

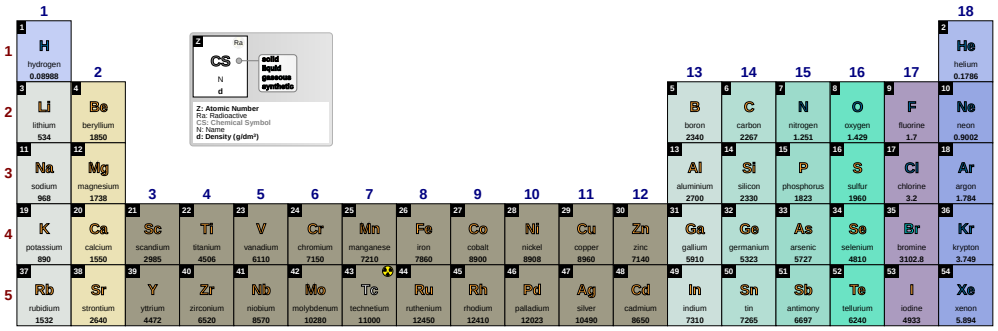


d precision default: *-1*

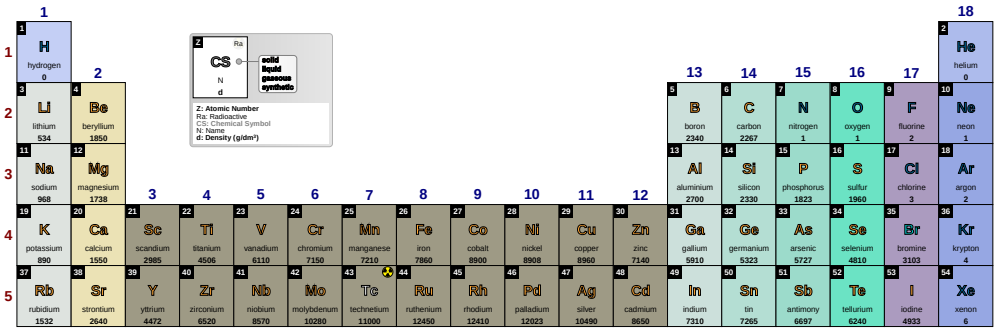
Sets the density precision, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

NOTE:
Rounding is performed over density values witch actually have a maximum 5 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.

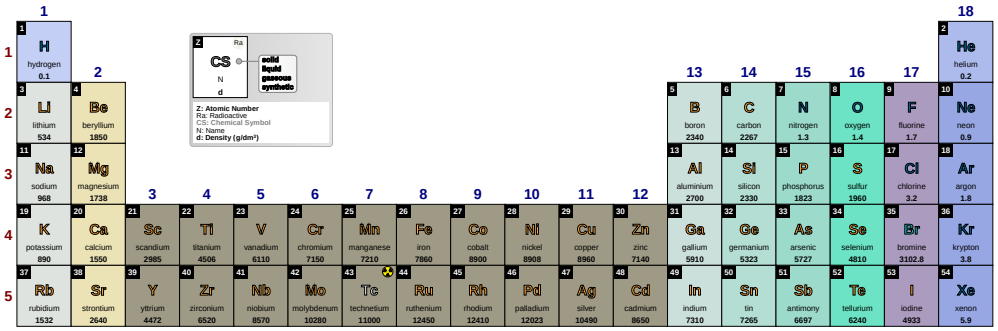
```
\pgfPTbuilcellstyle{myd}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;d)]
\pgfPTstyle[Z list={1,...,54},cell style=myd,show title=false]
\pgfPT
```



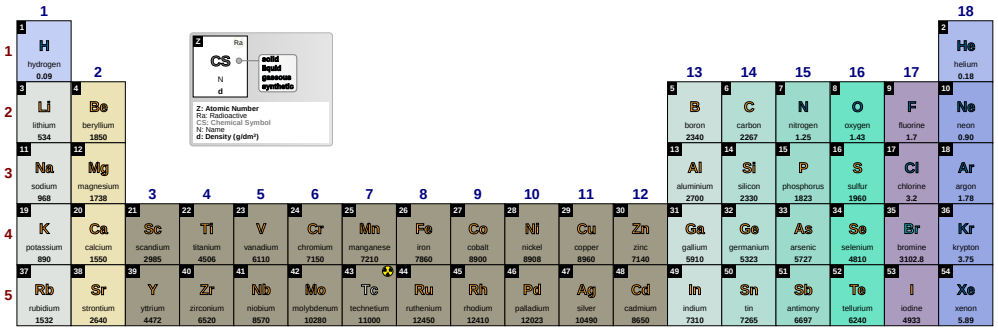

```
\pgfPT[d precision=0]
```



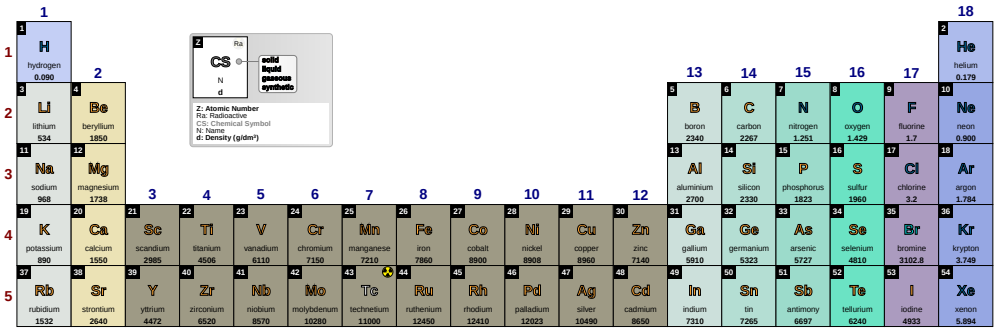

```
\pgfPT[d precision=1]
```



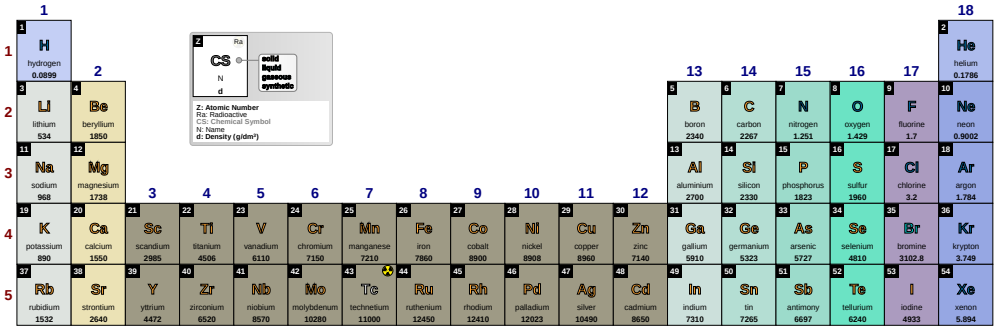
\pgfPT[d precision=2]



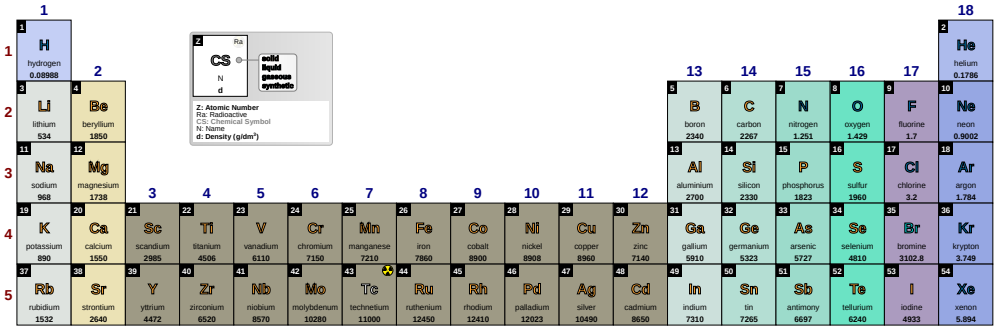
\pgfPT[d precision=3]



\pgfPT[d precision=4]



\pgfPT[d precision=5]



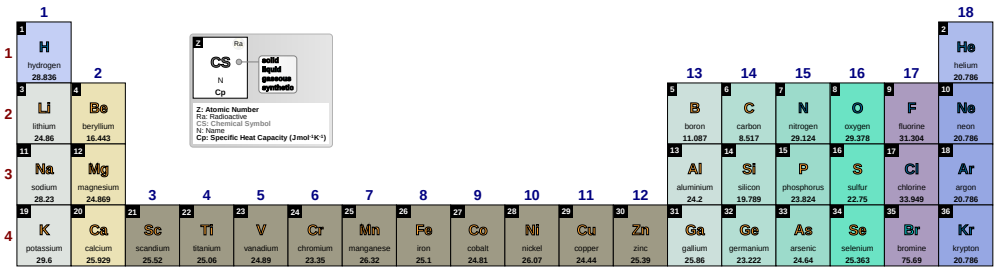
Cp precision default: *-1*

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.

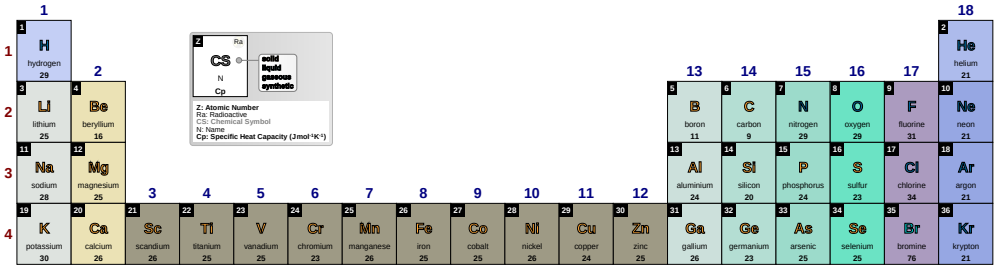
```
\pgfPTbuilcellstyle{myCp}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;Cp)]
\pgfPTstyle[Z list={1,...,36},cell style=myCp]
                                                    \pgfPT
```

Periodic Table of Elements



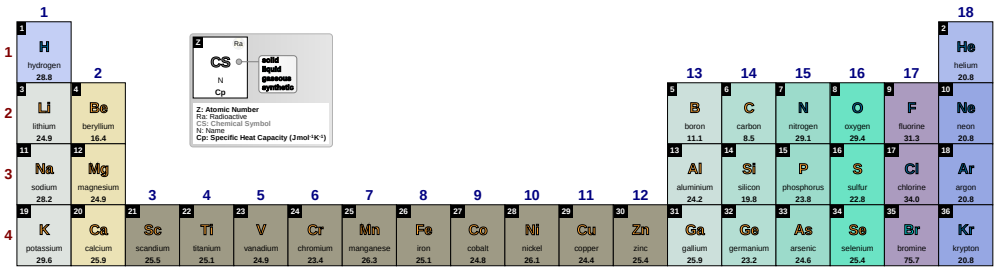

```
\pgfPT[Cp precision=0]
```

Periodic Table of Elements

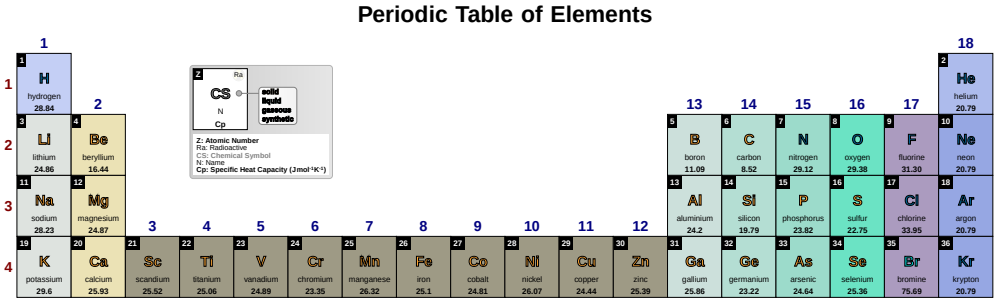



```
\pgfPT[Cp precision=1]
```

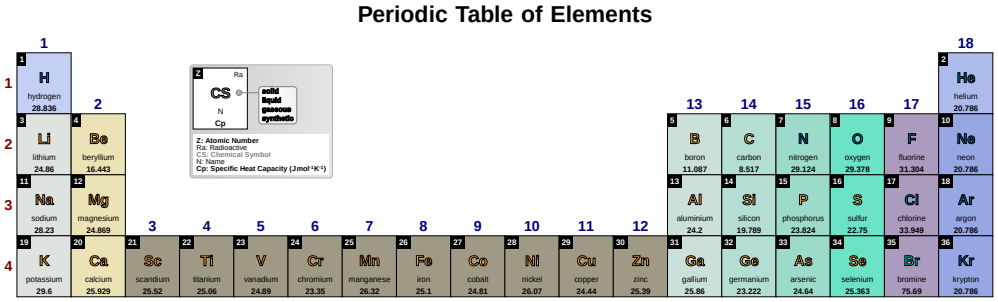
Periodic Table of Elements



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




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

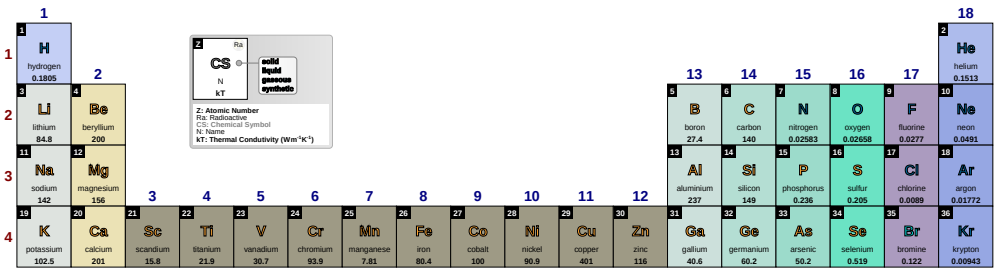


kT precision default: *-1*

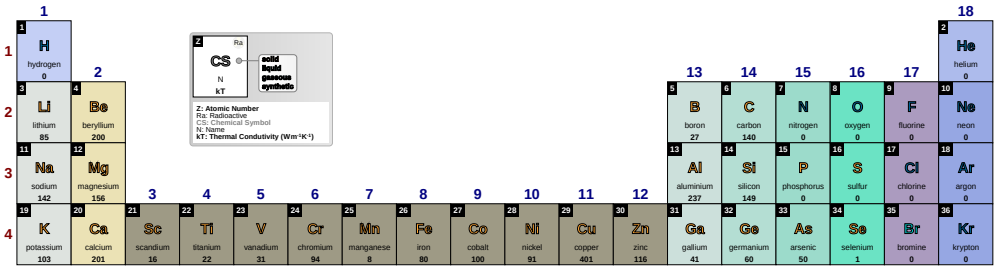
Sets the thermal condutivity precision, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

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.

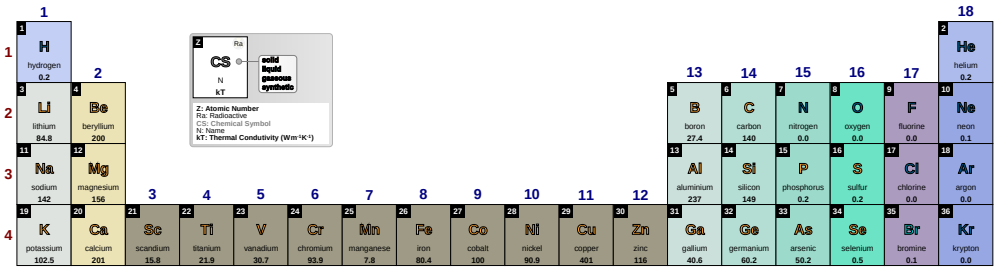
```
\pgfPTbuilcellstyle{mykT}(5,3)% 5 rows by 3 columns
[(1;1-2;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4;1-3;name),(5;1-3;kT)]
\pgfPTstyle[Z list={1,...,36},cell style=mykT,show title=false]
\pgfPT
```



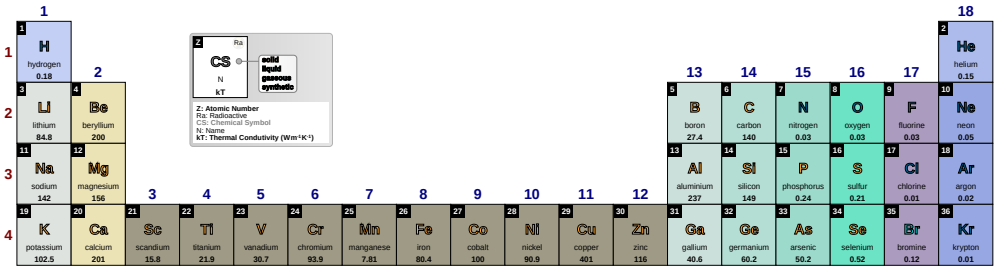
\pgfPT[kT precision=0]



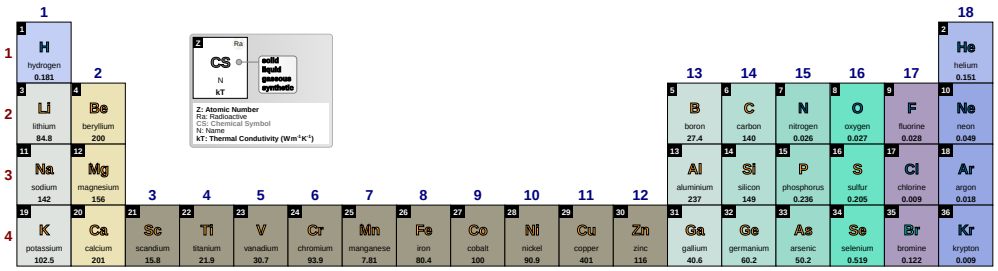
\pgfPT[kT precision=1]



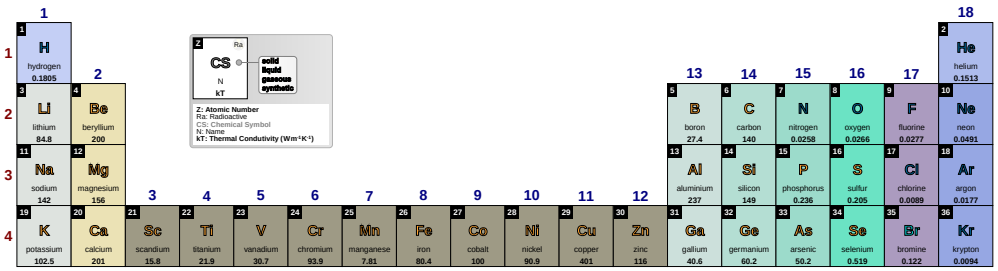
\pgfPT[kT precision=2]



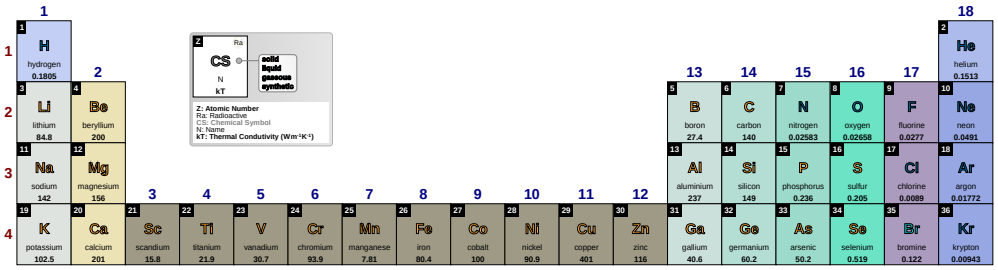
\pgfPT[kT precision=3]



\pgfPT[kT precision=4]



```
\pgfPT[kT precision=5]
```

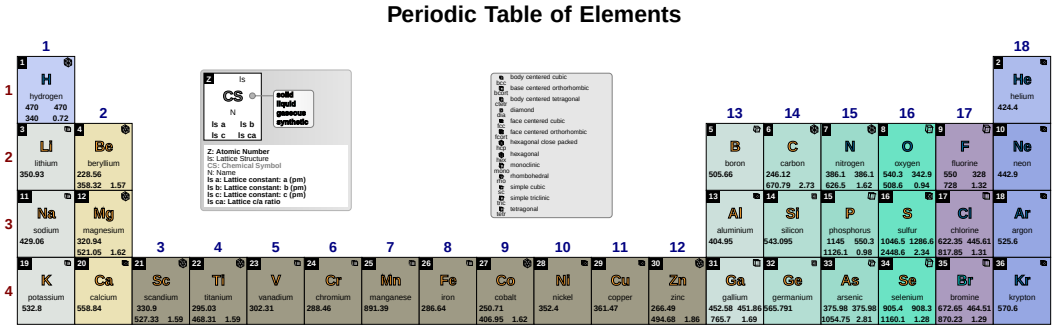


ls precision default: *-1*

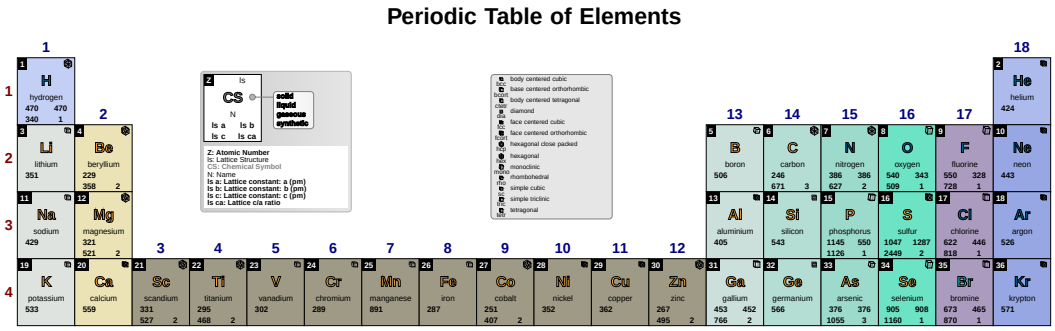
Sets the lattice structure constants - a, b, and c - precision, as also the lattice c/a ratio, *i.e.*, the decimal places displayed in their value, performing the respective rounding, without zero padding the value.

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

```
\pgfPTbuilcellstyle{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
```

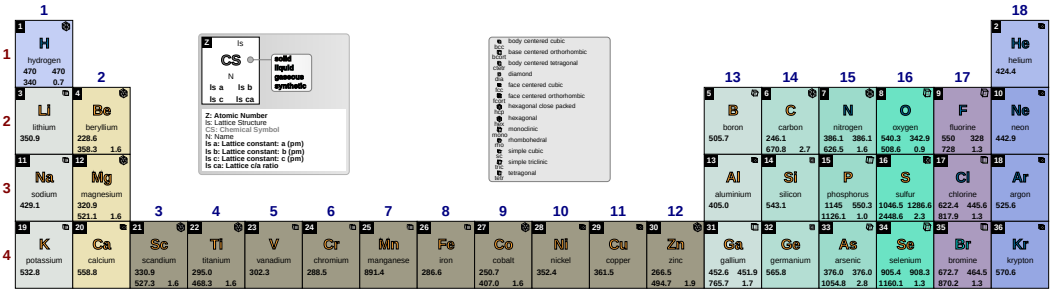



```
\pgfPT[ls precision=0]
```



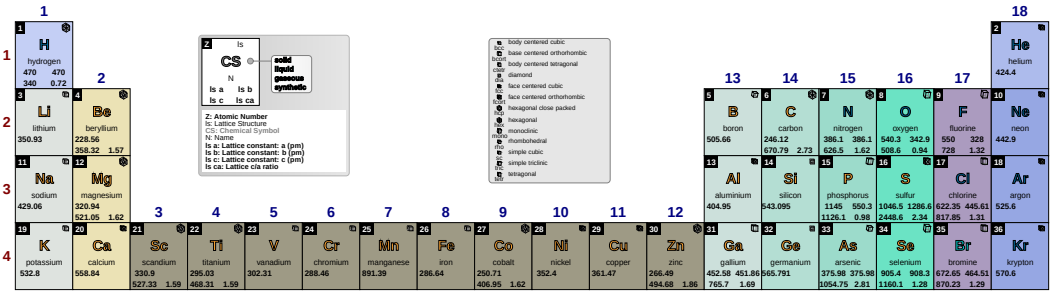
\pgfPT[ls precision=1]

Periodic Table of Elements



\pgfPT[ls precision=2]

Periodic Table of Elements

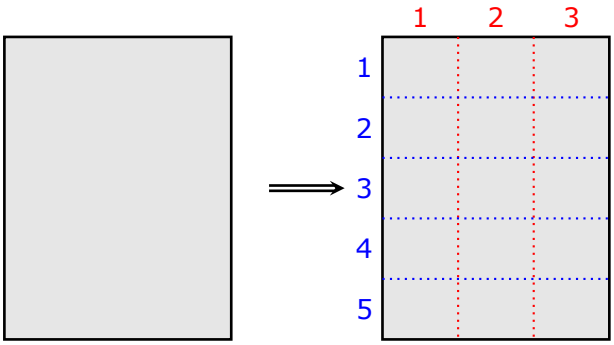


\pgfPTresetstyle

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:

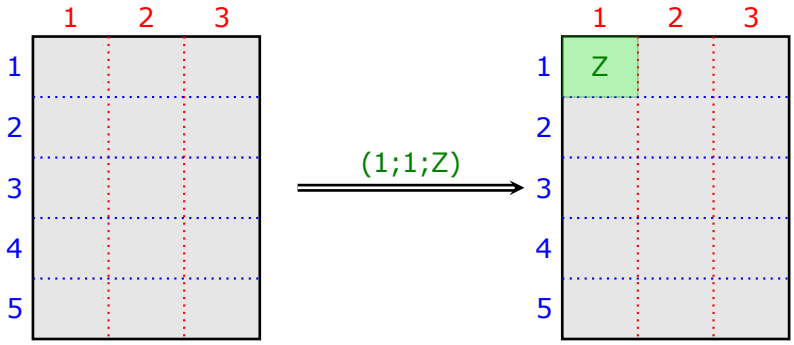


The next task is to assign contents to the cell by typing *trios* with the structure

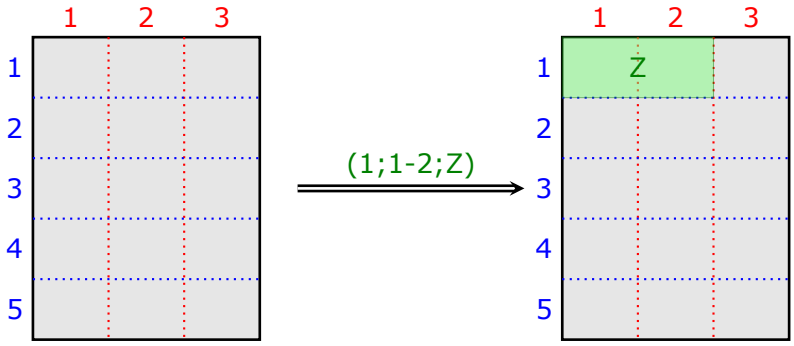
- **(row;column;content)**
- or **(start row-end row;start column-end column;content)**
- or a combination of both.

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, Is, Isa, Isb, Isc, Isca, DiscY, DiscC and spectra.

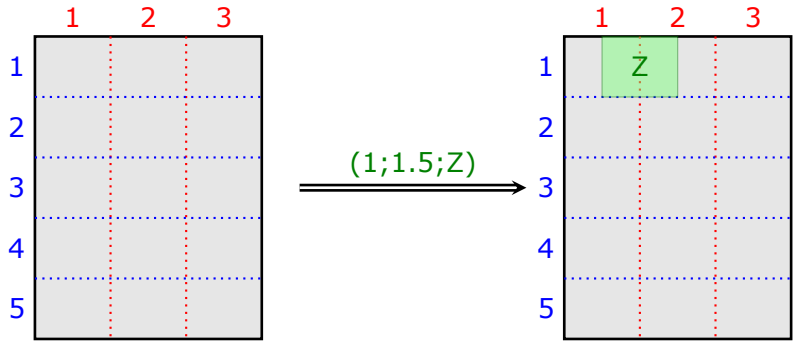
Assigning, for instance, (1;1;Z) will show the atomic number in the first row and in the first column,



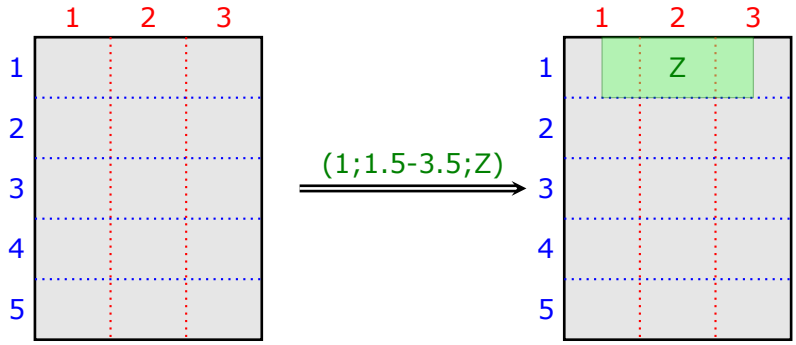
while the assignment (1;1-2;Z) will show the atomic number in the first row and filling the first and second columns,



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:

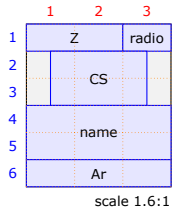
```
\pgfspectraStyle[back=visible40,line width=1pt,width=180pt,height=45pt,%
                 relative intensity,relative intensity threshold=.375,%
                 brightness=.5,charge=all,Imin=.125,gamma=1]
\foreach \SQ in {H,He,(...),Bi,Po,Rn,Fr,(...),Es}% Z=1,2,(...),83,84,86,87,(...),99
      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

✠ Built-in cell styles

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

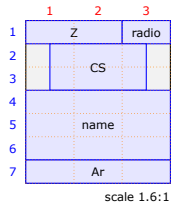
✓ **pgfPT2lang** – a cell layout to use with the name in two languages.

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)]



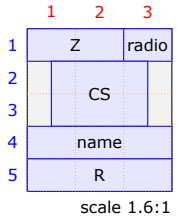
✓ **pgfPT3lang** – a cell layout to use with the name in three languages.

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)]



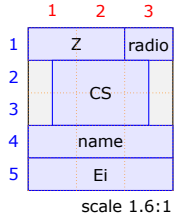
✓ **pgfPTR** – a cell layout to display the atomic radius and its periodic variations (if of course the show periodic variations key is set to true).

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)]



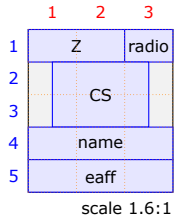
✓ **pgfPTEi** – a cell layout to display the first ionization energy and its periodic variations (if of course the show periodic variations key is set to true).

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)]



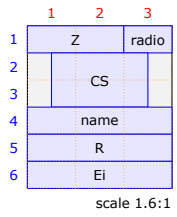
✓ **pgfPTeaff** – a cell layout to display the electron affinity and its periodic variations (if of course the show periodic variations key is set to true).

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)]



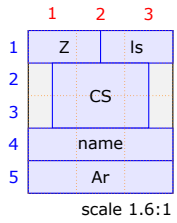
✓ **pgfPTREi** – a cell layout to display the atomic radius and first ionization energy and their periodic variations (if of course the show periodic variations key is set to true).

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)]



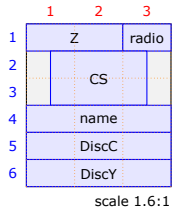
✓ **pgfPTls** – a cell layout to display the lattice system.

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)]



✓ **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 two ways to make a new color scheme:

- with the command \pgfPTnewColorScheme
- and using the *script* in the file pgfPTcolorSchemes.html

✠ Designing a color scheme with \pgfPTnewColorScheme

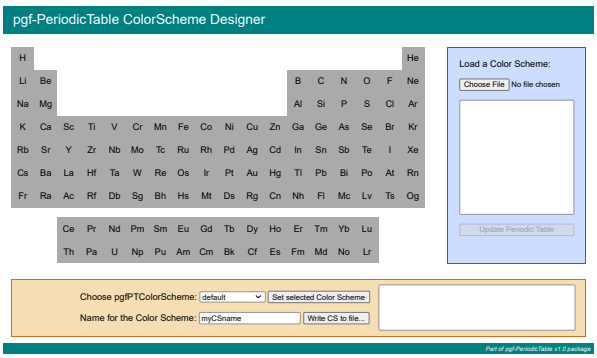
This command provides a way to set the cell background color of each of the 118 elements of the Periodic Table. *If the intention is to set the background color for all of them, it is highly recommended to use the file pgfPTcolorSchemes.html*, unless the trailing color begin at a small atomic number.

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.

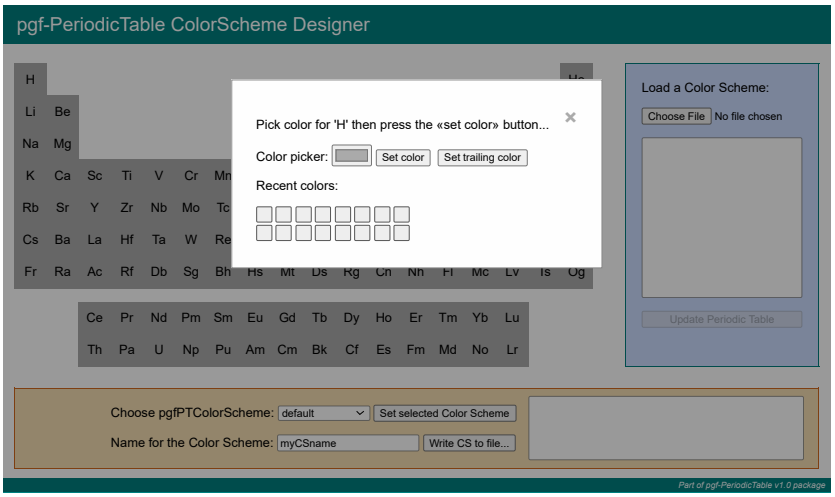
   If the color list has ten entries, these entries will set the background colors of the elements with atomic numbers from 1 to 10. For the following atomic numbers, greater than or equal to 11, the trailing color will be used in the color background.

✠ Designing a color scheme with pgfPTcolorSchemes.html

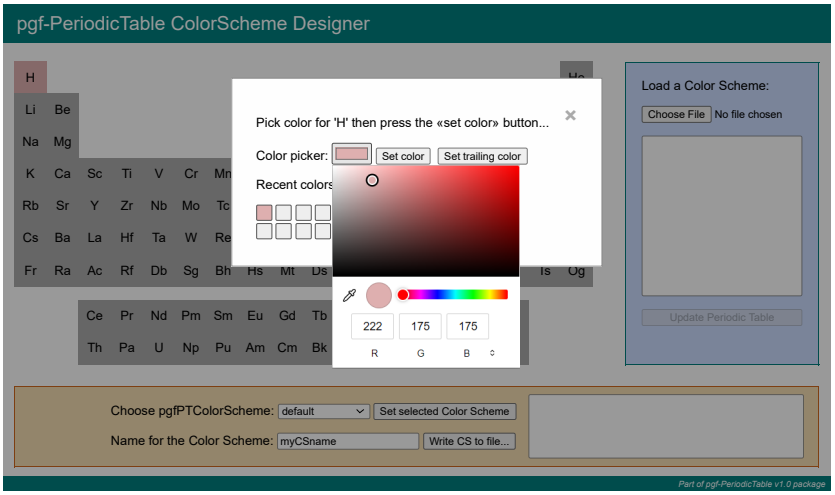


The pgfPTcolorSchemes.html *designer* is an *html* file with a little *javascript* code to perform the task of building a color scheme to use with the back color scheme key associated with the \pgfPT command.

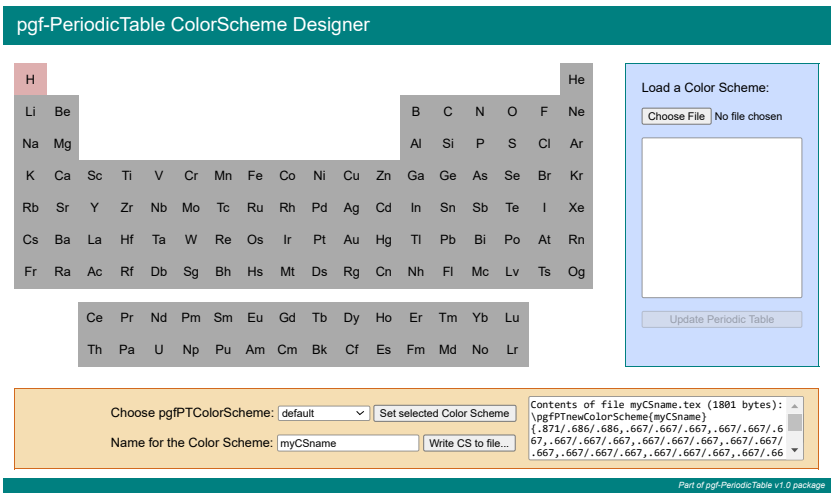
The Periodic Table of the Elements is displayed on the page and clicking on an element opens a color dialog:



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):



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

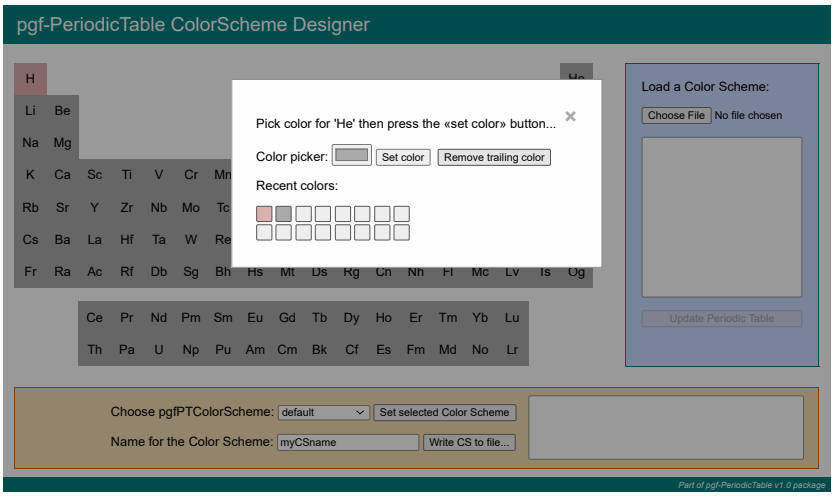


To use a color scheme saved in a file there are two possible ways:

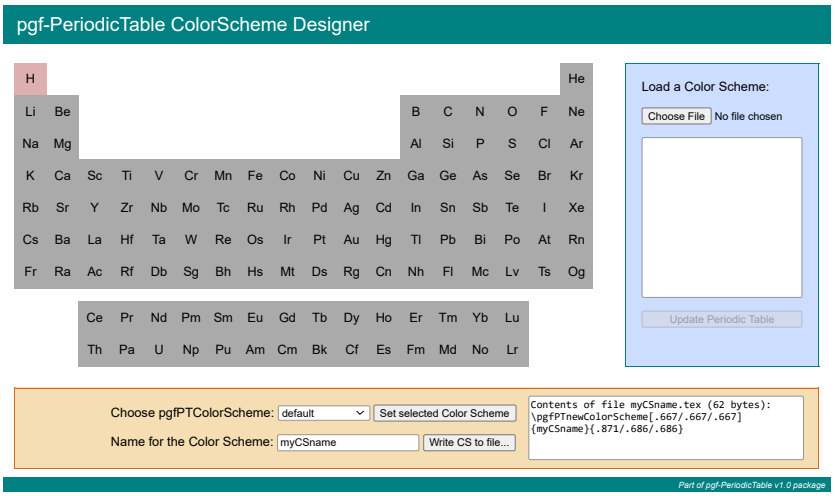
- loading the file in the working document via the \input LaTeX command, for instance, \input{myCSname.tex}.
- or by opening the file and copying and pasting its contents into the working document.

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:

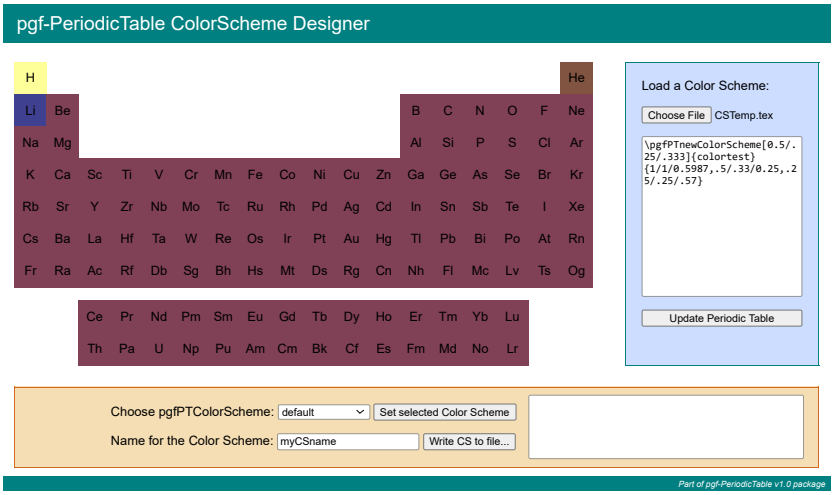


Then the saved color scheme will have the optional trailing color and the size will be smaller as only the color codes of the changed elements are stored:

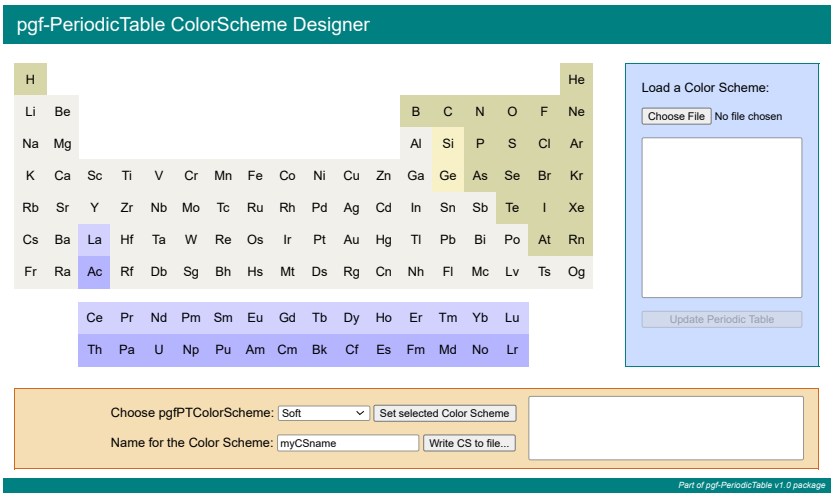


To remove the trailing color click on the last enabled element (in the above case helium) and then click on Remove trailing color. After that, all elements can be clicked again.

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:



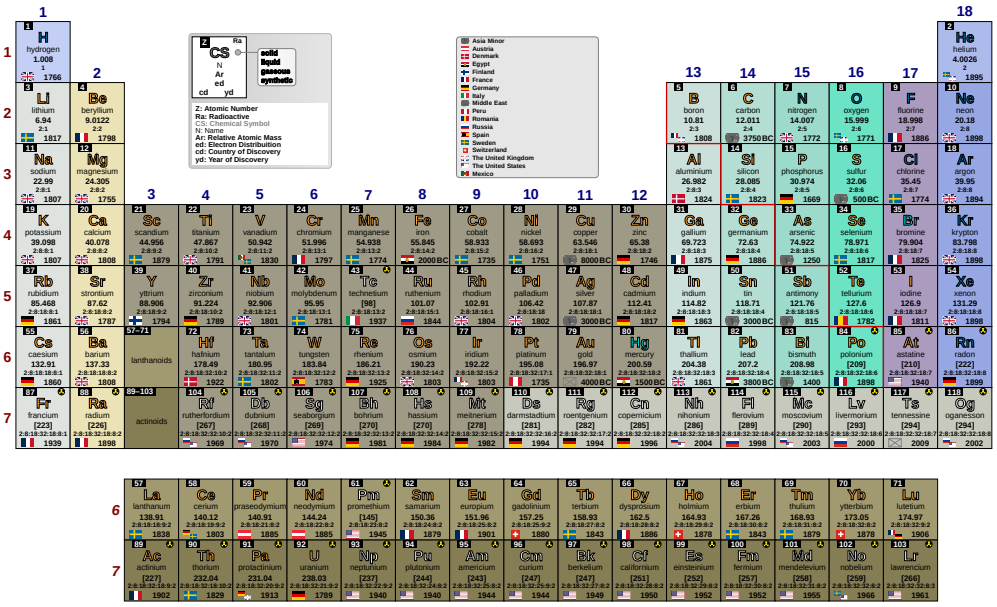
All the operations described are always available.

A few more examples

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

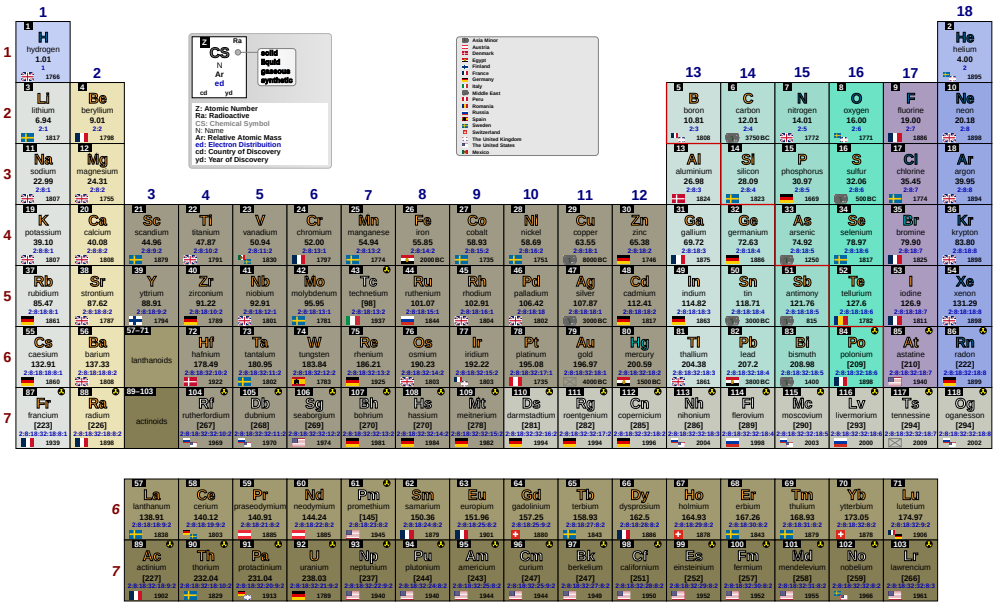
```
\pgfPTbuildcell(8,3)% 8 rows by 3 columns
[(1;1.4-2.8;Z),(1;3;radio),(2-3;1.5-3.5;CS),(4.2;1-3;name),
(5.4;1-3;Ar),(6.5;1-3;eDist),(7.55-8.95;1-2.25;DiscC),(7.55-8.95;2.25-3.8;DiscY)]
\pgfPT
```

Periodic Table of Elements

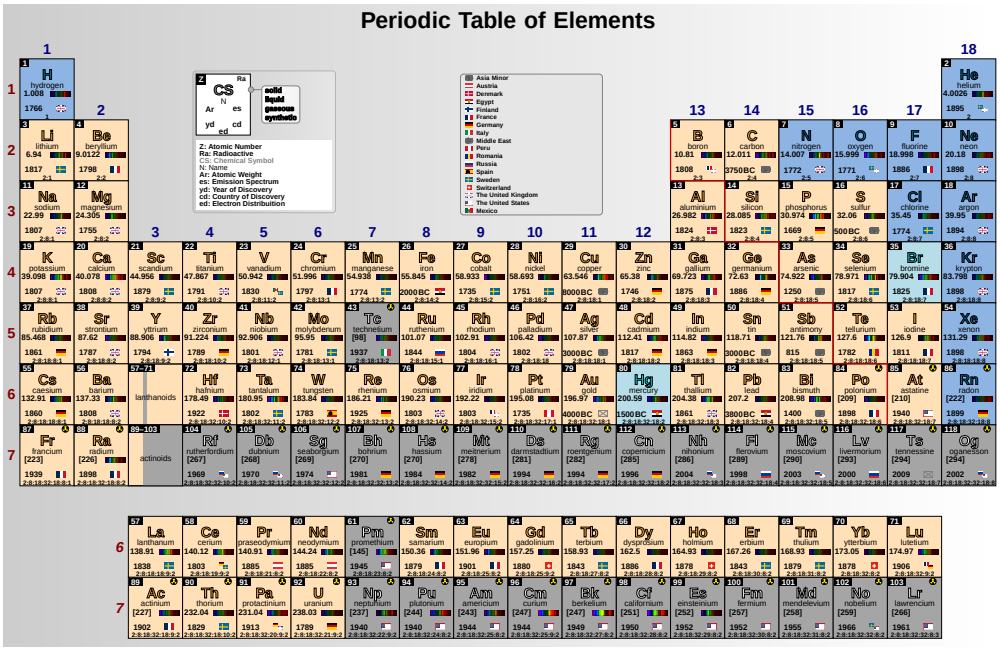


```
\pgfPT[eDist color=blue!70!black,Ar precision=2,DiscC
font=\fontsize{4}{4}\selectfont,DiscY font=\fontsize{4}{4}\selectfont\bfseries]
```

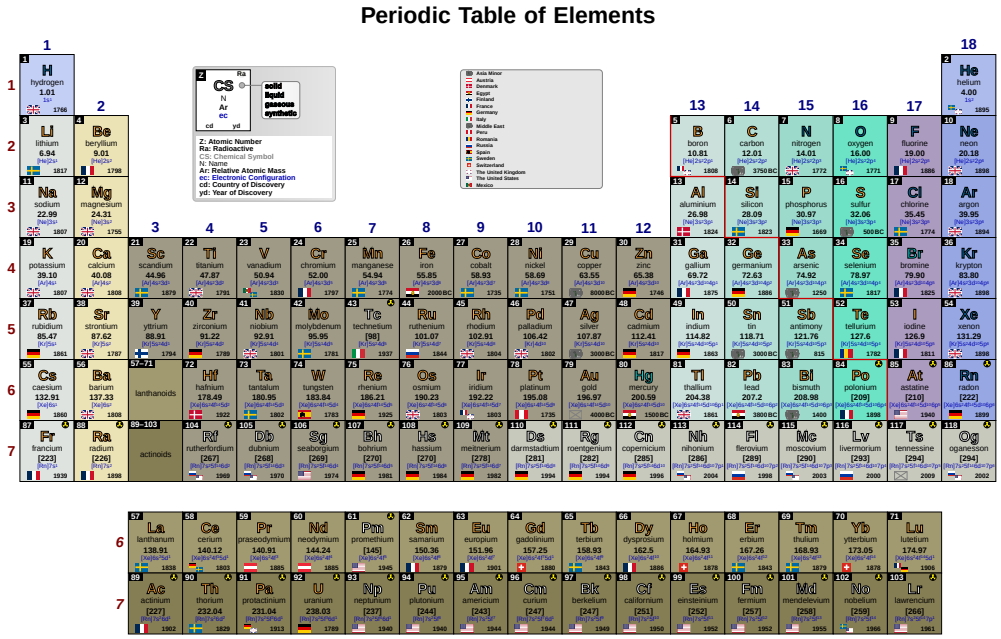
Periodic Table of Elements



```
\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]
```



Representative elements: element families

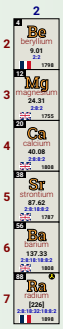
For the ***representative elements*** (groups **1**, **2** and **13** to **18**) it is common to speak of families that reflect their common characteristics. So we have **the families**:

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**.

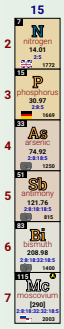
- ✓ Boron is a metalloid and the other are metals.
- ✓ Boron, aluminium, gallium, indium and thallium are often used as p-type silicon dopants.
- ✓ Aluminium is the third most abundant element in the Earth's crust (7.4%)

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.

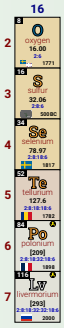


GROUP 1**5**: **Pnictogens**

► *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.

A																	B
C	D															E	
	F															G	H
I	J					K		L					M		N	O	
												P					Q
					R												S
T																	

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 block s.
5. identify the elements of block p.
6. identify the elements of block d.
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:

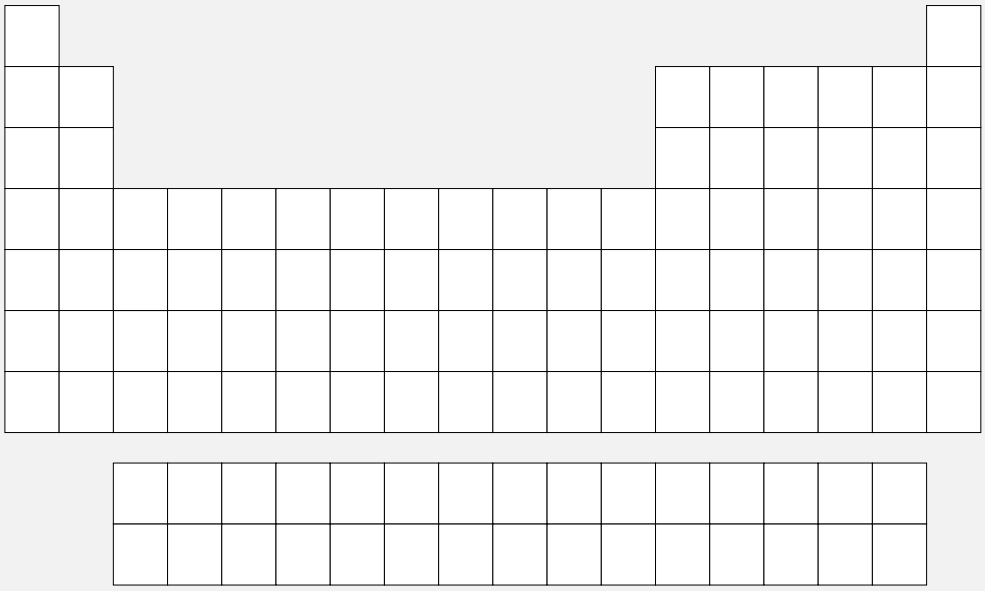
Using the following notation,

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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