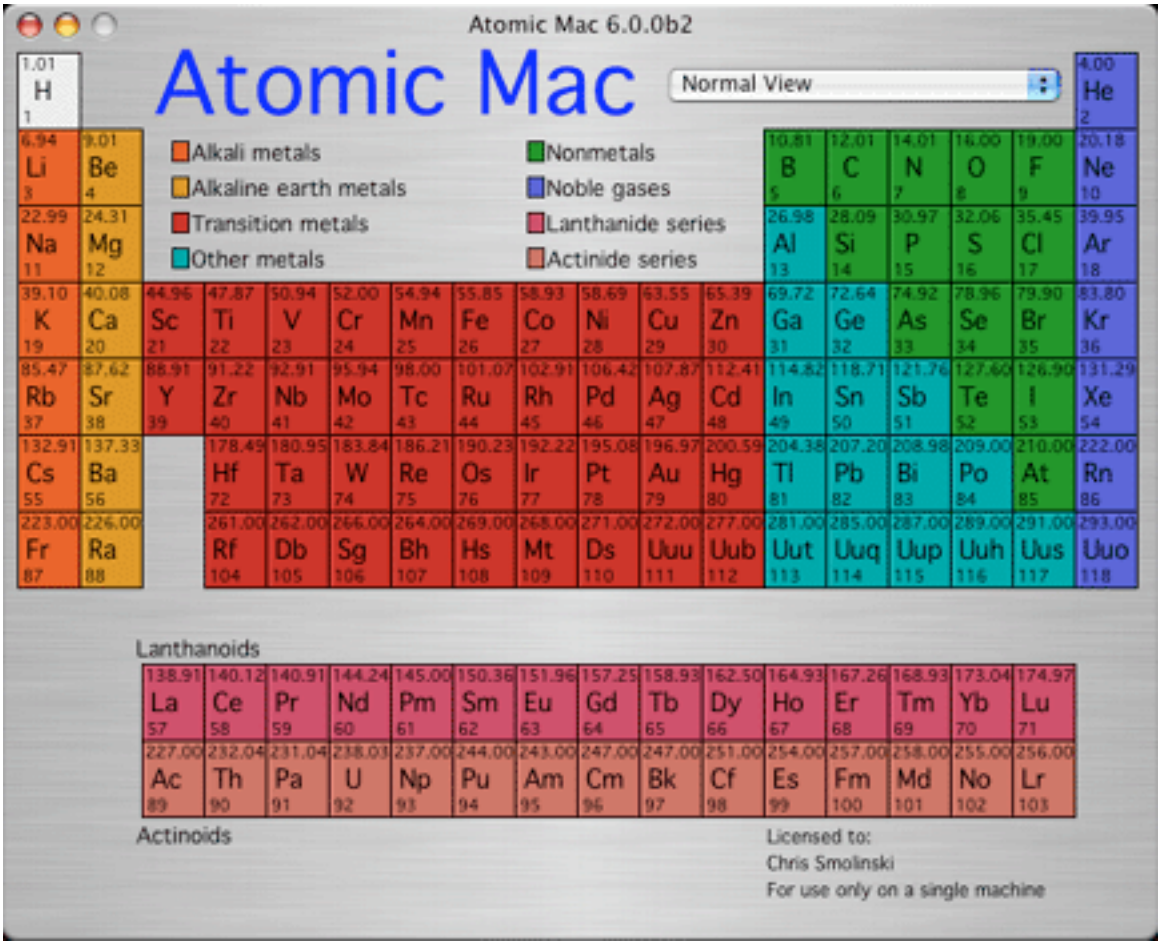
The Atomic Mac™
Atomic PC™
Atomic Penguin™
Version 6.5.0 August 1, 2006

Note: This documentation refers to the program as "Atomic Mac", but is also valid for the Atomic PC and Atomic Penguin, except as noted.

Introduction

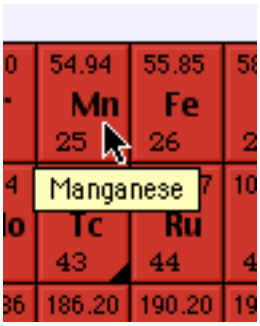
The Atomic Mac is a Periodic Table of the Elements. It runs under MacOS 9, Mac OSX, Windows, and Linux. The price to buy your copy is only $24.99. Until you buy, you will only be able to look at data for a few selected elements.



When you first launch the Atomic Mac, you see a normal presentation of the

periodic table of the elements.

If you place the cursor over an element for a few seconds, you'll see the name of the element pop up. [Except in Windows/Linux]

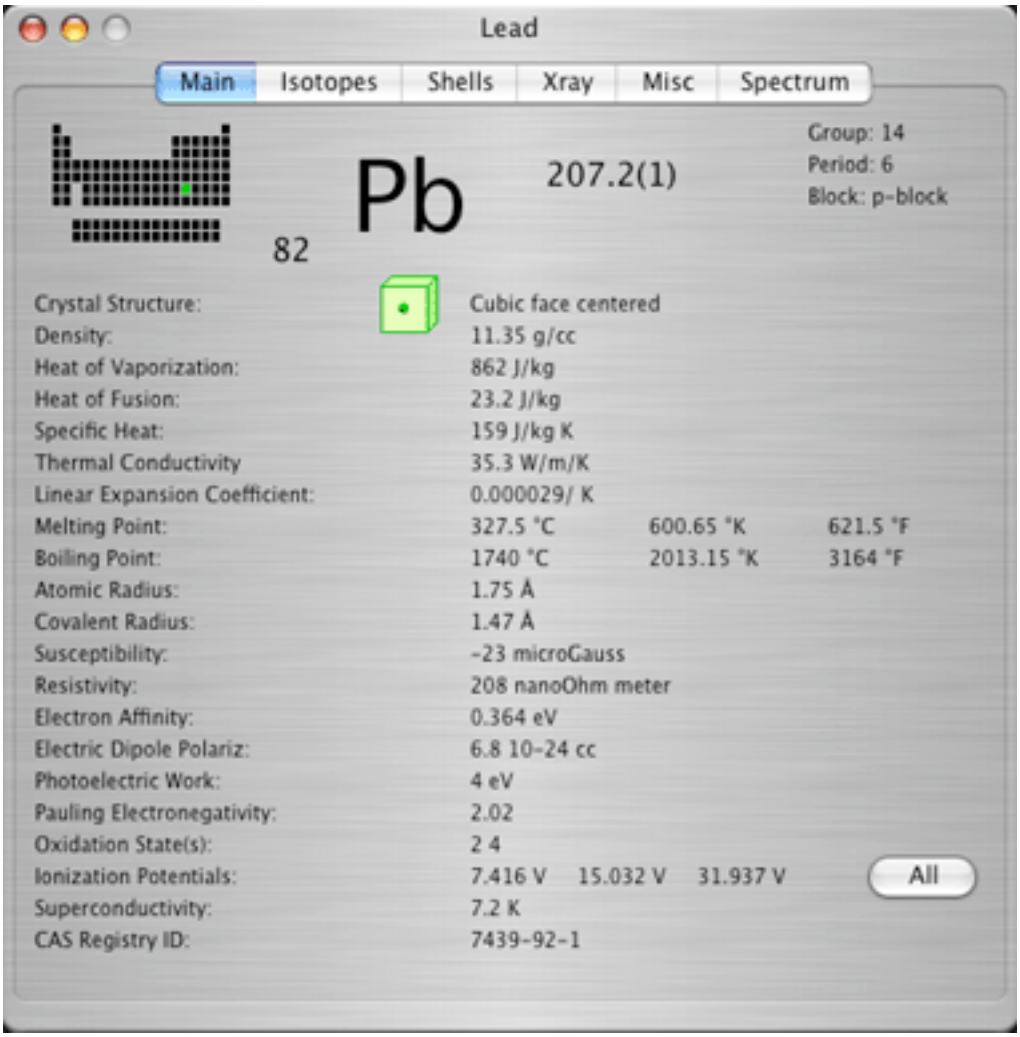


Clicking on one of the elements brings up a window that contains detailed information about that element.

You can also open the text list of elements (from the Windows menu) to get an alphabetical list of elements. Double click on one to open the detailed view window for that element.

There are six different sets of detailed information you can display, selected from the tabs in the window. They are:

Physical View - a list of physical properties, such as density, melting point, etc.

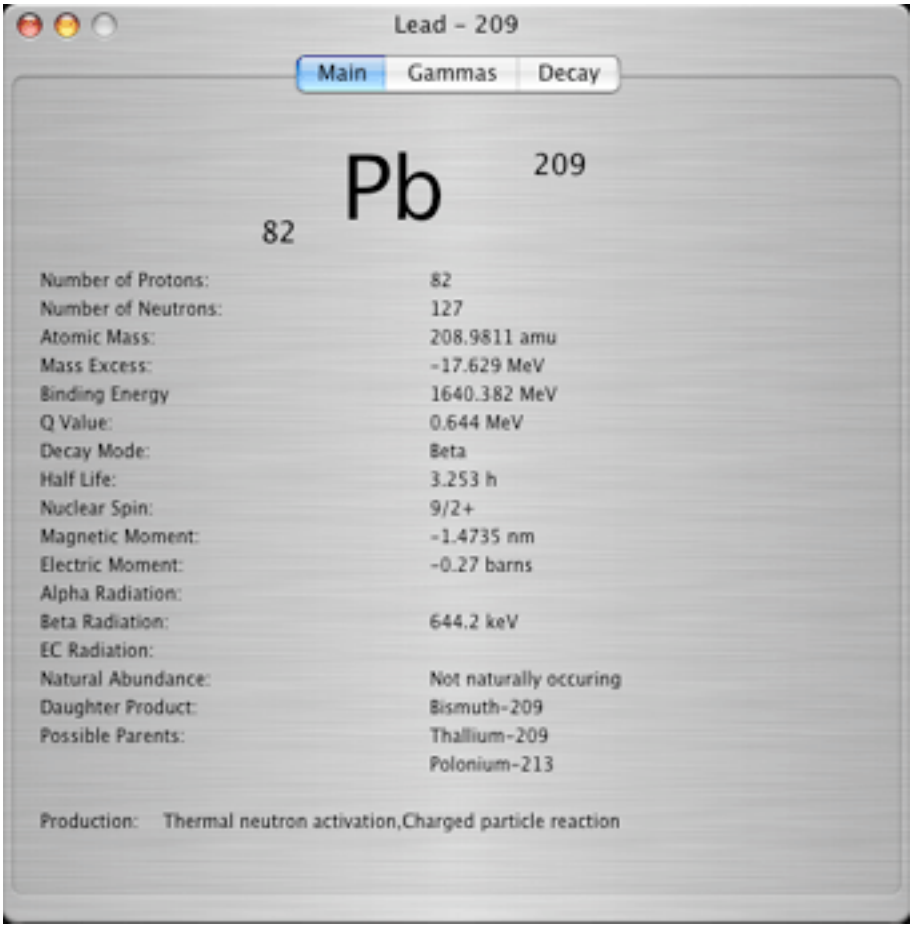


Isotopes View - a list of all isotopes for this element, showing the atomic mass, decay mode, half life, and percent natural abundance. If there are too many isotopes to fit in the window, then you can scroll down the list.

Parent	Daughter	Decay Mode	Half Life	Abundance
Pb194	Tl194	Electron Capture	12 m	
Pb195	Tl195	Electron Capture	15 m	
Pb196	Tl196	Electron Capture	37 m	
Pb197	Tl197	Electron Capture	8 m	
Pb198	Tl198	Electron Capture	2.4 h	
Pb199	Tl199	Electron Capture	1.5 h	
Pb200	Tl200	Electron Capture	21.5 h	
Pb201	Tl201	Electron Capture	9.33 h	
Pb202	Tl202	Electron Capture	52501.44 y	
Pb203	Tl203	Electron Capture	2.161375 d	
Pb204	Pb204	Stable		1.48 %
Pb205	Tl205	Electron Capture	15.30042 My	
Pb206	Pb206	Stable		23.6 %
Pb207	Pb207	Stable		22.6 %
Pb208	Pb208	Stable		52.3 %
Pb209	Bi209	Beta	3.253 h	
Pb210	Bi210	Beta	22.30061 y	
Pb211	Bi211	Beta	36.1 m	
Pb212	Bi212	Beta	10.64 h	
Pb214	Bi214	Beta	26.8 m	

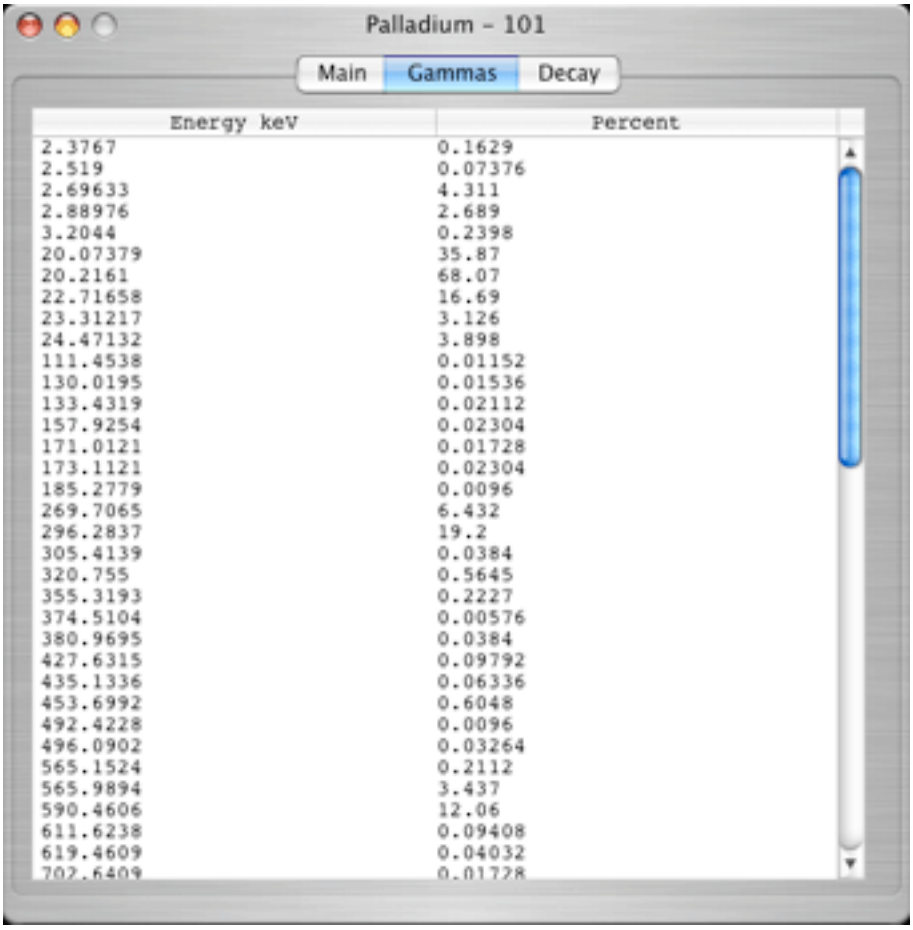
Isotope Detail View

Clicking on an isotope will bring up the another window, with detailed information, such as the number of protons and neutrons, atomic mass, mass excess, binding energy, natural abundance, decay mode and half life, nuclear spin, magnetic moment, and alpha and beta radiation energies. (Not all information is available for all isotopes) In addition, possible parent nuclides are also listed, as well as the daughter product.



Gamma Rays

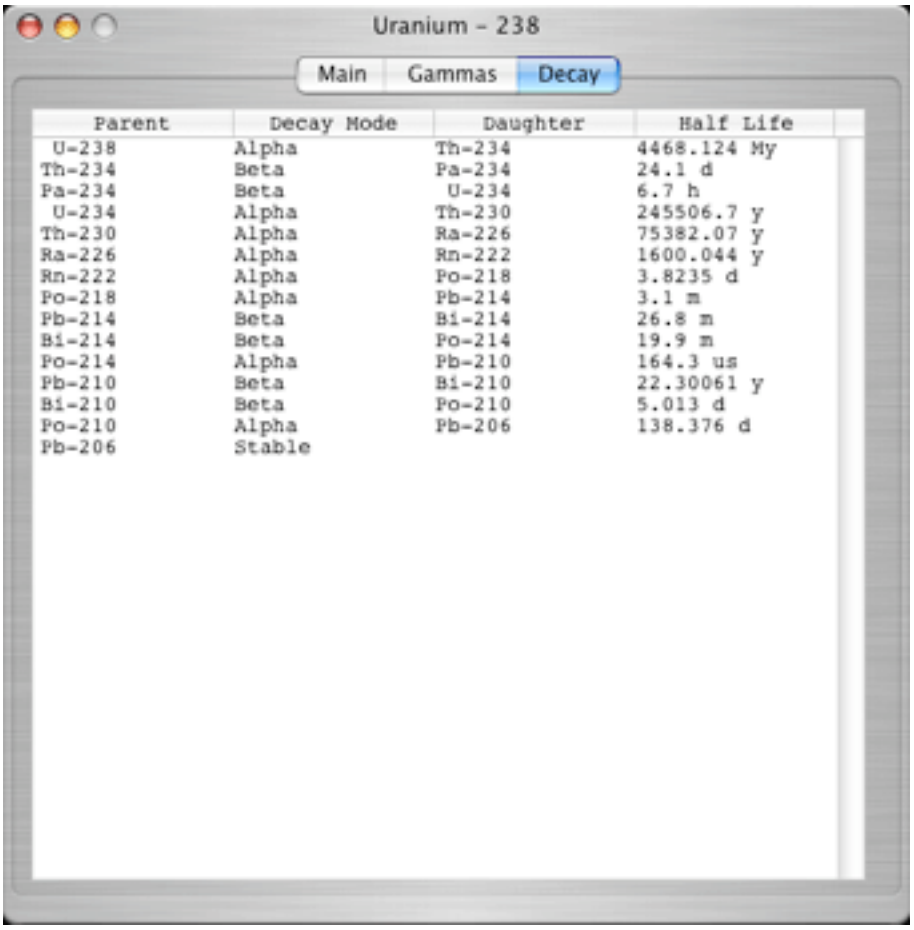
Clicking on the Gammas tab will bring up a window listing all of the gamma rays that occur in at least 0.1% of transitions.



Energy keV	Percent
2.3767	0.1629
2.519	0.07376
2.69633	4.311
2.88976	2.689
3.2044	0.2398
20.07379	35.87
20.2161	68.07
22.71658	16.69
23.31217	3.126
24.47132	3.898
111.4538	0.01152
130.0195	0.01536
133.4319	0.02112
157.9254	0.02304
171.0121	0.01728
173.1121	0.02304
185.2779	0.0096
269.7065	6.432
296.2837	19.2
305.4139	0.0384
320.755	0.5645
355.3193	0.2227
374.5104	0.00576
380.9695	0.0384
427.6315	0.09792
435.1336	0.06336
453.6992	0.6048
492.4228	0.0096
496.0902	0.03264
565.1524	0.2112
565.9894	3.437
590.4606	12.06
611.6238	0.09408
619.4609	0.04032
702.6409	0.01728

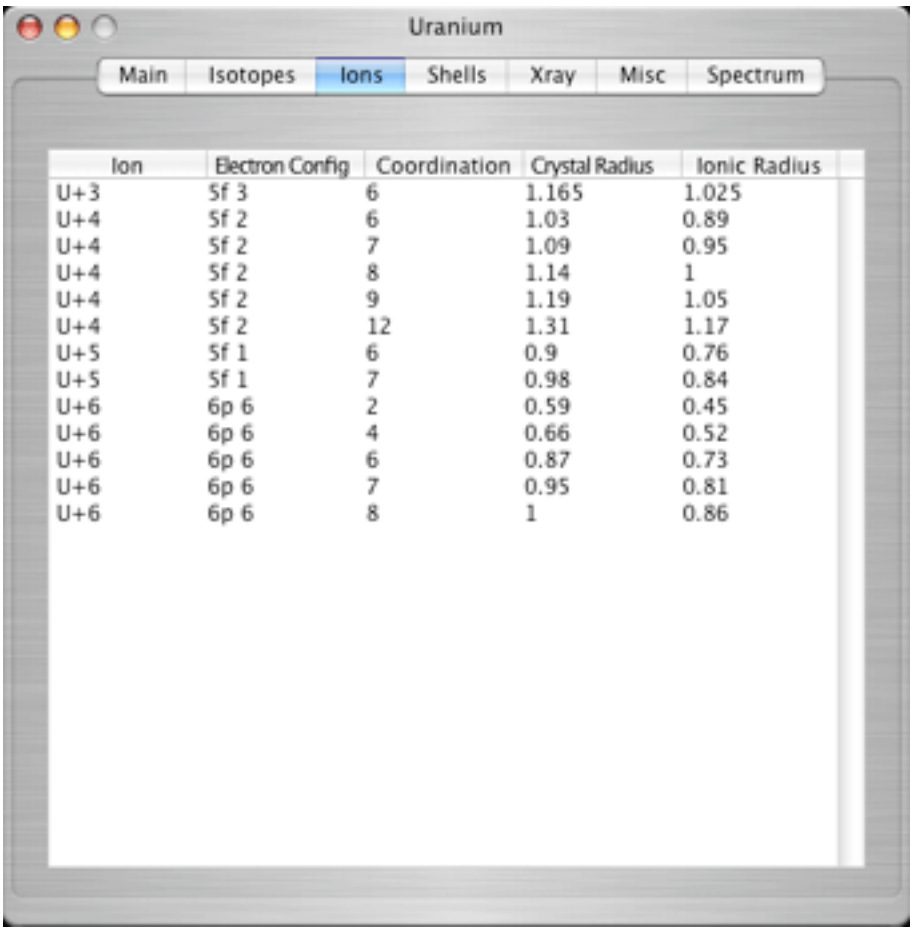
Decay Tree

Clicking on the Decay tab will display the path taken by the nuclide as it and daughter products decay, until they become stable. This view is of course only useful for radioactive nuclides.



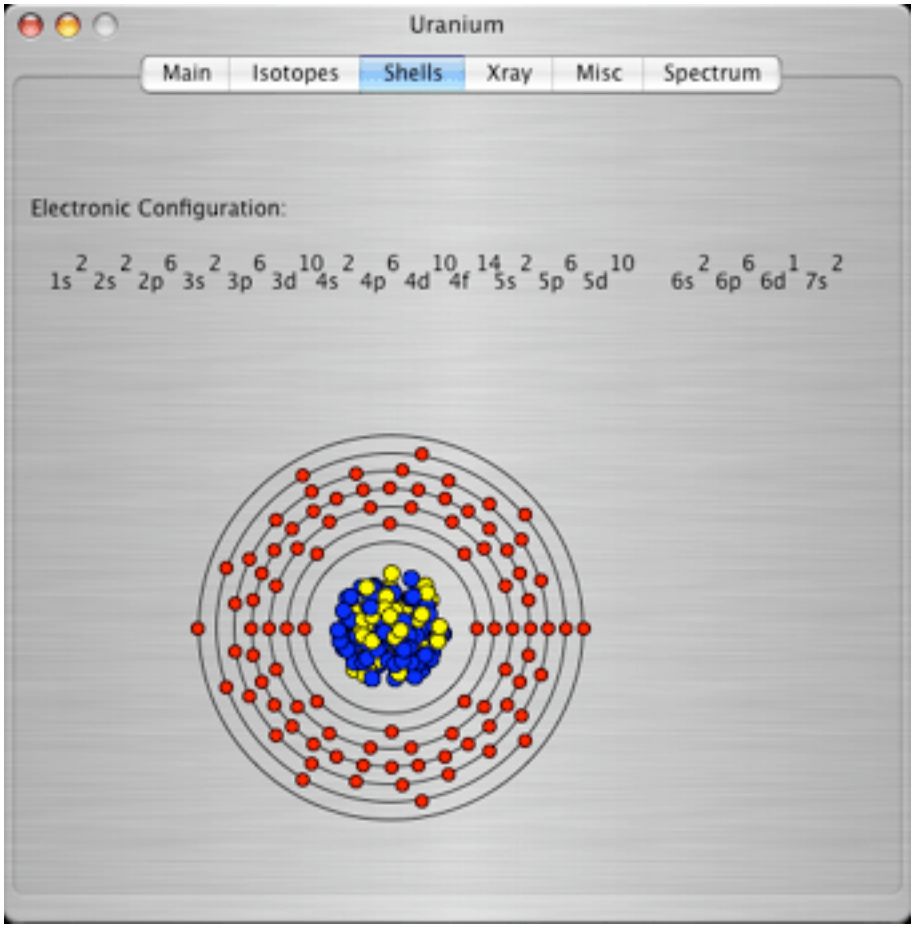
Parent	Decay Mode	Daughter	Half Life
U-238	Alpha	Th-234	4468.124 My
Th-234	Beta	Pa-234	24.1 d
Pa-234	Beta	U-234	6.7 h
U-234	Alpha	Th-230	245506.7 y
Th-230	Alpha	Ra-226	75382.07 y
Ra-226	Alpha	Rn-222	1600.044 y
Rn-222	Alpha	Po-218	3.8235 d
Po-218	Alpha	Pb-214	3.1 m
Pb-214	Beta	Bi-214	26.8 m
Bi-214	Beta	Po-214	19.9 m
Po-214	Alpha	Pb-210	164.3 us
Pb-210	Beta	Bi-210	22.30061 y
Bi-210	Beta	Po-210	5.013 d
Po-210	Alpha	Pb-206	138.376 d
Pb-206	Stable		

Ions View - a listing of the crystal and ionic radii for various ions and coordination numbers. Radii data are in Angstroms.

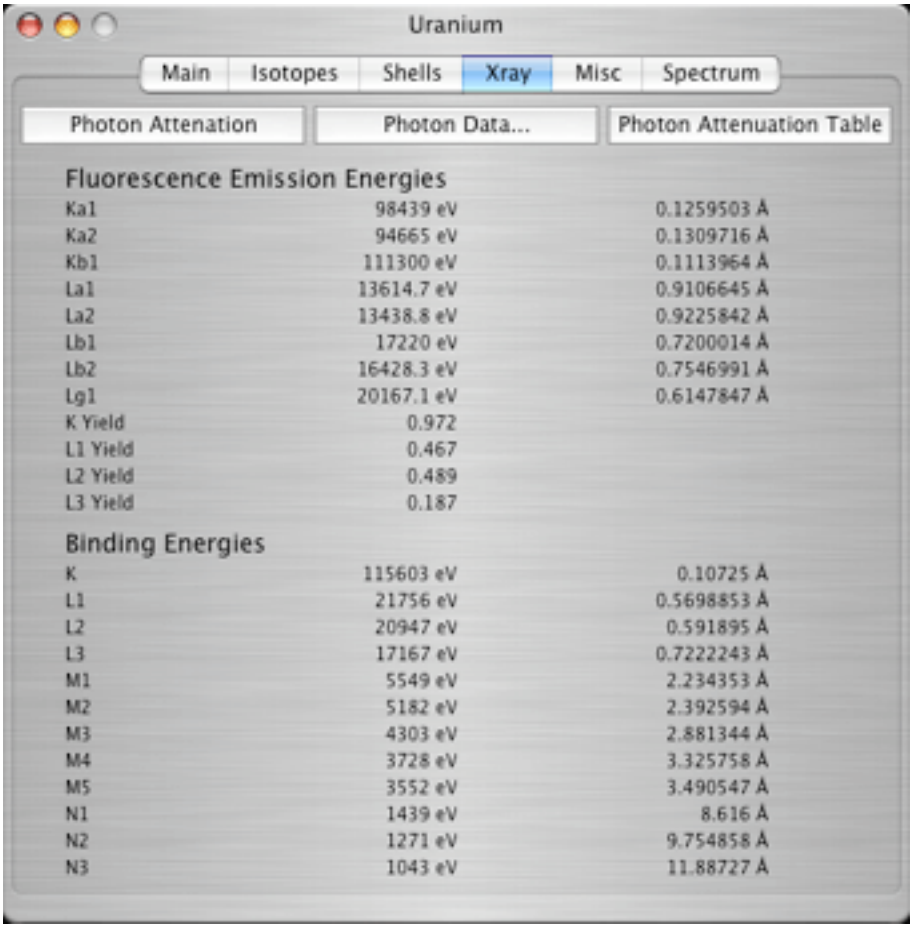


Ion	Electron Config	Coordination	Crystal Radius	Ionic Radius
U+3	5f 3	6	1.165	1.025
U+4	5f 2	6	1.03	0.89
U+4	5f 2	7	1.09	0.95
U+4	5f 2	8	1.14	1
U+4	5f 2	9	1.19	1.05
U+4	5f 2	12	1.31	1.17
U+5	5f 1	6	0.9	0.76
U+5	5f 1	7	0.98	0.84
U+6	6p 6	2	0.59	0.45
U+6	6p 6	4	0.66	0.52
U+6	6p 6	6	0.87	0.73
U+6	6p 6	7	0.95	0.81
U+6	6p 6	8	1	0.86

Shells View - a graphical display of the atom, showing the electron shells, along with the electronic configuration.

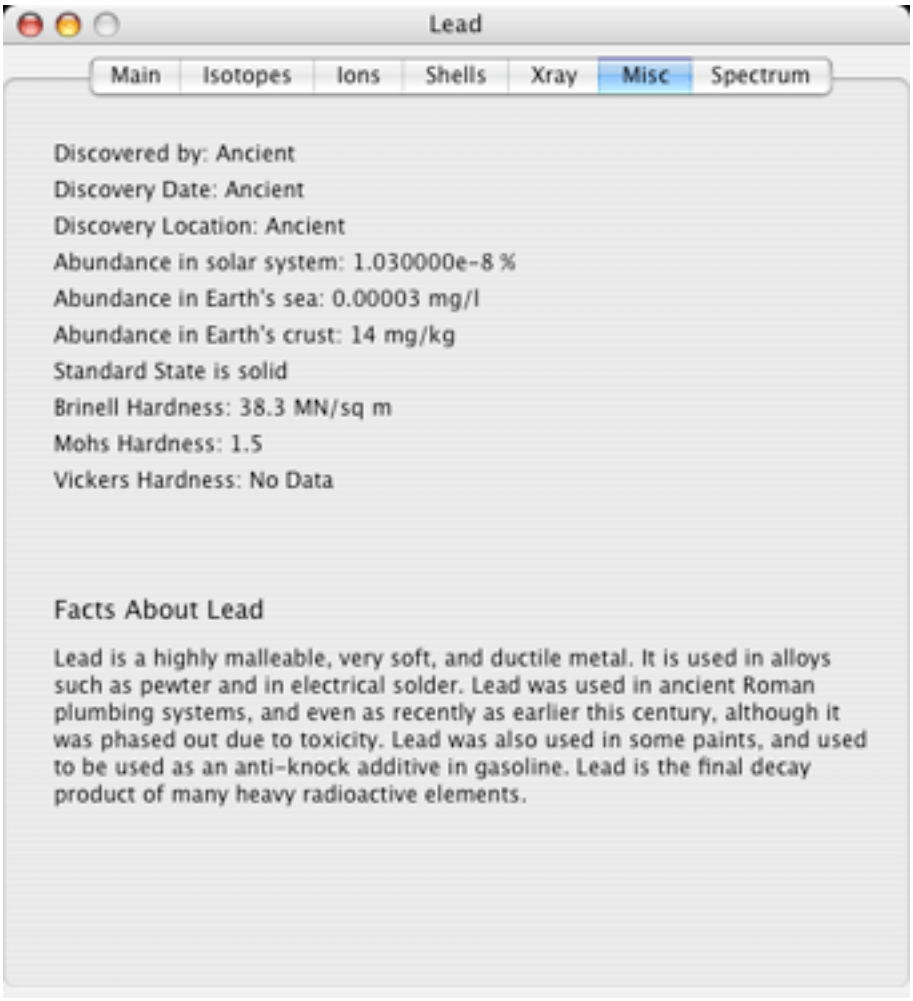


X-Ray View - A list of the K and L shell fluorescence energies, and K, L, M, and N shell binding energies. Clicking n the Photon Attenuation button will bring up a window showing the attenuation graph, while clicking on the Photon Attenuation Table button will bring up a tabular form of the same data. The information is based on the McMaster data. Clicking on the Photon Data button will bring up an interactive window, allow you to display the relevant data for any energy between 1 keV and 10 MeV.

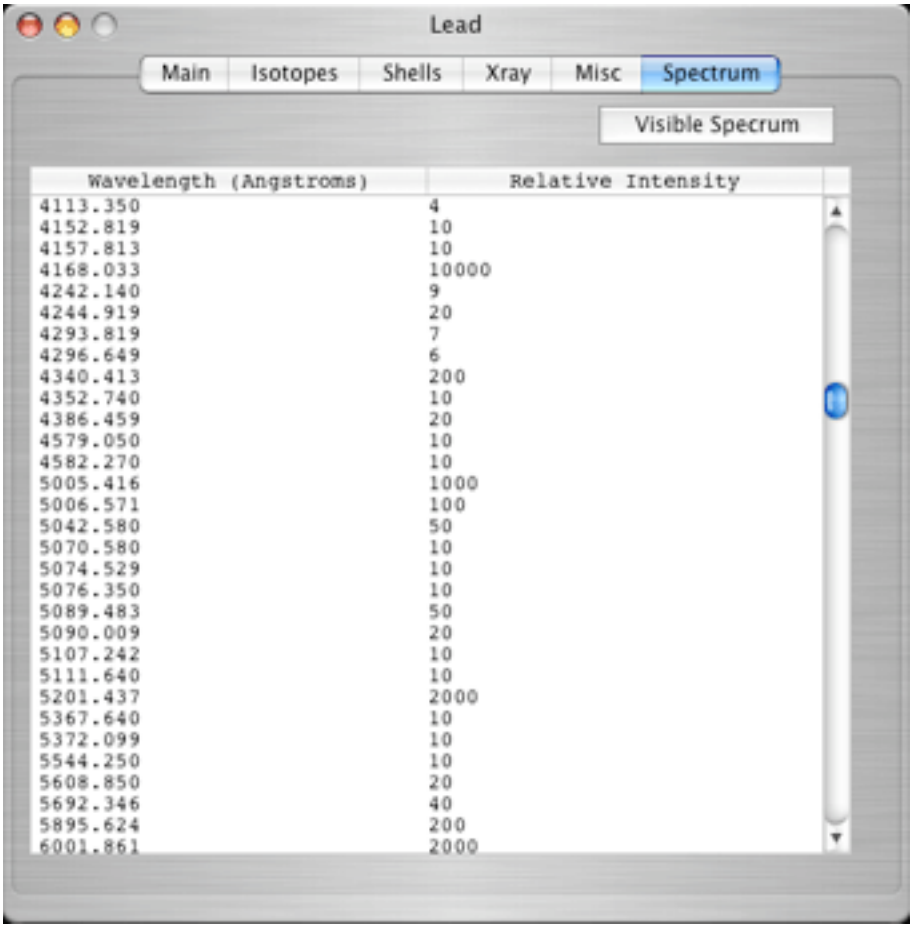


Misc View - General information showing the name of the discoverer of the element, and where and when it was discovered. Interesting bits of information are also displayed, including the Brinell, Mohs, and Vickers hardness, as well as the standard (room temperature) state of the element.

If you have any other interesting facts about an element, let us know, and we'll be glad to add them to a future version.



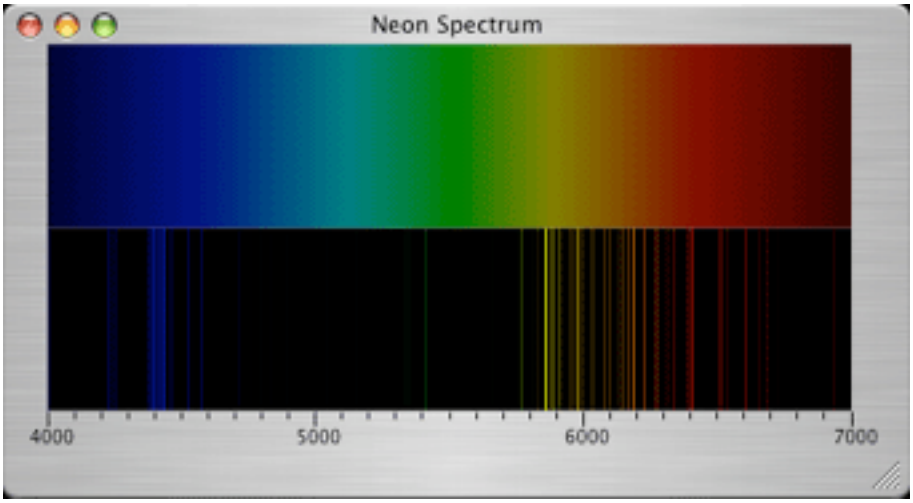
Spectrum View - A list of the wavelengths and relative intensities of the optical spectra of an element, including visible, UV, and IR.



Wavelength (Angstroms)	Relative Intensity
4113.350	4
4152.819	10
4157.813	10
4168.033	10000
4242.140	9
4244.919	20
4293.819	7
4296.649	6
4340.413	200
4352.740	10
4386.459	20
4579.050	10
4582.270	10
5005.416	1000
5006.571	100
5042.580	50
5070.580	10
5074.529	10
5076.350	10
5089.483	50
5090.009	20
5107.242	10
5111.640	10
5201.437	2000
5367.640	10
5372.099	10
5544.250	10
5608.850	20
5692.346	40
5895.624	200
6001.861	2000

Visible Spectrum Display

Clicking on the Visible Spectrum button will bring up a window showing the visible line spectrum of the element, along with a complete (rainbow) spectrum for reference.



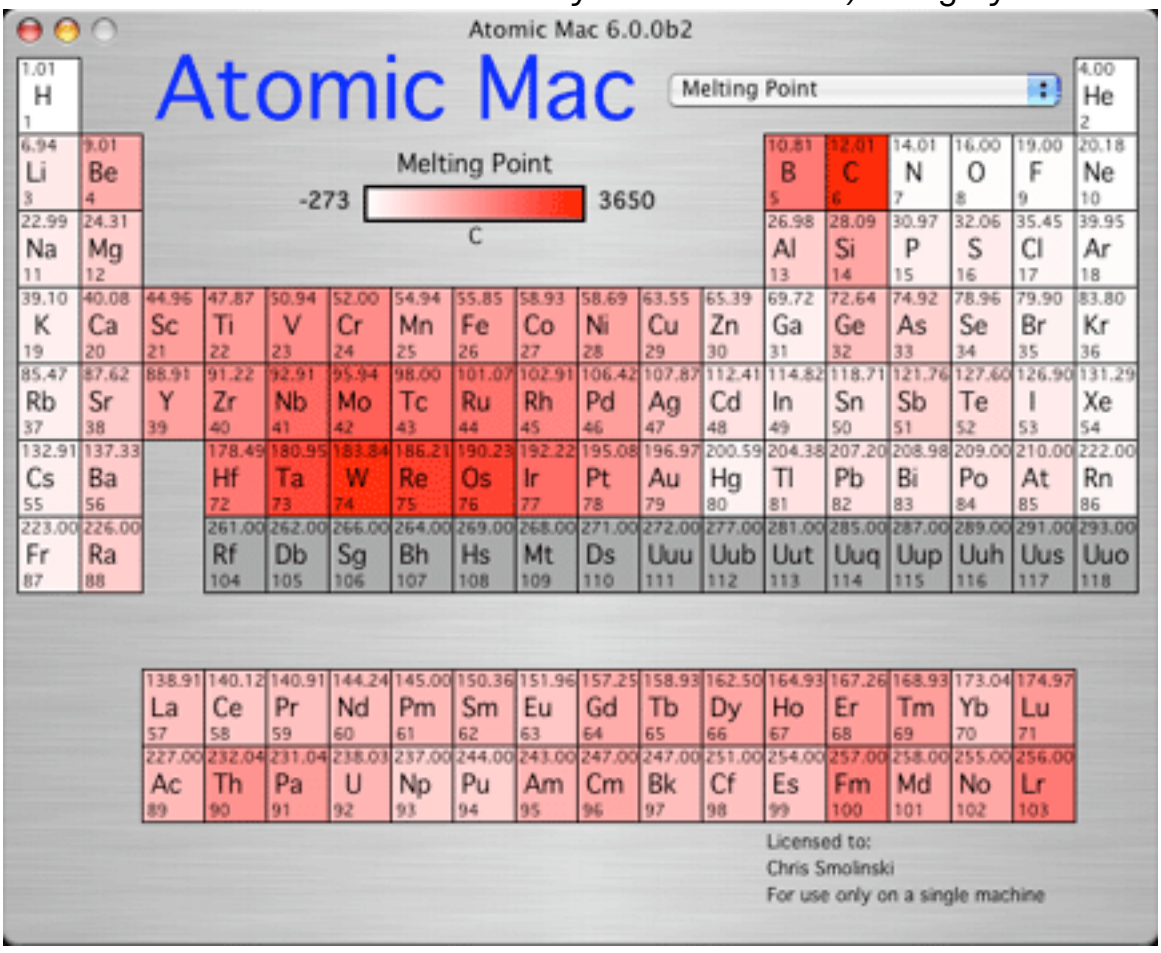
Property View

You can also alter the periodic table display to shade each element, by several properties, which include:

Density
Heat of Vaporization
Heat of Fusion
Specific Heat
Thermal Conductivity
Linear Expansion Coefficient
Melting Point
Boiling Point
Atomic Radius
Covalent Radius
Magnetic Susceptability
Electrical Resistivity
Electron Affinity
Electric Dipole Polarizability
State (gas, liquid, solid)
Photoelectric Work Function
Electronegativity
Crystal Structure
Abundance in Crust

Abundance in Sea
Abundance in Atmosphere
Solar Abundance
Number of Isotopes
Number of Natural Isotopes
Number of Stable Isotopes
Atomic Mass
Superconducting Critical Temperaure
First Ionization Potential
Second Ionization Potential
Third Ionization Potential

Below is a display with the view set to melting point. The elements with higher melting points are more red, those with lower melting points are more white. Elements for which there is no data (typically the man-made transuranic elements with extremely short half lives) are gray.



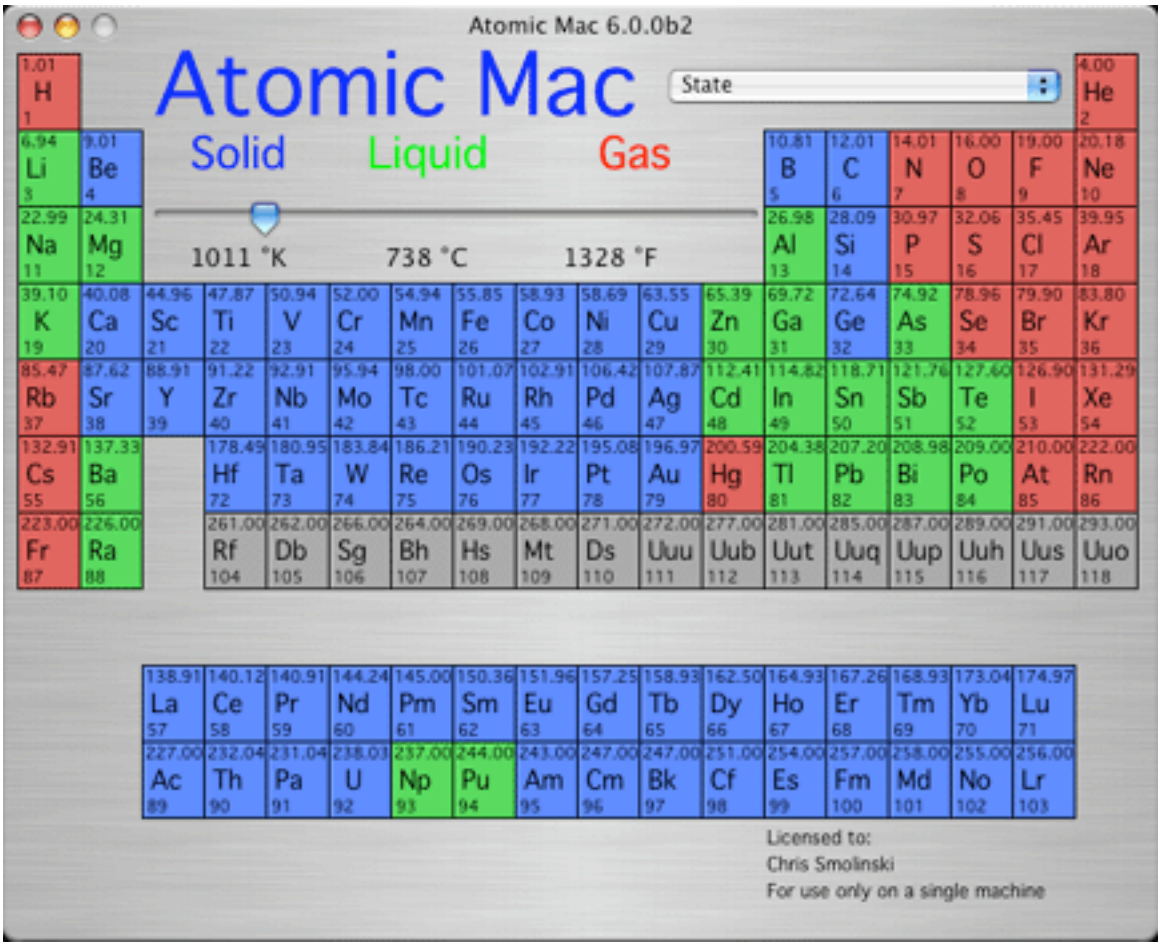
These properties are selected under the **View** menu. If you place the cursor over an element for a few seconds, you'll see the name of the element pop up, as well as the value for that view.

Temperature State View

When viewing the state, you can change the temperature using the slider control. The selected temperature is displayed below, in degrees Kelvin, Centigrade, and Fahrenheit.

You can also use the + and - keys on the numeric keypad to increase and decrease the temperature by one degree. Holding down option will make the change 10 degrees, and holding down shift will make the change 100 degrees.

The following picture shows the state of each element at 1000 degrees Kelvin:



One of the views is the **Molecular Weight Calculator**. Selecting this will display a text entry box just above the periodic table. You can enter a chemical formula into this box, and the molecular weight will be calculated for

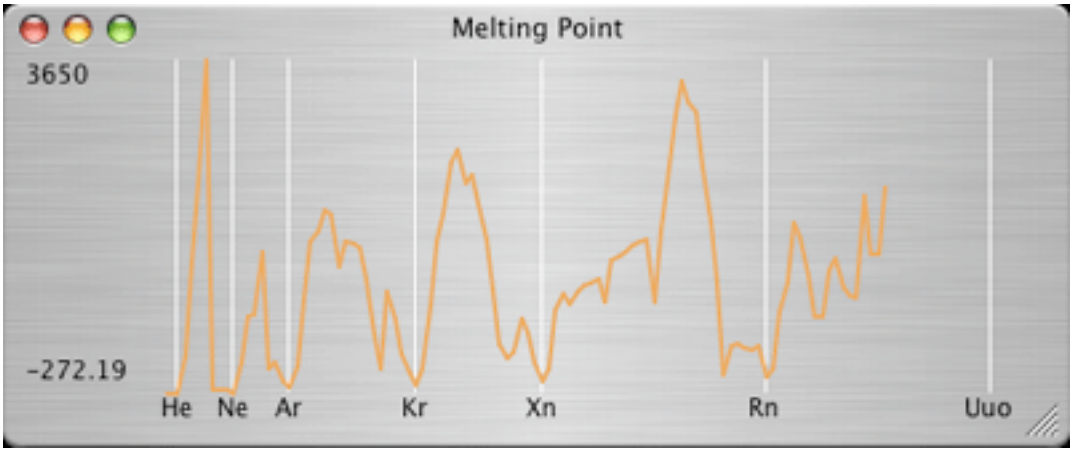
you. For example, entering H2O will compute the molecular weight of water. The text is case sensitive, so table salt must be entered as NaCl not NACL or nacl.

You can enter parenthesis in your formula, such as (H2O2)2

You can also enter in a hydrated compound using the • symbol (option 8 on your keyboard). An example: CuSO4•5H2O

Graphing Properties

Under the **File** menu is an option to graph the current view. Selecting this opens a window which shows a plot of the selected property against atomic number. The following picture shows a plot of the covalent radius:



Values of adjacent elements with known values are connected with a line. If an element is surrounded by two other elements with unknown values, it's value appears as an isolated dot.

X-Ray Energies Graph Window

By selecting **X-Ray Energies** from the **File** menu, you can get a graph showing the various fluorescence and edge energies for the elements. The range of

the horizontal (energy) axis can be changed, allowing you to zoom in on particular energy ranges. Positioning the cursor over a line shows the element, and the edge or fluorescence energy and type. Popup menus allow only specific transitions or edges to be displayed, removing unecessary clutter.

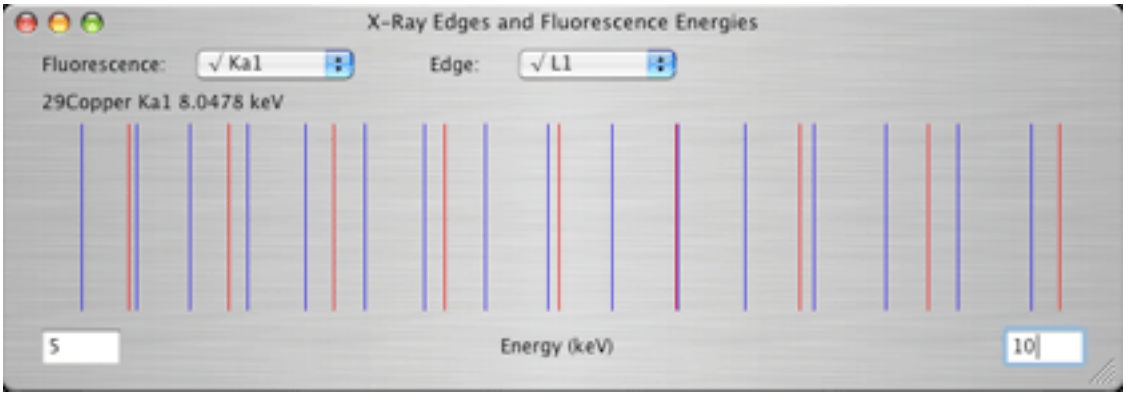


Table Of Nuclides

By selecting **Nuclides Table** from the **File** menu, you'll be presented with a large window showing all of the nuclides (isotopes) available. Clicking on one of them will bring up the window containing detailed information, such as nuclear spin, decay energies, etc. Here's a small portion of the table, the full table of course is huge, since The Atomic Mac has information regarding about 1600 nuclides!

Color Code for Nuclides Table:

Stable	- Gray
Beta Decay	- Green
Alpha Decay	- Blue
Positron Decay	- Red
Electron Capture	- Orange
Double Alpha Decay	- Purple
Isometric	- Tan
Spontaneous Fission	- Yellow
Neutron Emission	- Aqua
Proton Emission	- Brown

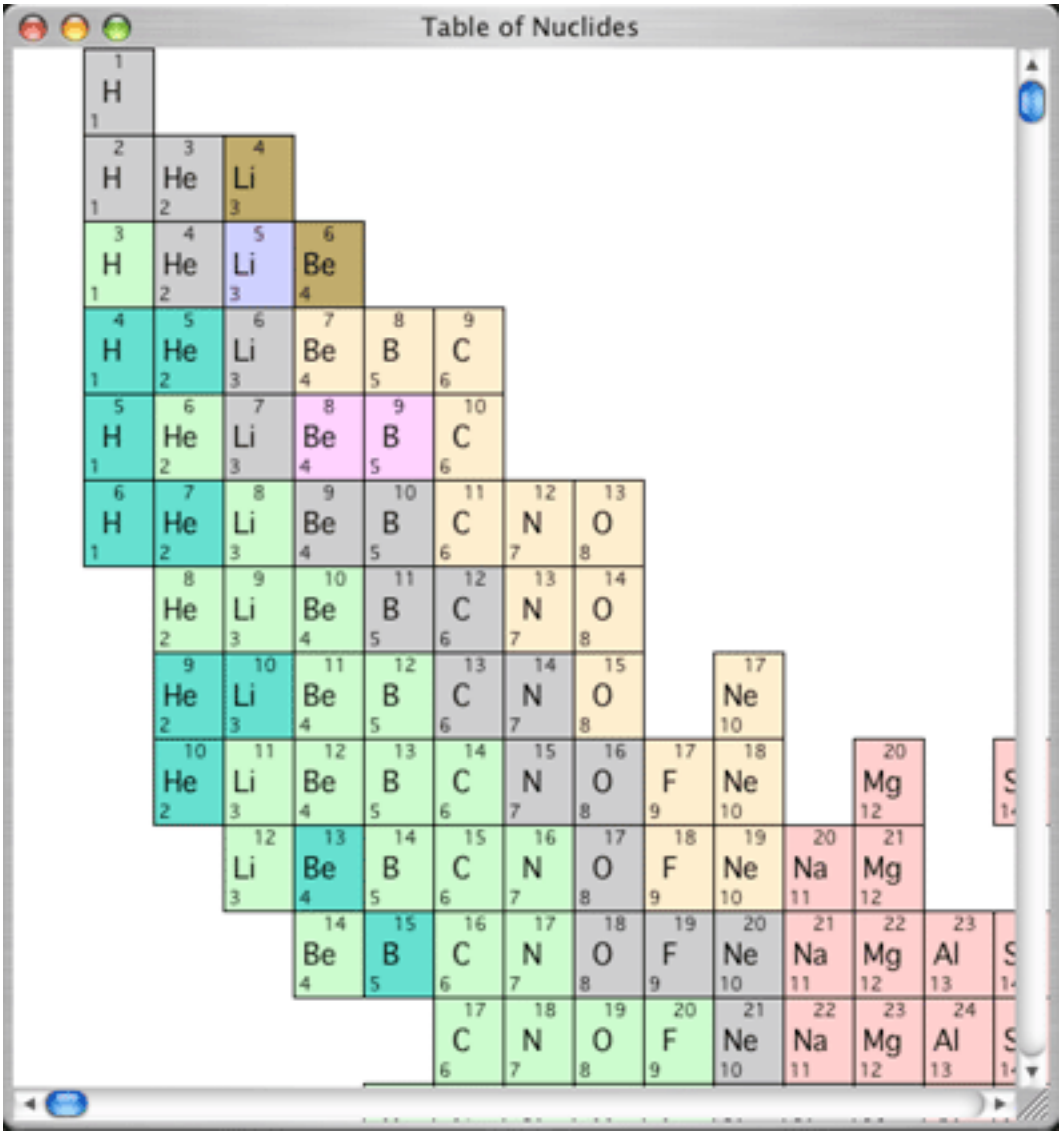
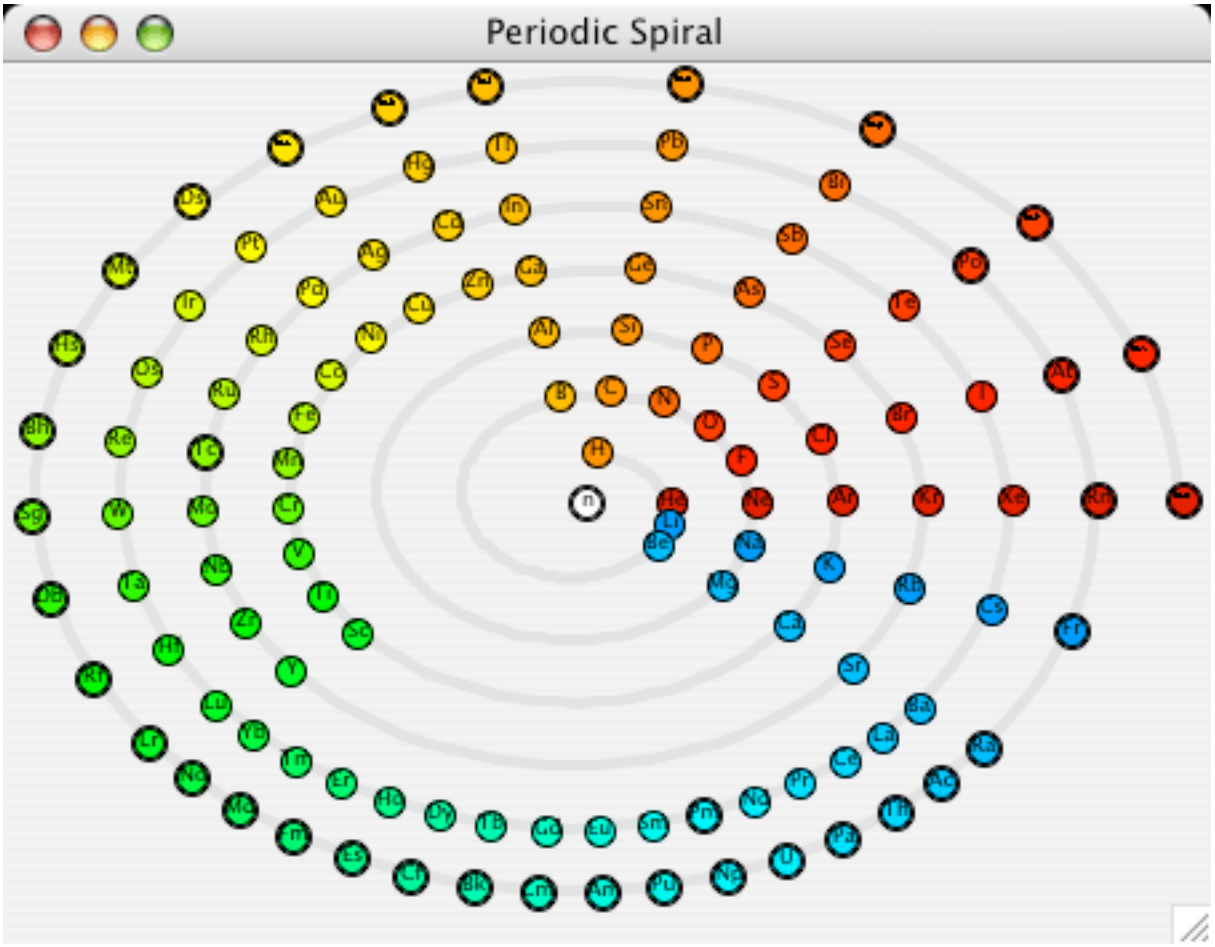


Table of Nuclides

Periodic Spiral

By selecting **Periodic Spiral** from the **File** menu, you'll be presented with a large window showing an alternate presentation for the periodic table of elements.



In this presentation, the neutron is in the center, and the elements spiral outwards. Each radial line from the center is similar to a group or column in the standard table. One advantage over the traditional table is that there are no “edges” on each line or period, the elements continuously flow one after the other, much as they do in nature.

Decay Tree Window

By clicking the **Decay Tree** button in an isotope window, you will display a window that shows the decay path until a stable nuclide is reached. This is only useful for radioactive nuclides, of course.

Getting the latest copy of The Atomic Mac

You can always get the latest copy of The Atomic Mac from our web site, the URL is:
http://www.blackcatsystems.com/software/atomic.html

You can launch your web browser and automatically go to this page by selecting **Go To The Atomic Mac Website** from under the **Apple Menu.**

If you have suggestions for improving The Atomic Mac, please let us know!

You can send us email at info@blackcatsystems.com

Please take a look at the next chapter to learn how to buy your copy of The Atomic Mac.

Puchasing the Atomic Mac

The Atomic Mac is distributed as shareware. The price is only 24.99, allowing the use on a single computer. If you wish to run The Atomic Mac on multiple computers, you must obtain a license for each system, or the appropriate site license.

Site licenses are also available, allowing copies to be run on multiple computers at a single location (for example, a school or university, or office). Please contact Black Cat Systems for pricing and details about site licensing.

By buying your copy of The Atomic Mac, you'll help support our efforts to develop new versions with additional information. When you register, you'll be entitled to use all new releases and updates to The Atomic Mac released over the next year, free of charge.

When you buy and receive your registration code, select **Enter Registration...** from the **Edit** menu, and enter the code. If you register and don't get your registration code within a week, please send us an email at info@blackcatsystems.com.

Thanks again for giving The Atomic Mac a try.

Black Cat Systems
4708 Trail Court
Westminster, MD 21158

email: info@blackcatsystems.com
Web: http://www.blackcatsystems.com/software/atomic.html

Buying by Check or Money Order Form

To order by check, please fill out and mail the following form, along with your payment. You can pay with a wide variety of cash from different countries but at present if you pay via check, it must be a check or money order drawn in US Dollars. While there is the risk of loss in the mail, currency is also OK, including foreign currency.

Please make sure you include your email address with your payment. That way we can send the registration code to you. If you do not send us a valid email address, we have no way to send you the code.

--------- The Atomic Mac/PC/Penguin CHECK / MONEY-ORDER ORDER FORM ---------

I would like to register _____ copies of The Atomic Mac @ $24.99 each
I would like to register _____ Atomic Mac/iUnit Combos @ $34.99 each
I would like to register _____ copies of The Atomic PC @ $24.99 each
I would like to register _____ Atomic PC/iUnit Combos @ $34.99 each
I would like to register _____ copies of The Atomic Penguin @ $24.99 each
I would like to register _____ Atomic Penguin/iUnit Combos @ $34.99 each

I would like to register _____ site licenses for The Atomic Mac @ $250
I would like to register _____ site licenses for The Atomic PC @ $250
I would like to register _____ site licenses for The Atomic Penguin @ $250

If you would like a CD-ROM, please add $10.00 to your order and check here:_____

I would like to renew my registration for $15. My previous registration code is: _____ (Your registration code can be found in the registration email that was sent to you originally. The number must be included to be eligible for the discounted renewal price.)

Maryland residents please add 5% sales tax.

TOTAL AMOUNT ENCLOSED: _____ in US funds.

Please send my registration code to:

Name: _____

Address: _____

City: _____ State: _____

Zip or Postal Code: _____ Country: _____

Email address: _____
Including your CORRECT email address is VERY important as this is how we will contact you with your registration code.

Make checks and money orders out to: Black Cat Systems

Mail This Form To:

Black Cat Systems
4708 Trail Court
Westminster, MD 21158
USA

Buying Online

To purchase online with a credit card, go to the following URL:
http://www.blackcatsystems.com/register/atomic.html

You will be sent to our order page at Kagi. Kagi handles our credit card payment processing.

Please make sure you include your email address when you buy online. That way we can send the registration code to you. If you do not send us a valid email address, we have no way to send you the code.

Revision History

6.5.0:
Added Brinell, Mohs, and Vickers hardness data.
Corrected Abundance in Universe view.
Corrected Fahrenheit temperature in state view.

6.4.0:
Added Bulk, Shear and Young's Modulus, as well as Poisson Ratio data.
Elements with only only radioactive isotopes are indicated as such in the main window.

6.3.1:
Fixed a bug with the Decay Tree Window.

6.3.0:
Added Decay Tree Window.

6.2.0:
Added the Periodic Spiral display.
User interface improvements.

6.1.0:
Can now view and graph first, second, and third ionization potentials.
Added crystal and ionic radii information for ions.
Fixed photon calculation problem if energy = 1 keV.
Fixed a bug with the molecular weight calculator.

6.0.1:
A few minor bug fixes

6.0.0:
Release

6.0.0b2:
Can now print the main window and graphing windows.

6.0.0b1:
First beta release of version 6. Complete re-write of the program.

5.9.6:
Added text list window of all elements.
Added additional isotopes for elements Hydrogen through Neon.
The state temperature can be changed using the keyboard.

5.9.5:
Added graph of fluorescence and edge energies.
Added additional data for x-ray fluorescence and edge energies for the elements 93 to 100.
Added display of version number in main window title.
Added menu option to check for latest version.

5.9.0:
Added additional ionization potential information

5.8.0:
Added photon data button in X-Ray element view to bring up interactive window to compute/display attenuation data.

5.7.0:
Added revised nuclear data

5.6.0:
Added gamma energies

5.5.1:
Fixed a bug with printing under OSX 10.2.

5.5.0:
Updated atomic mass values to latest IUPAC values.

5.4.0:
Can now zoom the main table window down to a small window.

5.3.0:
Added isotope data for abundance in universe and human body.
Added ability to copy most windows to the clipboard for other use.
Enhancements to the decay window.
Some graphs are now log based for better display.
Added/refined data for some nuclides.

5.2.1:
Misc Bug fixes.

5.2.0:
Added display of period, group, block, CAS Registry ID.

5.1.0:
Added window menu, showing list of available windows

5.0.2:
Error in U235 half life
Background of temperature slider not correct color.

5.0.1:
Fixed a bug that prevented the program from running under MacOS 8.1.

5.0.0:
Added pop-up names of elements and view value.
Added atmospheric abundance
Final release!

5.0.0 b2:
Third Carbon Release
Basically the full complement of features

5.0.0 b1:
Second Carbon Release
Added additional features from the 4.x versions.

5.0.0 b0:
Initial Carbon Release
Not all features implemented

4.6.1:
Fixed a bug where the name of the element would sometimes overwrite other information.

4.6.0:
Window locations (and in some cases size as well) are stored

Element name appears in main window when the cursor is over that element.

4.5.0:
Added Nuclides Table.

4.3.0:
Added data for atomic mass, mass excess, binding energy, and alpha and beta decay energies for most nuclides.

4.2.1:
Fixed a bug which could cause the element data window to not appear.

4.2.0:
Added NMR, magnetic moment, electric quadrupole moments.
Added display of additional information to Isotope information.
Added listing of possible parent nuclides.

4.1.0:
Added spectra information.

4.0.0:
Added table and graph of photon interaction data.
Added number of isotopes, stable, natural to graphing.

3.8.0:
Added views for abundance in the Earth's crust and sea, and solar system.
Added display of values in view mode.
Added data for several elements.

3.7.3:
Corrected density for sodium.
Added information for several elements.

3.7.2:
Fixed a bug that displayed a garbled registered user name.

3.7.1:
Compatability modifications.

3.7.0:

Added graphing display.

3.6.1:
More improvements to the decay window.

3.6.0:
Improvements to the decay window.

3.5.8:
The main table now prints in color.

3.5.7:
Added beta particle energies for some isotopes.
Changed Lawrencium symbol to Lr.
Fixed a bug which could cause a crash on some systems when an element window was closed.

3.5.6:
Added beta particle energies for some isotopes.
Fixed some small bugs.

3.5.5:
Added alpha particle energies for some isotopes.

3.5.1:
Fixed a bug which did not allow selecting the last isotope when following a decay series.
Fixed a bug which could cause a crash if the element information window was closed, and you attempted to increment or decrement to another element.
Added some information for a few of the super-heavy elements.

3.5.0:
Added Covalent Radius, Electronegativity, and Crystal Structure views and data.
Added interesting facts about each element.
Color-coded each series.
Lots of improvements to the display windows.

3.1.2:
Left and right arrow keys change the temperature by 1 degree K when

displaying the states of matter.
Fixed a bug which caused an erroneous half life to be displayed for stable isotopes.

3.1.1:
Modified Molecular Calculator to allow use of parenthesis and • symbol.

3.1.0:
Added display of state (gas, liquid, solid), and temperature control.
Added ability to shrink window to small size.

3.0.0:
Added several more catagories of data
Added Molecular Weight calculator
Major changes to user interface

2.3.1:
Display and Human-Interface tweaks.

2.3.0:
Lots of GUI work.
Ability to enter registration code directly into the program.
Added several metastable isotopes.

2.2.0:
Added X-Ray information (fluorescence and binding energies).
License files now used to register the program.

2.1.0:
Updated data for several elements.

2.0.0:
Updated to FAT, native on both 68K and PPC systems.

1.4.3:
Isotope display now always reverts to the first page when you change elements.
(The version displayed in the program is 1.4.2, but check the Finder Info, it really is 1.4.3)

1.4.2:
Clicking on an element in the decay tree will jump to that element.

1.4.1:
Re-compiled for 68020 machines, some speed improvement
Changed About... window, it looks a little nicer now, and doesn't beep at you.

1.4.0:
Misc cleanup

1.3.1:
Added several additional isotopes.
Added Decay Tree window.

1.3.0:
Fixed bug which could cause crash upon launch on some systems.

1.2.2:
First Release.

Software License Agreement

This is a legal agreement between you and Black Cat Systems. covering your use of the Atomic Mac , Atomic PC, and Atomic Penguin (the "Software"). Be sure to read the following agreement before using the Software. BY USING THE SOFTWARE (REGARDLESS IF YOU HAVE REGISTERED THE SOFTWARE OR NOT), YOU ARE AGREEING TO BE BOUND BY THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, DO NOT USE THE SOFTWARE AND DESTROY ALL COPIES IN YOUR POSSESSION.

The Software is owned by Black Cat Systems and is protected by United States copyright laws and international treaty provisions. Therefore, you must treat the Software like any other copyrighted material (e.g., a book or musical recording). Paying the license fee allows you the right to use one copy of the Software on a single computer. You may not network the Software or otherwise use it or make it available for use on more than one computer at the same time. You may not rent or lease the Software, nor may you modify, adapt, translate, reverse engineer, decompile, or disassemble the Software. If you violate any part of this agreement, your right to use this Software terminates automatically and you must then destroy all copies of the Software in your possession.

The Software and its related documentation are provided "AS IS" and without warranty of any kind and Black Cat Systems expressly disclaims all other warranties, expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Under no circumstances shall Black Cat Systems be liable for any incidental, special, or consequential damages that result from the use or inablility to use the Software or related documentation, even if Black Cat Systems has been advised of the possibility of such damages. In no event shall Black Cat Systems's liability exceed the license fee paid, if any.

This Agreement shall be governed by the laws of the State of Maryland. If for any reason a court of competent jurisdiction finds any provision of the Agreement, or portion thereof, to be unenforceable, that provision of the Agreement shall be enforced to the maximum extent permissible so as to effect the intent of the parties, and the remainder of this Agreement shall continue in full force and effect.

The Software and documentation is provided with RESTRICTED RIGHTS. Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subdivision (b)(3)(ii) of the Rights in Technical Data and Computer Software clause as 252.227-7013. Manufacturer is Black Cat Systems., 4708 Trail Court, Westminster, MD 21158, United States of America.

The name "Black Cat Systems", "The Atomic Mac", "The Atomic PC" and "The Atomic Penguin" are trademarks of Black Cat Systems.