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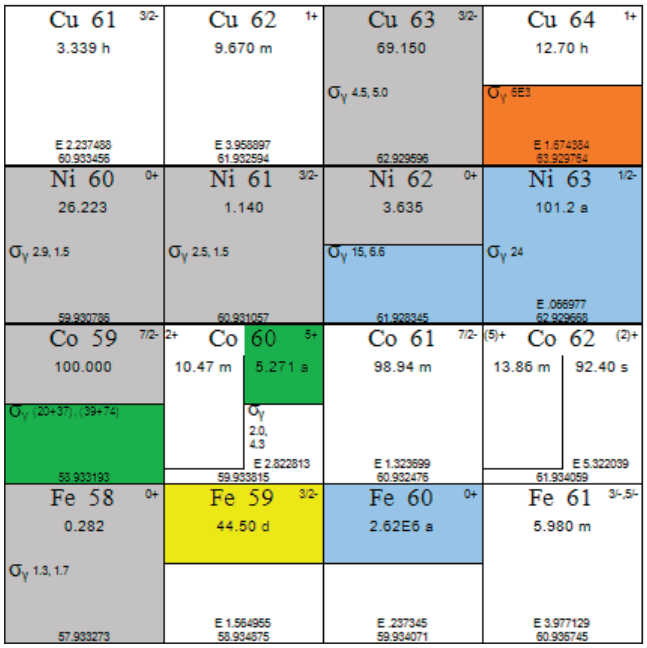
# NuclideNavigator-Pro V5.0

## Interactive Chart of the Nuclides and Reference Software

# NuclideNavigator-Pro V5.0

NuclideNavigator-Pro is an invaluable resource for nuclear decay and emissions data. It is compatible with Windows 10/11 in English, French, Spanish, German, and Simplified Chinese languages with the following key features:

- Master data libraries composed of data from reputable sources.
- Chart of the Nuclides with detailed nuclide and elemental emissions data with informative layout and color-coded views, and powerful search capabilities.
- Library Manager to build gamma spectroscopy libraries for use in ORTEC's Gamma Spectroscopy applications, such as GammaVision.
- Synthetic spectra for individual nuclides (alpha, beta, and gamma) and decay chain emissions (gamma only) which can be saved to ORTEC software compatible file formats.
- Extensive Nuclide Decay Scheme documentation.
- Periodic Table of the Elements with elemental properties.




## *New Features in Version 5*

***New!*** Windows 11 Compatiblity.

***New!*** Multi-Language Support including French, German, Spanish, and Simplified Chinese.

***New!*** Nuclear Data Libraries updated to include Nudat 3.0 from the National Nuclear Data Center at Brookhaven National Lab.

***New!*** Configurable Detectors for Synthetic Spectrum Generation including Energy, Peak Shape, and Efficiency calibration data imported from GammaVision spectrum files.

***New!*** Export Synthetic Spectra to standard ORTEC Spectrum File formats for evaluation in applications such as GammaVision.

***New!*** Save Target Libraries to SQLite database format in addition to GammaVision Libraries and XML files.

***New!*** Ingrowth calculations for Single Nuclides in additional to the standard Decay model.

***New!*** Selectable Metastable Daughters are available when using the Parent-Daughter decay mode.

***New!*** Metaloid color coding applied to the Periodic Table of the Elements.

***New!*** Updated interface for the Units Converter with the addition of several new conversion types.

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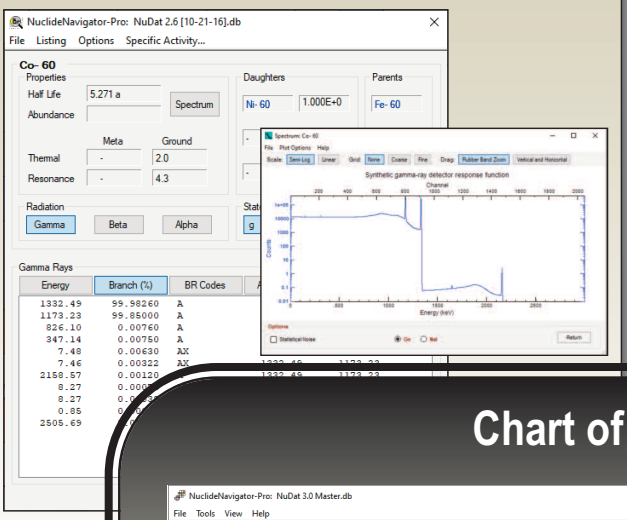
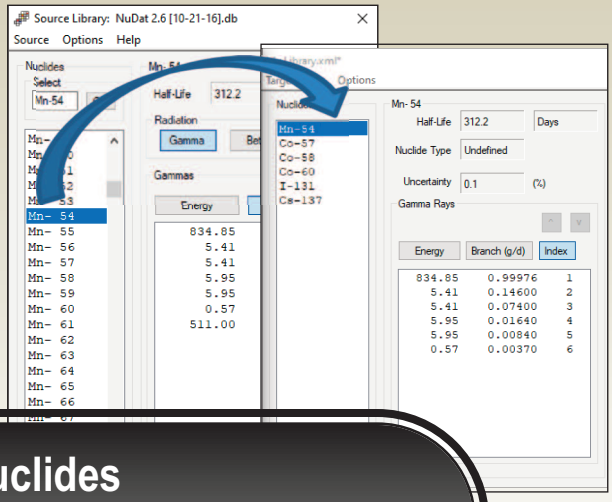
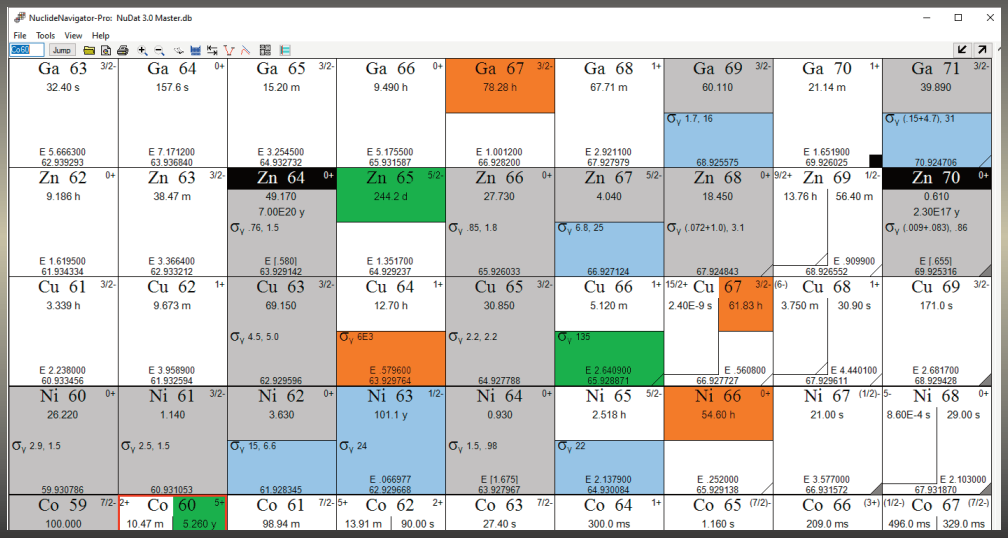
## Nuclide and Elemental Energy Emissions

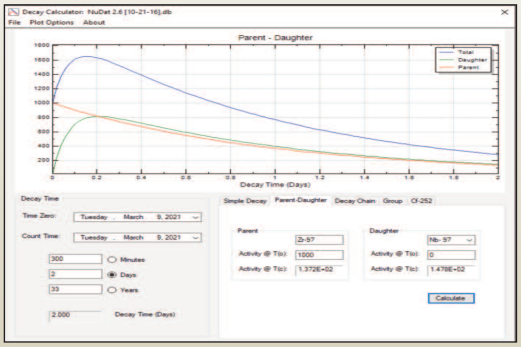



## Library Manager

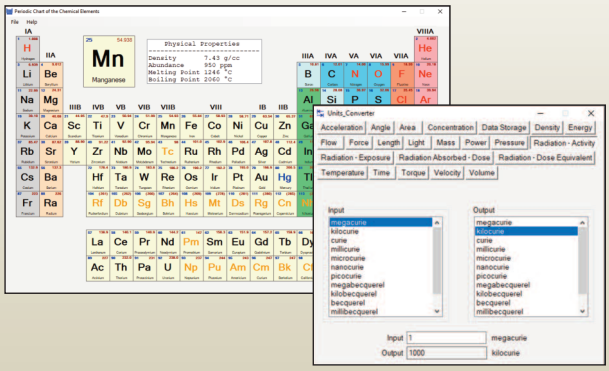



## Chart of the Nuclides




## Radioactivity Decay Calculator




## Periodic Table and Unit Converter

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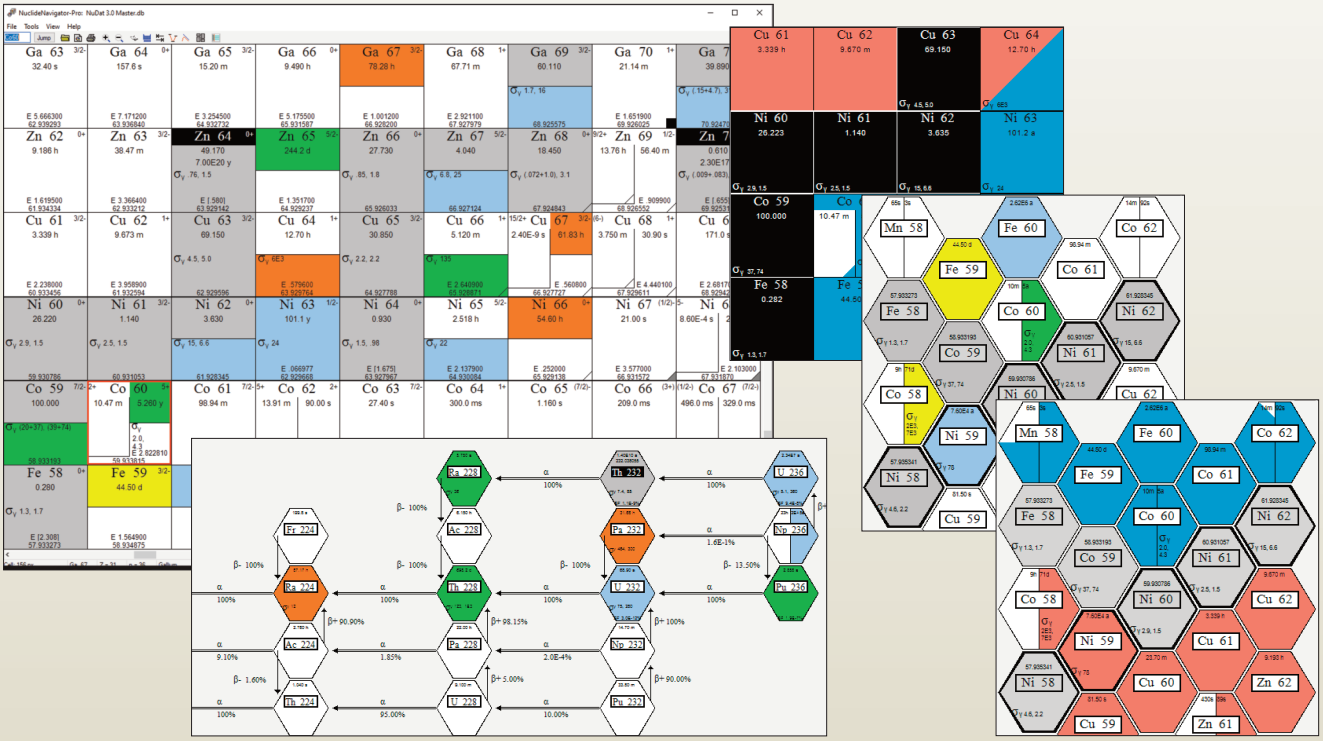
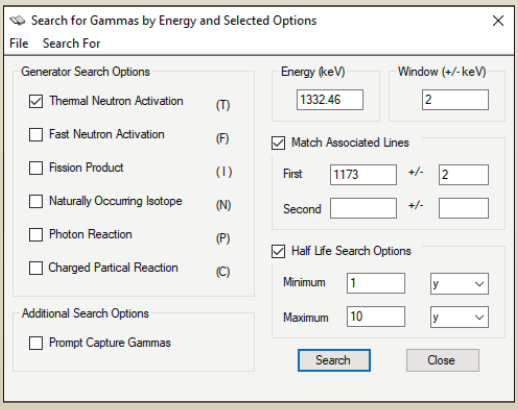
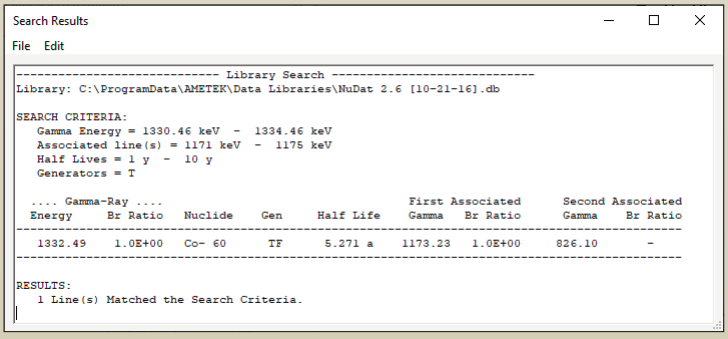
## Chart of the Nuclides

The main interface for NuclideNavigator-Pro is the Chart of the Nuclides which can be displayed in a variety of informative views including General Electric, Karlsruhe, and Trilinear formats. The General Electric and Karlsruhe formats use a common layout with a nuclide grid defined by the number of protons on the vertical axis and neutrons on the horizontal axis such that isotopes of a common element are displayed in rows. However, they use different color schemes with the General Electric view representing nuclide half-life and neutron cross section and the Karlsruhe representing nuclide decay modes. The Trilinear format, which is available in both color schemes, aligns isotopes on a diagonal. When “walking down” decay chains this layout uses vertical navigation for beta decay and horizontal movement for alpha decay instead of the diagonal movement associated with the traditional grid layout. The chart can also be limited to the natural series (Thorium, Neptunium, Uranium, and Actinium) to simplify evaluation of these decay chains.






Finding the source of gamma and alpha emissions is simple with the intuitive query tool. It not only allows setting an energy range for potential nuclide matches, but also allows filtering by nuclide generation mode, half-life, and secondary emissions. This additional information can greatly improve the quality of the search results and help the spectroscopist evaluate analysis results and optimize libraries.

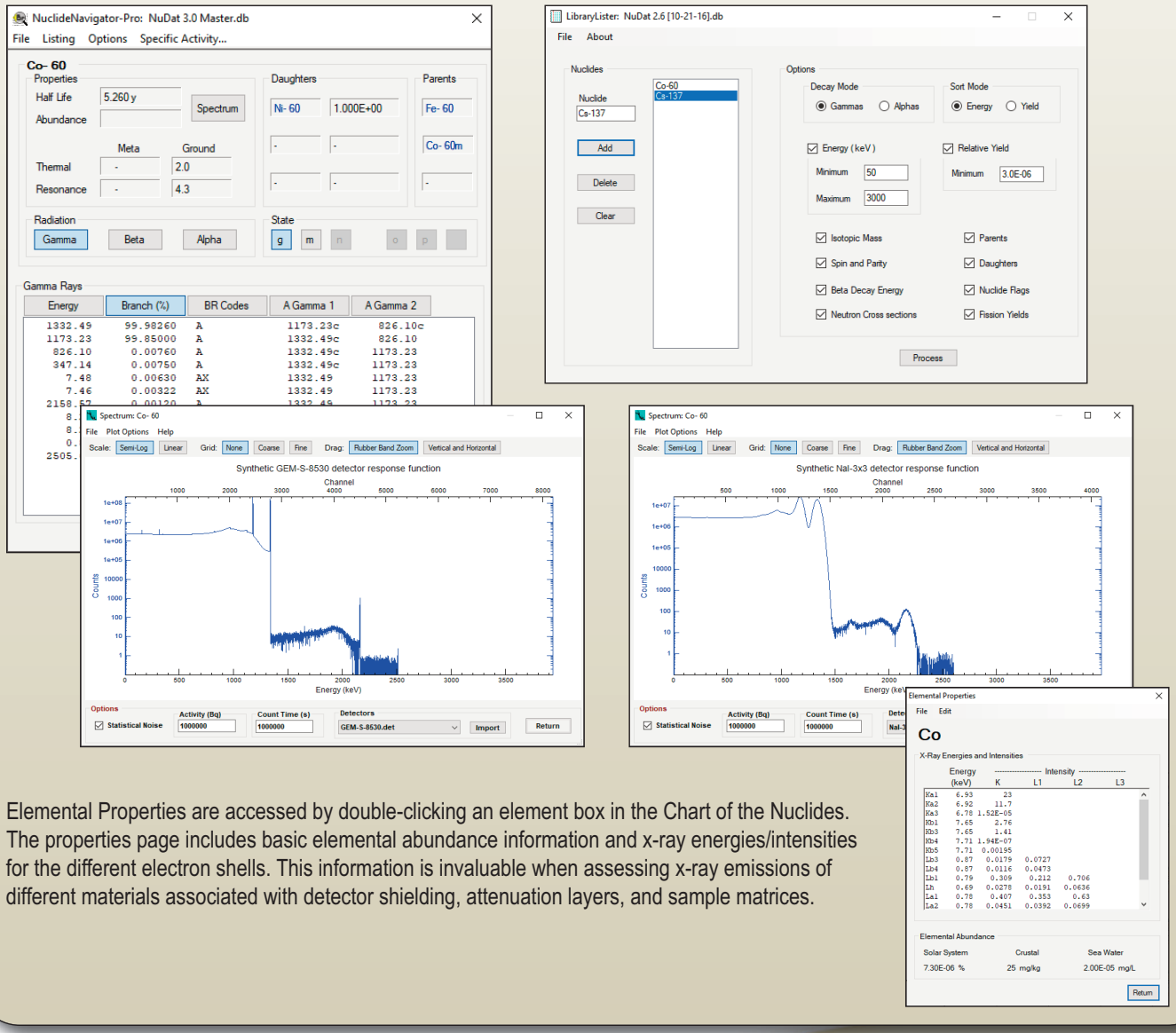


## Nuclide and Element Emission Data

Nuclide Properties are accessed by double-clicking a nuclide in the Chart of the Nuclides or a peak energy in the Peak Search results. The properties page includes basic nuclide information, such as half-life, energy emissions for the ground and metastable states, parent nuclides, and daughter nuclides with their generation probabilities. Clicking on the parent and daughter nuclides will navigate up or down the decay chain as applicable.

Energy emission type can be switched between gamma, beta, and alpha emissions and sorted by energy or branching ratio. A synthetic spectrum for the associated radiation type is also available with gamma spectra configurable for specific detector characteristics including energy range, peak width, and energy dependent efficiency. These synthetic spectra give the spectroscopist a good idea of what to expect with different types of instrumentation and can be used as a teaching aid in lieu of actual measurements. They can also be saved to standard ORTEC spectrum formats for evaluation in applications such as GammaVision, and the spectrum image and supporting data may be used in other software applications including spreadsheets and presentations.

Comprehensive reports of nuclide and emissions data can be generated for a subset of nuclides from the master libraries using the Library Lister. The content of the report is controlled through selectable parameter options including the decay mode, energy range, parent/daughter nuclides, and several other useful parameters.




Elemental Properties are accessed by double-clicking an element box in the Chart of the Nuclides. The properties page includes basic elemental abundance information and x-ray energies/intensities for the different electron shells. This information is invaluable when assessing x-ray emissions of different materials associated with detector shielding, attenuation layers, and sample matrices.

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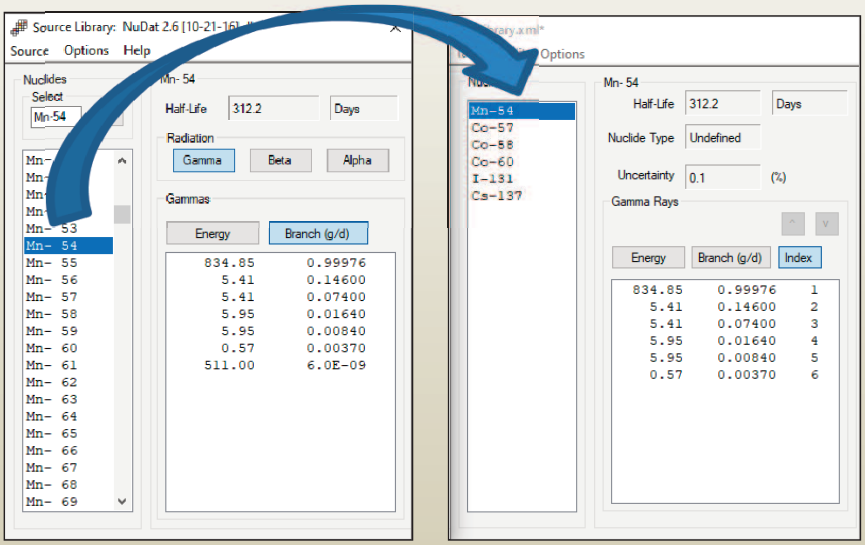
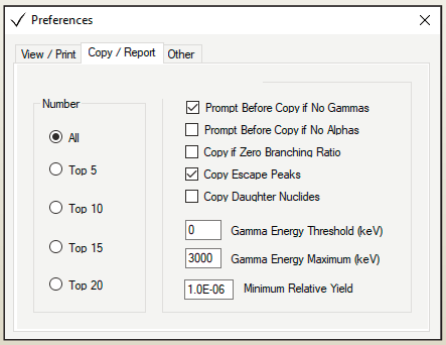
## Library Manager

The Library Manager greatly simplifies the generation of application specific libraries. Simply load a master library and drag the desired nuclides to the Target library list. Preferences can also be set to restrict which nuclides and peaks are copied to the Target, and the content can be manually adjusted as necessary for the intended library use. Target libraries can be saved to the SQLite database format, the standard ORTEC library format for use in applications such as GammaVision, an XML format that is readable in any text editor and can be processed by custom applications.

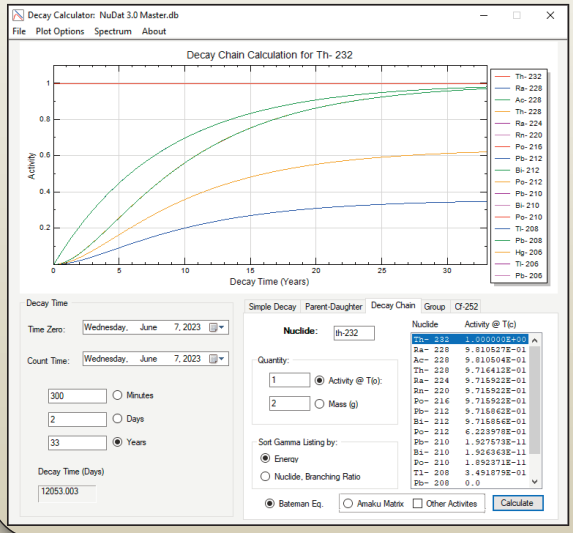


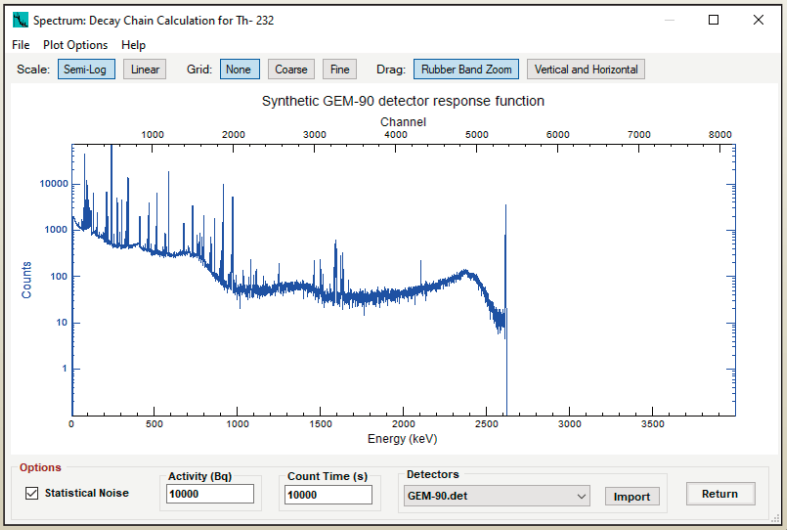




## Decay Calculator

NuclideNavigator-Pro's Decay Calculator makes it easy to perform and visualize complex decay calculations. It includes calculations for simple decay or ingrowth of a single nuclide, parent-daughter decay, full decay chains, user-defined nuclide groups, and Cf-252 with neutron count rate calculations. The calculation results for each nuclide and total activity are displayed graphically in addition to being available in comprehensive reports.

A synthetic spectrum of gamma emissions similar to those available for individual nuclides is also available when assessing full Decay Chains. This spectrum view can be useful for relatively simple parent-daughter relationships as well as the complex natural decay chains that include numerous nuclides.



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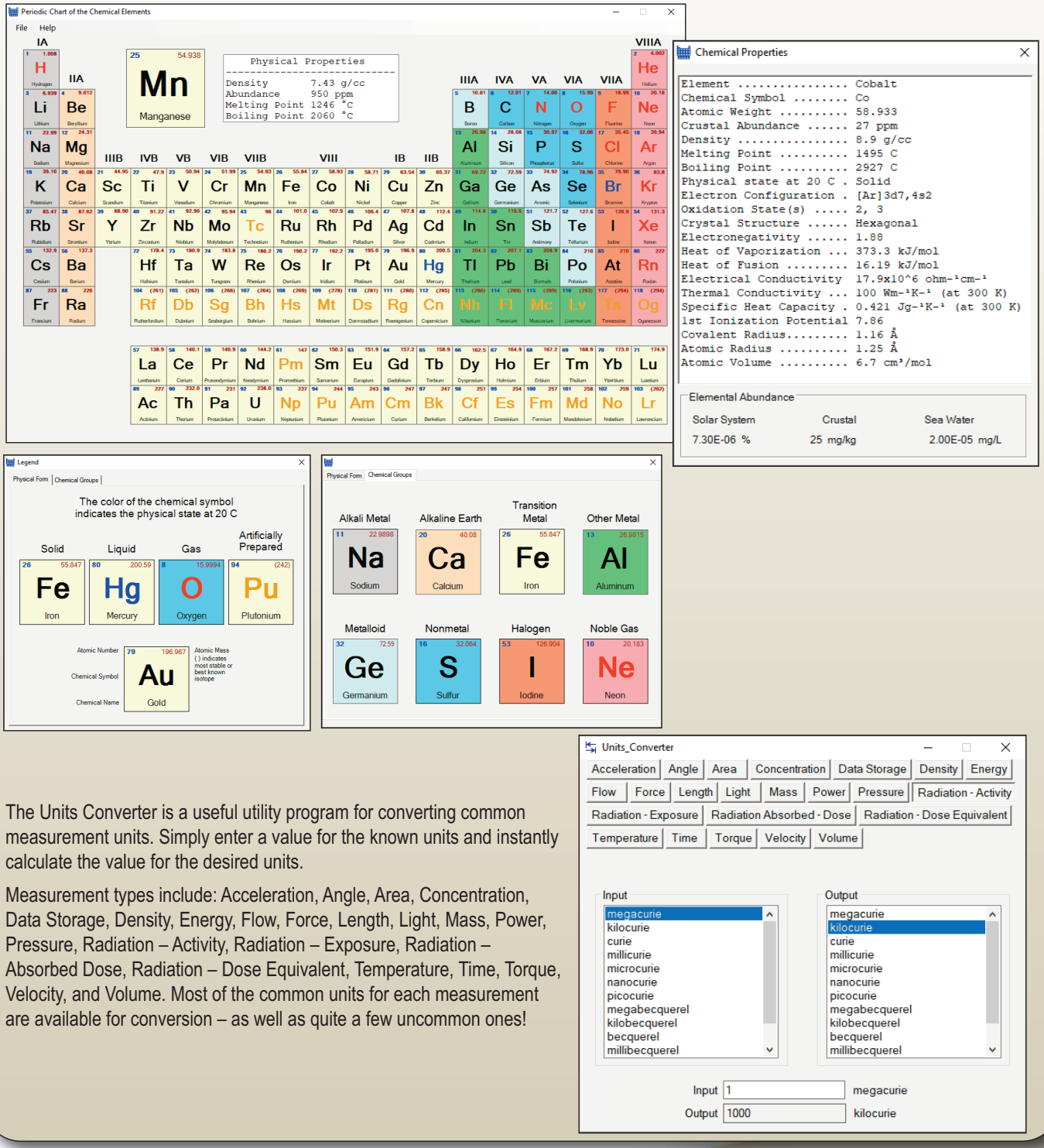
## Periodic Chart of the Elements and Units Converter

The Periodic Chart of the Elements is a rich, interactive resource for element properties. The main interface is the classic Periodic Table with informative color coding associated with chemical groups and the physical form of the element at room temperature. Basic physical properties are displayed as the mouse is moved over the elements and more detailed chemical properties are accessed by double-clicking the element. A short history for each element is available by right-clicking the element.




The Units Converter is a useful utility program for converting common measurement units. Simply enter a value for the known units and instantly calculate the value for the desired units.

Measurement types include: Acceleration, Angle, Area, Concentration, Data Storage, Density, Energy, Flow, Force, Length, Light, Mass, Power, Pressure, Radiation – Activity, Radiation – Exposure, Radiation – Absorbed Dose, Radiation – Dose Equivalent, Temperature, Time, Torque, Velocity, and Volume. Most of the common units for each measurement are available for conversion – as well as quite a few uncommon ones!

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## Ordering Information

| Model | Description |
|---|---|
| **C53-BW** | Nuclide Navigator Pro Single Computer License |
| **C53-UW** | Nuclide Navigator Pro update from C53-B32 or C53-BW |
| **C53-CDW** | Nuclide Navigator Pro 5-User License. Requires purchase of C53-BW. |

## References


### Master Nuclear Data Libraries

NuDat 3.0: National Nuclear Data Center, information extracted from the NuDat 3 database, http://www.nndc.bnl.gov/, and supplemented with Fission yields and Neutron cross sections referenced below.

NuDat 2.6 [10-21-16]: National Nuclear Data Center, information extracted from the NuDat 2 database, http://www.nndc.bnl.gov/, and supplemented with Fission yields and Neutron cross sections referenced below.

TORI-99c5x: Table of Radioactive Isotopes, The Isotopes Project at LBNL, http://ie.lbl.gov/toi/ supplemented with Cascade coincidence data derived from ENSDF, Positron annihilation data from PC_NuDat-04, and Fission yields and Neutron cross sections referenced below.

PC_NuDat-04: National Nuclear Data Center, http://www.nndc.bnl.gov/.

Erdtmann_Soyka: The Gamma Rays of the Radionuclides, G. Erdtmann and W Soyka, Verlag Chemie, Weinheim, 1979.

NNDC-Prompt: National Nuclear Data Center, Brookhaven National Laboratory, 2004.

RSICC-Prompt: THERMGAM, DLC-140, 1981, RSICC, Oak Ridge National Laboratory, https://rsicc.ornl.gov.

CapGam-2013: National Nuclear Data Center, information extracted from the CapGam data, http://www.nndc.bnl.gov/capgam.

### Decay Schemes

The Isotopes Project at LBNL, http://ie.lbl.gov.

### Fission Yields

T. R. England and B. F. Rider, LA-UR-94-3106, ENDF-349.

### Neutron Cross Section Data

S. F. Mughabghab, M. Divadeenam and N. E. Holden, Neutron Cross Sections from Neutron Resonance Parameters and Thermal Cross Sections, Academic Press (1981).

### Example Spectra Methodology

Synthetic emission spectra for gamma rays and alpha particles are generated using algorithms developed by the author for typical HPGe and NaI sensors. A significant amount of credit is due to the published works of, and private communications with Ray Gunnink.

Beta particle shapes are generated using the equations associated with the standard (Fermi) theory of beta decay. Coulomb corrections for positrons are non-relativistic point-charge approximations. Corrections for electrons are calculated using the equations from G. K. Schenter and P. Vogel, Nuclear Science 1983, Volume 83, page 393-396.

### Decay Calculation Methodology

H. Bateman, The solution of a system of differential equations occurring in the theory of radioactive transformations, Proc. Cambridge Phil. Soc., v.15 (1910) 423-427.

M. Amaku, P.R. Pascholati, V. R. Vanin, Decay chain differential equations: Solution through matrix algebra, Computer Physics Communications 181 (2010) 21-23.

### Elemental Data

Based on the “History of the Origin of the Chemical Elements and Their Discoverers” generated by Norman E. Holden, National Nuclear Data Center, Brookhaven National Laboratory.





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