First lifetime measurement of 78Ni isotope gives a glimpse of the origin of precious metals in nature

Figure: Paul Hosmer, a graduate student at the NSCL prepares a detector for the experiment, which will be part of his PhD Thesis. (Picture B. Richards)

The half-life of the unstable, exotic nucleus ^{78}Ni was measured for the first time at the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University. Previous to this experiment, ^{78}Ni had only existed in two places: exploding stars, and Darmstadt Germany, where 3 were produced at the GSI laboratory but no properties could be determined. At the NSCL a JINA collaboration of scientists from the US and Germany was now able to produce eleven ^{78}Ni, enough to finally measure an important property: the half-life, or how long the nucleus exists. The half-life was found to be only 110 ms, or about a tenth of a second.

^{78}Ni is doubly magic, which means that it has a special number of both protons and neutrons that fill shells in the nucleus, very much like electrons fill shells in noble gas atoms. Based on the classical nuclear shells there are only 10 such nuclei in nature and ^{78}Ni is the one with the largest neutron excess. Magic nuclei are of particular interest to nuclear theorists, since their special properties greatly simplify calculations.

In some models, the decay of ^{78}Ni also is a key link in the chain of reactions called the rapid neutron capture process (r-process) that is thought to occur in exploding stars. This process is responsible for producing about half of all the heavy elements found today in nature, including among many others gold, silver, platinum, and uranium. Where this process takes place is still a mystery and one of the most important open questions in science. ^{78}Ni acts as kind of a valve in the process, partly due its “magic” property. The half-life of ^{78}Ni was found to be substantially shorter than expected, which means nature can produce heavy elements faster than previously thought.

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