Technetium Is Made in Stars

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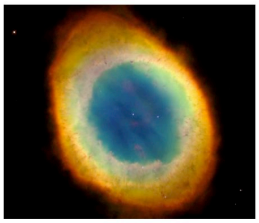
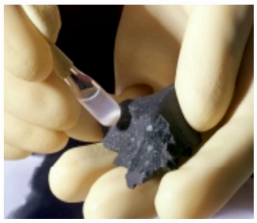
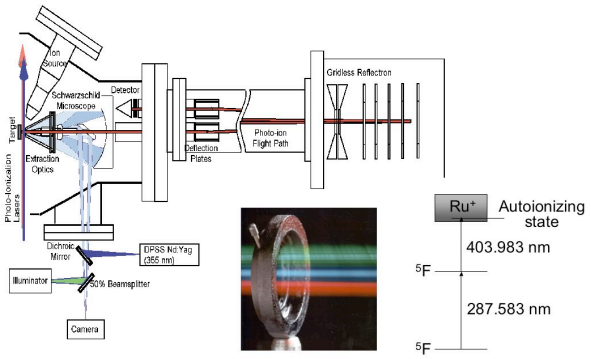


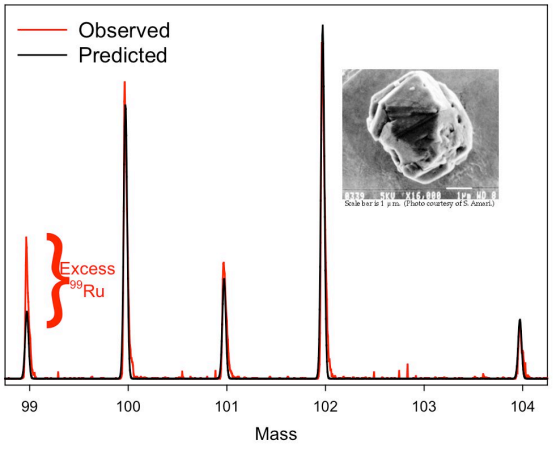
Late in their lives, Sun-like stars synthesize elements and expel them in gas and dust via strong stellar winds.



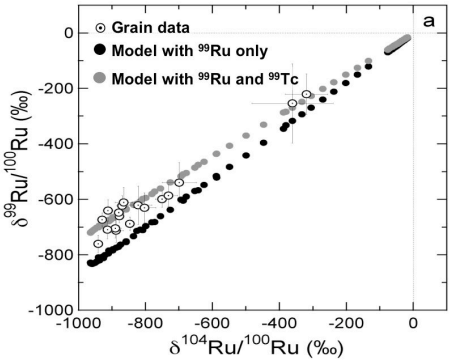
A few surviving stardust grains are isolated from primitive meteorites. The isotope distribution in each grain preserves a record of nucleosynthesis in the parent star.



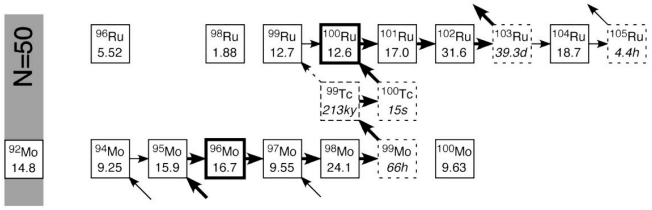
Resonant Ionization Mass Spectrometry (RIMS), is used to measure the isotope distributions of trace elements (such as Ru) in individual micron-size grains with extreme sensitivity and discrimination.



Ruthenium is present in parts-per-million quantities in micron-size silicon carbide grains, yet Ru isotope distributions can be measured by RIMS with enough accuracy to distinguish these grains from terrestrial material, and to determine the types of stars that created them.



Comparing the isotope distributions in many grains to models of stellar nucleosynthesis shows that these grains once contained Tc in appreciable quantities.



In intermediate-mass stars (~1.5 to 8 $M_\odot$), heavy elements are made by neutron capture. Theory predicts that all nuclei at mass 99 are made as ^{99}Tc, which later decays to ^{99}Ru. Our data and model show that much of the decay took place after the stardust grains formed.

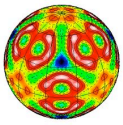
Conclusions:

- **This is the first detection of extinct Tc in extraterrestrial material.**
- **The star was of intermediate mass and was nucleosynthetically active at the time the stardust formed.**

Future Directions:

- **The ^{99}Tc/^{99}Ru ratio is a chronometer for events in the lifecycles of intermediate-mass stars.**
- **This method can be applied to grains from massive stars to constrain theories of nucleosynthesis in supernovae.**
- **This method will be used to measure isotopes in solar wind samples (NASA Genesis mission) and cometary dust grains (NASA Stardust mission).**

Extinct Technetium in Presolar Silicon Carbide Grains, M. R. Savina, A. M. Davis, C. E. Tripa, M. J. Pellin, R. Gallino, R. S. Lewis, and S. Amari, Science (submitted)



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