Researchers produce long-lived radioisotope that generates a needed isotope on demand

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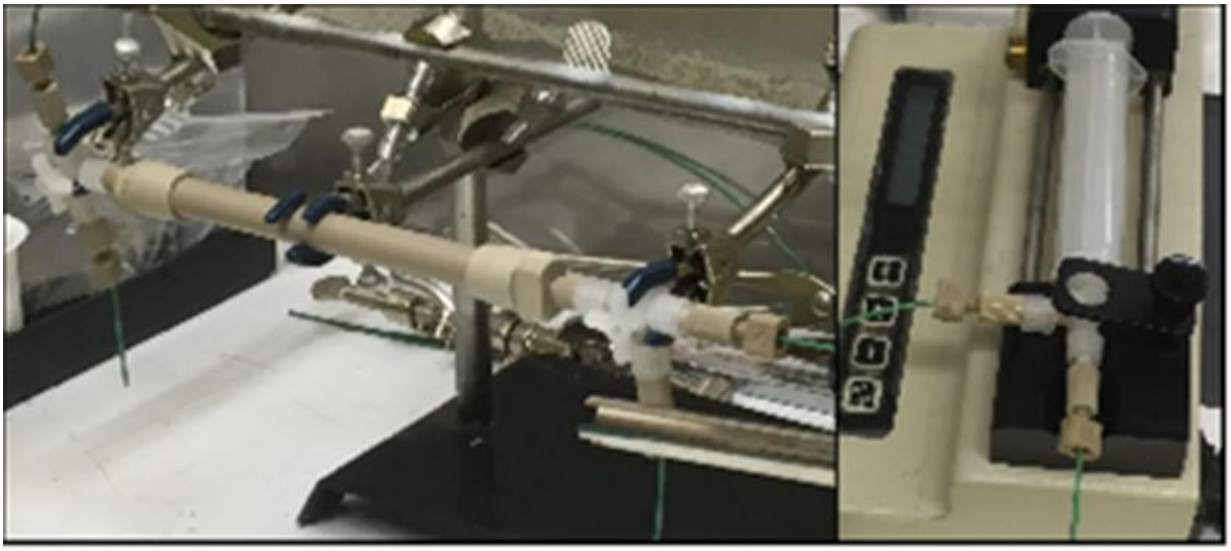

The titanium-44/scandium-44 (^{44}Ti/^{44}Sc) test generator system produces high-quality ^{44}Sc that is potentially suitable for use as an imaging agent in patients. Credit: US Department of Energy

Using high-intensity proton beams, researchers made significant quantities of titanium-44 (^{44}Ti), which is particularly useful to the astrophysics research community in their studies of supernovae. In pursuit of alternative uses for this isotope, the researchers also designed a system that fixes this isotope on a surface. There, it decays into the much shorter-lived scandium-44g (^{44}gSc). The scandium is vital to positron emission tomography (PET) scans of activities in the brain,

heart and elsewhere.

The challenge is in producing enough ^{44}Ti to satisfy the needs of the astrophysics and medical research communities such that keeping ^{44}gSc (half-life of ~4 hours) "in stock" at hospitals is not impacted by competing research usage of the "parent" ^{44}Ti material. In the team's new device, the ^{44}Ti becomes a "generator" of the ^{44}gSc. The scandium can be used in PET imaging to study metabolic processes in the body. Properly maintained, such a radionuclide generator could last for decades, providing an onsite supply of the needed isotope.

Positron emission tomography (PET) typically relies on relatively short-lived positron emitters, i.e., radioisotopes that decay with the emission of "antimatter" electrons and possess half-lives on the order of 10 to 110 minutes. Longer-lived positron emitters such as 44Sc in its energetic ground state (^{44}gSc) enable imaging of slower biological processes. Titanium-44 (half-life 60 years), which functions as a source for ^{44}gSc, is also of interest to astrophysicists who study the origin of matter in supernovae: the isotope is produced in silicon burning in the innermost regions of the material ejected in core-collapse supernovae in the same processes that produce iron and 56Ni. Reference samples of ^{44}Ti are thus used as standards for detector calibrations.

While hundreds of micrograms do not sound impressive to some, such masses can represent the world's stock of a precious isotope. Researchers from Los Alamos and Brookhaven National Laboratories have demonstrated a method to make quantities of ^{44}Ti that are sufficient to support important developmental research into the medical application of scandium. They also designed a technique to fix the radioactivity on a solid support so that it can continuously be washed with an appropriate solution to recover its daughter isotope ^{44}gSc for medical research. The long-lived parent yields ^{44}gSc on a daily "as needed" basis for PET imaging purposes directly available at hospitals and other facilities.

More information: V. Radchenko et al. Separation of ^{44}Ti from proton irradiated scandium by using solid-phase extraction chromatography and design of ^{44}Ti/^{44}Sc generator system, *Journal of Chromatography A* (2016). DOI: 10.1016/j.chroma.2016.11.047

Valery Radchenko et al. Proton-induced production and radiochemical isolation of 44 Ti from scandium metal targets for ^{44}Ti/^{44}Sc generator development, *Nuclear Medicine and Biology* (2017). DOI: 10.1016/j.nucmedbio.2017.03.006

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