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The quest for detection of ^{182}Hf in Earth's archives - new techniques in Accelerator Mass Spectrometry for the search of live nucleosynthesis signatures

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Accelerator mass spectrometry (AMS) is commonly the most sensitive technique for detection of long-lived isotopes and has allowed identification of ^{60}Fe and ^{244}Pu signals in terrestrial and lunar archives from recent nearby nucleosynthesis.
Belonging to the middle-mass region of r-process nuclides, ^{182}Hf ($T_{1/2}$=8.9 Ma) could potentially be produced in different scenarios to those for ^{244}Pu. However, AMS detection of astrophysical ^{182}Hf has failed up to now due to the strong interference from its ubiquitous stable isobar ^{182}W. Based on various yield- and elemental-ratio-calculations for possible ^{182}Hf production scenarios, the estimated ^{182}Hf/Hf signal intensity is at most a few times 10^{-13}, about two orders of magnitude below classical AMS sensitivity limits.

The novel Ion-Laser InterAction Mass Spectrometry (ILIAMS) technique achieves near-complete suppression of isobars via selective laser photodetachment and chemical reactions of decelerated anion beams in a gas-filled radio frequency quadrupole. It enables suppression of $^{182}WF_5^-$ vs. $^{182}HfF_5^-$ by >10^5 resulting in a W-corrected blank value of ^{182}Hf/^{180}Hf=(3.4±2.1)×10^{-14}.

We will highlight the potential of ILIAMS for sensitive detection of previously inaccessible long-lived radioisotopes and discuss ways to proceed in order to detect ^{182}Hf at astrophysical levels including the challenges this poses in chemical sample preparation of HfF_4 from 100 gram-amounts of deep-sea archives.

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