Ultra-sensitive radionuclide detection with Ion-Laser InterAction Mass Spectrometry

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Interferences from isobars typically restrict the applicability of Accelerator Mass Spectrometry (AMS) to only a select group of long-lived radionuclides. The novel Ion-Laser InterAction Mass Spectrometry (ILIAMS) technique at the Vienna Environmental Research Accelerator (VERA) can overcome this limitation in many cases by highly-efficient isobar removal at eV-energies [1]. This opens exciting possibilities in environmental radioactivity (^{90}Sr, ^{99}Tc, ^{135,137}Cs), astrophysics (^{44}Ti, ^{53}Mn, ^{182}Hf), Earth science and cosmochemistry (^{26}Al, ^{36}Cl, ^{41}Ca) research.
For example, ILIAMS-assisted AMS allows the detection of ^{26}Al and ^{41}Ca directly from crushed stony meteorites containing intrinsic ~1% Al and Ca, respectively, for fast provenance checks for extraterrestrial origin [2,3]. The measurement of ^{41}Ca in chemically untreated concrete from nuclear decommissioning and in coral sand samples emphasizes the huge potential of this technique for nuclear clearance. The presence of isobars originating from the natively abundant elements (^{26}Mg, ^{41}K) does not cause any analysis problems making radiochemical separation redundant.
For ^{90}Sr, ILIAMS enables a detection limit of <0.016 mBq in a sample of mg of stable Sr – at least a factor 100 better than other techniques. Recently, we have successfully determined the ^{90}Sr/Sr ratio in less than 0.5 g contemporary coral aragonite and seawater samples of less than 500 ml, and analyzed the ^{90}Sr concentration in small samples of soils, snails, antlers and reactor concrete after adding Sr carrier.

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