

NOBLE GASES FROM THE INTERSTELLAR MEDIUM TRAPPED ON THE MIR SPACE STATION AND ANALYZED BY IN VACUO ETCHING.

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Introduction: The composition of the present interstellar medium (ISM) provides an important benchmark in cosmochemistry. It serves as a reference for galactic chemical evolution (GCE) models, solar mixing predictions and provides information for understanding Big Bang nucleosynthesis. The present-day ISM ³He abundance allows, combined with the protosolar ³He, deduced from the Jovian atmosphere or meteorites [1,2], tracing the GCE over the past 4.56 Ga. ${}^3\text{He}/{}^4\text{He} = (2.5 \pm 0.6) \times 10^{-4}$ has been determined for the local ISM [3]. However, the uncertainty is too large to better constrain GCE models and - in combination with the present-day solar wind value - the protosolar D/H [4].

Experiment: The COLLISA experiment [*Collection of Inter-Stellar Atoms*, 5,6] sampled interstellar gas in Cu-Be foils covered with BeO and exposed to the flux of neutrals from the ISM on board the MIR space station. Stepwise heating extraction allowed the detection of interstellar ⁴He [6] and yielded $({}^3\text{He}/{}^4\text{He})_{\text{ISM}} = (1.7 \pm 0.8) \times 10^{-4}$ [7], in agreement with the value for pickup ions observed with SWICS/Ulysses [3].

Further foils are currently analyzed by closed system stepwise etching at ETH Zurich [8]. This technique allows to efficiently separate implanted interstellar He and terrestrial tritogenic ³He, probably residing in the Cu-Be substrate, which had to be taken into account for the determination of interstellar ³He during stepwise heating [7].

Results: Offline tests suggest that HF acid vapor efficiently and uniformly etches BeO. The system blank (in 10^{-14} cm³ STP, ³He ~3, ⁴He ~300, ²⁰Ne ~90) is now sufficiently low to measure the exposed foils. Two unexposed foils (31 and 50 cm²) were etched online and yielded no significantly increased values relative to these blanks, implying that the tritogenic ³He (0.5-1 10^{-14} cm³/cm² foil) indeed resides in deeper foil layers that are not affected by superficial etching. The analysis of a foil artificially irradiated with ³He and ²⁰Ne at energies comparable to those of the ISM neutrals (25 eV/amu) showed that our protocol (10 steps 1-30 min, HF vapor at 20 °C) releases all trapped noble gases. Results of the ongoing etching experiment on foils exposed to the ISM (including a witness foil doped with terrestrial ³He) will be presented. The expected concentrations of interstellar gas [3,6,7] in 50 cm² of exposed foil are (in 10^{-14} cm³ STP) ³He ~25, ⁴He ~200000, ²⁰Ne ~375).

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