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

H. Busemann 1*, F. Bühler 1, Y.N. Agafonov 2, H. Baur 3, P. Bochsler 1, N.A. Eismont 2, V.S. Heber 1,3**, R. Wieler 3 and G.N. Zastenker 2. 1Physikalisches Institut, University of Bern, Switzerland. 2IKI, Russian Academy of Sciences, Moscow, Russia. 3Earth Sciences, ETH Zurich, Switzerland. Present addresses: *E-mail: busemann@dtem.ciw.edu. DTM, Carnegie Institution, Washington DC, USA. **Earth Sciences, Open University, Milton Keynes, UK.

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 $^3$He abundance allows, combined with the protosolar $^3$He, deduced from the Jovian atmosphere or meteorites [1,2], tracing the GCE over the past 4.56 Ga. $^3$He/$^4$He = (2.5 $\pm$ 0.6) x 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 Interstellar 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 $^4$He [6] and yielded ($^4$He/$^4$He)$_{ISM}$ = (1.7 $\pm$ 0.8) x 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 tritiogenic $^3$He, probably residing in the Cu-Be substrate, which had to be taken into account for the determination of interstellar $^3$He during stepwise heating [7].

Results: Offline tests suggest that HF acid vapor efficiently and uniformly etches BeO. The system blank (in 10$^{-14}$ cm$^3$ STP, $^3$He $\sim$3, $^4$He $\sim$300, $^{20}$Ne $\sim$90) is now sufficiently low to measure the exposed foils. Two unexposed foils (31 and 50 cm$^2$) were etched online and yielded no significantly increased values relative to these blanks, implying that the tritiogenic $^3$He (0.5-1 10$^{-14}$ cm$^3$/cm$^2$ foil) indeed resides in deeper foil layers that are not affected by superficial etching. The analysis of a foil artificially irradiated with $^3$He and $^{20}$Ne 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 $^4$He) will be presented. The expected concentrations of interstellar gas [3,6,7] in 50 cm$^2$ of exposed foil are (in 10$^{-14}$ cm$^3$ STP) $^3$He $\sim$25, $^4$He $\sim$200000, $^{20}$Ne $\sim$375).

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