

LIGHT NOBLE GAS COMPOSITION OF DIFFERENT SOLAR WIND REGIMES: RESULTS FROM GENESIS.

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Introduction: The Genesis mission provided samples of solar wind (SW) from different regions on the Sun. These SW regime samples are important to understand fractionation processes upon formation and acceleration of the SW to ultimately deduce solar composition from SW values. We present He and Ne isotopic and elemental compositions of the bulk SW (SW of entire collection period) and the 3 major SW regimes: Slow (from the ecliptic plane, emanating from above streamers), fast (emanating from coronal holes), and coronal mass ejections (CME). At the conference we will also present Ar data.

Experimental: Noble gases were analyzed in targets composed of amorphous, diamond-like C on Si. The low atomic mass of C minimized backscatter losses and thus isotope fractionation. Backscatter loss was corrected for He and was negligible for Ne based on SRIM [1]. Gases were extracted by UV laser ablation (213nm). The main focus of this work is to detect differences between SW regimes. Therefore, He and Ne isotopes and ⁴He/²⁰Ne were analyzed in 3 separate runs, using standard-sample bracketing. The bulk SW target served as "standard" and the other regime targets as "samples". Experimental details are given in [2].

Results: The preliminary ⁴He/³He of the bulk SW is 2081±17. He isotopes are fractionated between slow and fast SW by 6%, ³He being enriched in the former. The ²⁰Ne/²²Ne and ²¹Ne/²²Ne of the bulk SW are 13.80±0.03 and 0.0328±0.0001, respectively, in excellent agreement with reported SW values [3, 4]. In contrast to He, fractionation of the ²⁰Ne/²²Ne between slow and fast SW is only marginally significant (≤1%), ²⁰Ne tending to be enriched in the slow SW. The enrichment of light isotopes in the slow SW is in accordance to the Coulomb drag theory, postulating isotope fractionation upon acceleration of SW species in the lower corona [5]. The preliminary ⁴He/²⁰Ne of the bulk SW is 669±6. The slow SW is depleted by 1% in He relative to Ne and fast SW either due to inefficient Coulomb drag [6] or fractionation upon ionisation in the chromosphere (although first ionisation potentials of He and Ne are similar, ionisation times are very different [7]). In contrast to the quasi-stationary slow and fast SW, transient CME events are known to vary in composition. The Genesis CME targets collected many events, providing an average CME composition. He isotopic composition is similar to bulk SW, thus an enrichment of ³He over ⁴He as observed in many single events could not be detected. Most prominent is, however, the ⁴He enrichment over ²⁰Ne of ~10% in CME's relative to quasi-stationary SW, in accordance with the He over O enrichment detected with the ACE spacecraft [8].

References: [1] Ziegler J.F. (2004) Nucl. Inst. Meth. Phys. Res. 219/220 1027-1036; [2] Heber V.S., et al. (2007) 38th LPSC #1894; [3] Benkert J.-P., et al. (1993) J. Geophys. Res. 98 13147-13162; [4] Geiss J., et al. (2004) Space Sci. Rev. 110 307-335; [5] Bodmer R., Bochsler P. (1998) Phys. Chem. Earth 23 683-688; [6] Bochsler P. (2007) Astron. Astrophys. Rev. 14 1-40; [7] Geiss J. (1998) Space Sci. Rev. 85 241-252; [8] Reisenfeld D.B., et al. (2007) Space Sci. Rev. in press.