Geophysical Research Abstracts
Vol. 13, EGU2011-8831-1, 2011
EGU General Assembly 2011

Solar Wind Elemental and Isotopic Abundance Results from the Genesis Mission

Daniel Reisenfeld and the Genesis Team
University of Montana, Physics and Astronomy, Missoula, United States (dan.reisenfeld@umontana.edu)

The GENESIS solar-wind (SW) sample return mission collected samples of solar wind from November, 2001 to April, 2004 and returned them to Earth for isotopic and elemental analyses, with the purpose of precisely determining the solar photospheric composition and thereby obtaining the average composition of the solar nebula. The composition of the SW is by no means identical to that of the solar photosphere, with many species undergoing significant elemental and even isotopic fractionation. Thus an ongoing effort of the Genesis team is to gain a better understanding of how the solar wind fractionates solar material, so that ultimately the photospheric abundances may be determined.

Sample analysis is an ongoing effort, and is expected to continue for years to come. To date, members of the Genesis sample analysis team have determined bulk solar wind elemental abundances for ten species (O, N, C, He, Fe, Mg, Ne, Ar, Cr, Ca), and isotopic abundances for many of these. In the case of the noble gas elements He, Ne and Ar, regime-specific elemental and isotopic abundances have also be determined, and with unprecedented accuracy. This has allowed for the first time us to observe that isotopes are fractionated differently in different solar wind types. For example, the fractional abundance of ^{22}Ne to ^{20}Ne differs by $(0.94 \pm 0.21)\%$ between the coronal hole (fast) and interstream (slow) solar wind. At first this may seem to be an inconsequential difference, but note that it has a 5σ statistical significance. Similarly, the fractional abundance of ^{38}Ar to ^{36}Ar differs by $(0.51 \pm 0.09)\%$ between the coronal hole (CH) and interstream (IS) solar wind, with a 4σ statistical significance [Heber *et al.*, 2008]. In both cases, the IS wind, which is believed to originate near the boundaries of closed-field regions on the Sun, shows a greater abundance of the light isotope. Although the enhancement is weak, it may be an indicator of the fractionation mechanism. For example, gravitational settling is consistent with enhanced light isotope outflow on previously-closed field lines.

In addition to sample analysis results, we will also present a comparison of the solar wind conditions during the 2.4 years of sample collection by Genesis to the average state of the solar wind as observed over the past forty years. In essence, we ask how “typical” the solar wind was during the Genesis collection period in relation to the average physical state of the solar wind. We find that significant differences exist; however, the state of the CH solar wind was essentially the same during the Genesis period as compared to the fast solar wind over a full solar cycle. This is encouraging because it is also expected that the CH sample has a composition most similar to the solar photosphere, and thus the greatest significance is placed on CH sample analysis results. Thus the stability of the CH plasma state provides further confidence that this flow contains the most pristine representation of solar composition.