SOLAR-WIND CONDITIONS DURING THE INITIAL PHASE OF THE GENESIS MISSION R.C. Wiens[1], B.L. Barraclough[1], J.E. Steinberg[1], E.E. Dors[1], M. Neugebauer[2], D.S. Burnett[3], J. Gosling[1], R.R. Bremmer[1], [1]Space & Atmospheric Sciences, Los Alamos National Laboratory (MS D466, Los Alamos, NM 87545, RWiens@LANL.Gov), [2]Jet Propulsion Laboratory (MS 169-506, 4800 Oak Grove Drive, Pasadena, CA 91109), [3]Geology & Planetary Sciences, Caltech (MS 100-23, Pasadena, CA 91125)

Introduction: The NASA Genesis Discovery spacecraft was launched August 8, 2001 on a mission to collect samples of solar wind for ≥ 2 years and return them to earth in 2004. Detailed analyses of the solar wind ions implanted into high-purity collection substrates will be carried out using various mass spectrometry techniques. These analyses are expected to determine key isotopic ratios and elemental abundances in the solar wind, and by extension, in the solar photosphere. Further, the photospheric composition is thought to be representative of the solar nebula with a few exceptions, so that the Genesis mission will provide a baseline for the average solar nebula composition with which to compare present-day compositions of planets, meteorites, and asteroids. The implications of the solar oxygen isotopic composition have been discussed in [1]. A list of other isotopic and elemental measurement objectives, and some of the rationale behind them, is given in [2].

It is critical to understand the solar-wind conditions during the collection phase of the mission. For this reason, plasma ion and electron spectrometers are continuously monitoring the solar wind proton density, velocity, temperature, the alpha/proton ratio, and angular distribution of suprathermal electrons. Here we report on the solar-wind conditions as observed by these *in-situ* instruments during the initial portion of the mission. This abstract reports on the period from the time the spectrometers were turned on shortly after launch in August until collector deployment in December, while the Houston presentation will address conditions during the start of solar wind collection between December and March.

Solar-Wind Regimes: The solar wind consists of three distinct types of plasma [e.g., 3]. All three types, or regimes, are elementally fractionated relative to the photosphere, but by different amounts and in different ways based on the characteristics of their acceleration out of the solar environment [e.g., 4]. Because of these different elemental compositions, a major effort was made for Genesis to collect separate samples of the different solar-wind regimes.

The interstream (IS), or slow (< 500 km/s), solar wind is the dominant regime encountered in the ecliptic. It is consistently fractionated based on first ionization potential (FIP), with elements having FIPs below 10 eV enhanced by a factor of about four relative to high-FIP elements. Coronal hole (CH) material is characterized by high velocity (500-800 km/s) and a relatively low FIP fractionation of around 2, with a consistent alpha/proton ratio of ~0.043. The Ulysses mission showed that CH is the dominant regime over the solar poles, particularly during the low-activity portion of the solar cycle [ref 5]. Coronal mass ejections (CMEs) are characterized by strong and often uneven enrichments of heavy elements, including alpha/proton ratios often > 10%. A cold plasma temperature is nearly always an indicator of CME material. This material is also identified by containment within closed magnetic field lines which the Genesis spacecraft identifies by a double-peaked electron distribution with peaks 180 degrees apart, as the electrons stream both directions along the field lines.

Identifying and Sampling the Regimes: Genesis is the first spacecraft to incorporate a relatively simple on-board algorithm that processes raw spectrometer data to identify the current solar-wind regime. The identification uses proton velocity, temperature, alpha/proton ratio, and bi-directional electron streaming. The “WIND” algorithm [6] and associated data-reduction software were tested extensively on the ground prior to launch. The algorithm was turned on in space August 23, and it has been operating since then. The distinction between IS and CH (slow and fast) wind is relatively straightforward and is based on velocity. Other indicators besides velocity, including temperature and alpha/proton ratio, confirmed that the WIND algorithm correctly distinguished CH from IS wind even though relatively few instances of CH wind were encountered.

CME material is somewhat more difficult to identify. Because of its often exotic composition, it is desirable to ensure that the other regime-specific collectors are not contaminated by CME material. One problem encountered during the algorithm check-out period prior to collector deployment was a hopping in and out of CME selection because of the fact that CME indicators are often ephemeral, and can disappear in the middle of a CME regime only to re-appear within an hour. Because of this, the algorithm was modified to continue CME collection until 6 hours after the last indication of CME is gone.

The fraction of time spent in each regime from August 23 to December 3 is shown in Figure 1. The period just past the peak of the solar cycle (which occurred around June, 2000) often has the largest fraction of CMEs, which was particularly true in fall, 2001. Relatively little CH flow was observed during this period. Typically the largest fraction of CH flow in the ecliptic occurs later in the declining phase of the solar cycle. It is hoped that the period of enhanced CH flow is captured by Genesis, most likely near the end of the collection phase. The CH material is probably the most desirable because its elemental composition is the most representative of the photosphere. The extent of *isotopic* fractionation among elements > 4 amu is poorly known [e.g., 7]. It is hoped that there is no isotopic fractionation between the photosphere and the solar wind. The best indication of this with Genesis data would come from identical isotopic ratios in material from all three solar-wind regimes. If isotopic fractionation does exist, its effect can be estimated based on intercomparisons of these regimes.

Genesis solar-wind collection began when the arrays were deployed December 3, 2001, and should continue until April, 2003 with only occasional interruptions for spacecraft maneuvers. The solar-wind conditions and the algorithm's regime selections will be catalogued to allow analyses of the samples themselves to be placed in the proper context with regard to FIP fractionation and other solar-wind properties. These data will continue to be available at http://genesis.lanl.gov.

References: [1] Wiens R.C. et al. (1999) *Meteoritics & Planet. Sci. 34*, 99-107. [2] Wiens R.C. et al. (2002) The Genesis solar-wind sample-return mission. Subm. to *EOS*. [3] Neugebauer M. (1991) *Science 252*, 404-409. [4] Bochsler P. (2000) *Rev. Geophys. 38*, 247-266. [5] McComas D.J. et al. (2001) subm. To *Geophys. Res. Lett.* [6] Neugebauer M. et al. (2002) to be subm. to *Spa. Sci. Rev.* [7] Kallenbach R. (2001) *Solar and Galactic Composition* (R. F. Wimmer-Schweingruber, ed), 113-119, Am. Inst. Of Physics.

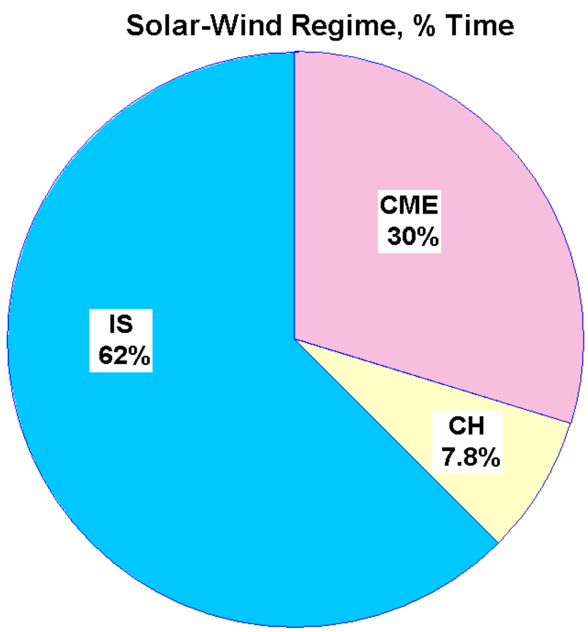

Fig. 1. Fraction of time in each of the three solar-wind regimes during the Genesis algorithm check-out phase prior to array deployment. The data are based on the on-board solar-wind regime selection algorithm, and cover 78 days. IS = interstream, CH = coronal hole, CME = coronal mass ejection.