INTERSTELLAR METEOROIDS DETECTED BY THE CANADIAN METEOR ORBIT RADAR. P. Brown[1], R.J. Weryk[1], [1]Department of Physics and Astronomy, University of Western Ontario, London, ON, N6A 3K7

Introduction: The number density of very large (>50 μm) interstellar grains is largely unknown [1]. Such large interstellar particles (ISPs) are of interest as they could contain a significant mass fraction of the solids in interstellar space [2]. Larger grains also have their original trajectories less affected by Lorentz and gas drag forces in the interstellar medium in addition to having longer lifetimes against catastrophic collisions. As a result, it is more probable that the specific origin for a given large ISP (such as ejecta from AGB or T Tauri systems and debris disks around young main sequence stars) can be established, assuming individual grain trajectories and velocities are known prior to detection. Such large ISPs should be able to penetrate deeply into the solar system without being stopped by the interplanetary magnetic field [3] and could potentially be detected at the Earth. Detection of large ISPs at the Earth has already been claimed based on data from the Advanced Meteor Orbit Radar (AMOR) operating in New Zealand [4].

Equipment: The Canadian Meteor Orbit Radar (CMOR) has been in routine operation since 2002 near 43N, 81W. This 6 kW interferometric automated radar operates at 29.85 MHz and records atmospheric trajectories and velocities for ~2500 meteoroids per day [5], [6]. The typical meteoroid mass detected by CMOR is near 10 μg, corresponding to particle sizes of order 100 μm. The beam coverage for CMOR is essentially all-sky, with 3 dB sensitivity contours located 60 degrees from the zenith. CMOR has a typical atmospheric collecting area of 200-300 km^2 for a given radiant direction. Meteoroid velocity is computed based on time-of-flight measurements made at two outlying stations; typical errors have previously been found to be of order 10% of the measured speed. Simulations [6] imply this error should be reducible by a factor of 2 – 3, suggesting further optimization of the existing signal analysis algorithms are warranted. Path orientation is dependent on both accurate measurement of the time-of-flight delays (t_1-t_0 and t_2-t_0 as in the figure) between different specular points along the trail as measured at the outlying stations (relative to the main station) and interferometric determination of echo location from the main radar station. Typical interferometric errors for high signal:noise ratio echoes are of order one degree.

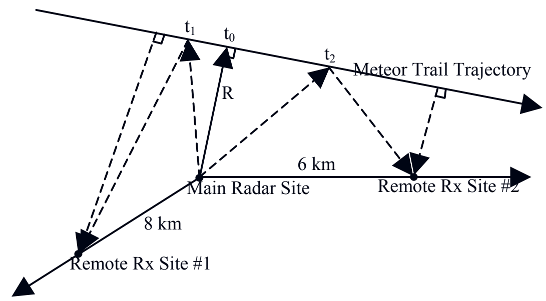

Figure 1.

Analysis and Results: A preliminary examination of potential very large ISPs detected by CMOR [7] produced only a handful (40) of possible detections from our initial population of more than 10^6 orbits. The primary limitation of this earlier work was a 2σ selection criterion, i.e. only echoes whose heliocentric orbits were more than 2σ above the hyperbolic threshold were examined. In practice, this produced a cutoff for events with heliocentric speeds greater than 55 km/s at the Earth. Here we extend this earlier analysis to the 1σ case and examine the large number of hyperbolic meteoroids having heliocentric velocities below 48 km/s at 1 AU. We have further improved our time-of-flight detection algorithm producing higher precision velocity measurements. We will present results of this investigation examining the fraction of unbound orbits at the 1σ level as a function of ecliptic coordinates to establish the nature of the hyperbolic meteoroids (solar system or possible true interstellar). Earlier results from the AMOR system have also suggested a discrete southern hemisphere interstellar meteoroid stream source [4] at smaller masses than CMOR detects. We will similarly examine northern hemisphere data to search for such discrete sources at the larger particle sizes detected by CMOR.

References: [1] Gruen E. and Landgraf, M. (2000) *JGR, 105,* 10291–10297. [2] Frisch et al. (1999) ApJ., *525,* 492-516. [3] Landgraf, M. et al.. (2003) *JGR, 108,* LIS 7-1 [4] Baggaley, W.J. (2000) *JGR, 105,* 10353-10361. [5] Webster, A.R. et al. (2004) Atmos. Chem. Phys. Discuss., 4, 1181-1201. [6] Jones, J. et al. (2005) Planet. Sp. Sci., 53, 413-421. [7] Weryk, R.J. and Brown, P. (2005), Earth, Moon and Planets, accepted.