AN AIRBORNE OBSERVING CAMPAIGN TO MONITOR THE FRAGMENTING FIREBALL RE-ENTRY OF ATV-1 "JULES VERNE" IN AUGUST 2008. P. Jenniskens[1] and J. Hatton, [2.]
[1]SETI Institute, 515 N. Whisman Road, Mountain View, CA 94043 (pjenniskens@mail.arc.nasa.gov),
[2.]ESA-ESTEC (HME-GA), Keplerlaan 1, 2200AG Noordwijk, the Netherlands (jason.hatton@esa.int).

Introduction: The next great opportunity to investigate aspects of entry and descent dynamics of large meteors is the artificial fireball caused by the reentry of ESA's 15-ton Automated Transfer Vehicle (ATV) called "Jules Verne". Jules Verne will enter in early August at a speed of about 7 km/s, which is slower than natural meteors, but it will fragment into numerous pieces causing a meteoric manifestation not unlike natural fireballs.

The maiden flight of the Automated Transfer Vehicle (ATV): This first in a series of ATVs was launched on March 9, 2008. ATV has a function similar to that of the Russian Progress, a re-supply ship for the International Space Station (ISS). It is scheduled to dock with ISS on April 3, then undock in early August for a controlled destructive re-entry into the southern Pacific Ocean on around August 9. The controlled reentry permits observations, but the position of ISS in early August will determine whether the reentry is a daytime or nighttime reentry.

An international observing campaign: An airborne observing campaign is being organized to monitor this reentry of ATV-1, similar to previous Hyperseed MAC missions [1,2]. An international team of researchers from governments, universities, and private institutions will deploy from NASA Ames Research Center in California, travel to the staging area, and field a wide range of imagers and spectrographs to record the manner in which ATV breaks during entry. Two aircraft have been made available for this mission: a Boeing 757 and a Gulfstream V, both privately owned but managed by H211 LLC under an agreement with NASA Ames. These aircraft provide up to 40 small and 5 large windows on the event, respectively, for up to 50 researchers.

The observing tools used are those commonly applied to meteor observations. Their successful application to reentry observations was demonstrated in an earlier observing campaign to study the reentry of the Stardust Sample Return Capsule on January 15, 2006 [4-8]. The ATV-1, and its fragments, is not expected to be resolved by the instruments and each fragment is a point source, like a natural meteor in most observations to date.

Aspects of entry and descent dynamics: The data from the observing campaign are expected to constrain the model uncertainties in the size of the debris footprint and help ensure future safe returns of ATV.

The observations may also help shed light on the processes of fragmentation, ablation and deceleration in natural bolides. The large size of the object may permit the detection of high altitude emissions from air molecules and atoms colliding with the spacecraft above 80 km. Paint layers will ablate and may be detected as meteoric emission lines under excitation conditions not unlike that of natural meteors [4]. Further down, the object is expected to heat up and break under thermal and dynamic stress [5]. The effect of fragmentation dynamics on the separation, rotation, and deceleration of fragments may be studied. And following the reentry, chemiluminescence from the recombination of oxygen atoms in the spacecraft wake and ozone molecules in the ambient environment may be observed if the reentry will be a night time reentry [6]. Also, sonic booms may be generated that can carry large distances [9].

Difficult observations: We are keenly aware that past attempts to monitor the reentry of spacecraft have often failed to produce the intended data. When MIR came down, the final burn was not terminated after a prescribed number of seconds, as a result of which MIR entered Earth's atmosphere much earlier along its trajectory than planned and was not observed from two commercial aircraft that were chartered for this event. In other reentries, acquisition of the object and tracking proved difficult. When tracking did succeed, the images were often saturated.

To our knowledge, this will be the first time that a multi-instrument aircraft campaign is deployed to study the reentry of a large spacecraft with such a large range in optical spectroscopic and imaging instruments. We hope to apply lessons learned from the Stardust Sample Return Capsule reentry, which was well observed on January 15, 2006. That reentry was not distructive, as intended.

References: [1] Jenniskens P., et al. (2004) *Earth, Moon, and Planets 95, 339.* [2] Jenniskens P., et al. (2007) *ESA-SP 643, 7*. [3] http://reentry.arc.nasa.gov. [4] Jenniskens P. (2008) *AIAA 2008-1210.* [5] Trumble K., et al. (2008) *AIAA 2008-1213.* [6] Harms F., et al. (2008) *AIAA 2008-1214.* [7] Boyd I. D., et al. (2008) *AIAA 2008-1215.* [8] Winter M., Herdrich G. (2007) *AIAA 2007-4050.* [9] Revelle D. O., Edwards W. N. (2007). *Meteoritics & Plan. Sci 42, 271.*

Additional information: http://atv.seti.org