

**DETECTION OF MICRON-SIZED PARTICLES IN METEOR STREAMS CROSSING THE TRAJECTORIES OF THE VEGA-1 AND VEGA-2 SPACECRAFT.\*** G. deNolfo, J.A. Simpson and A.J. Tuzzolino, Laboratory for Astrophysics and Space Research, Enrico Fermi Institute, The University of Chicago, Chicago, IL, 60637, USA;  
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In earlier reports (1,2) we described the Halley encounter dust measurements carried out by the University of Chicago DUST COUNTER AND MASS ANALYZER (DUCMA) instruments aboard the VEGA-1 and VEGA-2 spacecraft. Following the encounters, both DUCMA instruments continued to operate nominally and an arrangement was made for an extension of interplanetary telemetry coverage so that approximately one year of interplanetary data was obtained for each DUCMA instrument. This provided the opportunity to search in the DUCMA data for flux enhancements signaling possible detection of interplanetary meteor stream particles. This search was unique in that two independent sets of measurements at a given position would be involved, i.e., VEGA-1, followed within a few days by VEGA-2. Thus, an apparent enhancement of dust flux measured by DUCMA on one spacecraft could be confirmed by observation of a corresponding enhancement by DUCMA on the second spacecraft.

The trajectories for the two spacecraft were very similar, with the radial distance of the spacecraft from the Sun ranging from 0.73 to 1.07 A.U. We show in FIG. 1 the trajectories of three selected known meteor streams and that of the VEGA-2 spacecraft. Indicated are the points along the spacecraft trajectory corresponding to the times at which the spacecraft is closest to the streams. FIG. 2 shows the measured interplanetary integral counting rates for DUCMA, where the times labeled 1, 2, 3 correspond to those in FIG. 1. From these data we have concluded that:

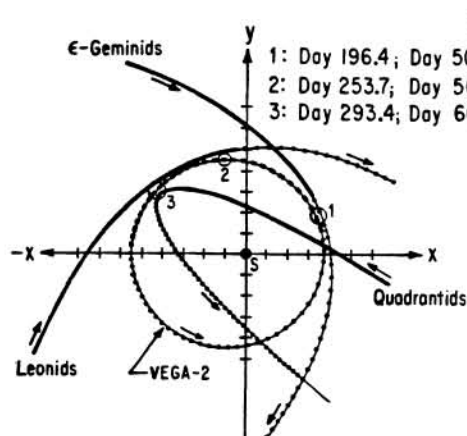
- $\sim 10^{-13}$ g particles have been unambiguously detected in the  $\epsilon$ -Geminids and Quadrantids meteor streams, with detection in the Leonids stream being strongly suggested, and;
- for the  $\epsilon$ -Geminids stream the mass distribution index  $s$ , defined by the relation that the integral spatial number density of stream meteoroids having mass  $m \geq M$ ,  $n(M)$ , is given by  $n(M) \propto M^{(1-s)}$ , has the values  $s = 1.2 \pm 0.1$  for  $1.5 \times 10^{-13}\text{g} \leq m \leq 5.6 \times 10^{-11}\text{g}$  and  $s = 1.4 \pm 0.3$  for  $5.6 \times 10^{-11}\text{g} \leq m \leq 1.6 \times 10^{-9}\text{g}$ .

The DUCMA results, combined with the observations reported earlier by others (3,4), demonstrate that submicron- and micron-sized particles are readily measurable constituents of several known meteor streams. This fact is contrary to most theoretical expectations and has strong implications regarding the importance of non-gravitational forces in removing such particles from the orbit of the stream.

#### REFERENCES

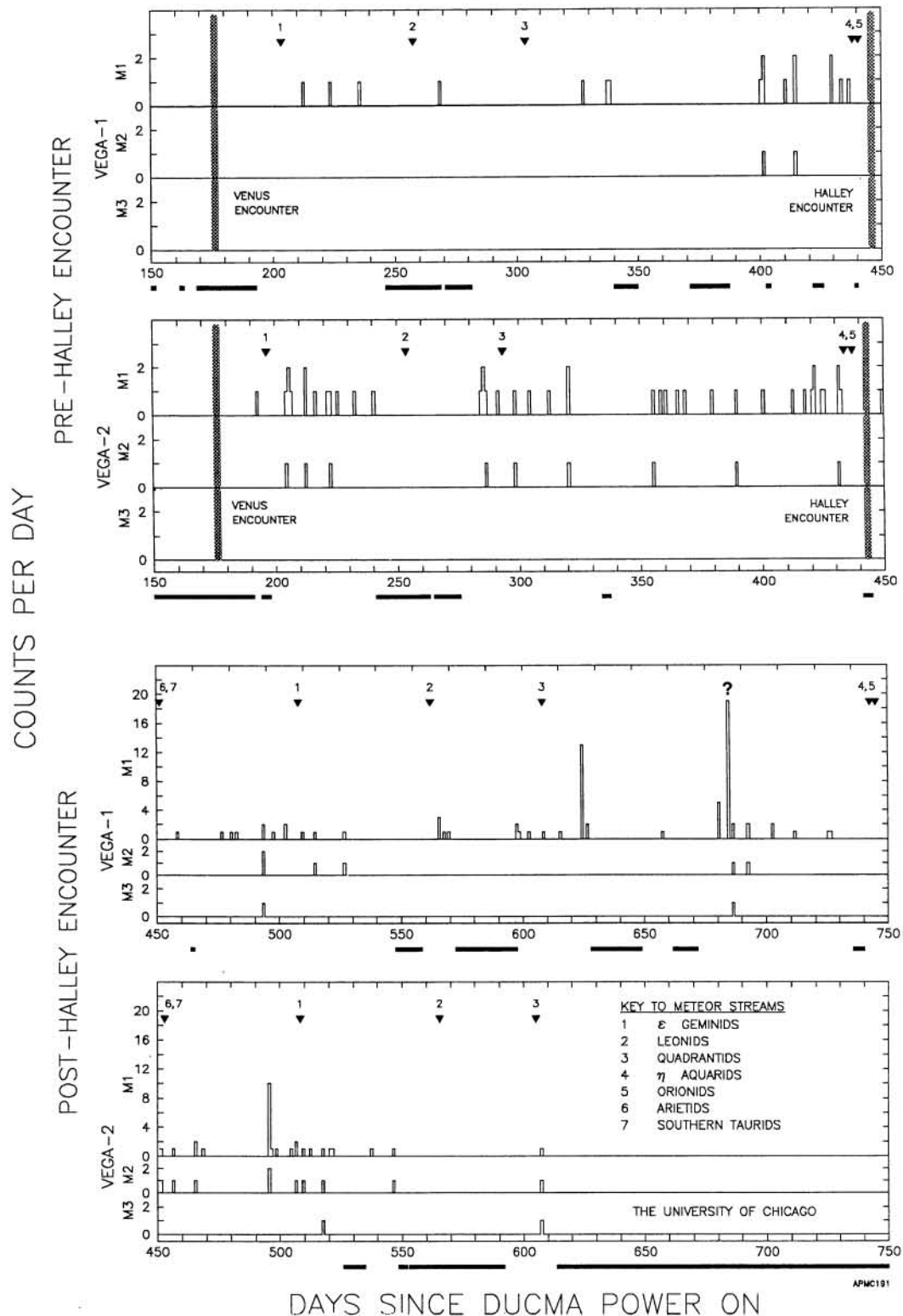
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**FIG. 1:** Trajectory of the VEGA-2 spacecraft and projected trajectories of the  $\epsilon$ -Geminids, Leonids and Quadrantids meteor streams. The Sun is at the origin and the x,y plane is the orbital plane of VEGA-2. For each of the meteor streams, the heavy-line portion of the projected trajectory corresponds to trajectory points which are above the VEGA-2 orbital plane, and the light-line portion to trajectory points which are below the VEGA-2 orbital plane. The tick marks along the axes are separated by 0.20 A.U. The circled points labeled 1, 2 and 3 are the points along the VEGA trajectory at which the spacecraft is closest to the  $\epsilon$ -Geminids, Leonids and Quadrantids meteor streams, respectively, and correspond to the marks labeled 1, 2 and 3 in Fig. 2. Each VEGA spacecraft passes through points 1, 2 and 3 twice during the missions, as indicated.

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**FIG. 2:** Measured integral counting rates for the DUCMA instruments aboard the VEGA-1 and VEGA-2 spacecraft during the interplanetary portions of the missions. Heavy bars indicate missing data. For an impact velocity of  $80 \text{ km s}^{-1}$ , the mass thresholds M1, M2, M3 correspond to particle masses  $1.5 \times 10^{-13} \text{ g}$ ,  $5.6 \times 10^{-11} \text{ g}$ ,  $1.6 \times 10^{-9} \text{ g}$ , respectively.