Imaging and mapping the circumsolar dust ring near the orbit of Venus

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Asteroids and comets are the dominant source of dust feeding the zodiacal cloud [1,2]. The orbits of grains of size 10–100 microns are expected to decay by Poynting-Robertson drag [3], but in the vicinity of planetary orbits dust may get trapped into exterior mean motion resonances [4] to form a circumsolar dust ring. It has long been known that such a ring exists close to the Earth's orbit [5], but even now, little is known about its detailed structure. No such ring or associated resonance feature has been detected at the orbits of Mars or Jupiter [6]. While re-analysis of photometry data from the Helios mission provided some evidence of a ring associated with Venus [7], the existence of such a ring could not be conclusively demonstrated.

Here we report on recent work that confirms the existence of a circumsolar ring at Venus from sensitive optical photometry of the zodiacal cloud [8]. Our analysis uses synoptic images from the HI-2 instrument on STEREO [9]. We discuss the techniques that we have developed to extract images of the Venus ring, and describe the approach taken towards creating a simple parametric model of the ring. We note that the maximum over-density in the ring is about 10% that of the smooth zodiacal cloud, and we highlight other aspects of the ring structure that we have already determined. We demonstrate that the STEREO HI-2 data allow the density structure of the Venus ring to be mapped in much greater detail than the Earth ring. Thus the Venus ring has the potential to provide a stringent test of models of resonance ring formation. Not only is this relevant to understanding the structure of the zodiacal cloud, it is of importance in the context of exoplanetary systems which are also expected to display analogous circumstellar dust rings [10,11]. We conclude by discussing current progress in mapping the density distribution of the Venus circumsolar ring.

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