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A Search for Vulcanoids Using STEREO Heliospheric Imager Data

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Abstract

Since Le Verrier proposed in 1859 that a small planet, or collection of planets, interior to Mercury, could explain the precession of Mercury's orbit [1], numerous attempts have been made to search for intra-mercurial bodies [2]. Although the theory of general relativity removed the need for a massive planet Vulcan, dynamical studies have shown that there is a stable region between 0.07 and 0.21 AU where a population of asteroid-like objects, known as Vulcanoids, may reside [3]. We present here the final results from our campaign to search for Vulcanoids in data taken by the Heliospheric Imagers on NASA's two STEREO spacecraft. The HI-1 camera has a 20º x 20º field of view centered on the ecliptic plane at an angular distance of 13.3º from the sun. We examined more than 2,800 HI-1 images obtained over an 80-day period in late 2008/early 2009. Since the longest synodic period between a stable Vulcanoid and the STEREO spacecraft is 39 days, all Vulcanoids–unless they are both at the inner edge of the stable Vulcanoid zone and highly inclined–will pass through the HI-1 field of view at least twice during this period. To quantify the detection efficiency of our search, we added synthetic Vulcanoids with albedos, spectra, and phase functions identical to that of Mercury to the data. All of these synthetic objects larger than 3 km in diameter were detected. Since radiative forces such as the Yarkovsky effect are likely to quickly remove all objects smaller than 1 km in diameter from the stable Vulcanoid zone [4], our search places strict constraints on the formation and evolution of the putative Vulcanoid population.

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References

[1] Le Verrier, U. J., Theorie DU mouvement de Mercure, Annales de l'Observatoire de Paris, Vol. 5, pp 1–195, 1859.

[2] Leake, M. A., Chapman, C. R., Weidenschilling, S. J., Davis, D. R., Greenberg, R., The chronology of Mercury's geological and geophysical evolution - The Vulcanoid hypothesis. Icarus, Vol. 71, pp. 350–375, 1987.

[3] Evans, N. W., Tabachnik, S. A., Structure of possible long-lived asteroid belts, MNRAS, Vol. 333, pp. L1–L5, 2002.

[4] Vokrouhlický, D., Farinella, P., Bottke, W. F., The Depletion of the Putative Vulcanoid Population via the Yarkovsky Effect, Icarus, Vol. 148, pp. 147–152, 2000.