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Non-Gravitational reorganisation of the dust tails of C/2006 P1 and C/2011 L4

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Abstract

We present results from a new application of Finson & Probstein's [1] model of cometary dust tails. The dominant forces of radiation pressure and gravity acting on dust both follow inverse square laws, so the structure of the tail can be explained by adjusting the Keplerian orbits of ejected material. Each particle is parameterized by its ratio of radiation pressure to gravity - beta, and its time of ejection from the nucleus. A temporal map is extracted from dust tail images, displayed for the first time directly in the beta and emission time parameter space.

Figure 1: The dust tail of C/2006 P1 from STEREO A HI-1 (enhanced), with the Sun below the image. After the re-organisation, the original striae and new sunward facing structures are visible.

We use this technique to examine the extensive tails of C/2006 P1 (McNaught) and C/2011 L4 Pan-STARRS, pictured in figures 1 and 2 respectively; using data from the STEREO SECCHI and SOHO LASCO instruments, as well as ground based images.

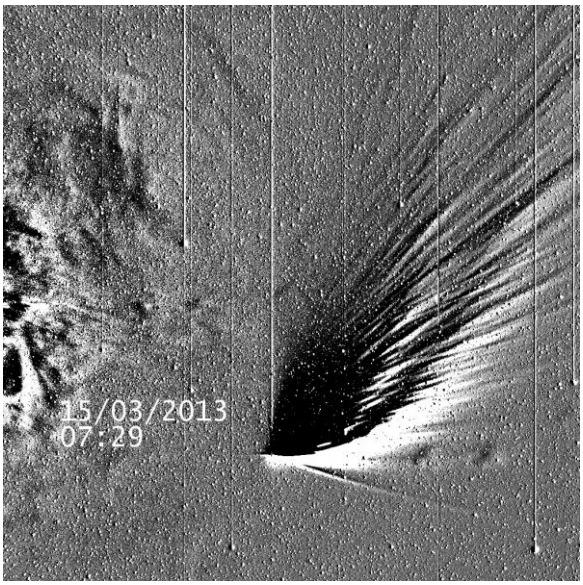

Figure 2: The dust tail of C/2011 L4 from STEREO B HI-1 (difference image), with the Sun to the left. The original striae are visible, along with several more sunwardly aligned features.

Our technique has allowed for the formation of striated features in a cometary tail to be resolved for the first time at comet McNaught. The nature of the formation mechanism of these striae remains an open question in cometary physics.

There is clear evidence that non-gravitational forces affect the morphology of striae in the dust tails of both comets. At McNaught, this appears to be from charged dust interaction as the comet crosses the Heliospheric Current Sheet. Here, we investigate what explanation there may be for the dust re-organisation at Pan-STARRS.

After the tail is affected at both comets, it appears to form new coherent dust features. We investigate also what explanations there may be for the formation of new features, which form well after the typical timescale for striae formation. We investigate what relation their structure has to the solar wind and structure within the heliosphere.

References

[1] Finson, M. J., & Probstein, R. F. (1968) The Astrophysical Journal, 154, 327-352.