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P/2010 A2 – Impact or rotational break-up?

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Abstract

The active asteroid P/2010 A2 was discovered in January 2010 by the LINEAR Sky Survey. It displayed a long, narrow dust tail, but has the orbit of an inner Main Belt asteroid. High resolution imaging with the Hubble Space Telescope (HST) showed that the dust in the tail seemed to emerge from a bright cross-shaped pattern of large dust grains rather than directly from the main nucleus, which appeared almost detached from the tail. Dynamical analysis of the tail's position angle on the sky revealed that the dust was emitted from the nucleus during a very short time span about nine months before the discovery of P/2010 A2 [1, 2]. We therefore proposed that in February or March 2009, P/2010 A2 either was impacted by a second asteroid or disrupted due to rotational break-up.

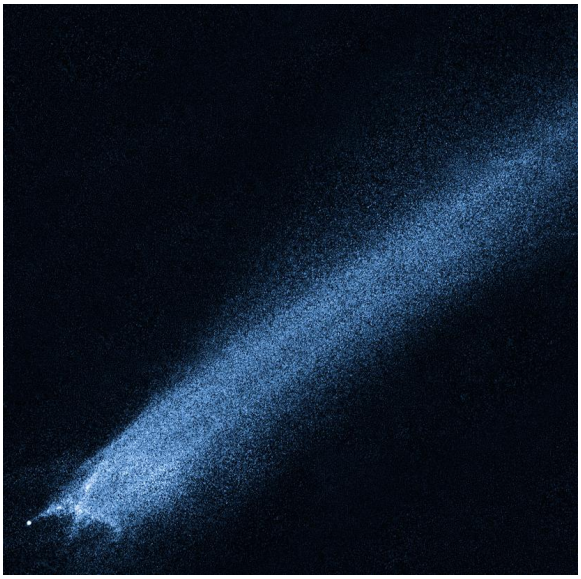

Figure 1: Asteroid P2010/A2 on 29 January 2010 seen with the HST WFC3/UVIS.

Here, we analyse the orbital paths of the tail structures at the head of the dust tail of P/2010 A2. We follow the positions of individual features over a series of HST images taken over several months in 2010. We simulate the trajectories of test particles emitted from the main nucleus in February or March 2009 to all directions, with variable speeds and radiation pressure parameters. We compare the trajectory of each test particle to the trajectories of the observed features, and in this way constrain the emission velocity and radiation pressure parameter (equivalent to size) of the grains forming the cross-shaped structure. We find that this region contains centimetre- to metre-sized particles ejected at speeds on the order of or below the escape speed of the 60m-sized nucleus. We discuss the implications of our results for the question of whether the dust eruption was triggered by an impact or by rotational break-up.

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References

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