P/2013 P5 PANSTARRS — a rubbing binary?

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P/2013 P5 PANSTARRS (hereafter P5) was discovered [1] on a Main Belt orbit, with a cometary appearance, thereby joining the small but growing collection of objects with such characteristics, loosely called the Main Belt Comets.

The dust-lifting process at play on these bodies is not known, although several hypotheses are considered. Furthermore, it is likely that different objects are associated with different processes. For instance, 133P [2,3] and 238P [4] were active for extended periods of time on consecutive passage through perihelion; traditional cometary activity, i.e. caused by the sublimation of volatile ice, is the most likely candidate. In other cases, e.g. (596) Scheila [5,6], P/2012 F5 [7,8] or P/2010 A2 [9–11], the morphology of the dust cloud was compatible with a short, impulsive dust release; they are interpreted as the result of an impact with a smaller body. Finally, in some cases, rotational disruption was proposed as the process causing the activity: a gentle centrifugal lift (proposed by Agarwal et al. [12] for A2) or a complete disruption for P/2013 R3 [13]. Other additional processes were proposed by Jewitt [14], but they do not apply in the case of P5.

P5 displayed a dust pattern [15–17] that had not been observed before in other objects. The dust cloud appeared as a series of radial fans and streaks, including some extremely narrow ones. The straight streaks matched synchrones, i.e. loci of dust particles emitted at a given time, and spread radially by the radiation pressure acting differently over a broad range of particle sizes. The narrowness of these lines, especially as observed with HST [15], indicated that the emission episodes were very short. Through a Finson-Probstein [18] analysis, it was shown that the dust release started at least 8 months before the observations, and had a series of very short episodes of dust releases.

Because of the location of P5 in the inner Main Belt, sublimation-driven activity is unlikely. Rotational disruption is a possible interpretation [15–17]: the peaks of activity would represent the effects of centrifugal landslides and surface readjustments.

We propose another process [17]: we suggest that P5 is a small, quasi-contact binary, whose components are either occasionally touching, or settling together into a full-contact binary. The object would then release dust liberated by these repeated low velocity impact, or rather rubbing between its components.

Sharma [19] studied the equilibrium of rubble-pile binaries, and concluded that many stable solutions exist for contact and near-contact objects, with a range of prolateness for both components and for a range of shear resistance of the rubble pile. In other words, such an object, if it can be formed, can be stable. Descamp [20] reviewed observations of known binaries in the context of the Roche systems, i.e. fully synchronized binary objects in fluid equilibrium. Several objects appear to be contact binaries, including some very small objects in the same size range as P5, e.g., 2002 $NY_4$0 and 2005 $CR_3$7. Radar observations [21] showed that (69230) Hermes is a fully synchronized binary, with components only slightly larger than P5 (630 and 560 m), separated by a few radii (1200 m). While their formation process is not known, these observations suggest that small, fully synchronized contact binaries do exist. In the case of P5, this hypothesis can be tested observationally, as the 3rd Kepler law indicates that the rotation period of the system should be of several hours, while a rotationally disrupted object should have a period of around 2 h or less. In the mean time, this idea is submitted to ACM.

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