Interplanetary Dust Particles from Jupiter-Family Comets

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There has been a long-standing question on the origins, that is, asteroids, comets and the other dust sources. To maintain the zodiacal cloud against the erosion by the Poynting-Robertson drag and the mutual collision among particles, there should be the substantial dust sources in the present Solar System [1].

We present evidence that Jupiter-family comets (JFCs) supply substantial materials into the interplanetary space. Nine JFCs, 2P/Encke, 4P/Faye, 22P/Kopff, 40P/Vaisala, 56P/Van Biesbroeck, 65P/Gunn, 67P/Churyumov-Gerasimenko, 118P/Shoemaker-Levy 4, and 123P/West-Hartley, were observed by Kiso 1.05-m Schmidt and the University of Hawaii 2.24-m telescope with optical CCD cameras ([2][3][4]). The obtained images were compared with the semi-analytical dynamical model of the dust particles emitted with none-zero velocities. It is found that all of these comets emitted big particles (>1mm) around 2 AU, and injected their mass at the rate of 23 kg/s on average. Assuming that all of JFCs (about 200 objects) inject the dust particles at the rate of 23 kg/s, the JFCs can compensate half of mass lost by Poynting-Robertson drag and mutual collision. Therefore, we conclude that JFCs are major dust sources in the current Solar system. Another finding is that the maximum size of the particles from nuclei is likely to depend on the perihelion distance. Around the Earth orbit, several centimeter-sized particles could be released from JFCs, which might be observable as fireball on earth.

References

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