Size Dependence of Dust Distribution around the Earth Orbit

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In our solar system, there are many interplanetary dust particles (IDPs) originating mainly from asteroid collisions and activity of comets. These particles gradually decrease its angular momentum and drift radially due to the absorption and re-radiation of the sunlight (Poynting-Robertson effect; e.g. Burns et al. 1979). Investigating the properties of the zodiacal dust particles may reveal the properties of parent bodies and the creation process of them.
We analyzed the thermal emission from the IDPs called as the zodiacal light observed via all sky survey by the first Japanese infrared astronomical satellite, AKARI. We found that the observed surface brightness in the trailing direction of the Earth orbit is greater than that in the leading direction by 3.7% in band at 9um and 3.0% in band at 18um. This result is consistent with previous observations with IRAS (Dermott et al. 1994). This asymmetry is thought to come from the asymmetric dust distribution made by the IDPs trapped by MMRs of Earth orbit.
In order to reveal dust properties resulting in the asymmetry of dust distribution, we numerically integrated dust orbits in the Solar system including radiation from the Sun. The orbital evolution can be characterized by the parameter βwhich represents the strength of the radiation force compared to the gravitational force from the Sun. The parameter βcan be defined as a function of dust properties such as dust radius s and material density ρ. In our calculations, particles are set to be 0.001-0.1 in β(corresponding to 3-300um in radius with ρ= 2g/cc) and their initial orbits are determined according to the origins of main-belt asteroids, Jupiter-family comets and Encke-type comets.
We found that larger particles are easier to be trapped by MMRs and make high density region in the dust distribution. However, larger particles are easier to be trapped by outer resonances which hardly contribute to the asymmetry in the surface brightness. In consequence, asteroidal grains of radius 30um are most likely to make the asymmetry in the surface brightness. For cometary grains, due to the high eccentricity, particles are difficult to be trapped by resonance and less likely to make the asymmetry compared to the asteroidal grains.
In this presentation, we show the results of analysis of AKARI observations and orbital calculations and discuss the origin and typical size of the IDPs.

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