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Dynamics of dust particles in the Jovian gossamer rings

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Abstract

In this work, we analyze the dynamics of dust particles in the Jovian gossamer rings with both analytical and numerical methods. Grain sizes from submicrons to one hundred microns are considered. For the numerical simulations, high accuracy orbital integrations for the orbital evolution of dust are employed, including the effects of higher degree Jovian gravity, the Lorentz force, solar radiation pressure, Poynting-Robertson drag, plasma drag, and gravity of the Sun and the Jovian moons (the four inner Jovian moons Metis, Adrastea, Amalthea and Thebe, and the four Galilean moons Io, Europa, Ganymede and Callisto). The dust particles are started from the orbits of the Jovian moons Amalthea and Thebe. For the Jovian plasma environment, we use the new Jovian plasma model DG2 [1]. For the Jovian magnetic field, we use the field model VIPAL up to fifth degree and fifth order [2]. The details of the dynamical model for numerical simulations are described and used in [3, 4, 5]. The long-term numerical integrations are carried out in the large computer cluster located at the Finnish CSC-IT Center for Science. For micron-sized and submicron-sized particles, the precise locations of orbital resonances in the region of the gossamer rings are size-dependent. We calculate the locations of these resonances (the 1:2, 2:3, 3:4 and 4:5 exterior Lorentz resonances, the 2:1 and 3:2 Io resonances, the 1:1 Amalthea resonance, and the 1:1 Thebe resonance) with the analytical method. The resonance locations calculated with the analytical method match well with the results obtained by the simulation results. The formation of the gossamer rings and the Thebe extension can be also explained in terms of the orbital resonances of dust particles [4]. Besides, we find that a large amount of sub-micron particles are transported outward to the region of the Galilean moons.

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References

[1] Garrett, H. B., Kim, W., Belland, B., and Evans, R.: Jovian plasma modeling for mission design. Pasadena, CA: Jet Propulsion Laboratory, National Aeronautics and Space Administration. JPL Publication 15-11. http://hdl.handle.net/2014/45478, 2015.

[2] Hess, S. L. G., Bonfond, B., Zarka, P., and Grodent, D.: Model of the Jovian magnetic field topology constrained by the Io auroral emissions. Journal of Geophysical Research, 116, A05217, 2011.

[3] Liu, X., Sachse, M., Spahn, F., and Schmidt, J.: Dynamics and distribution of Jovian dust ejected from the Galilean satellites. Journal of Geophysical Research: Planets, 121(7):1141-1173, 2016.

[4] Liu, X., Schmidt, J., and Krüger, H.: Formation of Jupiter's gossamer rings by resonant trapping of dust. submitted to Nature Communications, 2017.

[5] Liu, X. and Schmidt, J.: An arc of dust in the region of Jupiter's Trojan asteroids. submitted to Astronomy & Astrophysics, 2017.