ACCRETION OF SOLID PARTICLES ONTO CIRCUM-PLANETARY DISKS

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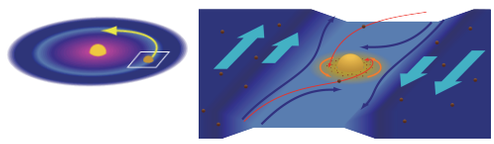
Abstract

Regular satellites of the giant planets in our solar system are believed to be formed in circum-planetary disks around the planets during the final stage of the formation. Recent hydrodynamic simulations have revealed that gas disks around giant planets are inevitably formed in the course of gas accretion growth phase. However, in order to form satellites, solid materials are necessary in the gas disks and thus should also be accreted onto the circum-planetary disks from proto-planetary disks.
In this study, we performed orbital simulations of solid particles which is originally rotating in heliocentric orbits in order to investigate accretion efficiency onto circum-planetary disks under the influence of gas accretion flow. We found that the accretion efficiency of the solid particles peaks around 10m-sized particles because energy dissipation of drag with circum-planetary disk gas in this size regime is most effective. The efficiency for particles larger than 10m size becomes lower because gas drag becomes less effective for larger particles. For particles smaller than 10m, the efficiency is lower because the particles are strongly coupled with the back-ground gas flow, which prevent from accretion. We will discuss satellite formation process based on the obtained accretion efficiency of solid particles.

Introduction

Hydrodynaic simulations for growing giant planets
(e.g., Miki 1982, Lubow et al. 1999; Ayliffe & Bate 2009, Tanigawa et al. 2012)

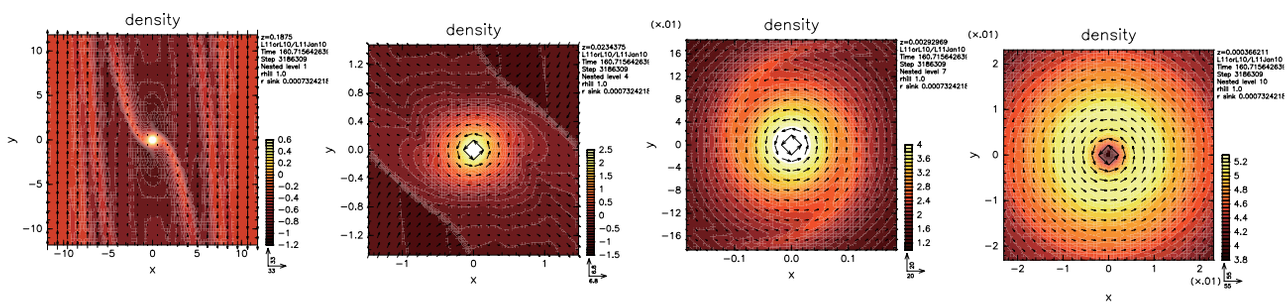
⟶ Formation of circumplanetary gas disks



To form satellites, solid material is necessary, however, accretion of solid material onto circumplanetary disks has not been studied.

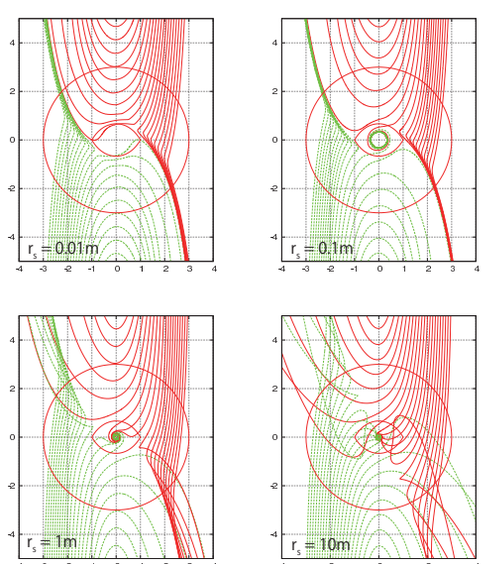
Background Gas Flow

(see Tanigawa, Ohtsuki, and Machida 2013, ApJ, 747, 47)



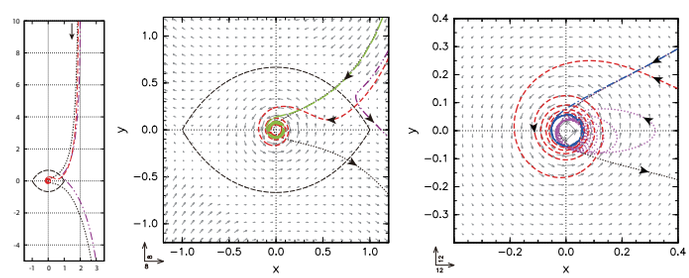
Movie here!

Strong gas drag cases

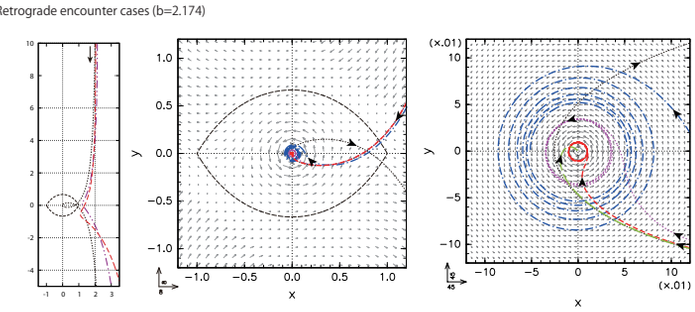


Weak gas drag cases

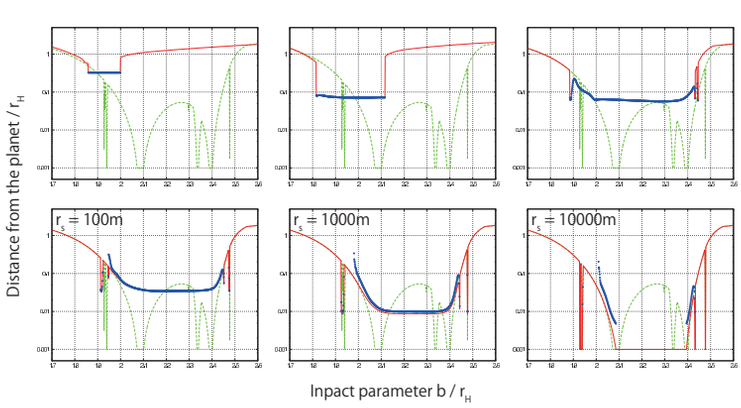
Prograde encounter cases (b=2.022)



Retrograde encounter cases (b=2.174)



Minimum distance to the planet and captured points



Captured radius