Local Linear Analysis of Interaction between a Planet and Viscous Disk and an Implication on Type I Planetary Migration

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We investigate the effect of the viscosity on disk-planet interaction and type I migration of planets. We have performed a linear calculation using shearing-sheet approximation and obtained the detailed, high resolution density structure around the planet embedded in a viscous disk with a wide range of viscous coefficients. We find that the density structure in the vicinity of the resonance is modified and the main contribution to the torque comes from this region, in contrast to inviscid case. The torque can be much larger than the inviscid case, depending on the Reynolds number. This effect has been neglected so far but our results indicate that the interaction between a viscous disk and a planet is qualitatively different from an inviscid case and the detail of the density structure in the vicinity of the planet is critically important. We also briefly discuss a possible connection between the analyses of viscous disks and turbulent disks.

Reference: Takayuki Muto and Shu-ichiro Inutsuka, preprint (arXiv:0902.1887)