Effects of magnetically-driven disk winds on type I migration

*Masahiro Ogihara[1], Eiichiro Kokubo[1], Takeru Suzuki[2], Alessandro Morbidelli[3], Aurélien Crida[3]

1. National Astronomical Observatory of Japan, 2. University of Tokyo, 3. Observatoire de la Cote d'Azur

Magnetically-driven disk winds would alter the surface density slope of gas in the inner region of a protoplanetary disk ($r < 1$au), which in turn affects migration of low-mass planets (type I migration). Recently, the effect of disk wind torque has been considered, showing that it would carve out the surface density of the disk from the inside out.

The direction and rate of type I migration depend on the surface density slope of gas and saturation of the corotation torque. We investigate migration of low-mass planets in disks evolving via disk winds. In MRI-active disks, the surface density slope can be flat in the inner region, and migration of super-Earth mass planets is suppressed. In MRI-inactive disks, in which a positive surface density slope can be achieved, planets in the sub-Earth mass range may undergo outward migration.

It has also been pointed out that the wind torque induces global gas flows (wind-driven accretion), which may modify the desaturation effect of the corotation torque. Then, we investigate effects of wind-driven accretion (global gas flows) on type I migration. In MRI-inactive disks, in which the wind-driven accretion dominates the disk evolution, the gas flow at the midplane plays an important role. If this flow is large, the corotation torque is efficiently desaturated. Then, the fact that the surface density slope can be positive in inner region due to the wind torque can generate an outward migration region extended to super-Earth mass planets. In this case, we observe that no planets fall onto the central star in *N*-body simulations with migration forces imposed to reproduce such migration pattern.

Keywords: Magnetically-driven disk winds, Type I migration, Protoplanetary disk, N-body simulation

