# ケルビンヘルムホルツ不安定の初期擾乱に対する鋭敏性

# 松本 洋介 [1]; 関 華奈子 [1]
[1] 名大 STE 研

# Sensitivity of Kelvin-Helmholtz instability to initial perturbations

# Yosuke Matsumoto[1]; Kanako Seki[1]
[1] STEL, Nagoya Univ.

The spatial degree of freedom in actual situations, for example, at the magnetopause, is much larger than box size of usual numerical simulations of the Kelvin-Helmholtz instability (KHI). If one allowed a larger simulation size, not only the fastest growing mode (the fundamental mode), but also the subharmonic modes start to grow [Wu, 1986; Miura, 1999]. Eventually, the longest wave mode dominates the system and a large scale vortex appears. In general, the subharmonic modes are initialized by seed perturbations with constant amplitudes and random phases among modes. However, 2-D simulations of the KHI showed that the growth of the subharmonic modes is sensitive to the initial perturbations: when the phases among modes are coherently set, the subharmonic mode saturates at larger amplitude [Patnaik et al., 1976; Baty et al., 2003].

In this study, we focus on sensitivities of the KHI to the initial perturbations in terms of phase and a spectrum power index. MHD simulations were conducted to examine how the initial perturbations determined the fate of the KHI through competitive processes of the subharmonic modes and the secondary instabilities.

First, we examined two cases focusing on the initial phase difference of the perturbations. 3-D MHD simulations of the KHI show that when the phase difference between the first subharmonic (m=1) and the fastest growing (m=2) modes is zero, the energy of the mode m=2 is inversely cascaded to the mode m=1, resulting an emergence of a large scale vortex. The vortex paring inhibits the growth of the secondary MRI instability [Matsumoto and Seki, 2007]. When the phase of m=1 is shifted by 0.5¥pi, the secondary instability grows inside each KH vortex and the system undergoes a transition to a turbulent state even under the strong magnetic fields (¥beta=1.0).

In addition to the phase difference, we have also examined the effect of a spectrum power index of initial perturbations. This has been examined by 2-D MHD simulations by comparing the growth rates of the subharmonic modes. Initially, we added 8 modes (m=4 is the fastest growing mode) whose amplitudes are related to the spectrum power index of ¥alpha ranging from -1 to +1.5, while the phases are randomly shuffled. We found much faster appearance of the largest vortex (m=1) for the case ¥alpha=1.5 than for ¥alpha=-1 in which we observed growth of m=1 mode as expected from the linear theory. The maximum growth rate of the mode m=1 reached three times as large as the one from the linearly theory. In this talk, we also show a possible mechanism of rapid formation of a broad mixing layer by a combination of fast appearance of large scale vortex (inverse cascade) and the secondary R-T instability (direct cascade) [Matsumoto and Hoshino, 2006].