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# プラズマ中におけるリヒトマイヤー・メシュコフ不安定の磁気流体的進化
# Magnetohydrodynamic evolutions of the Richtmyer-Meshkov instability in astrophysical and laboratory plasmas

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The Richtmyer-Meshkov instability (RMI) in magnetohydrodynamics is of great interest in many fields such as astrophysical phenomena, laboratory experiments, and inertial confinement fusion. The RMI occurs when an incident shock strikes a corrugated contact discontinuity. A strong shock wave traveling through the density inhomogeneity of magnetized interstellar medium is a promising site of the RMI. This astrophysically common event plays a key role in determining the dynamics of supernova remnants and gamma ray bursts. Recent laboratory experiments are designed to test the magnetic field amplification due to the RMI by the use of laser-induced shock waves. In inertial confinement fusion, the RMI excited at several capsule interfaces amplifies the perturbations that seed the Rayleigh-Taylor instability. For the fast ignition approach, the utilization of an external magnetic field to guide the fast electrons is discussed proactively and sheds light on the impact of magnetohydrodynamic (MHD) instabilities during the implosion.

The inclusion of a magnetic field brings two important consequences into the RMI, which are the amplification of an ambient field and the suppression of the unstable motions. The magnetic field can be amplified by the stretching motions at the interface associated with the RMI. A strong magnetic field inhibits the nonlinear turbulent motions of the RMI. The vorticity generated by the interaction between a shock front and a corrugated contact discontinuity is the driving mechanism for the RMI. For the cases of MHD parallel shocks, the role of the magnetic field is to prevent the deposition of the vorticity on the interface, and stabilize the RMI.

We have investigated that the critical strength of a magnetic field required for the suppression of the RMI numerically by using a two-dimensional single-mode analysis. For the cases of magnetohydrodynamic parallel shocks, the RMI can be stabilized as a result of the extraction of vorticity from the interface. A useful formula describing a critical condition for magnetohydrodynamic RMI is introduced and is successfully confirmed by direct numerical simulations. The critical field strength is found to be largely dependent on the Mach number of the incident shock. If the shock is strong enough, even low-beta plasmas can be subject to the growth of the RMI.

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