Overstability of strongly magnetized anisotropic MHD nonuniform astrophysical flows

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We present linear stability analysis of the perturbations modes in anisotropic MHD flows with velocity shear, strong magnetic field and accounting for the effect of heat fluxes. Considered model includes the effect of heat fluxes by considering 16-momentum anisotropic MHD system. This approach has already proved to be successful in explaining the solar wind properties in fluid approximation.

In the presented study magnetic field is set to be strong enough to ensure both, plasma anisotropy and justify the cold plasma approximation, when thermal pressure dominates over the magnetic one. Magnetic field and mean flow velocity point in the same direction, while the velocity shear is directed across the perpendicular to magnetic field direction. In this limit we investigate linear spectrum of the problem and derive analytic solution for linear modes for the case of strong magnetic field. Here we show that one slow magnetosonic mode is revealed into three different type of sonic waves, one of which is unstable at some supercritical heat flux parameter $\gamma= S_{\|}/C_{\|}$, where $S_{\|}$ and $C_{\|}$ are parallel to magnetic field heat flux and sound velocities. For the first time we derive the specific value of critical heat flux parameter and do not use the asymptotic description. We analyze the linear spectrum in the presence of the background velocity shear numerically. The study shows that magnetosonic waves can be unstable (overstable) for both, subcritical, as well as supercritical heat flux parameters. Therewith, for flows with strong anisotropic heat fluxes velocity shear can modify the growing magnetosonic wave and lead to its instability.

Described compressible destabilization in strongly magnetized inhomogeneous flows can play an important role for some astrophysical objects. Apart from well known solar wind problem, we expect that found instability can be important in magnetized outflows in the corona of astrophysical disks, as well as in magnetized galactic winds at large scales.