Instability of electromagnetically-driven liquid metal flow

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We present a new MHD experiment in which a flow of liquid metal (GaInSn) is driven in an annular channel by a Lorentz force due to a sinusoidal magnetic field traveling in the azimuthal direction. Both axial and azimuthal components of the velocity field are measured using ultrasound Doppler velocimetry and potential probes.

We show that the mean velocity profile is in agreement with some theoretical predictions, suggesting that flux expulsion due to the induction in the annulus plays an important role in the dynamics of the flow.

When the liquid metal is subject to two counter-propagative magnetic field, the flow becomes unstable and chaotic reversals of the mean azimuthal flow are observed: power spectrum of the velocity field exhibits $1/f$ noise on several decades and different regimes can be observed depending on the parameters. In particular, the occurrence of $1/f$ noise is related to the level of turbulence in the flow.