# Exploring the hydromagnetic Bermuda triangle between Taylor, Tayler, and Velikhov

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with

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The interaction of rotating fluids and magnetic fields is of fundamental importance for a number of astrophysical processes. The magnetorotational instability (MRI), discovered by Velikhov in 1959, is considered as a viable mechanism for triggering turbulence and angular momentum transport in accretion disks. The Tayler instability (TI), a kink-type current-driven instability, may play an important role in angular momentum transport in stars, and is also discussed as a possible ingredient of an alternative stellar dynamo mechanism.

We start by analyzing the problem of a viscous, resistive, incompressible rotating fluid under the influence of a constant axial magnetic field and an azimuthal field with arbitrary radial dependence. Within the short-wavelength approximation, we focus on the limit of low magnetic Prandtl numbers and explore the various inductionless versions of MRI, and the TI. As a main result, we show that with a slight deviation of the azimuthal magnetic field profile from the current-free 1/r law, the inductionless versions of MRI become capable of destabilizing Keplerian flows. In addition, we present a new 3D integro-differential equation code that allows to study TI for real liquid metal systems.

We further summarize recent results, obtained in various liquid metal experiments, on the helical and the azimuthal MRI, and on the TI. Finally, we discuss the prospects for studying MRI and TI in a combined large scale liquid sodium experiment in the framework of the DRESDYN project.