INFLUENCE OF THE MAGNETIC FIELD ON A VORTEX OF GALLIUM

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We built an experimental set-up to study the interaction between one single vertical vortex of liquid gallium, generated by a disk, and a transverse magnetic field. Magnetic Reynolds number of 0.1 has been reached. This experiment has been conducted on a rotating table. Thus, dominant forces are Coriolis and Lorentz forces, like in the Earth's core. We measured pressure profiles at the top of the vortex, differences in electrical potentials between some points in the vortex and the magnetic field induced by the flow. In order to understand the velocity flow of the vortex, we introduced a simple two dimensional model which actually predicts well these three kinds of measurements. Under the influence of the magnetic field, the vortex is slowed down but remains bidimensional; The Elsasser number (ratio of Lorentz over Coriolis forces) is the critical parameter for the dynamical aspect of the vortex. Moreover, the size of the vortex increases with the strength of the magnetic field. The vortex remains geostrophic up to Elsasser number of 0.2. The induced magnetic field forms a horizontal dipole perpendicular to the imposed field, and has a significant vertical component. We show that it is due to the geometry of the electrical currents and insulating boundaries rather than helicity.