FM19S_10235

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Bifurcation of Conical Magnetic Field

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The appearance of a magnetic field in a magnetic-free flow of an electrically conducting fluid is an intriguing manifestation of symmetry breaking. It is shown that bifurcation of magnetic field (BMF) is typical of conical flows. The conical flows include the Schlichting, Landau and Squire swirl-free jets, the Long swirling jet, and many other jet-like flows. Some jet-like flows consist of not only outflow but also inflow regions, e.g., near accretion disks in cosmic jets and near the surface of electro-slag flows. The inflows being sufficiently strong overcome magnetic diffusion and accumulate the magnetic field in the similarity region where the magnetic induction behaves as velocity. The accumulation manifests as BMF in a conical model. We prove that BMF occurs in a flow with accretion and show a few examples which mimic cosmic and technological jets. Interestingly, the accretion enhances mostly the magnetic field rather than the jet velocity.

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