Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Ertel's vorticity theorem and new flux surfaces in classical fluids[1]

ELIE HAMEIRI, Courant Institute - NYU — Following our work on the Ertel surfaces for multi-fluid plasmas [1], we work out the analogous case of an unmagnetized classical fluid. The case of a compressible and nonisentropic fluid is intriguing because it is typically not considered by fluid dynamiscists who mostly deal with incompressible fluids or with equations of state of the form p = p(density), but not when p also depends on the entropy. In the general case, the vorticity is not strictly carried by the fluid, but nevertheless there are still surfaces in which its toroidal and poloidal fluxes are conserved, a notion more familiar in plasma physics than in fluid dynamics. In carrying out this work it is necessary to find all independent constants of the motion, which are used as constraints in a variational principle. It is also necessary to distinguish between toroidal and cylindrical equilibria, since the number of constants of the motion is not the same for both. We are able to show in each case that we have indeed accounted for all the constants. This formulation allows the simple consideration of stability, which will also be discussed.

[1] E. Hameiri, Phys. Plasmas, 20, 092503 (2013).

[1]Work supported by USDOE Grant No. DE-FG02-86ER53223.

Eliezer Hameiri
New York Univ NYU

Date submitted: 23 Jul 2015 Electronic form version 1.4