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Exact Ellipsoidal Hamiltonian Reductions of Euler's Equations
P.J. MORRISON, University of Texas at Austin, N.R. LEBOVITZ, University of Chicago, J.A. BIELLO, University of California at Davis — There exist special initial conditions that result in simplified yet exact reductions of ideal fluid systems. Examples include point vortex dynamics, Kirchoff and Kida elliptical vortex patch dynamics, quasigeostrophic ellipsoidal dynamics, and equations that describe the dynamics of Riemann's self-gravitating ellipsoids. All of these systems except the last have been directly obtained from the Hamiltonian (noncanonical Poisson bracket) description of Euler's fluid equations [1], and the subject of the present work is to do this for the Riemann ellipsoids. We begin with the Poisson bracket for the compressible fluid and project it to obtain a bracket for incompressible dynamics. We then reduce by considering dynamics restricted to velocity and density moments. It is seen that this reduction is exact, and that the Poisson bracket obtained produces the finite degree-of-freedom Hamiltonian system that describes Riemann's ellipsoids.

[1] P.J. Morrison, Rev. Mod. Phys. **70**, 467 (1998).

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