1049-35-154 **Steve Shkoller*** (shkoller@math.ucdavis.edu), Department of Mathematics, University of California Davis, Davis, CA 95616. *A degenerate hyperbolic free-boundary problem for 3D compressible Euler flow in physical vacuum and the method of artificial phase.*

We prove existence and uniqueness for the three-dimensional compressible Euler equations with moving *physical* vacuum boundary, with an equation of state given by $p(\rho) = C_\gamma \rho^\gamma$ for $\gamma > 1$. The vacuum condition necessitates the vanishing of the pressure, and hence density, on the dynamic boundary, which creates a degenerate and characteristic hyperbolic *free-boundary* system to which standard methods of symmetrizable hyperbolic equations cannot be applied. We introduce a new method, which we call the *method of artificial phase*, to construct solutions for degenerate hyperbolic systems of equations, and apply it the degenerate compressible Euler equations. With this method, solutions to the compressible Euler equations are constructed as a limit of a sequence of two-phase problems, where one phase consists of non-degenerate Euler equations with initial density function $\rho_0^\epsilon = \rho_0 + \epsilon$ for $\epsilon > 0$, and the other artificial phase consists of a specially chosen elliptic system coupled to the Euler equations in such a way as to a priori smooth the moving vacuum boundary. This work is in collaboration with D. Coutand and H. Lindblad. (Received March 02, 2009)