1067-35-2009 **Michael T. Heitzman*** (heitzmanmt@gmail.com), 16 E. Stewart Rd. Apt. 7, Columbia, MO 65203, and **Carmen Chicone** (chiconec@missouri.edu), Mathematics Department, 202 Mathematical Sciences Bldg, University of Missouri, Columbia, MO 65211. *A nonlinear free boundary problem in gas dynamics.*

Motivated by the two-body problem in the classical field theories of electrodynamics and gravitation, we have developed a free boundary problem in gas dynamics to explore the motion of sources in a medium whose dynamics are governed by hyperbolic PDEs arising from physical conservation laws. In our model, the medium is a gas confined to a tube, and the sources are pistons which form a free boundary at each end. The pistons are attached to springs, and behave as damped harmonic oscillators driven by fluctuations in the gas pressure and density fields. The fields are governed by the nonlinear PDEs of gas dynamics, with the motion of the pistons included as boundary conditions. The coupled system is a nonlinear PDE/ODE hybrid with free boundary. In the linearized acoustic model, the fields are eliminated by the method of characteristics, yielding functional differential equations for the motion of the sources. These are approximated by reduction to a finite dimensional manifold. We also treat the full nonlinear free boundary problem and show that unique classical solutions exist locally in time, for initial fields close enough to their constant steady state. This is done by transforming to Lagrangian coordinates to fix the boundary, and applying the contraction mapping principle. (Received September 22, 2010)