

STRICHARTZ ESTIMATES FOR THE COMPRESSIBLE EULER EQUATION WITH VORTICITY AND LOW-REGULARITY SOLUTIONS

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We prove a series of intimately related results tied to the regularity and geometry of solutions to the three-dimensional compressible Euler equations. The solutions are allowed to have nontrivial vorticity and entropy, and an arbitrary equation of state with positive sound speed. The central theme is that under low regularity assumptions on the initial data, it is possible to avoid, at least for short times, the formation of shocks. Our main result is that the time of classical existence can be controlled under low regularity assumptions on the part of the initial data associated with propagation of sound waves in the fluid. Such low regularity assumptions are in fact optimal. To implement our approach, we derive several results of independent interest: (i) sharp estimates for the acoustic geometry, which in particular capture how the vorticity and entropy interact with the sound waves; (ii) Strichartz estimates for quasilinear sound waves coupled to vorticity and entropy; (iii) Schauder estimates for the transport-div-curl-part of the system. Compared to previous works on low regularity, the main new feature of our result is that the quasilinear PDE system under study exhibits multiple speeds of propagation. In fact, this is the first result of its kind for a system with multiple characteristic speeds. An interesting feature of our proof is the use of techniques that originated in the study of the vacuum Einstein equations in general relativity.