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Pointwise decay estimates for multidimensional Navier-Stokes diffusion waves. (English)

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Summary: Earlier we determined a unique "effective artificial viscosity" system approximating the behavior of the compressible Navier-Stokes equations. Here, we derive a detailed, pointwise description of the Green's function for this system. This Green's function generalizes the notion of "diffusion wave" in the one-dimensional case, being expressible as a nonstandard heat kernel convected by the hyperbolic solution operator of the linearized compressible Euler equations. It dominates the asymptotic behavior of solutions of the (nonlinear) compressible Navier-Stokes equations with localized initial data. The problem reduces to deriving estimates for the wave equation, with initial data consisting of various combinations of heat and Riesz kernels; however, the calculations turn out to be surprisingly subtle, involving cancellation not captured by standard L^p estimates for the wave equation.

MSC:

76N15	Gas dynamics, general
35Q30	Navier-Stokes equations
35L30	Initial value problems for higher-order hyperbolic equations
35K65	Degenerate parabolic equations

Keywords:

effective artificial viscosity; hyperbolic operator; Green's function; heat kernel; linearized compressible Euler equations; wave equation; Riesz kernels

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