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Magnetohydrodynamic Shock Wave Motion in a Moving Ideal Gas with Exponential Density Distribution

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Abstract: *The propagation of magnetohydrodynamic (MHD) shock waves in a moving ideal gas with exponentially varying ambient density is investigated using the self-similar method and the Chester-Chisnell-Whitham (CCW) approximation. The governing equations of ideal MHD are reduced to ordinary differential equations via similarity transformations suitable for an exponential density profile* $\rho_0 \propto exp(-r/\lambda)$*. Strong-shock assumptions and Rankine-Hugoniot jump conditions incorporating magnetic pressure are applied. Numerical integration of the resulting system reveals the effects of the Alfvén-Mach number, rotation (if present), and density scale height on post-shock flow variables. Results are compared with earlier gas-dynamic and MHD studies. The analysis shows that magnetic field and exponential density stratification significantly modify shock strength and flow profiles behind the wave*

Keywords: Magnetohydrodynamic shock waves, exponential density, self-similar solution, CCW method, ideal gas.

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