Suppression of X-rays from radiative shocks by their thin-shell instability

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We examine X-rays from radiatively cooled shocks, focusing on how their thin-shell instability reduces X-ray emission. For 2D simulations of collision between equal expanding winds, we carry out a parameter study of such instability as a function of the ratio of radiative vs. adiabatic-expansion cooling lengths. In the adiabatic regime, the extended cooling layer suppresses instability, leading to planar shock compression with X-ray luminosity that follows closely the expected (Lx âˆ¼ M^2) quadratic scaling with mass-loss rate M . In the strongly radiative limit, the X-ray emission now follows an expected linear scaling with mass loss (Lx âˆ¼ M), but the instability deforms the shock compression into extended shear layers with oblique shocks along fingers of cooled, dense material. The spatial dispersion of shock thermalization limits strong X-ray emission to the tips and troughs of the fingers, and so reduces the X-ray emission (here by about a factor 1/50) below what is expected from analytic radiative-shock models without unstable structure. Between these two limits, X-ray emission can switch between a high-state associated with extended shock compression, and a low-state characterized by extensive shear. Further study is needed to clarify the origin of this â€œshear mixing reduction factorâ€• in X-ray emission, and its dependence on parameters like the shock Mach number.

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