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Structure and Scale of Cosmic Ray Modified Shocks VASSILI ROZANOV, St. Petersburg University, Russia, MIKHAIL MALKOV, PATRICK DIAMOND, UCSD, ROALD SAGDEEV, University of Maryland — Astrophysical shocks, diffusively accelerating cosmic rays (CR) ought to develop CR precursors. The length of the precursor L_p is believed to be set by the ratio of the CR mean free path λ to the shock speed, $L_p \sim c\lambda/V_{sh} \sim cr_g/V_{sh}$, which is independent of the CR pressure P_c. However, the X-ray observations of supernova remnant shocks suggest that the precursor scale may be significantly shorter than L_p which would question the above estimate unless the magnetic field is strongly amplified and the gyroradius r_g is strongly reduced. We argue that while the CR pressure builds up ahead of the shock, the acceleration enters into a strongly nonlinear phase in which an acoustic instability, driven by the CR pressure gradient, dominates other instabilities (for $\beta < 1$). In this regime the precursor steepens into a strongly nonlinear front whose size scales with *the CR pressure* as $L_f \sim L_p \cdot (L_s/L_p)^2 \, (P_c/P_g)^2$, where L_s is the scale of the developed acoustic turbulence, and P_c/P_g is the ratio of CR to gas pressure. Since $L_s \ll L_p$, the precursor scale reduction may be strong in the case of even a moderate gas heating by the CRs through the acoustic and (possibly also) the other instabilities driven by the CRs.

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