Broad band and Gamma-ray emission from SNRs

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Abstract

I report on a model for the broad-band emission from SNR J1713 including a consistent calculation of thermal X-ray emission together with non-thermal emission in a nonlinear diffusive shock acceleration (DSA) model (Ellison et al. 2010, ApJ). This model tracks the evolution of the SNR including the plasma ionization state between the forward shock and the contact discontinuity. We use a plasma emissivity code to predict the thermal X-ray emission spectrum assuming the initially cold electrons are heated either by Coulomb collisions with the shock heated protons (the slowest possible heating), or come into instant equilibration with the protons. For either electron heating model, electrons reach X-ray emitting temperatures rapidly and the X-ray line emission near 1 keV is more than 10 times as luminous as the underlying thermal continuum. Since recent Suzaku observations show no detectable line emission, this places a strong constraint on the unshocked ambient medium density and on the electron to proton ratio. For the uniform circumstellar medium (CSM) models we consider, the low densities and high electron to proton ratios required to match the Suzaku X-ray observations definitively rule out pion-decay as the emission process producing GeV-TeV photons in this particular SNR. We show that a leptonic model, where inverse-Compton scattering against the cosmic background radiation dominates the GeV-TeV emission, can produce a satisfactory fit to the broad-band thermal and non-thermal observations in a uniform CSM.