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# The supernova remnant SN 1006 as a Galactic particle accelerator

The origin of cosmic-rays is an open issue of high-energy astrophysics. Supernova remnants are expected to be the main source of Galactic cosmic rays up to energies of about 3 PeV, provided that they transfer a significant fraction of their kinetic energy to the particles (~ 10%). In particular, the loss of such a large fraction of energy is predicted to alter the shock dynamics (shock modification) by enhancing the shock compression ratio above the canonical value of 4. The bilateral supernova remnant SN 1006 is an ideal target to study shock modification because of its evolution in a fairly uniform environment. SN 1006 shows bright synchrotron X-ray emission from ultrarelativistic electrons accelerated at the shock front in its northeastern and southwestern limbs. If efficient hadron acceleration occurs in these regions, we should observe shock modification therein. We performed a spatially resolved spectral analysis of Chandra and XMM-Newton observations of SN 1006 by selecting narrow regions between the shock front and the contact discontinuity and measuring the density of the X-ray emitting plasma. Our results show an increase of the compression ratio from the characteristic value of 4, in thermal limb, up to ~ 7 in nonthermal limbs, i.e. in regions where the ambient magnetic field is almost parallel to the shock velocity. We conclude that an efficient particle acceleration causes shock modification in quasi-parallel shocks in SN 1006. By comparing our results with state-of-the-art models, we find that SN 1006 is trasferring a significant fraction of its kinetic energy to hadrons. The inferred values of compression ratios and cosmic ray slopes are consistent with those expected for modified shocks which is affected by the effects of the postcursor.

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