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Cosmic rays acceleration in SN 1006

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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. The bilateral supernova remnant 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 expect that it affects the shock dynamics by enhancing the shock compression ratio above the canonical value of 4. We performed a spatially resolved spectral analysis of Chandra and XMM-Newton observations of SN 1006 by measuring the density of the shocked ambient medium in narrow regions between the shock front and the contact discontinuity. Our results show an increase of the compression ratio up to ~ 7 in northeastern and southwestern 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 transferring a significant fraction of its kinetic energy to hadrons.

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