

## Effects of neutral particles on SNR shocks

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H-alpha emission from supernova remnants (SNRs) implies the existence of neutral hydrogens in the ambient medium. Some of the neutral particles penetrating the shock are ionized by the charge exchange process and make a cold ion beam in the shock downstream region. We perform linear analyses of collisionless plasma instabilities between the cold beam and the hot downstream plasma. We find that, under typical SNR condition, either the resonant instability or the Weibel instability is the most unstable. This mechanism may amplify the magnetic field to more than 100 micro gauss and changes the shock structure.

In the precursor of an SNR shock modified by cosmic rays (CRs), upstream plasmas are pushed by the CR pressure, but neutral particles are not, so that the relative velocity appears and some neutral particles become pickup ions by the charge exchange process in the precursor. We investigate how the pickup ions affect the shock structure and the particle acceleration in the precursor. Because of the pressure of the pickup ions, the compression of the shock becomes smaller than that without pickup ions. As a result, even if the shock is modified by CRs, the total compression ratio can be smaller than 4. In addition, the pickup ions make an important role for the injection into the particle acceleration. If the multiply reflected ion acceleration occurs, the CR spectrum can be harder than that of the test particle diffusive shock acceleration below GeV.

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