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Low frequency radio observations: critical in revealing inhomogeneous shock structures

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Low frequency radio observations with the Giant Metrewave Radio Telescope (GMRT) in some core collapse supernovae have revealed inhomogeneous shock structure. Due to these inhomogeneities, the optically thick spectra of supernovae will evolve with flatter index than of expected from the free-free or synchrotron absorption mechanisms. While this mechanism has some analogy to compact AGN cores with relatively flatter spectral indices, and has been talked about in moderate details in literature [1, 2], the observations evidence has been suggested in a handful of cases only.

In this paper, I will show some examples where early GMRT observations have revealed this phenomenon directly. This manifests itself in the optically thick part of the spectra and light curve and can give information about the distribution of the magnetic field and the relativistic electrons (Fig. 1). In particular I will talk about MASTER OT J120451.50+265946.6, a Type Ib supernova, where the radio data reveal that the radio emission is arising from a shock with inhomogeneities mainly in the magnetic field distribution.

I will also discuss the predictions of such models. Our model predicts that the inhomogeneities should smooth out if followed long enough. We are continuing to observe SN J1204 at GMRT frequencies, especially 325 MHz band and these observations will test the above hypothesis, and reveal whether the synchrotron emitting region has emerged into a homogeneous one at late epochs. With low frequency sensitive telescopes like SKA, upgraded GMRT, such studies will be possible for a large number of supernovae in the future.

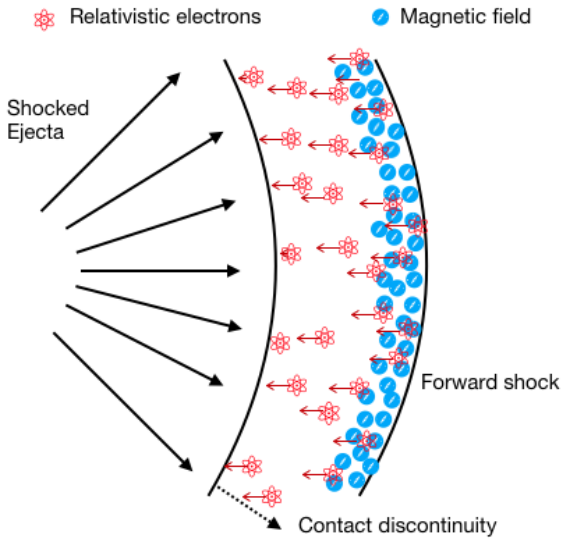

Figure 1. Cartoon diagram of a situation where relativistic electrons are homogeneously distributed, but magnetic field is not. The near constant magnetic field is confined within a small distance from the shock front..

References

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[2] C.-I. Bjórnsson and S. T. Keshavarzi, "Inhomogeneities and the Modeling of Radio Supernovae," *The Astrophysical Journal*, **841**, 20 May 2017, pp. 12–23, doi: 10.3847/1538-4357/aa6cad.