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Supernova Remnants in Starburst Regions

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Abstract. We study the evolution of SNRs in starburst regions taking into consideration the role of the high ambient pressure and the influence of gravitational forces from the stellar component within the shell of a SNR. On this basis, we discuss the connection between the radio, infrared, and gamma emissions from starburst regions.

Keywords. supernova remnants — galaxies: starburst

The evolution of SNRs in active starbursts occurs in extreme conditions of high pressure and high matter density that strongly differs from the case of evolution in the standard ISM of normal galaxies. The matter in the central parts of starbursts (SBs) consists of diffuse gas and stars (also possible dark matter). Because SBs consist of massive stars, which live for a few 10^6 yrs, the first SNe explosions occur in very high densities of both components. The SN blast wave propagating in such environs will sweep up the diffuse component into the shell and strip the nearby presupernova stars of their H-rich envelopes leaving them inside the SNR. The first stages of evolution of such SNR can be described by the standard theory of SNR evolution, according to which the initial phase of free expansion smoothly transits into Sedov phase. The diffuse component is of the order $\sim 10^{3-6}\,\mathrm{cm}^{-3}$, so the occurrence of the radiative phase is inevitable. Due to the high pressure in the ISM of SBs ($\sim 10^{5-10}\,\mathrm{K\,cm}^{-3}$) the Sedov phase is expected to be very short. The following evolution of the envelope of the SNRs will take place under the influence of the pressure in the ISM and the gravitational forces from the stars inside the envelope. The last component will strongly diminish the maximum size of SNR, and the impact of such SNRs on the general structure of the SB region will be minor. The temperature inside of such SNR will be very high and the X-rays from this gas (Draine& Woods 1991) and UV from young stars will ionize the surface of the SNR envelope and heat it. Observationally such SNRs can be seen as high velocity HII regions because at high densities the radiative phase begins at high velocities. In these shells there are all conditions (the formation of dust particles and their heating) to be bright sources of IR radiation. It is well known that SNRs are the sites where the acceleration of particles takes place. Electrons will emit the observed from starbursts synchrotron emission and they can also emit gamma rays but protons can manifest themselves through the gamma-radiation. Simple calculations show that active SBs can be the sources of > 100 MeV gamma emission (Storm *et al.* 2012), but it is hard to expect from them TeV gamma rays, because in such high density environments high energy protons and electrons have short lifetimes. So, the SNRs can easily explain the observed correlations between radio, IR and gamma emissions from active starbursts.

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