

Polarized synchrotron X-ray emission from supernova shells. XIPE perspective.

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Young supernova remnants are the sources of a broadband nonthermal synchrotron continuum emission from radio to X-rays produced by accelerated electrons. The process of electron acceleration by diffusion mechanism is accompanied by efficient amplification of the turbulent magnetic field which is a significant agent of the diffusion shock acceleration itself. Synchrotron X-rays are produced by the high energy (multi-TeV) electrons that are concentrated in the narrow region near the shock front due to strong synchrotron radiation energy losses. This near shock energetic electrons confinement together with the turbulent nature of a magnetic field leads to a complex small scale structure of SNR synchrotron X-ray maps including filaments and clumps structures. These X-ray structures are observed from almost all shell-type SNRs including Tycho, SN 1006, RX J1713.7-3946 etc. Some SNRs have even more rich structures like RX J1713.7-3946 where X-ray image revealed time variable clumps, while the strip-like structures were found in Tycho's SNR. In X-rays there is no Faraday depolarization so these synchrotron structures should be polarized and the degree of polarization could give a valuable information about magnetic field turbulence spectrum and anisotropy. This prediction is confirmed by radio observations that revealed polarized radiation from a number of SNRs including Tycho, SN 1006, Kes 69, W44, IC 443 and others while the Faraday depolarization is significant in the radio band.

So the observations with future generation X-ray polarimeters are highly appreciated. XIPE is a suggested international ESA mission of an X-ray polarimeter with high angular and spectral resolution. In order to estimate the ability of XIPE to detect polarization emission from a typical young SNR like Tycho we model the polarized emission maps of the Tycho-like SNR with different assumptions of magnetic field fluctuation power spectrum and anisotropy. We conclude that for some models of anisotropic turbulent magnetic field the polarized X-ray emission could be detected from Tycho SNR with the expected sensitivity and resolution of XIPE.

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