Detection of Linear Polarization from SNR Cassiopeia A at Low Radio Frequencies

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We report detection of the weak but significant linear polarization from the Supernova Remnant Cas A at low radio frequencies (327 MHz) using the GMRT. The spectro-polarimetric data (16 MHz bandwidth with 256 spectral channels) was analyzed using the technique of Faraday Tomography. Ascertaining association of this weak polarization to the source is non-trivial in the presence of the remnant instrumental polarization (<1% in our case) – the expected anti-correlation $\rho_{lp,x}$, between the linear polarized intensity and the soft X-ray counts gets masked by the correlation between the Stokes-I dependent instrumental leakage and the X-radiation that is spatially correlated with Stokes-I, if $\rho_{lp,x}$ is computed naively. Hence, we compute $\rho_{lp,x}$ using pixels within ultra narrow bins of Stokes-I within which the instrumental leakage is expected to remain constant, and establish the anti-correlation as well as the correspondence of this correlation with the mean X-ray profile (Figure 1). Given the angular and RM-resolution in our data, the observed depolarization relative to that at higher frequencies, implies that the mixing of thermal and non-thermal plasma within the source might be occurring on spatial scales $\sim 1000AU$, assuming random superposition of polarization states.

Figure 1. Left: 327 MHz Stk-I image of Cas A. Right: Profile of mean X-ray counts (max normalized to unity) (blue) & $\rho_{lp,x}$ (at RM=-110 rad/m$^2$) (red) as a function of binned Stk-I.

References