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$\Sigma - D$ RELATION AS INDICATOR OF RADIO LOOPS ORIGIN

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Abstract. Updated empirical $\Sigma - D$ relations (relations between the surface brightness Σ and the diameter D) for supernova remnants (SNRs) have been used to investigate the origin of the main galactic radio loops, Loop I, II, III, IV. In this thesis, we present results which suggest that the radio loops may have an SNR origin. The $\Sigma - D$ relations were updated by adding data on the radio loops to the SNR data sets. The updated relations have been measured to have slopes, $\beta \approx 2$ in log-log space. New $\Sigma - D$ relations for M31 and M33 were derived and these relations are shown to be flatter ($\beta < 2$) than those for Galactic SNRs alone. This result confirms that selection effects play an important role in data-sets made up of Galactic SNRs. A master $\Sigma - D$ relation with 157 reliable calibrators (both Galactic and extragalactic) is derived. This relation also has a slope $\beta \approx 2$.

The second part of this thesis is connected with the modification of the theoretical $\Sigma - D$ relation for SNRs in the adiabatic expansion phase. We derived model of the old SNR with important amount of thermal radiation. The modification is based on the convolution of the first relation derived by Shklovsky (1960a) with $\Sigma - D$ relation derived for thermal Bremsstrahlung radiation of the ionized gas cloud. In this paper, McKee & Ostriker's model (1977) is accepted for SNRs and the interstellar medium. Modified Shklovsky theory gives conclusion close to the empirical results. Kesteven's (1968) modified theoretical relation gives the best agreement with updated empirical Galactic $\Sigma - D$ relation (Case & Bhattacharya, 1998). The $\Sigma - D$ relation for four main galactic radio loops (modified theoretical relation by Duric & Seaquist, (1986)) is also derived in this paper. Test results of the updated empirical relation with added four radio loops are in good agreement with modified theoretical $\Sigma - D$ relation for main radio loops. It confirms the SNR origin of main radio loops.

References

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