Publ. Astron. Obs. Belgrade No. 86 (2009), 415 *MSc thesis*

MAGNETIC FIELD EVOLUTION IN SUPERNOVA REMNANTS

B. VUKOTIĆ

Astronomical Observatory, Volgina 7, 11060 Belgrade 38, Serbia
E–mail: bvukotic@aob.bg.ac.yu

Abstract. The scope of the thesis is to present and discuss the magnetic field-diameter ($H - D$) relation for supernova remnants (SNRs) and its applicability in SNRs evolution studies. From theoretical considerations follows the relation in the form $H \propto D^{-\delta}$, with δ being an evolutionary parameter. For selected Galactic and extragalactic SNR samples, magnetic field is calculated from the radio synchrotron luminosity (L) using the revised equipartition calculation. Equipartition calculation method assumes that SNR kinetic energy is being evenly distributed to magnetic field and cosmic-ray particles and is widely used for studies on magnetic field amplification, particle acceleration and resulting luminous radio-synchrotron emission from SNRs shocks. Obtained values for H and δ are compared to the ones found in literature and the equipartition assumption and selection effects of the samples are discussed.

The energy of supernova explosion and ambient medium density are two main parameters that drive SNR hydrodinamical evolution and produce the resulting radio-synchrotron emission. With the density criterion, five samples are selected and analyzed: SNRs from M82 as all probably being the consequence of recent starburst activity in M82 and as such are probably evolving in the same density environments, oxygen-rich SNRs, SNRs associated with giant molecular clouds and Balmer-dominated SNRs. It follows from equipartition that quality of $H - D$ relation is a direct consequence of $L - D$ corelation within the sample. The best fitting sample is formed from extragalactic remnants in M82 while other samples give poor $L - D$ fits probably caused by severe selection effects. A fit to M82 sample yields $\delta = 1.2$ while equipartition assumption under adiabatic aproximation gives $\delta = 1.5$. It is argued that the descrepancy is probably caused by sensitivity selection effects and correspondingly SNRs from M82 sample are likely in the equipartition state at the adiabatic phase of hydrodynamical evolution. If all M82 SNRs are not in the same evolution phase than they may not satisfy the equipartition constrain and δ could be anywhere between 0 and 1.5. H values calculated under equipartition assumption are of the order of mG and are ~ 2 times larger then the ones infered from literature. When compared to the μG interstellar magnetic fields it is evident that SNRs are strongly amplifying magnetic field in their vicinity.

Equipartition calculation and $H - D$ relation could be a useful probe for the studies on SNRs evolution. More precise conclusions will follow with better data samples with less selection effects.

References

Vukotić, B., Arbutina, B., Urošević, D.: 2006, *Publ. Astron. Obs. Belgrade*, **80**, 95.
Vukotić, B., Arbutina, B., Urošević, D.: 2007, *RevMexAA*, **43**, 33.