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IMPORTANCE OF SUPERNOVA TYPE FOR THE HYDRODYNAMIC AND RADIO EVOLUTION OF ITS REMNANT

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Abstract. The thesis gives an overview of the classification of supernovae (SNe) and supernova remnants (SNRs), SN rates, their progenitors and physics of supernova explosions, hydrodynamic and radio evolution of SNRs. Generally accepted scheme distinguishes between two main classes of supernovae (SNe): Ia resulting from the old stellar population (deflagration of a C/O white dwarf in close binary systems), and SNe of type II and Ib/c whose ancestors are young massive stars (died in a core-collapse explosion). Concerning the latter, certain attempts have been made to bring a particular class of SNe – the stripped-envelope SNe (Ib/c, IIb) in connection with their progenitors by using stellar initial mass function (IMF) and measured SN rates. Their potential use as "standard candles" is also discussed with emphasis on the extinction problem.

Main results of the thesis are those concerning radio SNRs, where we have analyzed samples of remnants in starburst galaxy M82 and Galactic molecular clouds (GMC), oxygen-rich and Balmer-dominated SNRs. Oxygen-rich and Balmer-dominated SNRs represent small classes of remnants supposedly linked with SNe Ib/c (IIb) and SNe Ia, respectively. The differences between the above classes can be clearly seen in the early phases of SNRs evolution (appearance/absence or radio-supernova, differences in ejected mass), but gradually disappear in later phases if the explosion energy and ambient density are nearly equal for all SNRs. This thesis, however, emphasizes the importance of the density of the interstellar medium (ISM). While differences in SN energy are not that extreme for different classes of remnants ($E_o \sim 10^{51}$ ergs, except in the case of hypernovae), ISM density values span across six orders of magnitude ($\rho_o = 10^{-3} - 10^{3}$ g cm^{-3}). It is shown in this thesis that M82, GMC and Oxygen-rich SNRs have, on average, higher radio luminosity than Balmer-dominated SNRs. Theories of radio synchrotron emission give direct dependence of luminosity on ISM density. On the other hand, we know from the stellar evolution theory that massive stars mainly occur and remain in dense environments (such as molecular clouds) owing to their shorter lifetimes, while the longer lived lower mass stars, on average, tend to be found in less dense environments, since they have enough time to abandon their birthplace. If the above mentioned SN–SNRs connection holds, it is then understandable why Balmer-dominated SNRs have lower luminosity. These are the main conclusions of the thesis.

References

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