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SUPERNOVA REMNANTS IN CLUMPY MEDIUM: HYDRODYNAMIC AND RADIO SYNCHROTRON EVOLUTION

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Abstract. The models of radio synchrotron emission of supernova remnants (SNRs) are usually analyzed assuming uniform density environment to obtain the surface-brightness-to-diameter (Σ–D) dependence. We put other perspective at this problem, considering that non-uniform environment around the SNRs might considerably affect their Σ–D evolutionary paths. It makes the non-uniform environment an important element in investigation of this problem. We present the emission model that implies the test-particle approximation. The model is used in hydrodynamic simulations of SNRs in environments of low-density bubbles and variety of clumpy media. Based on the simulation results, we developed the semi-analytical spherically-symmetric model of hydrodynamic evolution and emission of SNRs in a clumpy medium, which we utilized to generate large SNR samples. The results show that clumpy medium initially enhances the SNR brightness, but afterward the Σ–D slope steepens proportionally to the average density jump from uniform to clumpy medium. On the contrary, the average slope of Galactic SNR sample flattens at D ≈ 14–50 pc. The models of generated SNR samples with clumpy medium lead to a conclusion that the significant Σ–D flattening and scatter in Galactic sample originates in sporadic emission jumps of individual SNRs in a limited diameter interval. However, additional analyses considering the selection effects are needed.

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