An Interstellar Medium Driven by Supernovae: Turbulence and Dynamo

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We study the structure of a supernovae(SNe)-driven interstellar medium(ISM), including the effects of magnetic fields, and heating and cooling processes. The purpose of the current study is two-folded: one is to investigate the structure of driven interstellar turbulence, and the other is to see the growth of magnetic fields without any mean helicity. For these purposes, we solve the ideal MHD equations with the heating and cooling processes. We start simulations with a uniform density threaded by uniform magnetic fields with a normal Galactic value and 100 times weaker one. In the radiatively-cooling, and magnetized medium, we explode SNe one at a time at randomly chosen positions with four explosion rates, which are higher than, and equal to the Galactic value. The evolution of the system is basically determined by the input energy of SN explosions and the output energy by cooling. We follow the simulations to the point where the total energy of the system, as well as the energy in the thermal, kinetic, and magnetic variables, has reached a quasi-stationary value. Even though our model is simple, the two essential ingredients, SN explosions and cooling, form a rich turbulent interstellar medium. Here are our findings: 1) Volume filling factors for hot gas are dependent upon the field strength and the explosion rate, and the factor in the Galactic condition is a few percent or less. 2) The pressure in the warm phase of the ISM has a broad distribution, which determined by both thermal and dynamical processes. 3) The magnetic field without any enforced helicity can grow just by strong shocks driven by SNe