Magnetorotational supernovae

S. G. Moiseenko[1] *, G. S. Bisnovatyi-Kogan[1] †, N. V. Ardeljan[2] ‡

[1]Space Research Institute, Profsoyuznaya str. 84/32, Moscow 117997, Russia

[2]Department of Computational Mathematics and Cybernetics, Moscow State University, Vorobjevy Gory, Moscow B-234, Russia

We present the results of 2D simulations of the magnetorotational model of a supernova explosion. After the core collapse the core consists of a rapidly rotating proto-neutron star and a differentially rotating envelope. The toroidal part of the magnetic energy generated by the differential rotation grows linearly with time at the initial stage of the evolution of the magnetic field. The linear growth of the toroidal magnetic field is terminated by the development of magnetorotational instability (MRI), leading to drastic acceleration in the growth of magnetic energy. At the moment when the magnetic pressure becomes comparable with the gas pressure at the periphery of the proto-neutron star $\sim 10-15$ km from the star center the MHD compression wave appears and goes through the envelope of the collapsed iron core. It transforms soon to the fast MHD shock and produces a supernova explosion. Our simulations give the energy of the explosion $0.6\cdot 10^{51}$ ergs. The amount of the mass ejected by the explosion is $\sim 0.14\,M_{\odot}$. The implicit numerical method, based on the Lagrangian triangular grid of variable structure, was used for the simulations.

References

[1] N.V.Ardeljan, G.S.Bisnovatyi-Kogan, S.G.Moiseenko. MNRAS (2005) (accepted) preprint astro-ph/0410234

*E-mail: moiseenko@iki.rssi.ru
†E-mail: gkogan@iki.rssi.ru
‡E-mail: ardel@cs.msu.su