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# Formation of collapsing cores in magnetically subcritical clouds : three-dimensional simulations

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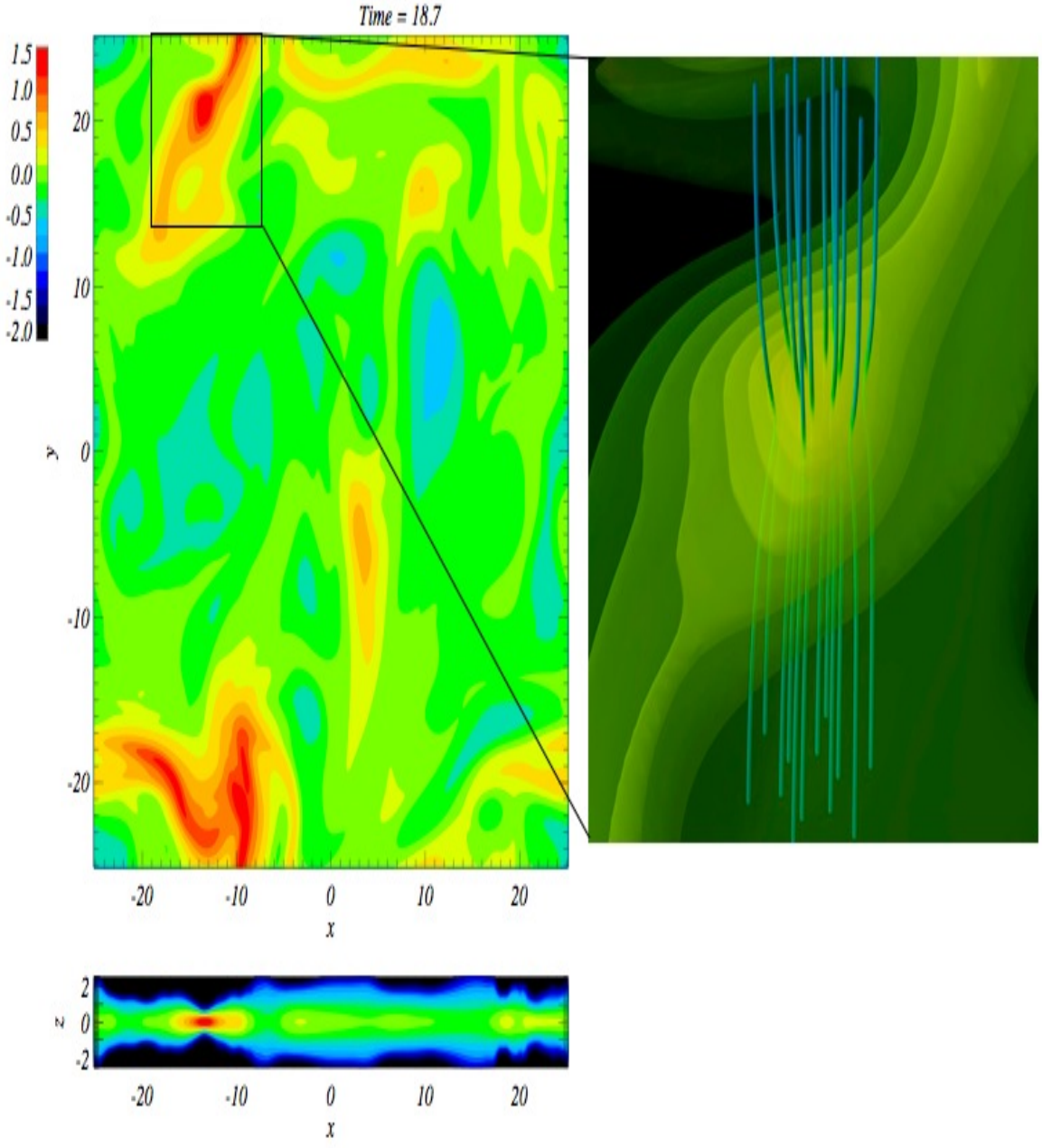


We employ the fully three-dimensional simulation to study the gravitationally driven fragmentation of magnetically subcritical molecular clouds, in which the initial magnetic energy is

larger than the gravitational energy. The cores in an initially subcritical cloud generally develop gradually over an ambipolar diffusion time, which is theoretically estimated to be a few times $10^7$years in a typical molecular cloud. On the other hand, the formation of collapsing cores in subcritical clouds is known to be accelerated by the supersonic nonlinear flows. Here, we have demonstrated the acceleration of the core formation by three-dimensional MHD simulations. The parameter study shows that the cores form faster with increasing the initial velocity strength in the clouds. We found that the formation time is roughly proportional to the inverse of the square root of the enhanced density driven by the supersonic nonlinear flows. It means that the ambipolar diffusion time, which is estimated to be proportional to the inverse of the square root of the density, becomes shorter when the density is enhanced by the supersonic nonlinear flows. We have also demonstrated that the accelerated formation time is not strongly dependent on the initial strength of the magnetic field if the cloud is highly subcritical. In the real molecular cloud, the supersonic turbulence is observed with 3-10 times sound speed. Our simulation shows that the core formation time in magnetically subcritical clouds is shortened to be several times $10^6$years by the large scale supersonic flows (> 3 times sound speed). The core formation time of the order of $10^6$years is consistent with some observations.

The left figure shows the colour map of the normalized density when a collapsing core is formed. The right figure shows the close up view of the core with magnetic field lines. The density generally shows the thin disk structure along the magnetic field lines when the magnetic field is strong.

Keywords: MHD, self-gravity, protostar