国立天文台天文シミュレーションプロジェクト成果報告書

研究課題名

利用者氏名 (所属機関)

利用カテゴリ XT4S ・ XT4A ・ XT4B ・ XT4C ・ XT4MD ・ SX9A ・ SX9B ・ SX9MD ・ GRAPE-A ・ GRAPE-B ・GRAPE-C ・ 汎用 PC

成果の概要を記入してください。必要に応じてページを加えても構いませんが、pdf のファ イルサイズの上限は 2MB とします。 Write up your research report in this area. Total file size should be less than 2 MB in PDF format.

The aim of this project is to push to very high (1 pc) resolution in a simulation of a galaxy disc. Previously, simulations at this resolution were restrained to model only a small patch of the galaxy disc. This meant that these models were not able to consider the impact of galactic structure on the formation of stars. This project aims to model the formation of stars (more specifically, the formation and evolution of the cold gas cloud in which they are born) in a global model, including the affects of galactic structure and interactions between the star-forming clouds.

One of the problems we encountered was in setting up a suitable galactic model. In 2011 (running primarily on the supercomputers in Canada, since I only gained XT4A status in April 2012), we found that fingers of hot gas from the galactic halo could probe the dense star forming disc, causing hot gas to be found on the highest 1pc refinement level. This caused the time step to become unusably small.

Since gaining XT4A usage in April, I have been working on improving the model to prevent hot halo gas interfering with the star forming gas disc. Although this is a physics effect (not a numerical error), we found that the boundary conditions of the simulation were encouraging hot gas to fall onto the disc from the edges of the box. In the last 3 months, I have developed a new boundary scheme (non-trival for a rotating system) where by the corners of the box are repeatedly re-set to their original (low density, low velocity) value to prevent strong infalls accidentally occurring.

Secondly, I have been developing a disc model that is hydrostatically balanced at the start of the simulation, such that it does not collapse once the gas starts to cool.

These models are still under development, and I have been running three different simulations (with different gas surface densities) on the XT4 at 30 pc resolution to test the stability. The aim is to have decided on a suitable model within the next month. After this time, a simulation will be run at 7.8 pc resolution. This will allow the disc to evolve away form its initial state before we increase the resolution to 1 pc. Due to the factor of 10 difference in the resolutions, we plan to increase the simulation refinement in stages to ensure there are no numerical artifacts due to the sudden jump in this refinement.

I am the lead author on this project and I am collaborating with Professors James Wadsley and Ralph Pudrtiz at McMaster University in Canada. Further projects I am engaged in are performed on the XT4 by my student, Yusuke Fujimoto.