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MODELING THE FORMATION OF GRAVITATIONALLY BOUND OBJECTS AFTER COLLISION OF ROTATING MOLECULAR CLOUDS

Abstract

For detailed modeling of astrophysical processes, parallel algorithms are used with grids of the highest possible spatial resolution and high-resolution numerical schemes. The correct solution of astrophysics problems on ultra-high resolution grids requires huge computational resources. Recently, there has been a qualitative leap in the architecture of modern multi-core processors and new efficient graphics accelerators. The new hardware has increased speed and energy efficiency, low costs for intra-thread communication for each thread compared to systems with shared memory. The hardware implementations are noted may be preferable for numerical simulations of astrophysical phenomena such as supernova explosions, giant jet bursts, or molecular cloud collisions (CCC). The paper presents the analysis of computer simulation results and reveals conditions in new gas formations during molecular clouds collision in their mutual penetration that leads to the origination over compressed clumps in this area. Such clumps form gravitationally bound regions that can lead to the formation of stellar systems. Using authored code we study the influence of rotation in cloud-cloud collision on over dense compression in the core with clumps and filaments forming in this area. The results of modeling head-on collisions of clouds in the case without rotation or with rotation according to the scenario, when the rotation axes of clouds are perpendicular to the collision line, are presented. Taking the rotation effects into account made it possible to reveal additional dissipative effects of clumps fragmentation, filaments and density wave's redistribution along radii compressed lens-like core. The simulation showed that the density of clumps reaches values that can lead to the formation of the prestellar condition via more rapid and volumetric gas compression in the case of clouds rotation. It leads to spiral-like arising clumps distribution and the appearance of a corrugated structure with divergent density matter oscillations in new formations. The use of multi-core processors and new GPUs with tensor cores has a significant impact on the choice of software tools. In the proposed program, the use of Coarray Fortran (CAF) and OpenACC technology made it possible to increase the speed of program execution. For this, an array was introduced, which stores general information that was distributed over the images. The CAF syntax allows you to work with remote data that can be located both on the same node and on different server nodes. Acknowledgments. Russian Basic Research Foundation is acknowledged for financial support (project code 19-29-09070 mk).