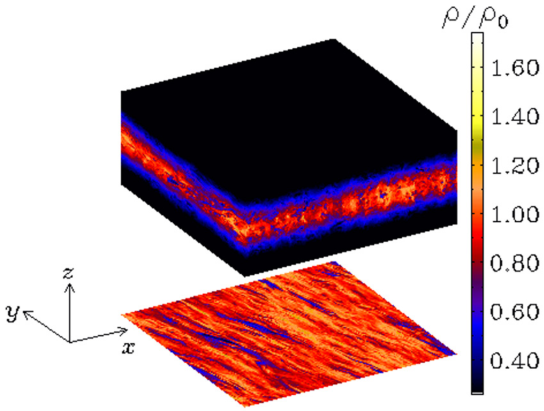
Simulation of Hydromagnetic Turbulence and Planet Migration

Science Mission Directorate

Extrasolar planets are a major focus of NASA missions. In recent years, their detection has become routine, and the number of observed planetary systems is now significant enough that they can be used to constrain theoretical models. Our models explore in detail one of the major processes that may occur in the course of planet formation, enabling further comparison between theories and observations.

The circumstellar gaseous disk around a young stellar object plays a crucial role in the formation and migration of planets. The disk is generally believed to be turbulent, most likely due to the presence of a weak magnetic field. The gravitational influence of the density fluctuations of this turbulent gas makes the planetary objects therein undergo "random walks."



Snapshot of the gas density in a local region of a turbulent circumstellar disk. The x, y, and z axes indicate radial, azimuthal, and vertical directions, respectively. The bottom plane shows the slice along the disk midplane. *Chao-Chin Yang, University of California, Santa Cruz/American Museum of Natural History*

The magnitude of this effect has many important consequences for our current understanding of planet formation scenarios. We use the Pencil Code, a parallelized, cache-efficient, high-order finite-difference code capable of solving magnetohydrodynamics equations as well as calculating the movement of particles.

Using a statistical approach, we can accurately quantify the evolution of the orbital properties of these particles with time. This measurement has provided us with further insight into the life of extrasolar planets and our own solar system.

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