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Abstracts

ACCRETION DISKS AROUND BLACK HOLES. M. A. Abramowicz, Gothenburg University, Gothenburg, Sweden.

The physics of accretion flow very close to a black hole is dominated by several general relativistic effects. It cannot be described by the standard Shakura Sunyaev model or by its relativistic version developed by Novikov and Thorne. The most important of these effects is a dynamical mass loss from the inner edge of the disk (Roche lobe overflow). The relativistic Roche lobe overflow induces a strong advective cooling, which is sufficient to stabilize local, axially symmetric thermal and viscous modes. It also stabilizes the non-axially-symmetric global modes discovered by Papaloizou and Pringle. The Roche lobe overflow, however, destabilizes sufficiently self-gravitating accretion disks with respect to a catastrophic runaway of mass due to minute changes of the gravitational field induced by the changes in the mass and angular momentum of the central black hole. One of the two acoustic modes may become trapped near the inner edge of the disk. All these effects, absent in the standard model, have dramatic implications for time-dependent behavior of the accretion disks around black holes.

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A TWISTED DISK EQUATION THAT DESCRIBES WARPED GALAXY DISKS. K. Barker, Department of Physics and Astronomy, Louisiana State University, Baton Rouge LA 70803, USA.

Warped HI gas layers in the outer regions of spiral galaxies usually display a noticeably twisted structure. This structure is thought to arise primarily as a result of differential precession in the HI disk as it settles toward a "preferred orientation" in an underlying dark halo potential well that is not spherically symmetric. In an attempt to better understand the structure and evolution of these twisted, warped disk structures, we have utilized the "twist-equation" formalism originally developed by Petterson [1]. Specifically, we have generalized the twist equation presented by Hatchett, Begelman, and Sarazin [2] to allow the treatment of non-Keplerian disks and from it have derived the steady-state structure of twisted disks that develop from free precession in a nonspherical, logarithmic halo potential. This generalized equation can also be used to examine the time-evolutionary behavior of warped galaxy disks.

References: [1] Petterson (1977) Astrophys. J., 214, 550. [2] Hatchett et al. (1981) Astrophys. J., 247, 677.

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A HETEROGENEOUS COMPUTING ENVIRONMENT FOR SIMULATING ASTROPHYSICAL FLUID FLOWS. J. Cazes, Department of Physics and Astronomy, Louisiana State University, Baton Rouge LA 70803, USA.

In the Concurrent Computing Laboratory in the Department of Physics and Astronomy at Louisiana State University we have constructed a heterogeneous computing environment that permits us to routinely simulate complicated three-dimensional fluid flows and to readily visualize the results of each simulation via three-dimensional animation sequences. An 8192-node MasPar MP-1 computer with 0.5 GBytes of RAM provides 250 MFlops of execution speed for our fluid flow simulations. Utilizing the parallel virtual machine (PVM) language, at periodic intervals data is automatically transferred from the MP-1 to a cluster of workstations where individual three-dimensional images are rendered for inclusion in a single animation sequence. Work is underway to replace executions on the MP-1 with simulations performed on the 512-node CM-5 at NCSA and to simultaneously gain access to more potent volume rendering workstations.

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AN EFFICIENT THREE-DIMENSIONAL POISSON SOLVER FOR SIMD HIGH-PERFORMANCE-COMPUTING ARCHITECTURES. H. Cohl, Department of Physics and Astronomy, Louisiana State University, Baton Rouge LA 70803, USA.

We present an algorithm that solves the three-dimensional Poisson equation on a cylindrical grid. The technique uses a finite-difference scheme with operator splitting. This splitting maps the banded structure of the operator matrix into a two-dimensional set of tridiagonal matrices, which are then solved in parallel. Our algorithm couples FFT techniques with the well-known ADI (Alternating Direction Implicit) method for solving Elliptic PDEs, and the implementation is extremely well suited for a massively parallel environment like the SIMD architecture of the MasPar MP-1. Due to the highly recursive nature of our problem we believe that our method is highly efficient, as it avoids excessive interprocessor communication.

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THE DYNAMICAL SETTLING OF WARPED DISKS AND ANGULAR MOMENTUM TRANSPORT IN GALAXIES. P. Fisher, Department of Physics and Astronomy, Louisiana State University, Baton Rouge LA 70803, USA.

We present results of three-dimensional, hydrodynamic models of gaseous disks settling in a nonspherical potential. As the gas settles, differential precession creates a warped disk similar to the warps seen in spiral galaxies. A logarithmic potential, indicative of a massive halo, seems to induce warps more extreme than those produced by a 1/r potential with a quadrupole distortion.