Simulating Swirling Disks of Matter Around White Dwarf Stars

Rotating disks are observed throughout the universe, from planet-forming disks around young stars to gargantuan accretion disks around supermassive black holes in quasars. Such disks are often magnetized and turbulent, and can only be understood through combining supercomputer simulations of these flows with observational data from NASA satellites and ground-based telescopes.

White dwarfs in binary systems can rip material off their companion stars to form a disk that undergoes amazingly complex variability on human time scales. These are the only disks that are compact enough to be fully simulated, thanks to the power of NASA high-performance computing resources. Simulating these systems will help us understand all classes of disks.

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View of the mass distribution of a disk forming around a white dwarf star (black center) as it is being fed by a magnetized stream from the orbiting companion star. Colors indicate the brightness of the light being emitted by the flow, with red and pink being the brightest, and green being the faintest. Material orbiting closest to the white dwarf is very bright, as is material near where the stream is crashing into the disk. The white dwarf and companion star are not shown here. Patrick Moran, NASA/Ames; Yan-Fei Jiang, University of California at Santa Barbara

Another view of the rotating disk some ten binary orbital periods later. The outer edge of the disk is spreading outward, tilting out of the orbital plane, and precessing (wobbling) like a top. This precession may explain some of the variability that we observe in such binary systems. Patrick Moran, NASA/Ames; Yan-Fei Jiang, University of California at Santa Barbara