Measuring the clumpiness of proto-planetary disks

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A combined X-ray and optical image of the young stars in the heart of the Orion Nebula. A new infrared study has found that most of the young stars vary in intensity, some apparently due to obscuring clumps of material in a rotating disk. Credit: X-ray: NASA/CXC/Penn State/E.Feigelson & K.Getman et al.; Optical: NASA/ESA/STScI/M. Robbert et al.

(PhysOrg.com) -- The process of star formation, once thought to involve just the simple coalescence of material under the influence of gravity, actually entails a complex series of stages, with the youngest stars assembling circumstellar disks of material (possibly preplanetary in nature) for example. Understanding these early stages has been difficult for astronomers, in part because because they take place in nurseries

heavily obscured by dust. Nevertheless, they are critically important to an understanding of how our young solar system and its planets were born and evolved.

The Spitzer Space Telescope and its IRAC infrared camera have enabled astronomers during the past few years to discover and study large numbers young stellar objects ("YSOs") in star forming clouds of gas and dust. Its sensitive infrared images can penetrate most of the dusty veil and pinpoint the many faint stars, cool and red, that are between about one and ten million years old, or sometimes younger.

In a new study of the time variability of YSOs, CfA astronomers Joe Hora and Jan Forbrich, together with a large team of collaborators, used IRAC to conduct a timed series of observations (81 snapshots over 40 days) of YSOs in the Orion nebula. They discovered that 70% of the YSOs thought to have disks around them vary in time, with variations that fall roughly into four categories: periodic, flaring, irregular, and narrow flux dips.

These latter cases, called "dippers," are suspected of being caused by clumps of dust in the circumstellar disk that happen to pass across the line-of-sight to the star as the disk rotates; they may also be due to a warp in the rotating disk that crosses the line-of-sight. With additional observations, including some from ground-based telescopes, the scientists plan to confirm and model the nature of these clumps, as well as to explain more specifically each of the other types of variability on a case-by-case basis.

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