New Evidence of Budding Solar Systems

With visions of young solar systems dancing in their heads and potential candidates captured by their telescopes, astronomers this week reported new evidence that many stars — some less than 100 light years away — possess disks of hot gas and dust that may already have begun evolving into planet-sized objects. "Some of the new findings are very uncertain, but these stars may allow a glimpse of what it was like early in our solar system," notes Steven V.W. Beckwith of Cornell University in Ithaca, N.Y.

Researchers had previously gathered strong hints that young, solar-type stars in the Milky Way have disks similar to the one believed to have given birth to the solar system's planets some 4.5 billion years ago. But how many of these stellar disks will eventually become planetary systems? The answer to that astronomical question has eluded scientists because of poor estimates of the amount of mass in circumstellar disks and uncertainties about whether most disks stick around long enough to form planets.

New studies provide some preliminary answers. One research group combined previous optical and infrared data with newer infrared studies to track 83 solar-type stars in Taurus-Auriga, one of the nearer dark clouds of dust and gas that serve as stellar birthing places. Half the stars younger than 3 million years emit larger-than-expected amounts of infrared radiation, indicating the presence of grainy, glowing disks that extend to the stellar surface, reports Stephen E. Strom and his co-workers at the University of Massachusetts at Amherst and the NASA Infrared Telescope in Hawaii.

Strom notes that due to their larger surface area, heated dust grains, unlike a belt of solid matter, can generate the excess radiation observed. His team also measured radiation from stars in the same group that had an estimated age of 10 million years. The investigators found that less than 10 percent emitted excess infrared radiation, indicating that if these older stars had possessed circumstellar disks, the disks had been destroyed "or had begun to assemble distributed gas and dust into larger bodies, such as planets," Strom says. The findings suggest circumstellar disks may survive no more than 10 million years, he says.

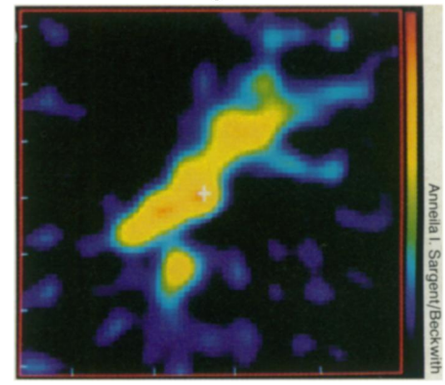
Perhaps most dramatically, he adds, infrared observations of 33 stars surrounded by disks suggest three of them have holes or gaps near their center. These inner holes may be caused by dust grains clumping together, under the influence of gravity, possibly to form "the first stages of planet building," Strom says. "[Our] observations may represent the first evidence of a disk in transition from a massive, optically-thick structure to one that may have begun to build planet-like structures." Strom says the study suggests the transition takes about 300,000 years. He presented the findings this week at Protostars and Planets III, a conference held in Tucson, Arizona. The work will appear in the May ASTROPHYSICAL JOURNAL.

In a related report at the conference, researchers presented their findings about excess infrared light among clusters of stars ranging in age from 50 million to 700 million years. Astronomers believe the extra, unexplained radiation could be caused by warm, dusty debris created when asteroids or other massive objects collide.

Astronomer Dana Backman of NASA's Ames Research Center in Mountain View, Calif., and his colleagues found that younger star clusters in the group studied, such as the 80-million-year-old Pleiades, emit double the expected amount of infrared radiation at certain wavelengths. In contrast, a 300-million-year-old cluster of stars that includes those in the constellation Ursa Major produces excess radiation that amounts to just 25 percent over expected levels. Backman notes that the excess radiation, and its decrease in older clusters, supports the notion that many of these stars may be in the final throes of forming a planetary system akin to our own. He adds that the possibility of planet formation in Ursa Major — a relatively close 70 light years to Earth — "is particularly exciting" because of the opportunities for further study.

Not all astronomers find that excess radiation lessens with age. Cornell's Beckwith and his co-workers at the California Institute of Technology in Pasadena and the Max Planck Institute for Radioastronomy in Munich, West Germany, found no such correlation. But their study, also presented at the conference, reveals that of 86 young stars in Taurus-Auriga, 42 percent, or 36, emit an excess glow at millimeter wavelengths. This percentage, says Beckwith, indicates that disk-forming, solar-type stars may be fairly abundant in the dark cloud. The researchers found the disks ranged in mass from one-thousandth to one solar mass, Beckwith says. Most of the 36 disks weighed in at greater than one-hundredth of a solar mass — a value many researchers believe may be required to form a planetary system similar to our own.

Beckwith cautions that not all stars with the apparent ability to form planetary systems may do so. But he finds the work intriguing. "Most people who talk about life in the universe say planets are a prerequisite for it," he notes. — *R. Cowen*



Map of millimeter radiation from carbon monoxide emission reveals portion of a disk that surrounds the young star HL Tauri (white cross at center). Yellow connotes high-intensity radiation, blue connotes lower.

Moving tiny things by optical tweezers

A living cell is best handled with cell-sized tools. For three years or so, researchers have been honing their jeweler-like control over the movements of cells, microbes and even organelles within cells by using tightly focused, low-power laser beams as "optical tweezers."

At a meeting of MIT's nanotechnology study group this week, biophysicist Steven M. Block of the Rowland Institute for Science in Cambridge, Mass., reported using optical tweezers to probe the physical properties of "mechanoenzymes," proteins responsible for cellular movements such as the rotary motions of flagella, which propel bacteria.

Laser tweezers don't actually squeeze, but they allow researchers to lift up, move, and position microscopic objects, using the pressure of the laser light itself — a phenomenon akin to a blast of air levitating a plastic ball.

"Laser tweezers are very much like a [science-fiction] tractor beam, except they work in the microscopic rather than the macroscopic domain," Block told SCIENCE NEWS. "You can manipulate living things without damaging them," adds physicist and optical-tweezer developer Arthur Ashkin of AT&T Bell Laboratories in Holmdel, N.J.

Last spring, Block and his co-workers reported experiments in which they used an optical tweezer to twist flagella — the minuscule motor/propeller assemblies