Astronomy

Ron Cowen reports from San Antonio at a meeting of the American Astronomical Society

More evidence of extrasolar planets

Still reeling from reports of three planets orbiting nearby stars? Christopher Burrows has some advice: Don't forget about one of the original candidates for a planetary system—the dusty disk surrounding the star Beta Pictoris.

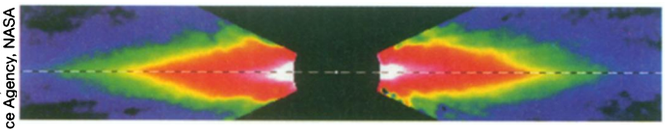
Mounting evidence suggests that circumstellar disks provide the spawning ground for planets. Under the right conditions, ice and dust in these doughnut-shaped objects collide and clump together, coalescing into new worlds.

The disk around Beta Pictoris has garnered special attention, in part because it contains an intriguing gap near its center, as if a planet had swept the area clear of debris. Now, the Hubble Space Telescope has taken a closer look at the central part of the disk and has found another piece of tantalizing evidence.

The inner region of the disk, just outside the gap, has a warp, or tilt, of about 3° relative to the outer parts of the disk. Burrows, of the Space Telescope Science Institute in Baltimore, suggests that the gravitational tug of an unseen planet circling Beta Pictoris created the tilt.

The planet, he says, would reside somewhere in the 8-billion-kilometer-wide clear zone in the center of the disk. The size of the warp indicates that the planet has a mass between one-twentieth and 20 times that of Jupiter.

Burrows concedes that the tug of a passing star could also have produced the warp, but he argues that such an encounter would have distorted the entire disk, not just the inner part. He adds that for the warp to persist, some object must continually be "twisting the disk and keeping [it] out of a basic flat shape."



Burrows, J. Krist/Eur. Space Agency, NASA

Disk surrounding Beta Pictoris. Inner edge (white) is slightly tilted from the plane of the outer disk (red-yellow-green).

Shedding light on our galaxy's dark matter

There's more to the cosmos than meets the eye. To keep a rapidly rotating galaxy from flying apart, to explain how fast-moving galaxies in a cluster stick together, and to account for the evolution of large-scale structure in the universe, astronomers have been forced to hypothesize that the universe harbors hidden gravitational glue. The seemingly empty blackness of space must abound with vast amounts of dark matter—faint or invisible material adding up to at least 10 times as much mass as the visible stars and galaxies have.

Researchers have hotly debated whether dark matter consists of ordinary matter, unknown elementary particles or other exotic material, or a combination of both. Astrophysicists now report that at least half the missing glue in our own galaxy resides in ordinary dead stars called white dwarfs.

Because dark matter can't be seen, David P. Bennett of the Lawrence Livermore (Calif.) National Laboratory and an international team of colleagues relied on an indirect technique to detect its presence. Any massive object, visible or not, can serve as a gravitational lens, bending and brightening light emitted by a body that happens to pass directly behind it.

To reach Earth, light from stars in the nearby Large Magellanic Cloud must pass through the Milky Way's halo—a region of dark matter that extends far beyond our galaxy's visible outline. By monitoring changes in the brightness of 9 million of these stars nightly, Bennett's team hoped to detect the gravitational lensing that clumps of dark matter would cause.

In analyzing the first 2 years' worth of data from their continuing search, the researchers found seven lensing events that they ascribe to assemblages of dark matter known as Massive Compact Halo Objects (MACHOs). Interpreting these results proved difficult, because the team can measure each event only by a single number that depends on three unknowns: the mass, speed, and location of the MACHO.

By combining the seven events and making standard assumptions about the distribution of dark matter within the halo, the researchers conclude that MACHOs most likely have a mass between one-tenth and one solar mass. This places the unseen matter in the domain of white dwarfs, which represent the burned-out remains of stars like the sun.

Calling the result "surprising," cosmologist David N. Spergel of Princeton University says many astronomers had expected that the team would find about 30 shorter-duration lensing events or virtually none. The larger number would arise if brown dwarfs, objects not quite massive enough to be stars, make up most of the dark matter in our galaxy. The absence of lensing events would indicate that the dark matter consists of uniformly scattered exotic material. "It's a very exciting result, but with only seven events, it's not a definitive one," Spergel adds.

Rosemary F.G. Wyse of Johns Hopkins University in Baltimore cites a possible discrepancy between the results and the chemical evolution of our galaxy. In becoming white dwarfs, stars shed a significant amount of helium. However, the Milky Way doesn't have the high helium concentration expected from a large population of white dwarfs. Joseph I. Silk of the University of California, Berkeley, notes two loopholes: The helium might have blown completely out of the galaxy, or the dwarfs, which presumably formed billions of years ago, might have unusual properties that allowed them to retain most of their helium allotment.

He and Spergel agree that even if most of the Milky Way's dark matter is ordinary stuff, prevailing theories about the evolution of the universe and the abundance of elements forged in the Big Bang all but demand that the cosmos at large harbor huge amounts of mystery material—dark matter that bears no resemblance to ordinary atoms.

The real meaning of 50 billion galaxies

By now, most people have read the headlines or seen the television reports. "Suddenly, Universe Gains 40 Billion More Galaxies," blared the Jan. 16 New York Times. The newspaper touted the number in five more articles over the next 7 days. These and several other media accounts said astronomers had found that the universe harbors 40 billion more galaxies than expected.

Scientists, however, are nonplussed by all the fuss.

The stories refer to the faintest detailed image ever taken of the heavens, recorded by the Hubble Space Telescope last month (SN: 1/20/96, p. 36). Astronomers estimate that this slice of the heavens contains at least 150,000 galaxies. If the slice is representative of the rest of the universe—and researchers believe it is—then the cosmos could indeed contain 40 billion to 50 billion galaxies, Hubble researchers say.

So far, so good. But that impressive number is not a surprise, asserts the Hubble team that released the image 2 weeks ago. Although Hubble scientists hadn't previously published a formal count, Robert E. Williams and Harry Ferguson of the Space Telescope Science Institute in Baltimore say that several shorter-exposure images taken with the telescope since its 1993 repair all indicate that the cosmos contains at least 50 billion galaxies.

"Anyone who has gone to meetings over the last year would not be surprised [by that number]," says Ferguson. He adds that some confusion in the press may have come about because ground-based images, which have a lower resolution, indicate that the universe contains only 10 billion galaxies.

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