Hubble Eyes Signs of Nearby Planets

About the last thing Brad A. Smith expected to find when he examined the region around a young, nearby star was a large-scale replica of one of the rings of Saturn.

Like the planet's icy rings, the band of dust around the star HR 4796A, some 220 light-years from Earth, is narrow and has sharp edges. And, just as Saturn's rings are corralled by the gravity of closely orbiting moons, Smith and his colleagues suggest that the stellar dust ring owes its slender shape to the guiding influence of one or more massive bodies, most likely fledgling planets.

Although the star has only about twice the mass of the sun, its ring lies about 70 astronomical units (AU), or 70 times the Earth-sun distance, from the parent star. "That's way out there, and in our solar system, we don't see bodies of any significant size beyond the orbits of Neptune and Pluto," says Smith, a researcher at the University of Hawaii in Honolulu. Those planets orbit 30 to 50 AU from the sun.

The dust ring, recorded by an infrared camera on the Hubble Space Telescope, is one of several new Hubble findings suggesting that planets may be circling three youthful, nearby stars. The discoveries were reported this week in Austin, Texas, at a meeting of the American Astronomical Society.

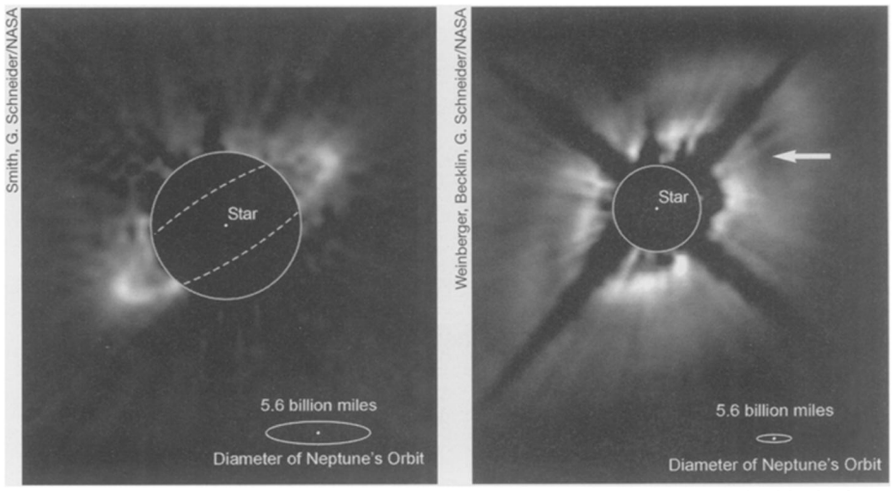
All three stars have for years been known to emit infrared light at a higher intensity than can be accounted for by starlight alone. That characteristic indicates that the bodies are swaddled by dust, which absorbs visible and ultraviolet starlight and reradiates it at longer wavelengths. Planets are thought to coalesce from swirling disks of dust, gas, and ice around newborn stars.

The Hubble camera was crucial for the new observations. By using a mask to block starlight, it can search stars' surroundings for faint, near-infrared light reflected by planets and the disks from which they arise.

Perhaps the most intriguing of the three findings is a direct image of what may prove to be a planet. Eric E. Becklin of the University of California, Los Angeles unveiled a picture showing a reddish point of light lying close to a star in the TW Hydrae Association. This is the nearest known cluster of young stars, roughly 170 light-years from Earth.

Imaged at three near-infrared wavelengths, the point of light is about 150 AU from the star. The observations suggest that the object could be about twice as massive as Jupiter.

"There needs to be follow-up work to determine the nature of this object," says theorist Alan P. Boss of the Carnegie Institution of Washington (D.C.). Last June, another team using the same camera imaged a candidate planet near a pair of stars (SN: 6/6/98, p. 357).



Left: Ring of dust encircling HR 4796A. Dotted line shows the ring crossing the blocked-out section of the star. Right: Dust disk with gap (arrow) surrounding the star HD 141569.

In a separate study, Becklin and his colleagues found that a huge disk of dust surrounding the star HD 141569 contains a large dark band. Among the handful of disks imaged around young, fully developed stars, this is the first to show a clear gap. It is roughly the width of the solar system and lies about 250 AU from the star, which is 320 light-years from Earth. The disk extends to about 350 AU.

Becklin and his colleagues, including Alycia J. Weinberger and Murray D. Silverstone, both of UCLA, argue that the void was cleared out by an unseen object, most likely a planet, lying in or near the gap. Becklin told SCIENCE NEWS that his team found no evidence of a companion star or massive brown dwarf in the vicinity of the star. This "helps bolster the case" that a planet is responsible for clearing the region, says Boss.

The planet "could be sweeping up the dust and rocks from the disk as it travels in its orbit around the star, or the gravity of the planet could knock the dust out of one part of the disk," notes Weinberger.

"The most ready explanation is that an embedded planet is gravitationally clearing material to either side," agrees Eugene Chiang of the California Institute of Technology in Pasadena.

Alternatively, speculates Becklin, this disk region might look dark simply because the material there has a different composition and reflects less light.

Before taking the Hubble image, Silverstone and his collaborators had studied HD 141569 using one of the twin Keck telescopes atop Hawaii's Mauna Kea. Observing the disk at longer infrared wavelengths than the Hubble images recorded, the telescope detected the glow from the inner, warmer part of the disk, out to a radius of about 75 AU.

The Keck image essentially leaves off where the Hubble image begins, notes Weinberger, and the two together may shed light on the size of dust particles and their density throughout the disk. Similarly, a Keck image of the disk surrounding HR 4796A is helping to reveal the composition and size of the particles in that system (SN: 4/25/98, p. 260).

The three findings pose a puzzle: The planets suggested by the images would all be much farther from their parent stars than Pluto lies from the sun. At such distances, the raw material for making planets thins dramatically. There may simply not be enough dust, gas, and ice at such remote regions to make planetary bodies, says Boss.

In addition, disk material orbiting at great distances from a star moves slowly. The collisions required to pack material together to make a planet are not as frequent as they are in the inner disk. Thus, it would seem, planets could not be made quickly in outlying regions. Yet none of the three stars is older than 20 million years, a period that may be too short to make a planet at those distances.

Theorists, says Smith, "will have an interesting time trying to understand how you can form planetary bodies at such great distances around stars so young." In the meantime, Hubble's near-infrared camera has run out of coolant and has ceased operation. —*R. Cowen*