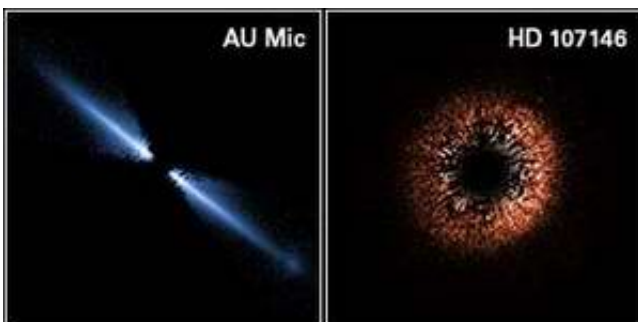


Spitzer And Hubble Capture Evolving Planetary Systems

December 9 2004



Two of NASA's Great Observatories, the [Spitzer](#) Space Telescope and the [Hubble](#) Space Telescope, have provided astronomers an unprecedented look at dusty planetary debris around stars the size of our sun.

Spitzer has discovered for the first time dusty discs around mature, sun-like stars known to have planets. Hubble captured the most detailed image ever of a brighter disc circling a much younger sun-like star. The findings offer "snapshots" of the process by which our own solar system evolved, from its dusty and chaotic beginnings to its more settled present-day state.

Image caption: see below.

"Young stars have huge reservoirs of planet-building materials, while

older ones have only leftover piles of rubble. Hubble saw the reservoirs and Spitzer, the rubble," said Dr. Charles Beichman of NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif. He is lead author of the Spitzer study. "This demonstrates how the two telescopes complement each other," he added.

The young star observed by Hubble is 50 to 250 million years old. This is old enough to theoretically have gas planets, but young enough that rocky planets like Earth may still be forming. The six older stars studied by Spitzer average 4 billion years old, nearly the same age as the sun. They are known to have gas planets, and rocky planets may also be present. Prior to the findings, rings of planetary debris, or "debris discs," around stars the size of the sun had rarely been observed, because they are fainter and more difficult to see than those around more massive stars.

"The new Hubble image gives us the best look so far at reflected light from a disc around a star the mass of the sun," said Hubble study lead author, Dr. David Ardila of the Johns Hopkins University, Baltimore. "Basically, it shows one of the possible pasts of our own solar system," he said.

Debris discs around older stars the same size and age as our sun, including those hosting known planets, are even harder to detect. These discs are 10 to 100 times thinner than the ones around young stars. Spitzer's highly sensitive infrared detectors were able to sense their warm glow for the first time.

"Spitzer has established the first direct link between planets and discs," Beichman said. "Now, we can study the relationship between the two." These studies will help future planet-hunting missions, including NASA's Terrestrial Planet Finder and the Space Interferometry Mission, predict which stars have planets. Finding and studying planets around

other stars is a key goal of NASA's exploration mission.

Rocky planets arise out of large clouds of dust that envelop young stars. Dust particles collide and stick together, until a planet eventually forms. Sometimes the accumulating bodies crash together and shatter. Debris from these collisions collects into giant doughnut-shaped discs, the centers of which may be carved out by orbiting planets. With time, the discs fade and a smaller, stable debris disc, like the comet-filled Kuiper Belt in our own solar system, is all that is left.

The debris disc imaged by Hubble surrounds the sun-like star called HD 107146, located 88 light-years away. John Krist, a JPL astronomer, also used Hubble to capture another disc around a smaller star, a red dwarf called AU Microscopii, located 32 light-years away and only 12 million years old. The Hubble view reveals a gap in the disc, where planets may have swept up dust and cleared a path. The disc around HD 107146 also has an inner gap.

Beichman and his colleagues at JPL and the University of Arizona, Tucson, used Spitzer to scan 26 older sun-like stars with known planets, and found six with Kuiper Belt-like debris discs. The stars range from 50 to 160 light-years away. Their discs are about 100 times fainter than those recently imaged by Hubble, and about 100 times brighter than the debris disc around the sun. These discs are also punctuated by holes at their centers.

Both Hubble images were taken with the advanced camera for surveys. They will be published in the *Astronomical Journal* and the *Astrophysical Journal Letters*. The Spitzer observations are from the multiband imaging photometer and will appear in the *Astrophysical Journal*.

Images:

[LEFT: AU Microscopii] - A visible-light image of a debris disk around the red dwarf star AU Microscopii. Planets may be forming, or might already exist, within it. The disk glows in starlight reflected by tiny grains of dust created by the collisions of asteroids and comets. Because it is composed of the pulverized remnants of these objects, it is called a "debris disk." More than 40 billion miles across, it appears like a spindle of light because we view it nearly edge on (like looking at a dinner plate along its side). The star is about 12 million years old and is only 32 light-years from Earth. This makes its disk the closest yet seen in reflected starlight. It is also the first disk imaged around an M-type red dwarf, the most common type of star in the stellar neighborhood around the Sun. The Hubble Space Telescope images, taken with the Advanced Camera for Surveys (ACS) reveal that the disk has been cleared of dust within about a billion miles of the star (first indicated from infrared-light measurements).

The ACS images confirm that the disk is warped and has small variations in dust density that, along with the central clearing, may be caused by the tugging of an unseen companion, perhaps a large planet. ACS shows that this is the only debris disk known that appears bluer than the star it surrounds. This may indicate that there are more small grains of dust, compared to large ones, than has been seen before in other such disks. Smaller grains scatter blue light better than red. The surplus of small grains may be due to the fact that the star is not bright enough to blow away these tiny particles. In brighter, hotter stars, the pressure from radiation can actually push small dust grains out of the disk and far out into space.

Credit: NASA, ESA, J.E. Krist (STScI/JPL), D.R. Ardila (JHU), D.A. Golimowski (JHU), M. Clampin (NASA/GSFC), H.C. Ford (JHU), G.D. Illingworth (UCO-Lick), G.F. Hartig (STScI) and the ACS Science Team

[RIGHT: HD 107146] - This is a false-color view of a planetary debris disk encircling the star HD 107146, a yellow dwarf star very similar to our Sun, though it is much younger (between 30 and 250 million years old, compared to the almost 5 billion years age of the Sun). The star is 88 light-years away from Earth. This is the only disk to have been imaged around a star so much like our own. The slight difference in brightness on one side of the disk is due to the fact that small dust particles scatter more light when they are between Earth and the star, rather than behind the star. This suggests that the bright side is closer to us. The disk is redder than the star whose light it reflects, indicating that it contains grains one two-thousandth of a millimeter in size (about 100 times smaller than household dust).

Our Sun is believed to have a ring of dust around it, lying just beyond the orbit of Neptune, although it is ten times narrower than the one around HD 107146. Our solar system also has between 1,000 and 10,000 times less dust. The size of the ring, its thickness, and the amount of dust make it unlikely that HD 107146 will ever evolve into a system like our own. This is interesting, as it shows that the planetary systems around the same kind of stars may have very different evolutionary paths.

Credit: NASA, ESA, D.R. Ardila (JHU), D.A. Golimowski (JHU), J.E. Krist (STScI/JPL), M. Clampin (NASA/GSFC), J.P. Williams (UH/IfA), J.P. Blakeslee (JHU), H.C. Ford (JHU), G.F. Hartig (STScI), G.D. Illingworth (UCO-Lick) and the ACS Science Team

Source: NASA

Citation: Spitzer And Hubble Capture Evolving Planetary Systems (2004, December 9) retrieved 23 April 2024 from <https://phys.org/news/2004-12-spitzer-hubble-capture-evolving-planetary.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.