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Building a new planet

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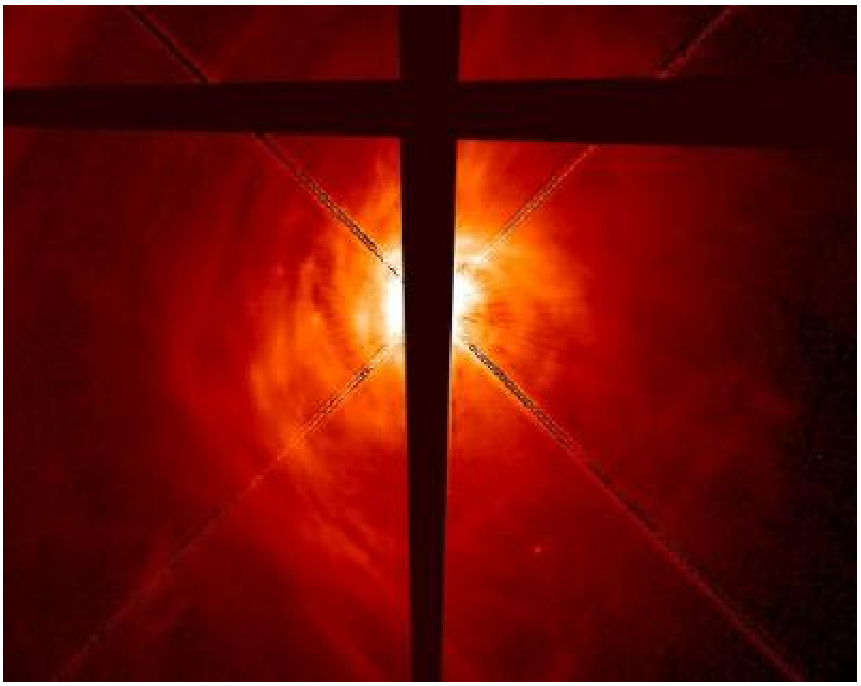

An enhanced optical image showing the inner portion of the disk of dust surrounding the young star AB Aurigae, with knots of material suggestive of the early stages of planet formation. New observations of the dust in a similar system find the grains have grown to sizes of one centimeter, or even larger. Credit: Hubble, and APOD

(PhysOrg.com) -- Astronomers over the past decade have made remarkable progress in the study of extrasolar planets; over 500 distant worlds are now confirmed. Meanwhile, as this active research community continues to discover and characterize more planets and planetary systems, another group of scientists has been asking the question, "Where do these planets come from in the first place?"

There are two ideas commonly advanced to explain the formation of planets. Both start with a disk of gas and dust around a star younger than a few million years old. In one ("bottom-up") scenario, small dust particles in the disk (similar to the dust in the interstellar medium) begin to stick together, coagulating over millions of years until kilometer-sized objects are formed. These in turn can coalesce and grow into planets. The second ("top-down") scenario supposes that gas and dust first collects into a planet-sized clump, which then collapses via gravity to form a planet.

New observational studies have tried to discriminate between these two scenarios and refine their various assumptions. CfA astronomer David Wilner and five of his colleagues used the Submillimeter Array, along with several other radio and millimeter telescopes, to probe the dusty disk around the star CQ Tauri, a roughly ten million year old star located only about 300 light-years away.

A dust grain emits most strongly at wavelengths of radiation that are approximately the same as its size; its efficiency radiating at other wavelengths similarly depends on its size. By measuring the spectral behavior of dust emission, therefore, it is possible to determine the ensemble properties of the dust grains in a disk. The dust in the interstellar medium (and by implication in the very early disk around a star) has sizes comparable to or smaller than a wavelength of optical light. In contrast, the astronomers found that the dust in the disk of CQ Tauri was huge: consistent with sizes of a centimeter or perhaps even more - almost ten thousand times larger than the typical dust grains in interstellar space. They also report marginal evidence that the dust grains in the inner portion of the disk were larger than those in the outer regions. These new results lend support to models of bottom-up grain growth, and in turn help to explain how, where and when new planets are made.

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