# Young planet challenges evolutionary theory

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The evolutionary accretion model—the accepted theory of the origin of the solar system—was invented with our solar system in mind. Despite theoretical difficulties, adherents of this model have argued that it is quite successful in explaining the properties of this solar system. But the real test is whether the accretion model can account for the newly discovered extrasolar planets, which it was not designed to explain. Extrasolar planets, as it turns out, have a tendency to pose serious challenges to evolutionary models of planetary formation. A recent find provides yet another example: NASA's Spitzer Space Telescope has found a planet too young to have been formed by the standard accretion scenario.

## The new planet

Spitzer's infrared spectrograph found evidence for a clearing in the gas and dust disk around a star called CoKu Tau 4. The clear region extends to about 10 AU from the star. (Earth is 1AU—astronomical unit—from the sun.) It is believed that this is caused by the presence of a giant planet. As dust falls in towards the star, the planet would collect any dust coming from outside its orbit, while material inside the orbit would fall uninhibited to the star, leaving a clear region between the star and the orbit of the planet.[1]

Several other mechanisms might produce such a hole in a protoplanetary disk, but none seems to fit the specifics of the disk around CoKu Tau 4. For example, a companion star could explain the hole, but no companion star has been observed. Alternatively, the formation of a group of smaller objects such as asteroids could clear a hole, but this would not explain the observed sharp boundary.[2] While there is still some scepticism, the most likely explanation is a large planet. Dan Watson, a co-discoverer of the gap in the disk, said: 'The planetary-formation scenario is the only one that really gives the degree of clearing that we see in the center of the disk, and the sharpness of the inner edge of the disk that we see in the data.'[3,4]

Holes in disks have been observed before on several occasions. But this case is remarkable in that the star is dated at only about one million years old.[5] The planet clearly cannot be any older than the star, and according to evolutionary theories it must be younger. This means that evolutionists have to explain how a giant planet could form in less than one million years, while the most widely accepted theory of planetary formation requires about four times that long.[2,6]

## A challenge to the accretion model

According to the accretion model, the formation of a giant planet begins when dust grains in the protoplanetary disk[7] stick together in clumps, which in turn stick together to produce larger clumps, and so on, all the way to asteroid-size planetesimals and eventually a planet-size, rocky protoplanet. The protoplanet's gravity then pulls in some of the surrounding gas, giving the planet the thick atmosphere characteristic of such giants.

There are theoretical difficulties with this model. For example, when the planetesimals reached about a kilometre in size, they would wear each other down in collisions as fast as they could accrete.[8] Planets can hardly form this way. According to extrasolar planet researcher Denise Kaisler, 'No one knows quite how planetesimals ever attain protoplanet status.'[9] (Nevertheless, most astronomers are still confident that the theory is basically correct, and that the problems will be resolved by further study.)

But newly discovered extrasolar planets have compounded these problems, and have repeatedly forced evolutionists to rethink their ideas. This latest example means evolutionists must find a way for a large planet to form in less than a million years. Watson admitted that this planet's age 'really causes problems for the standard model of planetary formation'.[10]

## Conclusion

In a previous issue of *TJ*,[11] Robert Newton discussed a planet too *old* to be explained by accretion.[12] The planet orbiting CoKu Tau 4, if confirmed, would be too *young* for that same model.[13,14] The accretion model, already plagued by theoretical difficulties, is becoming more and more untenable as the increasing knowledge of extrasolar planets continues to highlight that theory's weaknesses. It is becoming apparent that the accretion model works (to some degree) in our solar system simply because it was tailor-made to do just that. But it fails the critical test of being able to account for data other than those it was invented to explain.

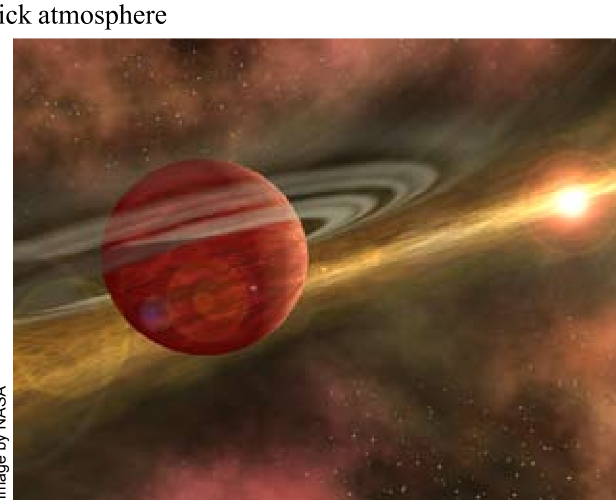

Image by NASA

*Artist's conception of the planet orbiting CoKu Tau 4. Courtesy NASA/JPL-Caltech.*

## References


1. Battersby, S., 'Youngest planet' flouts theory of formation, <www.newscientist.com/news/news.jsp?id=ns99995052>, 28 May 2004.
2. Mullen, L., Young planet challenges old theories, <www.astrobio.net/news/modules.php?op=modload&name=News&file=article&sid=993&mode=thread&order=0&thold=0>, 28 May 2004.
3. Shiga, D., An 'impossibly' young planet? <skyandtelescope.com/news/article_1264_1.asp>, 28 May 2004.
4. This observation is more indirect than usual, but the existence of a planet seems the most likely explanation. While some caution is in order, we can safely say that such a planet poses a challenge to the accretion model.
5. Raw ingredients for life detected in planetary construction zones, <sse.jpl.nasa.gov/news/display.cfm?News_ID=8457>, 27 May 2004.
6. Astrophysicist Richard Durisen believes the planet's age may not be that serious a problem. He points out that the age of the star is not known precisely, and thus it might be a little older. But even then, it would take a 'somewhat improved version' of accretion to account for this planet. See Kerr, ref. 10.
7. The protoplanetary disk, or solar nebula, is the disk of gas and dust around a young star from which, it is hypothesized, the planets, asteroids, comets and other objects of that solar system form.
8. Kaisler, D., The puzzles of planethood, *Sky & Telescope* **104**(2):32–38, 2002.
9. Kaisler, ref. 8, p. 36.
10. Kerr, R.A., Youngest extrasolar planet reported, *Science* **304**:1423, 2004.
11. Newton, R., New planet challenges evolutionary models, *TJ* **17**(3):9, 2003.
12. Accretion depends on the presence of metallic grains. Thus, no planet could form by accretion until after several billion years of stellar evolution had synthesized the metals. When the globular cluster M4, in which this planet resides, supposedly formed, there would not have been enough metals present. (Note that 'metal', in astronomical jargon, refers to any element heavier than helium.)
13. Note that this should not be used as evidence for a young universe. If such dating of stars were to be trusted, many stars in the Milky Way would be on the order of 12 billion years old.
14. This planet, though quite problematic for accretion, does not pose any difficulties for Alan P. Boss's disk instability model. However, disk instability, like accretion, has theoretical difficulties. In addition, there are other extrasolar planets that seem to have challenged disk instability. See: Schilling, G., Metals hint at how planets form, *Sky & Telescope* **106**(3):23, 2003.