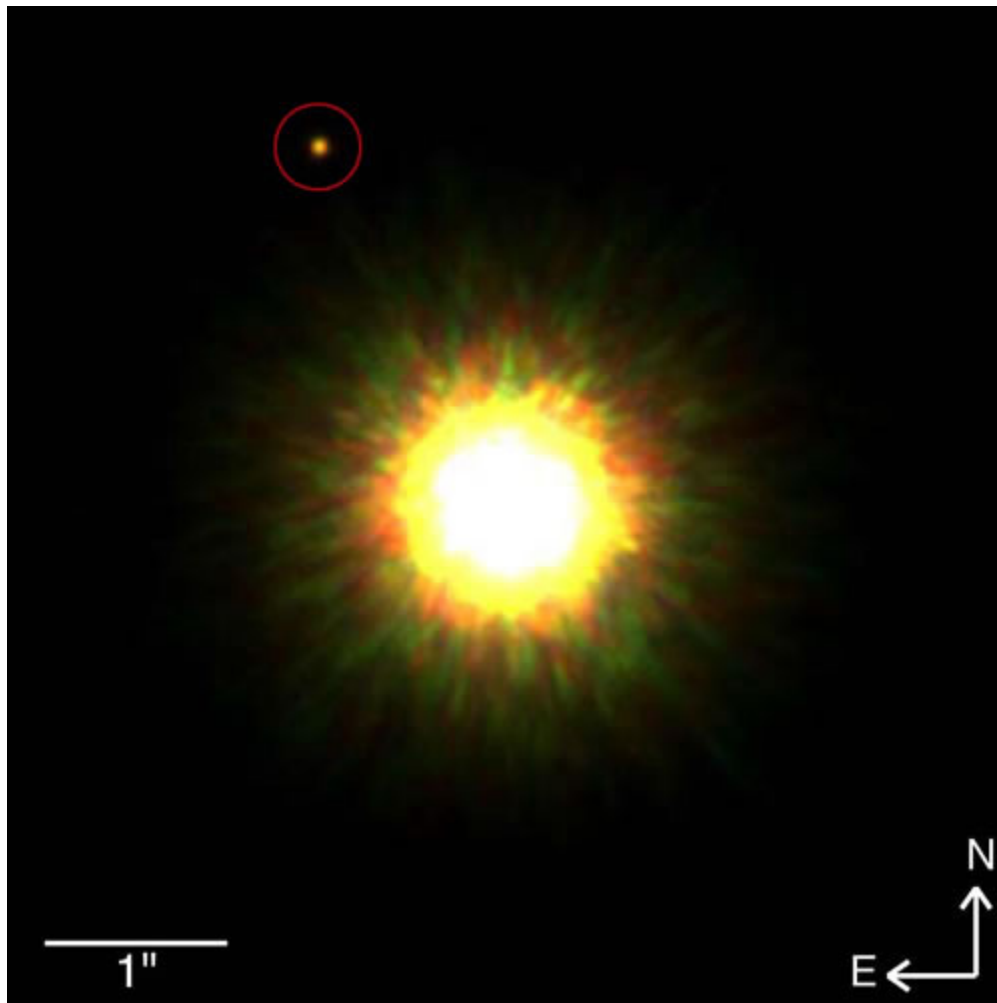


Posted September 15, 2008. The article below is from:

<http://blogs.discovermagazine.com/badastronomy/2008/09/15/planet-imaged-around-a-sunlike-star/>

PLANET IMAGED AROUND A SUNLIKE STAR?!

Is this it? **Is this the very first image of a planet orbiting a star like the Sun?**



[The image come from the monster 8 meter Gemini North telescope in Hawaii.](#) The star is 1RSX J160929.1-210524 (for those taking notes at home) — it's a K7 dwarf, a bit cooler and smaller than the Sun — and the planet is the blip circled at the upper left. It has no real name as yet — **it hasn't been confirmed yet**; more on that in a sec — but if it's a planet orbiting the star, it has a mass of about 8 times that of Jupiter.

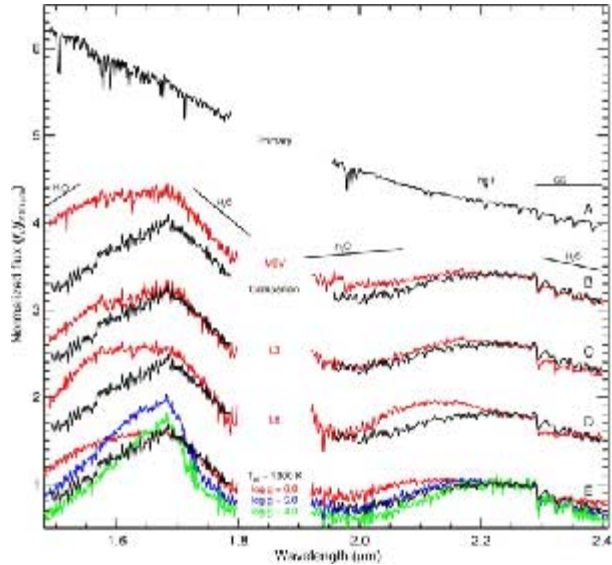
The image is in near-infrared, just outside the human range of vision. This is a good place to hunt for young planets, because for millions of years after they are formed, planets are hot and glow in the infrared, while stars like the Sun are faint in the IR. Well, *relatively* faint; they still pour

out energy, but it's a lot less than in the visible part of the spectrum. So using IR detectors means you're looking where young planets put out most of their light, and stars put out the least.

The planet seen by Gemini appears to be about 5 million years old—the parent star is part of a cluster of stars whose age is known. They lie about 500 light years from Earth.

The reason astronomers think this is a planet is because they took spectra: they broke the light up into a rainbow, if you will, and when you carefully examine the spectrum you can determine all sorts of things about the object emitting the light: how hot it is, what chemical composition it has, how old it is, even if it's spinning!

The spectrum of the object matches that of an old, very low mass star. That might make you think it's a star, but wait! The planet is young, and still hot. The light it gives off depends on its temperature, so a young low mass object, like a planet, can look just like a more massive object like a star. Since we know this object is young, we know it has a lower mass than its spectrum naively suggests. When models of how planets cool are used, we get a pretty good match for one with 8 times Jupiter's mass if it's the age of the star cluster, 5 million years.



Spectra of the star and planet. Click to embiggen.

But this is not confirmed! For example, it could be a low mass star that happens to be near the other star along our line-of-sight — in other words, it's in the background. The best way to see if that's true is to wait a year or two and take more images. If the object moves against the background stars along with the brighter star, then it must be physically associated with the star, and therefore it's a planet. [This is how we confirmed the first image of an exoplanet back in 2005](#) [Professor Vakil inserts: This *first image of an exoplanet* blog entry appears below] — but that was orbiting a brown dwarf, a star very different than the Sun.

If confirmed, this one is pretty important, because the parent star is much like our own Sun. The most interesting thing about this is the distance of the purported planet from the star: 50 billion kilometers! That's *11 times* the distance Neptune is from the Sun. And that's a lower limit; it might be farther. That makes me very suspicious: we don't know of any way to form planets that far from their parent stars.

Stars and planets form from rotating disks of gas and dust. The stuff collects in the middle to form the star, and the stuff farther out forms the planets — [we have seen many examples of this in the sky](#). The disks we see around new stars are big, sure, but by the time you get 50 billion km out they are very thin, and there's just not enough material out there to form a planet, let alone one with 8 times the mass of Jupiter.

In this case, the most likely explanations for this image are that 1) this isn't a planet, but a background star, or 2) it formed closer in and was ejected by an encounter with another planet, moving it way the heck out from the star. (1) is a bummer, and is unlikely just due to statistics; it's isn't high odds to see an object like this by coincidence so near another star. (2) seems unlikely to me as well; it's hard to toss around a planet that mass unless an even more massive planet was involved. I hope this star is a target for searches for more planets, just to get more information on this scenario.

To their credit, the astronomers involved are also clear about this [in their paper announcing the discovery](#). This is a carefully done observations, and they are appropriately careful in their announcement.

But if it's true... WOW. This would be the second planet ever seen directly in an image, and the first to orbit a star like the Sun. The implications would profound. It would be direct evidence of planets orbiting other stars at great distances. It would mean there could be another planet in our own solar system (unlikely, [but I've written about that before](#)). And it would mean that it's possible to use this method of near-infrared mapping to actually get pictures of more planets! Seeing one might be a fluke, seeing two means there are more to find.

The next clear night, do yourself a favor: go outside. Look up. See all those stars? Whether or not this particular planet pans out, we still know that a large fraction of those stars — 10%? 20? — may have planets. And some fraction of those may have planets like Earth orbiting them. We really weren't sure about this even 15 years ago, and now we're able to not only start plugging numbers into the equations, *but we can actually take pictures of some of these objects*.

My oh my. How I do love science.

September 15th, 2008 9:07 AM by [Phil Plait](#) in [Astronomy](#), [Cool stuff](#), [Pretty pictures](#), [Science](#) | 11 comments | [RSS feed](#) | [Trackback >](#)

Posted April 29, 2005. The article below is from:

<http://blogs.discovermagazine.com/badastronomy/2005/04/29/first-exoplanet-imaged/>

FIRST EXOPLANET IMAGE CONFIRMED!

The very first image of a planet orbiting a star other than the Sun [has been confirmed](#). They really did it; they bagged a planet!

I won't keep you in suspense: here is the picture:



The planet is the red fuzzy blob to the lower left of the blue fuzzy blob. The blue blob is the parent star, and is a [brown dwarf](#), a very low-mass star (it looks blue because this is a false-color image). The planet has about 5 times Jupiter's mass, well within the range of being a planet and way too low to be even a brown dwarf, let alone a star. It orbits the star at about 1.5 times the distance Pluto orbits from the Sun. The two are close by as these things go: just 70 parsecs (230 light years) from here.

So how do we know that's a planet? Ah, it's a fine story to tell. Have a seat and get comfy; this'll take a while.

We've known about other planets for some time now. [The first were discovered in 1990](#), orbiting, of all things, a pulsar, a dead star. These are pretty interesting planets, given their circumstances, but they are not orbiting a sunlike star (though I highly recommend [reading the story behind the discovery](#), it's a grand tale, full of real science and real scientists).

The first planets orbiting stars like the Sun [were found in 1995](#). They were *not* seen directly, but only through their influence on their parent star. A star, of course, has lots of gravity, so the planet orbits the star in a big circle (or ellipse). But the planet has gravity too, which tugs on the star. It's like two people, one big and one small, locking hands and swinging around each other. The little one makes a big circle, and the big one makes a little circle.

As the star moves, this motion is betrayed through the Doppler shift, the same effect that makes a race car go "EEEEEEEEooooooooowwwwwrrrrrrrrrr" as it zips past you. When the star moves toward us in its tiny orbit around the planet (if you want to think of it that way), the Doppler shift means its light gets a wee bit bluer. When it moves away from us, the light gets a bit redder. This shift is incredibly small, and takes fantastically sensitive instruments to detect it. That technology only became available 10 years ago, and we've come pretty far: [over 150 planets have been found this way](#).

While this is fantastic, it still leaves us semi-evolved apes dissatisfied: we want to *see* something! Those detections come about as plots of sine waves and wiggly lines.

I wanna see a planet!

Heehee. Now I can. This is so cool!

OK, I got distracted there. Back to the story.

There has been something of a race to get the first image of a planet around another star. I played a minor role in this race. When I worked on [a camera onboard Hubble](#), we wondered if we could image a planet orbiting the nearest sunlike star, Alpha Centauri. I wrote some programs to simulate how the camera worked, and I determined that we might, *might*, just *barely*, detect one if the conditions were just so. But it would have been an extremely difficult observation, and we couldn't convince the folks who controlled Hubble to do the observation— I really don't blame them, given how monumentally hard this observation would have been, for so low a chance of success. We did search other, nearby stars, and never found one (duh, or else I wouldn't be writing this blog entry now; I'd have written it years ago!).

Well, then came images from an infrared camera on Hubble. Looking for planets in the IR is good. Stars are bright, so bright that they totally drown out the feeble light from a planet. In *visible* light, that is. In the infrared, planets are much brighter, and stars dimmer. Instead of being a billion times brighter (as Alpha Cen was over any hypothetical planet I tried to simulate), in the IR stars might only be thousands of times brighter. That's still a lot, but easier to deal with.

My friend [Glenn Schneider](#) had some intriguing data from the IR camera, showing a dim star (for the record, it was called TWA 6, because it's part of a loose group of young stars called the TW Hydrae Association), with another, dimmer star next to it. The colors of the object were consistent with it being a planet. Had he found a planet orbiting another star? He couldn't be sure, because it might be a background star masquerading as a planet. He needed proof.

The only way to know was to either wait a year to see if the two objects moved across the sky together (more on that in a moment, because it's crucial to our tale), or to take a spectrum, break the light up into its colors like a rainbow. By doing that, you can tell the difference between a planet and a star.

So Glenn used the camera I worked on to take spectra, and asked me to help analyze the data. I spent *months* slaving over that data. Months! But the goal was sweet: to have proof of the first image of an alien world orbiting a far off star...

Other people (like my friend [Eliot Malumuth](#)) worked hard on the data too, but in the end we just couldn't do it. The star's light was swamping the fainter light from the other object. Dejected, we gave up. Turns out, later, follow-up observations showed it was a background star. Oh well.

How did we know it wasn't a planet? Let's back up a sec. The Milky Way Galaxy is a collection of hundreds of billions of stars (and clouds of dust and gas and other junk) in the shape of a

flattened disk. The stars orbit the center, and that includes the Sun. Even at 200 km/sec, it takes about 240 million years to circle the Galaxy once. Yikes.



But other stars orbit at different speeds. So over years, we see the stars in the sky move with respect to each other. We call this their “proper motion” ([I wrote a web page about this](#), with a Hubble picture showing this motion for a nearby star). So if you take an image of a star, wait some time, and take another one, you can detect this motion. See where this is going (har har)?

If we see a blip of light near a star, it might be a background star. So we wait a while, and then take another picture. If the nearby star moves a lot with respect to the other blip of light, chances are that blip is a star much farther away. If it were planet, it would share its stars motion across the sky.

With Glenn’s star, it turned out that the later observations showed the two objects *not* to be moving together. They were unassociated, and we didn’t have a planet.

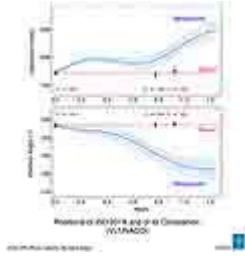
Fast forward five years or so, to 2004...

Last year, a team led by astronomer Gael Chauvin used the prosaically-named Very Large Telescope in Chile, and [they spotted something interesting](#). Near a faint red star called 2M1207 (ironically, in the TW Hydrae association!) was a fainter, even redder blip of light. Hmm...they got a spectrum, and it sure looked like a young planet, still hot from its formation, but they couldn’t be positively, *absolutely* sure. The only way to confirm whether it was a planet or not was to wait, and get more images later. Then they could see if the two blips moved together.

Fast forward again, to April 2005...

Hey, that’s *now*!

Success!



The image above (clicking it takes you to a 220kb higher-res image) shows the proof. The blue line is the motion of the planet relative to the star if it's *not* a planet, and the flat red line is if it really is a planet, moving with the star. Note the points on the plot— they are smack dab on the red line.

The two blips moved together. That means the last bit of doubt is gone. They did it! I now pronounce you star and planet. In fact, the star needs a name change: it's now called 2M1207A. The planet is 2M1207b (stars are upper case, planets are lower case, so that's not a typo).

My sincere and very exuberant congratulations to Gael Chauvin and his team who made this incredible image. Look at it! Sure, it's young, only about 8 million years old (compared to 4.5 billion for the Earth), and it's still so hot that water in its atmosphere is still steam. And sure, it'll take a few million years to cool off, and even then it'll be a gas giant probably much like Jupiter.

But it's a *planet*. And you can *see* it.

As our technology gets better, we'll find lower and lower mass planets. Then there may well be a quantum leap: NASA plans on building space telescopes [which can image planets the size of Earth](#), normal, mature planets, *just like Earth*, if they're out there.

I think they are, and I think we'll see them. I wonder. My daughter is nine years old. By the time she's in college, taking an astronomy class — will her professor show her an image of a world with blue oceans, green and brown continents, white clouds... orbiting Alpha Centauri?

April 29th, 2005 9:58 PM by [Phil Plait](#) in [Cool stuff](#) | 63 comments | [RSS feed](#) | [Trackback >](#)