Blueshift - November 17, 2009

Dust in the Interstellar Wind

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Sara Mitchell: Welcome to the November 17, 2009, episode of Blueshift. I'm Sara Mitchell.

Here at Goddard Space Flight Center in Greenbelt, Md., astrophysicists study the dusty disks around stars where planets may form. One scientist, John Debes, has an explanation for the sometimes curious shapes these disks take. Here's Blueshift's Francis Reddy with more.

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Francis Reddy: Astronomers know of more than 400 planets beyond our solar system. Now, finding planets around other stars is one thing, but understanding how and why they form as gas-giant planets -- like Jupiter -- or ice giants -- like Neptune -- or rocky worlds -- like Earth -- is quite another.

The disks of dust and gas that surround young stars are the places where planets are born. But they're not easy to understand, cautions Goddard's John Debes.

John Debes:These disks are really complicated and really interesting, and they need to be looked at in a variety of ways to really understand what's going on with them, because not only do you have to sort of figure out the details of what makes up these disks, but you also have to figure out what's the environment of the disk, and how that affects what you're ovserving.

Francis Reddy: One example is the disk around HD 61005, a star is located about 100 light-years away in the southern constellation Puppis.

John Debes: This disk has a slight bend in it. It's actually a fairly subtle bend in the data, and there aren't any really good explanations for why you would get that kind of a bend.

Francis Reddy: Some suggested this bend was caused by the presence of planets in the disk or close flybys of passing stars. But Debes finds that what's shaping HD 61005's disk is its motion through patchy gas clouds between stars, what astronomers call the interstellar medium, or ISM.

John Debes: The whole system is moving through this ISM cloud, and so all those little dust grains are slamming into the ISM, and they're getting slowed down. And they

eventually want to follow the direction of the ISM cloud rather than their original direction. So they slowly bend away from their original trajectory in space.

Francis Reddy: Debes calls this process "supersonic ballistic gas drag." He likens it to what happens when a meteor enters Earth's atmosphere.

John Debes: It just slams into the atmosphere and slows down really quickly, because the atmosphere has so much more strength to slow it down than the meteorite has speed, in a sense.

Francis Reddy: The dust grains being blown out of the system are tiny -- about a micron across, or roughly the size of the particles in smoke. The shape of the disk depends on its motion through interstellar gas.

For HD 61005, this encounter is face on, so the disk edge gently sweeps backward, away from the direction of motion. For an edgewise encounter -- essentially a headwind -- astronomers may see only half a disk. But does this gentle "grain drain" somehow harm the disk, make it less likely to form planets?

John Debes: What we're actually seeing is just sort of these leftover bits of planetesimals crashing together or evaporating away. And they're going to be leaving the system anyway, but they just get sort of sculpted by their environment. So It actually doesn't hurt dust disks too badly. It doesn't affect the source of the dust. It just has an effect on the dust that's sort of blowing out anyway.

Francis Reddy: Debes hopes this work will lead to better ways of understanding what's going on in planet-forming disks.

John Debes: One of the things that I'd like to work on in the future is combining this model with real compositions of dust to get a much more holistic picture of a disk. Not just “is it moving through the ISM?”, but if it is, what effect that might have on the outer dust composition or grain size.

Francis Reddy: Getting a better feel for what affects the outer regions of a planet-forming disk will shed light on how "ice giant" planets like Uranus and Neptune -- and the more distant swarm of small, icy bodies known as the Kuiper Belt -- formed within our own solar system.

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Sara Mitchell: It's amazing that just 14 years after the first planet was detected around another star, astronomers now know of over 400 more. And that's a fitting number,

because 2009 is the 400th anniversary of Galileo's first look at the sky through a telescope.

You can find more information on today's story, as well as some links to related stories, on our website: universe.nasa.gov/Blueshift. You can also see what we're up to by following us on Twitter. We're @NASABlueshift.

We'll be back with another episode in a couple of weeks. This is Sara Mitchell, bringing the Universe closer to you with Blueshift.