Cosmic births revealed by disks of dust

November 15 2010

By carving 'gaps' in the disks of dust that create and enshroud them, newborn planets are giving astronomers clues to locating possible new worlds.

An international research team, led by Swinburne University's Associate Professor Sarah Maddison, is studying the disks of dust that enfold newborn planets in order to better understand cosmic birth.

Because dust obscures optical light, astronomers need to look for other ways to identify the presence of unseen planets in the dusty disks around young stars. A new planet's existence can be inferred from the behaviour of the dust (and gas) around it; much as a ship's presence might be inferred from its wake on the ocean by an observer flying high above.

This is where Maddison's work comes in. To help spot newborn planets, her team has assembled a complex supercomputer model that simulates what happens when a planet is embedded in the disks of dust and gas that surround young stars.

Specifically, the model allows them to observe the creation of gaps that form in the disks (like grooves in an old LP vinyl record) due to the gravity of the unseen planet.

"Rather than hunt for the planets themselves, our aim is to investigate the formation and structure of gaps found in the dust layers," Maddison said.

“We can add a virtual planet to our model and watch how the dust and gas disks behave in response. This gives us a recognisable ‘signature’, which astronomers can then compare to what they are observing in real planetary disks.

“It allows us to distinguish between gaps due to dust grain growth or, more excitingly, gaps caused by young planets in the process of forming.”

The subtlety of the new model is based on the fact that gas and dust in a planetary disk respond differently to the presence of a massive body.

By combining the two signatures they give off around a gap, the team’s technique can say more definitively whether a young planet is the cause.

“What separates this from previous work is that a planet has a different effect on the dust than on the gas in the disk,” Maddison said. “Previous models just looked at the gas, but it turns out that planets have a stronger effect on the dust phase than on the gas phase.”

According to Maddison, one of the most exciting aspects of their model is that these simulations can be used to predict what observers will ultimately see.

The team is in the process of identifying and cataloguing likely young planets in preparation for the completion of a powerful new telescope being built in Chile, the Atacama Large Millimetre Array (ALMA).

Based on Maddison’s simulations, astronomers will be able to use ALMA to observe disks which contain planets that are gradually assembling themselves from tiny grains of matter to giant objects potentially capable of sustaining life.

More information: Read more about this research in the latest edition of the Swinburne Magazine.

Provided by Swinburne University of Technology