Mind the gap: VLT instrument hints at the presence of planets in young gas discs

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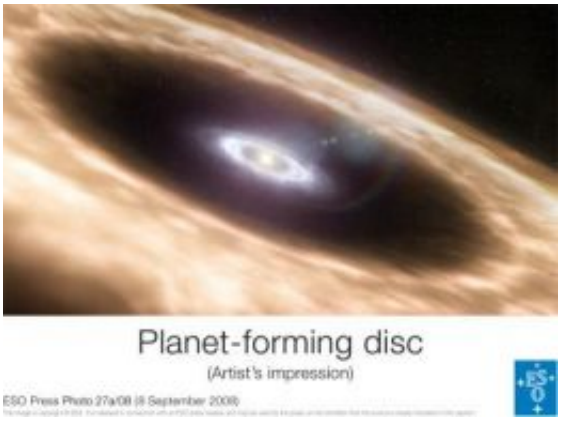

Astronomers have been able to study planet-forming discs around young Sun-like stars in unsurpassed detail, using ESO's Very Large Telescope. The studied discs were known to have gaps in the dusty discs (represented by the brownish color in the image) but the astronomers found that gas is still present inside these gaps (represented by the white color in the image). This can either mean that the dust has clumped together to form planetary embryos, or that a planet has already formed and is in the process of clearing the gas in the disc. Credit: ESO

Astronomers have been able to study planet-forming discs around young Sun-like stars in unsurpassed detail, clearly revealing the motion and distribution of the gas in the inner parts of the disc. This result, which possibly implies the presence of giant planets, was made possible by the combination of a very clever method enabled by ESO's Very Large Telescope.

Planets could be home to other forms of life, so the study of exoplanets ranks very high in contemporary astronomy. More than 300 planets are already known to orbit stars other than the Sun, and these new worlds show an amazing diversity in their characteristics. But astronomers don't just look at systems where planets have already formed - they can also get great insights by studying the discs around young stars where planets may currently be forming. "This is like going 4.6 billion years back in time to watch how the planets of our own Solar System formed," says Klaus Pontoppidan from Caltech, who led the research.

Pontoppidan and colleagues have analysed three young analogues of our Sun that are each surrounded by a disc of gas and dust from which planets could form. These three discs are just a few million years old and were known to have gaps or holes in them, indicating regions where the dust has been cleared and the possible presence of young planets.

The new results not only confirm that gas is present in the gaps in the dust, but also enable astronomers to measure how the gas is distributed in the disc and how the disc is oriented. In regions where the dust appears to have been cleared out, molecular gas is still highly abundant. This can either mean that the dust has clumped together to form planetary embryos, or that a planet has already formed and is in the process of clearing the gas in the disc.

For one of the stars, SR 21, a likely explanation is the presence of a massive giant planet orbiting at less than 3.5 times the distance between the Earth and the Sun, while for the second star, HD 135344B, a possible planet could be orbiting at 10 to 20 times the Earth-Sun distance. The observations of the third star, TW Hydrae, may also require the presence of one or two planets.

"Our observations with the CRIRES instrument on ESO's Very Large Telescope clearly reveal that the discs around these three young, Sun-like

stars are all very different and will most likely result in very different planetary systems," concludes Pontoppidan. "Nature certainly does not like to repeat herself".

"These kinds of observations complement the future work of the ALMA observatory, which will be imaging these discs in great detail and on a larger scale," adds Ewine van Dishoeck, from Leiden Observatory, who works with Pontoppidan.

To study the gaps in dust discs that are the size of the Solar System around stars that are located up to 400 light-years away is a daunting challenge that requires a clever solution and the best possible instruments.

"Traditional imaging cannot hope to see details on the scale of planetary distances for objects located so far away," explains van Dishoeck. "Interferometry can do better but won't allow us to follow the motion of the gas."

Astronomers used a technique known as 'spectro-astrometric imaging' to give them a window into the inner regions of the discs where Earth-like planets may be forming. They were able not only to measure distances as small as one-tenth the Earth-Sun distance, but to measure the velocity of the gas at the same time.

"The particular configuration of the instrument and the use of adaptive optics allows astronomers to carry out observations with this technique in a very user-friendly way: as a consequence, spectro-astrometric imaging with CRIRES can now be routinely performed," says team member Alain Smette, from ESO.

Source: ESO