Polarization technique focuses limelight

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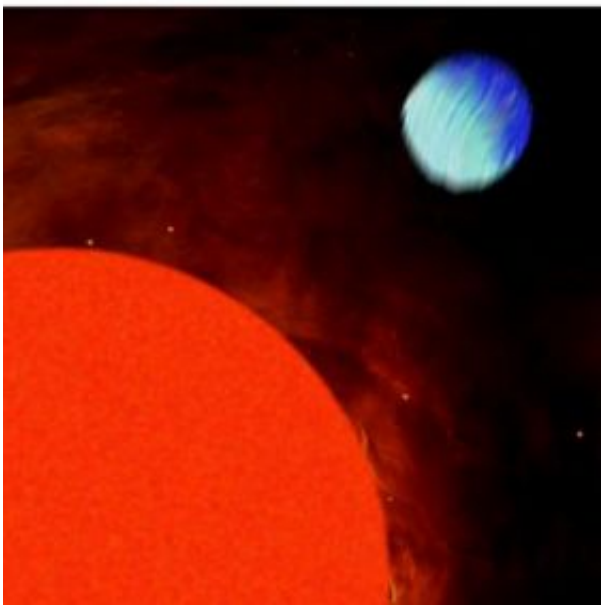

An artistic view of the HD189733 star-planet system near a half-moon phase when polarization of the light reflected by the planet reaches the maximum. Credit: ETH Zurich, S.V. Berdyugina

The ability to explore remote worlds in space has been enhanced through a polarization technique that allows the first ever detection of light reflected by extrasolar (exoplanet) planets. The study has been accepted for publication in *Astrophysical Journal Letters*.

An international team of astronomers, led by Professor Svetlana Berdyugina of ETH Zurich's Institute of Astronomy, has for the first time ever been able to detect and monitor the visible light that is

scattered in the atmosphere of an exoplanet.

Employing techniques similar to how Polaroid sunglasses filter away reflected sunlight to reduce glare, the team of scientists were able to extract polarized light to enhance the faint reflected starlight 'glare' from an exoplanet. As a result, the scientists could infer the size of its swollen atmosphere. They also directly traced the orbit of the planet, a feat of visualization not possible using indirect methods.

Hot Jupiter

The transiting exoplanet under study circles the dwarf star HD189733 in the constellation Vulpecula and lies more than 60 light years from the earth. Known as HD189733b, this exoplanet was discovered two years ago via Doppler spec-troscopy. HD189733b is so close to its parent star that its atmosphere expands from the heat. Until now, astronomers have never seen light reflected from an exoplanet, although they have deduced from other observations that HD189733b probably resembles a 'hot Jupiter' – a planet orbiting extremely closely to its parent star. Unlike Jupiter, however, HD189733b orbits its star in a couple of days rather than the 12 years it takes Jupiter to make one orbit of the sun.

Two half-moon phases

The international team, consisting of Svetlana Berdyugina, Dominique Fluri (ETH Zurich), Andrei Berdyugin and Vilppu Piirola (Tuorla Observatory, Finland), used the 60cm KVA telescope by remote control. The telescope, which belongs to the Royal Swedish Academy of Science, is located at La Palma, Spain and was modernised by scientists in Finland. The researchers obtained polarimetric measurements of the star and its planet. They discovered that polarization peaks near the moments when half of the planet is illuminated by the star as seen from the earth.

Such events occur twice during the orbit, similar to half-moon phases.

The polarization indicates that the scattering atmosphere is considerably larger (>30%) than the opaque body of the planet seen during transits and most probably consists of particles smaller than half a micron, for example atoms, molecules, tiny dust grains or perhaps water vapour, which was recently sug-gested to be present in the atmosphere. Such particles effectively scatter blue light – in exactly the same scattering process that creates the blue sky of the earth's atmosphere. The scientists were also able for the first time to recover the orientation of the planet's orbit and trace its motion in the sky.

"The polarimetric detection of the reflected light from exoplanets opens new and vast opportunities for exploring physical conditions in their atmospheres", Pro-fessor Svetlana Berdyugina said. "In addition, more can be learned about radii and true masses, and thus the densities of non-transiting planets."

Citation: Svetlana V. Berdyugina, Andrei V. Berdyugin, Dominique M. Fluri, Vilppu Piirola: First detection of polarized scattered light from an exoplanetary atmosphere, *Astrophys. J. Lett.*, online publication 24. December 2007.

Source: Swiss Federal Institute of Technology