True colour of exoplanet measured for the first time

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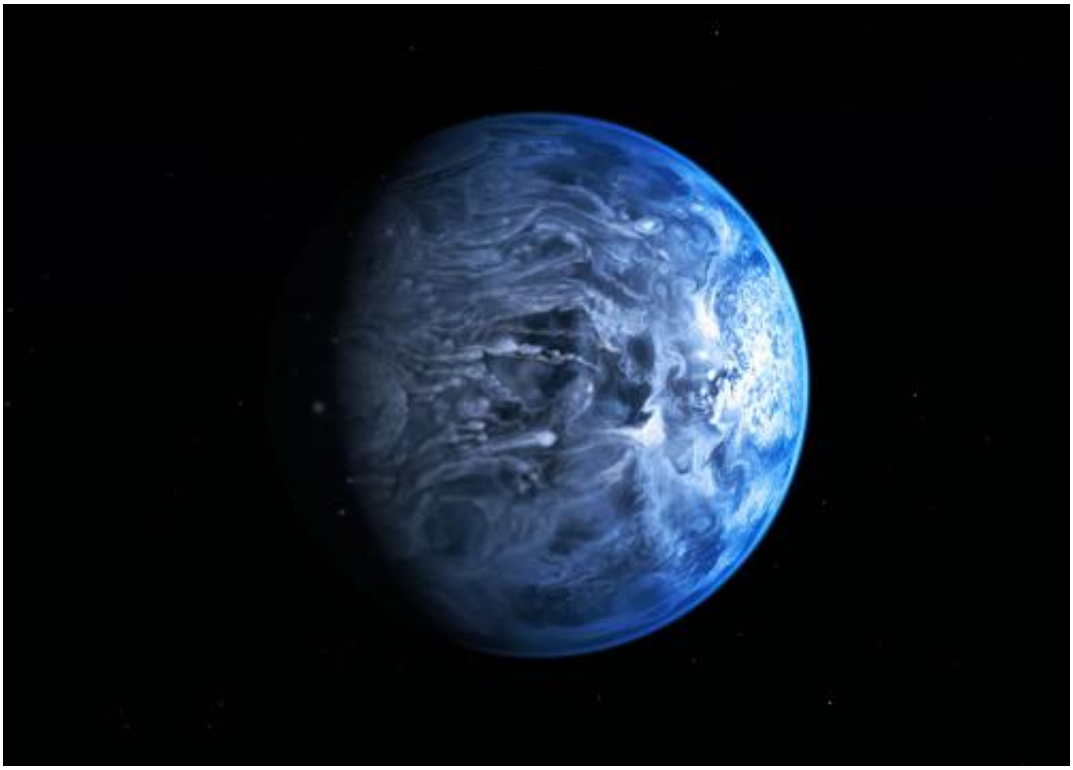


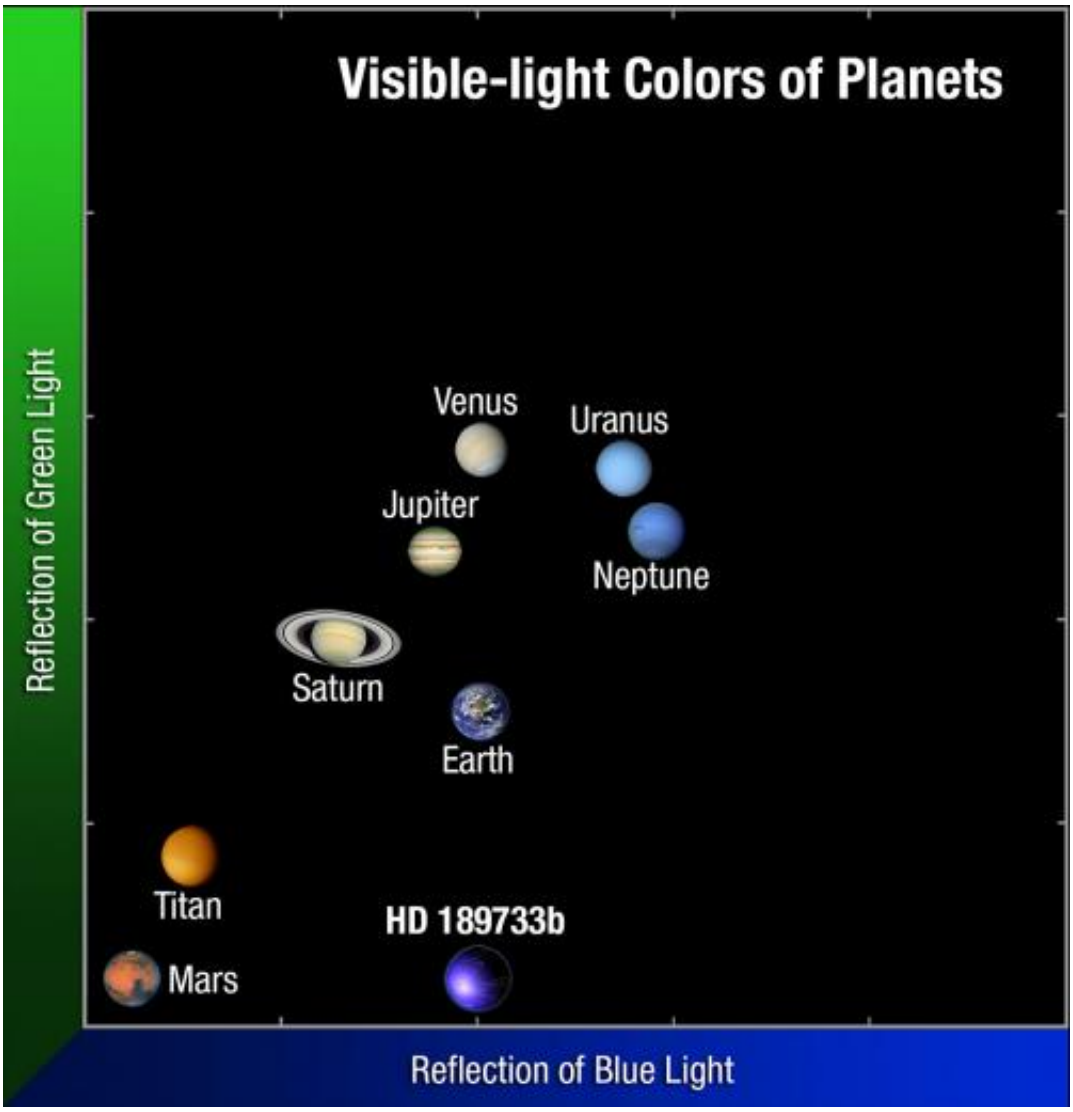
This illustration shows HD 189733b, a huge gas giant that orbits very close to its host star HD 189733. The planet's atmosphere is scorching with a temperature of over 1000 degrees Celsius, and it rains glass, sideways, in howling 7000 kilometre-per-hour winds. At a distance of 63 light-years from us, this turbulent alien world is one of the nearest exoplanets to Earth that can be seen crossing the face of its star. By observing this planet before, during, and after it disappeared behind its host star during orbit, astronomers were able to deduce that HD 189733b is a deep, azure blue — reminiscent of Earth's colour as seen from space. Credit: NASA, ESA, M. Kornmesser

(Phys.org) —Astronomers using the NASA/ESA Hubble Space Telescope have, for the first time, determined the true colour of a planet orbiting another star. If seen up close this planet, known as HD 189733b, would be a deep azure blue, reminiscent of Earth's colour as seen from space.

But that's where the similarities end. This "deep blue dot" is a huge gas giant orbiting very close to its host star. The planet's atmosphere is scorching with a temperature of over 1000 degrees Celsius, and it rains glass, sideways, in howling 7000 kilometre-per-hour winds.

At a distance of 63 light-years from us, this turbulent alien world is one of the nearest exoplanets to Earth that can be seen crossing the face of its star. It has been intensively studied by Hubble and other telescopes, and its atmosphere has been found to be dramatically changeable and exotic, with hazes and violent flares. Now, this planet is the subject of an important first: the first measurement of an exoplanet's visible colour.

"This planet has been studied well in the past, both by ourselves and other teams," says Frédéric Pont of the University of Exeter, UK, leader of the Hubble observing programme and an author of this new paper. "But measuring its colour is a real first—we can actually imagine what this planet would look like if we were able to look at it directly."



This plot compares the colours of Solar System planets to the colour of the hot Jupiter HD 189733b. With the exception of Mars, the colours are primarily determined by the chemistry of the planets' atmospheres. Earth's blue atmosphere plus the blue tint of the oceans dominate our world's hue. HD 189733b's deep blue colour is produced by silicate droplets, which scatter blue light in the scorching atmosphere. Credit: NASA, ESA, and A. Feild (STScI/AURA)

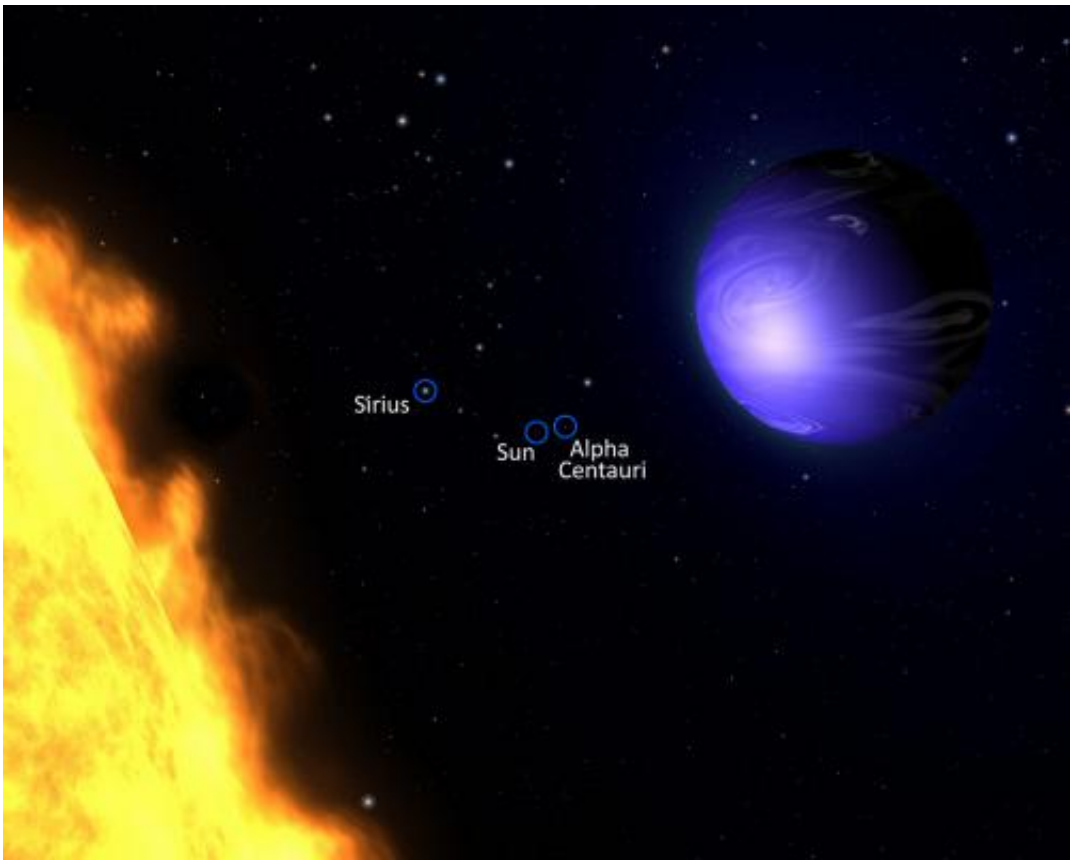
In order to measure what this planet would look like to our eyes, the astronomers measured how much light was reflected off the surface of

HD 189733b—a property known as albedo.

HD 189733b is faint and close to its star. To isolate the planet's light from this starlight, the team used Hubble's Space Telescope Imaging Spectrograph (STIS) to peer at the system before, during, and after the planet passed behind its host star as it orbited. As it slipped behind its star, the light reflected from the planet was temporarily blocked from view, and the amount of light observed from the system dropped. But this technique also shows how the light changes in other ways—for example, its colour.

"We saw the brightness of the whole system drop in the blue part of the spectrum when the planet passed behind its star," explains Tom Evans of the University of Oxford, UK, first author of the paper. "From this, we can gather that the planet is blue, because the signal remained constant at the other colours we measured."

The planet's azure blue colour does not come from the reflection of a tropical ocean, but is due to a hazy, turbulent atmosphere thought to be laced with silicate particles, which scatter blue light. Earlier observations using different methods have reported evidence for scattering of blue light on the planet, but these most recent Hubble observations give robust confirming evidence, say the researchers.



This illustration shows a "hot Jupiter" planet known as HD 189733b orbiting its star, HD 189733. The NASA/ESA Hubble Space Telescope measured the actual visible light colour of the planet, which is deep blue. This colour is not due to the presence of oceans, but is caused by the effects of a scorching atmosphere where silicate particles melt to make "raindrops" of glass that scatter blue light more than red light. Because the planet is only 63 light-years from Earth, a visitor would see many of the same stars we see in our nighttime sky, though the constellation patterns would be different. Our Sun and the nearest star to our Sun, Alpha Centauri, are labelled here – two faint stars near the centre of the image. Also labelled is Sirius, the brightest star in our skies in the constellation of Canis Major (The Greater Dog). Credit: NASA, ESA, and G. Bacon (AURA/STScI)

HD 189733b presented a favourable case for these kinds of measurements as it belongs to a class of planets known as "hot Jupiters".

These massive planets are similar in size to the gas giants in the Solar System, but instead lie very close to their parent star—this size and proximity to their star make them perfect subjects for exoplanet hunting. We know that hot Jupiters are numerous throughout the Universe. As we do not have one close to home in our own Solar System, studies of planets like HD 189733b are important to help us understand these dramatic objects.

"It's difficult to know exactly what causes the colour of a planet's atmosphere, even for planets in the Solar System," says Pont. "But these new observations add another piece to the puzzle over the nature and atmosphere of HD 189733b. We are slowly painting a more complete picture of this exotic planet."

More information: The new paper, titled "The deep blue colour of HD 189733b: albedo measurements with HST/STIS at visible wavelengths", will appear in the 1 August issue of the journal *Astrophysical Journal Letters*. www.spacetelescope.org/static/ … _papers/heic1311.pdf

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