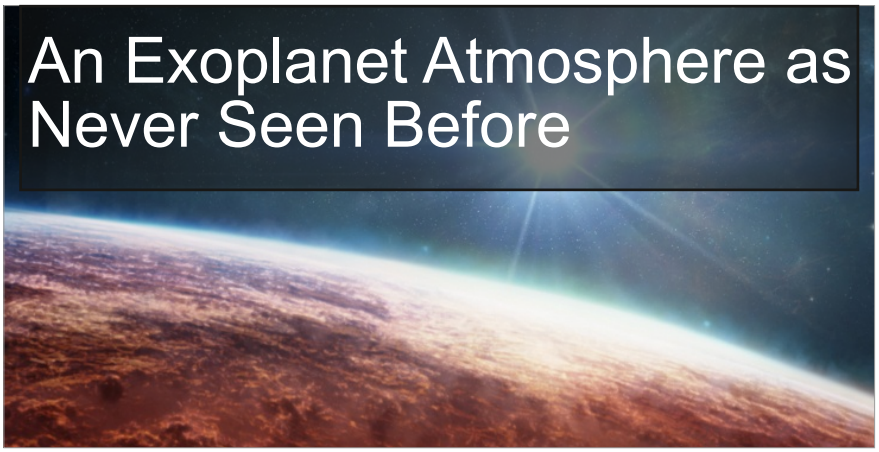
INSTITUTE OF ASTRONOMY
PUBLIC OPEN EVENING

— 23 November 2022 —

An Exoplanet Atmosphere as Never Seen Before



For the first time, JWST has been able to obtain both a molecular and chemical profile of an exoplanet's atmosphere. Previous telescopes have been able to identify individual components of this planet's atmosphere, but not the full list of atoms, molecules and signs of chemical activity JWST can now see.

The exoplanet being observed, WASP 39-b, is a "hot Saturn" – a planet around the same size as Saturn but closer to its star than Mercury is to our Sun. To determine its atmospheric composition, JWST observed WASP 39-b as it passed in front of the star. Some light from the star was absorbed by WASP 39-b's atmosphere, resulting in missing colours in the stellar spectra. Since different molecules absorb different colours of the spectrum, the missing colours allowed astronomers to determine the atmosphere's composition.

One of the molecules detected was sulphur dioxide, a molecule produced by chemical reactions powered by high-energy radiation from the host star (similar to how ozone is created on Earth). This is the first time sulphur dioxide has been detected in an exoplanet and the first time evidence for photochemistry (reactions powered by high-energy radiation) on an exoplanet has been observed.

Having a complete list of chemical ingredients allows scientists to measure the abundance of different elements relative to each other. This provides insights into how WASP 39-b first formed. For instance, the large quantity of oxygen relative to carbon suggests that WASP 39-b originally formed far away from its host star.

IoA astronomers Sean Jordan and Oliver Shorttle made up one of four teams worldwide who carried out these studies. "We have found the first evidence for an exoplanet's atmosphere being modified by starlight, a key step in our ongoing characterisation of other worlds that will one day yield insight into their geology and potential life.", said Dr Shorttle.

TONIGHT'S SPEAKER

Robin Catchpole
Are we alone?

Our weekly welcome

WELCOME to our weekly public open evenings for the 2022/23 season. Each night there will be a half-hour talk which begins promptly at 7.15pm. Please note that the talk will be recorded and archived for online streaming.

The talk is followed by an opportunity to observe if (and only if!) the weather is clear. The IoA's historical Northumberland and Thorrowgood telescopes, along with our modern 16-inch telescope, will be open for observations. In addition, the Cambridge Astronomical Association will provide a floorshow outdoors on the Observatory lawns, relaying live images from their telescopes and providing a commentary. If we're unlucky and it's cloudy, we'll offer you a conciliatory cup of tea after the talk (with perhaps some more astro-information in the lecture theatre for those who want to stay on).

If you have any questions, suggestions or comments about the IoA Open Evenings please contact Matt Bothwell at bothwell@ast.cam.ac.uk.

The talk schedule for this term can be viewed at: www.public.ast.cam.ac.uk

Volcanos may have altered ancient Venus' climate

Observations and climate modelling of Venus suggest that it may have had a liquid-water ocean and habitable surface temperatures for up to 2 billion years of its early history, much like Earth. However while Earth has remained habitable, Venus is now an acidic hothouse.

A recent NASA paper suggests that volcanic activity could be to blame for this transformation. According to the paper, the occurrence of several massive volcanic outpourings in a short span of geologic time (within a million years) could have caused a runaway greenhouse effect that gave Venus its high surface temperature (over 460 degrees Celsius) and pressure (90 times that of Earth).

Igneous provinces, large fields of solidified volcanic rock, covering 80% Venus' total surface support this theory however some uncertainty remains. The exact mechanism by which these provinces form is unknown. Moreover, Earth itself has endured several eruptions that produce large igneous provinces. The climate disruptions from these events were responsible for many of Earth's mass extinction events, each wiping out at least 50% of all animal life on the planet at the time. Yet despite this disruption to its climate, Earth remained habitable for reasons still unknown.

NASA's Deep Atmosphere Venus Investigation of Noble gases, Chemistry and Imaging (DAVINCI) mission, scheduled for launch in the late 2020s aims to study the history of Venus in greater depth to better understand how it changed over time. In doing so scientists will also have a greater understanding of how volcanism on Earth affected life in the past, and how it may continue to do so.

Milky Way halo isn't a perfect sphere

The Milky Way is surrounded by a diffuse globe of gas, dark matter and stars known as a halo. For decades astronomers assumed that this halo formed a sphere and therefore looked the same in every direction.

However, a new map of the halo's stars constructed using Gaia shows that the distribution is not spherical. Instead, these stars form an off-kilter ellipsoid with three axes all of different lengths, a massive departure from the symmetrical model.

One possible cause for this is an act of galactic cannibalism, a process in which a large galaxy merges with a smaller galaxy to form a larger – often irregular – galaxy. Astronomers believe that a collision with the Gaia Sausage galaxy around 7 to 10 billion years ago created the Milky Way's stellar halo. If the two galaxies collided at an angle the result would be a skewed halo. At the Gaia Sausage met with Milky Way, its stars were flung into wild orbits, slowing down and eventually coming to a stop far away from the galactic centre. This model seems to explain the warped distribution of stars, but since the collision happened such a long time ago astronomers would expect the stars to have settled back into a sphere. Which means there must be something holding them in place. Dark matter, the invisible mass responsible for the excess gravity measured in the Universe, must therefore also be highly tilted. Still, questions remain. How exactly did our galaxy evolve? Why does dark matter have this distribution?

Joke of the Week

What do you get when you cross a joke with a rhetorical question?