INSTITUTE OF ASTRONOMY
PUBLIC OPEN EVENING

— 15 MARCH 2023 —

Astronomers find missing link for water in the Solar System

A team of astronomers used the Atacama Large Millimeter Array (ALMA) to detect gaseous water in the disc around star V883 Orionis. By studying the composition of water in this disc they were able to determine that the water on Earth is even older than the Sun.

In simple water the hydrogen atom consists of a single proton and electron, however it is possible to form heavy water by replacing the hydrogen atom with an atom consisting of a single proton, electron and neutron. This extra neutron makes the atom heavier.

Since heavy water and simple water form under different conditions, measuring their ratio can help determine when and where the water formed. In Earth's case, the ratio of heavy water to regular water was found to be similar to that of some Solar System comets. This suggests that Earth's water might have come from comets.

While the journey water makes from comets to planets is relatively well understood, and previous studies have looked at the journey of water from star-forming clouds to young stars, until recently the link between these young stars and comets was unclear. With a similar water composition to the comets in our Solar System, V883 Orionis allowed astronomers to confirm the idea that water on Earth formed billions of years ago.

However, observing water in these discs can be challenging. “Most of the water in planet-forming discs is frozen out as ice, so it’s usually hidden from our view," said co-author of the study Margot Leemker, a PhD student at Leiden Observatory in the Netherlands.

Thankfully, large outbursts of energy from star V883 Orionis cause its disc to become unusually hot which causes the water to become gas.

In future the team hope to use ESO's Extremely Large Telescope to strengthen the current understanding of the path water travels from star-forming clouds to planets.

TONIGHT'S SPEAKER

Simon Mitton
Georges Lemaitre and the Big Bang

IoA Open Day: 18th March 2023

As part of the Cambridge Science Festival 2023, the Institute of Astronomy and the Kavli Institute for Cosmology will be open to the public on Saturday 18th March, 26pm.
There will be activities for all ages, including children's craft activities provided by the Whipple Museum, SunSpaceArt workshops, a cloud chamber, a simulated Venus room, Kerbal Space Program, an obstacle course, and more!
There will be a series of popular lectures given throughout the day by IoA and Kavli researchers. In addition, the Cambridge Astronomical Association will present planetarium shows.

This event is free, and there's no need to book.

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

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

JWST captures rare Wolf-Rayet star

Wolf-Rayet stars are some of the most massive and luminous stars that we know of, with luminosities up to a million times that of our Sun. The Wolf-Rayet phase is short compared to the lifetime of most stars, and only some of the most massive stars (with masses typically 25 times that of the Sun) will undergo this brief phase before going supernova. Wolf-Rayet stars are therefore very rare, making the image produced by JWST incredibly valuable to astronomers.

The star imaged, WR 124, has a mass 30 times that of the Sun and has ejected around 10 Suns worth of material so far. As this gas moves away from the hot star it cools, allowing dust to form. The dust glows in infrared, the wavelength range JWST is optimised for.

Dust plays an important role in astrophysics. It provides a surface on which molecules can form, it can clump together to form planets and it shelters newly-formed stars. However, there is more dust in the universe than can be explained by astronomers' current dust-formation theories. They are therefore interested in learning how cosmic dust - such as that surrounding WR 124 - can survive a supernova explosion as this could provide an explanation for the origin of some of the excess dust observed.

Studying WR 124 will also reveal more about the early universe, as similar stars in that period were responsible for producing heavy elements that are now commonplace.

Researchers devise a new path towards quantum light

Researchers from the University of Cambridge, along with colleagues from Austria, Israel and the US, developed a theory describing a state of light called quantum light. This light has controllable quantum properties up to high x-ray frequencies and could be used to investigate new properties of matter at the atomic level.

Part of the difficulty in researching quantum light lies in the fact that - unlike most light - it cannot be described using classical physics since quantum fluctuations are now significant. “Quantum fluctuations make quantum light harder to study, but also more interesting: if correctly engineered, quantum fluctuations can be a resource,” said lead author Dr Andrea Pizzi, a research fellow at Cambridge. “Controlling the state of quantum light could enable new techniques in microscopy and quantum computation.”

Quantum light can be generated by pointing a strong laser at several emitters, causing some electrons to be ripped away and become energised. Some of these electrons will then recombine with the emitters and release their excess energy as light. This turns the low-energy light input into a high-energy radiation output.

Pizzi and colleagues used a combination of theoretical analysis and computer simulatios to study a system in which the emitters were not independent of each other to determine the connection between the input correlations and the quantum fluctuations of the output.

The theory they developed demonstrates that controllable quantum light can be generated using a strong laser. Following on from this, the team hope to work with experimental physicists to see if their results can be validated.

Joke of the Week

How many astronomers does it take to change a lightbulb? None; astronomers use standard candles.