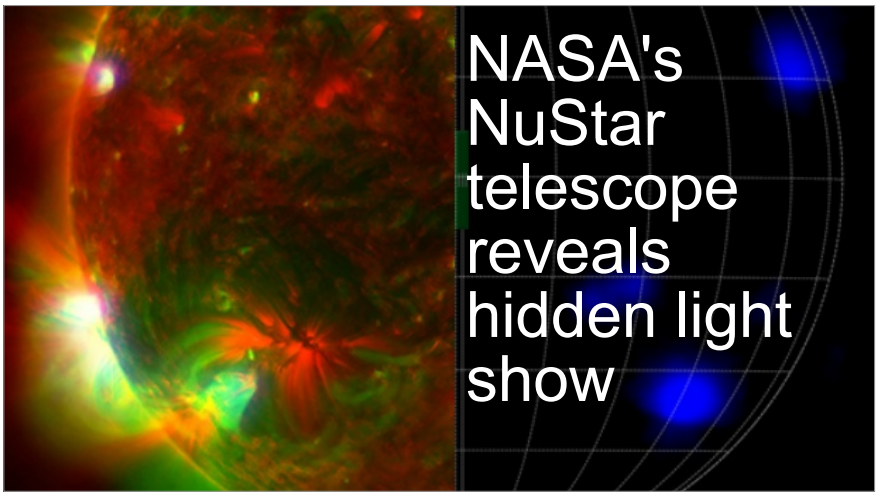
# INSTITUTE OF ASTRONOMY
# PUBLIC OPEN EVENING

— 15 February 2023 —



## NASA's NuStar telescope reveals hidden light show

The image above shows the Sun as seen by three different observatories. Data from NASA's Nuclear Spectroscopic Telescope Array (NuSTAR) is shown in blue, observations by the Japanese Aerospace Exploration Agency's X-Ray telescope (XRT) are represented by green and the Atmospheric Imaging Assembly on NASA's Solar Dynamics Observatory appear in red.

Overlapping these produces the unique view of the Sun seen on the left.

NuSTAR data is, shown by itself on the right, shows that high-energy X-rays only appear at a few points in the Sun's atmosphere, unlike low-energy X-rays and UV light, which both appear across the entirety of the Sun's atmosphere. Its ability to view high energy X-rays allows NuSTAR to observe small eruptions in the Sun's surface, known as nanoflares, that would usually be obscured. This allows scientists to determine how often these nanoflares occur and how they release energy, which could resolve one of the greatest unsolved questions in astrophysics: the coronal heating problem.

Temperatures in the corona - the upper layer of the Sun's atmosphere - can go as high as 1 million degrees celsius. However less than 2km below, temperatures drop to only 5,500 degrees celsius. This appears to contradict the fact that heat is produced in the Sun's core and then travels outwards.

Scientists are seeking an answer to this problem using both the data from NuSTAR and observations made with NASA's Parker Space Probe - which is currently travelling closer to the Sun than any other spacecraft in history. Combining NuSTAR's images with the direct samples taken by the probe will allow scientists to link remote observations of solar activity to the temperature measured at the source. By doing so they may be able to determine the role nanoflares play in the coronal heating problem.

TONIGHT'S SPEAKER

Emily Sandford
Oh, the Planets you'll go!

## 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).

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.

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

# Dwarf planet Quaoar has a physics-defying debris ring

The dwarf planet Quaoar, located just beyond Neptune in our solar system, appears to have a ring that defies our current understanding of physics. This understanding comes from astronomer Édouard Roche who put forward the idea of the Roche limit radius. If a smal object lies within the Roche limit of the body it orbits, the larger object will rip apart the small object into even smaller chunks that eventually form rings. Small objects that lie beyond the Roche limit won't be torn apart. Dust particles in this region should coalesce to form larger objects such as moons.

Until recently, every ring and moon observed by astronomers obeyed this limit. But Quaoar was observed to have a ring extending out to almost 4000km, despite its Roche limit being less than a third of this at only 1300km. The cause of this physics-defying ring is still unclear, but researchers suspect that the low temperature of Quaoar and its surroundings could play a role in preventing moon formation - allowing for a larger ring. Another possibility being considered is that the ring is being sustained by interactions with Quaoar's moon, Weywot. Either way, the Roche limit will probably need to be modified, potentially altering other calculations in astrophysics.

“The Roche limit has its uses, but in reality there’s no exact radius,” says Carl Murray of Queen Mary University. “It’ll depend on the physical properties of the material that’s orbiting and, as they’ve shown here, there are other characteristics that need to be taken account of as well.”

# A rapidly-growing rocket industry may threaten the ozone layer

The ozone layer absorbs most of the UVB radiation from the Sun, preventing it from reaching the Earth's surface. This is hugely important to life on Earth, as increased exposure to this radiation would result in damage being done to DNA, potentially leading to skin cancer and eye cataracts in humans, as well as damage to crops, plants and microorganisms.

In a recent report detailing the progress of the Montreal Protocol, a UN-backed panel of experts confirmed that nearly 99% of ozone-depleting substances had been phased out. “The impact the Montreal Protocol has had on climate change mitigation cannot be overstressed,” said Meg Seki, Executive Secretary of the UN Environment Programme’s (UNEP) Ozone Secretariat. Thanks to this, the ozone layer is on track to heal within 40 years. However an increase in rocket launches expected during the same period could undo this progress. The combustion of rocket fuel produces products including reactive chloride and nitrogen oxides, which are known to destroy ozone. Emissions are capable of lingering for longer in the upper atmosphere than the lower atmosphere. This means that small amounts of rocket fuel byproducts can have a large destructive effect to ozone in the stratosphere. Despite this potential damage, rocket fuel emissions are not regulated yet.

To mitigate this problem, researchers at the University of Canterbury suggest encouraging the collecting and sharing of data. This would include sampling emission plumes in the atmosphere and forming a collaboration between the space industry and ozone research community to produce more accurate models. In doing this, sustainable rocket launches could become a reality.

## Joke of the Week

I just watched a documentary about Pluto's reclassification. It was very ex-planetary.