INSTITUTE OF ASTRONOMY
PUBLIC OPEN EVENING
— 3 OCTOBER 2018 —

The galaxy collision that formed the Milky Way

An impression of the collision between the Milky Way and the smaller Sausage galaxy about 8 to 10 billion years ago. *Credit: V. Belokurov (Cambridge, UK)*

AN INTERNATIONAL team of astronomers has discovered an ancient and dramatic head-on collision between the Milky Way and a smaller object, dubbed 'the Sausage Galaxy'. The cosmic crash reshaped the structure of our Galaxy, fashioning both the Galaxy's inner bulge and its outer halo.

The astronomers propose that around 8 to 10 billion years ago, an unknown dwarf galaxy smashed into our own Milky Way. The dwarf did not survive the impact! It quickly fell apart, and the wreckage is now all around us.

"The paths of the stars from the galactic merger earned the nickname 'Gaia Sausage'" explained Wyn Evans of the IoA. "We plotted the velocities of the stars, and the sausage shape just jumped out at us. As the smaller galaxy broke up, its stars were thrown out on very wide orbits. These Sausage stars are what's left of the last major merger of the Milky Way."

There are ongoing mergers taking place right now, such as between the puny Sagittarius dwarf galaxy and the Milky Way. However, the Sausage galaxy was much more massive: its total mass (including gas, stars and dark matter) would have been more than 10 billion times the mass of our Sun. When it crashed into the young Milky Way, it caused a lot of mayhem. The Sausage's piercing trajectory meant that the Milky Way's disk was probably puffed up or even fractured following the impact, and the Milky Way had to re-grow a new disk. At the same time, the Sausage debris was scattered all around the inner parts of the Milky Way, creating the 'bulge' at the Galaxy's centre and the surrounding 'stellar halo'.

The head-on collision of the Sausage galaxy was a defining event in the early history of the Milky Way that shaped our galaxy as we know it. Even though the merger took place in the very remote past, the stars from the Sausage galaxy can be picked out today. Evidence of this event lies all around us in the movements and compositions of stars.

TONIGHT'S SPEAKER

Matt Bothwell
What on Earth is dark energy?

Our weekly welcome

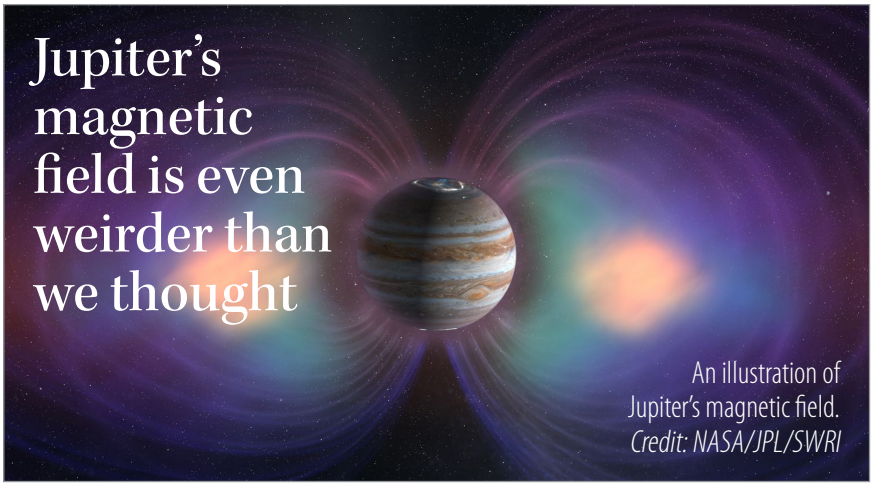
WELCOME to our weekly public open evenings for the 2018/19 season. Each night there will be a half-hour talk which begins promptly at 7.15pm: tonight Matt Bothwell will be giving us a talk entitled What on Earth is dark energy?

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 Carolin Crawford at *csc@ast.cam.ac.uk* or Matt Bothwell at *bothwell@ast.cam.ac.uk*.

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

Jupiter's magnetic field is even weirder than we thought



An illustration of Jupiter's magnetic field. *Credit: NASA/JPL/SWRI*

MOST planets in the Solar System – along with the Sun – have magnetic fields, caused by processes going on deep within their cores. Earth's magnetic field is even surprisingly useful, allowing compasses to point towards magnetic north as well as protecting us from harmful radiation. Planetary magnetic fields are caused by the so-called 'dynamo effect': deep oceans of conducting fluids, rotating around the planet cores.

We have long known that Jupiter's magnetic field is surprisingly weird. To start with, it's amazingly strong: around 20,000 times stronger than Earth's. Scientists have used this fact to try to understand Jupiter's interior and came up with a picture of a giant planet filled with 'liquid metallic hydrogen', a strange substance produced when hydrogen is liquidised under unimaginable pressures.

A new study led by Kimberly Moore of Harvard University, using data from NASA's Juno probe, has now revealed that Jupiter's magnetic field is even weirder than we thought. Rather than having a simple 'north magnetic pole' like the Earth, Jupiter's magnetic field emerges from a large area spread across the whole northern hemisphere. And it has two – rather than one – magnetic 'south poles': one in the expected place (at the South Pole!) and one just below the equator. Scientists are calling this newly-discovered magnetic pole the 'Great Blue Spot'.

"Before the Juno mission, our best maps of Jupiter's field resembled Earth's field," said lead author Kimberly Moore. "None of the existing models predicted a field like that."

These new findings indicate that something very strange must be going on inside Jupiter. One idea is that Jupiter's magnetic field might be generated by a strange 'slushy' blend of liquid metallic hydrogen with ice and rock chunks mixed in it. Another idea is that 'helium rain' could be falling down onto Jupiter's core, knocking the field off-kilter.

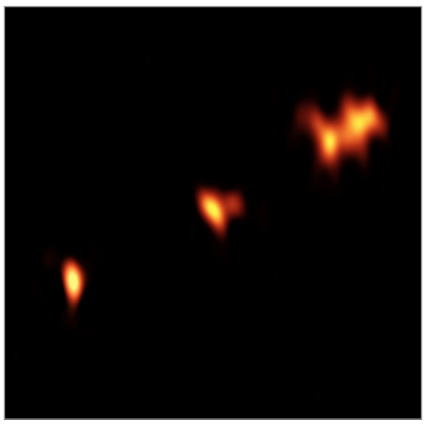
The Juno spacecraft will be making more observations of Jupiter in the future, which scientists hope to use to solve this mystery.

The brightest ancient galaxy ever found.

THE quasar P352-15 may not look like much, but it may be one of the useful objects ever found for unlocking the mysteries of the early Universe.

After the Big Bang 13.7 billion years ago, the Universe rapidly settled down into the 'dark ages', with nothing but blackness until the first stars and galaxies formed and turned on the lights. The effect of the first stars and galaxies beginning to shine is known as 'reionisation', and is one of the most important processes for astronomers to understand.

Trying to understand reionisation is difficult though, because the Universe during the dark ages was very difficult to see through. For astronomers, studying the early Universe is a bit like peering back through a misty veil, trying to get glimpses of the behaviour of the earliest galaxies.



The light in this image emanates from a supermassive black hole at the centre of a galaxy 13 billion light-years away. *Credit: Momjian, et al.; B. Saxton (NRAO/AUI/NSF)*

That's where quasars like P352-15 come in. P352-15 isn't the most distant thing ever seen (that record goes to a galaxy dubbed 'GN-z11') but it is around 10 times brighter than any other galaxy seen at these distances. Shining out like a lighthouse through the fog, the authors say P352-15 'presents the first real chance' to study the end of cosmic reionisation.

The image above shows that P352-15 consists of three separate 'blobs'. It is thought that one of these is the quasar itself, and the other two are powerful 'jets', shot out of a supermassive black hole at the quasar's heart.

P352-15 will be an excellent candidate for more study with the ultra-powerful 'Square Kilometre Array', when the new radio telescope comes online in the 2020s. Astronomers hope that learning more about P352-15 will finally reveal better information about the processes involved in early galaxy formation, as well as giving us a better understanding of the growth of supermassive black holes.

Joke of the Week

Why didn't the sun go to college?
Because it already had 15 million degrees!