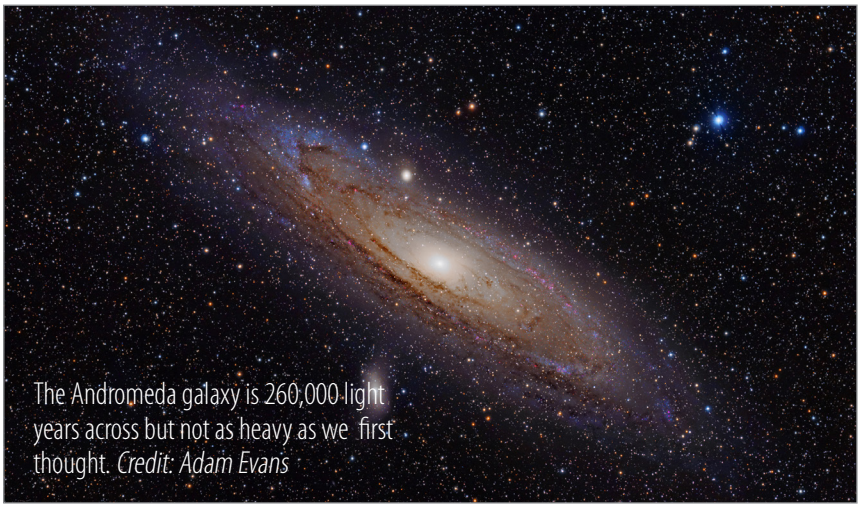
INSTITUTE OF ASTRONOMY
PUBLIC OPEN EVENING
— 21 FEBRUARY 2018 —

New observations cut Andromeda down to size



The Andromeda galaxy is 260,000 light years across but not as heavy as we first thought. *Credit: Adam Evans*

THE Andromeda galaxy has long been considered a 'sibling' galaxy to our own Milky Way. Both residing in the 'local group' of galaxies, the Milky Way and Andromeda are the only two large spirals, standing out from the large number of smaller galaxies that comprise the rest of the group.

But Andromeda has always been thought to be a larger sibling. While our own Milky Way weighs in at around 800 billion times the mass of the Sun (a unit astronomers shorten to 'solar masses'), the Andromeda galaxy was previously thought to be around three times larger. Astronomers have now measured the mass of Andromeda more accurately, finding that its mass is very close to our own Milky Way, at around 800 billion solar masses. Rather than being a larger sibling to our galaxy, we should think of Andromeda as our twin.

The team, led by astronomer Prajwal Kafle at The University of Western Australia, used a new technique to measure the mass of Andromeda. The method involved looking at the 'escape velocity' required to escape from the galaxy's gravitational pull. Once you know the escape velocity you know the strength of the galaxy's gravitational pull, and so you know the mass.

"When a rocket is launched into space, it is thrown out with a speed of 11 (kilometers per second) to overcome the Earth's gravitational pull," Prajwal Kafle said. "Our home galaxy, the Milky Way, is over a trillion times heavier than our tiny planet Earth so to escape its gravitational pull we have to launch with a speed of 550 (kilometers per second). We used this technique to tie down the mass of Andromeda."

This new result will send astronomers back to the drawing board in order to re-calculate what will happen when Andromeda collides with our Milky Way, in around 5 billion years time. "It's really exciting that we've been able to come up with a new method and suddenly 50 years of collective understanding of the local group has been turned on its head.", said the authors.

TONIGHT'S SPEAKER

Renske Smit
Peering back to the dawn of time with the Atacama Large Millimetre Array

Our weekly welcome

WELCOME to our weekly public open evenings for the 2017/18 season. Each night there will be a half-hour talk which begins promptly at 7.15pm: tonight Renske Smit will be giving us a talk titled Peering back to the dawn of time with the Atacama Large Millimetre Array.

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

TRAPPIST-1 planets could be water worlds

THE cool dwarf star TRAPPIST-1, 40 light years from Earth, was observed in 2016 by the Transiting Planets and Planetesimals Small Telescope (TRAPPIST), and was found to host 7 planets. Excitingly, three of these planets are in the so-called 'habitable zone', which is the zone around the star at the right distance for liquid water to exist on a planet's surface.

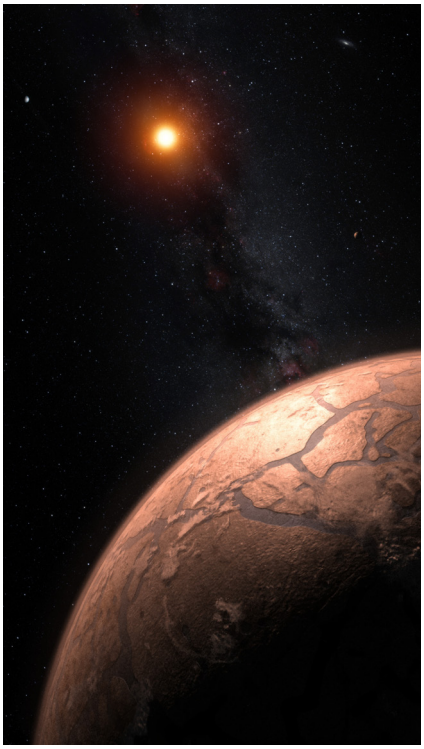
A new study has now measured the densities of these planets, finding that they are all rocky 'terrestrial planets', and five of the seven seem to host a significant amount of water.

Simon Grimm at the University of Bern in Switzerland, lead author of the study, explains: "The TRAPPIST-1 planets are so close together that they interfere with each other gravitationally, so the times when they pass in front of the star shift slightly. These shifts depend on the planets' masses, their distances and other orbital parameters. With a computer model, we simulate the planets' orbits until the calculated transits agree with the observed values, and hence derive the planetary masses".

The results show that five of the TRAPPIST-1 planets are not dry rocky worlds, but contain large amount of water – up to 5% by mass. For comparison, the Earth is only 0.02% water by mass. These planets seem to have up to 250 times more water than Earth!

These results are supported by a parallel study using the Hubble Space Telescope, which failed to detect puffy hydrogen envelopes around the TRAPPIST-1 planets (a positive result would have suggested the TRAPPIST-1 planets were gas giants).

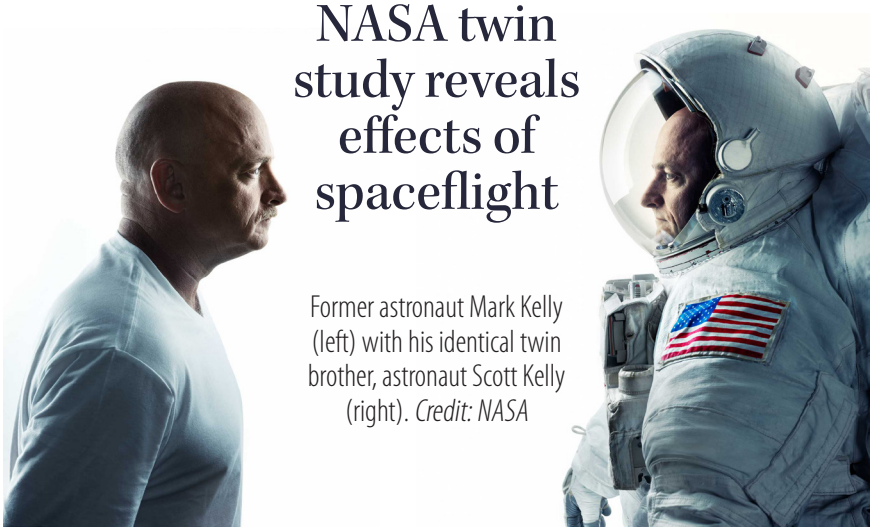
"TRAPPIST-1 still represents the best opportunity we have for studying Earth-sized worlds outside of our own solar system" said Hannah Wakeford, an author of this second study.



Credit: ESO/M. Kornmesser

An artist's impression of the TRAPPIST-1 planetary system. New results suggest that all seven of the Earth-sized planets are rich in volatile materials, probably water.

NASA twin study reveals effects of spaceflight



Former astronaut Mark Kelly (left) with his identical twin brother, astronaut Scott Kelly (right). *Credit: NASA*

HUMANS did not evolve for life in space. Our bodies have been tuned by evolution for life on Earth – with plentiful oxygen, a constant force of gravity, and protection from high energy solar particles (courtesy of Earth's magnetic field). But if we are to embark upon long-term human space missions (including a possible mission to Mars), we need to better understand the biological effects of living in space.

Of course, if we want to study the biological effects of being in space we would like to have a control group – a genetically identical person to stay on Earth who can be compared to their space-faring twin. Enter Scott and Mark Kelly, identical twins who are the subject of NASA's Twin Study. NASA astronaut Scott Kelly spent a year living on the international space station, while his twin brother Mark remained grounded on Earth. By looking at both brothers, researchers were able to learn about the effects (both mental and physical) of long-term spaceflight.

One significant finding was the growth of astronaut Scott's 'telomeres', the genetic sequence which 'caps' chromosomes and protects them from damage. While these telomeres returned to normal shortly after Scott Kelly returned to Earth, this finding could offer insight into how to make the human genetic code more robust.

Another fascinating result is that spaceflight may trigger gene mutations, with astronaut Scott experiencing hundreds more gene mutations compared to his twin.

While these findings are based only on one set of twins, it still contains a lot of information which will help scientists plan future space missions. The full report is due to be published later this year.

Joke of the Week

A seminar on time travel will be held last Tuesday.