

# Three nights at the Pic du Midi Observatory

This summer **Damian Peach** was recruited to join a crack team of planetary imagers to visit the Pic du Midi Observatory, high in the Pyrenees, where they took some of the best-ever images of the planets as seen from Earth. He writes exclusively for *Astronomy Now* to describe this epic mission.

**I**t is perhaps the dream of almost every amateur astronomer to have the opportunity to use a large professional telescope at a historic and renowned observatory. Most of the time we have to battle against vicissitudes of the weather and problems with equipment to obtain good results, and we constantly dream of what a larger telescope could reveal (hence the term 'aperture fever' – a well-known affliction among amateurs!).

Such an opportunity presented itself to me and a small group of advanced planetary observers in the summer of 2017, and this article summarises what would turn out to be an extremely memorable few days that produced some remarkable images.

## A rich history

Many readers will no doubt have heard of Pic du Midi Observatory, perched high atop the Pic du Midi de Bigorre (at an altitude of 2,877 metres above sea level) in the French Pyrenees. The observatory is located approximately 150 kilometres south-west of Toulouse and has been a world-renowned site for astronomical observations for more than a century.

Construction of the observatory began back in 1878 and from there on telescopes rapidly appeared on the mountain top. There are remains of many of these original buildings still on site. One can only ponder at how difficult it must have been to construct an observatory at such a location, where heavy snowfall and freezing temperatures can occur at almost any time of the year!

The observatory is especially well known for its planetary observations. In the early twentieth century, observations of Mars made at the Pic du Midi helped to discredit Percival Lowell's theory of Martian canals. Many famous astronomers have also observed at Pic du Midi over its long history, with Bernard Lyot (the inventor of the coronagraph) being the best known, and the largest telescope at the observatory (a two-metre reflector) is named in his honour.

Perhaps the most famous telescope on site is the one we used for our observations: the one-metre (105cm to be precise), f/17 Cassegrain reflector that was built in 1963 and is located in the Gentilli Dome. This telescope was built in the pre-Apollo era and funded by NASA primarily for detailed photography of the lunar surface to aid with mission planning.

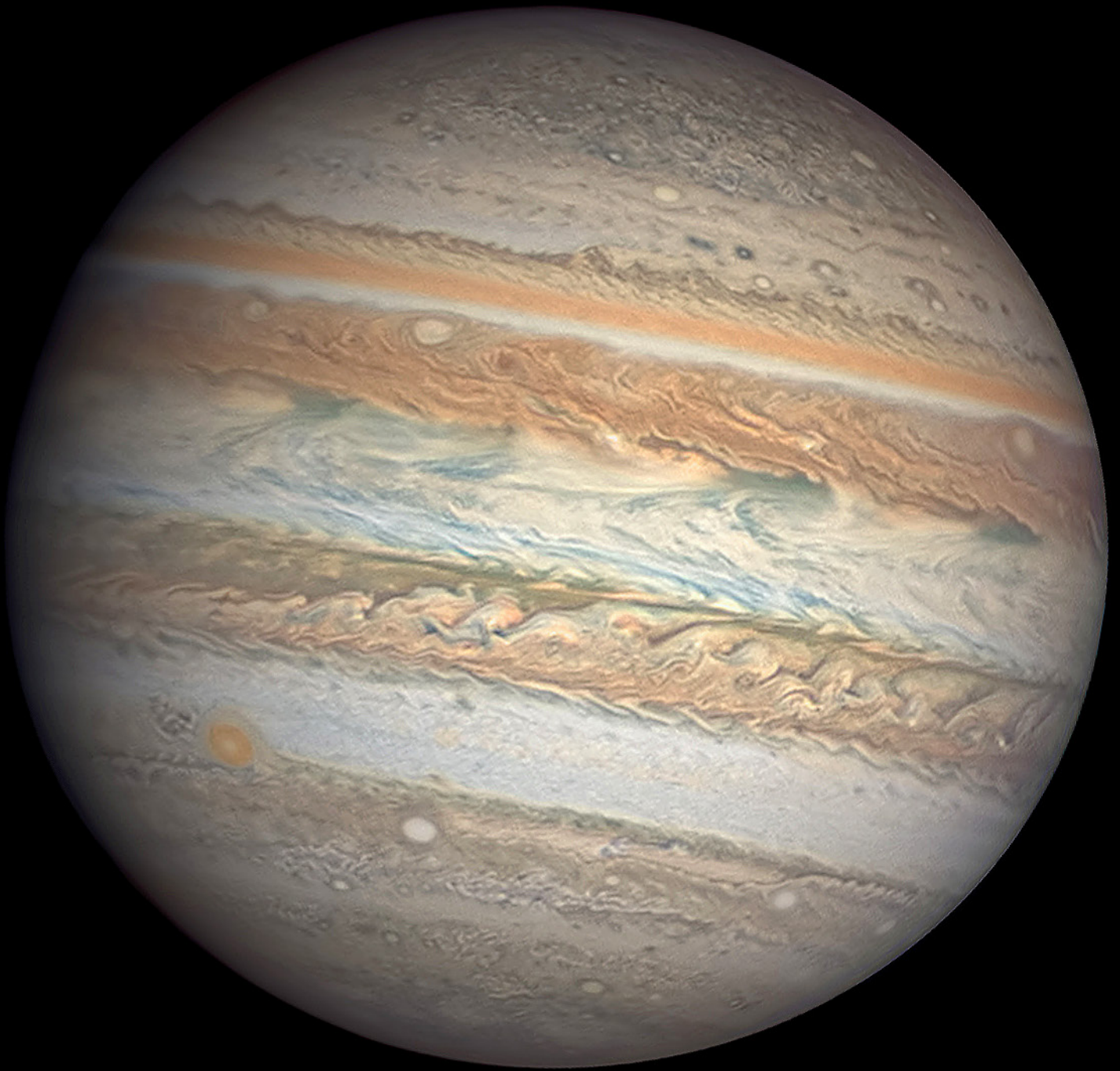
The telescope optics were found to be of only average quality and so were re-figured by French master optician Jean Texereau (a well-known figure to amateur telescope makers). From the 1960s to the 1990s the telescope was often used for planetary photography and indeed many of the finest photographic film images of the planets ever obtained from Earth were taken with this telescope. In more recent times the telescope has been used only sporadically for planetary observations, and it was this fact that led to this observing mission being realised.

## Observing team and arrival

In 2016 the lead astronomer of the one-metre telescope, François Colas, after discussion with some French amateurs who regularly visited the observatory, decided to try and form a small but dedicated team of experienced planetary observers (both amateur and professional) to make more regular use of the one-metre telescope for planetary studies.

Along with funding kindly provided by Europlanet 2020 for this prototype mission, we soon formed a team and decided on suitable dates. The team consisted of seven observers in all (two professionals and five amateurs). We chose June 2017 for our visit, as Saturn would be close to opposition and Jupiter would still be well placed in the early evening. Uranus, Neptune and Venus would also be visible towards dawn.

Following our initial welcoming at Toulouse airport, we split into two cars for the three-hour drive to La Mongie, from where we would



■ Jupiter imaged on the third evening, revealing a wealth of fine detail within its atmosphere. Image: T1M – Pic du Midi (pic-net.org)/R. Hueso/D. Peach/M. Delcroix/G. Thérin/C. Sprianu/E. Kraaikamp/F. Colas.





catch the cable car to the Observatory itself. The journey through this region of France is spectacular, with mountainous scenery and small country villages. Finally, we reached the small town of La Mongie, at 1,650 metres above sea level, where we broke through a sheet of low clouds into blazing sunlight!

The cable car journey from La Mongie to the Observatory is not one for anyone with a fear of heights! On the slow ascent up the face of the mountain we were suspended high above deep mountain ravines. The view was spectacular, however, with the low clouds below and jagged mountain peaks as far as the eye can see.

Eventually we reached the first cable car station, where we disembarked and changed to the second cable car for the final ascent to the summit. It is at this point that you can clearly see the Observatory perched high atop the mountain. I must admit that when it came into view I wondered how an Observatory was ever constructed at such a location!

Upon arriving we transported all of our equipment and supplies (including food and drink for our stay) to the laboratory of the one-

▲ The observing team alongside the dome of the one-metre telescope at Pic du Midi in the French Pyrenees. From left to right: Ricardo Hueso, Damian Peach, Marc Delcroix, Gerard Thérin, Constantin Sprianu, Emil Kraaikamp and François Colas.

metre telescope. During our visit we remained on site at the astronomers' lodgings (which consist of several small rooms with a bed and washing facilities in a quiet area several metres below the telescope domes).

The one-metre telescope (or T1M as it's known) isn't at all like your typical large amateur telescope. As it was built back in the 1960s, many of its control systems are outdated and take time to learn. Prior to sunset on the first evening of our stay we spent some time learning how to operate the telescope from the laboratory directly below the telescope's dome. All the initial set-up of locating the target object and installing the camera has to be done in the dome itself. Locating the target object can be quite challenging as it involves climbing a tall ladder to reach the finder-scope eyepiece. François' many years of using the telescope were invaluable here.

### Evening preparations and Jupiter observations

After walking across to the western side of the Observatory to watch the sunset (which is always a spectacular sight at this amazing location) we quickly returned to the one-metre telescope, where we would spend the next three nights. We had a wide range of equipment to choose from in terms of cameras and filters. We ended up using a ZWO ASI174MM monochrome camera for most of the image captures, but also utilised a ZWO ASI224MC and a ZWO ASI290MM camera. We had also

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brought large amounts of storage in preparation for what we hoped would be a productive few days. As it turned out, we only just had enough for all of the data we would eventually capture.

Each evening began with Jupiter. Despite being long passed opposition, the planet was well placed for observation high in the south-west and, each evening, the first couple of hours were spent imaging it. The first night was affected by quite a bit of thick high cirrus clouds, but nonetheless we were able to obtain good images of the planet. The second and third evenings, however, produced far better conditions and resulted in some extremely detailed images being obtained.

While we captured images using various filters and with various cameras, the best results of all were in the near-infrared wavelengths where the resolution obtained was remarkable. During the three nights we covered most longitudes of the planet, and obtained very high spatial resolution images that would later allow wind speeds in Jupiter's atmosphere to be measured.

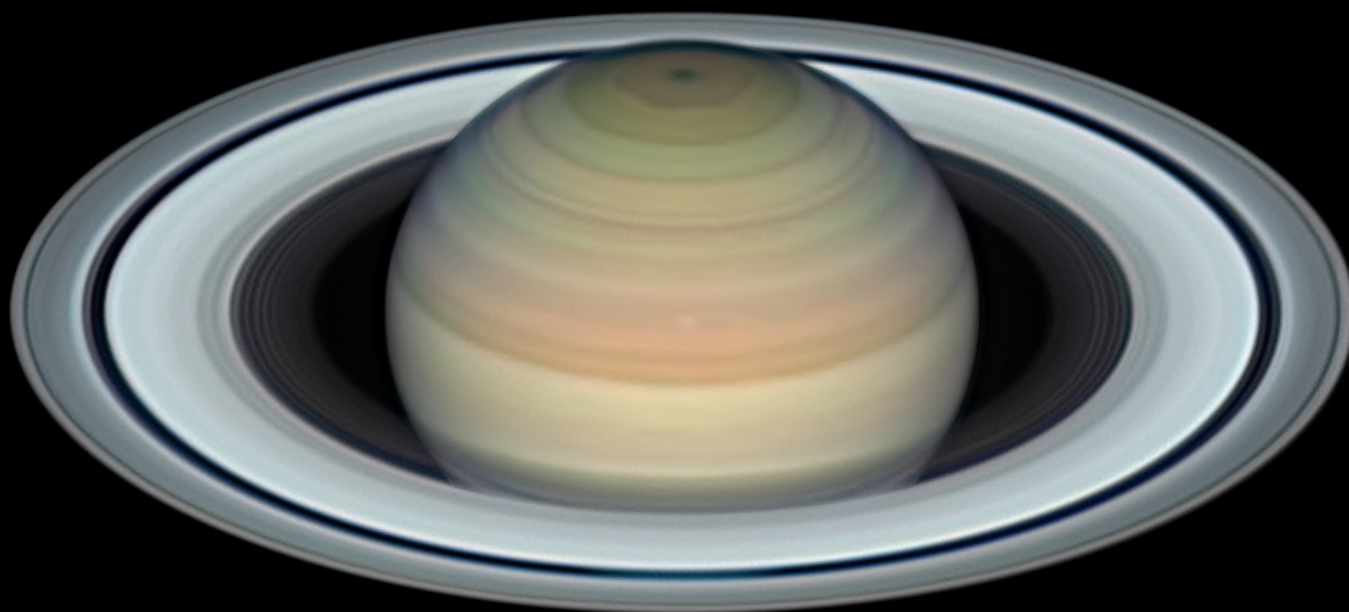
## Through the night

Once we had finished with Jupiter it was time to move on to Saturn, which meant we had to go back up to the dome to move the telescope

■ The author alongside the one-metre f/17 Cassegrain telescope used for planetary observations at Pic du Midi. Image: Damian Peach.



■ Saturn imaged under excellent seeing using the one-metre telescope. Many rarely seen details have been captured, such as the fine ringlets within the ring C. Image: T1M – Pic du Midi (pic-net.org)/ Image: D. Peach/E. Kraaikamp/F. Colas/M. Delcroix/R. Hueso/G. Thérin/C. Sprianu.





and recalibrate the dispersion corrector, as well as taking a few looks through the eyepiece!

Saturn was only a few days from opposition during our stay. The ring system was also close to its maximum possible tilt towards Earth. However, we worried that Saturn's low altitude might limit results somewhat. As it turned out, these concerns were completely unfounded and the sessions imaging Saturn into the early hours were perhaps the highlight of each night's work.

While Saturn's altitude never climbed above 25 degrees, the exceptional conditions that can prevail in the Pyrenees were in full effect, particularly during the second night, which produced seeing conditions of exceptional quality. Never have I seen a planet so still at such a low altitude above the horizon. Even when Saturn had dropped down to just 18 degrees the image was still razor sharp and still – a remarkable thing to witness, especially



when you consider that we were using over a metre of aperture. We actually joked at one point that the image quality would finally only degrade when Saturn set behind the mountains on the horizon!

Minor details, such as the Encke Gap, could be seen on the planet while capturing the images, but it was only later when processing them that we realised we had obtained some really exceptional data, perhaps resulting in the sharpest ground-based image of Saturn ever obtained. We also captured lengthy animations of the planet at near-infrared wavelengths (the high altitude permits some infrared observations) showing small spots and storms, as well as ultraviolet and methane-band imagery.

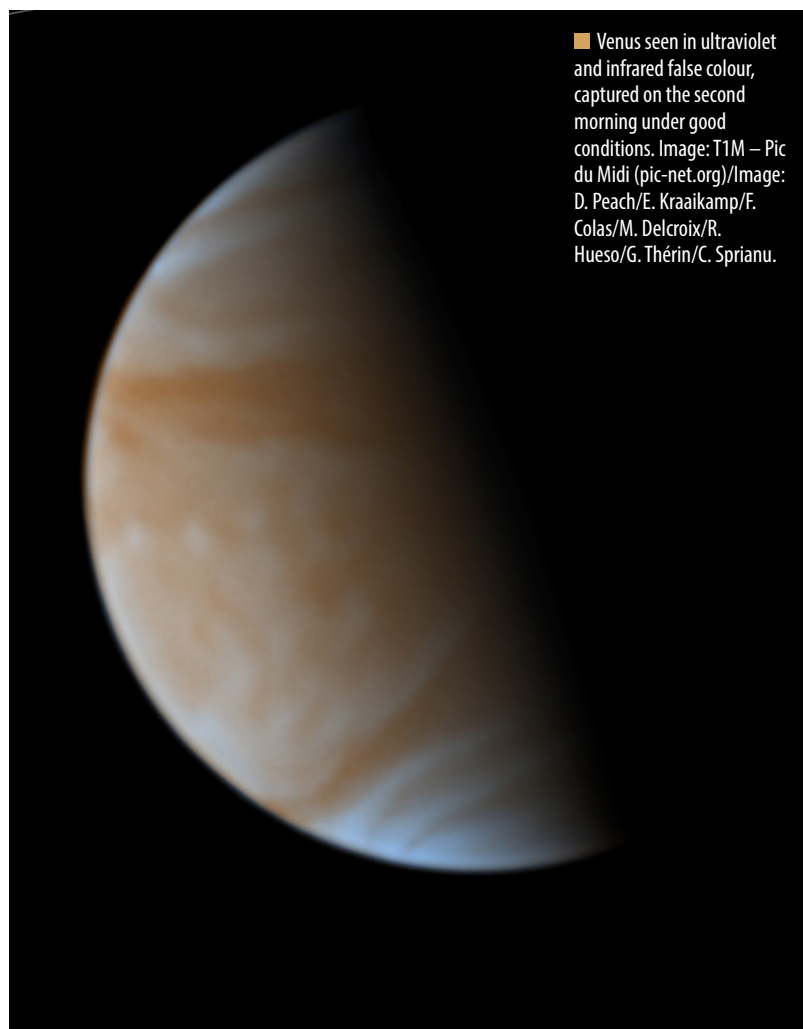
## Dawn approaches

Once our Saturn observations were completed in the early hours of the morning, just before morning twilight, we shifted attention to the most distant planet in the Solar System – Neptune! One of the objectives of our stay was to obtain early-apparition images of the planet, since it was still quite low in the pre-dawn sky. It was a great opportunity to be the first to detect any activity on the planet that might be occurring, and, as it turned out, we got lucky on both mornings that we imaged the planet.

We swapped cameras at this point to use the highly infrared-sensitive ASI290MM camera, which is great for imaging the distant ice giants. We took several runs at near-infrared wavelengths and on both mornings we saw strikingly bright storms on the planet. This made our team the first to detect activity there during the present apparition. We also obtained one very early Uranus image, but nothing could be seen on the planet aside from the familiar bright polar region.

As the sky brightened with the approaching dawn we moved on to Venus, which was blazing

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■ Venus seen in ultraviolet and infrared false colour, captured on the second morning under good conditions. Image: T1M – Pic du Midi (pic-net.org)/Image: D. Peach/E. Kraaikamp/F. Colas/M. Delcroix/R. Hueso/G. Thérin/C. Sprianu.

## WHAT IS PIC-NET?

With the intention of employing the one-metre telescope at Pic du Midi Observatory on a planetary imaging programme, François Colas and Marc Delcroix devised the Pic-net project. Its intention is to gather together some of Europe's best planetary imagers to use the one-metre T1M telescope at Pic du Midi to perform high-resolution planetary imaging. The aim isn't just to take pretty pictures, but to use the imagery to monitor wind speeds and global meteorology, support interplanetary missions and keep a weather eye out for the flashes of asteroid or comet impacts in the atmospheres of planets like Jupiter.

In particular, this pro-am partnership is focusing on assisting space missions, both past and present. "For instance, the high quality of Pic-Net observations of Saturn, which show clearly the hexagon feature surrounding the north polar vortex, atmospheric bands and cloud features, provide an avenue for continued study of Saturn and [to] build on the legacy of the Cassini mission."

Other space missions that could benefit from the Pic-Net project include NASA's Juno mission to Jupiter and JAXA (Japanese Aerospace Exploration Agency) Akatsuki mission to Venus. To really gather significant amounts of coverage of the atmospheres of the planets, there will need to be several observing dates at Pic du Midi each year. Colas, who is an astronomer at the Institut de Mécanique Céleste et de Calcul des Ephémérides (IMCCE) in France, is convinced that Pic-Net is worth the effort. "We believe that these are some of the best planetary observations from the ground to date."

brilliantly in the east. By this time those of us who had remained awake were feeling pretty tired, but it was worth the effort. We obtained some very fine images of the planet (especially in the ultraviolet), revealing the familiar cloud patterns clearly. Observations continued beyond sunrise, and we finally closed up and powered down around an hour after dawn.

## Results and conclusions

Having now completed processing of all the data, I can only conclude that our stay was a resounding success. We were fortunate with the weather conditions, but the dedication of the team to maximise every available moment really helped to deliver the results you see presented in this article.

On a personal note, the Pic du Midi is a remarkable place to observe from, not only for the superb astronomical conditions, but also the spectacular natural scenery to be found in every direction you care to look. One never tires of the breathtaking views there, especially during dawn and dusk, when the lighting and colours are spectacular.

The long tradition of planetary observing from this historic observatory

looks assured. Thinking back through the decades to the observations of observers such as Lyot, Dollfus and Camichel, you certainly felt some connection with those famous observers who also spent many memorable nights here pondering the details they saw through the telescopes.

Modern technology such as high-speed cameras coupled with sophisticated image-processing software has really given Pic du Midi's one-metre telescope a whole new lease of life to continue producing planetary images of astounding quality. I can see a bright future both for the observatory and the historic T1M telescope. I greatly look forward to returning there. As the saying goes, viva le Pic!

Damian Peach is a world-renowned astrophotographer.