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Remote high resolution imaging of Jupiter and Saturn from Chilescope Observatory

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Abstract

Unlike most forms of astronomical imaging today, high resolution imaging of the planets has only been possible to accomplish by the observer being present at the telescope in person. Indeed the vast majority of amateur planetary images are still produced in this way. During early 2017 an observatory opening in the Atacama region, Chile offered the possibility of remotely observing the planets via the use of a large aperture 1 metre telescope. This paper presents some of the early results achieved by the team during February – April 2017.

1. Observatory conception

Chilescope Observatory was conceived back in 2013 by Russian astronomers Ivan Rubtsov and Sergey Pogrebisskiy to offer the astronomical community the use of high quality telescopes situated at a site of very high quality. The observatory is located in the Atacama region, Chile, 40km south east of Cerro Pachon (site of the Gemini South Telescope.) The observatory is situated at 1600m above sea level at S30º28'15" W70º45'25" and consists of four telescope domes – one of which is privately leased by the team for satellite tracking. The other three domes house two 50cm astrographs and a 100cm Ritchey Chretien (the telescope used for planetary observations.) All three telescopes are available for use by professional or amateur astronomers.

2. Astroclimate of the observatory

The site being located in the southern half of the Atacama Desert experiences around 300 clear nights per year. Seeing conditions from the site are typically below 1 arc second and from site testing there (and indeed our own observations) the seeing can frequently reach values well below this. Sky transparency is also frequently excellent with very low amounts of dust and other aerosols. Overall the site appears to be an excellent choice for an astronomical observatory.

2. The 1 metre telescope

The primary telescope on site and the one used for planetary observations is a 1 metre F/7 Ritchey Chretien designed and manufactured by ASA with optics by LOMO. It features dual Nasymth foci with a large format Deep Sky camera on one focus while a high speed planetary imaging camera occupies the other focus. The telescope is housed inside a 5m dome and situated 5m above ground level to help reduce ground turbulence. The observatory is equipped with ventilation fans, air conditioning and temperature sensors to help reduce any instrumental turbulence to a minimum. This cooling system will eventually become automatic, turning on and off as required maintaining night time temperature values inside the dome.

3. Camera, Software & Operation

The camera chosen for planetary work during the planning phase was a ZWO ASI174MM high speed video CMOS camera. The camera can provide images up to more than 100 frames per second. More recently this camera was further upgraded to an ASI290MM incorporating a more sensitive chip and even faster capture rates. Firecapture is used for camera control and operation.

The entire system itself is operated remotely via Teamviewer software. This allows multiple individuals to join the session. Typically two or three of the team were present during the majority of observing sessions.

A wide range of filters are available through which to image, from UV through to IR though with other more specialized filters to be added soon.

4. Results

At the time of writing we have completed only around 30 nights of observations imaging Jupiter, Saturn or both. Results so far have been very promising already achieving a level of resolution superior to the best amateur imagery

taken with smaller apertures. The system operates very smoothly via remote operation. Observations are possible almost any night, and already we provided support imagery for Juno's Perijove 5 encounter (obtaining good images within 2hrs of the spacecraft close approach.) We have also watched a pair of small anti-cyclonic ovals in the SSTC region of the planet approach and collide, capturing the clearest ground based result of the merger itself.

High quality images of the Jovian moons have also been possible, with excellent resolution achieved on Ganymede and Europa, revealing clear details on their surfaces.

With Saturn the results have been similarly excellent. The best results so far clearly resolve the narrow Encke division around the full circumference of the A-ring (a feat only achieved by one other non-adaptive optics ground based telescope at Pic du Midi.)

5. Figures

Figure 1: The creators of Chilescope Observatory alongside the domes – 1 metre telescope is far right.

Figure 2: The 1 metre telescope used for observations.

Figure 3: Jupiter obtained using the 1 metre telescope. Many fine details are resolved within its atmosphere.

6. Summary and Conclusions

Although still in its early stages, and with improvements and upgrades on-going, the results obtained using the 1m telescope operated by Chilescope have been most impressive. The system works extremely well for planetary imaging, and for amateur planetary observers it represents a major breakthrough in being the first large aperture telescope to offer planetary imaging via a remote controlled observatory.

The observatory represents a powerful resource for longer term planetary study, particularly as time on large professional telescopes is often very limited. Image quality using this telescope is already of a very high standard, and with ongoing improvements the resolution possible should improve further.

7. Acknowledgements

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