Introduction to Astronomical Observations using IRiS

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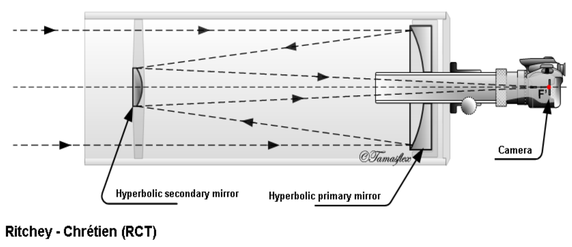
Abstract : Whether in space or on the ground, telescopes remain cornerstones of astronomical studies. While space-based telescopes can observe phenomena in wavelengths absorbed by the Earth's atmosphere, ground-based telescopes are much cheaper, easier to maintain, upgrade and less prone to damage. In this work, we observe various astronomical objects like stars, galaxies, nebulae and planets using a telescope from IRiS located at the Observatoire de Haute Provence, France. The telescope was operated remotely using a web interface keeping in mind the time of maximum visibility of each object in the sky. The use of several filters enabled analysis in multiple wavelegths.

Experimental instrumentation

The telescope

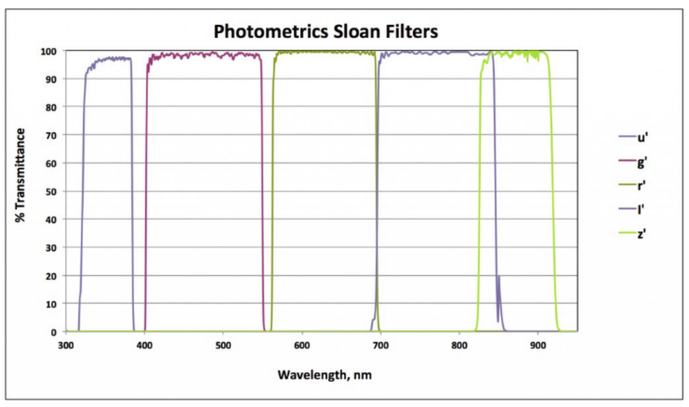
The instrument is a Ritchey-Chrétien model telescope with an aperture of 50 cm and a field of view of 24 arcmin (roughly the size of the moon). The telescope [1] is located at the Observatoire de Haute Provence, Provence, Marseille. Remotely controlled motorized shutters allow the protection of the telescope from dust and the weather. A camera mounted on the focal plane permits acquisition of images of the sources across many spectral bands like Sloan Digital Sky Survey ultraviolet, green, red, infrared, GRISM and CH_4 along with narrow bands on the H-alpha and O[III] lines. The ensemble is mounted on a rotator that can direct the camera in any angle.

The entire telescope and its equipment can be controlled remotely by a simple web interface. The large database allows automated finding from object ID, while the compensation of Earth movement done by the telescope allows long exposures. Auto-focus is performed by minimizing the areas of bright stars.



Schematic diagram of Ritchey-Chrétien model of a telescope.

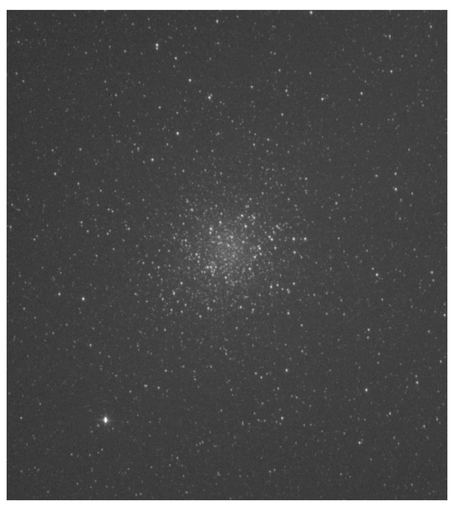
Data acquisition and manipulation



Photometric Sloan Filters: absorbed wavelengths per filter can be seen as absorption troughs of different colours.

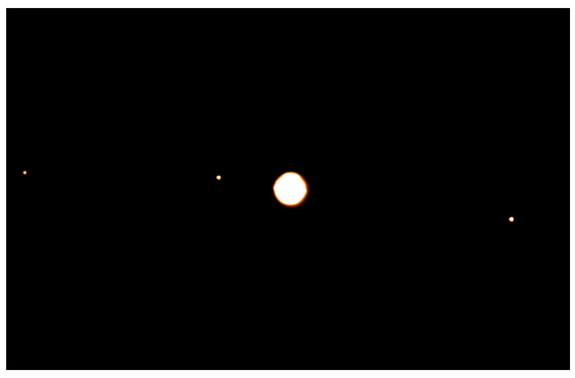
The latitude and longitude of the observatory are +43° 55' 54" and 5° 42' 44" E respectively. Each object was chosen such that it was (approximately) at the zenith of the telescope. This ensures that the light emitted by the object under study passes through minimum thickness of the atmosphere thereby reducing distortion due to the atmosphere itself.

Once the observations were finished, the raw FITS file were downloaded from the IRiS's open database. Images are analyzed with SAOimage DS9 software [2]. The colour scale distribution of the recorded signal is adjusted to optimize the visibility of faint objects (possibly by using logarithmic scale).

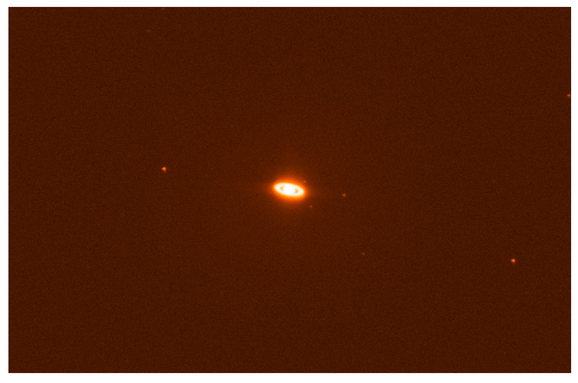


Sagittarius Globular Cluster (M22) before processing.

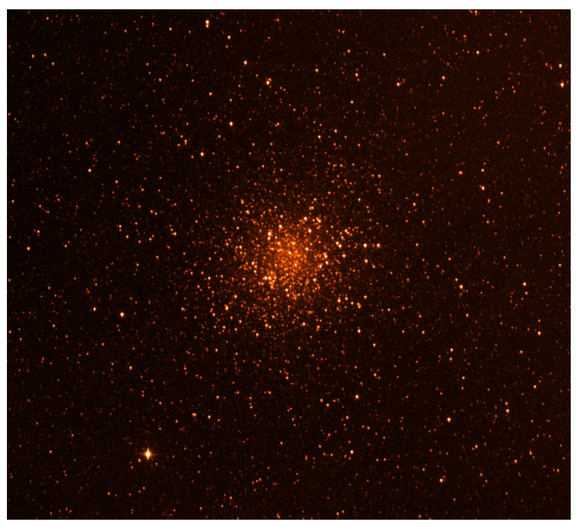
Results



Jupiter with its Galilean satellites.

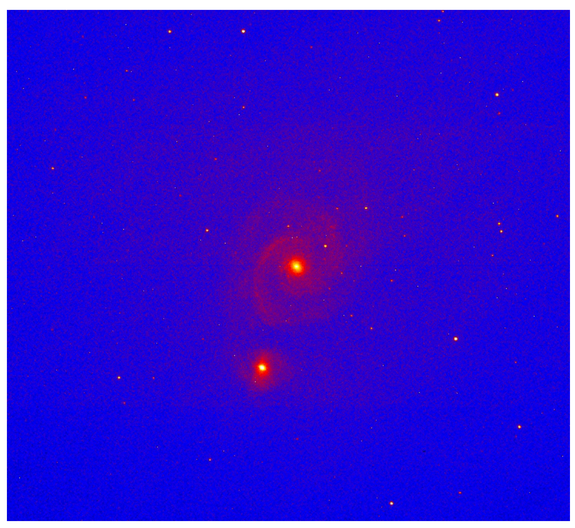


Saturn and some of its satellites.

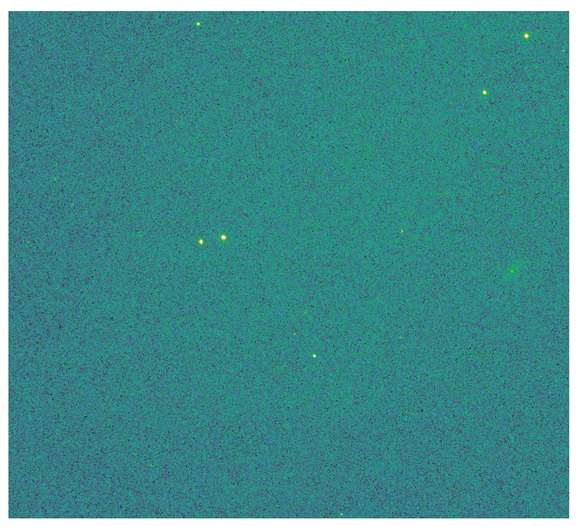


Sagittarius Globular Cluster (M22) after processing.

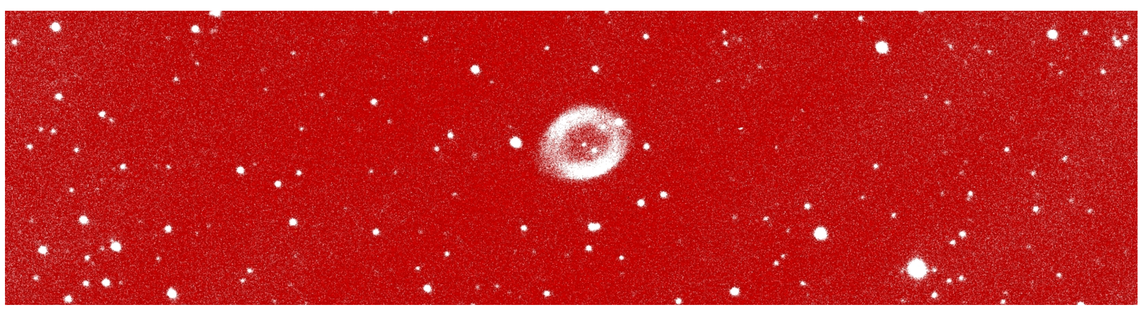
Bode's Spiral Galaxy (M81).



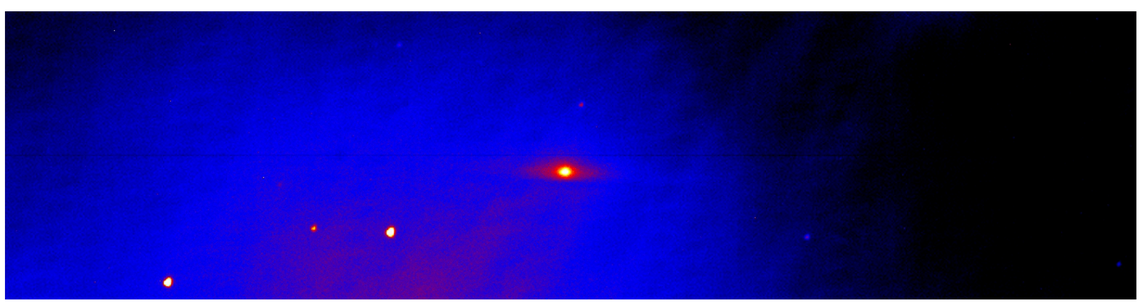
Whirlpool Spiral Galaxy (M51).



Winnecker 4 Double Star (M40).



Ring Planetary Nebula (M57).



Sombrero Spiral Galaxy (M104). The red halo on the bottom left is due to a brighter object.

Conclusions

An introductory astronomical observation has been performed in the context of the 5th Summer School on INtelligent signal processing for FrontIEr Research and Industry, in Wuhan, China, using IRiS telescope. Data were acquired and manipulated with SAOimage DS9 software. Results are reported for several astronomical objects, including planets, galaxies, star clusters and nebulae.

References

[1] http://iris.lam.fr/
[2] SAOImage DS9 2003adass.12.489J

Acknowledgments

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