RMxAC, **53**, 40–41 (2021)

https://doi.org/10.22201/ia.14052059p.2021.53.09

OPPORTUNITIES TO USE NEW ROBOTIC TELESCOPES IN SPAIN

E. Ansbro[1]

RESUMEN

El Space Exploration Ltd (SEL) ha establecido nuevas instalaciones de observatorios en España para brindar a los astrónomos la oportunidad de acceder de forma remota a una variedad de telescopios de grado de investigación y acceder a un espectrógrafo, un polarímetro y un sistema de fotometría y óptica adaptativa. En el futuro, también se probarán y pondrán a disposición observaciones automáticas simultáneas en múltiples longitudes de onda. Esto permitirá el desarrollo de nuevos procesos de observación y análisis para astronomía y astrofísica. Las observaciones se programarán a través de Internet, incluídos los proyectos que requieren un monitoreo continuo a largo plazo. Se puede acceder a los datos rápidamente siguiendo las observaciones programadas. El acceso es sobre una base comercial, no competitiva, evitando los requisitos administrativos convencionales que requieren mucho tiempo, los tiempos de espera y las decepciones.

ABSTRACT

The Space Exploration Ltd (SEL) has established new observatory facilities in Spain to provide the opportunity for astronomers to remotely access a range of research-grade telescopes and access to a spectrograph, polarimeter. photometry and adaptive-optics system. In the future, simultaneous automated multi-wavelength observations will also be tested and made available. This will enable the development of new observational and analytical processes for astronomy and astrophysics. Observations will be scheduled via Internet, including projects requiring long-term ongoing monitoring. Data can be accessed rapidly following scheduled observations. Access is on a commercial, non-competitive basis, avoiding conventional time-consuming administrative requirements, wait times, and disappointments.

Key Words: telescopes — instrumentation: adaptive optics — instrumentation: polarimeters — instrumentation: spectrograph

1. INTRODUCTION

New facilities in Spain will provide the opportunity for astronomers to schedule time on a range of research-grade robotic telescopes. The first telescopes are being installed and will be operational in 2020. They range in size from 0.4m to 0.9m, with various focal lengths and a wide range of instrumentation. Scheduling is via Internet on a first-come first-served commercial basis. No proposal-writing or committee approvals are involved. All telescopes and instrumentation are fully robotic, thus no travel is involved. The observatory site is within the Monte de Las Animas Starlight Reserve Area, Andalucía, Jaen Province. Its elevation is 1500 metres (5000 feet) and has 250 clear nights. Sky quality (SQM) is 22.0 arc sec mag; seeing resolution (DIMM) averages 1 arc sec.

2. INSTRUMENTATION

Recent discoveries in astronomy and astrophysics offer new scientific vistas for exploration, and also increase the need for facilities suitable for follow-up observations. SEL aims to increase the possibilities for astronomers by including a suite of instruments not commonly available.

Most robotic telescope provide imaging capabilities with CCD cameras and a range of common filters, but more specialised filters and instruments to carry out specialised scientific projects are often lacking. Options such as high-resolution spectroscopy, polarimetry, narrow band imaging, diffusion-assisted photometry and adaptive-optics to significantly improve resolution will all be available. This means astronomers will have a broader range of research possibilities.

2.1. *Telescopes*

The robotic telescope sizes will include two 0.4m, two 0.6m and one 0.9m. These are suitable for imaging and studying deep sky objects, comets, variable stars, novae, supernovae, minor planets, planets, and exoplanets. In addition, we are including a unique suite of scientific instrument plug-ins-all fully robotic-to support polarimetry, high-resolution spectroscopy, narrow band imaging, photometry and

[1]Space Exploration Ltd, Kingsland, Boyle, County Roscommon, Ireland.

VI Workshop on Robotic Autonomous Observatories (Mazagón, Huelva (Spain), September 30 - October 4, 2019)
Editors: A. J. Castro-Tirado, S. B. Pandey, & M. D. Caballero-García - DOI: https://doi.org/10.22201/ia.14052059p.2021.53.09

planetary imaging. Different telescopes have different fields of view, including some that are very wide-field up to 1.5°.

0.4 m (16 inch) SCT @ f/5 for UBVRI imaging.

0.4 m (16 inch) Direct Imager @ f/ 3.5 for wide field imaging (LRGBHa).

0.6 m (24 inch) Cassegrain @ f/18 for polarimetry.

0.6 m (24 inch) RC @ f/8 for narrow band imaging and spectroscopy.

0.9 m (36 inch) Astrograph @ f/4 for narrow band imaging.

2.2. *Instrumentation*

Polarimetry is a powerful technique for revealing more detailed two and three-dimensional structures in astrophysical objects beyond the spatial resolution provided by direct imaging. The **DiPol 2 Polarimeter** Piirola et.al.(2014) is included in the SEL suite of instruments was the instrument used to discover the first atmosphere around an exoplanet. Berdyugina et al. (2011) compare this with transit photometry and spectroscopy techniques, which cannot yet detect exoplanet atmospheres.

The **Echelle spectrograph** robotic instrument has a high resolution (>20,000) that can be used for determining radial velocities of binary stars, Doppler shift of exoplanets, and composition of different categories of stars. Kozlowski (2016).

A new technique called diffusion-assisted photometry will be available on one of the telescopes. This process improves the resolution and profiling of data of variable stars, exoplanets and minor planets. Stefansson et.al. (2017).

2.3. *Filters-broadband and narrow-band*

A range of photometric filters includes the following:

LRGB, Bessel UBVRI, Sloan griz, Hα, SII, OIII, CH^4, NIR.

HB filter set with CN, C0+, C^2, C^3 for comet species types and production material rates.

WR filter set for Wolf-Rayet massive star detection photometric characteristics.

Broadband exoplanet filter for improved contrast in transits.

Diffused-assisted photometric filters for improved resolution and PSF.

2.4. *Adaptive optics (AO)*

Adaptive optics for these telescopes offers further improvement in resolution. A fundamentally new approach in AO systems will be introduced with one of the telescopes, to further benefit from the existing outstanding seeing conditions at the site. Early tests with the new AO system are showing a resolution down to 0.3 arc sec. Quintavalla et.al.(2019).

3. SIMULTANEOUS AUTOMATIC MULTIWAVELEGTH ASTRONOMY

Non-simultaneous, multi-wavelength observations have provided new, important insights into a wide variety of sources and physical processes. However, in cases where emissions at different energies vary on timescales shorter than the coordination between bands, researchers using a single telescope at a time are commonly provided with at best a fundamentally limited view and at worst a misleading one. The relevant timescales that need to be considered determine the difficulty inherent in coordinating observations, and depend on the physical processes under consideration and the object class.

Conventionally, the main difficulties inherent in arranging coordinated campaigns-even with no emphasis on simultaneity-are obtaining observing time, scheduling, human limitations, and the rarity of the event. A crucial issue is the need to automate most of-if not the whole-process: transient detection, first-look classification, prioritisation, communication, trigger of multi-wavelength follow-up and further classification. The solution may be a suite of telescopes in situ at the SEL observatory site with a range of instrumentation like polarimeters, spectrographs, and high speed photometry, together with robust software that provides simultaneous autonomous multi-wavelength synchronised timestamped observations. SELs exploring this future goal and expects to carry out a pilot programme of this nature. This may inspire other observatories to consider this possibility. Middleton (2017).

REFERENCES

Berdyugina, S. V., Berdyugin, A. V., Fluri, D. M., & Piirola, V. 2011, Ap J, 728, L6
Kozlowski, S. K. 2016, PASP, 128, 074201
Middleton, M. J. 2017, ArXiv:1709.03520 Astro-ph.IM.
Piirola, V., Berdyugin, A., & Berdyugina, S. 2014, SPIE, 9147, 8I
Quintavalla, M. F., Santiago, S., Bonora, S., & Restaino, S. 2019, Appl. Opt., 58, 2
Stefansson, G., et. al. 2017, ApJ, 848, 9