Exploring rapid astrophysical variability – a pilot study for a network of small-aperture telescopes with CMOS detectors.

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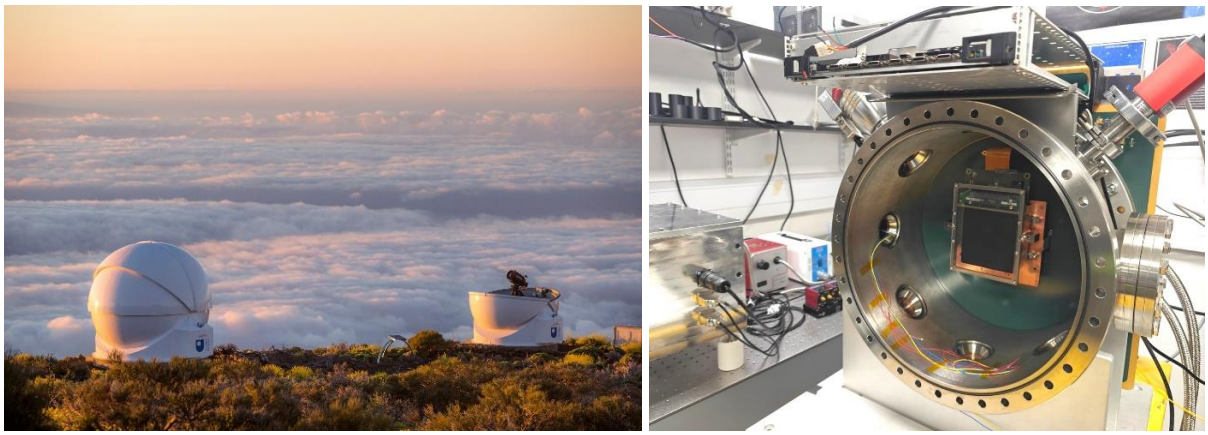

Image: (left) The Open University telescopes at Observatorio del Teide (Tenerife); (right) One of the CMOS image sensor test facilities in the Centre for Electronic Imaging

Project highlights:

- Explore opportunities in time-domain astrophysics, including on exoplanet host star variability and exploiting the occultation of asteroids
- Use the world-leading CEI facilities and gain expertise in cmos camera design and operations
- Test cmos cameras in real-world astrophysical applications at our Canary Islands facilities, the best observing site of the Northern hemisphere
- Interact with industry leaders Teledyne

Project description:
Variability is a defining characteristic of virtually all constituents of the near and far Universe. Recording and characterising the time-dependence of celestial objects is an essential method for the interpretation of astrophysical phenomena. The coverage of the variability phase space of period and amplitude is continuously improving via dedicated ground-based facilities such as the large Vera Rubin Observatory (1) and space-based facilities such as Fermi (2) or the small future mission StarBurst, in the optical waveband and across the electromagnetic spectrum and beyond. Yet astronomy is still a long way from being able to monitor the Sky 24/7 at all cadences, even in the optical waveband.

This project explores the contribution a network of small-aperture optical telescopes can make when equipped with fast-cadence CMOS detectors. Distributed small facilities with off-the-shelf detectors represent a cost-effective and easily expandable addition to the

effort exploring the variability space. The project will characterise and commission one or more CMOS detectors for the Open University's PIRATE and COAST facilities (4, 5) located at Observatorio del Teide (Tenerife), and deploy the detector to conduct photometric measurements and lucky imaging for bright, rapidly changing phenomena in three astrophysical areas:

- Stellar activity during exoplanet transits (4)
- Stellar occultations by asteroids (5)
- Light curves of artificial satellites

The work includes optimising the setup and operation of the CMOS cameras, and has potential for a close collaboration with representatives of Teledyne Scientific Instruments, via the OU's Centre of Electronic Imaging.

References:

1. Rubin Observatory
2. The Fermi Gamma-ray Space Telescope
3. Jackson S, Kolb U, Green SF 2021, Publications of the Astronomical Society of the Pacific, Volume 133, Issue 1025, id.075003, 21 pp: Asteroid Photometry with PIRATE: Optimizations and Techniques for Small Aperture Telescopes
4. Salisbury M, Kolb U, Haswell CA, Norton AJ 2021, New Astronomy, Volume 83, article id. 101477: Monitoring of transiting exoplanets and their host stars with small aperture telescopes
5. Morgado BE, et al 2023, Nature, Volume 614, Issue 7947, p.239-243: A dense ring of the trans-Neptunian object Quaoar outside its Roche limit.

Qualifications required:

BSc 2:1 or a MSc in astronomy or a related field, preferably an MPhys degree.