SF2A 2025
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ASTRONOMY FROM THE MOON

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Abstract. China, Europe and USA are preparing intensively activities on the Moon. In perticular, telescopes will be installed there. I review the sciences cases for an optical telescope, from Solar System observations to Cosmology.

Keywords: lunar optical telescope

1 Introduction

The Moon will be the next territory of many activities, from exploiting lunar resources to fundamental science questions. From an operational point of view, the low lunar gravity and absence of wind allows to built telescopes larger than on Earth. It will be upgraded in situ and will not be limited in time contrary to space telescopes. From an astronomical point of view, for instance the low lunar rotation allows for interferometric observations with shorter variation of the optical delay and in situ close obsevation of the Moon.

Here I present LOT, a 30-cm class Lunar Optical Telescope, equipped with a moderate resolution spectrograph, and its science objectives.

2 Science cases for an optical telescope

2.1 Solar System

1. *The Moon itself.* LOT will be able to make in-situ observations of lunar mountains nearby to it.

2. *The Earth* With LOT one will observe the Earth at low spatial resolution and its global flux as if it were an exoplanet. One will compare them with high sptial resolution data. This comparison will help to validate exoplanet atmosphere models inferred from monpixel data.

3. *The Sun.* Soler eclipses by the Earth seen from the Moon last 3.8 times longer than Solar eclipses by the Moon seen from the Earth and will allow to characterise the solar corona 3.8 times further.

4. *Small bodies and planets.* Thanks to its location, LOT will be able to seen stellar occultations by asteroids and mutual eclipses of binary asteroids not visible from Earth (Figure 1). The combination of terrestrial and lunar determination of asteroid trajectories will provide a very accurate probability of their possible impact on Earth. It will contribute to planetary protection.

2.2 Exoplanets

Thanks to the very long duration of LOT, it will make the photomectric monitoring of planetary transits leading to the possible detection of exomoons (Sartoreti and Schneider 1999). Its spectral capacities will allow the detection of chemical species in transiting exoplanet exoplanet atmospheres.

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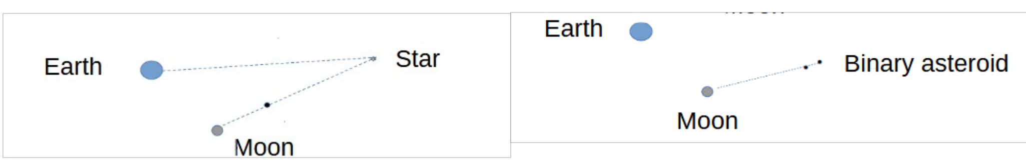

Fig. 1. Small bodies: stellar occultations and mutual eclipses seen from the Moon

2.3 *Extragalactic domain*

The very long duration of LOT will also allow the monitoring of gravitationally lensed binary quasars. The time delay between the light curve of the two components provides constraints on the Hubble constant (Vanderriest et al. 1989).

For a detailed review of science cases with any telescope type see Schneider et al. (2024).

3 Present and future telescopes

The 30 cm Lunar Ultraviolet Telescope (LUT) was operated successfully from 2013 to 2015 (Wang et al. 2018) and observed seventeen stars.

Several projects propose telescopes from 30 cm aperture to several meters or more:
- LUSTER, submitted to NASA, is a 30 cm telescope devoted to transits (Boyajian et al. 2024).
- A $600m^2$ array at the lunar pole (Angel 2024).
- Thanks to large available distances, interferometers with multi-kilometric base lines like MoonLITE (van Belle et al. 2024), and AeSI (Rau et al. 2024) will provide an angular resolution down to milli- and micro-arcsec.

4 Conclusion

With a 30cm-class optical telescope we will start a new era of astronomy. It will make observations and long term monitoring possible from nowhere else. For a review of lunar base activities see `http://luth7.obspm.fr/Moon.html`

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