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Article: ***Scientific Opportunities***

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ABSTRACT

A Moon Base would offer excellent opportunities for scientific research. In Astronomy, it would combine the advantages of space (freedom from atmospheric turbulence, absorption and weather) with those of ground based observatories (easy maintenance, upgrades, state-of-the-art instrumentation). This means that an observatory on the Moon would be able to probe the heavens at wavelengths ranging (at least) from the far ultraviolet to the extreme infrared and sub-mm radio waves (although it may not be possible to cover the whole wavelength range with a single telescope). While one would envision that the telescope(s) and instruments should be as maintenance-free as possible, a manned Moon Base could provide technical support that would allow new instruments to be integrated, upgrades to be made and problems to be fixed, at the same time relaxing some of technical requirements (e.g. redundancy) and therefore cost.

Some possible astronomical scenario(s) for the third/fourth decade of the third millennium include Extremely Large Telescopes (30 to 100 m in diameter) and large interferometers on the ground, and several space telescopes (JWST, possible UV/optical successors of HST, TPF/Darwin etc). These facilities will make quantum-jump advances in observational astronomy, looking for earth-like planets around other stars, studying the bulding blocks of stars and galaxies, measuring directly the acceleration of the expansion of the Universe. This will set constraints and requirements (e.g. wavelength, resolution, kind of instrumentation) for potential telescopes/instruments on the Moon, which may turn out to be scientifically and financially competitive alternatives to some of these projects.

I will discuss some science cases for a Moon Base astronomical facility, ranging from all sky surveys at unprecedented resolution and sensitivity, to cosmological studies of the very early Universe, to the analysis of Earth-like planets around other stars, in the context of several options for the possible observational configurations (e.g. large steerable telescopes, fixed altitude telescopes, interferometers and others).