

The FOCOS Mission Concept - Fundamental physics with an Optical Clock Orbiting in Space

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Precise time and frequency comparisons of high-stability optical lattice clocks via free-space optical links can dramatically improve tests of fundamental physics and searches for physics beyond the standard model. The FOCOS mission concept consists of an orbiting optical lattice clock with a high-performance optical link to state-of-the-art ground clocks. An 8-hour elliptical orbit enables frequency comparisons of the orbiting clock at periapsis and apoapsis with the same ground clock every 12 hours, utilizing the orbiting clock's high frequency stability to measure the Earth's gravitational redshift at the ppb level. The orbiting FOCOS clock may also serve as a primary frequency standard, free from gravitational tidal perturbations on Earth, and provide world-wide high-performance links between ground clocks. A network of ground clocks will allow precise frequency comparisons and can extend searches for dark matter and time variations of fundamental constants. The 8-hour orbit requires a modest telescope for the optical link, and reducing the FOCOS SWaP (size, weight and power) will also be discussed.

References

- [1] Derevianko, A., Gibble, K., Hollberg, L., Newbury, N. R., Safronova, M. S., Sinclair, L. C., Yu, N., Fundamental physics with a state-of-the-art optical clock in space, Quantum Science and Technology, Vol. 7, pp. 044002, 2022.