The Space Optics Laboratory (SOL@IESL)

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ABSTRACT

Technical optics in space is rapidly gaining in importance as a tool for communication and for manipulation. The Space Optics Laboratory (**SOL**) @ IESL is focused on the development and deployment of optical tools for optical space communication for large data-rates, quantum communication and space-based quantum sensors.

Optical Space Communication: Arguably the 21^{rst} century is defined by communication. The internet has become omnipresent and is now starting to penetrate space. More and more data is generated in earth's orbit (e.g. commercial imaging from space, mapping, weather satellites, and earth observation). Only optical communication can accomplish the data rates, that we will require in the near future. **SOL** will install at the Skinakas Telescope of FORHT/UoC the first installation upgrade in Greece for space communication with low-earth orbit and deep-space satellites.

Quantum Space Cryptography: Cryptography lies at the heart of much of our interactions, from WhatsApp messages to banking transitions. When it comes to state secrets, our future lives may depend on secret messages. Quantum Key Amplification (commonly known as Quantum Cryptography) gives us with a method of communicating in a physically secure fashion, where any intruder can be detected based on the laws of Quantum Mechanics. **SOL** will install at Skinakas the first ground station for Space-Earth quantum cryptography.

Space-Based Quantum Sensors: Matterwave (atom) interferometry offers the most sensitive absolute measurements of acceleration and gravity to date. **SOL** is part of Science Core Team of two mission proposals CARIQA and STE-QUEST. CARIQA is the future EU mission to measure Earth's gravitational field using atom quantum sensors in space. STE-QUEST will continue Einstein's and Galileo's tradition and test the weak equivalence principle (in vacuum a feather and a stone fall both at the same acceleration) using matterwaves. We aim at a precision of 10^{-18}, i.e. 18 orders of magnitude. For this **SOL** will provide key optical components.

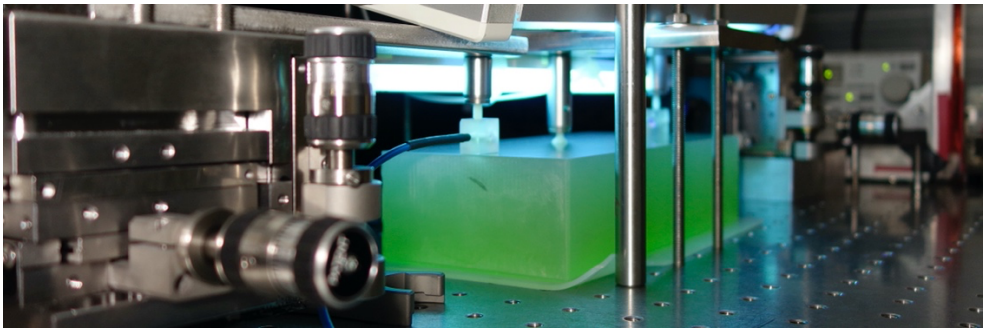

Figure 1: A space-optical Fiber Bench under construction @ SOL