The Synthetic Aperture Lunar Telescope (SALT)

Group 4

Modern mid-infrared telescope designs are approaching their performance limits. Ground based telescopes are greatly limited by atmospheric disturbances. Space based telescopes eliminate atmospheric interference and reduce thermal disturbances, but they are far from a panacea. Their mass, power, and volume limitations lead to high costs and limited apertures, which leads to less frequent launches and slower development of capabilities. The goal of the SALT project is to sidestep these limitations and provide revolutionary spectral measurements of exoplanet atmospheres. Its novel design exploits recent advancements in metrology, precision mechanisms, and launcher capabilities to provide angular resolution exceeding any existing telescope, with sensitivity better than even the James Webb Space Telescope.

SALT is a new class of nulling interferometer for measuring exoplanet spectral emissions. The system is located near the lunar south pole and composed of four independent unit-telescope rovers that maneuver freely around a central beam-combiner. Rover independence enables fine spacing control over a very wide range, while maintaining full control over the angular position of each unit-telescope. This lets SALT optimize its configuration for each target system in a way that no other system can. The rover design also enables easy expansion to eight or more unit-telescopes, while an upgradable optical system allows for instrument upgrades. This, along with the continuous involvement of astronauts for installation and maintenance, makes the SALT system more flexible than all space based competitors, and even most ground based telescopes.

SALT's location in Sverdrup crater shields the telescope from sunlight and provides it an unadulterated view of the cosmos. The lunar vacuum obviates the need for many noise reduction procedures which significantly reduce the throughput of ground based systems. This vacuum also eliminates many internal disturbances that limit the performance of other systems.

We conducted a performance estimation based on the optical characteristics of the SALT system and known exoplanets. This showed that, whereas most existing systems can only detect exoplanets, SALT will be able to characterize hundreds of them at resolutions of $5\,[mas]$ or better and SNRs of at least $10\,[-]$.

Humanity has never been satisfied with stagnation. From our earliest days we have toiled not just to do, but to do more, bigger, better, faster, and further. The Wright brothers, Lipperhey and Einstein shared a common aim: to expand the range of human ingenuity physically and intellectually. SALT is the next step in that storied tradition.