
LAsER guide Star Sensor Integrated Extreme adaptive optics (LASSIE) Project

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Abstract

Extreme adaptive optics (ExAO) systems are optimized for high-contrast imaging and coronagraphy. ExAO systems are currently limited to wavefront sensing using a bright natural guide star (NGS) due to the performance requirements for high precision wavefront control. Laser guide stars (LGS) are artificial beacons widely used to increase sky-coverage of conventional AO systems, but have not yet been applied to ExAO systems due to the limitations inherent to a laser beacon such as extent, elongation, and focal anisoplanatic error. Recent advances in LGS technology such as AO correction of the laser uplink produce bright beacons that offer higher wavefront sensitivity than uncompensated beacons. Pairing this LGS technology with ExAO could enable better high-contrast imaging of dim targets. The LAsER guide Star Sensor Integrated Extreme adaptive optics (LASSIE) project at the Starfire Optical Range will explore the trade space in beacon size, brightness, coherence, and wavefront sensor design to perform path-finding research on the potential performance of an uplink corrected LGS-ExAO system. We investigate a new type of hybrid wavefront sensor that combines a Shack-Hartmann with a pyramid wavefront sensor to maximize the sensitivity of the wavefront measurement from a partially coherent extended beacon. The project will also explore incorporating a low-order NGS wavefront sensor to mitigate residual errors from spatial frequencies not well sensed by the LGS wavefront measurement. LASSIE is a newly funded project and we will present an overview of the project and our current progress. Approved for public release; distribution is unlimited. Public Affairs release approval #AFRL-2022-4238

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