Extreme Adaptive Optics Testbed Planet Imager Short and Long Term Stability

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The objective of the Extreme Adaptive Optics project is to build a system capable of detecting young Jupiter-sized planets orbiting nearby stars. The Extreme Adaptive Optics Testbed is used to develop and test these high contrast measurements (detecting a faint object near a bright one). Of particular importance is precise wavefront control and evaluating the stability of the system over short and long periods of time. The system has measured features 107 fainter than the reference laser light source. These experiments have used shaped pupils with low edge roughness to generate higher contrast images by suppressing diffraction from the laser source and increasing the ability to detect faint objects. The wavefront control is evaluated using a Phase Shifting Diffraction Interferometer to measure the wavefront errors with both a flat mirror and a MEMS (Micro-Electro-Mechanical-System) deformable mirror. A MEMS mirror is expected to be a component of the final system and its stability is important. First, we performed stability tests over short and long periods of time with a flat mirror in order to characterize the system. Then, the stability of the system with the MEMS deformable mirror was tested. At short period intervals, the wavefront error is dominated by measurement noise, and at long periods, the wavefront error is due mostly to changes in the optical system. Individual zernike modes (decompositions of the optical aberrations) were analyzed in order to identify which ones contribute more to the wavefront error over time.

Nella Barrera was born and raised in Columbia. She is a fourth year student majoring in Aerospace and Mechanical Engineering at the University of California, Irvine. She plans on attending a graduate program at a University of California. She has done research and has studied the behavior of turbulent jets in order to make jet propulsion engines more fuel efficient and reduce noise. Nella has also found special interest in analyzing the characteristics of the Airborne Laser (ABL) system developed by Boeing to be implemented into Planetary Defense. Her interest has been to find ways to mitigate turbulence to avoid the deflection and loss of intensity of the laser beams through the atmosphere.