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Coronagraphic Imaging of Exoplanets from a High Altitude Balloon Platform

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Direct imaging of exoplanets orbiting nearby stars is a major observational challenge, demanding high angular resolution and extremely high dynamic range close to the parent star. Such a system could image and characterize the atmospheres of exoplanets, and also observe exozodiacal dust within the exoplanetary system. The ultimate experiment requires a space-based platform, but demonstrating much of the needed technology as well as performing valuable measurements of circumstellar debris disks, can be done from a high-altitude balloon platform.

In this paper, we show how progress in key technologies leads to a balloon experiment as a logical future step toward a space mission. The HCIT testbed has shown ultra-high contrast using small optics in a vacuum testbed. A recent ground-based experiment has demonstrated the ability to control three active optics in series - a lightweight controllable primary mirror, and two deformable mirrors - to achieve close to the best wavefront correction possible with large optics in an in-air testbed. We briefly describe the Wallops Arcsecond Pointer (WASP), which as had a very successful first flight, showing the capability of a balloon platform to stably point to the accuracy required for a coronagraph payload experiment. A balloon-borne coronagraph mission would incorporate all of these advances in an instrument that verifies each one in a space-like environment, and enabling forefront science. Such an experiment would be a step toward mitigating the technical risks of a major space-based exoplanet coronagraph.

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