# Achromatic focal plane mask for exoplanet imaging coronagraphy

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250-word Abstract:

Recent advances in coronagraph technologies for exoplanet imaging have achieved contrasts close to 1e-10 at 4 λ/D and 1e-9 at 2 λ/D in monochromatic light. A remaining technological challenge is to achieve high contrast in broadband light; a challenge that is largely limited by chromaticity of the focal plane mask. The size of a star image scales linearly with wavelength. Focal plane masks are typically the same size at all wavelengths, and must be sized for the longest wavelength in the observational band to avoid starlight leakage. However, this oversized mask blocks useful discovery space from the shorter wavelengths.

We present here the design, development, and testing of an achromatic focal plane mask based on the concept of optical filtering by a diffractive optical element (DOE). The mask consists of an array of DOE cells, the combination of which functions as a wavelength filter with any desired amplitude and phase transmission. The effective size of the mask scales nearly linearly with wavelength, and allows significant improvement in the inner working angle of the coronagraph at shorter wavelengths. The design is applicable to almost any coronagraph configuration, and enables operation in a wider band of wavelengths than would otherwise be possible. We include initial results from a laboratory demonstration of the mask with the Phase Induced Amplitude Apodization coronagraph.

100-word Abstract:

A remaining challenge for coronagraph technology is to achieve high contrast in broadband light; a challenge that is largely limited by chromaticity of the focal plane mask. We present here the design, development, and testing of an achromatic focal plane mask based on the concept of optical filtering by a diffractive optical element (DOE). The effective size of the mask varies nearly linearly with wavelength, and allows significant improvement in the inner working angle of the coronagraph at shorter wavelengths. The design enables operation in a wider band of wavelengths than would otherwise be possible.