Author: Prashant Pathak (ESO, DOE, Sys eng)
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Title: On-sky closed loop correction of atmospheric dispersion for high-contrast coronagraphy and astrometry

Abstract:

On ground-based telescopes employing adaptive optics (AO) systems, atmospheric dispersion compensation is essential to deliver high-quality imaging, and critical for coronagraphy and high-precision astrometry. In AO systems delivering high-Strehl, residual dispersion if often a dominant source of error, and is especially challenging to correct on large aperture telescopes. Imperfect compensation by atmospheric dispersion compensator (ADC) can be due to errors in the atmospheric dispersion estimation (usually derived from local temperature and pressure measurements), or calibration errors in the instrument and ADC optics. These limitations can be addressed with a high-precision on-sky measurement of residual dispersion in a closed-loop control scheme. In this work, we present a focal plane based technique, which utilizes the chromatic scaling of speckles to measure residual dispersion (atmospheric and optical) in the final science image. By using an adaptive speckle grid generated using a deformable mirror (DM) with a sufficiently large number of actuators, the residual dispersion is accurately measured and subsequently corrected in a closed-loop control. On-sky residual dispersion of < 1 mas across H-band was demonstrated, which reduced from 8.4 mas before closing the loop.