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OmegaCAM Technical Time proposal: Atmospheric effects on astrometry serving E-ELT studies.

The turbulent behavior of the atmosphere causes jitter in the apparent position of sources on short (subsecond) timescales. This thus limits achievable astrometric accuracy. The adaptive optics system counters the turbulent behavior by determining and applying a real-time a correction to mirror shapes that optimizes the spatial resolution optimally at a single location in the FoV. Away from this point the correction also has an effect, but corrects less optimal.

We are involved in the E-ELT First Light instrument MICADO. One of our main science cases is high-precision relative astrometry for which the MICADO instrument will be optimized. However, associated adaptive optics systems, like the MCAO for the E-ELT, optimize for image spatial resolution, not for astrometric accuracy. The combined effect of atmospheric turbulence and deformation of mirrors has a complex impact on astrometry. Studies on the direct impact of atmospheric turbulence on astrometry (i.e., without AO correction) are scarce for time scales ranging from minutes up to a full night in combination with simultaneous coverage of a wide range of baselines.

We therefore propose a small pilot with OmegaCAM on the VST in bright technical time to measure the power spectrum of astrometric variability on small and large angular baselines and on short and long timescales up to a night. Paranal has an atmosphere expected very similar to the E-ELT atmosphere, which is only 20 miles away. The combination of a seeing limited and stable PSF over a wide FoV (1sq.deg.) makes OmegaCAM a very appropriate instrument to determine the astrometric power spectrum. We propose sequences of short (39 sec) i-band observations of a dense, but not crowded, stellar field (e.g., a southern standard field) that crosses zenith around midnight during Technical Time. Time permitting, observations can run up to a night long to sample long-term astrometric systematics. The dithered observations will be unguided to optimize observing efficiency. This strategy follows the successful short-exposure observing strategy of the OmegaWHITE program now running for several years on the VST. I-band is chosen to limit bright moon effects. Details of the observations will be finalized with OmegaCAM instrument staff.

The empirically determined power spectrum will be compared with its prediction based on extensive measurements of atmospheric turbulence for the E-ELT (e.g., [Sarazin et al., 2013](#)). Our current astrometric image simulations for MICADO are based on such atmospheric models.

In conclusion, the value of the proposed OmegaCAM observations is that they can give an empirical validation of the astrometric modelling approach used in the context of the E-ELT. We will report our results and make it available to the E-ELT community.

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