Contribution ID: **14** Type: **not specified**

Improved Point Spread Function Correction for Aerosol Measurements Using Wide-field Stellar Photometry

Wednesday, 13 July 2022 11:30 (30 minutes)

When using wide-field stellar photometry to measure Vertical Aerosol Optical Depth (VAOD), we model the dependence of measured stellar fluxes on the star color and position within the field of view of the imaging system in order to control systematic uncertainties introduced through those dependencies. In wide-field imagers, the Point Spread Function (PSF) varies significantly across the instrument's field of view (FOV) as the deformation of star images increases with the distance from the center of the FOV. While such dependence can be compensated using a synthetic flat-field correction created through the simultaneous analysis of many images, such an approach fails to account for the image-to-image changes in this correction due to minute changes in focus over time. This effect is believed to be the main reason for fluctuations in the conversion factor between measured photometric flux and actual star brightness(also known as zeropoint) as determined by self-calibration scans, which is the dominant source of uncertainty for single-image VAOD measurements. We study the possibilities and limitations of using the PSF Extractor code to extract the precise model of the PSF from wide-field images and compare the modeled PSF with the actual star shapes and search for optimal choices of global PSF extraction methods,including dividing the frame into smaller segments, across which the PSF is more stable.

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Session Classification: The influence of the atmosphere on the measurements of present and future UHECR and Gamma-Ray experiments