Reference-star differential imaging on SPHERE

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Abstract

As the primary technique in high contrast imaging, angular differential imaging (ADI) is limited by the self-subtraction effect, which lowers its sensitivity to exoplanets at short angular separations (e.g., < 0.3") and prevents a good recovery of disk emission in total intensity. To avoid the self-subtraction effect, we can use reference-star differential imaging (RDI) as an alternative technique. We present the performance of RDI on SPHERE. We made use of all the archival data obtained by SPHERE in the past 5 years to build the reference library. In the point-source detection, RDI can outperform ADI at small angular separations (< 0.4") with a peak gain of 0.85 mag over ADI at 0.15". In disk imaging, RDI can reveal more disk features than ADI and provide a more robust recovery of disk morphology. In combination with advanced PSF reconstruction techniques (such as non-negative matrix factorization), our RDI technique obtains even better disk images than the usual RDI-PCA reductions by mitigating the over-fitting problem. The reference library we built can be easily implemented into legacy or future SPHERE surveys to perform RDI without additional observations of reference stars, achieving better performance than that of ADI.

Keywords: techniques: high angular resolution – techniques: image processing

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