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SAM: The promising AMI/friend of the JWST

In less than 3 months, the James Webb Space Telescope (JWST) will inherit the mantle of being the world's pre-eminent infrared observatory. JWST will carry with it an Aperture Masking Interferometer (AMI) as one of the supported operating modes of the Near-InfraRed Imager and Slitless Spectrograph (NIRISS) instrument. The Sparse Aperture Masking (SAM) interferometry introduces a mask with well-selected holes into the pupil plane of a telescope to enable interferometric capabilities. Major ground-based observatories have successfully implemented NRM interferometry using existing instruments and observing procedures. Landmark discoveries such as dusty disks imaged around young stellar objects, mass-loss shells of evolved stars and the fascinating time-varying spiral plumes surrounding dusty Wolf-Rayet systems have been reported among the 50-odd peer-reviewed papers describing results produced by this technique (Martinach et al. 2007, Tuthill et al. 2008, Ireland et al. 2008).

The modern era of extreme adaptive optics (XAO) pushes this technique to its next level by dramatically reducing atmospherically-induced wavefront error. The last five years have seen the resurgence of this technique, which is now offered on major observatories around the world—the Very Large Telescope (VLT) with SPHERE and recently VISIR, on Gemini South with GPI, and on the Keck with NIRC2. Recent studies have revealed the full potential of this technique on various astrophysical domains such as planetary systems, protoplanetary disks, brown dwarfs, low-mass stars, and more (Sallum et al. 2015, Haubois et al. 2019, Greenbaum et al. 2019).

The primary advantage of the AMI mode is its ability to probe the very core of the point spread function (PSF), where coronagraphic techniques on JWST are blind. Thus AMI complements other high contrast JWST imaging on NIRCAM and MIRI in the range of inner working angles between 0.5λ/D and 4λ/D which are masked by the JWST coronagraphic spots. This opens the search for companions down to roughly 1 AU for the closest star systems (≤ 50 pc). AMI will be particularly suited for follow-up observations of the major giant planet imagers such as SPHERE on the Very Large Telescope (VLT) and GPI on Gemini, providing a complementary wavelength coverage and better overall sampling of their spectral energy distribution (SED) and hence effective temperature and cooling history. The number of exoplanets directly imaged by such instruments continues to rise (49 planets in 2022), indicating a rich field for NIRISS' AMI mode to exploit.

Aboard such a powerful platform, the AMI mode will deliver the most advanced and scientifically capable interferometer ever launched into space, exceeding anything that has gone before it by orders of magnitude in sensitivity. Here we propose to present key aspects of the design and commissioning of this facility: realistic data simulations through the package ami-sim (developed A. Sivaramkrisnan), the extraction of interferometric observables using the versatile AMICAL software, and an updated view of AMI's expected performance (Soulain et al. 2020). SAM and AMI are definitely two friendly words for the french community and should get new regard considering the new facilities equipped with this mode. NIRISS, with the JWST, will be definitely the most promising one, but the french community is also implicated to offer SAM with the other major ground-based facilities (SPHERE, VISIR, LBTI, etc.). We propose to take advantage of the SF2A to present this promising mode beyond the JWST, and especially the unexplored synergy with the so-french interferometric technique.