The mid-infrared spectrum of β Pictoris b

First VLTI/MATISSE interferometric observations of an exoplanet

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The mid-infrared was the first spectral region to provide the direct emission spectrum of an exoplanet (Janson+ 2010). Since then, no other mid-infrared spectrum at medium-to-high spectral resolution has been published, partly because of the scarcity of mid-infrared AO-assisted spectrographs and the high telluric background in this region. The mid-infrared is yet a rich spectral window for exoplanetary atmospheres, for example to study cloud coverage and disequilibrium chemistry, or to distinguish between protoplanet atmospheres and dust shells. To remedy this situation, we are extending to the mid-infrared the breakthrough spectro-interferometric method developed with VLTI/GRAVITY in the near-infrared (GRAVITY Collaboration+ 2019). We employ a new observing strategy making use of the VLTI/MATISSE interferometer and its GRA4MAT narrow off-axis mode, which enables simultaneous science on a planet with MATISSE and fringe tracking on its host star with GRAVITY. This new mode greatly improves the sensitivity of MATISSE and brings exoplanets within reach. We present here our successful observation of β Pictoris b and the planet's first medium-resolution *LM*-band spectrum between 3 and 5 µm. We use the ForMoSA fitting tool (Petrus+ 2023) and ExoREM model spectra (Charnay+ 2018) to recover the planet's C/O ratio and metallicity, and we link them to planetary formation scenarios. We finally give an overview of future possibilities. Given its very high spatial resolution, MATISSE provides a great complementarity to the JWST for exoplanets at narrow separations (<0.4") that are too challenging to be spectrally characterized with NIRSpec. Its detection limits will further improve with the commissioning of the new adaptive optics system of the VLTI in summer 2024.