Towards real-time magnetospheric accretion monitoring with VLTI/GRAVITY+

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Abstract

Among the solar-mass Classical T Tauri Stars (CTTS), some are strong accretors (Macc _˜ a few 10ˆ-7 Msun/yr). These objects are still poorly understood (and studied). Yet they represent a unique opportunity to study and test the magnetospheric accretion phenomenon in a sustained regime (_˜100 times larger than in CTTS) along with every accretion-related phenomena from the inner disc (stellar/disc wind, jet launching, etc...). Following the successful example of the CTTS DoAr44 (Bouvier et al. 2020a, b), we obtained unique results in the multi-technique observation of the strong accretor S CrA N that I will present in this communication. I will also show how they represent a first glance at the exciting perspectives brought by the upcoming VLTI/GRAVITY+.

The power of the multi-technique observation we led on S CrA N resides in the cross-constraints brought by two techniques.

With GRAVITY observations, we reveal the sublimation front of its dusty disk in the K-band continuum. We also probe the accretion flows at its natural scales by means of differential interferometric quantities obtained at a cadence of an hour timescale, with a precision of a few stellar radii. While such a temporal resolution is currently reachable for strong accretors only, it will be feasible for a sample of CTTS large enough to be statistically significant with GRAVITY+ and its sensitivity increase. This change of paradigm will enable the magnetospheric accretion phenomenon to be modeled and understood like never before.

With CFHT/ESPaDOnS observations, we study the topology of the magnetic field of S CrA N along with accretion-related emission lines. Such an optical spectro-polarimetric study gives unique insights on the high-energy processes linked to magnetospheric accretion/ejection. Among them, the accretion regime of the star (for instance) provides a mean of direct interpretation of the interferometric models. Combining GRAVITY+ with spectropolarimeters such as ESPaDOnS and SPIRou, the study of star-disk interactions could even extend to class I protostars.

GRAVITY+ will be a game changer for studying star-disk interactions in a more representative sample of CTTS with a unique temporal resolution. New targets could encompass class I sources that will be observed for the first time with near-infrared interferometry. If the study of strongly accreting CTTS – such as S CrA N – gives some hints of what an embedded, strongly accreting source may look like, reaching new sensitivity limits might open new exciting perspectives.

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