ACCRETION IN YOUNG STARS: MEASURE OF THE STREAM VELOCITY OF TW HYA FROM THE X-RAY DOPPLER SHIFT
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CONCLUSIONS AND FUTURE PERSPECTIVES WITH ATHENA
8. THE ACCRETION ONTO TW HYA
We have measured for the first time the radial velocity of the X-ray emitting plasma in a CTTS. In particular we have found that the plasma at a few MK on TW Hya is redshifted of 36.5 ± 4.7 km s⁻¹ with respect to the stellar photosphere. We can deduce that:
- soft X-rays in CTTS are indeed produced in the post shock region;
- for TW Hya X-ray and UV lines (in particular the narrow component of the C IV line, Ardila et al. 2013) provide evidence that the plasma components at 10⁹ K and that at 10⁸ K are located in the same structure, i.e. the post-shock region at the base of the accretion stream;
- the post-shock plasma has a velocity vₚₛ = 100 km s⁻¹ minimum value of vₛ is needed to have a post shock hot enough to radiate in X-rays, Sacco et al. 2010), then, since TW Hya is observed from the pole, an observed radial velocity for the post shock of + 35 km s⁻¹ indicates that the base of the accretion stream is located at low latitudes on the stellar surface.

9. ACCRETION IN YOUNG STARS WITH ATHENA
The extremely large effective area of ATHENA/XR, with respect to the Chandra and XMM gratings, together with a spectral resolution of 1.5 eV in the soft X-ray band, will allow:
- enormously increase the number of CTTs for which high resolution X-ray spectra can be gathered; up to now only a few CTTs have been investigated with high resolution X-ray spectroscopy, with ATHENA it will be possible to investigate accreting stars at different ages, different accretion rates, different accretion geometries;
- investigate accretion on very short time scales, i.e. down to 1 ks; up to now CTTs X-ray spectra are integrated over exposures of >100 ks, while instead monitoring in other wavelength bands have proved that accretion varies on significantly shorter time scales.
One of the goals for the X-IFU instrument is the measurement of bulk velocities, reaching >20 km s⁻¹ as the minimum error from each individual spectral line. This resolution will allow to:
- measure the radial velocity of the post-shock plasma for several CTTs, exploring inclination and rotationally modulated variations of vₛ. Up to now TW Hya is the only CTTs for which the radial velocity measurements in X-rays is possible.