UV variability and accretion in PMS stars in NGC 2264

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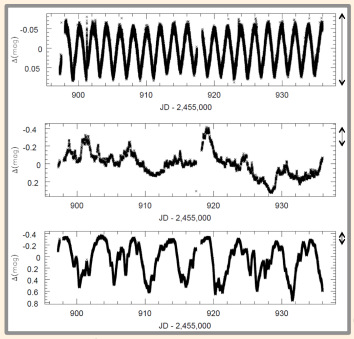
The diversity in young stellar objects variability



spot modulation

(+)

accretion bursts

(+)

disk occultation

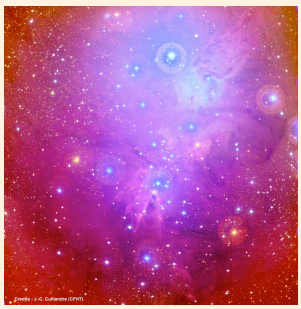
(+ flares, geometric effects etc.)

CoRoT light curves for three young stellar objects in NGC 2264, each representative of a well defined class of variables. The double arrow marks in each case a variation of 0.2 magnitudes.

⇨ need to **explore time & wavelength domains** to fully understand and characterize YSO variability

The ***Coordinated Synoptic Investigation of NGC* 2264** project (Dec. 2011 – Feb. 2012; P.I. = J. R. Stauffer and G. Micela): Spitzer+CoRoT+Chandra+MOST+**CFHT**+VLT/Flames and additional ground observations for *simultaneous X-ray-to-IR* monitoring of YSO variability on *hour-to-week* timescales (Cody et al. 2013).

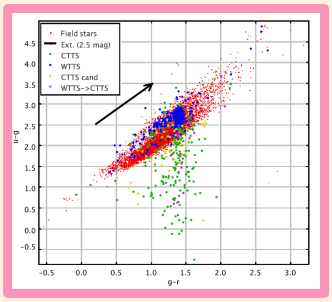
CSI 2264: the CFHT/MegaCam survey of NGC 2264



CFHT/MegaCam *ugr* image of NGC 2264 (distance: 800 pc; age: 3 Myr)

- u,g,r,i deep mapping (1 sq. degree FOV)
  +
- u-band and r-band monitoring (2 weeks)

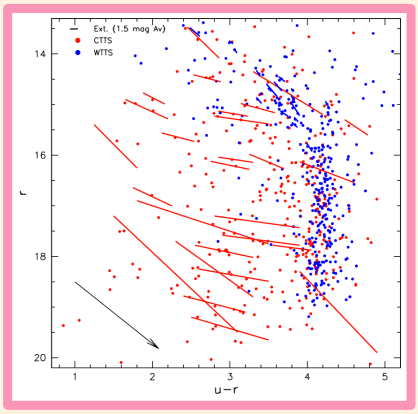
Complete UV/optical photometry + variability monitoring for **>700 known members** + **50 new CFHT candidates**



g-r vs. u-g color distribution for NGC 2264 members and field stars. Many accreting stars are clearly identified based on the color excess displayed, linked with the UV emission from the accretion shock.

Goal: ***probing accretion and its variability across the region from the direct UV excess diagnostics and u-band variability monitoring***

UV excess and mid-term variability of CTTS and WTTS

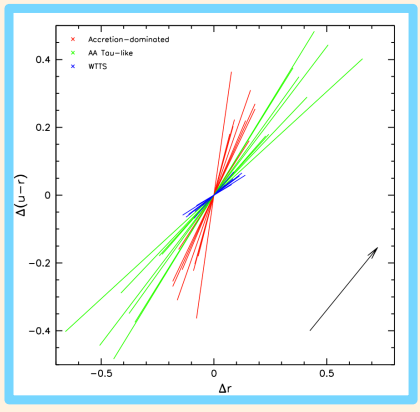


Variability bars obtained as linear fits to correlated r vs. u-r variations are shown for representative CTTS/WTTS, on top of the average photometry for the whole PMS population (with WTTS tracing the sequence of reference colors).

CTTS display significantly larger variability than WTTS and show in many cases a (variable) UV excess.

The **different slopes** of **variability bars** are indicative of **different dominant processes**.

Color behavior: clues on the nature of YSO variability

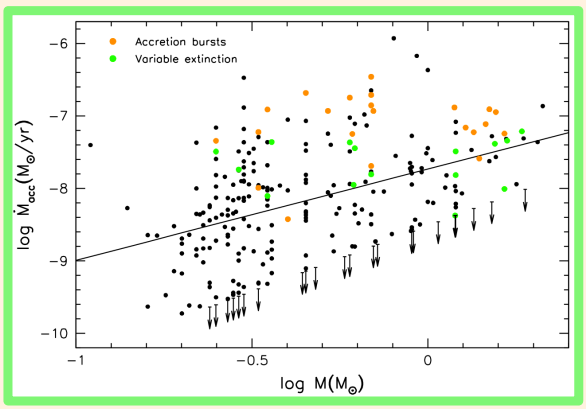


Amplitudes and slopes of linear fits to the color-mag variations are compared for representatives of:

- **WTTS** (blue lines);
- **CTTS dominated by accretion** bursts (red lines);
- **CTTS dominated by disk occultation** (green lines).

Cold spots, hot spots and variable extinction produce well distinct photometric behaviors in the u-band + r-band.

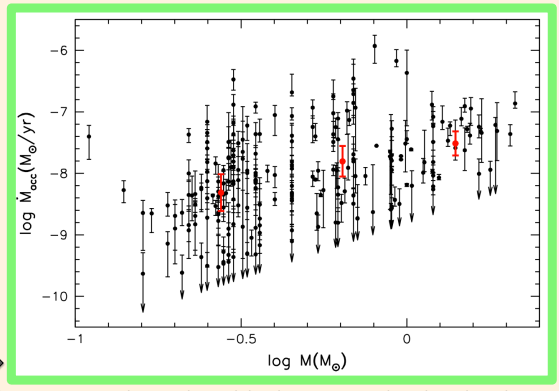
Accretion in NGC 2264



The mass accretion rate is obtained from the UV excess measured on g-r vs. u-g and dereddened u-r vs. r diagrams. The u-band excess luminosity is converted into total L_{acc} according to the prescription $\mathbf{\log(L_{acc}/L_{Sun}) = 0.95 \log(L_{u\_exc}/L_{Sun}) + 1.06}$ (Venuti et al., in prep.)

Variability bars (accounting for intrinsic variability + geometric effects during stellar rotational cycle) are associated to the M_{acc} estimates for each object by computing UV excess and mass accretion rate from each observing epoch during the 2 week long CFHT monitoring.

Different accretion regimes?



The mean M_{acc} values and variability bars computed in three broad mass intervals (< 0.4 M_{sun}; 0.4 - 1 M_{sun}; > 1 M_{sun}) are depicted in red. The observed spread in M_{acc} values in each mass bin is significantly larger than what can be accounted for by M_{acc} variability on week timescales.

On average, $\mathbf{M_{acc} \propto M^{1.25}}$; a **large scatter** (2-3 orders of magnitude) in the M_{acc} values is observed **at each mass**.
M_{acc} variability on a timescale of weeks cannot explain the observed spread.