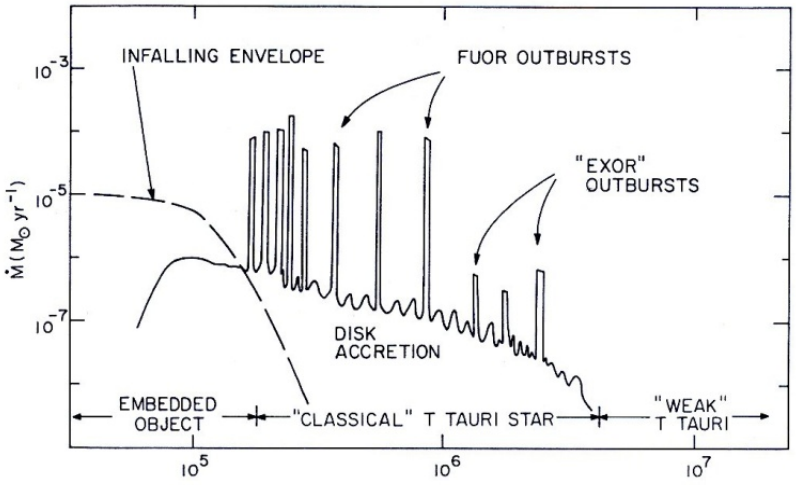
A new vision of the star formation process

G1. Episodic accretion from circumstellar disk



Hartmann 1998

- Outburst strength : FUors: 4-6 mag, EXors: 2-4 mag in V (more in U/B)
- Outburst duration: FUors ≥ 10-100 yr, EXors: months, years
- Mass accretion rate : FUors : 10^{-6}-10^{-4} $M_\odot yr^{-1}$, EXors: 10^{-7}-10^{-5} $M_\odot yr^{-1}$

⇒ EXors suitable for effective monitoring (wrt human life)

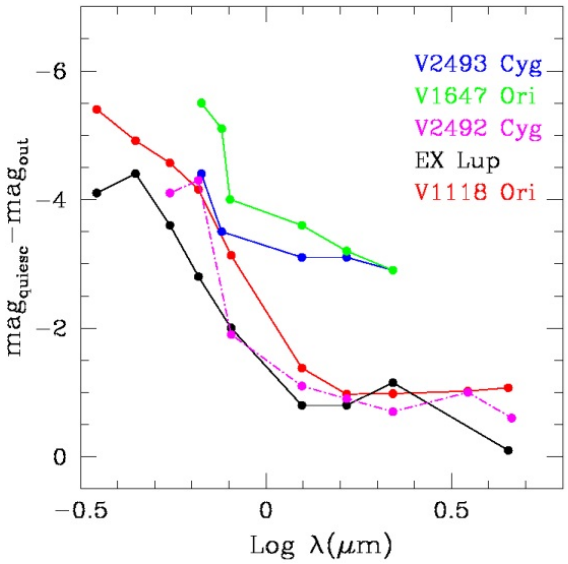
…. but so-far only about 50 FUor/EXor known !!!

Main objectives :

1. **Investigate episodic accretion on statistical basis**
2. **Explore protostars in different evolutionary phases**
3. **Derive observational clues to models for burst triggering and evolution.**

LSST ideally suited because of:

- Frequency of monitoring
- Filters (major variations at shorter wavelengths)
- Large FoV (statistics)
- Sensitivity



A new vision of the star formation process

G2. Pre-main-sequence star populations across the Galactic Plane

Main objectives :

1. Stellar census of star-forming regions over entire mass spectrum
2. Star formation history: coeval versus sequential/triggered formation
3. Initial Mass Function
4. Star cluster dynamical evolution, dispersed PMS populations in the Galactic Plane
5. Accretion in PMS stars from near-UV variability and excess emission

Synergies between G1 and G2

G1 : erupting variables in clusters → G2: associated with PMS clusters ?
G2 : spatial identification of SFR → G1: identification of candidates among other variables
G1+G2 : use of common tools (e.g. magnitudes, colors, association with known objects)
G1+G2 : band u as a proxy for accretion
G2 : X-rays expertise → G1: tools to separate accretion from chromosphere

Connection with other *facilities*

G1.Episodic accretion

1) Preparatory work : monitoring of SFR to test tools for LSST analysis (CI, Asiago)
2) LSST will be used in synergy with:
   - ESO facilities for spectroscopical follow-up (X-shooter, SOXS, MOONS, JWST)
   - VVV, ESO archive, WISE for IR counterparts

G2.Pre-main sequence stellar populations across the Galactic Plane

1) Gaia (astrometry)
2) VPHAS+, UKIDSS, VVV (bright stars, NIR counterparts)
3) X-ray catalogs from deep Chandra/XMM observations
4) Optical spectroscopy (Gaia, X-shooter, ESO archive, VLT FLAMES +4MOST, WEAVE)

Participants and individual interests/responsibilities

G1.Episodic accretion

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EXPERIENCE:

1) Optical/IR monitoring of EXor (EXORCISM) . Facilities: LBT, X-shooter, GIANO, CI, Asiago
2) Line excitation models
3) Accretion models
4) Ejection phenomena (winds/jets)

G2.Pre-main sequence stellar populations across the Galactic Plane

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EXPERIENCE:

1) Optical, UV and NIR photometry (single-shot and monitoring for variability)
2) X-Rays (Chandra & XMM-Newton: imaging, spectroscopy)
3) Optical spectroscopy (FLAMES, X-shooter, VIMOS at VLT)
4) Accretion/outflows models in PMS stars

Data analysis and timeline

G1.Episodic accretion

1) **Preparatory work (2017-2019) :**

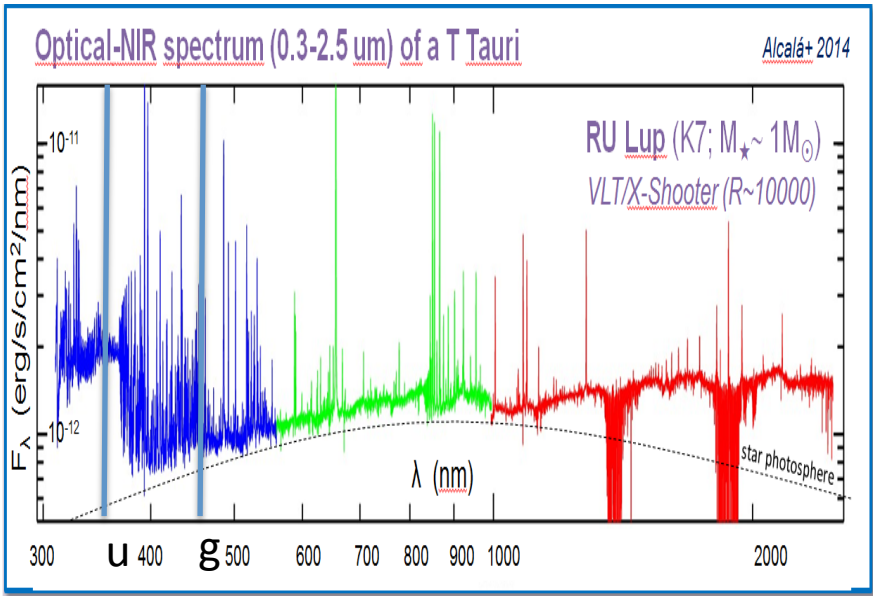
→ preparation of tools (X-shooter experience based) to define the candidates; monitoring of selected regions (CI, Asiago)

2) With the single visit data :

→ spatial and color-color selection of the candidates, photometric analysis , spectroscopic follow-up

3) **At the end of the mission:**

→ light-curves, final catalog, statistics



G2.Pre-main sequence stellar populations across the Galactic Plane

1) Preparatory work (2017-2019):

→ tests on PMS selection from color-color diagram in VPHAS/UKIDDS

2) With the single visit data :

→ selection of star-forming complexes between 500-2000 pc
→ Spatial and color-color selection to obtain M-type candidate members
→ Within Gaia (V up to 21.5) → SFR mean proper motion
→ Complete member list, using VPHAS+Gaia photometry, proper motion and distances
→ Use of NIR surveys for counterparts in most obscured region

3) At the end of the mission:

→ study of more distant/absorbed regions (2000-8000 pc) down to r<27