Image: Kwon O Chul

YOUNG STAR SCIENCE WITH SKYMAPPER

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BACK TO THE FUTURE...

November 2007

Ph.D. Thesis Proposal

Towards a complete census of young stars in the solar neighbourhood with SkyMapper

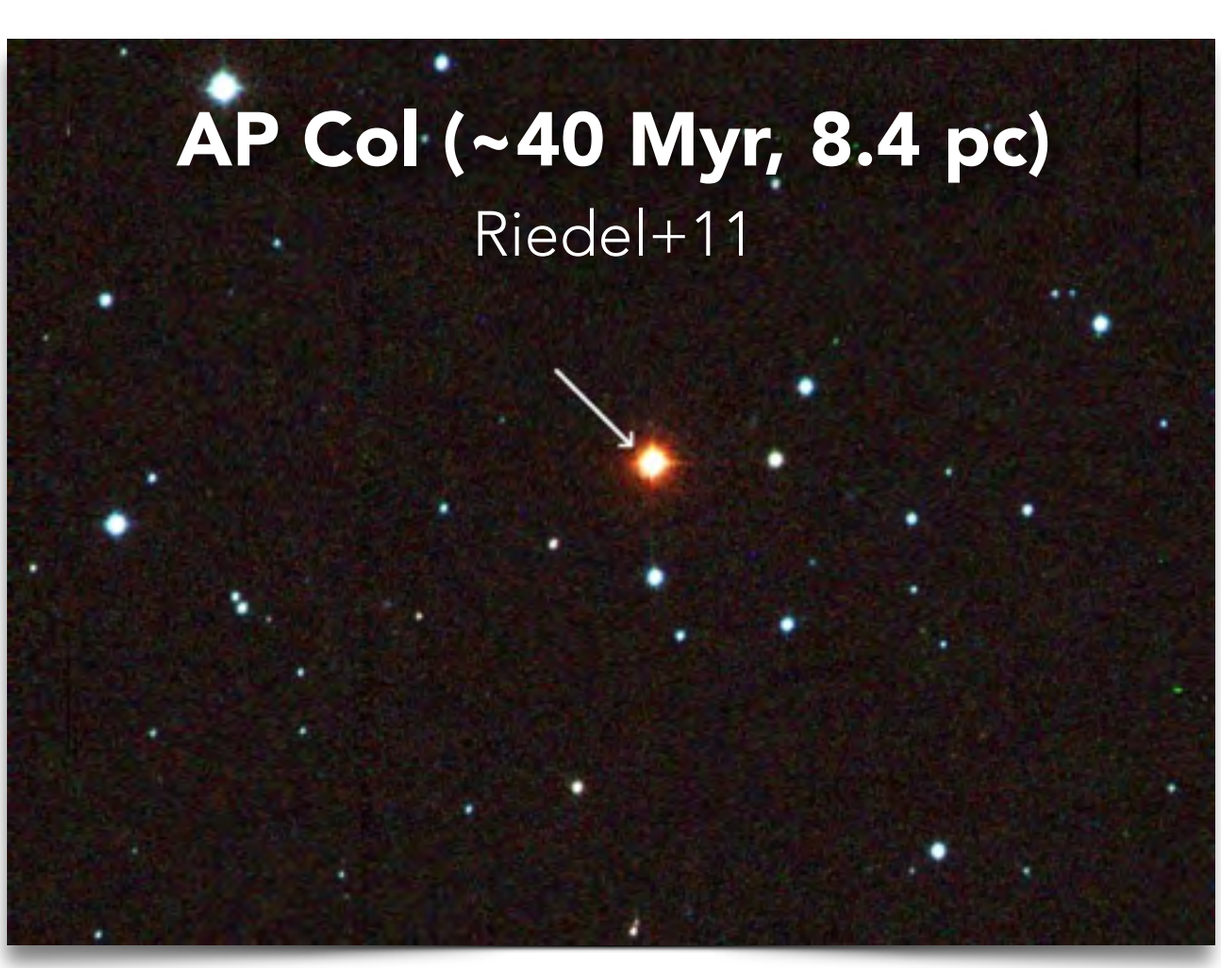
Simon J. Murphy, RSAA

Supervisor
Prof. Michael Bessell, RSAA

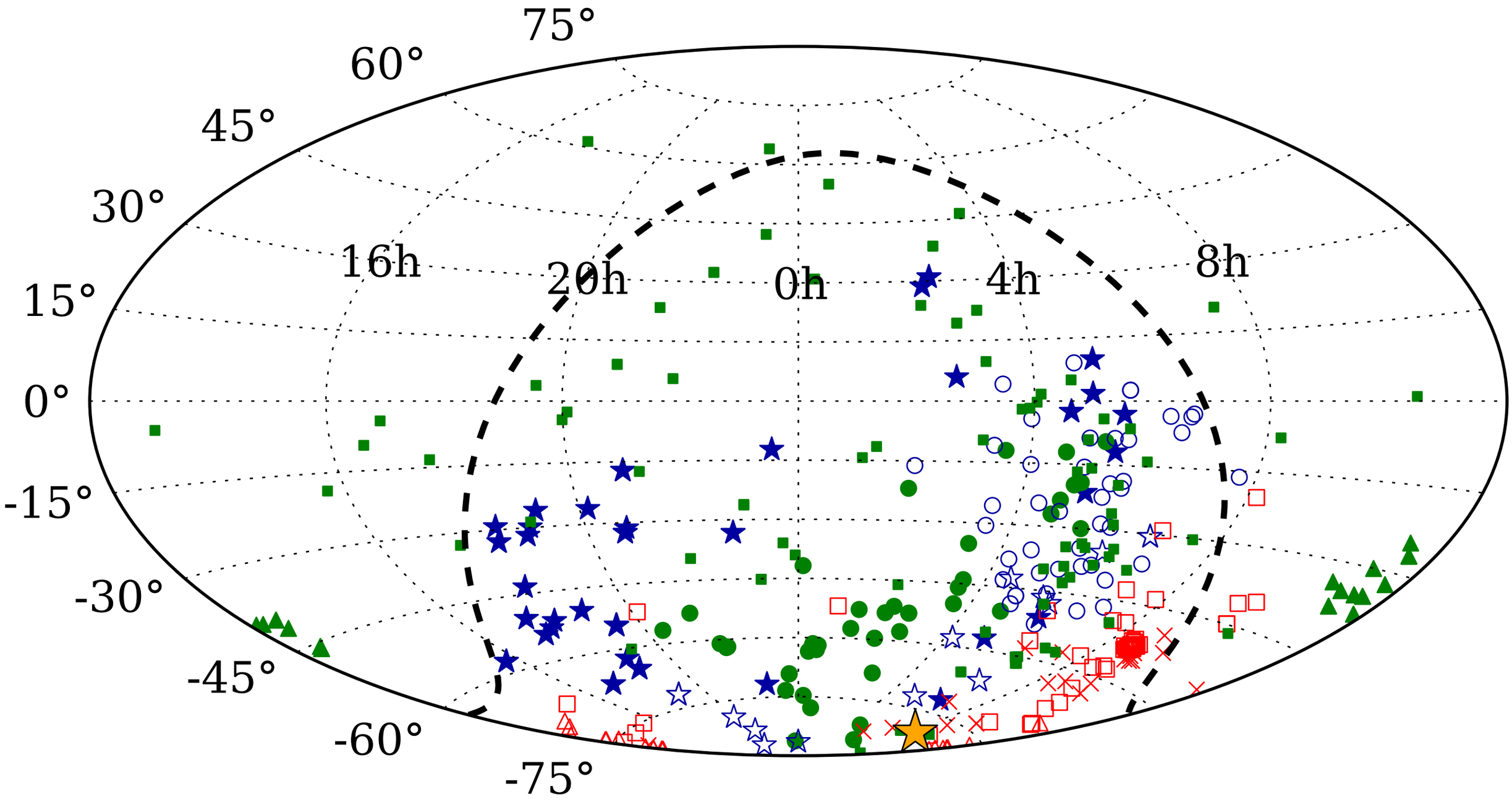
Supervisory panel
Dr. Stefan Keller, RSAA
Dr. Agris Kalnajs, RSAA
Assoc. Prof. Warrick Lawson, UNSW@ADFA
Dr. Inseok Song, IPAC, Caltech
Prof. Ben Zuckerman, UCLA

IDENTIFYING YOUNG STARS

- Wide-field photometry
- Variability
- Astrometry
- **Hα photometry**



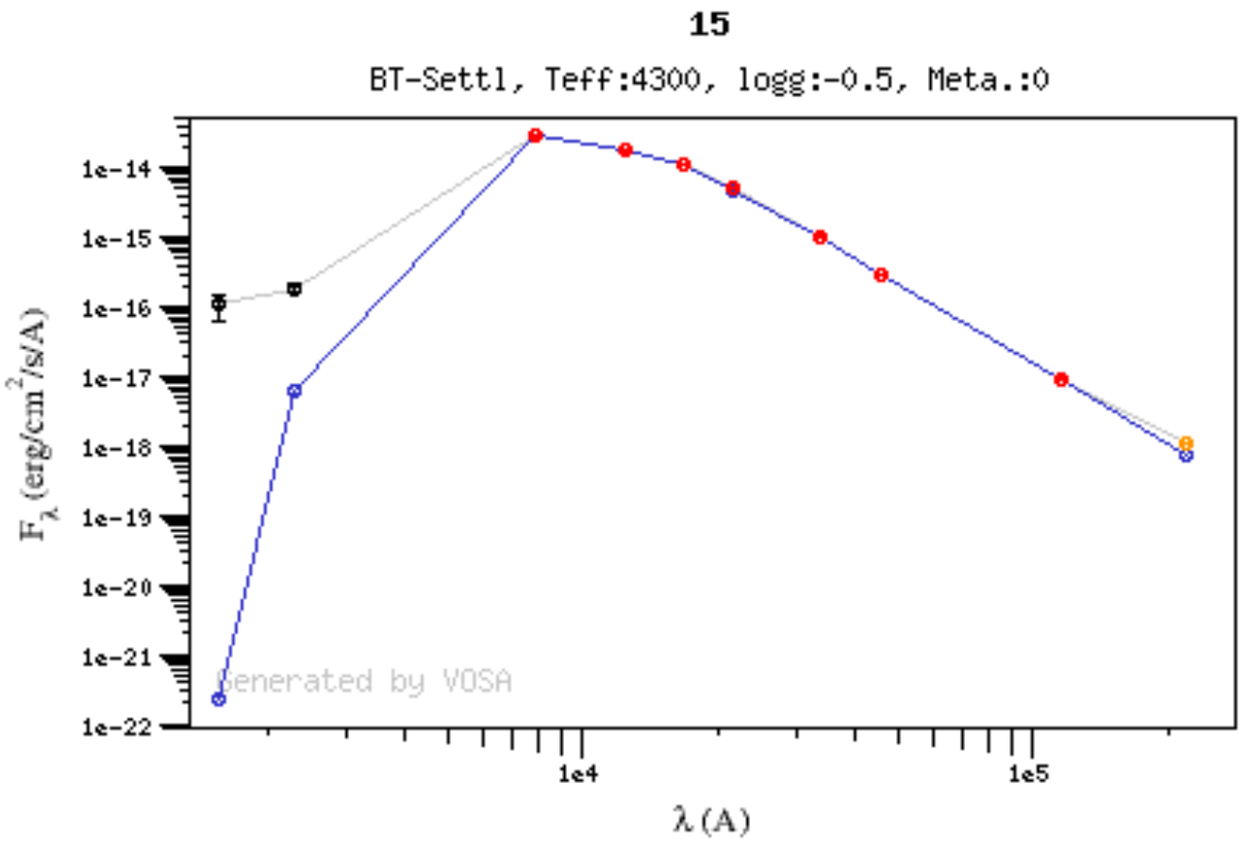
WIDE-FIELD PHOTOMETRY

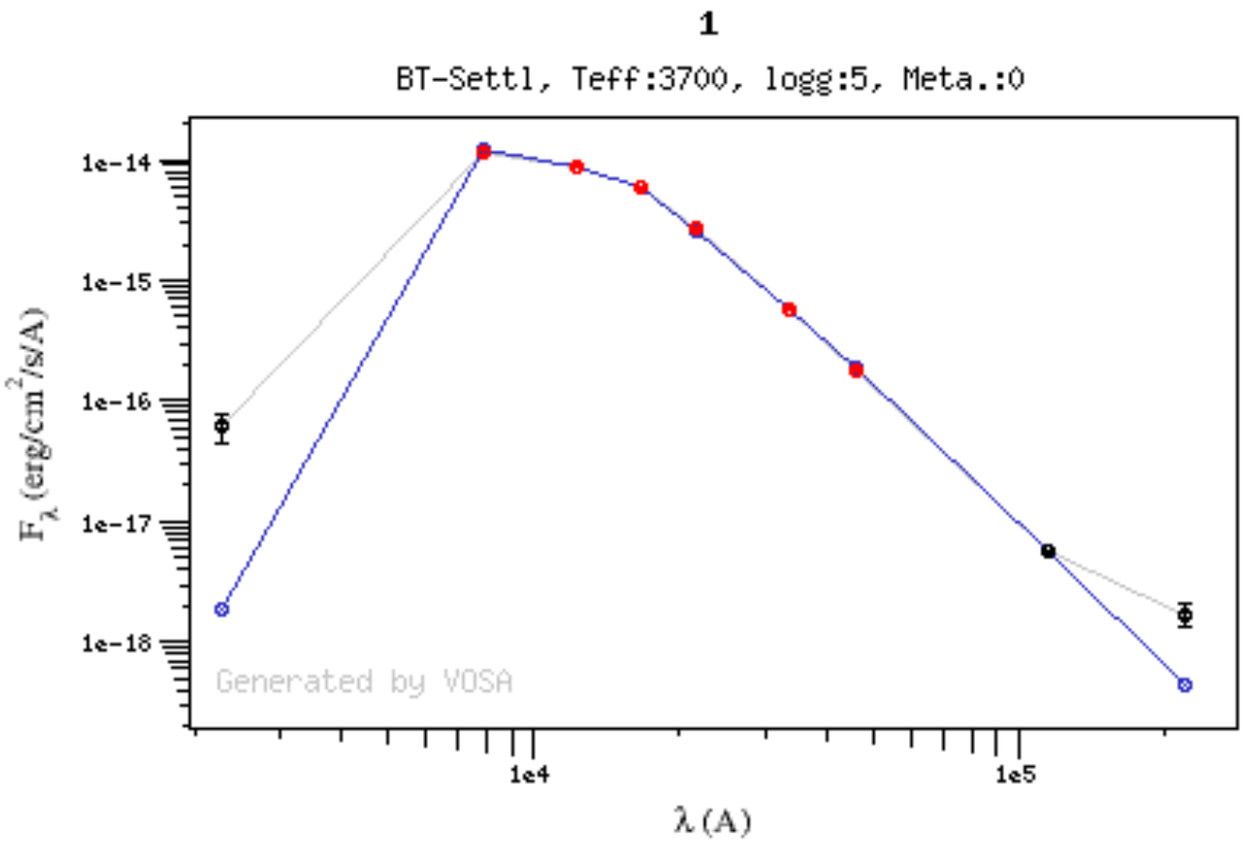


Torres+08 SACY sample

WIDE-FIELD PHOTOMETRY

- Combine with GALEX, 2MASS, VHS, WISE, AKARI,…
  - SEDs from 0.3 < **λ** <160 μm
  - Disks, extinctions, temperatures, gravities, Fe/H?

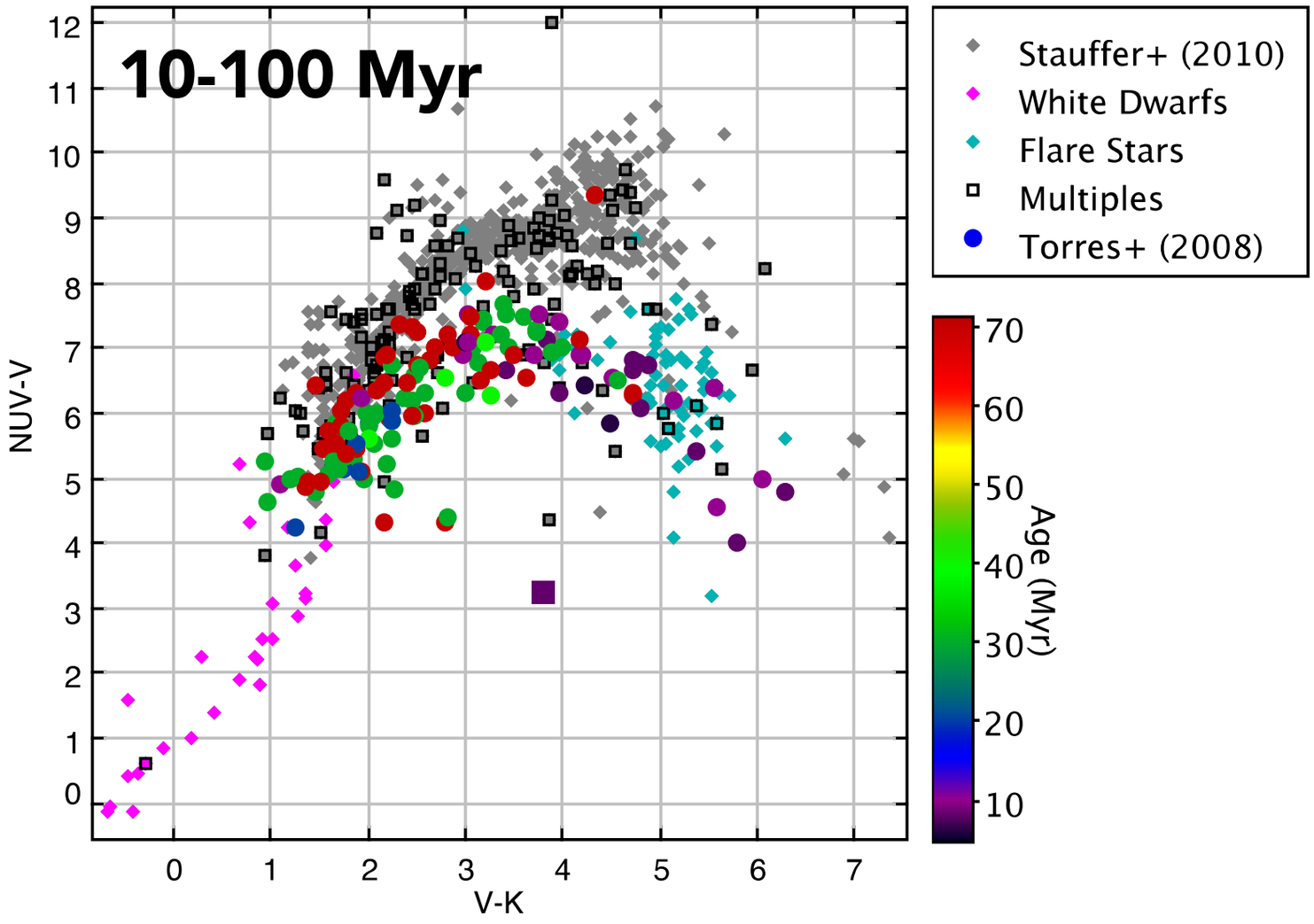




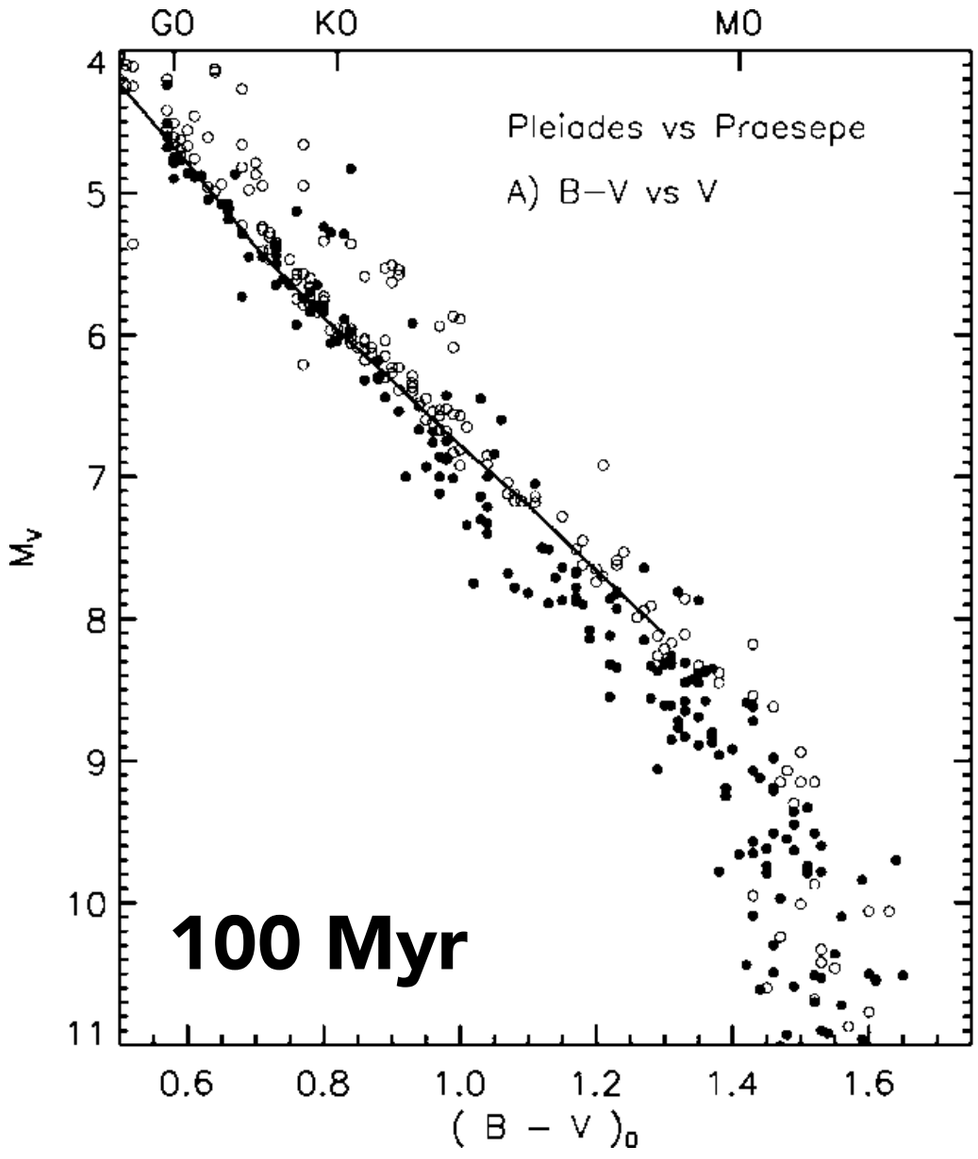
VO SED Analyser (VOSA, http://svo2.cab.inta-csic.es/theory/vosa/)

WIDE-FIELD PHOTOMETRY

- UV and blue excess emission (activity, spots, accretion)



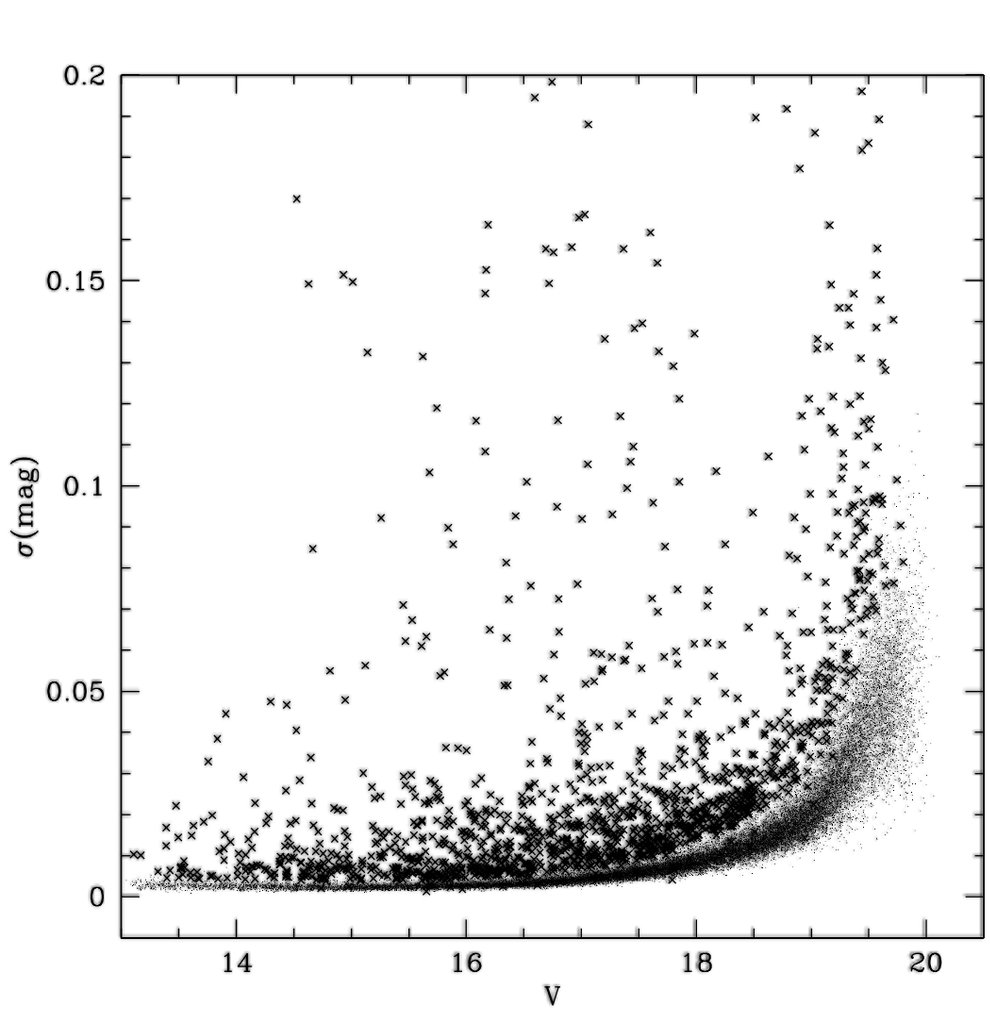
Rodriguez+11

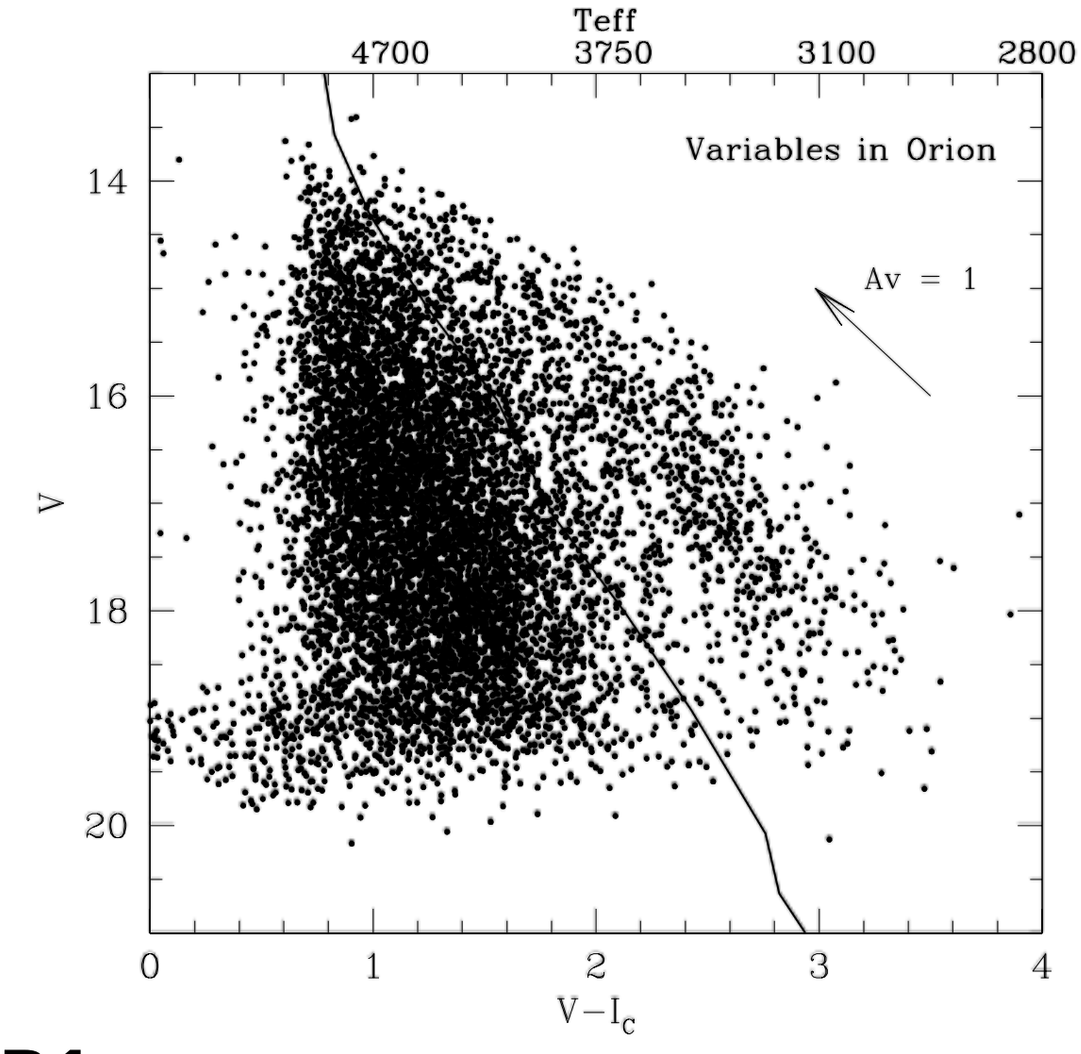


Stauffer+03

VARIABILITY

- Irregular (flares, accretion) and periodic (spots)
- Hour-week timescales - cadence problematic?

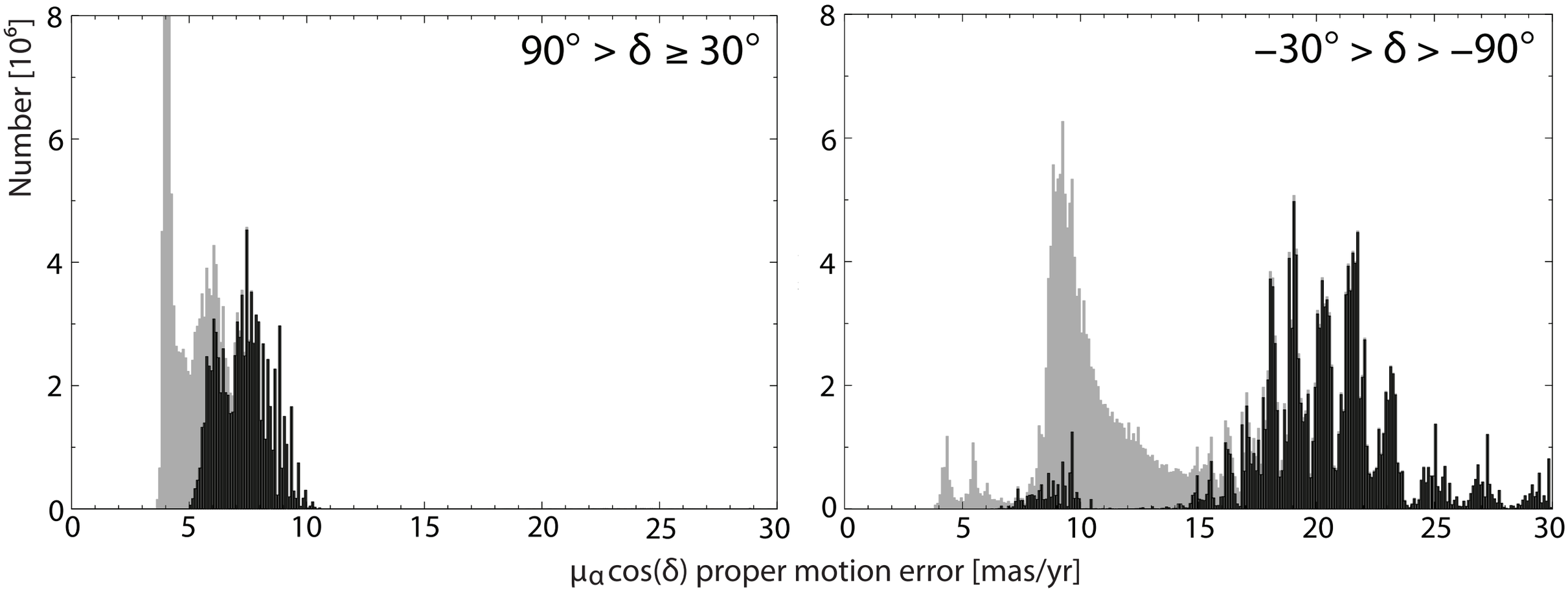




Orion OB1 (Briceño+05)

ASTROMETRY

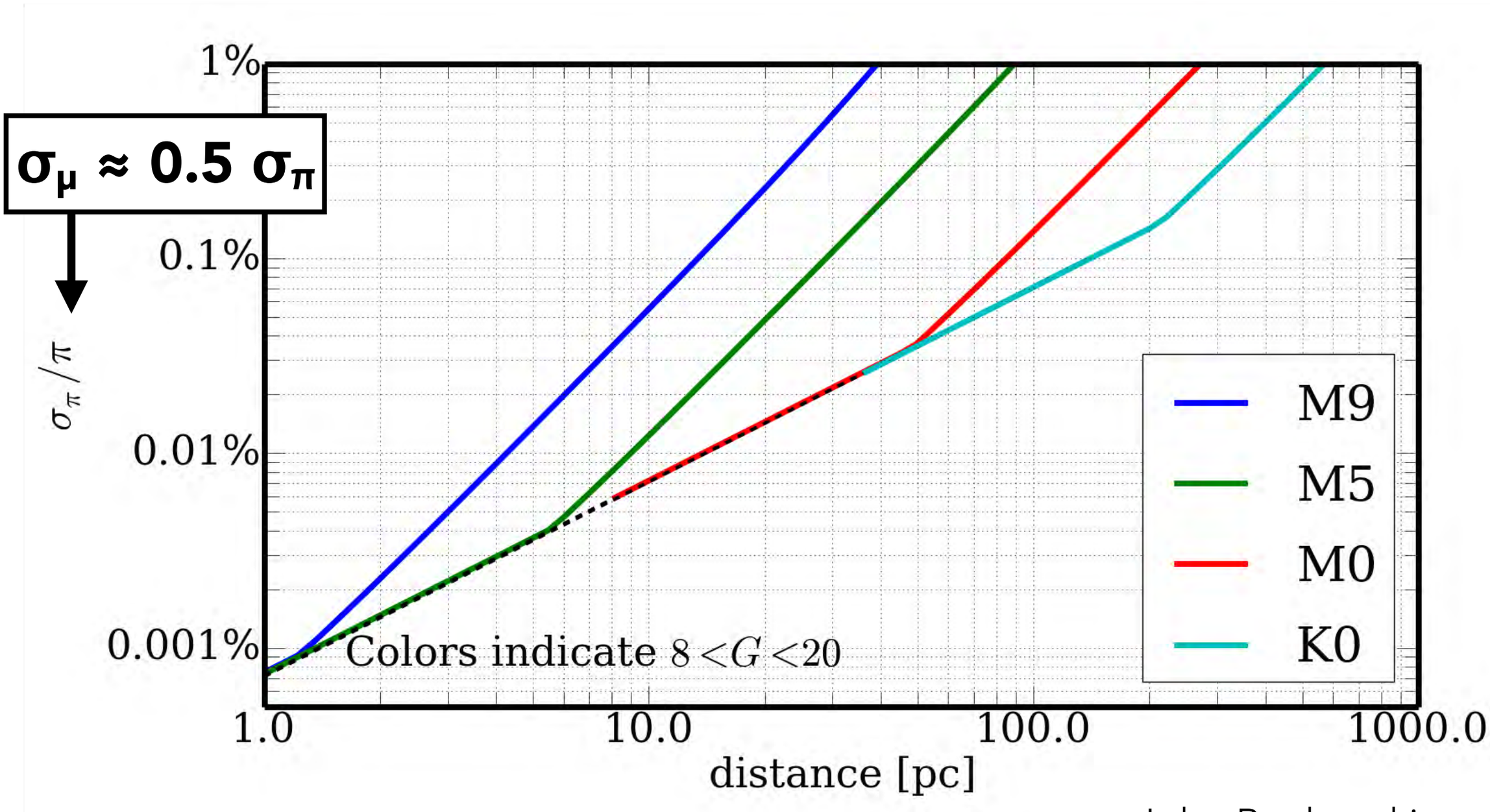
- Much room for improvement below $\delta < -30°$
- Original plan: 36 epochs/5 years → PMs to 2-4 mas/yr



PPMXL (Röser+10)

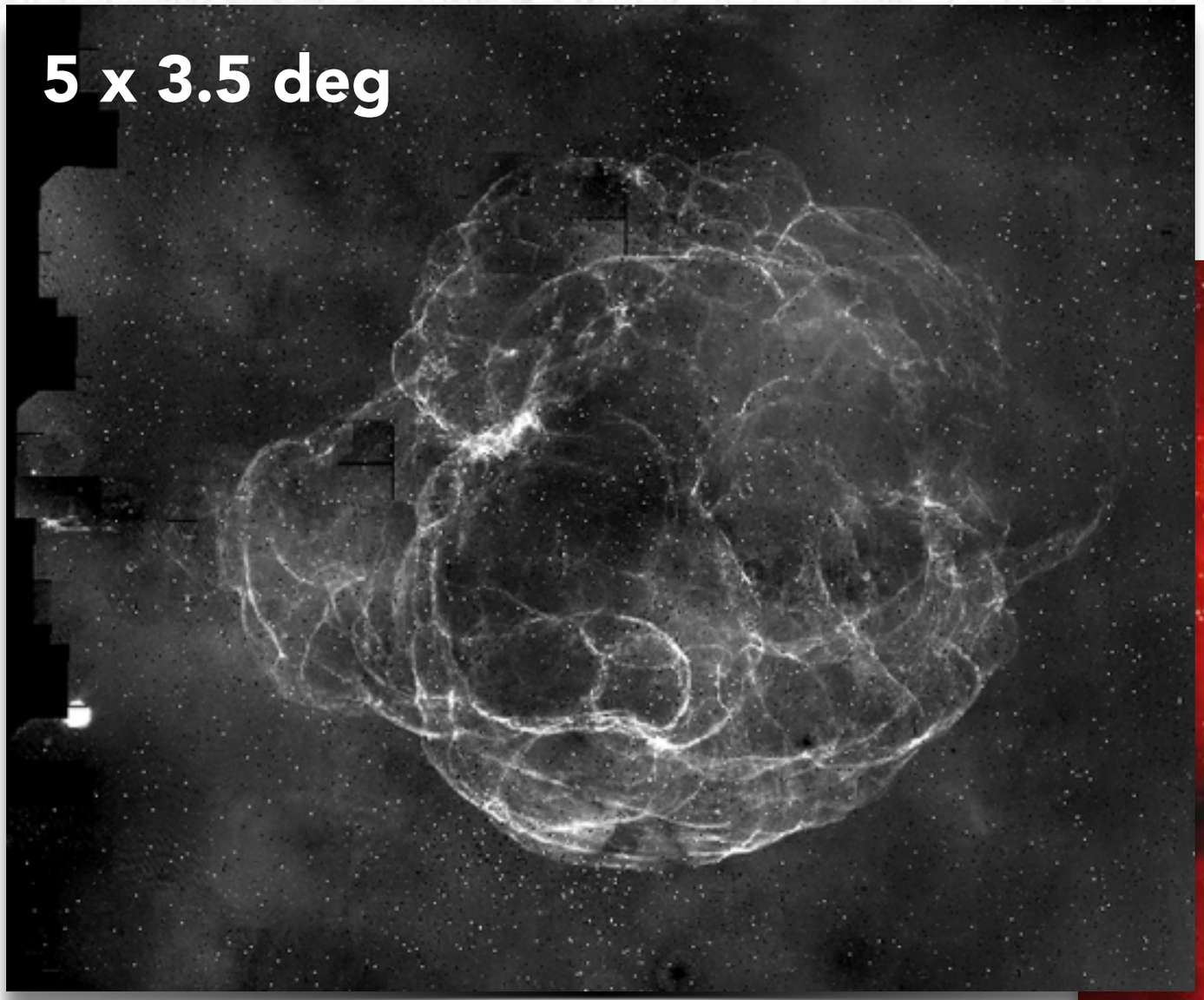
ASTROMETRY

- …but why compete with *Gaia*?



John Bochanski

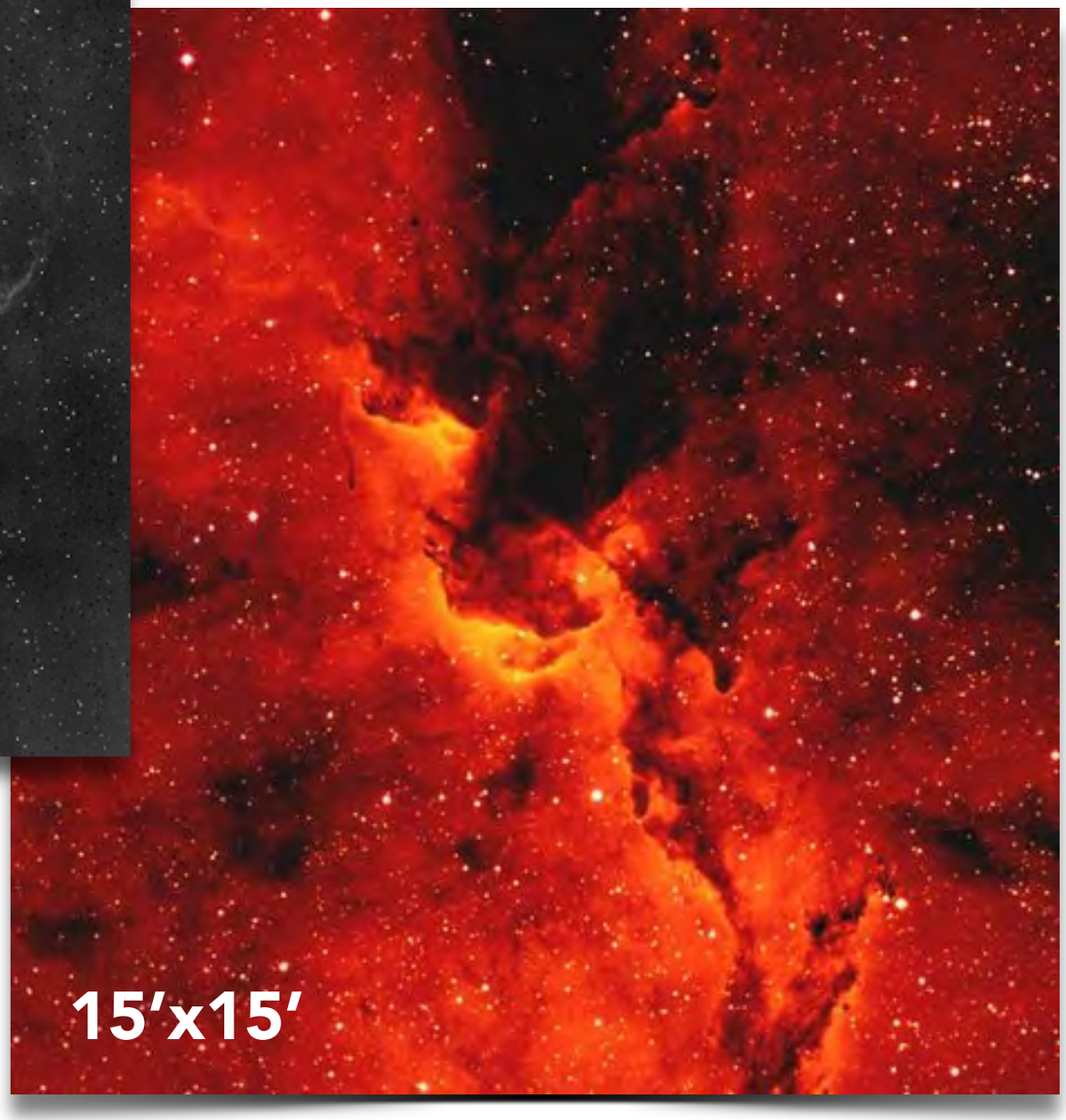
H-ALPHA PHOTOMETRY



SNe remnant S147 (A. Zijlstra & J. Irwin)

THE INT PHOTOMETRIC Hα SURVEY
IPHAS
OF THE NORTHERN GALACTIC PLANE

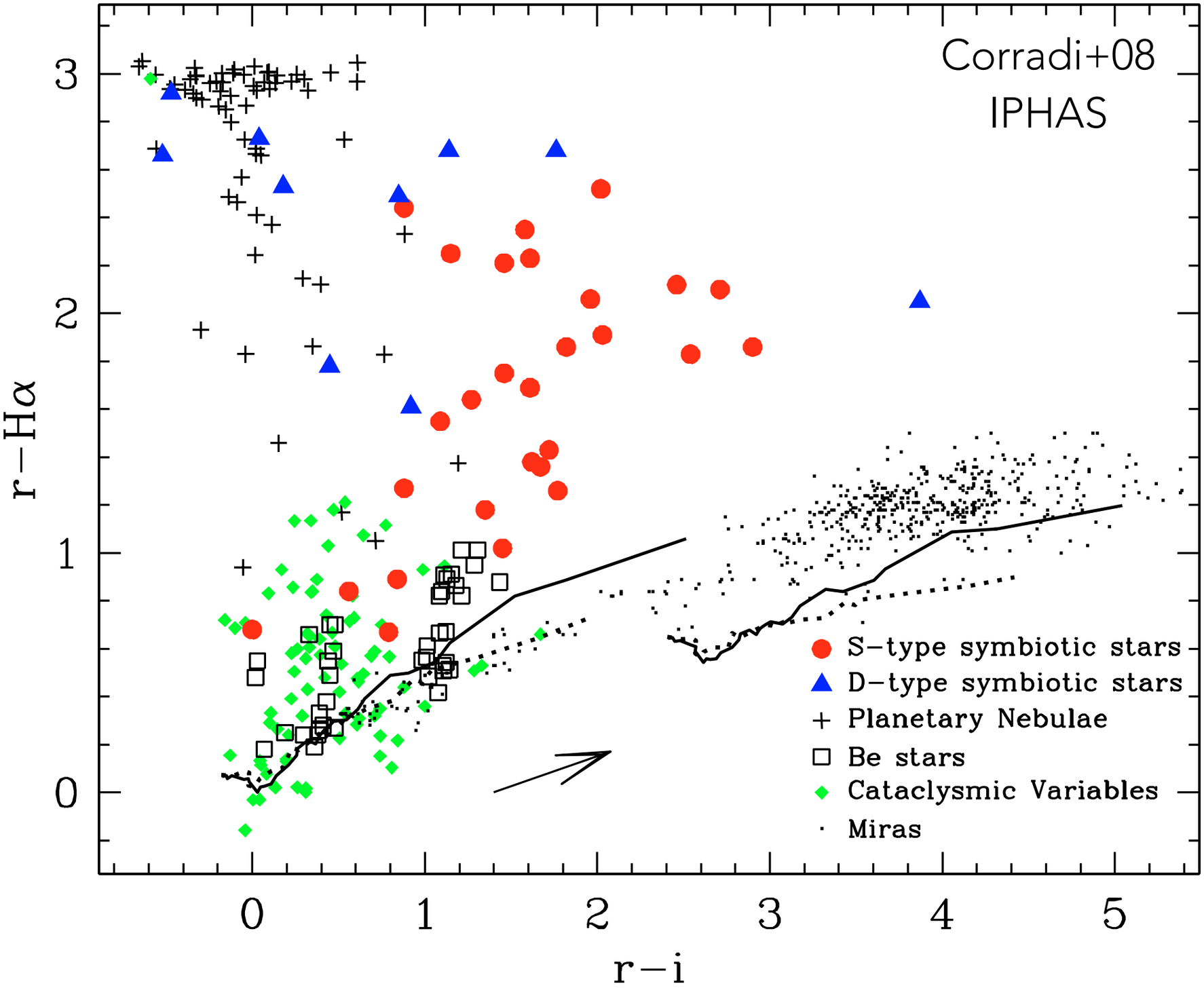
IC 1396B (Nick Wright)



H-ALPHA PHOTOMETRY

- Hα emission common in pre- and post-MS evolution:
  - **Accreting young stars (particularly M dwarfs)**
  - Unresolved PNe; post-AGB stars
  - Be stars (incl. **young Herbig Be)**
  - Interacting binaries (symbiotic, accreting systems)
  - H-rich white dwarfs
  - Near-MS A stars and M giants
- **Extragalactic studies (SFR etc…)**

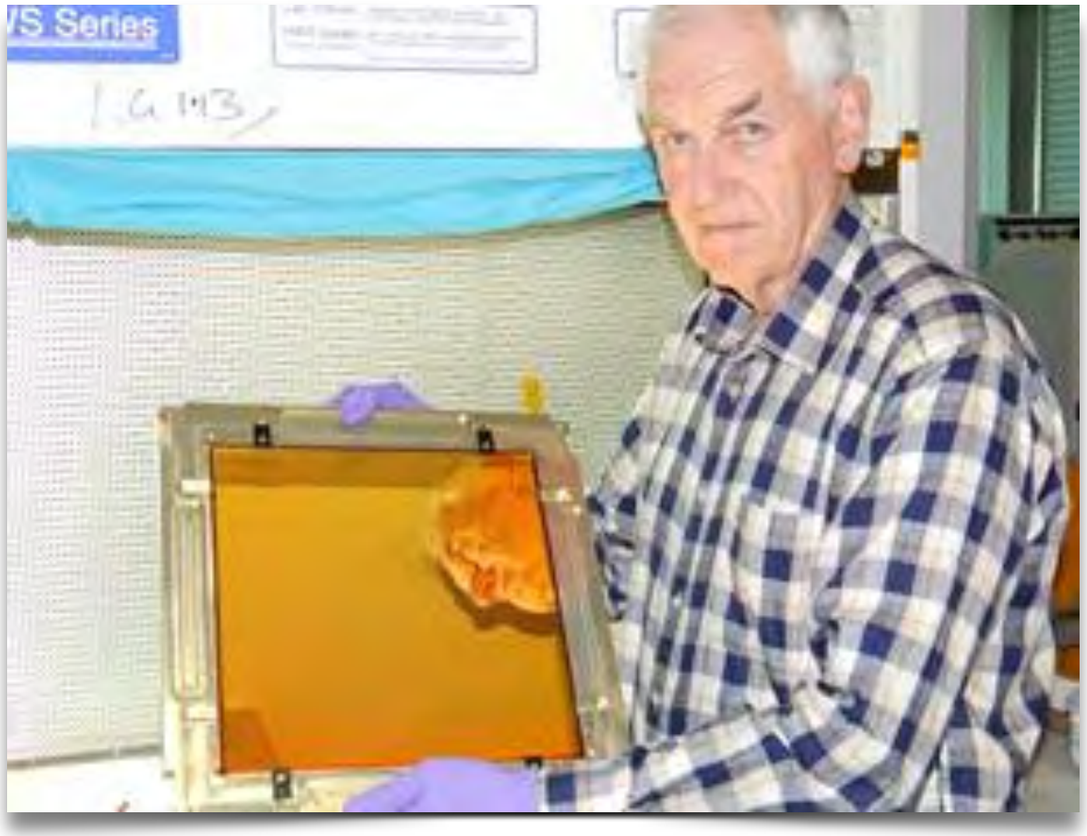
H-ALPHA PHOTOMETRY



H-ALPHA PHOTOMETRY

- 658 nm; 12 nm FWHM Hα filter from Materion (Barr)
- 93% transmission
- Worlds largest (309x309 mm) and most uniform
- Will be swapped with *u* filter in non-survey time

The happy father after a long and painful delivery

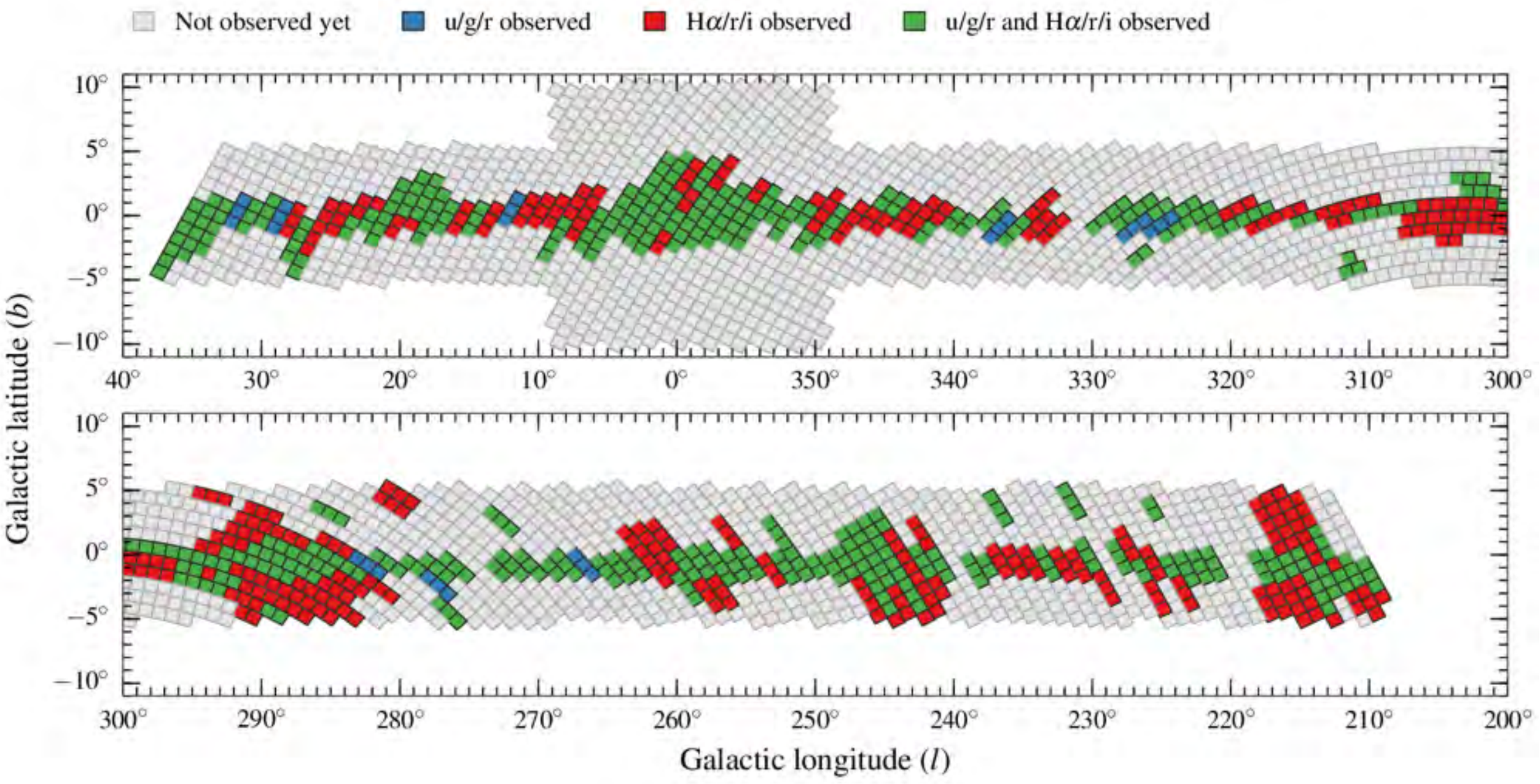


H-ALPHA PHOTOMETRY

- UKST SuperCosmos H**α** Survey (SHS, Parker+05)
  - 4000 deg^2 along southern Galactic plane, photographic; *R*=20.5
- VST Photometric H**α** Survey (VPHAS+, Drew+14)
  - 2000 deg^2 along northern Galactic plane (*b* +/- 5°) + bulge
  - VST/OmegaCam; *ugri+H***α** to 20th mag

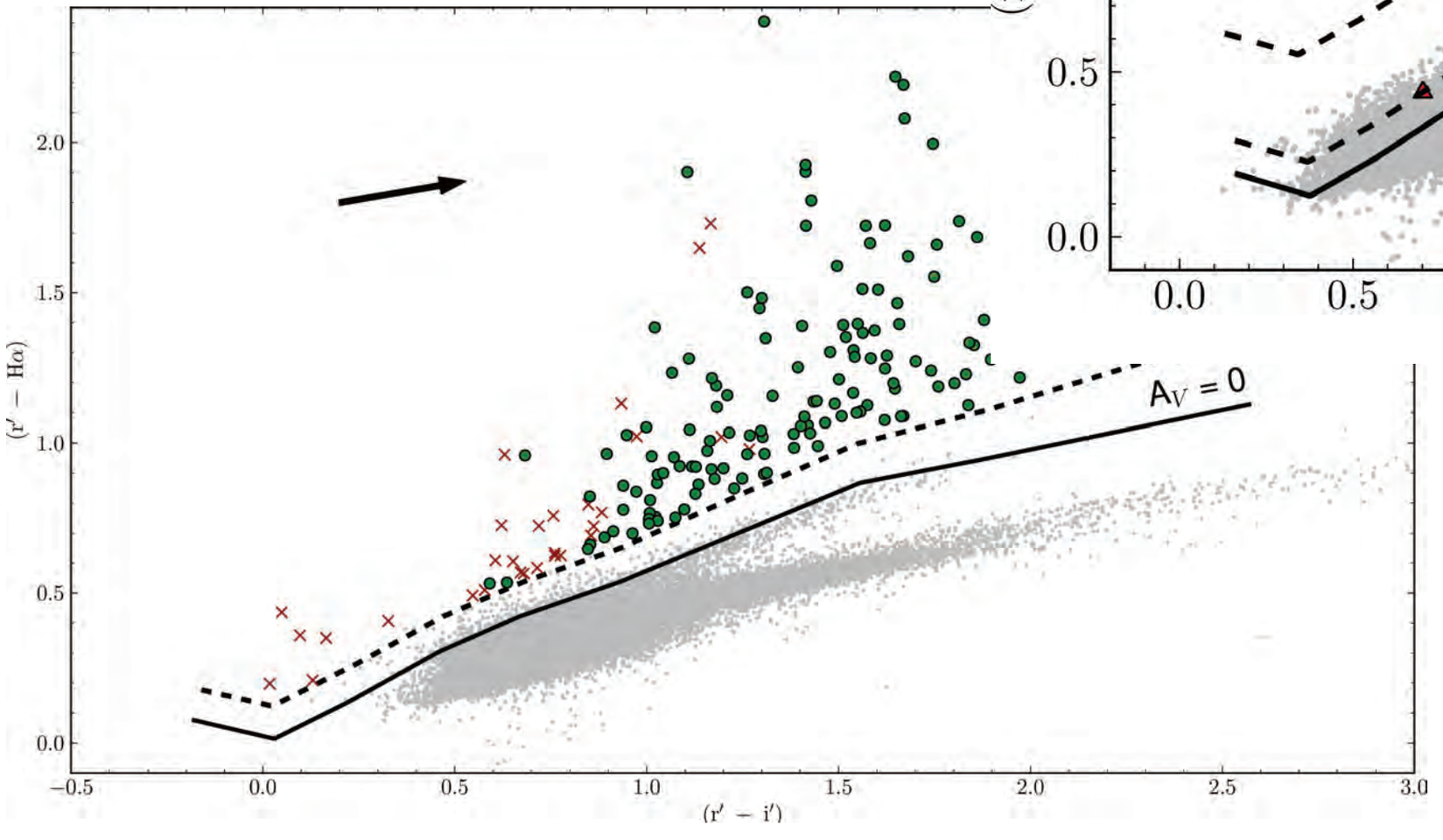
H-ALPHA PHOTOMETRY

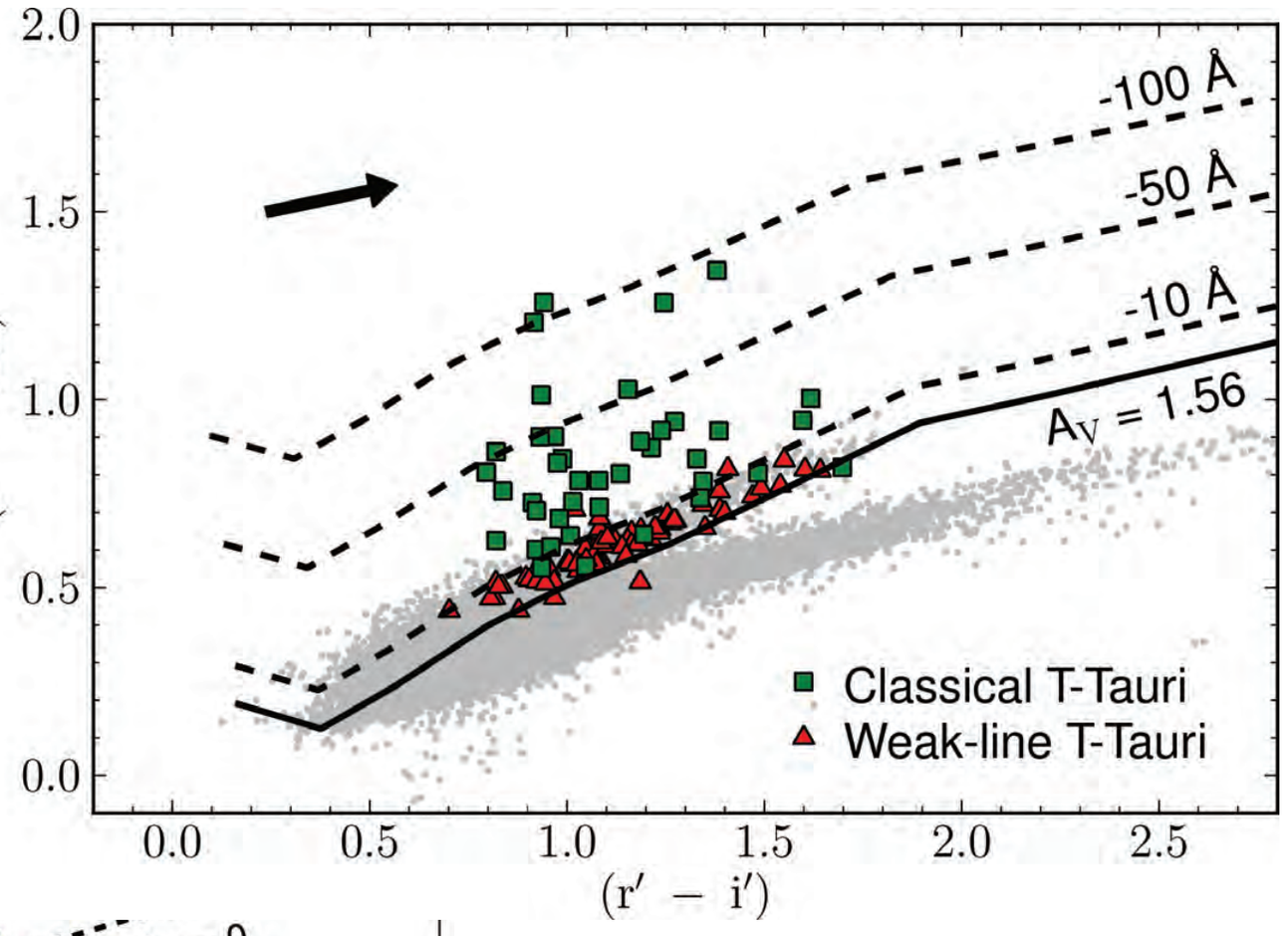
VPHAS+ at January 2014



H-ALPHA PHOTOMETRY

- Pull out excess sources
  - Photometric EWs
  - Mass accretion rates



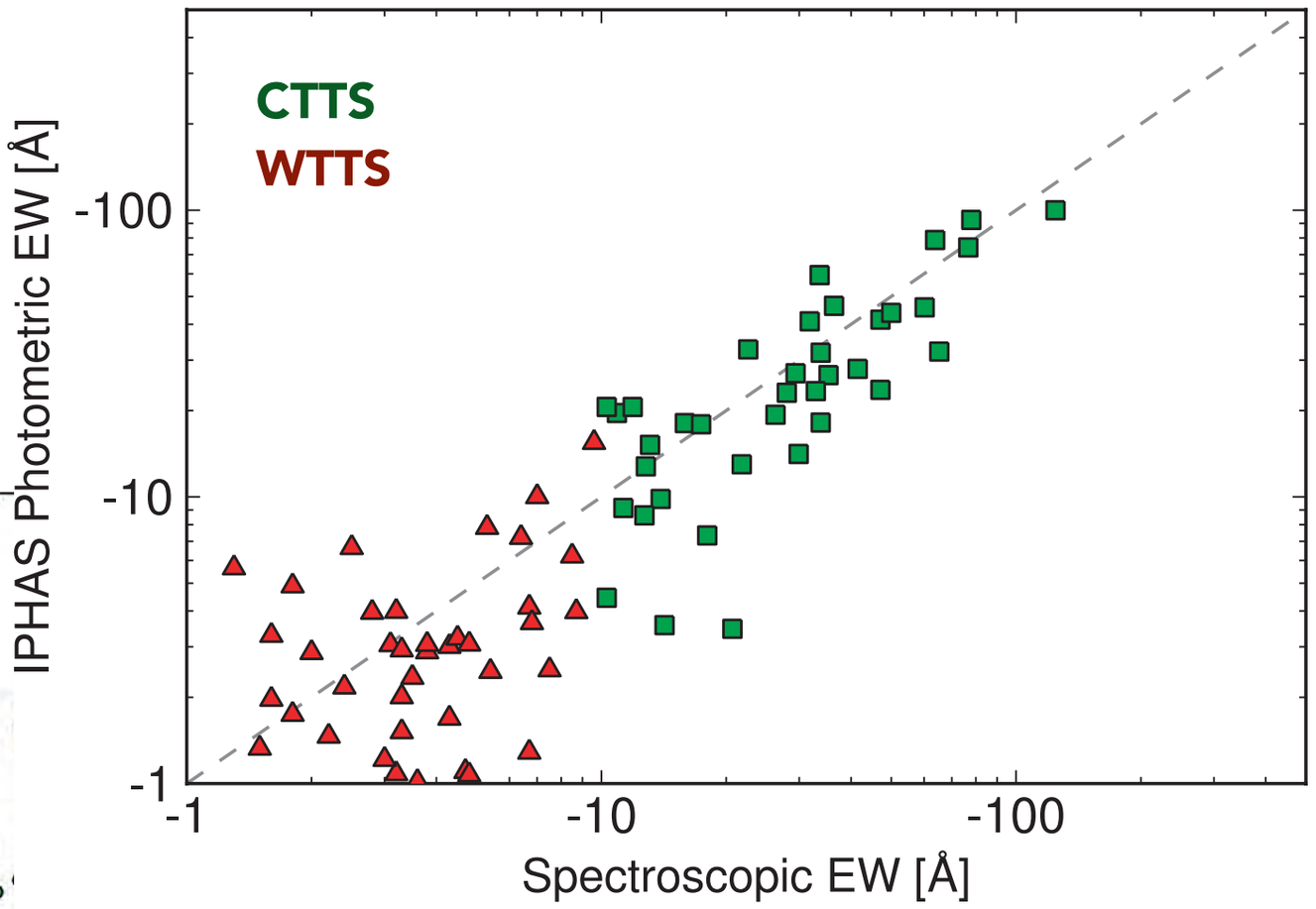


IC 1396 (~2 Myr)

Barentsen+11

H-ALPHA PHOTOMETRY

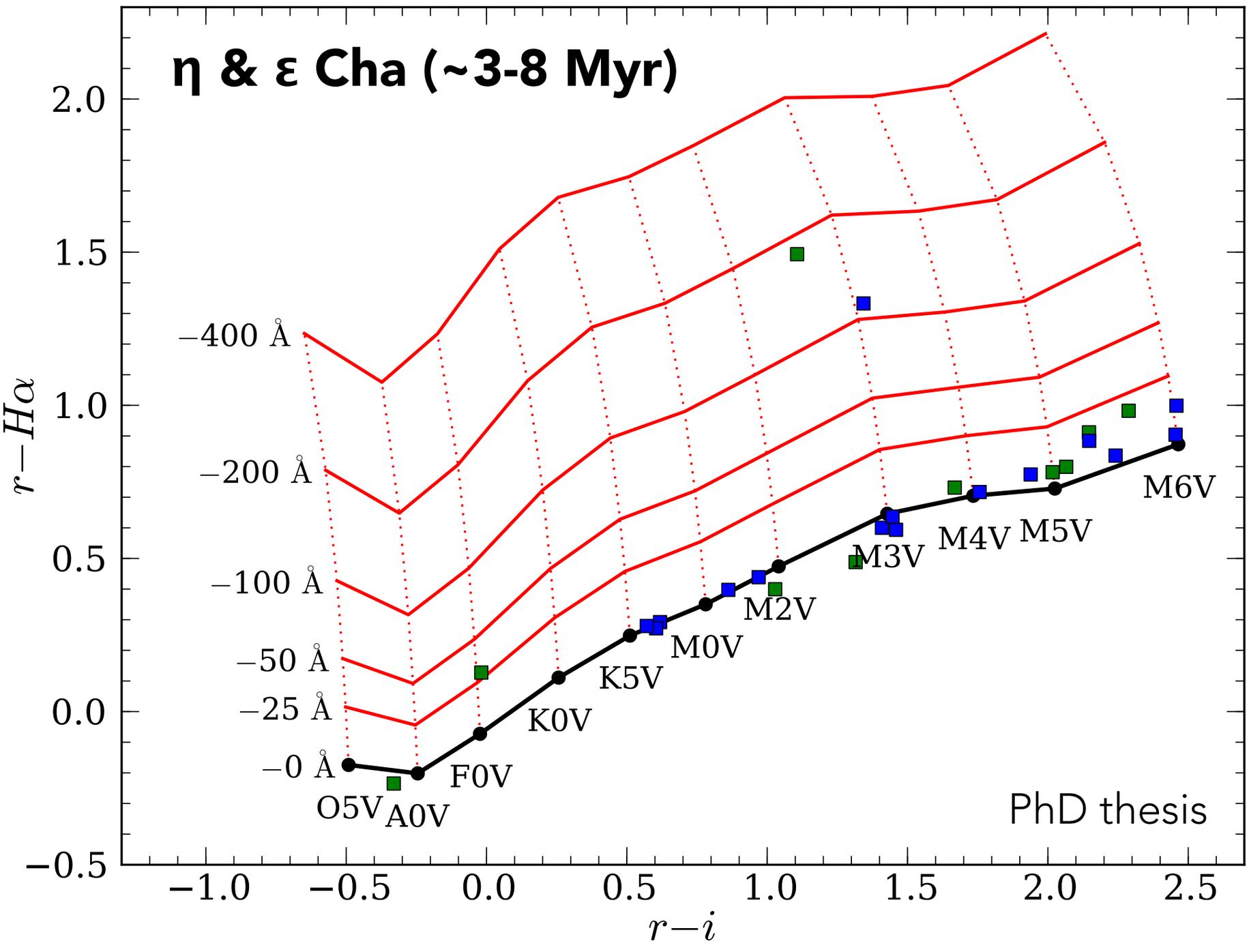
- Pull out excess sources
  - Photometric EWs
  - Mass accretion rates



IC 1396 (~2 Myr)

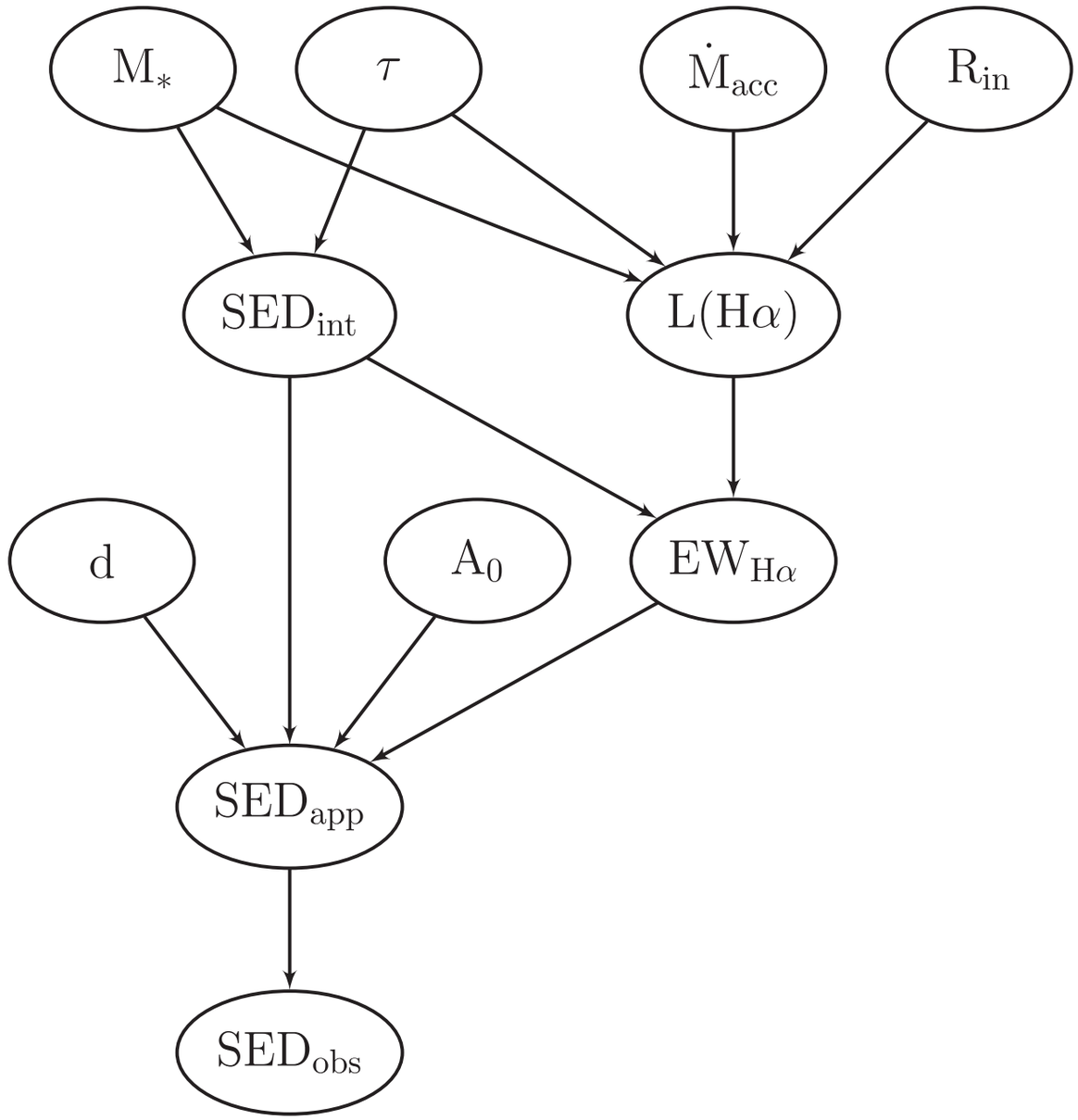
Barentsen+11

H-ALPHA PHOTOMETRY



STELLAR PARAMETERS

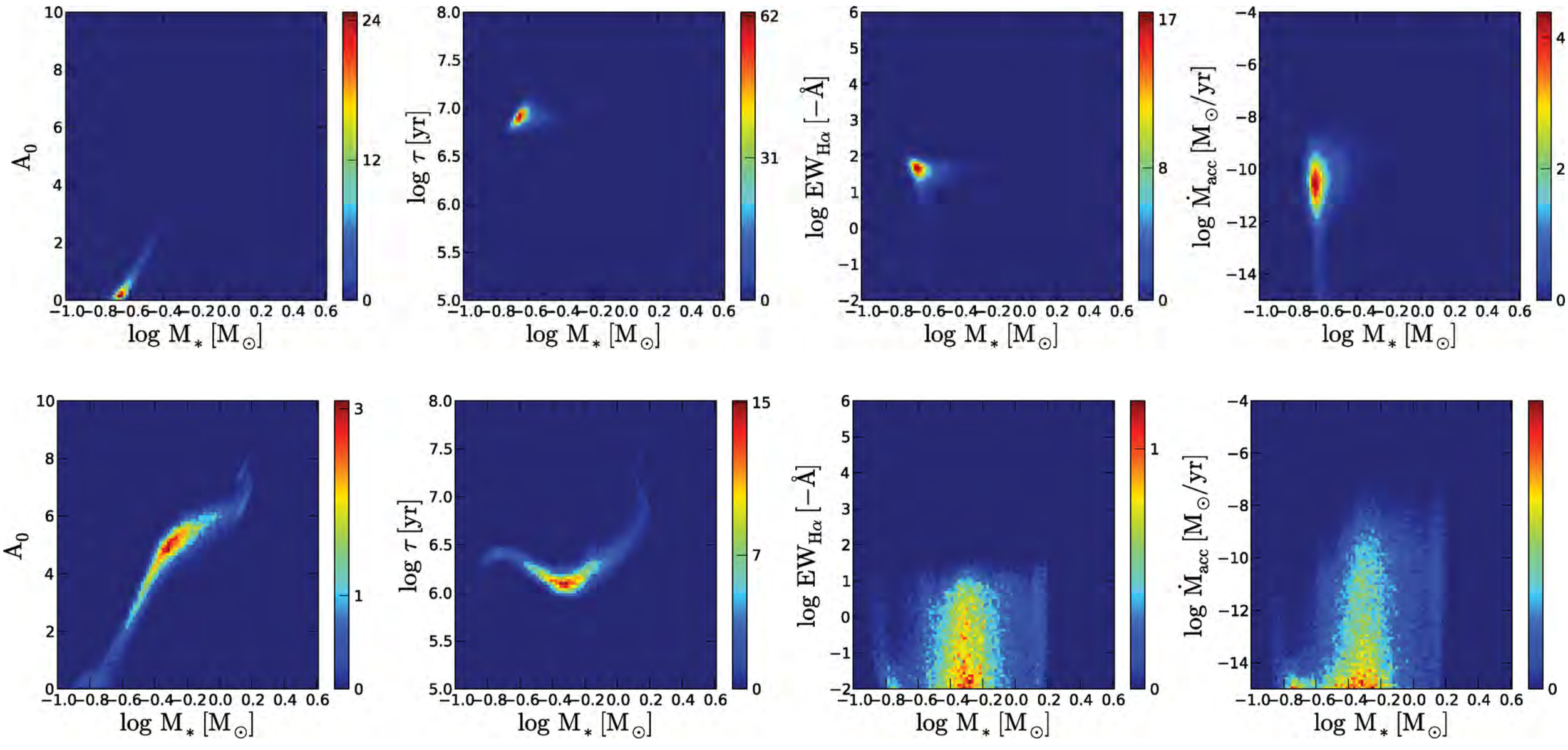
- **Degeneracy between *M*, age, A_0 and Hα emission**
- Bayesian network
- Priors on ***M***,***d***,**age**,***dM/dt*** $\mathbf{R_{in}}$ (disk truncation) & $\mathbf{A_0}$
- Compare model (*r*,*i*,*H*α) to observations
- Sample joint distribution using MCMC



Barentsen+13

STELLAR PARAMETERS

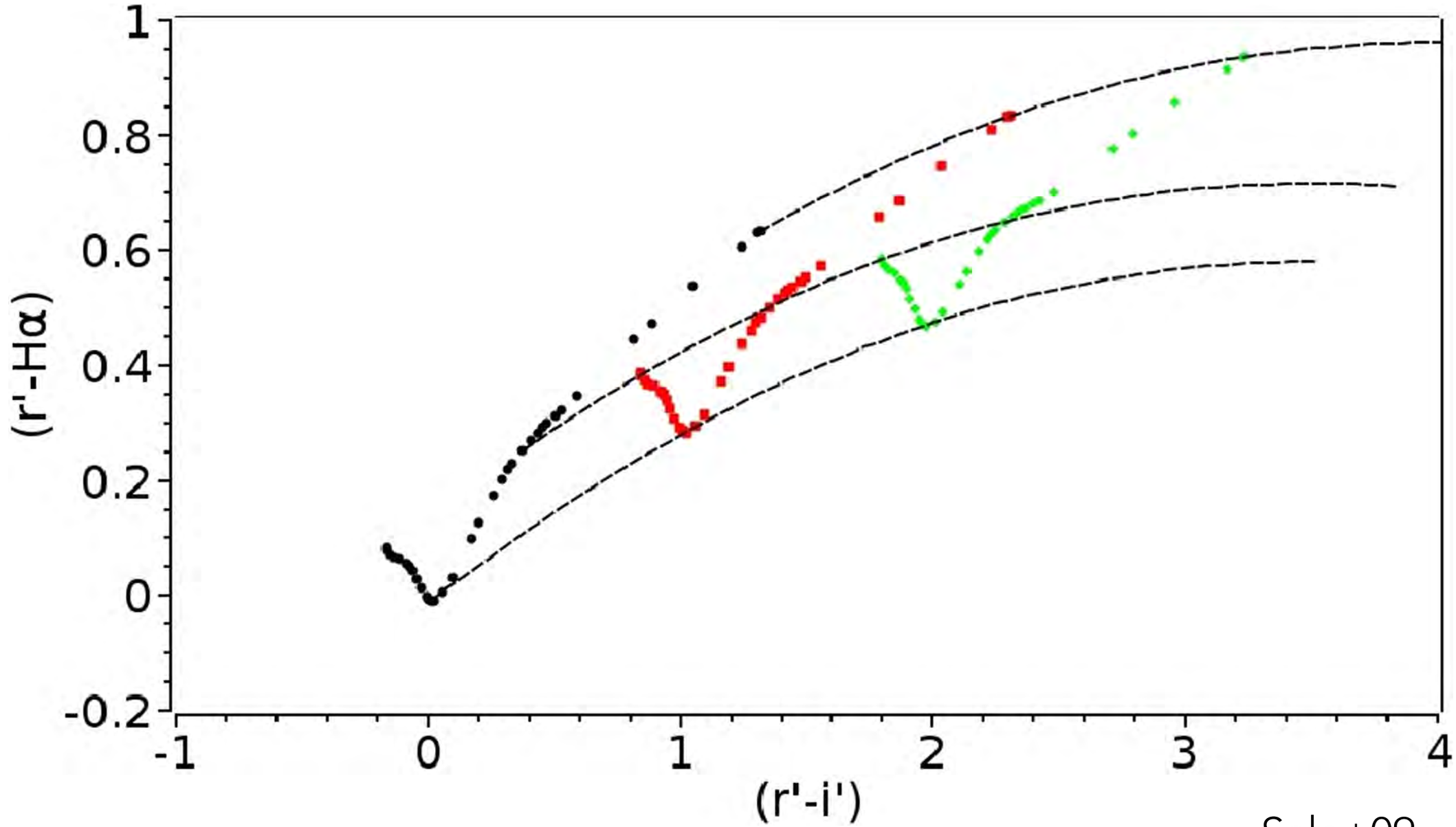
- Able to explore degeneracies, prior dependencies



Barentsen+13

EXTINCTION MAPPING

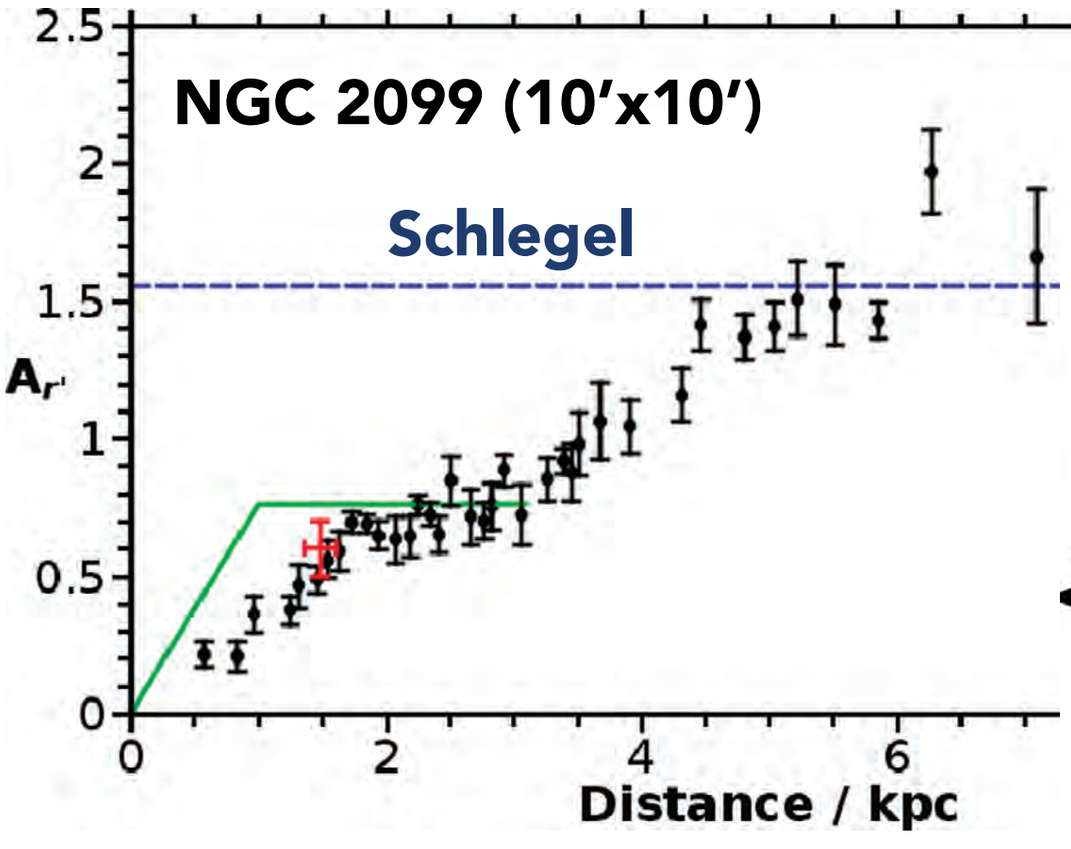
- (*r-i*,*r-H*α) reddening vector at large angle to MS

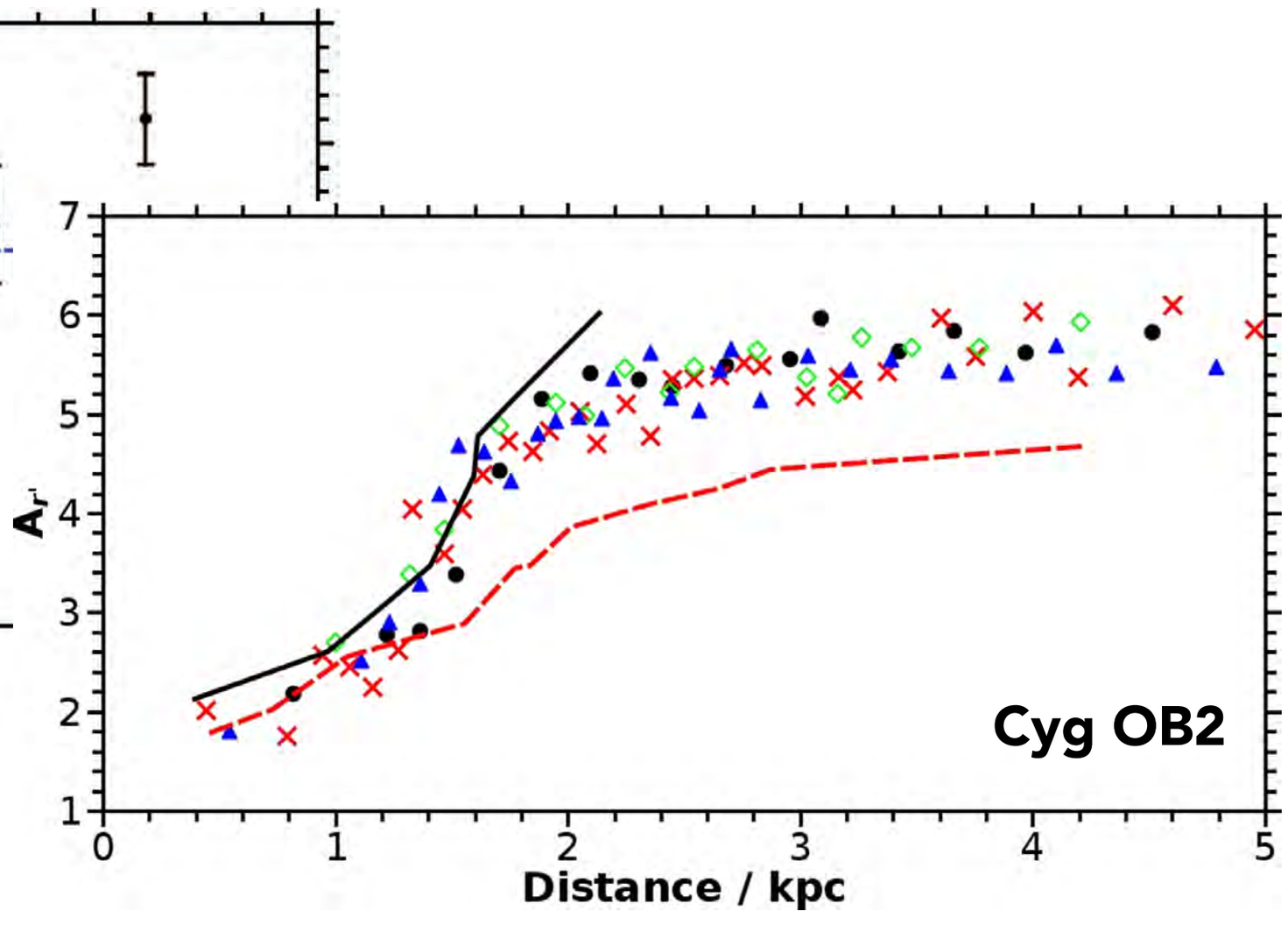


Sale+09

EXTINCTION MAPPING

- Extract $A_{v,d}$ for early-A to K4 stars
- MEAD (Sale+09): Map $A_{r'}$ at 10′, 0.1 kpc resolution



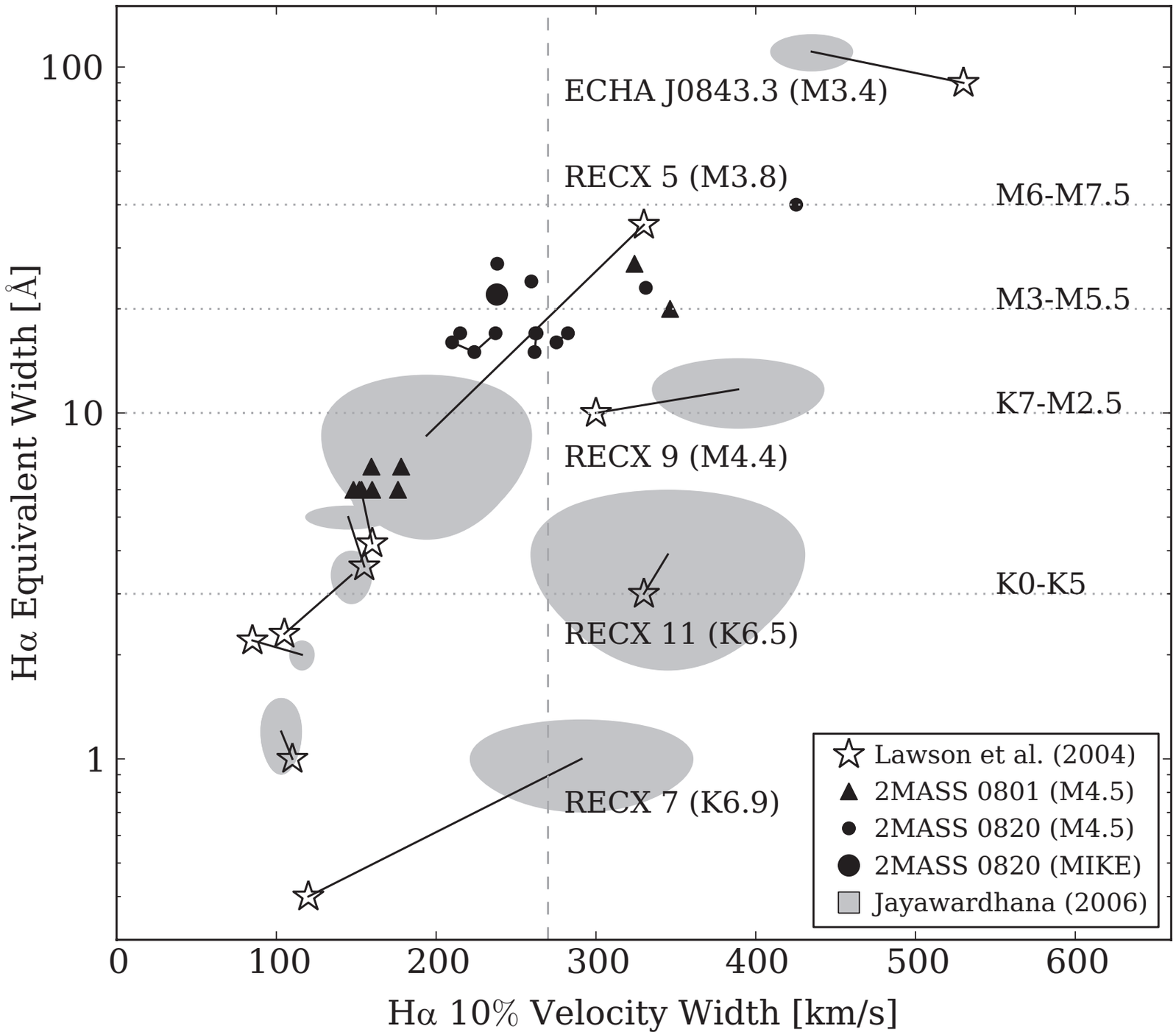


Sale+09

SURVEY STRATEGY

- Filter available in (bright) non-survey time (25%)
- **VPHAS+ bright limit is *r*=12-14**
- Cover Galactic plane to start, entire 2π deep survey?
- MC/galaxy survey
- Monitoring of southern SFR

ACCRETION VARIABILITY



Murphy+11