VPHAS+

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Introduction

VST Photometric Hα Survey (VPHAS+) of the Southern Galactic Plane and Bulge (Drew+ 2014)

…is the southern counterpart to both:

INT Photometric Hα Survey (IPHAS) of the Northern Galactic Plane (Drew+ 2005)

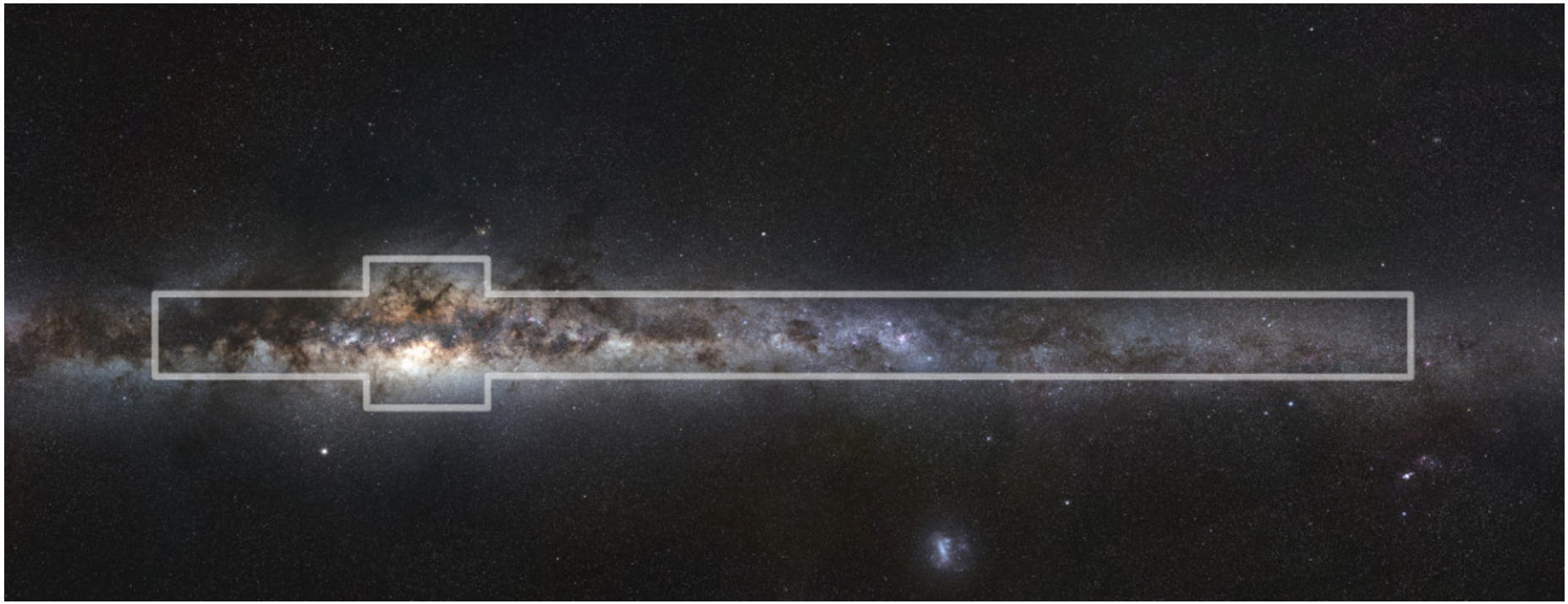
The UV Excess Survey (UVEX) of the Northern Galactic Plane (Groot+ 2009)

All three together known as European Galactic Plane Surveys (EGAPS)

Northern Survey area: IPHAS and UVEX

Survey coverage: Galactic Plane, $|b| < 5°$, $30° > l > 215°$

Southern Survey area: VPHAS+



Survey coverage: Galactic Plane, $|b| < 5°$, $35° > l > 210°$

Galactic Bulge, $|b| < 10°$, $10° > l > 350°$

Combined survey coverage: Entire Milky Way disc, 360° !

Science goals

To improve our understanding of short-lived phases of stellar evolution:

- Pre-main sequence T-Tauri and HAeBe stars
- Massive OB stars, luminous blue variables (LBVs) and Wolf-Rayets (WR)
- Compact and accreting binary systems, cataclysmic variables, and novae
- Post-main sequence AGB stars, white dwarfs, and planetary nebulae

To facilitate large-scale stellar population and Galactic structure studies:

- Spiral arm structure from the distribution of young & massive stars
- Galactic star formation history from stellar remnants
- Galactic structure from 3D Galactic extinction mapping
- Galactic energy budget from nebulosity studies

The VPHAS+ survey

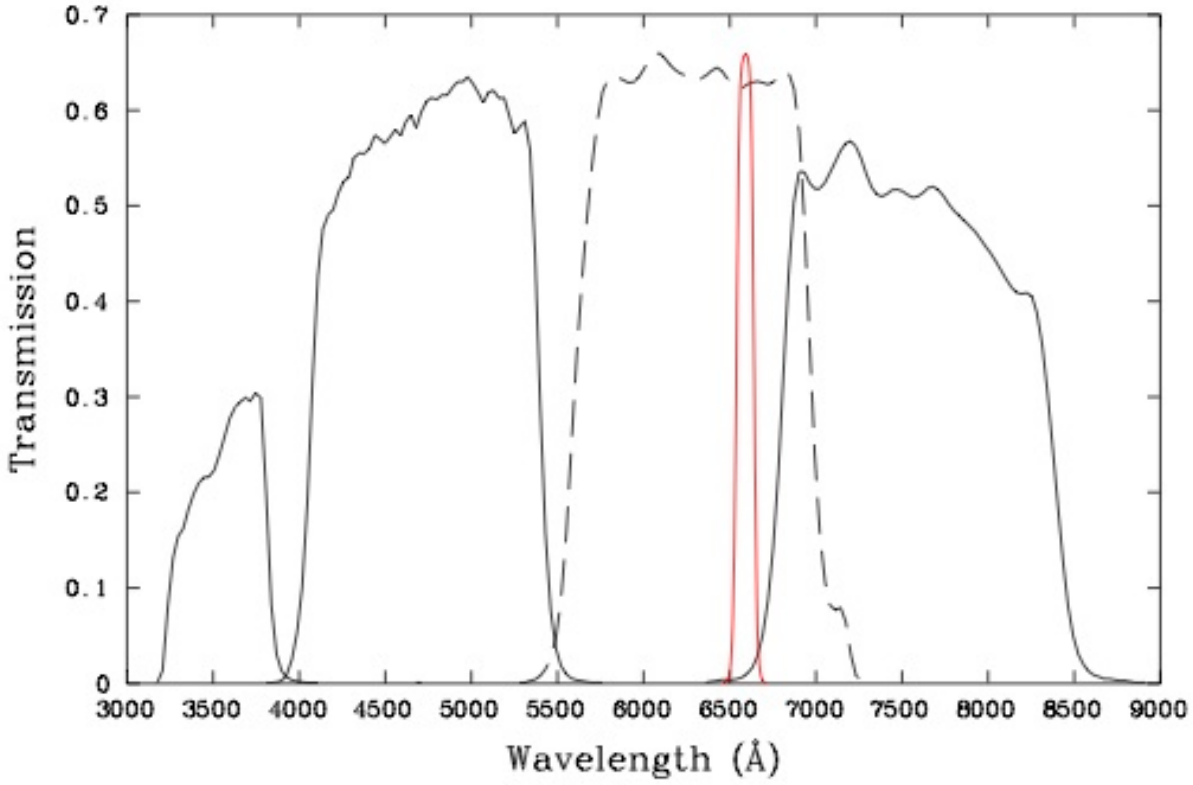
Photometric imaging survey using VST/OmegaCam

Uses broad-band Sloan *u*, *g*, *r*, and *i* filters and narrow-band Hα filter

Cf.

IPHAS uses r, i, Hα

UVEX uses U, g, r



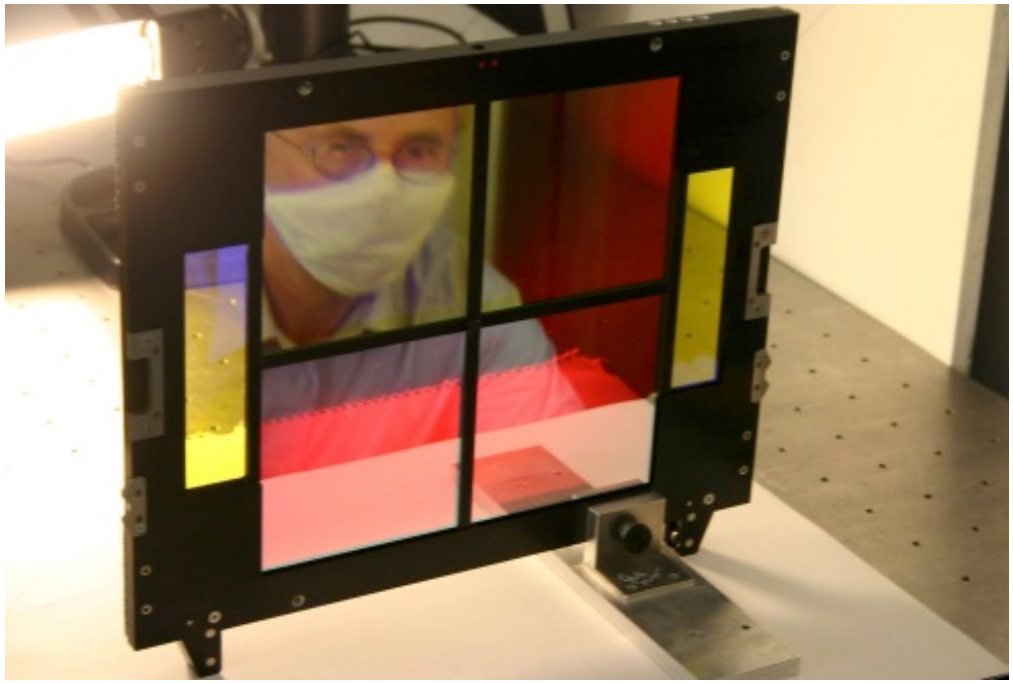
Drew+ 2014

The Hα filter

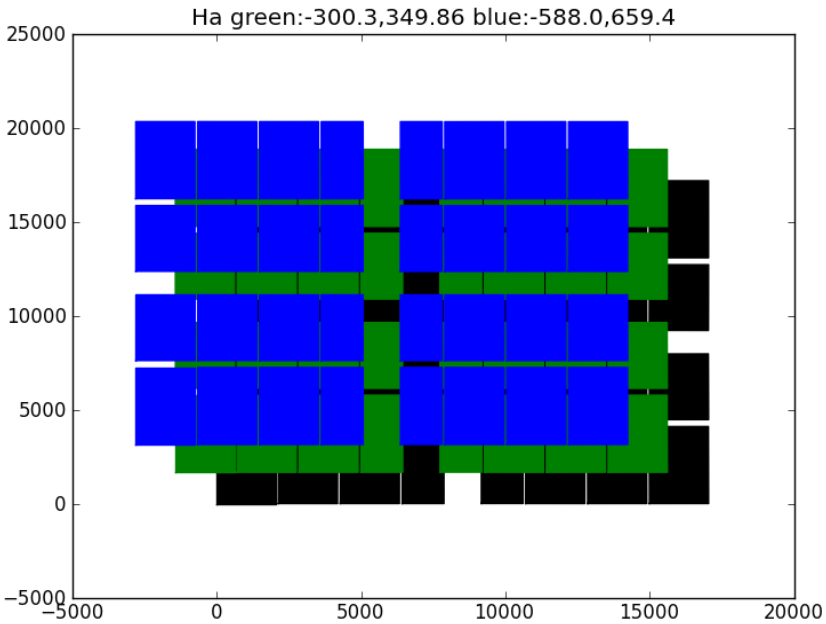
Large (27 × 27 cm^2) four-segment Hα filter

Central wavelength ~ 6589Å, bandpass ~ 100Å

Testing at the University of Munich Observatory



Tiled repeat observations to avoid gaps



Survey depth and data quality

Deep photometry:

- All surveys reach 5σ depth at g,r $\sim$ 21st magnitude
  (saturation at $\sim$ 12-13th magnitude)

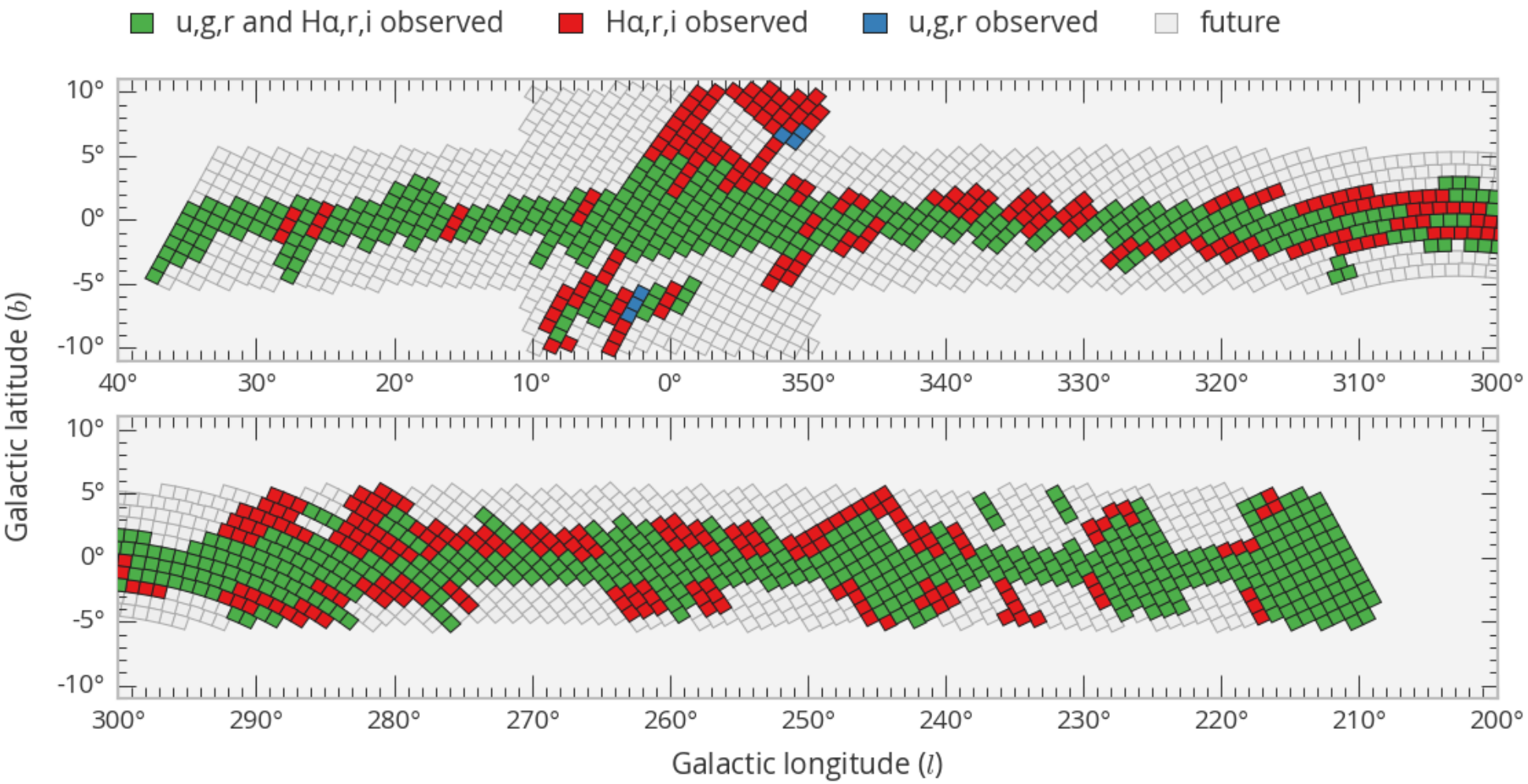
Good observing conditions:

- VPHAS+ median seeing = 0.8” in g,r,i,Hα (pixel scale = 0.2”)
- IPHAS / UVEX median seeing = 1.1” (pixel scale = 0.33”)

Separated blue and red multi-band photometry:

- Blue filters u/g/r in one observing block
- Red filters r/i/Hα in another at another time
- r serves as the link filter between the two sets ⇒ variability studies

Current survey status



Total survey area ≃ 2000 deg^2

Data access: VPHAS+

www.vphas.eu

www.eso.org/sci/observing/phase3/data_releases.html

VPHAS-DR1 (2013):

- First 9 months of survey data (10% of total survey)
- Reduced images and single-band source lists

VPHAS-DR2 (2015):

- First 21 months of survey data (24% of total survey)
- ugri and Hα images and associated source lists, band-merged PSF and aperture photometry, approximate global calibration

Goal:

- Fully calibrated catalog of >300 million objects
- 5-band photometry to a precision of 0.02-0.03 magnitudes

Northern Data access: IPHAS and UVEX

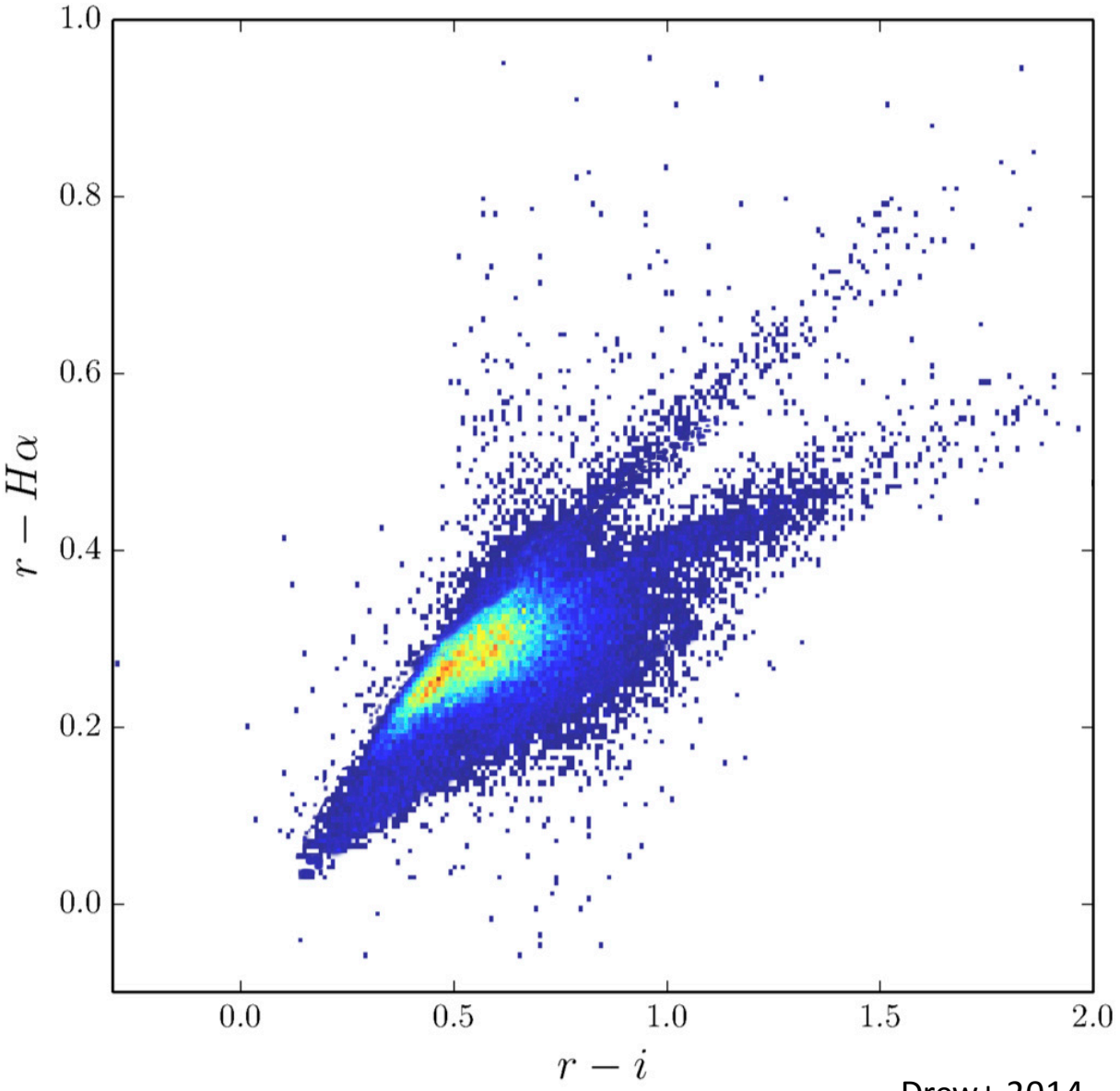
IPHAS-DR2 (2014):

- 1860 deg^2 of the Northern Galactic Plane (92% of survey area)
- Photometry and astrometry for 219 million objects
- Pipeline processed images in the r, i, Hα bands
- www.iphas.org/dr2/
- Read about it in: Barentsen et al. 2014

UVEX-DR1:

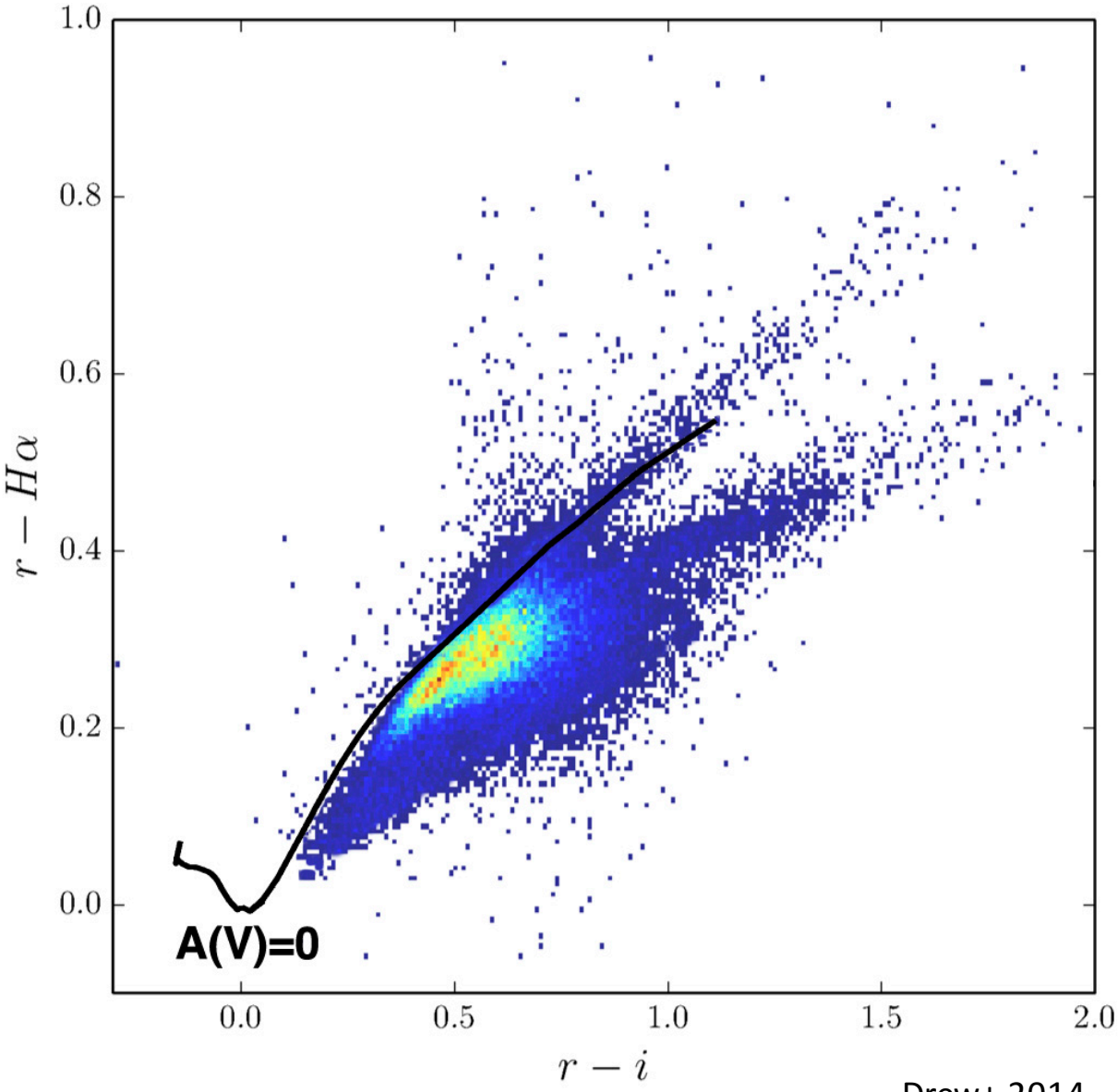
- www.astro.ru.nl/uvex
- Coming soon!

Photometry



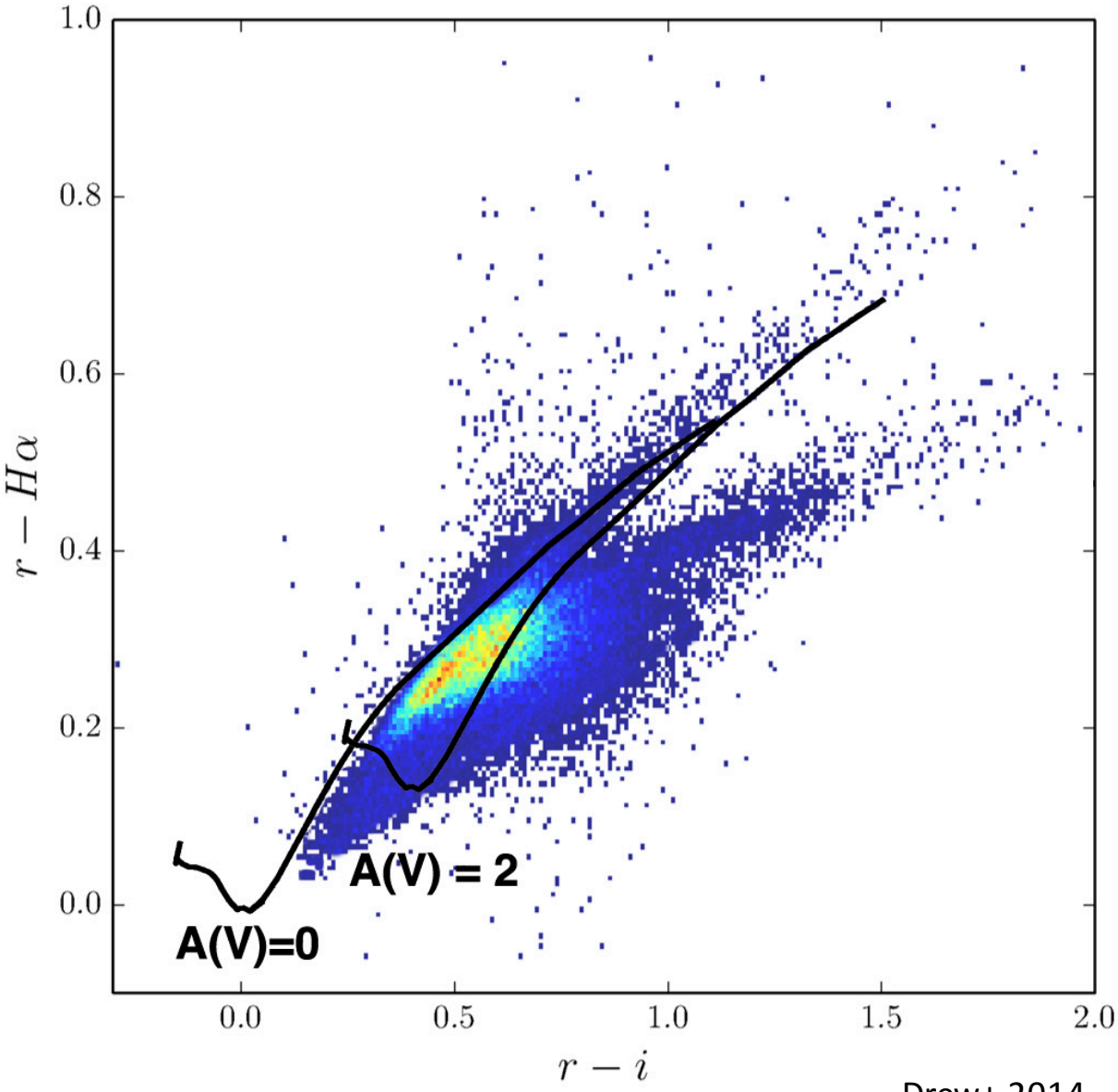
Drew+ 2014

Photometry



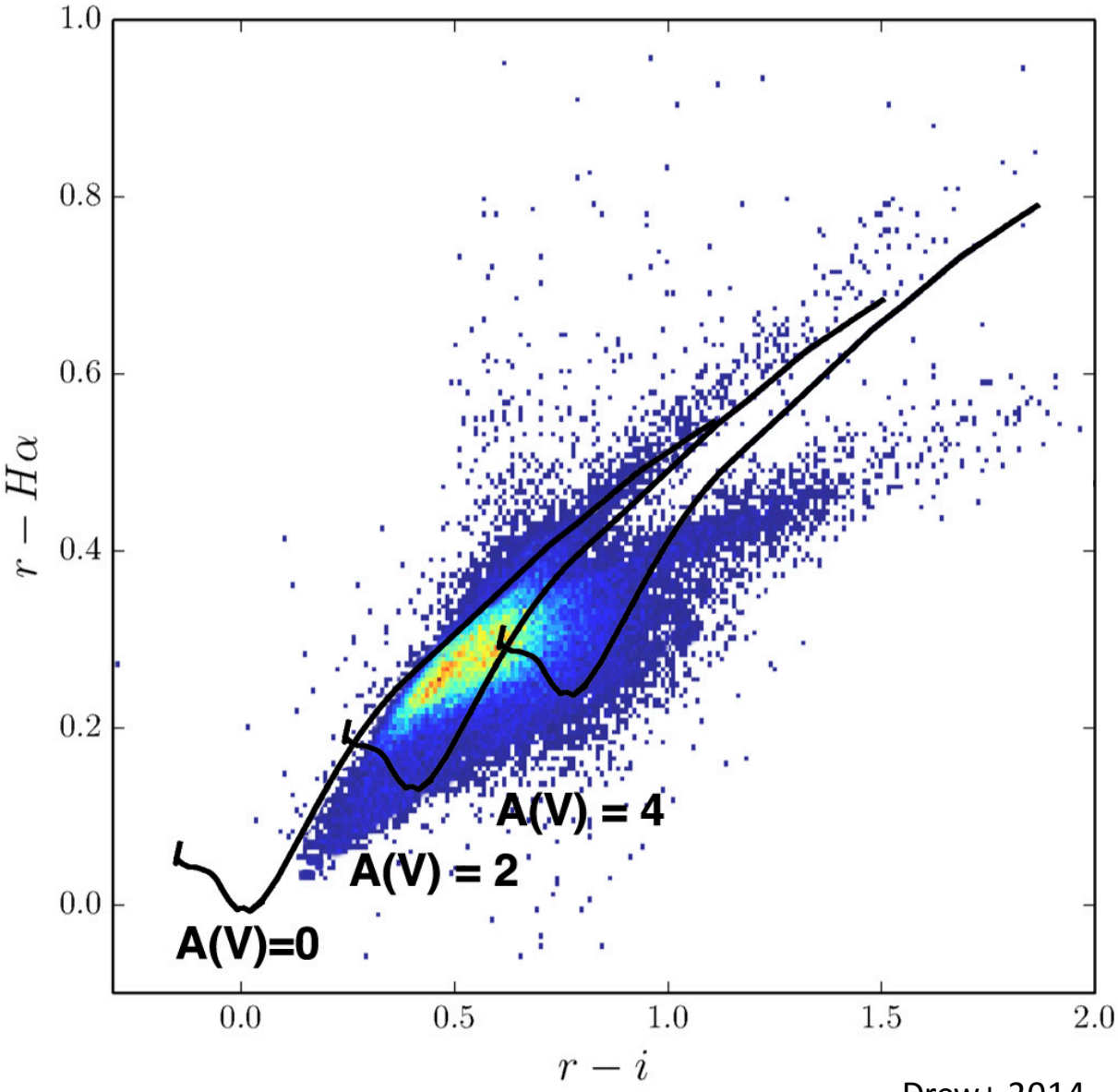
Drew+ 2014

Photometry



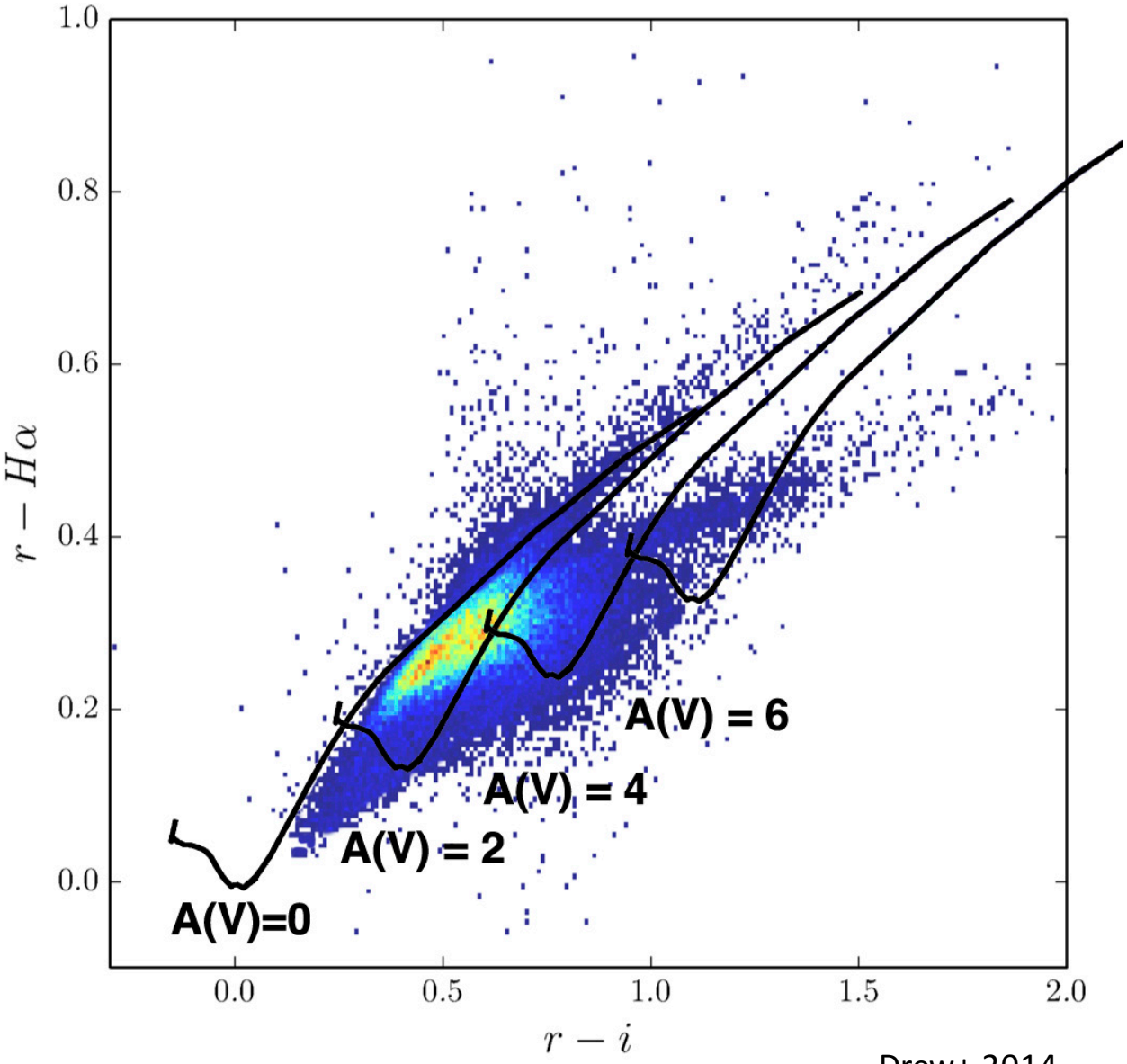
Drew+ 2014

Photometry



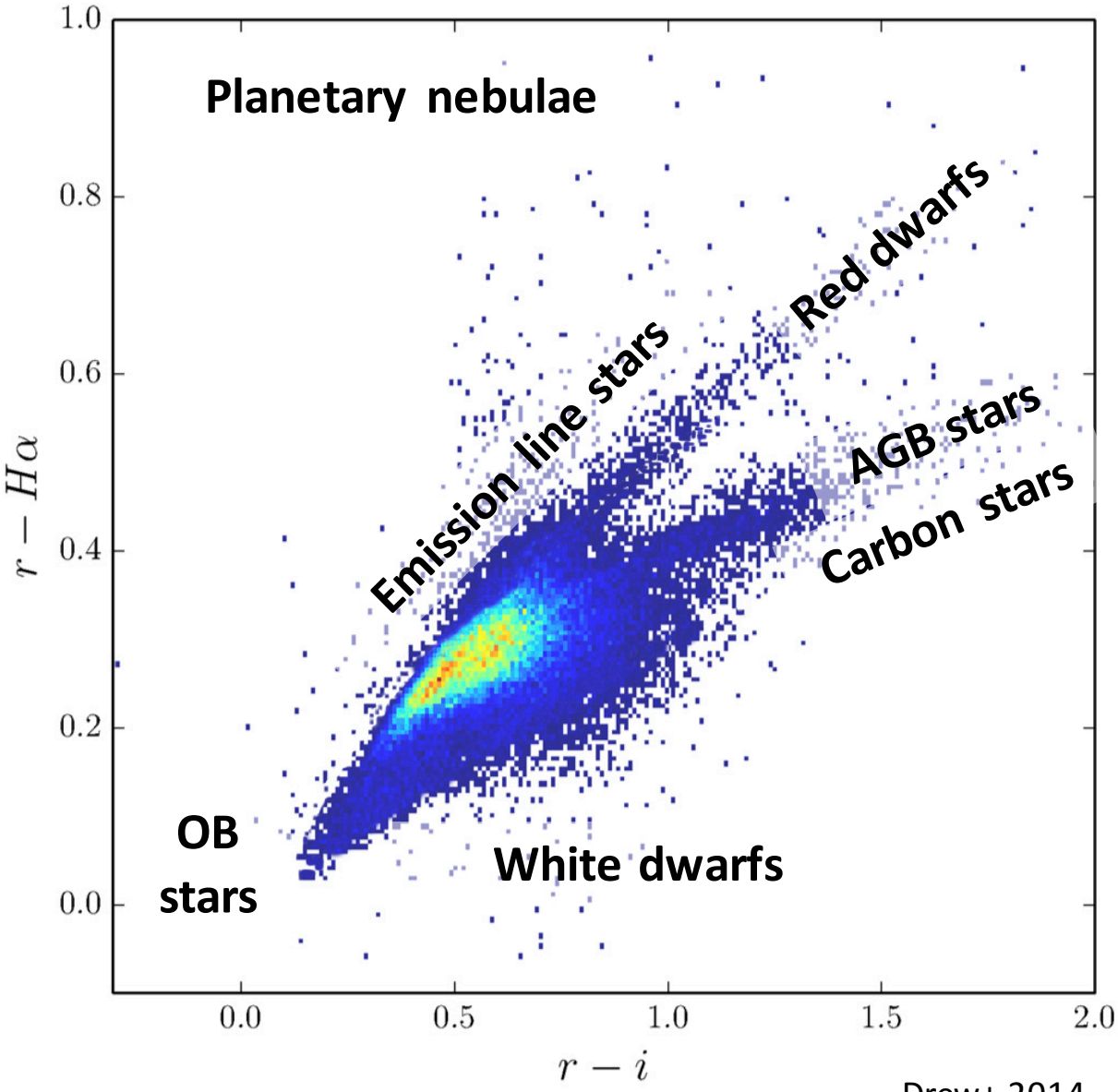
Drew+ 2014

Photometry



Drew+ 2014

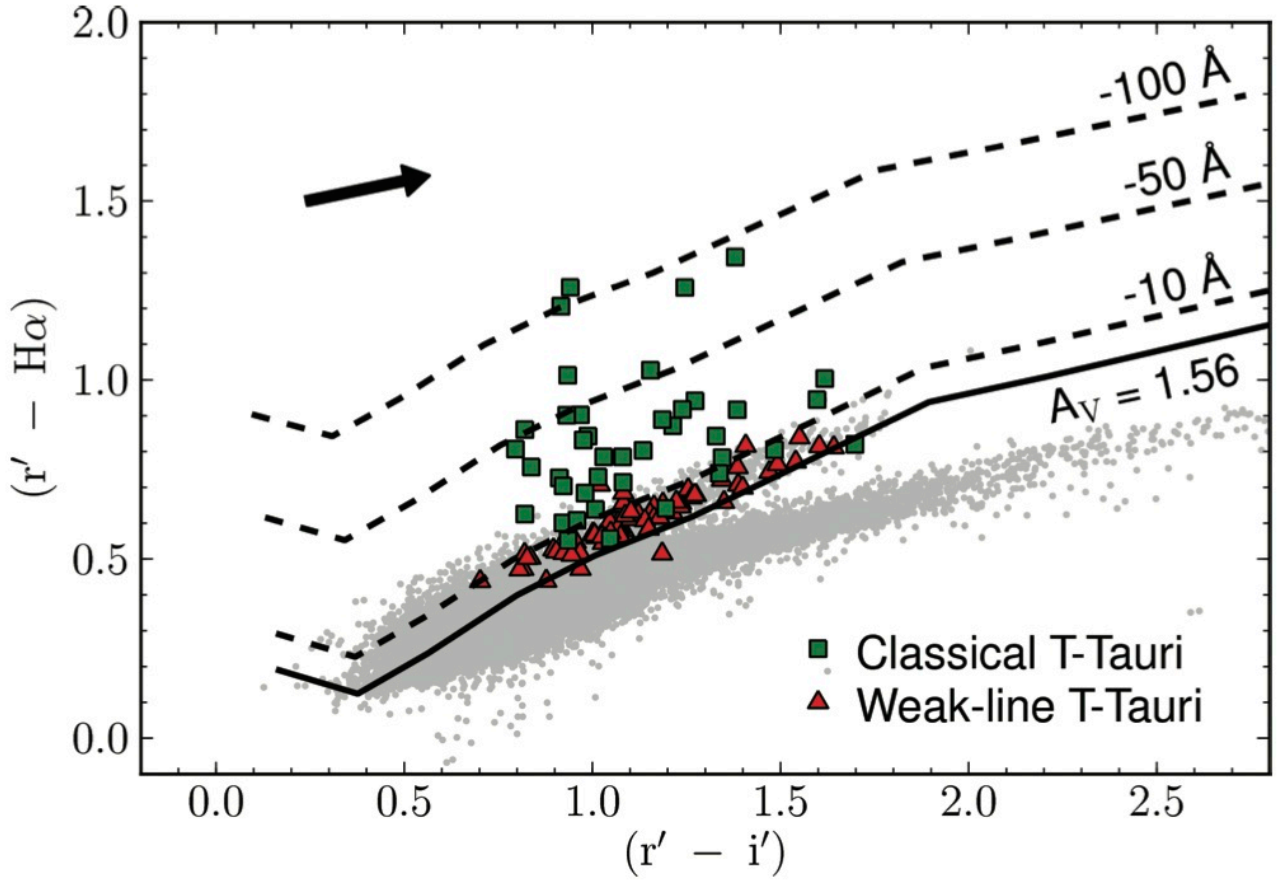
Photometry



Drew+ 2014

Young stars

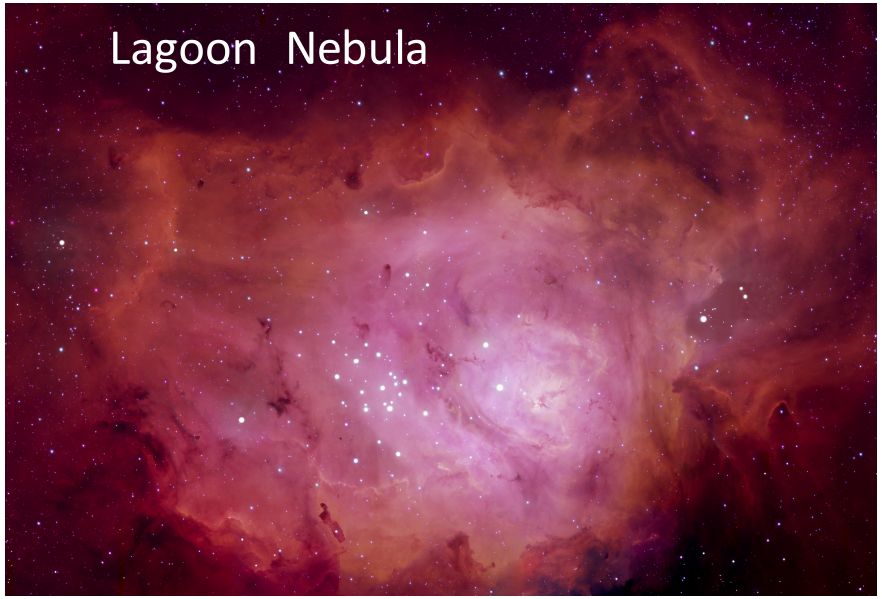
Photometric identification of T-Tauri stars in IC 1396

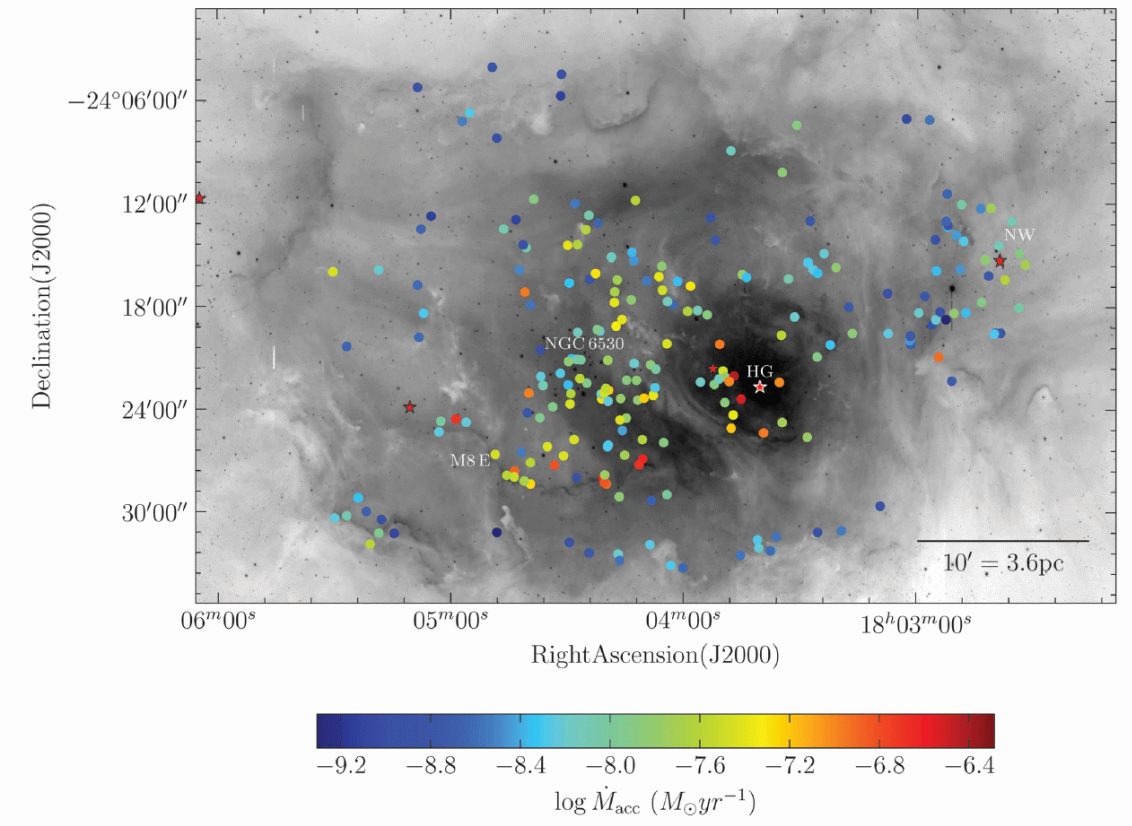


Barentsen+ 2011

Young stars

Homogeneous studies of star formation across the Galactic Plane.

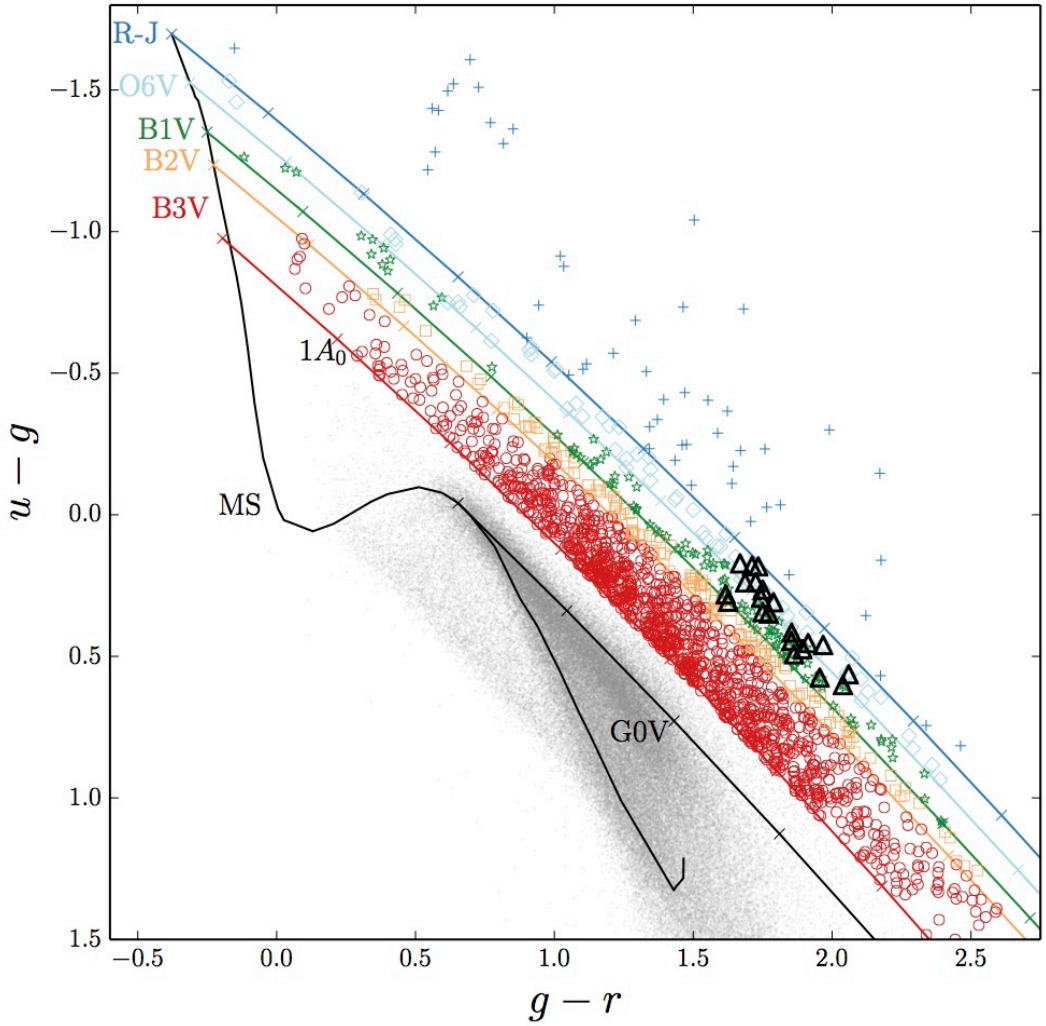




Kalari+ *2015*

Massive stars

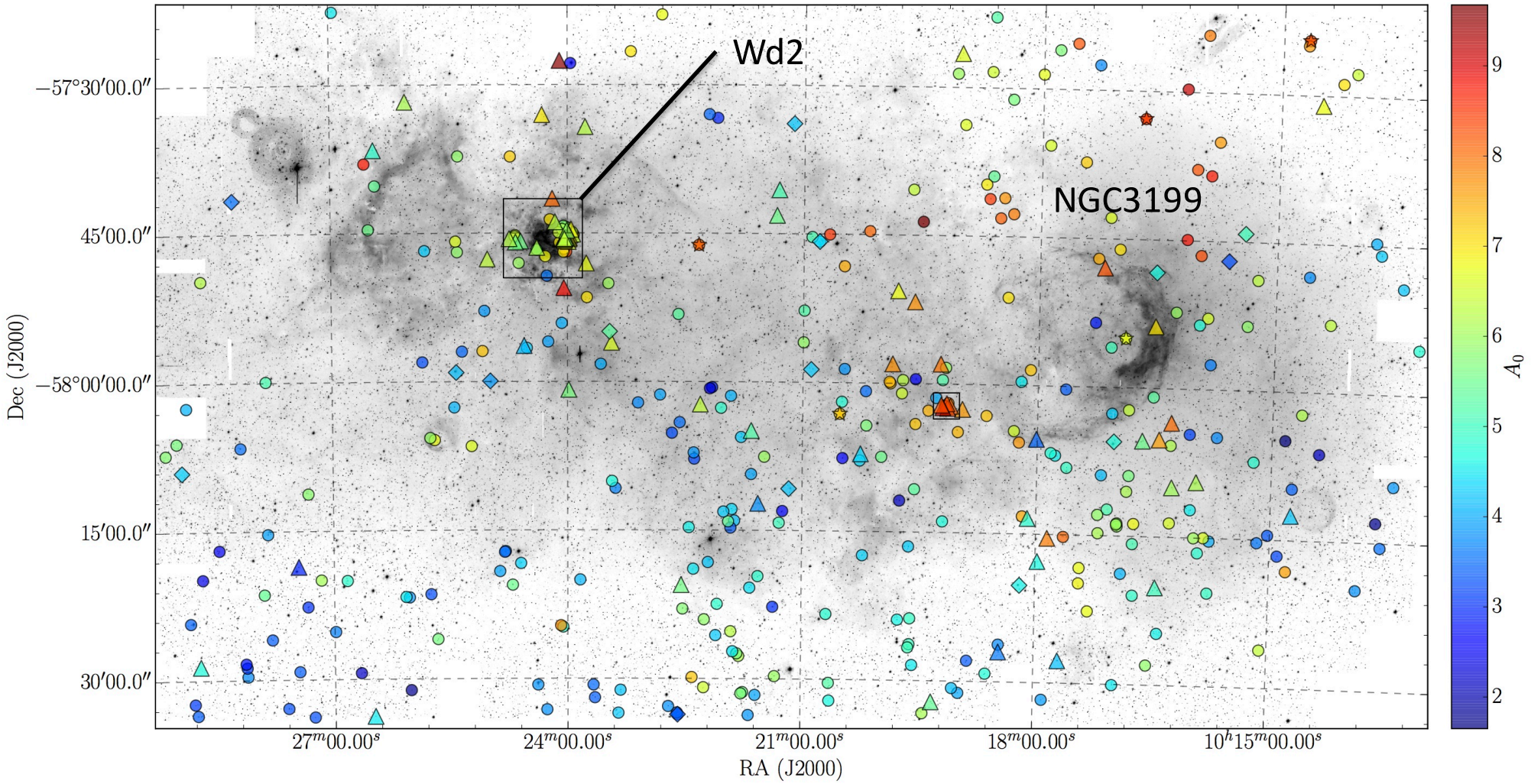
Efficient identification and parameterization of OB stars from photometry.



Mohr-Smith+2015

Massive stars in the Carina Arm around Westerlund 2

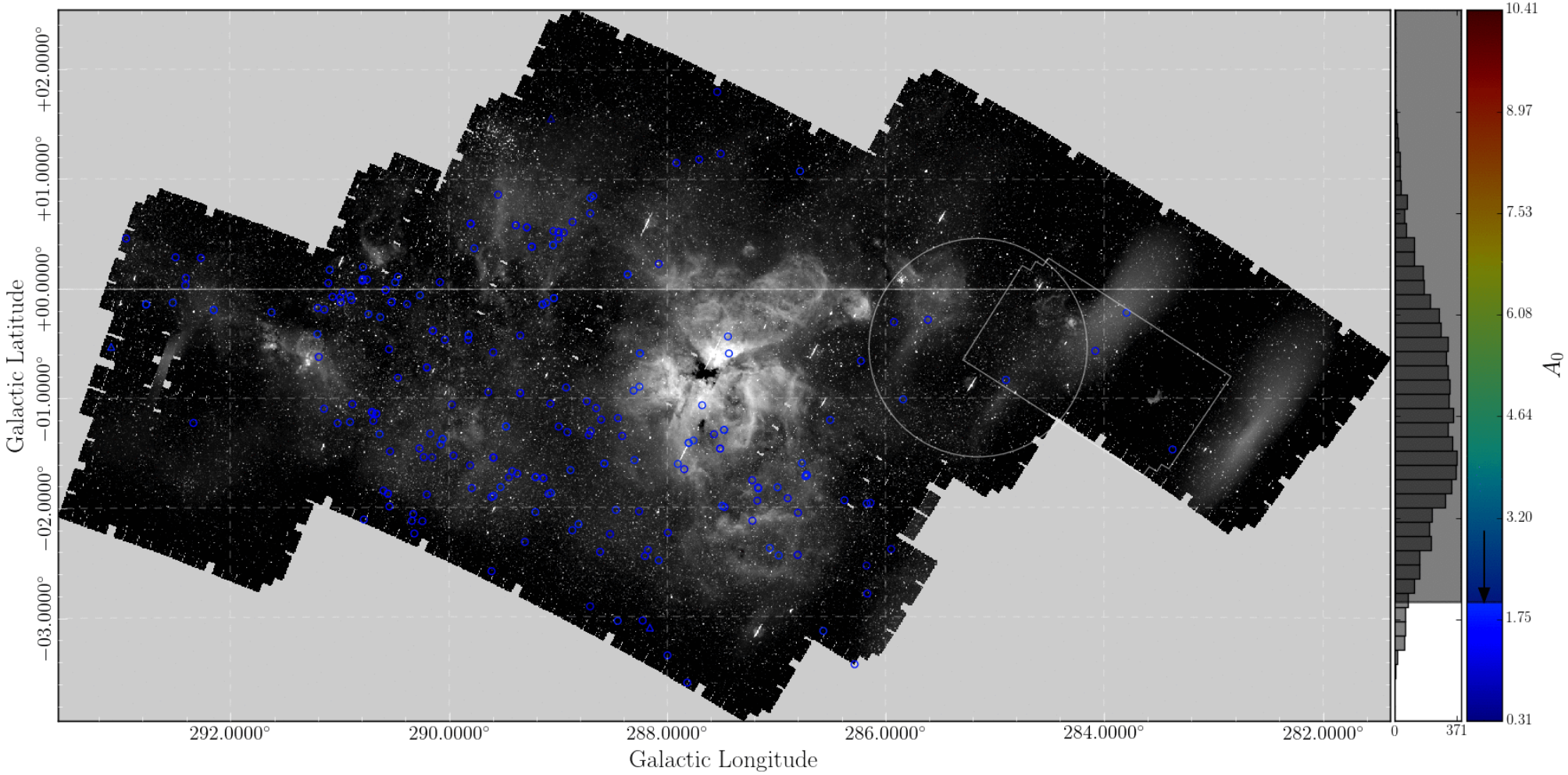
~490 new O (△) and B (○) stars



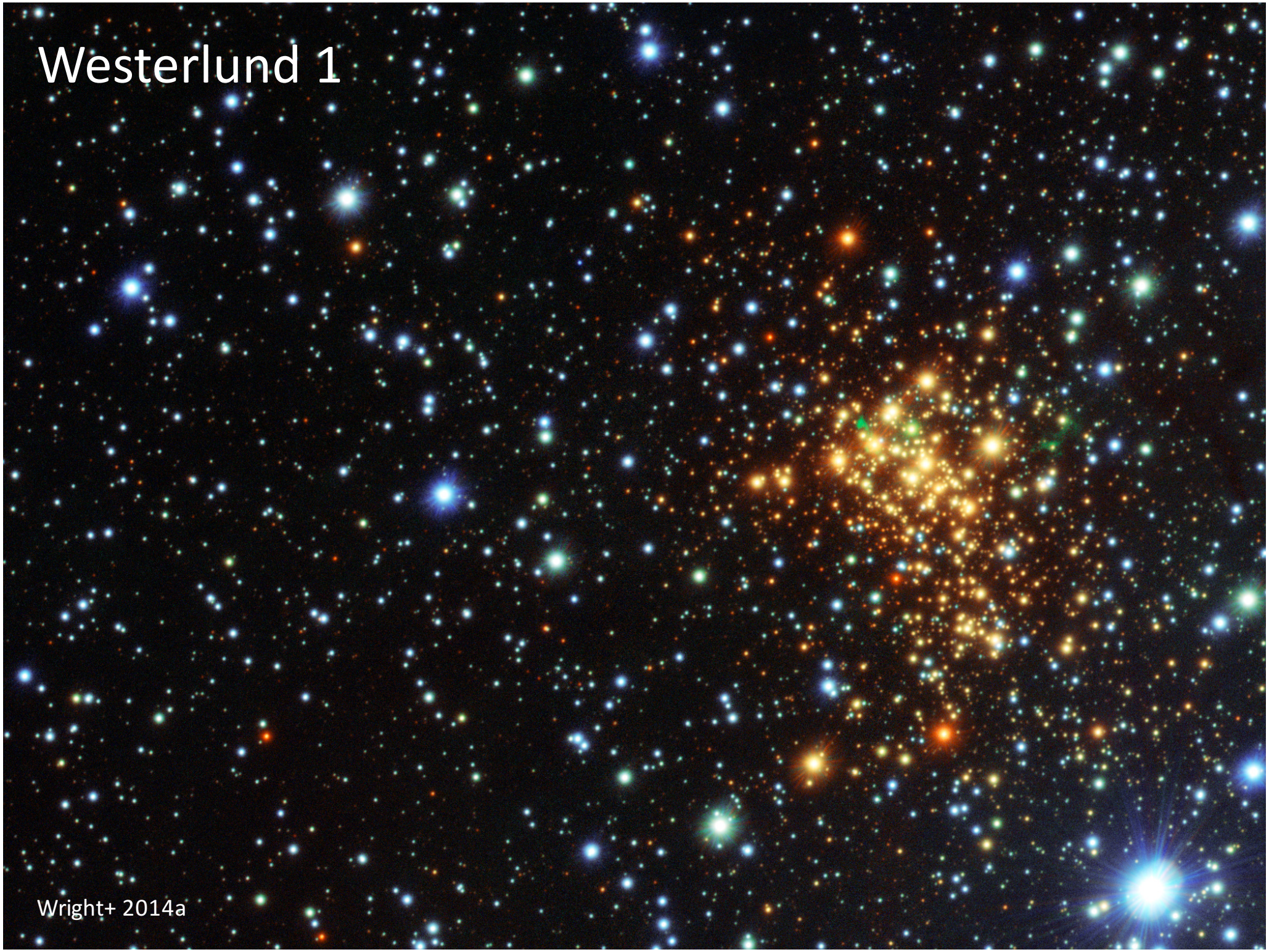
Mohr-Smith+2015

OB stars in Carinae

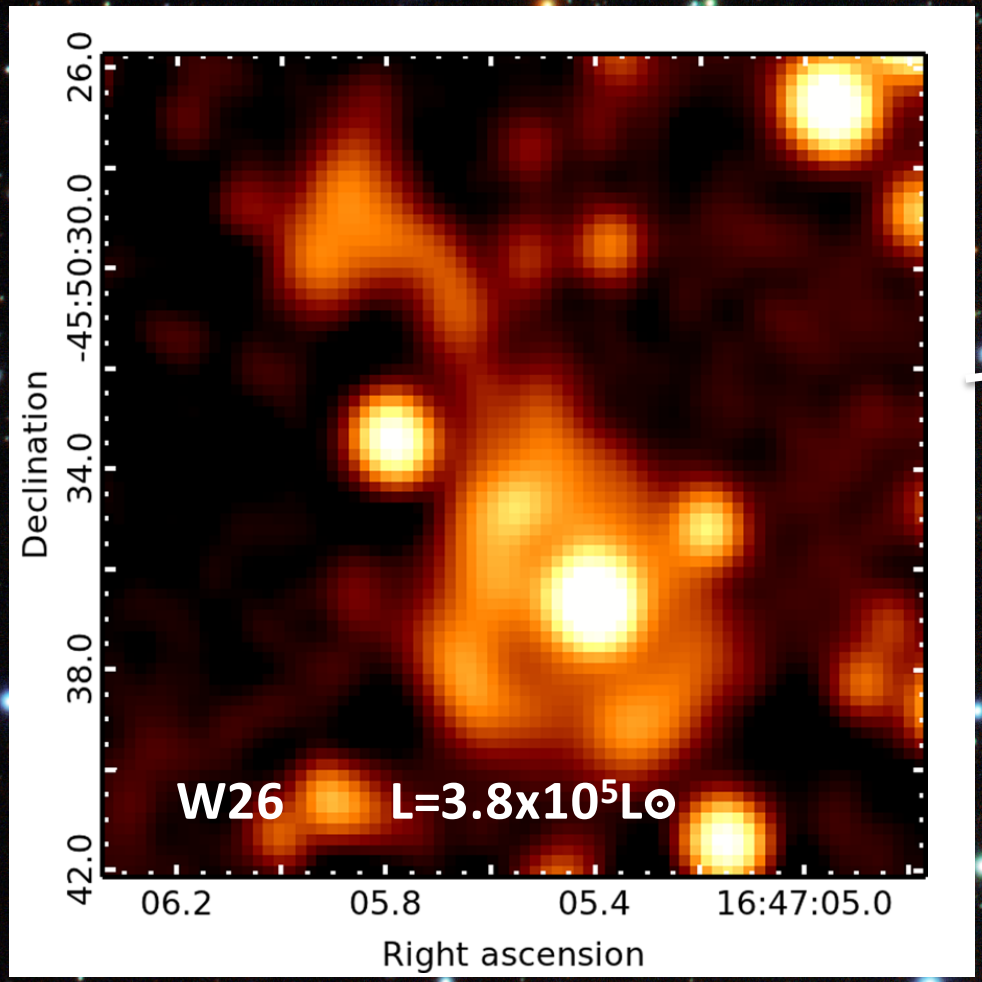
- 42 deg2
- 7000 stars B2 and earlier
- 1000 O-stars



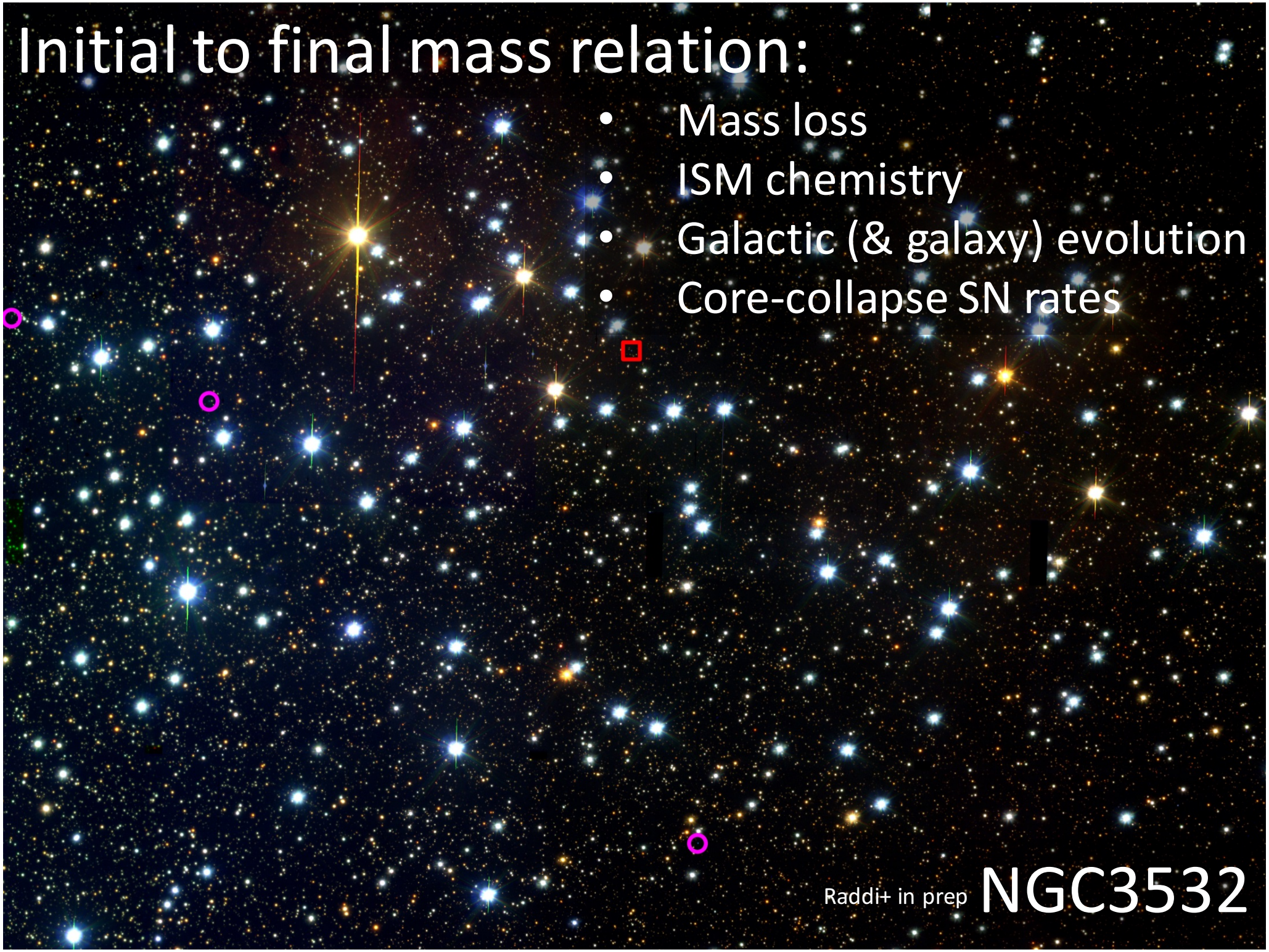
Mohr-Smith in prep

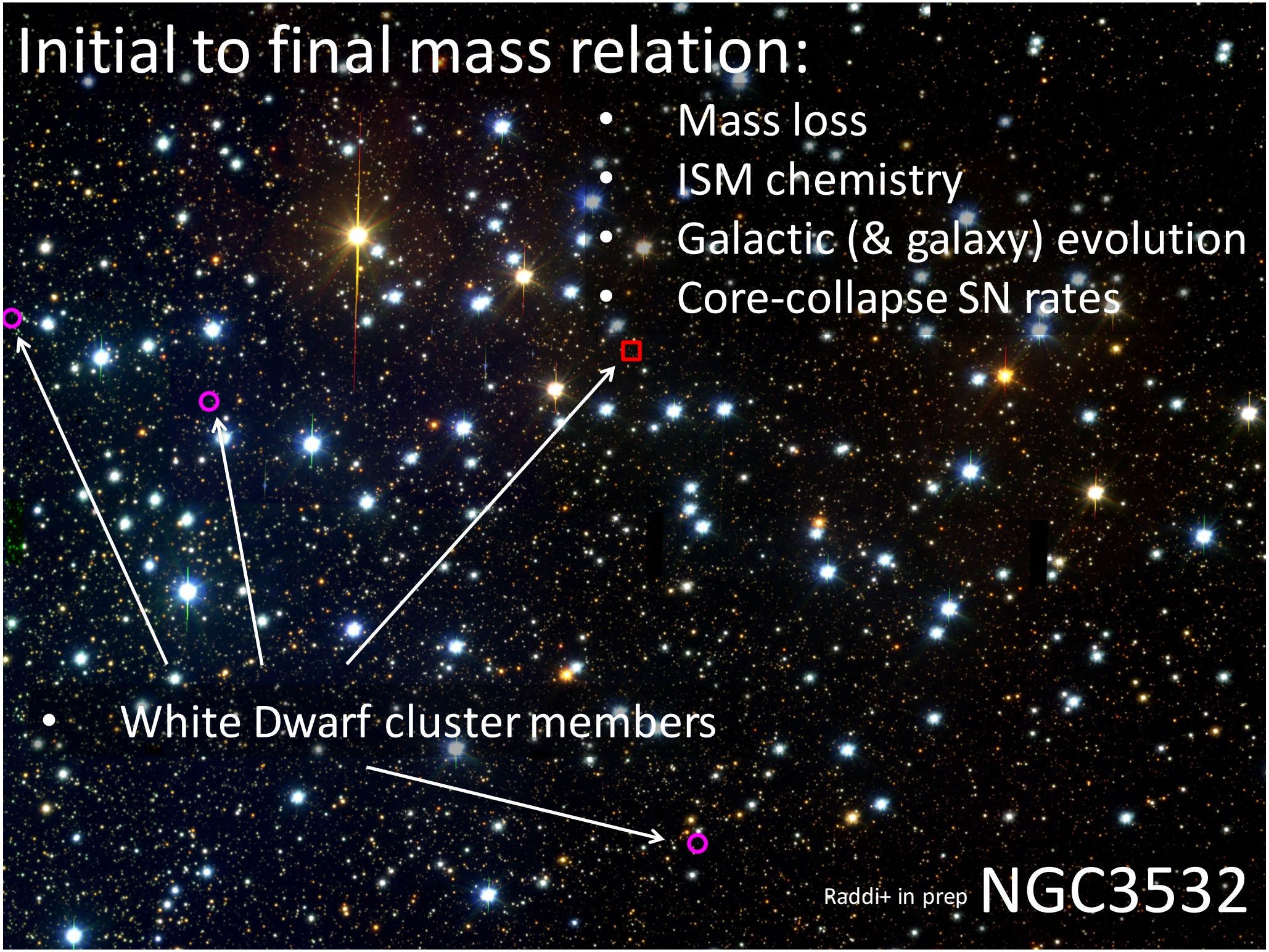

Westerlund 1
Wright+ 2014a

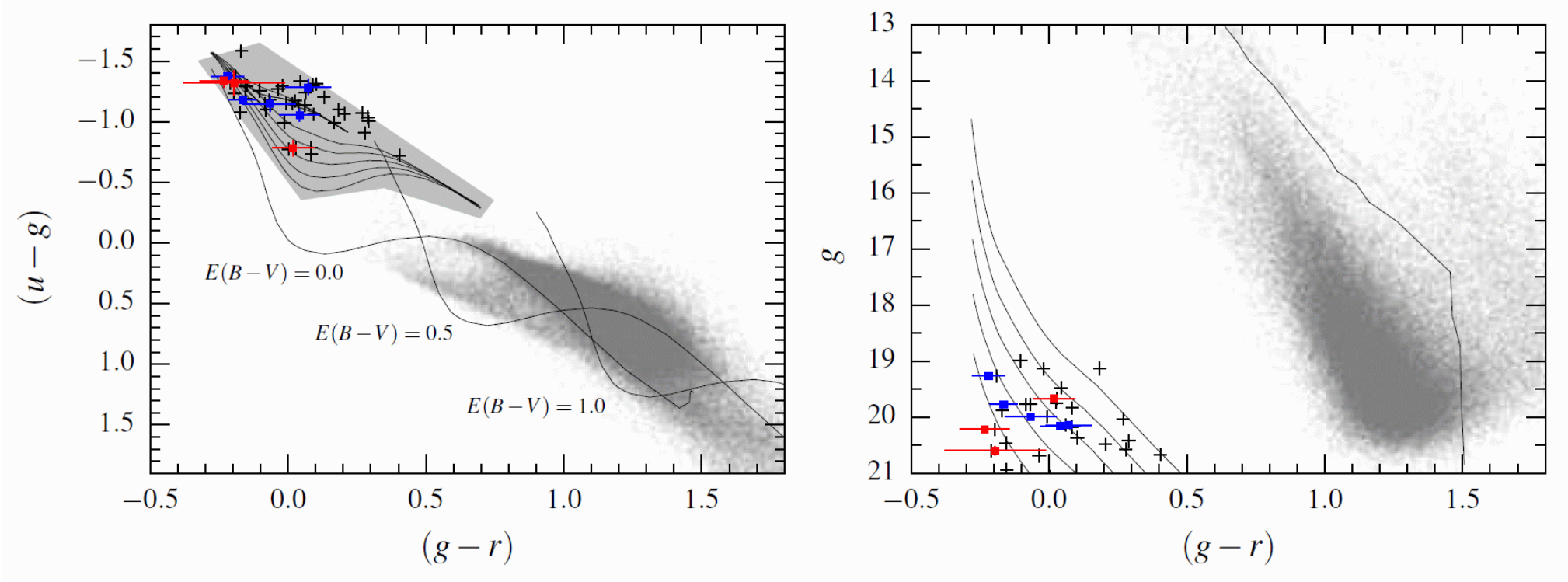
Westerlund 1



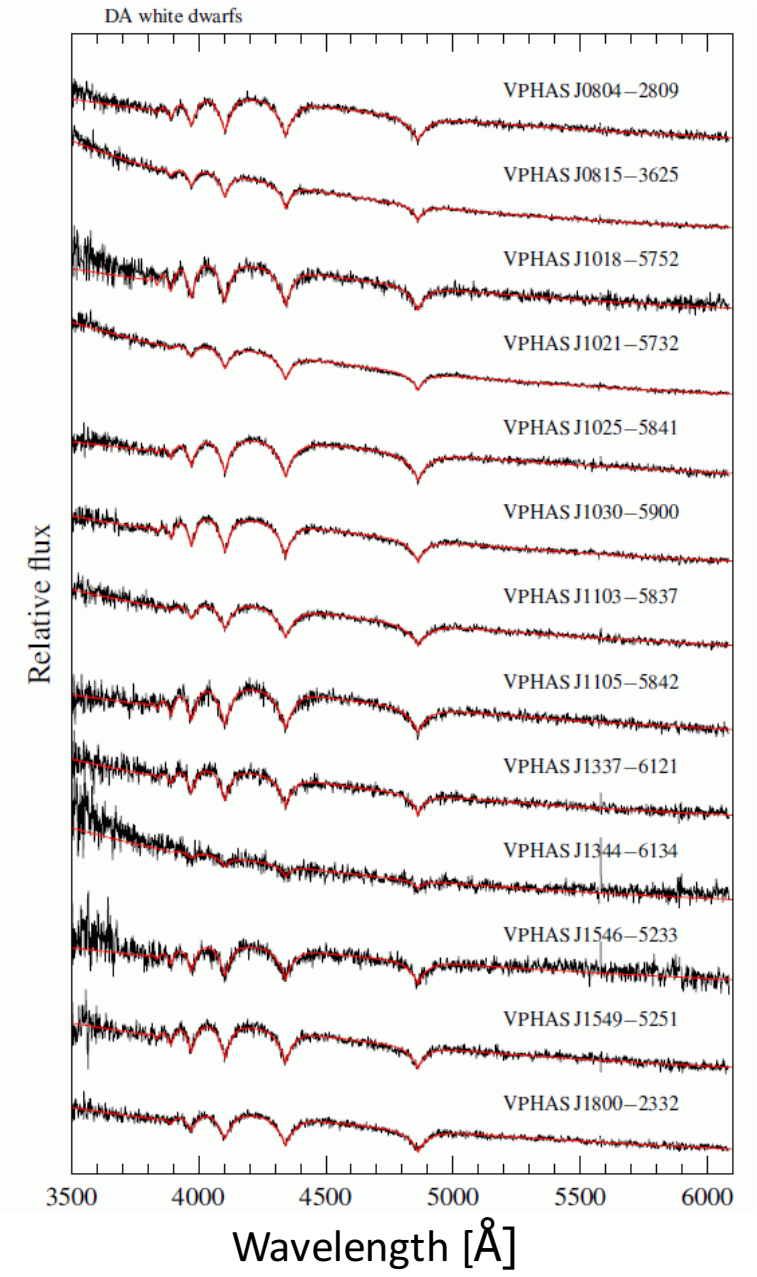
Wright+ 2014a – Hα emission around the extreme red supergiant , W26


Initial to final mass relation:
• Mass loss
• ISM chemistry
• Galactic (& galaxy) evolution
• Core-collapse SN rates
Raddi+ in prep
NGC3532


Initial to final mass relation:
• Mass loss
• ISM chemistry
• Galactic (& galaxy) evolution
• Core-collapse SN rates
• White Dwarf cluster members
Raddi+ in prep
NGC3532



Raddi+ in prep

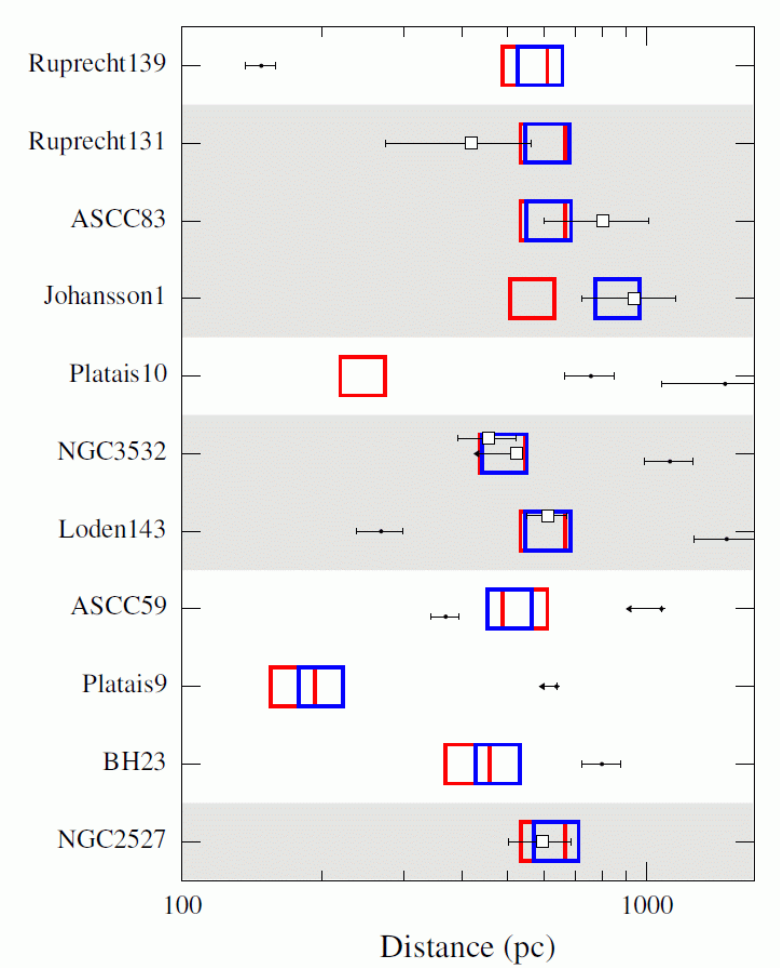


Teff, logg

+ stellar models

Mass
Radius
Cooling age
Distance

Cluster membership



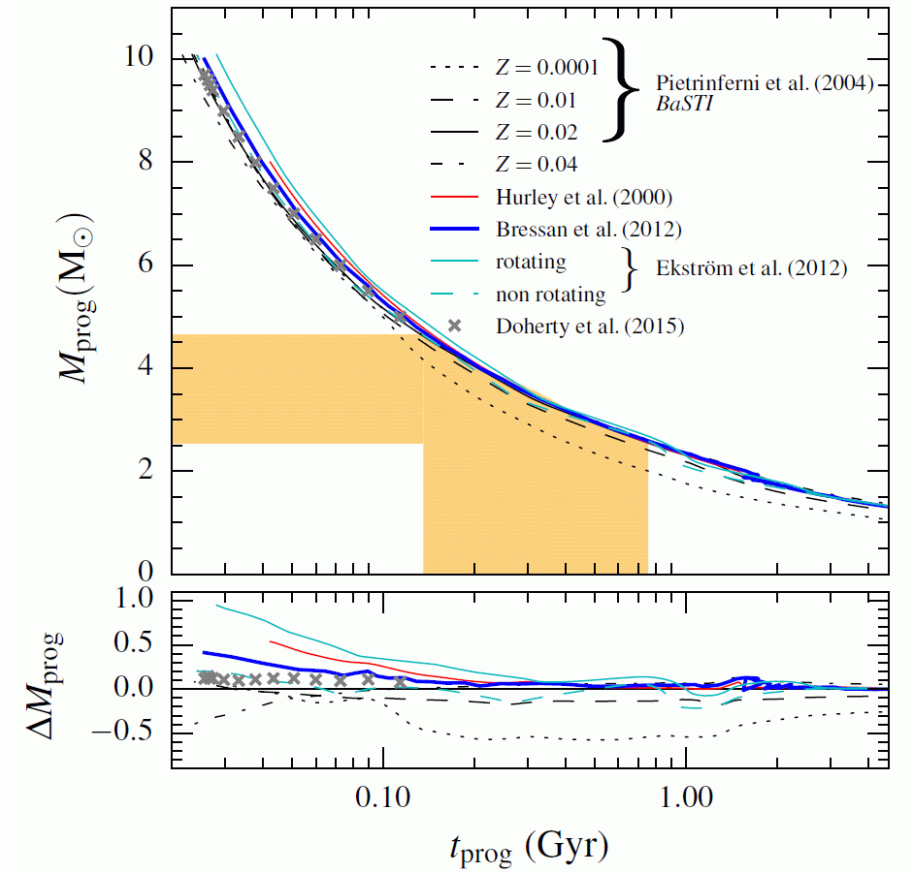
Progenitor age =

cluster age – WD cooling age

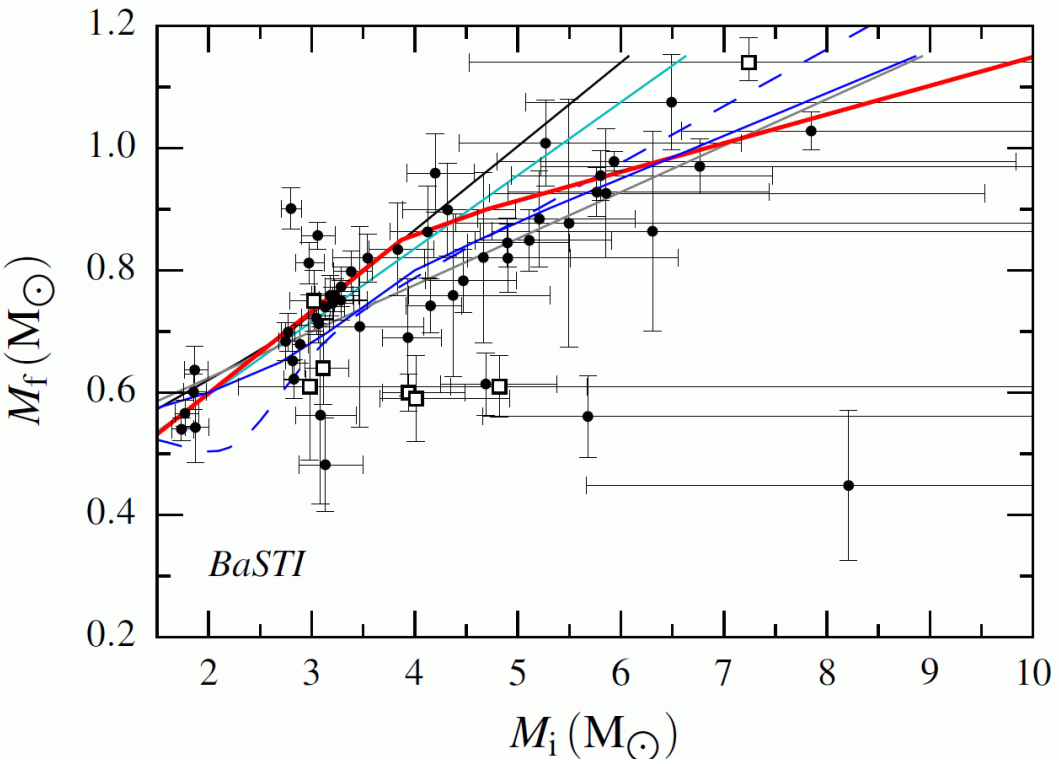
+ stellar models => progenitor mass

⇨

Initial-to-final mass relation



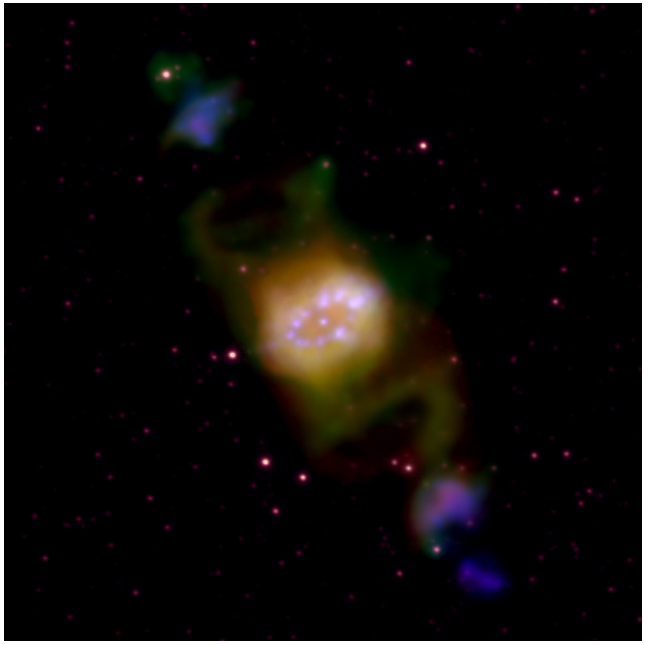
… currently only ≃ 50 stars …



Planetary Nebulae

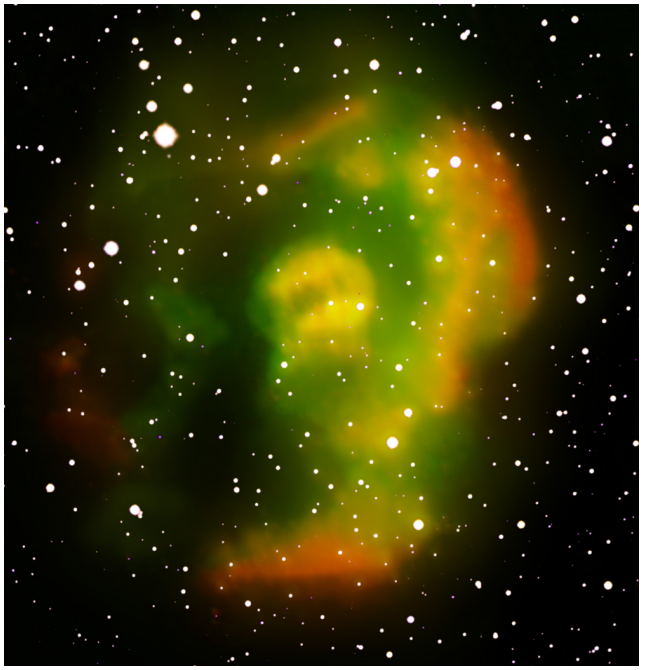
Effective means of identifying planetary nebulae:

- Point source (Viironen+ 2009)
- Extended (Sabin+ 2014)
- ISM interactions (Wareing+2008)



Corradi+ 2011

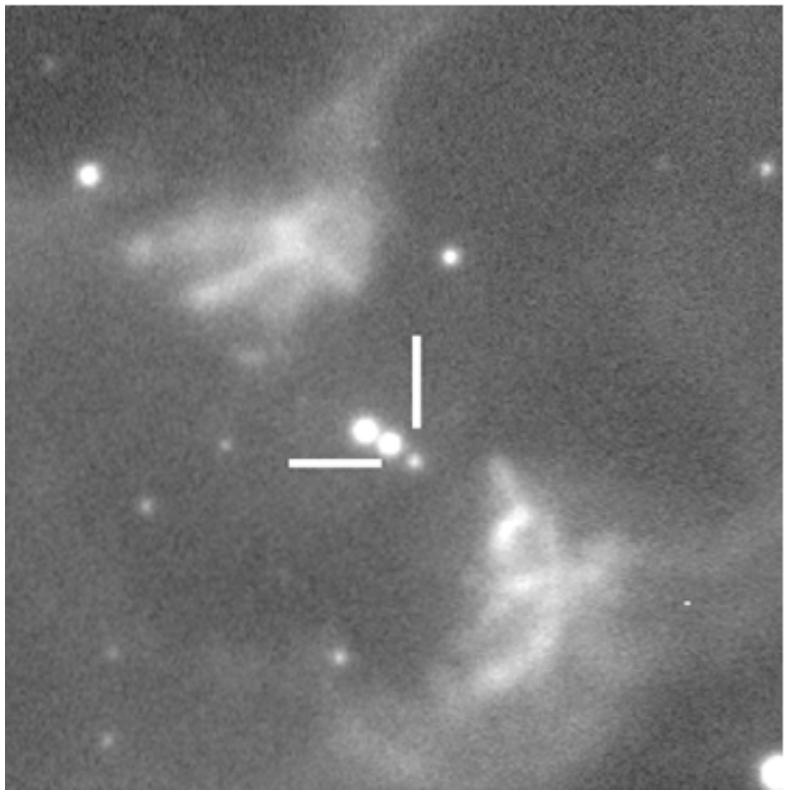
Wareing+ 2008



Sabin+ 2014

Planetary Nebulae

And for identifying the central stars of PNe, e.g. NGC 2899



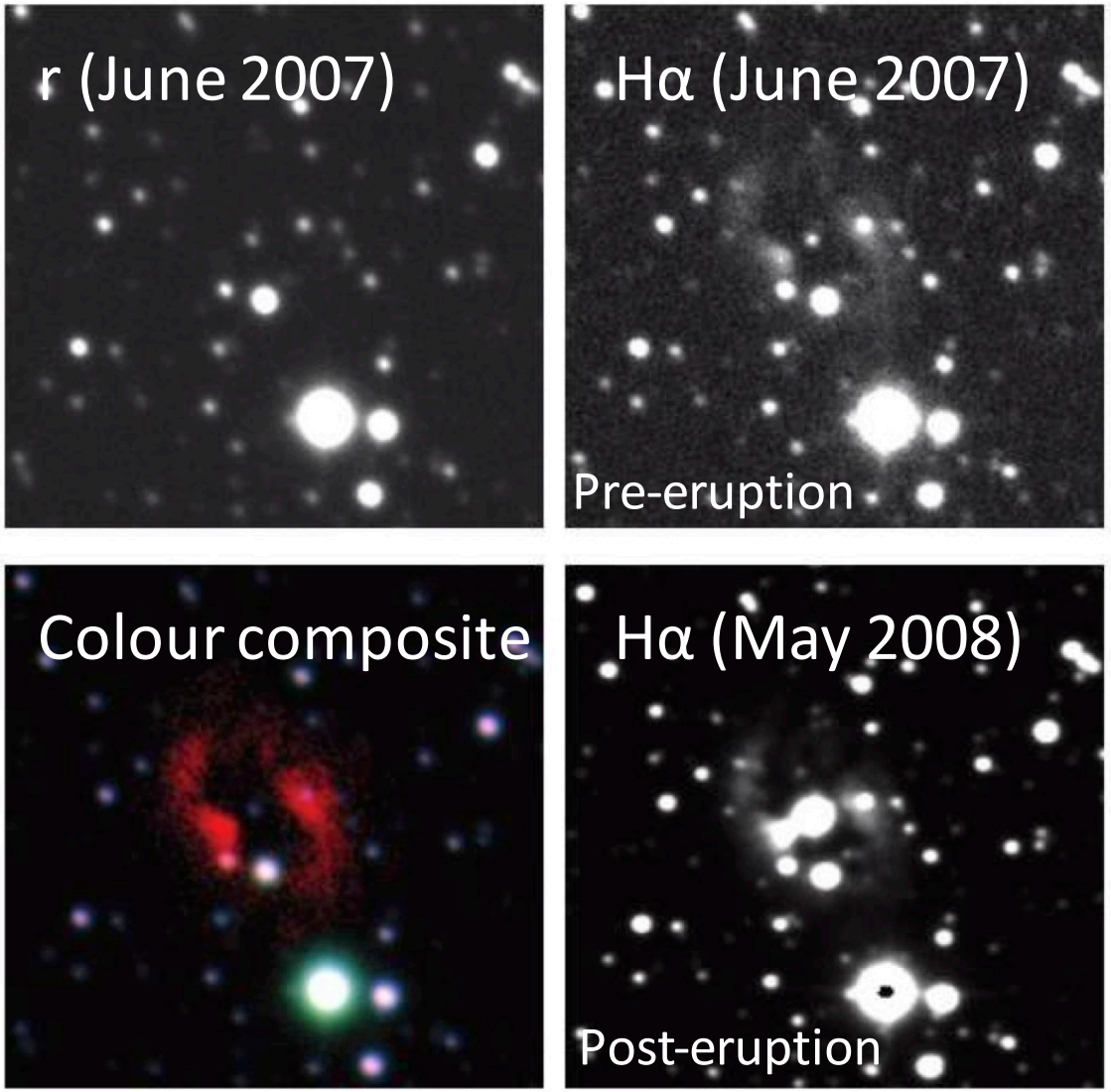
Drew+ 2014

Accretion & Explosions

Effective means to identify:
- Interacting binaries
- Novae

Nova Vulpeculae 2007

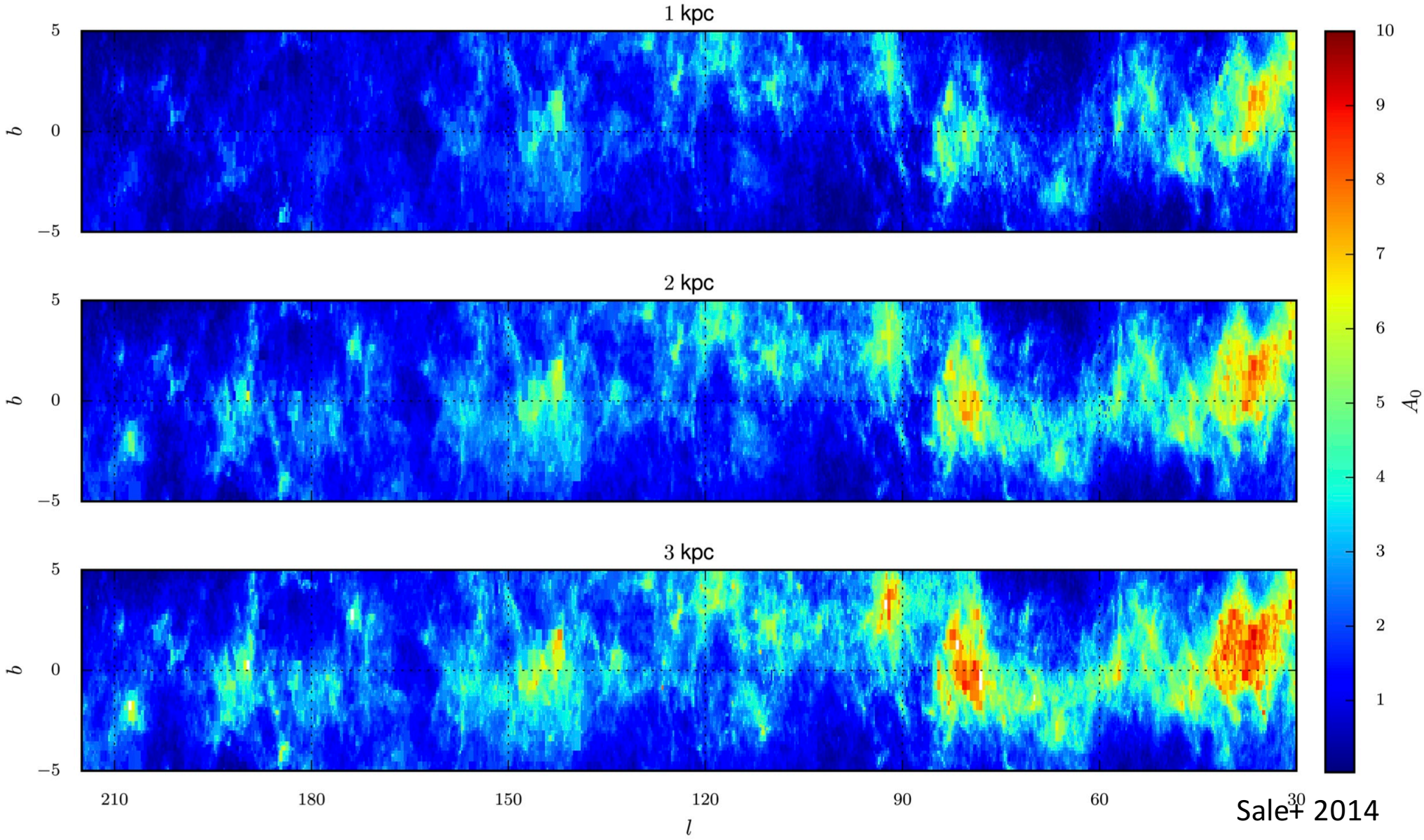
- Pre-eruption Hα image shows a massive shell
- Shell burning on a young white dwarf in a planetary nebula
- Double-degenerate, possible SNIa progenitor



Wesson+ 2008, Rodriguez-Gil+ 2010

3D extinction mapping:

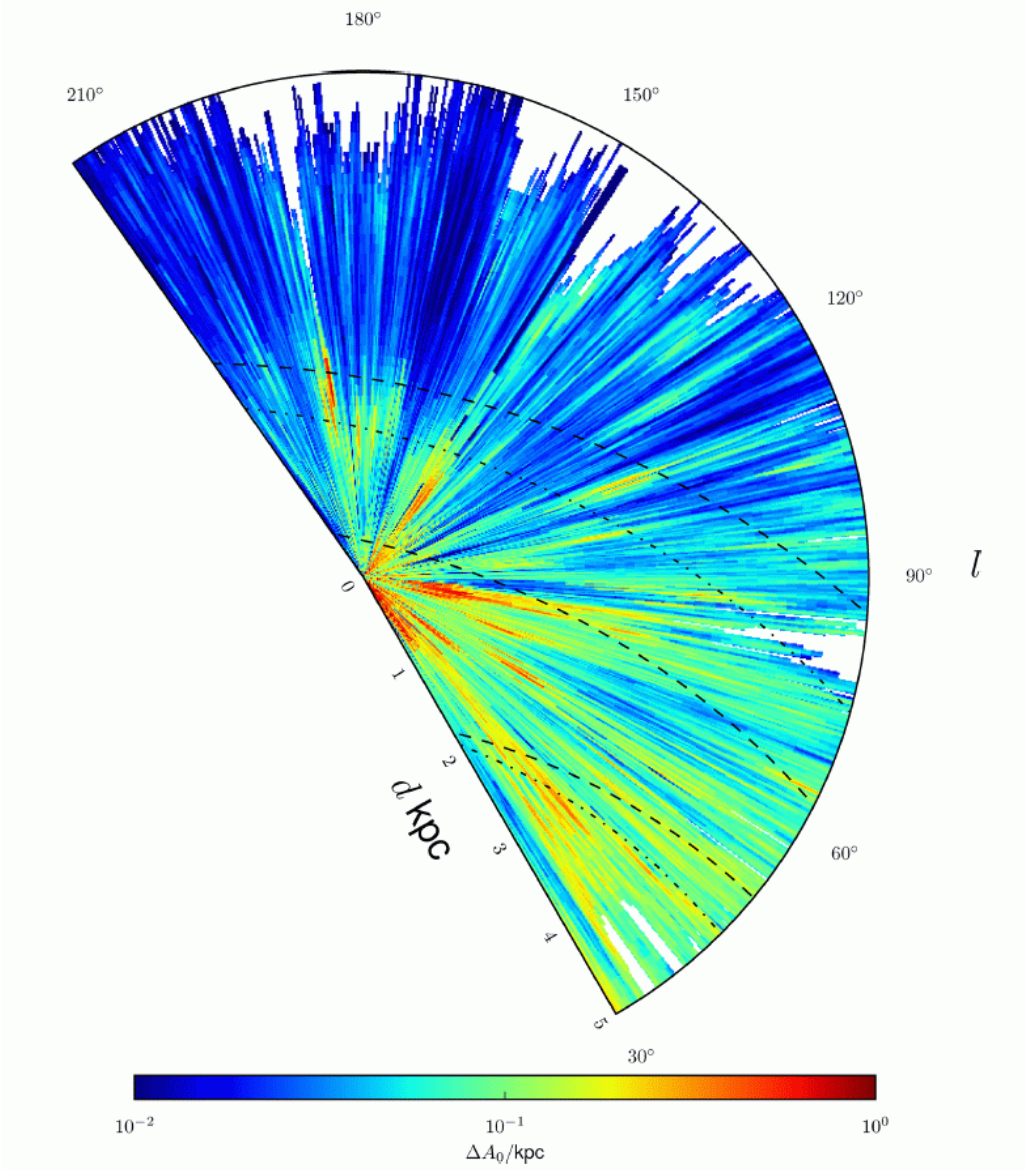
In the north, already achieved, just using r,i,Hα: more power will come from including more bands



Sale+ 2014

3D extinction mapping:

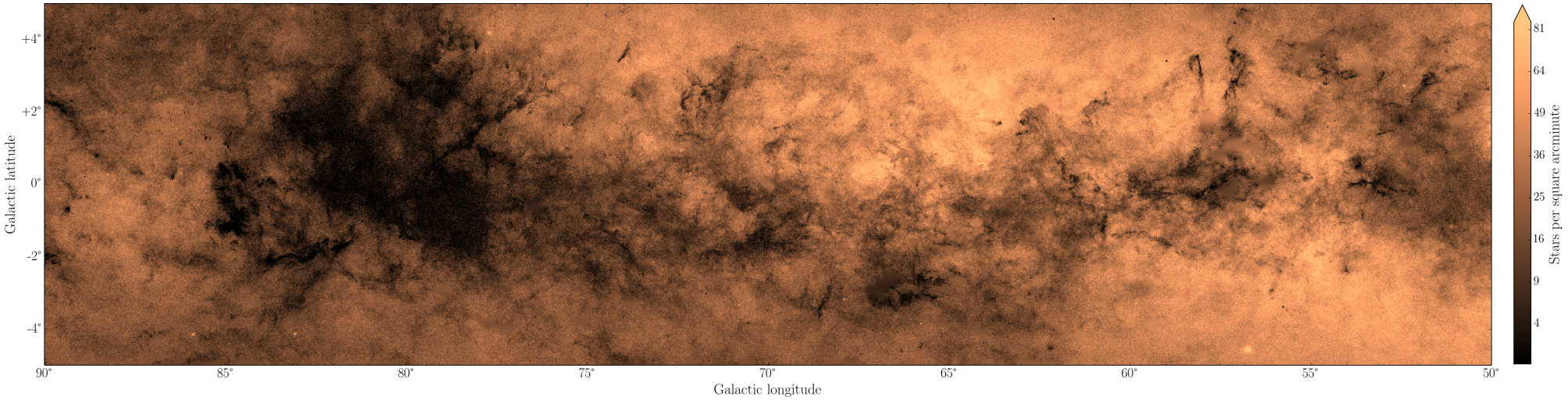
In the north, already achieved, just using r,i,Hα: more power will come from including more bands



Sale+ 2014

Faint star counts for testing Galactic models

Completeness-corrected counts to i = 18 from Aquila through Cygnus, at 2 arcmin^2 resolution



Farnhill+ *MNRAS submitted*

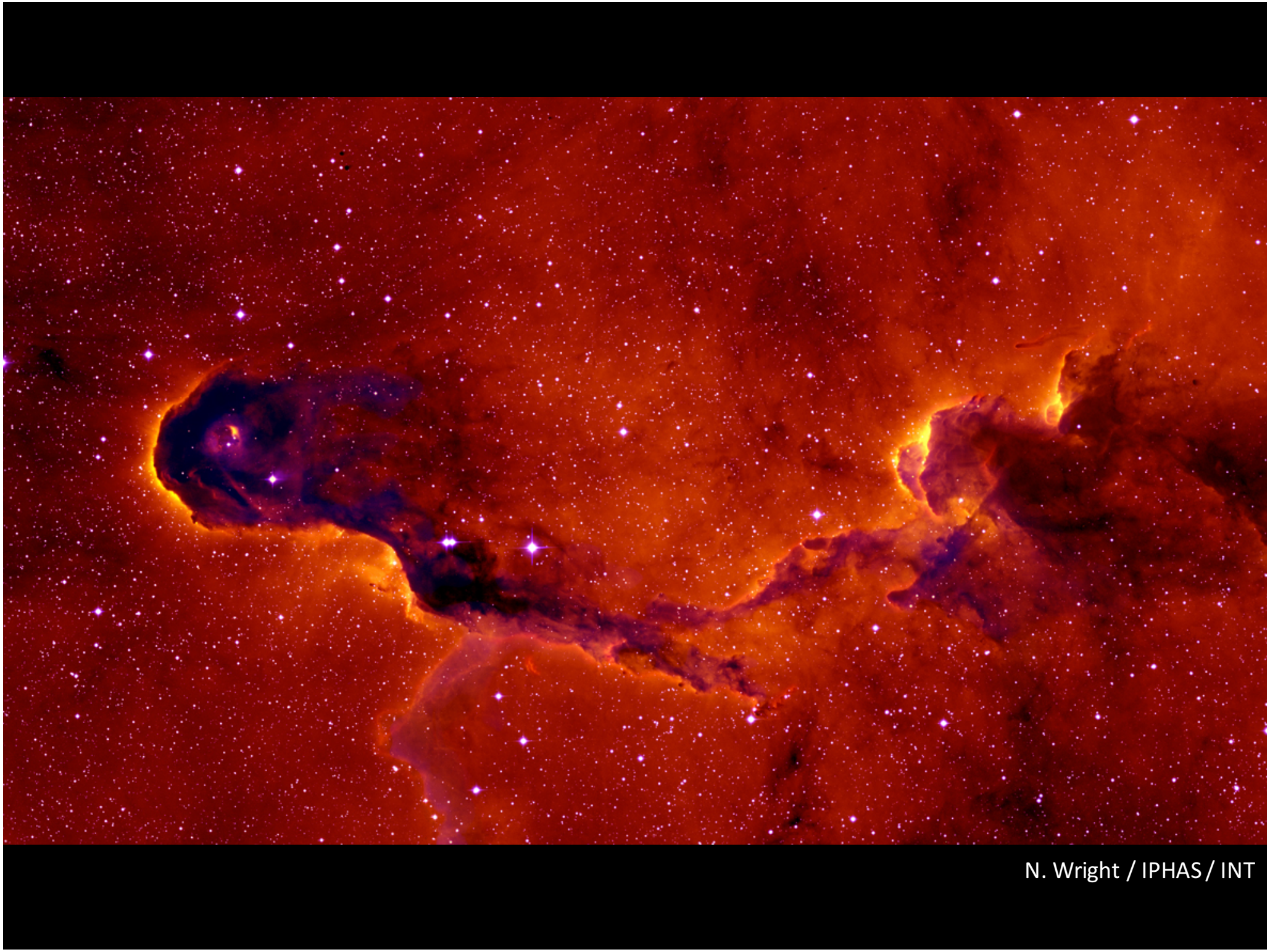
Summary

Galactic Plane surveys IPHAS, UVEX & VPHAS+

- Deep, high-precision, multi-band photometry
- High spatial resolution Hα imaging

The science:

- Studies of short-lived stages of stellar evolution
- Large-scale Galactic population / structure studies



N. Wright / IPHAS / INT