The nearest massive star forming región with Gaia and WEAVE: An exploration of Cygnus

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Expanding the Gaia Legacy
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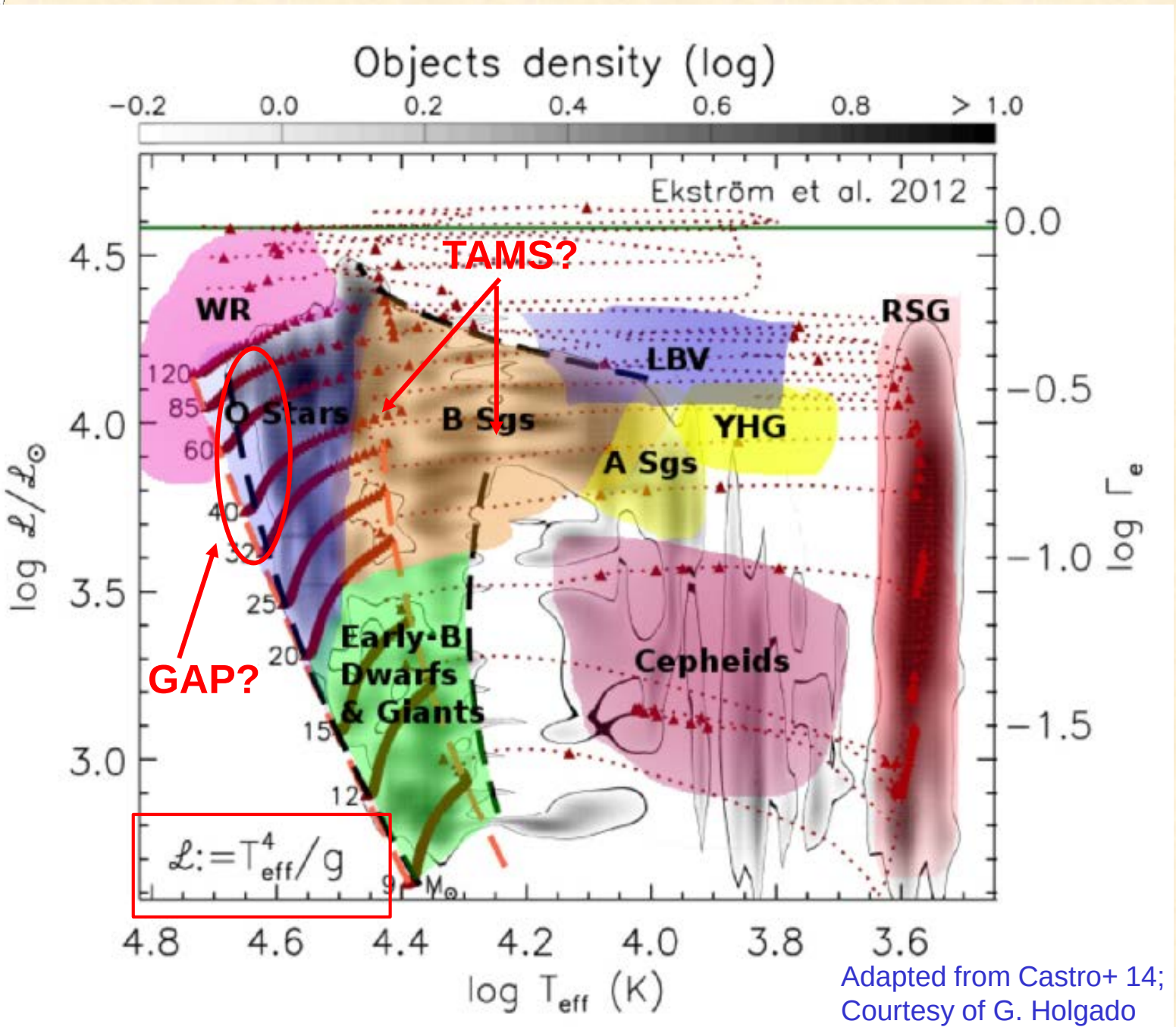
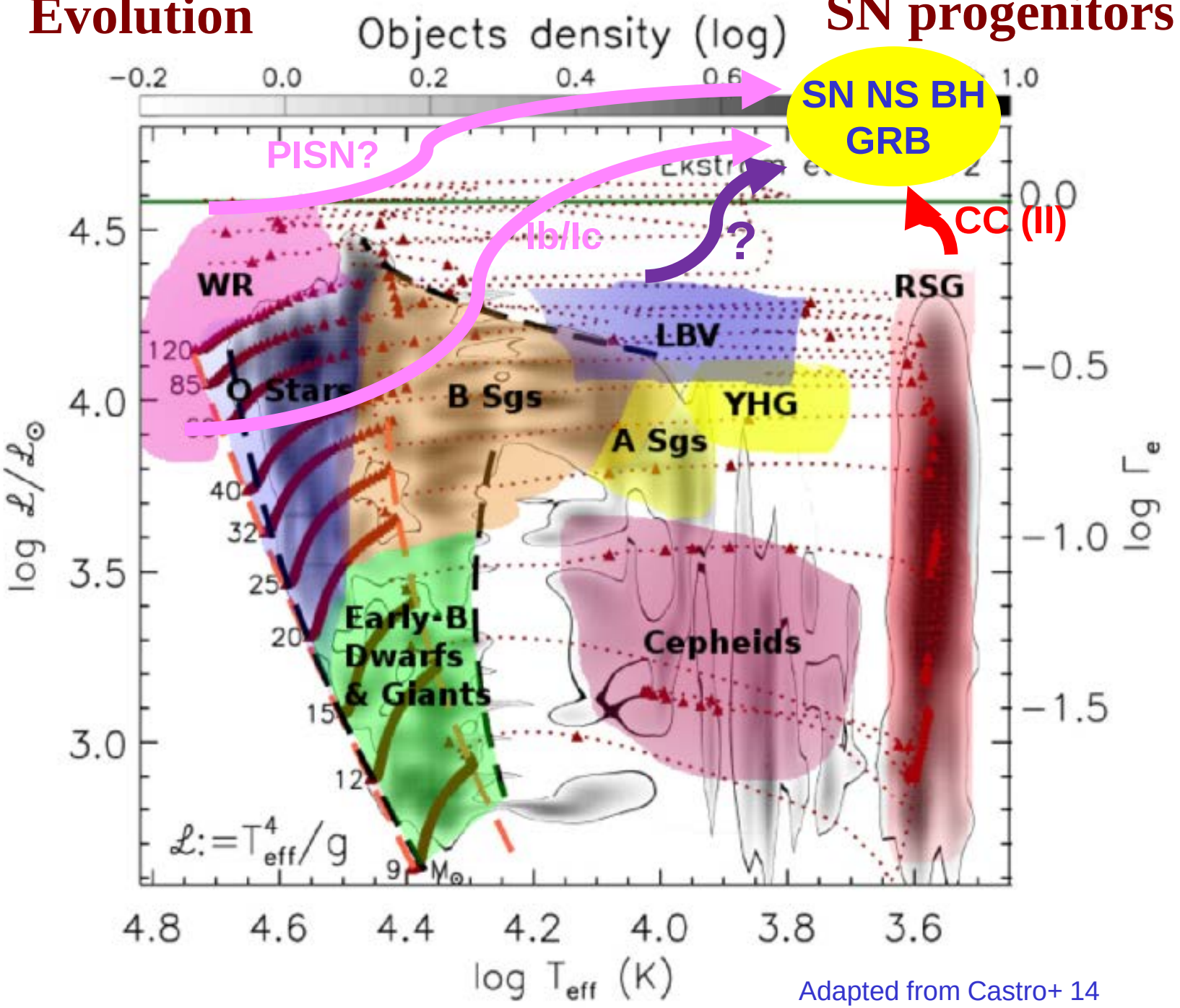
Massive Stars



Adapted from Castro+ 14;
Courtesy of G. Holgado

Evolution

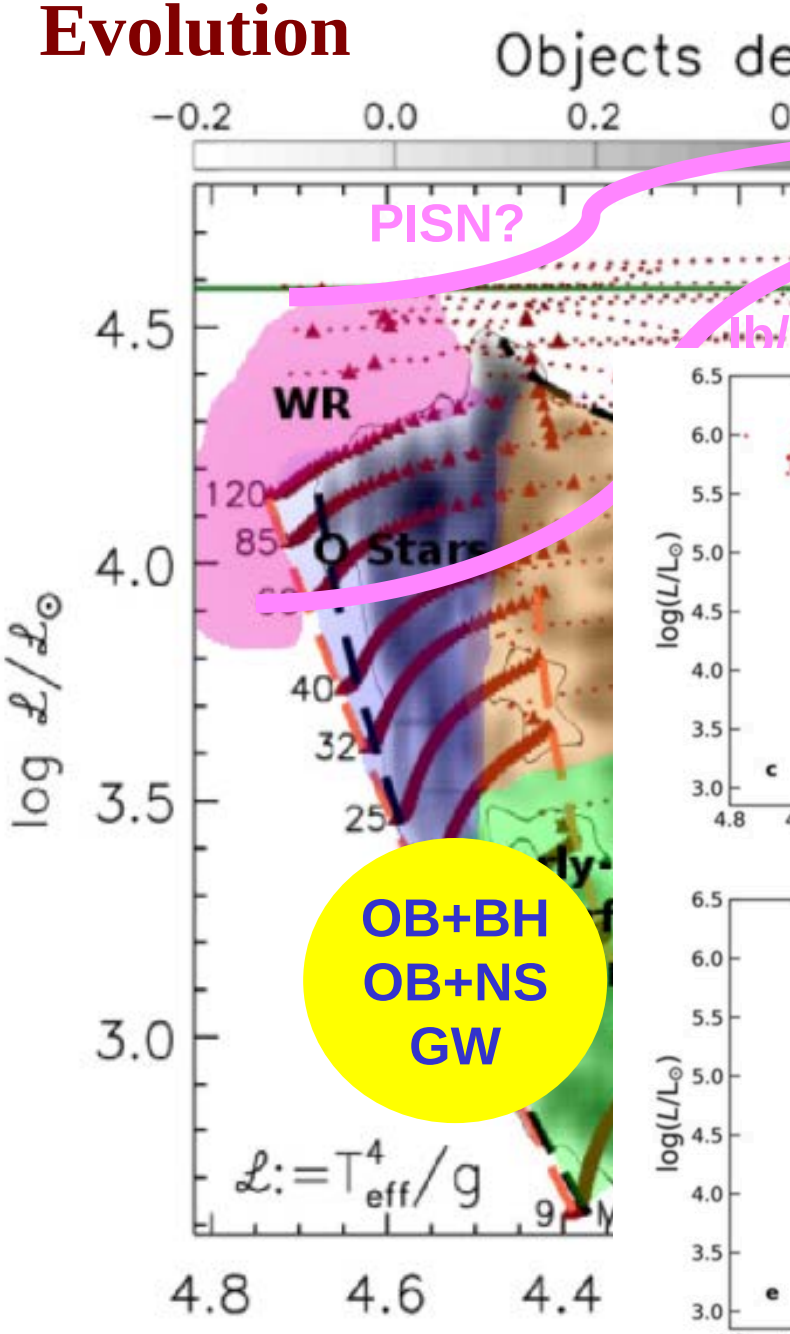
SN progenitors



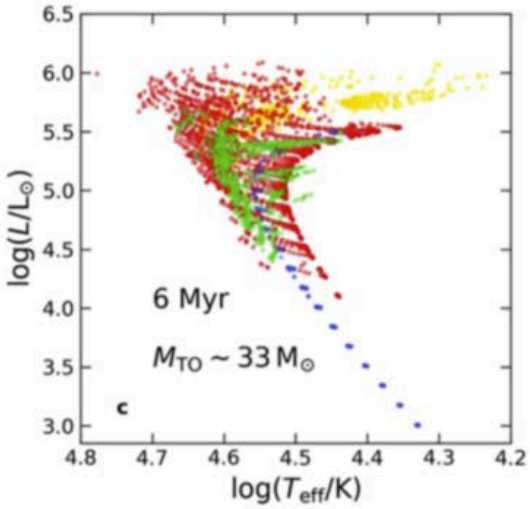
Adapted from Castro+ 14

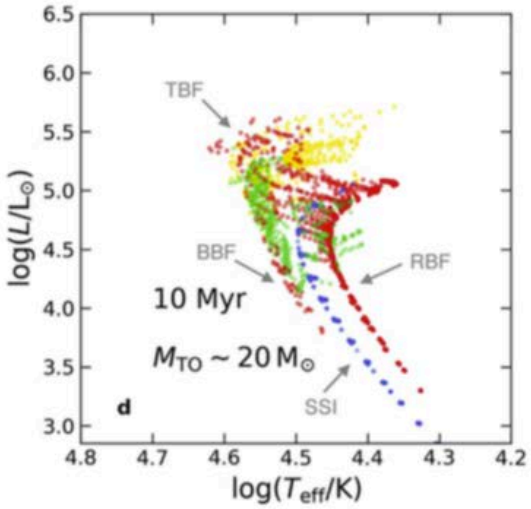
Evolution

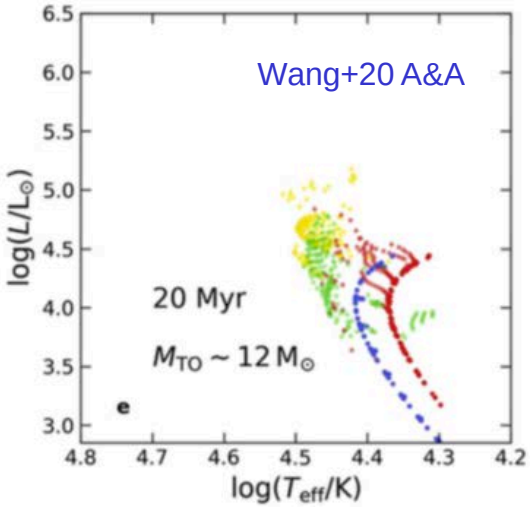
Multiplicity

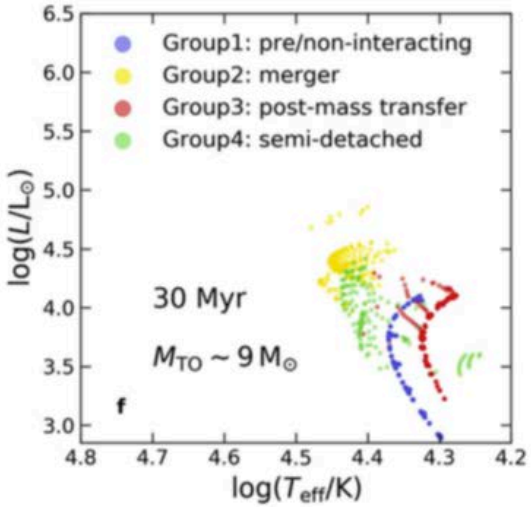


OB+BH
OB+NS
GW



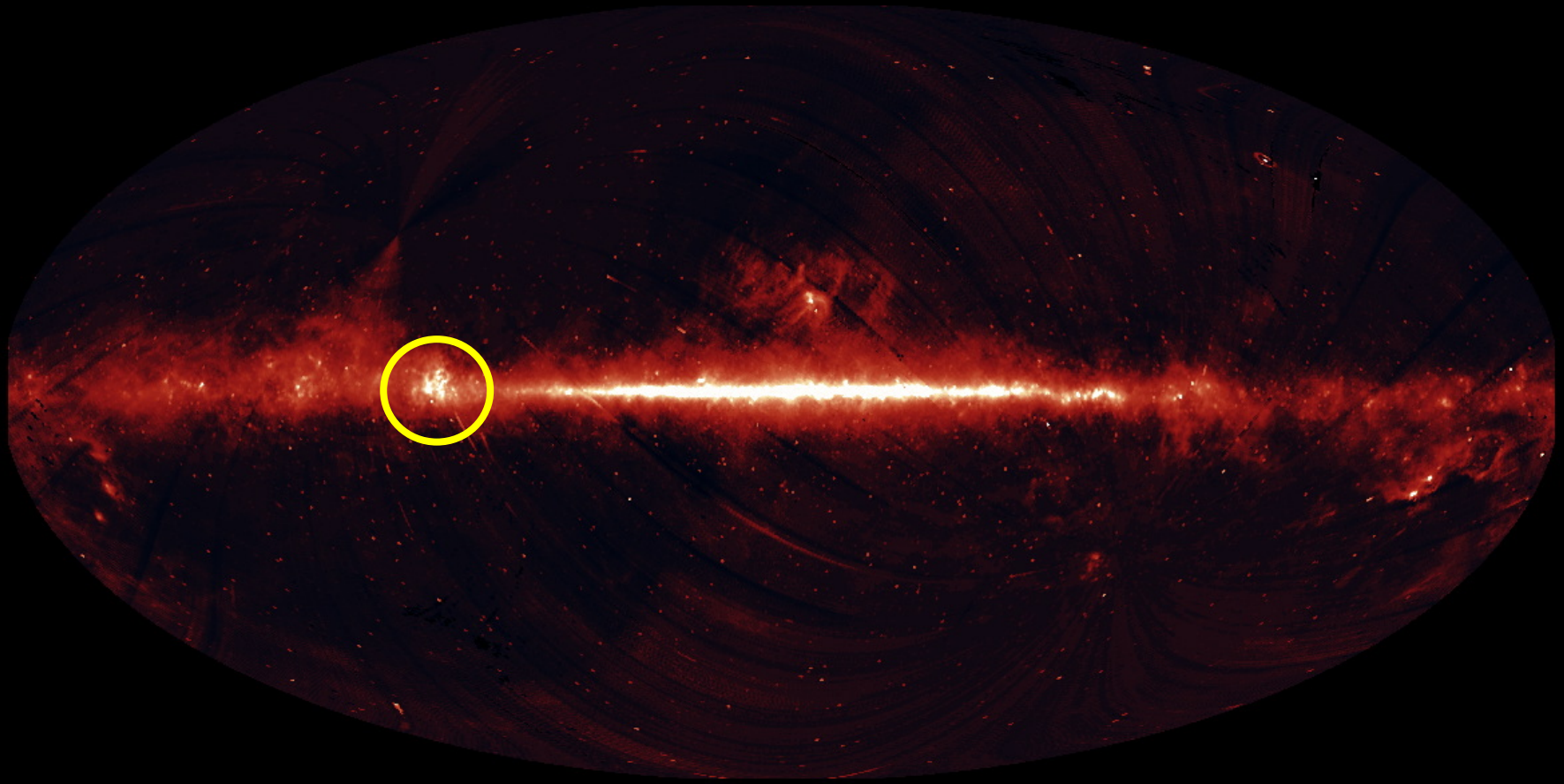






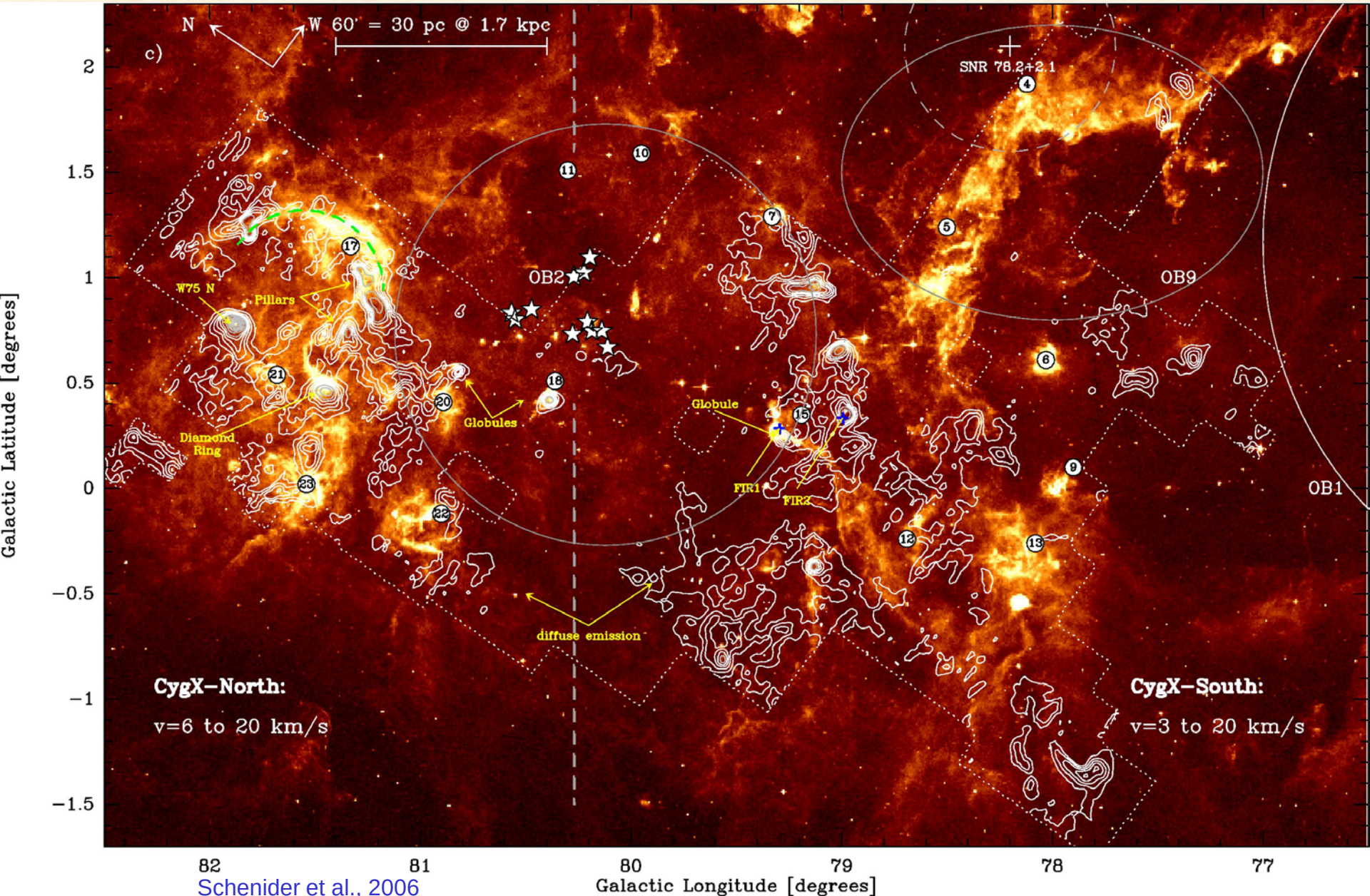
Adapted from Castro+ 14

Massive Stars in the Milky Way – Cygnus X



Credit: AKARI

Massive Stars in the Milky Way – Cygnus X

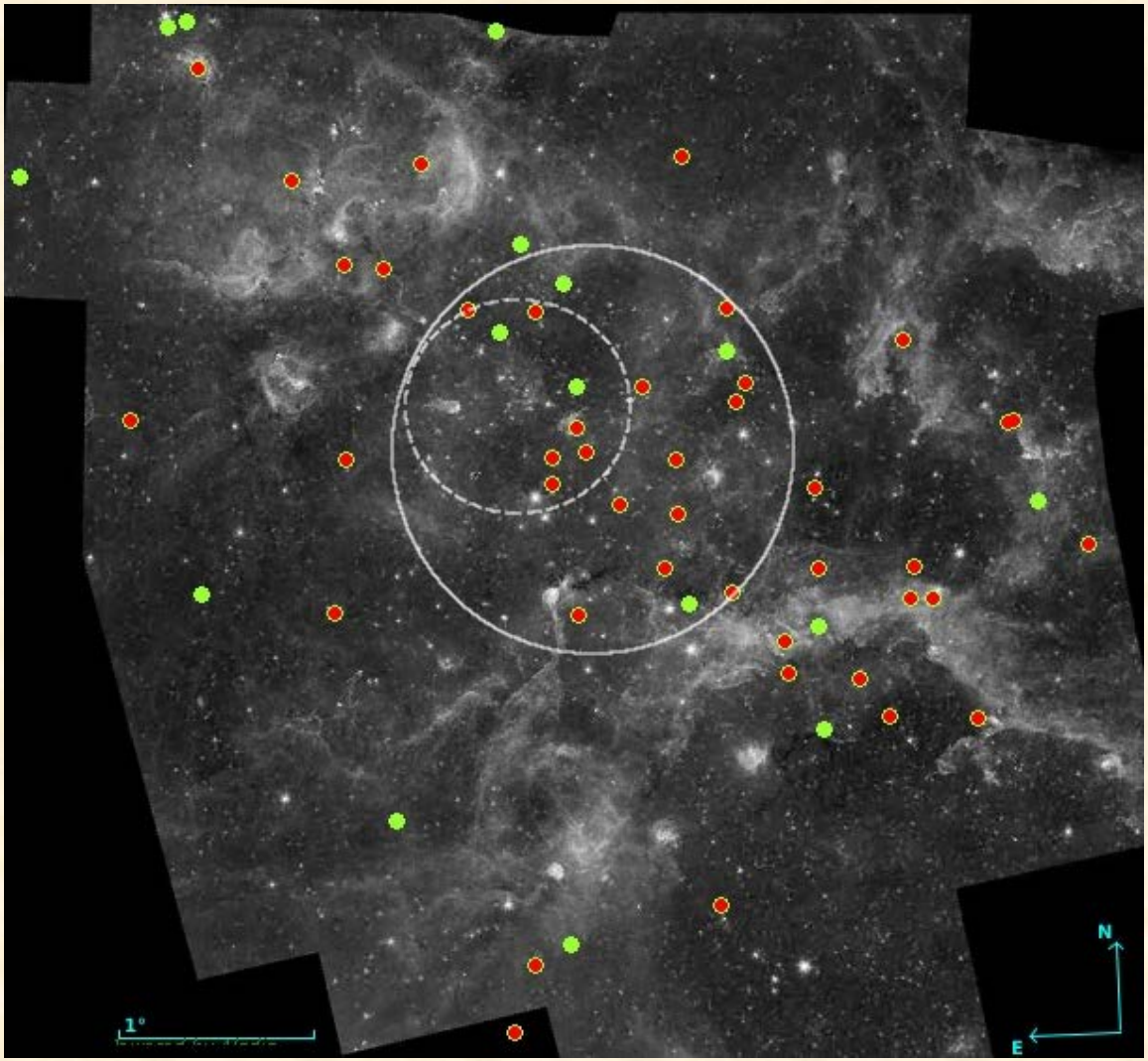


Schenider et al., 2006

Massive stars in Cyg OB2 - census

(Berlanas et al., 2018)

Start: 102 known O2-B3 stars
Comerón & Pasquali (2012): 61 new OB candidates

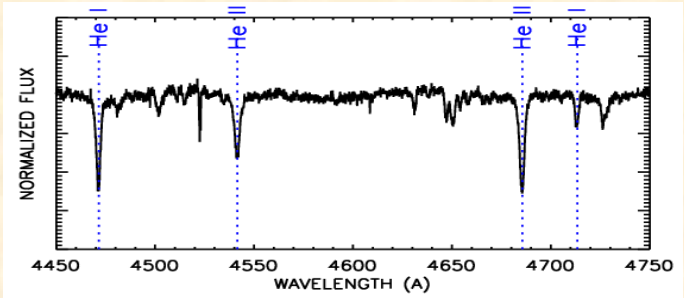


Spectral classification of new spectra (WHT + INT obs + GOSSS)

11 O-type
31 early-B
 # 42 < B3 V

19 late-B, A, F, G types

Example:



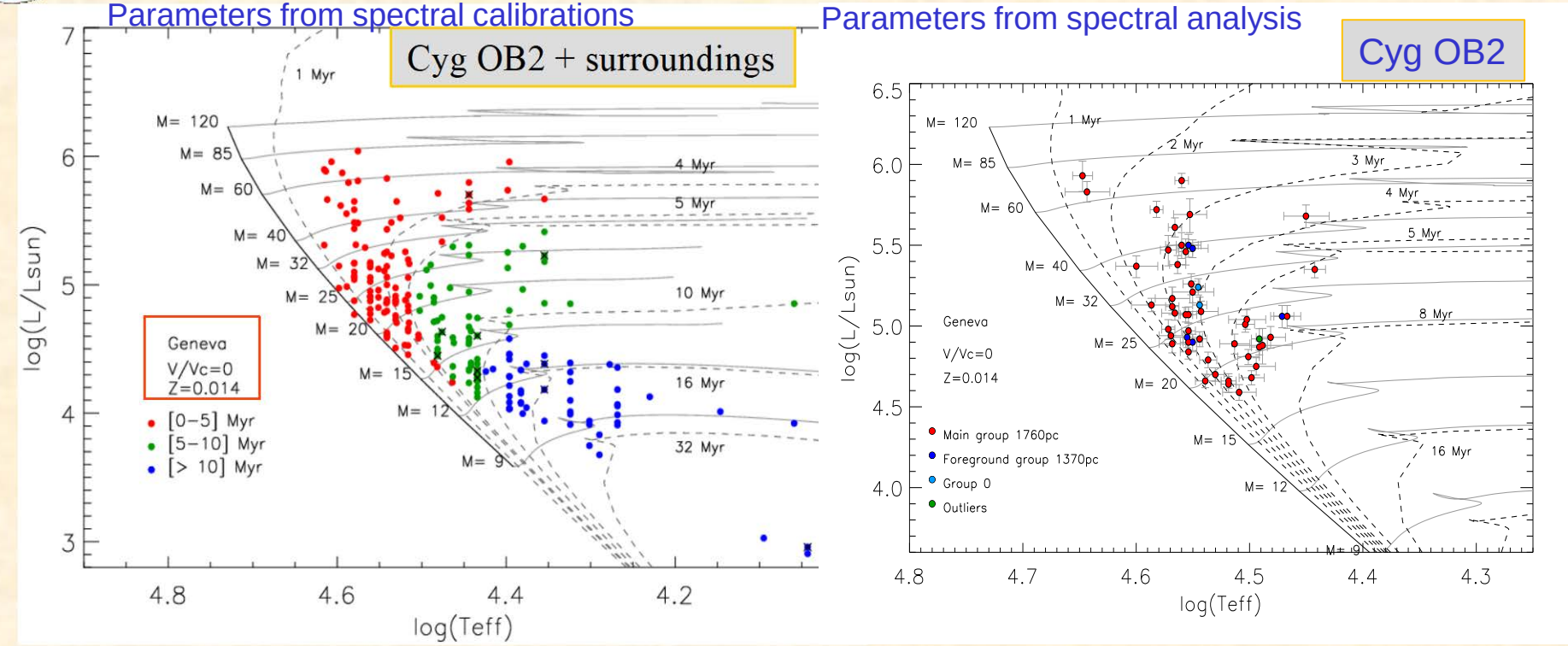
J20293563+4024315 / O8.5IIIz

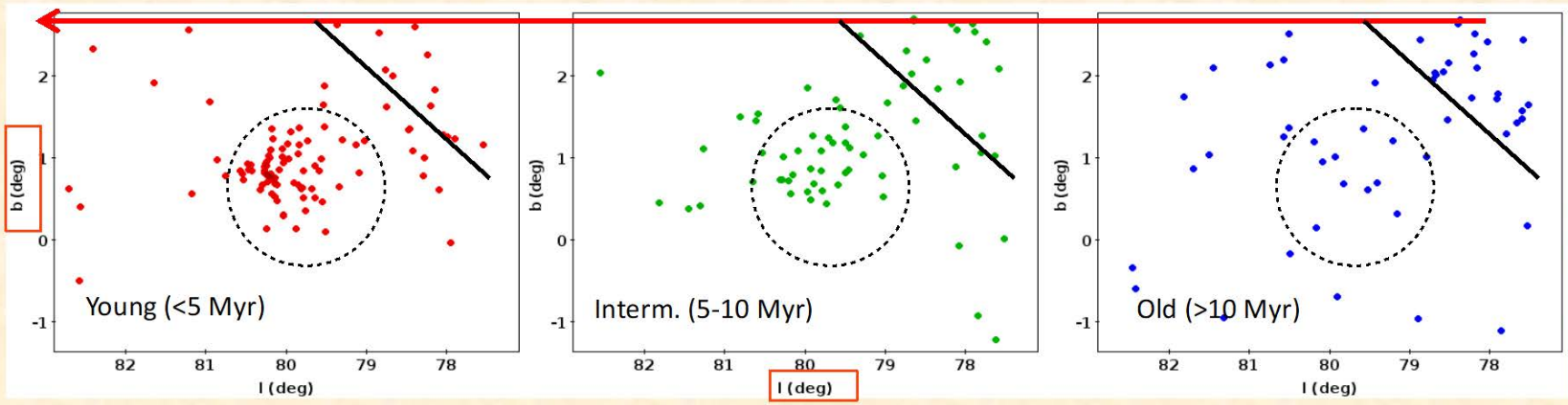
Massive stars in Cyg OB2 - analysis

(Berlanas et al., 2018; Berlanas et al., in prep.)

Parameters from spectral calibrations

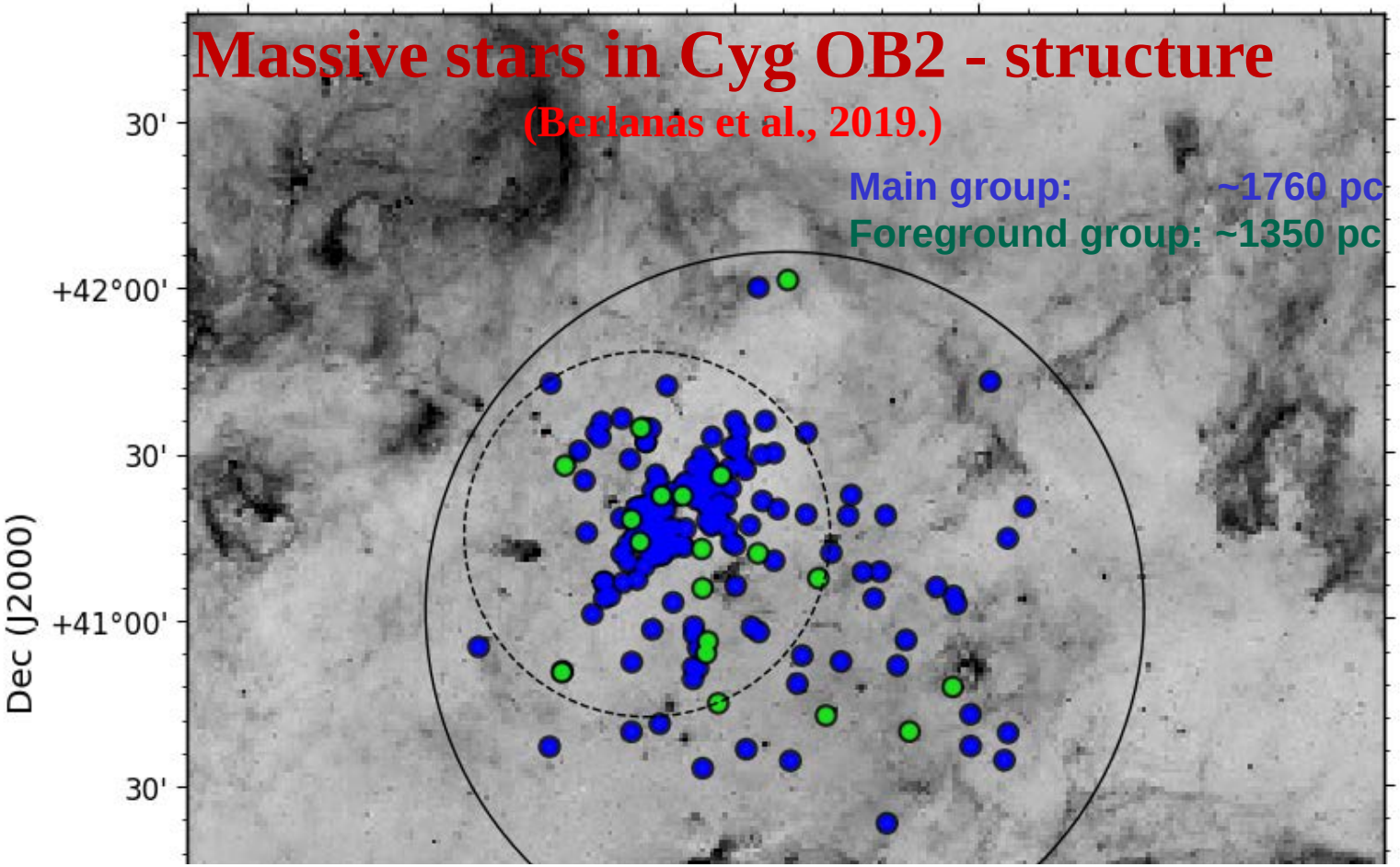
Parameters from spectral analysis

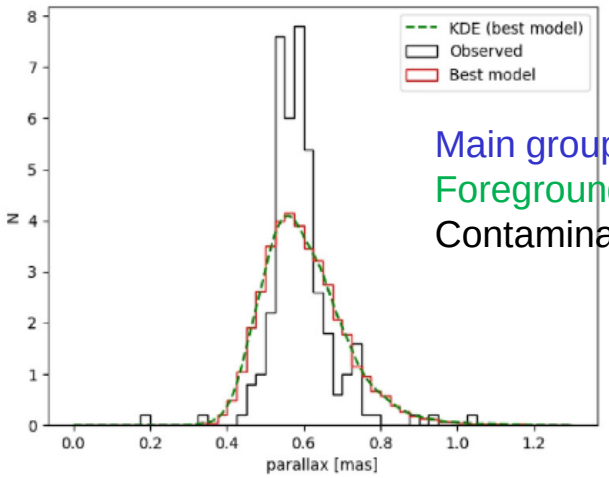




Massive stars in Cyg OB2 - structure

(Berlanas et al., 2019.)

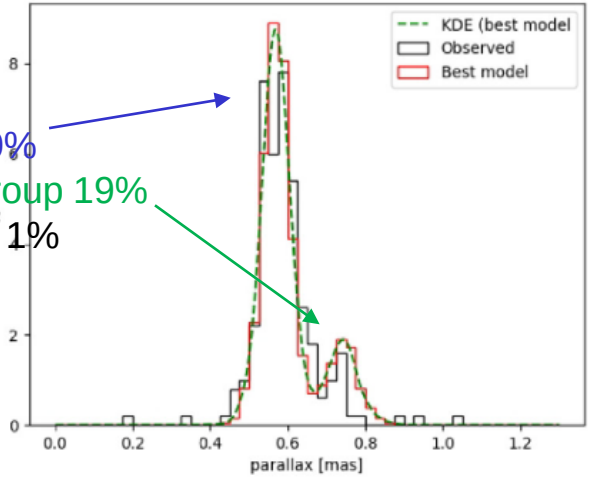


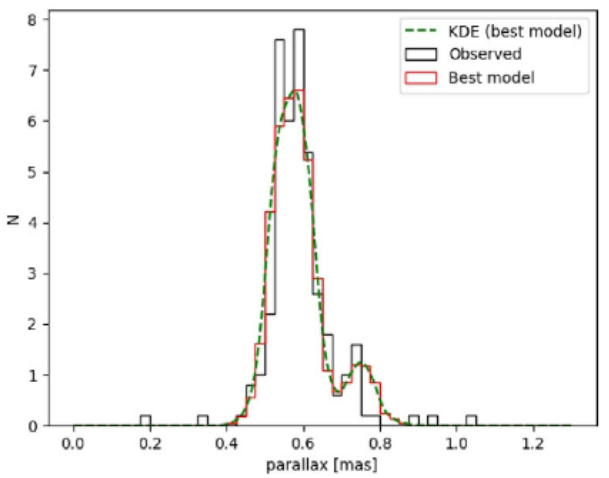


Main group 80%

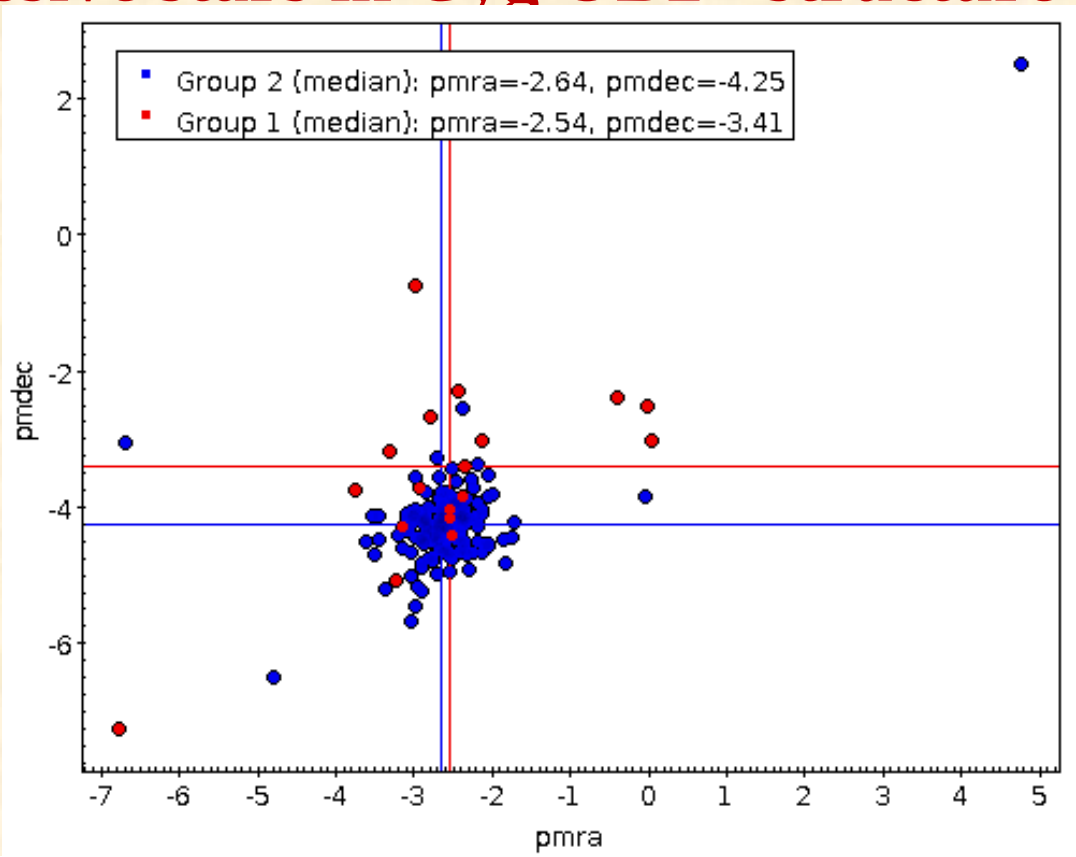
Foreground group 19%

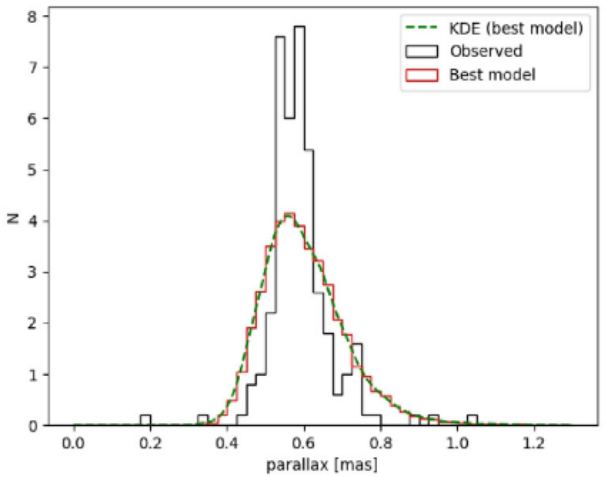
Contaminants 1%

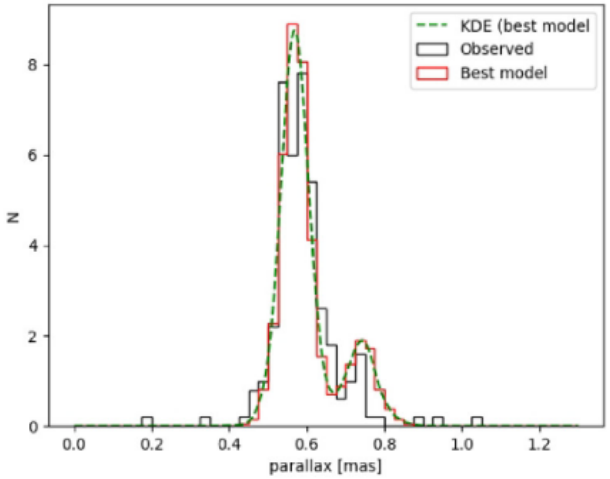


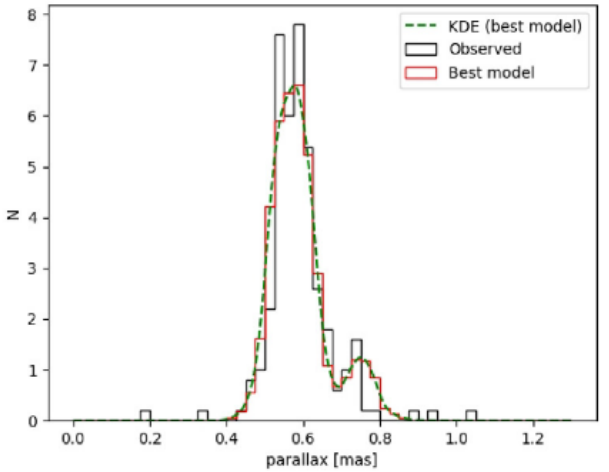


Massive stars in Cyg OB2 - structure

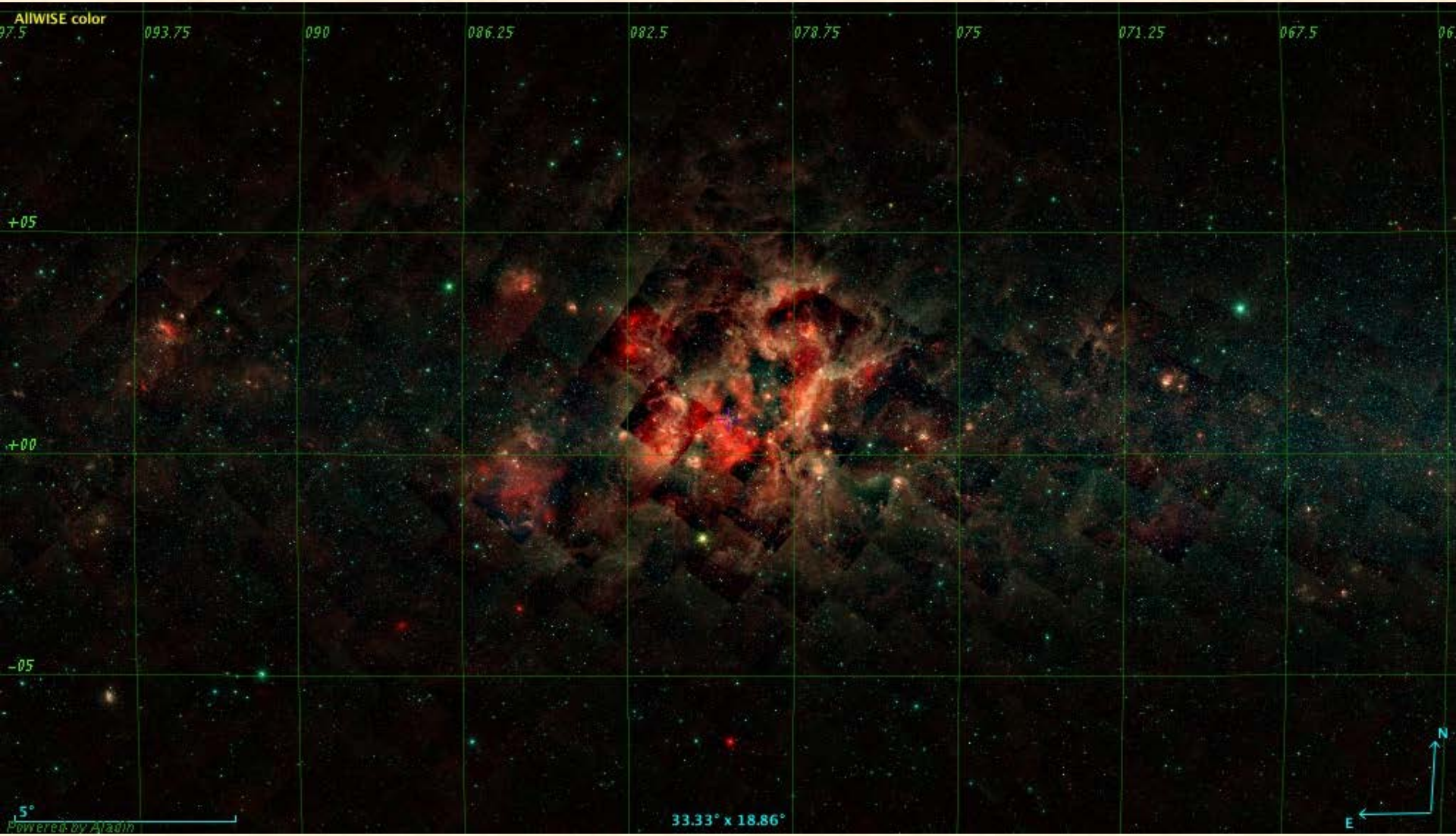








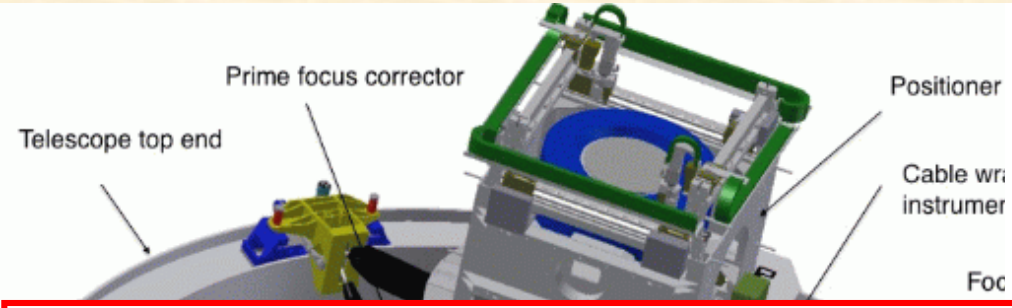
Massive stars in Cygnus X with WEAVE

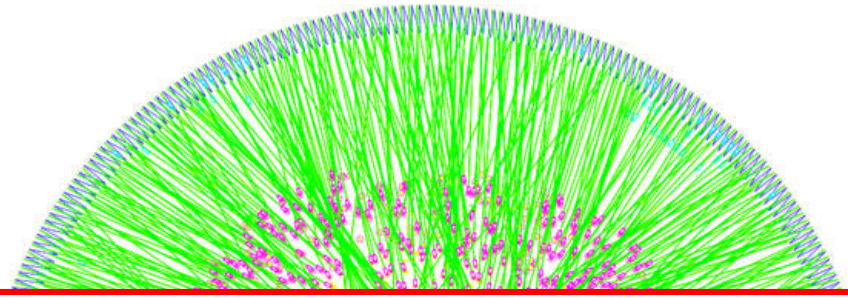


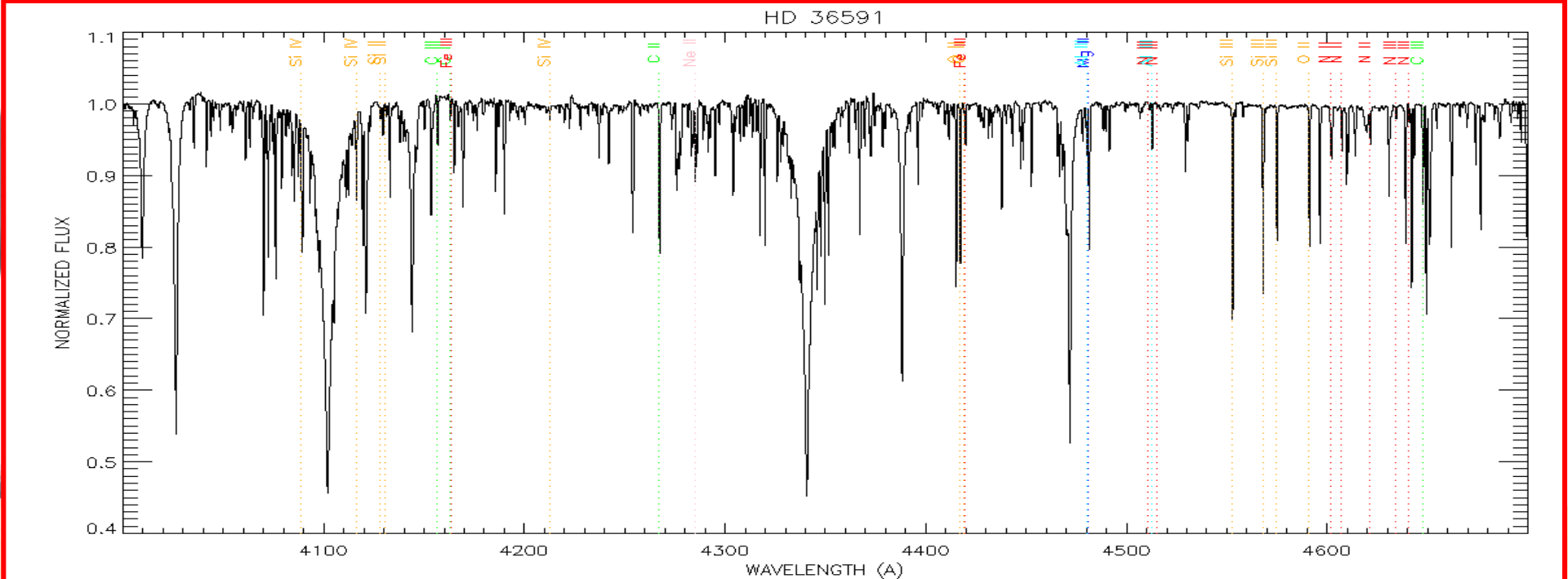
Massive stars in Cygnus X with WEAVE

2 deg ϕ
960-940 fibers
IFU mode

HR mode
blue/green + red grating
R=2000 404-465nm
595-685nm



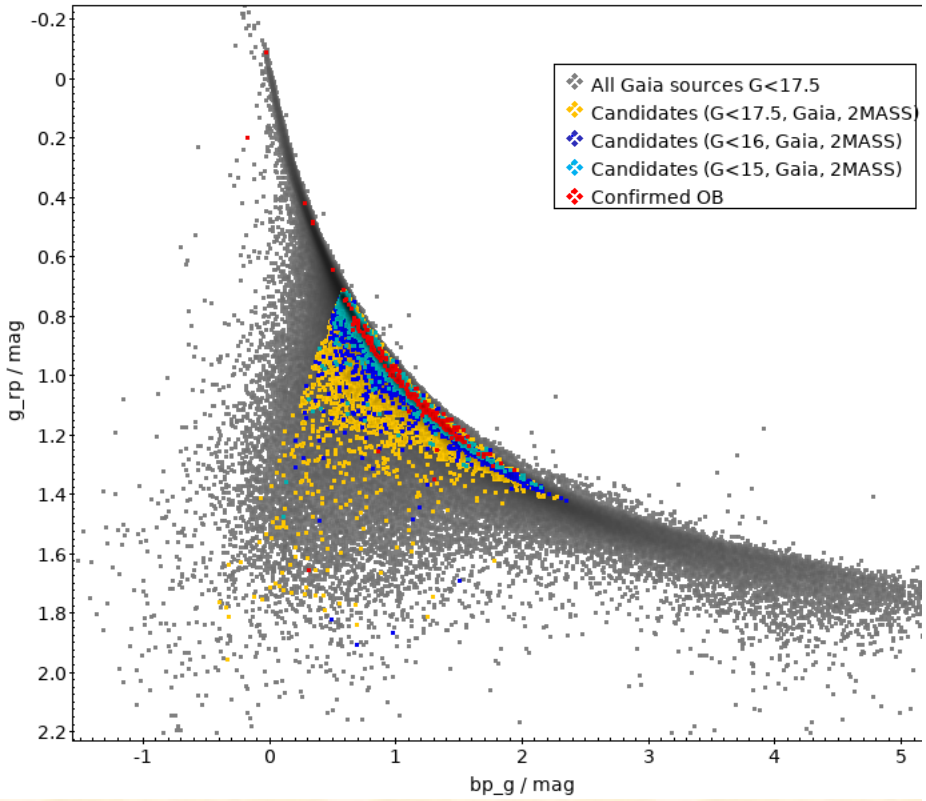


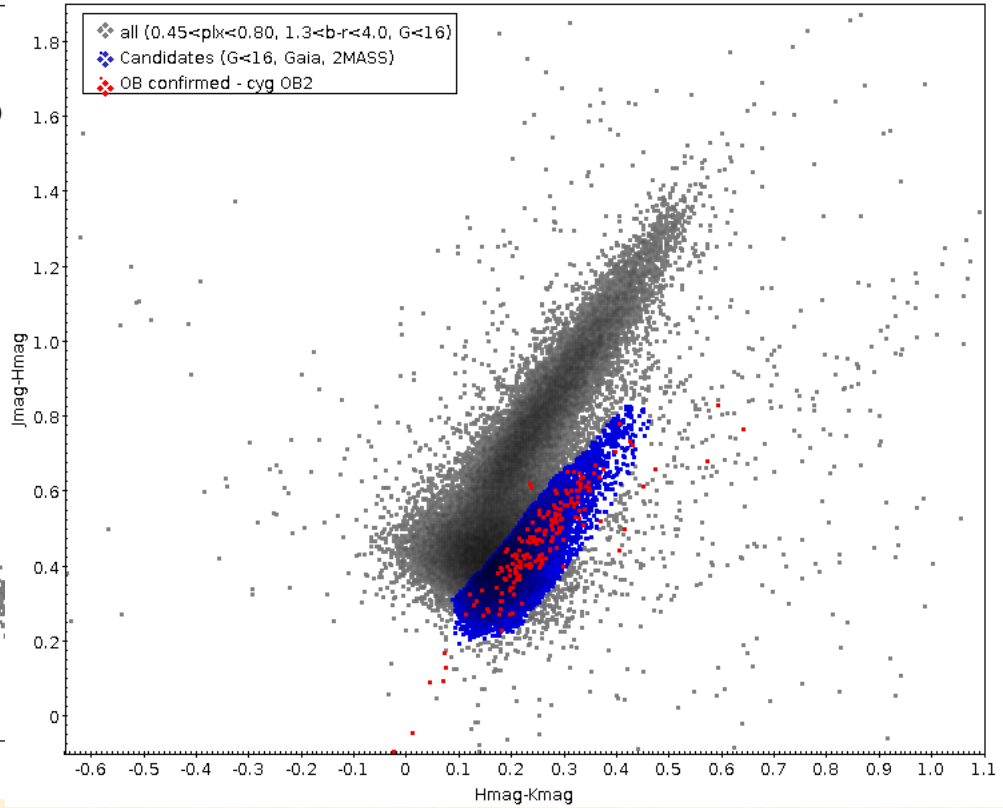


Massive stars in Cygnus X with WEAVE

- Target selection is made following Gaia and 2MASS
  - $0.45 < \pi < 0.80$
  - $1.3 < Bp\text{-}Rp < 4.0$

  From the structure paper (Berlanas et al., 2019)
  - $G < 16$ — Given by WEAVE efficiency
  - No RV measurements in Gaia catalog





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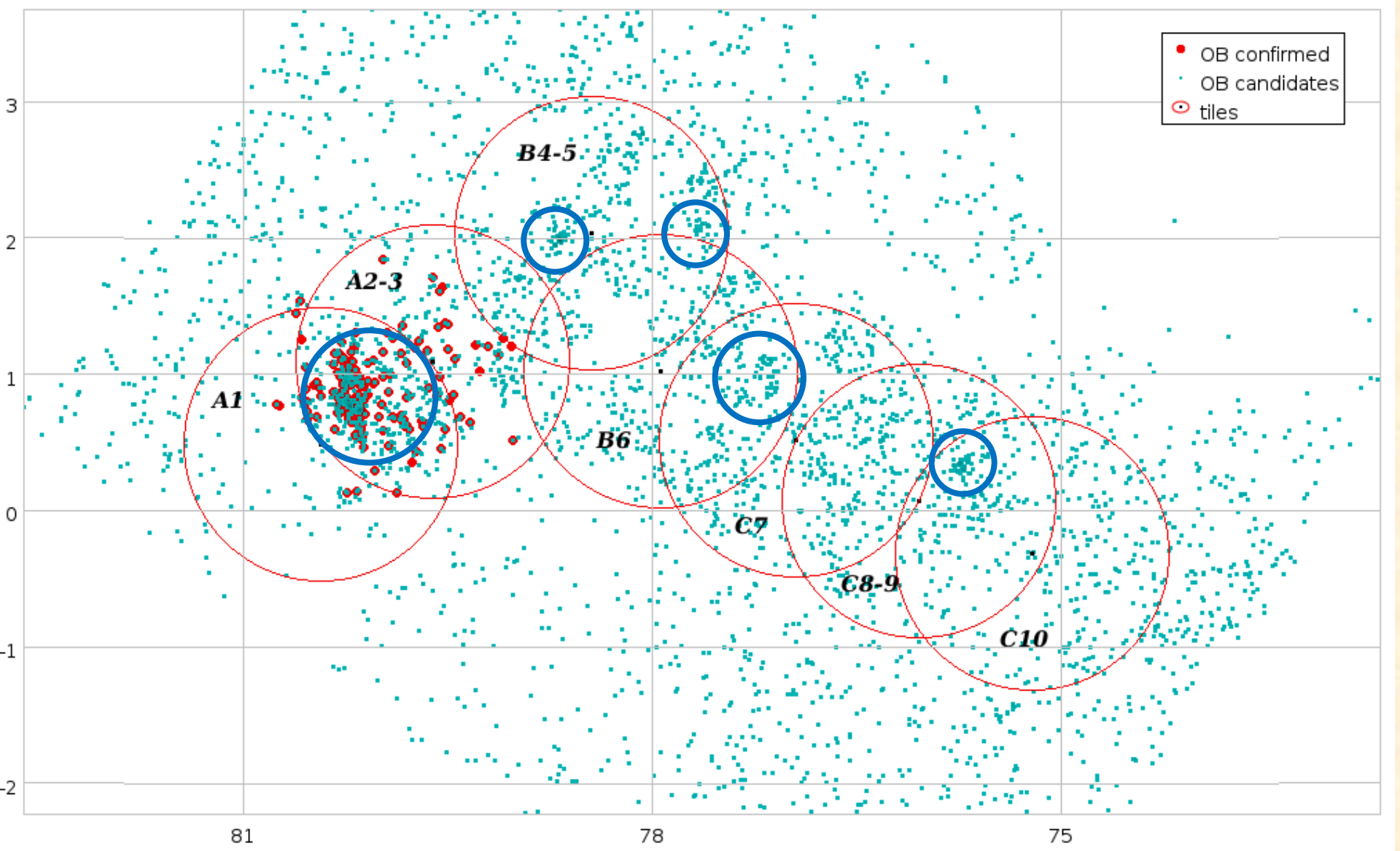
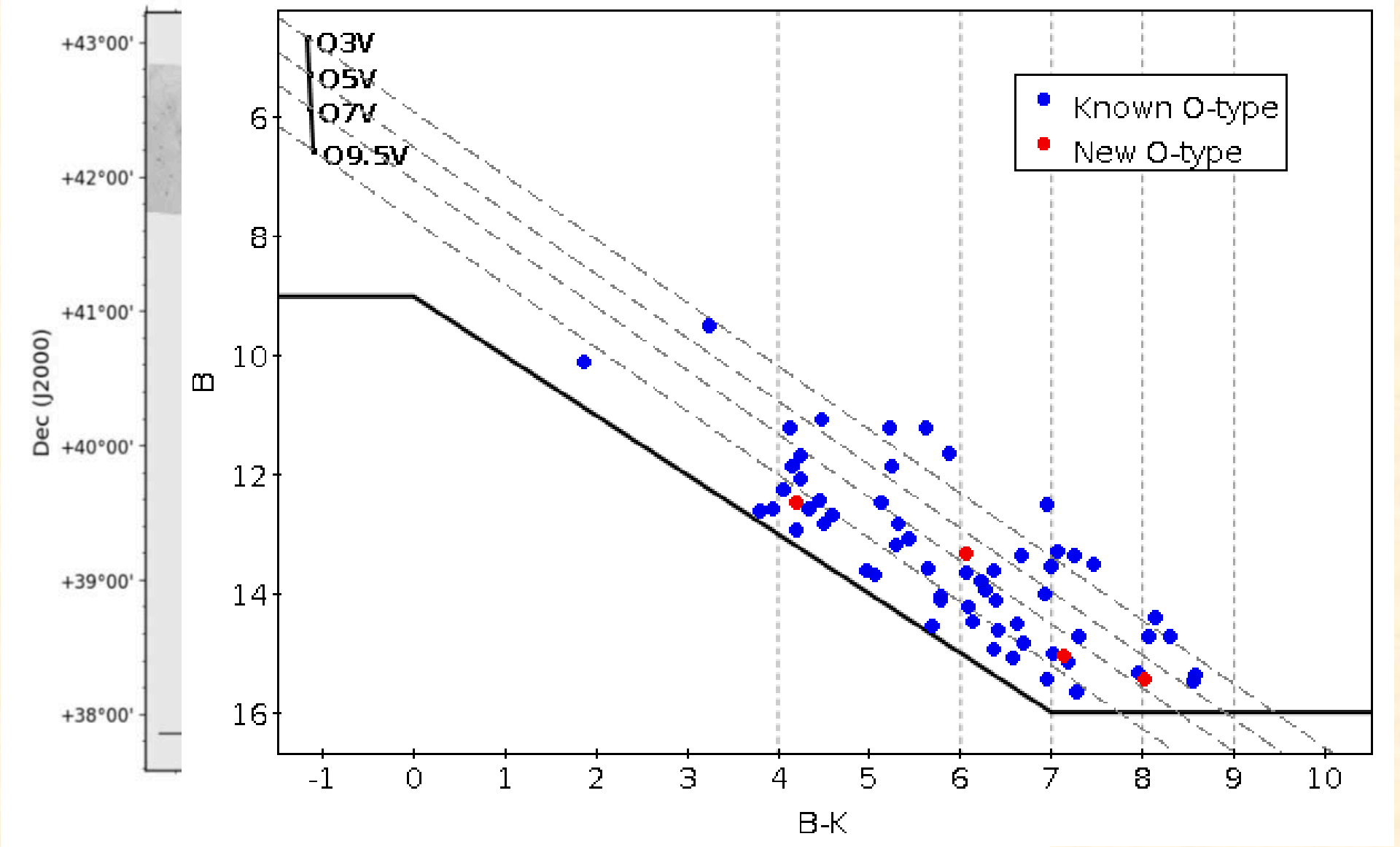


Main WEAVE Cygnus-HR objectives

- Initially driven by the study of abundances in massive stars (of any spectral type)
- Secure high S/N massive star spectra at the highest WEAVE resolution in the star-forming Cygnus region to:
  1. Obtain rotational velocities and their distributions, especially in the low vsini region (< 100 km/s)
  2. Determine binary fractions and stellar multiplicity
  3. Determine accurate stellar parameters, particularly gravity, improving those obtained from the LR survey and allowing more precise radii and masses with the help of Gaia data
  4. Obtain accurate abundances and spatial abundance patterns for O3-B9 stars in the region for targets with 11<B<16.5
  5. Determine the kinematical and dynamical status of the stars in the Cygnus region

- But these are not the only targets
  - BAF stars: age extensión, ZAMS anchor point, kinematics, dynamics, structure
  - BA stars: TAMS characteristics
  - PMS and YSO: kinematics, star formation activity
  - ISM: abundances, kinematics
  - Individual targets (Cepheids, withe dwarfs)

Massive stars in Cygnus X beyond WEAVE



Massive stars in Cygnus X beyond WEAVE

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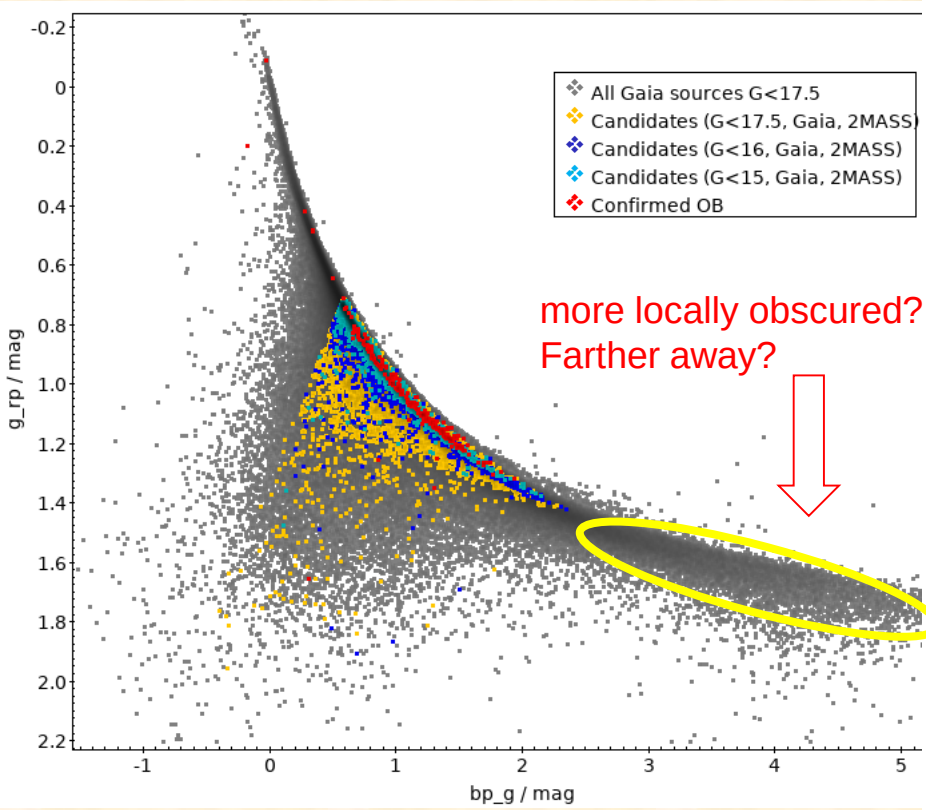
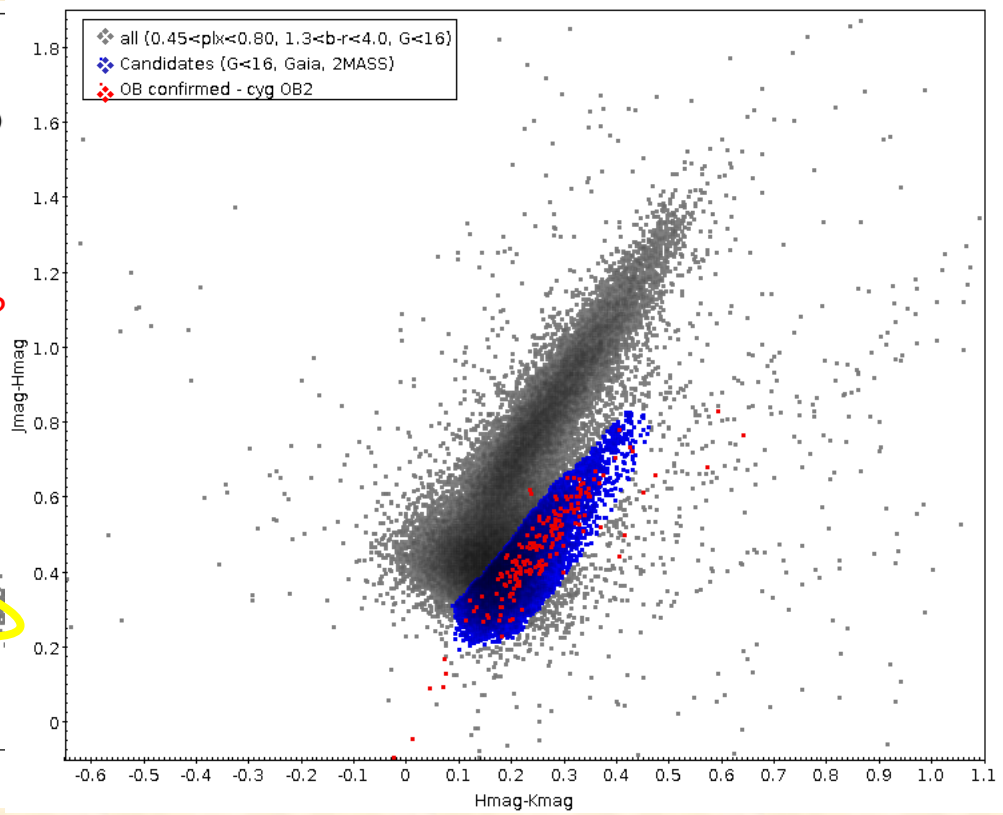
  } From the structure paper (Berlanas et al., 2019)
  - $G < 16$ Given by WEAVE efficiency
  - No RV measurements in Gaia catalog

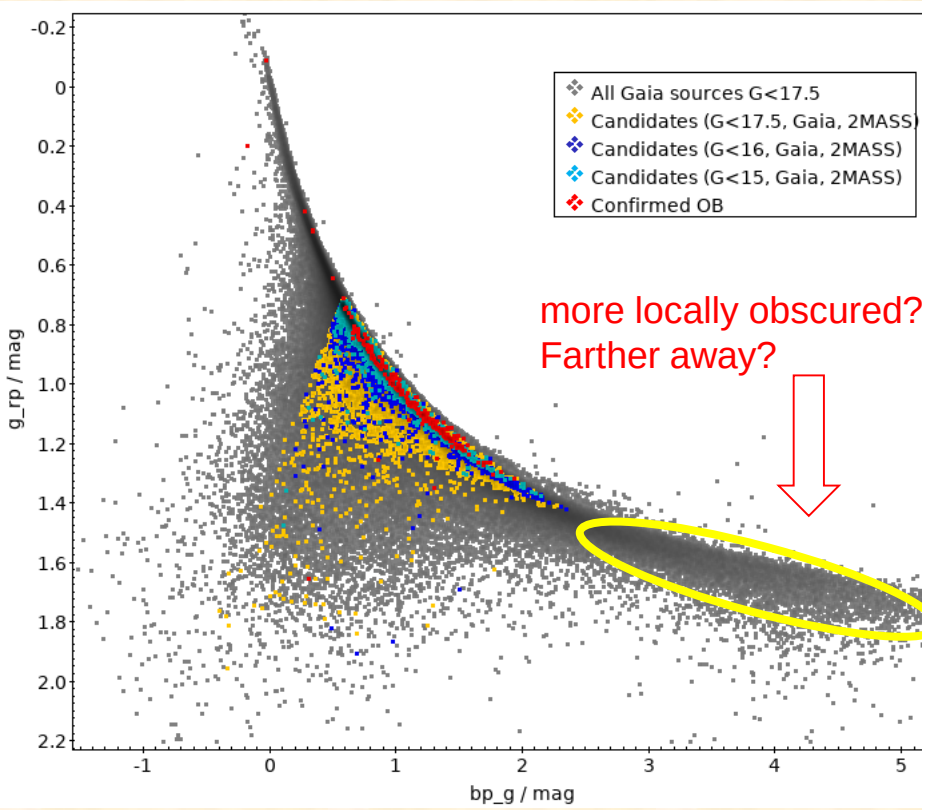


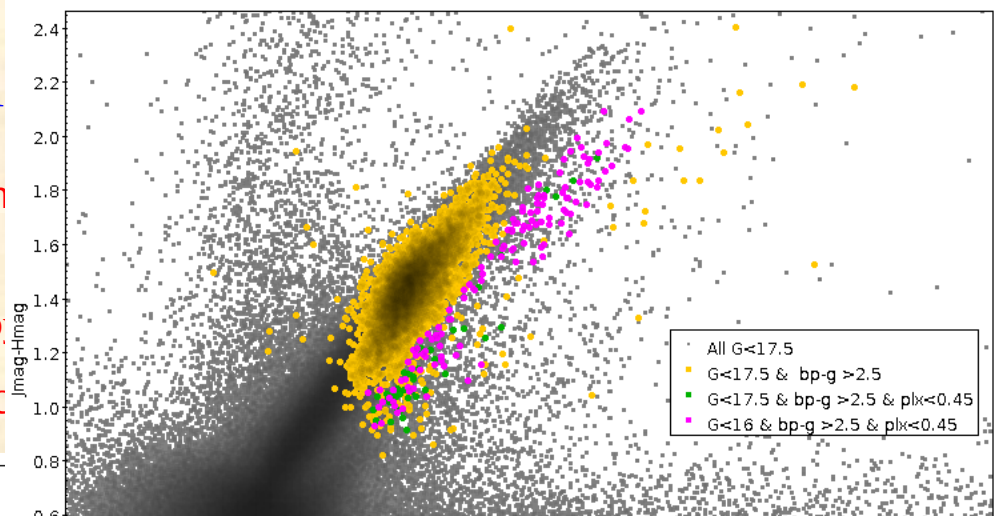


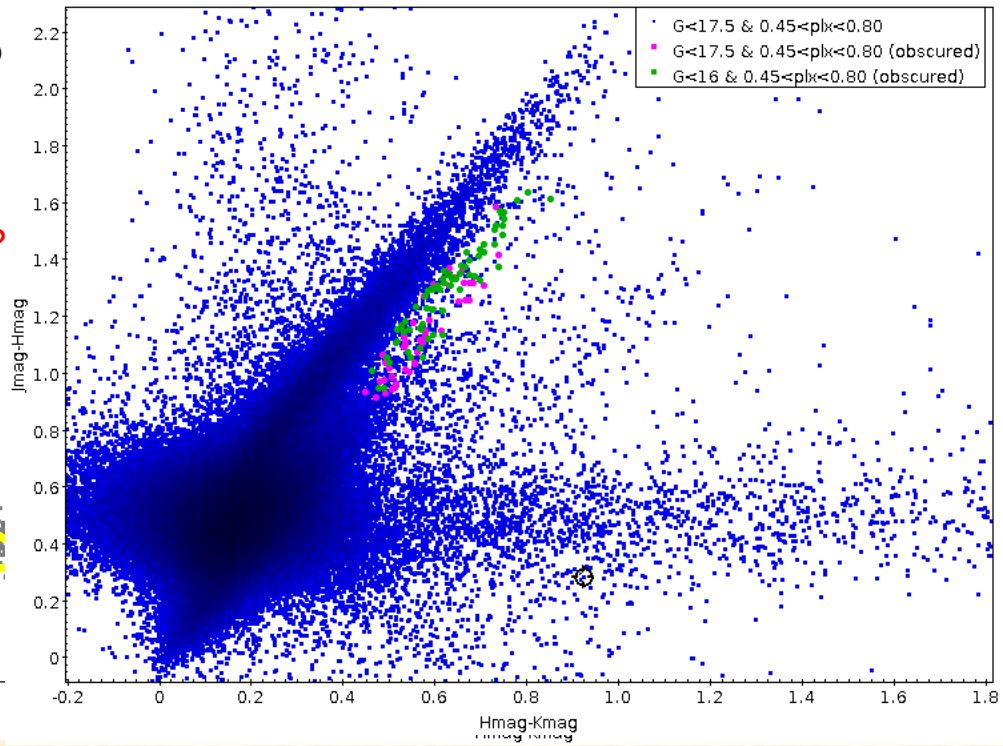
Massive stars in Cygnus X beyond WEAVE

- Target selection is made followi
  - $0.45 < \pi < 0.80$
  - $1.3 < Bp\text{-}Rp < 4.0$

  } From th
  - $G < 16$ Given b
  - No RV measurements in Gaia c







Expectations

- With the combination of WEAVE HR Cygnus Survey plus Gaia we expect to reach a much deeper knowledge of
  - the Cygnus star forming región, its structure, kinematics and dynamics
  - the stellar population and star forming history (still active) of the región
  - the stellar structure and evolution of massive stars
  - the multiplicity of massive stars
  - the whole environment (ISM)