The IACOB Project: Physical parameters of Galactic OB stars, present status and the utility of TGAS

Gonzalo Holgado Alijo

S. Simón-Díaz, +IACOB and OWN Collaborations

Barcelona, 05/16

IACOB project: Massive stars in High Resolution

IACOB

Simón-Díaz et al. (2011, 2015)

4560 Spectra
663 Stars

R= 25000-85000

OWN

Barbá et al. (2008, 2014)

5000 Spectra
240 Stars

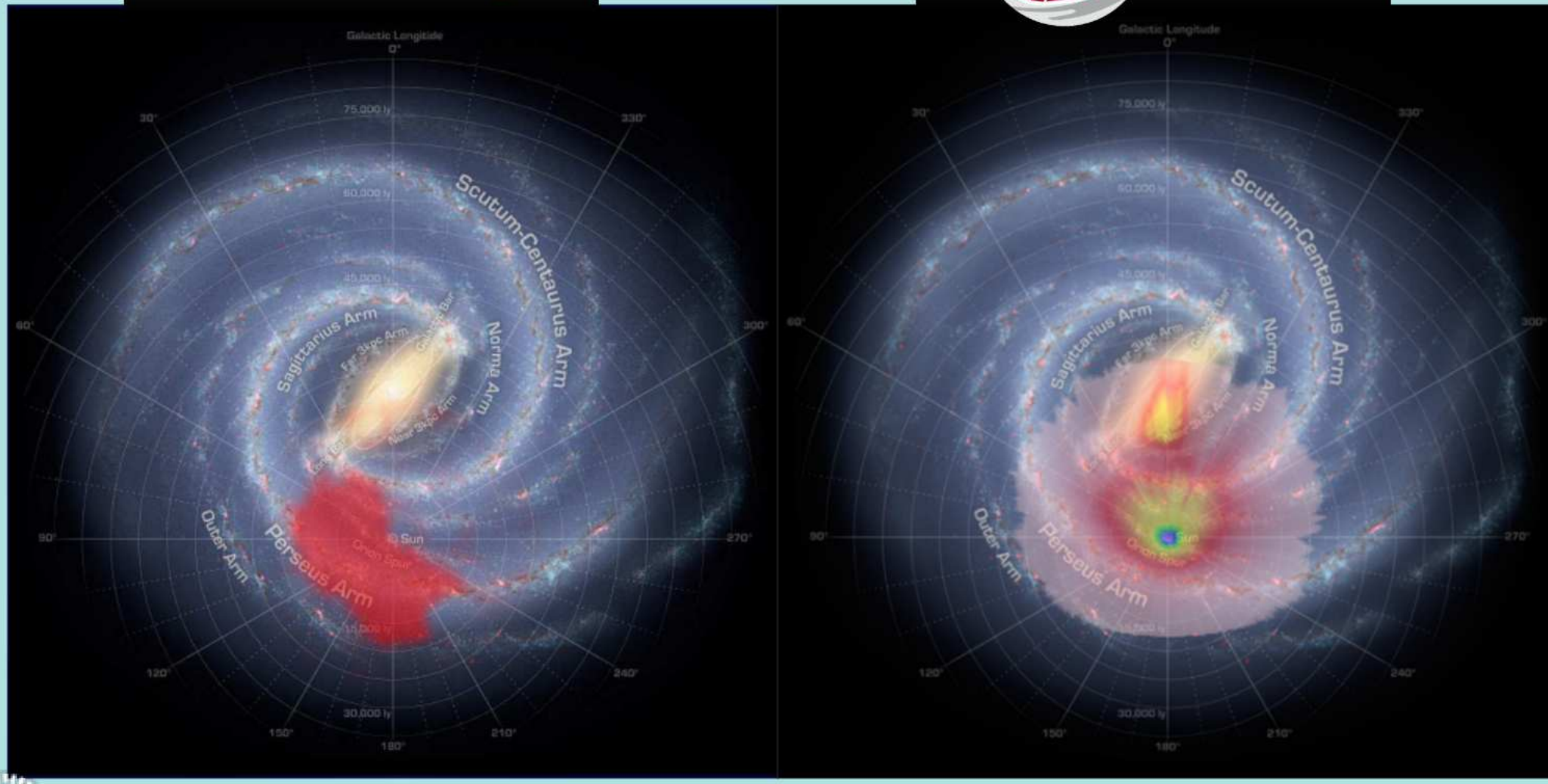
High resolution spectroscopic surveys of Galactic Massive Stars:

- IACOB
- OWN
- CAFE-BEANS
- NoMaDS
- MiMeS

IACOB project: Distribution of Galactic OB stars

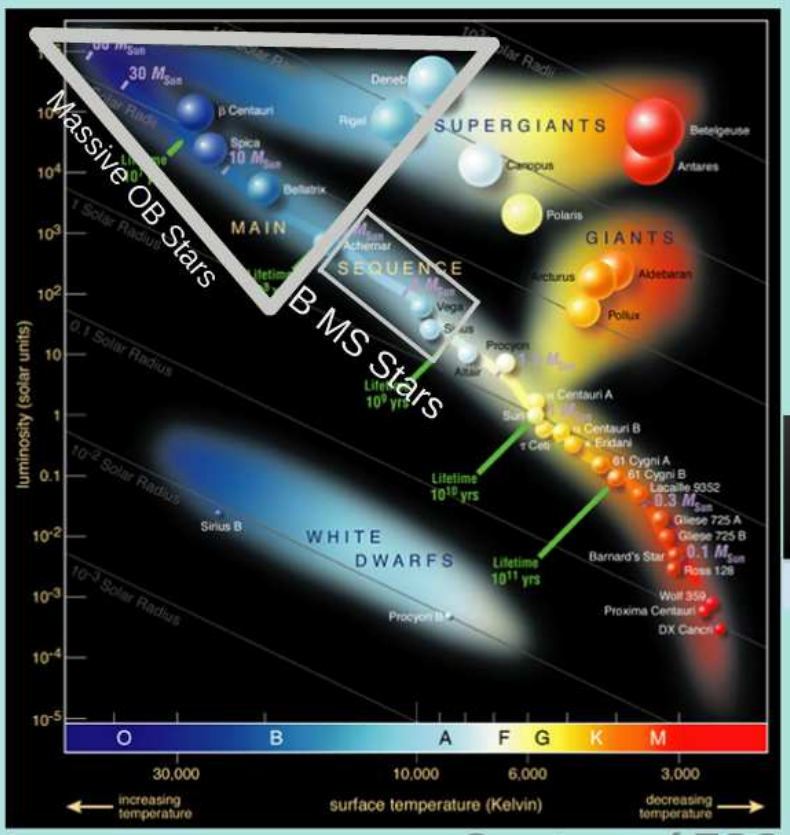
IACOB

gaia



IACOB project
IACOB+TGAS Synergy
Future Work

IACOB +TGAS: Strategy of Analysis, Synergies



Courtesy of ESO

GOSC

Maíz-Apellaniz et al. (2012)

IACOB

Simón-Díaz et al. (2011, 2015)

Spectra

OWN

Barbá et al. (2008, 2014)

gaia

Perryman et al. (2001)

We want to obtain :

- *Teff*
- *logg*
- *R_**
- *Z*
- *$\dot{M}$*
- *β*
- *L*
- *M*

Aware of :

- Binarity
- Variability

We will obtain physical properties and constraint evolutionary models

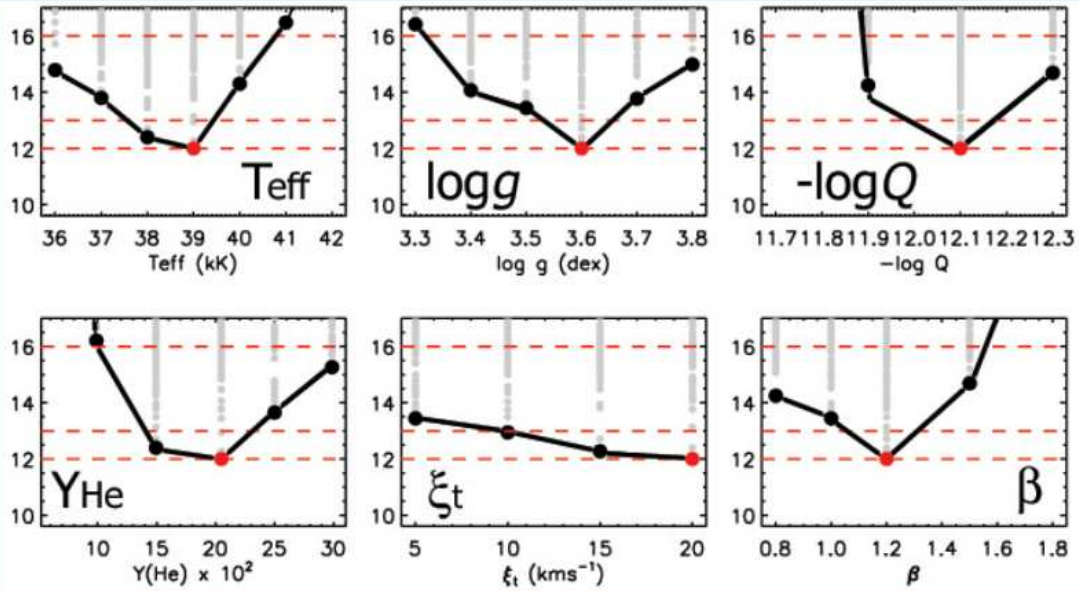
IACOB +TGAS: Done so far

One Spectra per star → Quantitative spectroscopic analysis (line broadening parameters + Spectroscopic parameters)

PROGRAM	PARAMETERS	DIAGNOSTIC LINES
iacob_broad Fourier Transform (FT) + Goodness of fit (GOF) Gray (1976, 2005) Simon-Diaz & Herrero (2007)	• $v\sin i$ • V_{macro}	OIII 5592
iacob_gbat FASTWIND Models grid + χ^2 algorithm Santolaya-Rey et al. (1997) Puls et al. (2005) Simon-Diaz et al. (2011b)	• Teff • Y(He) • logg • ξ_t • logQ • β	Hα HeII 4200 HeI 4387 Hβ HeII 4541 HeI 4471 Hγ HeII 4686 HeI 4713 Hδ HeII 5411 HeI 5875 HeI+II 4026 HeI 6678+HeII6683
~ 6-30 min x Star	$Q=\dot{M}/(v_\infty R)^{1.5}$	Full spectra coverage, only one observation

IACOB +TGAS: Next step

Best SNR Spectra + vsini & vmacro+ FASTWIND Models grid + χ^2 algorithm Simon-Diaz et al. (2011b)



HD14947 : O4.5 If

vsini (kms^{-1}) = 108 , Θ_{RT} (kms^{-1}) = 80
vinf (kms^{-1}) = 2350 Mv (mag) = −5.94

	P +/− ΔP	BFM
Teff (kK)	= 38.5 +/− 0.9	(39.0)
log g (dex)	= 3.60 +/− 0.06	(3.60)
Y(He) x 10^2	= 18 +/− 4	(20)
ξ_t (kms^{-1})	> 9.5	(20.0)
−log Q	= 12.08 +/− 0.09	(12.10)
β	= 1.19 +/− 0.12	(1.20)
R ($R_\odot$)	= 0.0 +/− 0.0	(16.4)
log ($L/L_\odot$)	= 0.00 +/− 0.00	(5.75)
M ($M_\odot$)	= 0.0 +/− 0.0	(39.1)
−log Mdot	= 0.00 +/− 0.00	(5.22)

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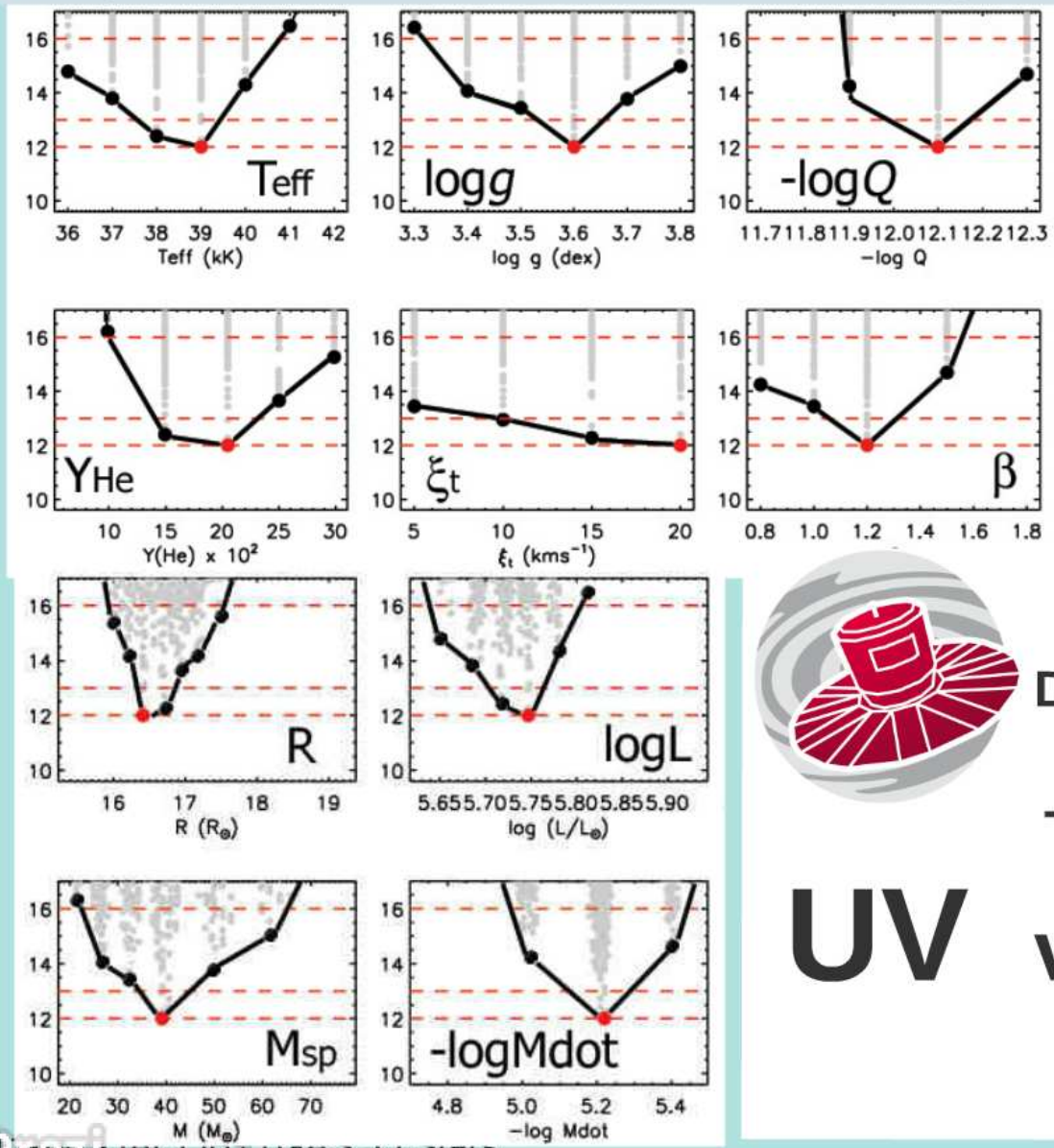

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extinction
+
Distance

+

R, log *L*, M_{sp}, log $\dot{M}$

UV

v_{inf}

IACOB +TGAS: Next step

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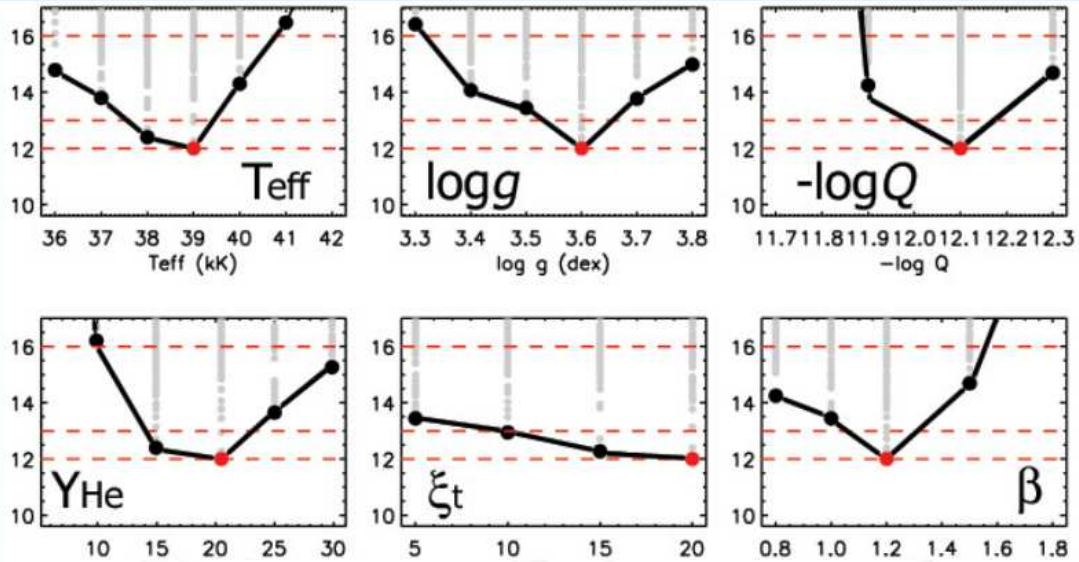

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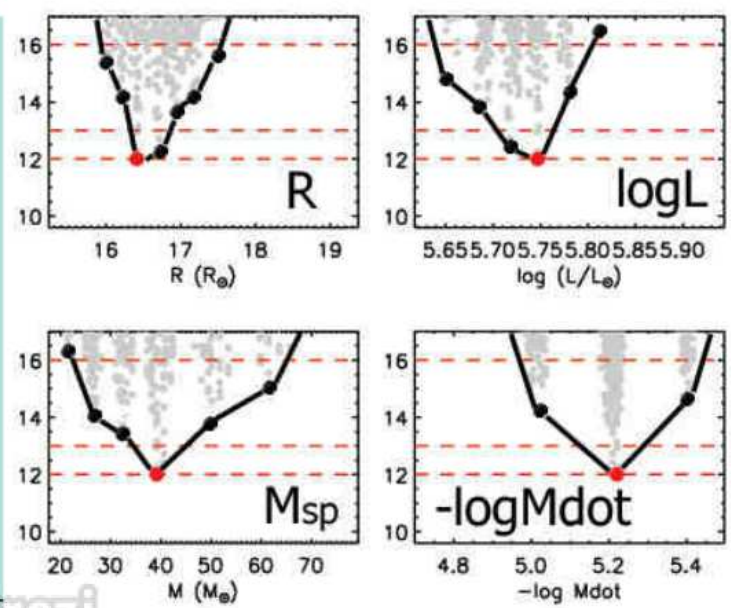
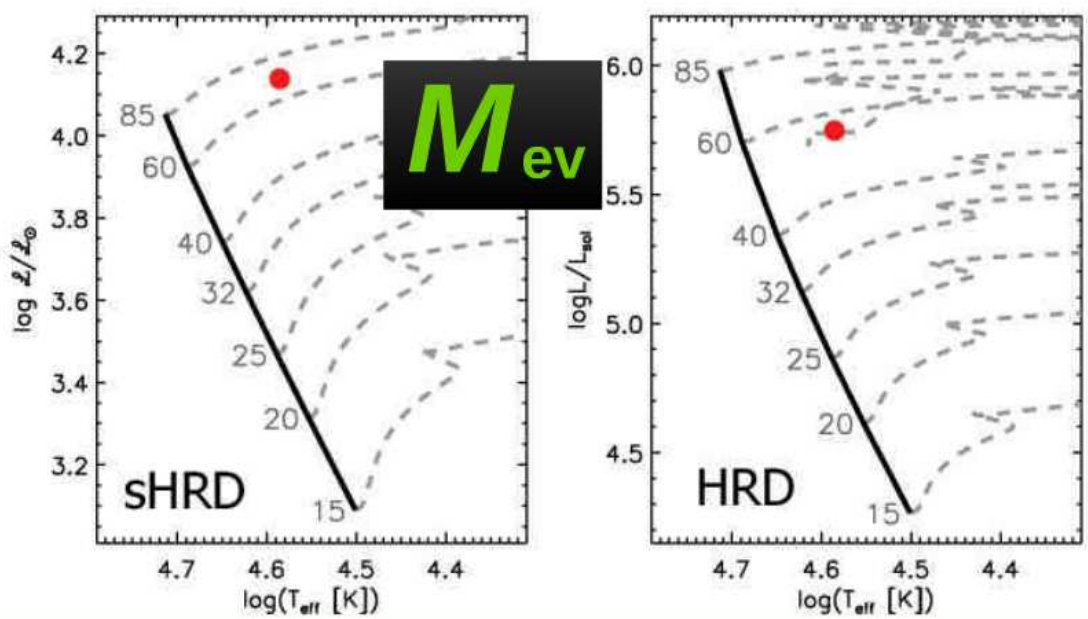
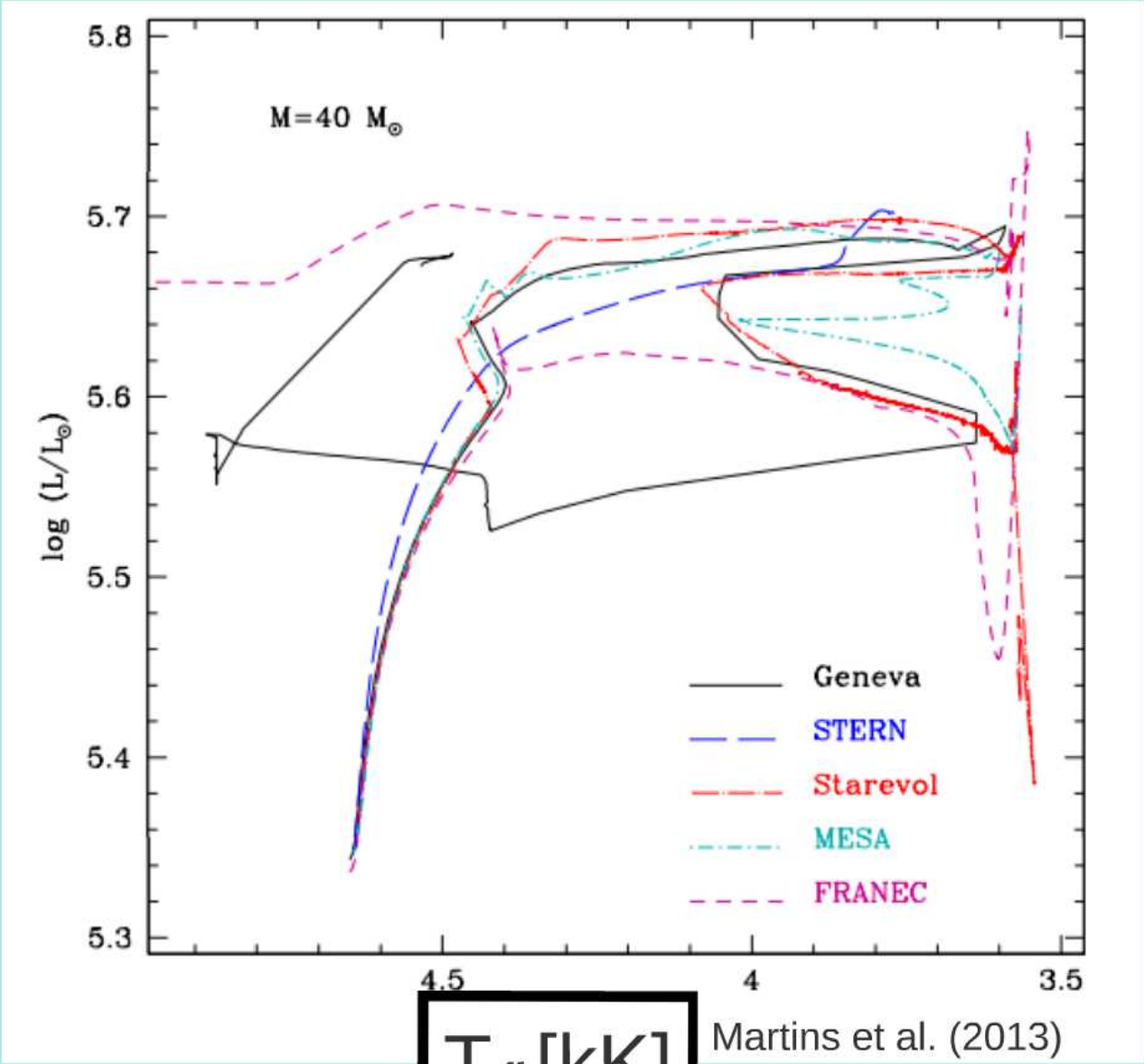




IACOB +TGAS: Evolution, HR Diagram



T_{eff} [kK]

Martins et al. (2013)

Constraint evolutionary theories

IACOB project
IACOB+TGAS Synergy
Future Work

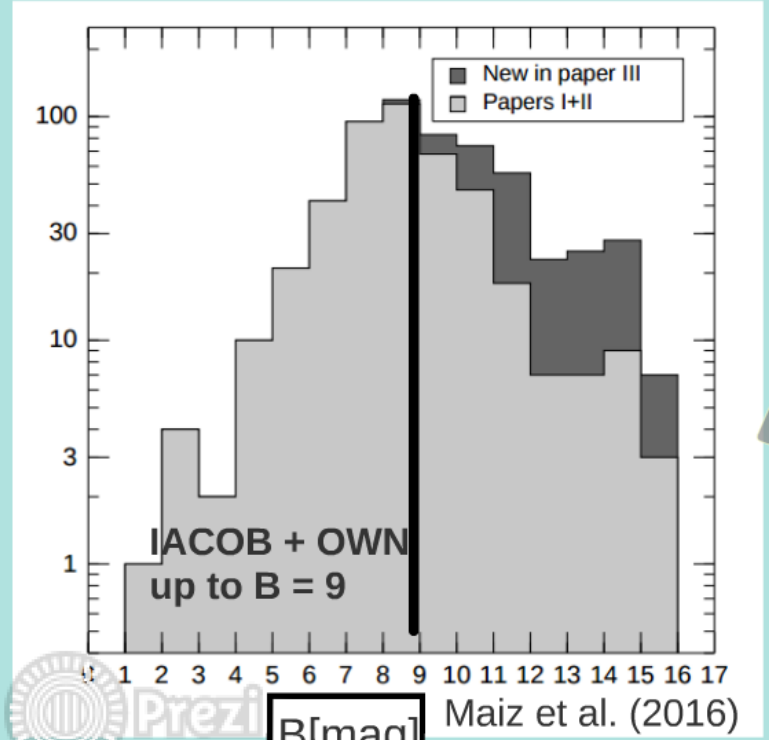
IACOB+TGAS: Real Numbers

GOSC | **IACOB** + **OWN**

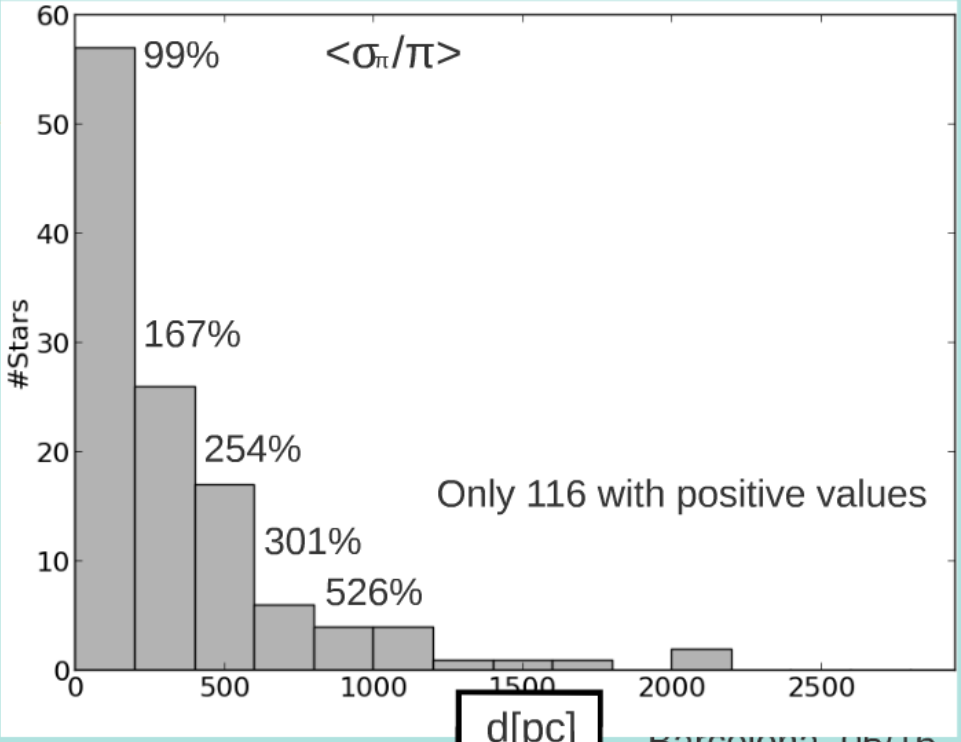
Low resolution R~2500 | **High resolution R~25000-85000**

590 Stars
409 with Tycho Plx + errors

286 Stars analyzed
235 with Tycho Plx + errors



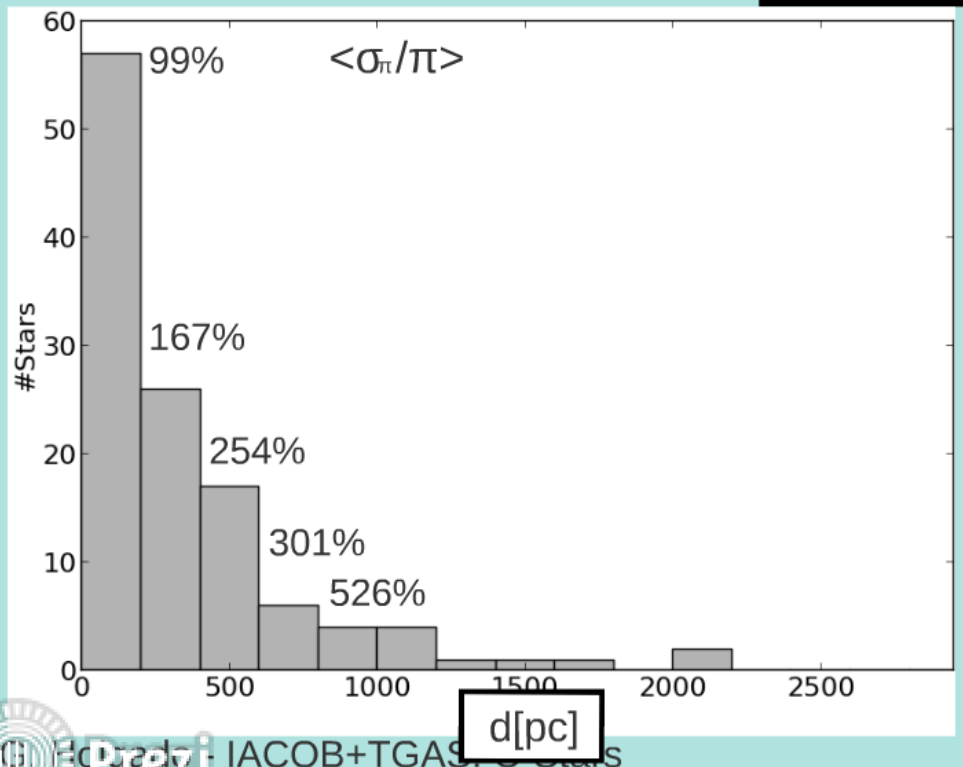
Maiz et al. (2016)



IACOB+TGAS : TGAS data

TGAS

Parallaxes and proper motions for ~??% of Tycho-2 Stars



- **Improvements in the values and uncertainties**
  - How many?
  - How much?

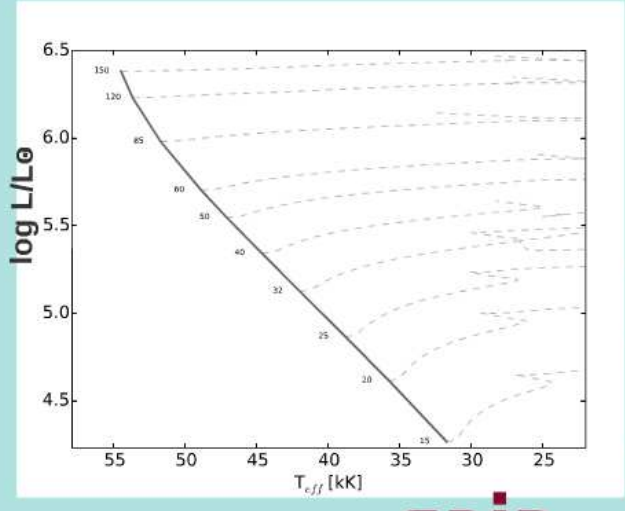
Future Work

gaia

Future Work: Spectroscopic HR Diagram (I)

Spectroscopic Hertzsprung-Russell diagram

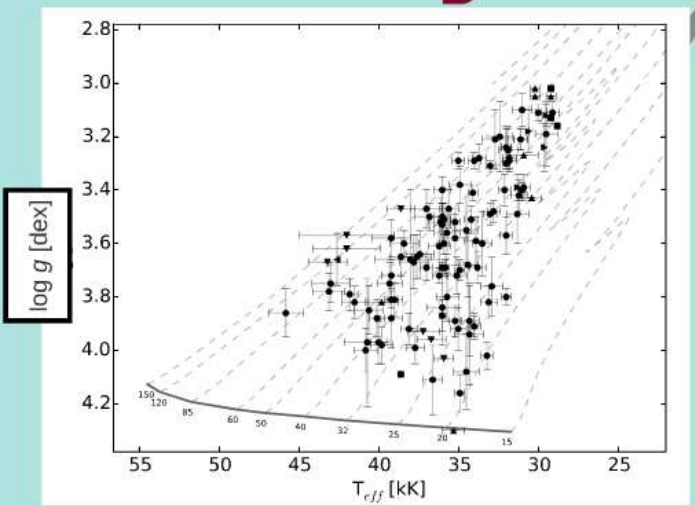
Langer & Kudritzki (2014), Castro et al. (2014)

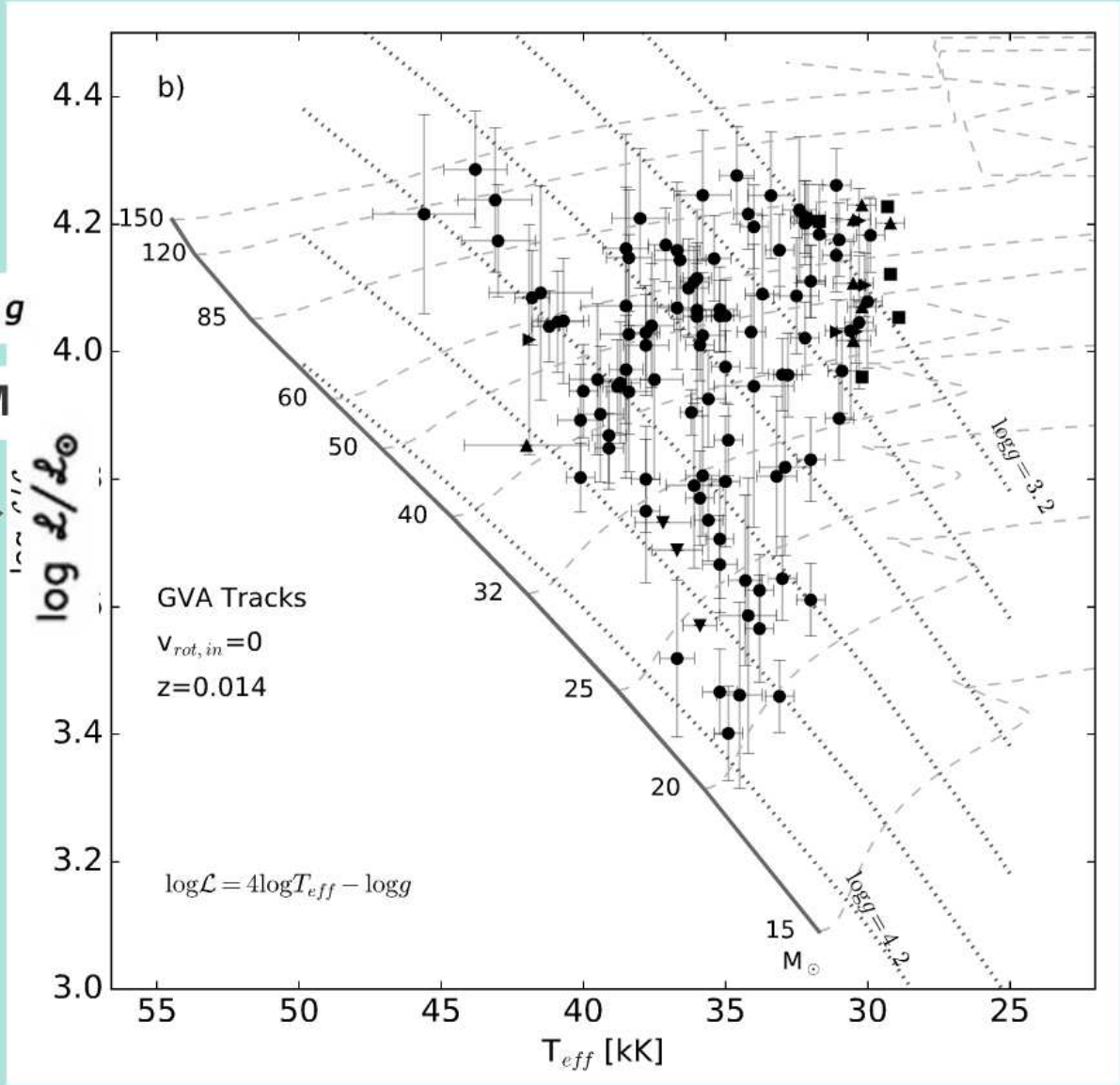


$\mathcal{L} := T^4_{eff} / g$

$\mathcal{L} : \sim L/M$

Need distances from gaia





Future Work: Spectroscopic HR Diagram (I)

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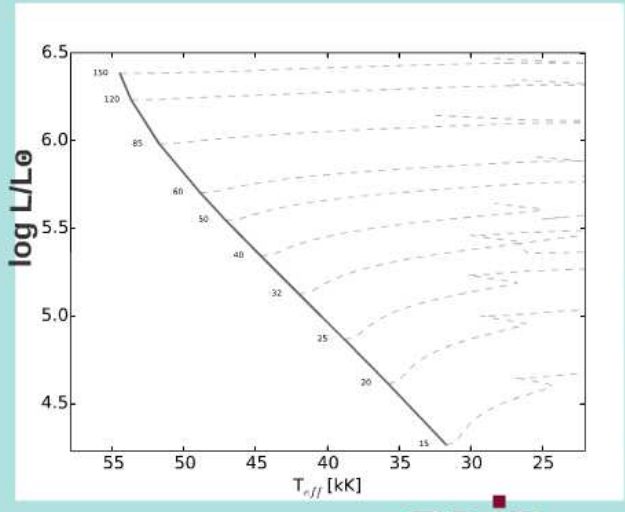

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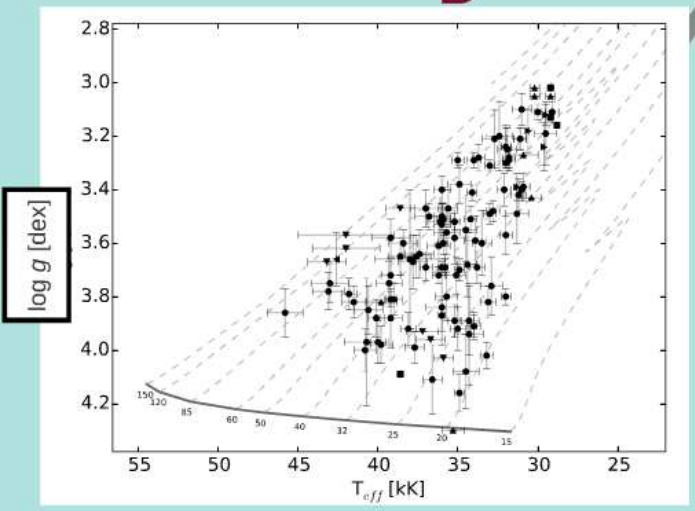
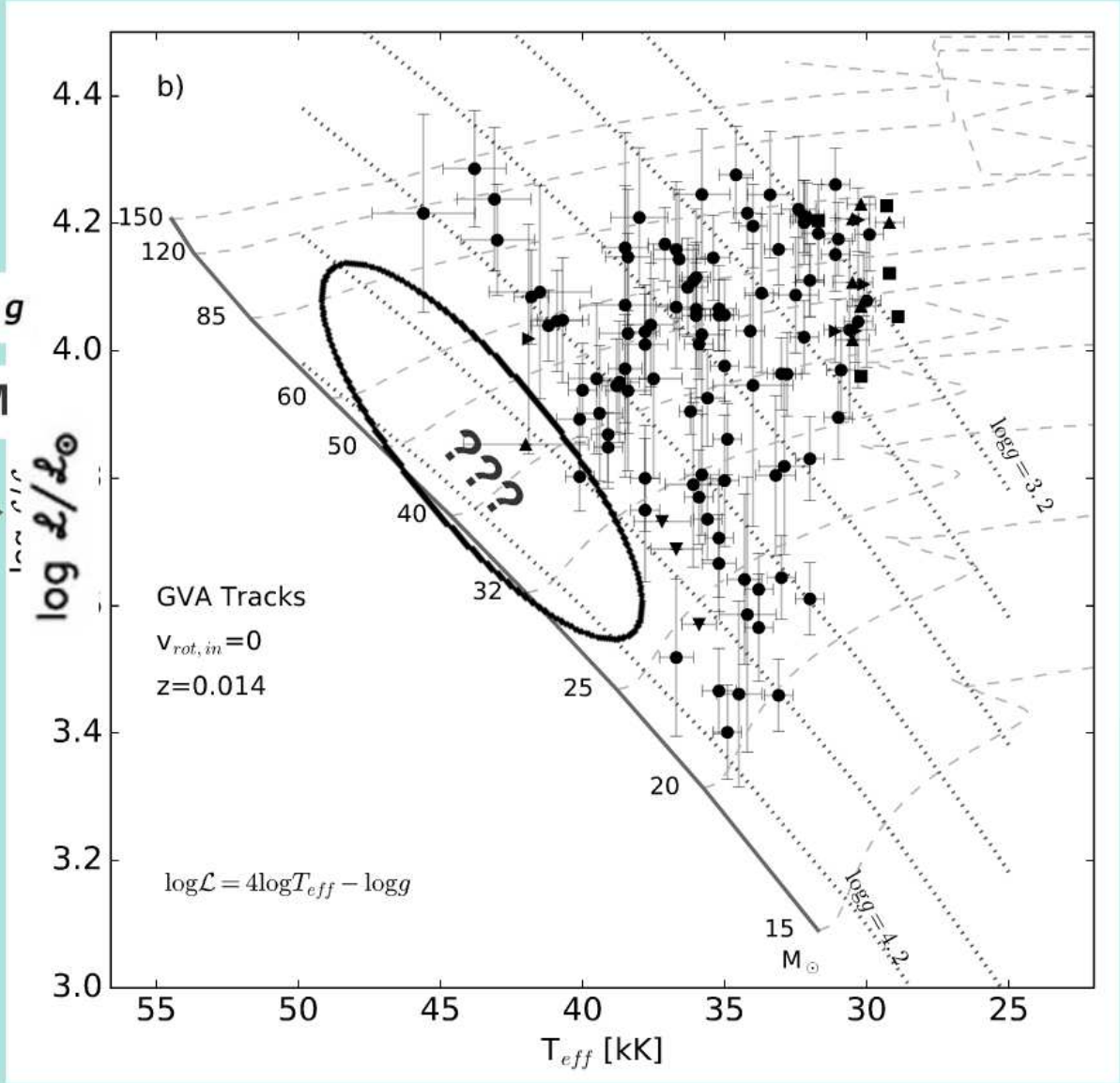
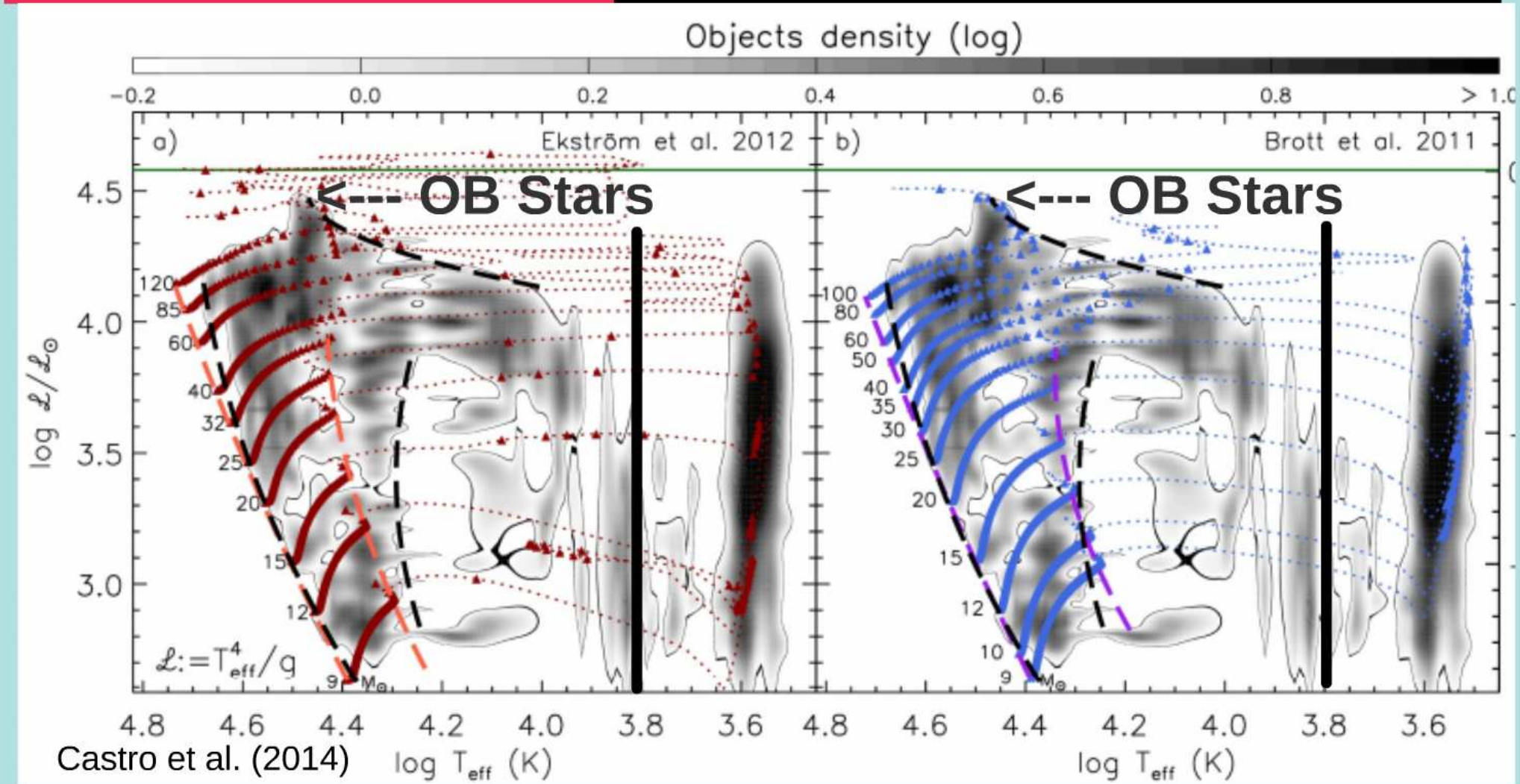




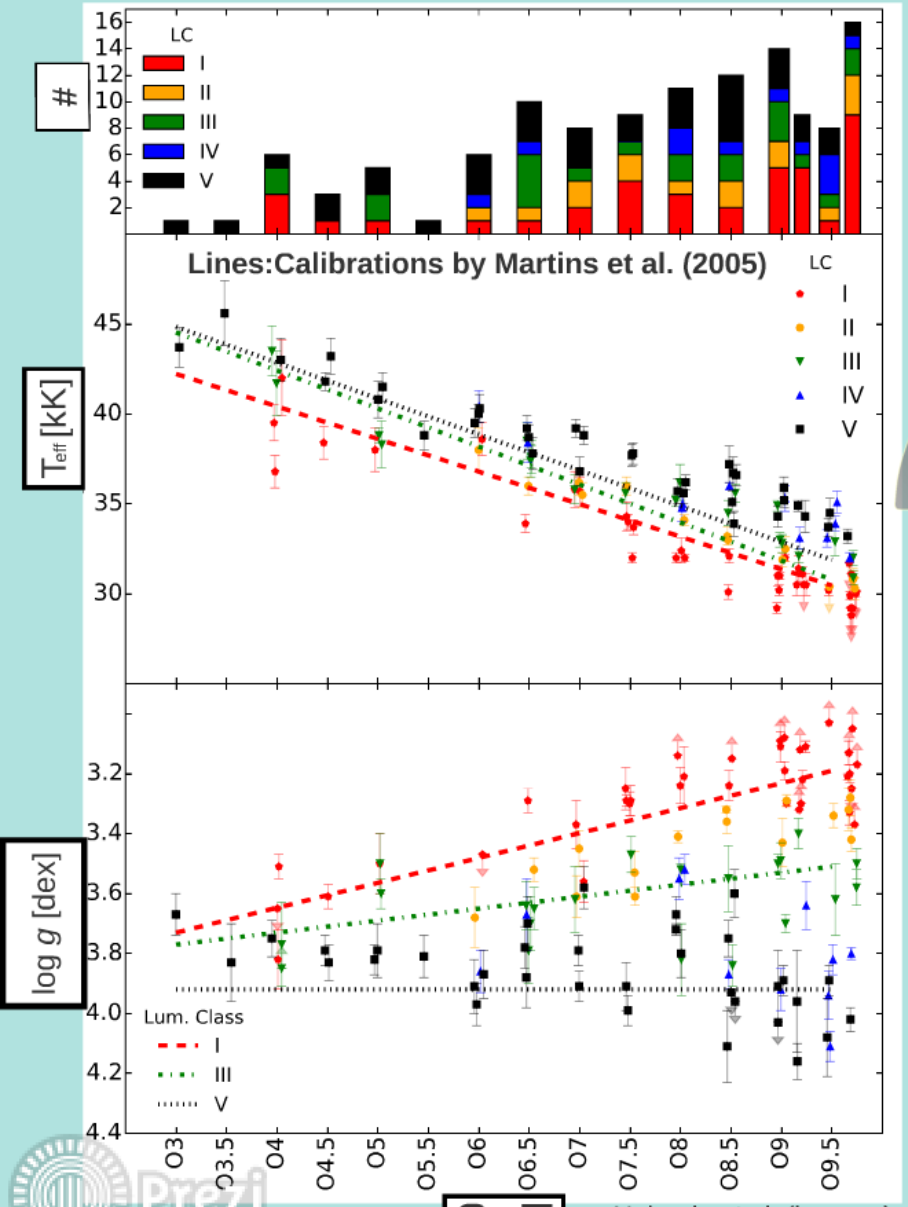
Future Work: Spectroscopic HR Diagram (II)



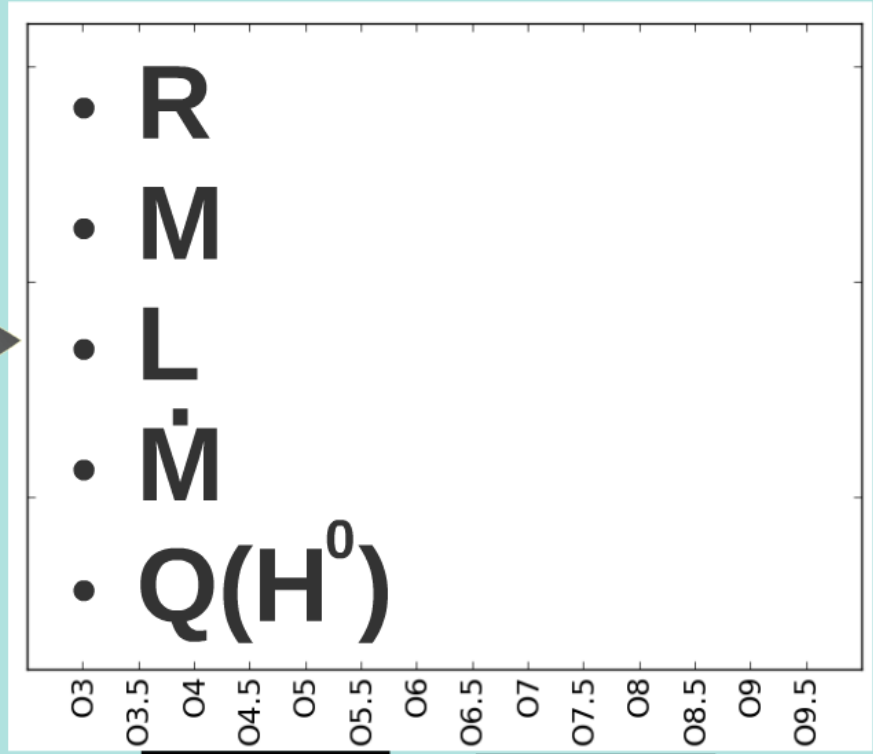
Castro et al. (2014)

Huge sample of OB Stars in HR diagram to study and constraint the different evolutionary models

Future Work: Calibrations



Holgado et al. (in prep.)



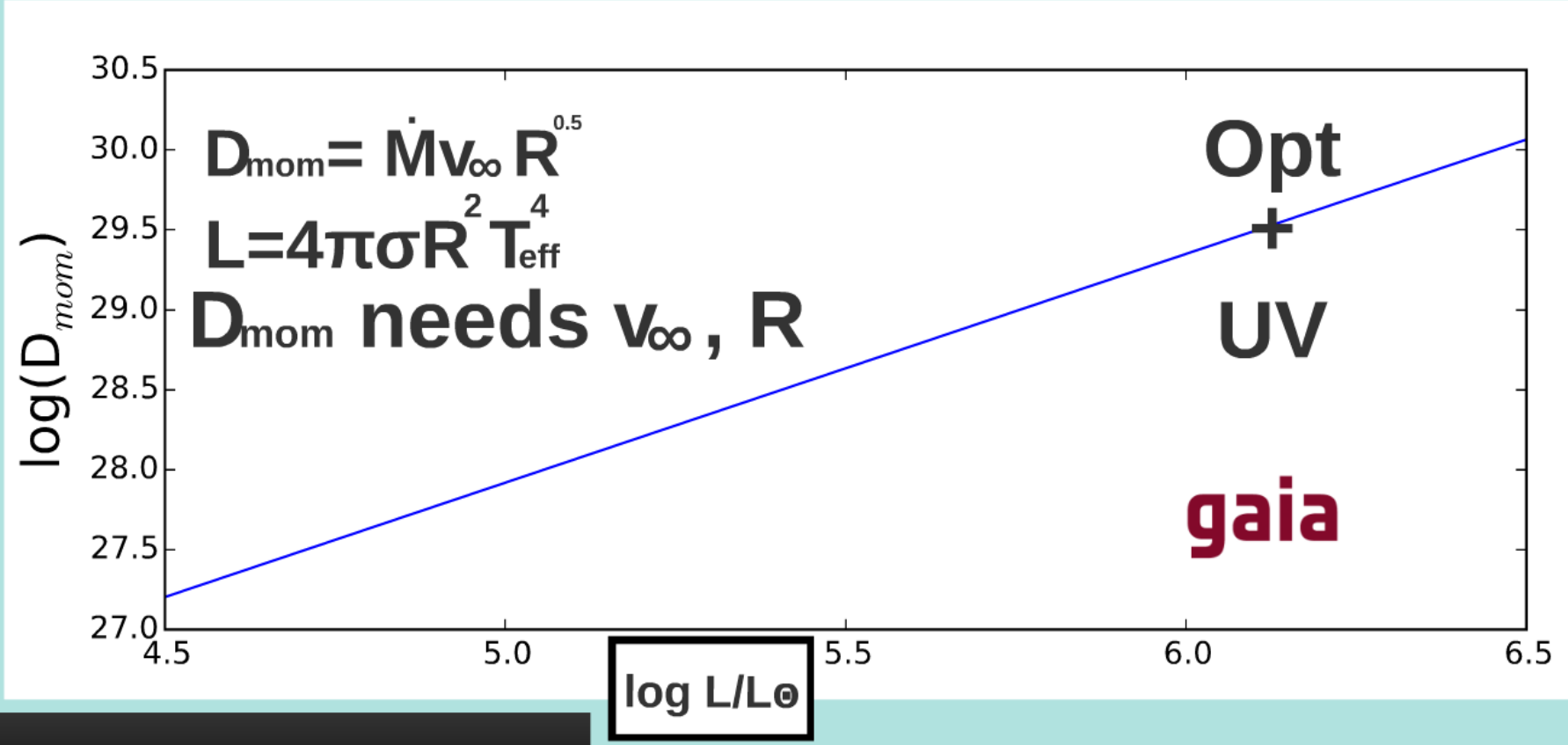
SpT + LC

Calibrations Physical parameters - Spectral type and Luminosity Class

Calibrations T_{eff} - Spectral type and log *g* - Spectral type

Future Work:

Wind Momentum-Luminosity Relationship



$D_{mom} = x \log L/L_\odot + D_0$

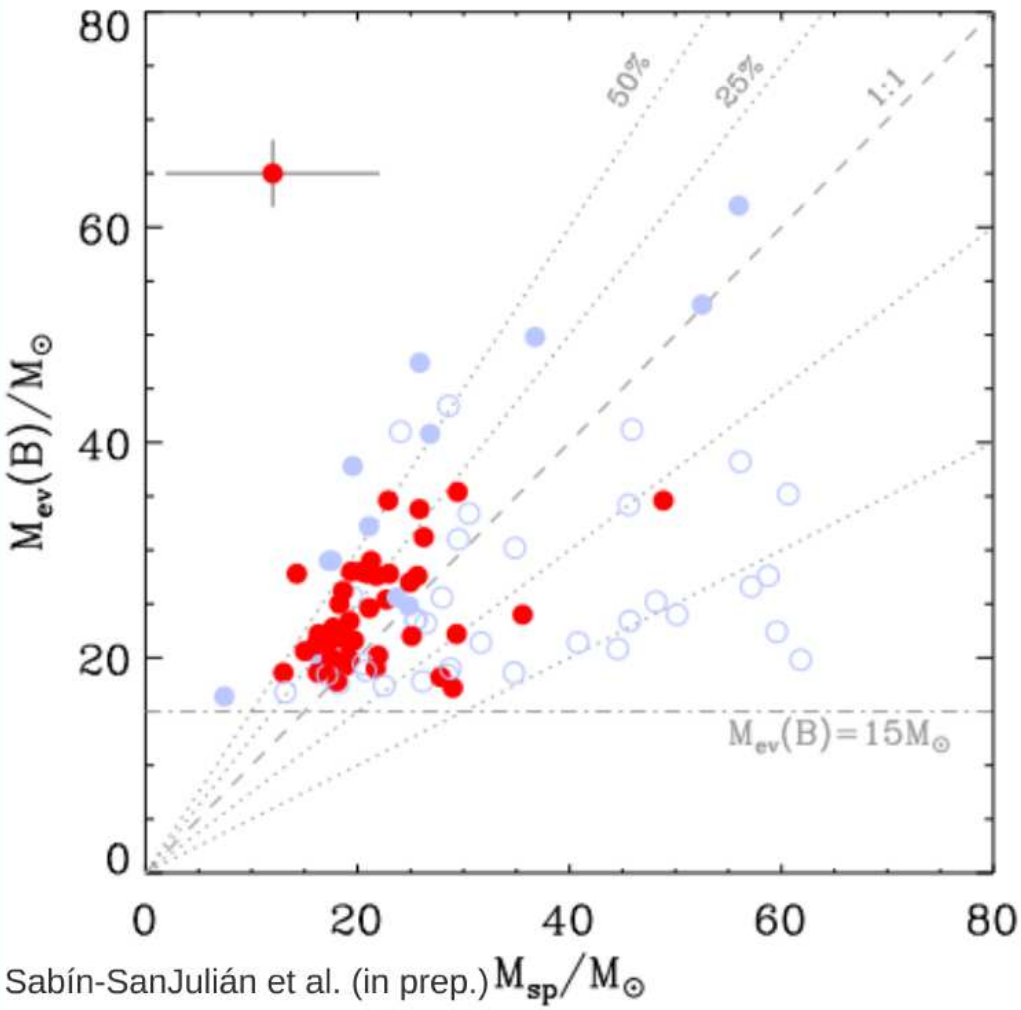
Spectroscopic : $D_{mom} = \dot{M} v_\infty R^{0.5}$ → Luminosities and distances in MW and other galaxies

Future Work:

Mass discrepancy

Herrero et al.(1992)

Factor ~2 between M_{sp} and M_{ev}



Sabín-SanJulián et al. (in prep.)

- **The determination of accurate masses must be a strong constraint in both the atmospheric and evolutionary theories**
- **It will affect the high massive tail of the IMF**

Summary :

- **HR Diagram: Constraint evolutionary theories, obtain evolutionary Masses** M_{ev} **GAP**
- **Calibrations in physical parameters**
- **WLR : Extragalactic Luminosities**
- **Mass discrepancy : Constraints , IMF**
  Herrero et al.(1992)
- **And future data ...**

Summary :

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gaia

- **Mass discrepancy : Constraints , IMF**
  Herrero et al.(1992)
- **And future data ...** **HORS (GTC)** R~25 000 **MEAVE** R~5 000

Thanks