ETH zürich

GaiaESO

Stellar dynamics in the ρ-Ophiuchi star forming region

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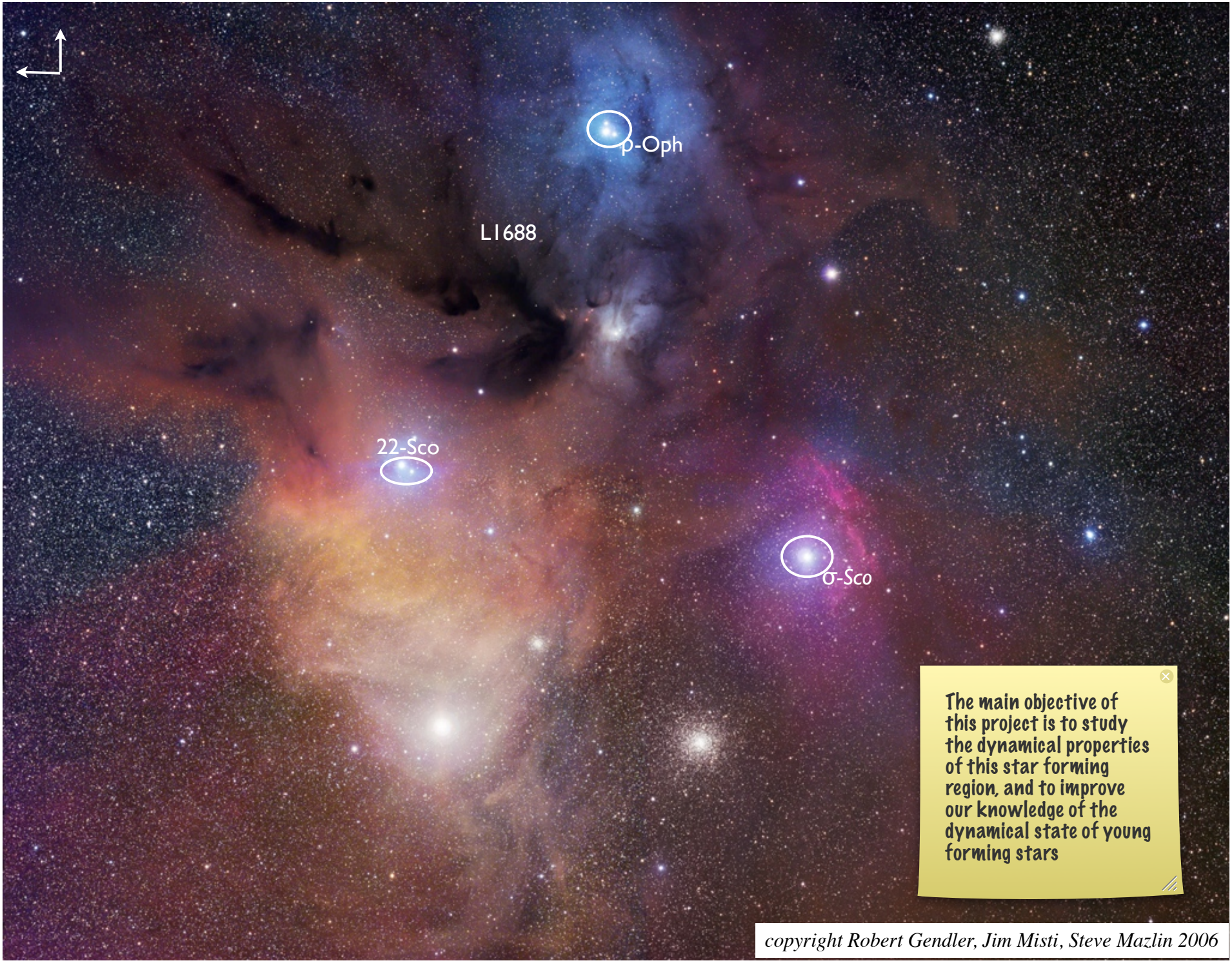
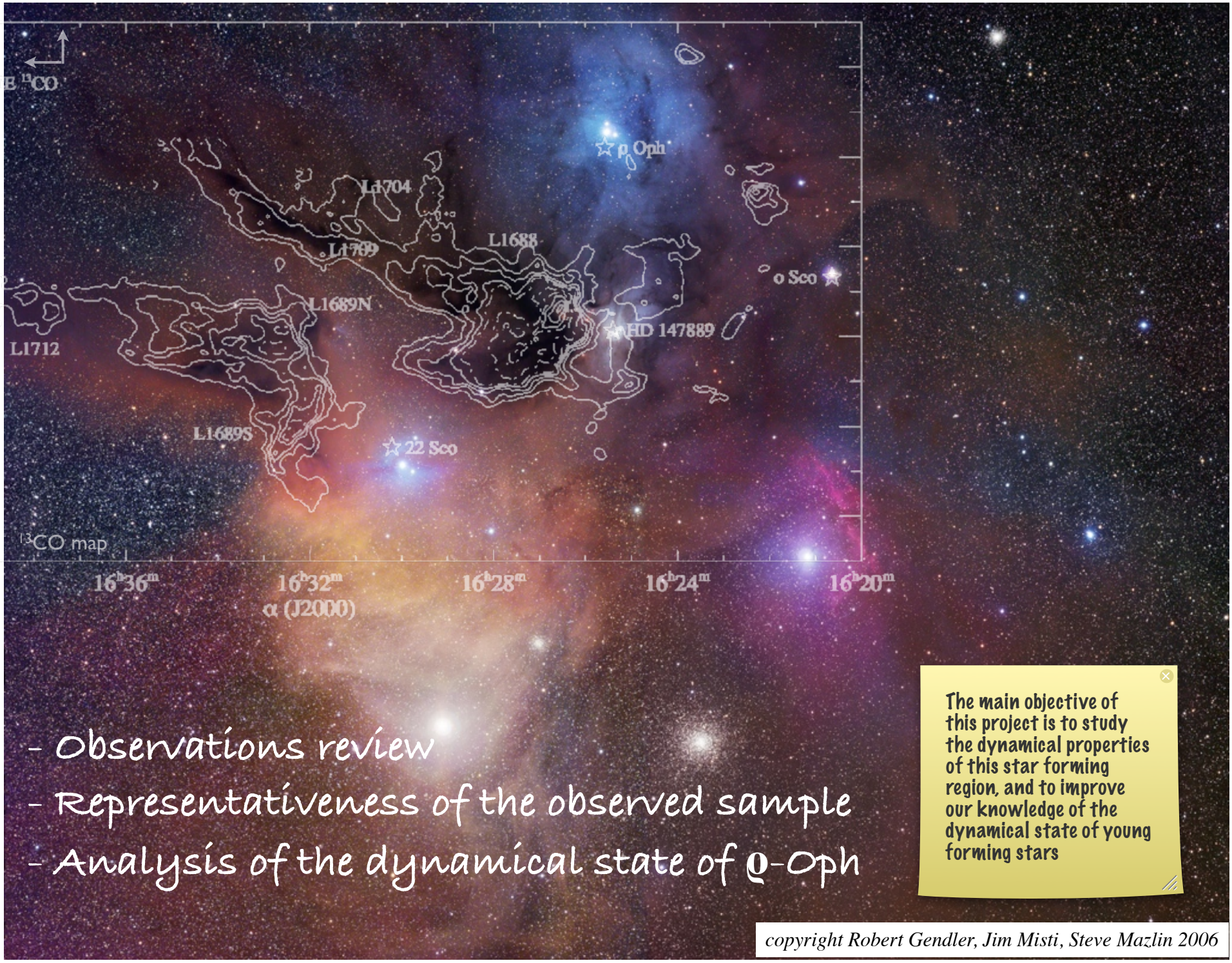
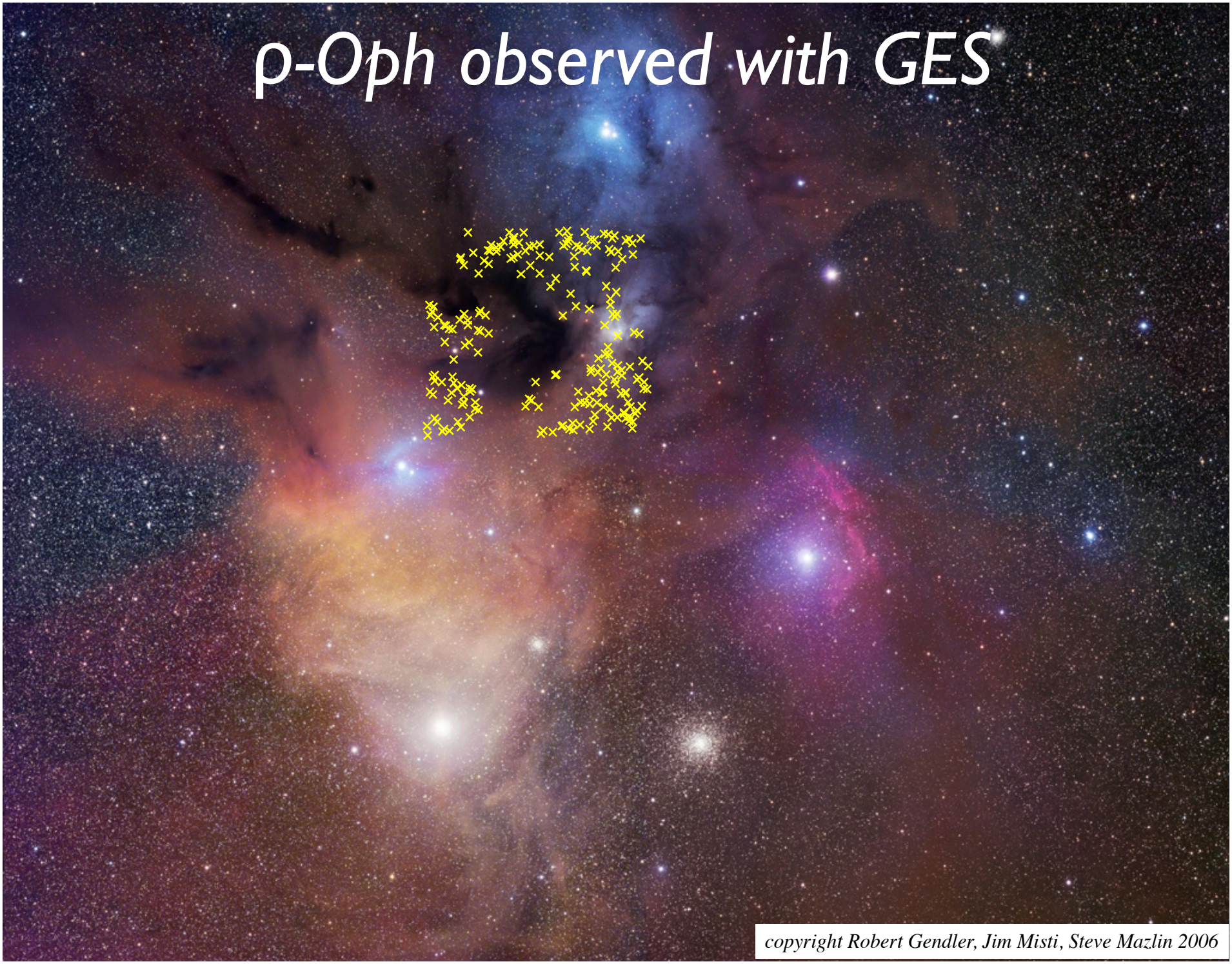

ρ-Oph
L1688
22-Sco
σ-Sco
The main objective of this project is to study the dynamical properties of this star forming region, and to improve our knowledge of the dynamical state of young forming stars
copyright Robert Gendler, Jim Misti, Steve Mazlin 2006



- Observations review
- Representativeness of the observed sample
- Analysis of the dynamical state of ρ-Oph

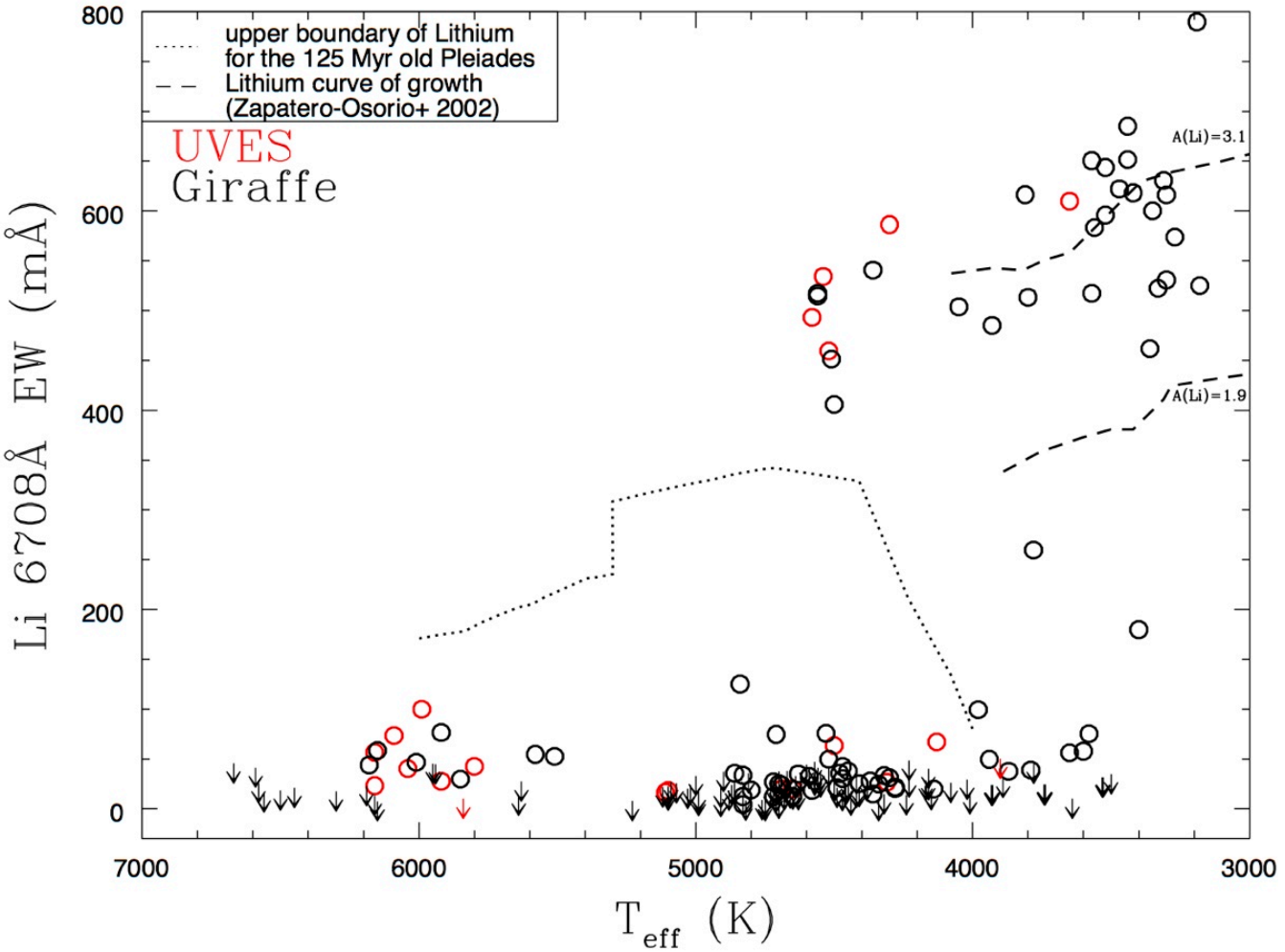
The main objective of this project is to study the dynamical properties of this star forming region, and to improve our knowledge of the dynamical state of young forming stars

ρ-Oph observed with GES



ρ-Oph observed with GES

223 total objects observed with GES (200 with Giraffe, 23 with UVES)



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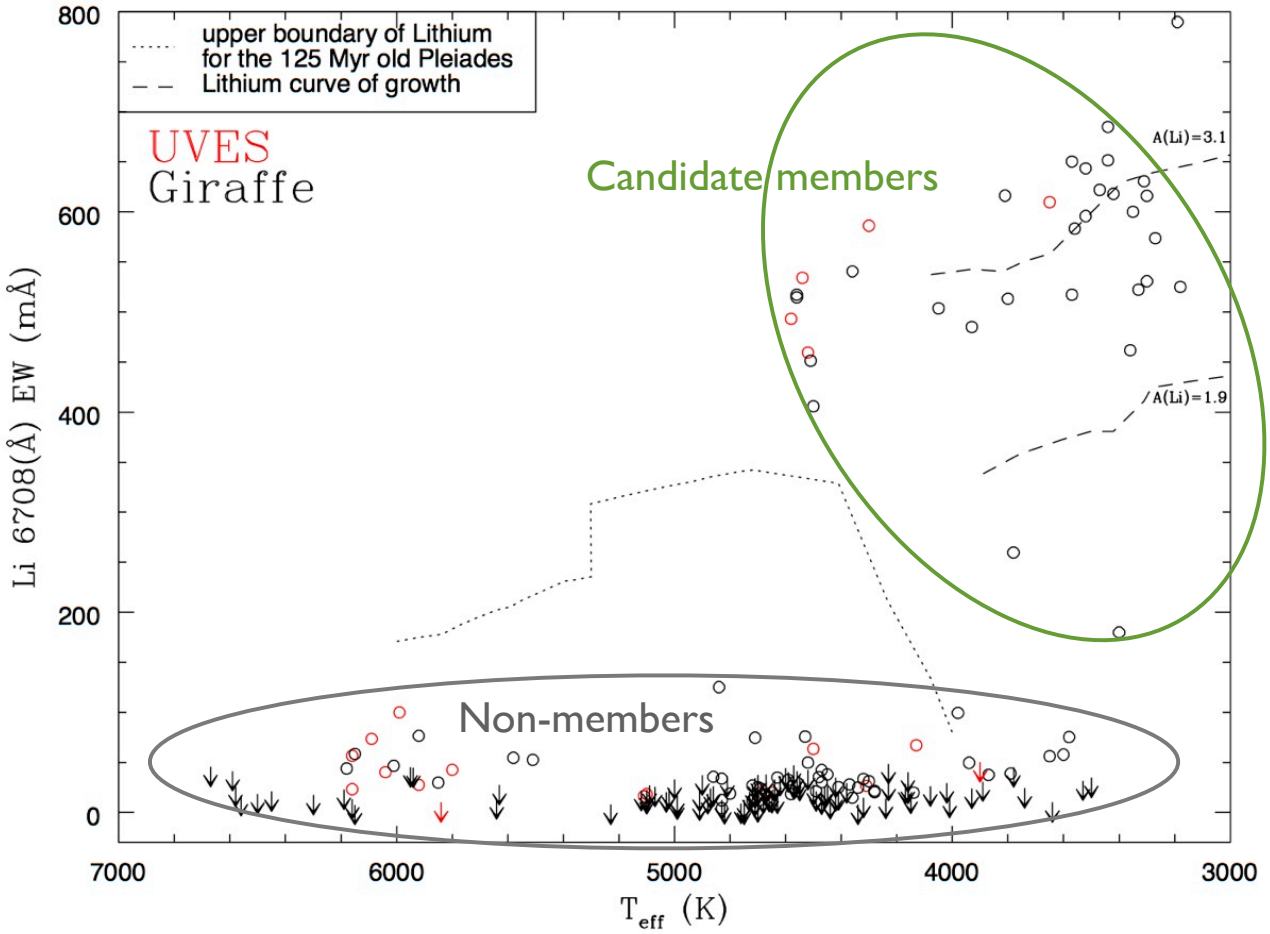
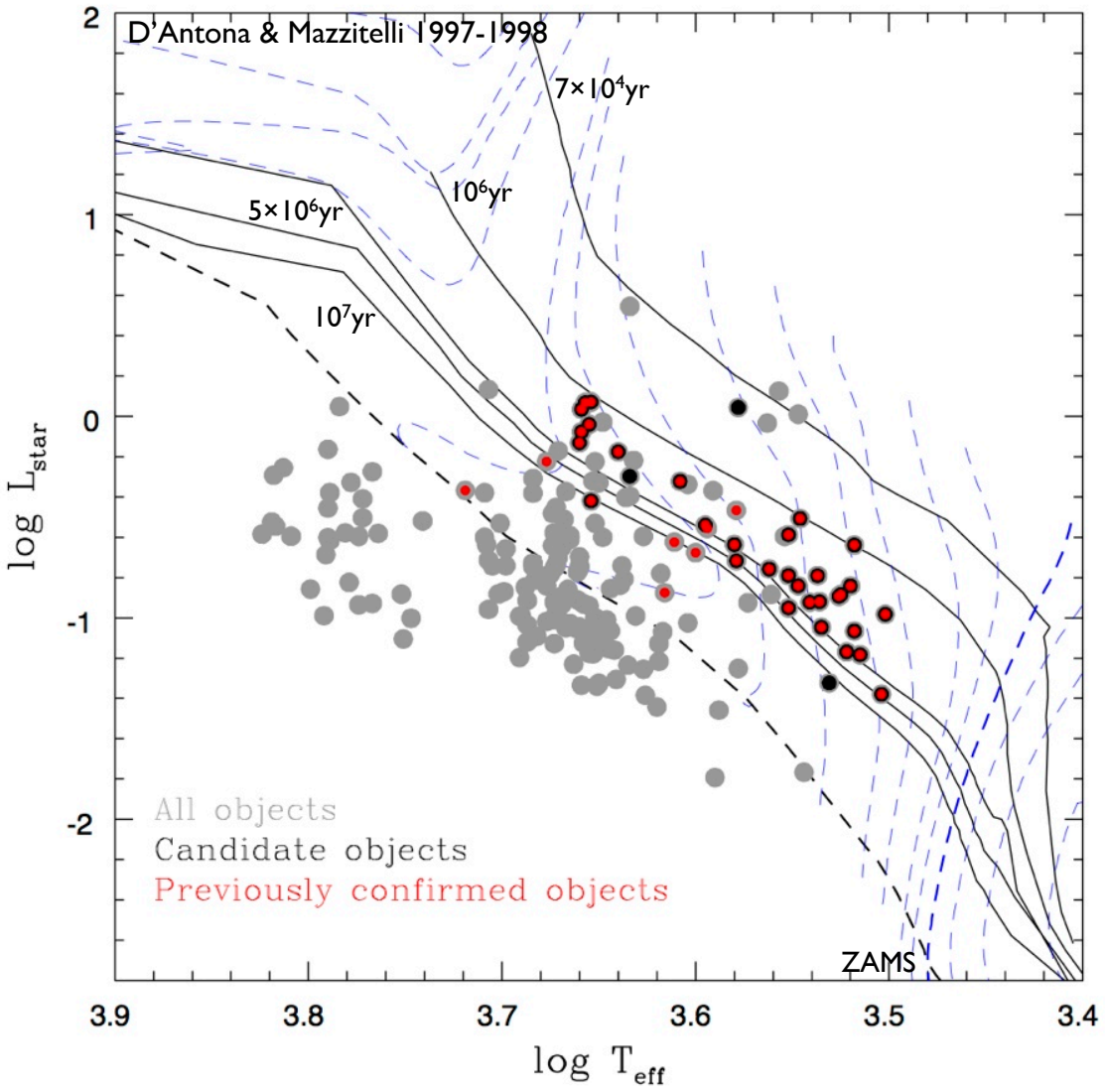
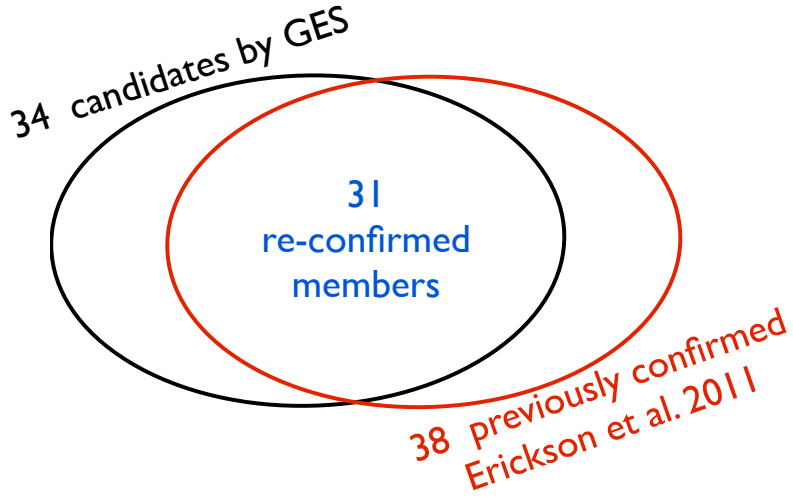


191 objects with reported effective Temperature:

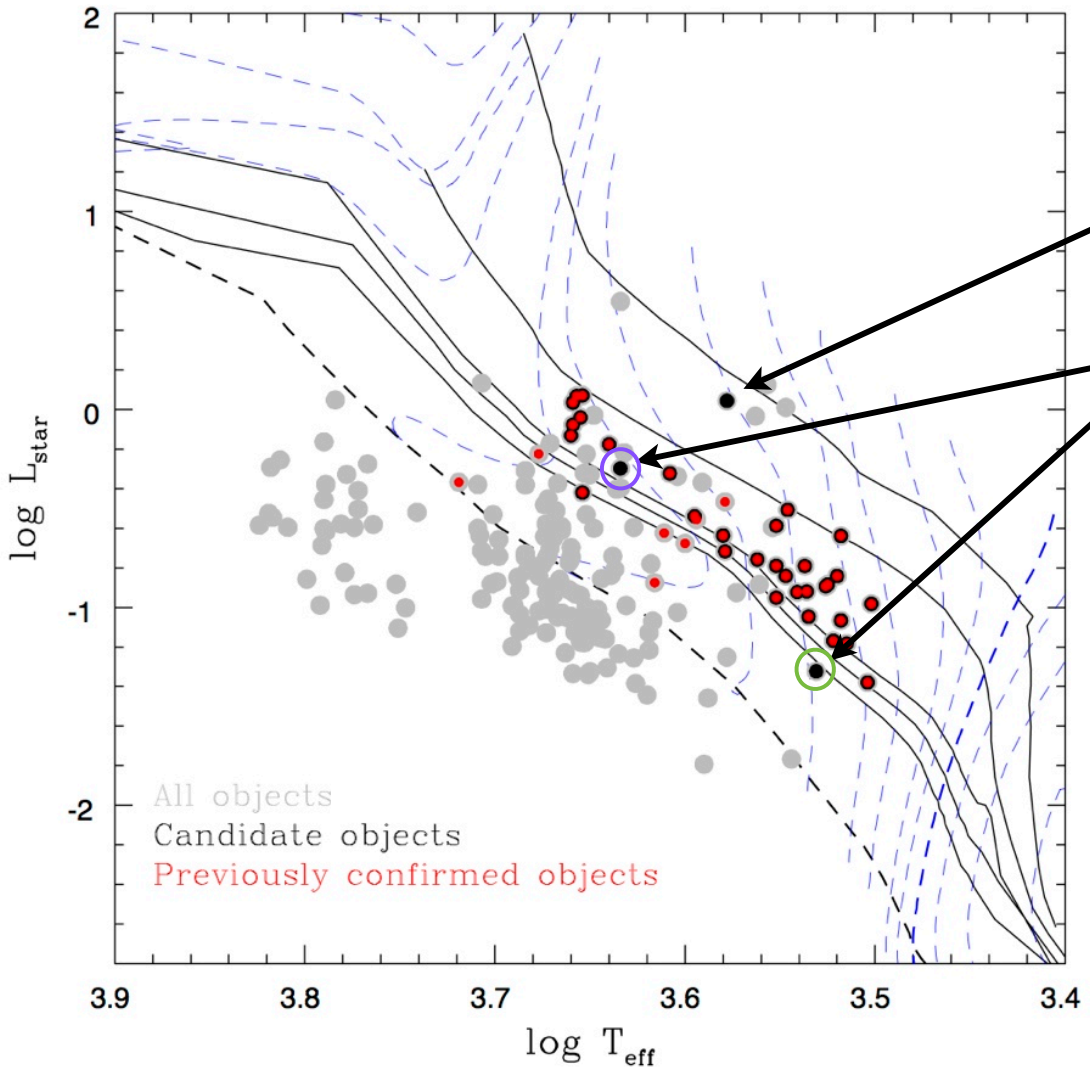
21 UVES (5 candidates)
170 Giraffe (29 candidates)

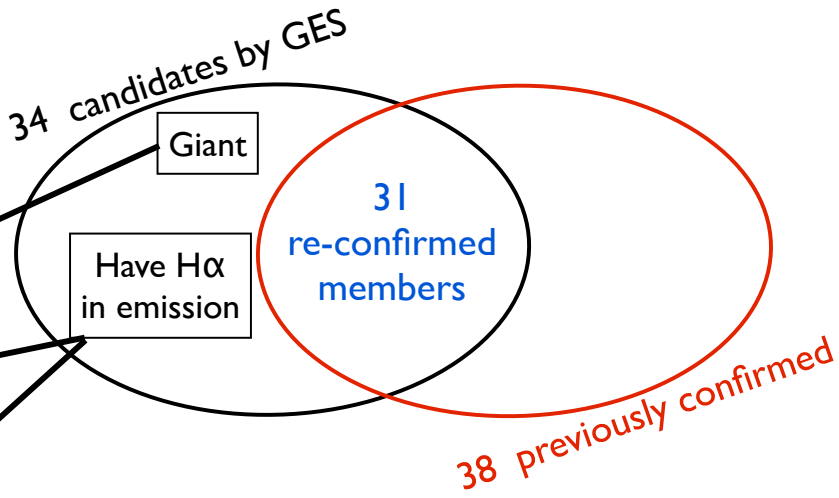
HR Diagram

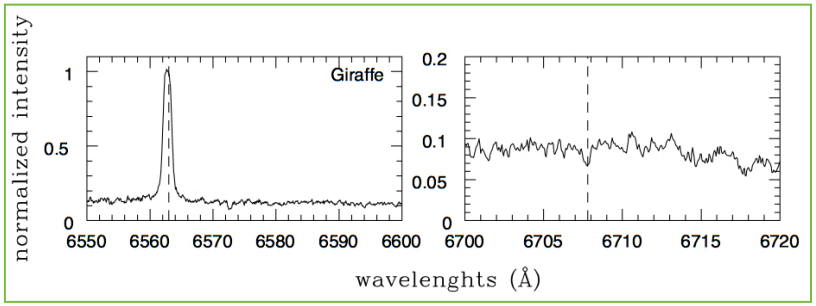

D'Antona & Mazzitelli 1997-1998
7×10⁴yr
10⁶yr
5×10⁶yr
10⁷yr
All objects
Candidate objects
Previously confirmed objects
ZAMS
log L_star
log T_eff
2
1
0
-1
-2
3.9
3.8
3.7
3.6
3.5
3.4

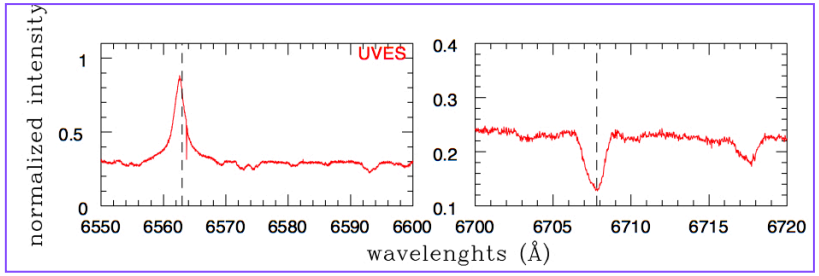

34 candidates by GES
31
re-confirmed
members
38 previously confirmed
Erickson et al. 2011

HR Diagram

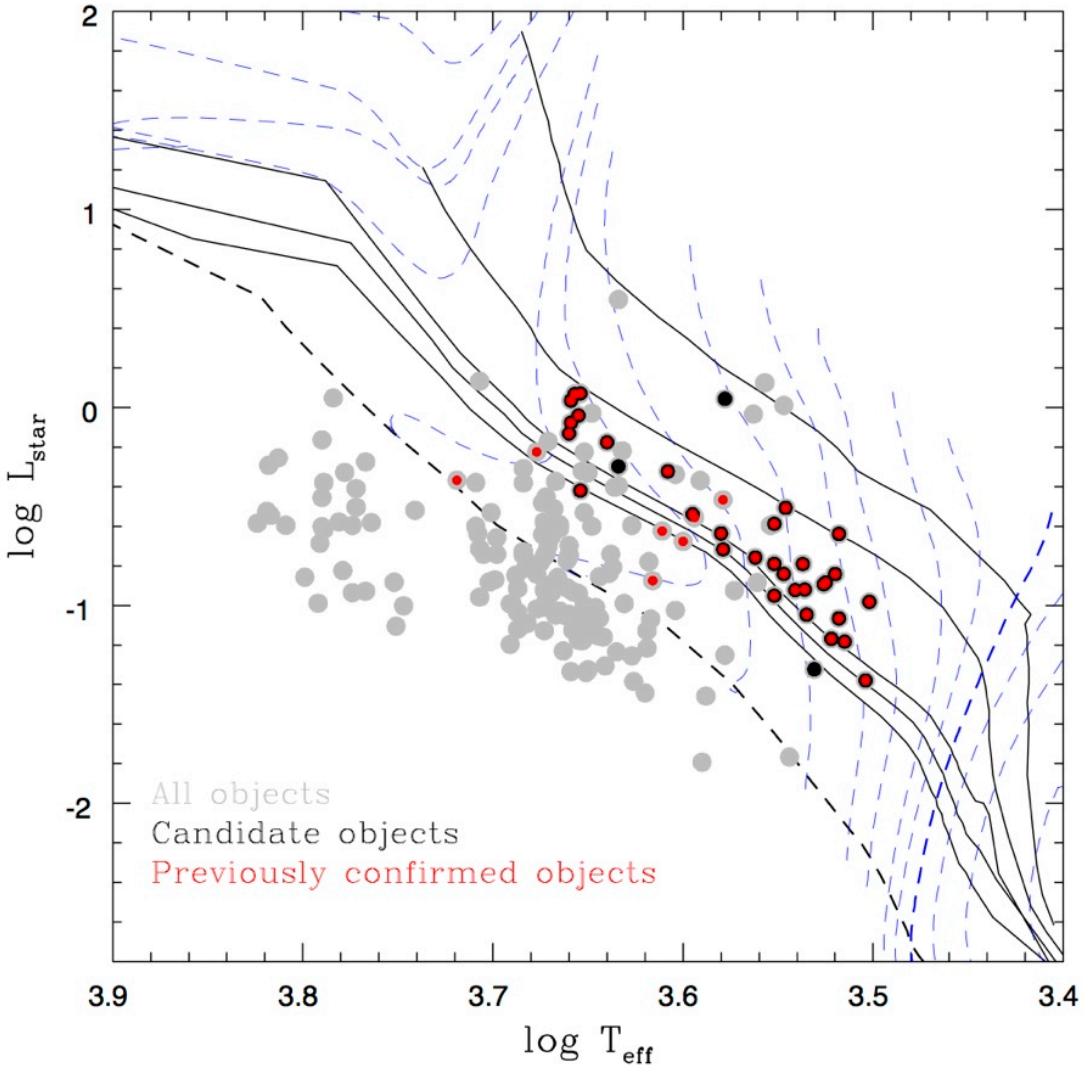

log L_{star}
log T_{eff}
All objects
Candidate objects
Previously confirmed objects

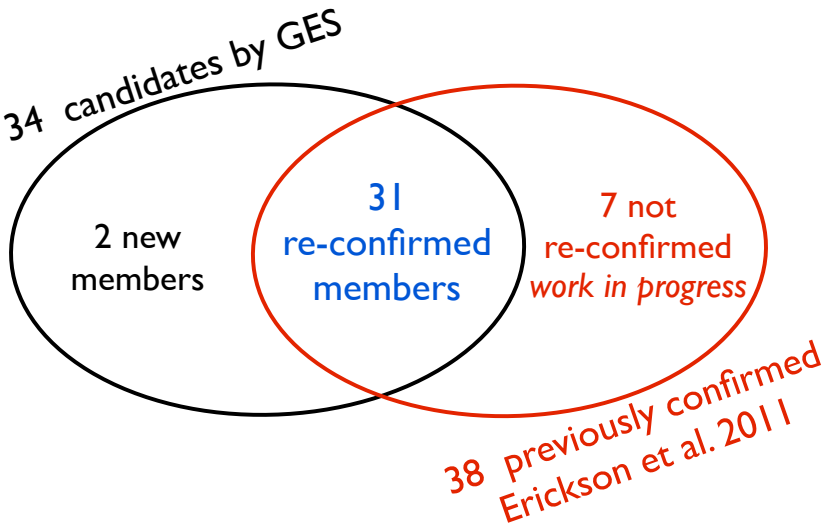

34 candidates by GES
Giant
Have Hα in emission
31 re-confirmed members
38 previously confirmed


normalized intensity
Giraffe
wavelenghts (Å)


normalized intensity
UVES
wavelenghts (Å)

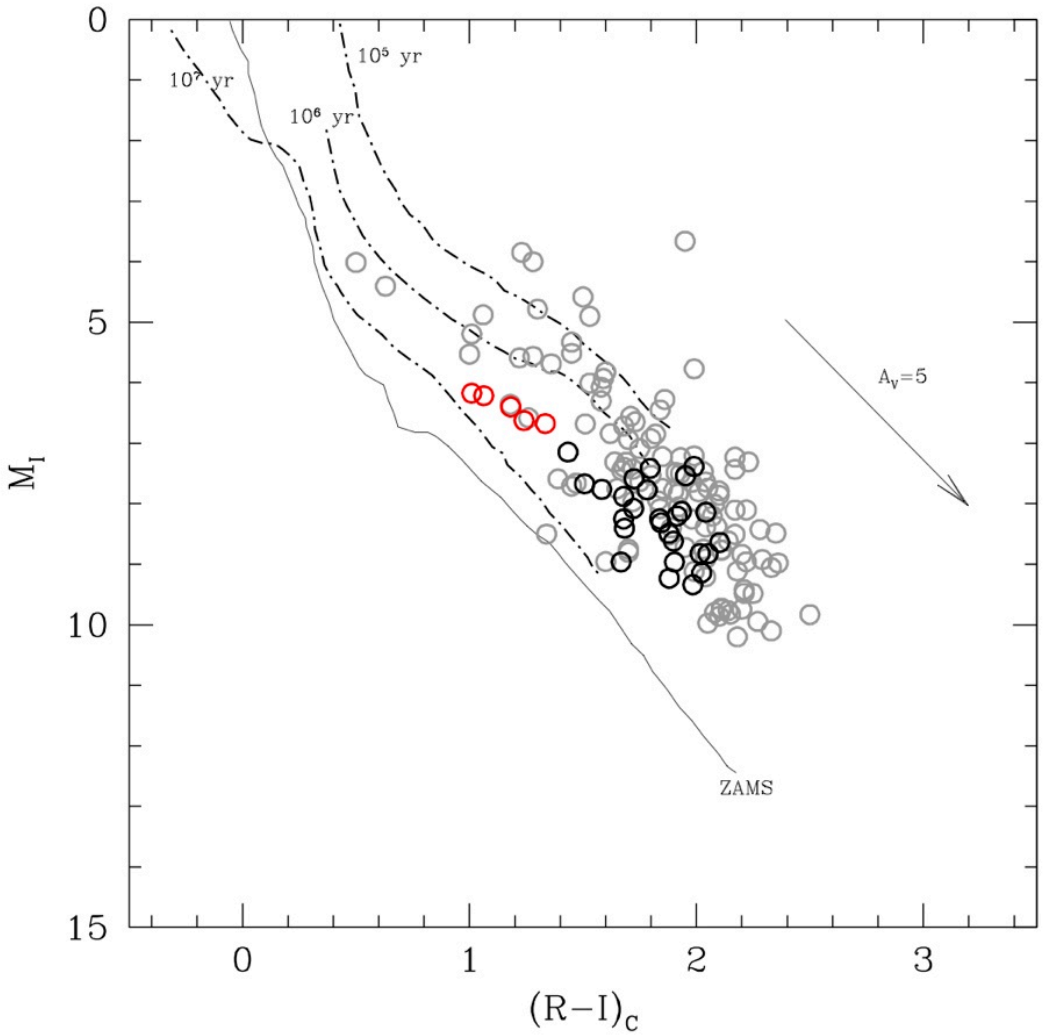
HR Diagram





In total we have 33 among re-confirmed and new members!
(5 UVES + 28 Giraffe)

Color-Magnitude Diagram

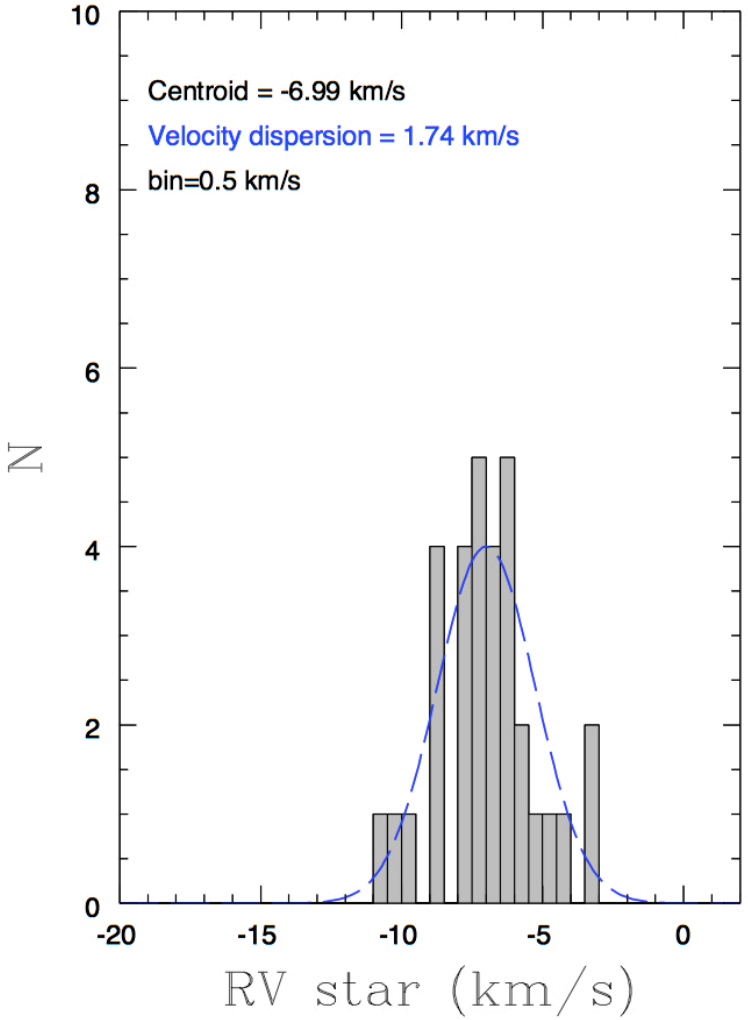


KS-2D test gives a probability ~ 0.13

➜ the two populations are similar!

Dynamical state of ρ-Oph: Radial velocities

Observed RV distribution for the confirmed members



Intrinsic velocity distribution

(Cottaar et al. 2012):

convolve with the measurement uncertainties

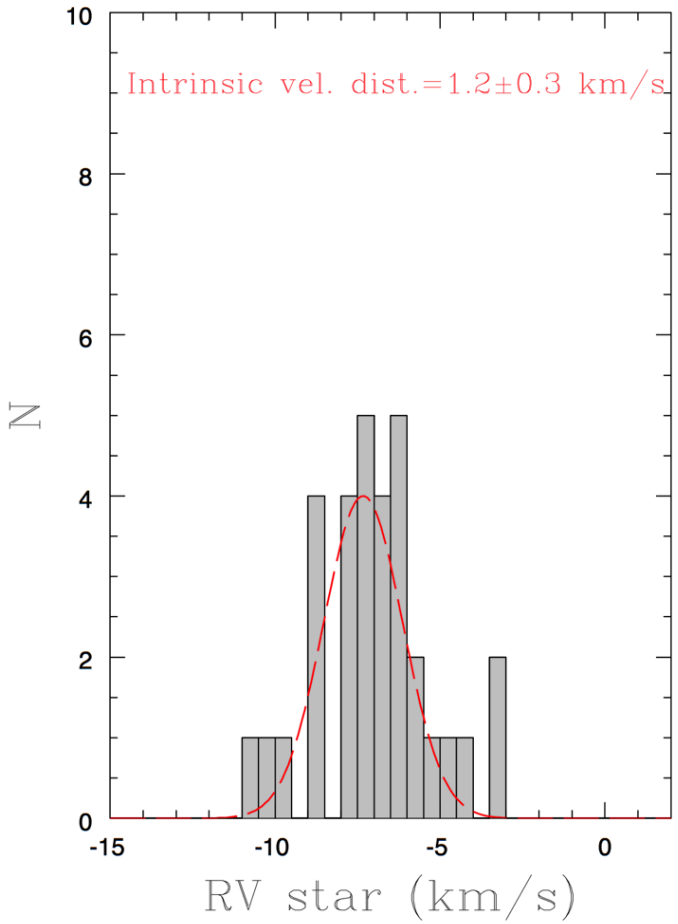
convolve with the binary orbital motion *assuming binary period, mass ratio, eccentricity distribution*

$P(v_{obs}) = (1 - f'_{bin})\ P(v_{intr}) * P(v_{unc}) + f'_{bin}\ P(v_{intr}) * P(v_{unc}) * P(v_{bin})$

f'_{bin} = *binary fraction*
$P(v_{obs})$ = *probability distribution observed velocity*
$P(v_{unc})$ = *probability distribution measured uncertainties*
$P(v_{bin})$ = *probability distribution binary orbital motion*
(Cottaar et al. 2012)

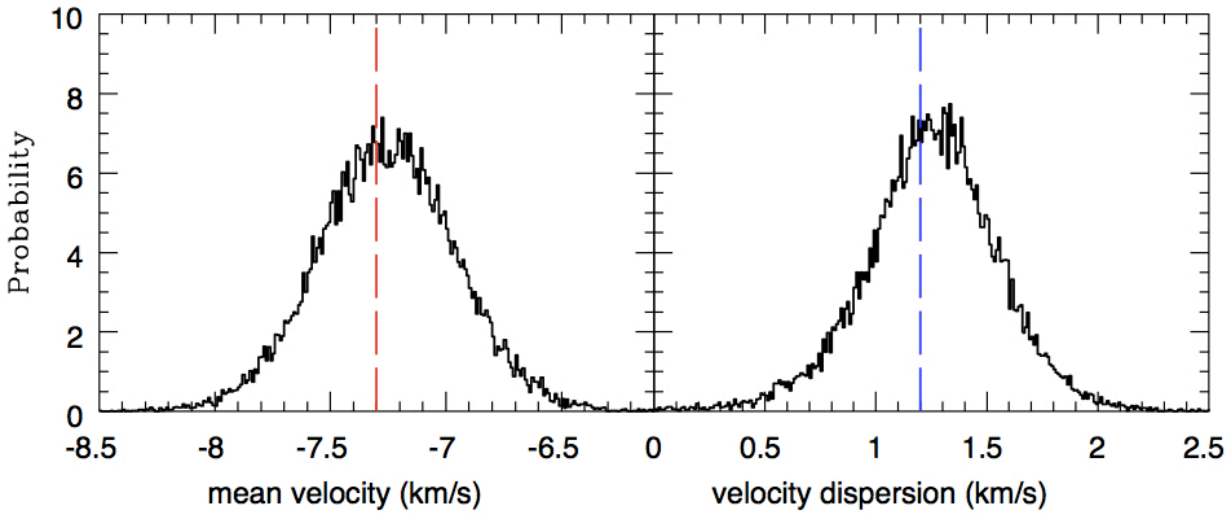
Dynamical state of ρ-Oph: Radial velocities

$\sigma_{intr} < \sigma_{obs}$



mean velocity = -7.3 ± 0.3 km/s

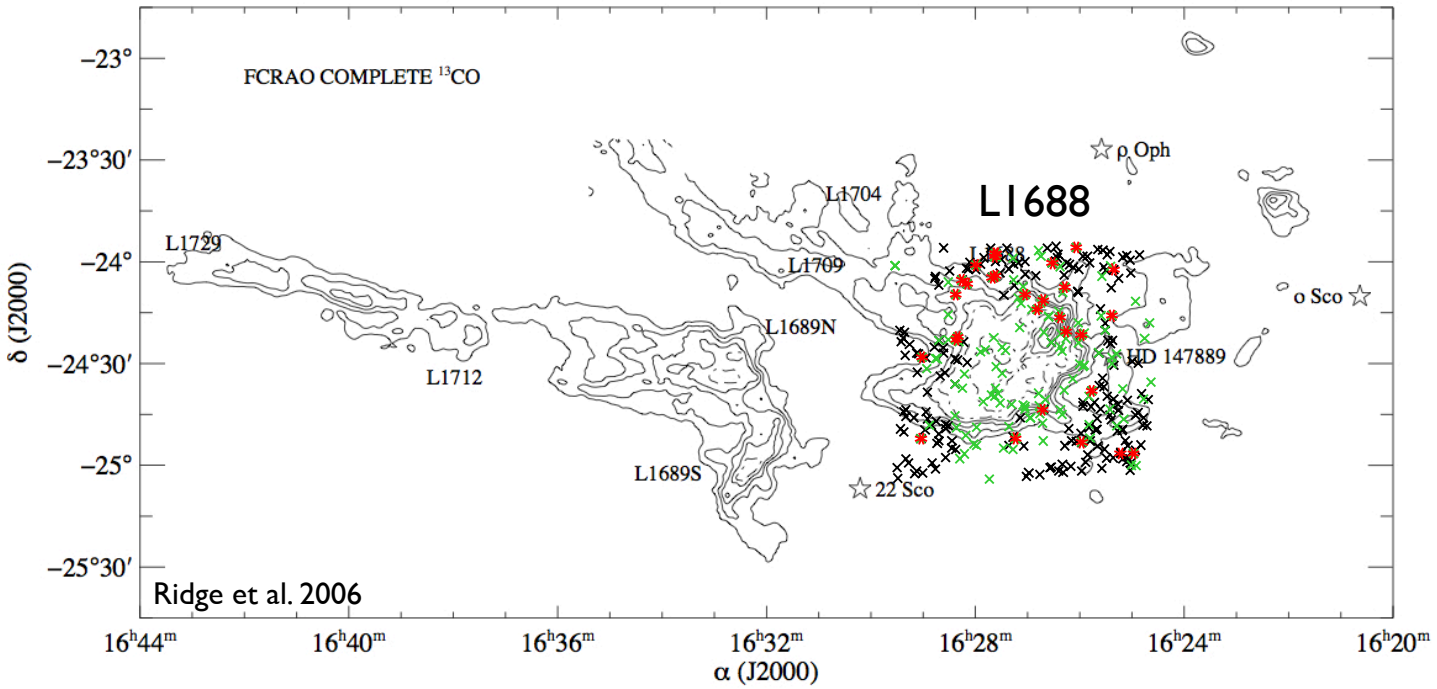
Vel. disp. = 1.2 ± 0.3 km/s



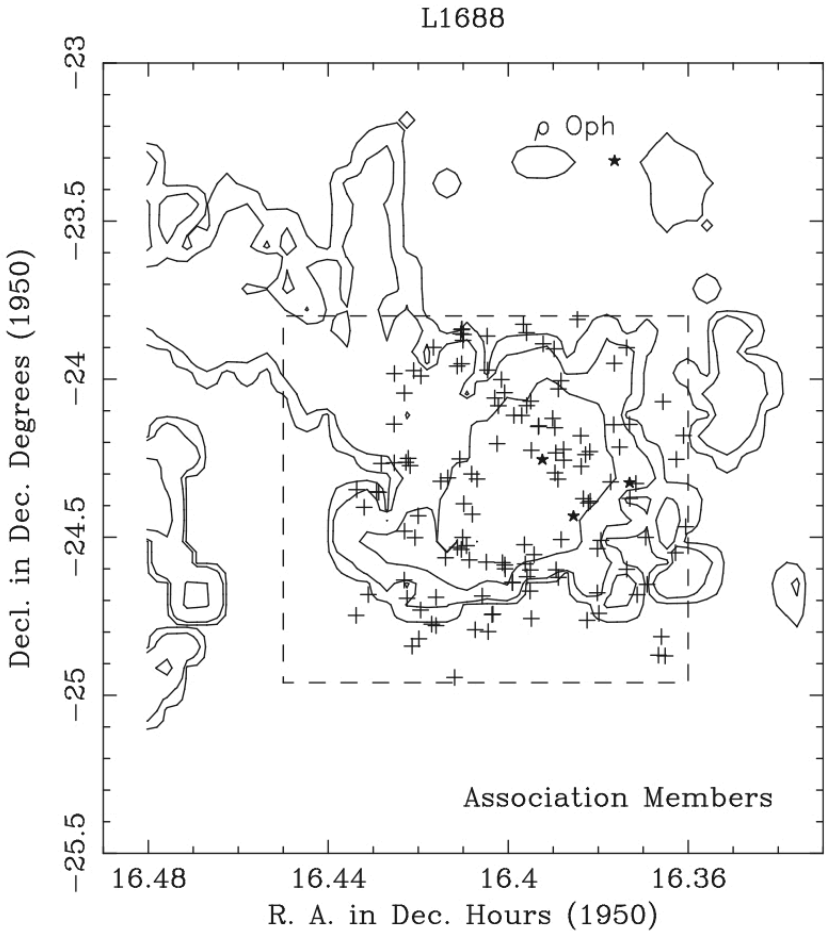
What does this intrinsic velocity dispersion mean for the dynamics of ρ-Oph?

Virial state of ρ-Oph: preliminary results

$$\sigma_{\rm dyn} = \sqrt{\frac{GM}{\eta r_{\rm hm}}}$$



Virial state of ρ-Oph



Erickson et al. 2011, Loren 1989

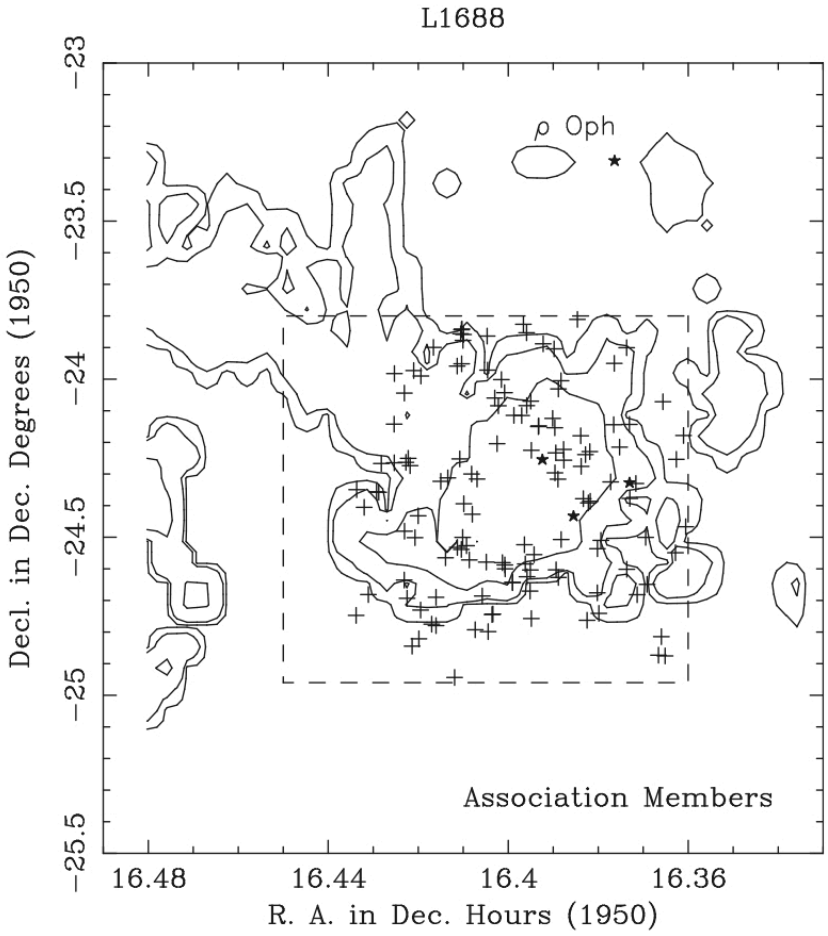
M_{L1688} = 1900 $M_\odot$

r_{hm} ~ 0.6 pc

η=10

σ_{dyn} = 1.2 km/s

Virial state of ρ-Oph



Erickson et al. 2011, Loren 1989

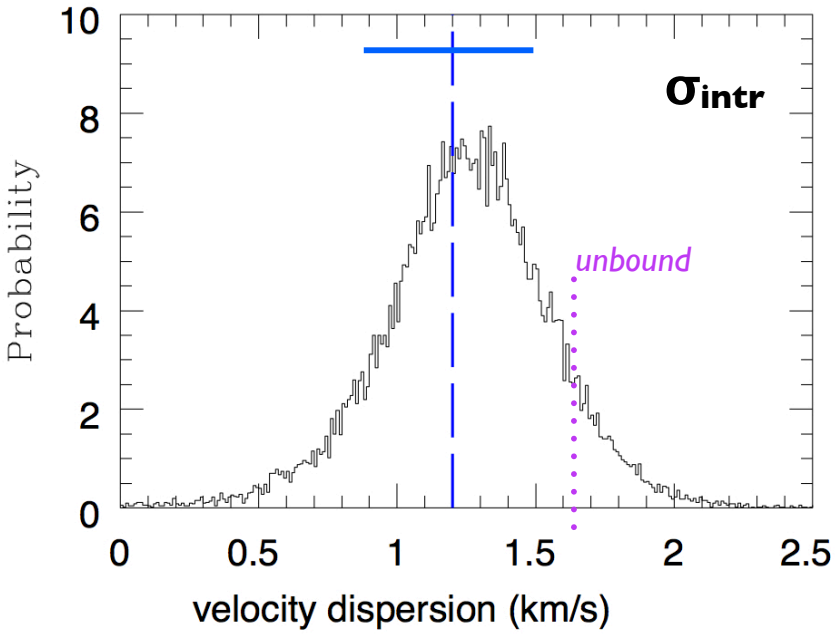
M_{L1688} = 1900 $M_\odot$

r_{hm} ~ 0.6 pc

η=10

σ_{dyn} = 1.2 km/s

σ_{intr} = 1.2 ± 0.3 km/s



Dynamical evolution of star clusters

Gamma Velorum (Jeffries et al 2014): 2 kinematic components, one is consistent with **virial** equilibrium

IC348 (Cottaar et al. 2014 in prep.): **supervirial**

ρ-Oph (Rigliaco et al. in prep.): **virial**

Westerlund 1 (Cottaar et al. 2012): **subvirial**

Cha I (Sacco et al. in prep.): similar to ρ-Oph? complicated morphology! (G. Sacco talk)

Take Away Messages

- One kinematic population

- A more thorough analysis of a few objects could enlarge the sample of re-confirmed members

- The re-confirmed objects are representative of the surface population

- Accurate estimate of the intrinsic radial velocities distribution

- ρ-Oph appears consistent with virial equilibrium