

Dance of the Stars:

An Analysis of the Spatial Evolution of Two Clusters

Anne Buckner (University of Leeds)

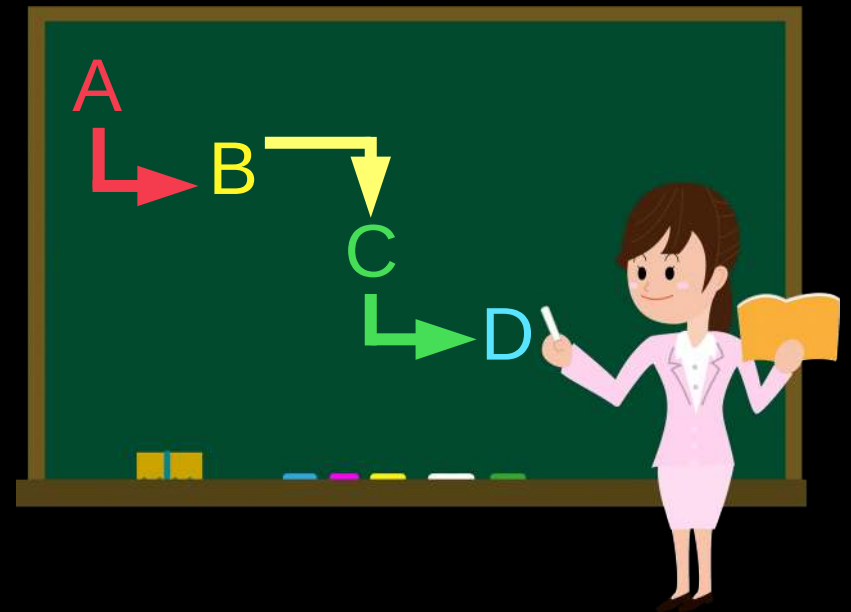
& the SFM Collaboration



UNIVERSITY OF LEEDS

Talk Outline

- ◆ Stellar Association
- ◆ INDICATE
- ◆ Carina Nebula
- ◆ Upper Scorpius



Stellar Association

- Point processes
 - intensity
 - correlation
 - spatial distribution

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Q. How “clustered” are stars?

Why is studying stellar association important?

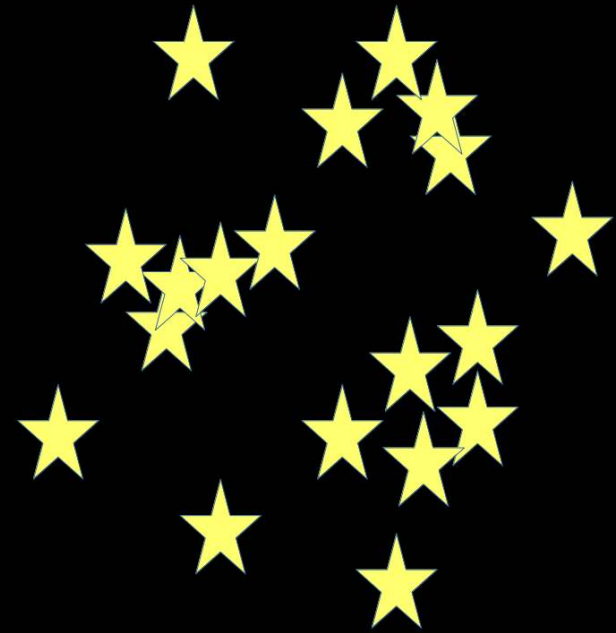


Why is studying stellar association important?

- Define the distribution and clustering of stars
- Trace morphological features → variation in degree of clustering of stars in regions
(as a function of e.g. age, mass, position)
- Discriminate between different modes of Massive SF

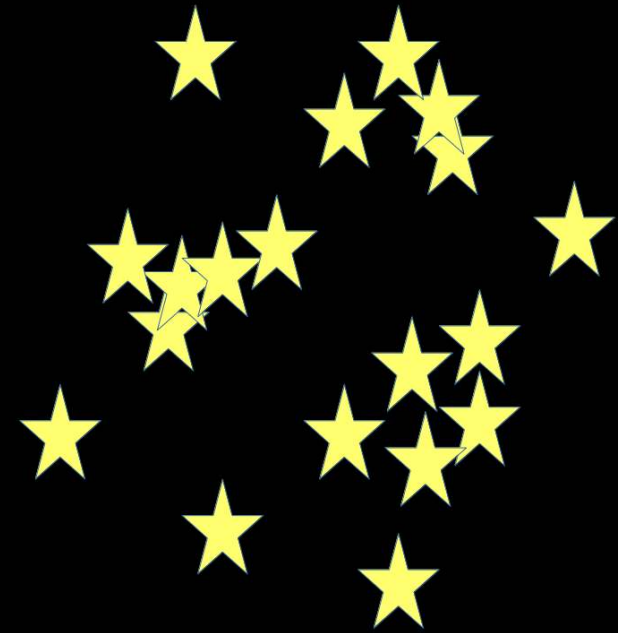


Measuring Stellar Association



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1. Global measures



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- 2-point correlation function
- Hopkins Statistic



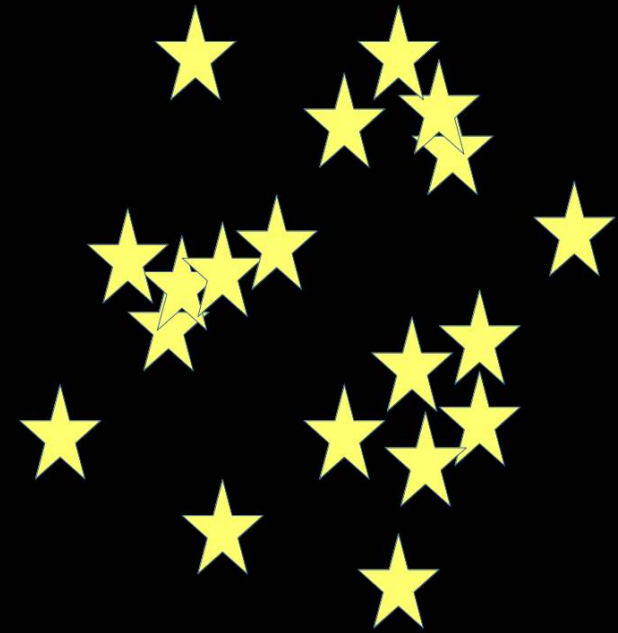
$= X$

Measuring Stellar Association

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2. Local measures



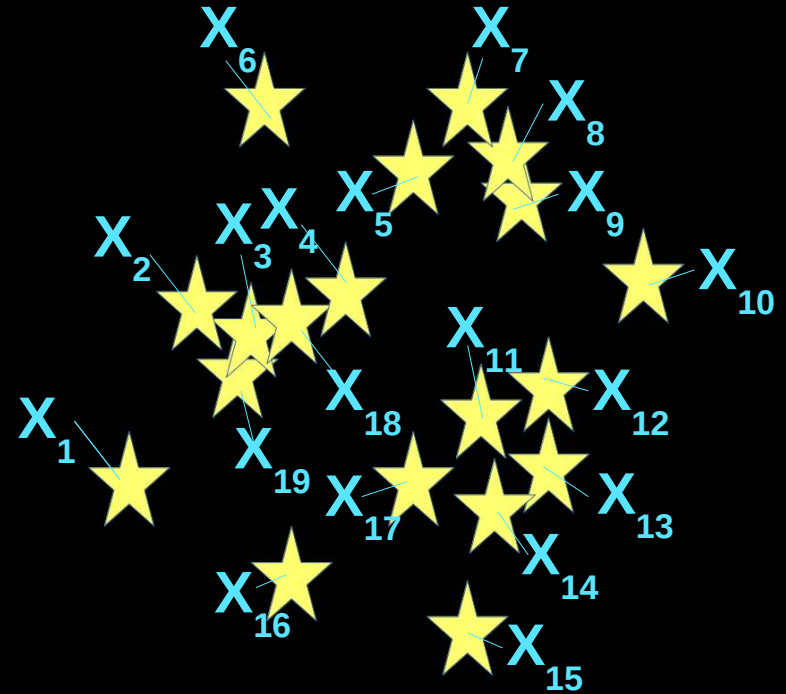
Measuring Stellar Association

1. Global measures

- 2-point correlation function
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2. Local measures

- INDICATE



INDICATE

Index to **D**efine **I**nherent **C**lustering **A**nd **T**endencies

INDICATE

Index to **D**efine **I**nherent **C**lustering **A**nd **T**endencies

- Local measure of degree of stellar association
- Any parameter space
- 2+D

INDICATE

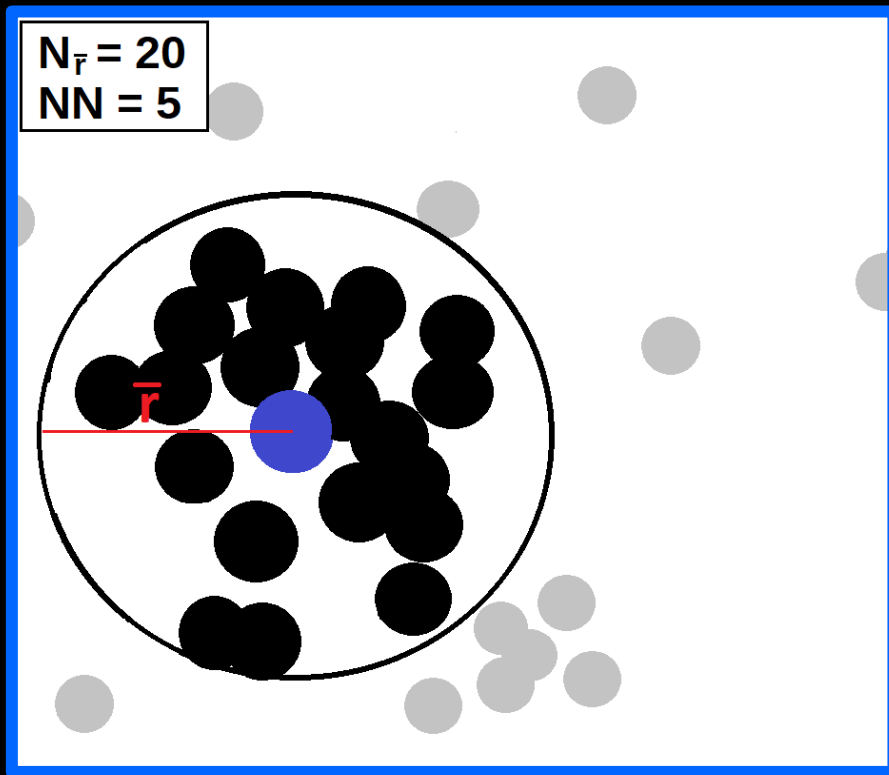
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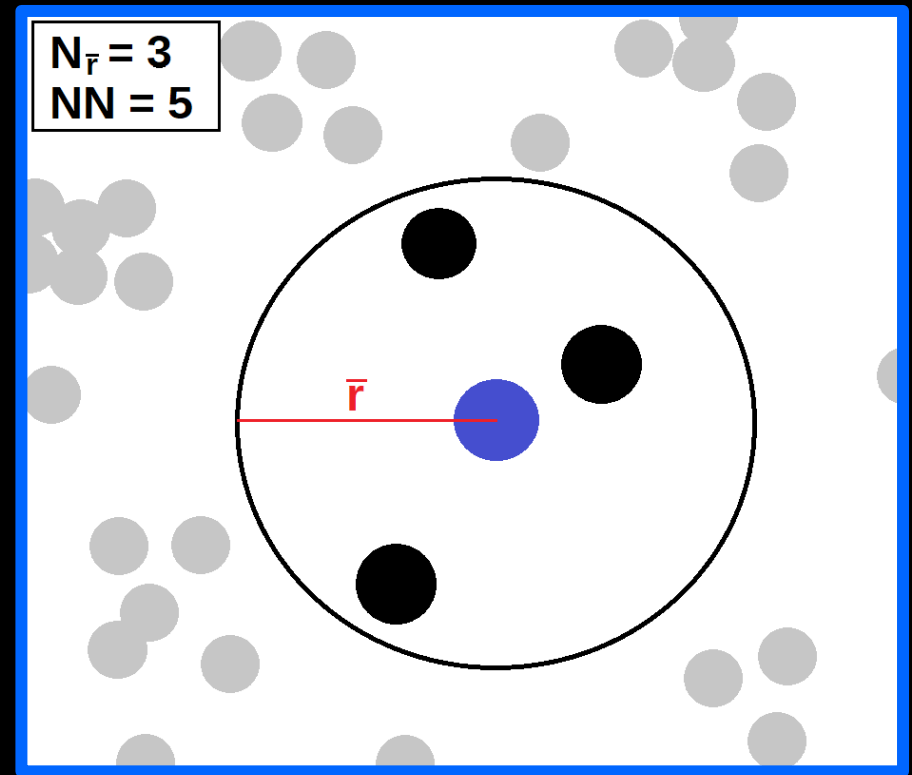
- Assigns a clustering index to each star
- Comparison of number of nearest neighbours with an evenly spaced control field
- Meaningful index values → calibrated against random distributions

INDICATE

Index to Define Inherent Clustering And Tendencies



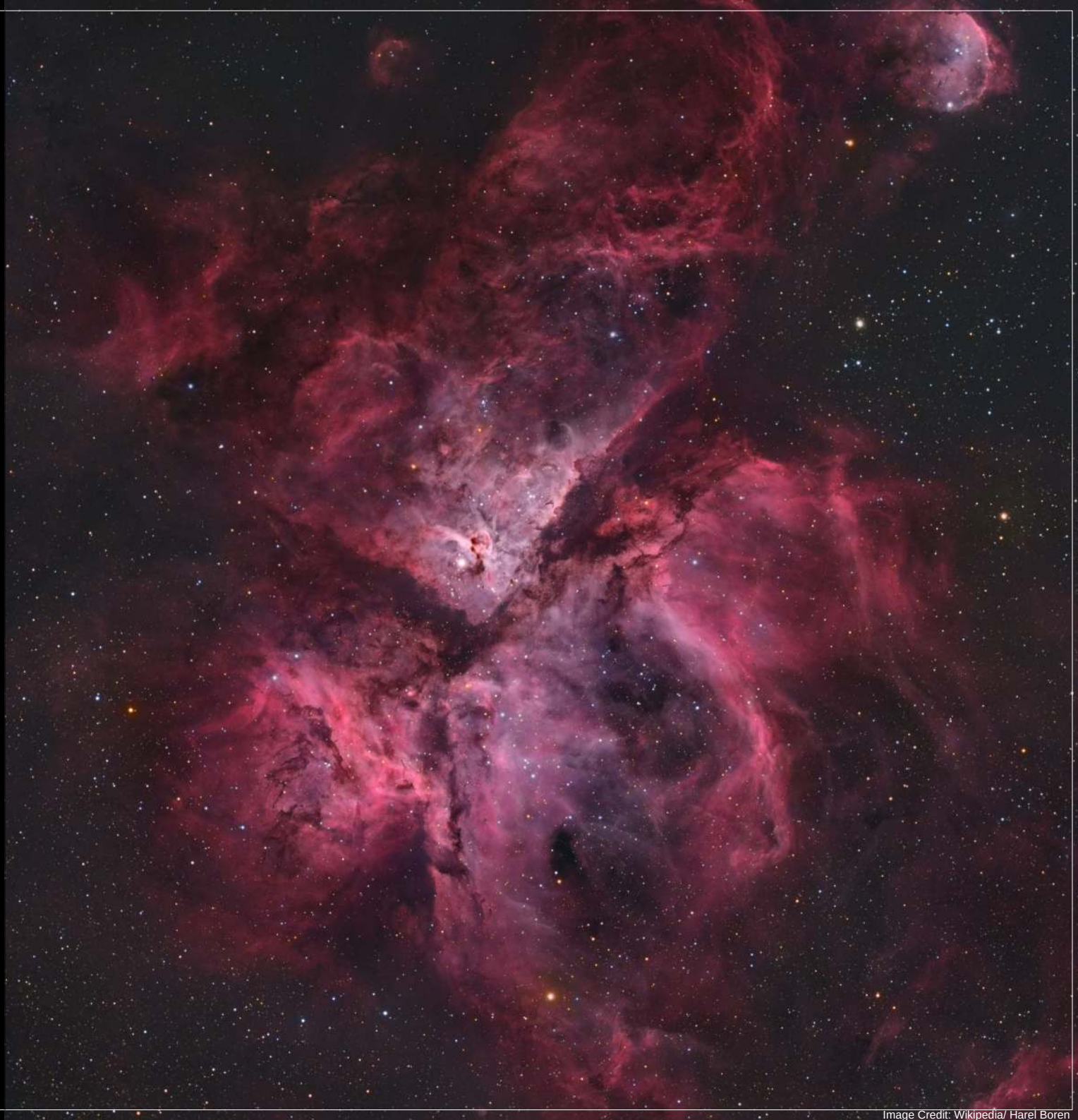
$$I = 20/5 = 4$$

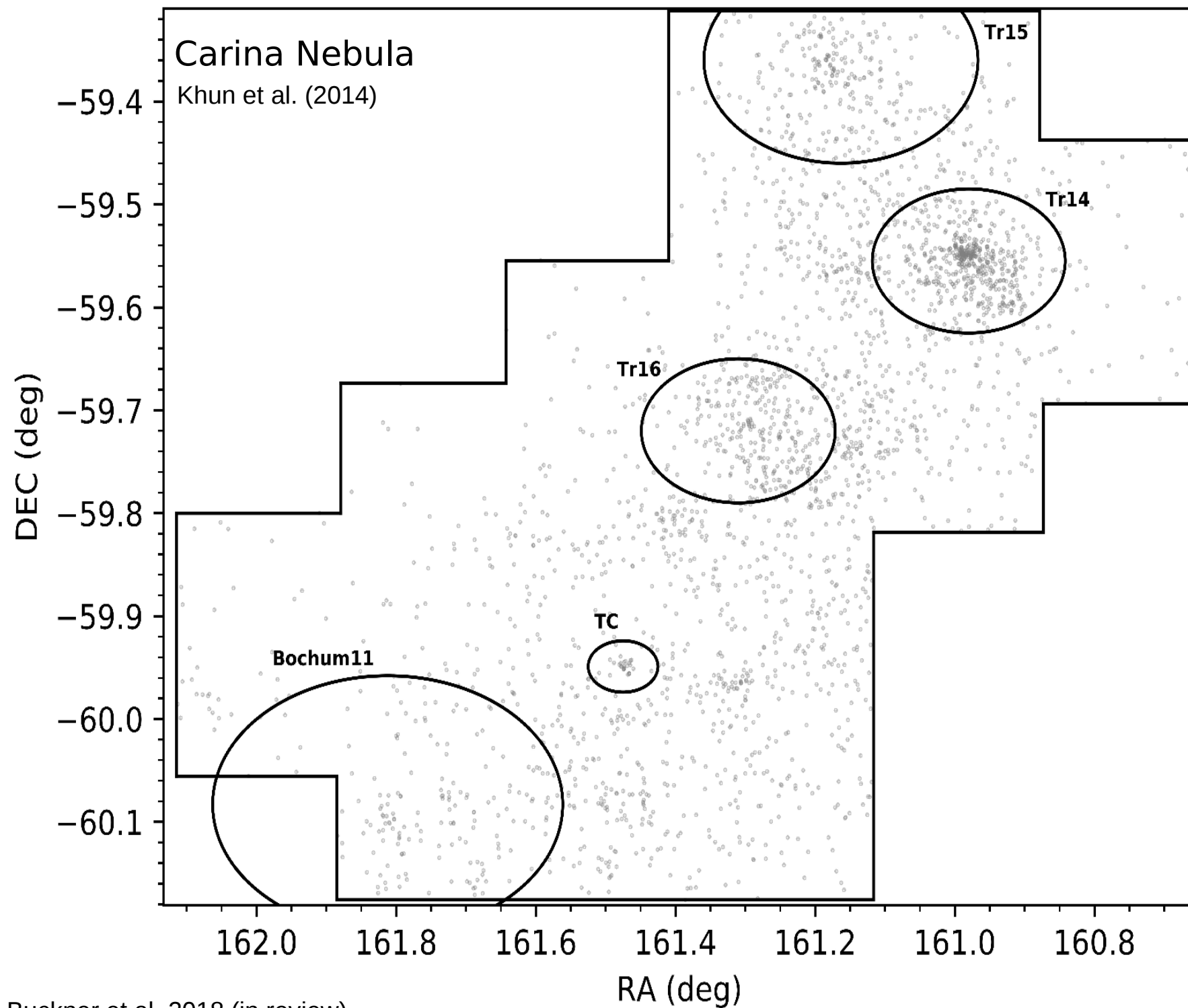


$$I = 3/5 = 0.6$$

Carina Nebula

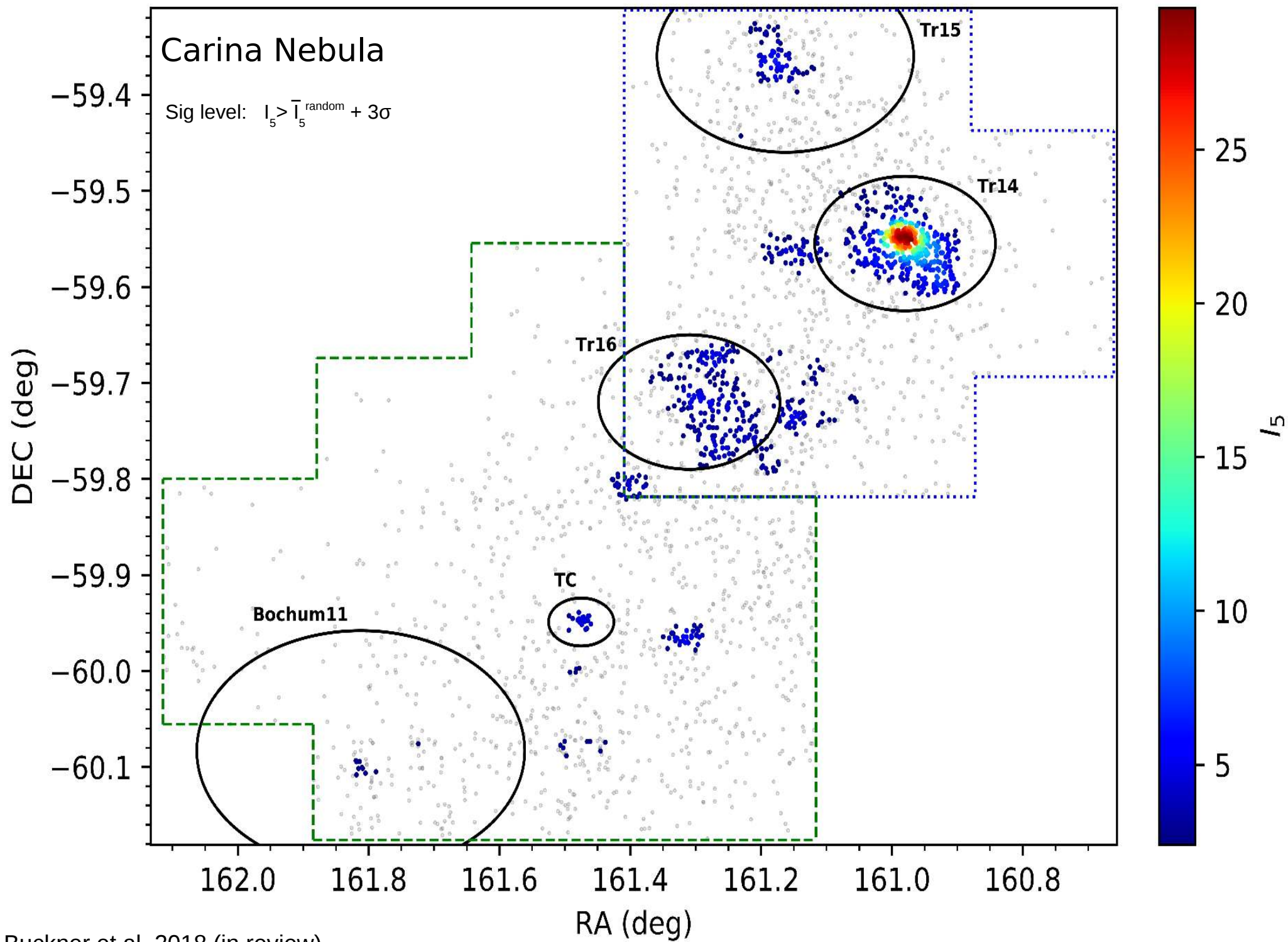
- Typical $A_V \sim 0.5-3$ mag (≤ 10 mag)
- Age ≤ 6 Myr
- $D \sim 2.3$ kpc
- $M > 10^5 M_\odot$
- 130+ OB Stars

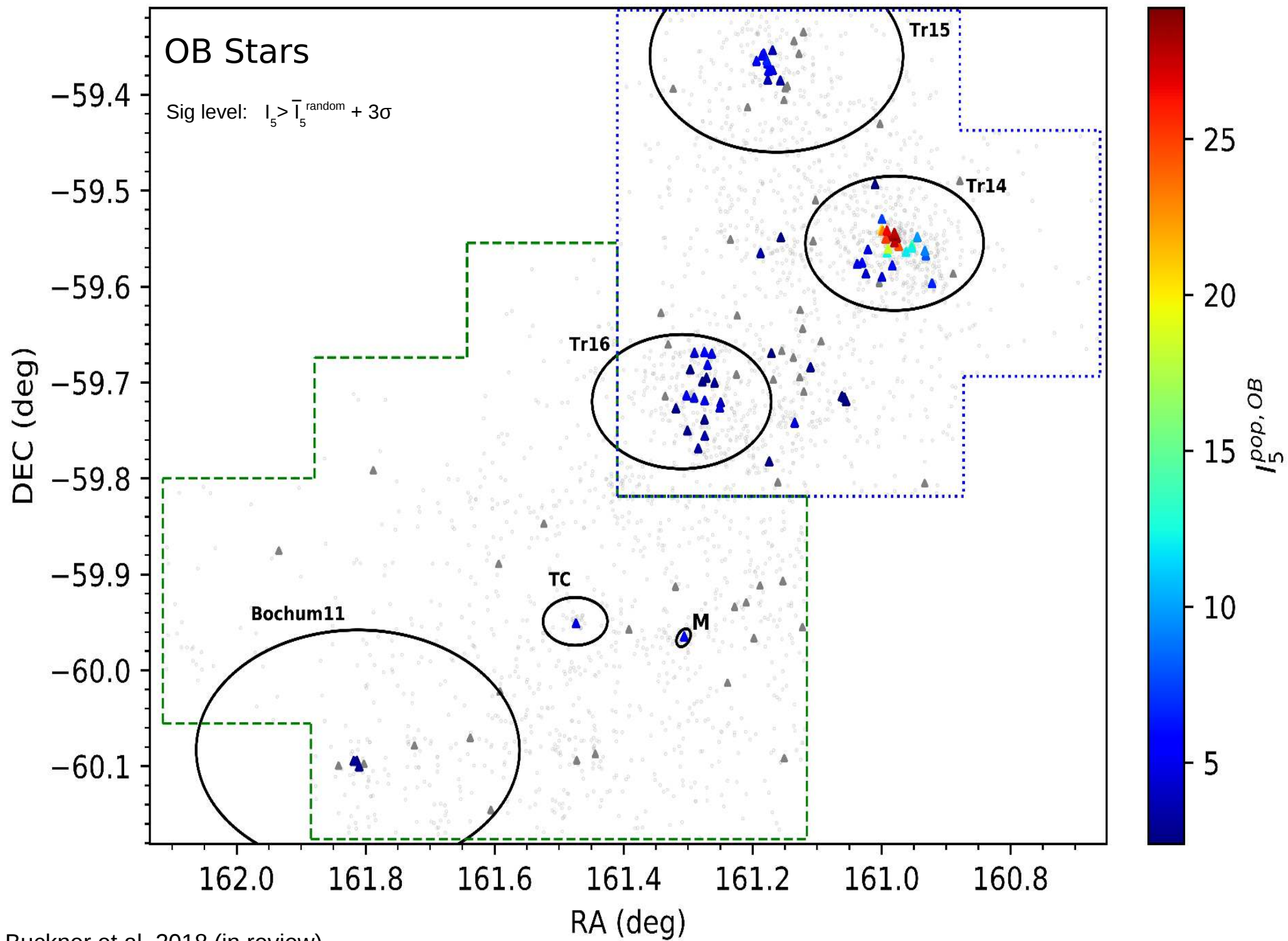


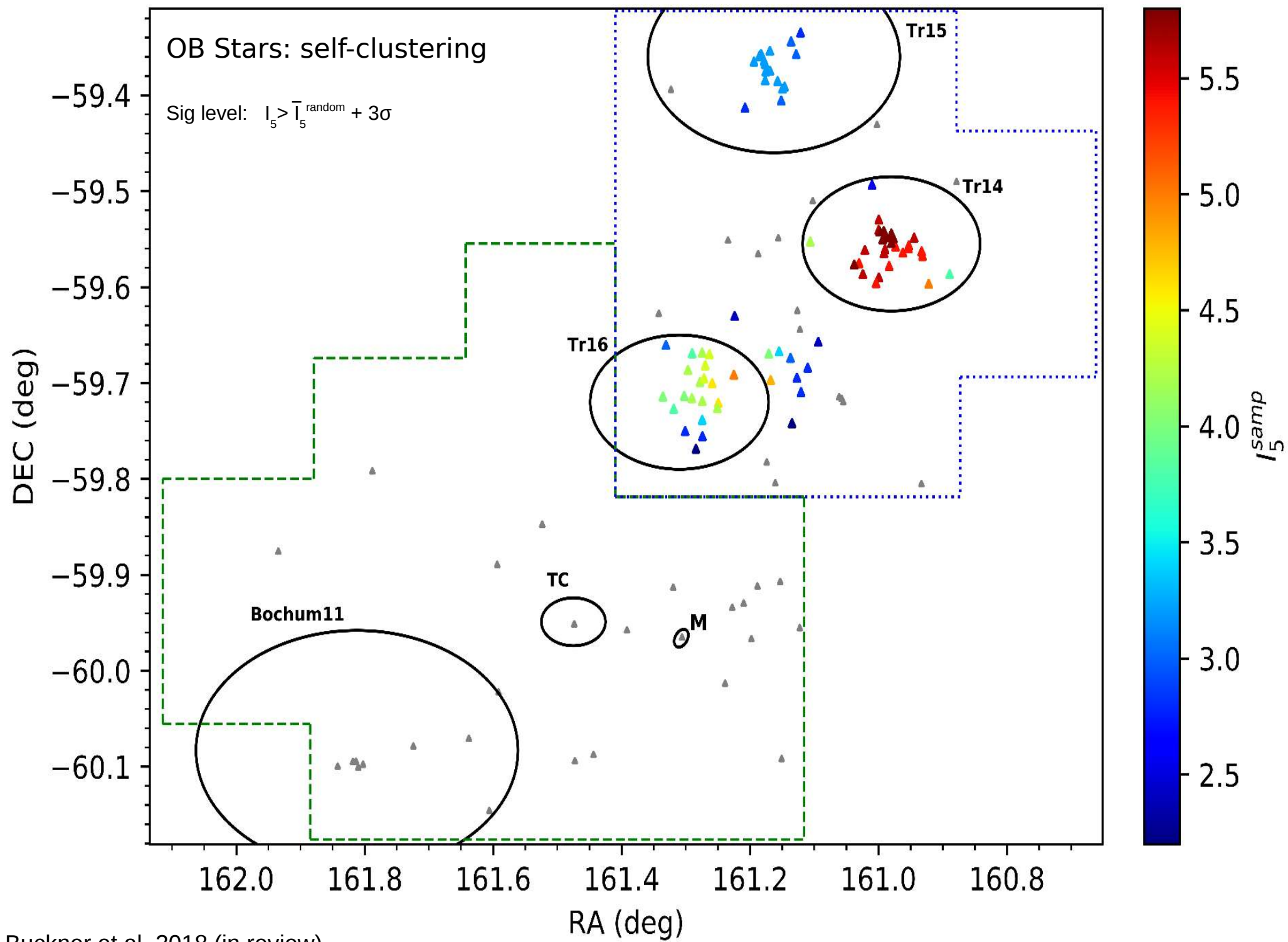


Carina Nebula

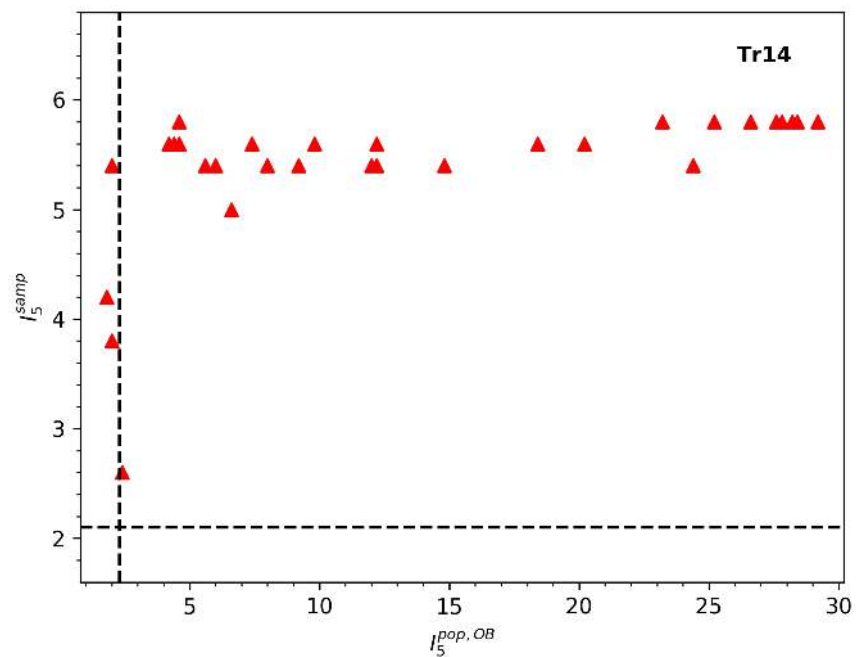
Sig level: $I_5 > \bar{I}_5^{\text{random}} + 3\sigma$



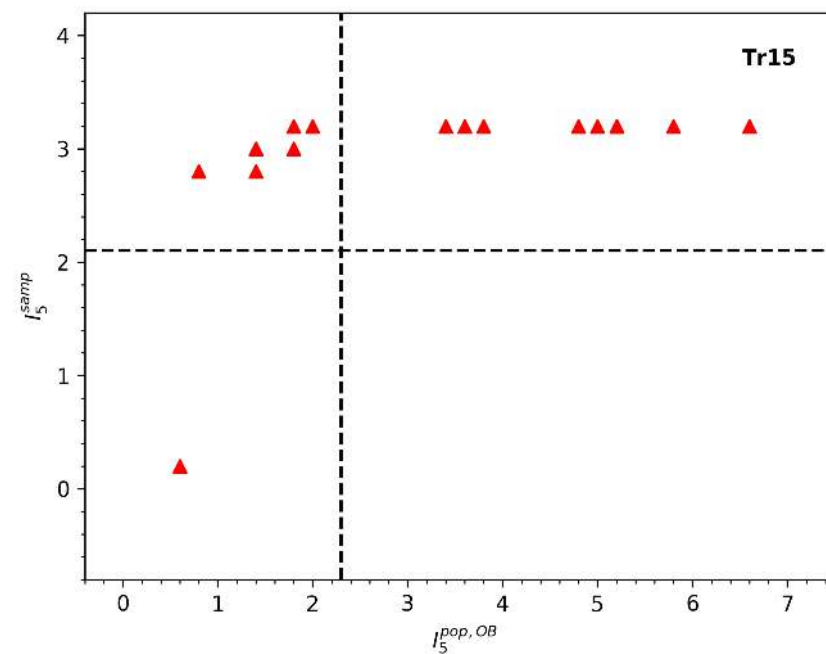




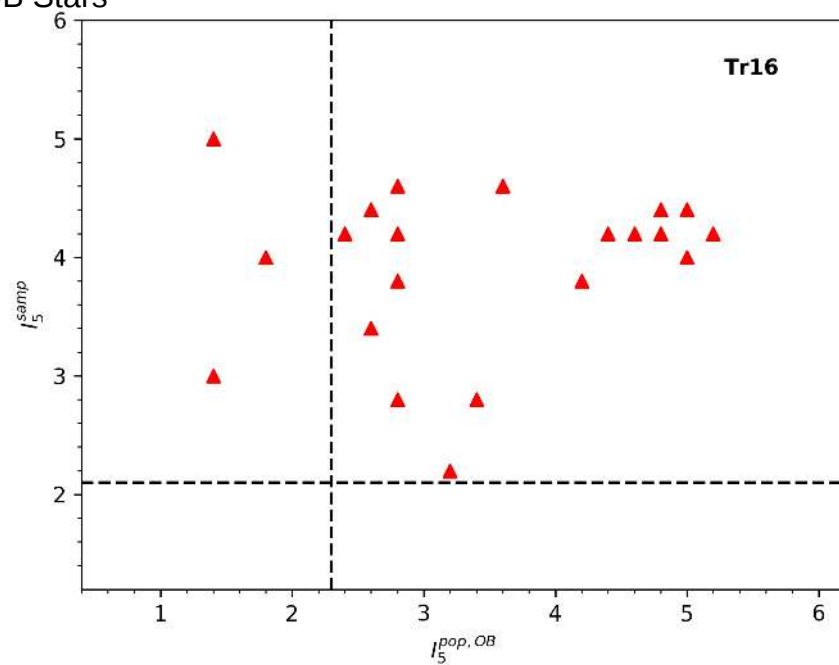
OB Stars



OB Stars

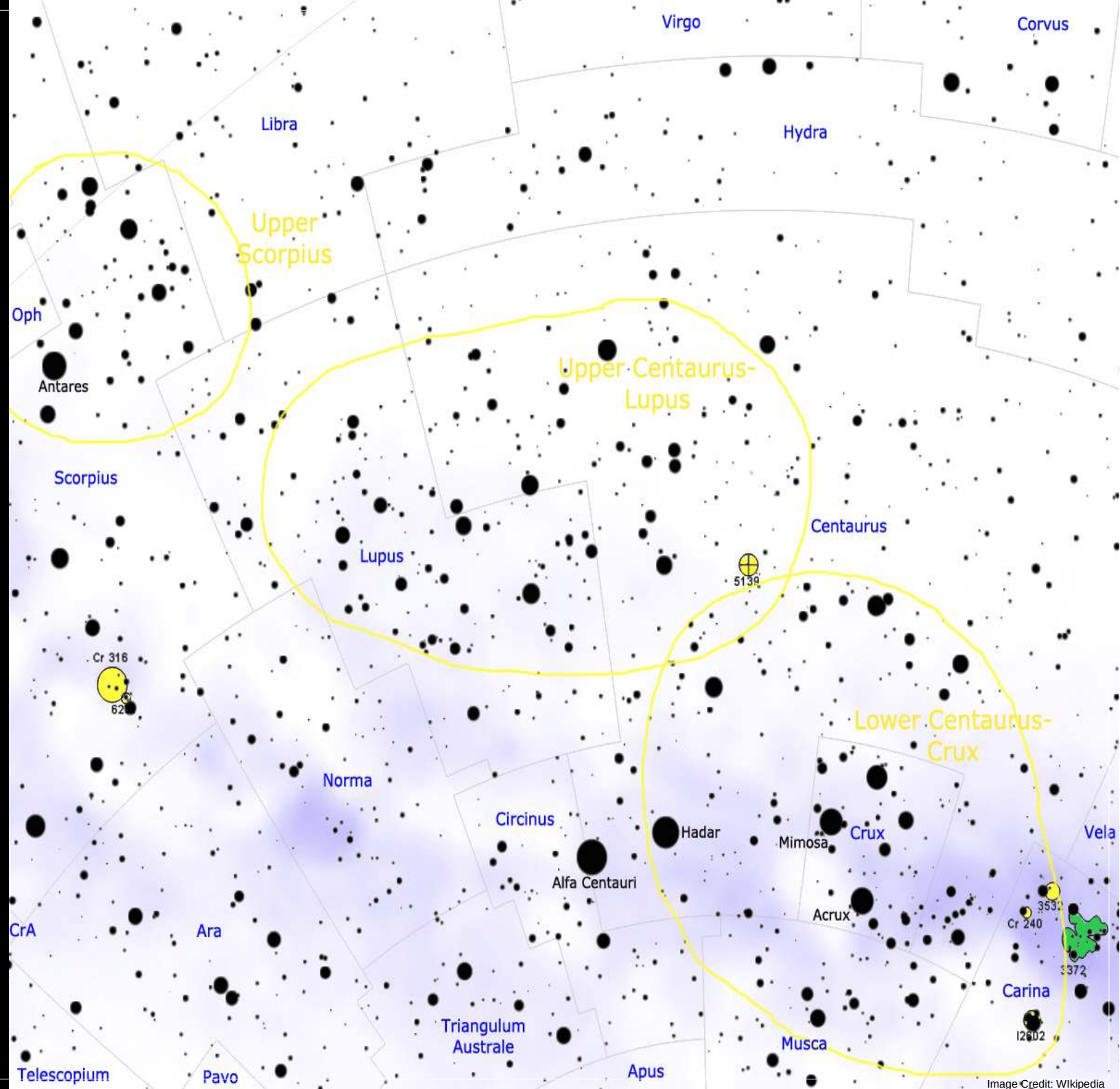


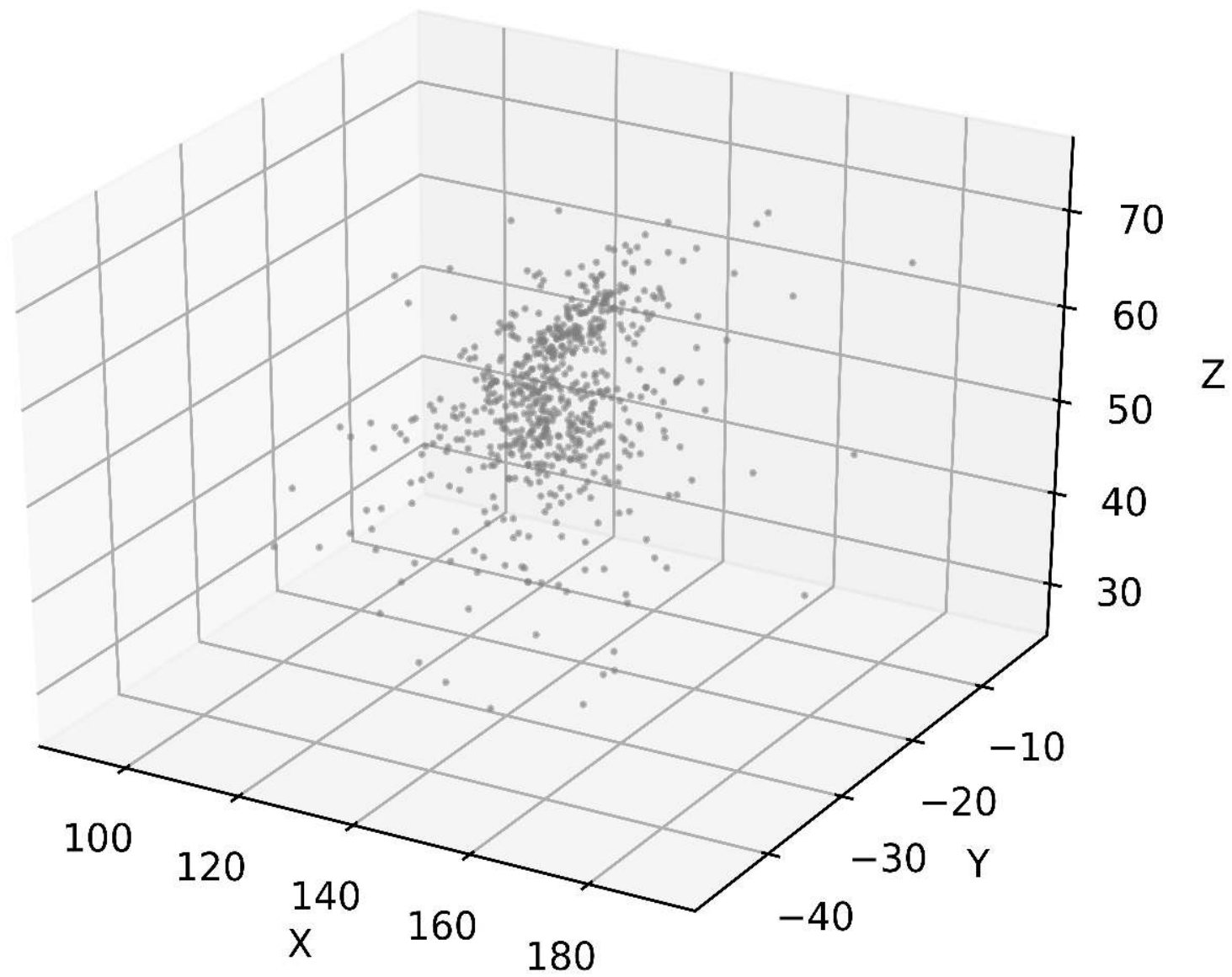
OB Stars

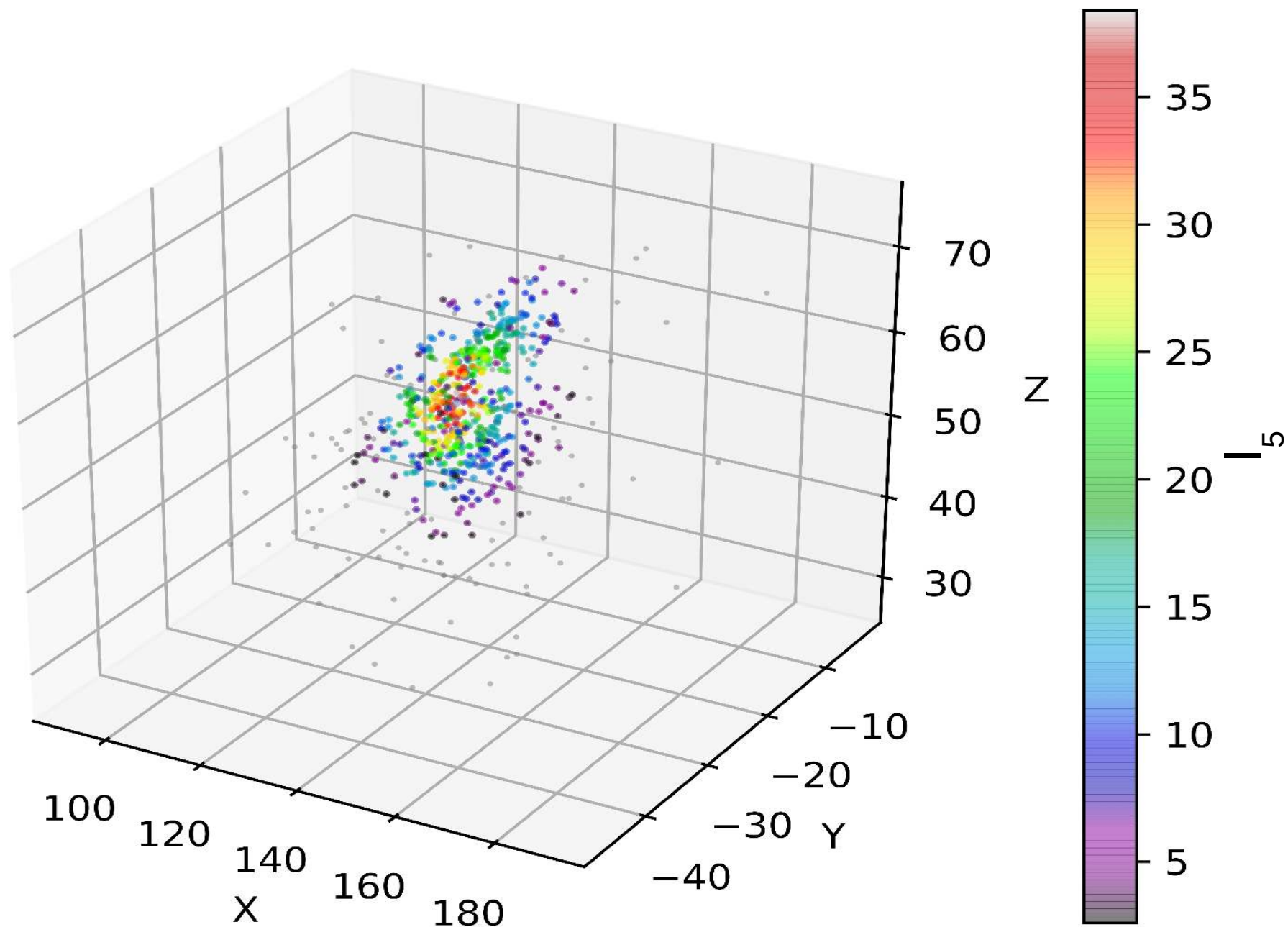


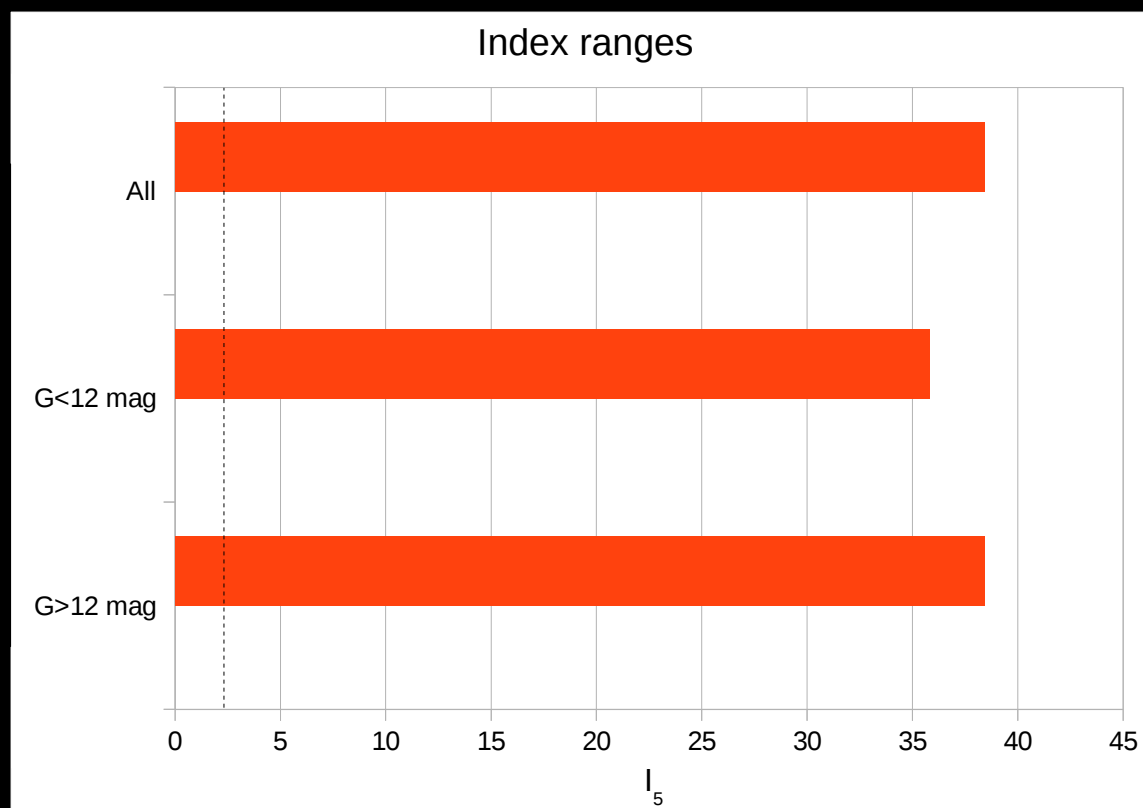
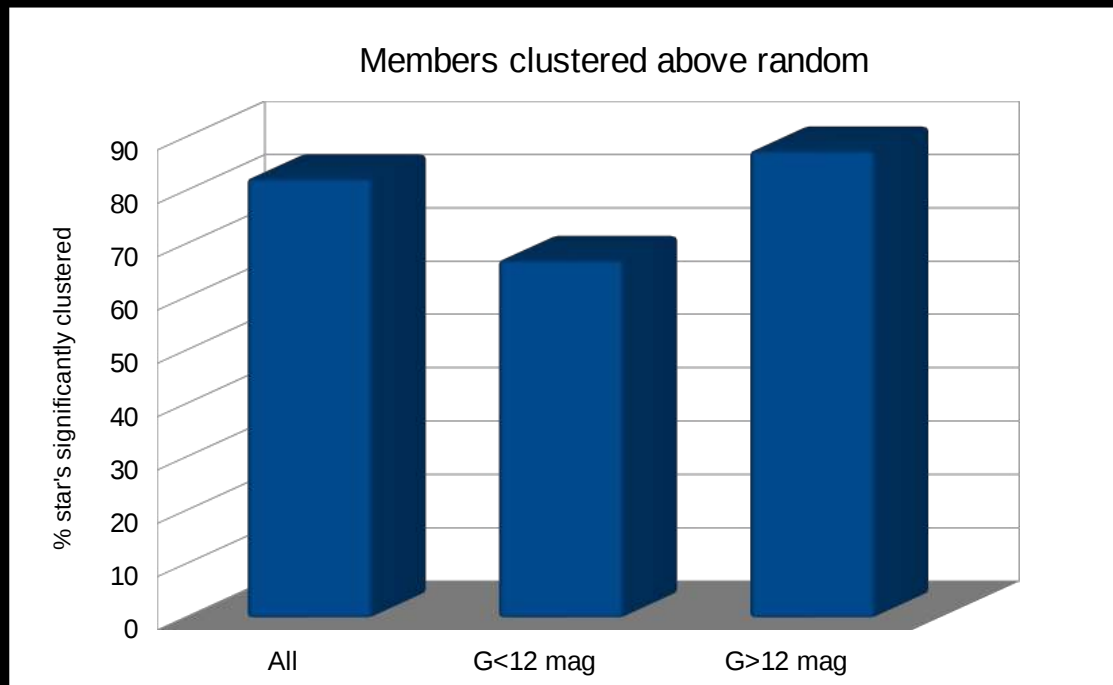
Upper Scorpius

- Age ~5-10 Myr
- D ~ 145 pc
- OB association
- ~1300 candidate members

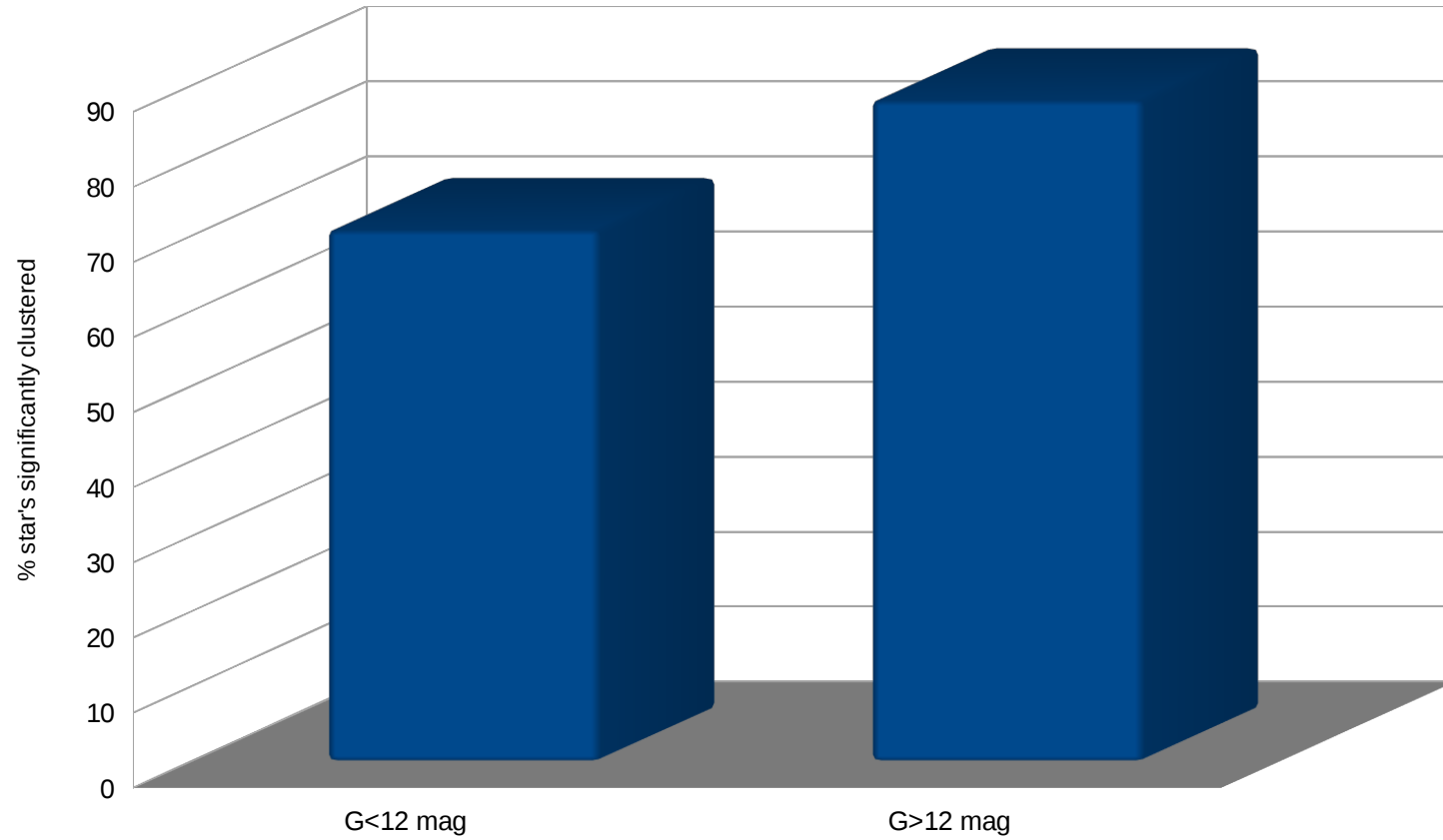




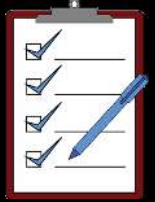




Self-clustering

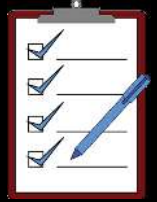


Summary



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- ◆ 2+D, any parameter space
- ◆ Trace morphological features in SF regions
- ◆ Buckner et al. (2018, A&A, in review)

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- ◆ Clustering tendencies in NW and SE regions of Carina different
- ◆ More pronounced for OB stars
- ◆ No mass segregation in SE region

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- ◆ Upper Scorpius is centrally concentrated
- ◆ Higher mass population more spatially dispersed than lower mass
- ◆ Signature of SF history