Unravelling the Story of Massive Star Formation: Clues from the YSOs of NGC2264

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Images:Flicker/ Martin Heigah

Structure of Talk

- NGC2264
- What's special about it?
- INDICATE
- What did we find?
- Conclusions

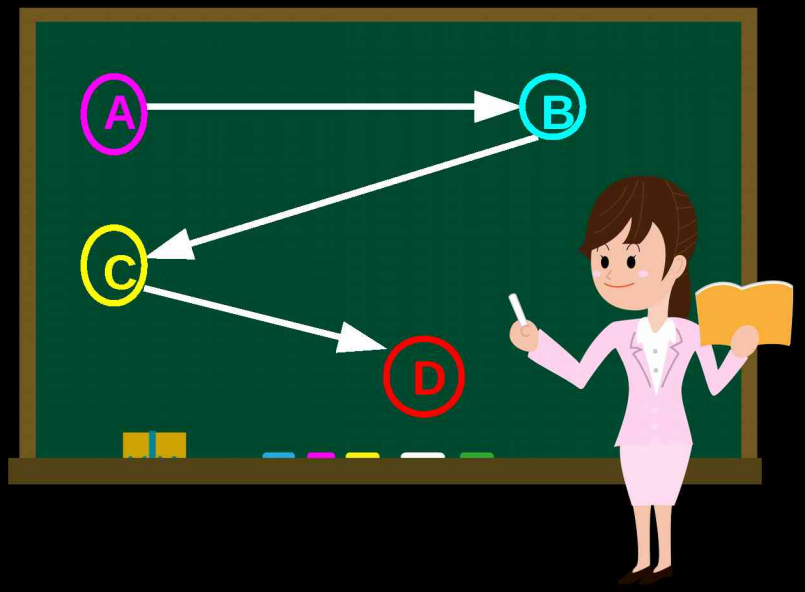
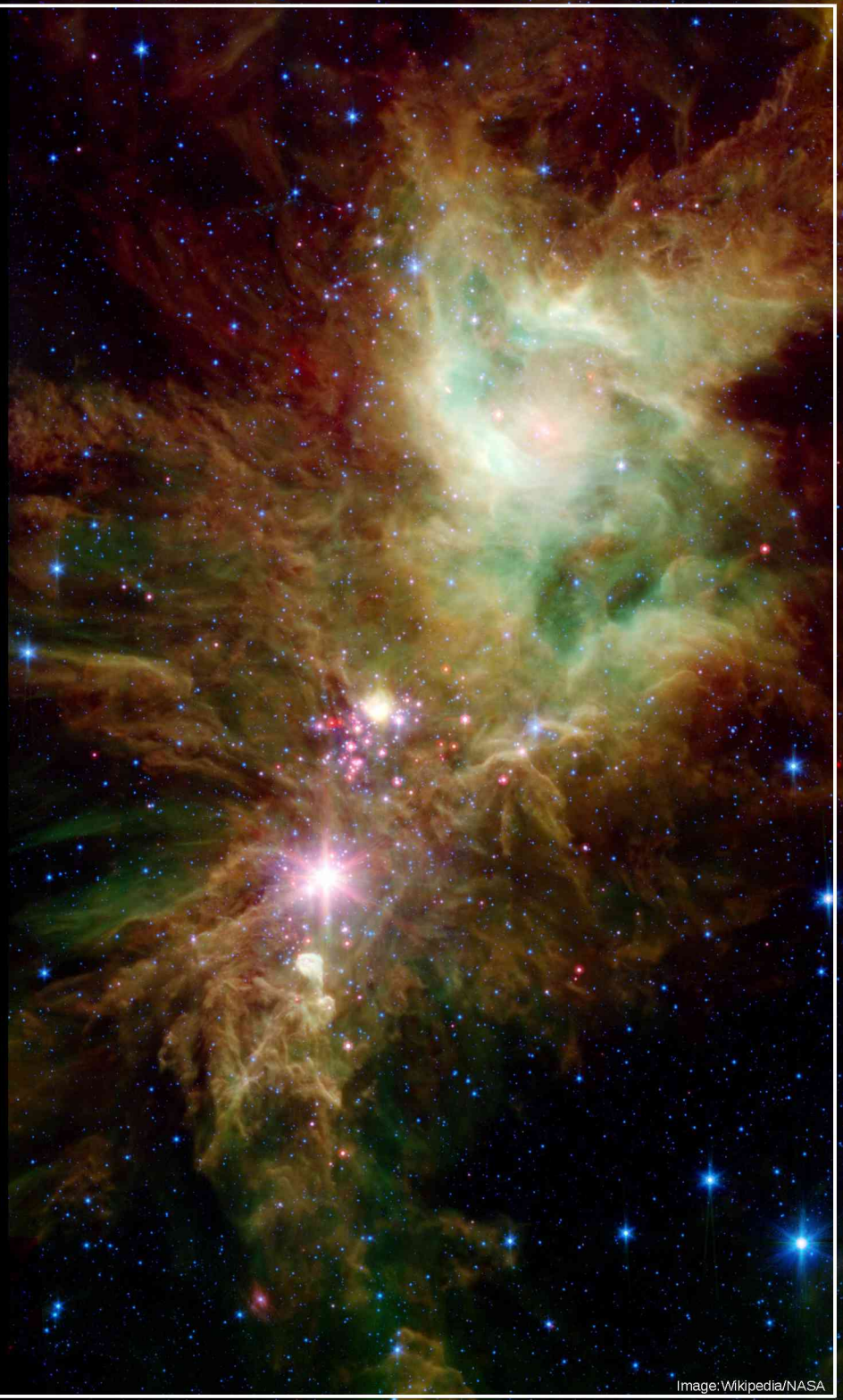
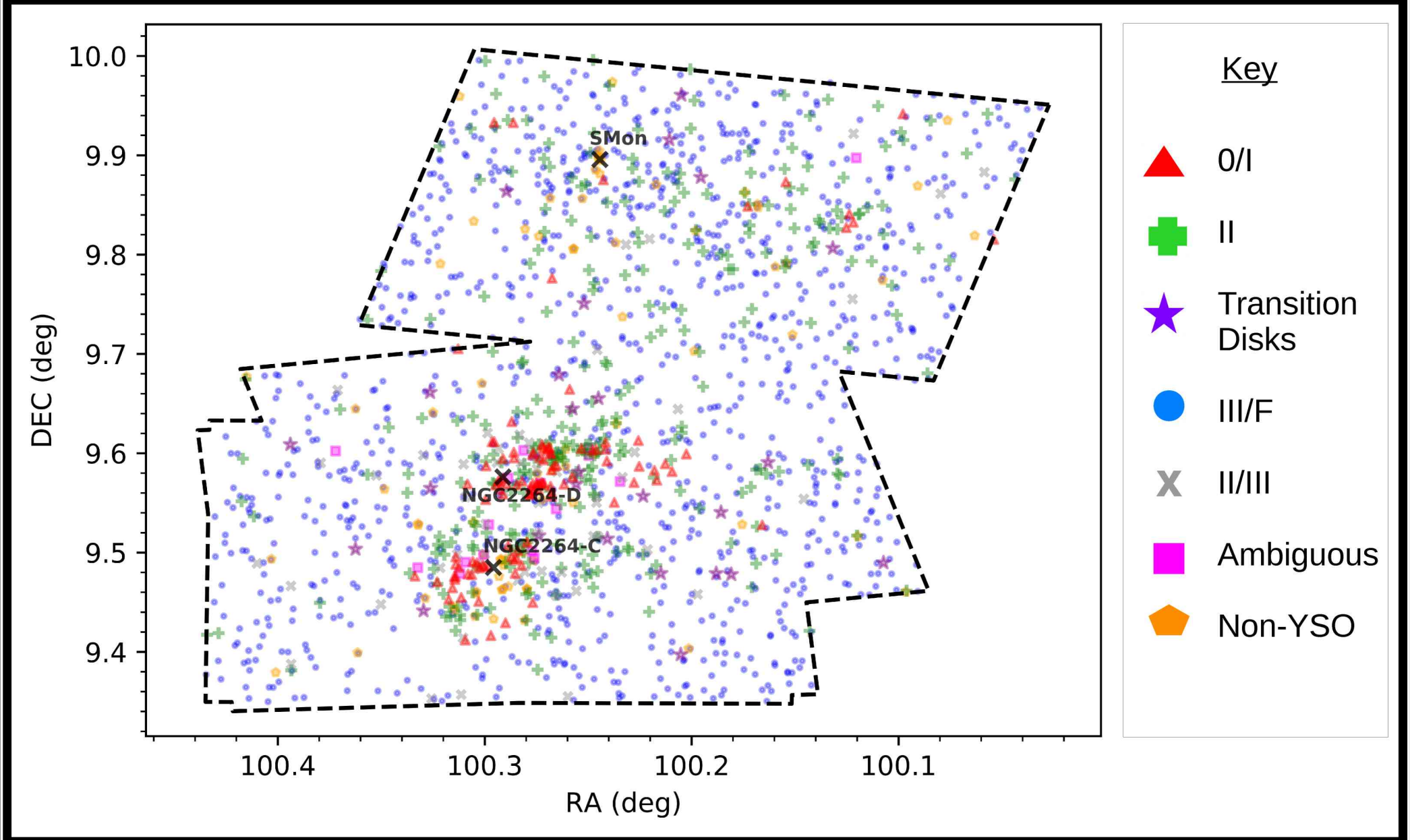


Image: Clipartmax

NGC2264

- Embedded cluster in Mon OB1
- Distance ~720pc
- Age spread of ~4-5 Myr
  (e.g. Mayne & Naylor 2008, Venuti et al. 2017)
- 1 O-type star (binary), SMon
- North older
- Star formation active





[Catalogues: Rapson et al.(2014) + Kuhn et al.(2014)]

Buckner et al. (A&A, in prep)

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- Distinguishes clustered point from random
- Quantifies the DEGREE of clustering of each point
- Assigns an index to each point

The Index

- An evenly spaced control field of the same size & parameter space as dataset is created
- Calculate average distance to point's 5^{th} nearest neighbour in control field
- Count how many neighbours are within that radius for each point in the dataset

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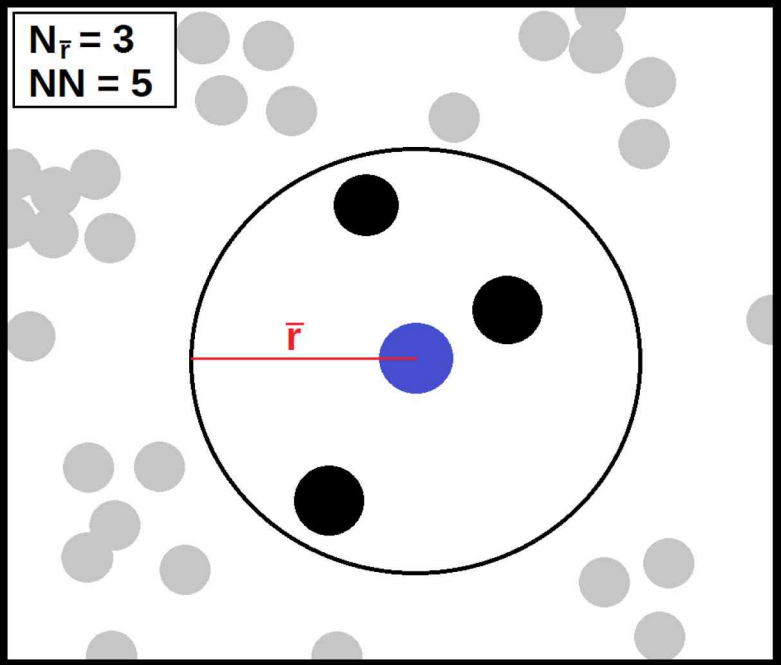
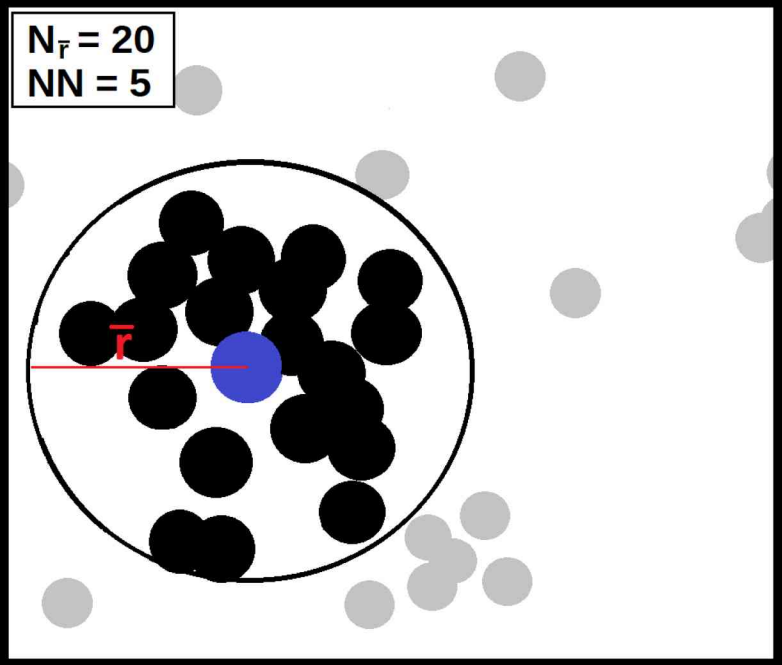


I = 3/5 =0.6



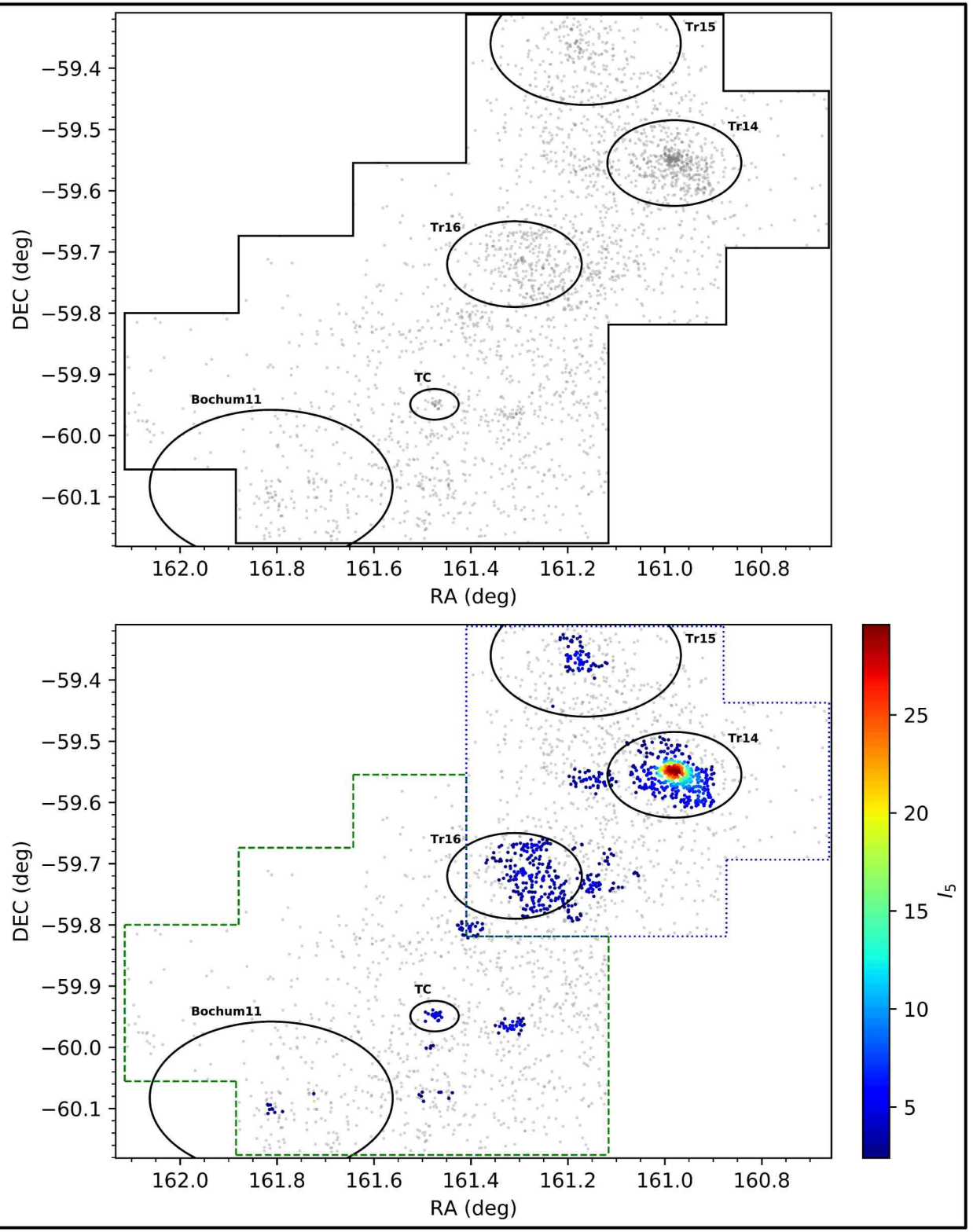
I = 20/5 =4

Buckner et al. (2019)

Example

BEFORE

AFTER



Buckner et al. (2019)

The higher the index → more spatially clustered the star is

Image:Clipart Panda

WAIT! WAIT! WAIT!

HOLD ON A SECOND!

I want to know more about this!

In detail here:

- ✔ Buckner et al. (2019)

  Bibcode: 2019A&A...622A.184B

- ✔ Demonstration on Thursday

  Location: The Hospitium

Free Stuff!

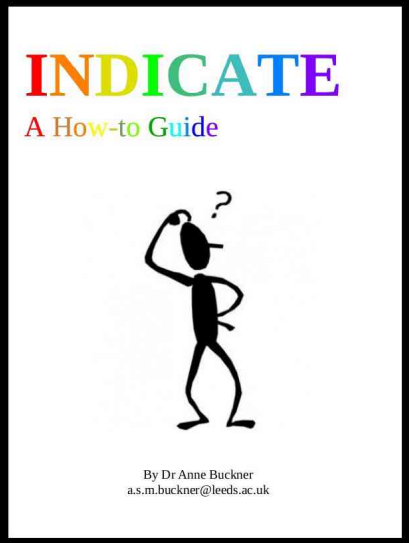


Image:Clipart Panda

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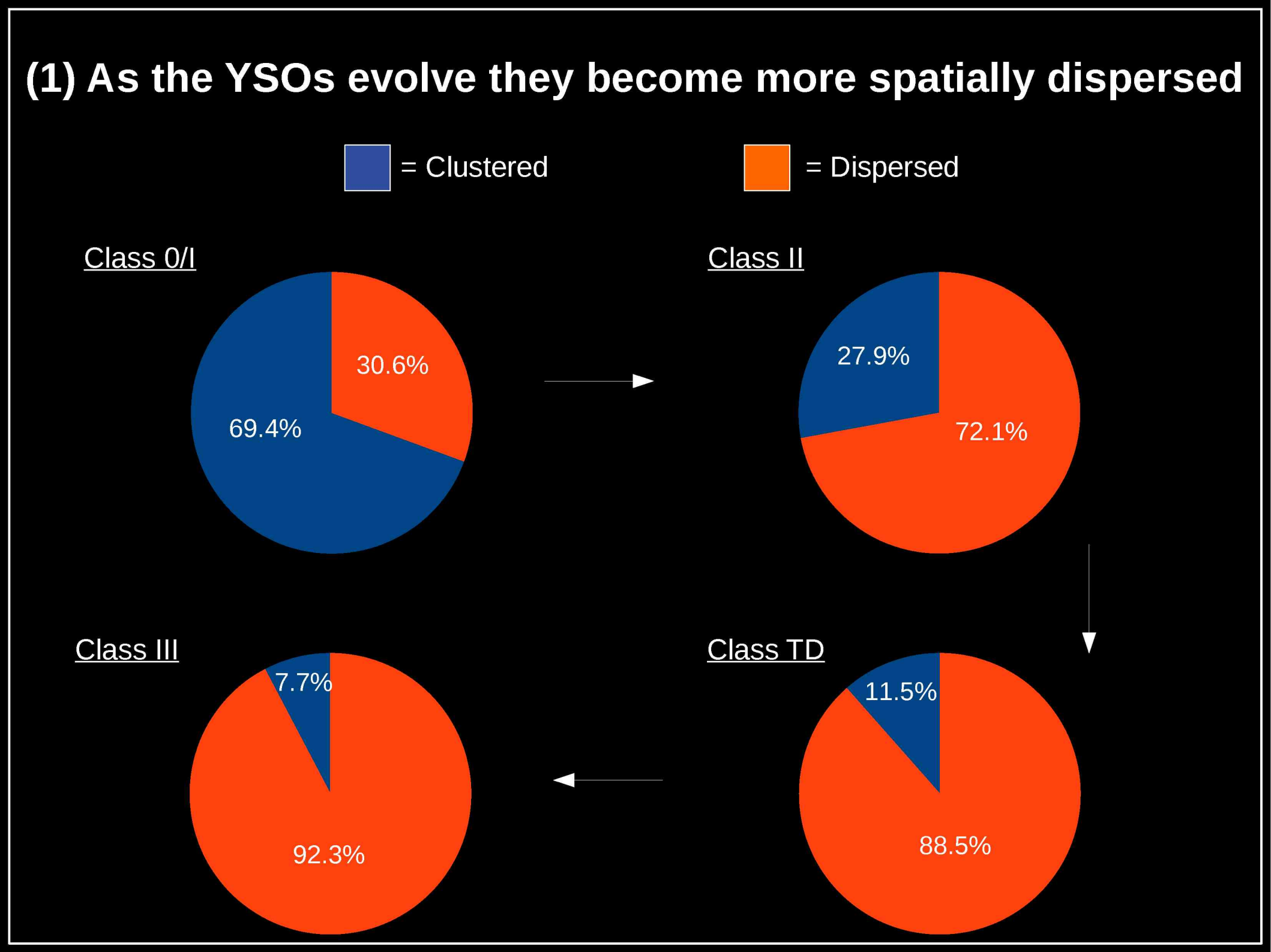

(2) The degree of clustering also decreases as they evolve

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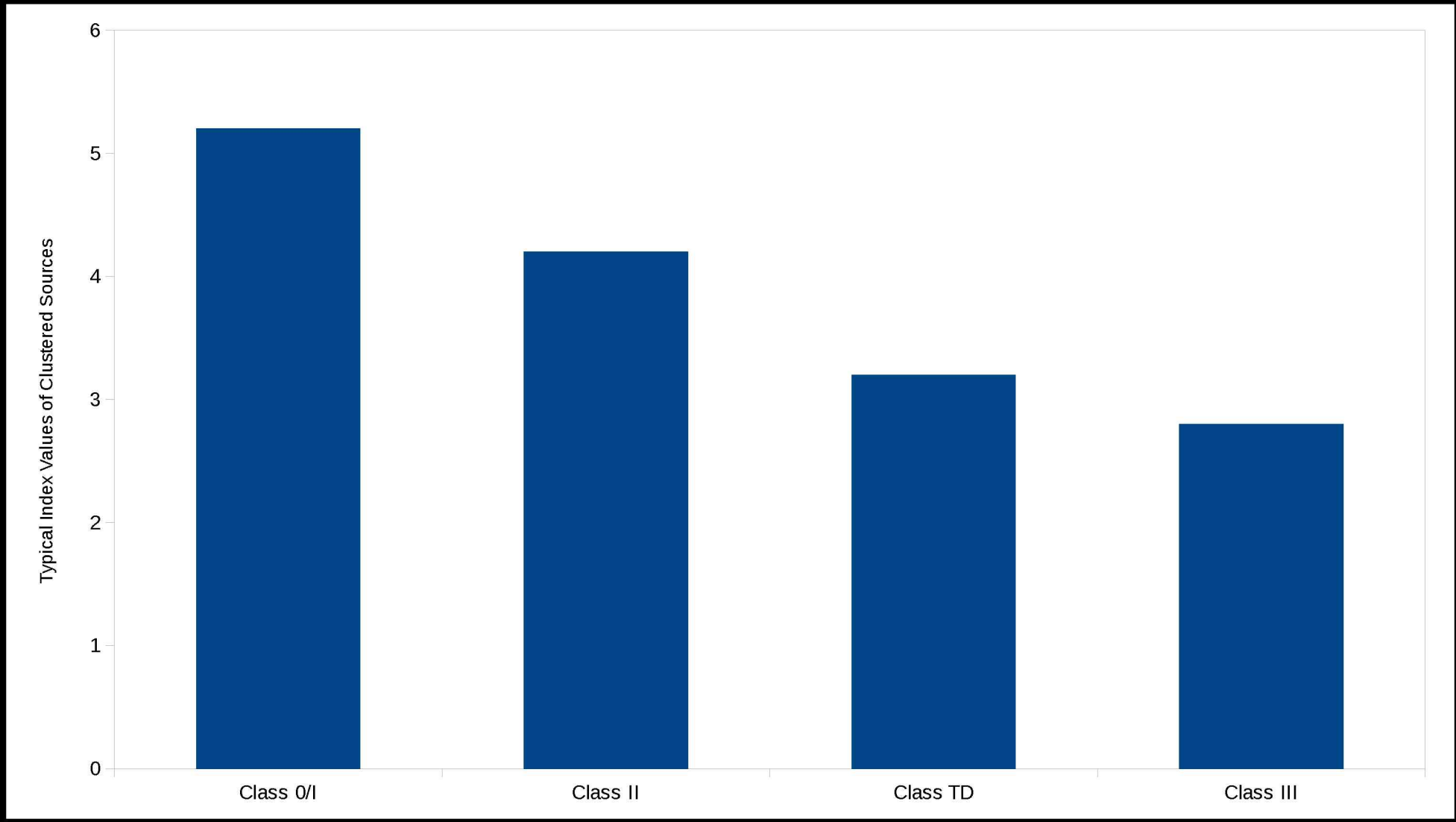
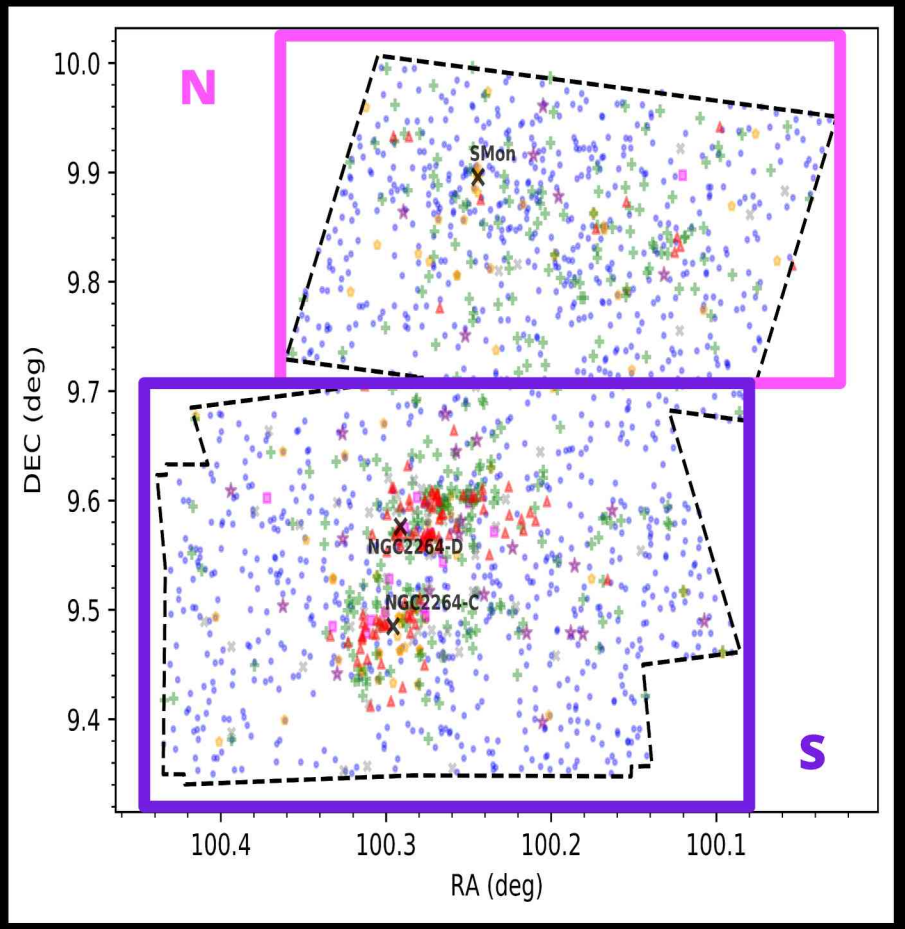


(3) Less objects are spatially clustered in (older) North

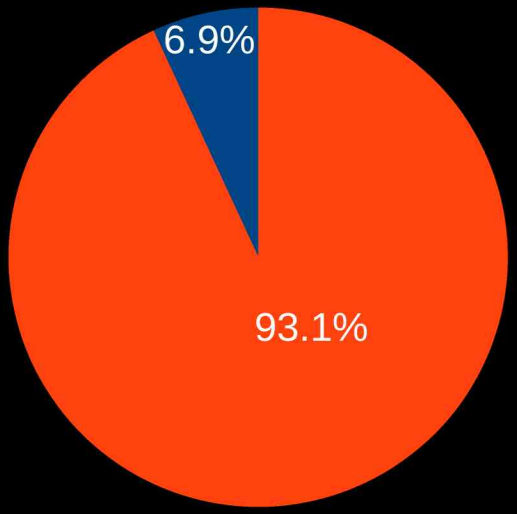


(3) Less objects are spatially clustered in (older) North

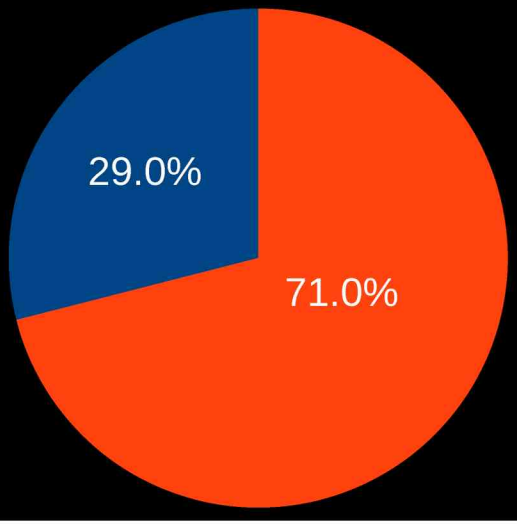
= Clustered

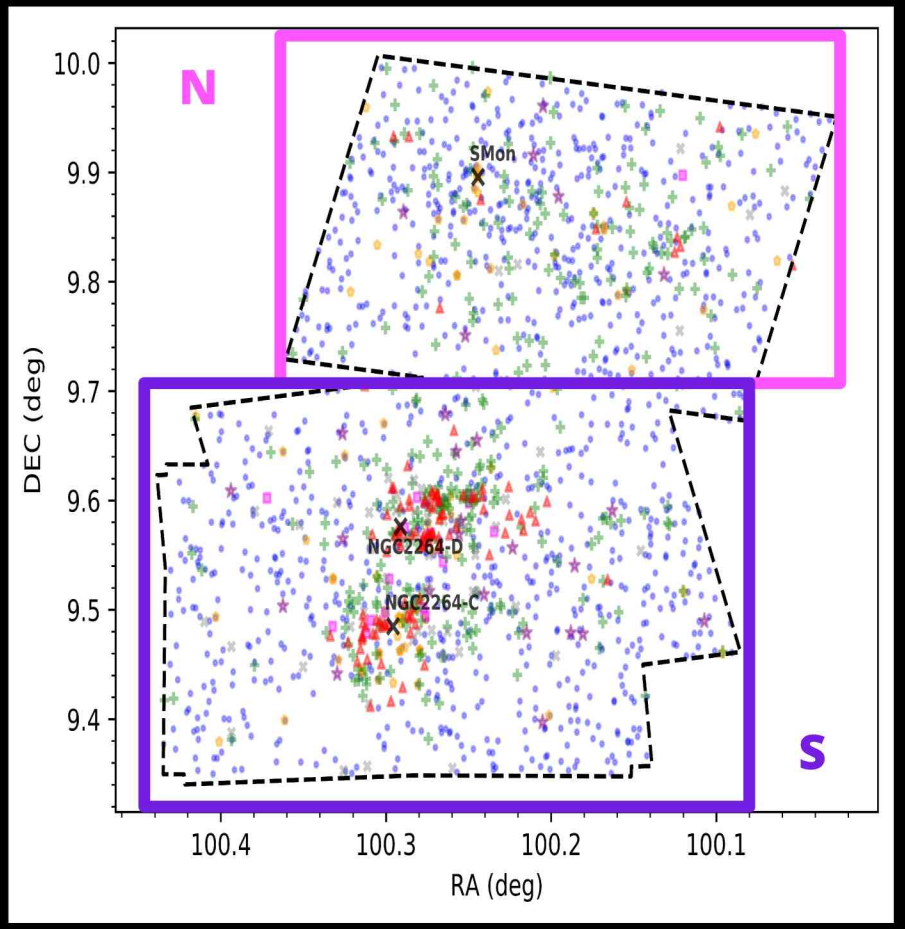
= Dispersed

North

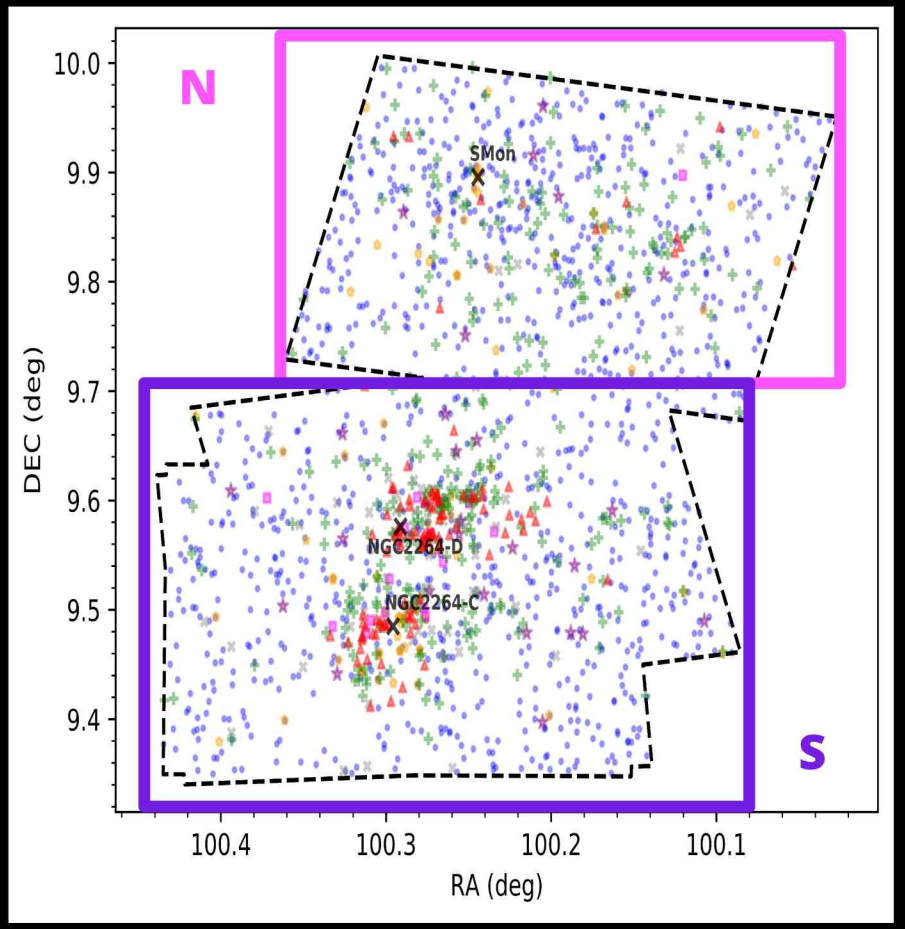


South





(4) Clustered objects in North are less tightly so than in South



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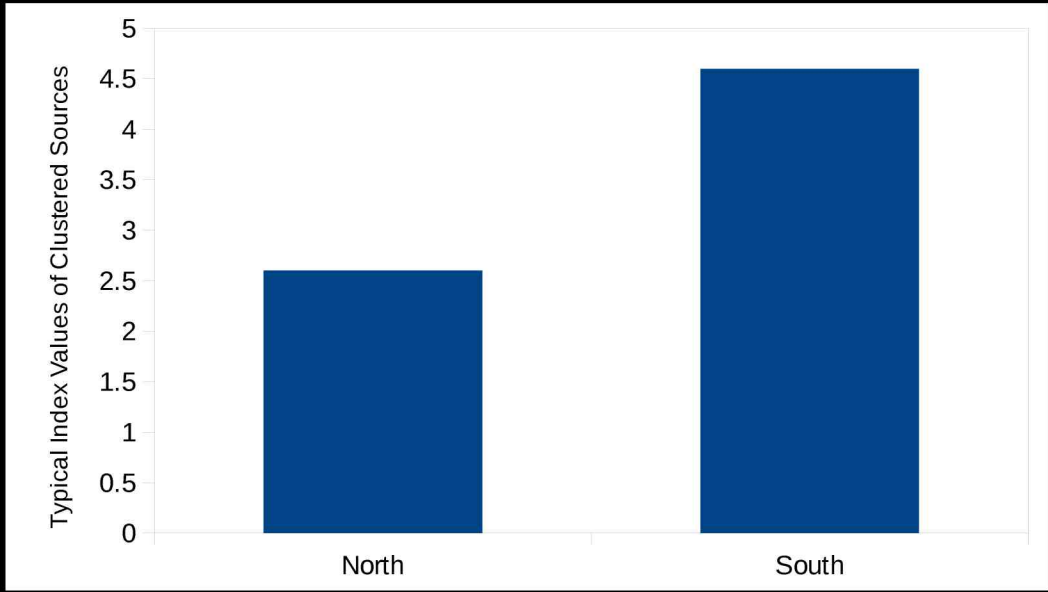
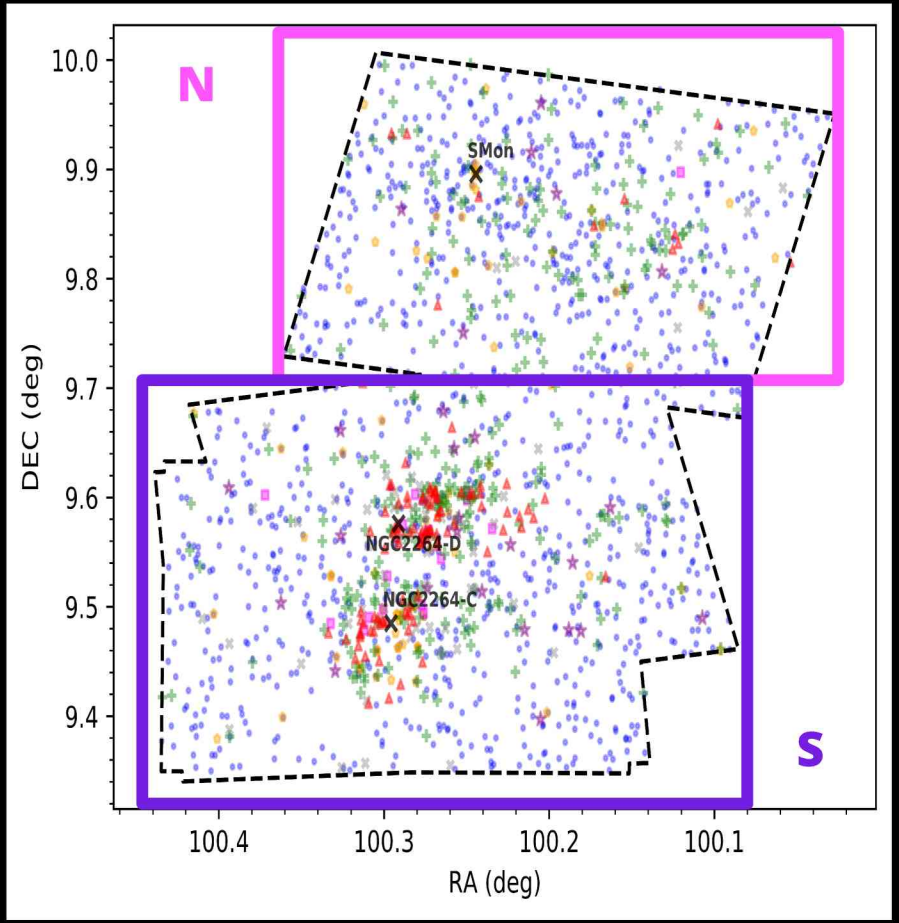
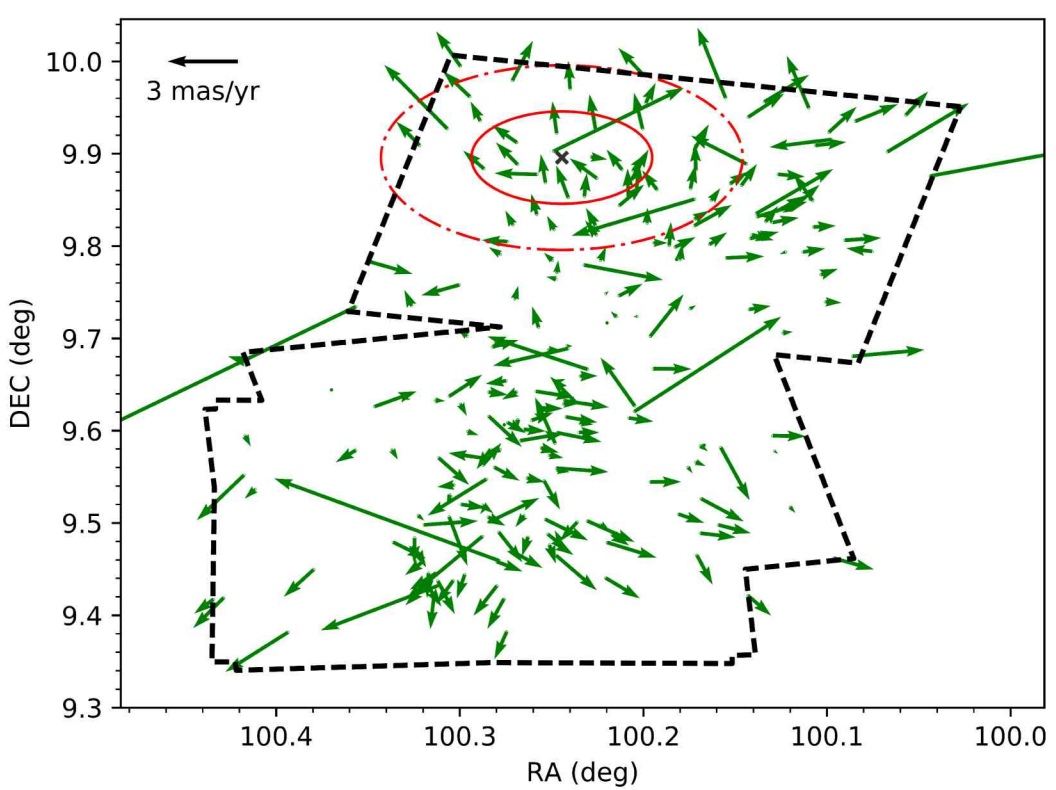




Stars are forming in a tightly clustered environment, then dynamically evolving to form part of NGC2264's dispersed population

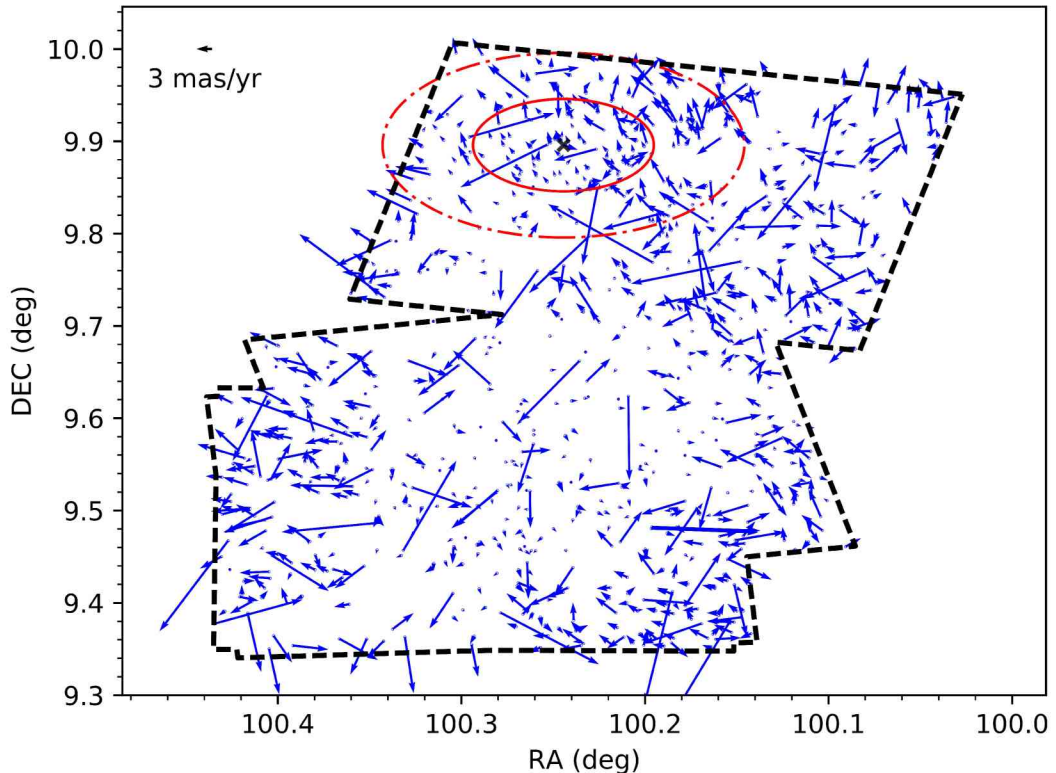
Class II

1.132 mas/yr



Class III

2.047 mas/yr

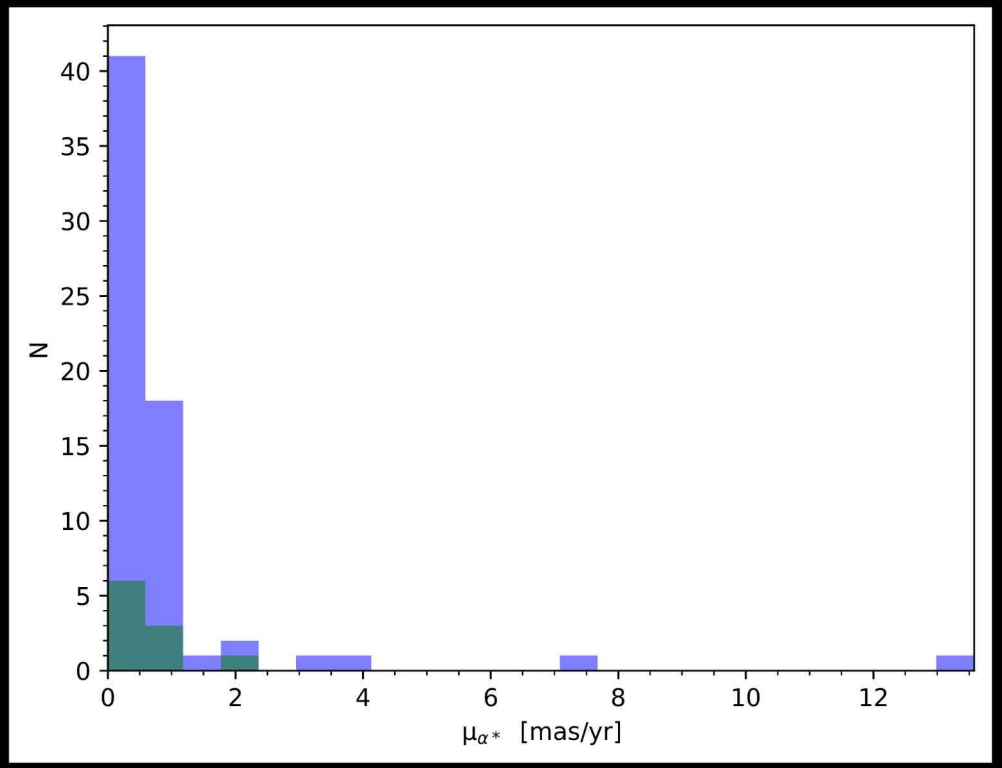


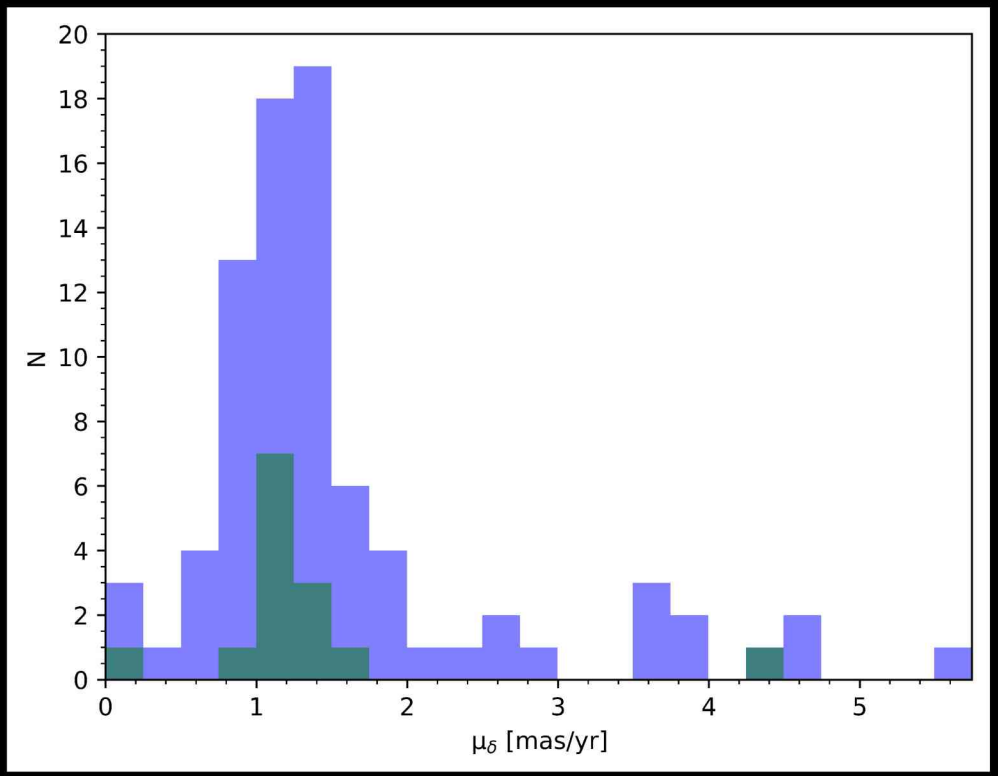
Buckner et al. (A&A, in prep)

Internal PMs for within 0.05° of SMon

= Class II

= Class III





Summary

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- Characterised the spatial & kinematic behaviour of YSOs in NGC2264
- Distinct difference in clustering behaviour by evolutionary stage
- More evolved objects → More dispersed
- Typical PM's of Class III objects are ~2x larger than Class II
- Argue dynamical evolution rather a primordial signature of SF
- Effect of stellar feedback from SMon is significant within 0.05^{o}