HAWK-I, VLT Credit: ESO/T. Preibisch

The low-mass stellar and substellar IMF of the young galactic star cluster Trumpler 14

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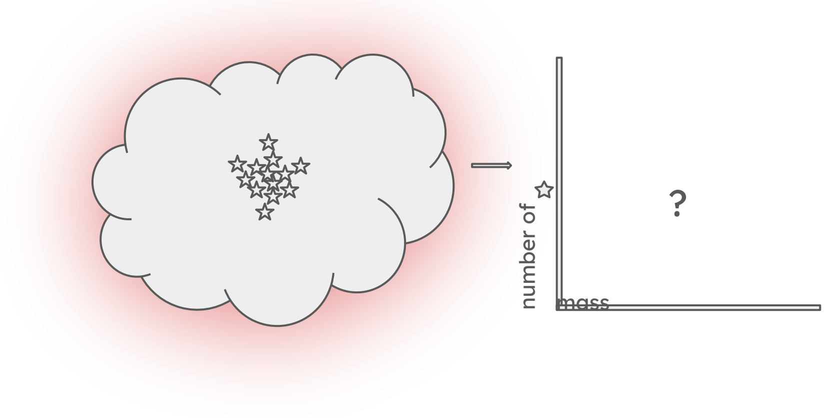
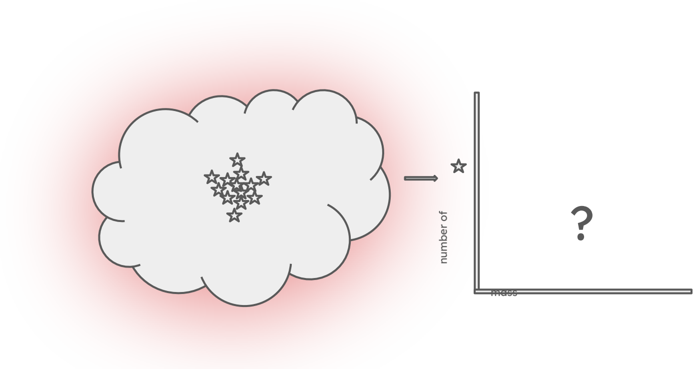
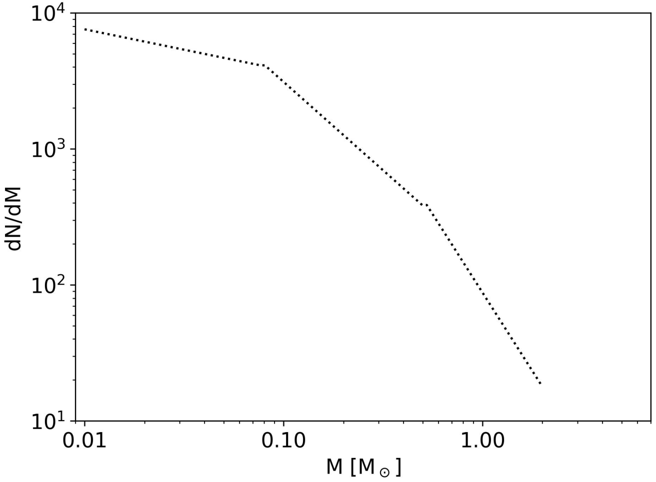
Initial mass function

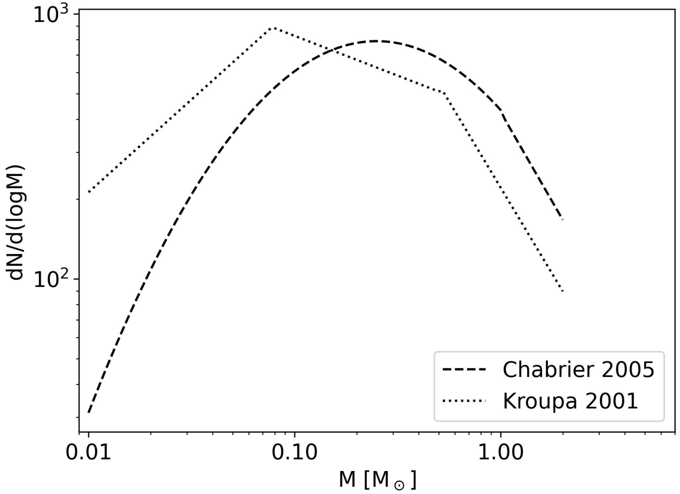


- ➔ Is it universal in the sub-stellar domain? I.e. does the environment affect it?
- ➔ How does this environment affect the production of brown dwarfs?
- ➔ What can we conclude about the formation of brown dwarfs?

Initial mass function



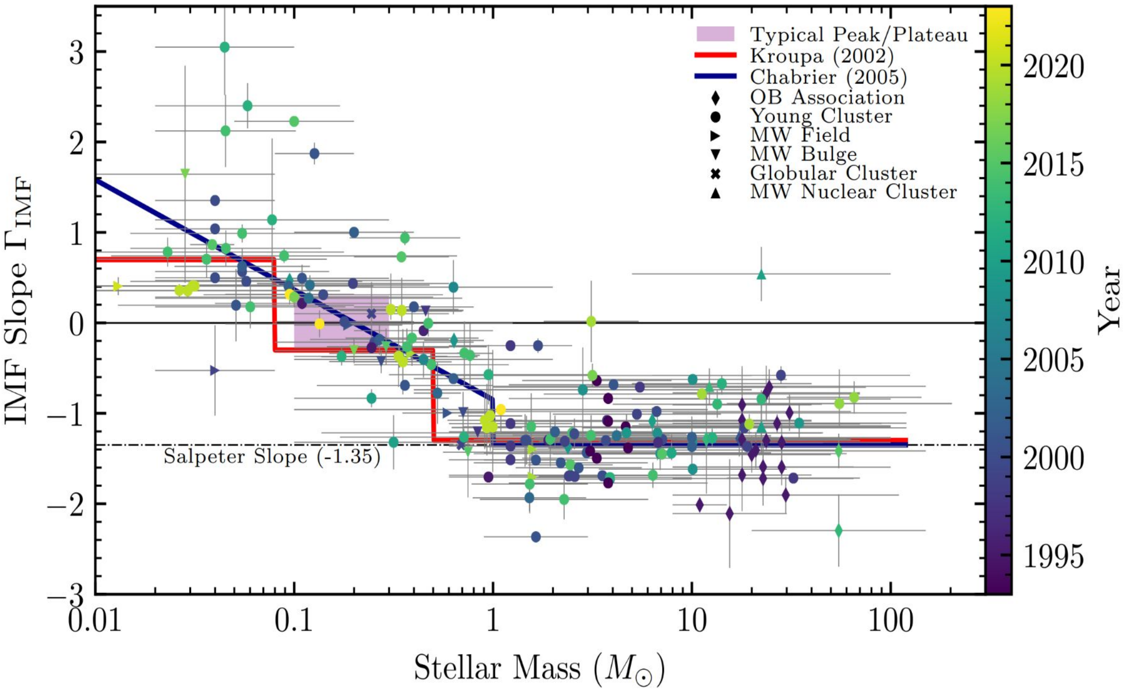


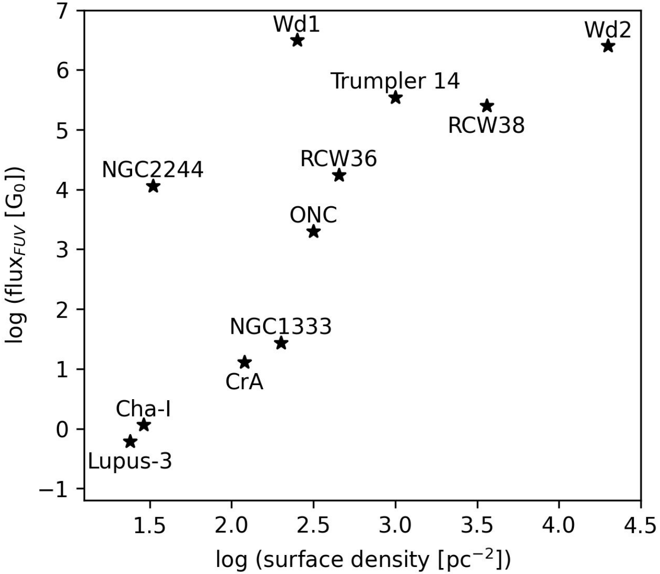


$dN/dM \propto M^{-\alpha}$

$dN/d\log M \propto e^{-(\log M - \log M_c)^2/2\sigma^2} \propto M^{\Gamma}$

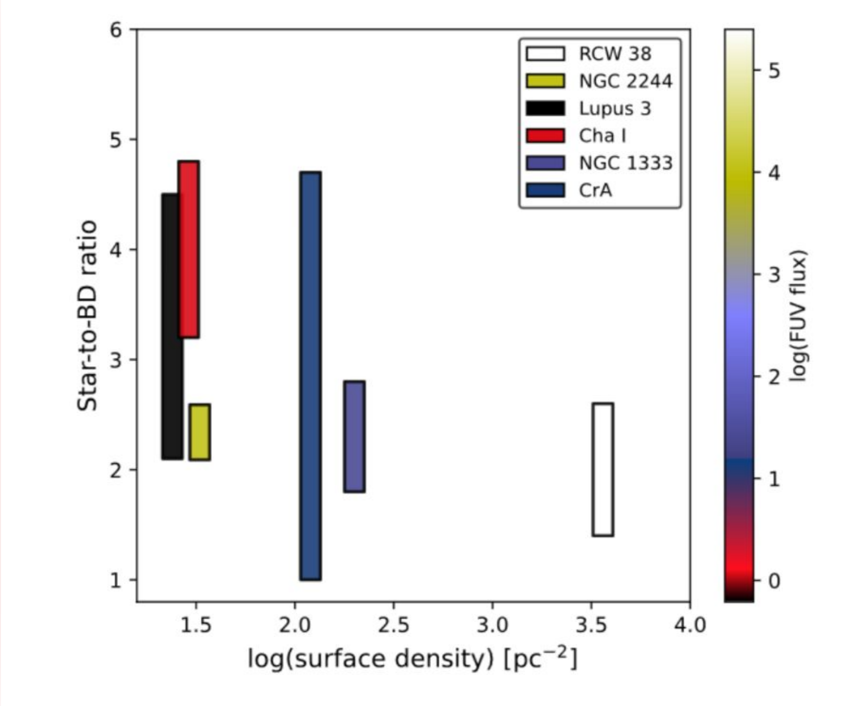
$\alpha = \Gamma + 1$





Credit: Mužić, K.

Hennebelle&Grudić 2024

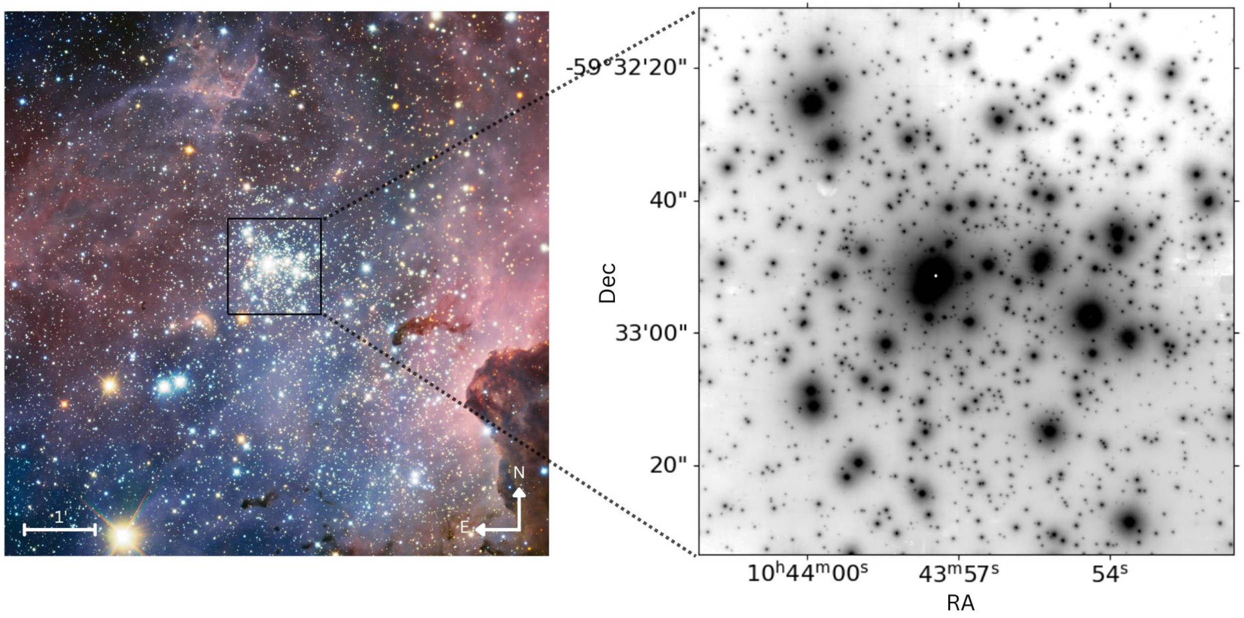


Mužić et al., accepted

N(*)/N(BD)
Stars= (0.075-1) $M_\odot$
Brown dwarfs= (0.03-0.075) $M_\odot$

Trumpler 14

Rom et al. submitted



- ★ Carina Nebula

~10^3 $M_\odot$ (Sana+2010) → **massive**

Contains ~20 OB-type stars (Shull+2021) → **high UV flux**

~2.3 kpc (Shull+2021)

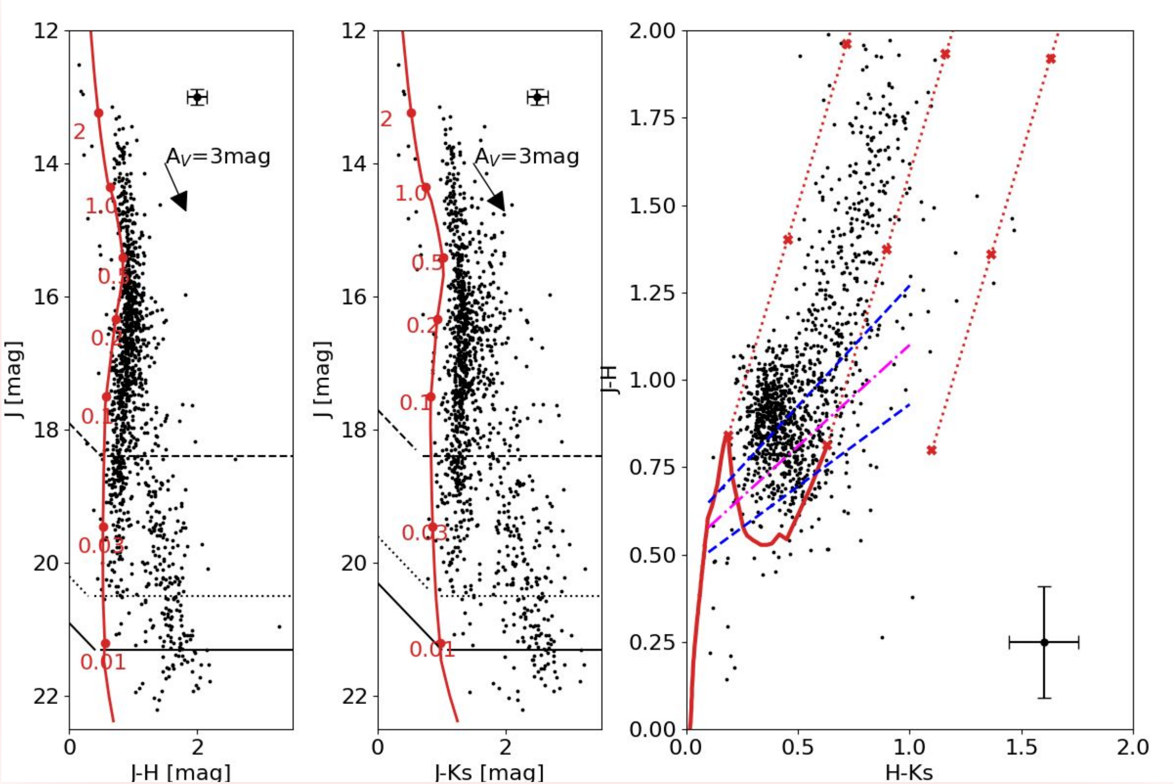
~1 Myr (Itrich+2024) → **young**

- ★ Gemini South Adaptive Optics Imager
- ★ *J, H, Ks* bands

Photometry & completeness

Rom et al. submitted

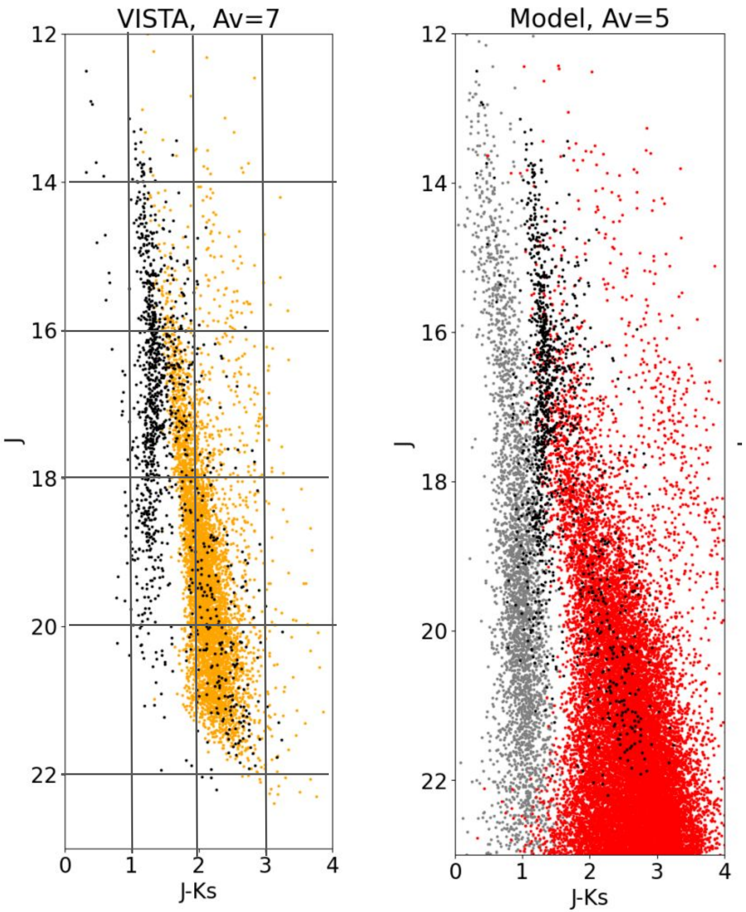
- ★ Extraction and photometry using Source-extractor (Bertin & Arnouts 1996) & PSFEx (Bertin 2013)
- ★ Completeness using artificial star test
- ★ **Result:** ~0.01 $M_\odot$ at 20% completeness



(de)Contamination

Besancon Galactic model vs VISTA (Preibisch+2014) control field

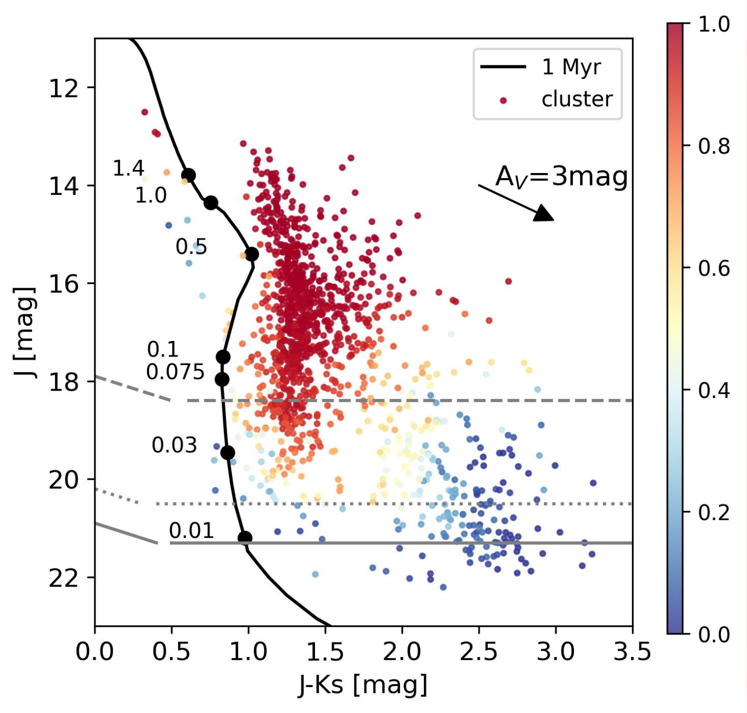
1. divide the color-magnitude diagram (CMD) in a grid
2. we count the number of sources in each cell
3. number of sources of the cluster vs number of sources of the control field → randomly remove the expected field population



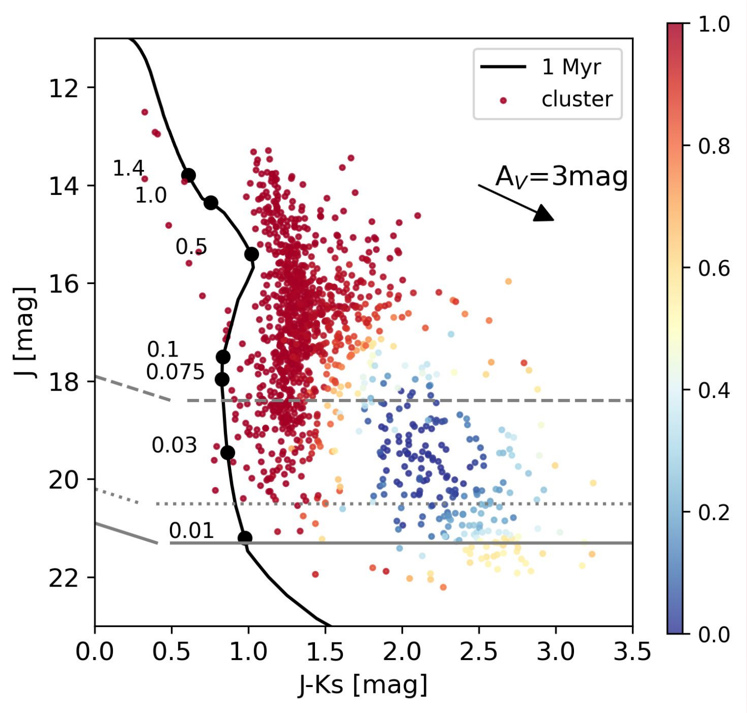
Rom et al. submitted

Members

Rom et al. submitted



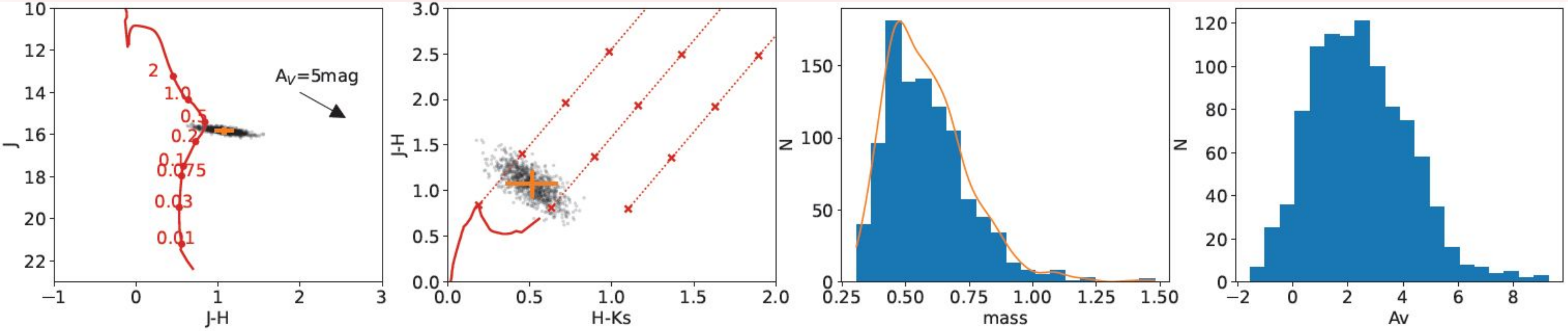
Galactic model



control field

Mass determination

Idea: de-redden the source to the evolutionary model (~1 Myr) in the CMD and get corresponding mass and extinction value, repeat for 1000 times to be more statistically accurate



Rom et al. submitted

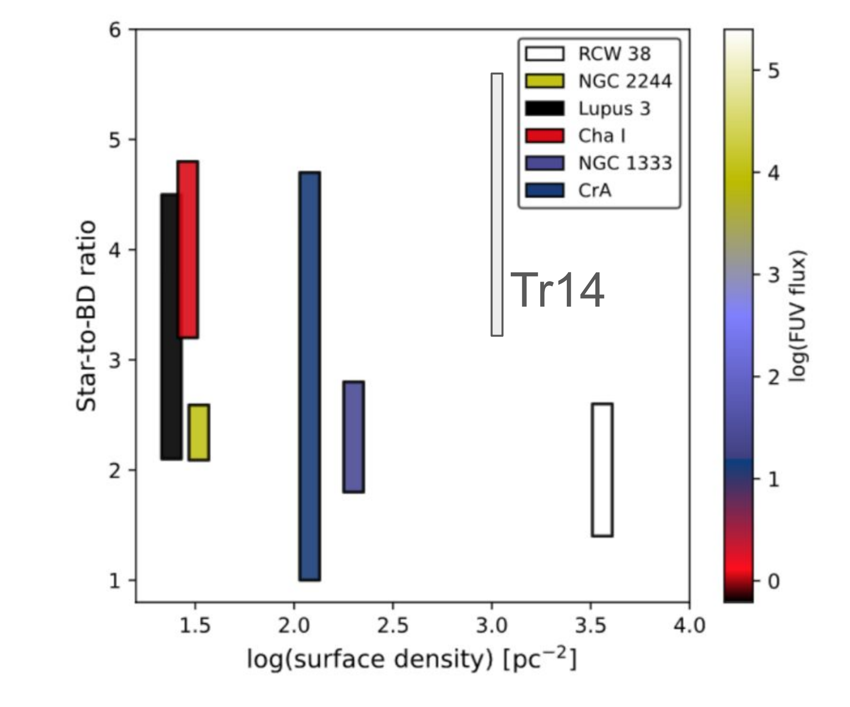
Star-to-brown dwarf ratio

(0.03-1) $M_\odot$

~4 stars to

brown dwarfs

Mužić et al. accepted



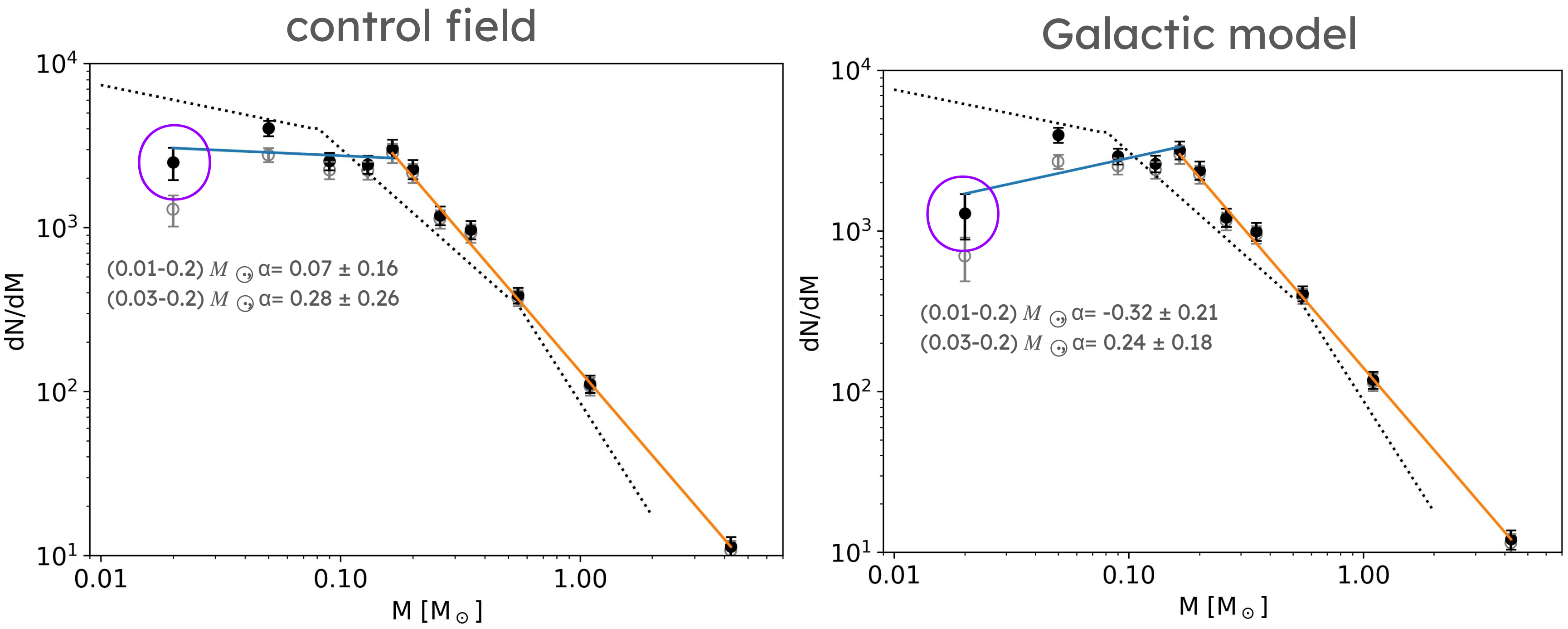
N(*)/N(BD)

Stars= (0.075-1) $M_\odot$

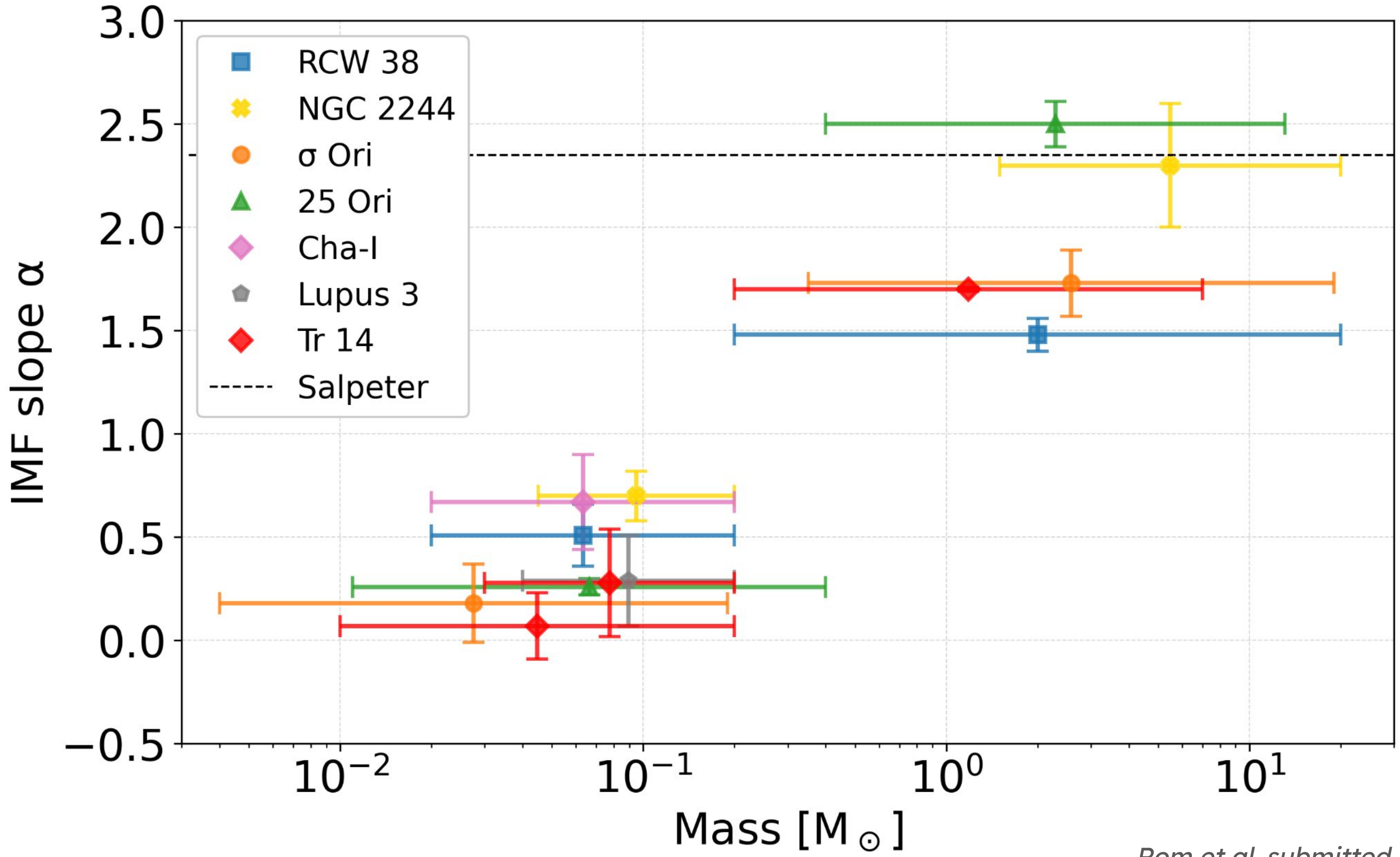
Brown dwarfs= (0.03-0.075) $M_\odot$

Initial mass function

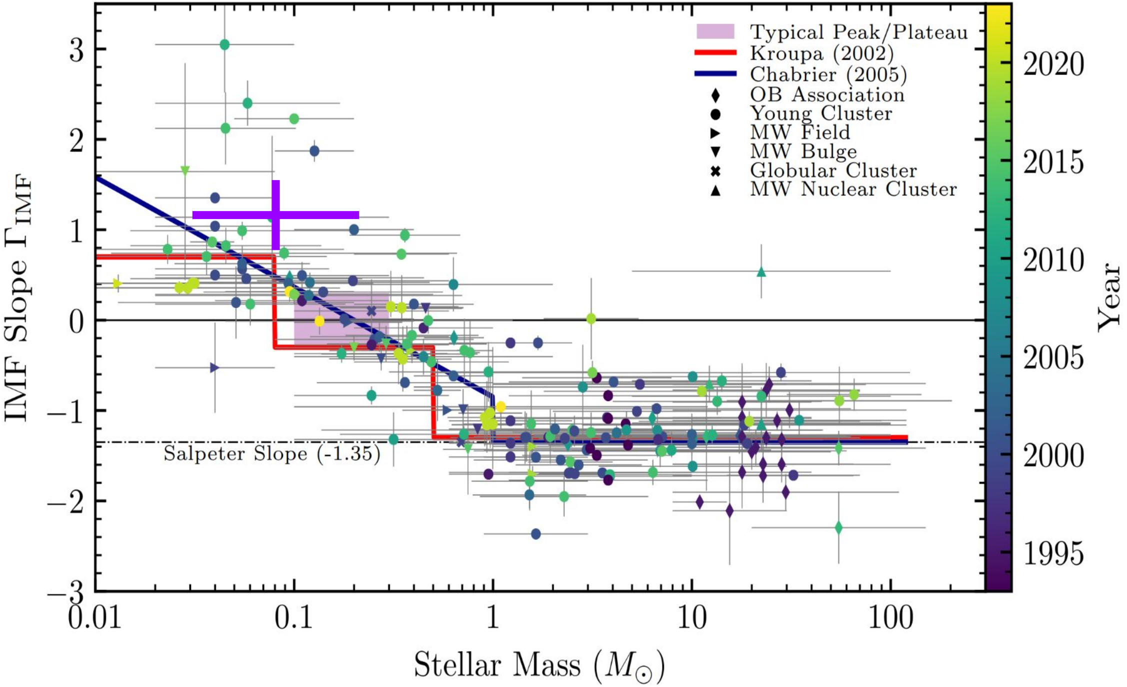
Idea: mass of each object is sampled from its distribution (errors in mass determination propagate into IMF)

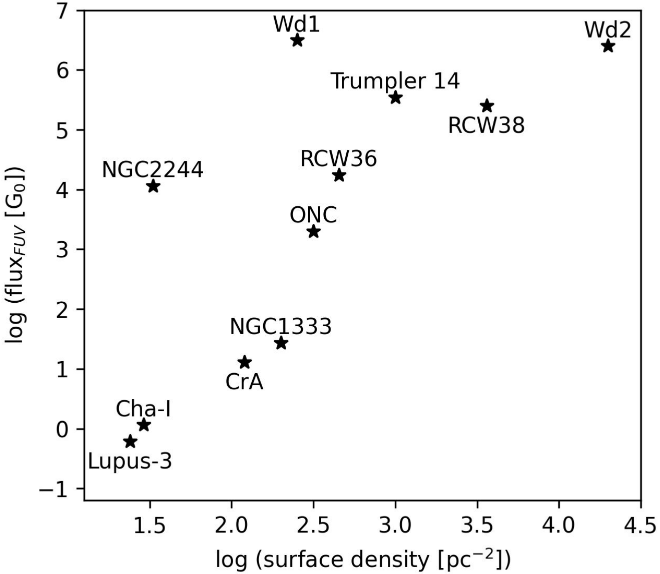


Rom et al. submitted



Rom et al. submitted

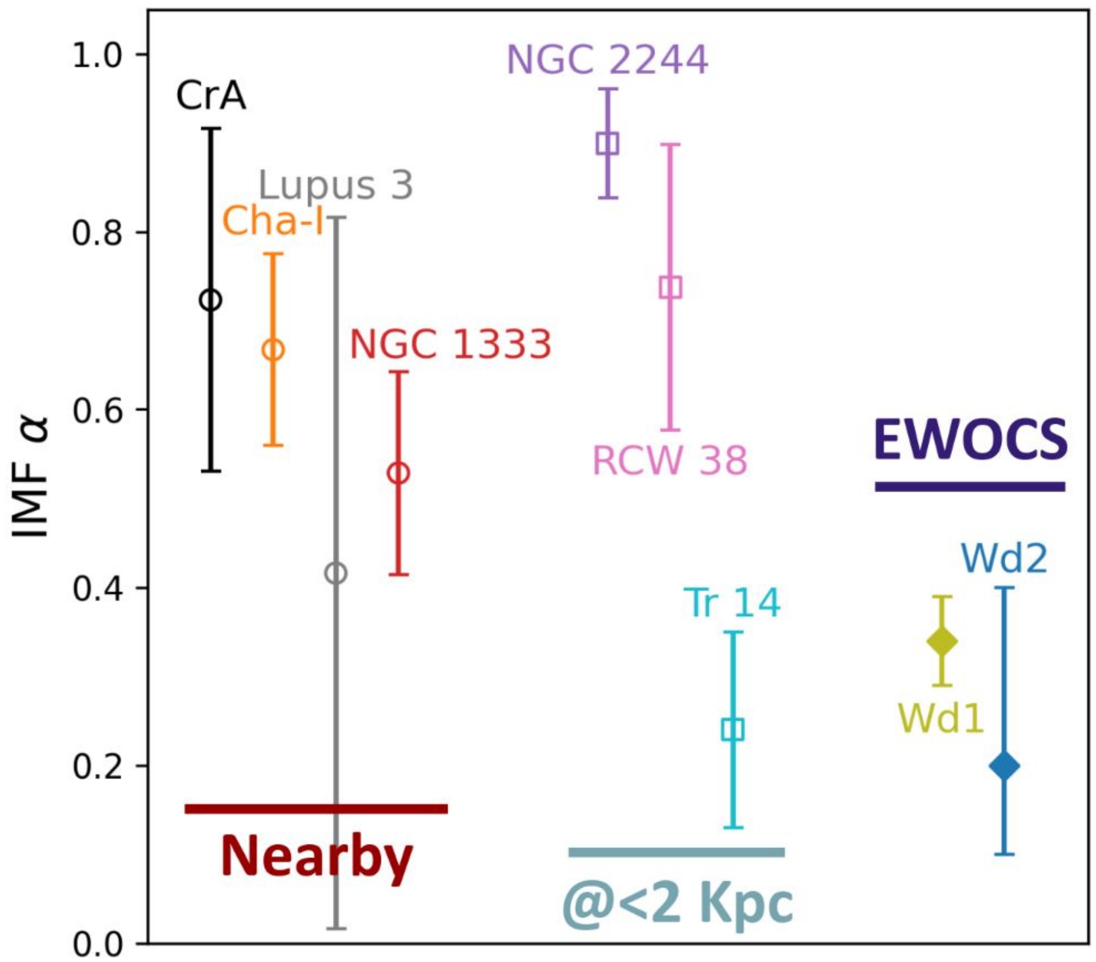




Credit: Mužić, K.

Hennebelle&Grudić 2024

Our IMF is on the shallower side!



Adapted from Mužić et al. accepted

Final remarks

- ★ Deepest data in Trumpler 14 so far (~0.01 $M_\odot$ at 20% completeness)
- ★ IMF and star-to-brown dwarf ratio
  - comparable to other similar regions above 0.03 $M_\odot$
  - shallow in 0.01-0.2 $M_\odot$ region → suggests lower production of low mass brown dwarfs!
- ★ High UV flux in a high density region – brown dwarf formation is suppressed?