The Inner Milky Way with *WFIRST*

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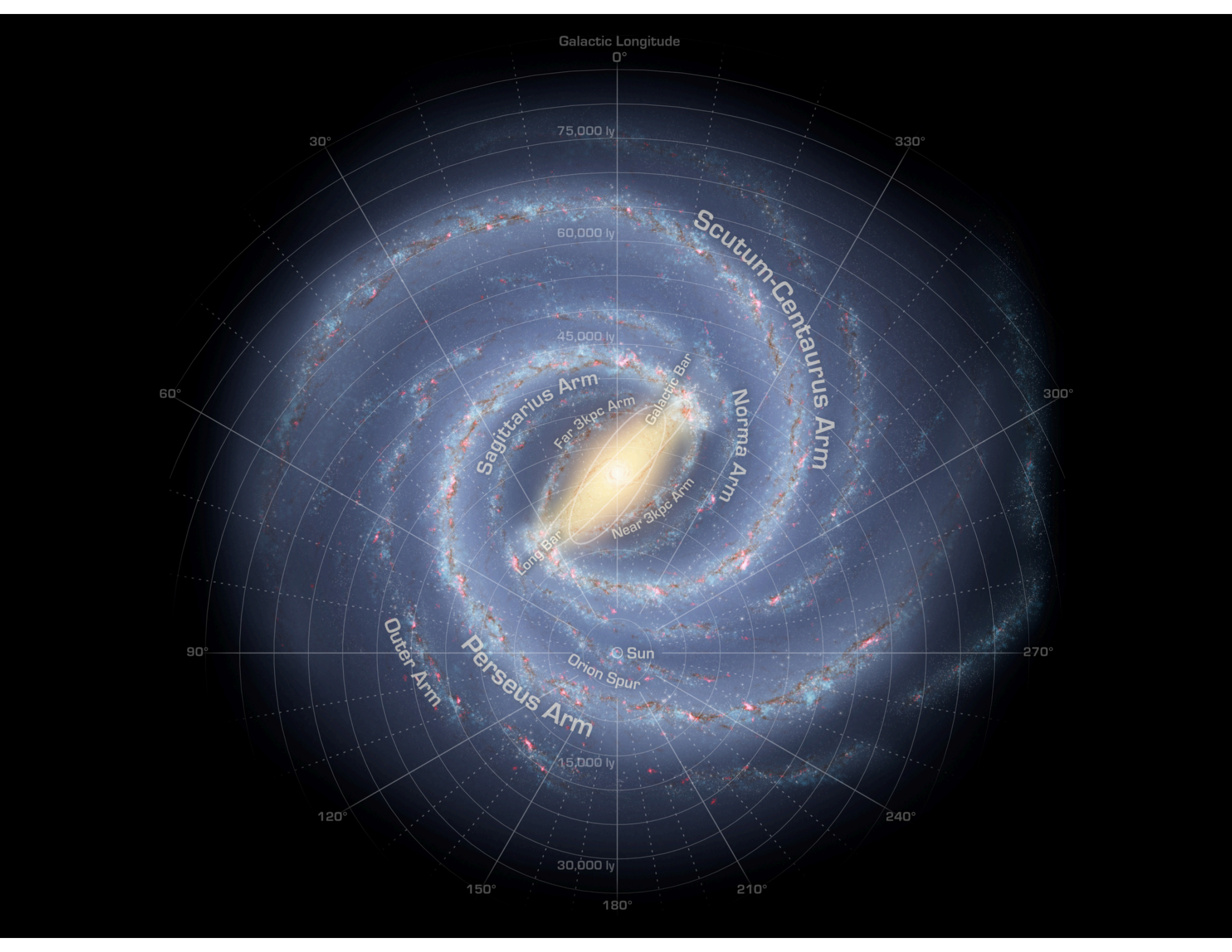
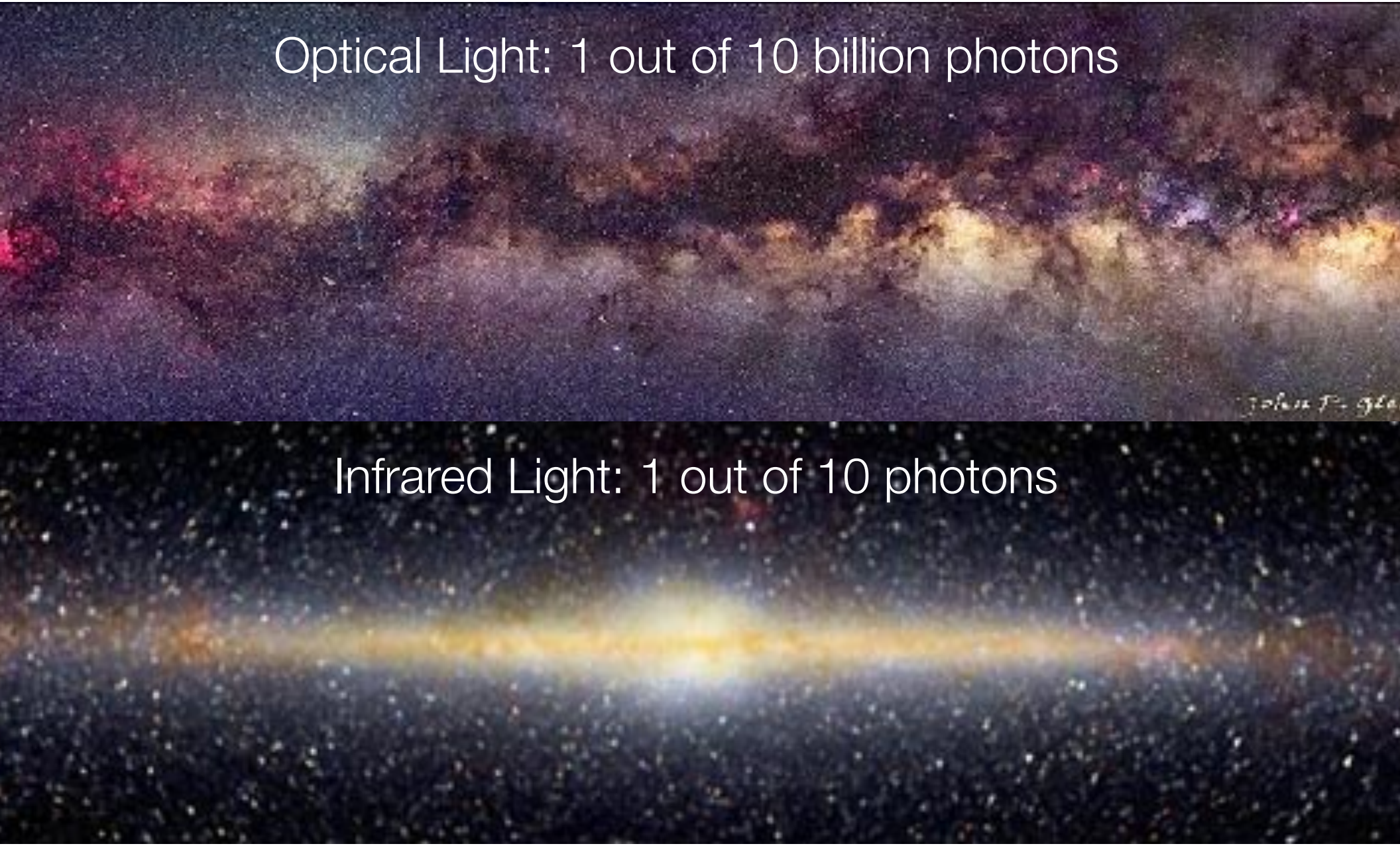
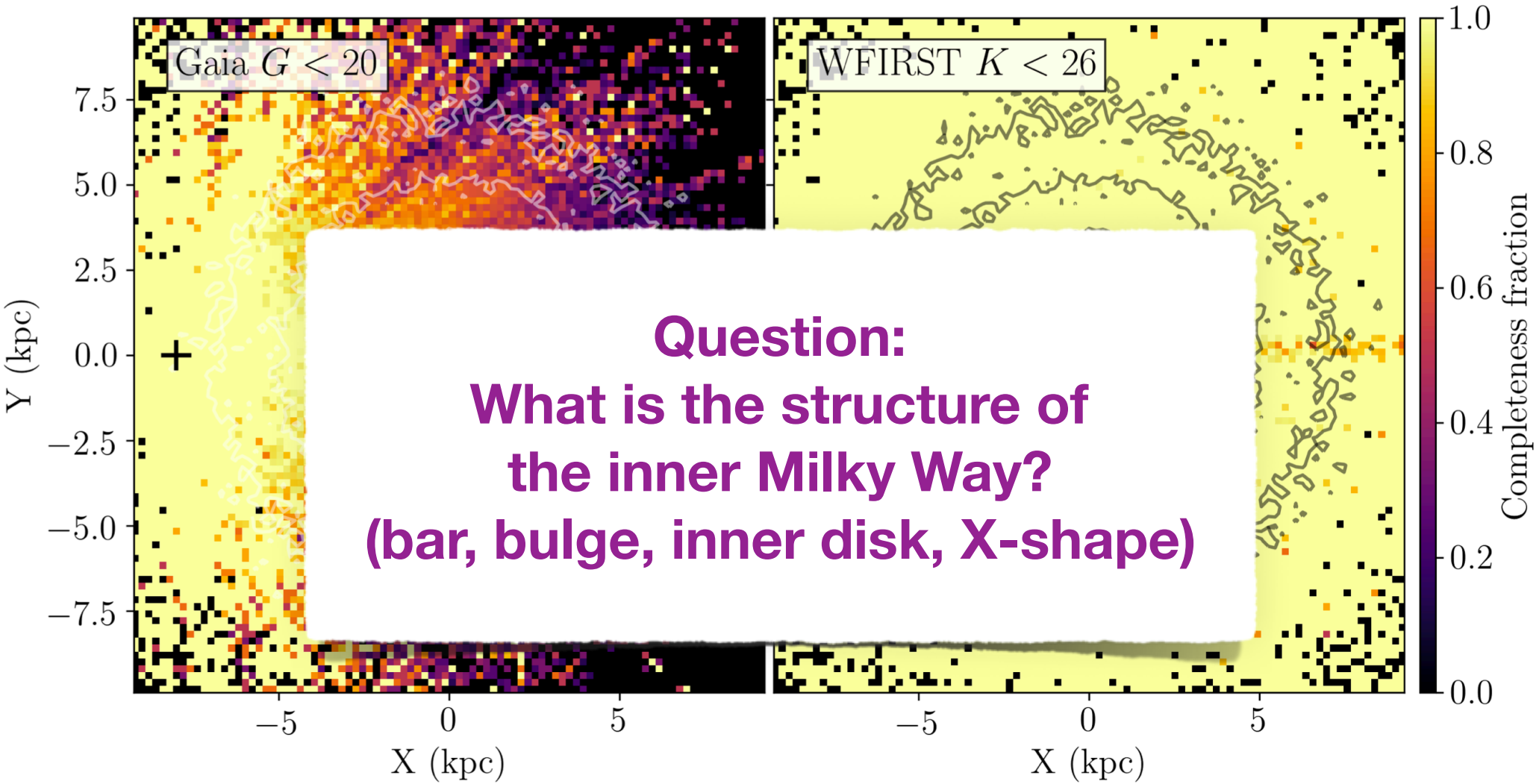
Image Credit:
NASA / JPL-Caltech / S. Stolovy (Spizter Science Center/Caltech)


Galactic Longitude
0°
30°
330°
60°
300°
90°
270°
120°
240°
150°
210°
180°
75,000 ly
60,000 ly
45,000 ly
30,000 ly
15,000 ly
Scutum-Centaurus Arm
Sagittarius Arm
Norma Arm
Perseus Arm
Outer Arm
Far 3kpc Arm
Near 3kpc Arm
Galactic Bar
Long Bar
Sun
Orion Spur



Inner Milky Way studies require
infrared wavelengths to minimize extinction.

Structure of the Inner Milky Way: WFIRST sees where Gaia is blind.



Question:
What is the structure of the inner Milky Way?
(bar, bulge, inner disk, X-shape)

Caption: Red clump stars visible in Gaia (left) and WFIRST (right).

Need proper motions and parallaxes.

> "a mission-long astrometric accuracy of 10 μas or better (with a stretch goal of 3 μas) should be achieved at $H_{AB} = 21.6$. (9% relative parallax at 8 kpc)."

WFIRST sees the entire Central Molecular Zone

r~100 - 200 pc
~10^8 M_{sun} in H_2
High T, B, ρ, σ_{turb}

Morris & Serabyn 1996
Molinari+ 2011
Kruijssen & Longmore 2013
Henshaw+ 2016

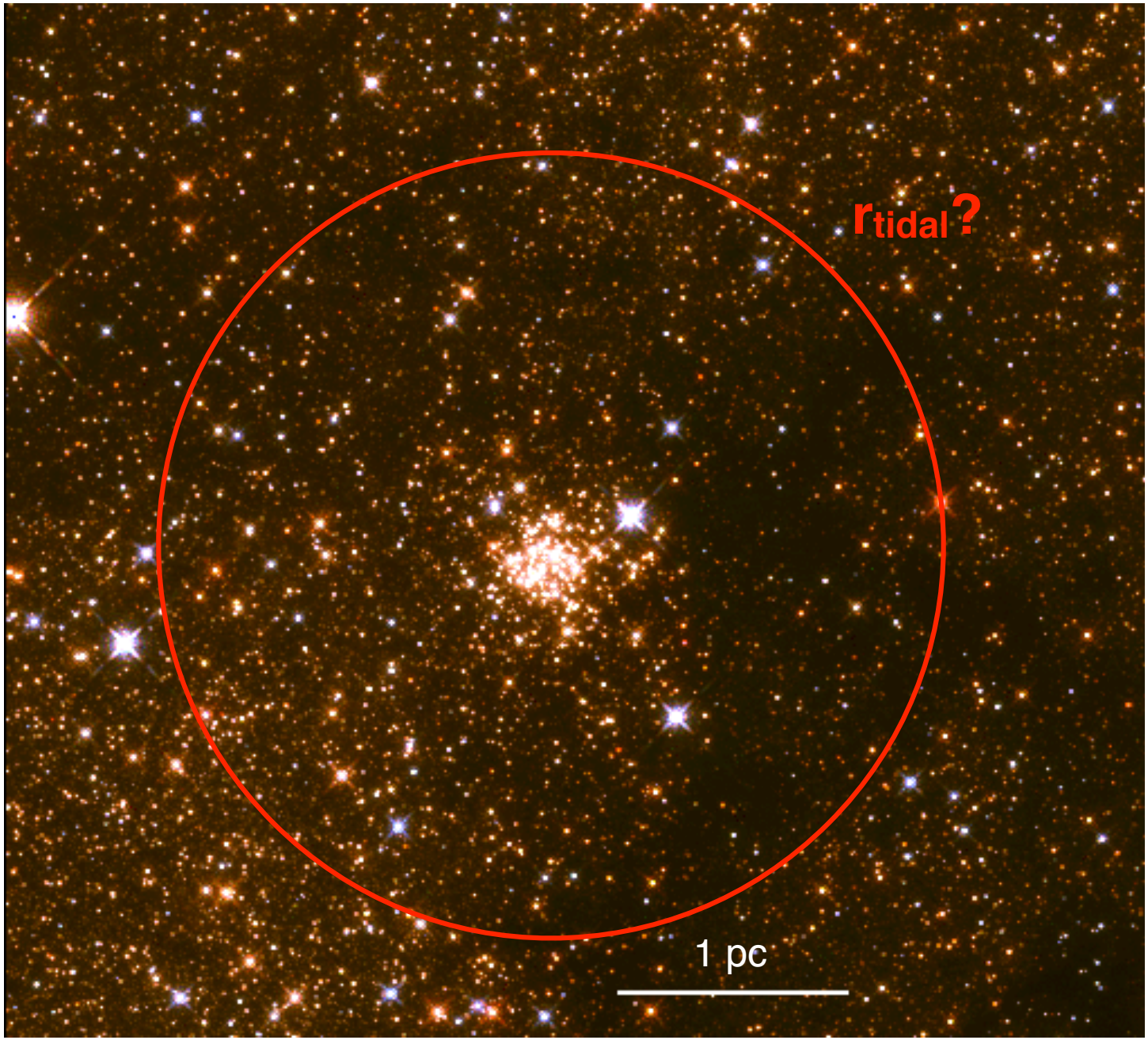
HST WFC3IR

JWST NIRCam

Question:
Is the CMZ unique and representative of high-z starburst conditions?

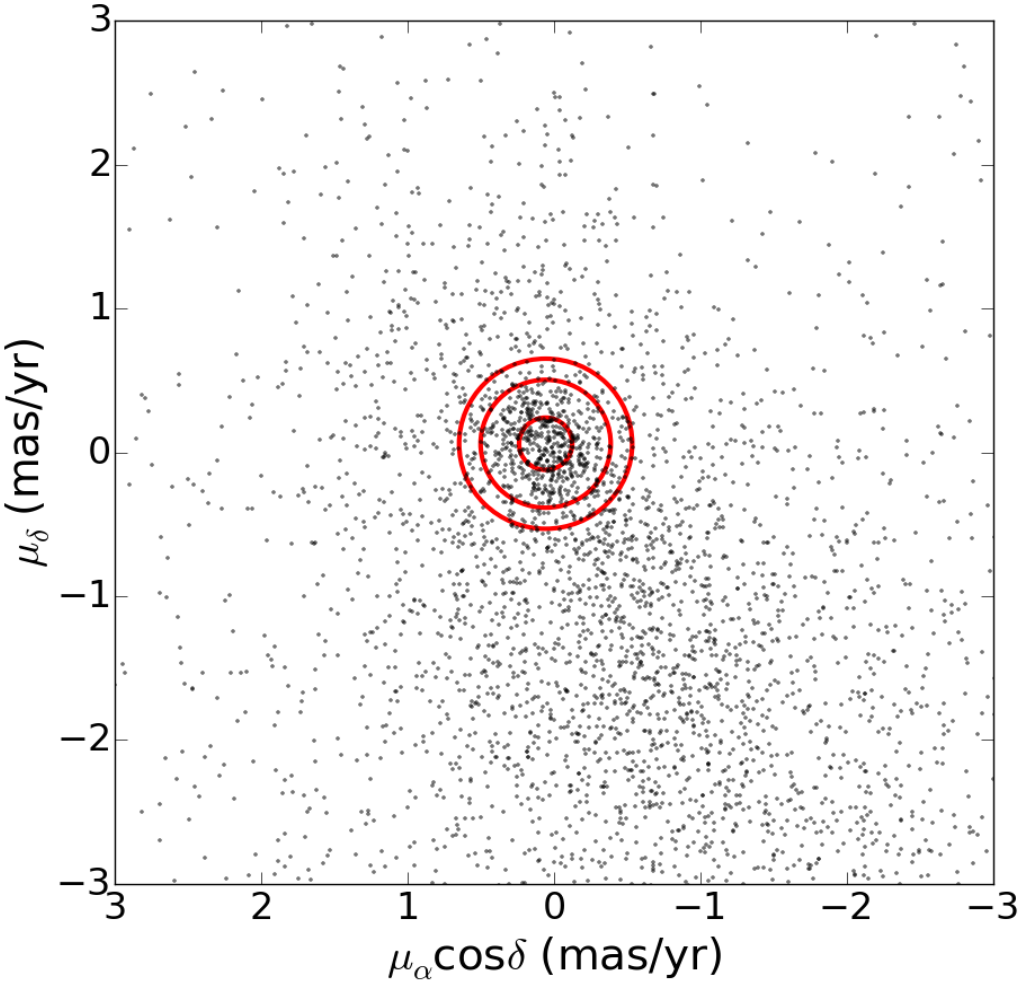

HST NICMOS
Spitzer IRAC
Arched
Filaments
2-3 Myr
Arches
Cl
Question:
Do these initial conditions impact the
outcome of the star formation process?
yr
Sgr A
Cluster
Pistol Star
3-5 Myr
10 pc

How does the strong tidal field effect the Arches cluster structure, dynamics, evolution, and mass function?



HST WFC3-IR

Keck AO and HST astrometry on the Arches cluster selects cluster members and gives precise proper motions.



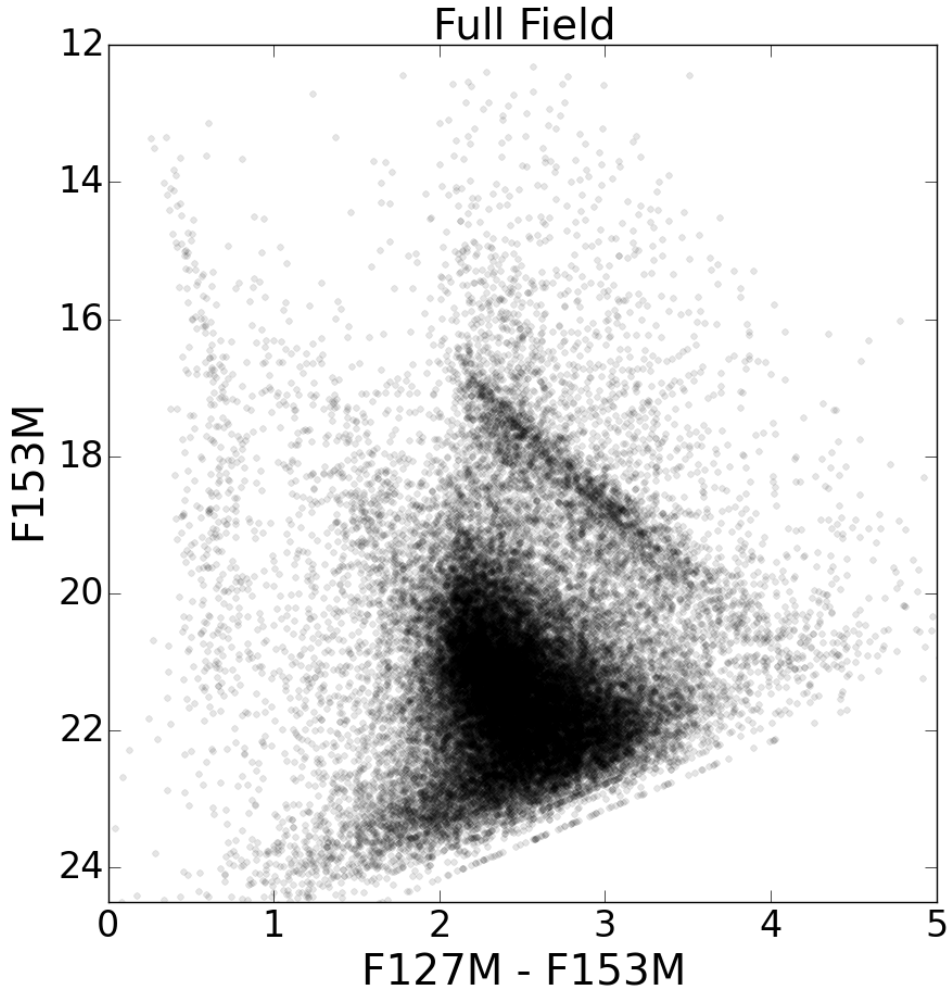
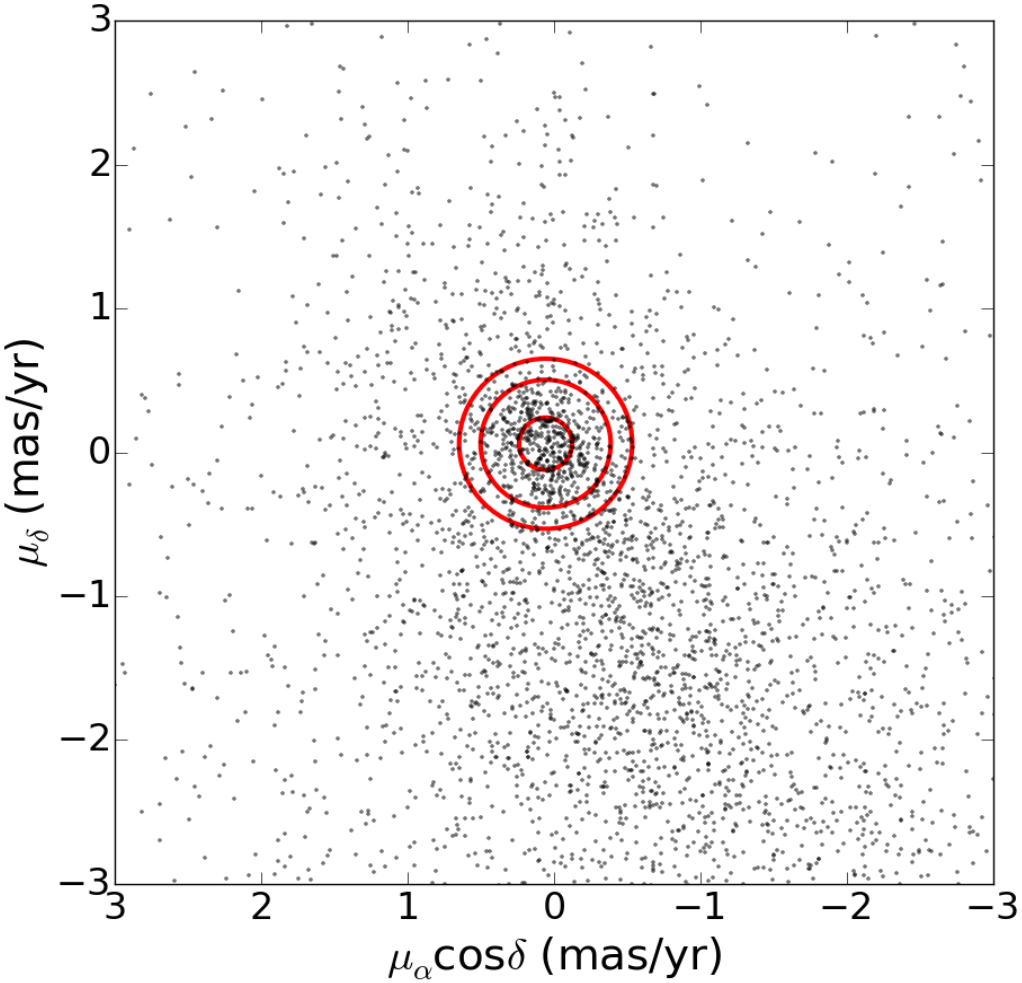
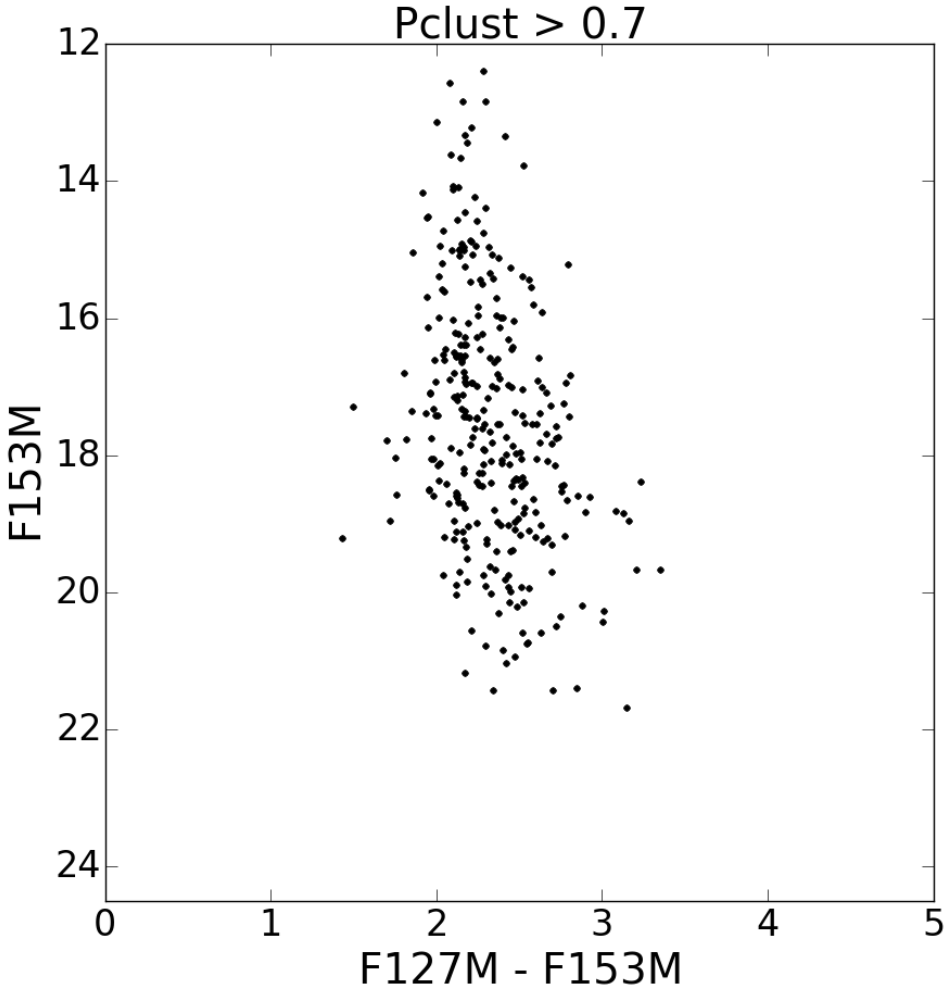


Figure from Hosek+ 2015

Keck AO and HST astrometry on the Arches cluster selects cluster members and gives precise proper motions.





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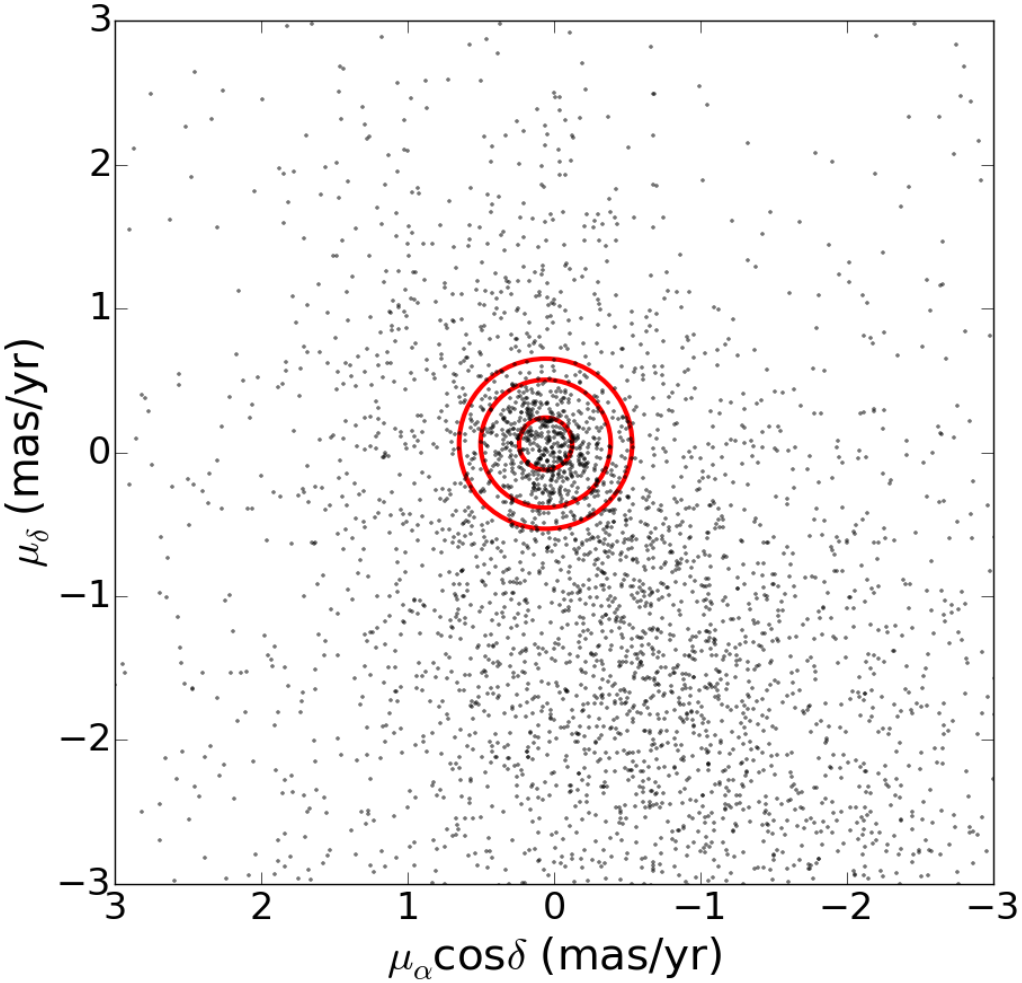


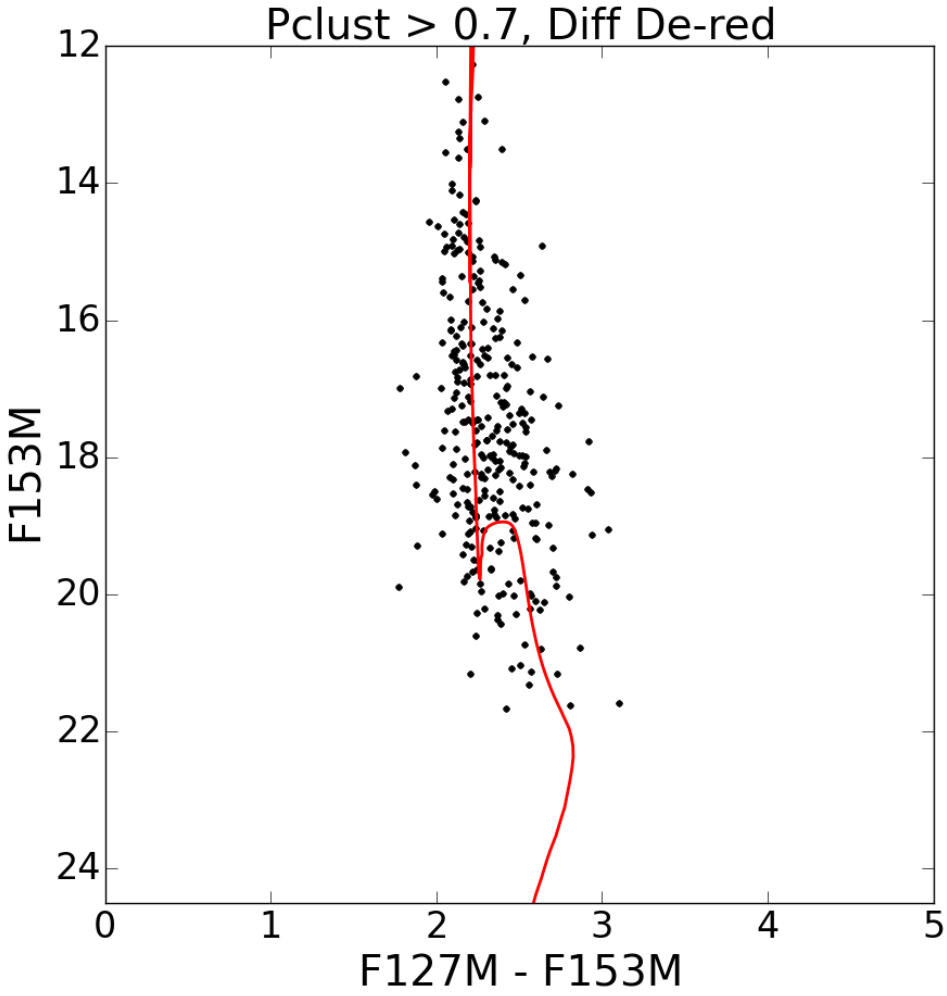
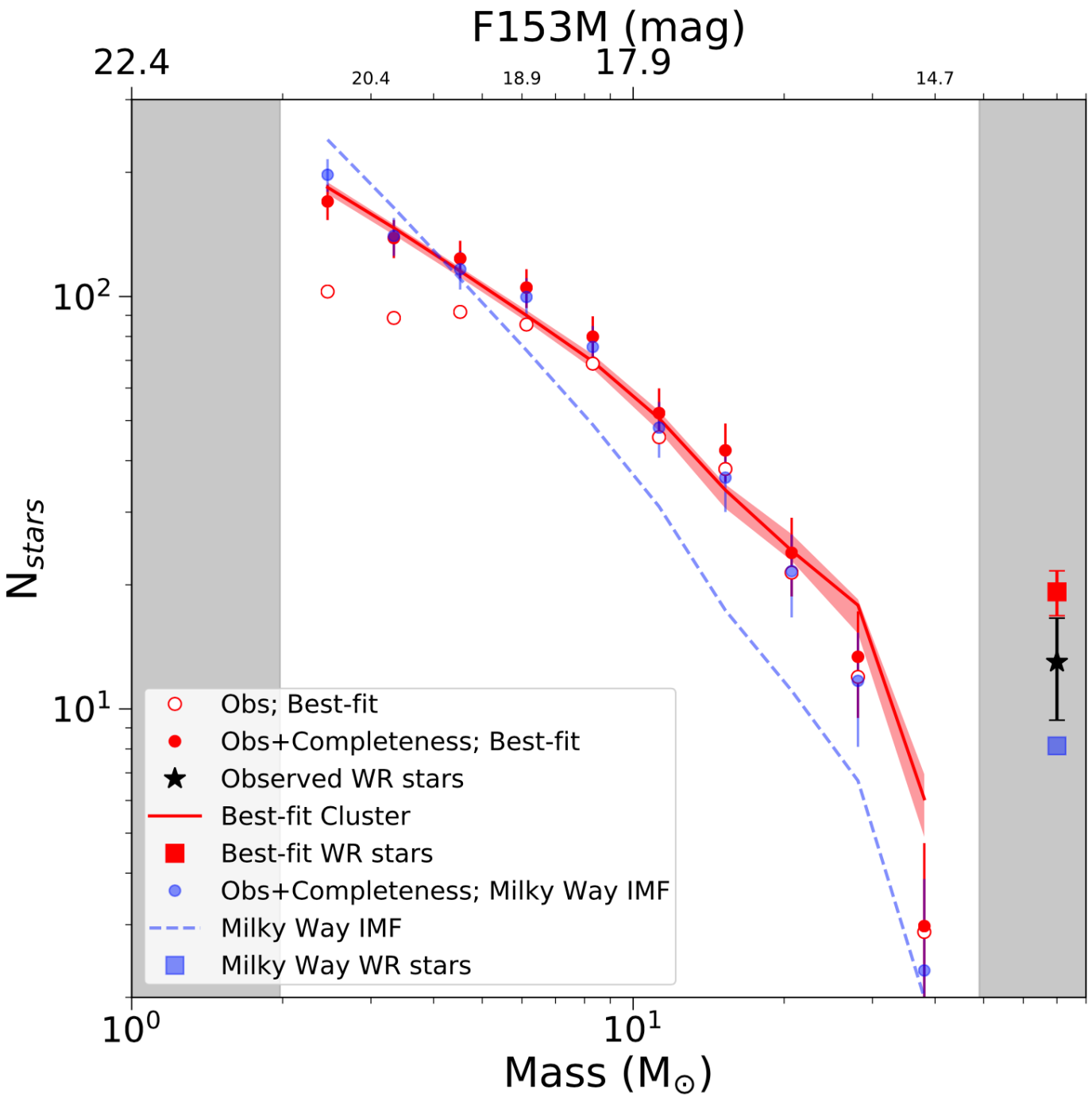


Figure from Hosek+ 2015

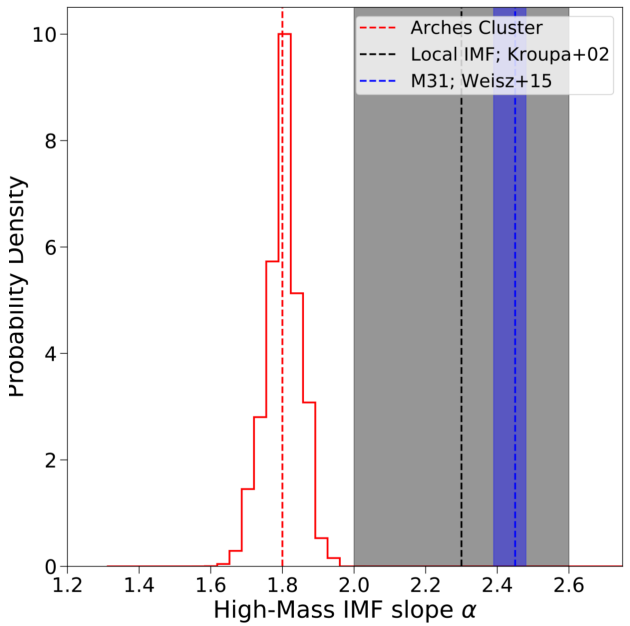
The Arches IMF does not match the “universal” Salpeter IMF.



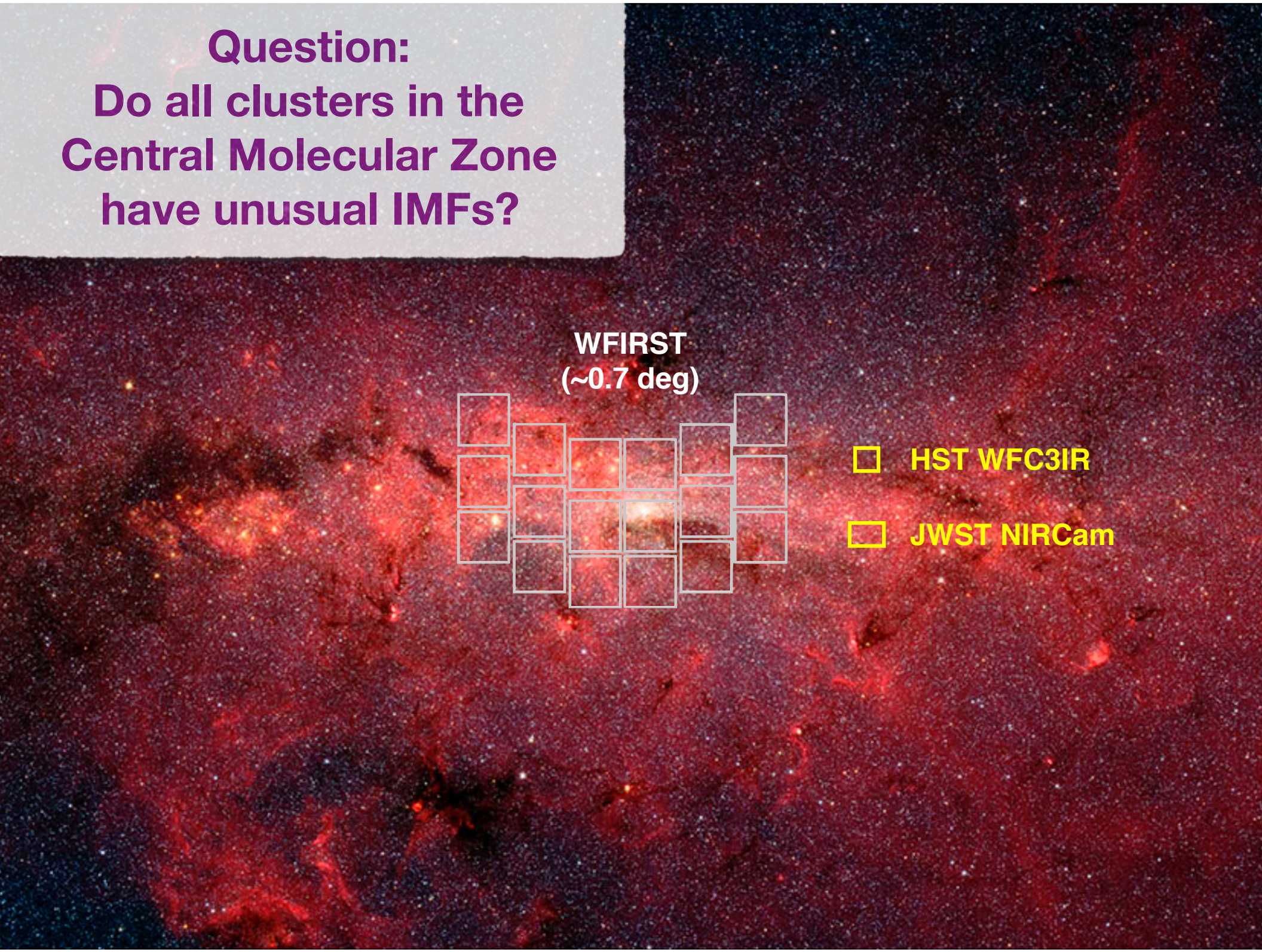
Top-heavy IMF

$$\frac{dN}{dm} \propto m^{-\alpha}$$

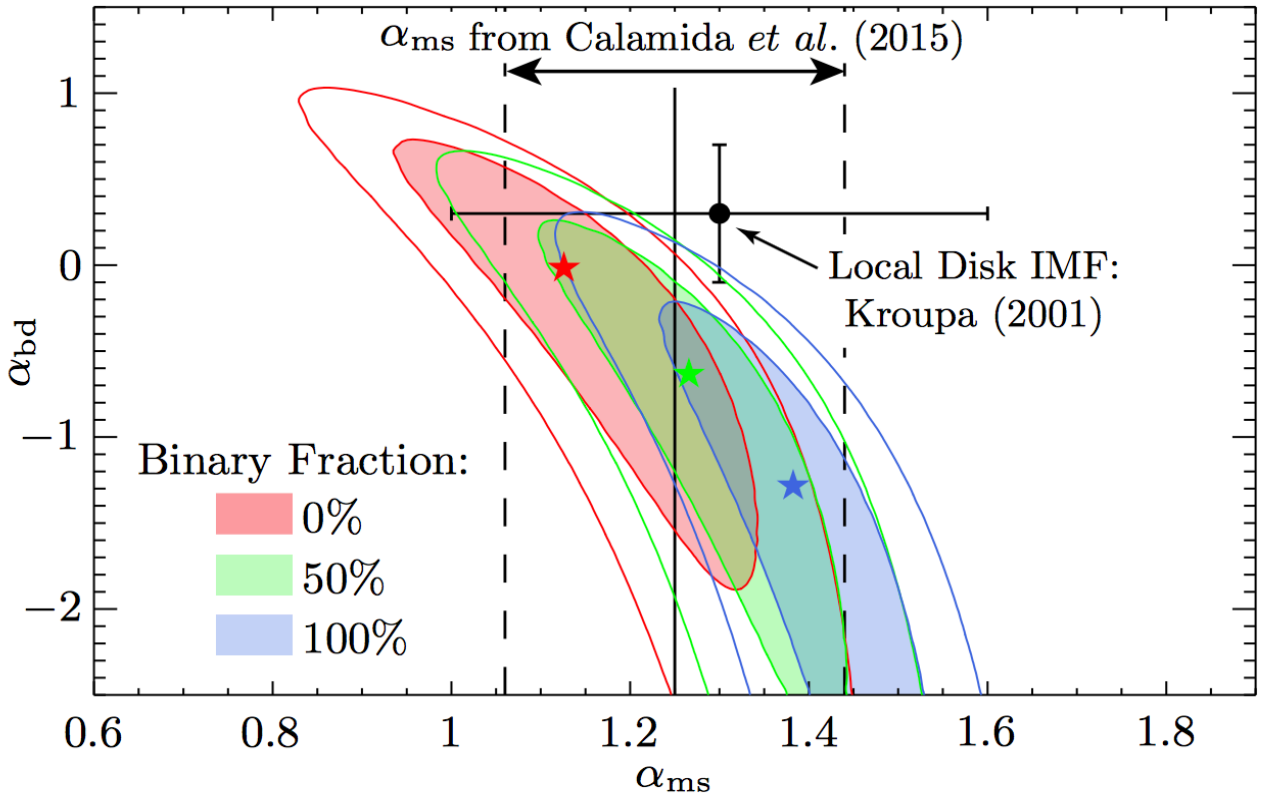
$$\alpha = 1.8 \pm 0.07$$



Hosek et al. 2018


Question:
Do all clusters in the
Central Molecular Zone
have unusual IMFs?
WFIRST
(~0.7 deg)
HST WFC3IR
JWST NIRCam

Field IMF toward the Central Milky Way from microlensing



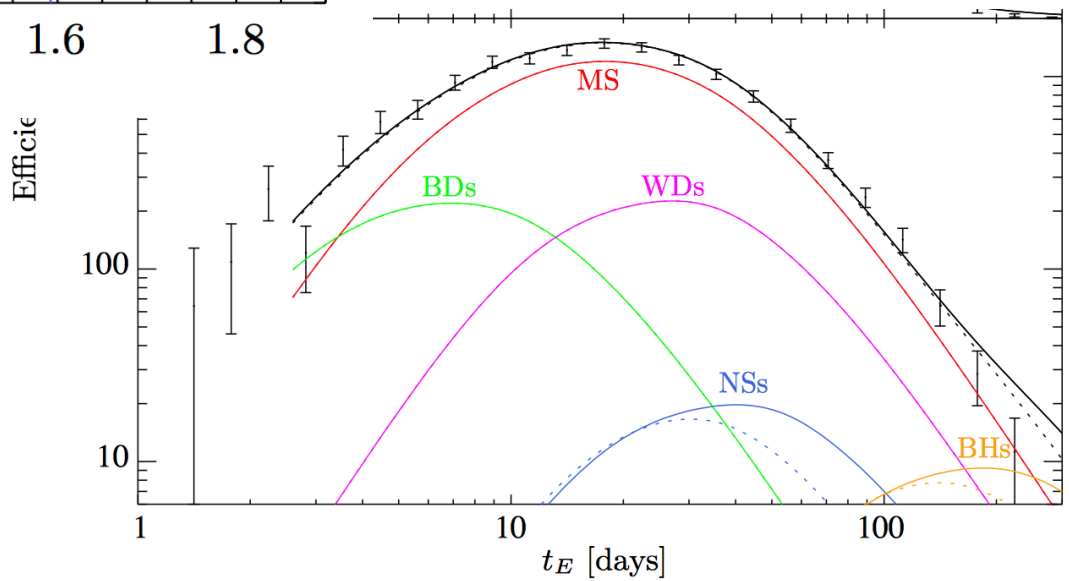


Figure 3. The efficiency-corrected timescale distribution from Wyrzykowski et al. (2015) compared to the best fitting power-law IMF with 0% binary frac-

Wegg et al. 2018

HST Study of Westerlund 1

Question:
Does the star formation process change in the most massive star clusters?

Obse

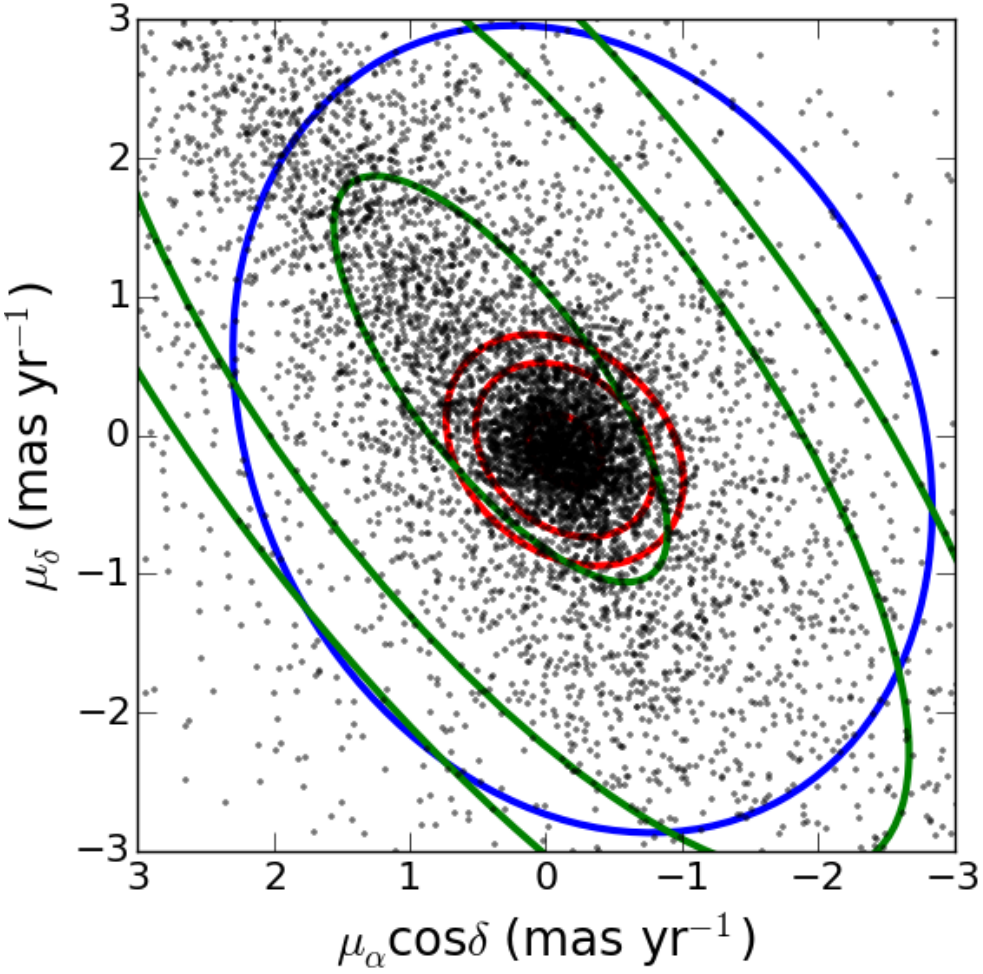
2005 F814W
2010 F125W
2010 F139M
2010 F160W
2013 F160W

Wd 1

age = 5 Myr
d = 3.8 kpc
M = 10^5 M_{sun}

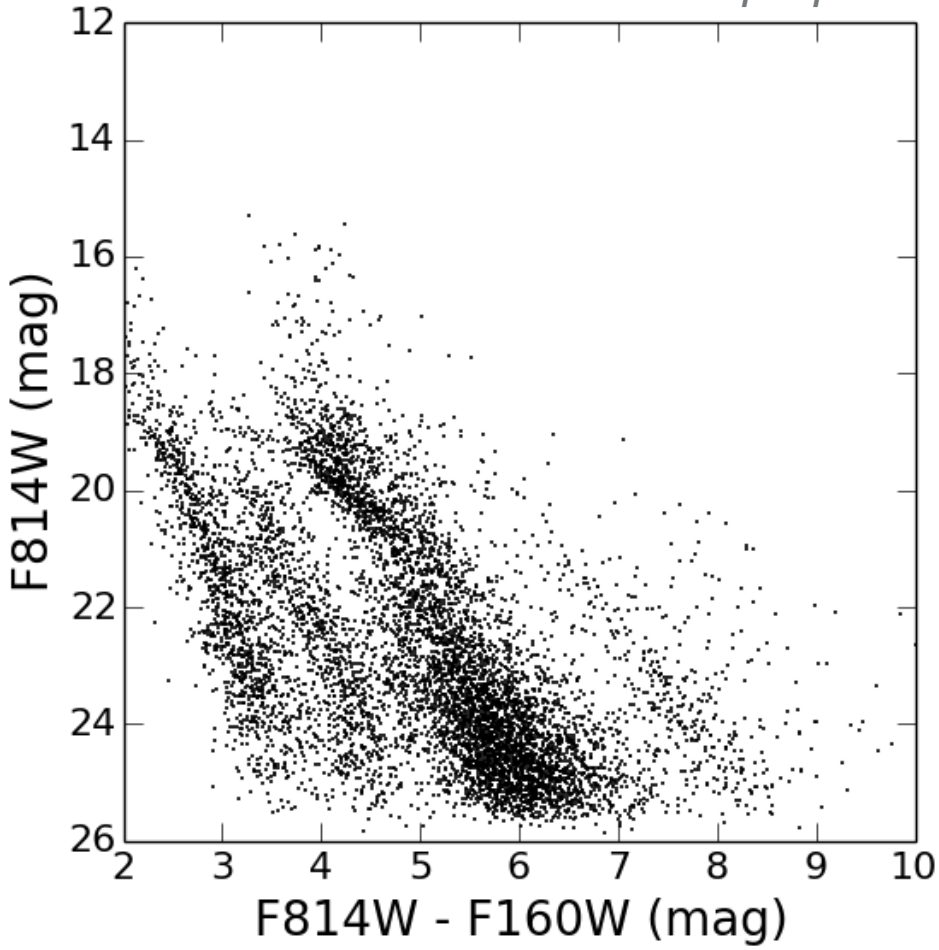
Distinguish members of Wd 1 with HST proper motions.

Proper motion errors < 0.5 mas/yr (2 km/s).



HST IR+optical
proper motion diagram

Lu+ in prep.



HST IR+optical
color magnitude diagram

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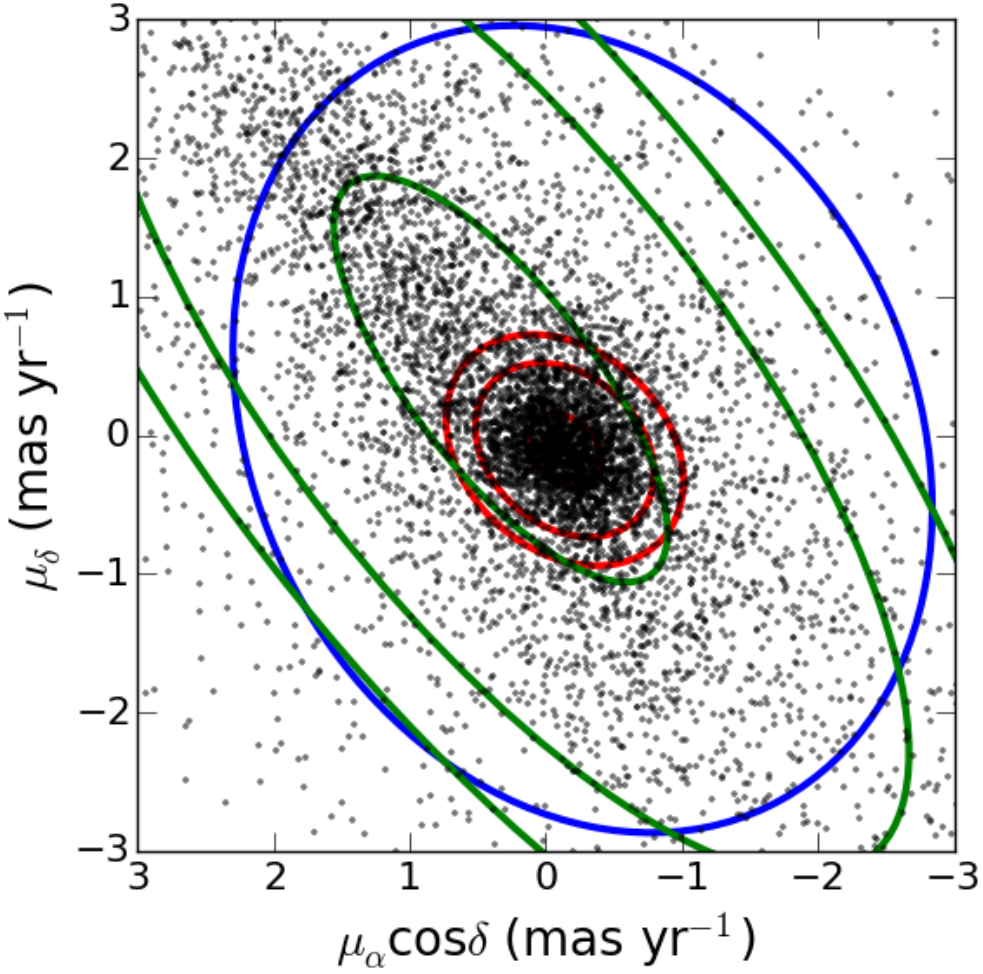

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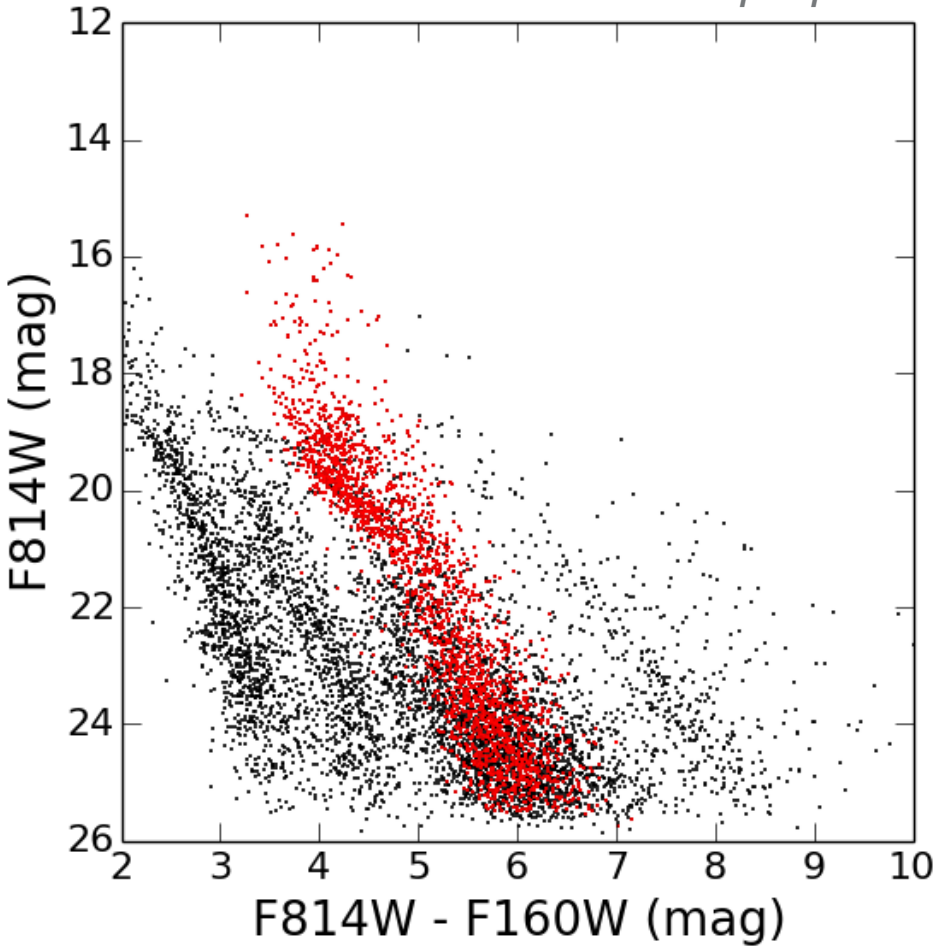


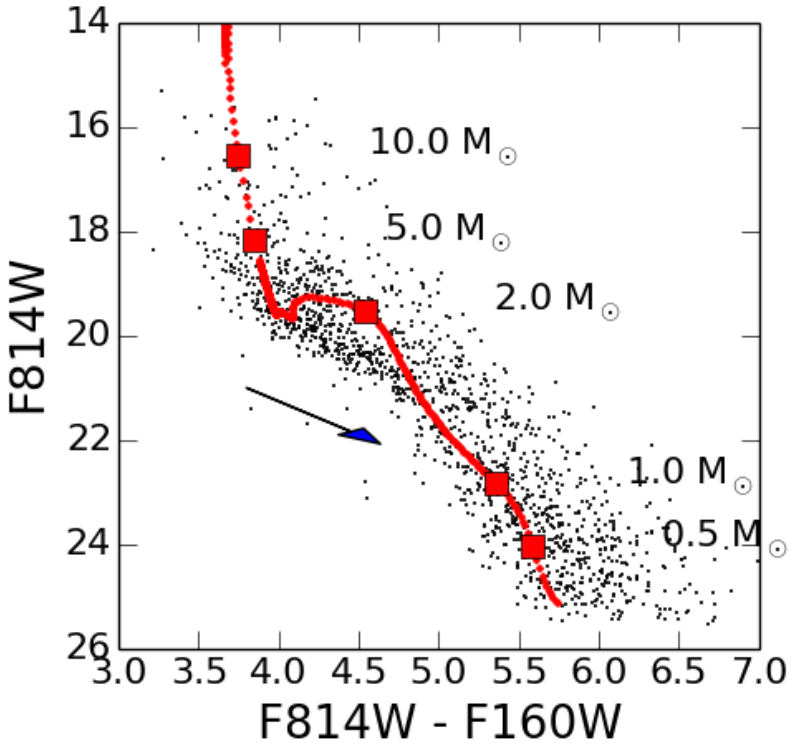
HST IR+optical
color magnitude diagram

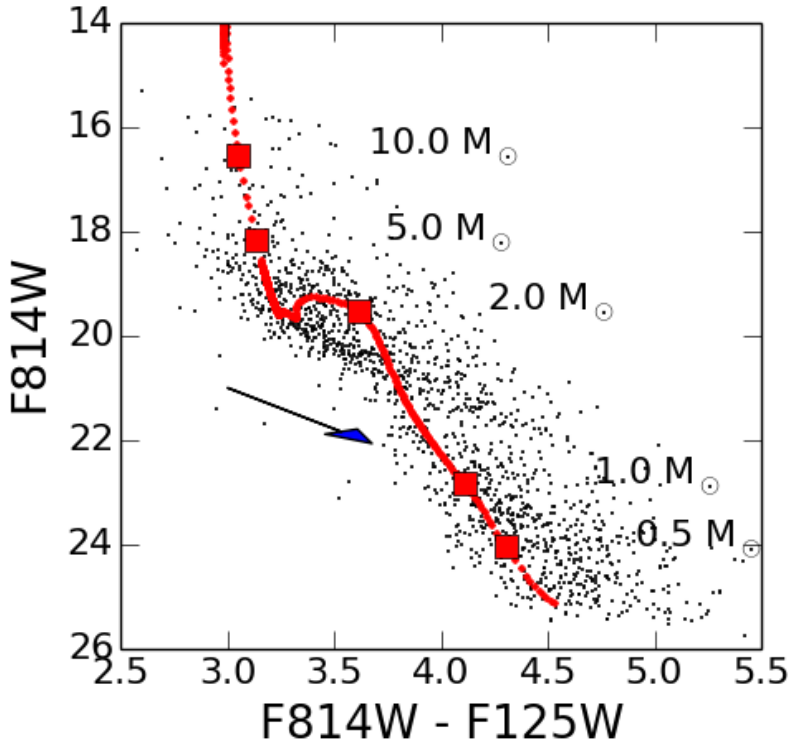
Wd 1

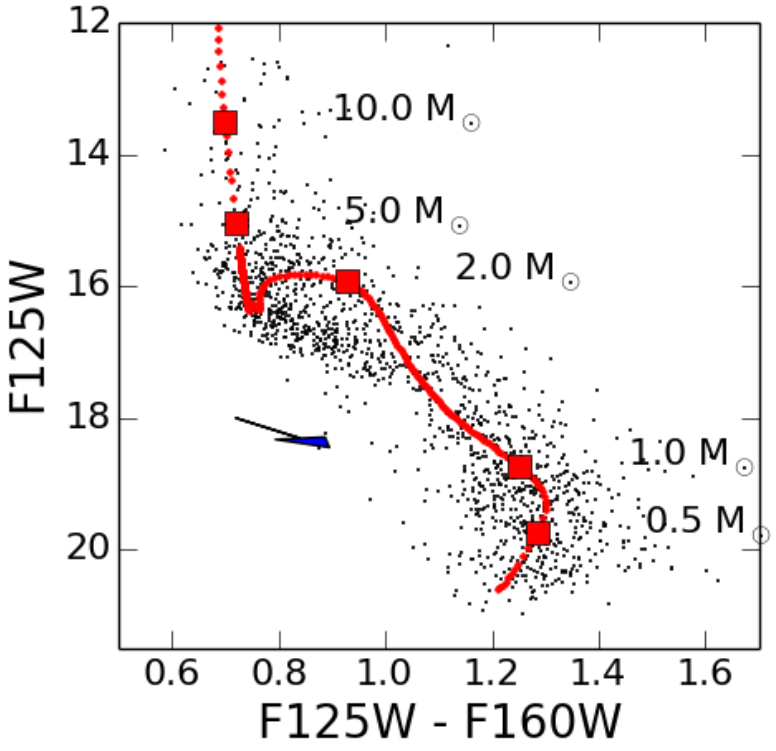
Best-fit
to CMD

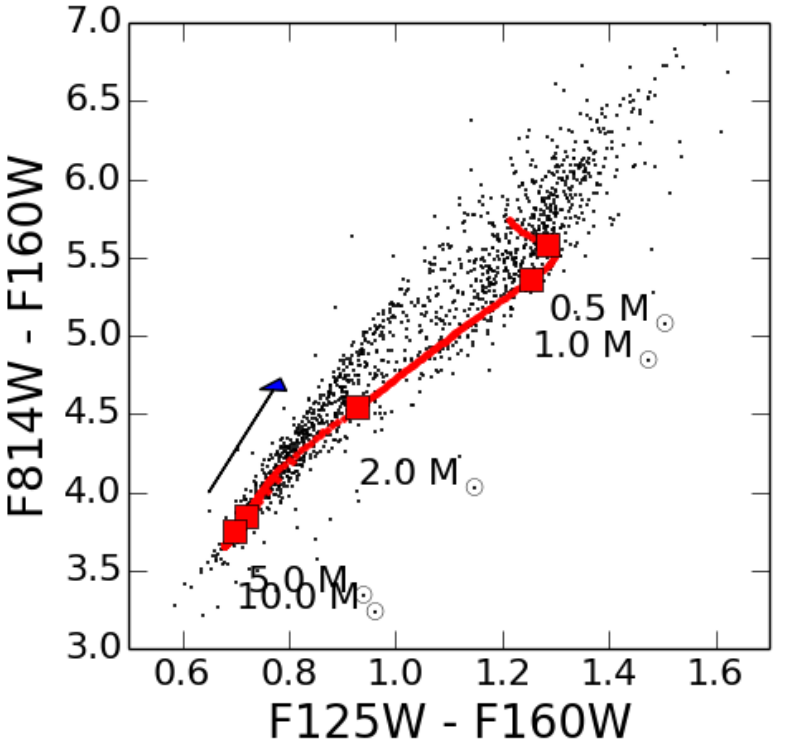
age = 5 Myr
AKs = 0.7
d = 4000 pc

Custom
extinction
law.



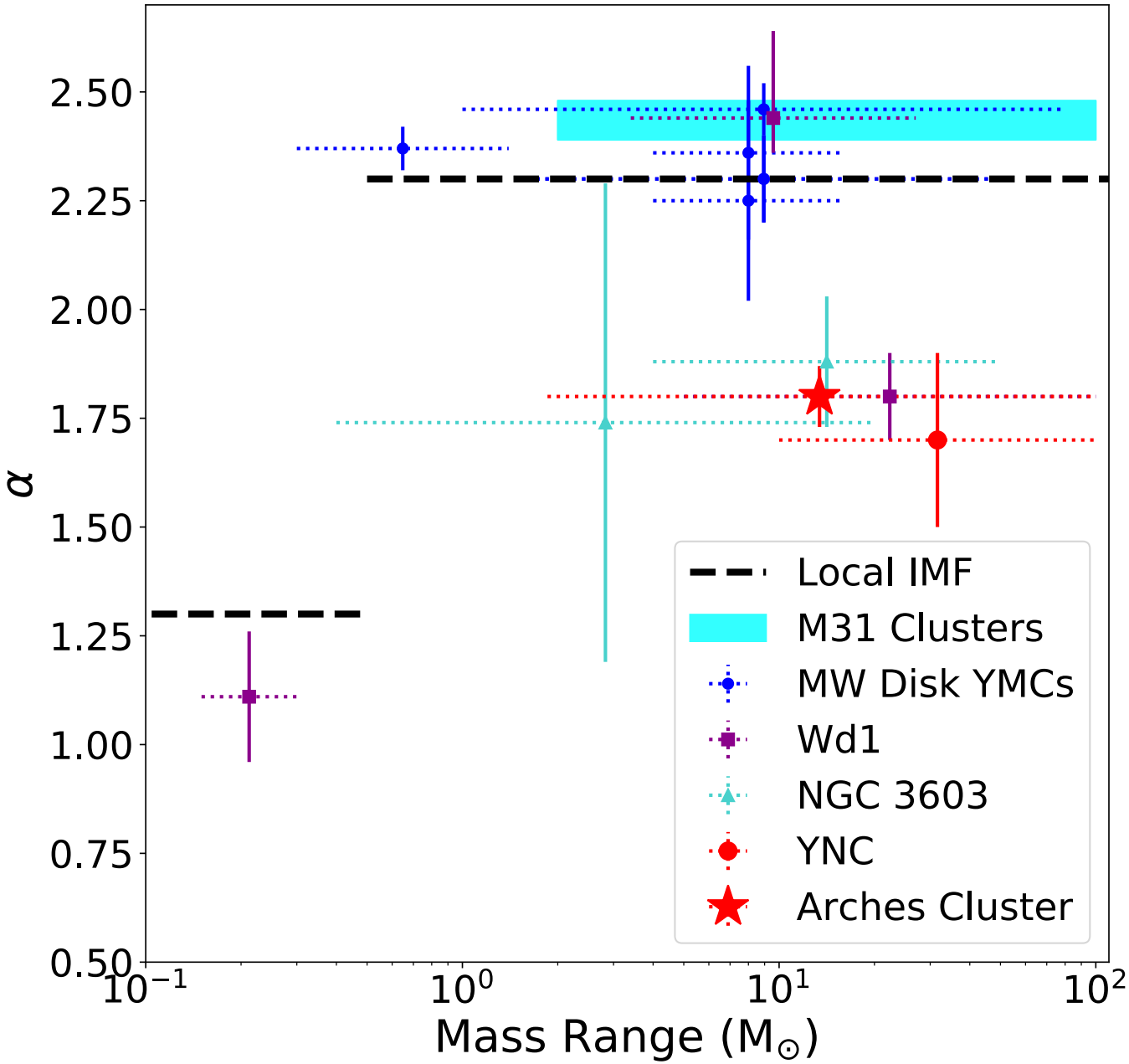


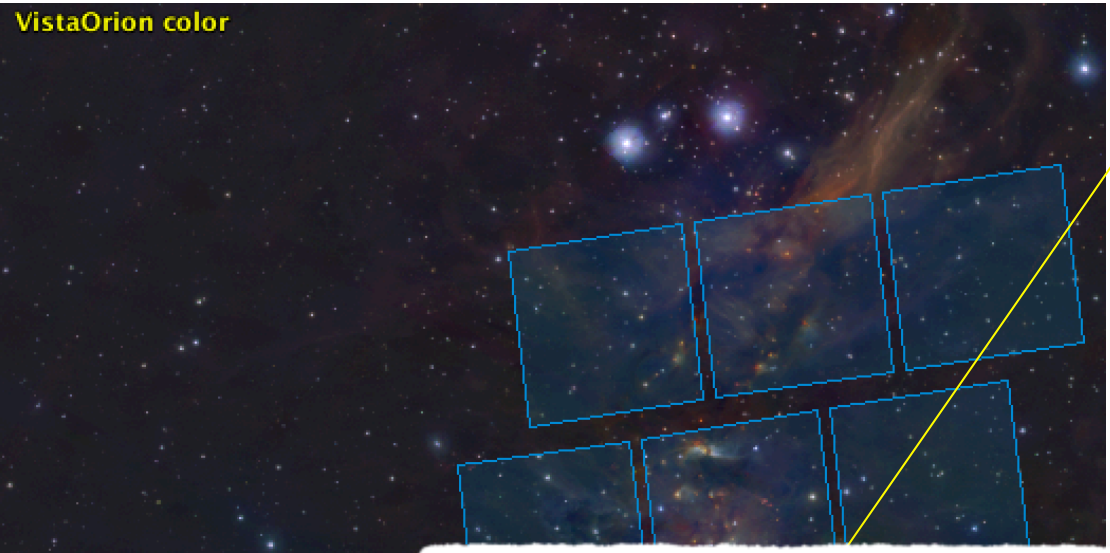


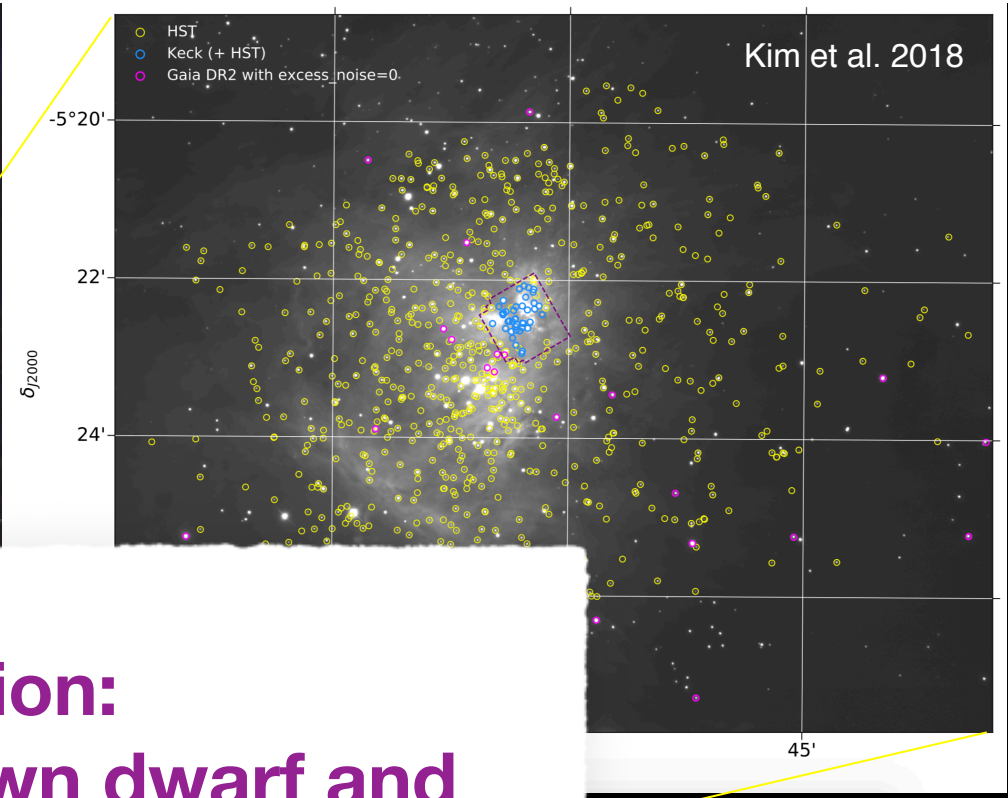


Kim, Lu+ in prep.

Preliminary Conclusion:
Extreme environment == massive (dense) clusters
NOT Galactic Center

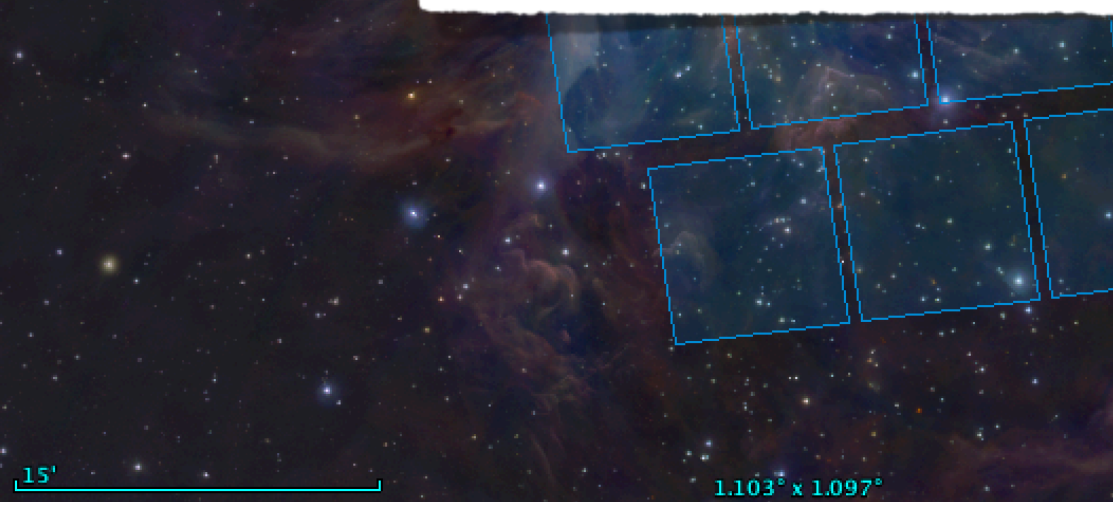




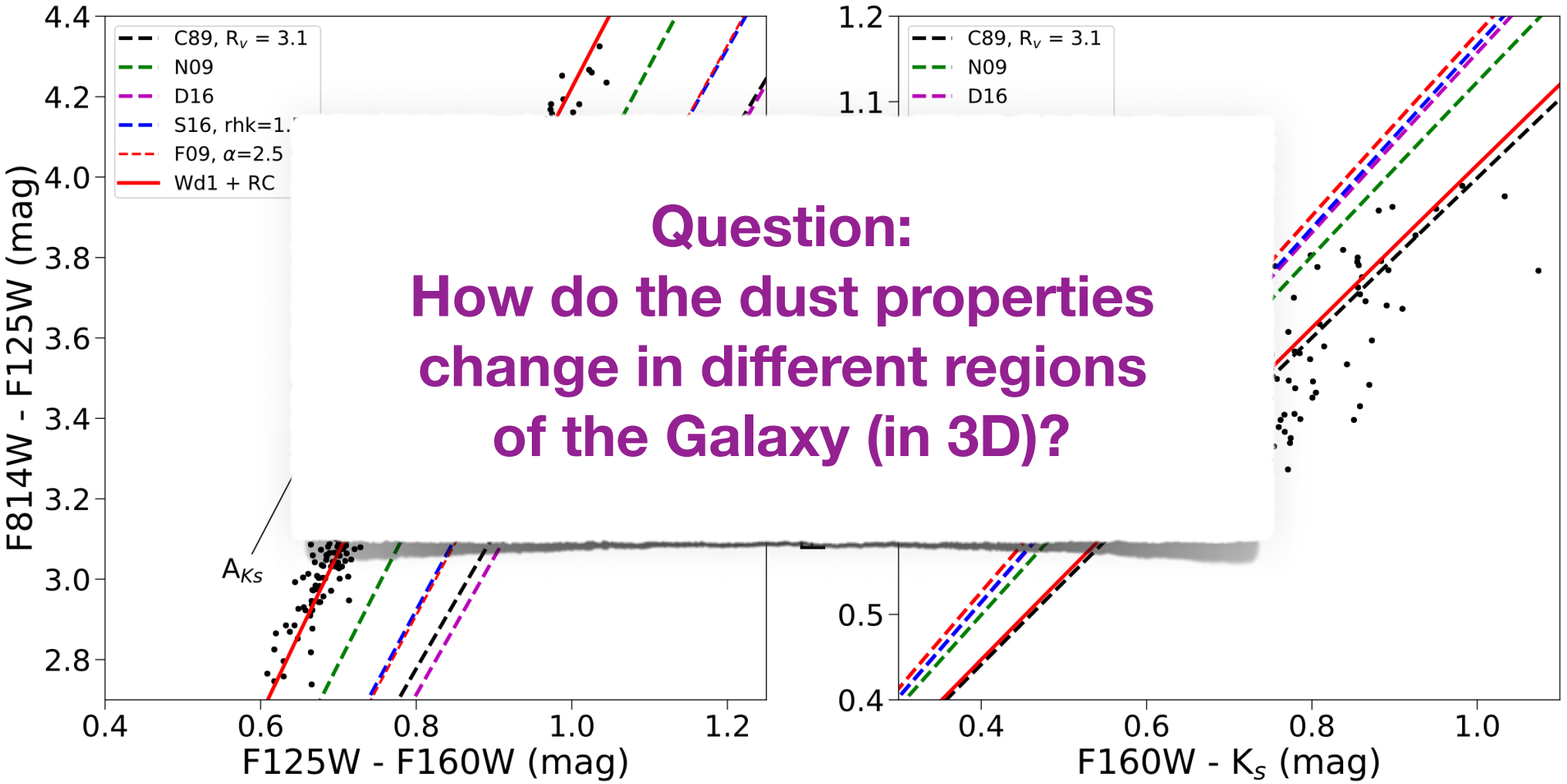


Question:
What is the brown dwarf and free-floating planet mass function?

rion IR
strometry
currently
very sparse
(blue points
above)



Extremely dusty regions show a discrepant extinction law.



Question:
How do the dust properties change in different regions of the Galaxy (in 3D)?

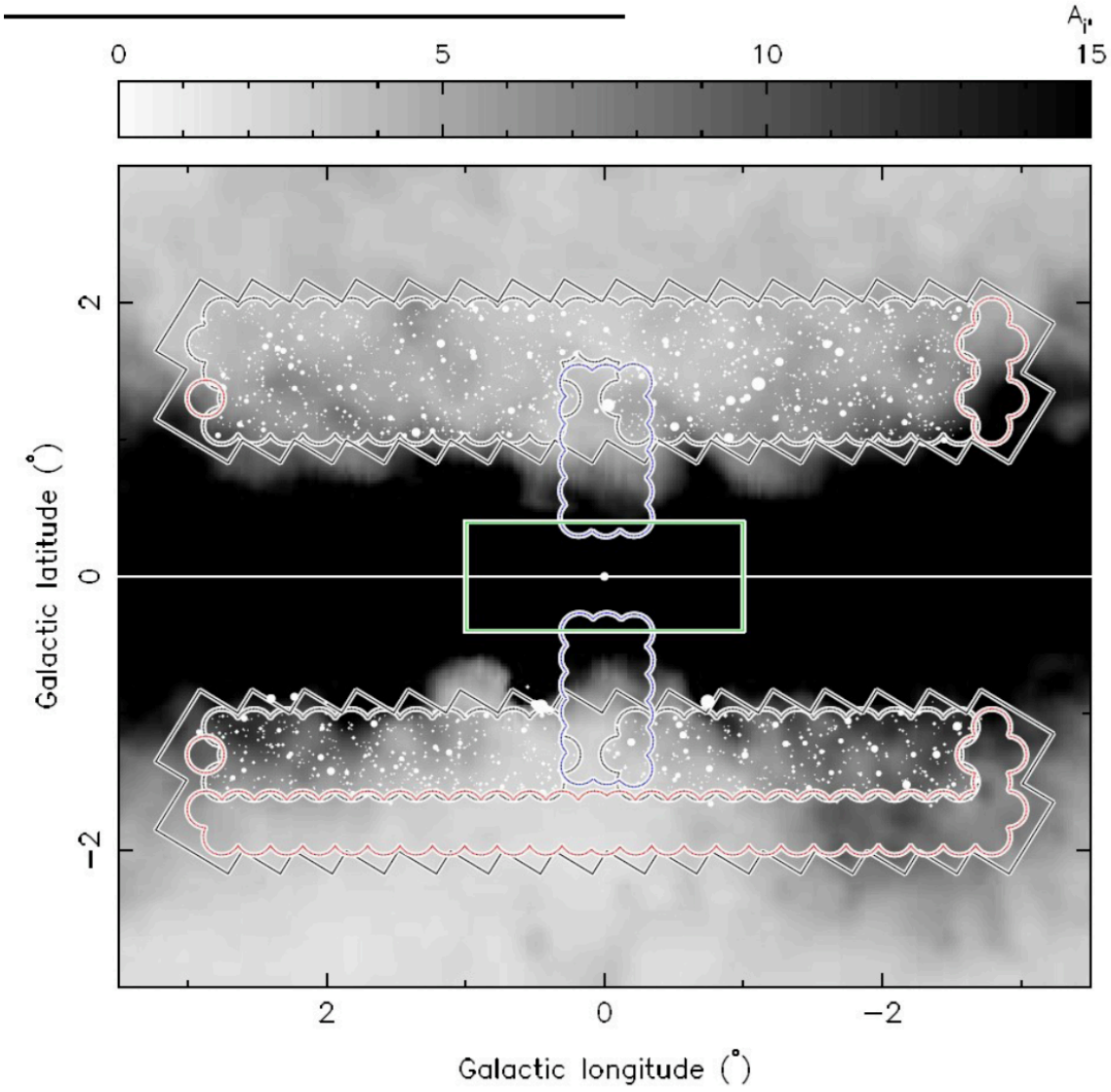
Hosek, et al. 2017

WFIRST sees the variable infrared sky.

IR + X-ray Variability Studies:

Chandra Galactic Bulge Survey

- How many LMXBs are in the Galaxy?
- What are the black hole and neutron star mass distribution?
- Where are the eclipsing black holes?



Jonker et al. 2011, Britt et al. 2014

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