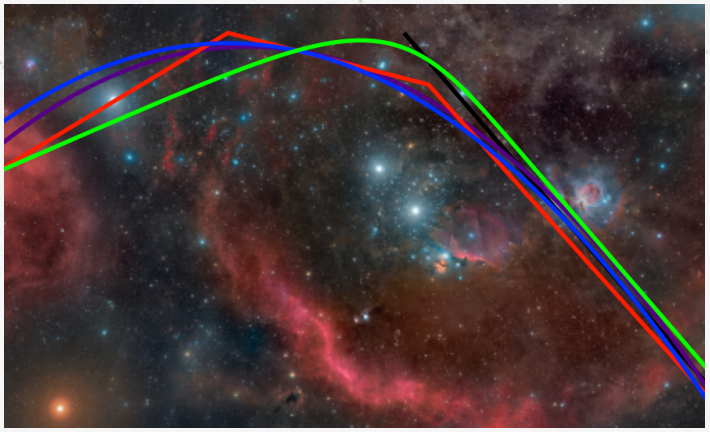
Initial Mass Function of 25 Orionis down to the Planetary-Mass Domain

Genaro Suárez
Department of Physics & Astronomy, University of Western Ontario



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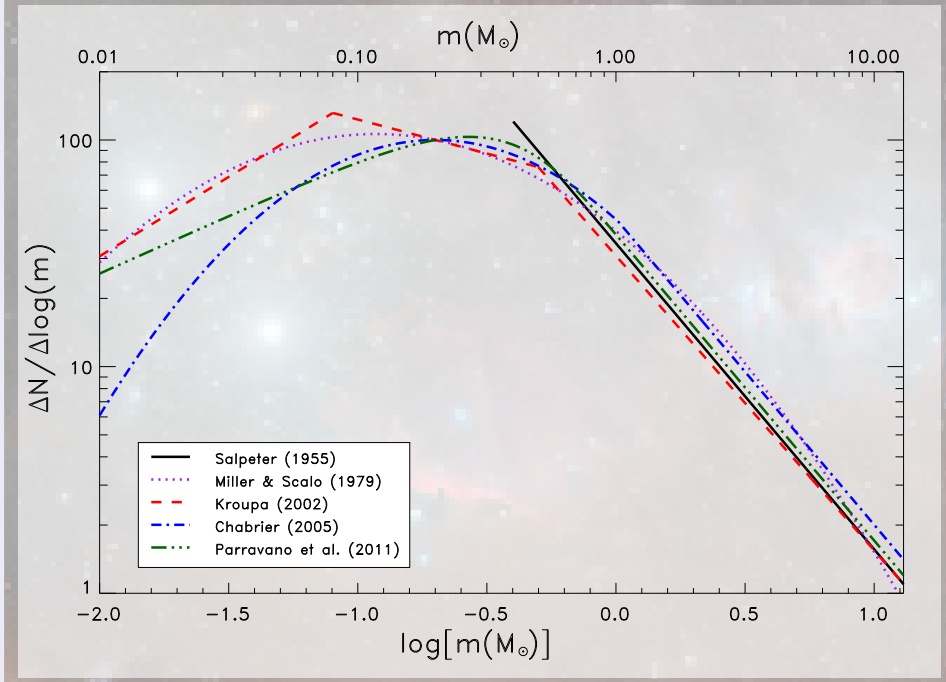
Outline

Initial Mass Function

The initial mass function (IMF) is the main outcome of the star forming process and is an essential input in a diversity of astrophysical studies.

Only in a few cases it has been determined for the whole mass spectrum of a stellar population (e.g. Bayo *et al.* 2011, Peña-Ramírez *et al.* 2012).



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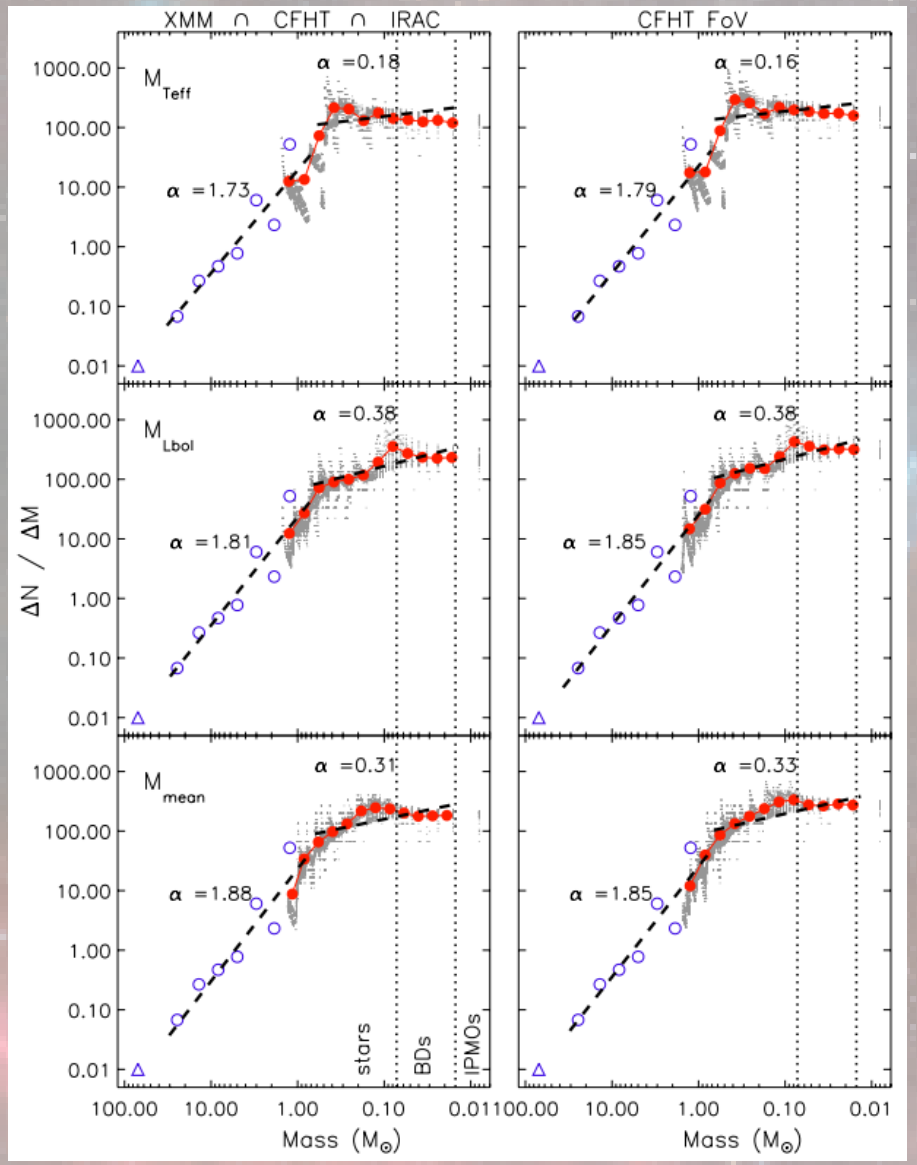

Bayo et al. (2011)

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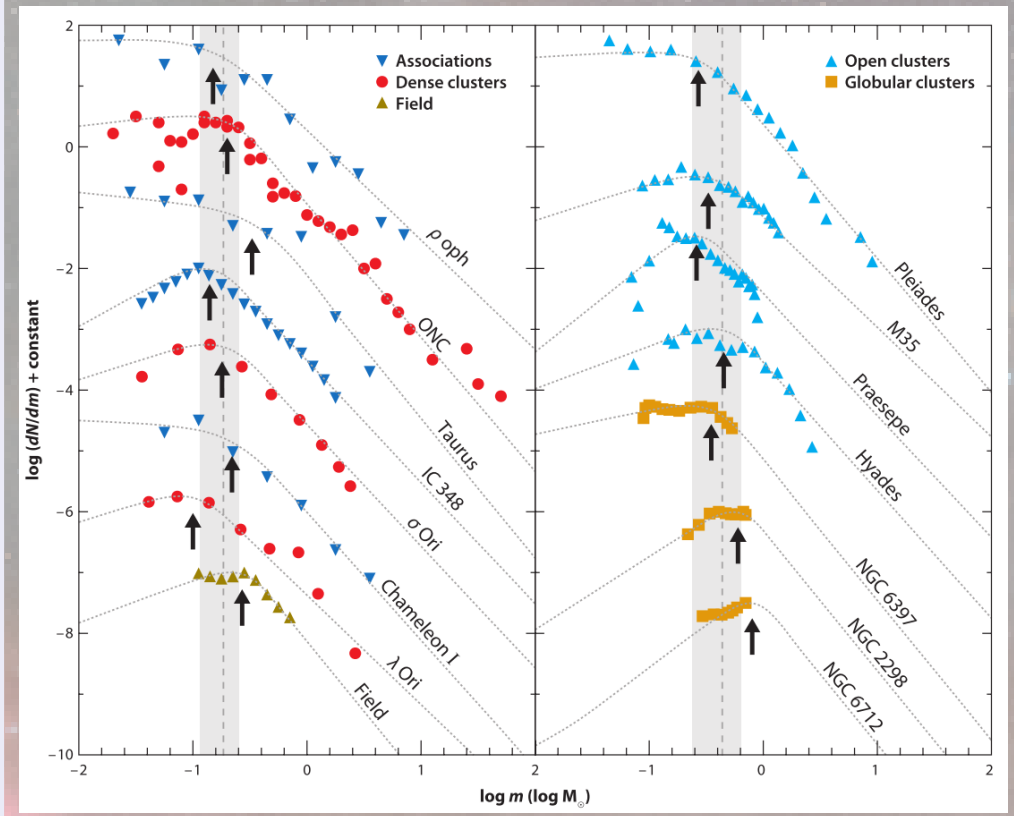

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Main Goal

Determination of the IMF of a stellar population over the whole cluster mass range and covering its entire spatial distribution.

25 Orionis Stellar Group (25 Ori)

Distance of 356±47 pc.

Age of 6.5 ± 2.5 Myr.

$\bar{A}_V = 0.29 \pm 0.26$ mag.

Cluster radius of 0.5-1.0°.

(Briceño et al. 2005,2007, Kharchenko *et al.* 2005, Downes et al. 2014, Suárez *et al.* 2017, Briceño *et al.* 2019, Suárez *et al.* 2019)

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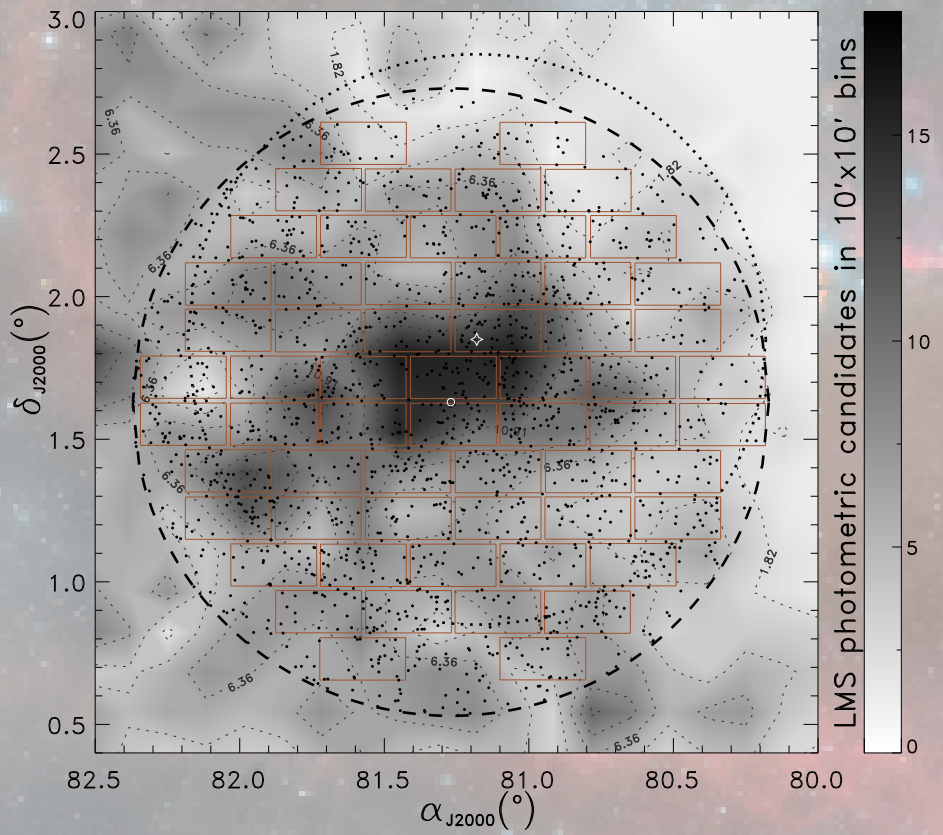
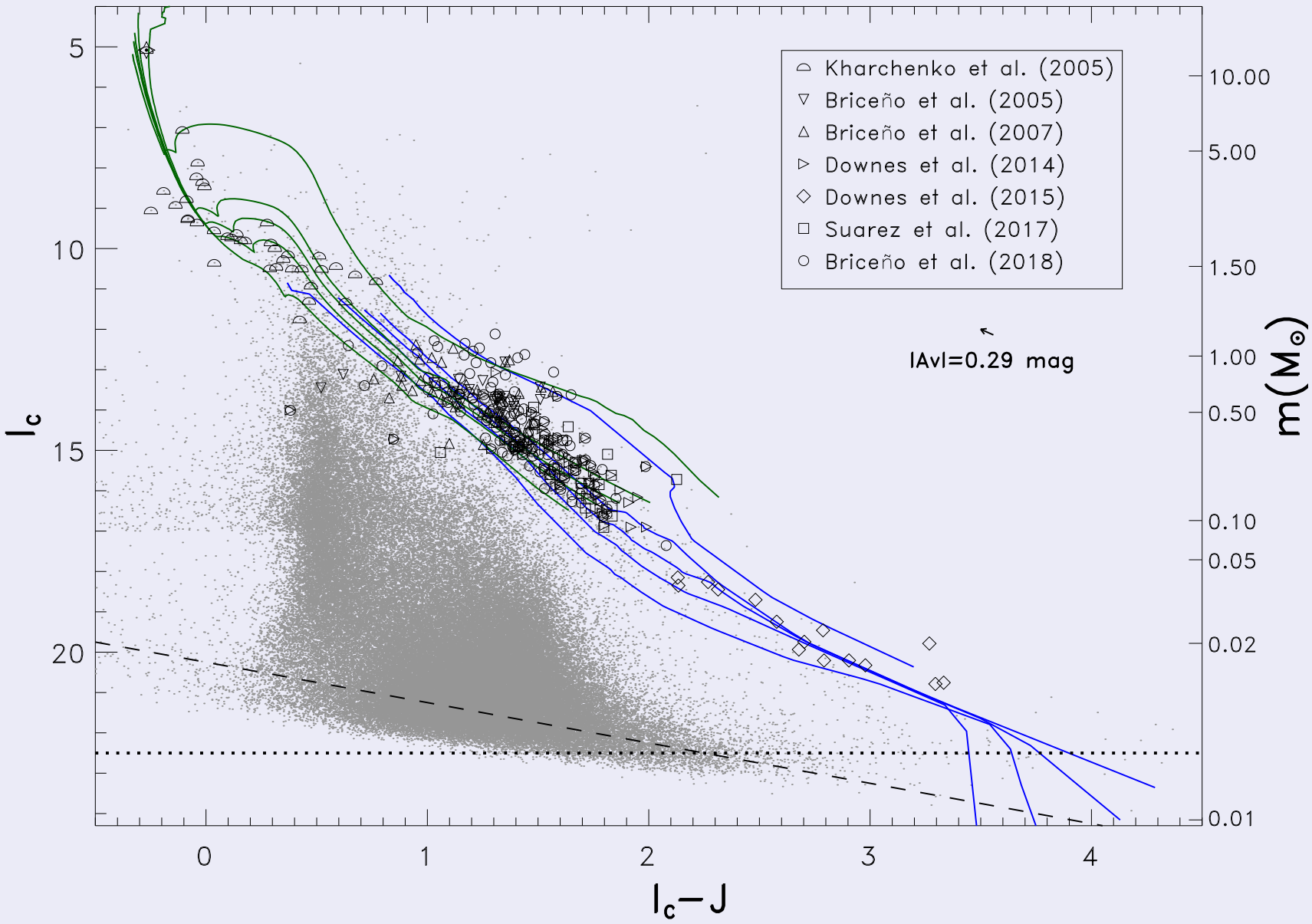
Photometric Data

Survey	Phot. Band	FWHM (arcsec)	Area (%)	Satur. (mag)	Comp. (mag)	Satur. ($M_\odot$)	Comp. ($M_\odot$)	Reference
DECam	I_c	0.9	$\approx$ 86	16.0	22.50	0.16	0.012	Suárez et al. (2019)
CDSO	I_c	2.9	100	13.0	19.75	0.86	0.020	Downes *et al.* (2014)
UCAC4	I_c	1.9	100	7.0	14.75	6.33	0.340	Zacharias *et al.* (2013)
Hipparcos	I_c	—	100	$<$5.0	—	$>$13.5	—	Perryman *et al.* (1997)
VISTA	J	0.9	100	12.0	20.25	0.85	$<$0.010	Petr-Gotzens *et al.* (2011)
2MASS	J	2.5	100	4.0	16.25	19.3	0.287	Skrutskie *et al.* (2006)



Photometric Candidate Selection



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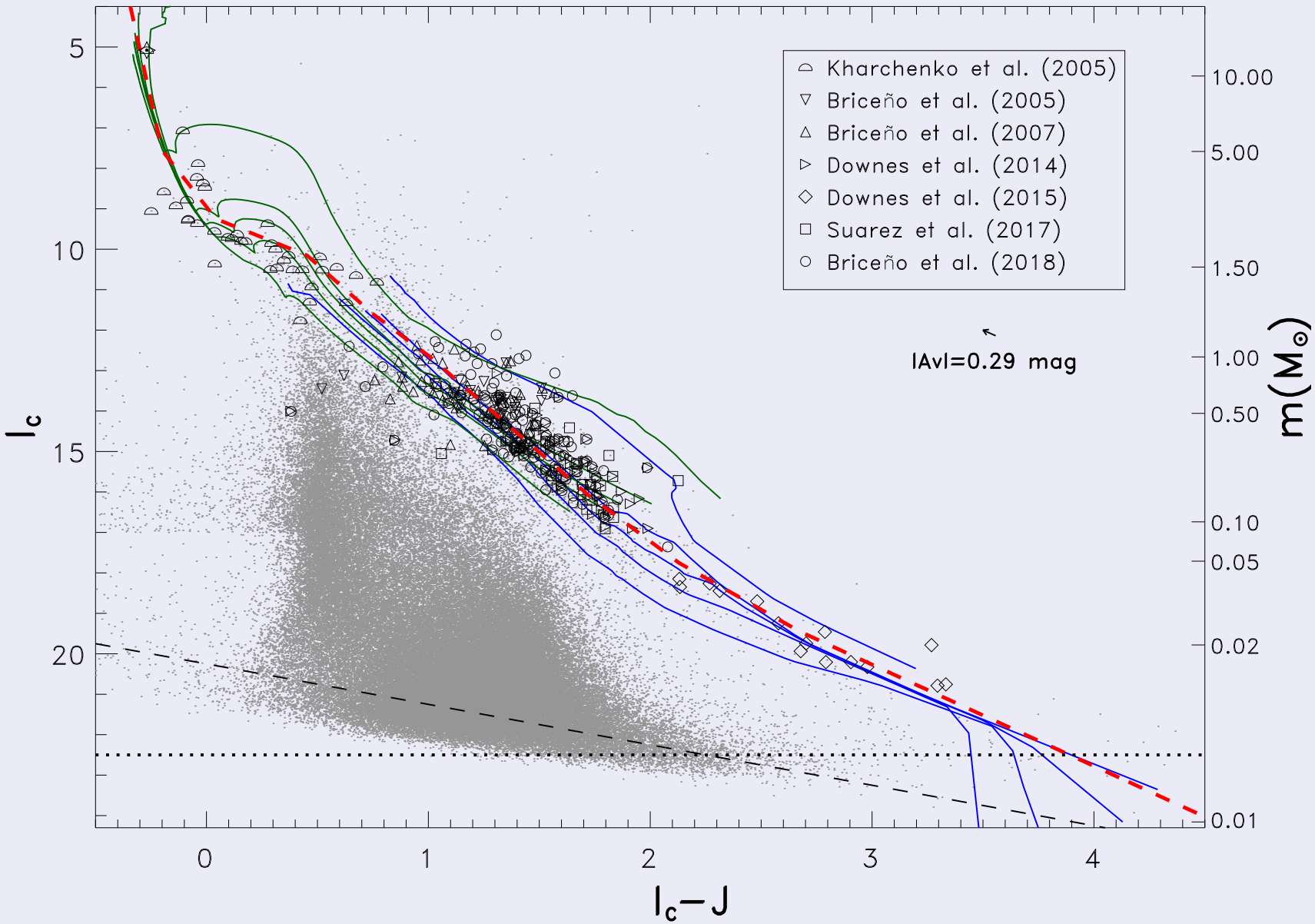

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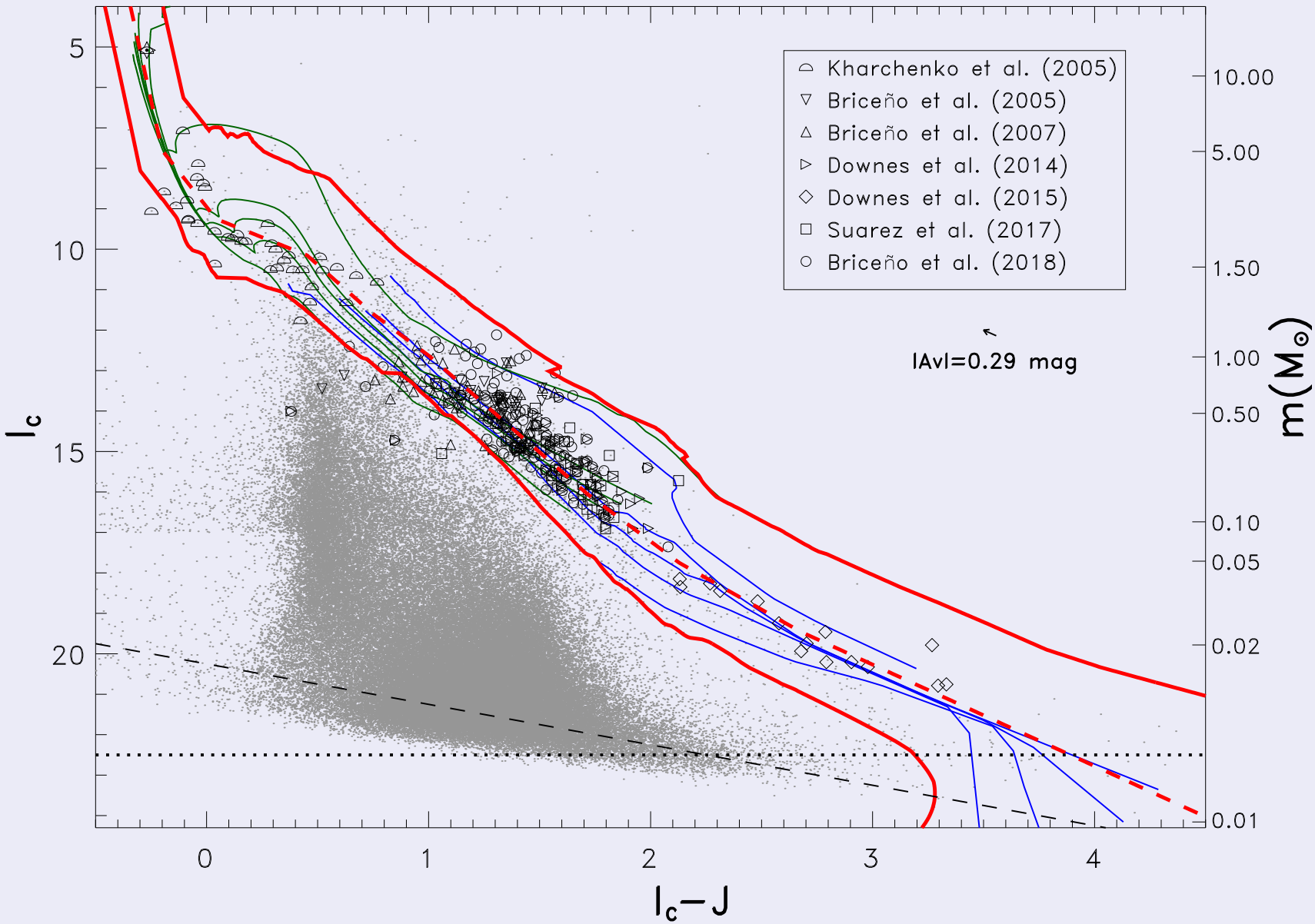

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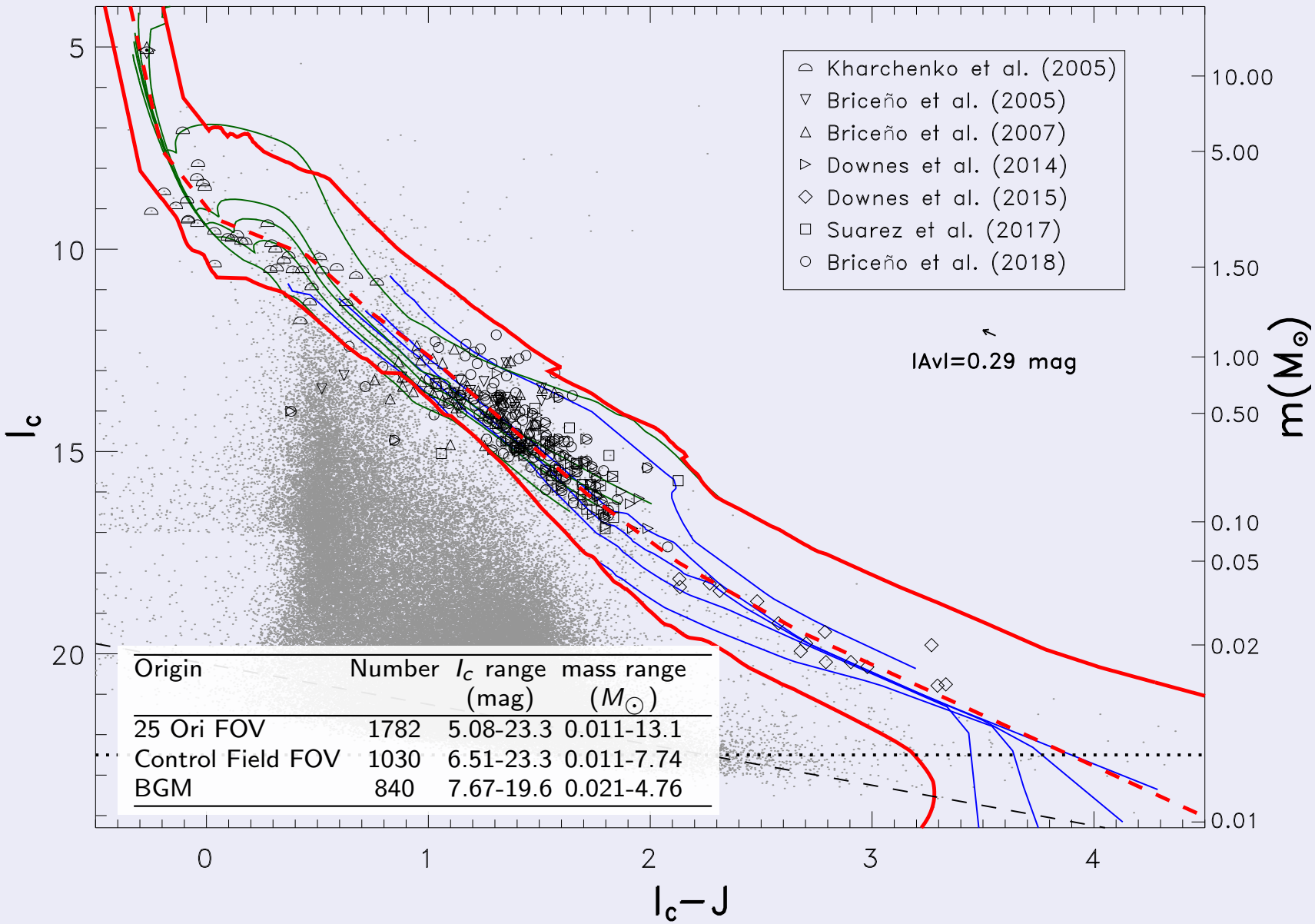

Origin	Number	I_c range (mag)	mass range ($M_\odot$)
25 Ori FOV	1782	5.08-23.3	0.011-13.1
Control Field FOV	1030	6.51-23.3	0.011-7.74
BGM	840	7.67-19.6	0.021-4.76

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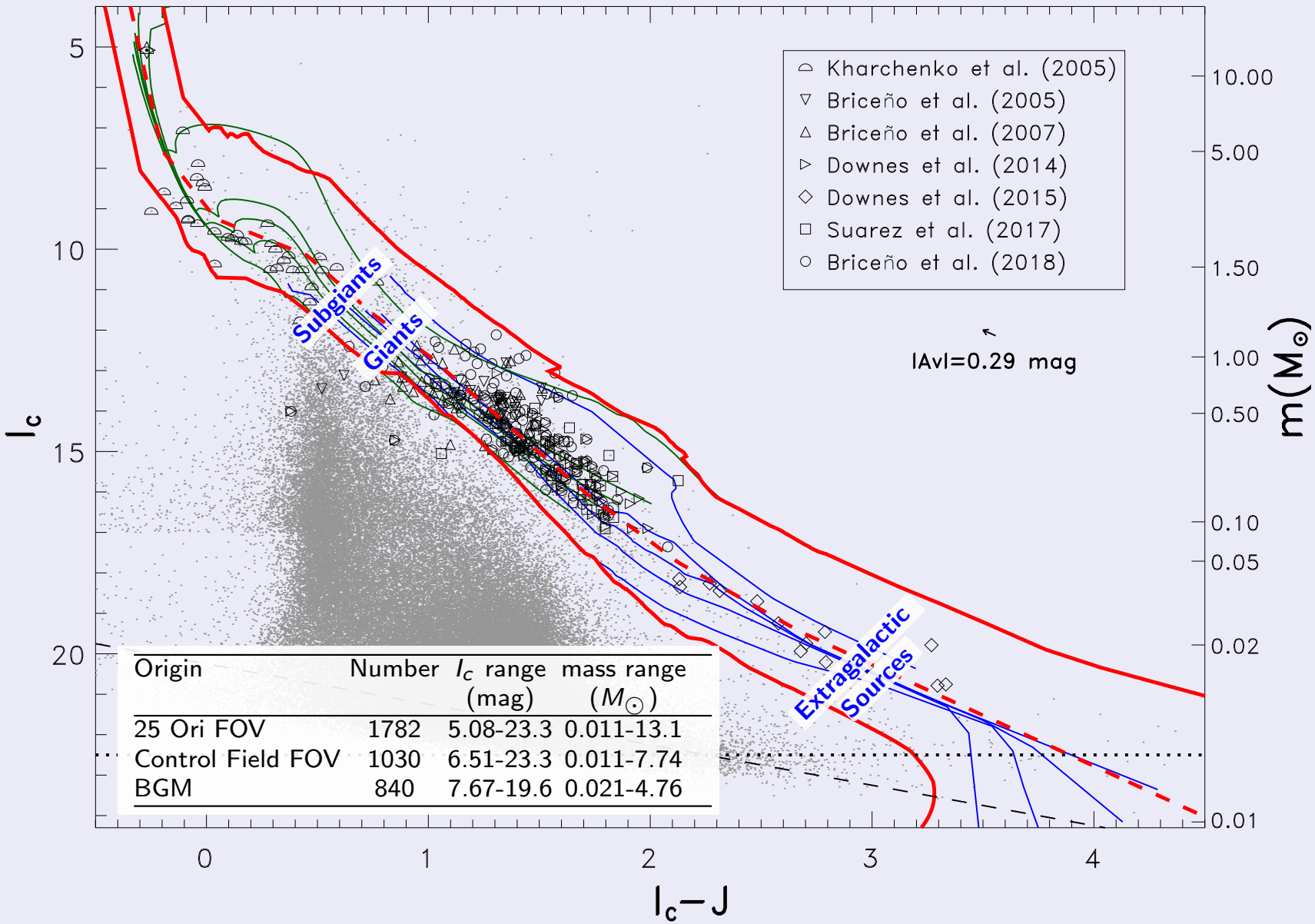

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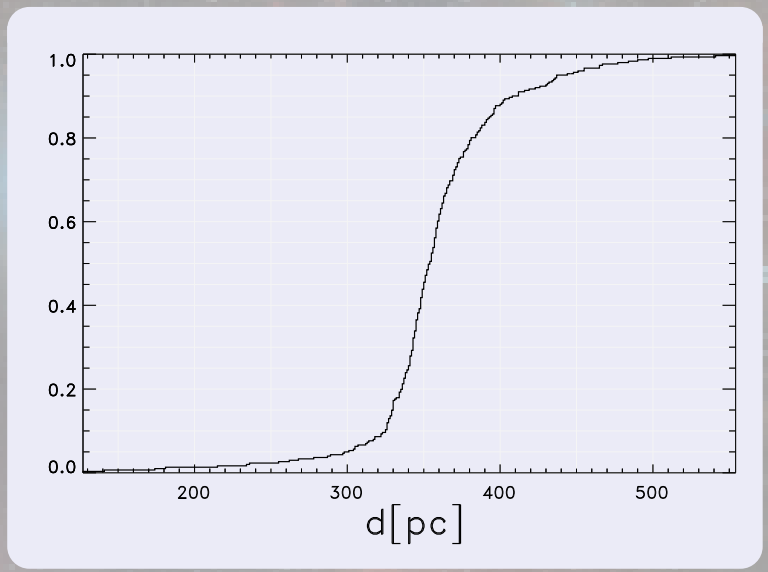
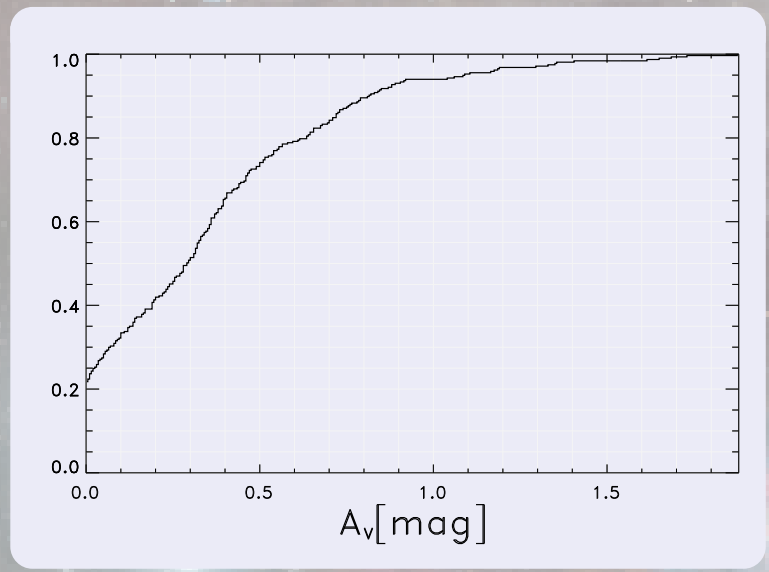
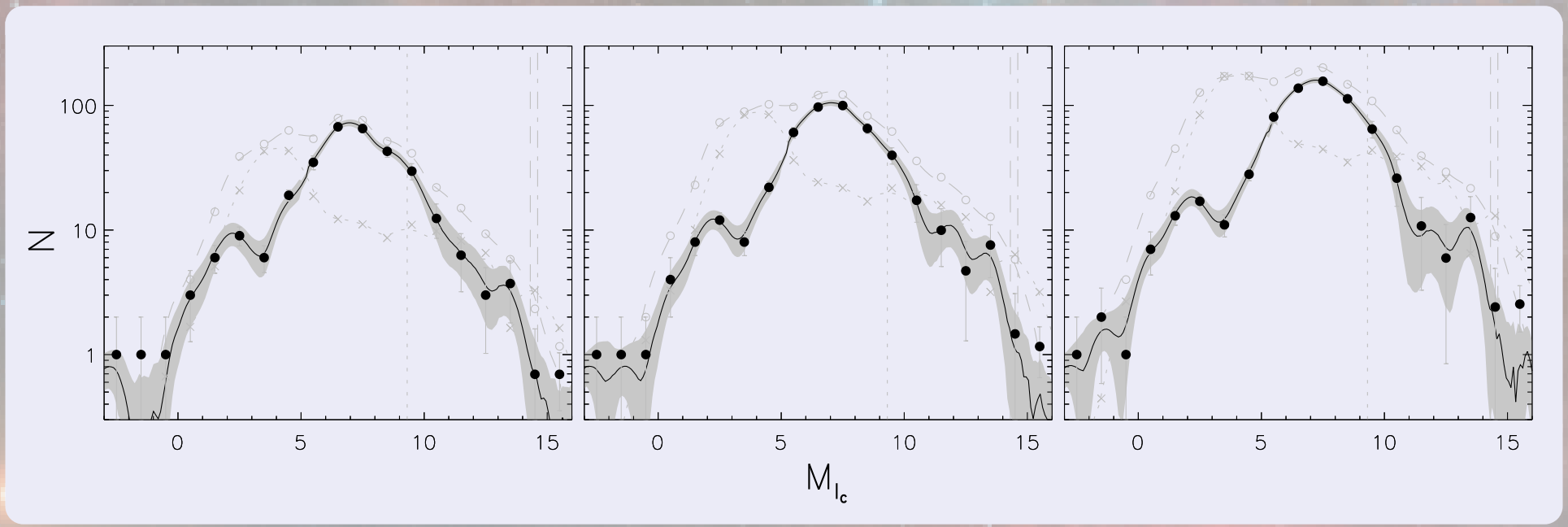
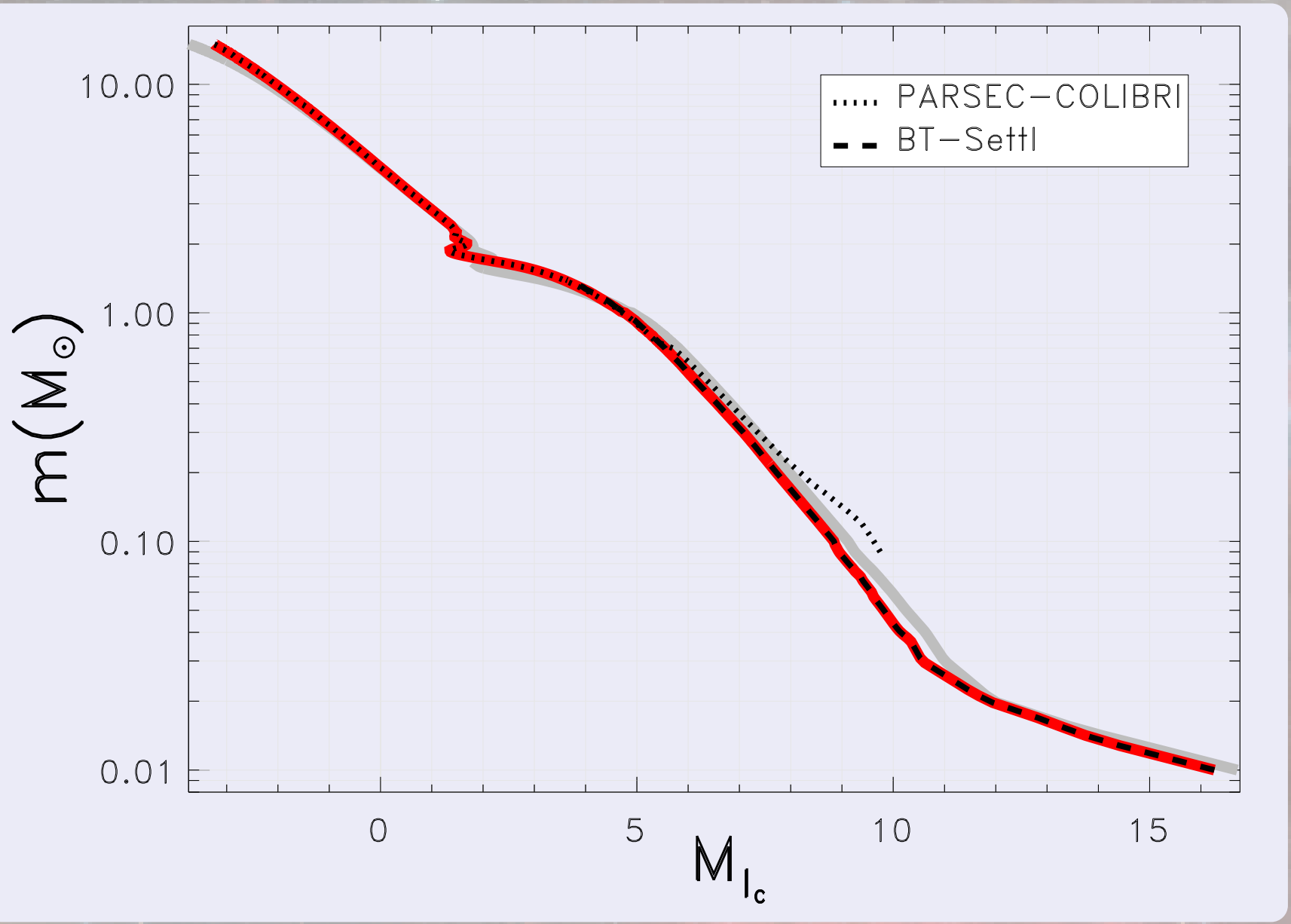




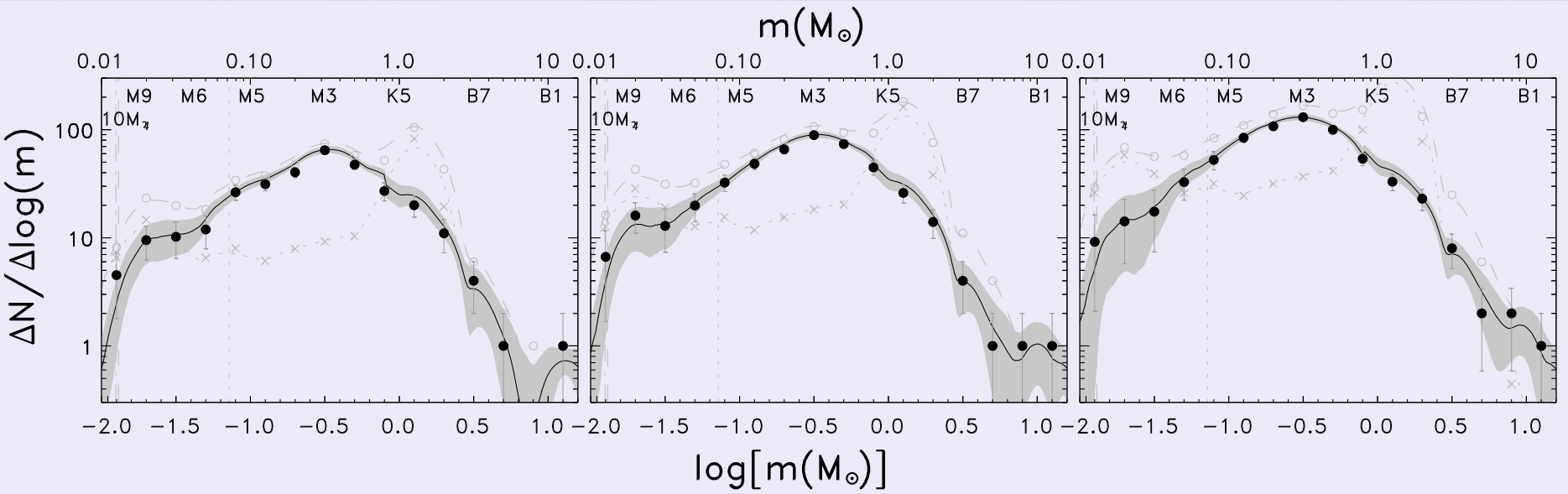


Mass-M_{I_c} Relation



System IMF of 25 Ori

Suárez *et al.* 2019



System IMF complete from 0.012 to 13.1 $M_\odot$

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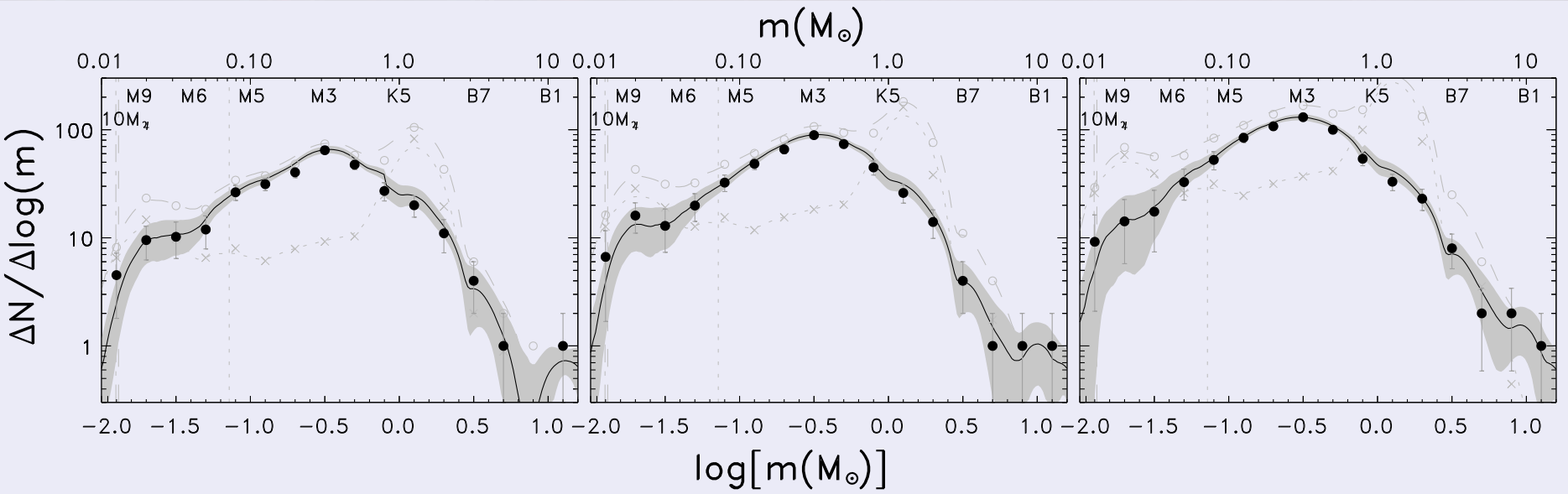

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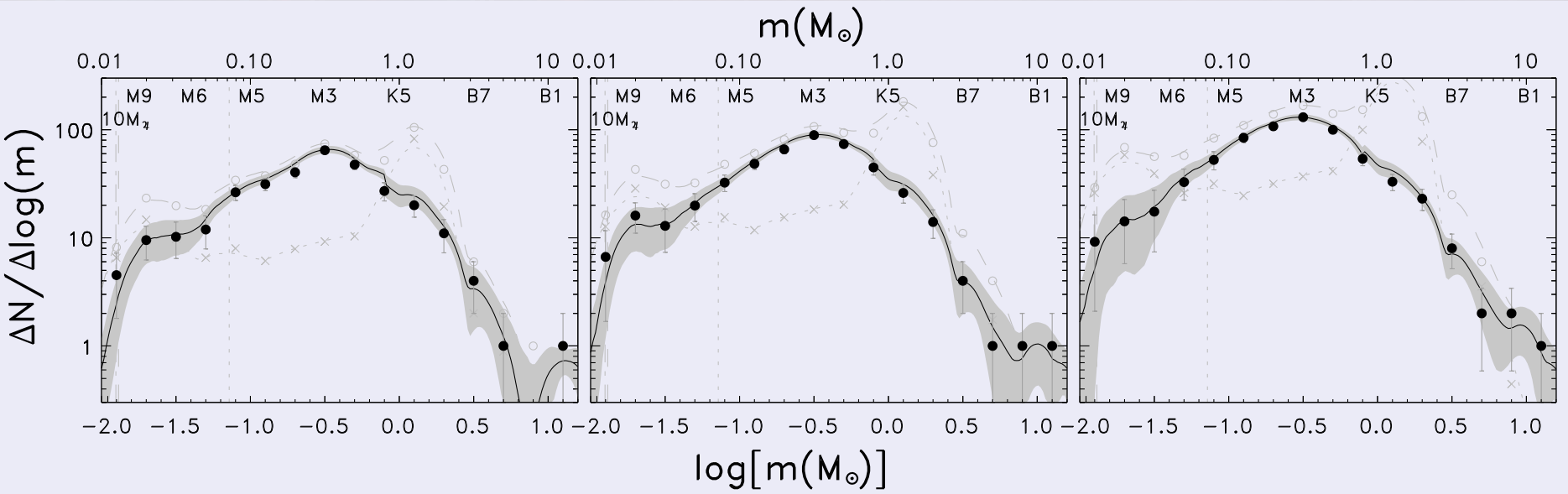

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($0.02 \leq m/M_\odot \leq 10$ and BD-star limit at 0.08 $M_\odot$; Briceño *et al.* 2002)

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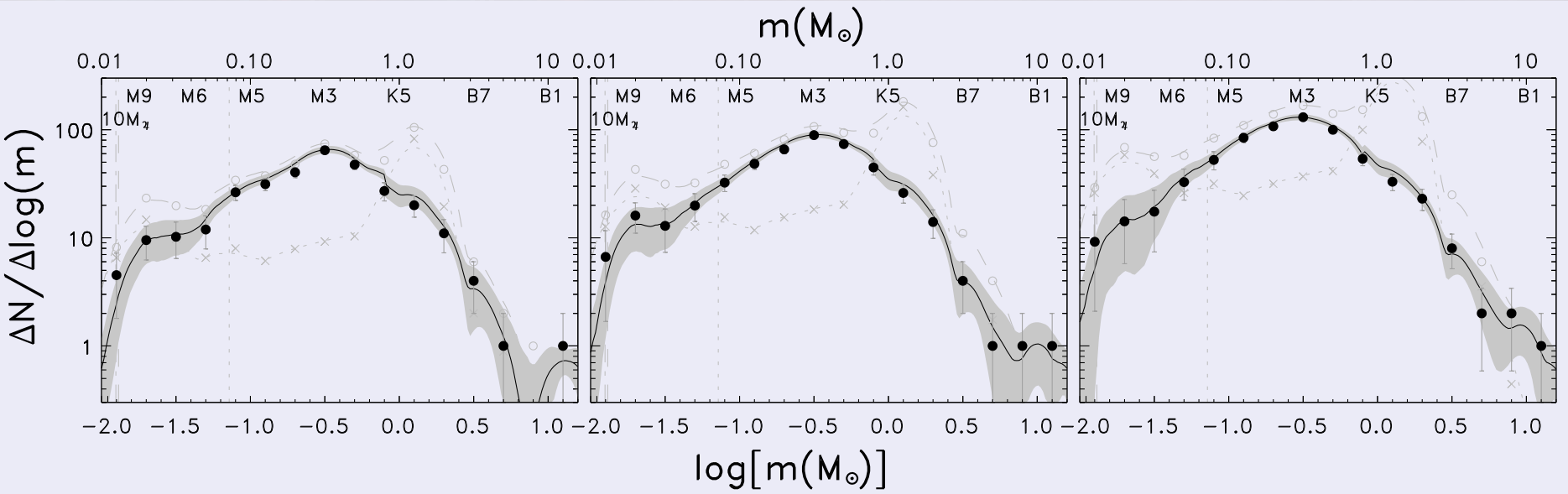

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$R_{ss} = 0.16 \pm 0.03$.

For each 6 stars in 25 Ori we roughly expect 1 BD.

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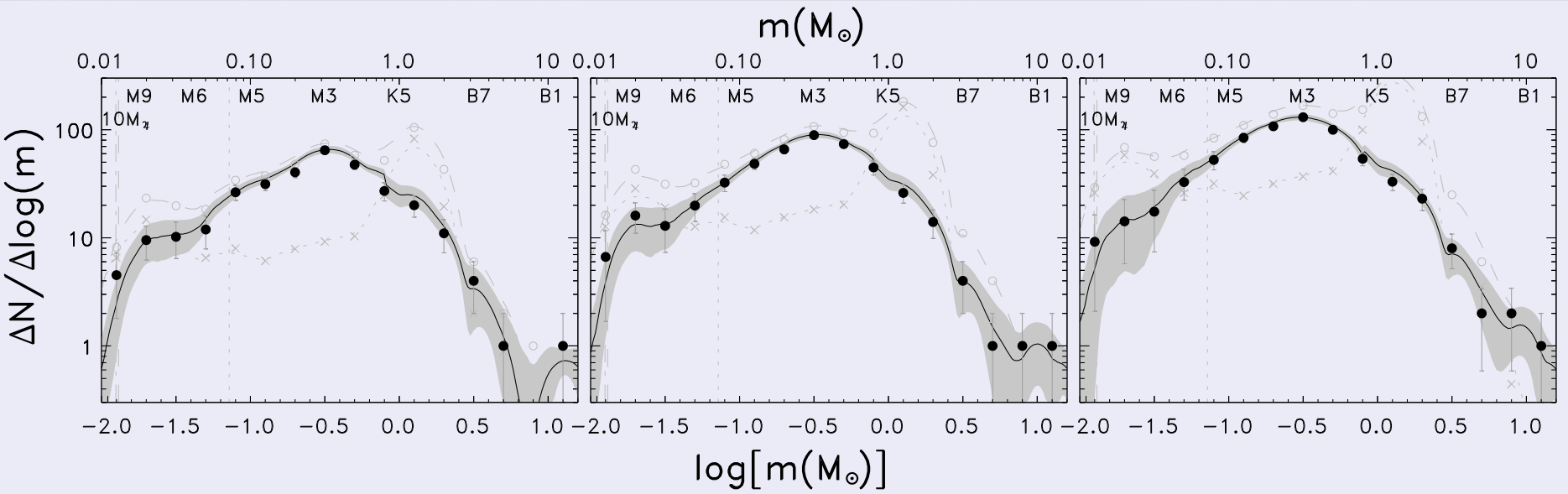

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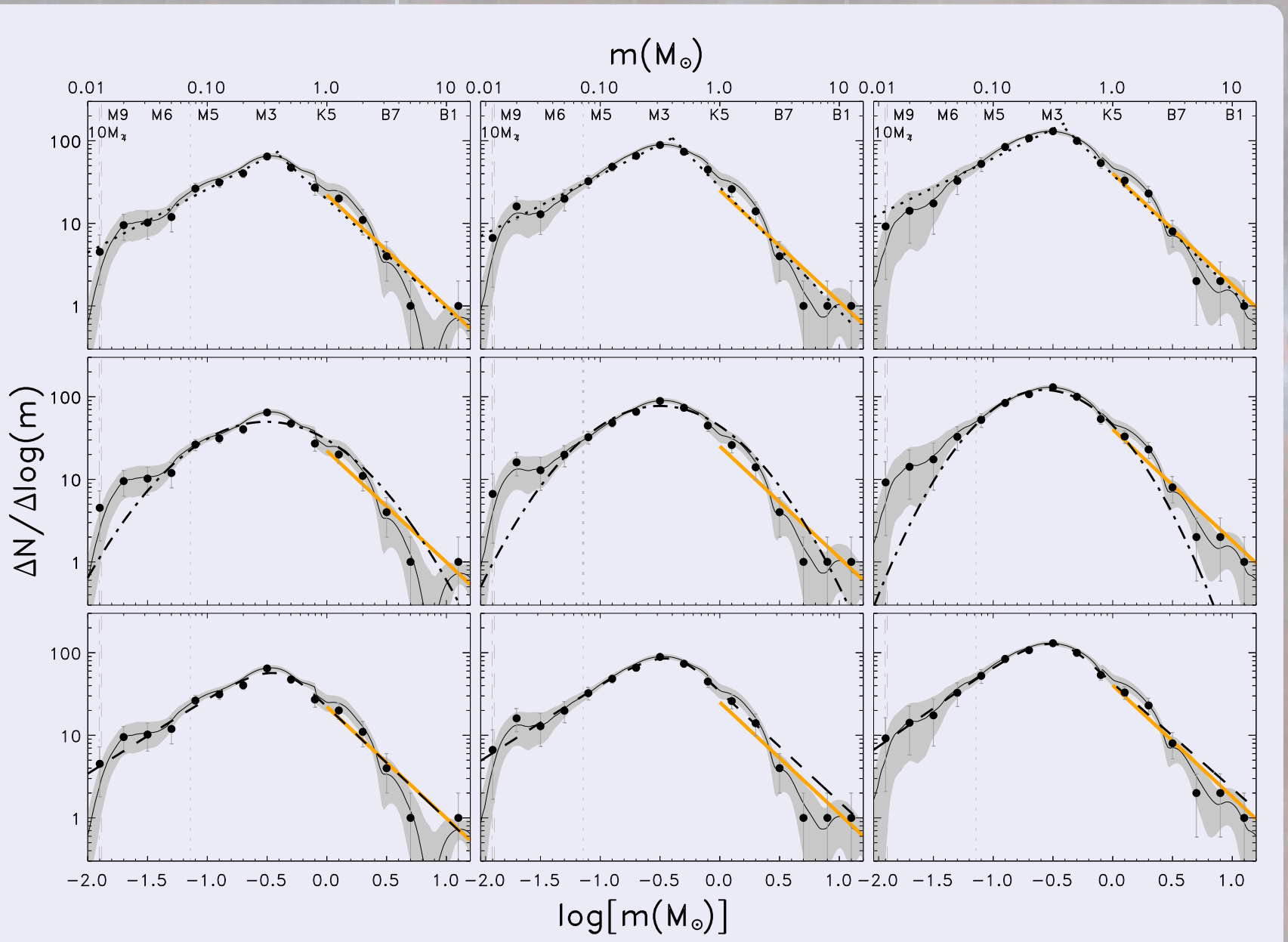

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Area radius ($^\circ$)	Lognormal		Two-Segment Power Law		Tapered Power-Law		
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0.5[a]	0.31±0.06	0.51±0.08	-0.77±0.06	1.33±0.12	1.36±0.39	0.36±0.07	2.27±0.33
0.7[b]	0.32±0.04	0.47±0.06	-0.74±0.04	1.50±0.11	1.34±0.14	0.36±0.03	2.26±0.11
1.0[c]	0.27±0.02	0.41±0.03	-0.71±0.07	1.40±0.09	1.28±0.07	0.30±0.02	2.28±0.07

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25 Ori Dynamics

Suárez *et al.* 2019

Relaxation time:

Considering $N \approx 700$ members, $r_{hm} \approx 3$ pc and $\sigma_{RV} \approx 2$ km/s.

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Conclusions

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This system IMF do not present significant variations within a radius of about 7 pc, which indicates that the substellar and stellar objects in 25 Ori do not have any preferential spatial distribution

No significant differences were found with other stellar groups with a diversity of physical conditions, which supports the idea that the star formation process is largely insensitive to the enviromental conditions.

We estimated that for each 6 stars in 25 Ori we can roughly expect one BD.

We found that 25 Ori is a dynamically young group and confirmed that it is a gravitationally unbound association that will be part of the Galactic Disk population.

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