

# The stellar Initial Mass Function (IMF)

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**Kroupa Pavel (Universität Bonn, Charles University in Prague)**

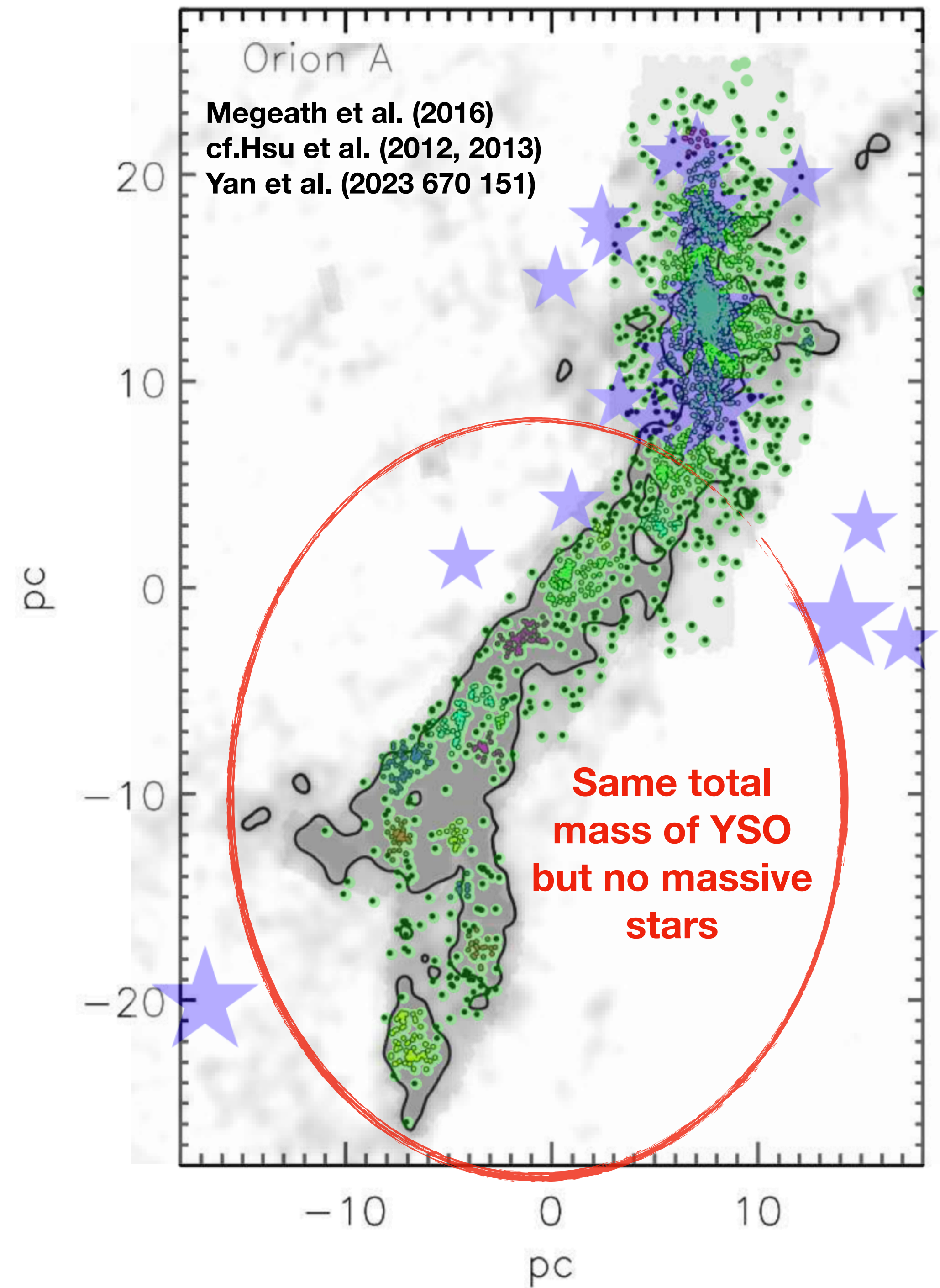
**Jerabkova Tereza (ESO), Li Jiadong 李佳东 (MPIA)**

**18.9.2024**











**Measure the stellar  
Initial Mass Function (IMF)**



**1**

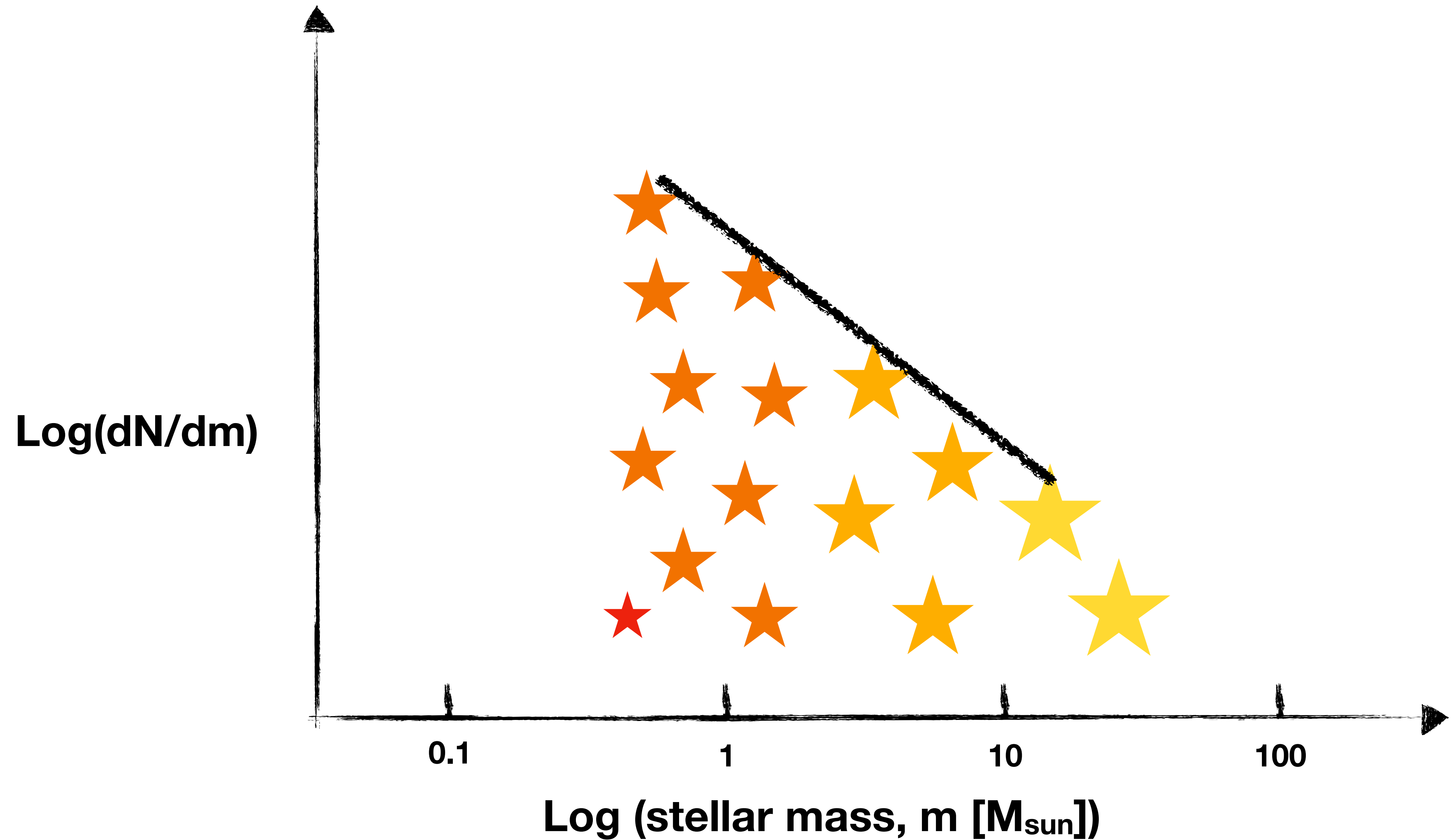
**Measure the stellar  
Initial Mass Function (IMF)  
by Counting Stars**





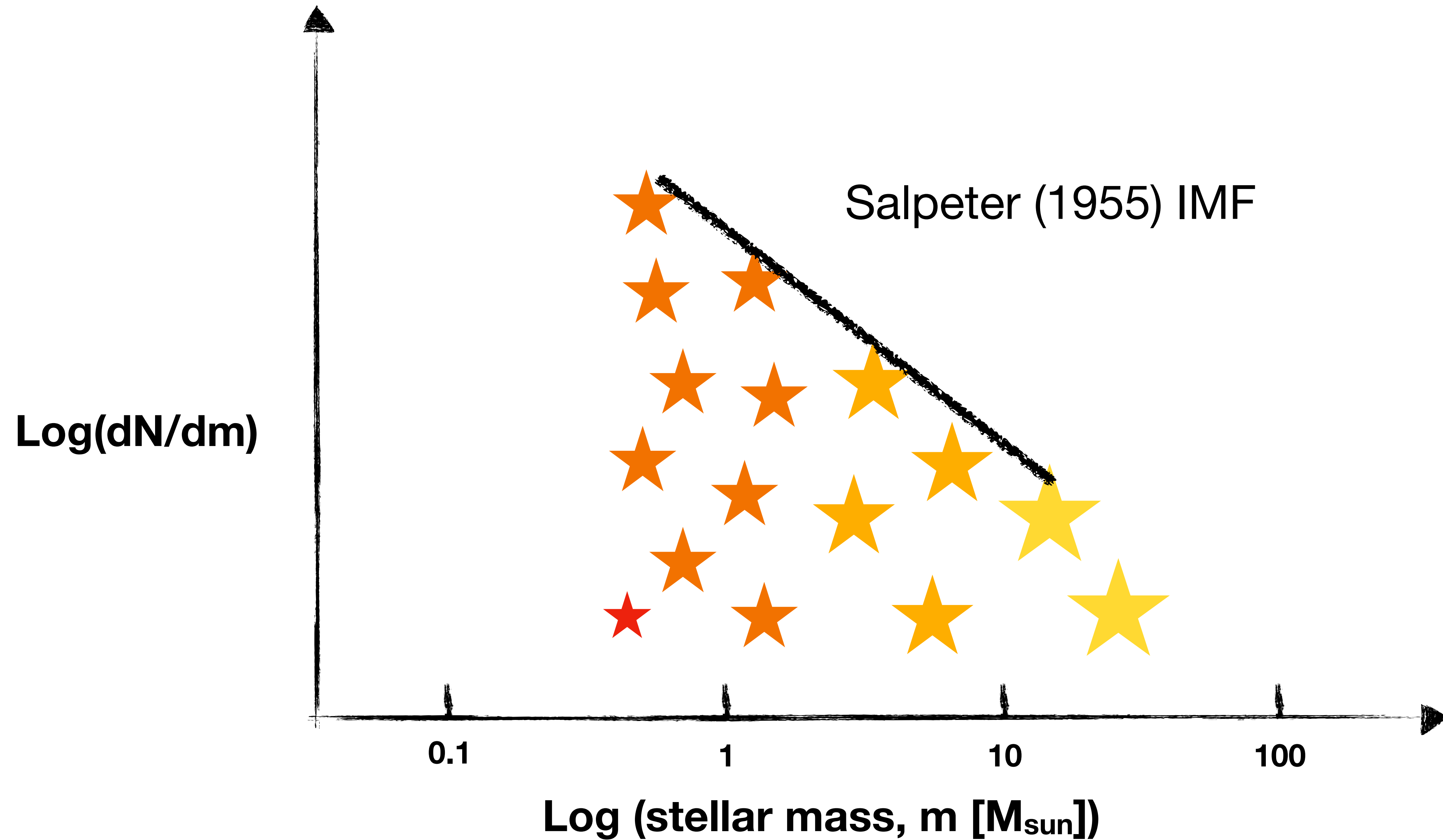


# Stellar Initial Mass Function (IMF)



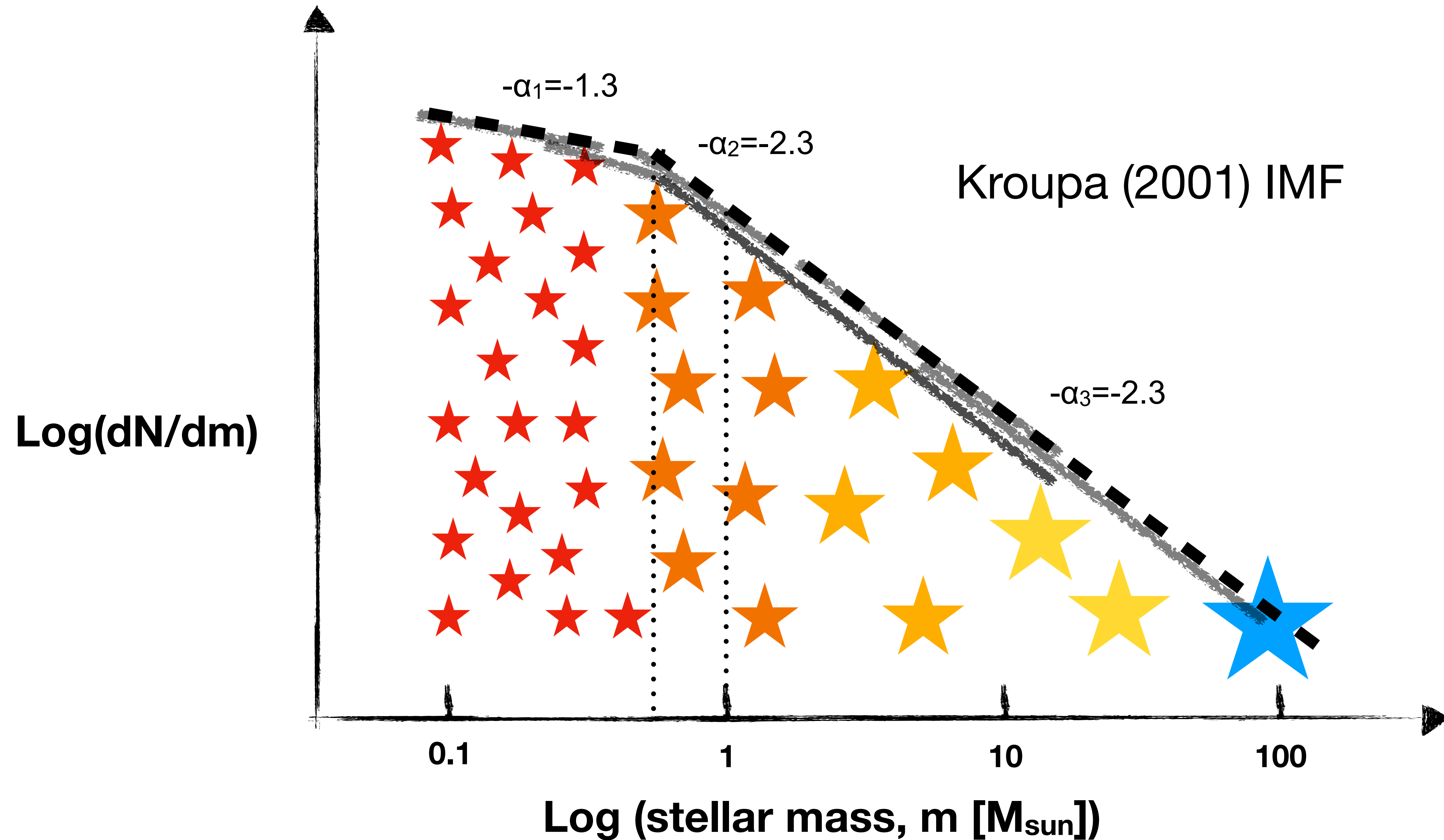


# Stellar Initial Mass Function (IMF)



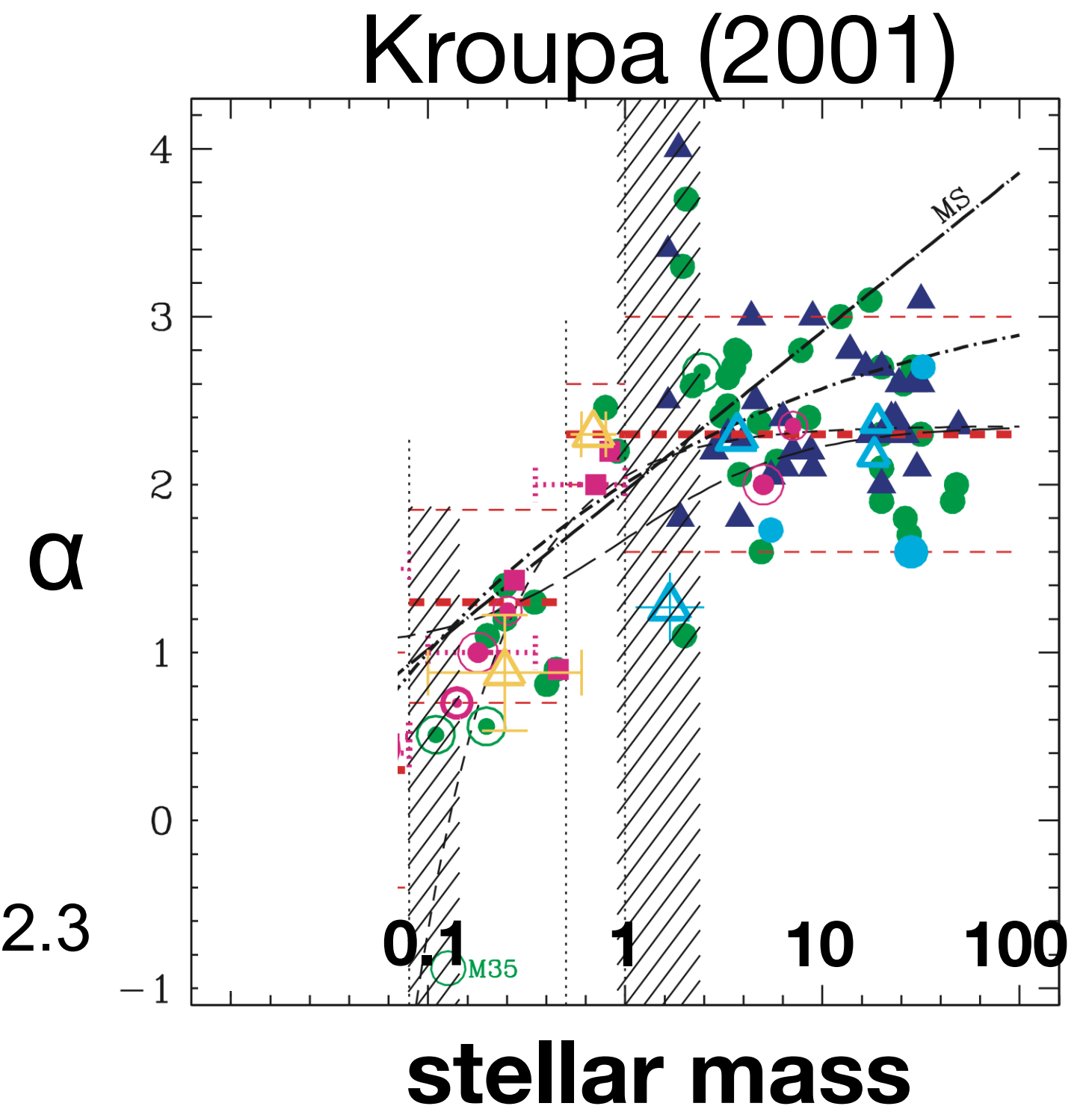
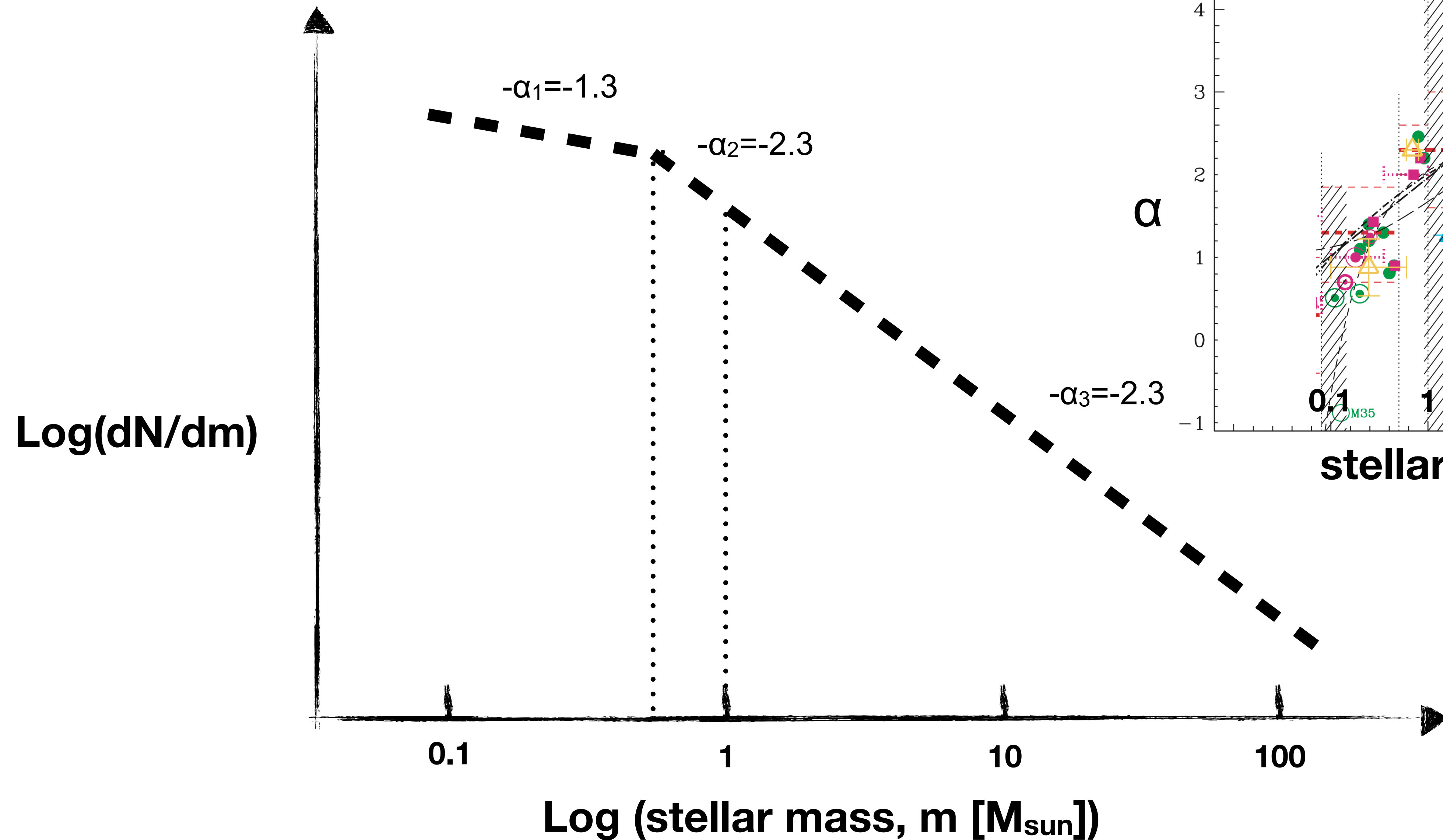


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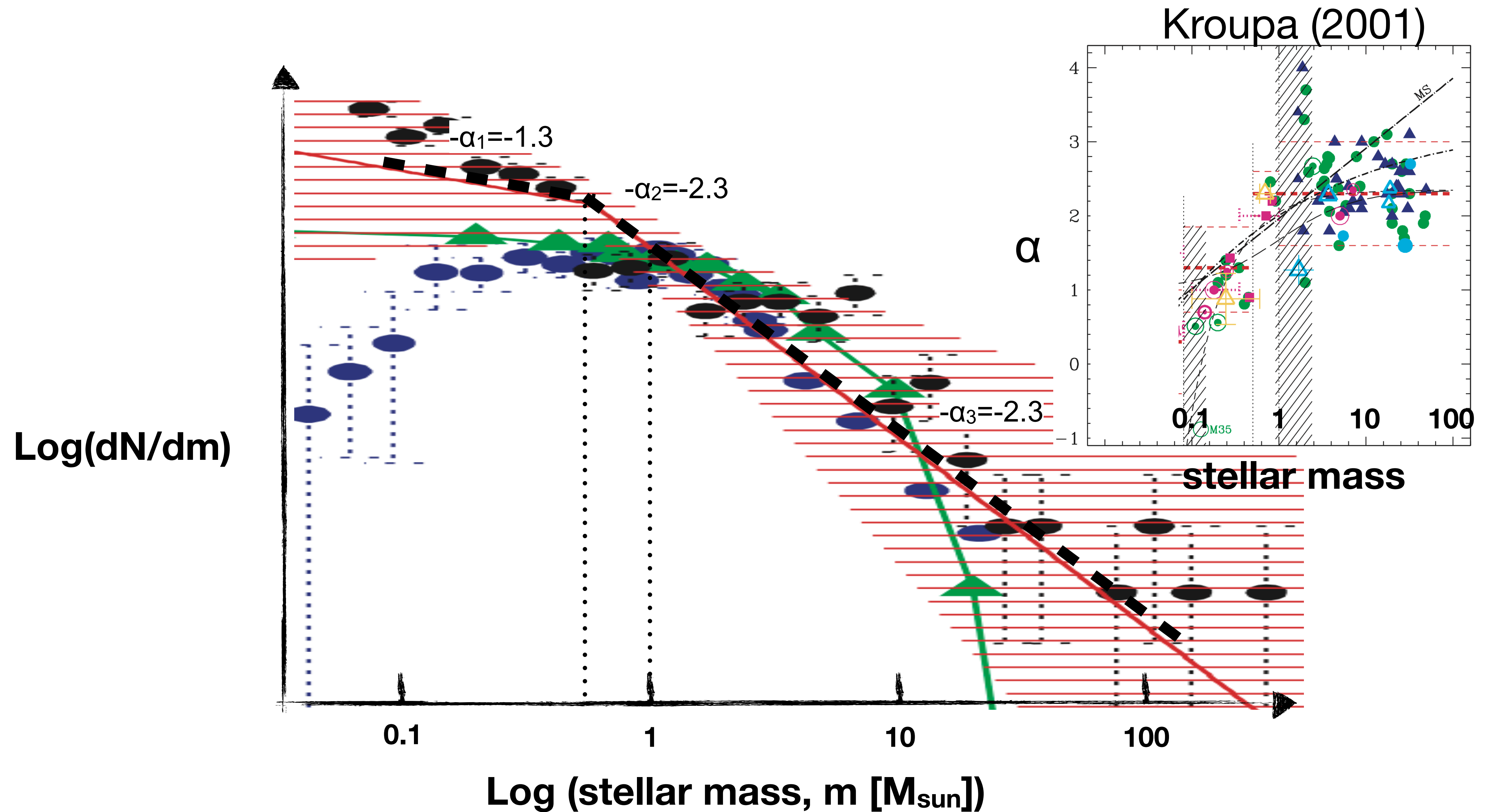


# Stellar Initial Mass Function (IMF)

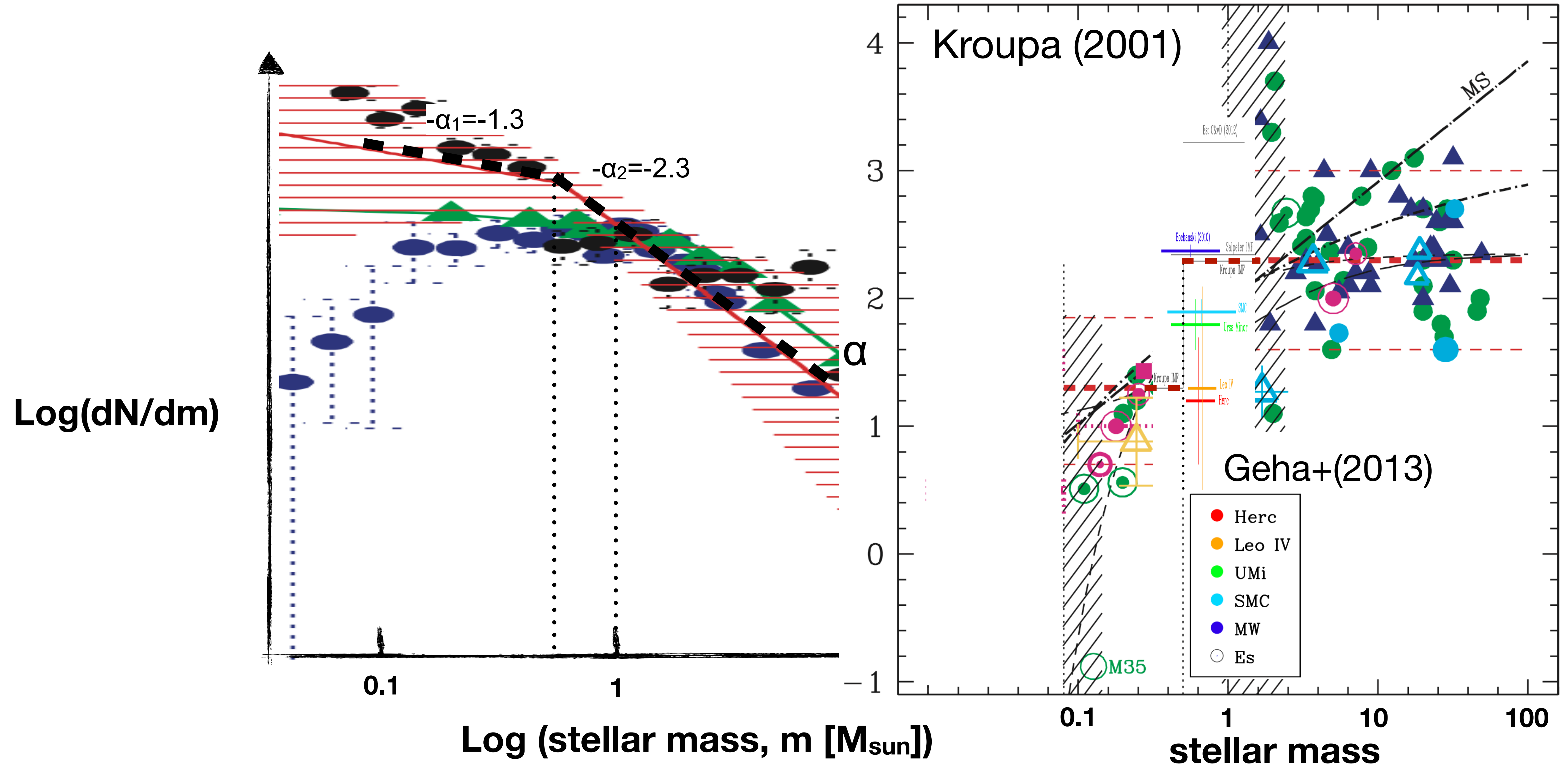




# Stellar Initial Mass Function (IMF) for low-mass stars



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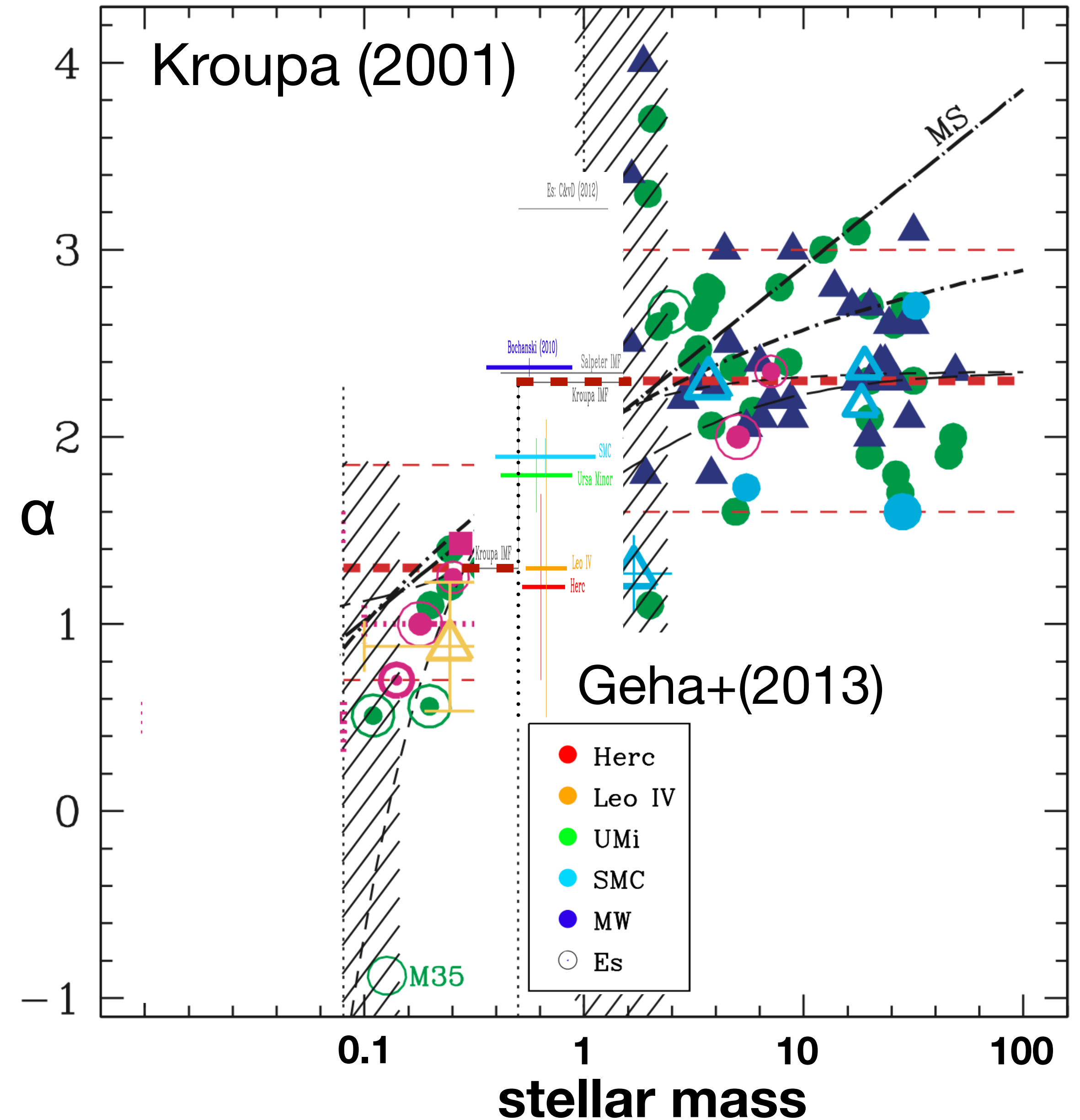
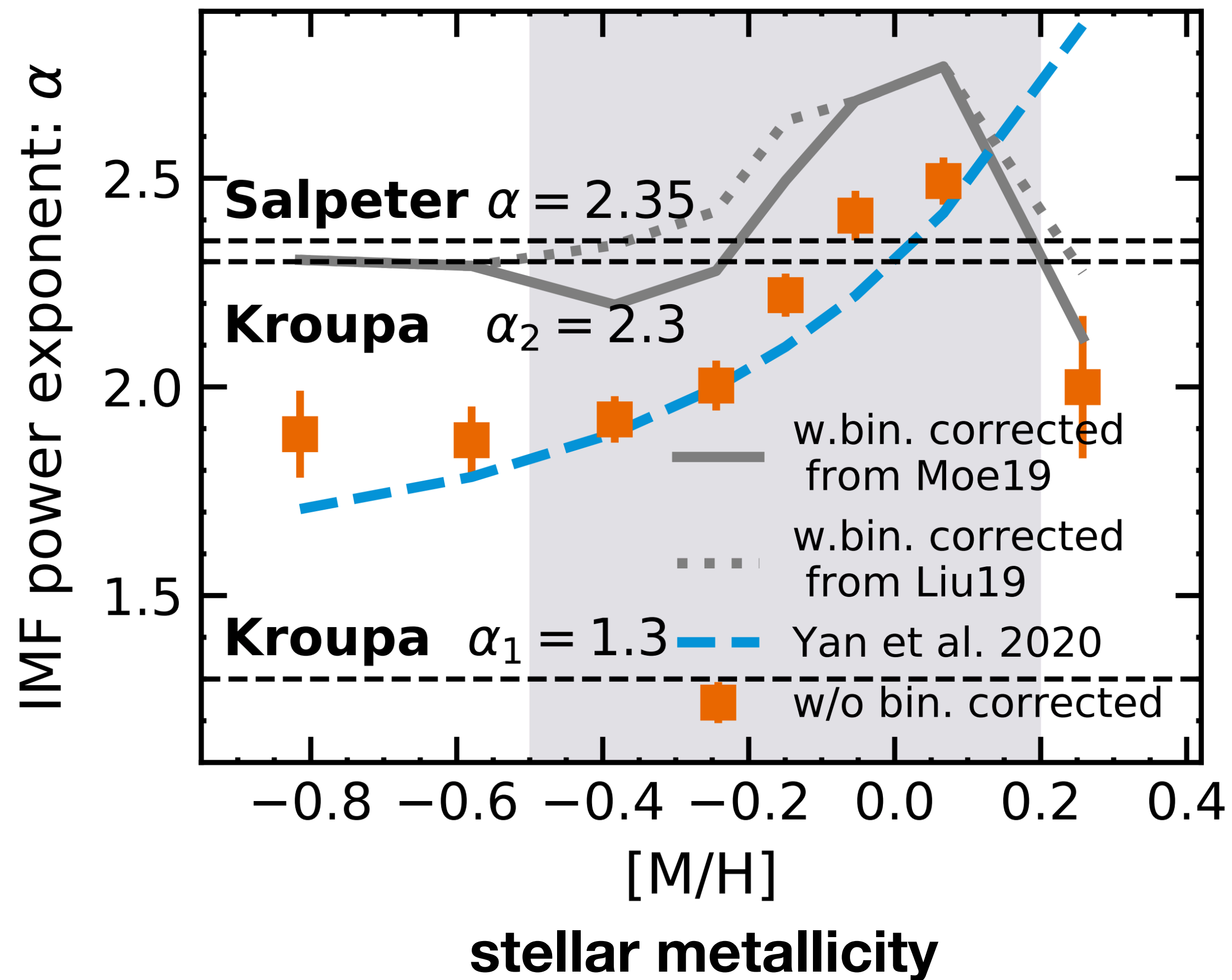




# Stellar Initial Mass Function (IMF) for low-mass stars

Li+ (2023 Nature 613 460)

LAMOST telescope



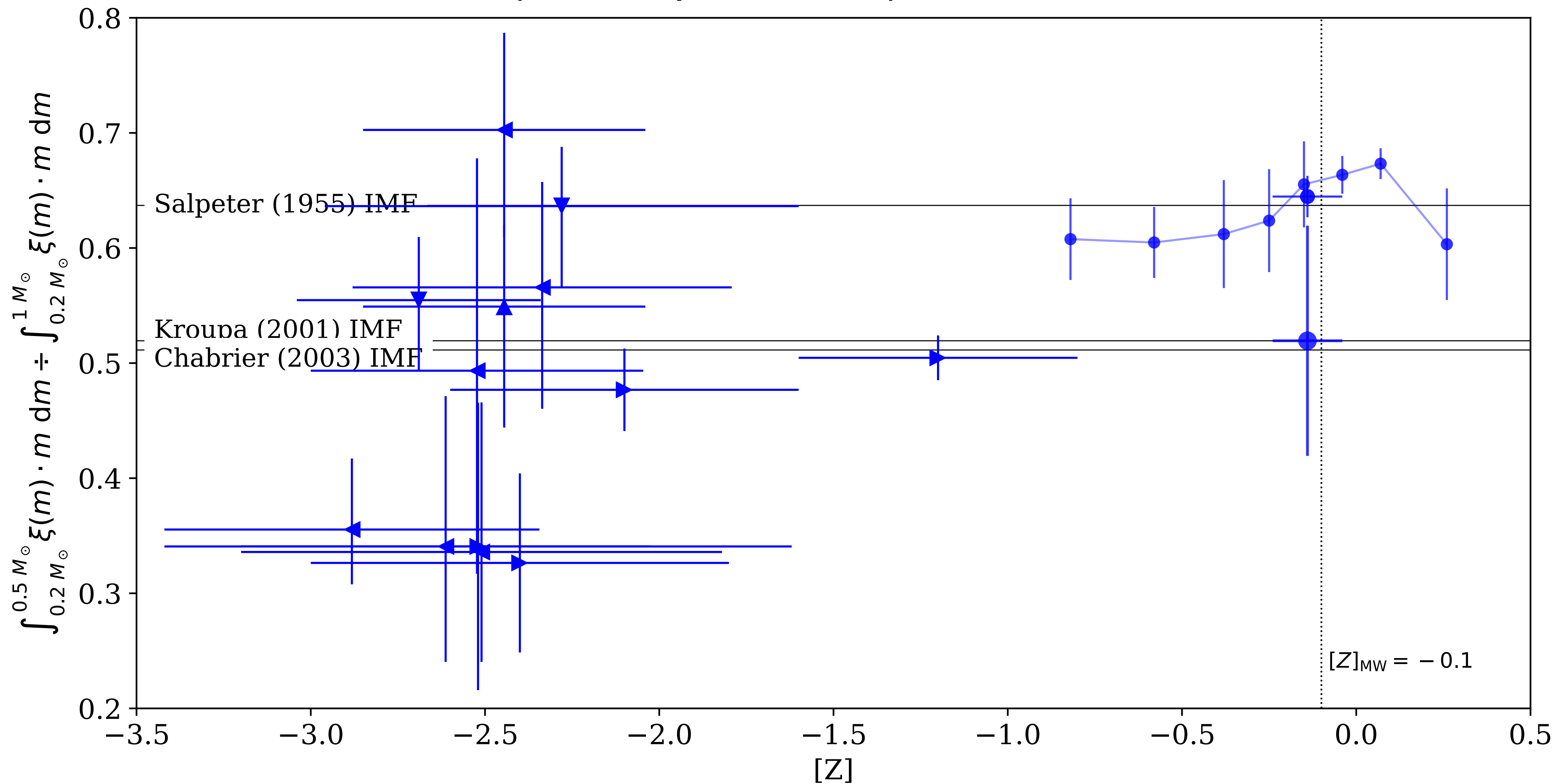
# Stellar Initial Mass Function (IMF) for low-mass stars

Yan+ (2024 ApJ 969 95)

“Bottom-heavy”

↑  
A unified  
IMF slope  
indicator for  
low-mass  
stars  
↓

“Bottom-light”



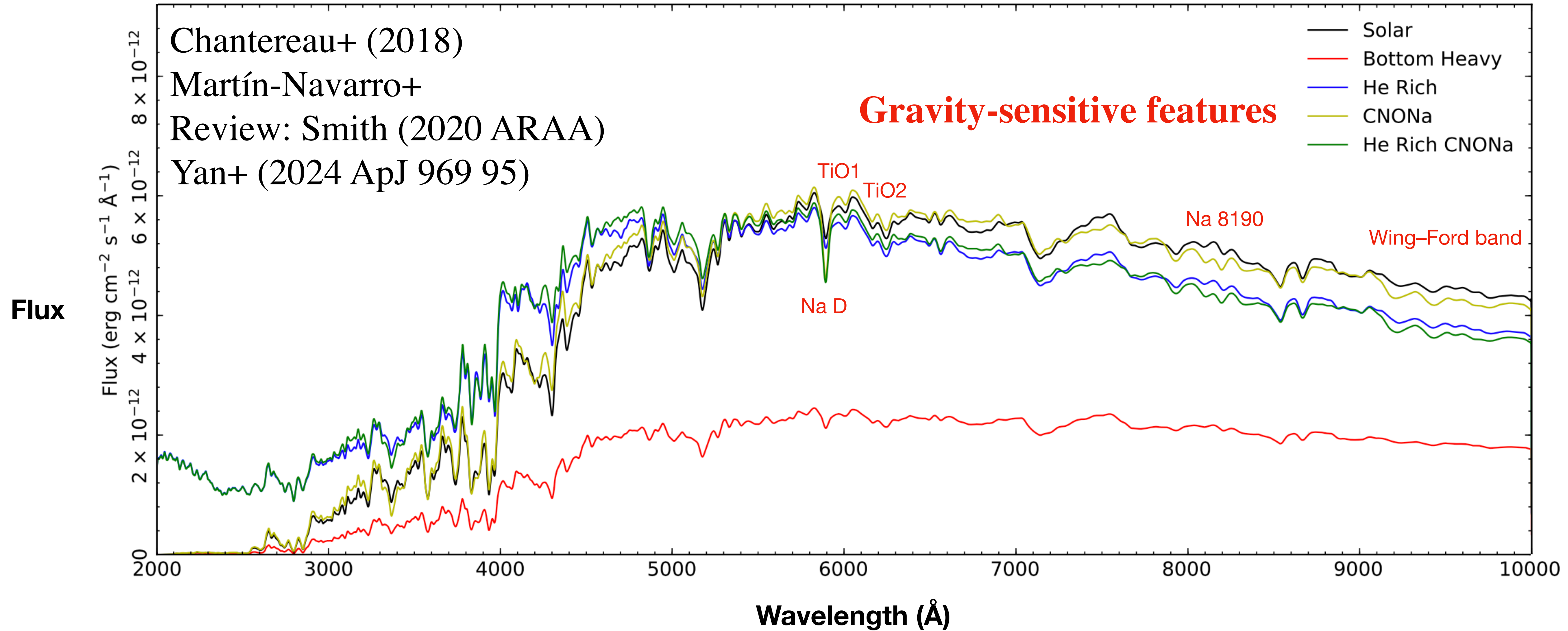


# 2

## **Measure the stellar IMF by analysing spectra (Stellar Population Synthesis)**

Photometry, number of X-ray binaries, supernova rates,  
gravitational wave and micro-lensing events, neutrinos

# Stellar Initial Mass Function (IMF) for low-mass stars





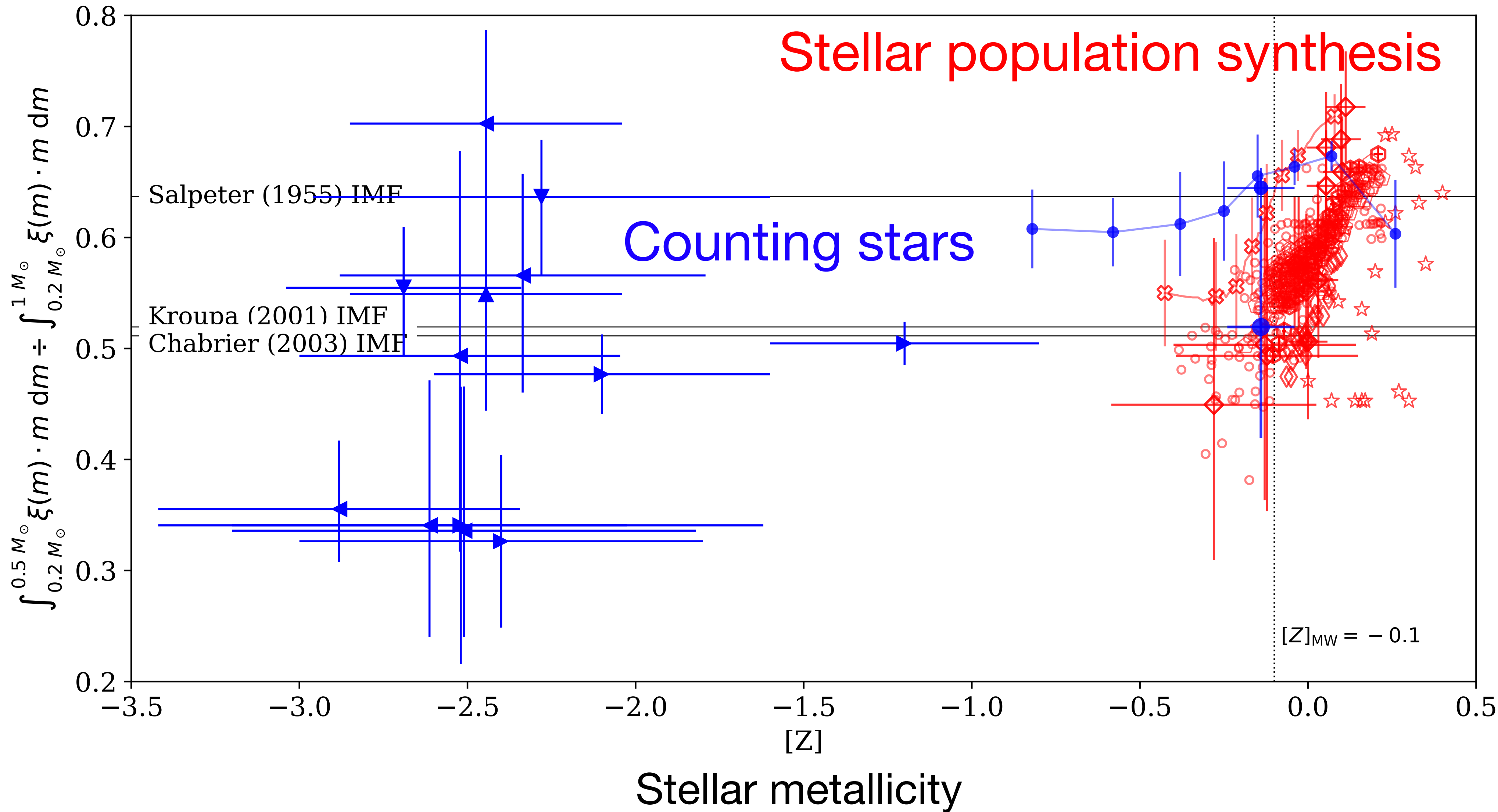
# Stellar Initial Mass Function (IMF) for low-mass stars

Yan+ (2024 ApJ 969 95)

“Bottom-heavy”

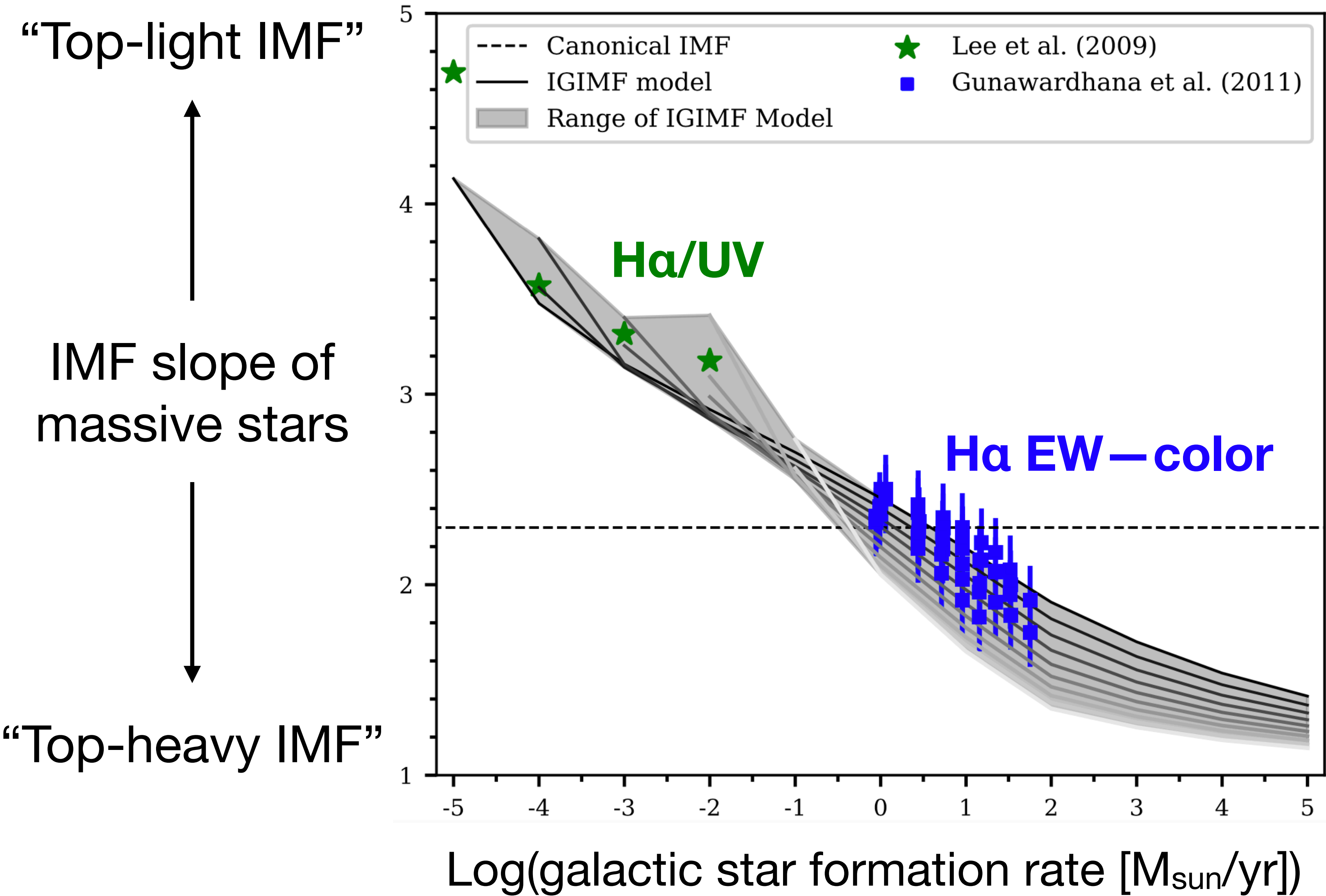
A unified  
IMF slope  
indicator for  
low-mass  
stars

“Bottom-light”



# Stellar Initial Mass Function (IMF) for high-mass stars

Yan, Jerabkova, Kroupa (2017)

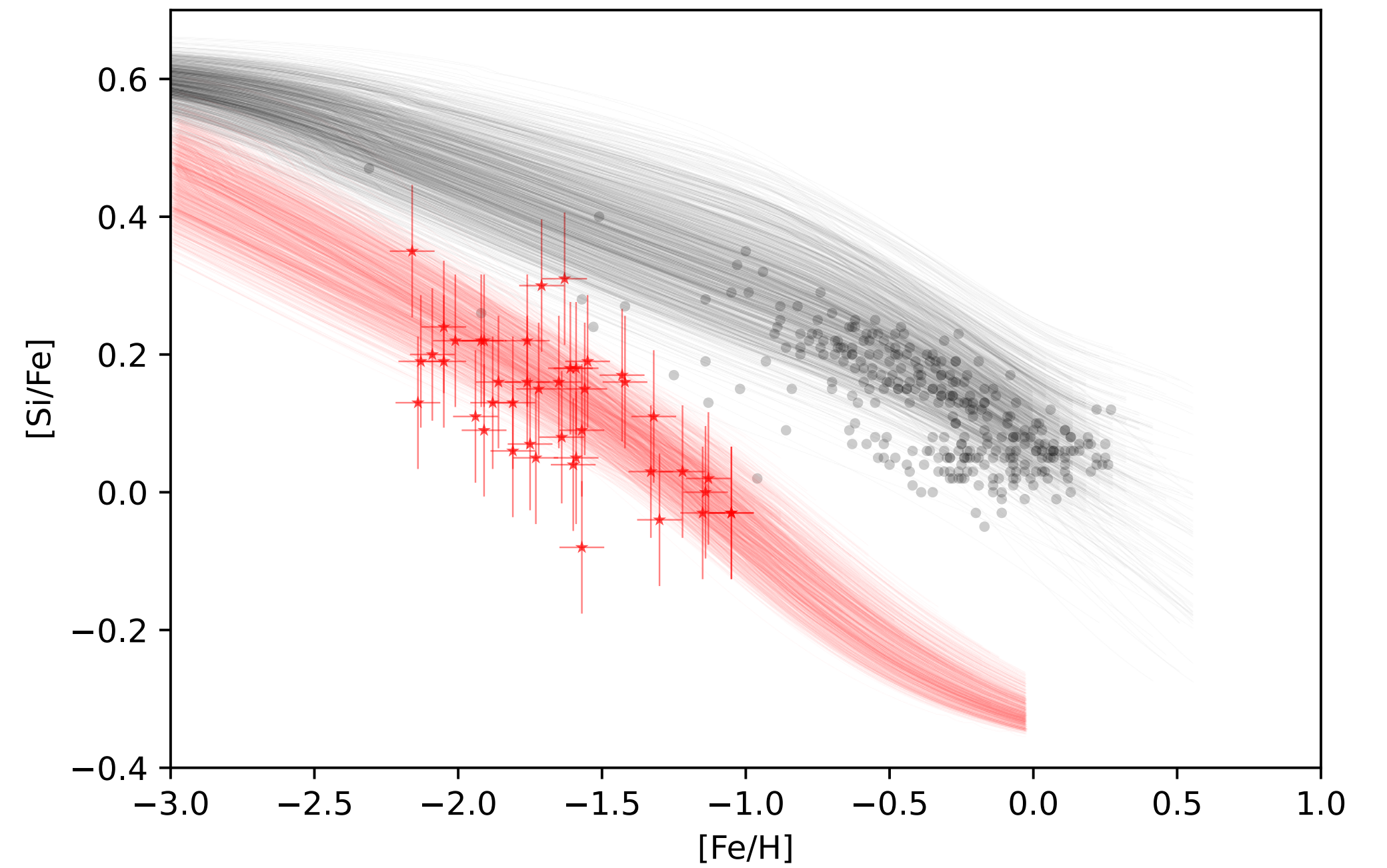
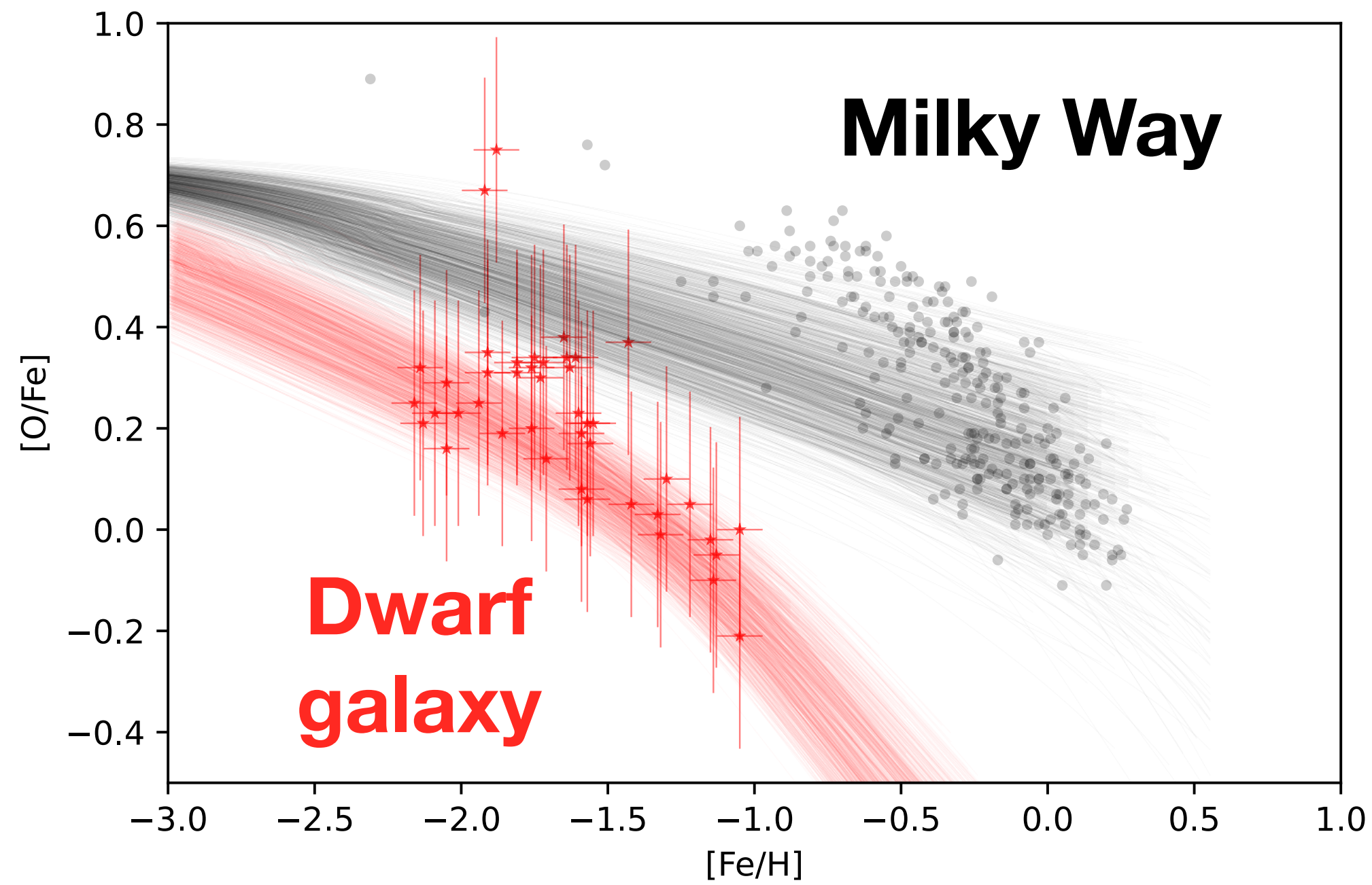




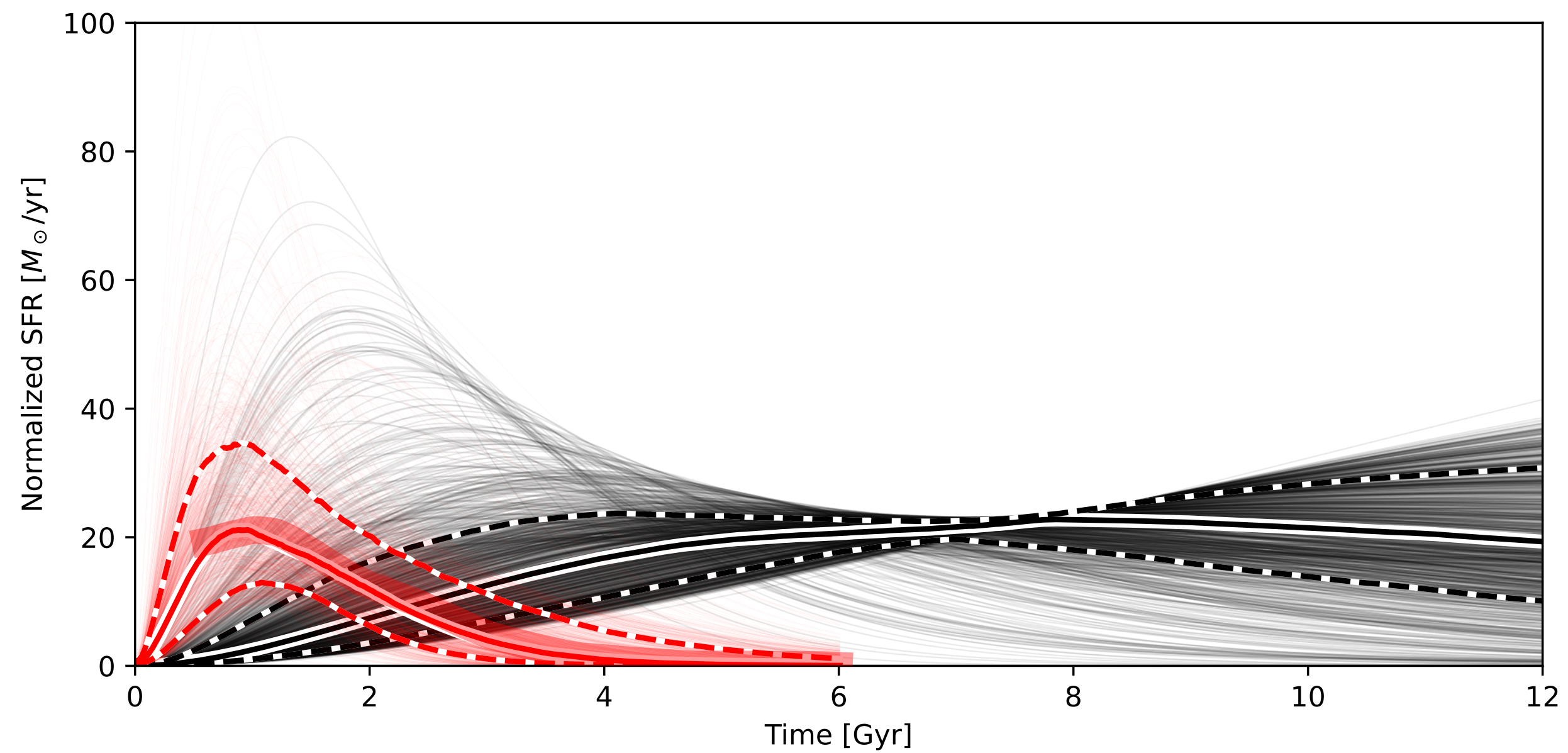
# 3

**Measure the stellar IMF  
by analysing element  
enrichment history  
(Galaxy Chemical Evolution)**

# Galaxy Chemical Evolution for dwarf galaxies



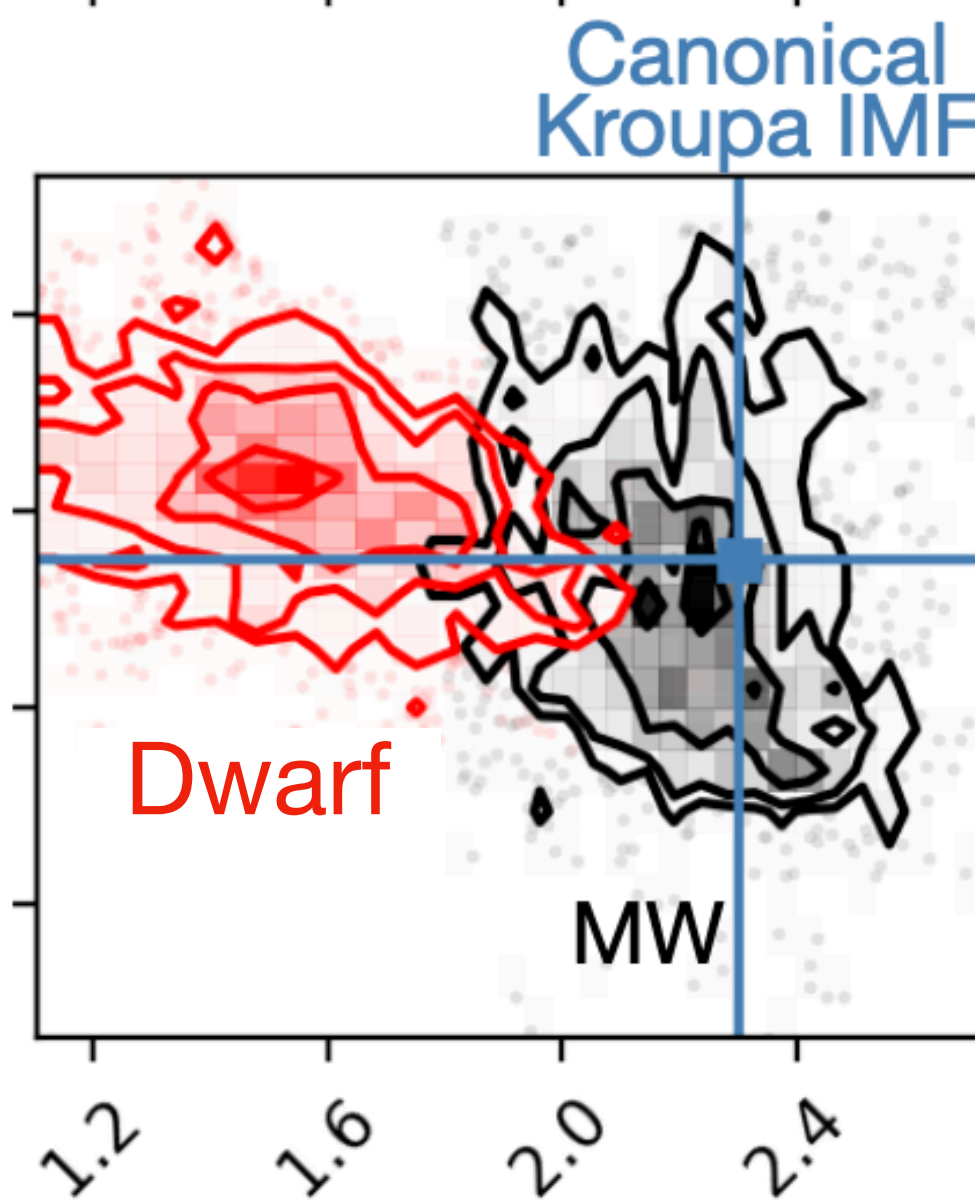
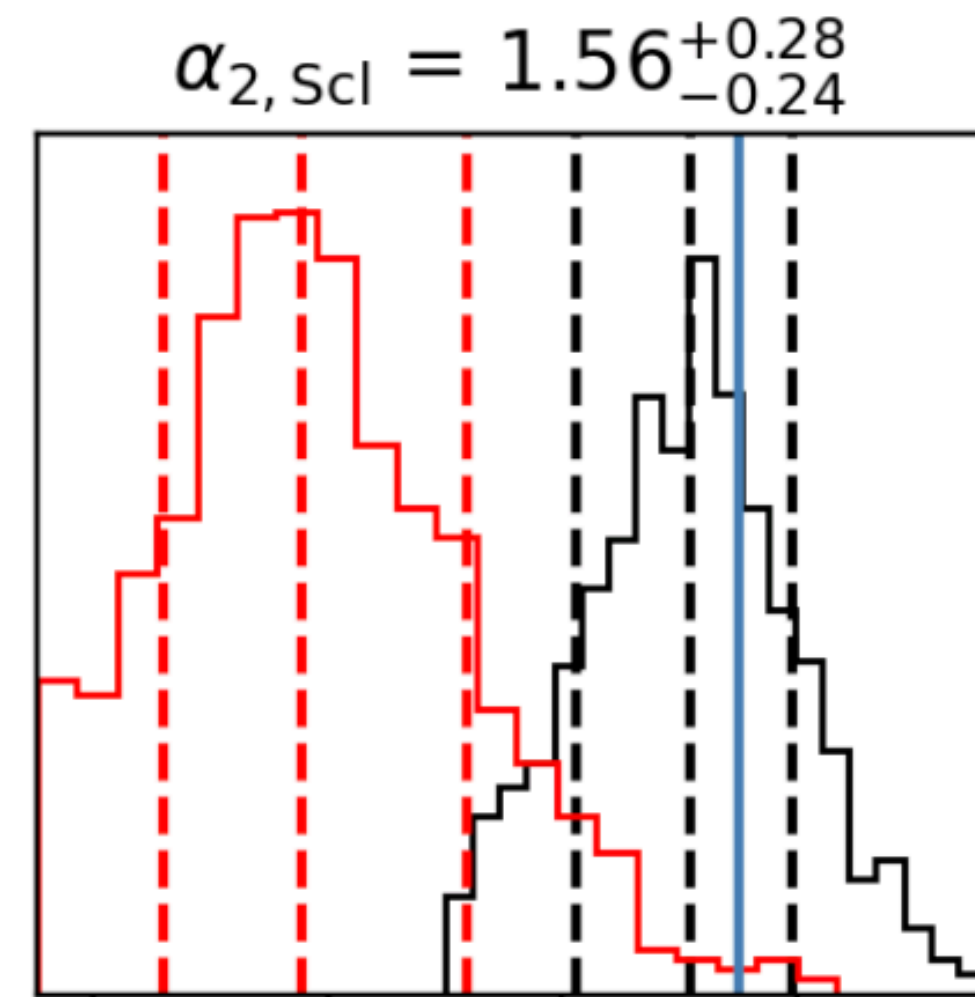
**Rescaled  
SFR**



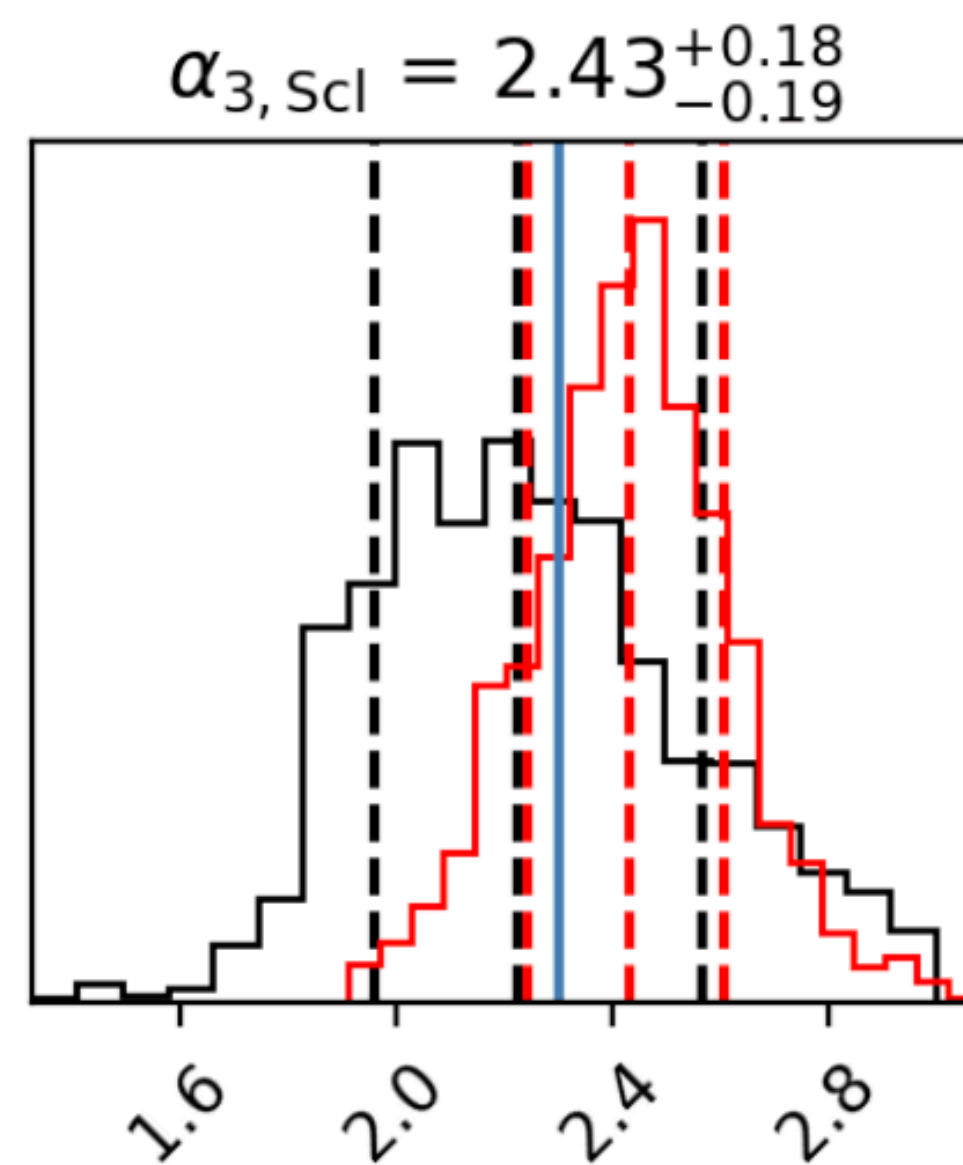
**Galaxy age**



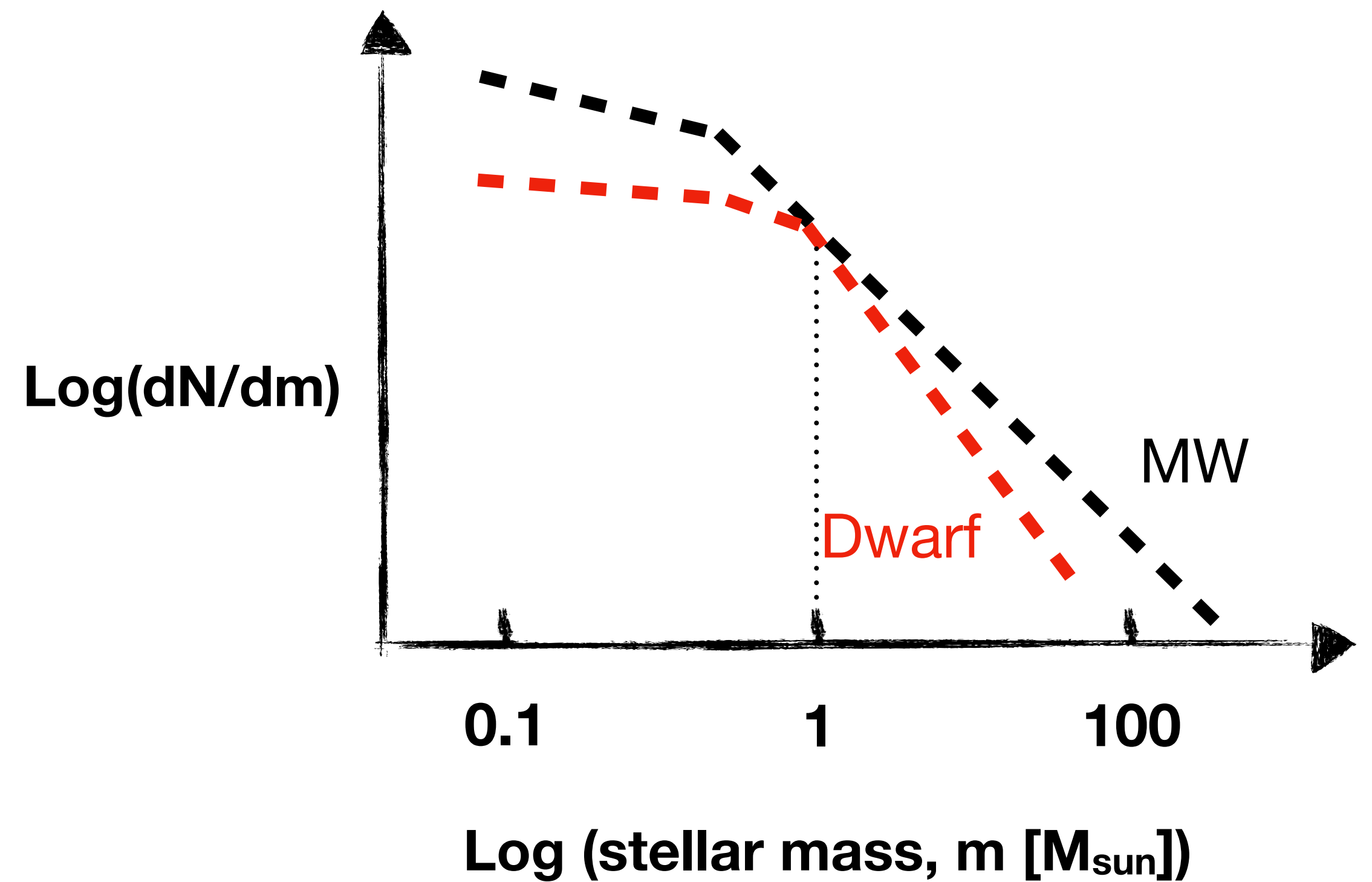
# Galaxy Chemical Evolution for dwarf galaxies



low-mass IMF slope

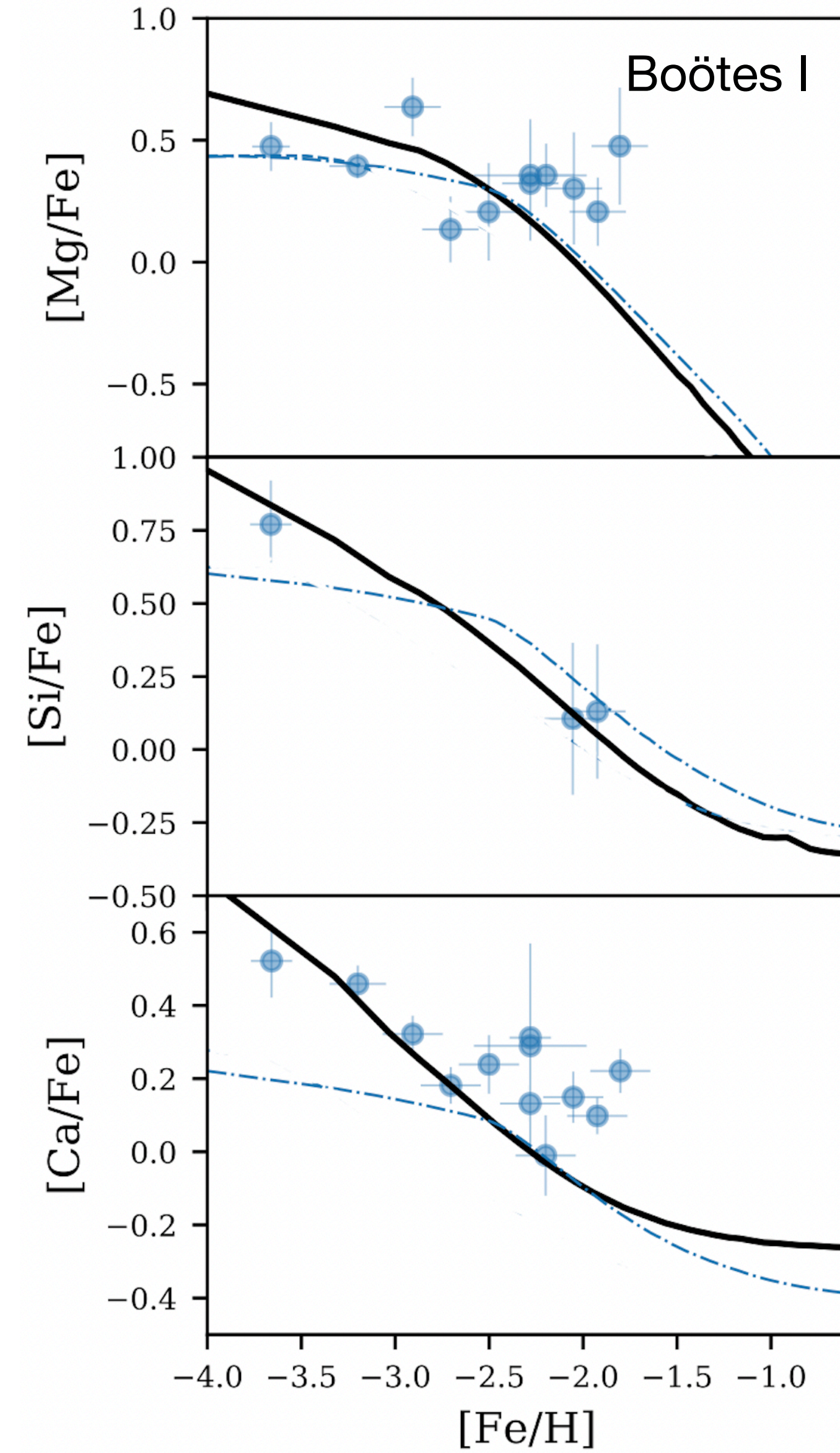


high-mass IMF slope

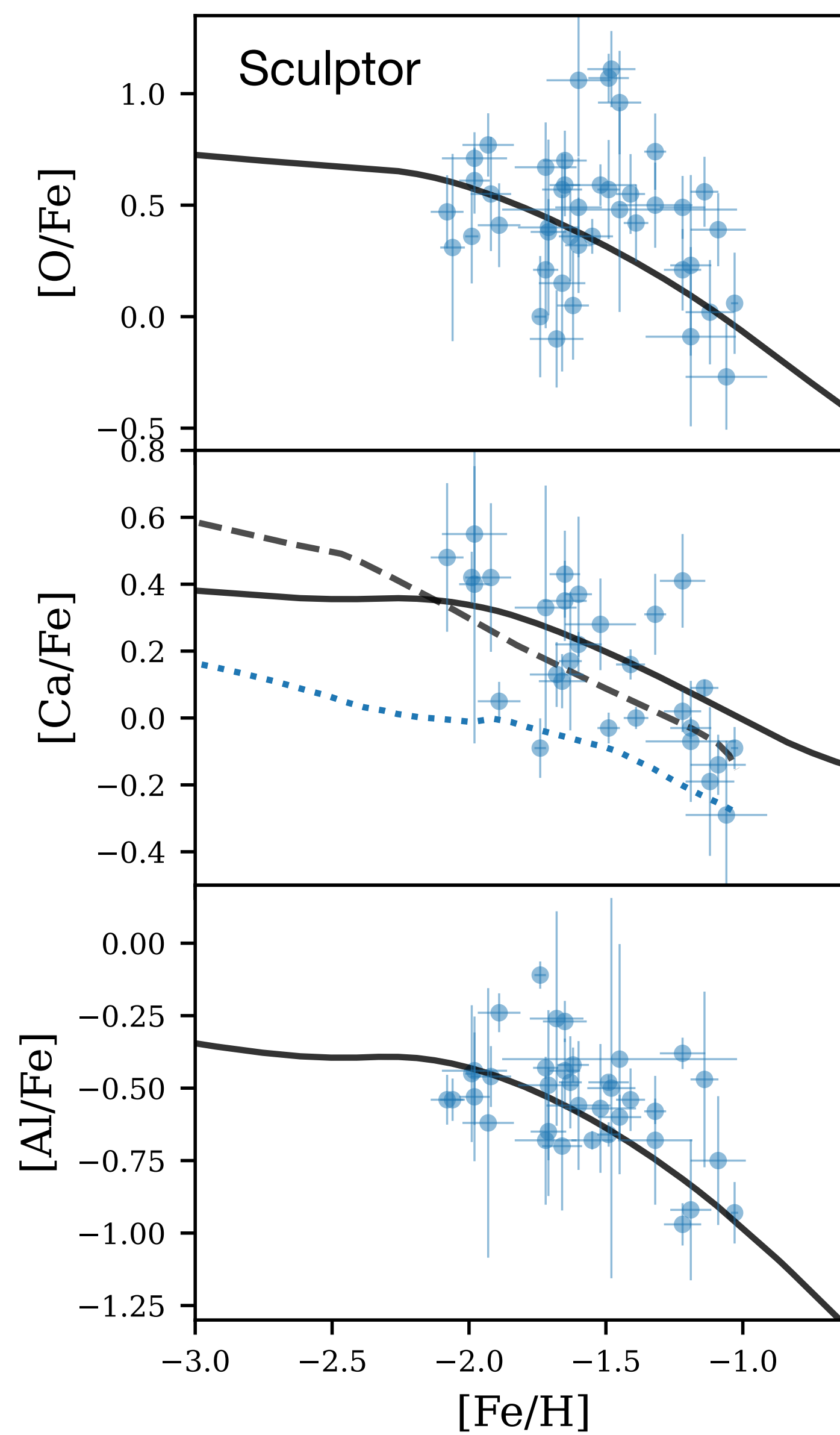


# Galaxy Chemical Evolution for dwarf galaxies

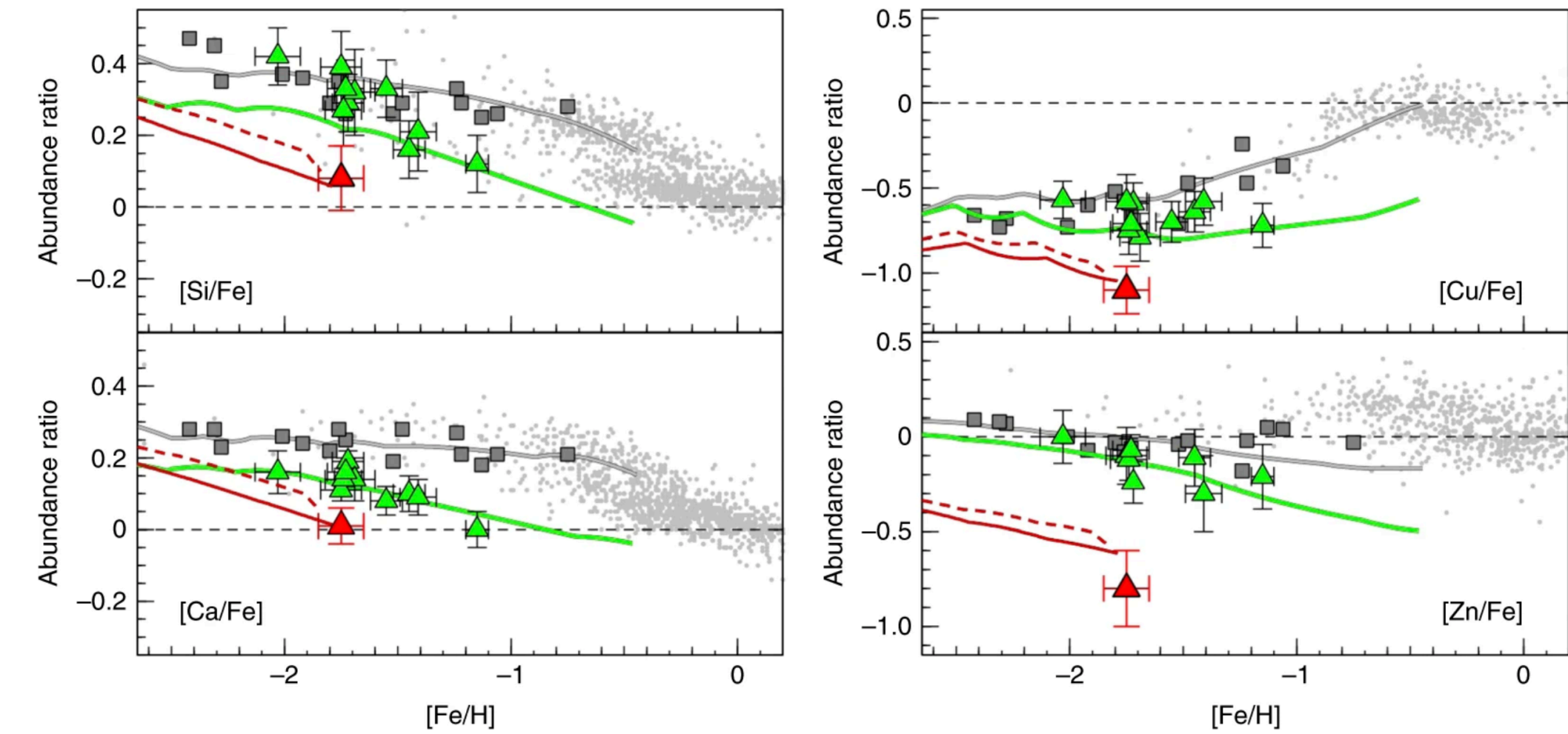
Yan, Jerabkova, & Kroupa (2020)



Tang...Yan+(2023)



Mucciarelli+ (2021)





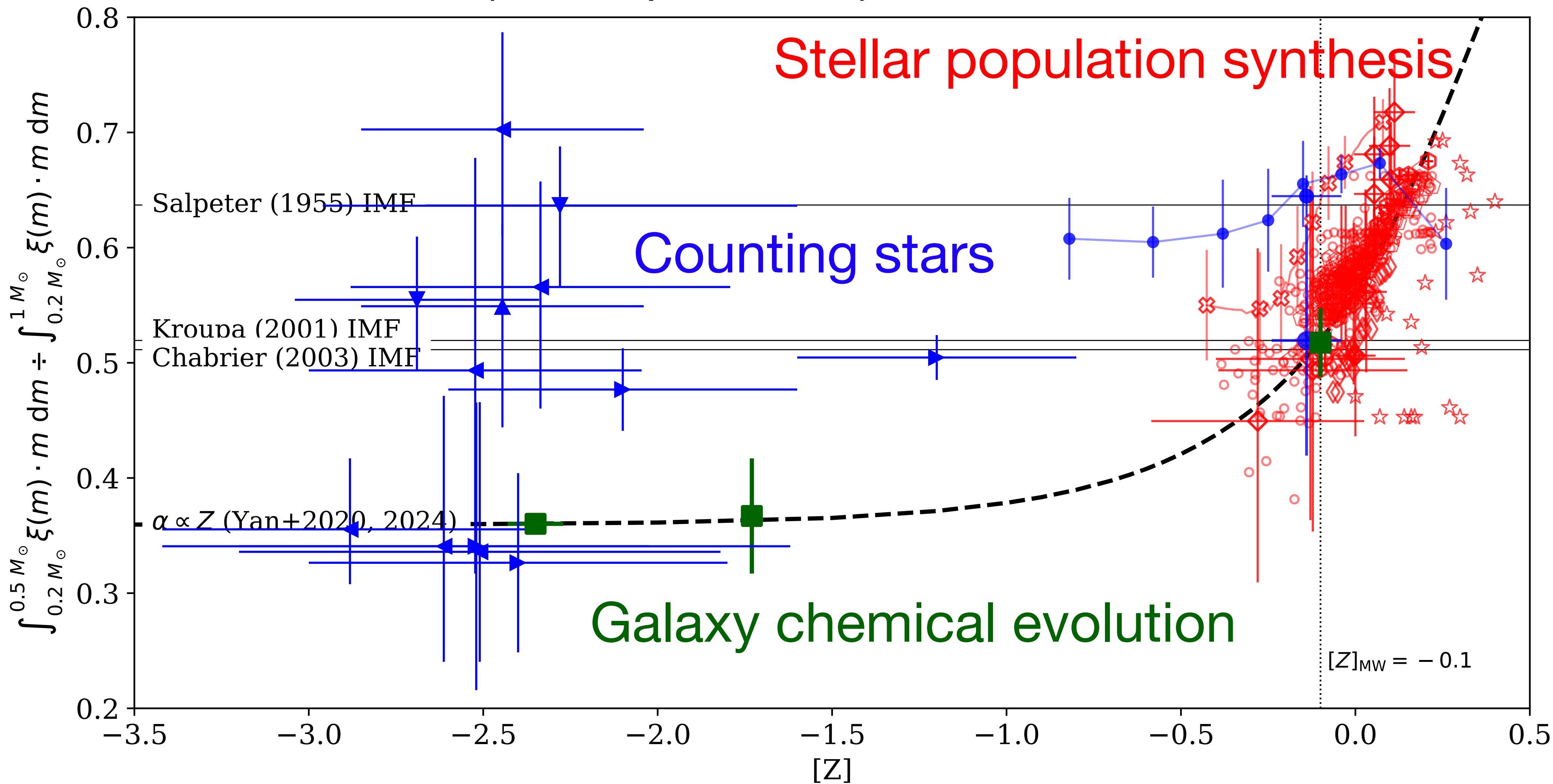
# Stellar Initial Mass Function (IMF) for low-mass stars

Yan+ (2024 ApJ 969 95)

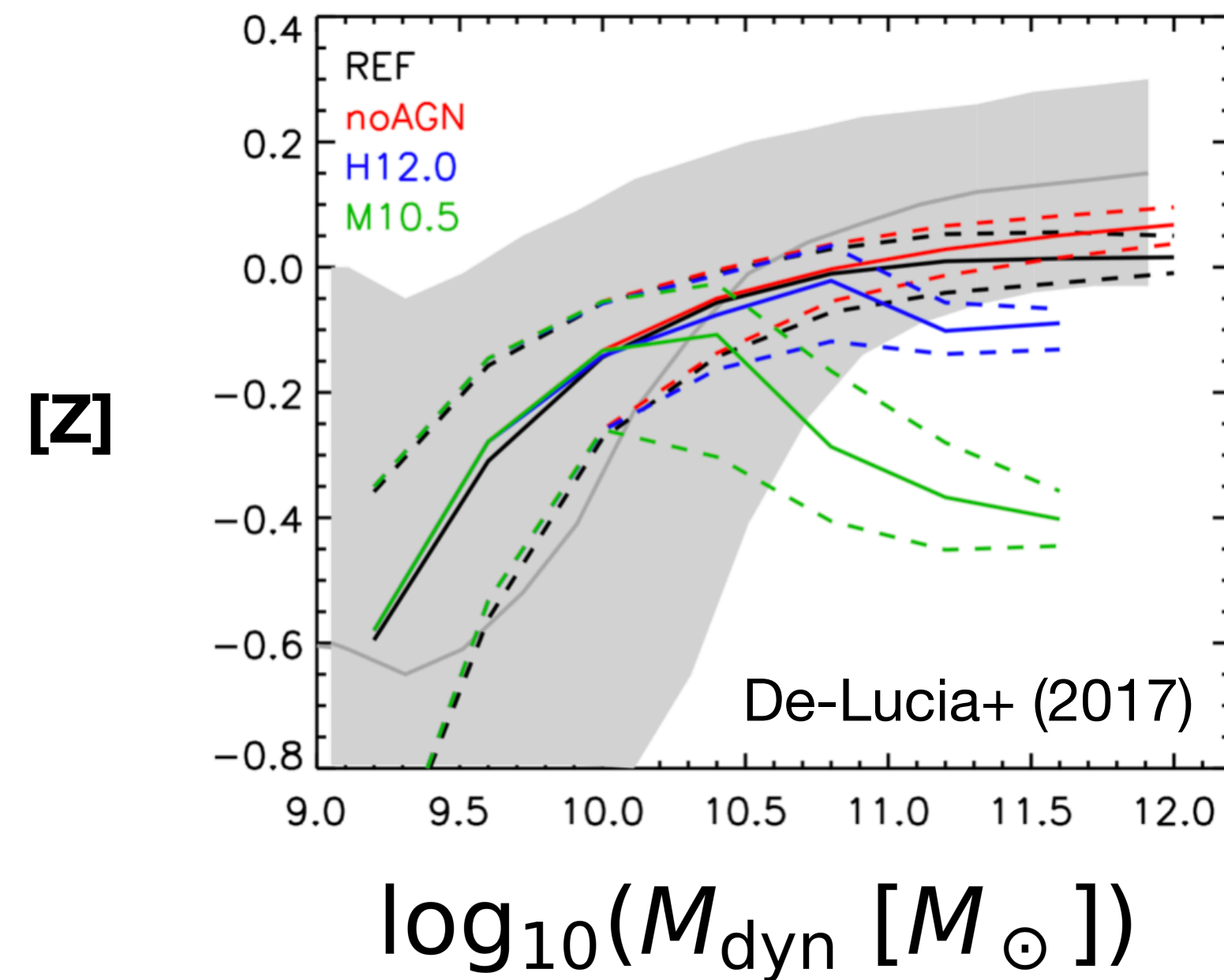
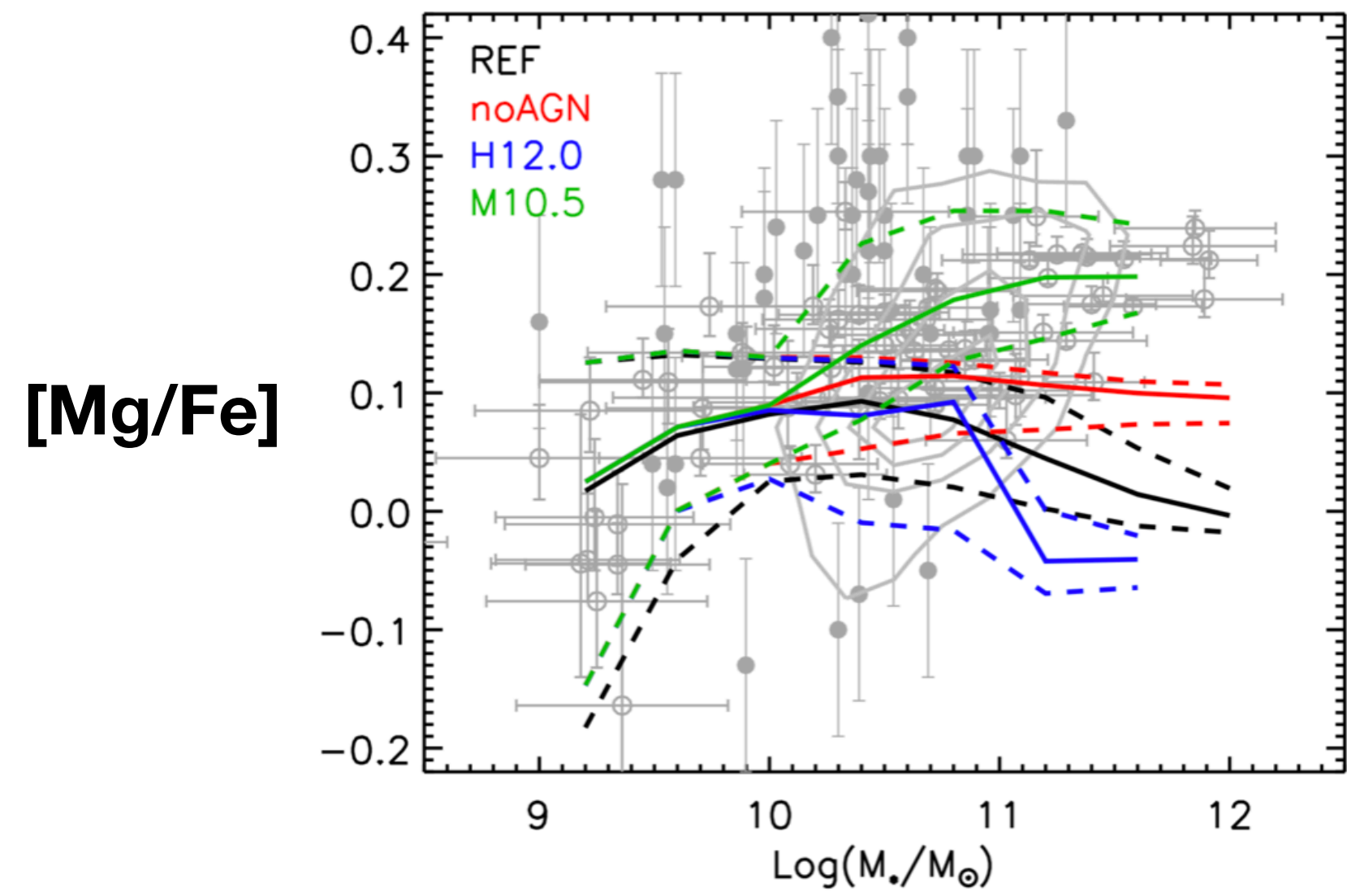
“Bottom-heavy”

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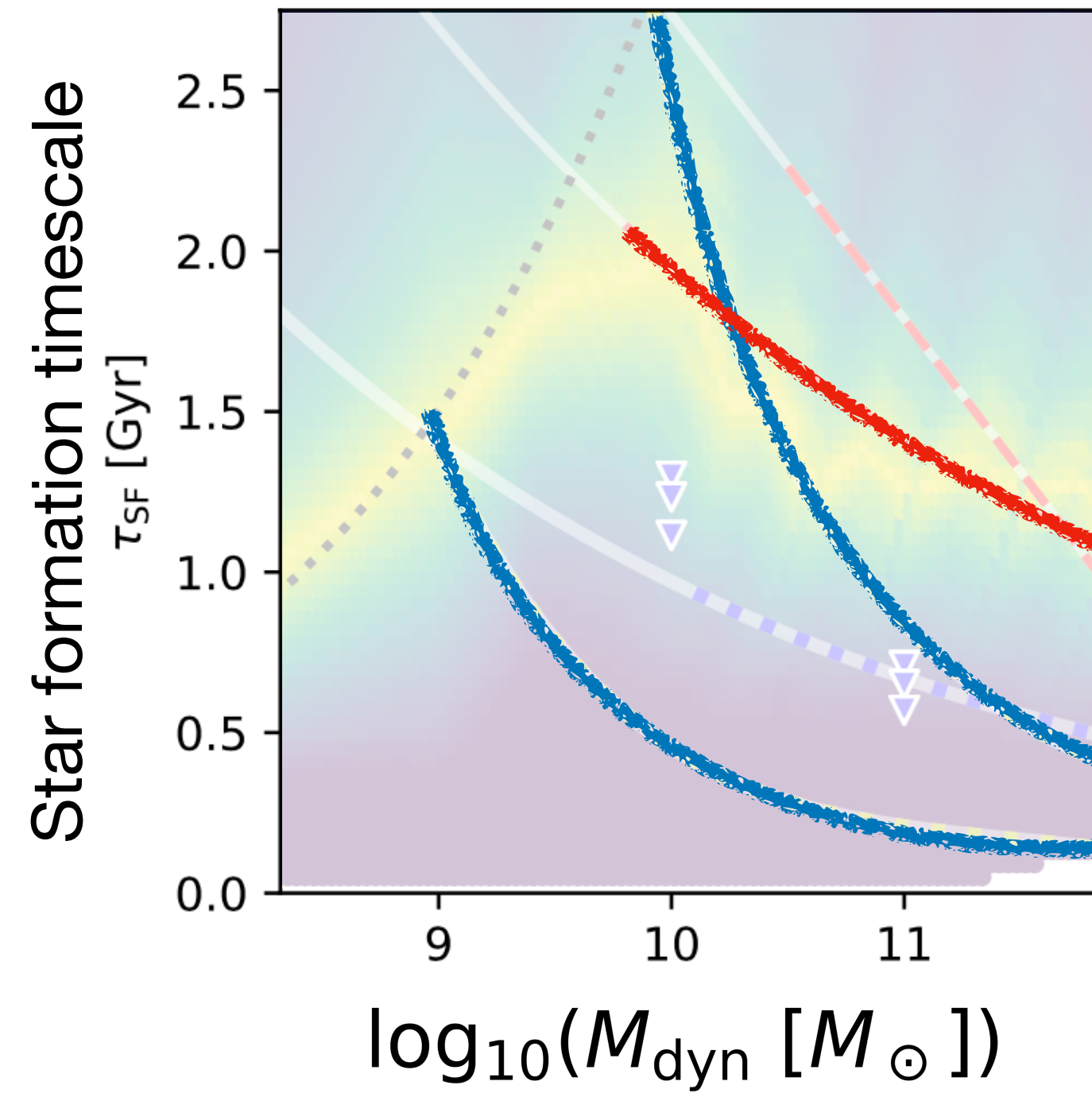
“Bottom-light”



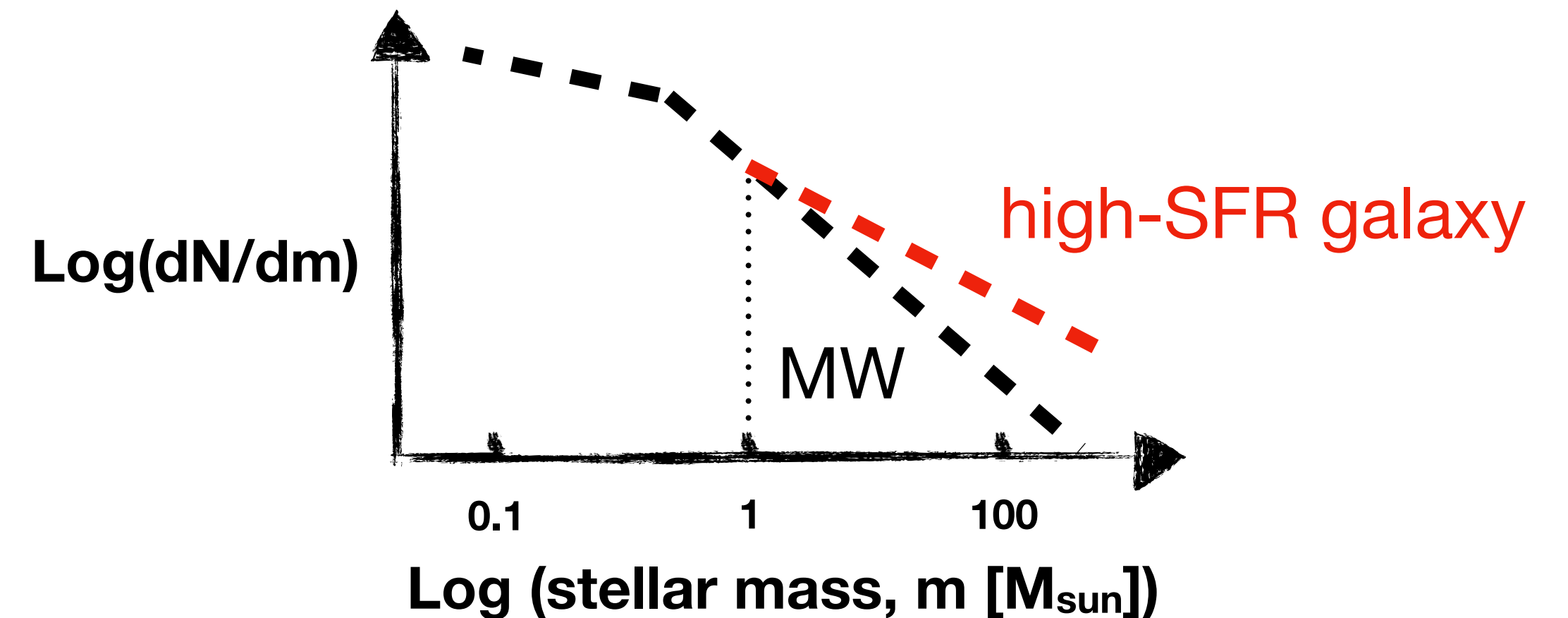
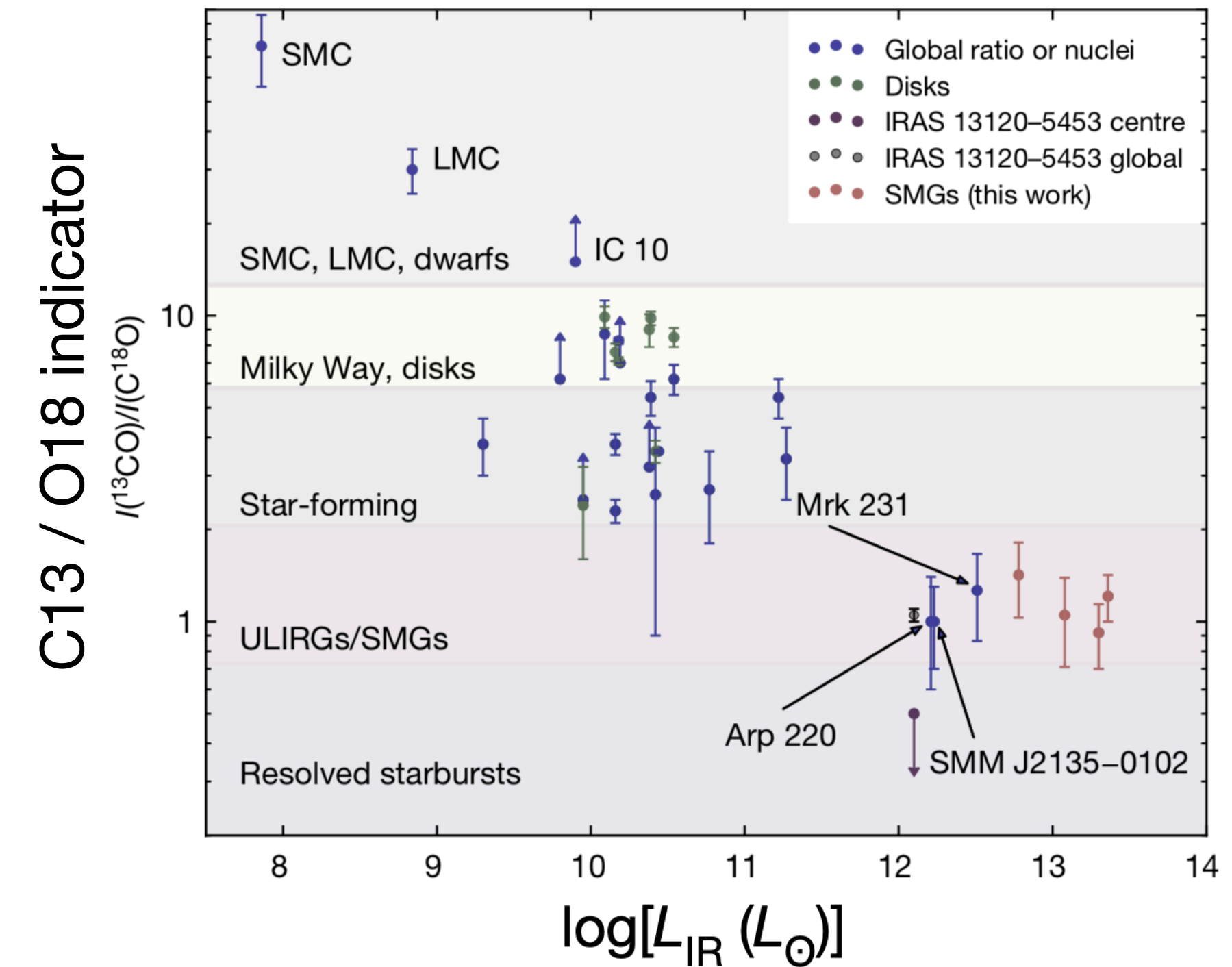
# Galaxy Chemical Evolution for massive galaxies



Yan, Jerabkova, & Kroupa (2019, 2021)



Zhang+(2018 Nature 558 260)

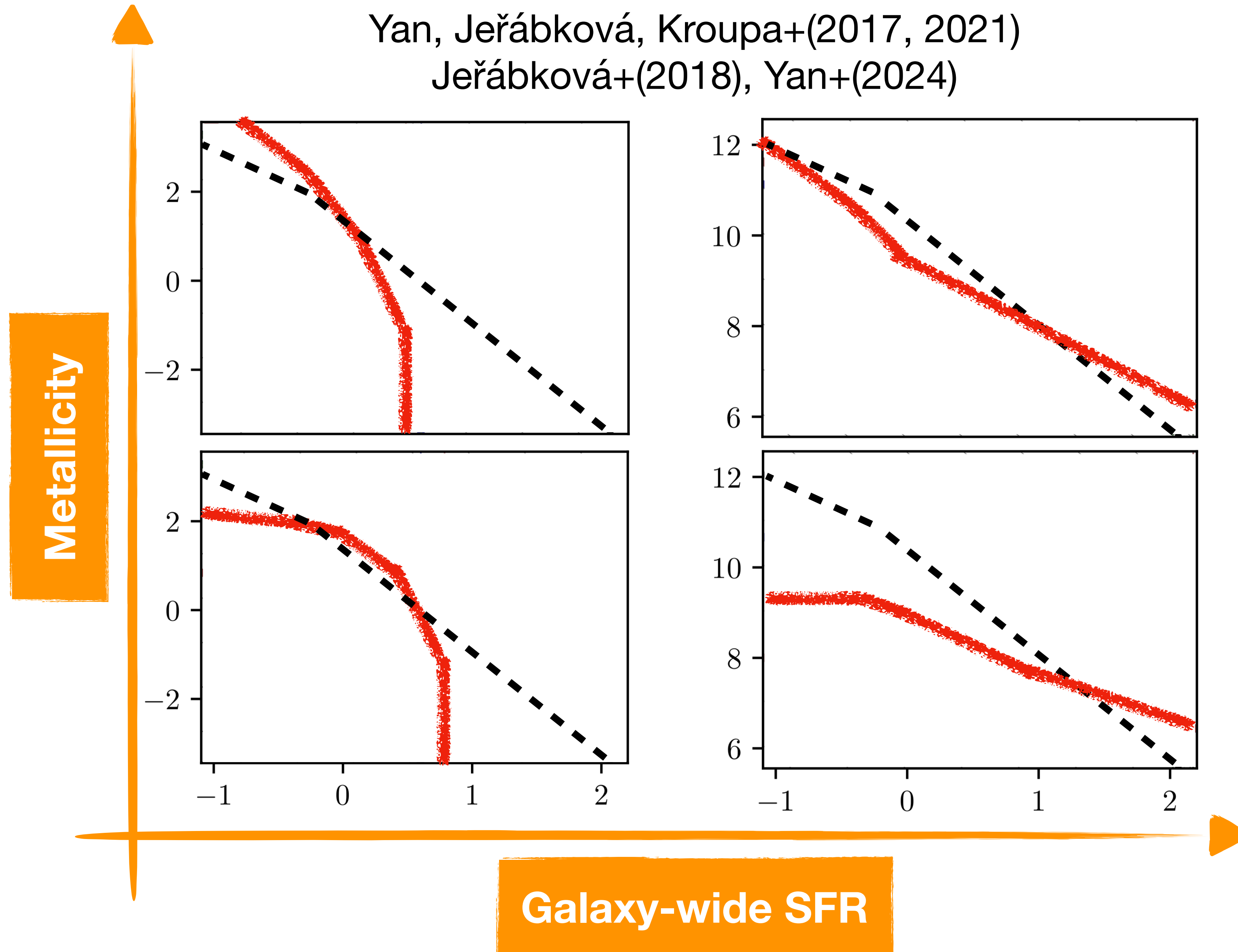




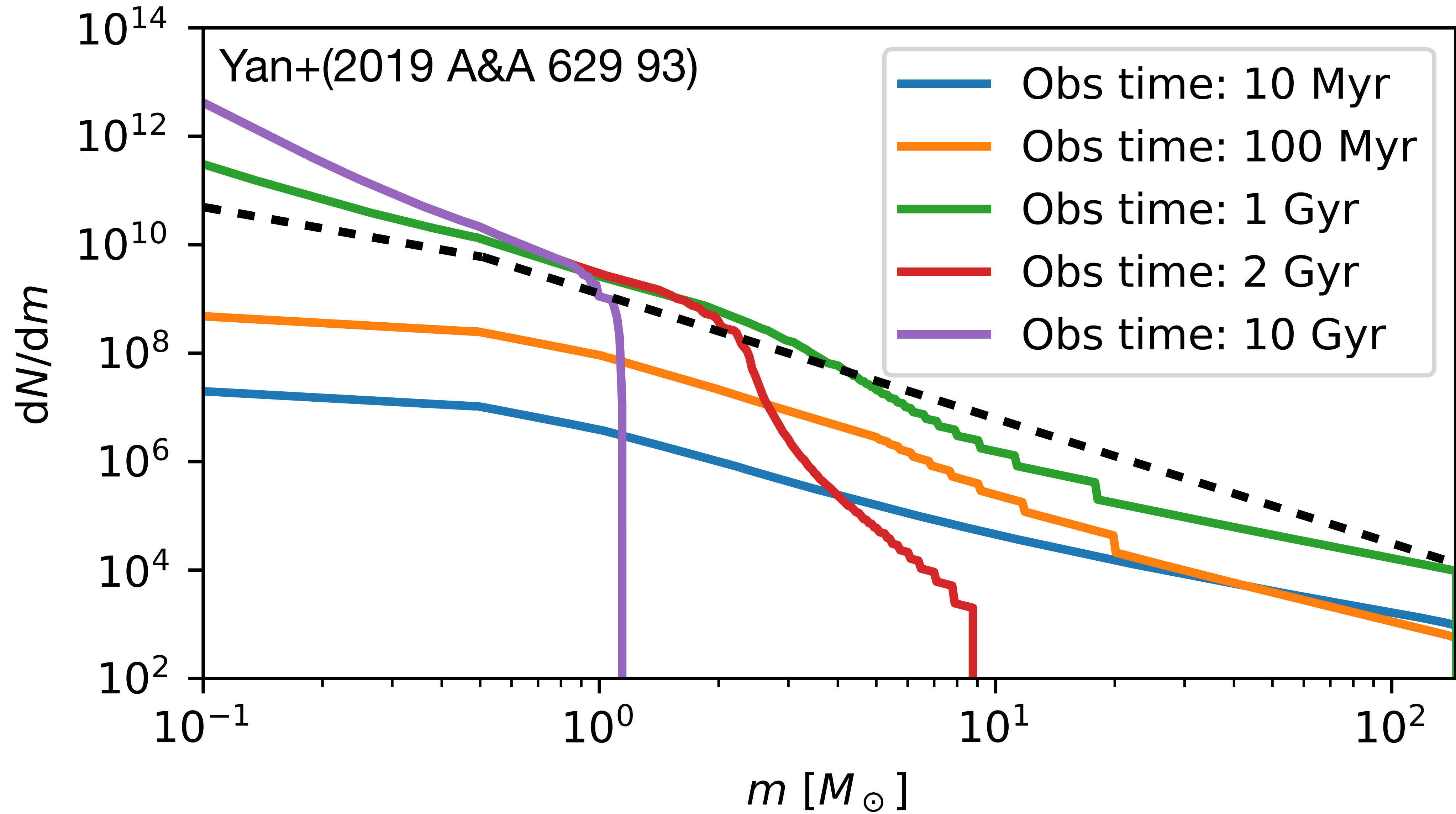
# Summary

# A variable galaxy-wide IMF that depends on local star formation environment

Yan, Jeřábková, Kroupa+(2017, 2021)  
Jeřábková+(2018), Yan+(2024)



# The time evolution of Present-Day stellar Mass Function (PDMF) for a massive early-type galaxy

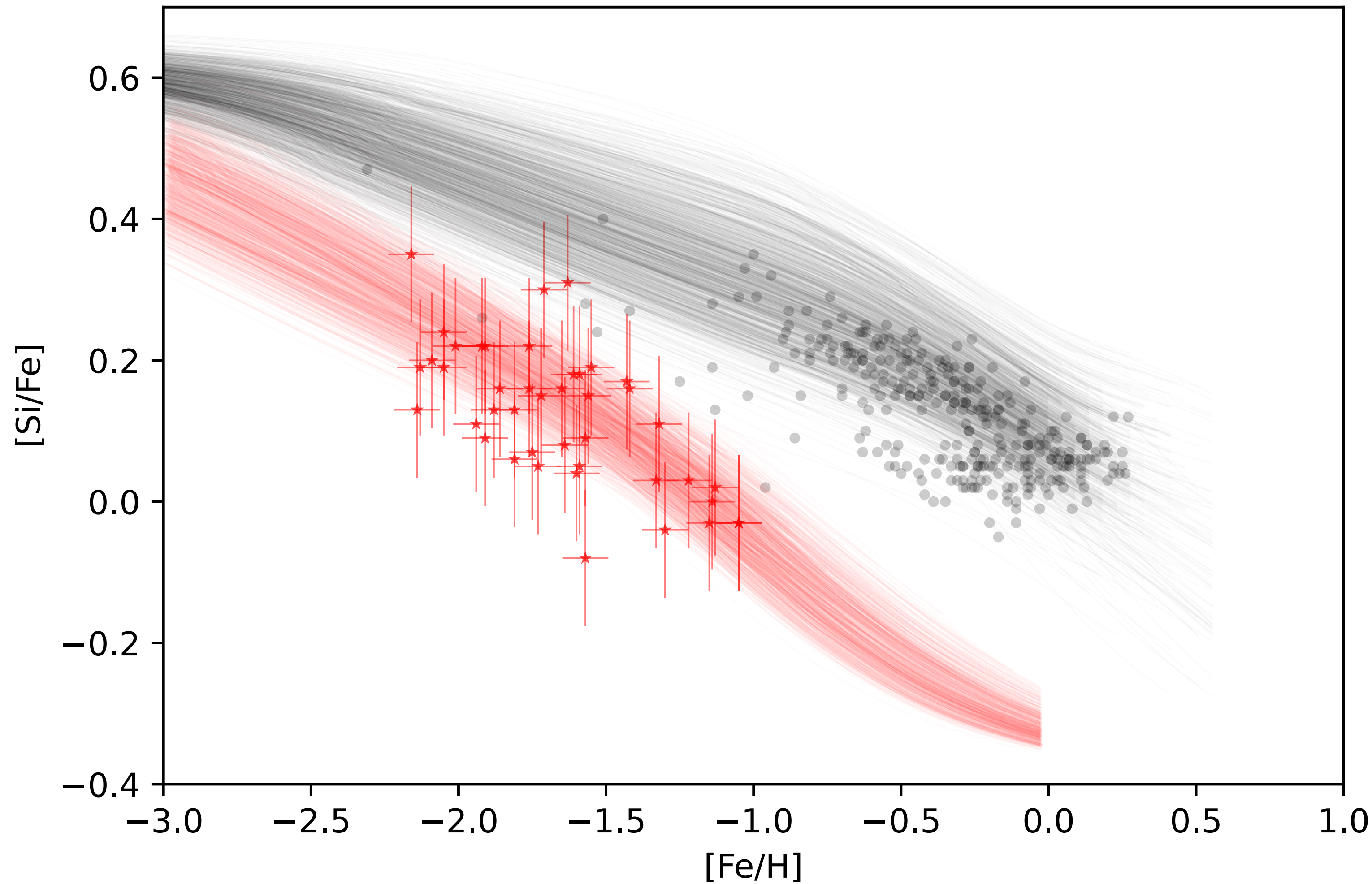


*The end*





# How can GCE constrain the IMF for *low-mass* stars?

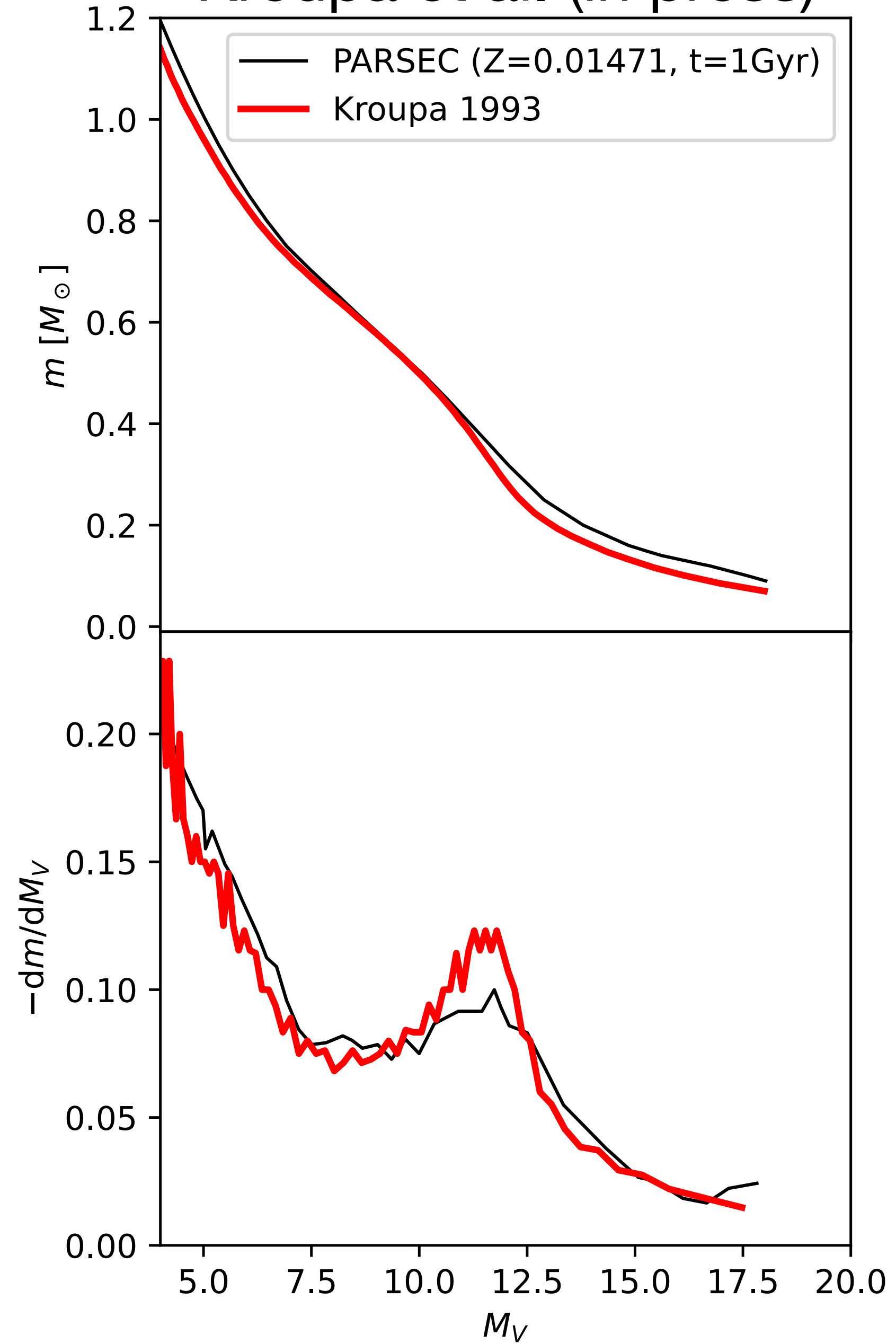


Distribution of [Fe/H]  
of the low-mass stars  
correlates with their mass

Yan et al. (2020, 2024)



Kroupa et al. (in press)



## IMF measurement uncertainty from different stellar evolution model (stellar mass–luminosity relation)

