



# *How old are bars?*

*Determining the cosmic epoch of bar formation using archeological data of nearby galaxies*

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**+ TIMER team**

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# Why do we care when bars formed

1. More than half of disc galaxies in the Local Universe have bars

e.g., Eskridge+00; Menéndez-Delmestre+07; Barazza+08; Sheth+08; Aguerri+09; Nair & Abraham 2010; Buta+15; Erwin18

2. Bars affect their host galaxies

e.g., Lynden-Bell & Kalnajs 1972, Combes & Gerin 1985, Fragkoudi+16, Masters+12, Géron+21, Ishizuki+90, Ellison+11, Coelho & Gadotti 2011)

How old are bars observed in the Local Universe?

Do bars and bar-built structures grow?

How the bars affect their host galaxy?

For how long?

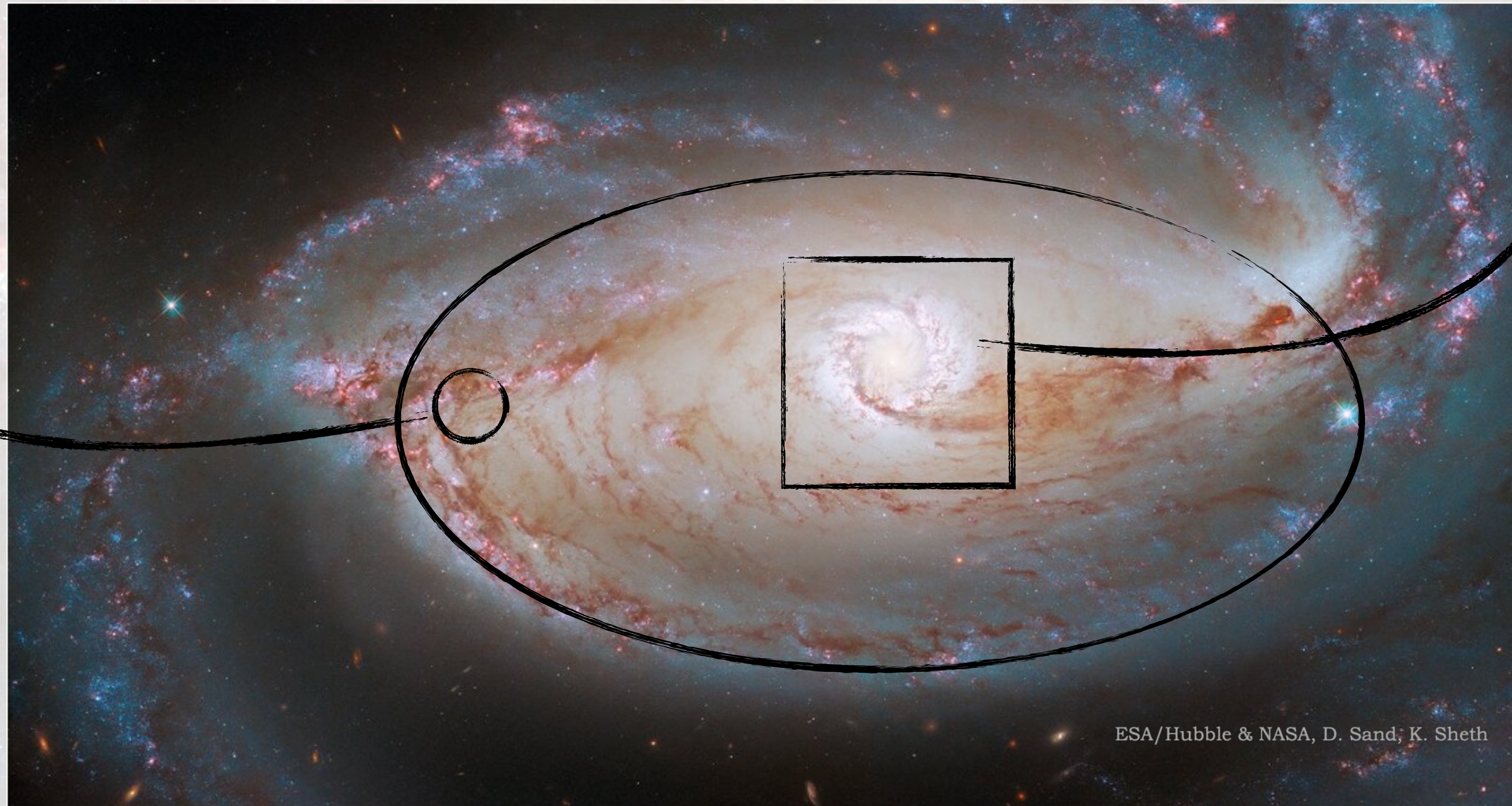
Are massive galaxies able to form bars earlier?



# Measuring ages of extragalactic bars

Problem: tangled information

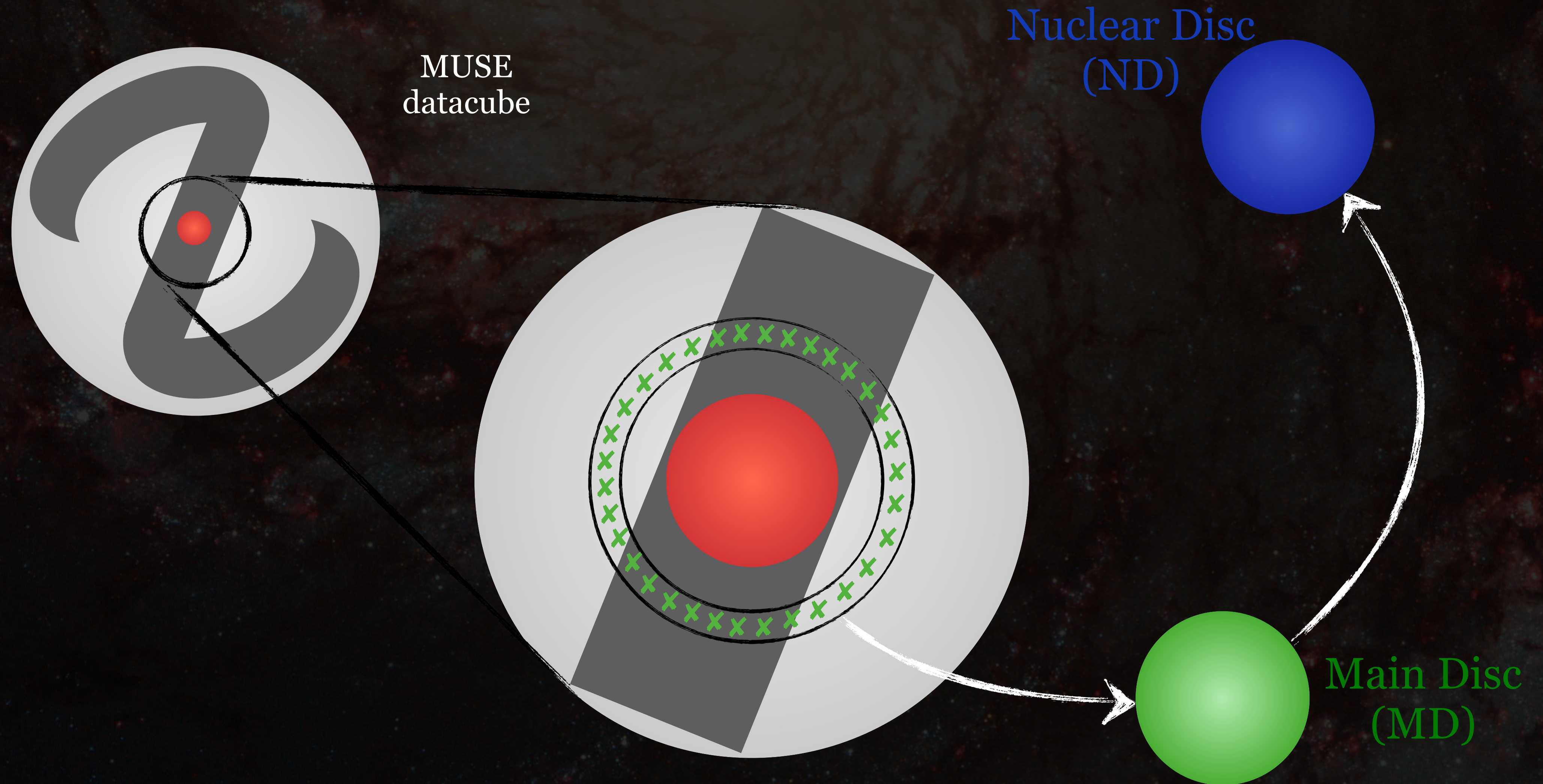
Trapped stars from the disc



ESA/Hubble & NASA, D. Sand, K. Sheth



# Timing bar formation



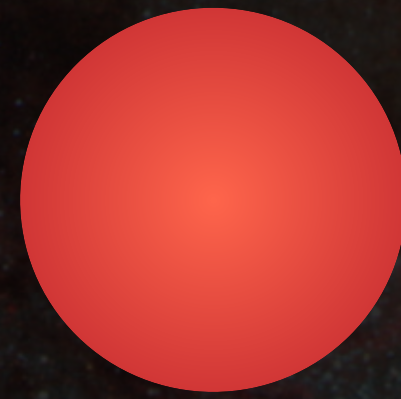
How old are bars? | Camila de Sá-Freitas



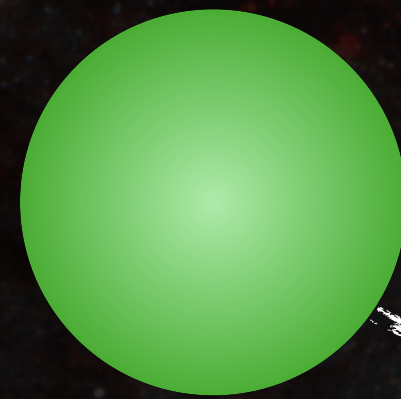
# Timing bar formation

Tested the approach in simulated galaxies!

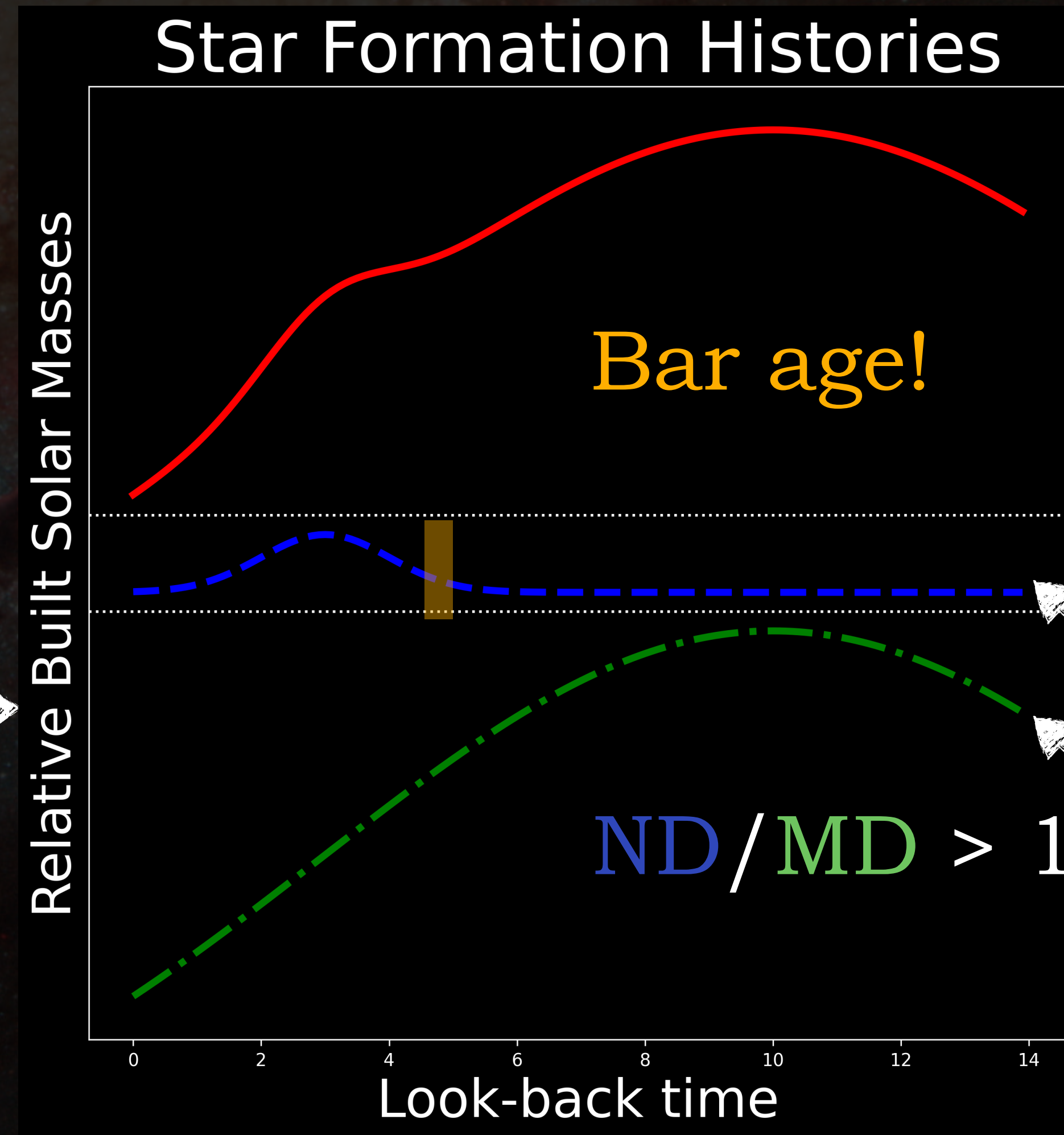
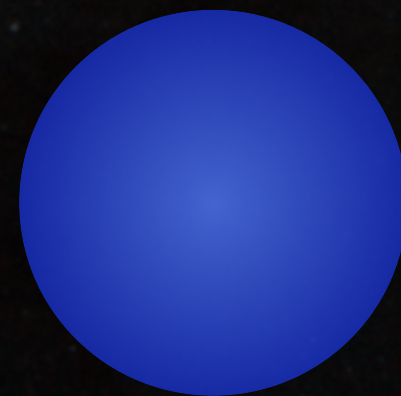
MUSE Original



Main Disc (MD)



Nuclear Disc (ND)

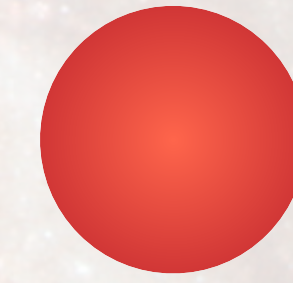


Adapted from C. de Sá-Freitas+23

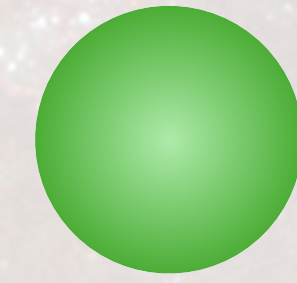
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# NGC 1433 hosts an old bar



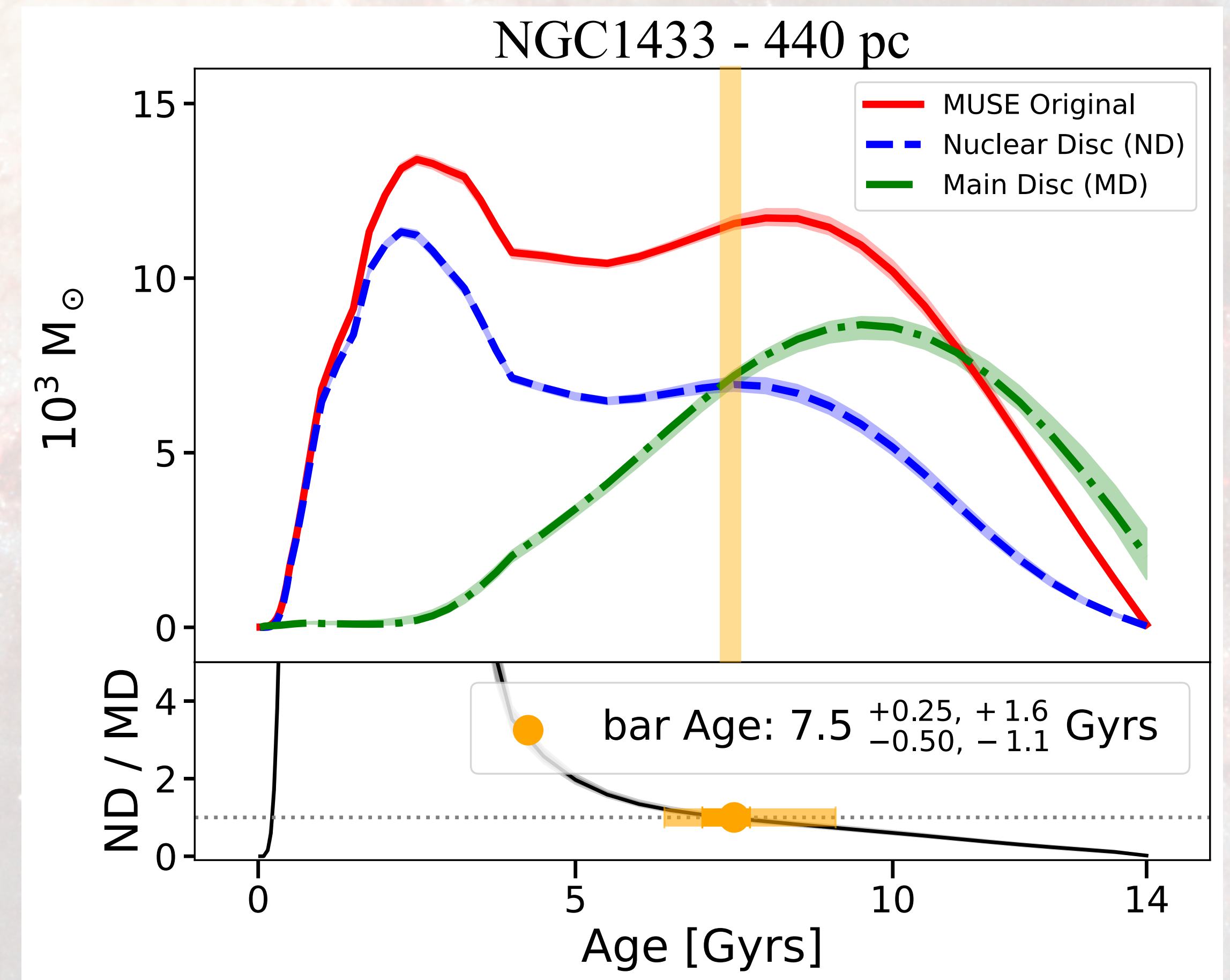
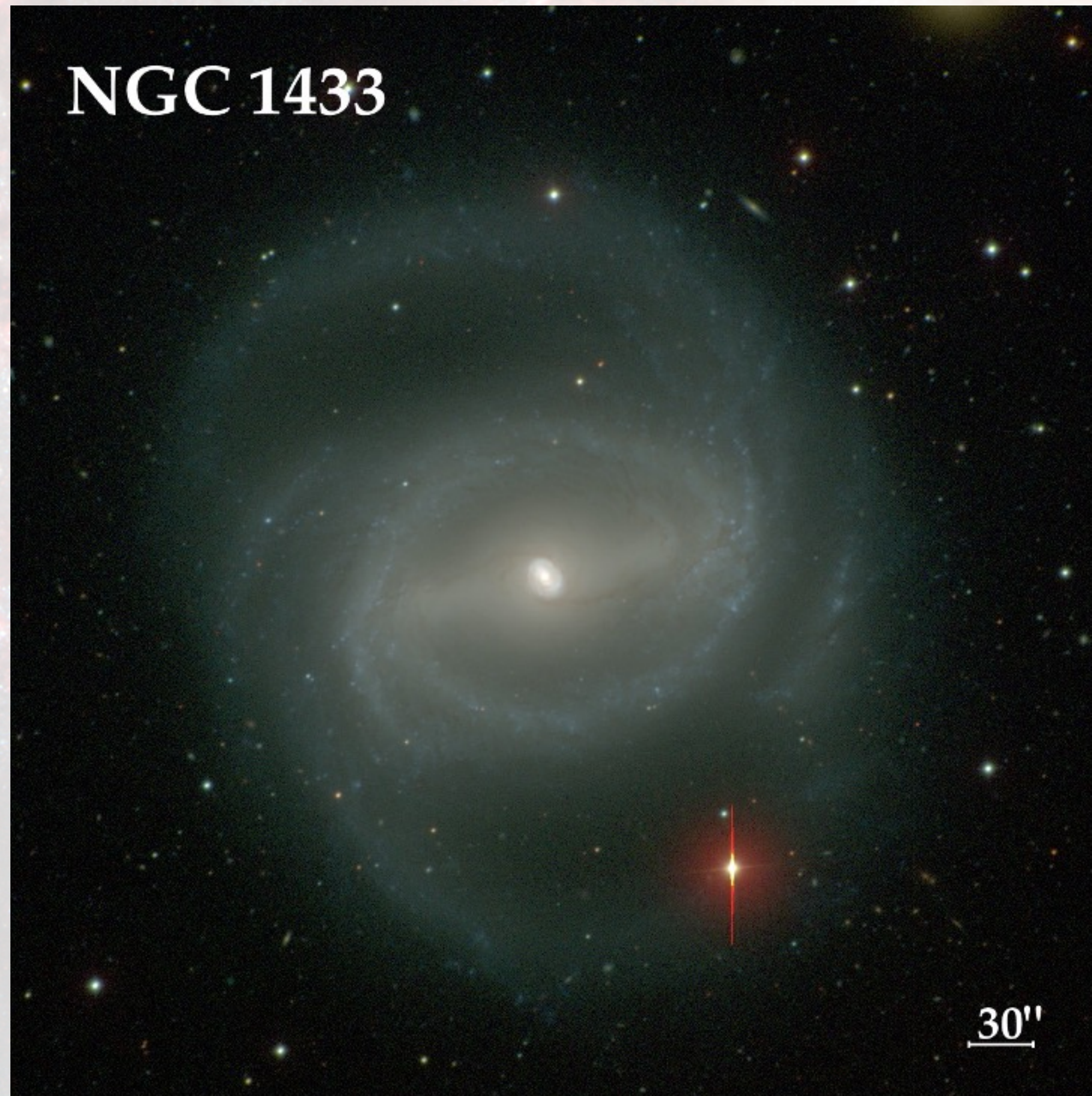
MUSE  
Original



Main Disc  
(MD)



Nuclear Disc  
(ND)



Adapted from C. de Sá-Freitas+23

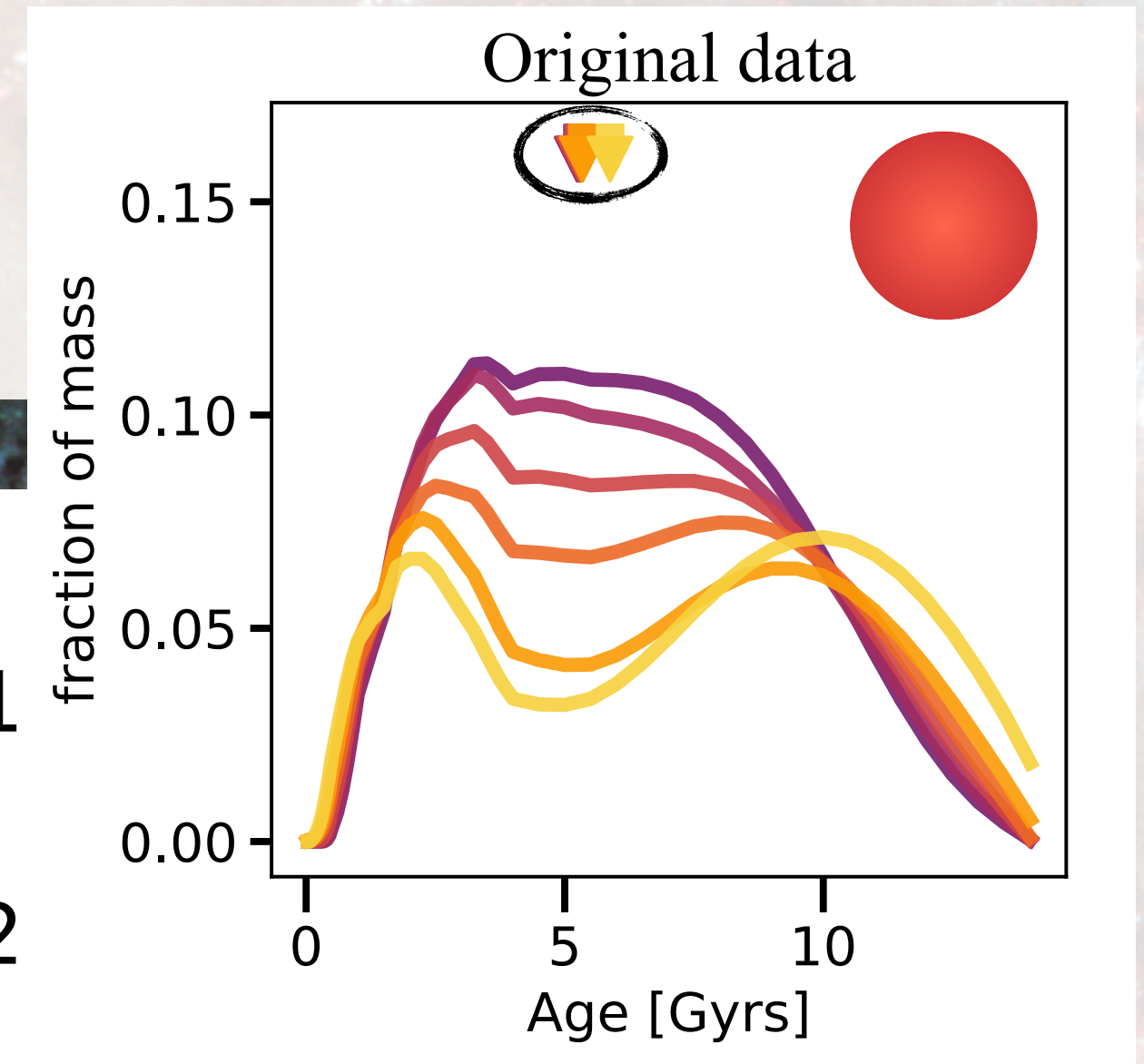
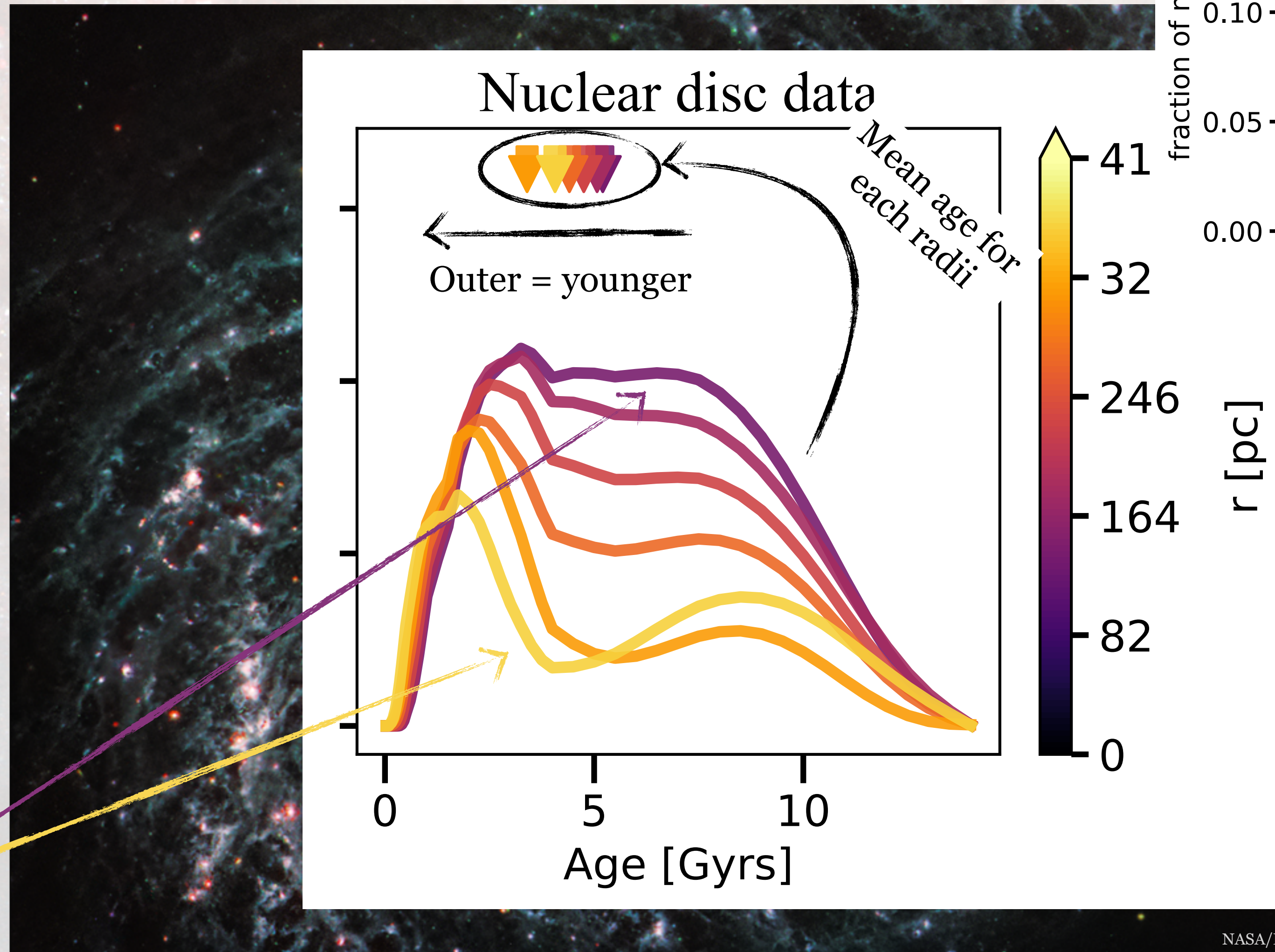
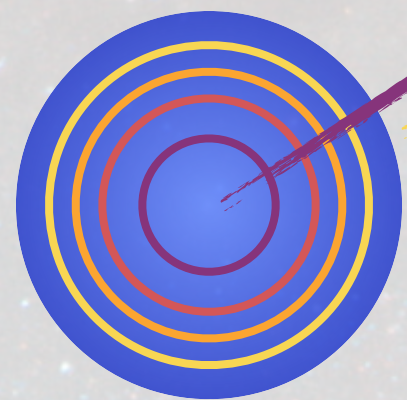


A little detour

# Nuclear disc inside-out build

Bittner+2020

Nuclear Disc  
(ND)



NASA/ESA/CSA/JWST

Adapted from C. de Sá-Freitas+23

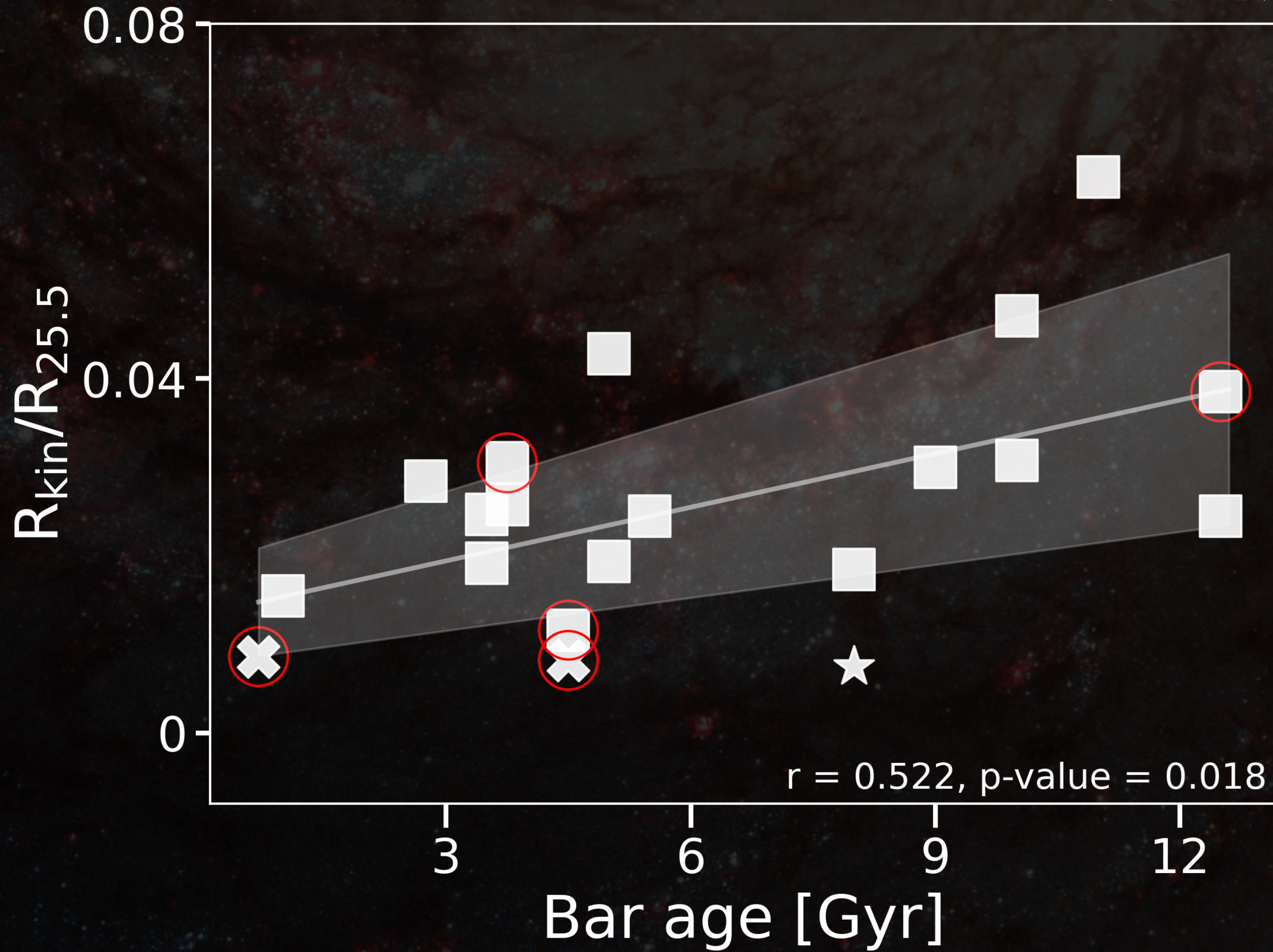
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# Bar ages on the TIMER survey

Work in progress

de Sá-Freitas+ TIMER (in prep)



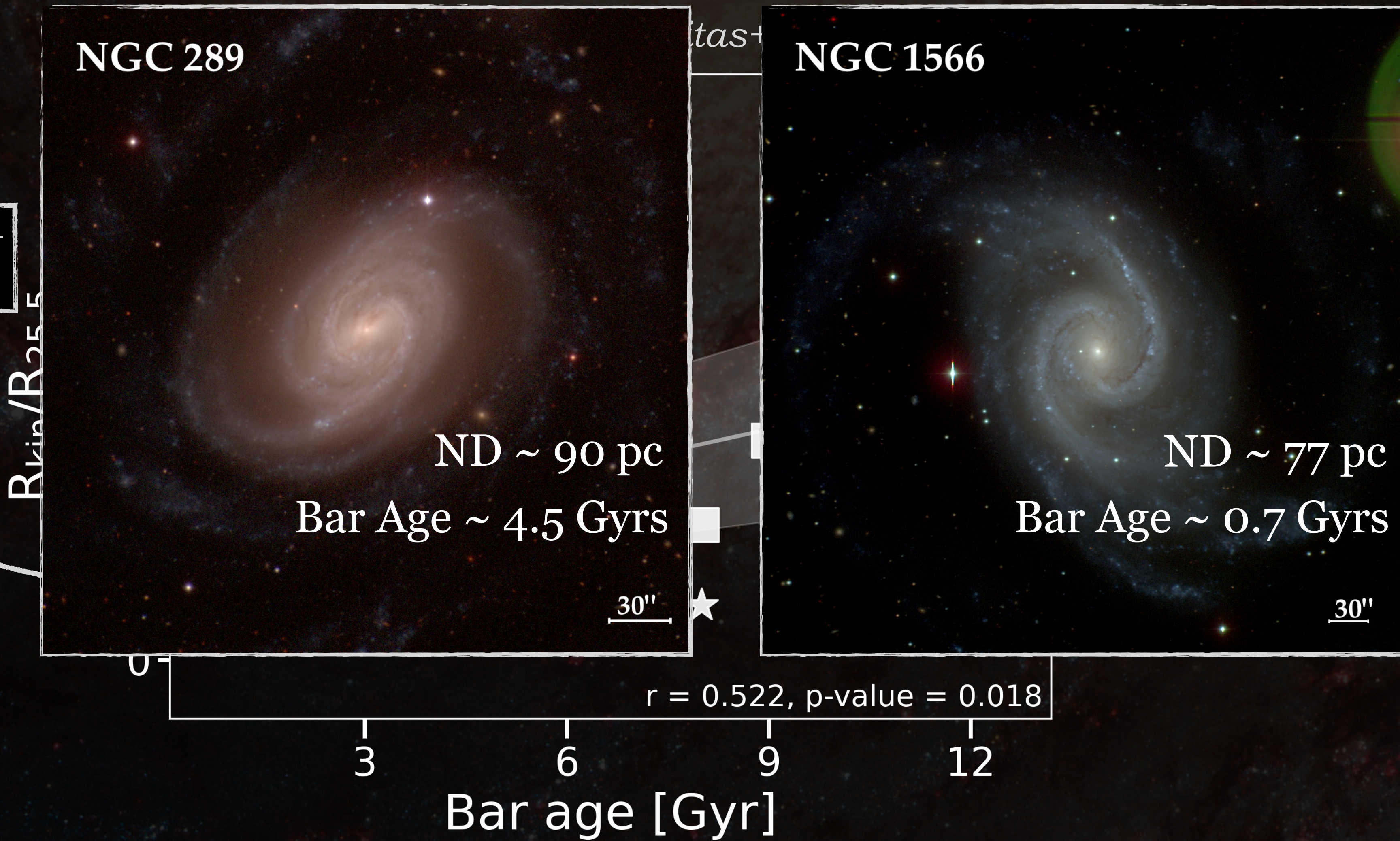
Nuclear discs are bigger in older bars



Work in progress

# Bar ages on the TIMER survey

de Sá-Freitas+  
2023b (subm)

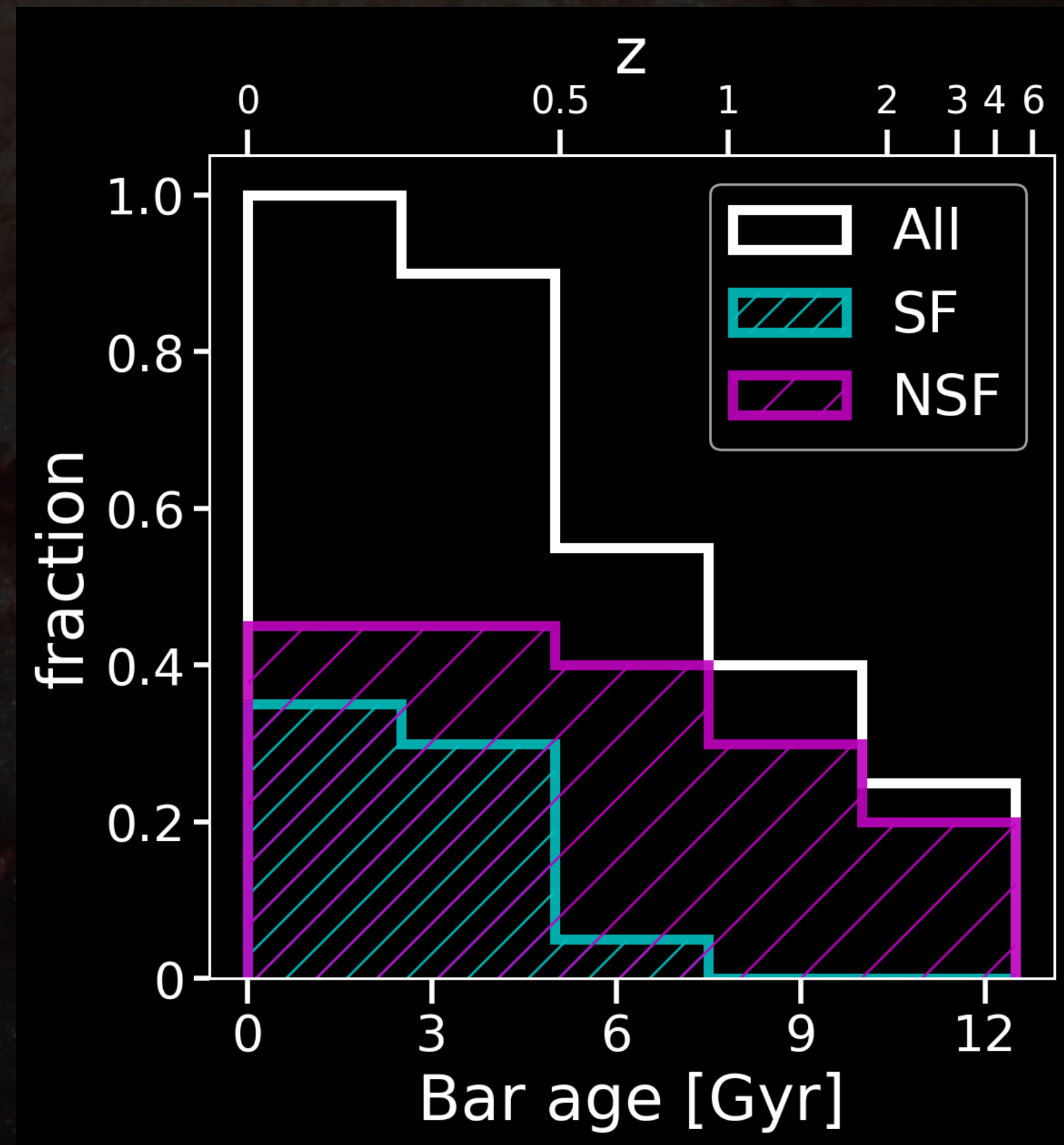
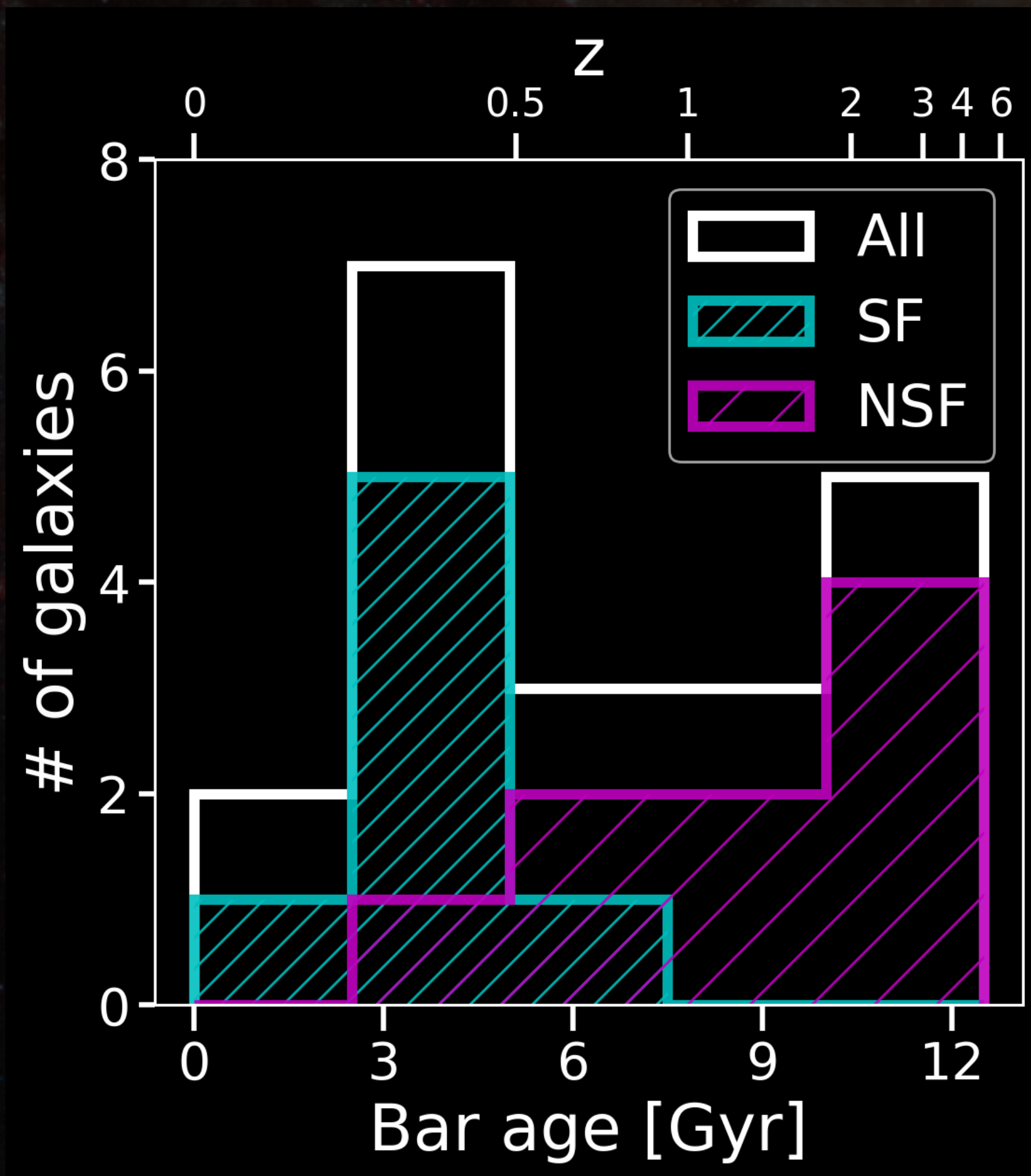




Work in progress

# Bar ages on the TIMER survey

de Sá-Freitas+ TIMER (in prep)



Star-forming nuclear discs

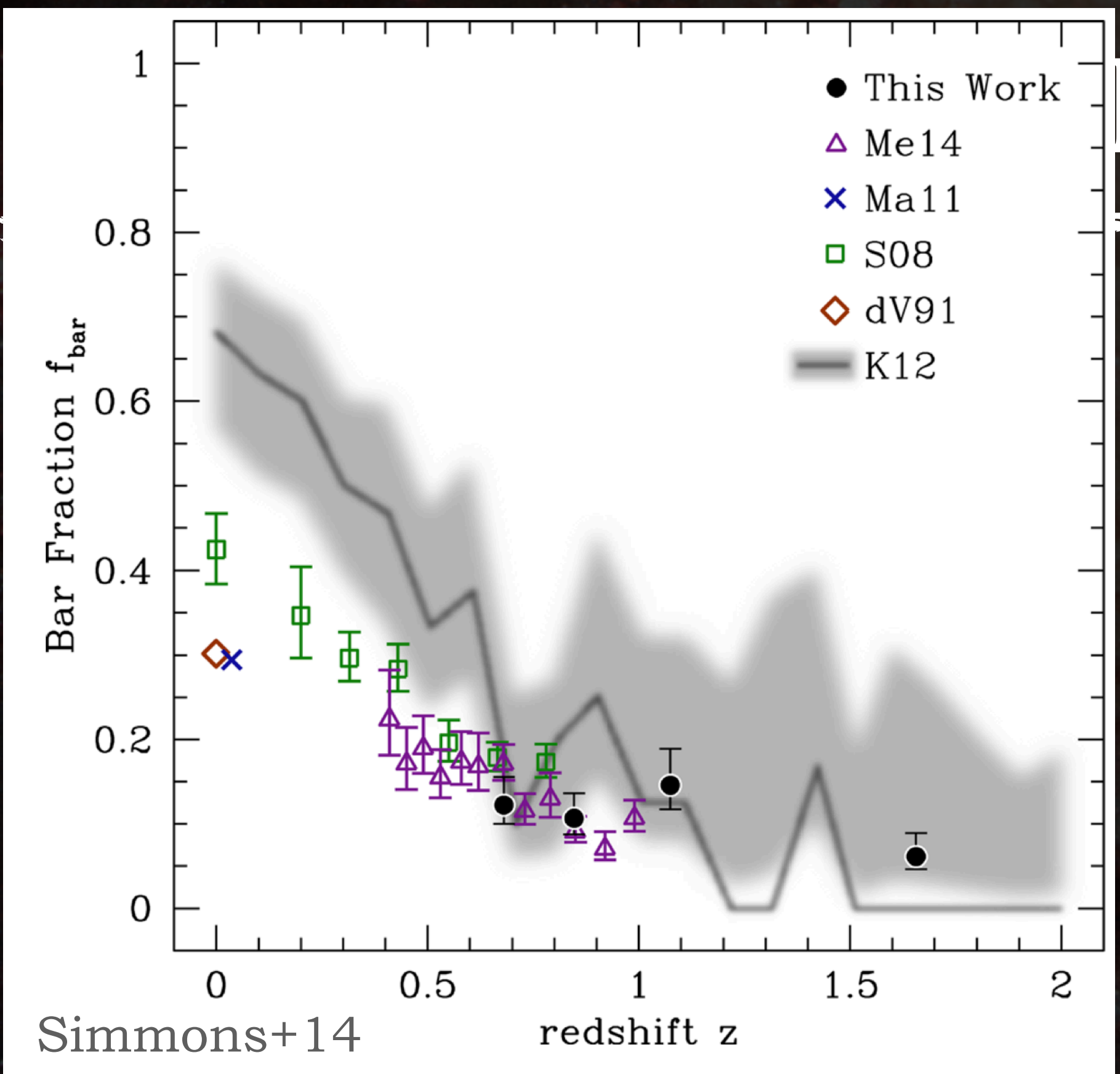
*Bittner+2020*

Non-star-forming nuclear discs

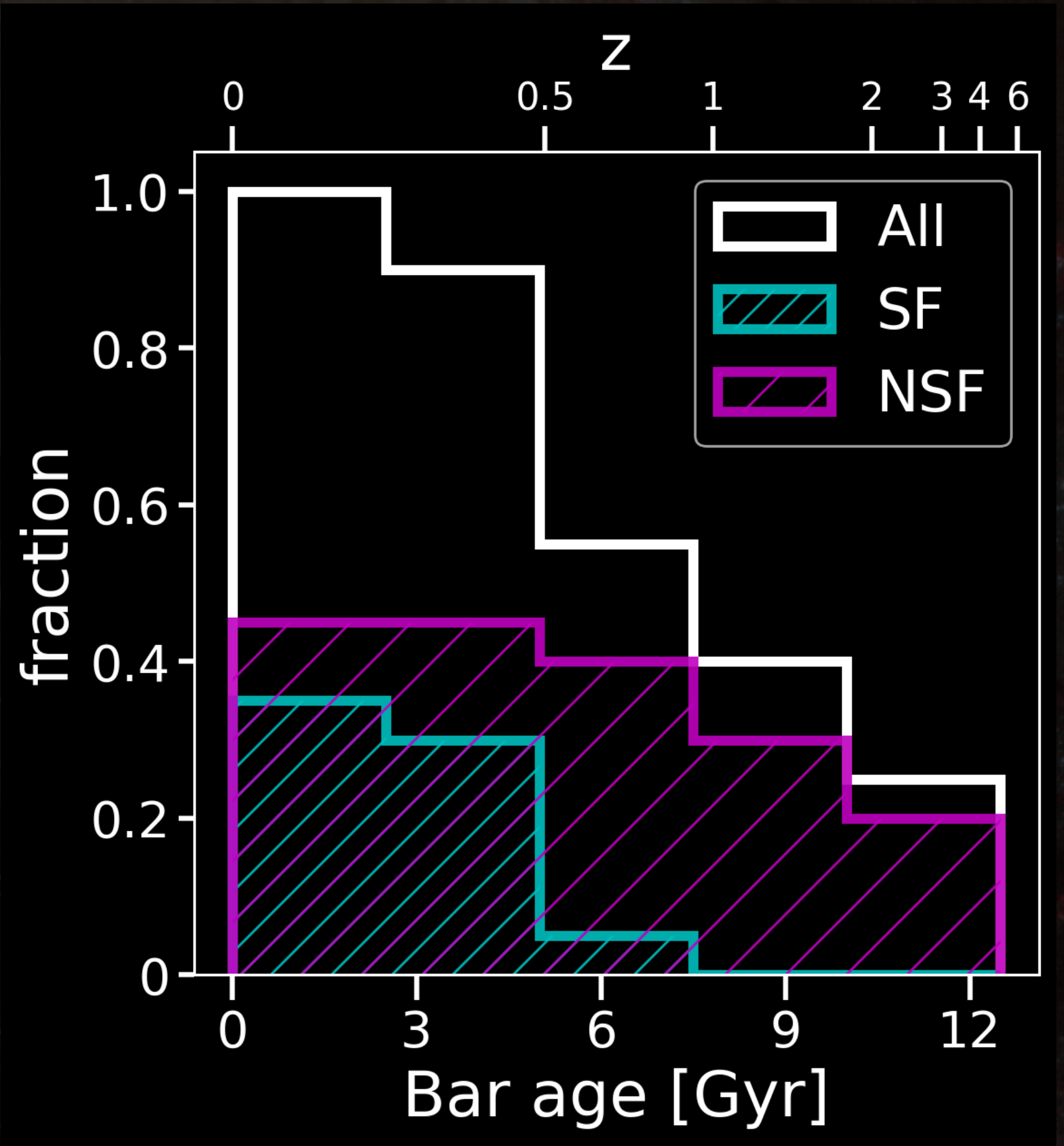


# TIMER survey

Work in progress



de Sá-Freitas+ TIMER (in prep)



Star-forming nuclear discs

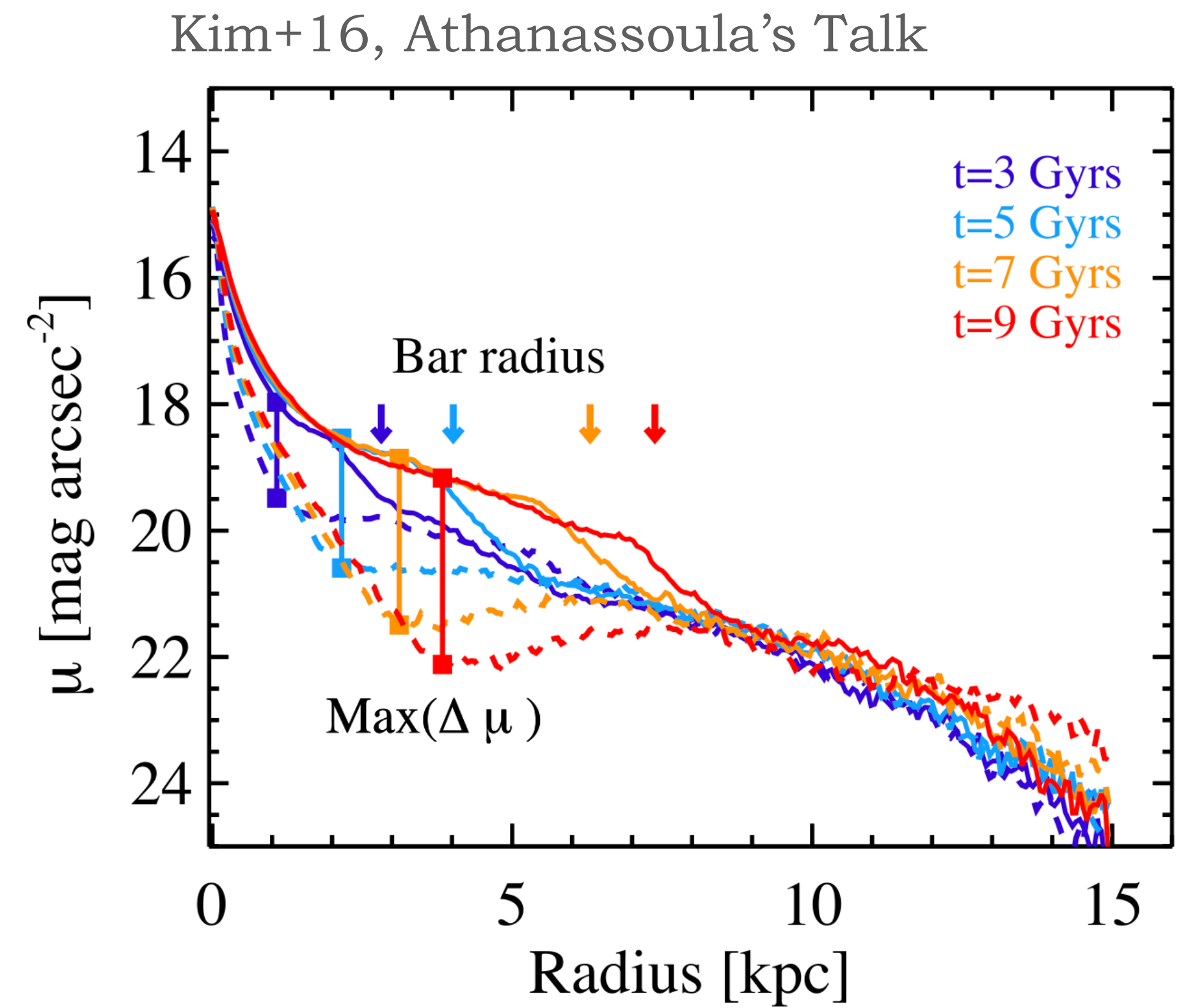
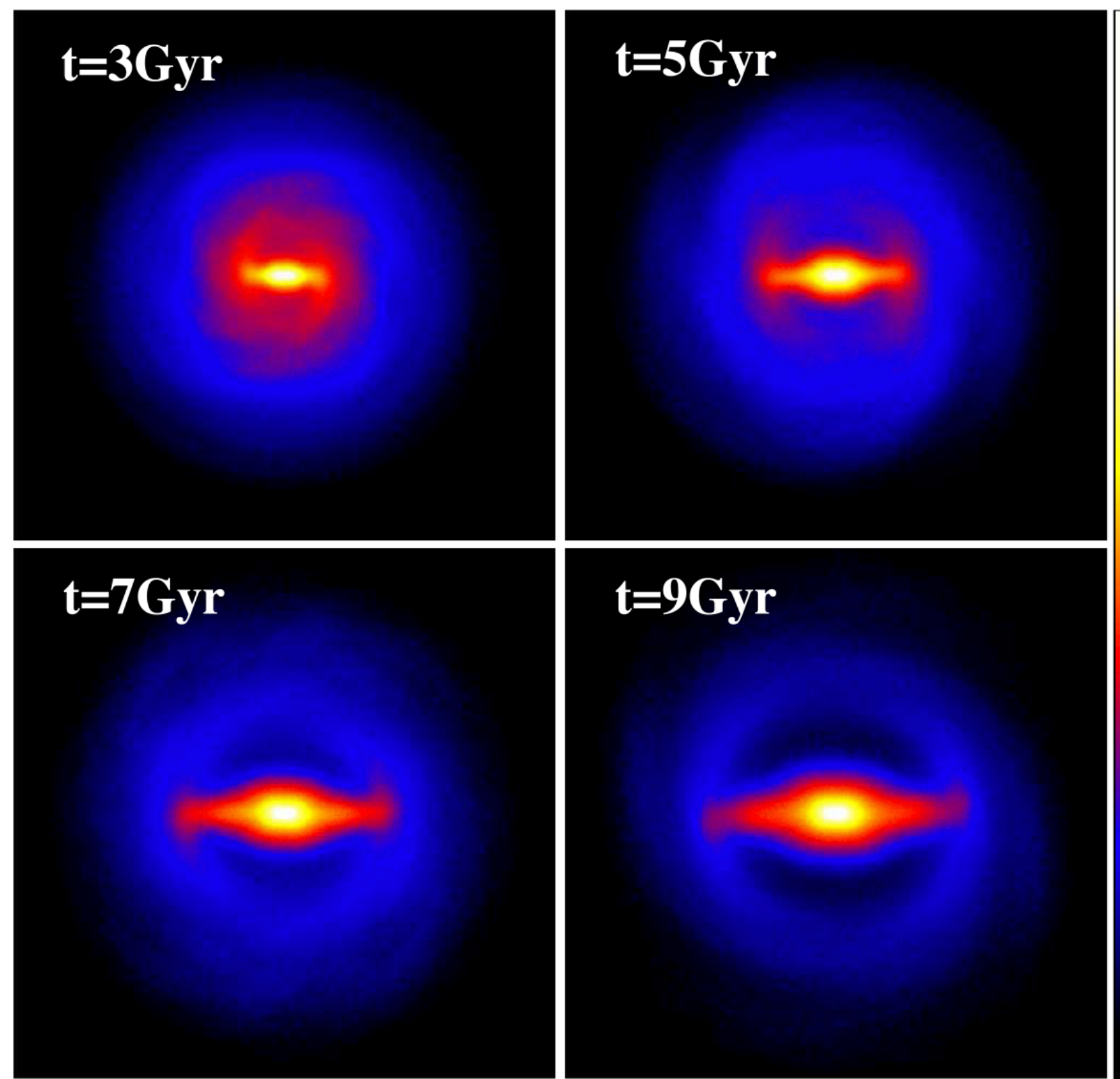
Non-star-forming nuclear discs

See Zoe Le Conte's talk tomorrow for bar fractions at  $z > 2$



# Bars capture stars from the disc

Work in progress

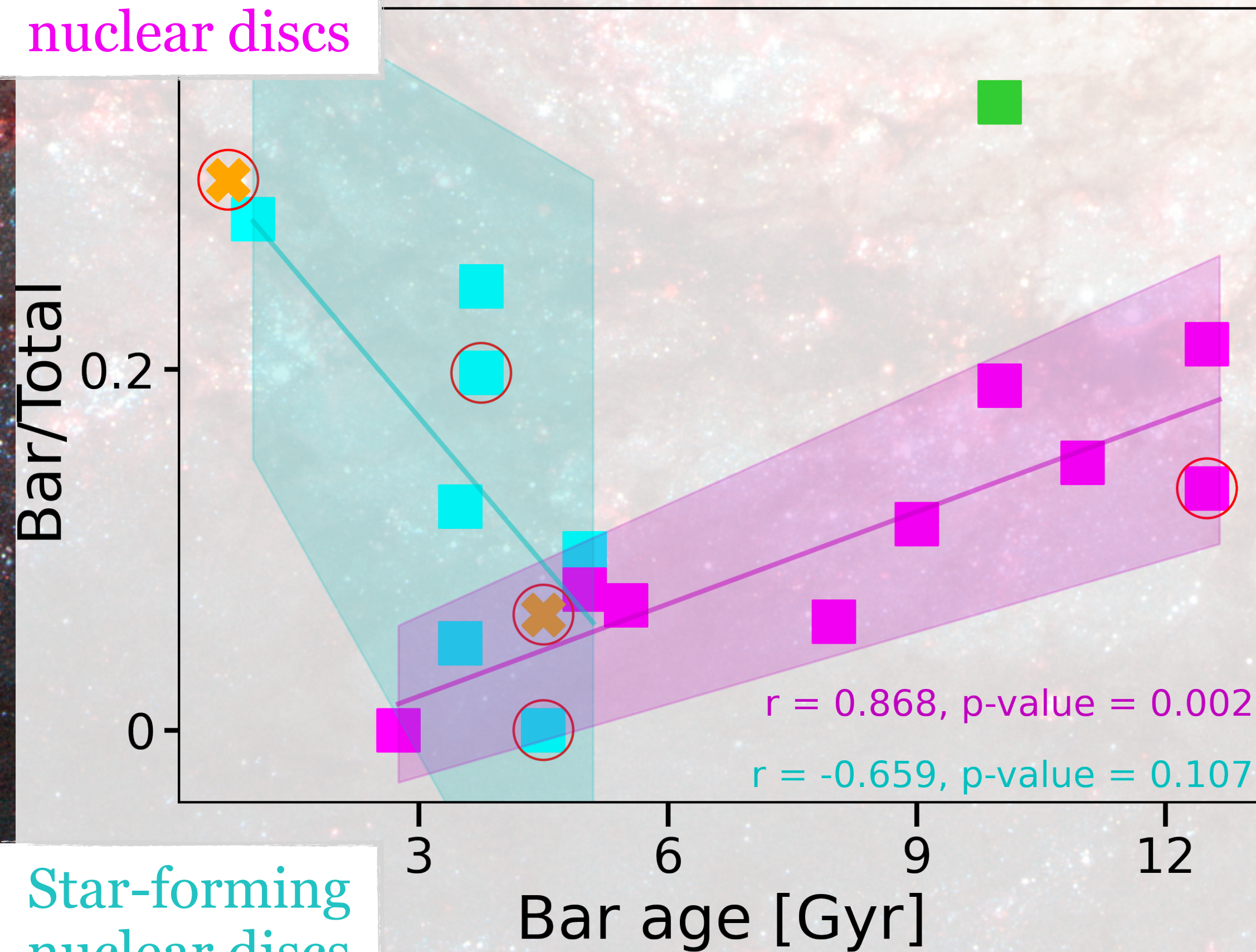




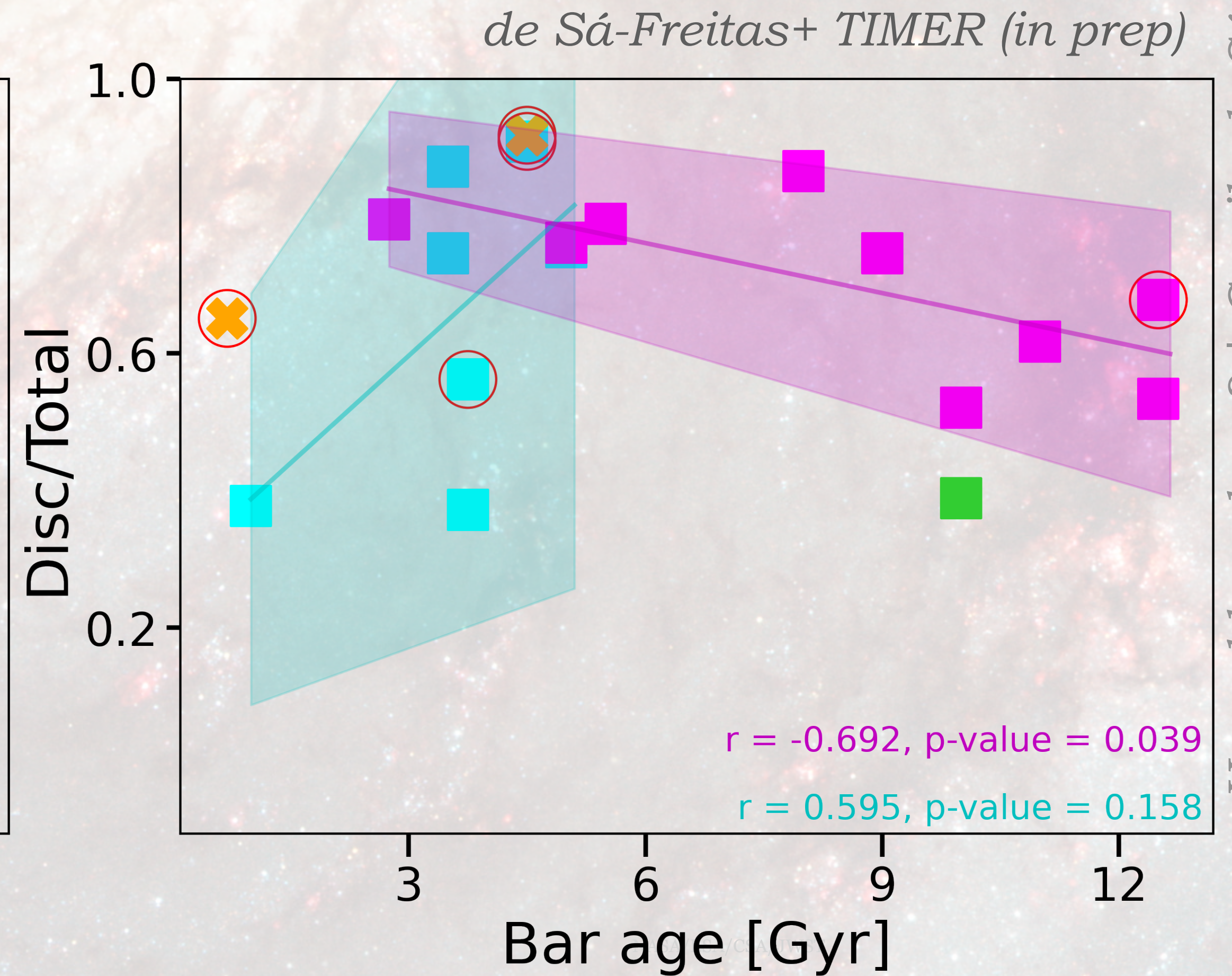
# Bars capture stars from the disc

Work in progress

Non-star-forming nuclear discs



Star-forming nuclear discs

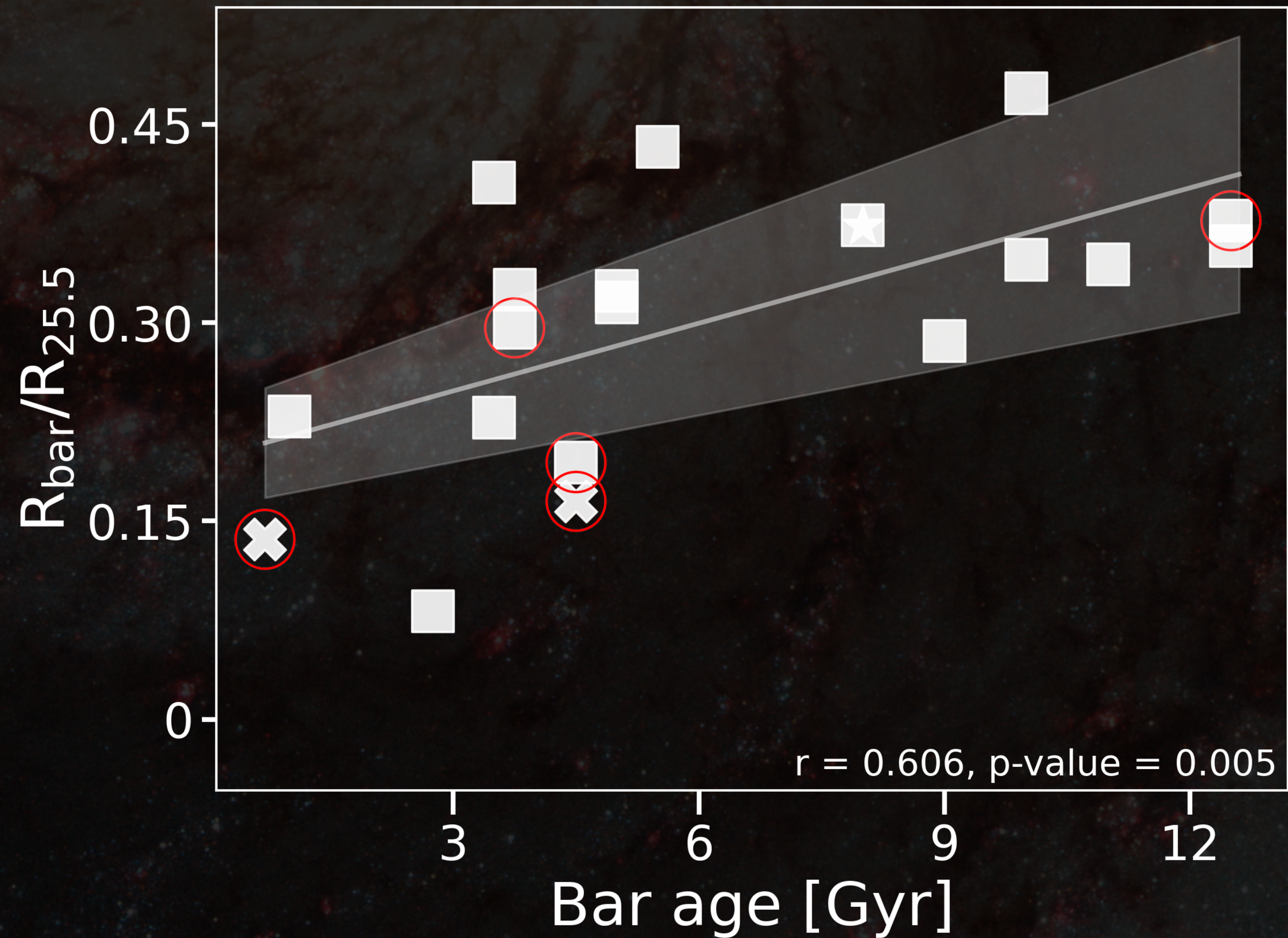




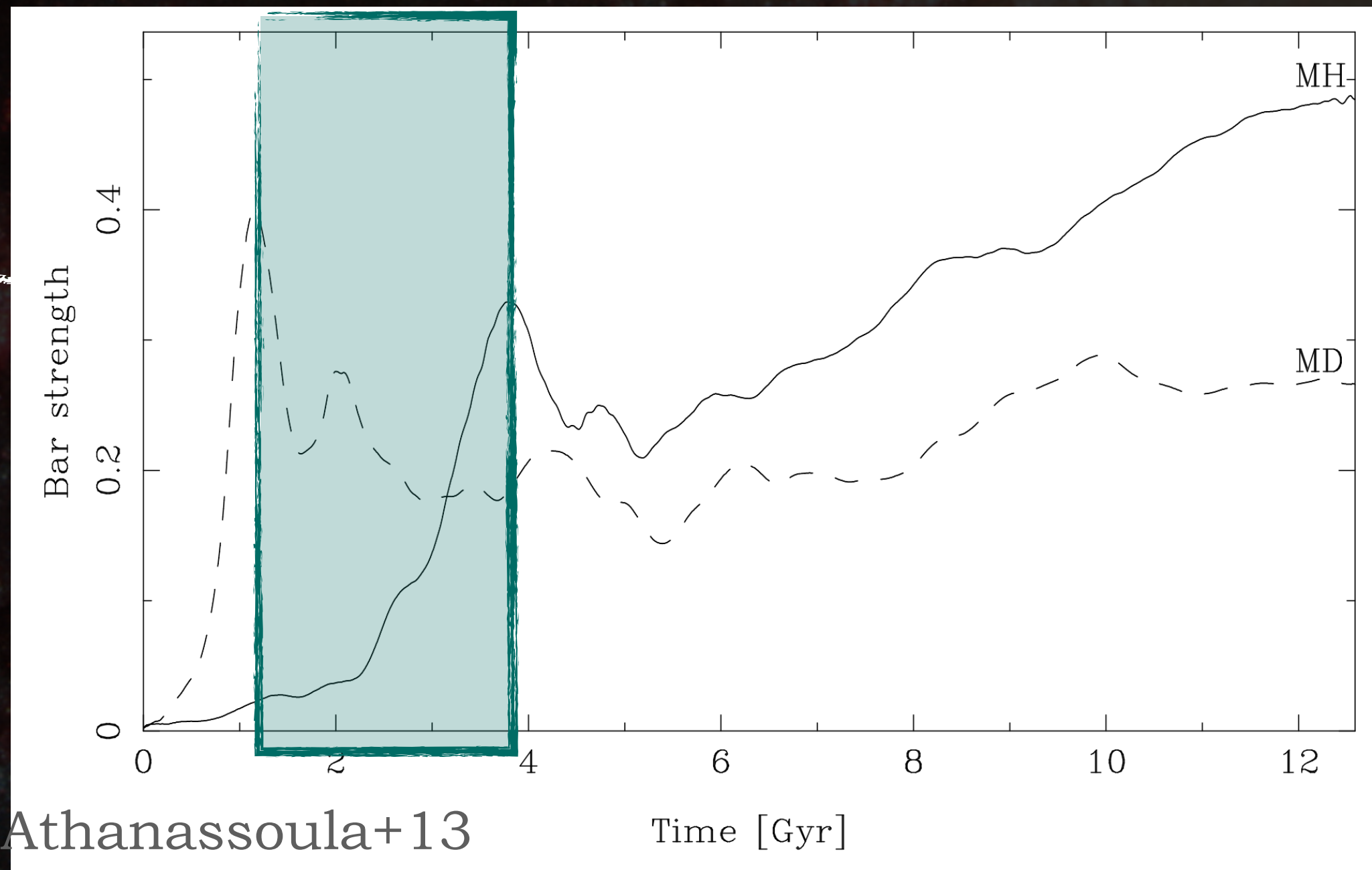
# Do bars grow with time?

Work in progress

de Sá-Freitas+ TIMER (in prep)



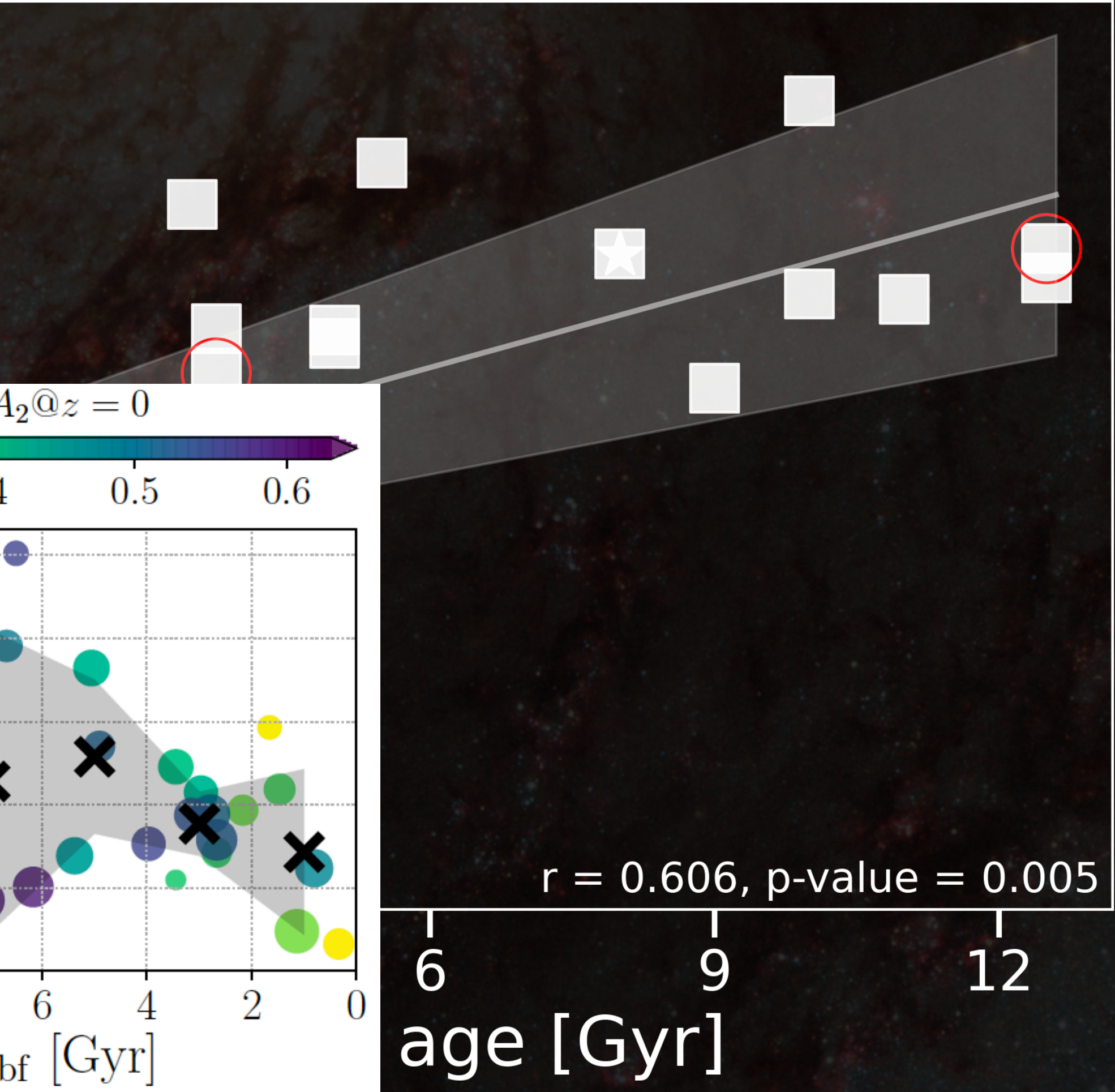
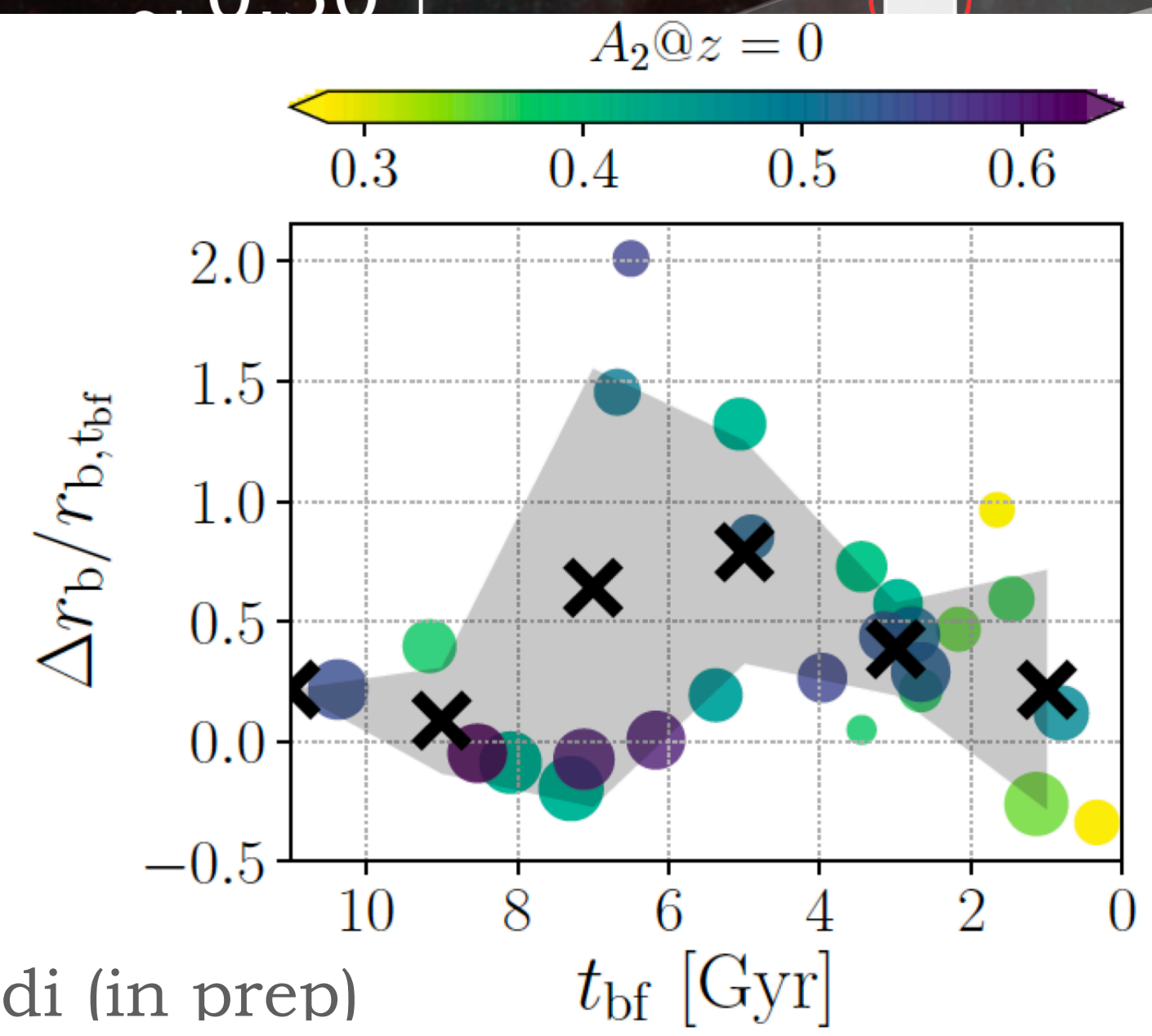
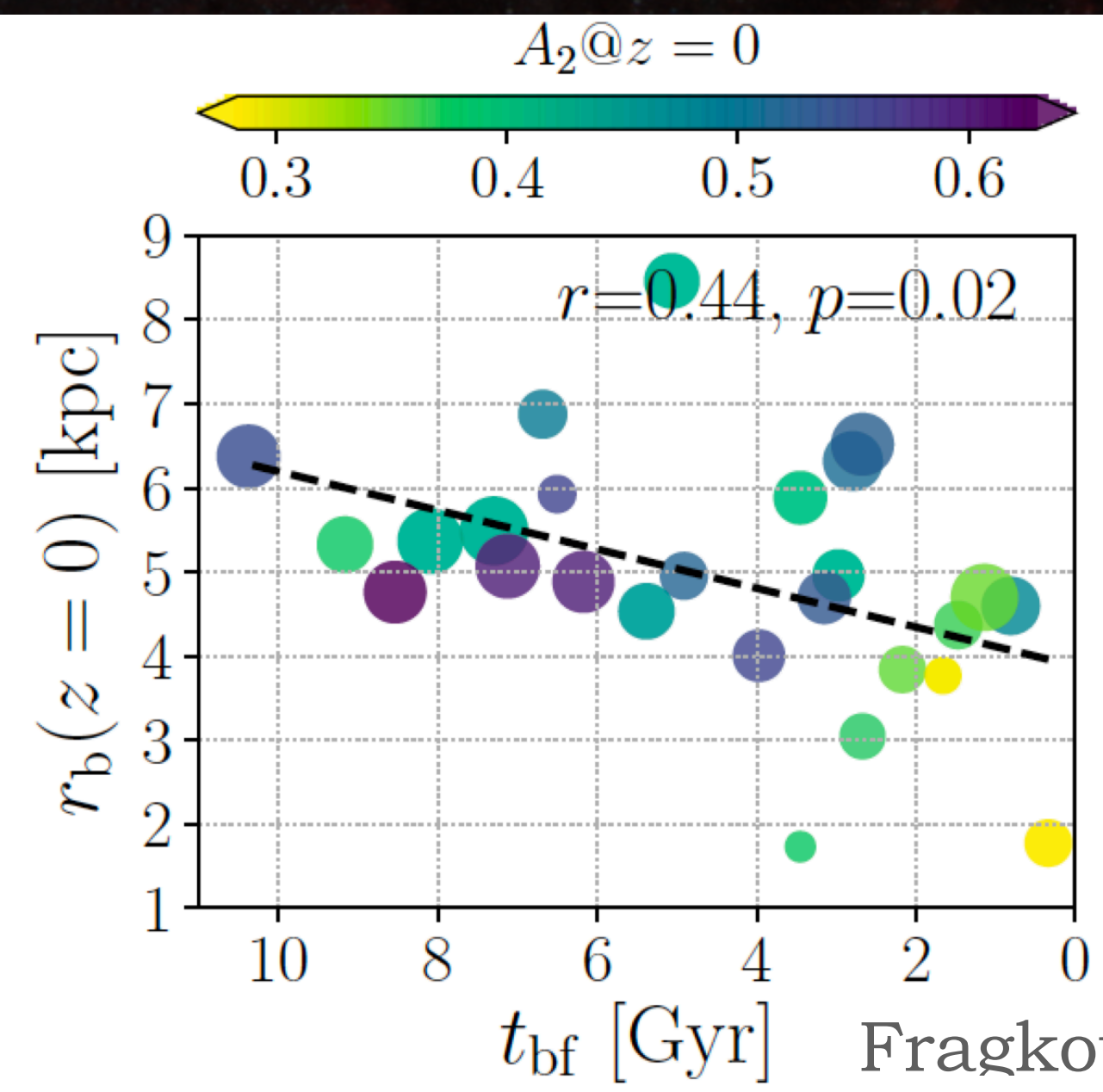




time?

Work in progress

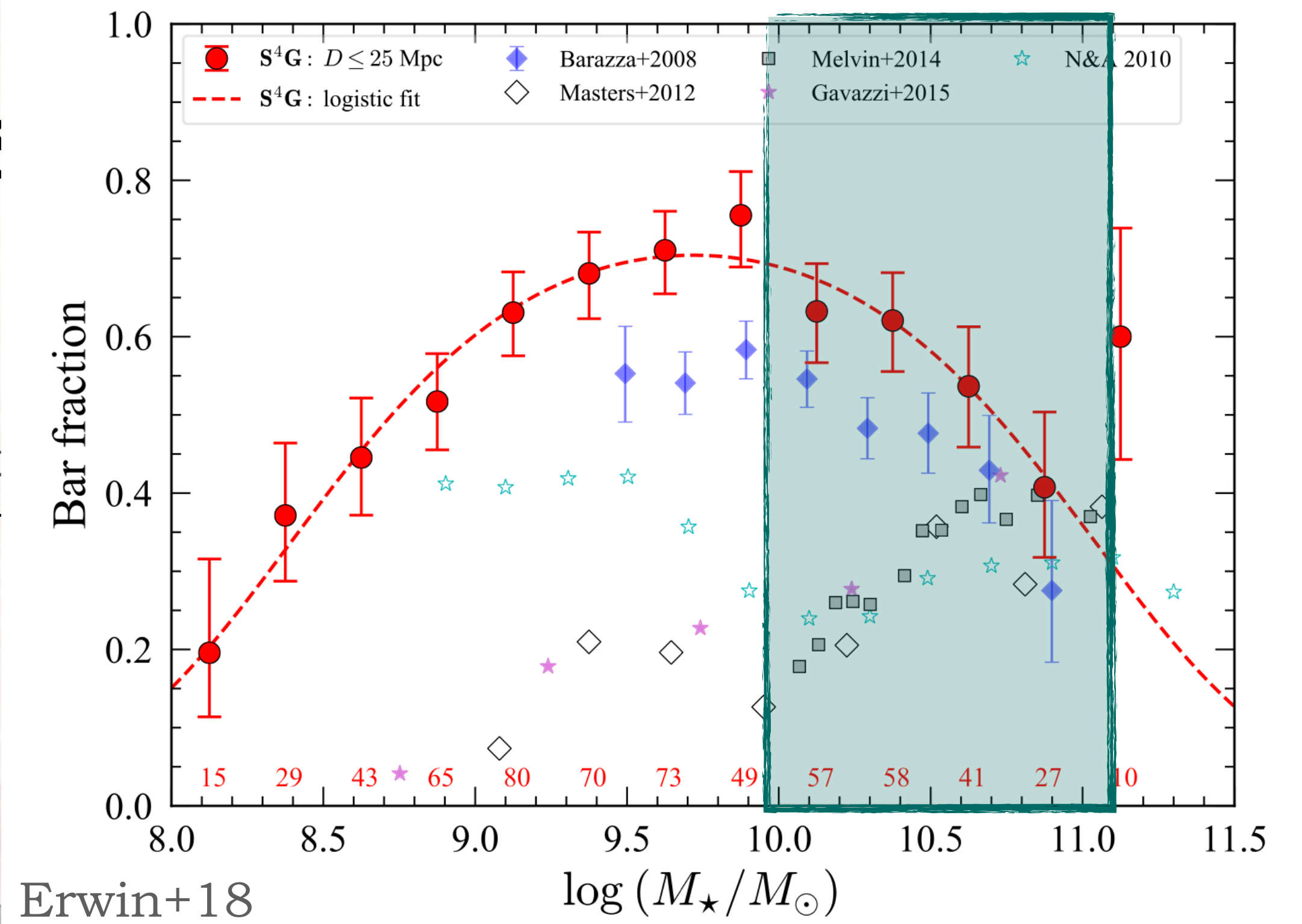
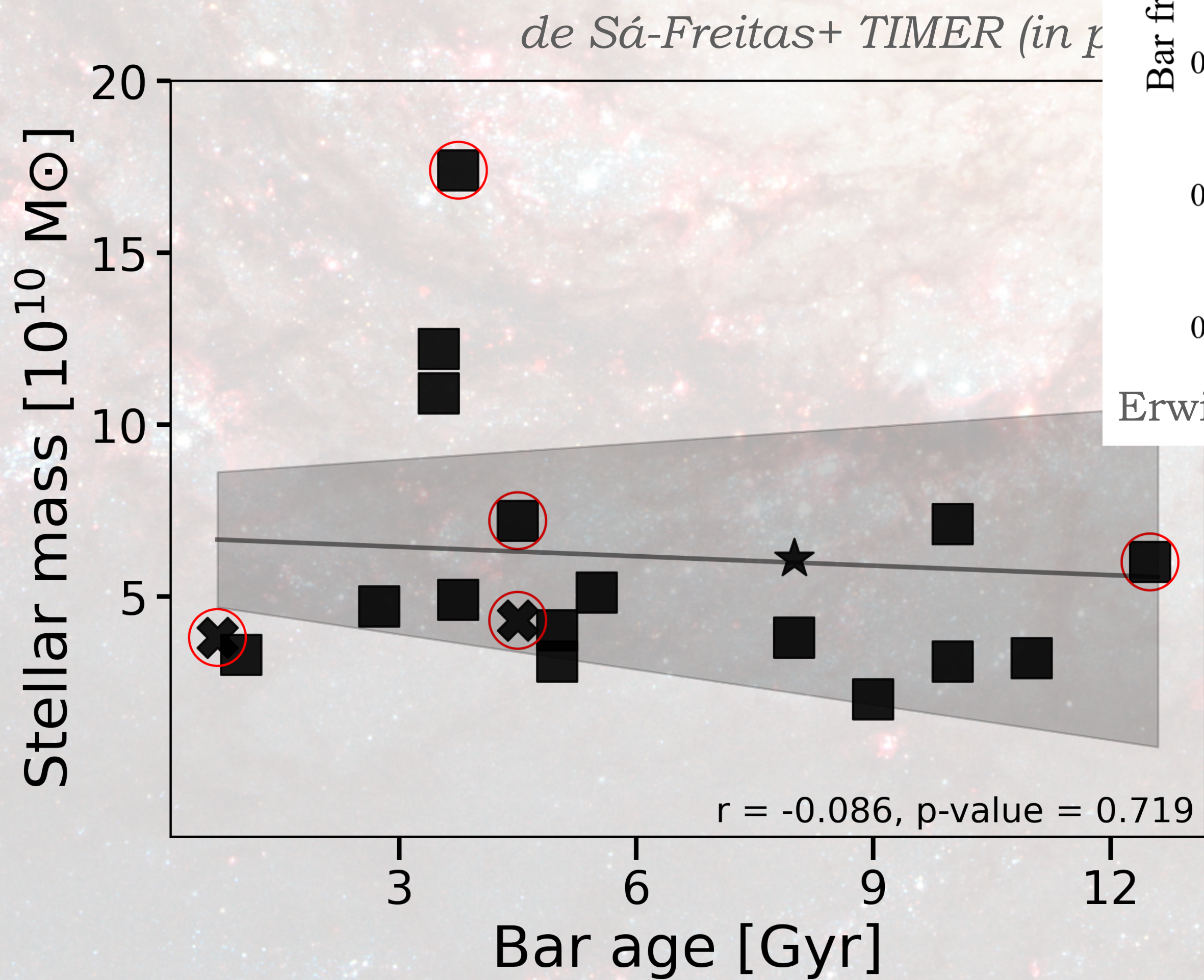
de Sá-Freitas+ TIMER (in prep)



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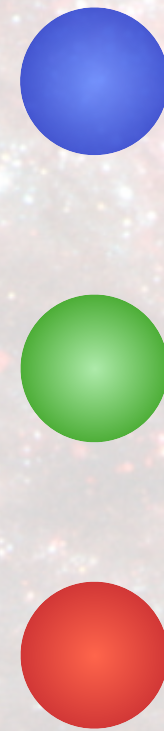
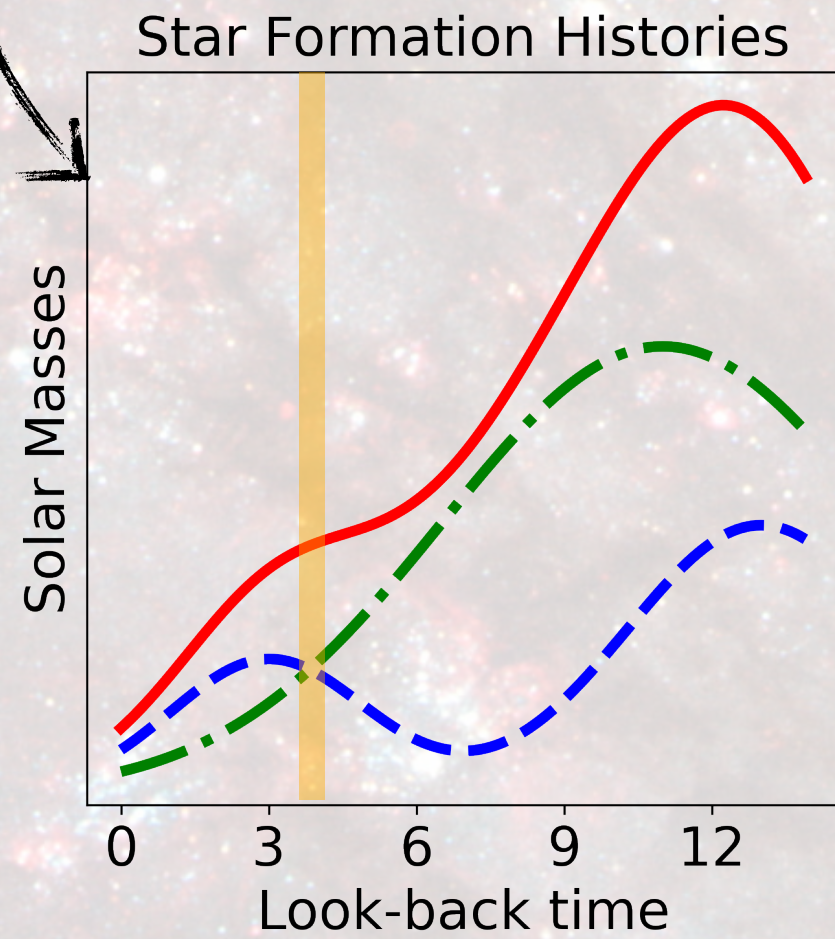
# Bar formation: is mass





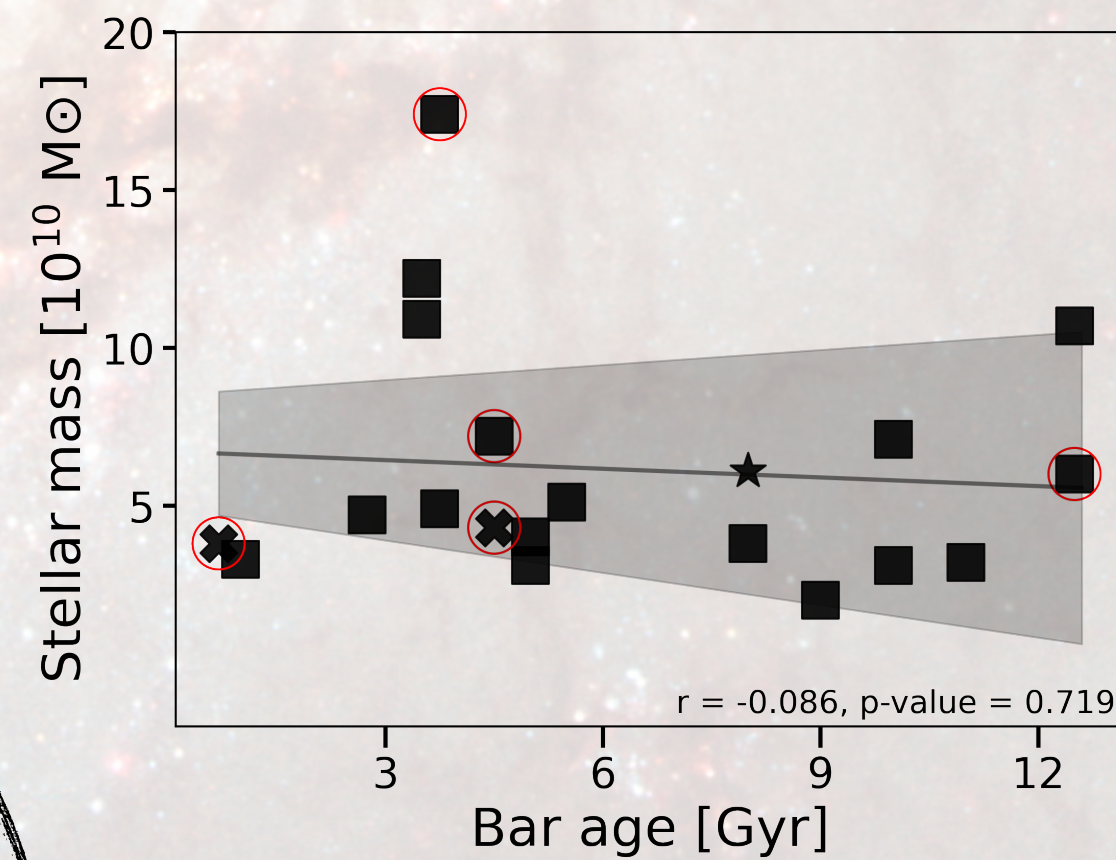
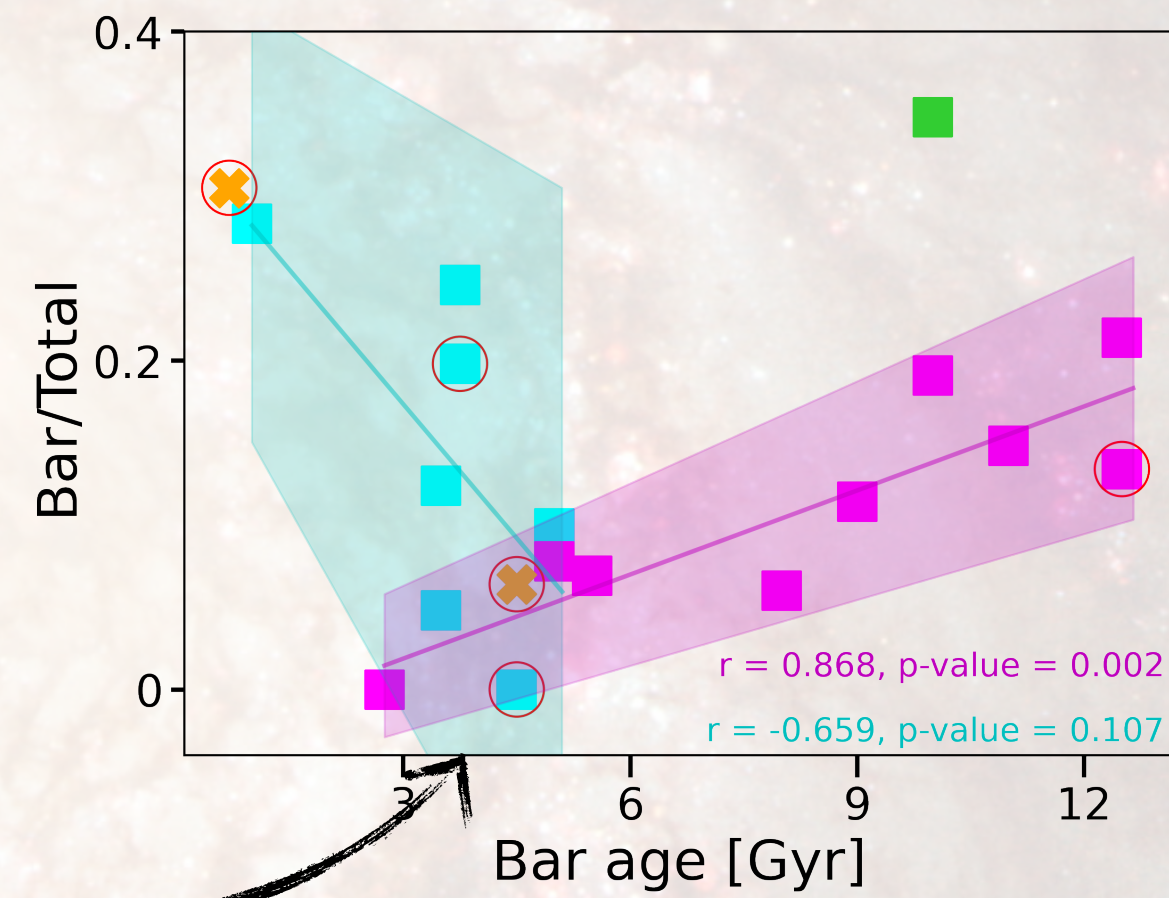
# Take away messages

For how long?



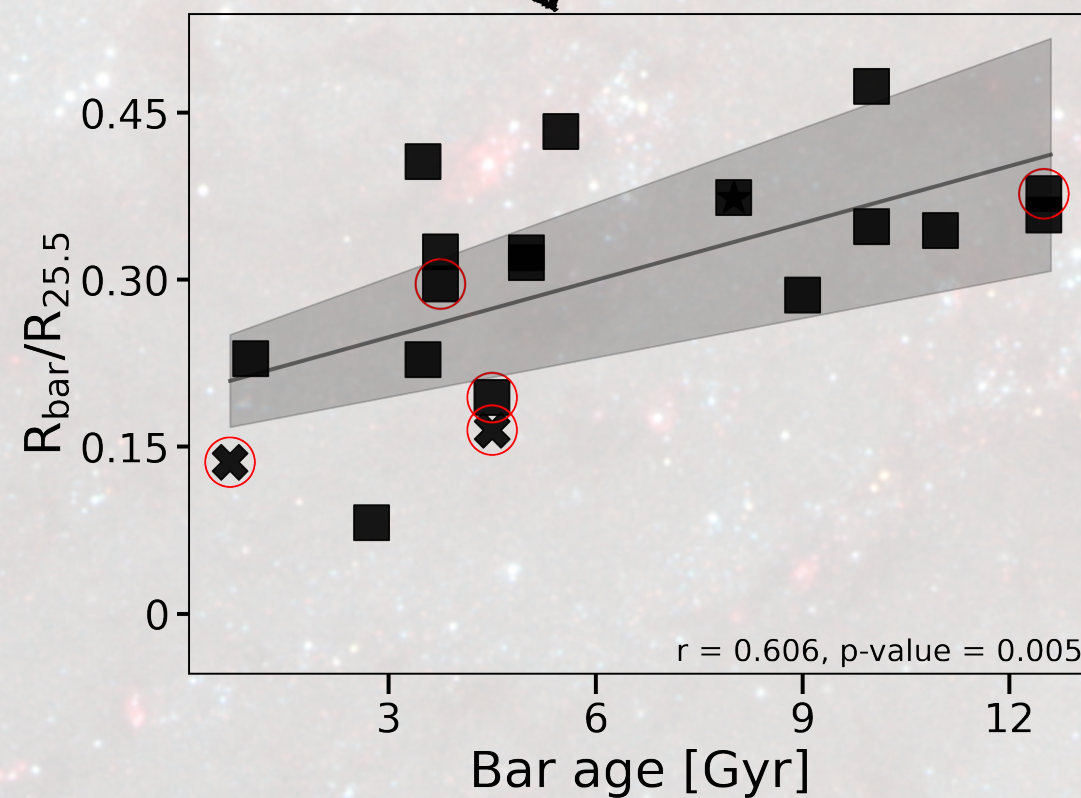
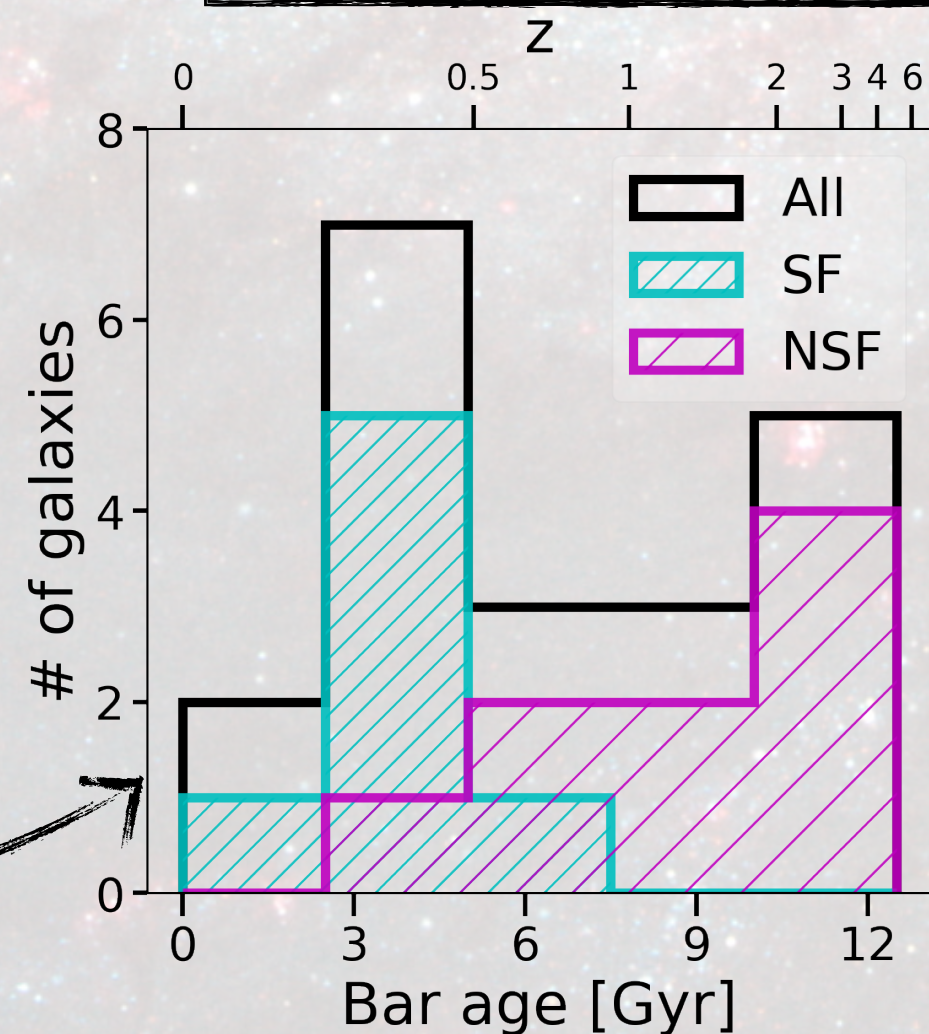
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Do bars and bar-built structures grow?



What's next?

How old are bars observed in the Local Universe?



Are massive galaxies able to form bars earlier?





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