

# The age- $\sigma_v$ correlation in Andromeda's disk

Claire Dorman (UCSC)  
Santa Cruz Galaxy Workshop  
14 August 2014

with Raja Guhathakurta, Anil Seth, Julianne Dalcanton,  
Dan Weisz, PHAT team, SPLASH team

# Disk evolution theory limited by observations

goal: map stellar  $h$  or  $\sigma$  as function of age

Kinematics ( $\sigma$ )

Scale height ( $h$ )

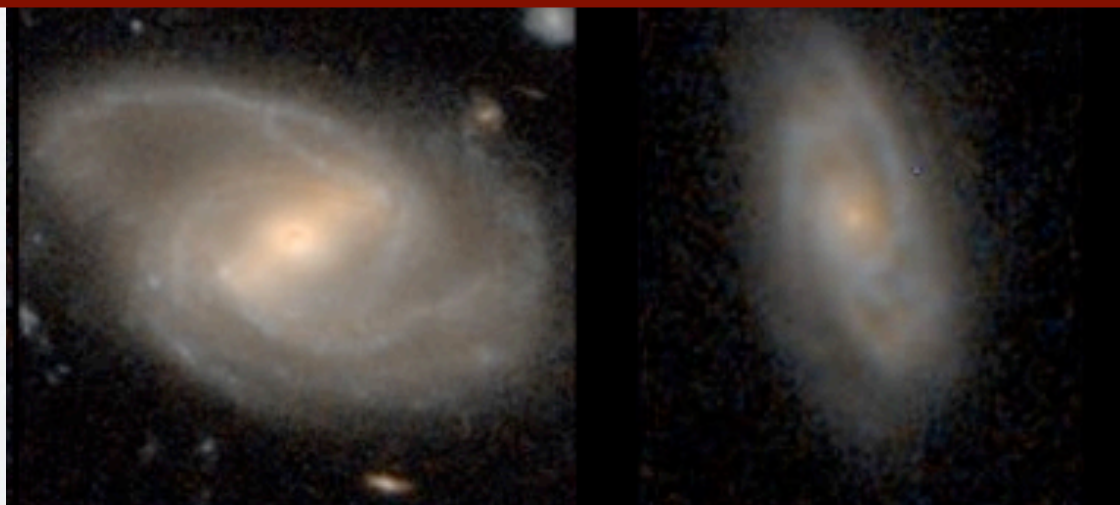
Milky Way: limited to solar neighborhood

e.g., Nordstrom+ 2004

Resolved photometry in local edge-on galaxies: dusty; no view of disk face

e.g., Seth+ 2005

Kinematics of face-on galaxies: difficult to separate stellar pops in integrated light





# M3 I ideal for studying age trends in disks

large spiral:  
“analogue” to MW

near enough for  
resolved kinematics

unobstructed  
view of disk

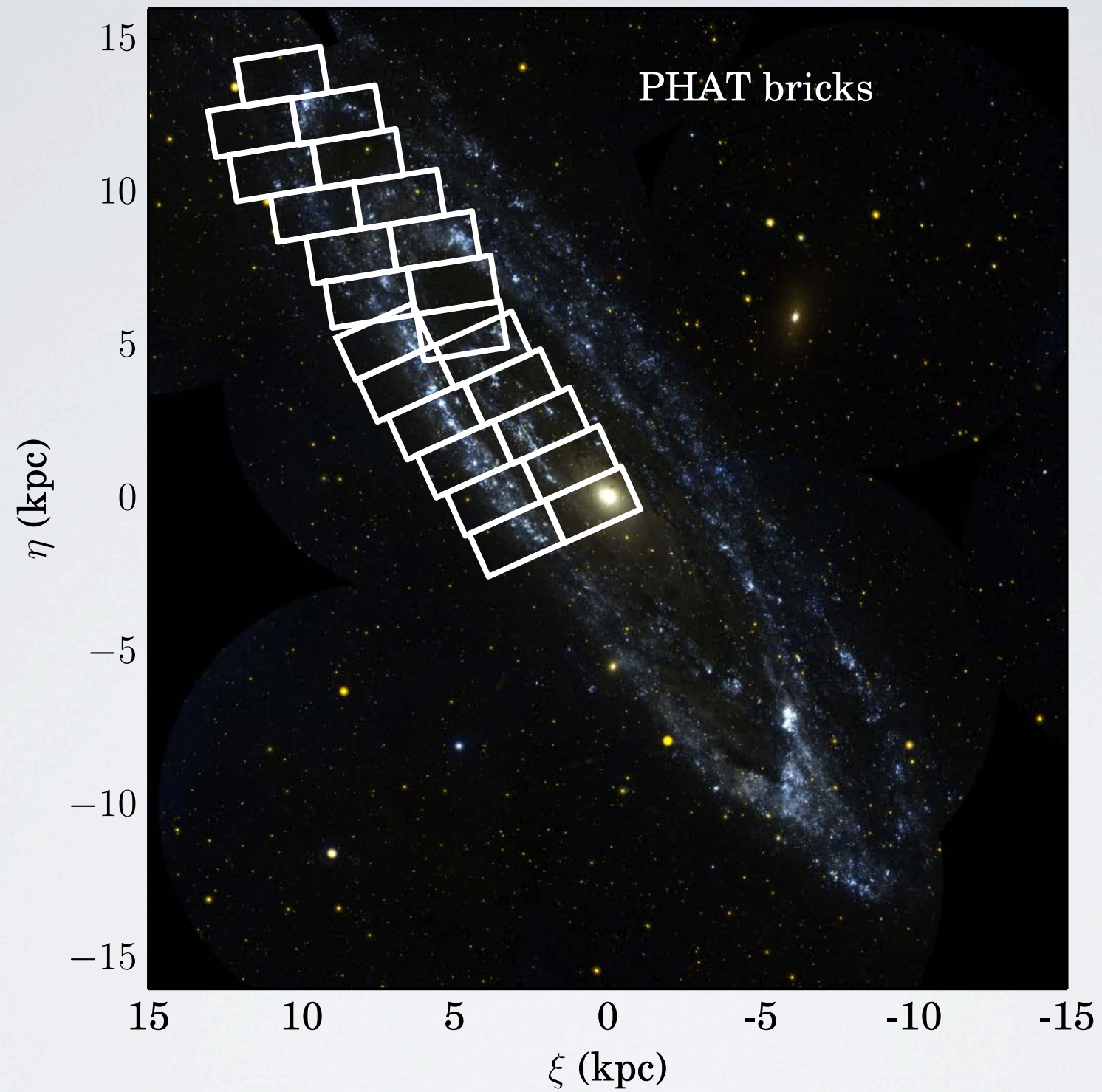


**Goal:**  
**Map  $\sigma_v$  in M3 I's disk**  
**for stars in 4 age bins**

# Data



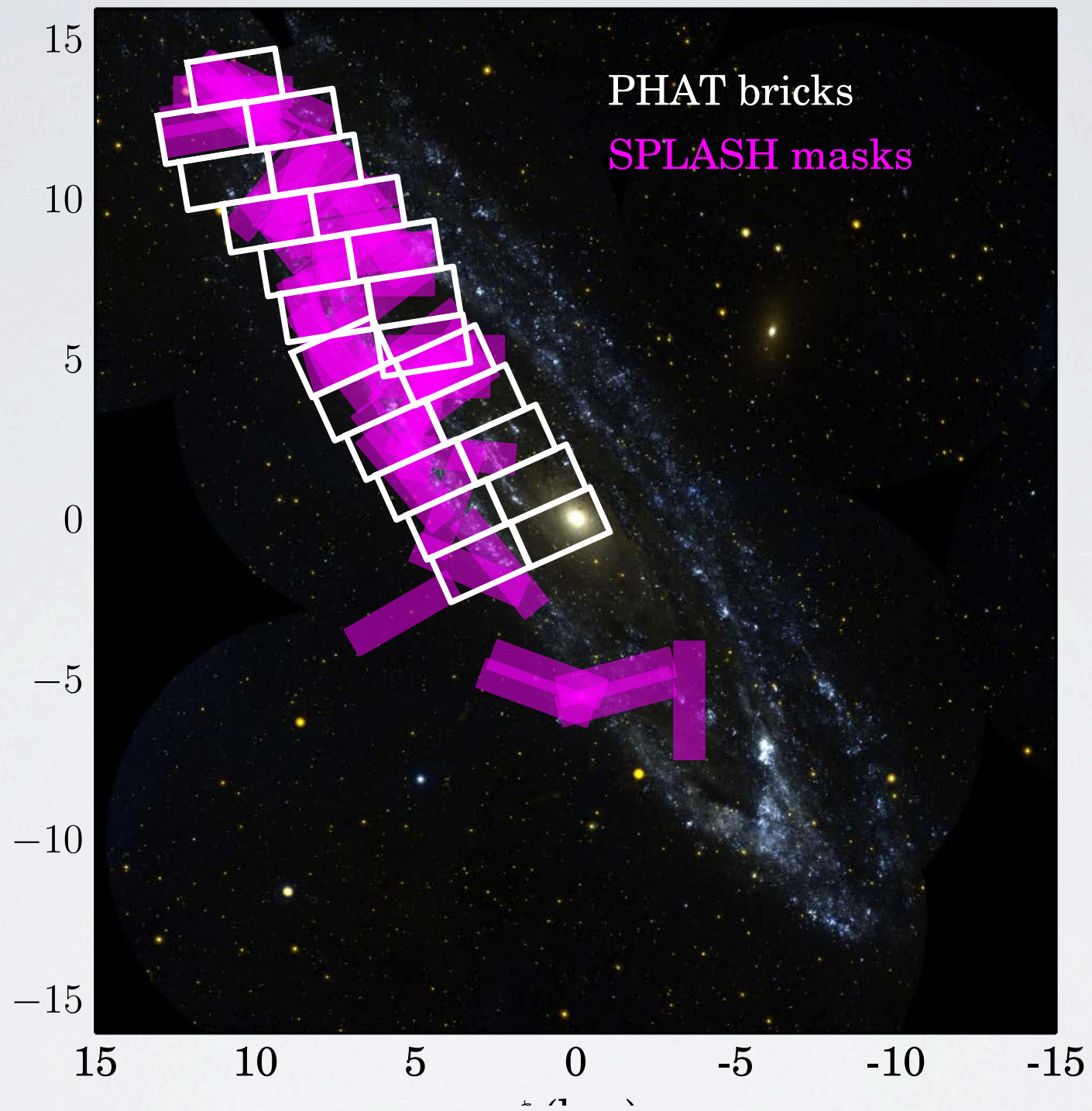
# PHAT: 6-filter HST photometry of $10^8$ stars



see Dalcanton+ 2012



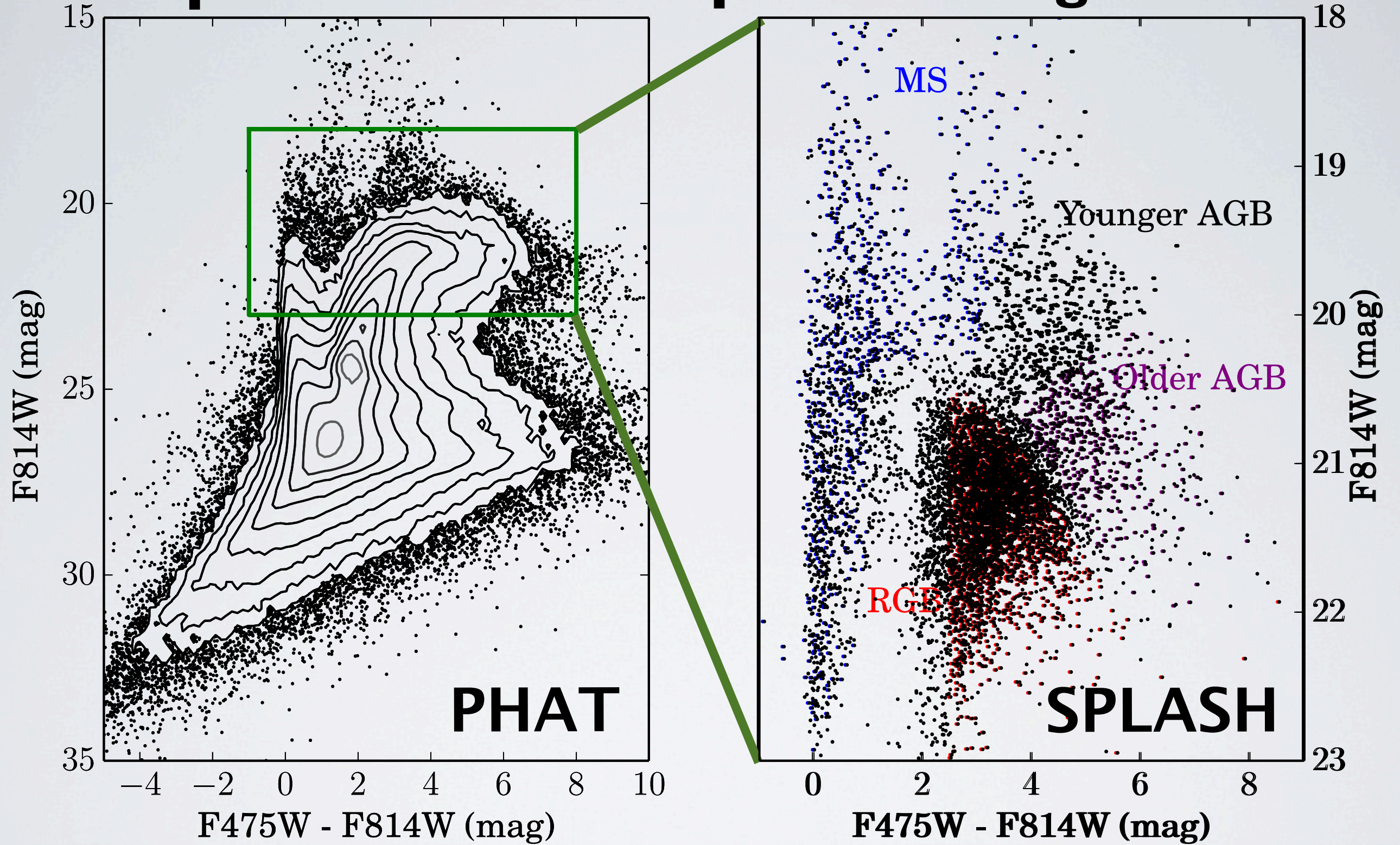
# SPLASH: Keck radial velocities of 9000+ stars



# Methods

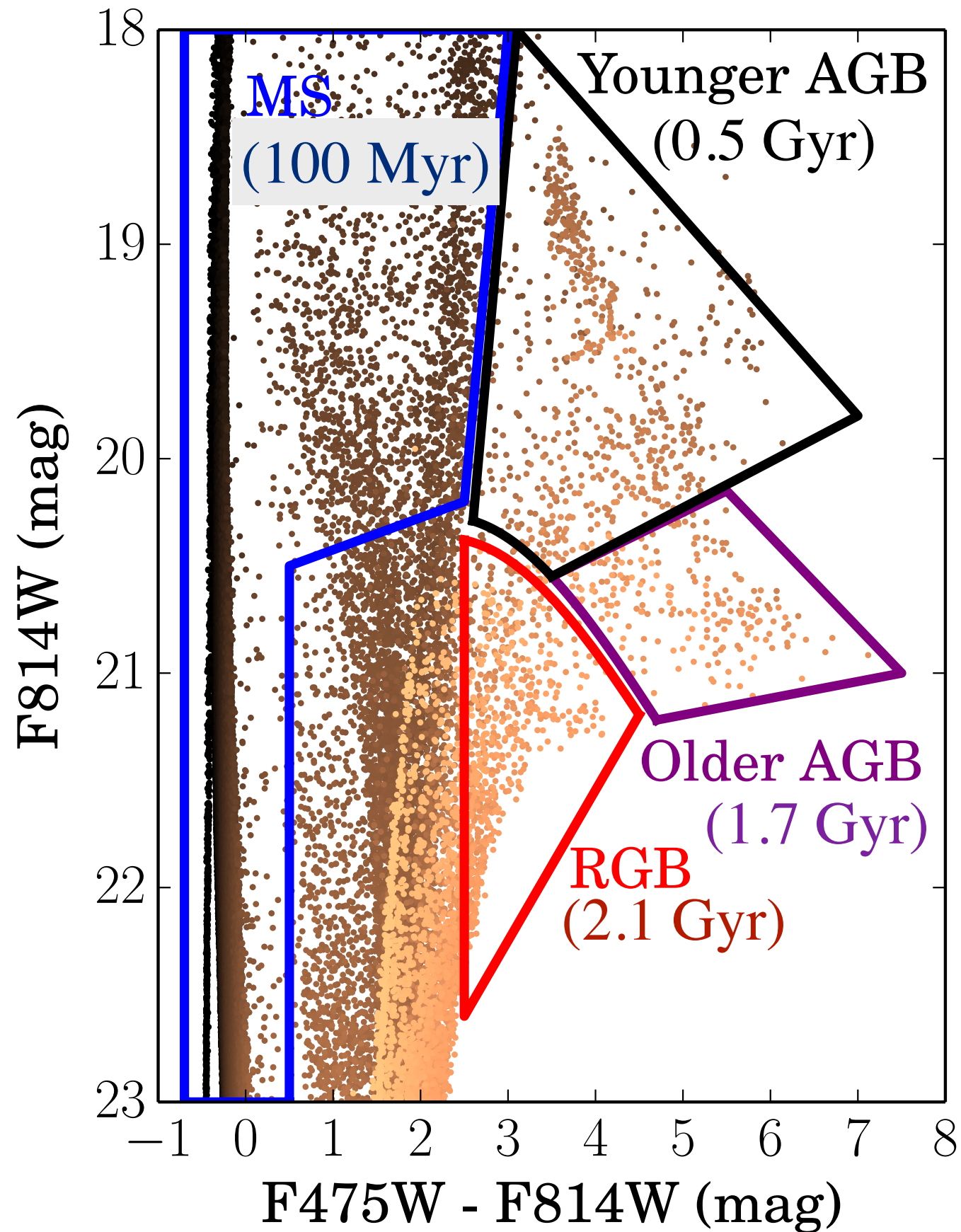


# Split SPLASH sample into 4 age bins





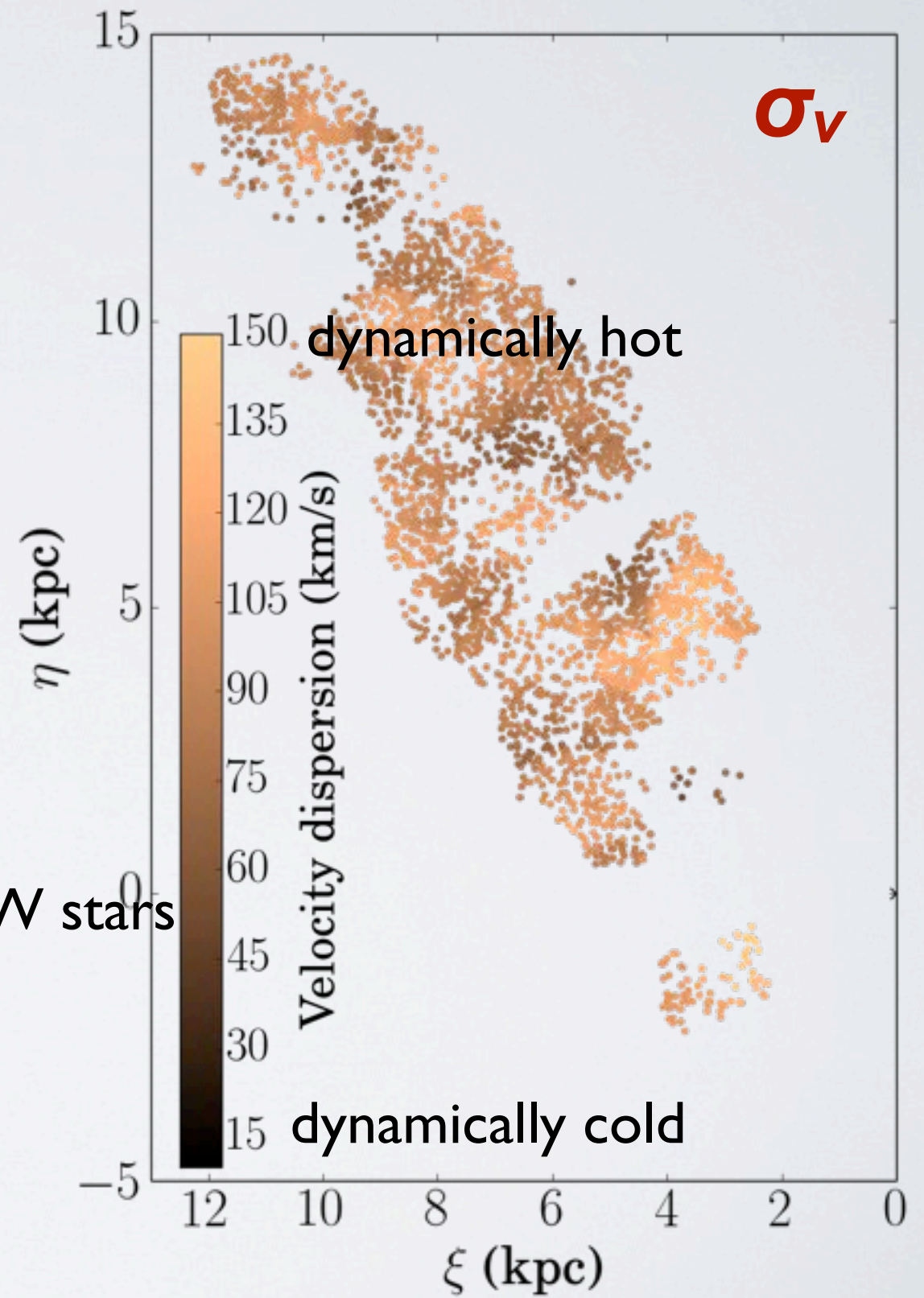
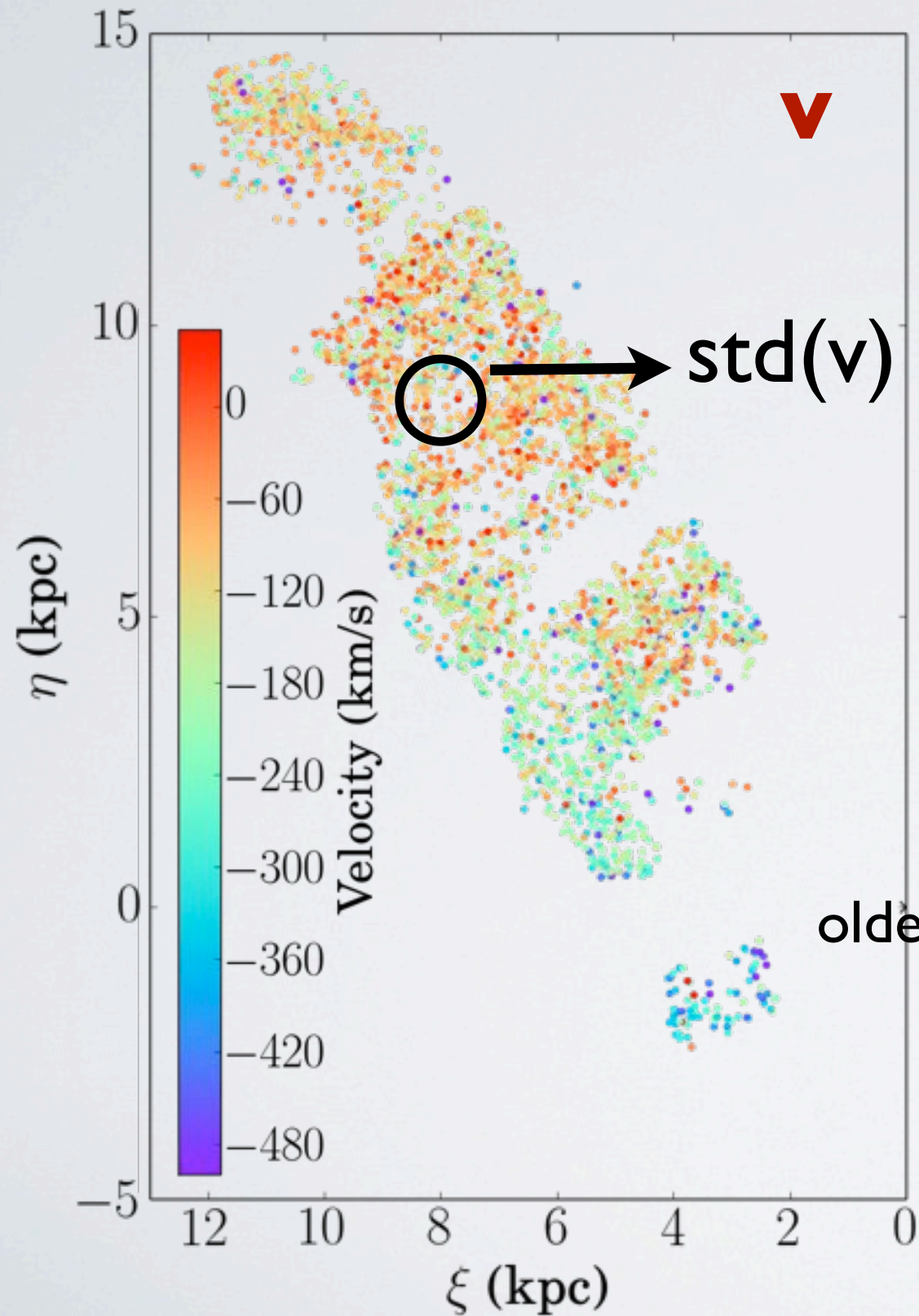
# Estimate ages using simulated CMD





# Map $\sigma_v$ for each age bin via smoothing

## Example: RGB

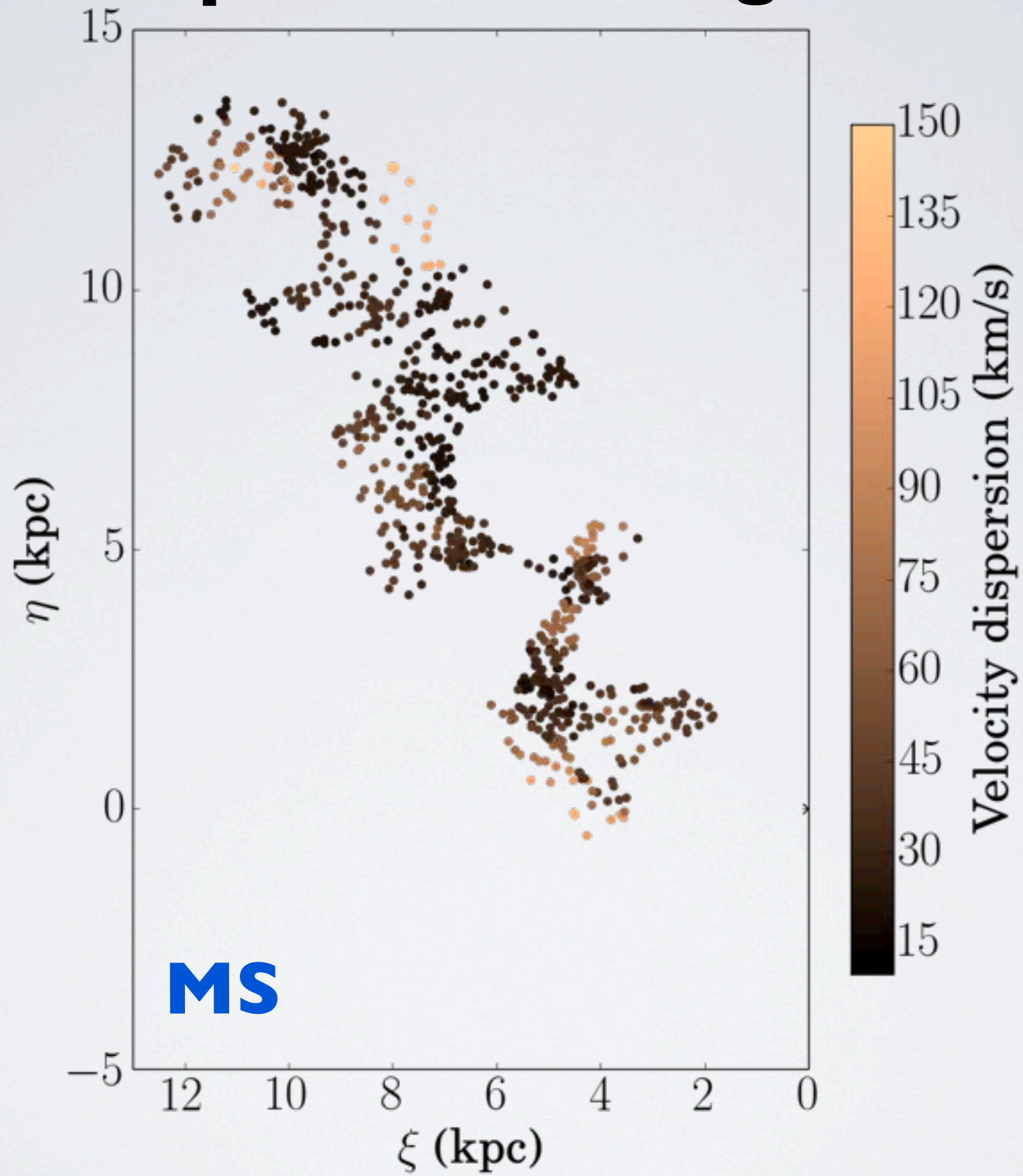




# Results

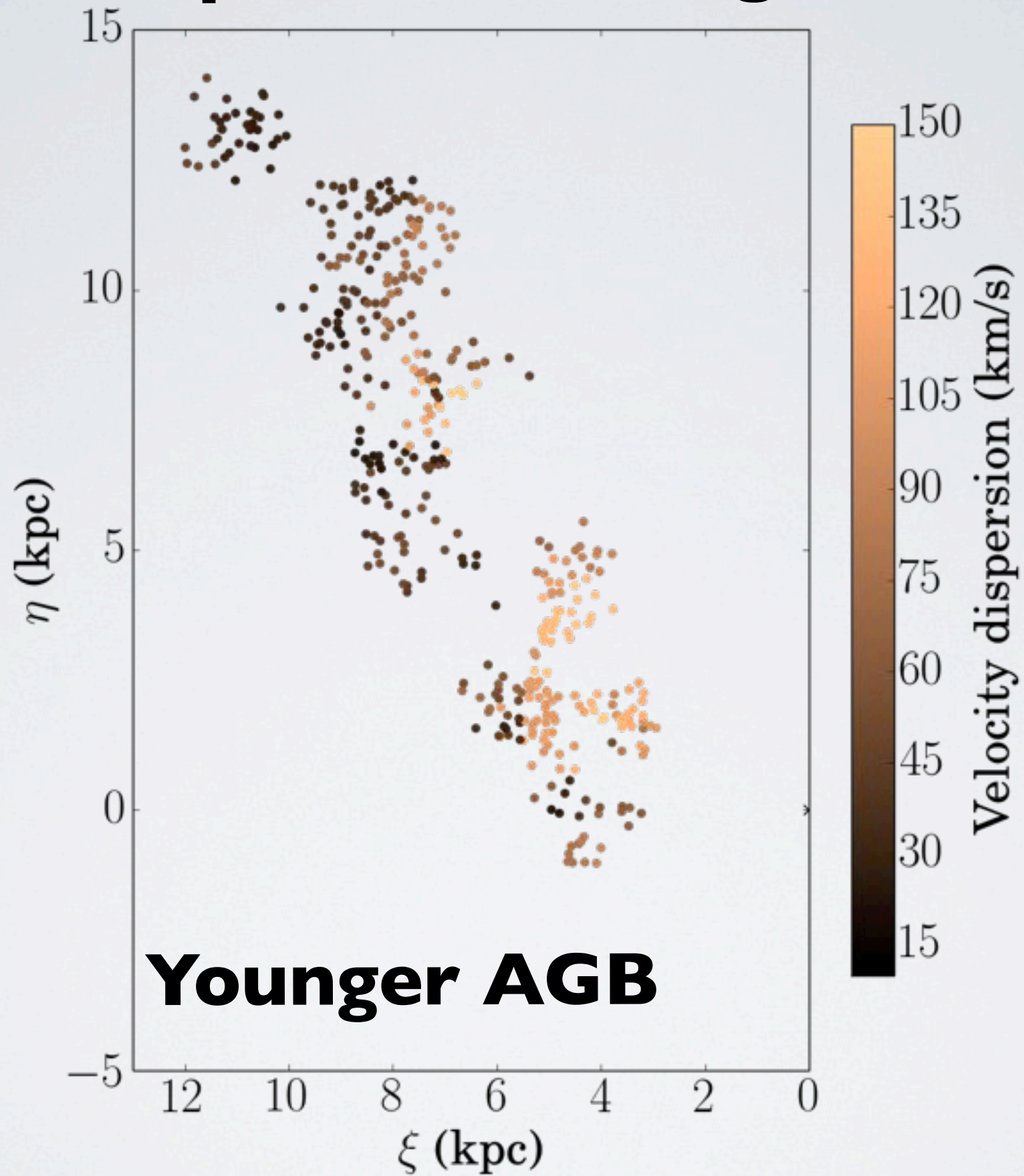


# Map $\sigma_v$ for each age bin



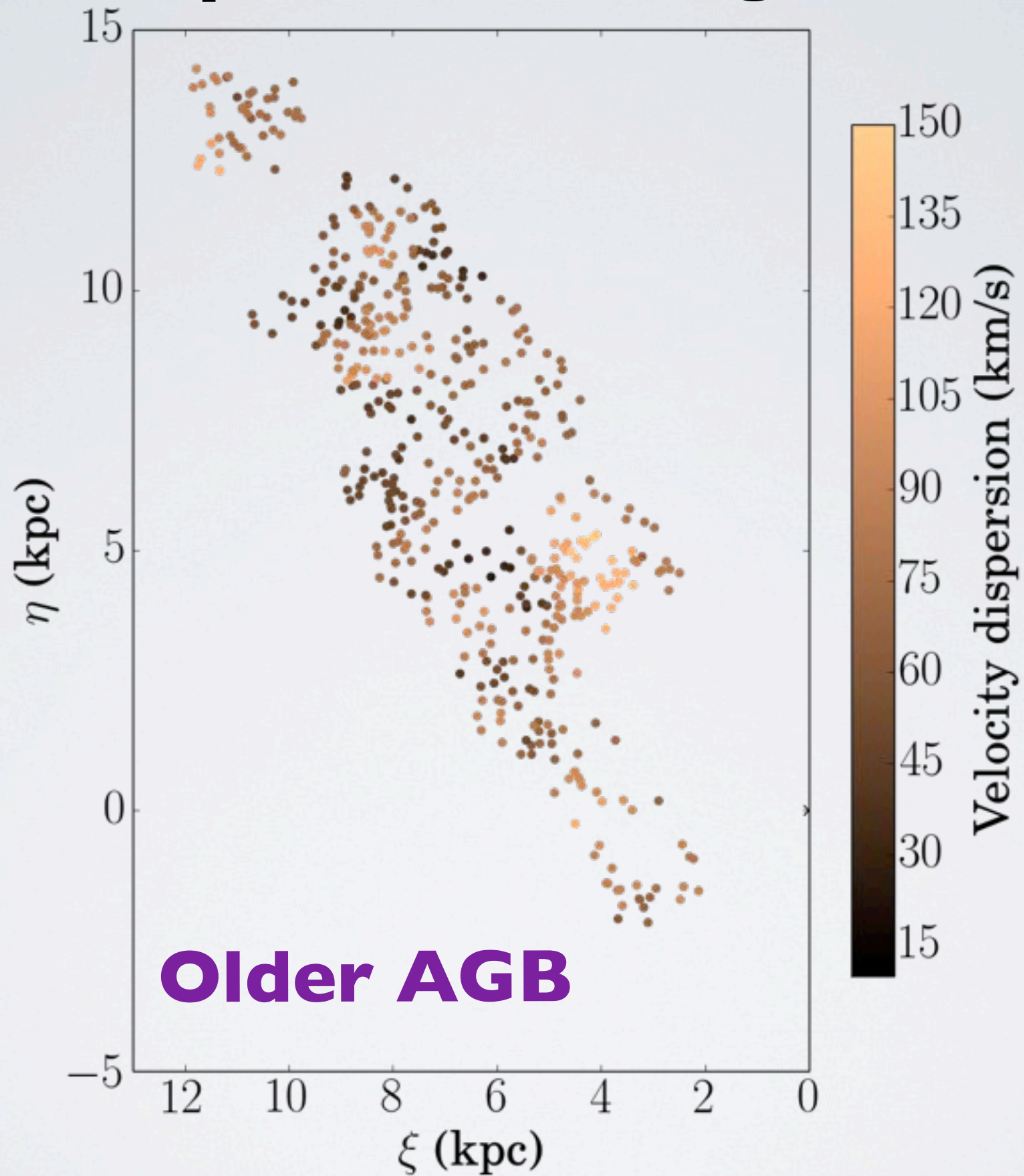


# Map $\sigma_v$ for each age bin



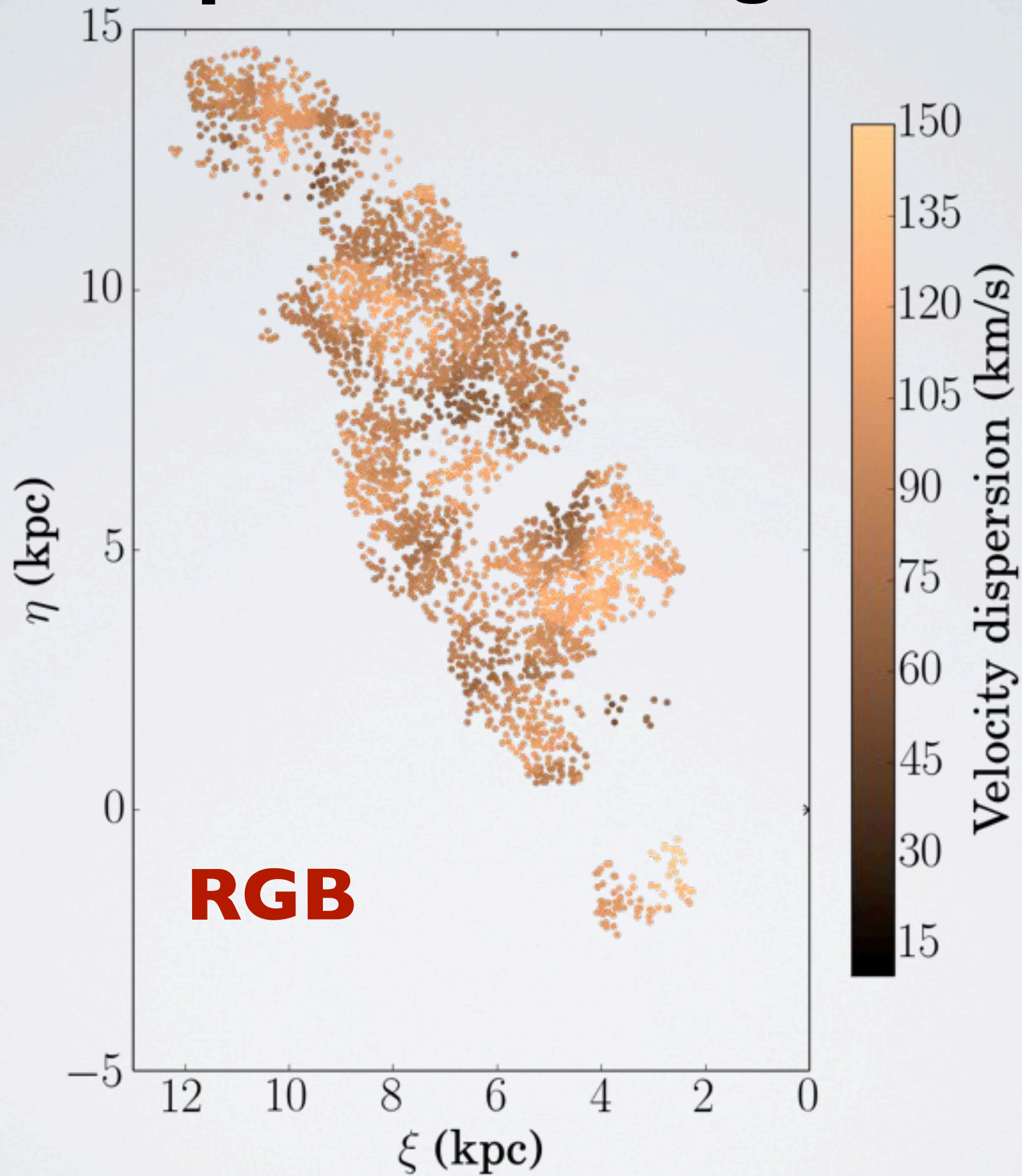


# Map $\sigma_v$ for each age bin



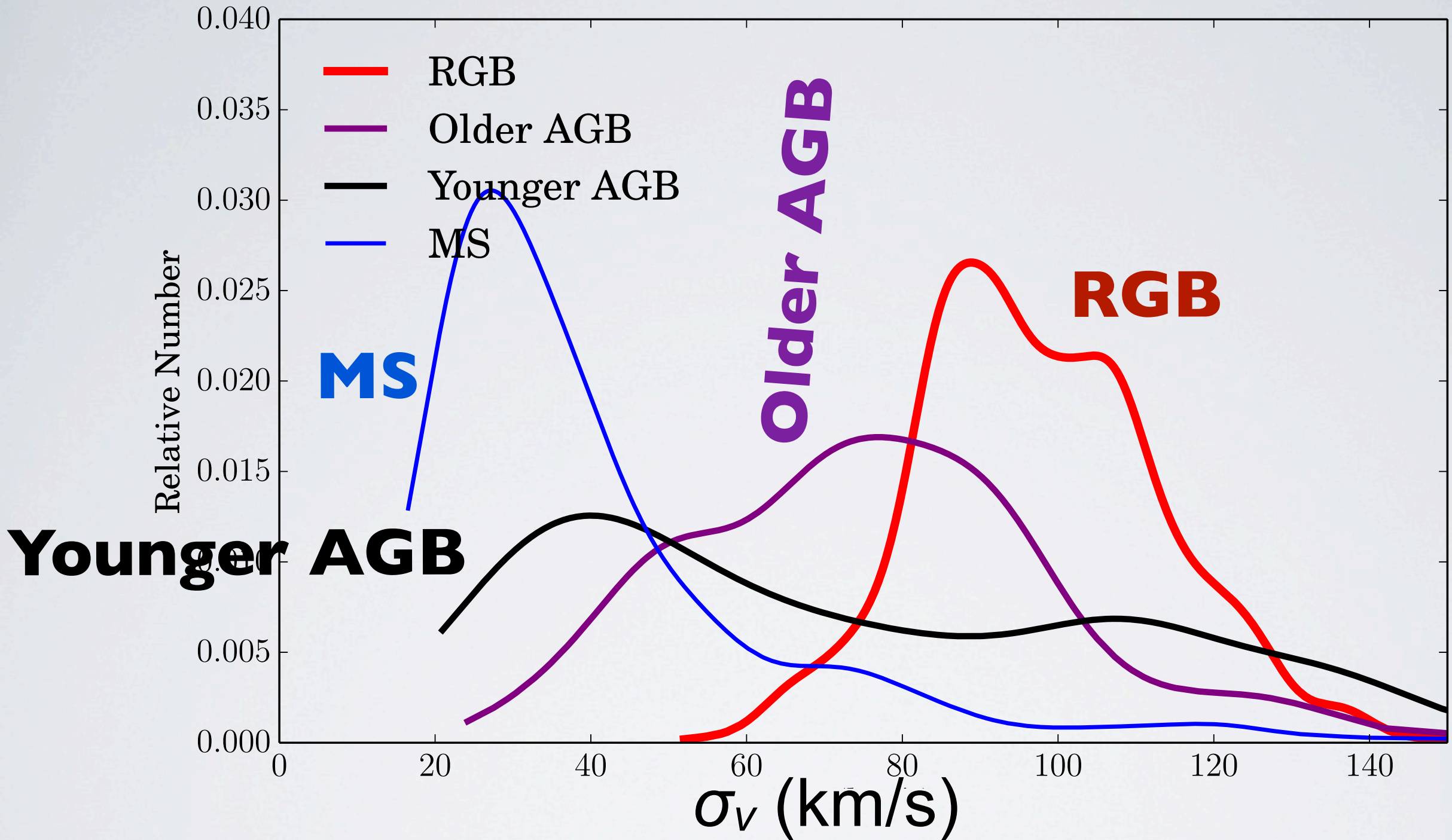


# Map $\sigma_v$ for each age bin





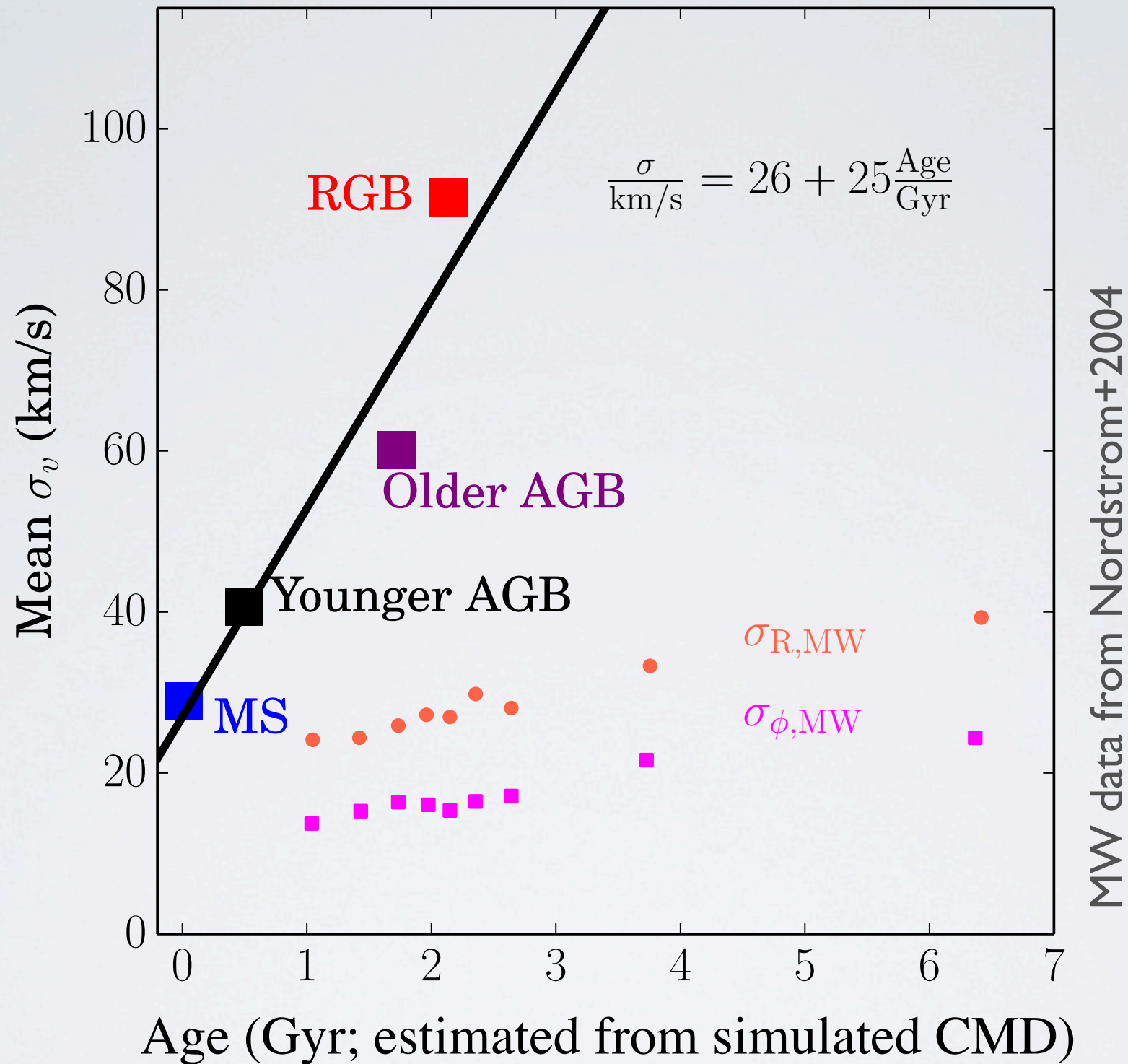
# Dispersion increases monotonically with age



→ need continuous (heating) process

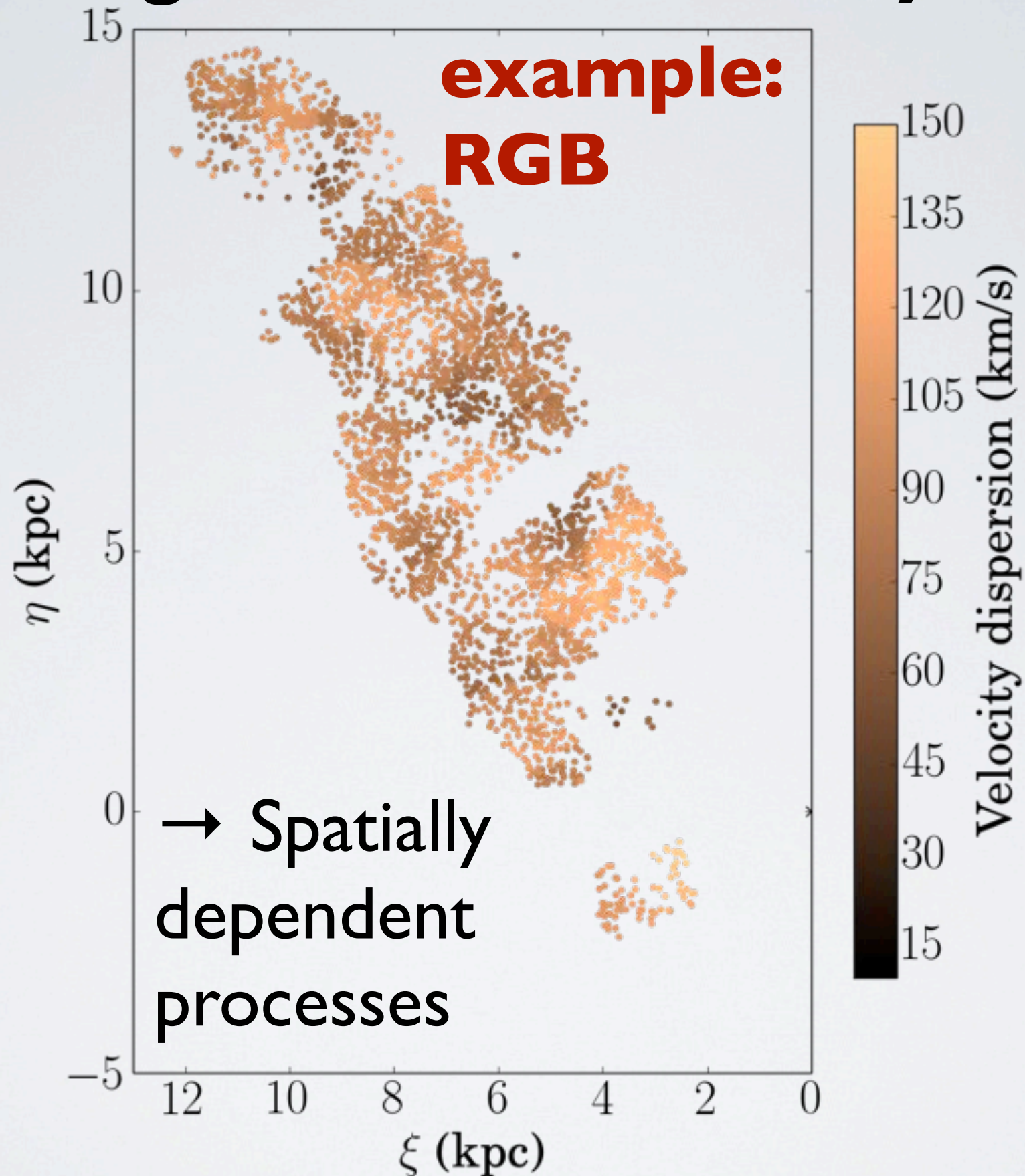


# Heating rate & total $\sigma_v$ higher than in MW



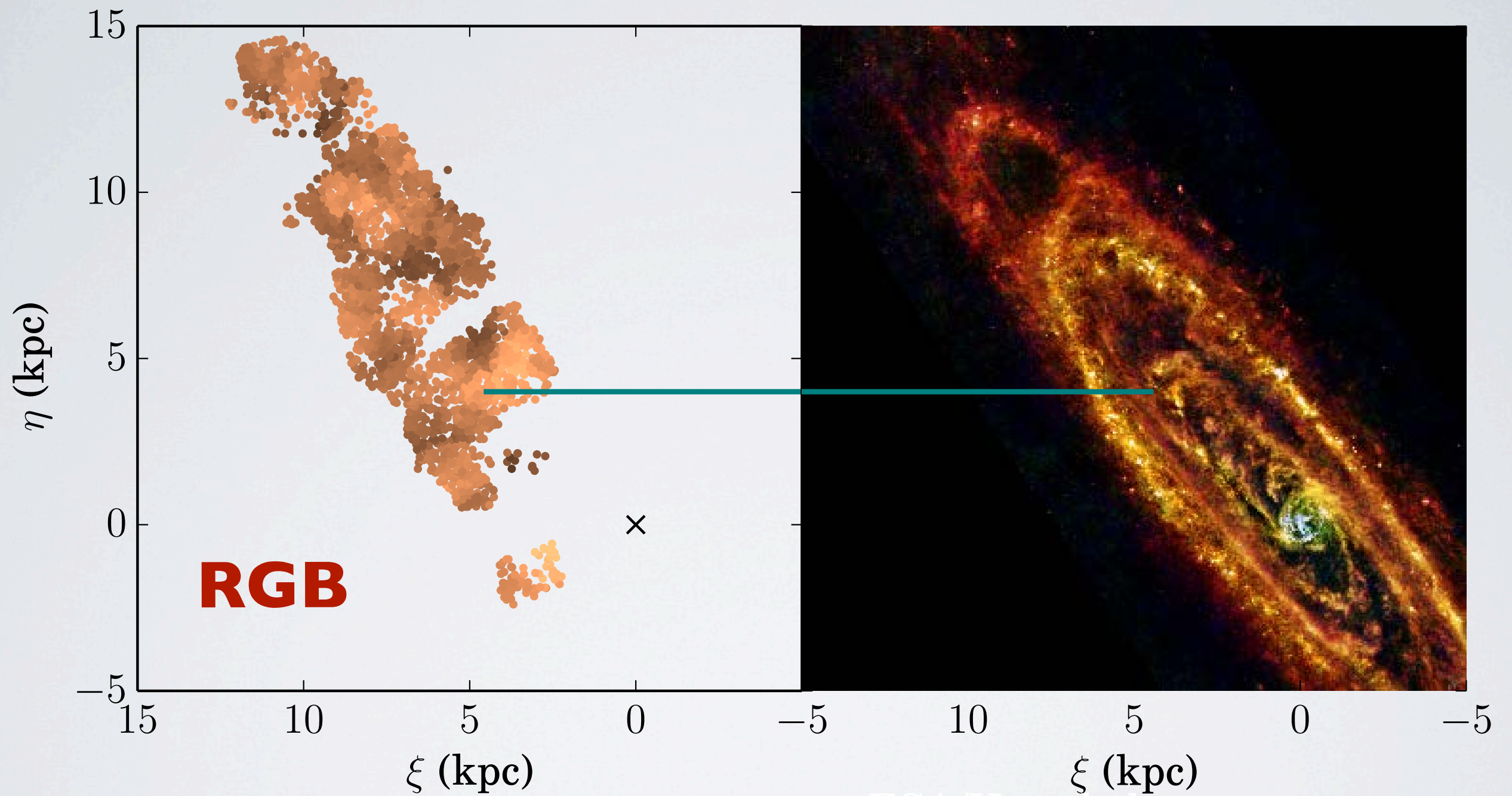
**More active history than MW  
(same trend seen in halos)**

# Stars in all age bins kinematically “clumpy”

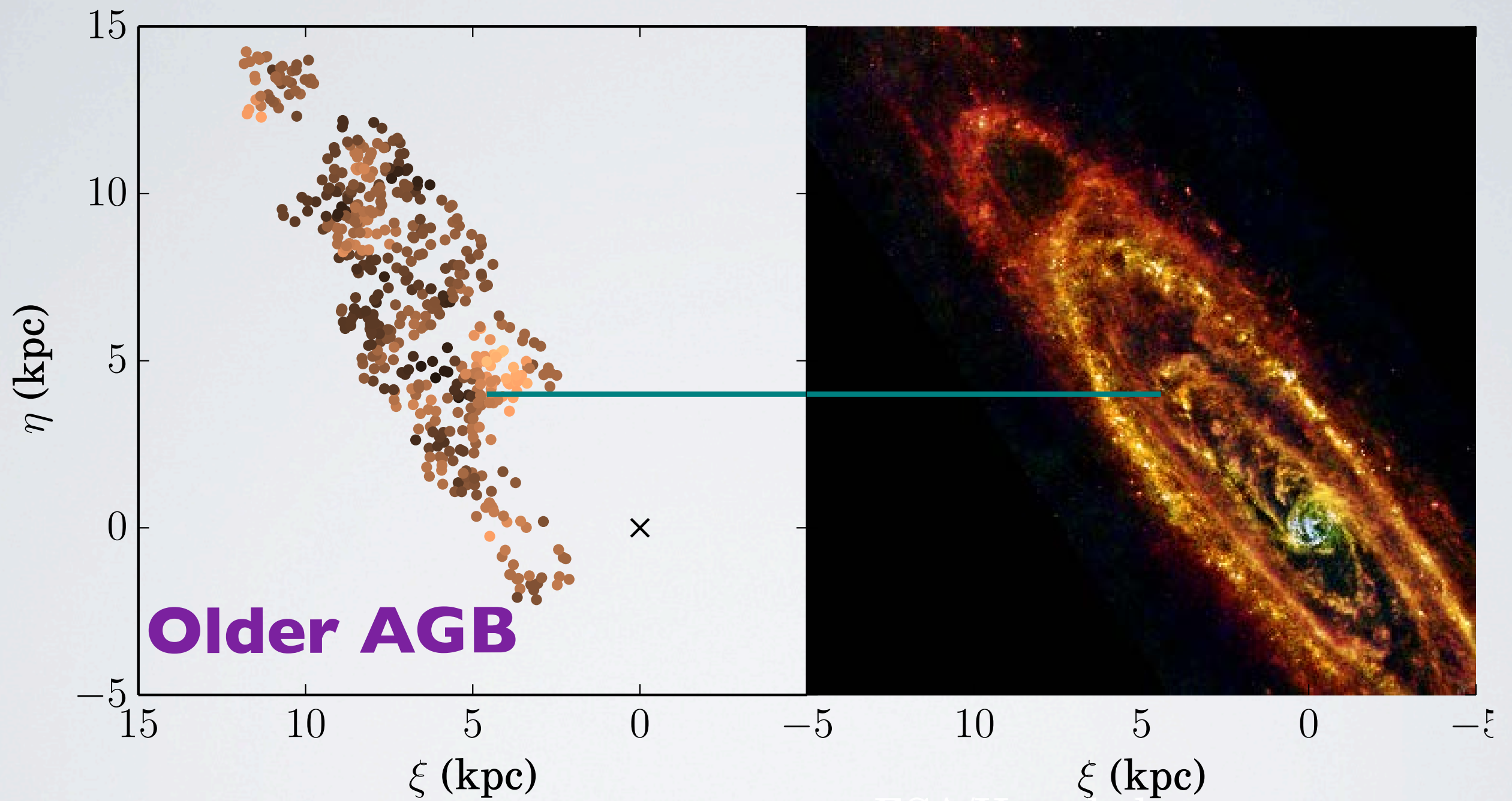




# Dynamically hot feature in all bins

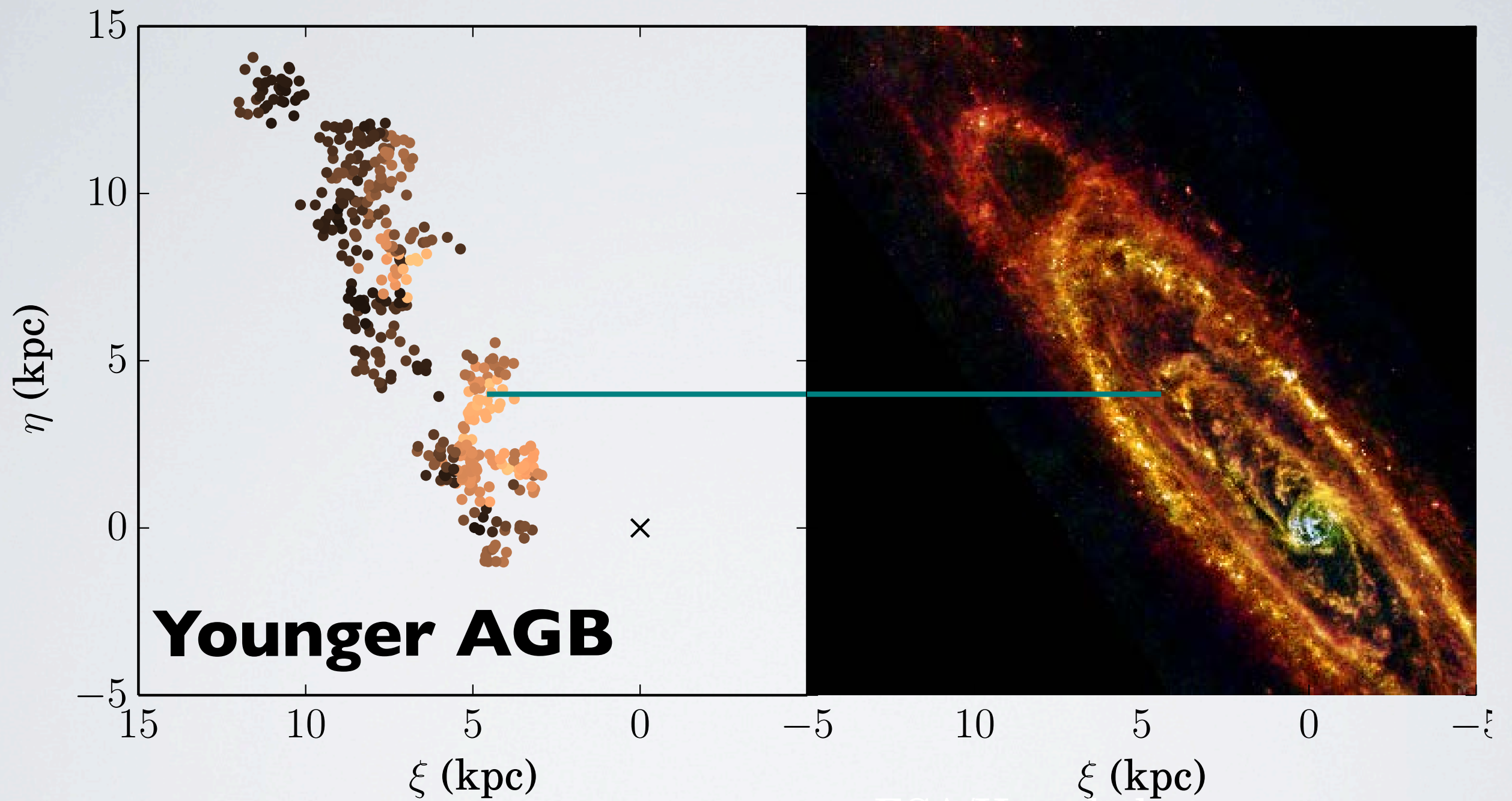


# Dynamically hot feature in all bins

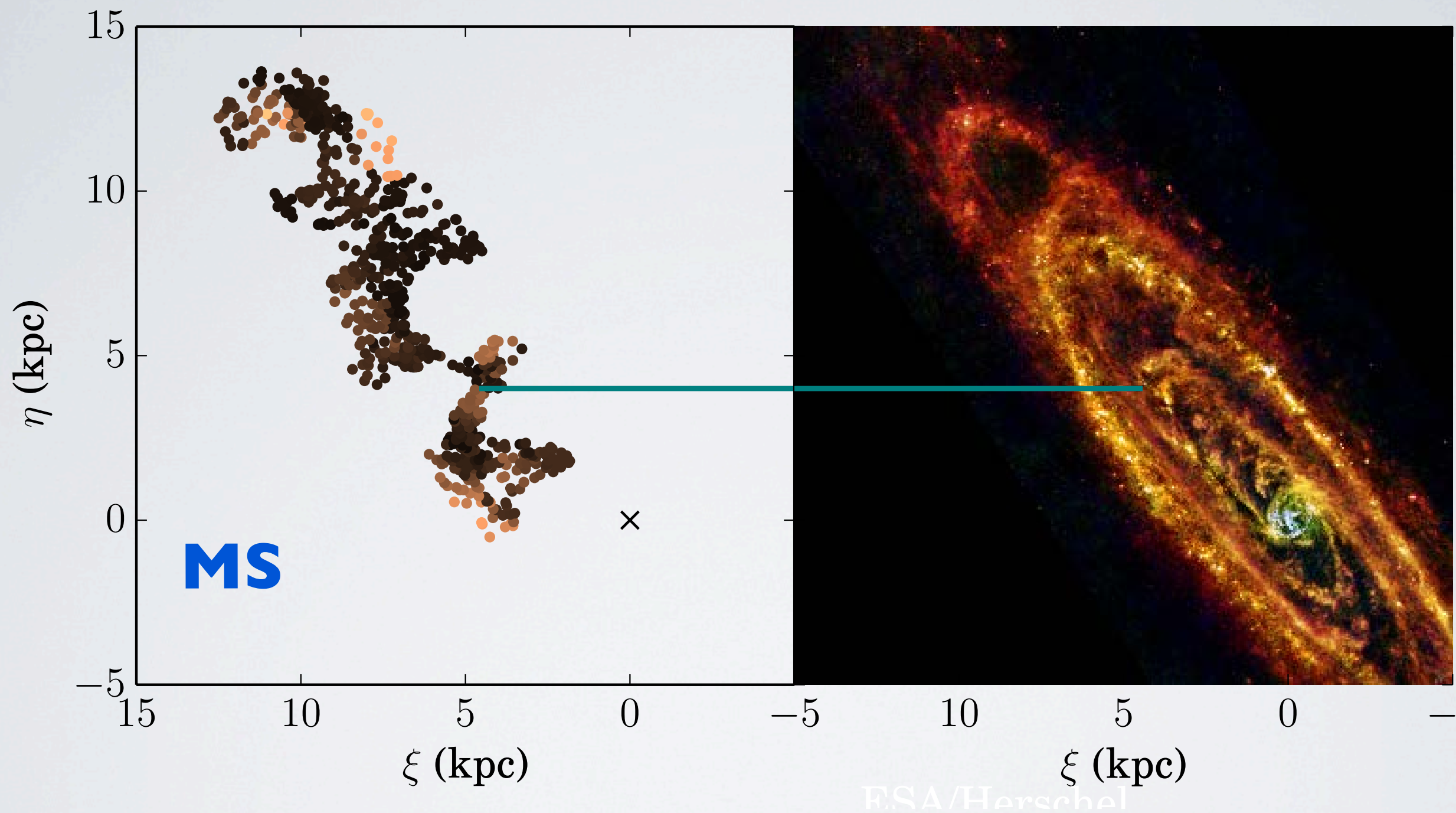




# Dynamically hot feature in all bins

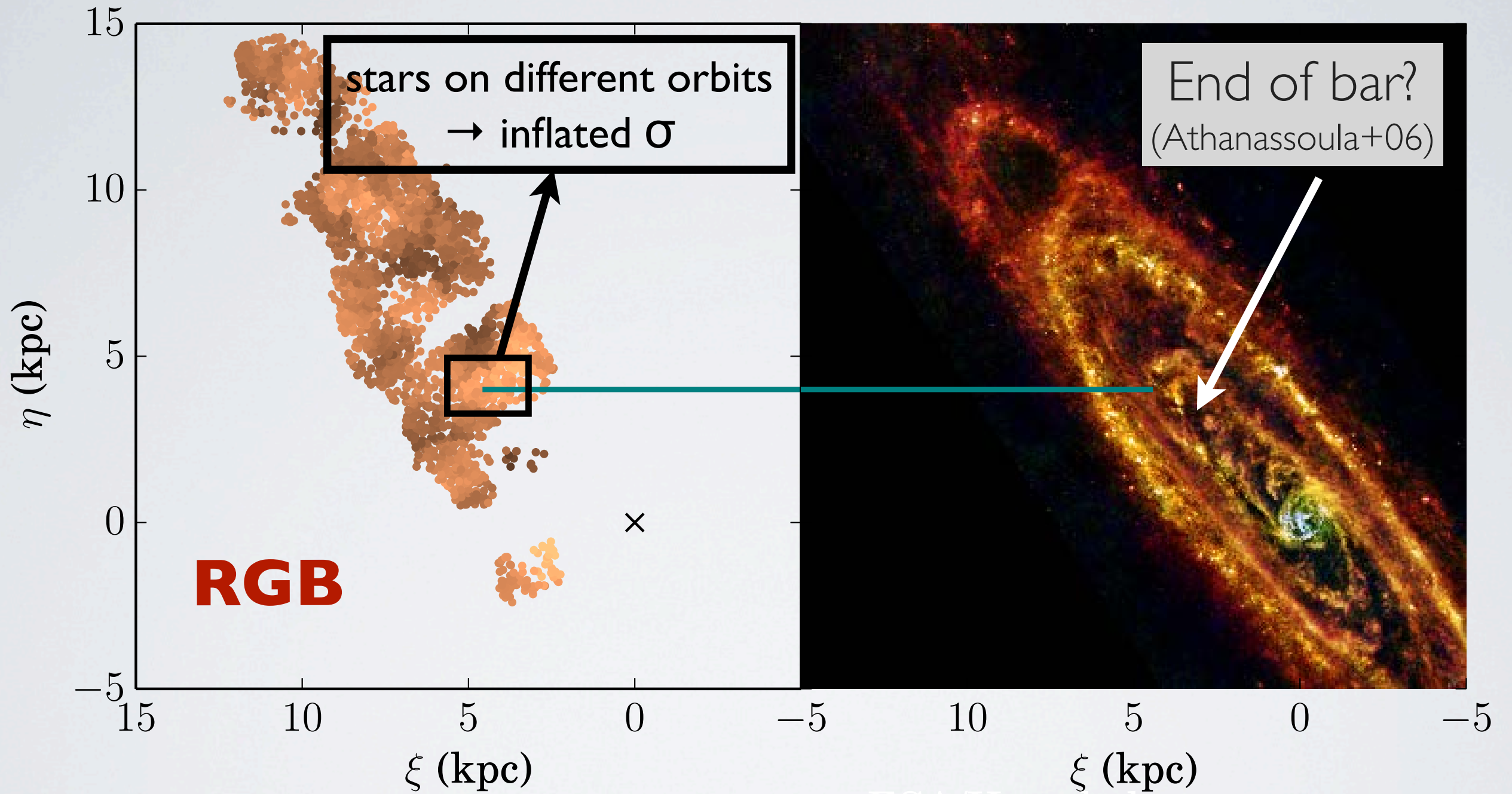


# Dynamically hot feature in all bins





# Dynamically hot feature in all bins: signature of ring or bar?



# Summary

**1. age:dispersion correlation**

**2. clumpy dispersion map for all ages**

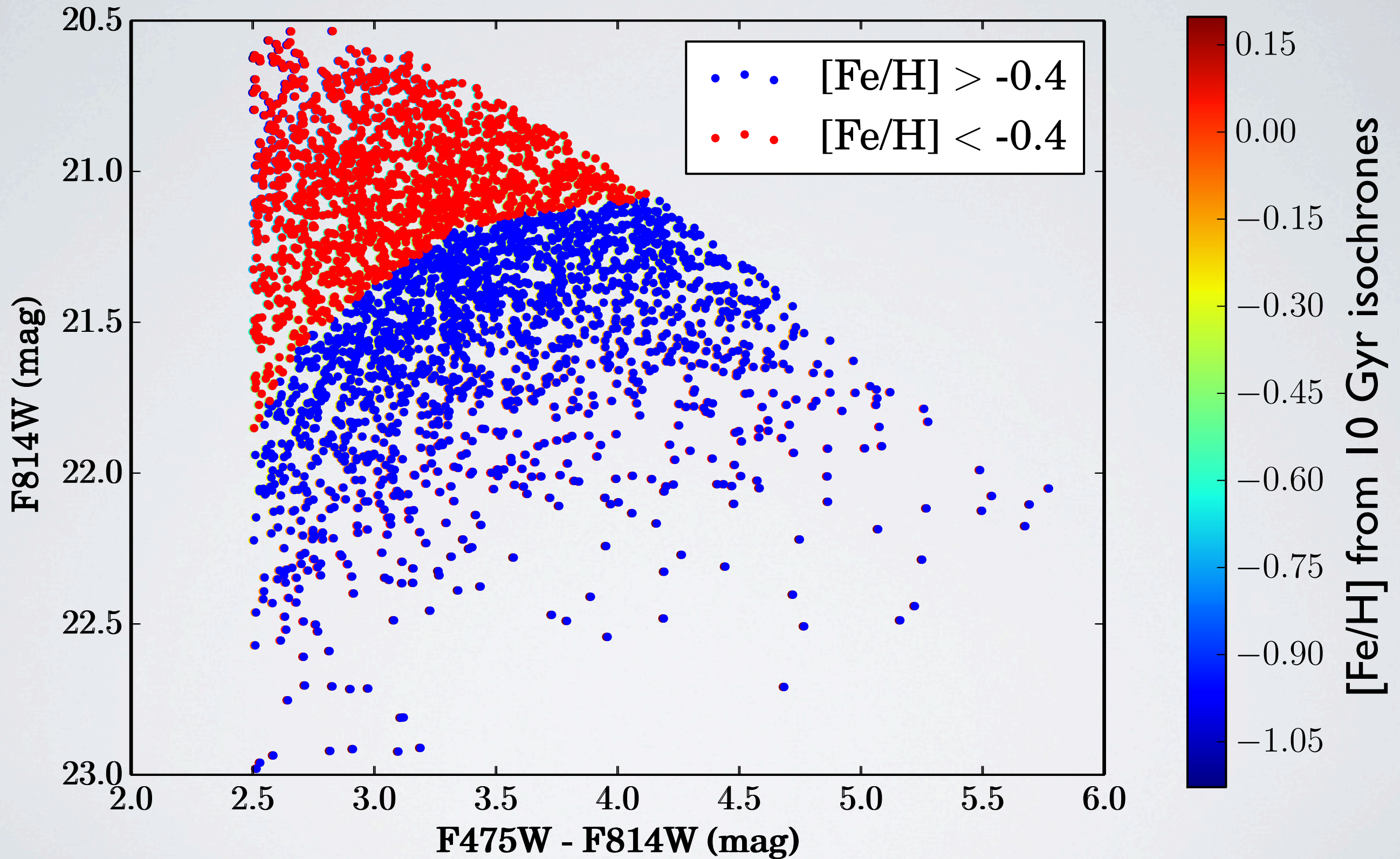
**3. high overall dispersion and heating rate**

See Dorman et al. (2014, in prep) for more details.



# Trends in **RGB** kinematics with metallicity

# Split RGB stars by photometric $[\text{Fe}/\text{H}]$





# RGB dispersion decreases with $[\text{Fe}/\text{H}]$

