# Connecting disk galaxy kinematics near and far

Jonathan Bird
VIDA Fellow
Vanderbilt University

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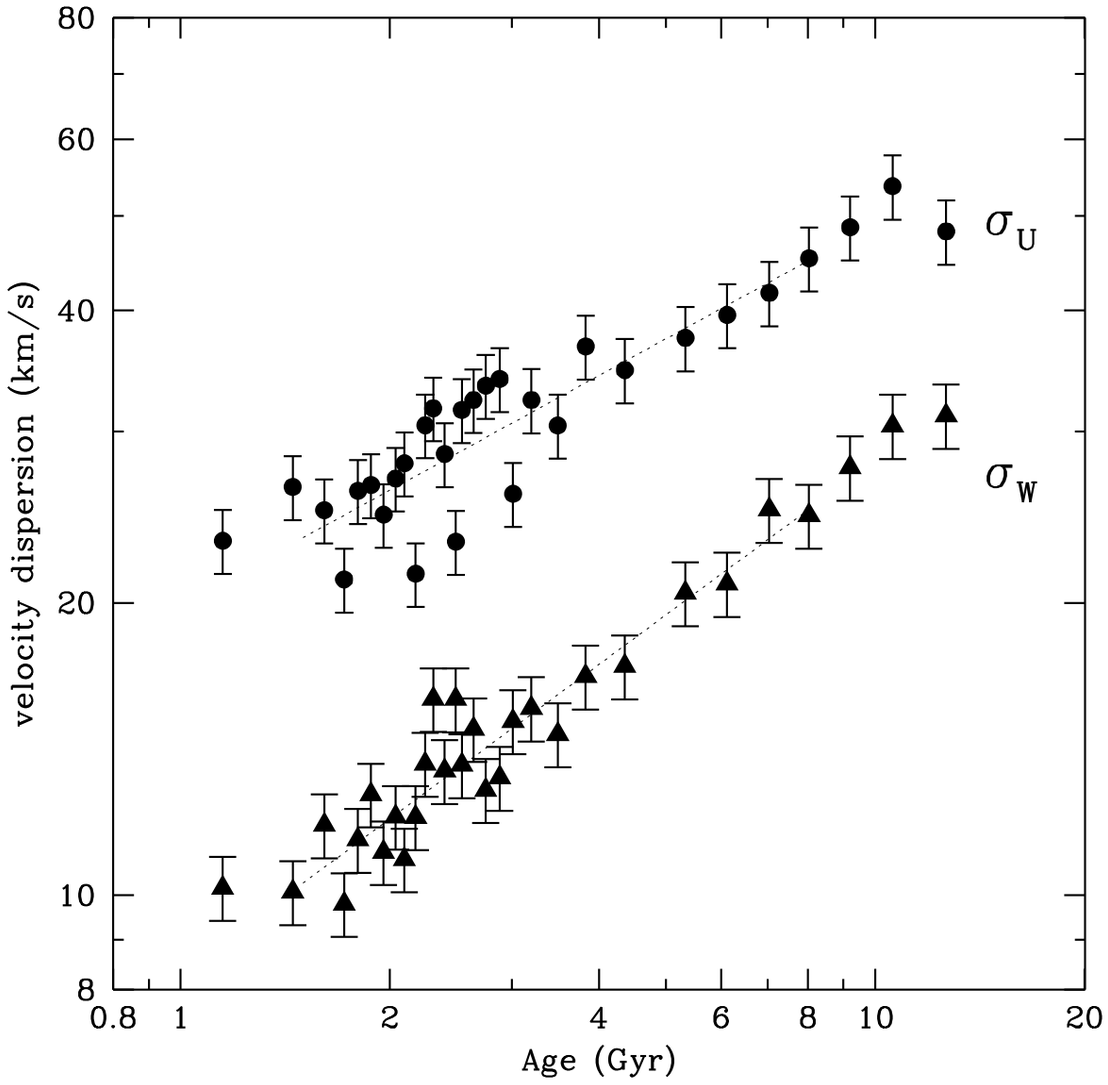
In collaboration with:
David Weinberg, Stelios Kazantzidis,
Sarah Loebman, Alyson Brooks,
Fabio Governato, Charlotte Christenson,
Kelly Holley-Bockelmann, Andreas Berlind

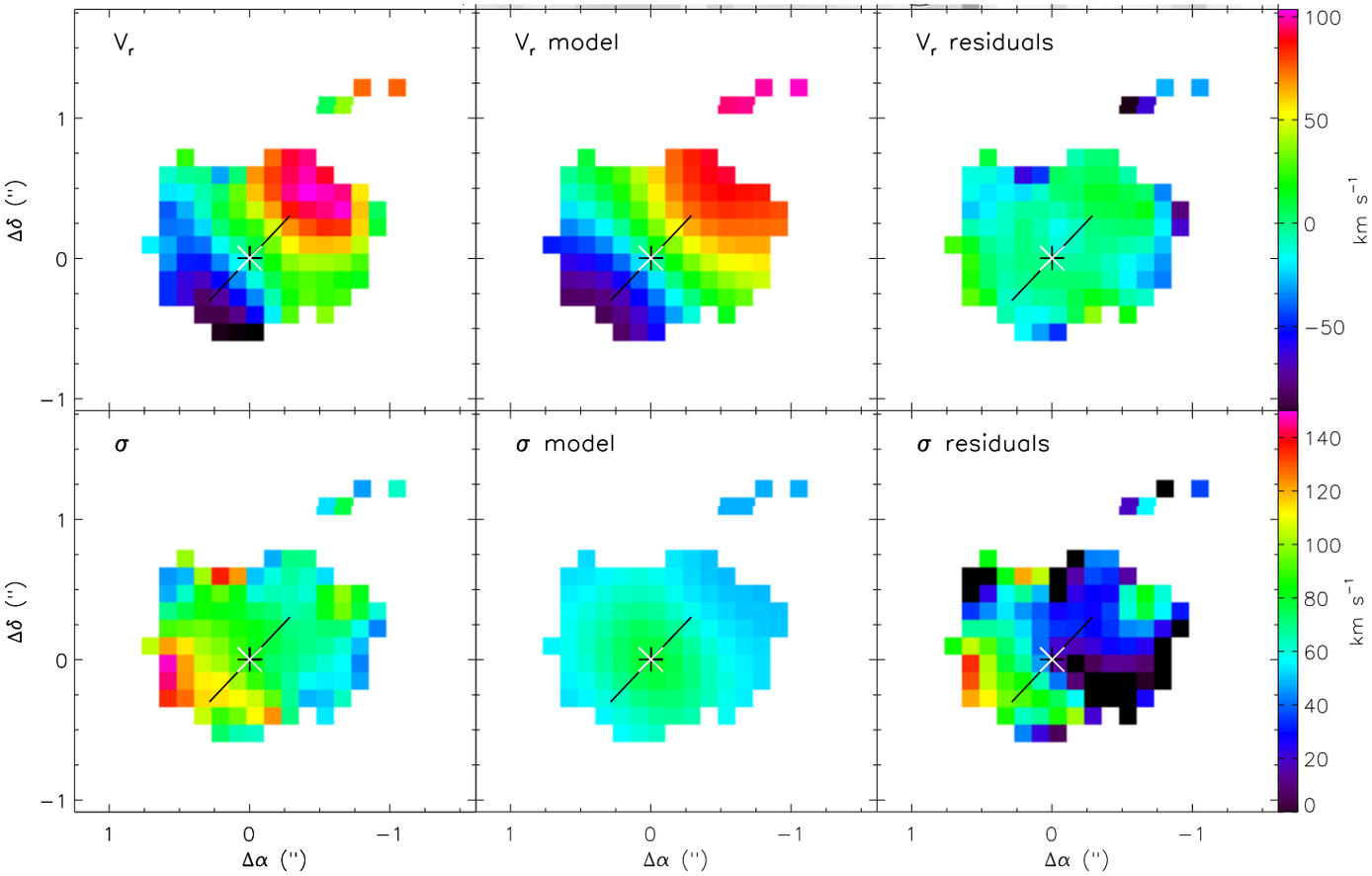
# Near → Far

local stellar kinematics




Age-Velocity Relationship

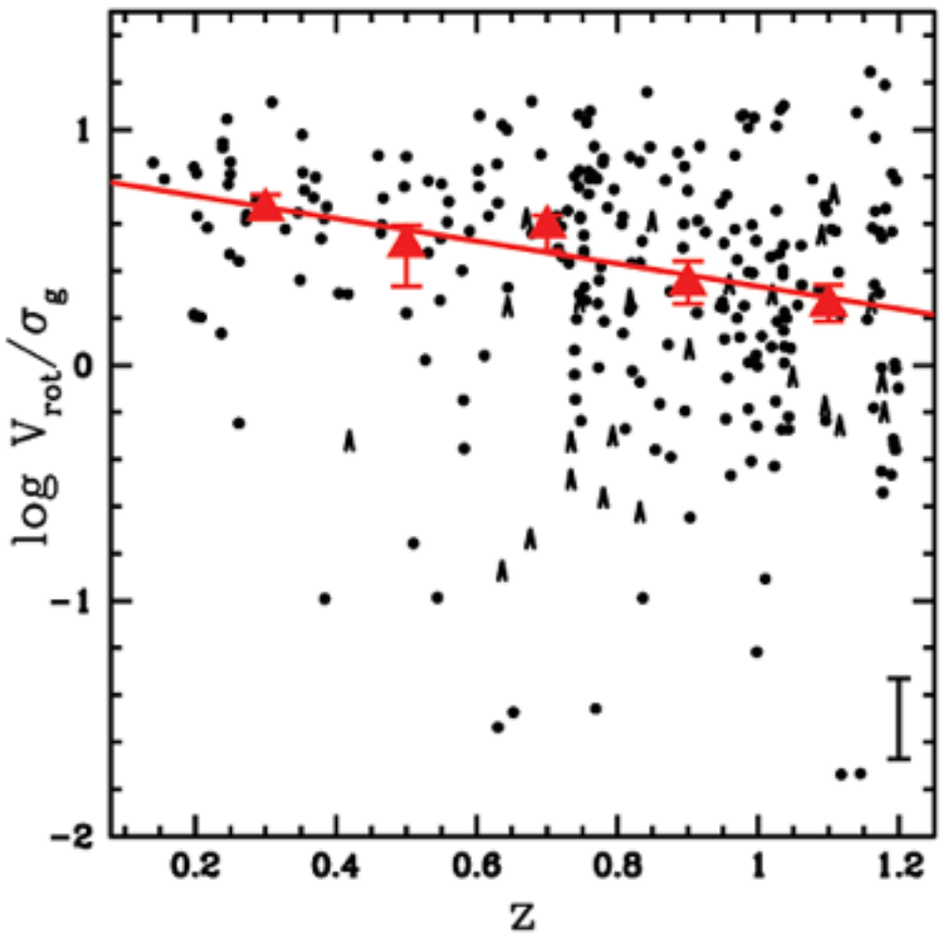
Properties of disk galaxies at high redshift



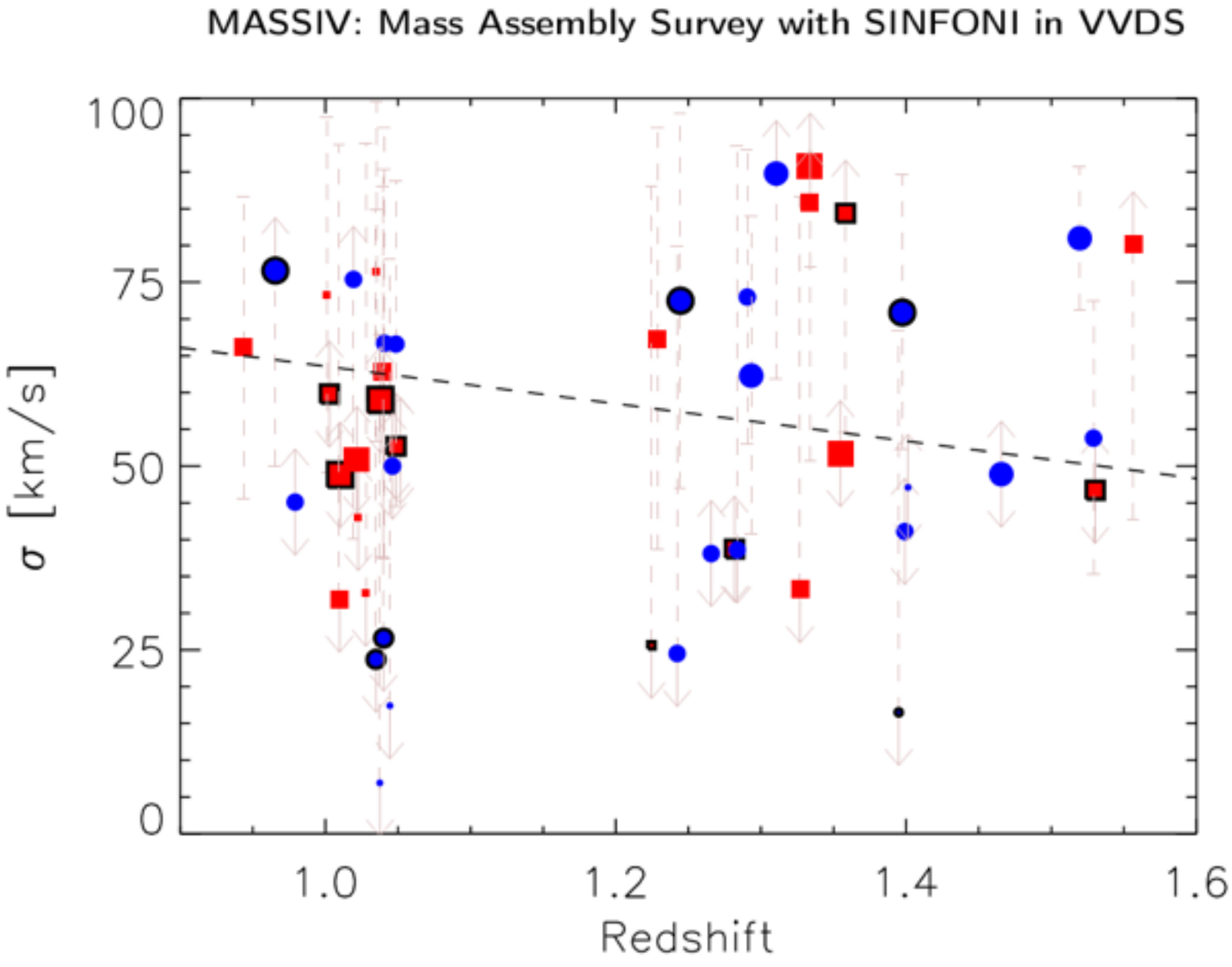

MASSIV: Mass Assembly Survey with SINFONI in VVDS

Epinat+ (2012)

# Young stars in disks dynamically settle from z~1 to now

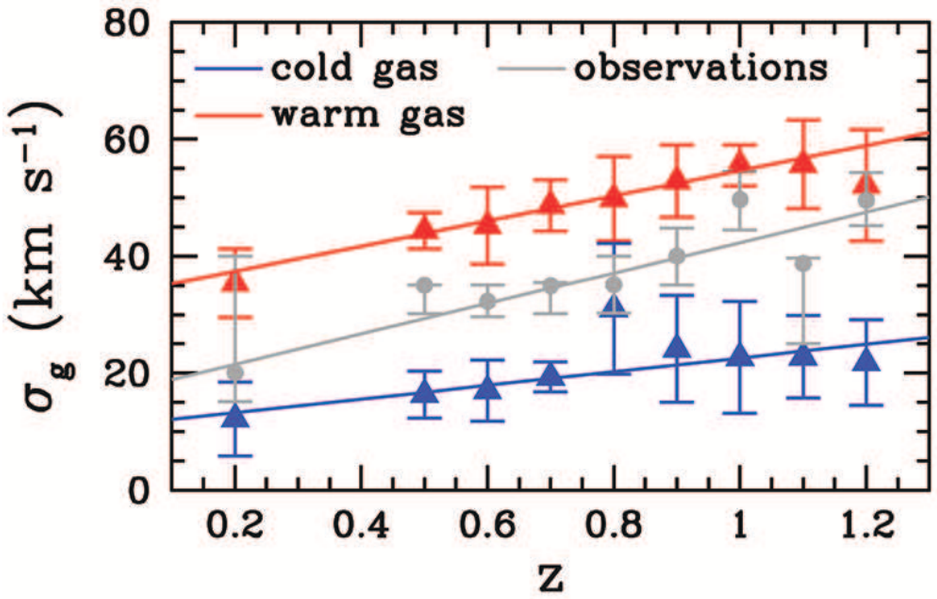


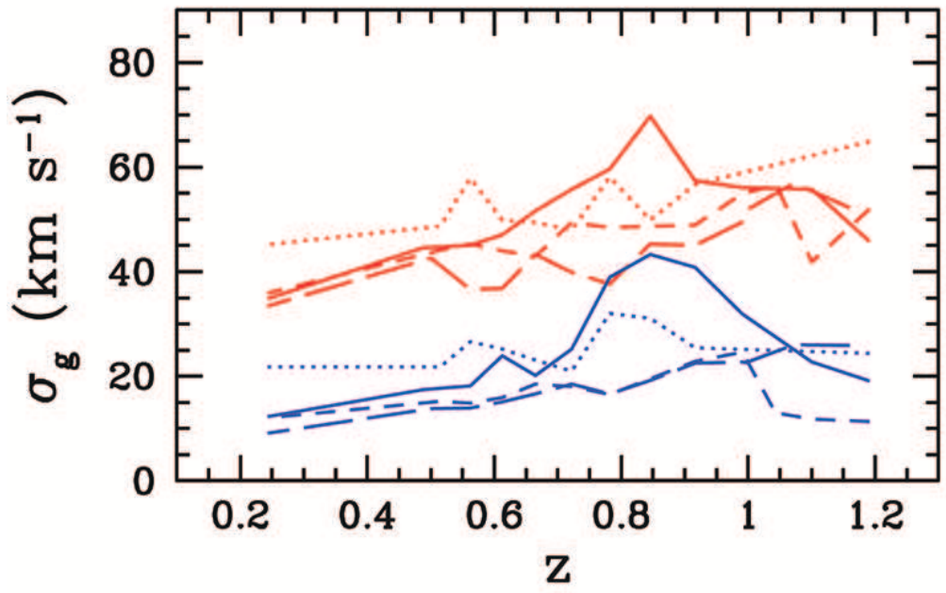

Kassin+ (2012)



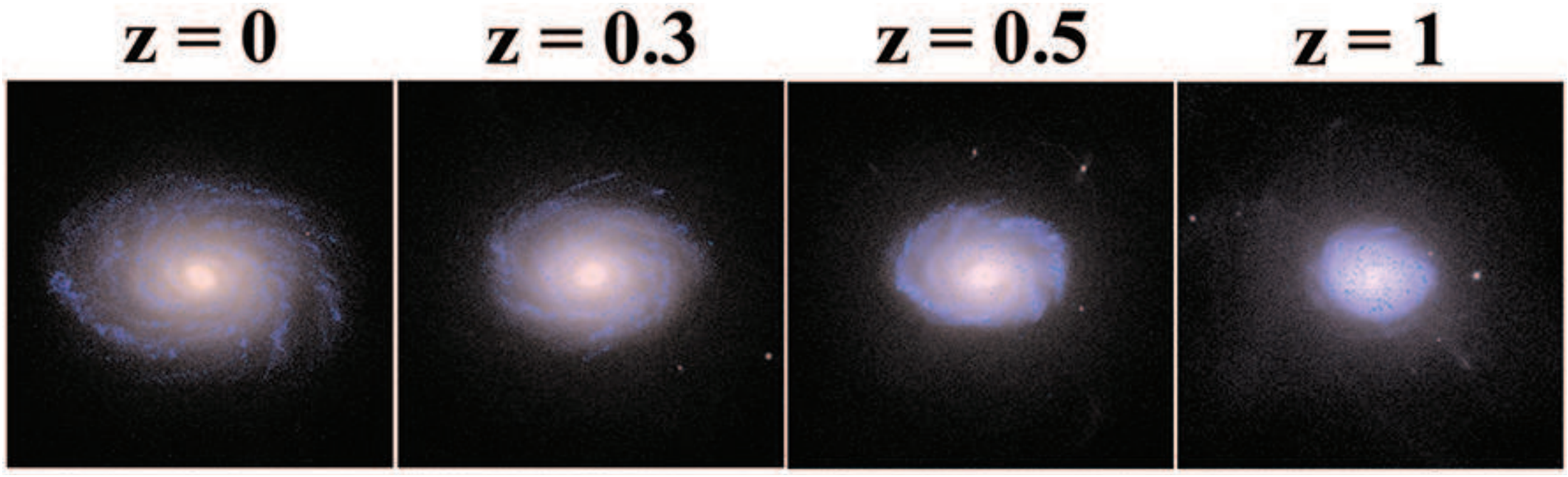

Epinat+ (2012)

# New simulated galaxies also show disk settling



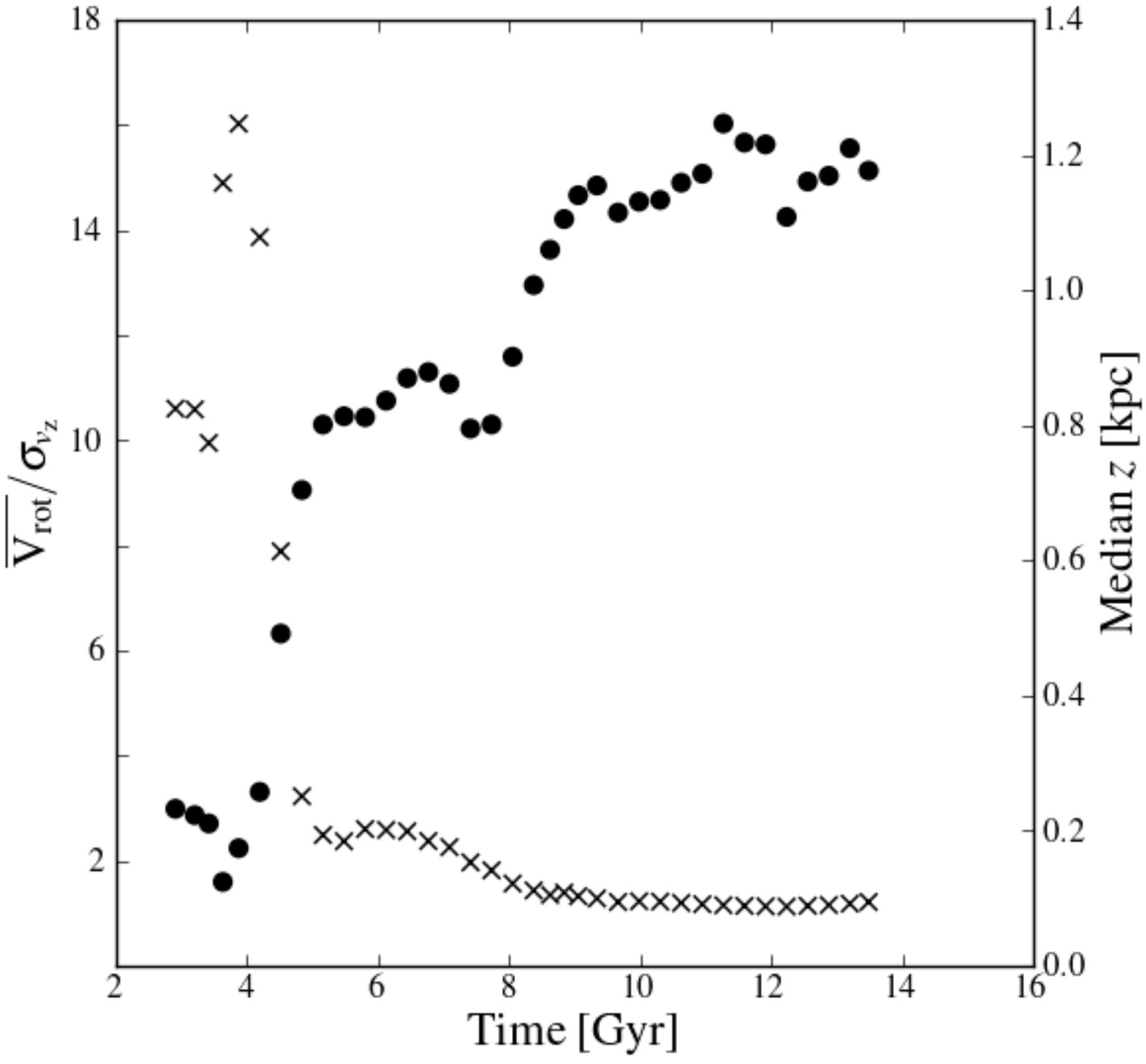




Kassin+ (2014)




Munshi, Brooks, Christensen+ (2012)

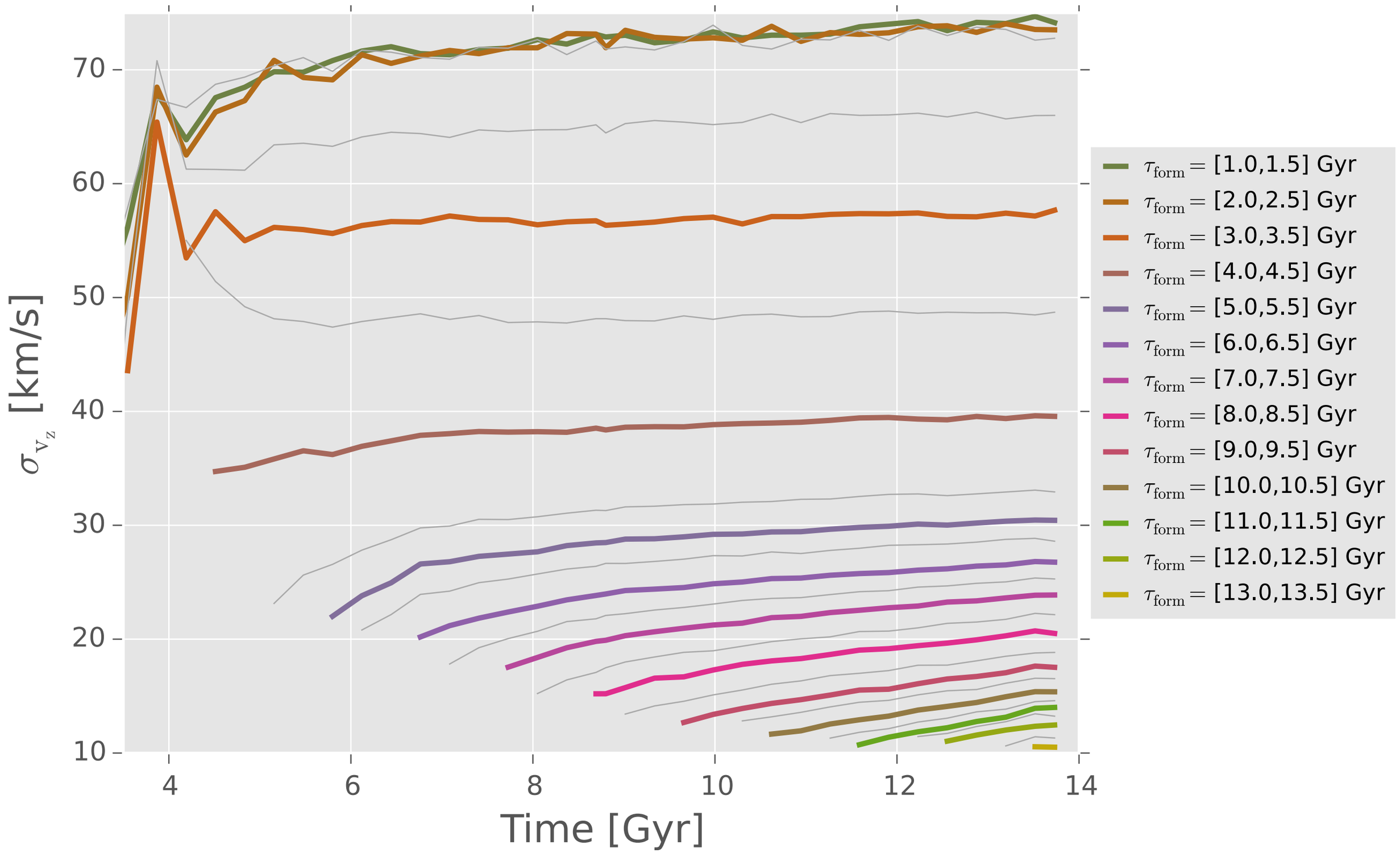
# Gas disk height decreases as rotation dominates



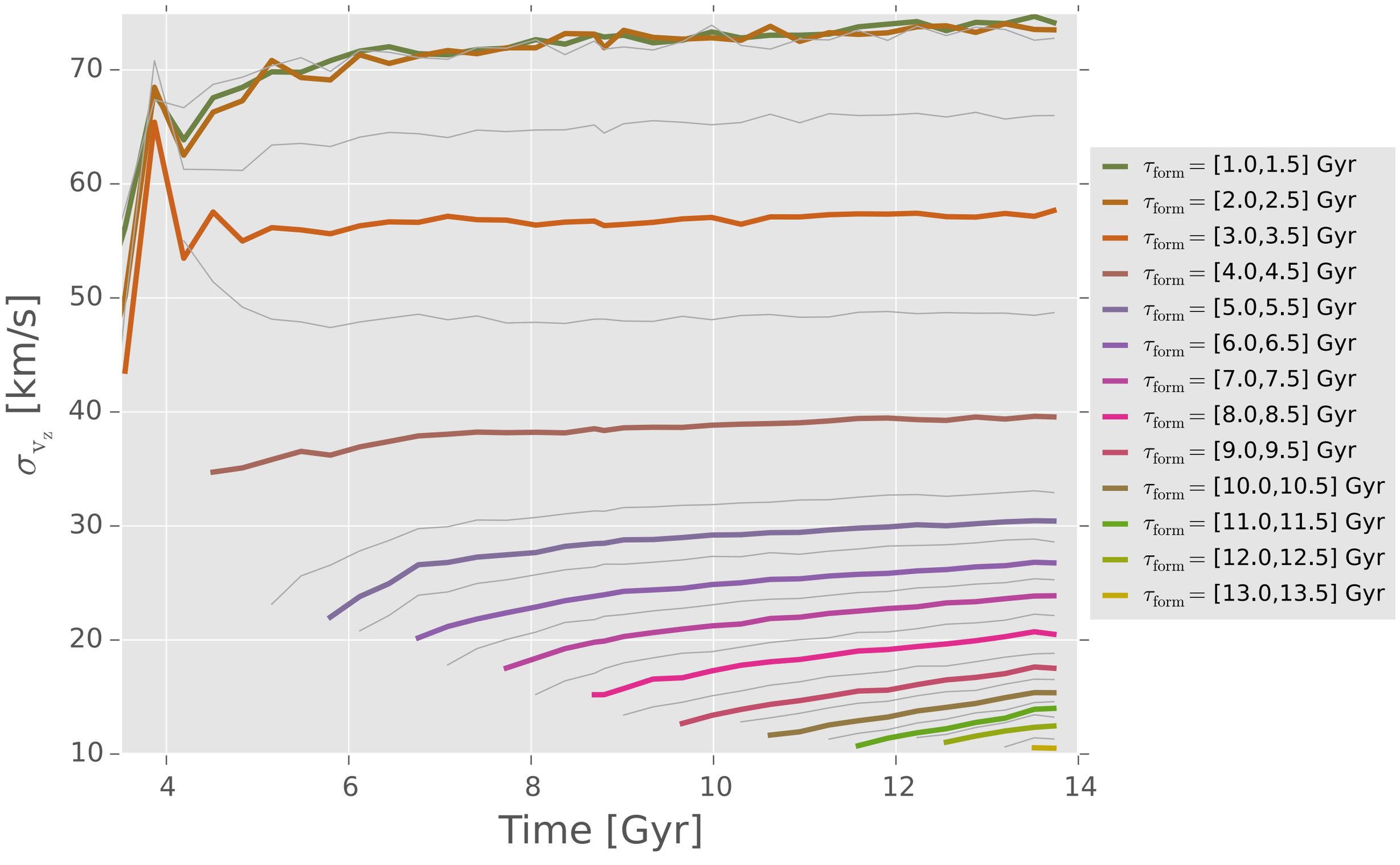

kinematics and structure of star-forming gas in h277

Bird+ (2014, in prep.)

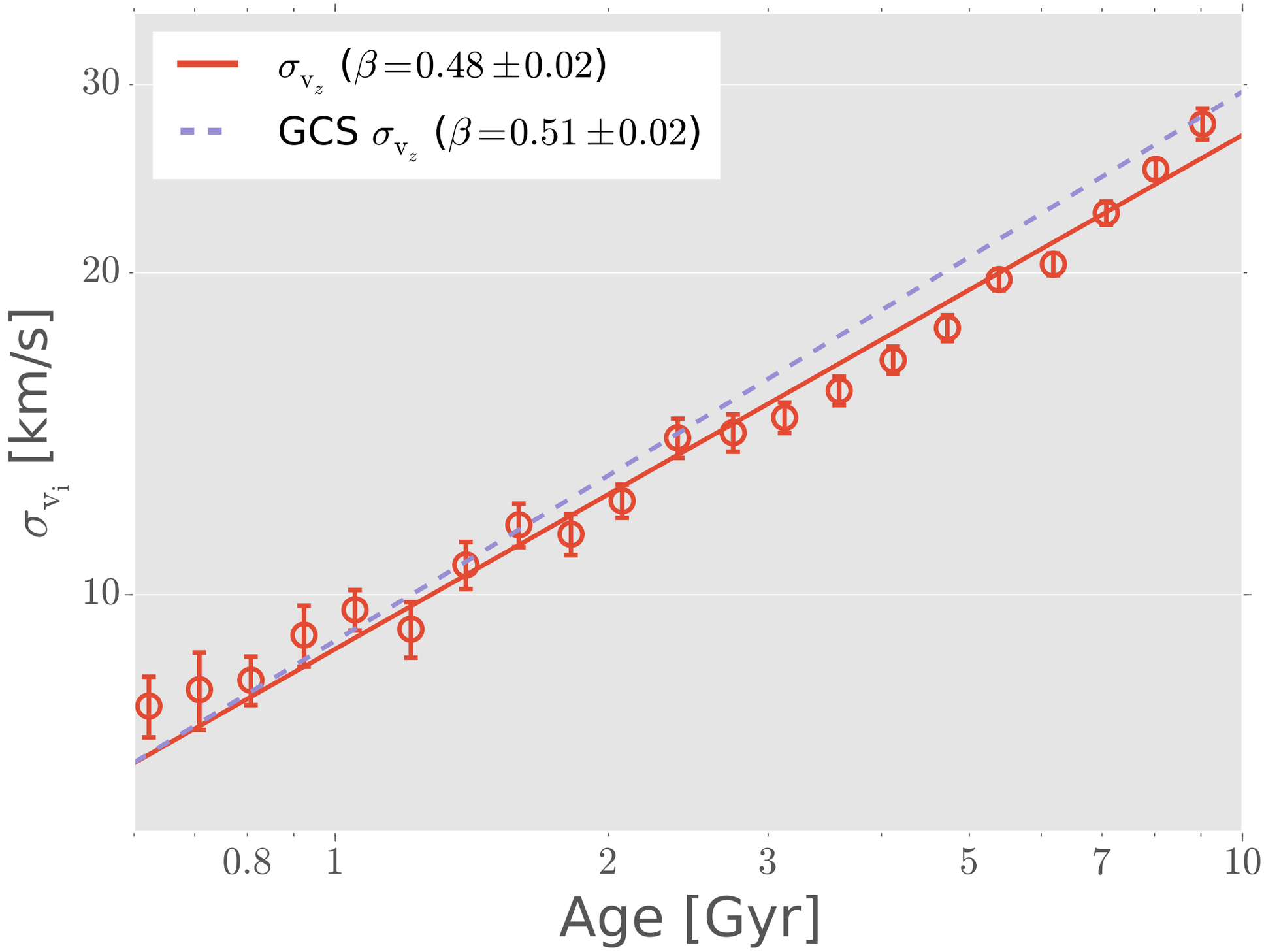
# Stars follow gas:
# disk constructed ‘Upside Down’



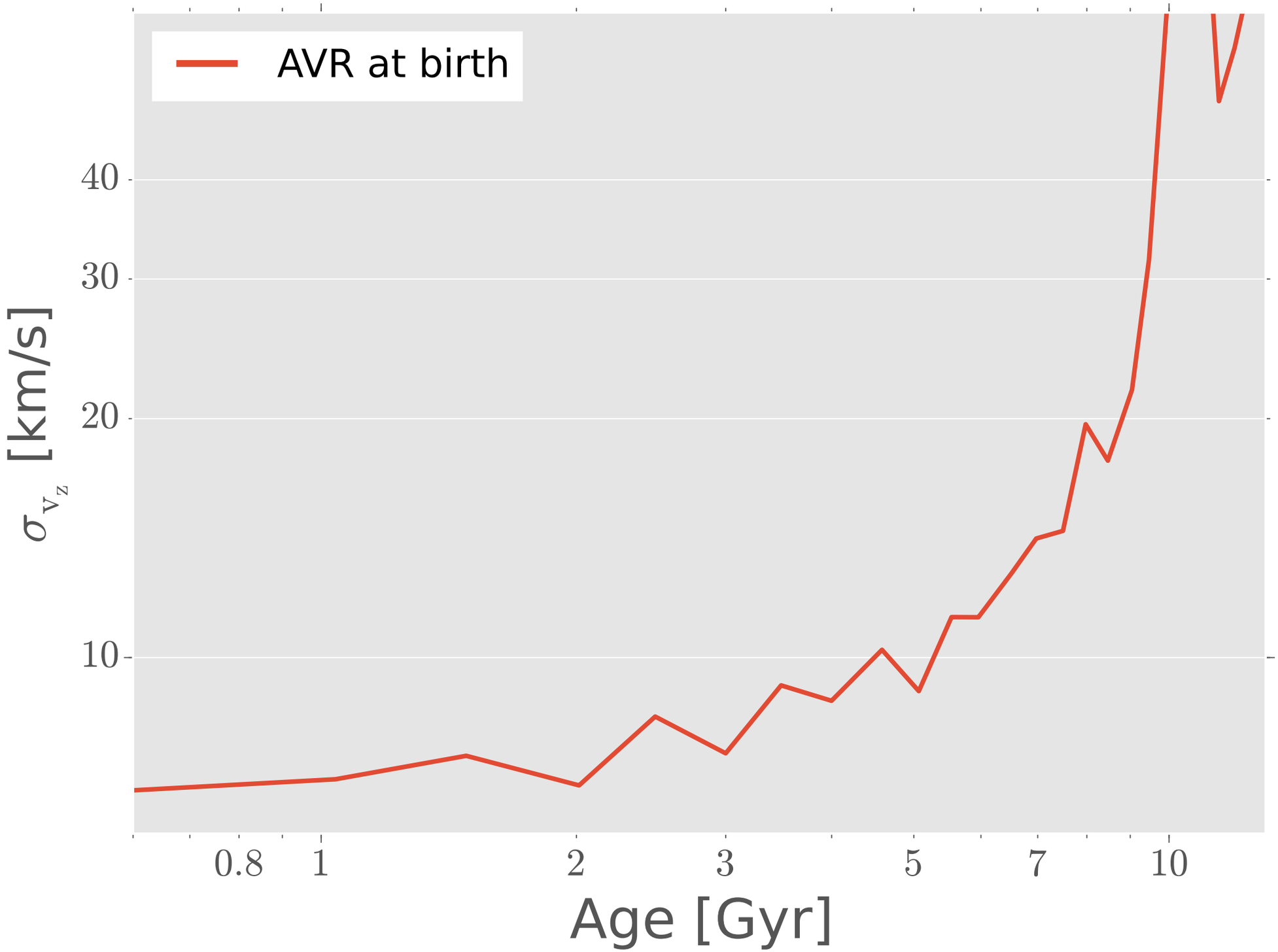
# Younger stars are born progressively colder matching observations



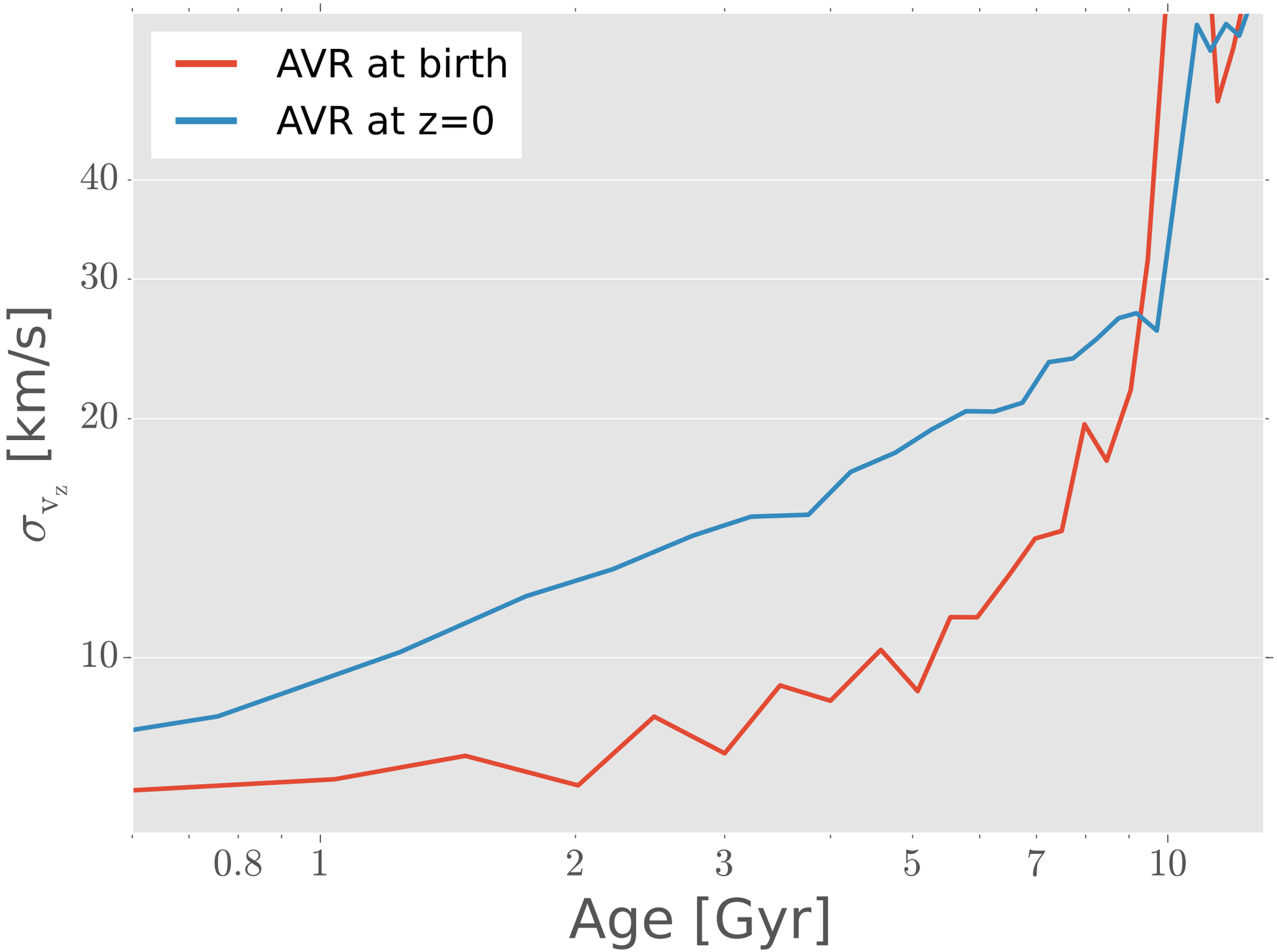
# Solar neighborhood AVR at z=0 is similar to MW



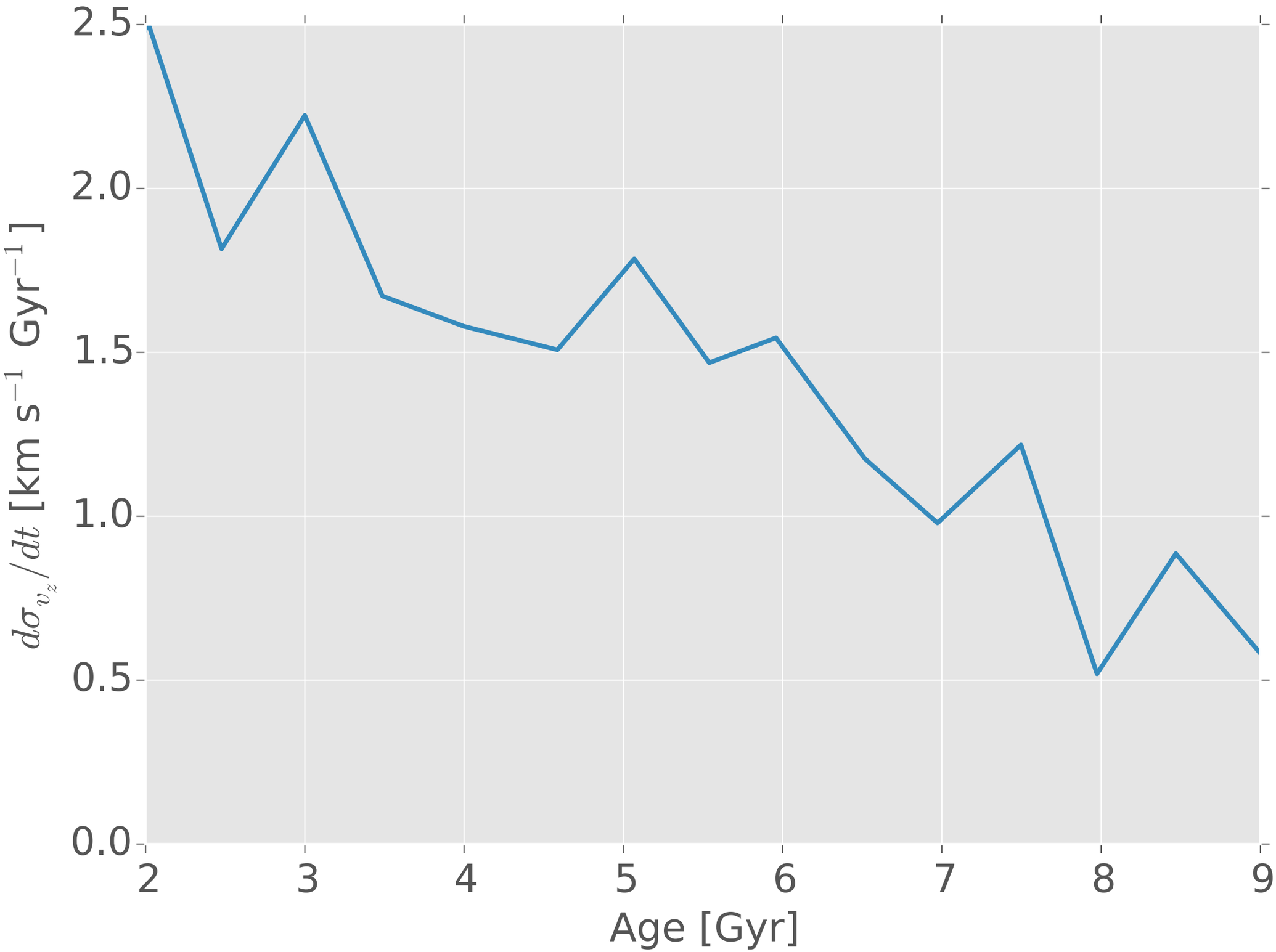
# Upside-Down construction determines an initial AVR



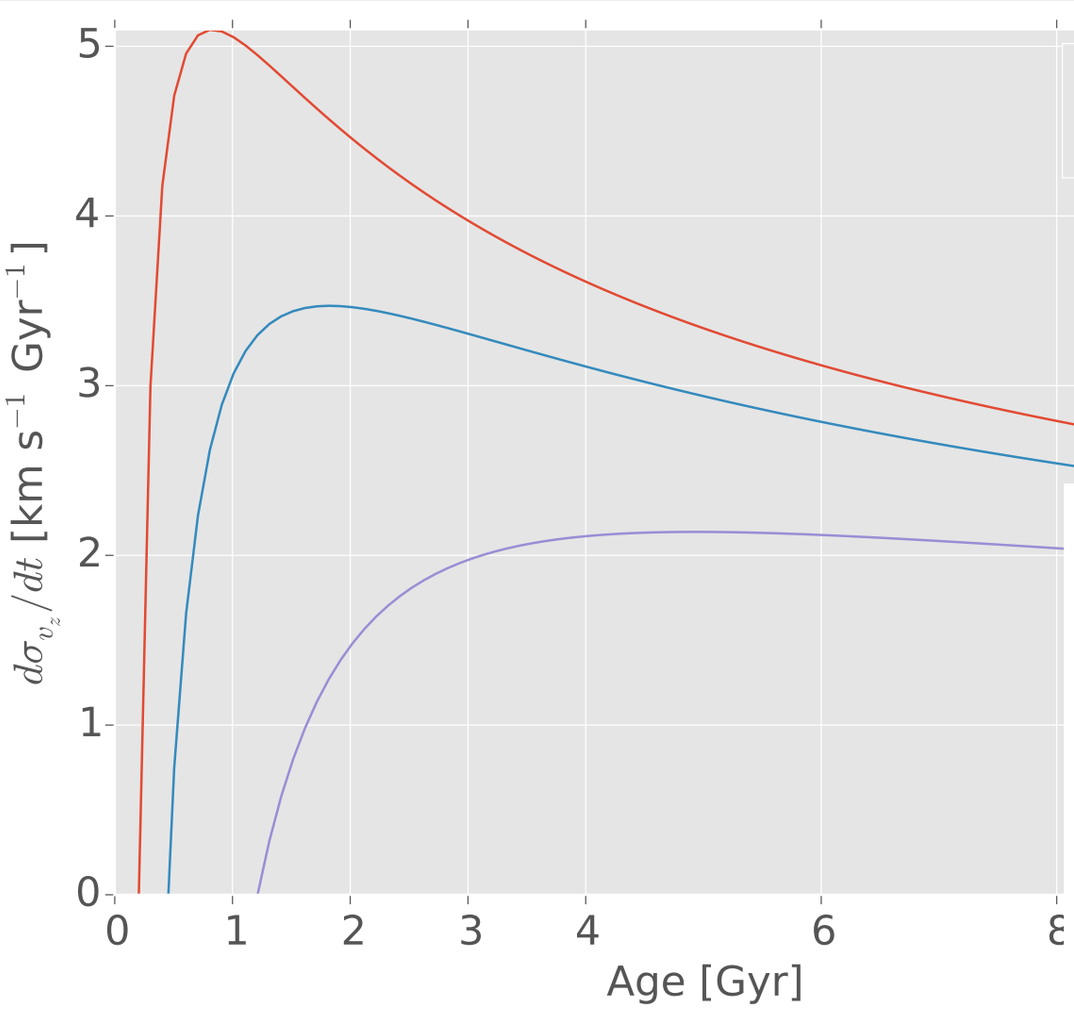
# Heating requirement reduced for intermediate ages

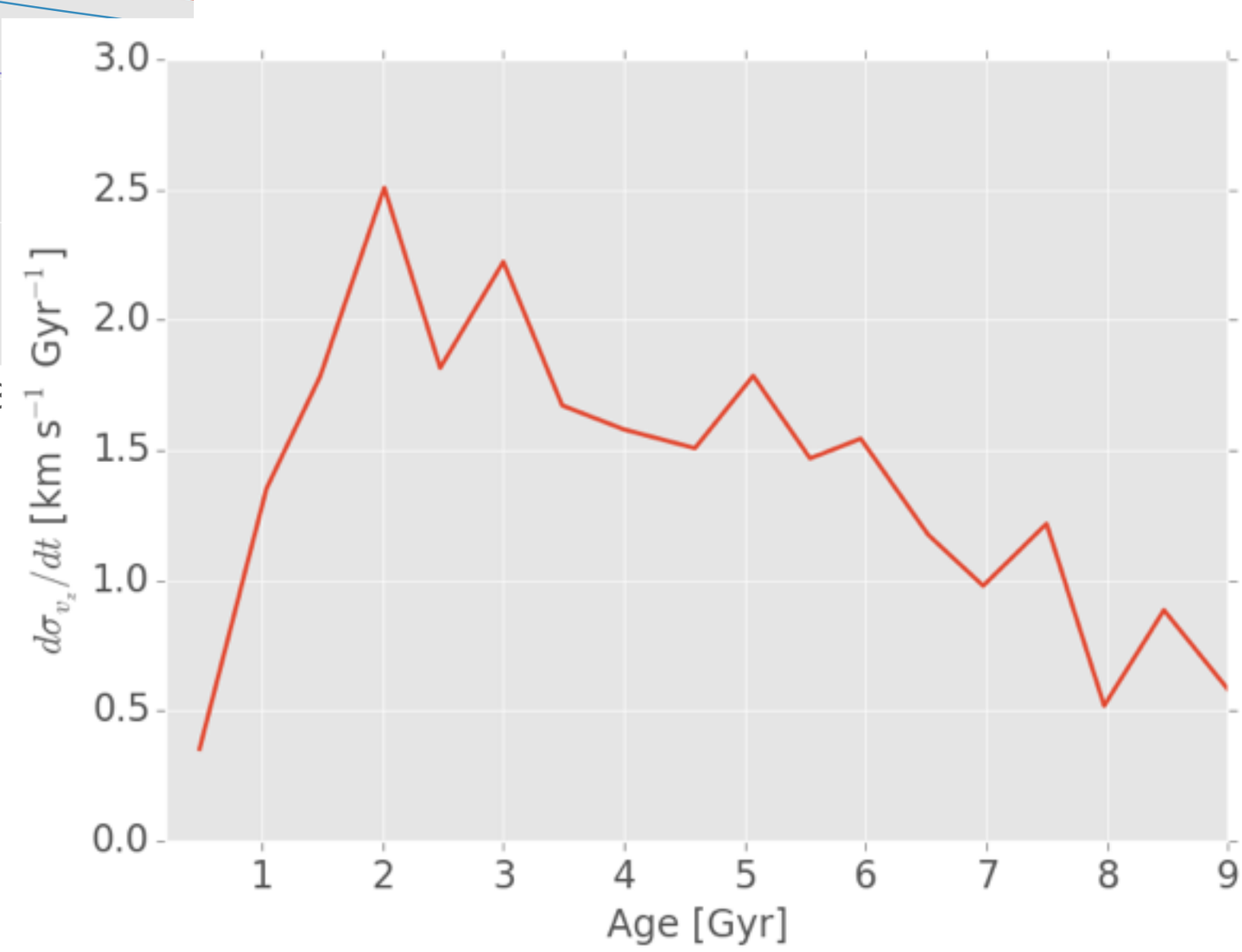


# Average heating declines with age



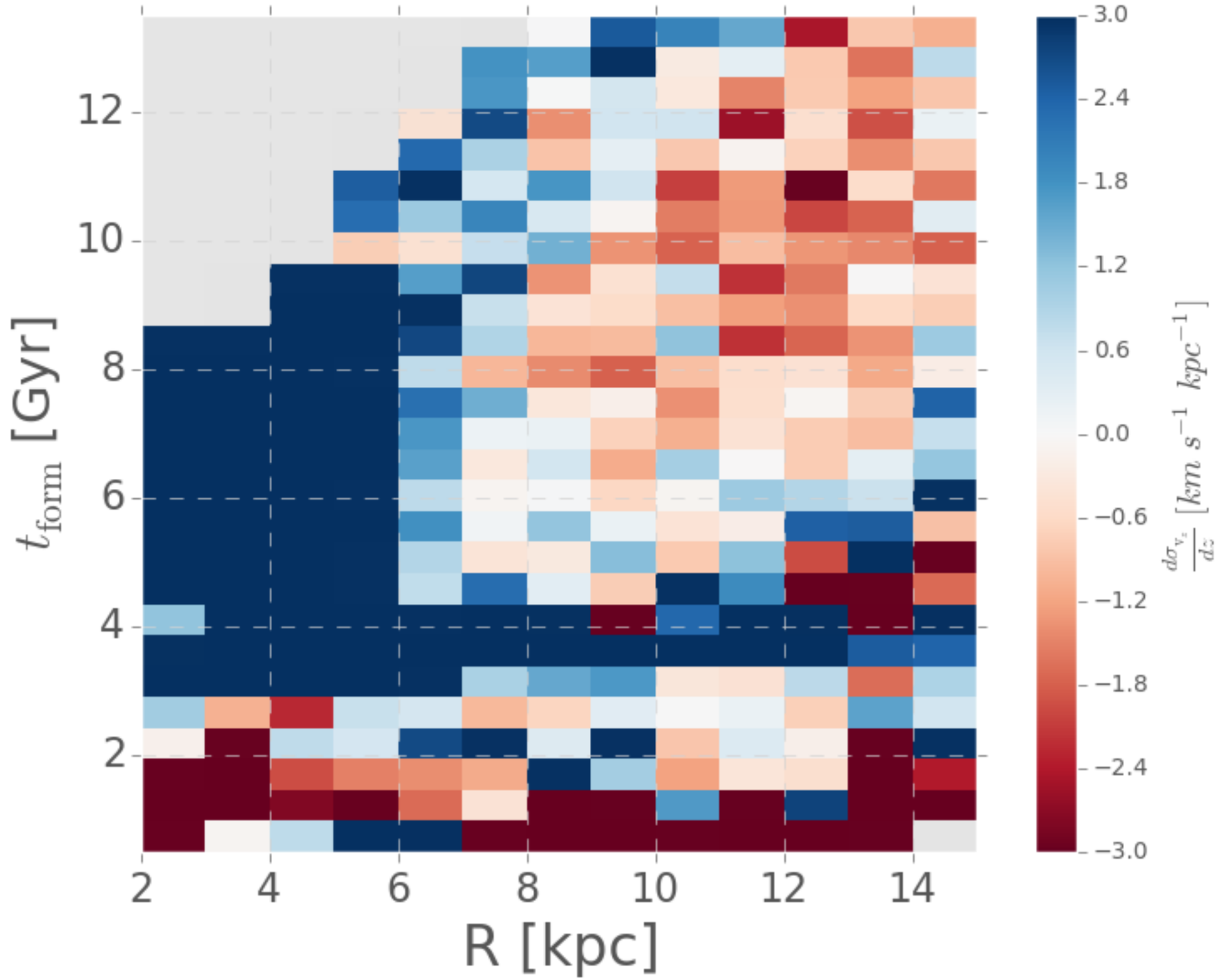
# Compare with Power Law Heating



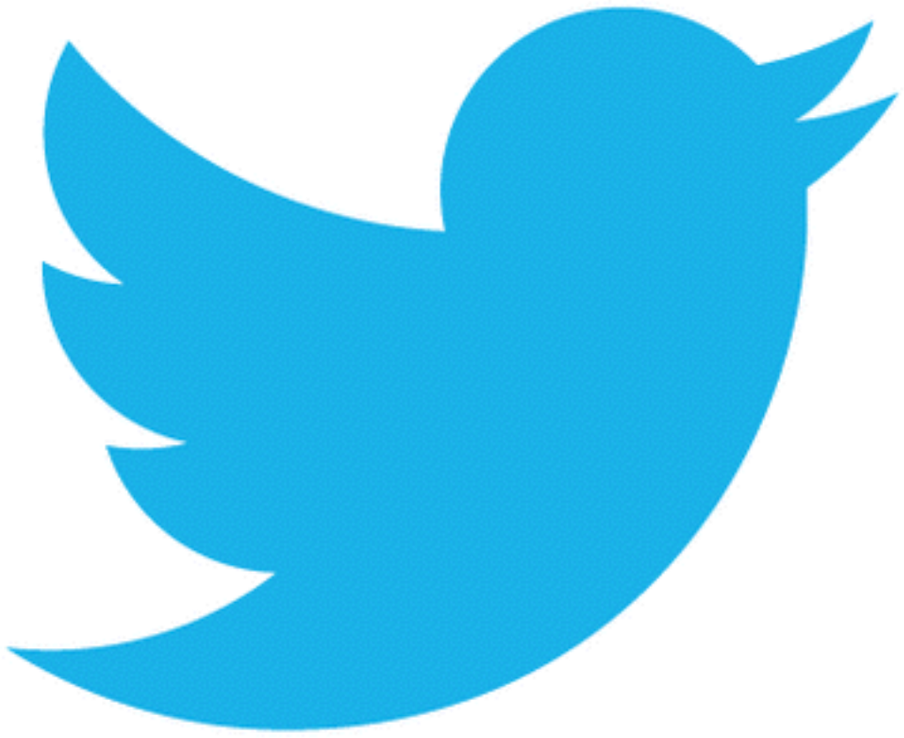
# Vertical Isothermality of stellar populations

# Upside Down disks naturally exhibit vertically Isothermal populations



# Twitter for JBH

To match kinematic observations at high z and AVR at z=0: disk must form upside down from collapsing gas disk #FlagstaffDisks



# Conclusion, Questions too!

- Disk settling naturally reproduces z=0 AVR and high redshift kinematic constraints (old, in-situ, hot stars also seen by Brook+2004, House+2011, Stinson+2013)
- Dynamical burden on Mono-age stellar populations is reduced: much more conducive for vertical isothermality
- Possible change in slope in the heating rate, tests?
  - Old, thin disk is crucial!
- Bird+ (2013) : evolution of global kinematics and structure broken down by age in Upside-Down formation scenario
- Nidever, Bovy, Bird+ (2014): APOGEE stellar abundance distributions from 4 < R < 13 kpc. High alpha sequence constant across disk.

To match kinematic observations at high z and AVR at z=0: disk must form upside down from collapsing gas disk #FlagstaffDisks

twitter: @galaxyhistorian ; jonathan.bird@vanderbilt.edu