Star Formation and Gas

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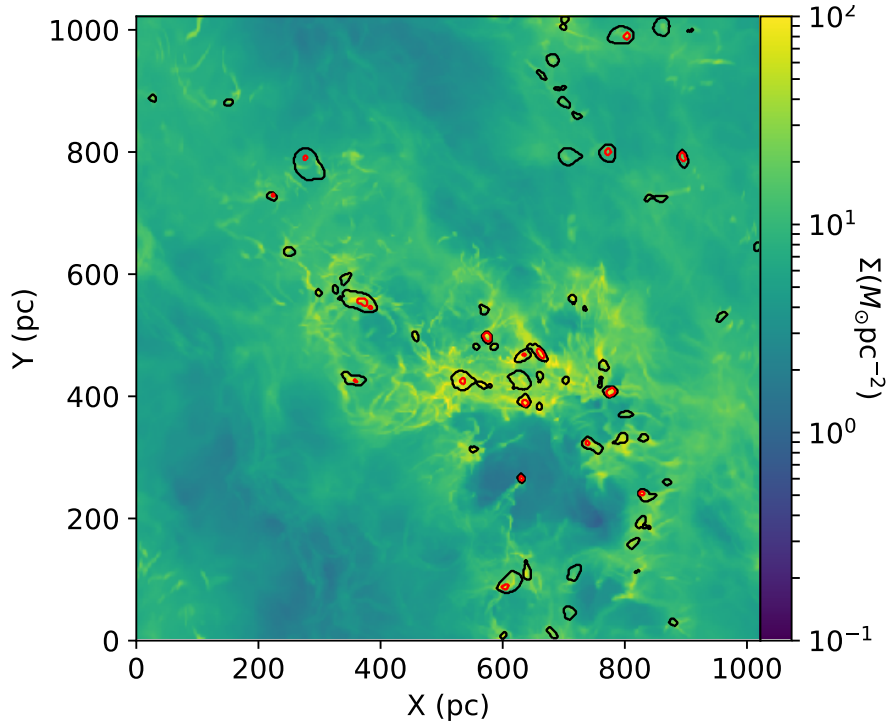


Collaborators: Eve Ostriker, Chang-Goo Kim

Outline

1. Introduction: Efficiency of What Gas?
2. Time Series: Delay and Variability
3. Correlation Comparison of Density vs. Energy
4. Plans++

Outline

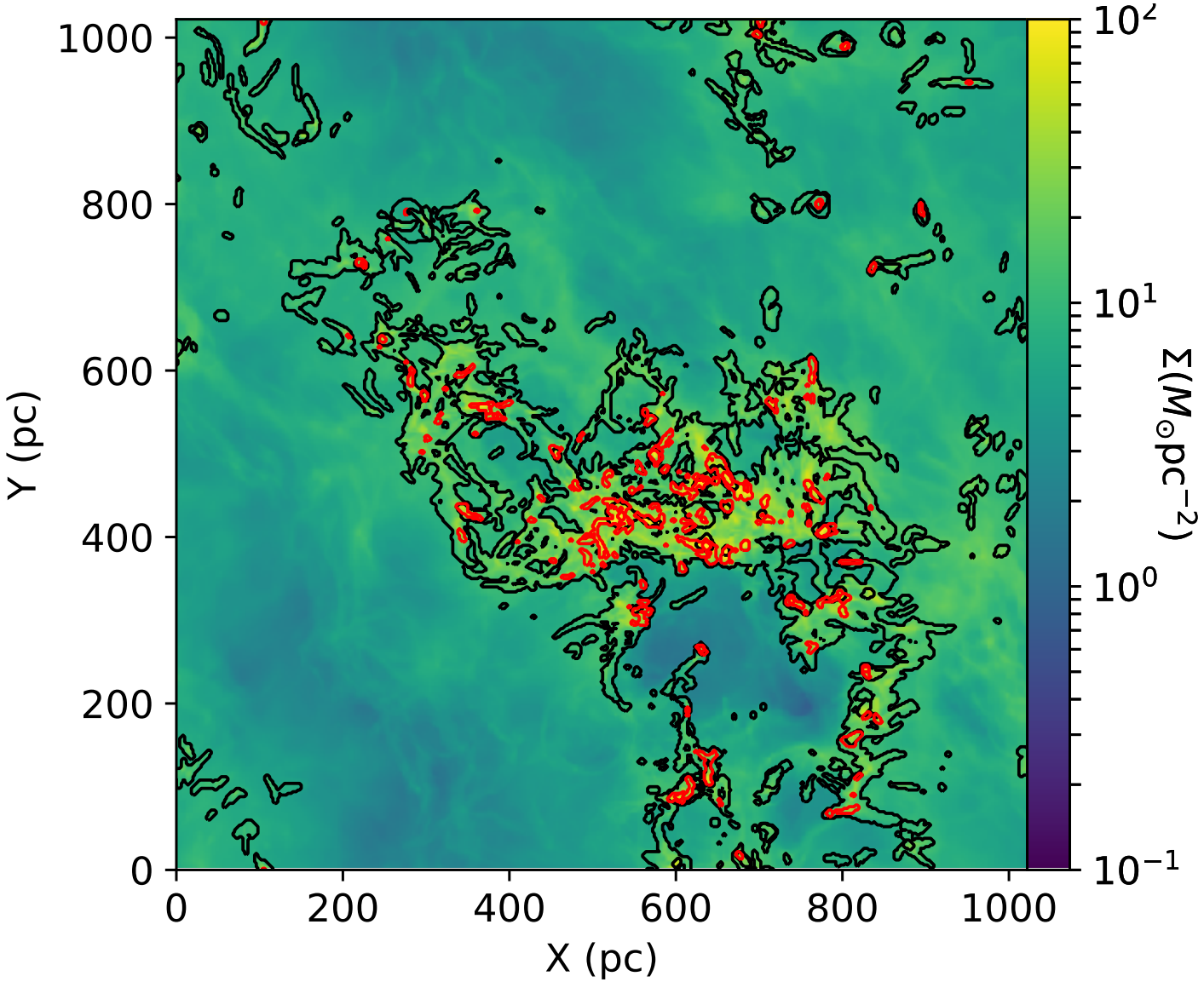
Motivation - Efficiency per free-fall time

- $SFR = \epsilon_{\rm ff} \frac{M}{t_{\rm ff}}$
- $\epsilon_{\rm ff} \sim 10^{-2}$ on galactic scales
- $\epsilon_{\rm ff} \sim 1$ for bound collapsing objects?
- $\epsilon_{\rm ff} \propto e^{-\beta t_{\rm dyn}/t_{\rm ff}}$
- $\beta = 1.6$ (Padoan, Haugbolle, and Nordlund 2012)
- $\alpha_v < 2$?

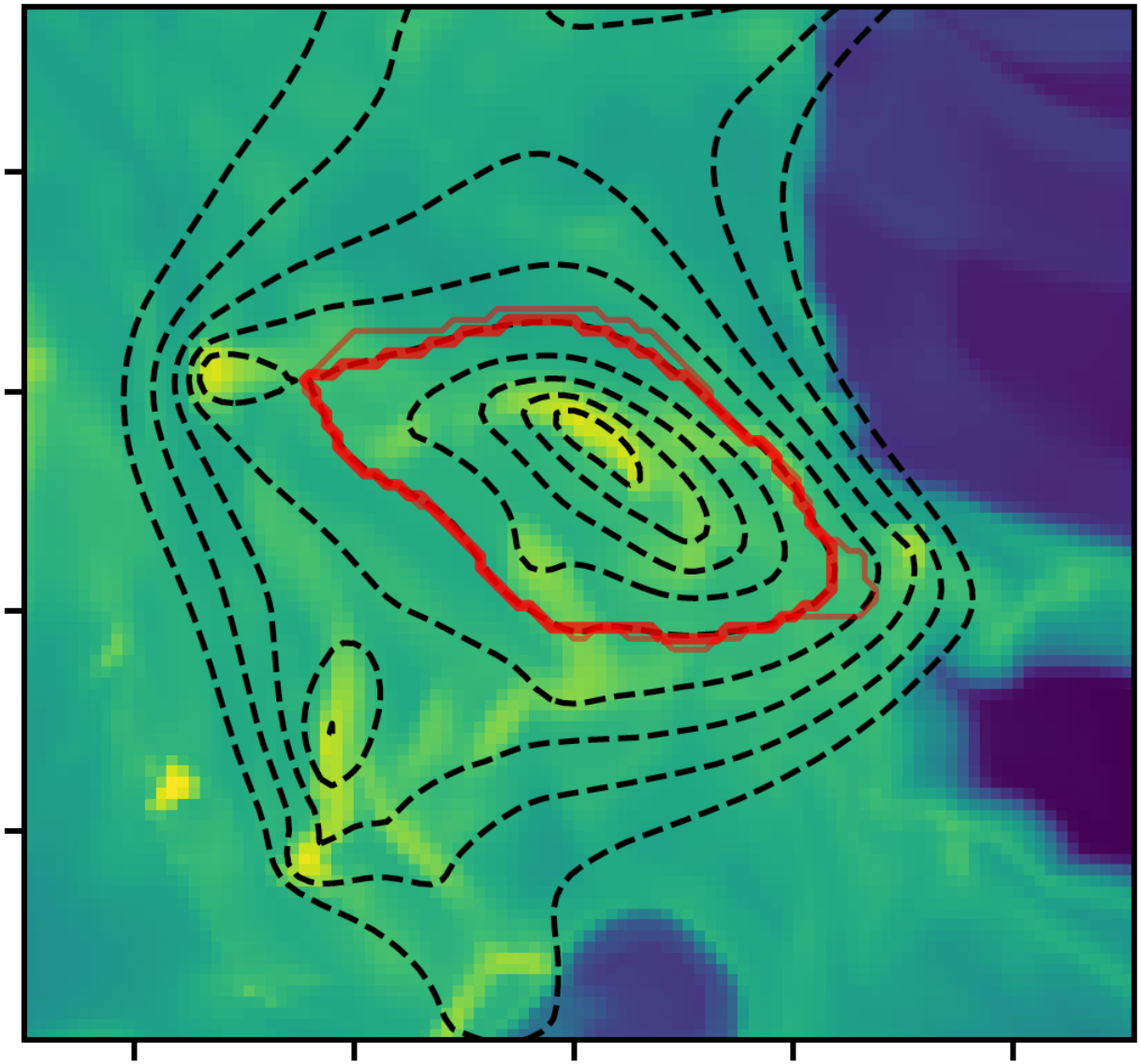
Motivation - TIGRESS

- Athena MHD + self gravity + cooling/heating
- Sink/star particles and supernova feedback
- Galactic potential, kpc shearing box, tall box, pc resolution
- Three-phase ISM in Galaxies Resolving Evolution with Star formation and Supernova feedback.

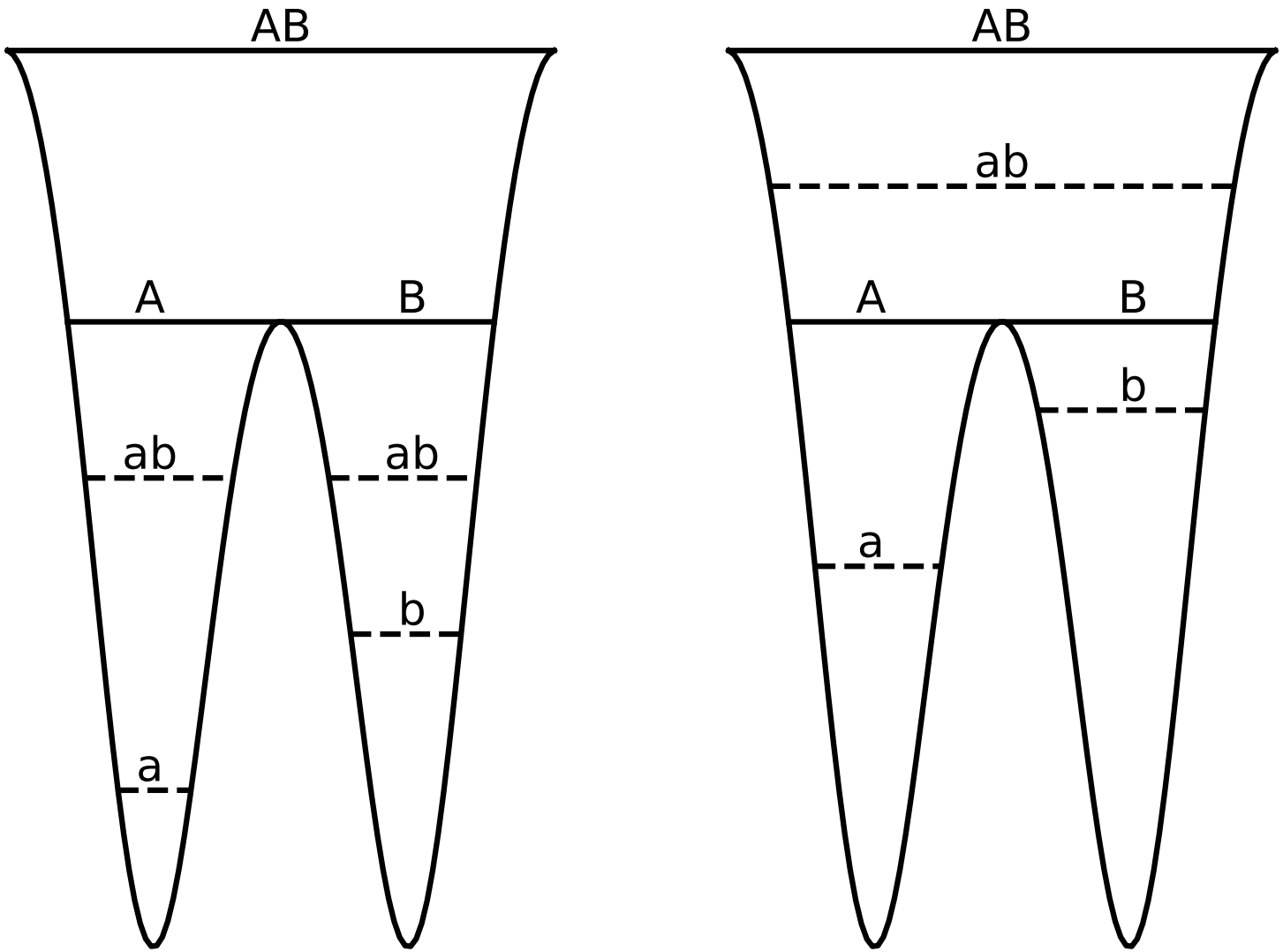
Density Threshold



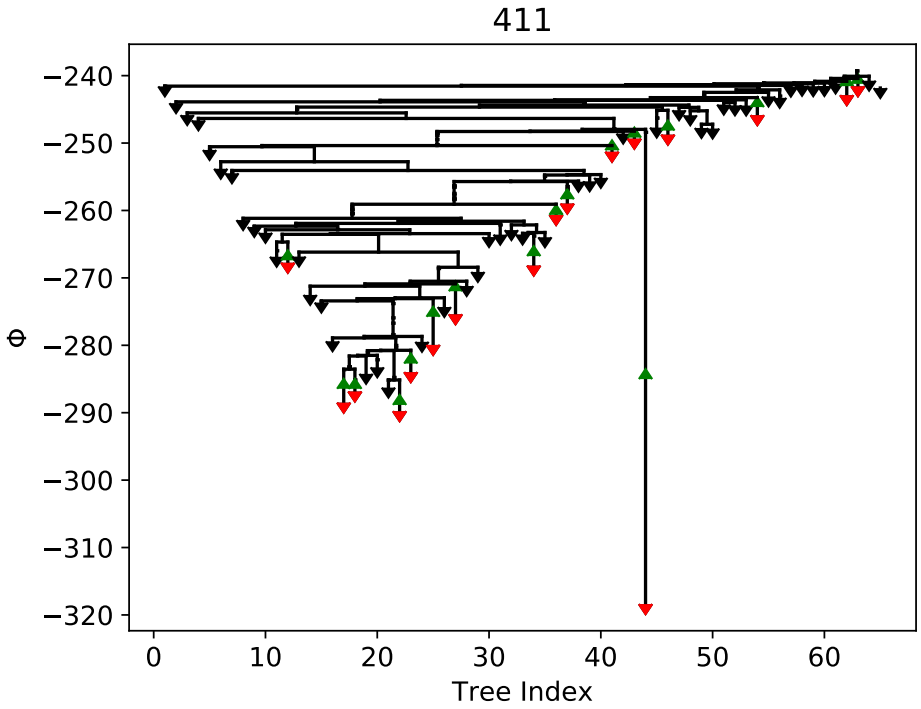
Gravitational Energy - Isocontour

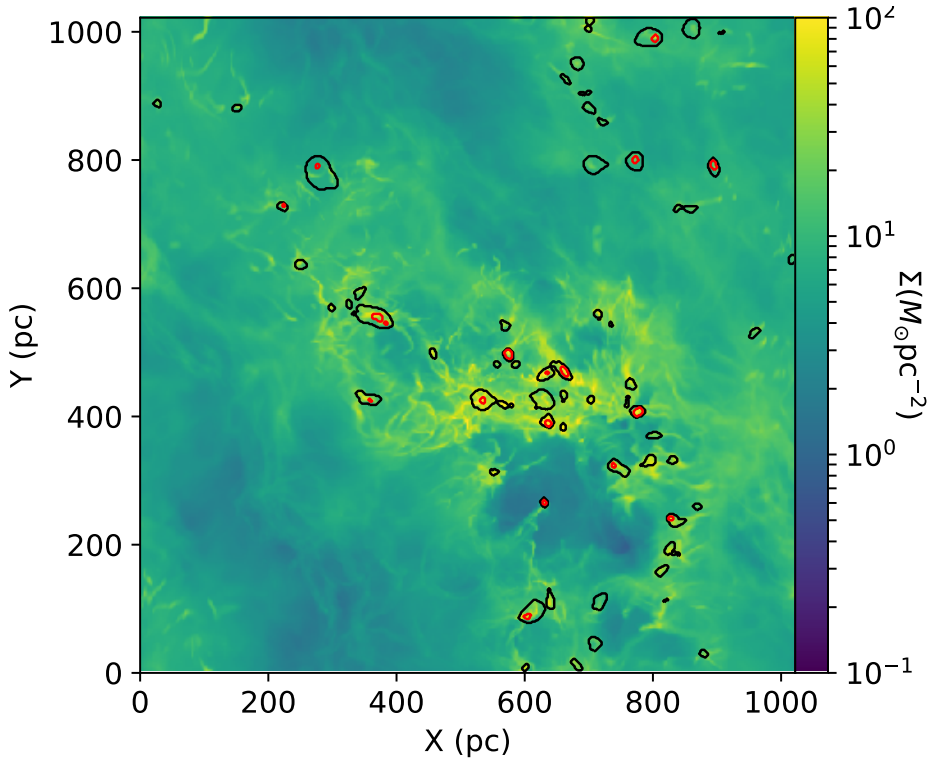


Grav. Energy - Well

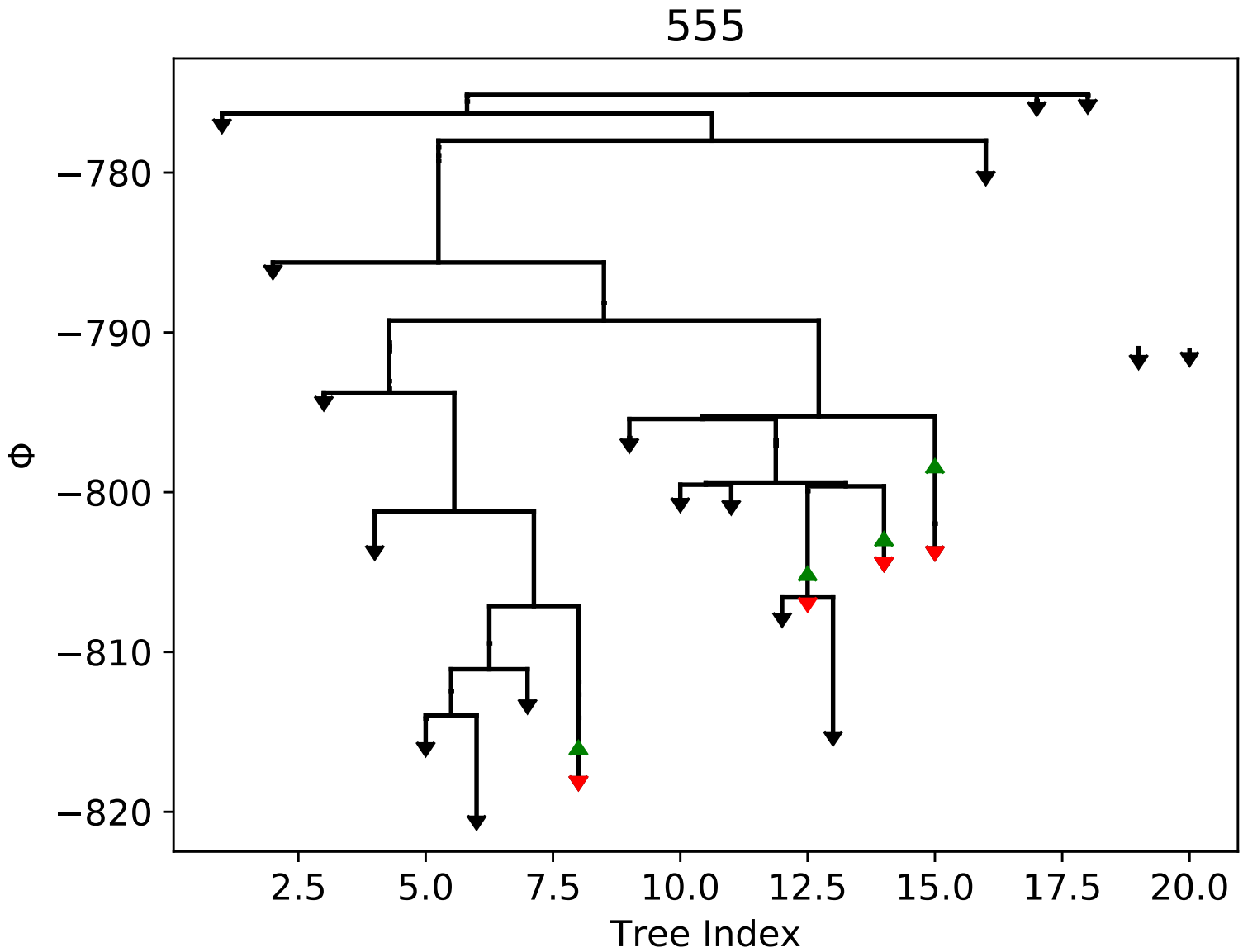


Grav. Energy - Tree Example

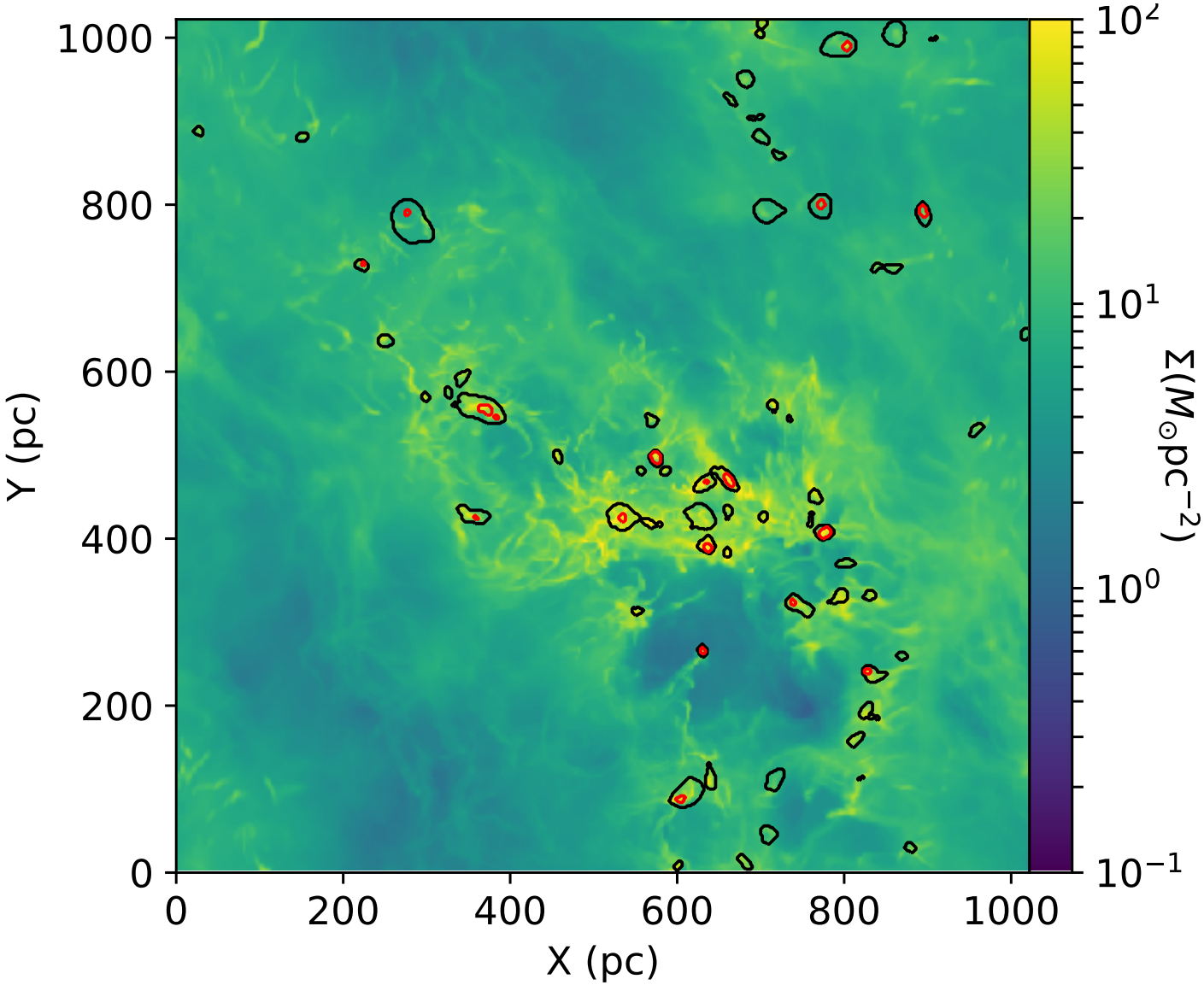




Grav. Energy - Tree (Merged Example)

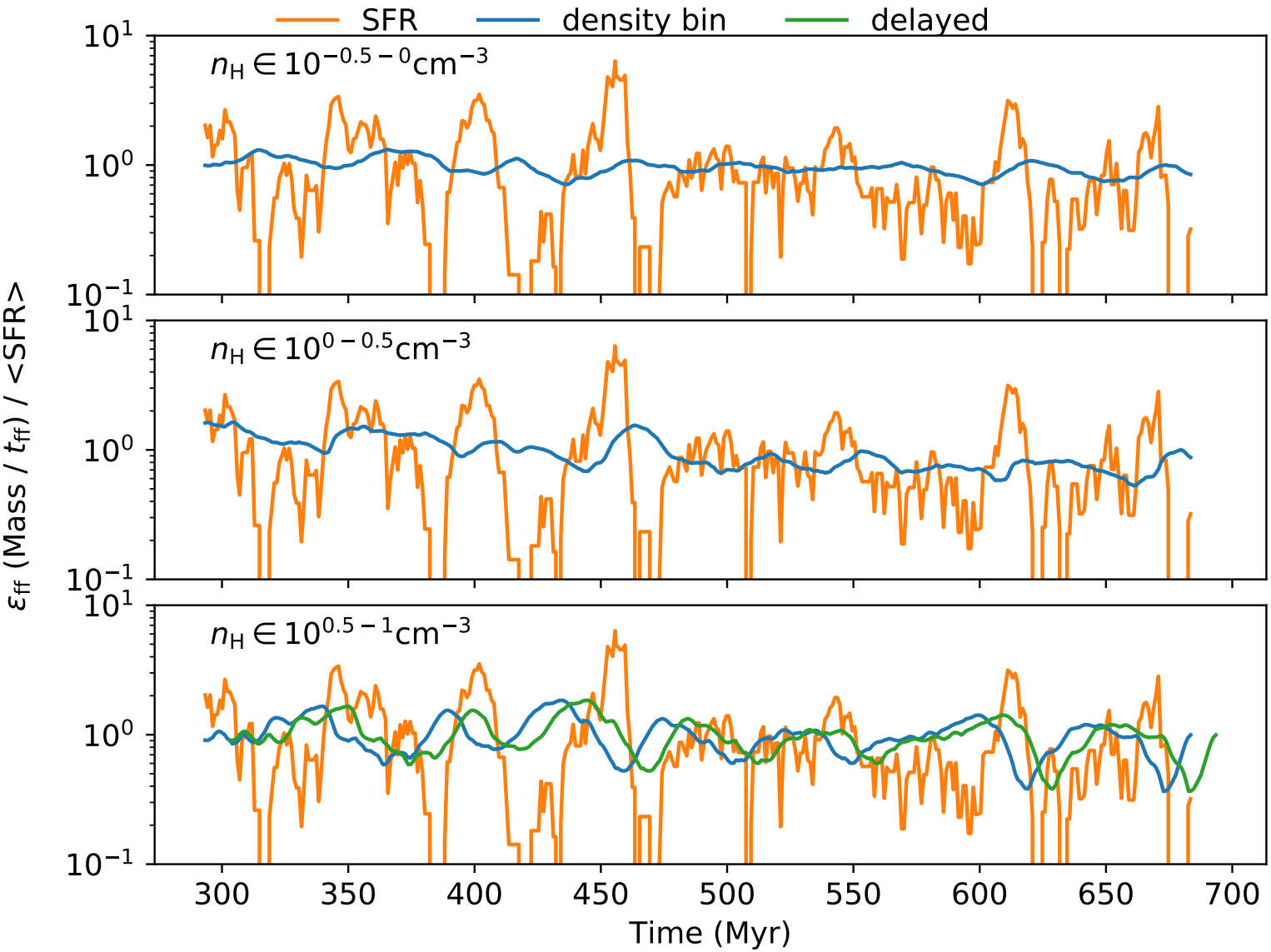


Grav. Energy - Movie

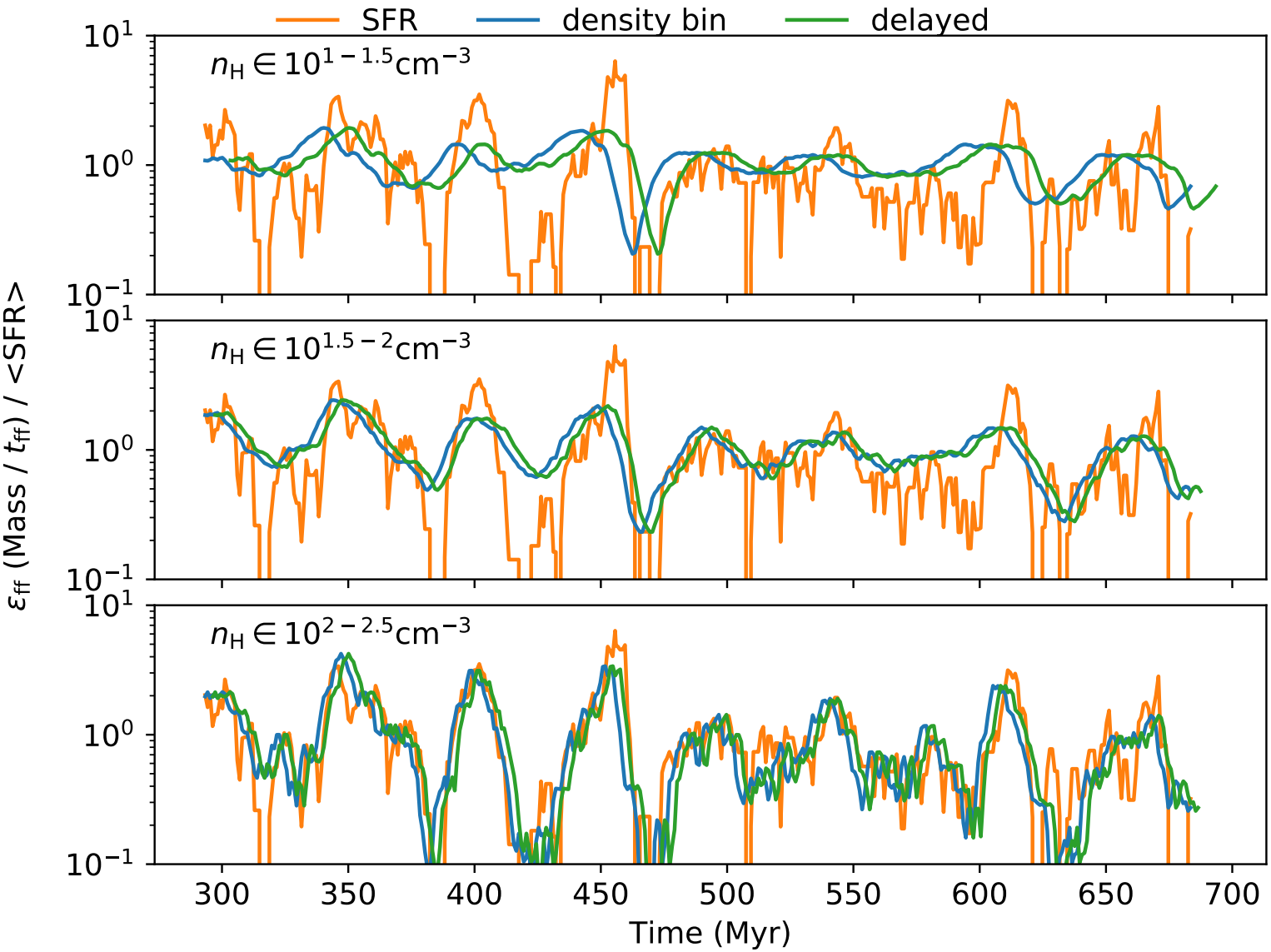


Outline

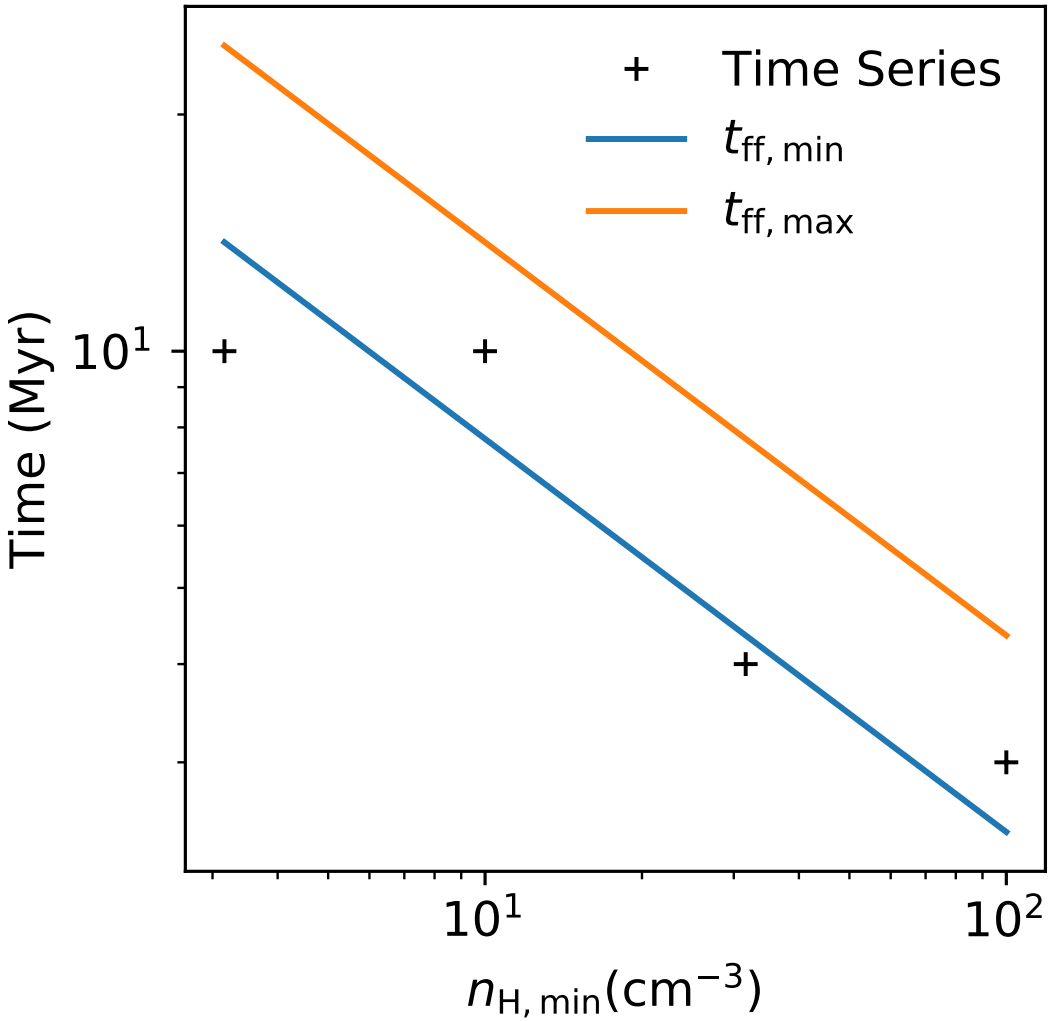
Time Series - Density



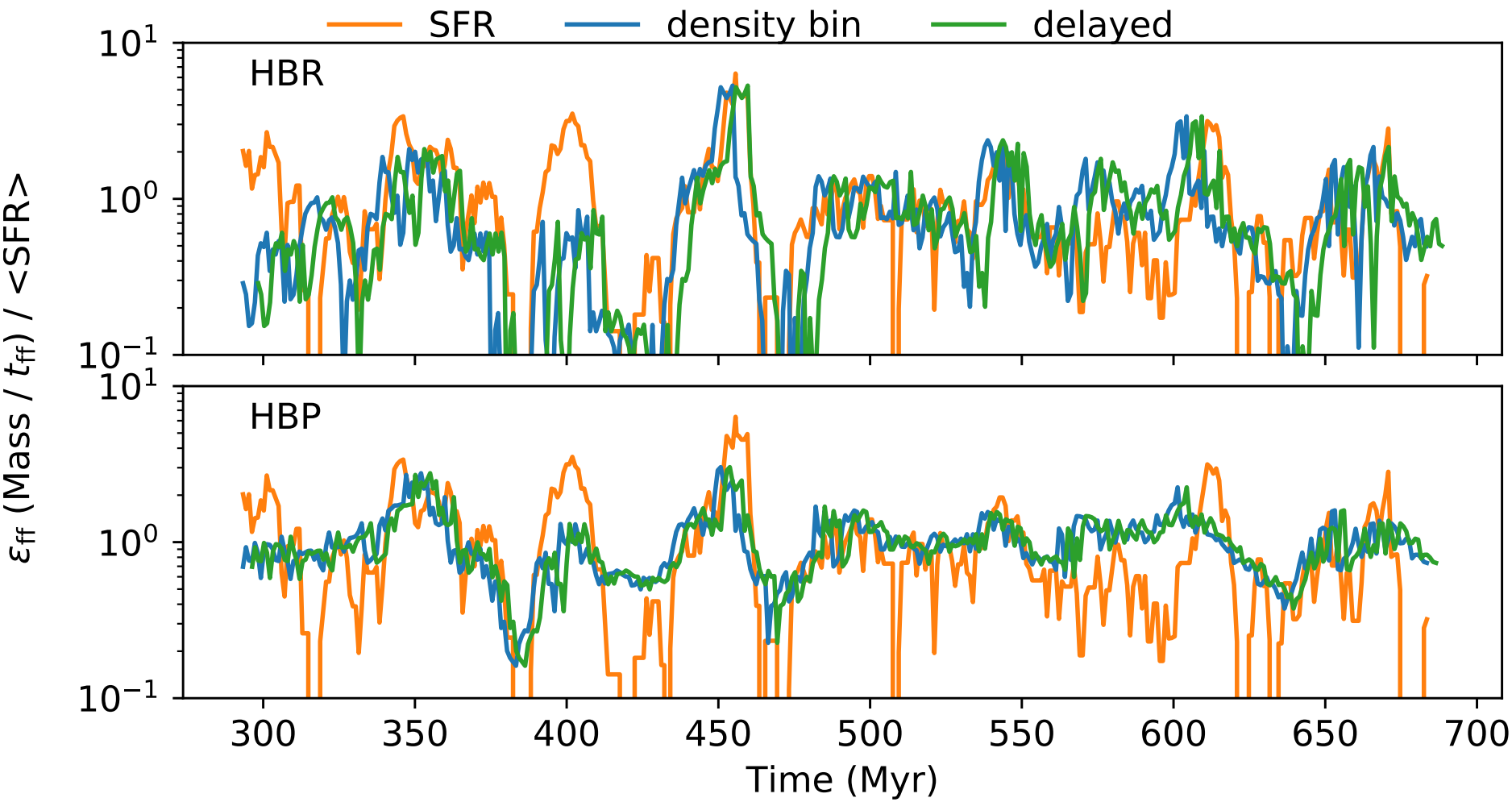
Time Series - High Density



Time Series - Density Time Delay

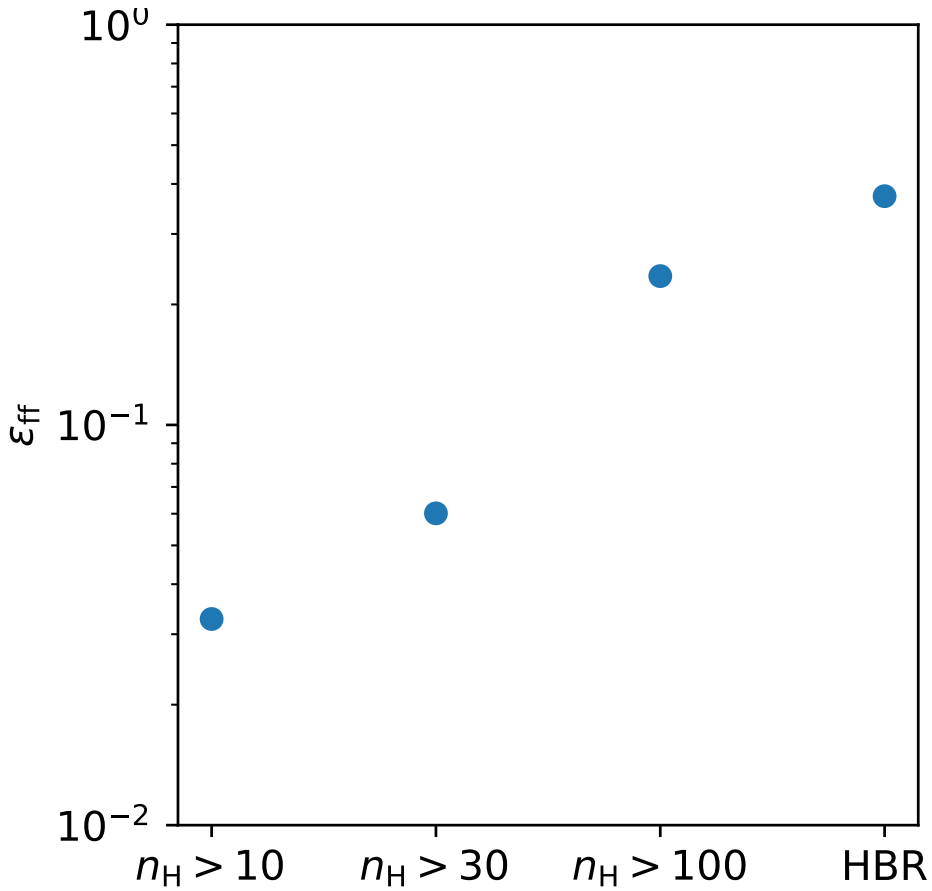


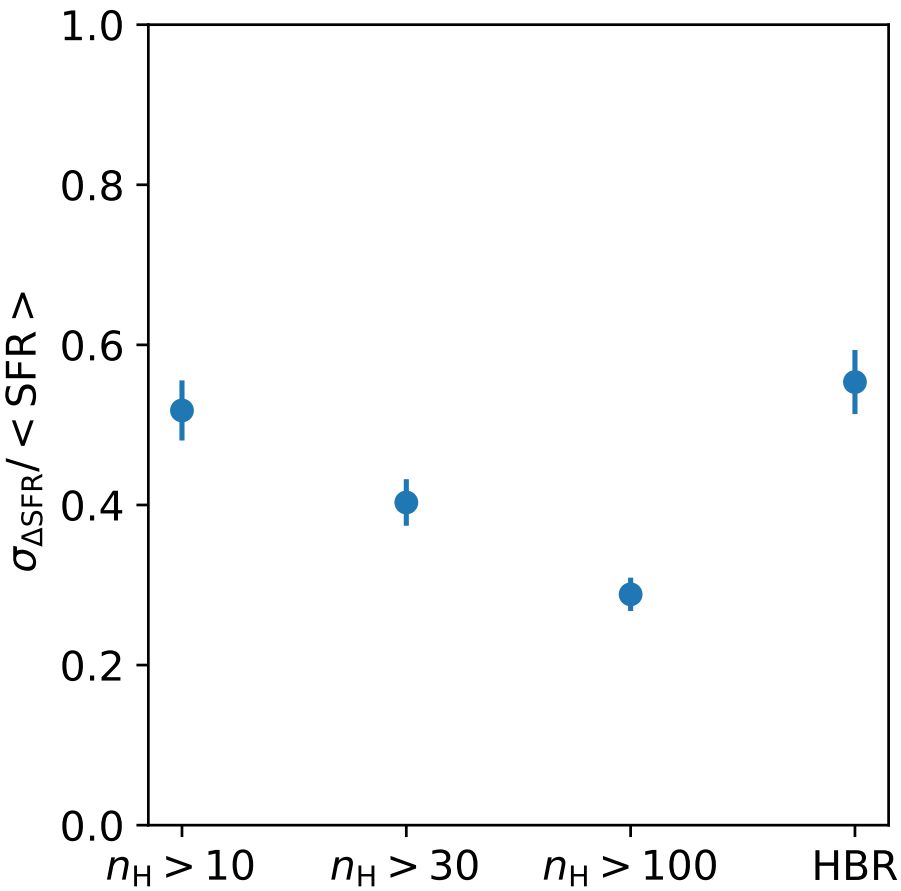
Time Series - Energy-selected



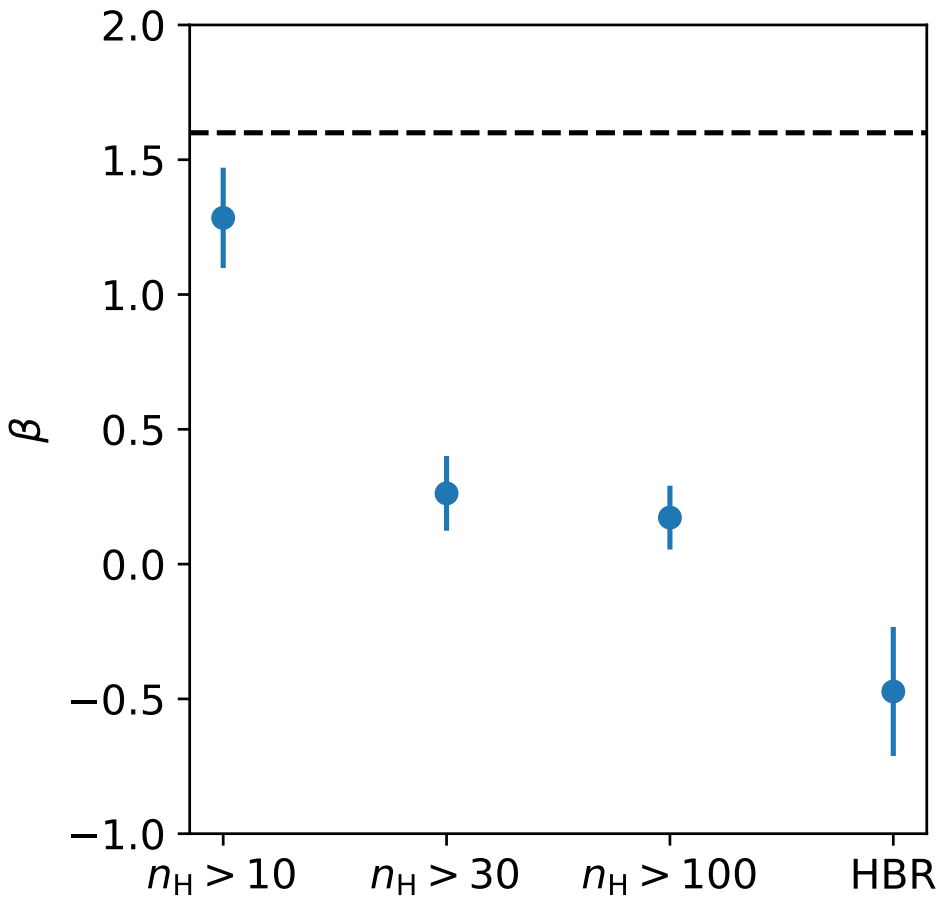
Outline

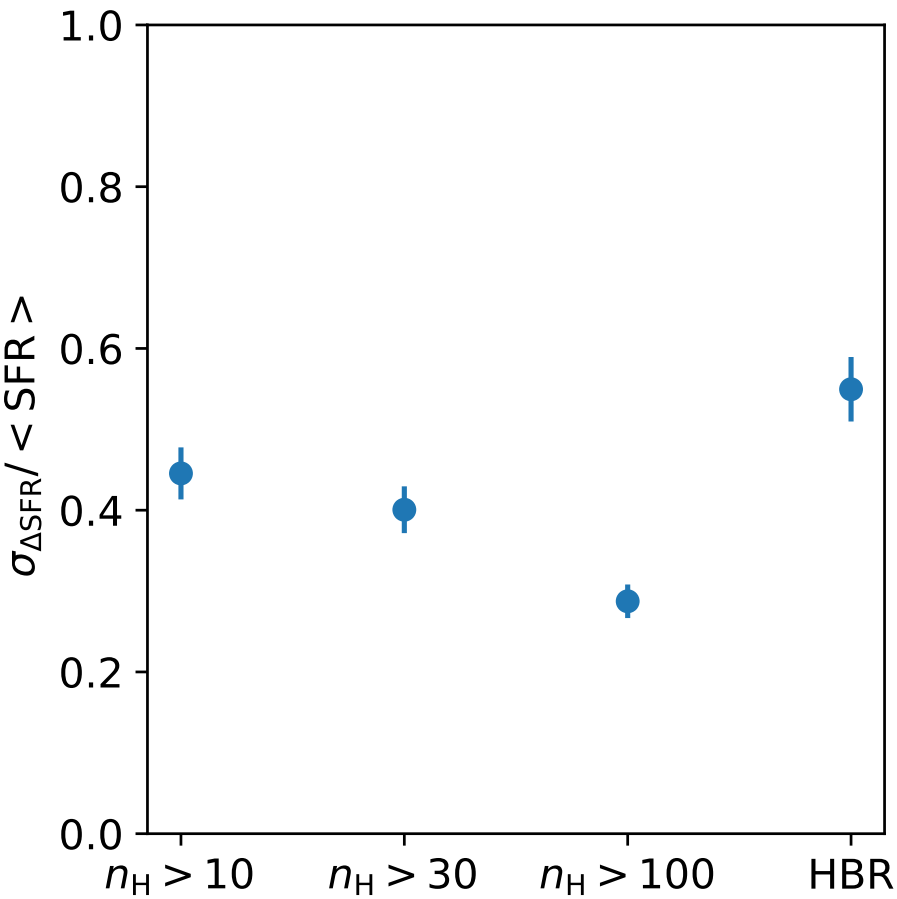
Correlation - Constant $\epsilon_{\rm ff}$ Model between $10^{-2} - 1$



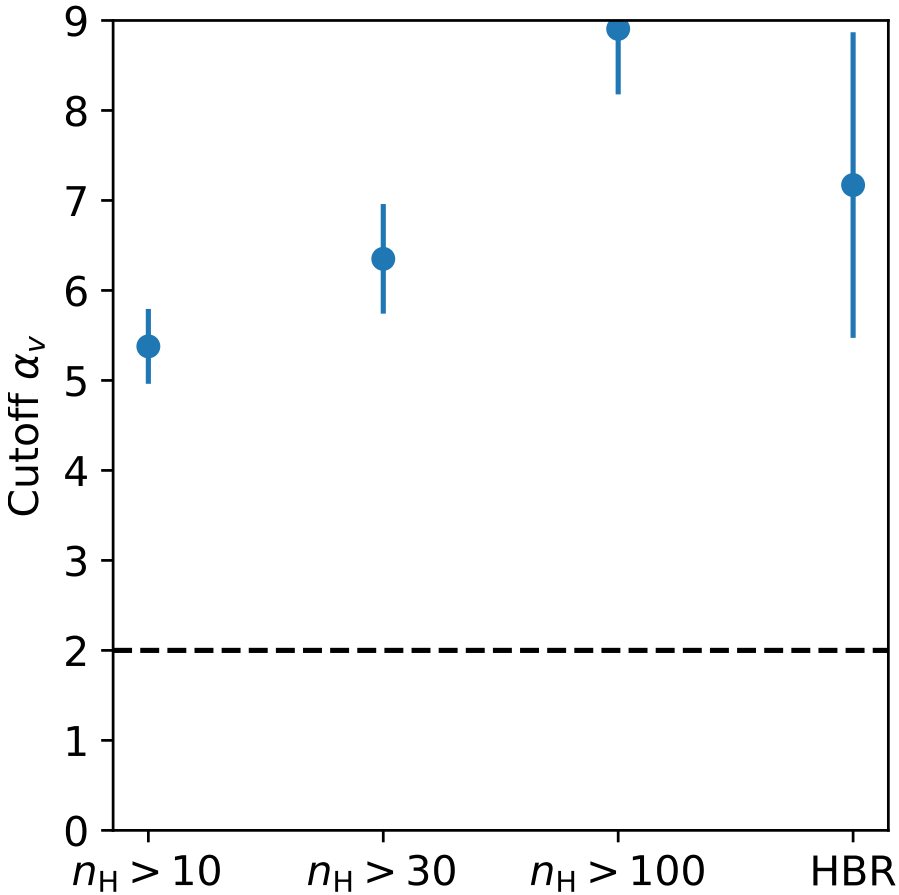


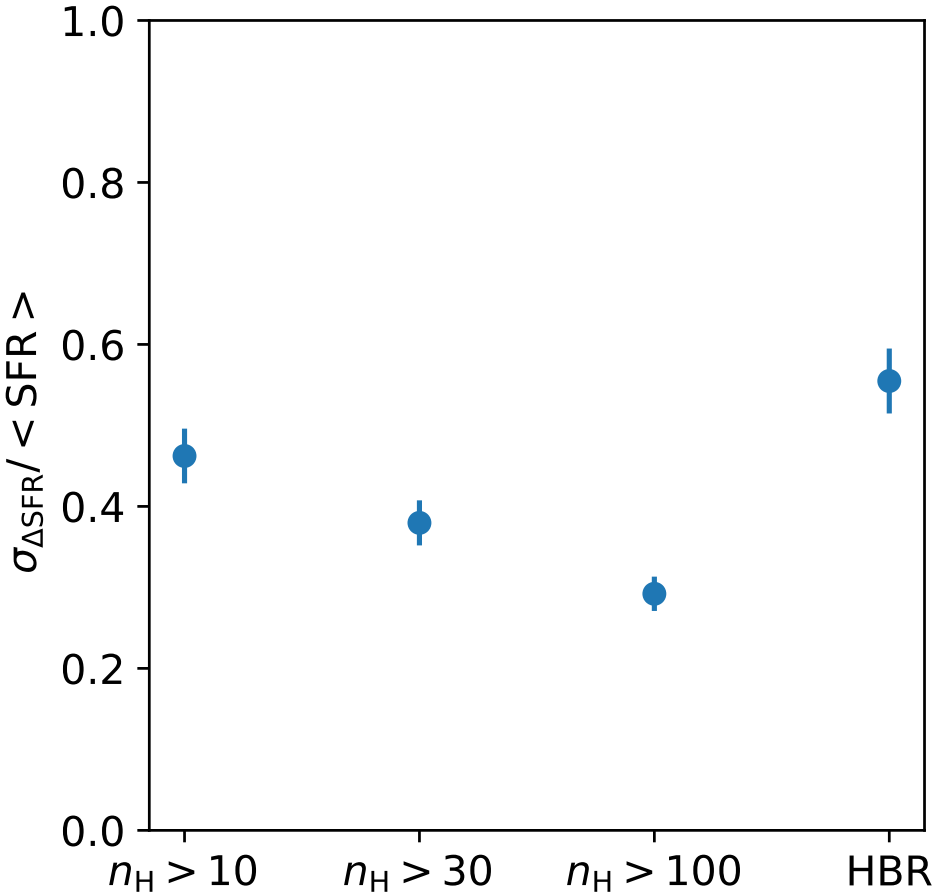
Correlation - $\epsilon_{\rm ff} \propto e^{-\beta t_{\rm dyn}/t_{\rm ff}}$ Model





Correlation - $\alpha_v <$ Cutoff α_v Model





Outline

Plans++

- Form stellar cores in turbulent boxes in dense (100-10000 cm^{-3}) gas
- Compare various Lagrangian Tracer Particle implementations
- Figure out ways to distill understanding

Conclusions

- Time delay $\approx t_{\rm ff}$
- $\epsilon_{\rm ff}$ depends on gas selection
- More sophisticated energy-based selection not necessarily closer to SFR
- Most mass is unbound, and does not stay bound for long (few Myr)
- Unbound objects are involved in star formation