

Stopa stapanja galaksija; veza s udjelom bliskih parova i vremenom stapanja

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Stopa stapanja galaksija; veza s udjelom
bliskih parova i vremenom stapanja

$$\frac{dN}{dt} = \frac{f}{T}$$

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$$\frac{dN}{dt}(M_*, z) = \frac{f(M_*, z)}{T(M_*, z)}$$

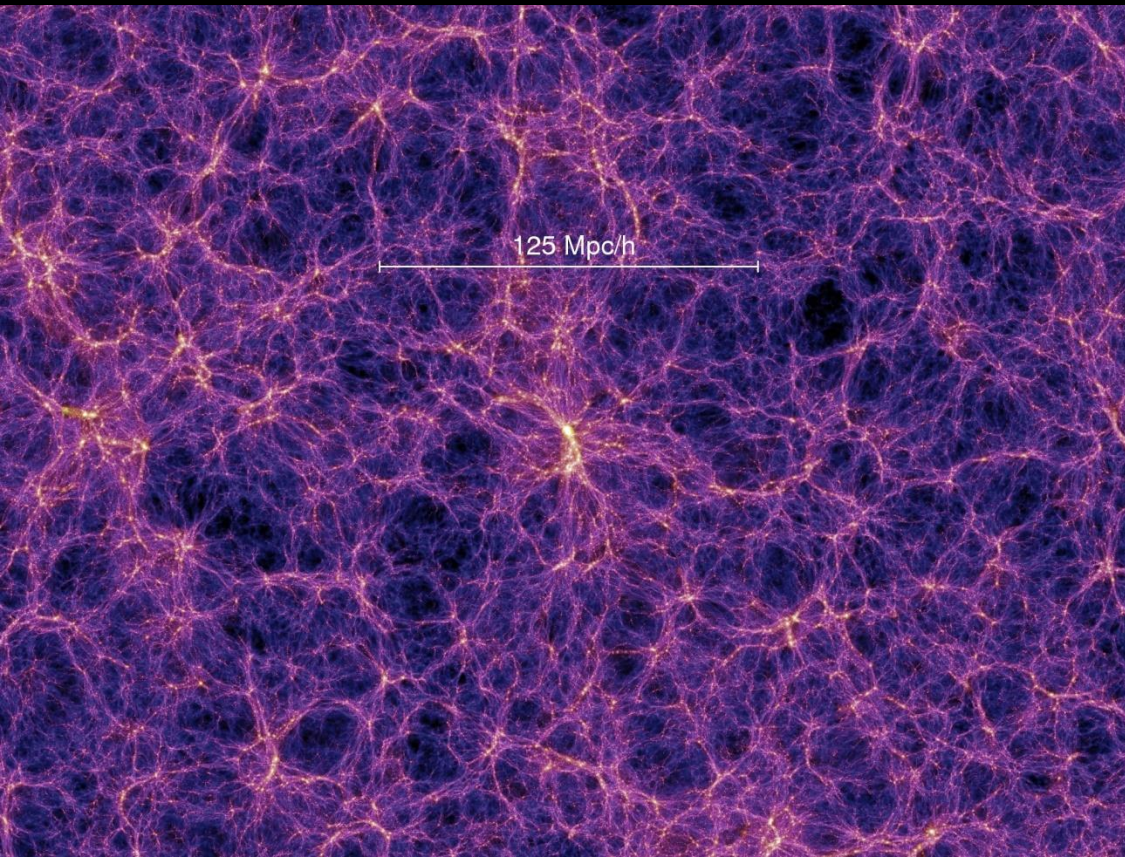
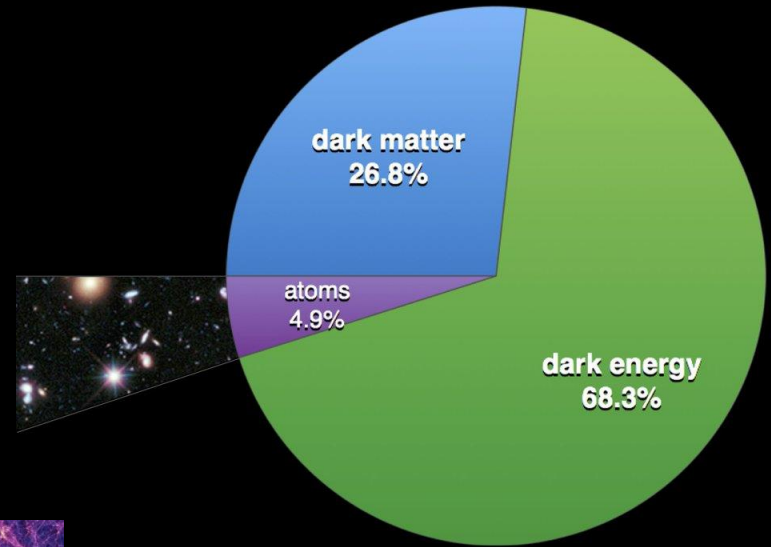
Stopa stapanja galaksija; veza s udjelom bliskih parova i vremenom stapanja

$$\frac{dN}{dt}(M_*, z, \mu_*) = \frac{f(M_*, z, \mu_*, r_{\text{sep}}, v_{\text{sep}})}{T(M_*, z, \mu_*, r_{\text{sep}}, v_{\text{sep}})}$$



N-body kozmološka simulacija:

- Millennium simulacija: $V=(800 \text{ Mpc})^3$, $(5040)^3$ čestice, $M_{\text{čestice}} \approx 10^8 M_{\text{sol}}$, 269 outputa

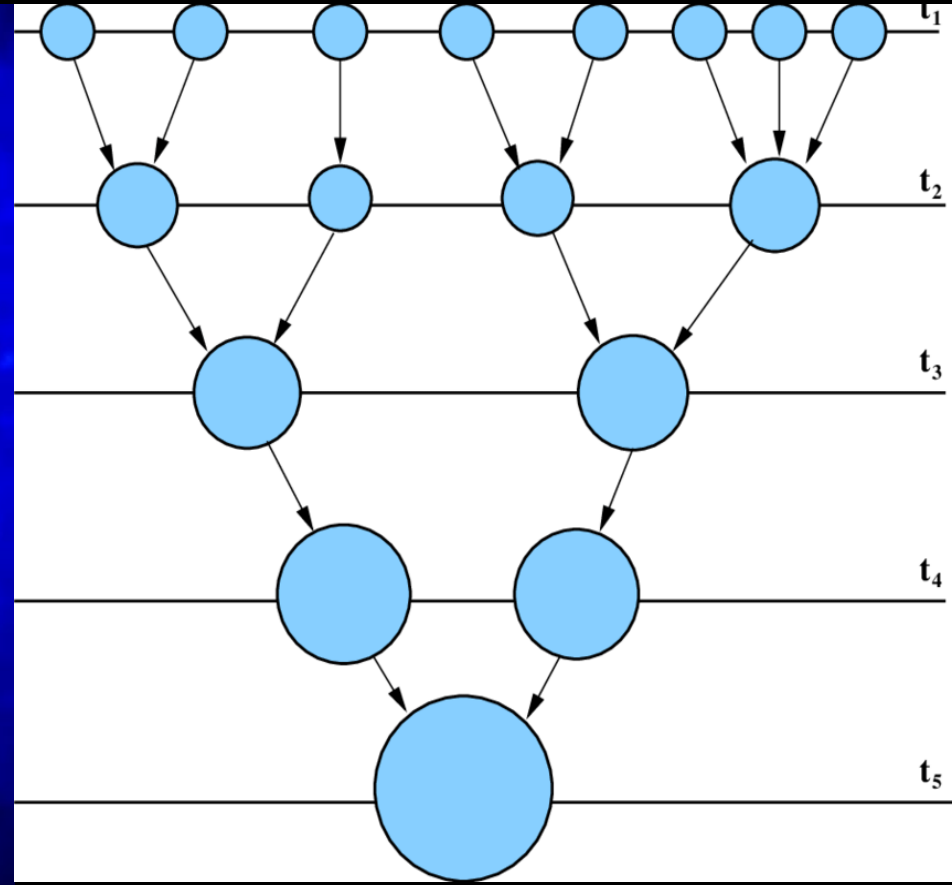
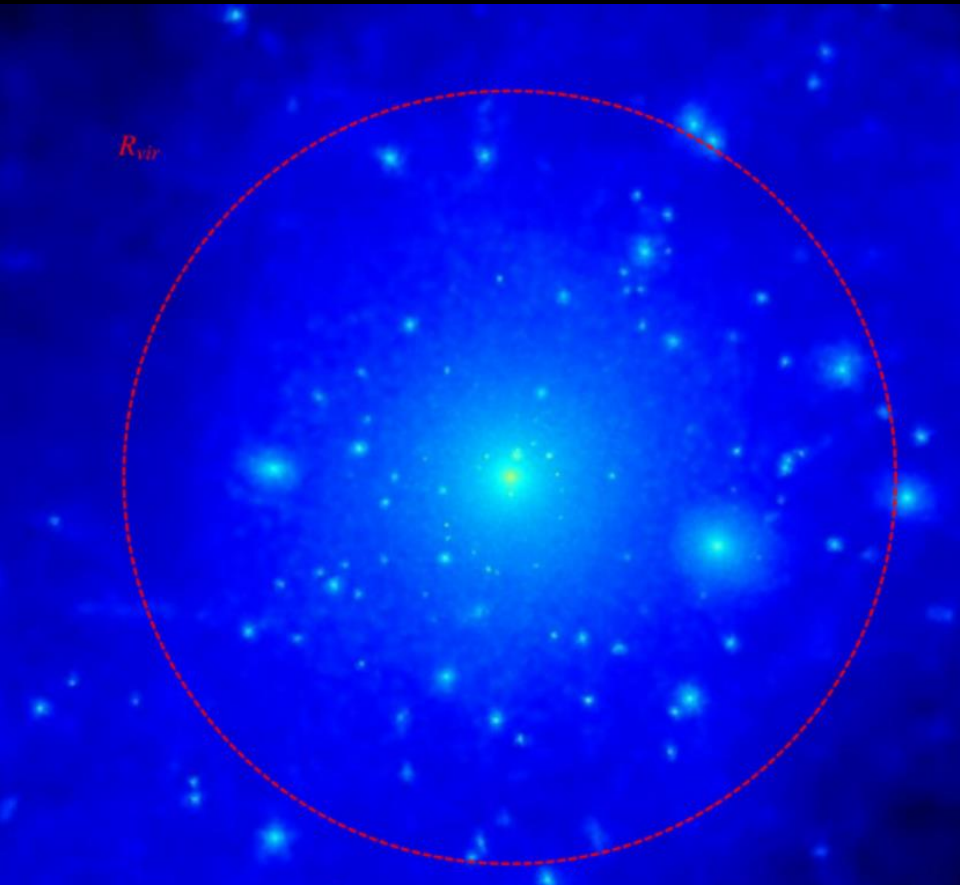


- Planck kozmološki parametri:
 $\Omega_m=0.32$, $\Omega_\Lambda=0.68$, $\Omega_b=0.05$,
 $h=0.067$

N-body kozmološka simulacija:

- haloj tamne tvari s gustoćom:

$$\rho(r) = \frac{\rho_0}{r/r_s(1 + r/r_s)^2}$$



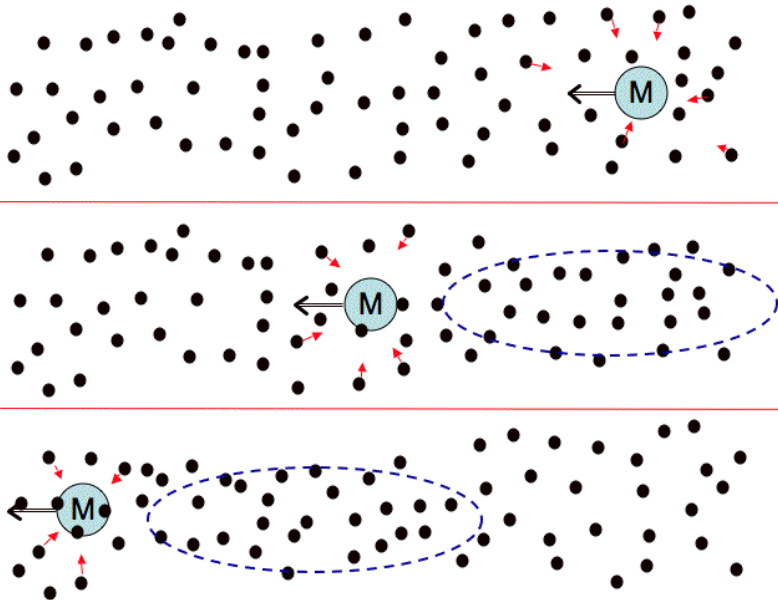
GALFORM model formacije galaksija:

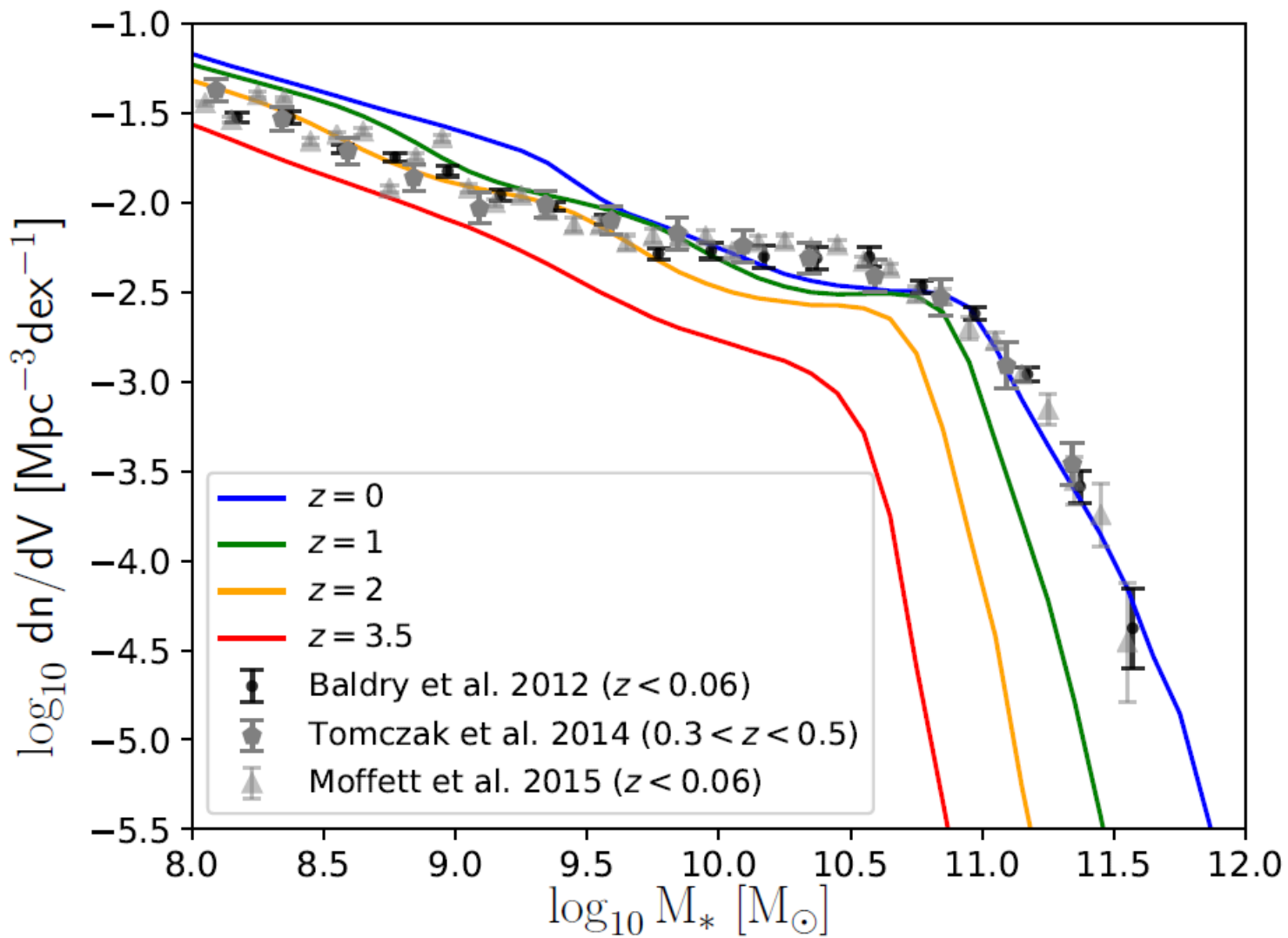
- uključuje upad plina, njegovo izbacivanje kroz supernova i AGN feedback, formacije zvijezda, stapanje galaksija i mnoge druge efekte

- potrebno analitički modelirati upad podhaloa u glavnom halou nakon što se dostigne granična rezolucija

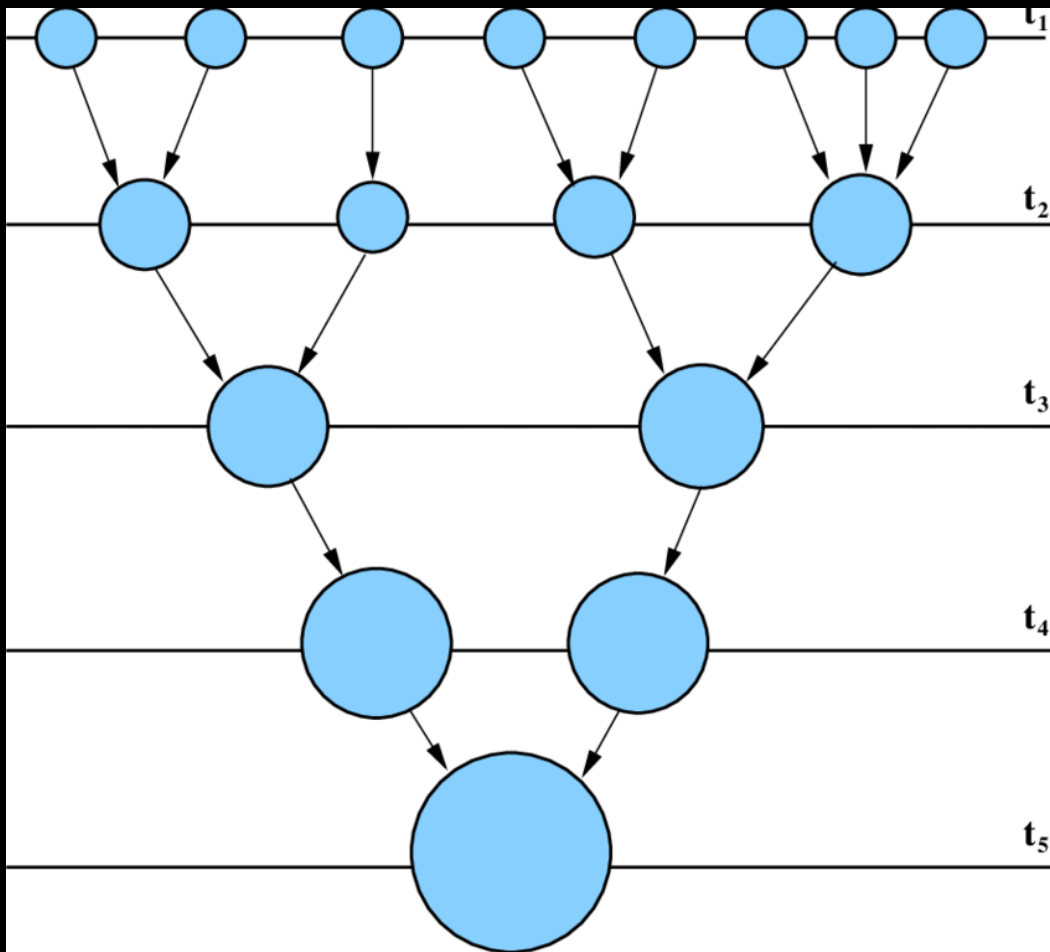
$$\tau \approx \frac{16}{5} \sqrt{\frac{\rho_0}{G}} \frac{r_s}{m \ln(1 + M/m)} R_0^2$$

Dynamical Friction I



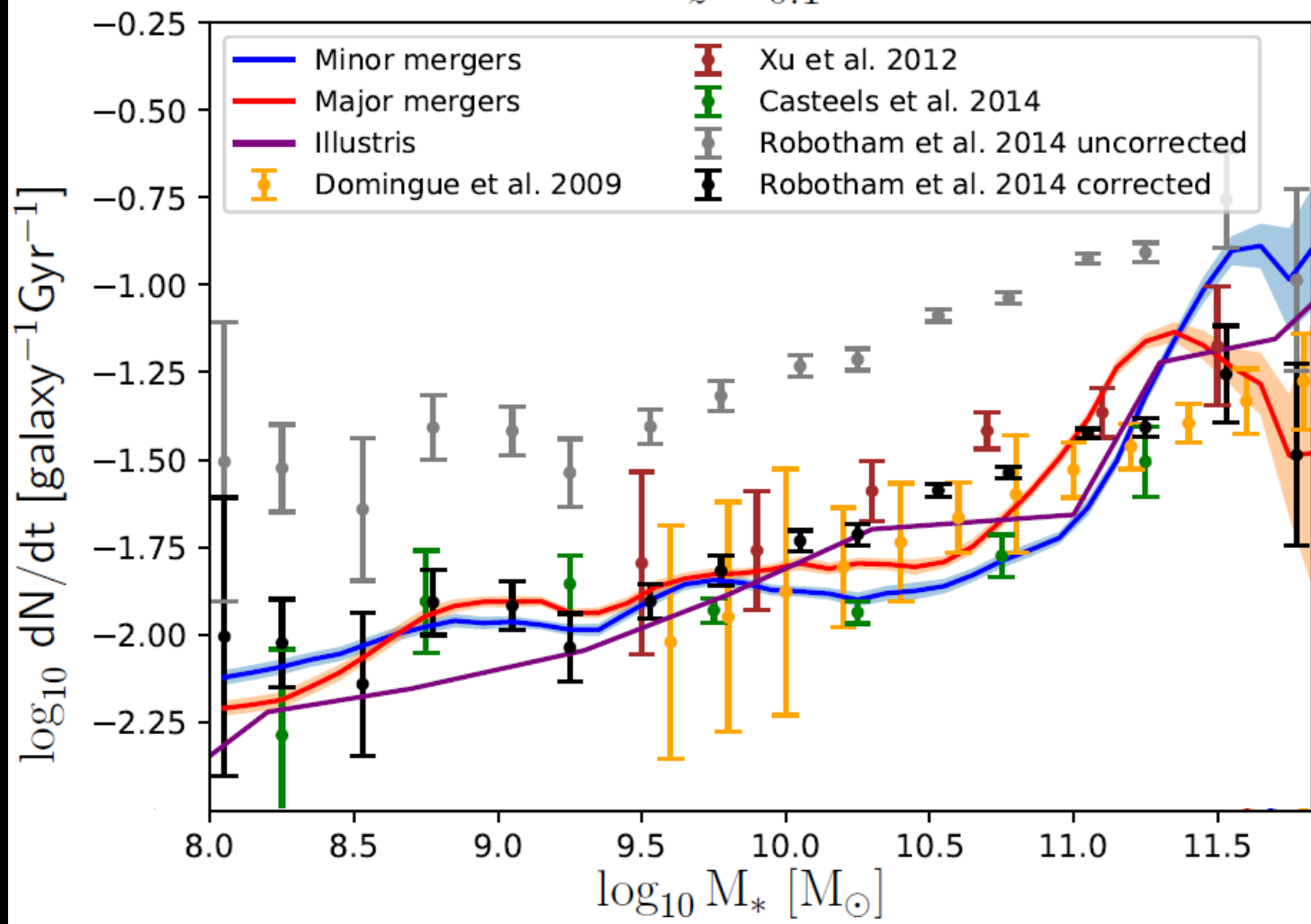


Stopa stapanja u GALFORM-u:

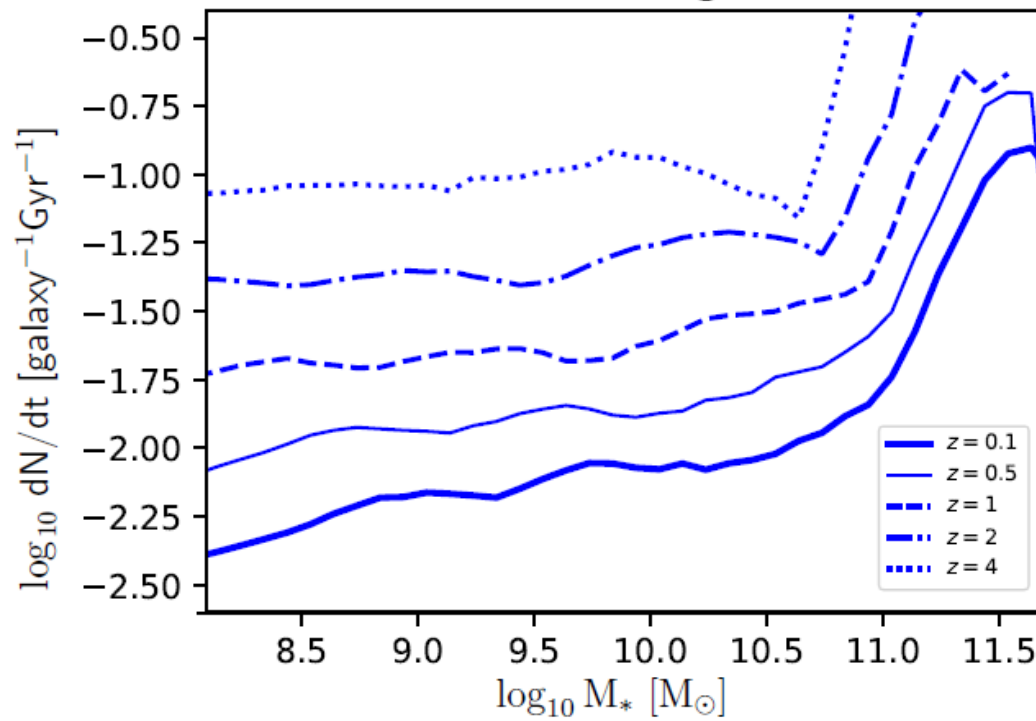


$$\frac{dN}{dt} = \frac{\Delta N_{\text{merg}}}{\Delta N \Delta t}$$

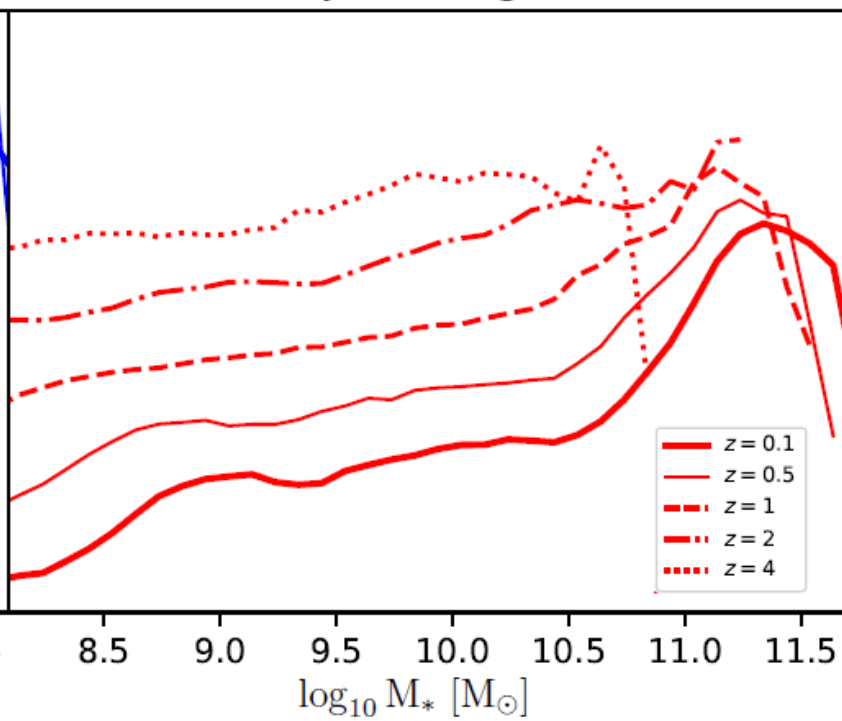
$z = 0.1$



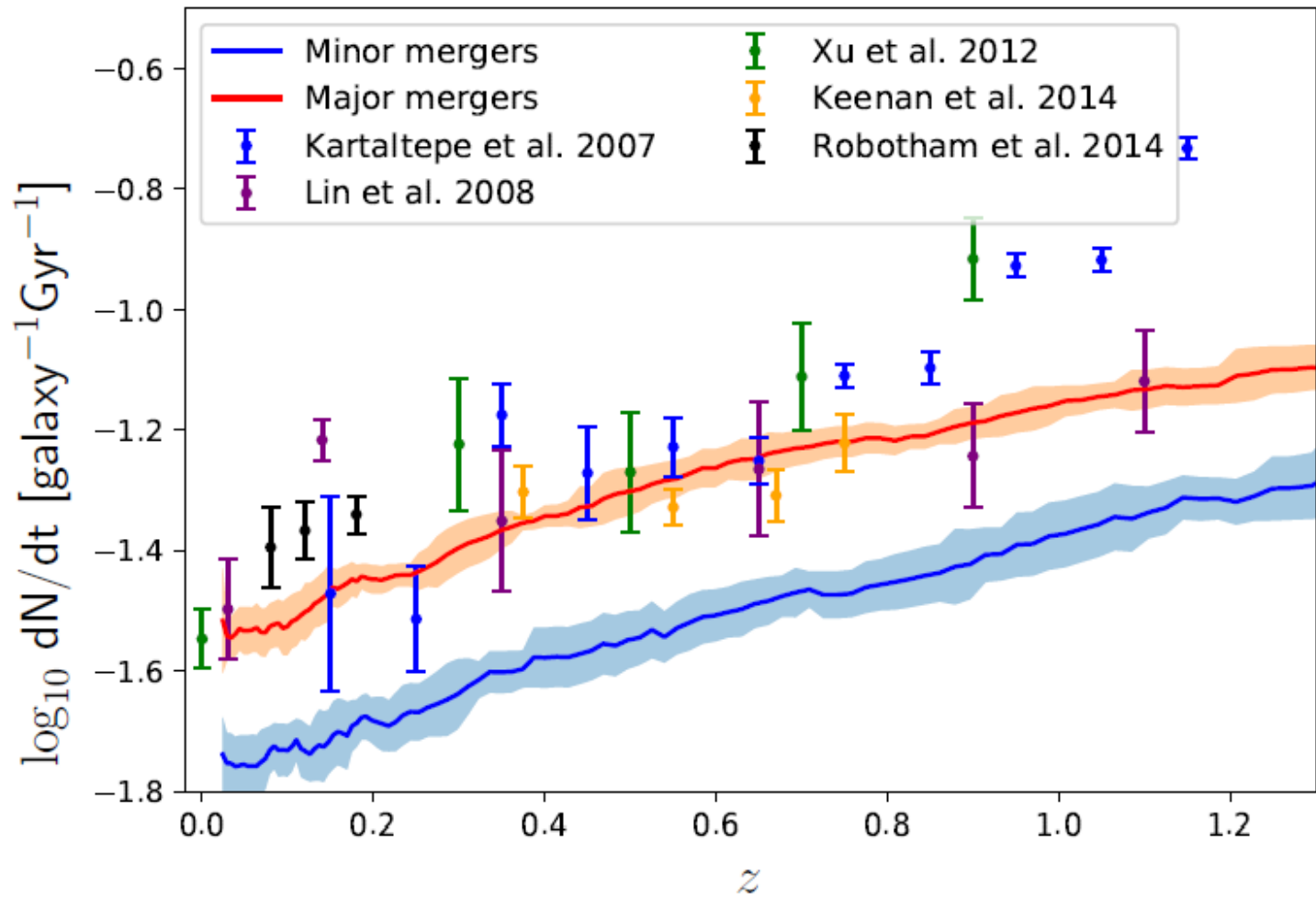
Minor mergers

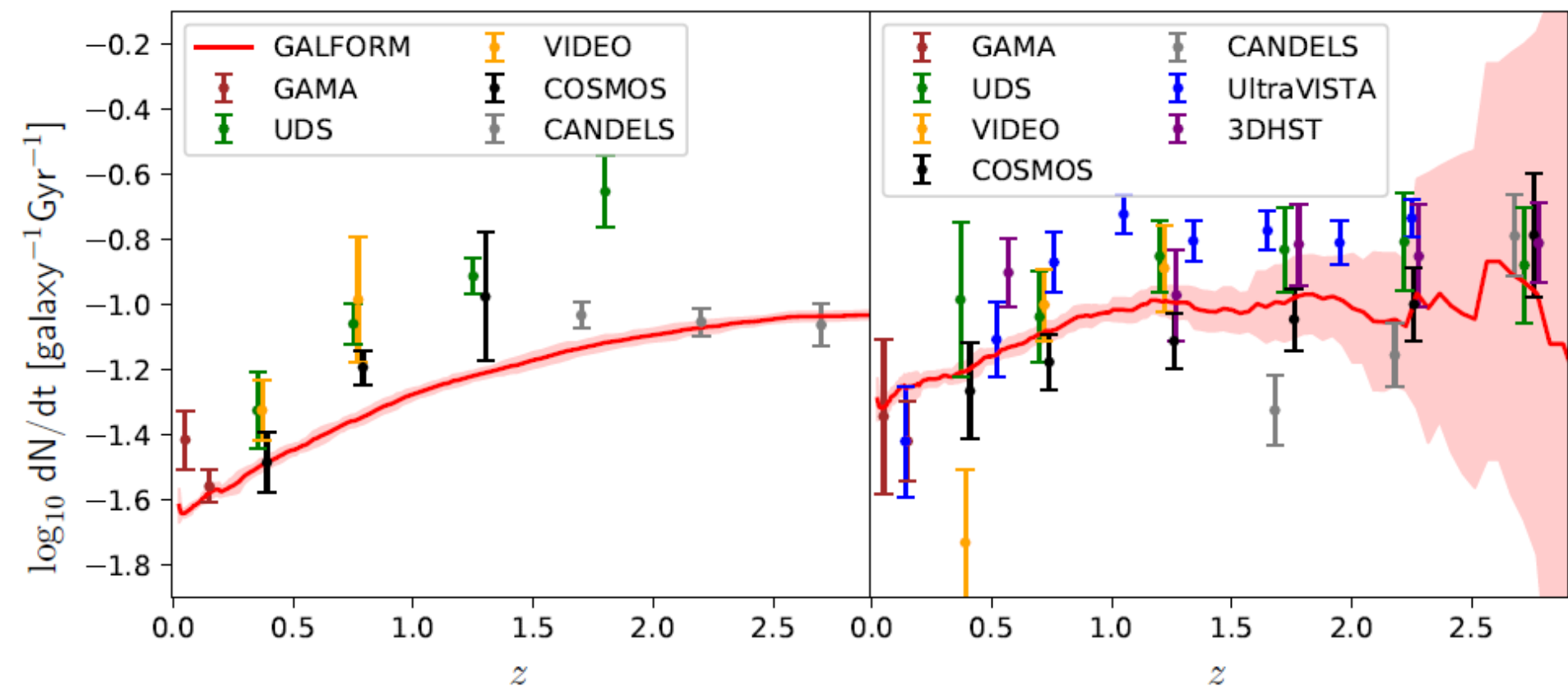


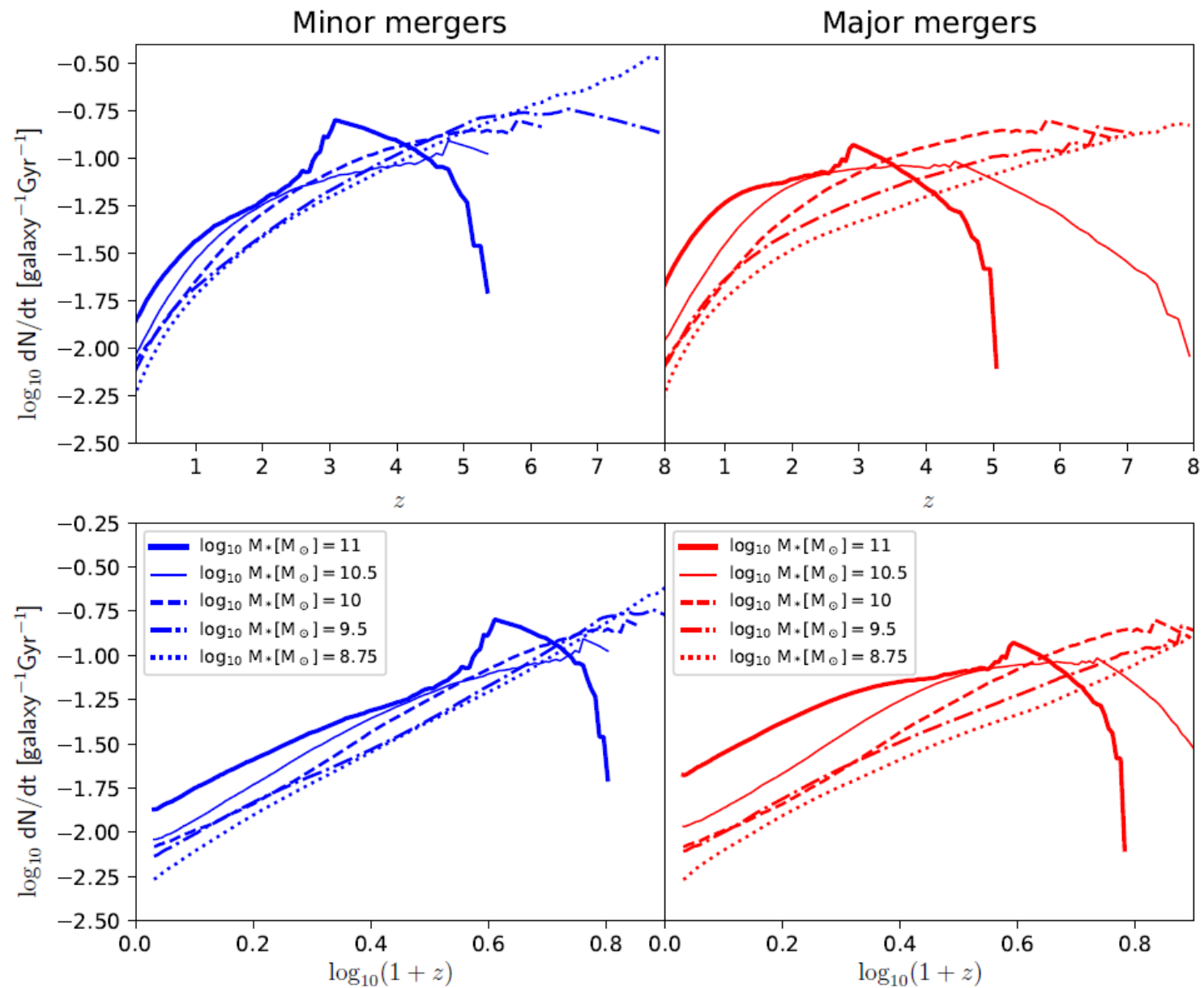
Major mergers



$$\log_{10} M_* [M_{\odot}] = 10.8$$

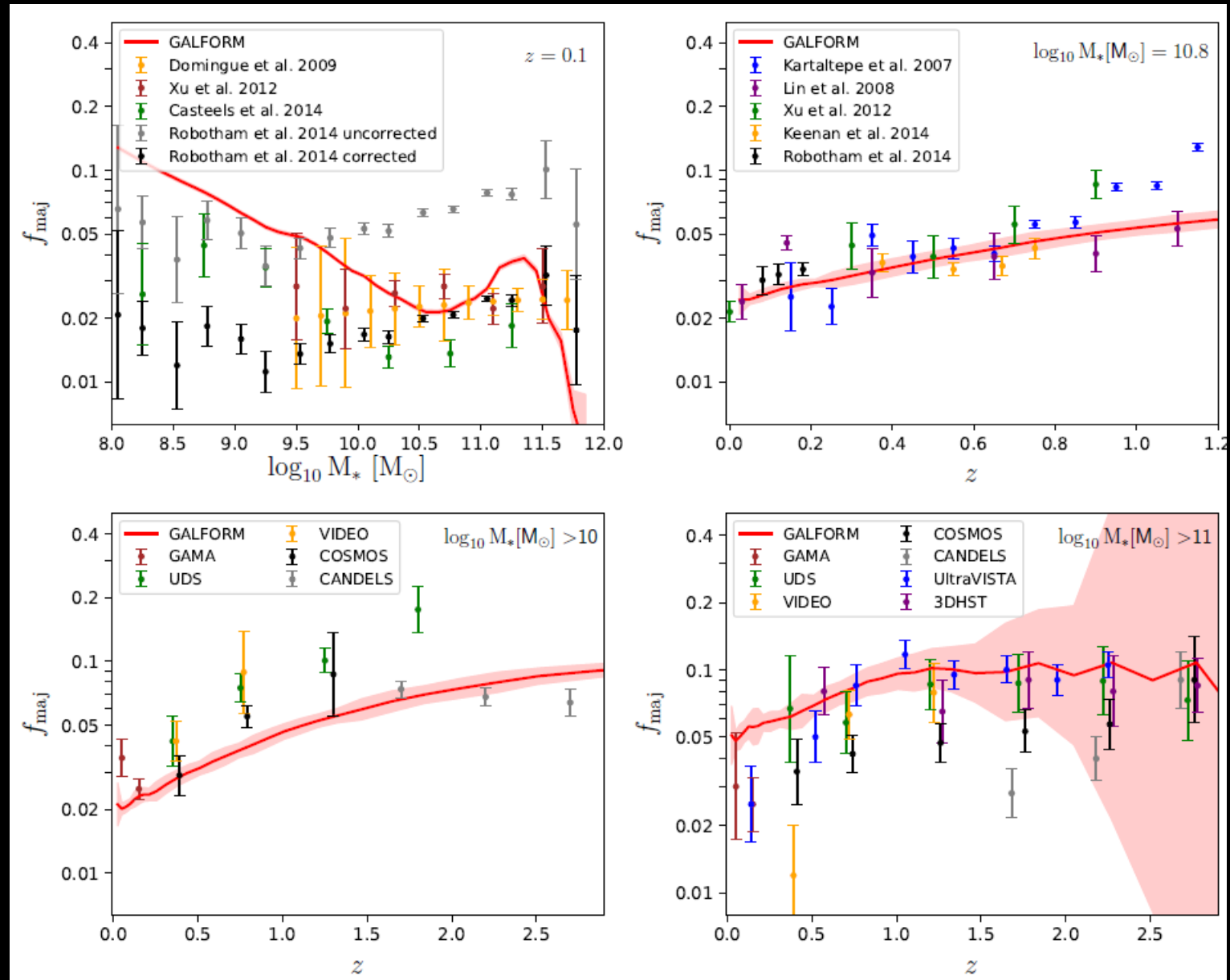


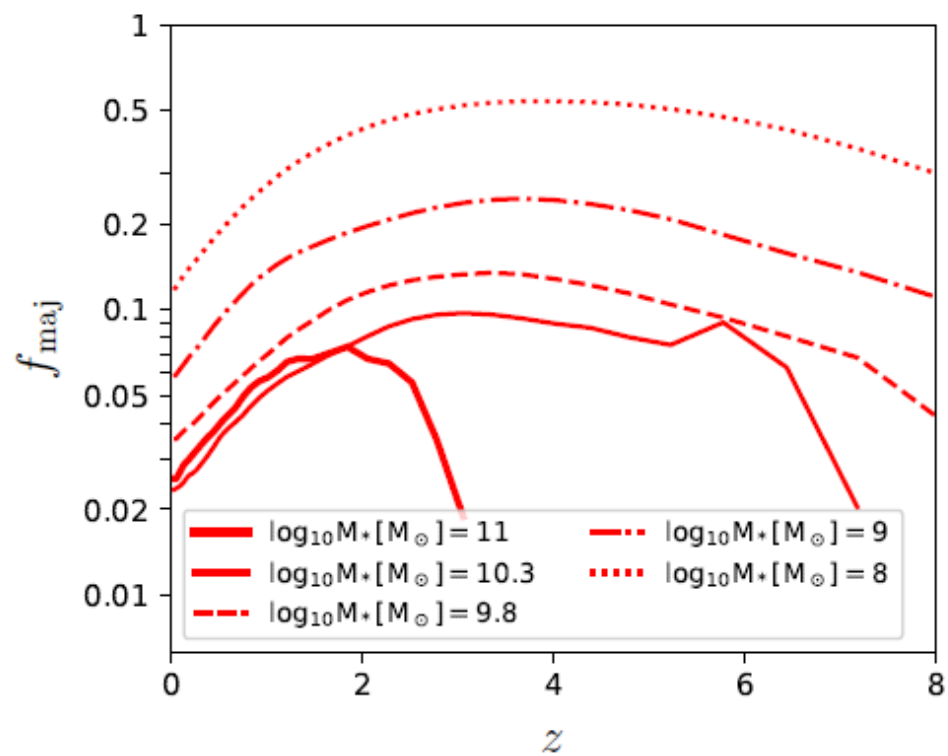
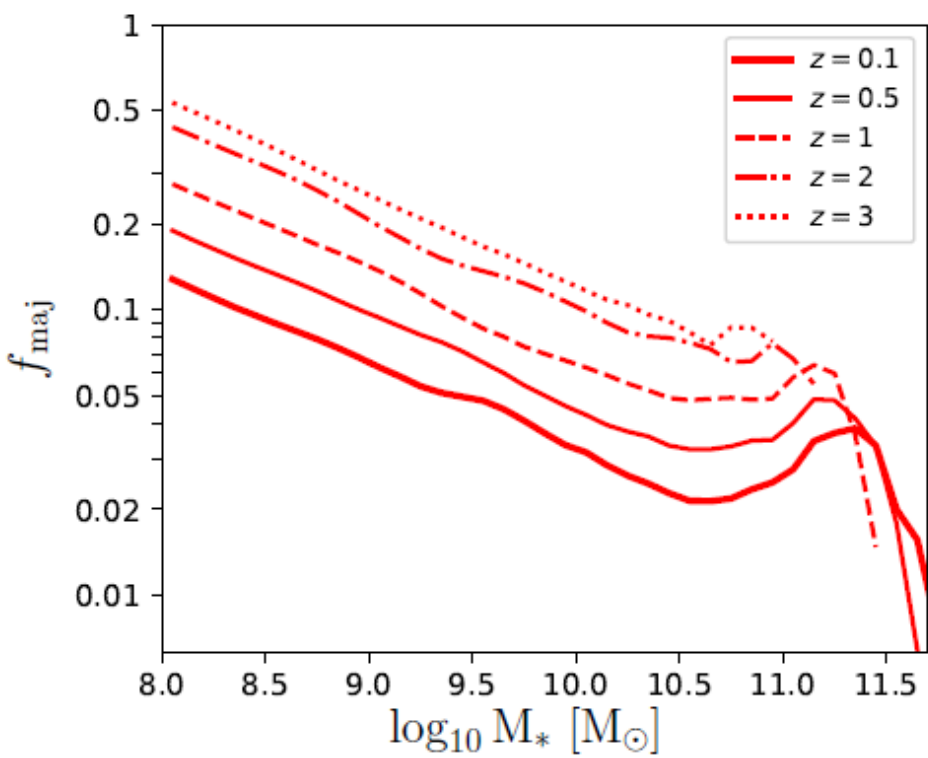
$\log_{10} M_* [M_\odot] > 10$ $\log_{10} M_* [M_\odot] > 11$ 



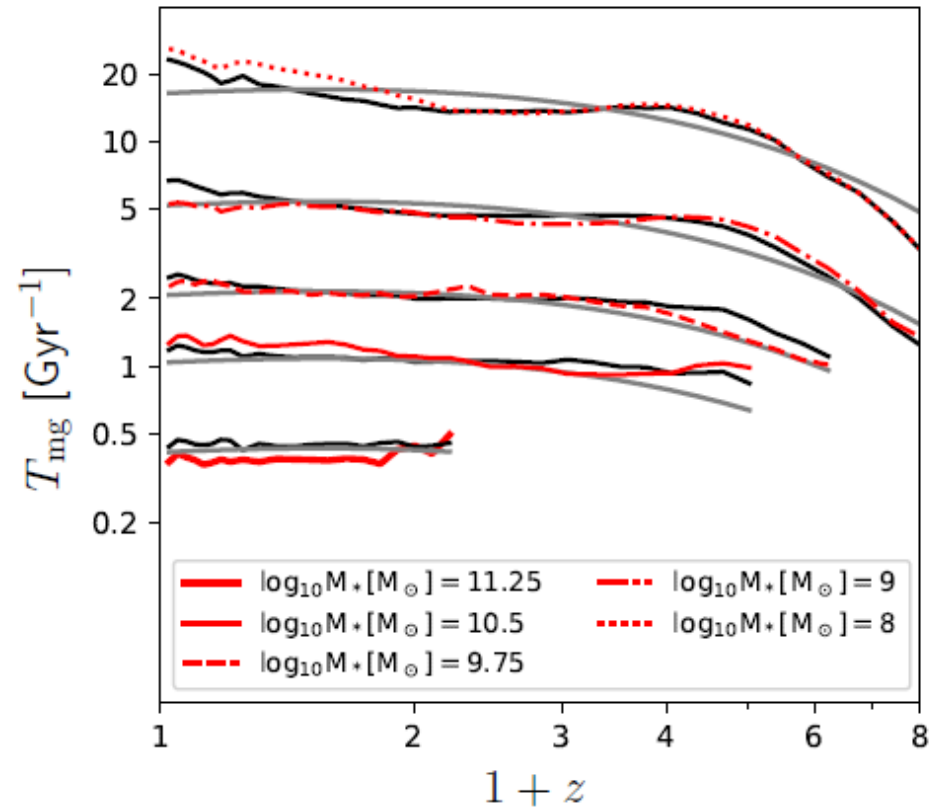
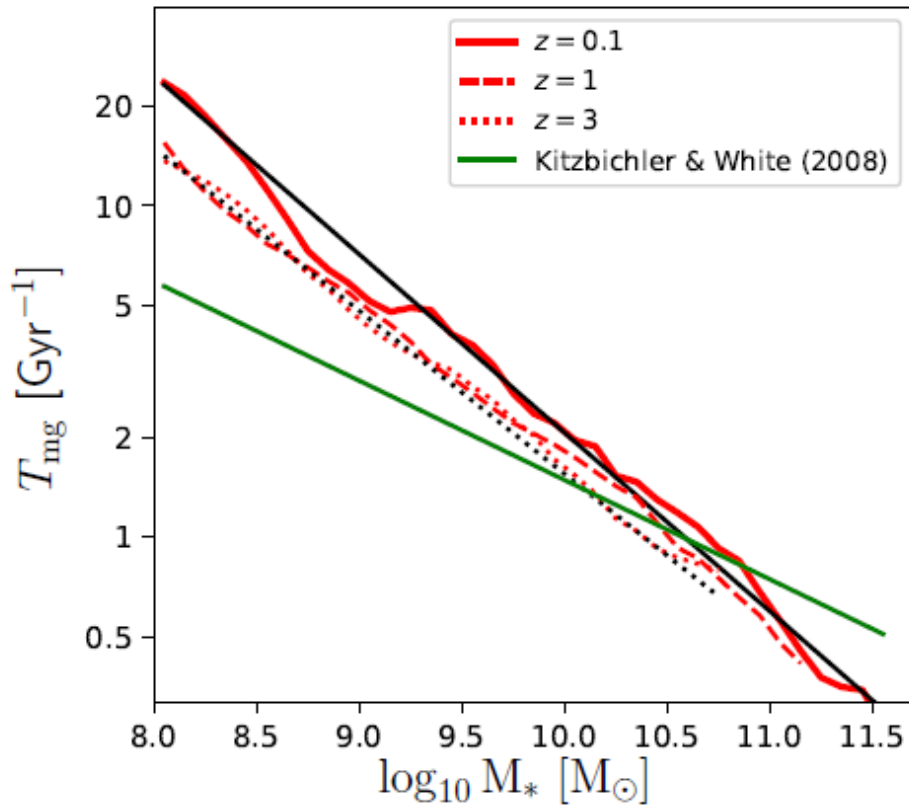
Udio bliskih parova u GALFORM-u:

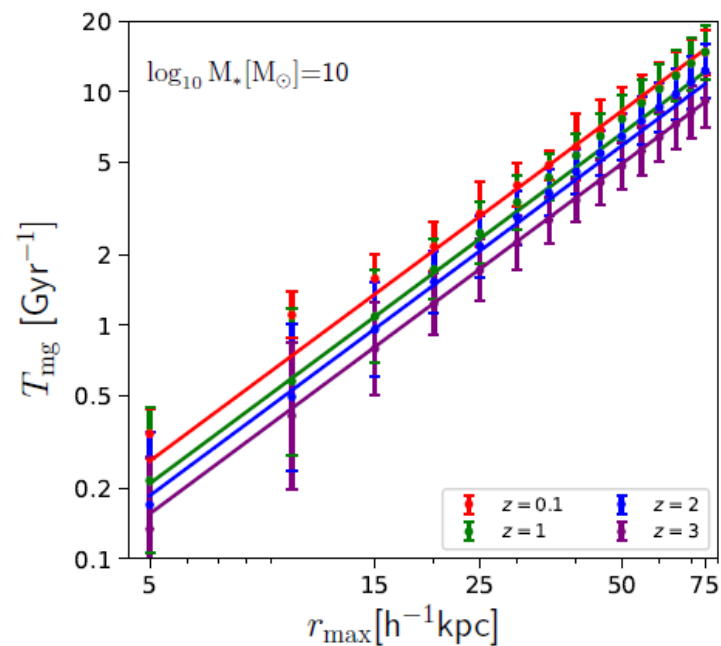
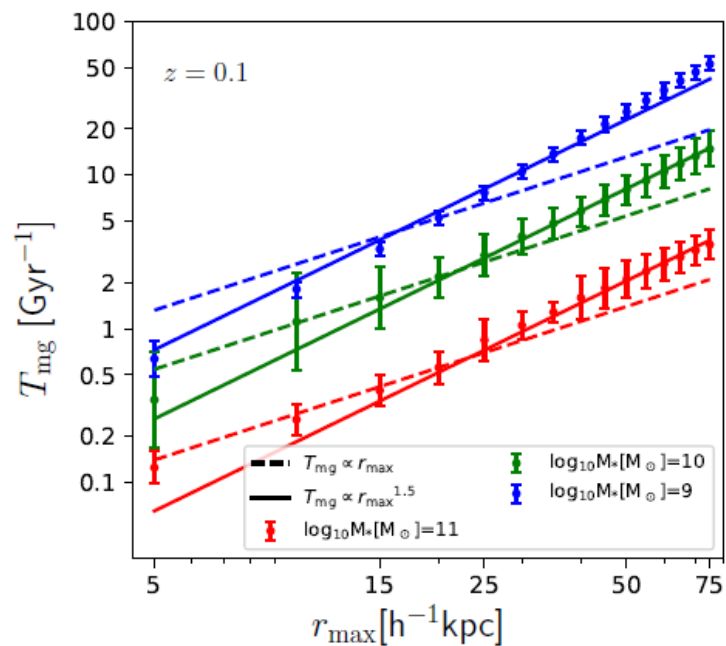
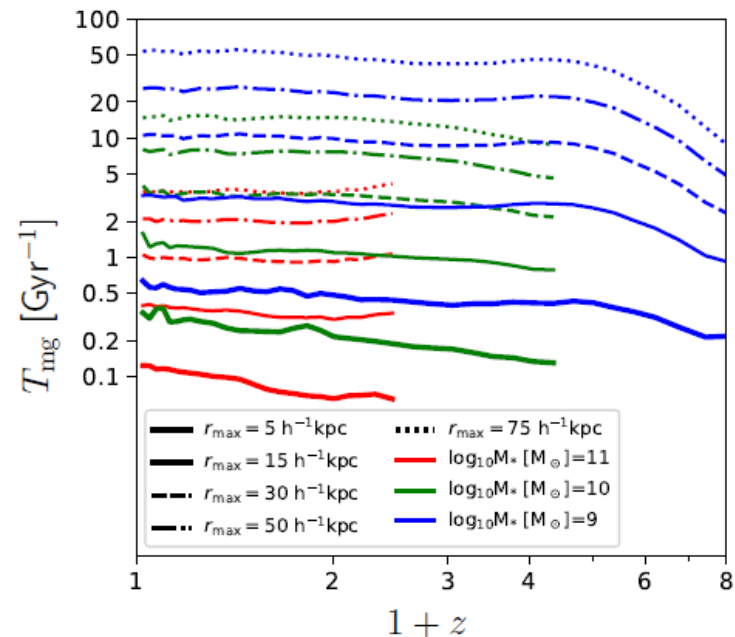
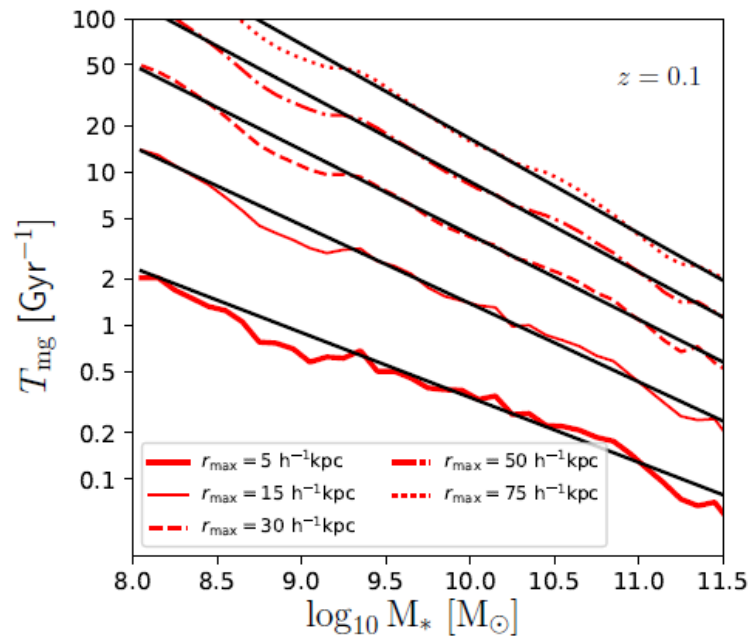
$$f(M_*, z, \mu_*, r_{\text{sep}}, \nu_{\text{sep}})$$

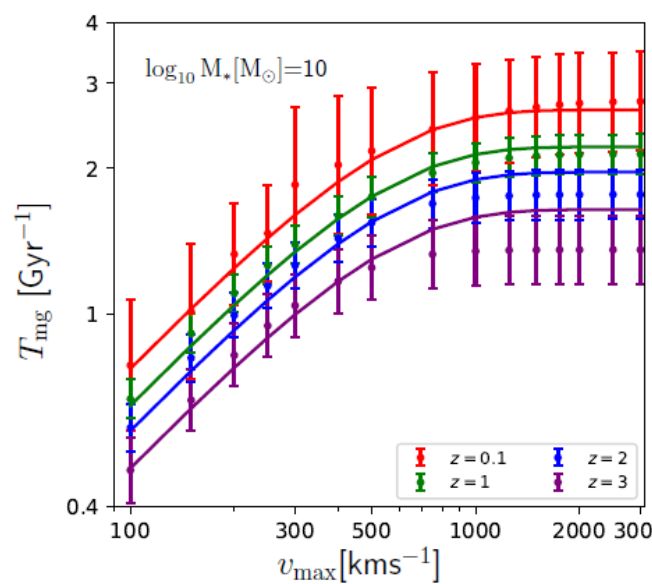
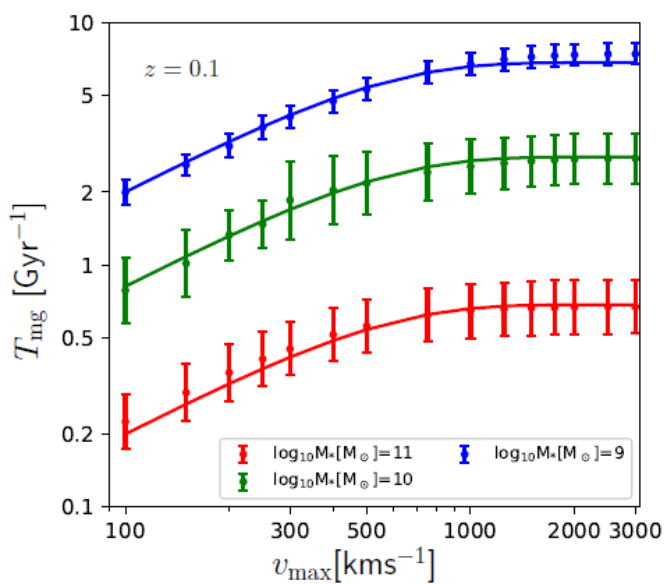
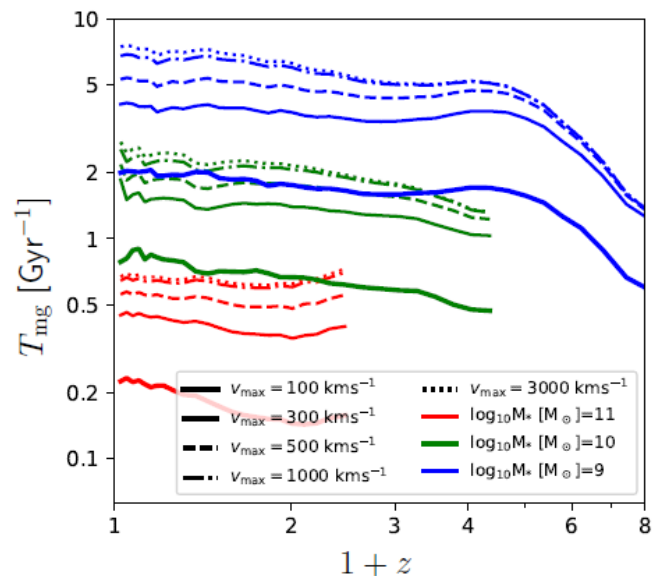
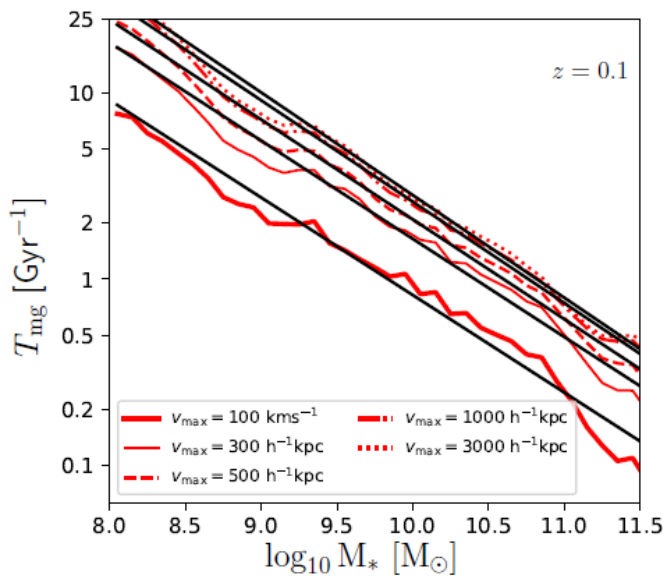




Vremenska skala stapanja u GALFORM-u:







$$T_{\text{mg}} = 2.2 \text{ Gyr} \times r_{\text{max},20}^{1.5} \text{erf}(v_{\text{max},0}^{0.75}) \times M_{*,10}^{-0.5} (1+z)^{0.5} e^{-0.14z}$$

Zaključak:

- stopa stapanja je općenito veća za masivnije galaksije i ranija vremena, osim za galaksije masivnije od neke granične mase ($M_* \approx 10^{11} M_{\text{sol}}$)
- stopa stapanja se dobro slaže s opservacijama, i kao funkcija zvjezdane mase i crvenog pomaka
- udio velikih bliskih parova se dobro slaže s opservacijama za masivnije galaksije ($M_* > 10^{10} M_{\text{sol}}$), a lošije za manje masivne
- pronađena je empirijska formula za vremensku skalu stapanja kao funkcija mase i crvenog pomaka, kao i selekcijskih varijabli

Reference:

- Mundy, C. J.; Conselice, C. J.; Duncan, K. J.; Almaini, O.; Haussler, B.; Hartley, W. G. (2017), MNRAS, 470(3), 3507
- <https://arxiv.org/abs/0909.2028>
- http://people.virginia.edu/~dmw8f/astr5630/Topic12/t12_D_Fric.html