Study of the Mass-Metallicity Relation in Galaxies

MultiDark Galaxies Workshop

Florencia Collacchioni

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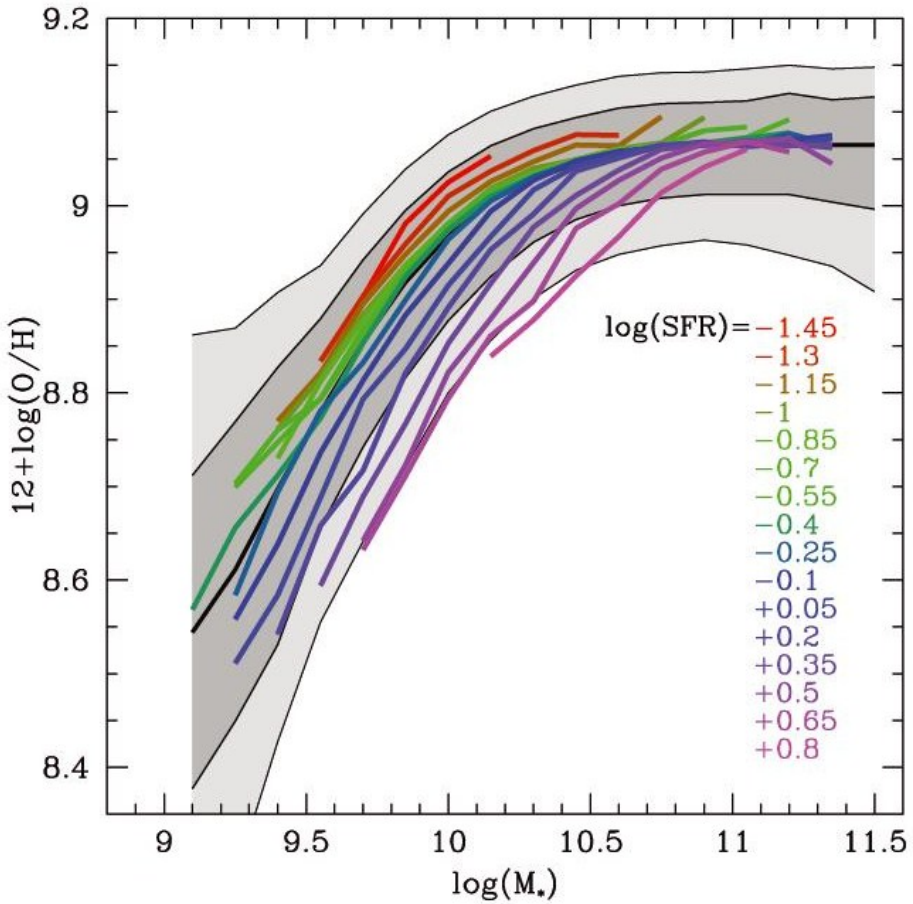
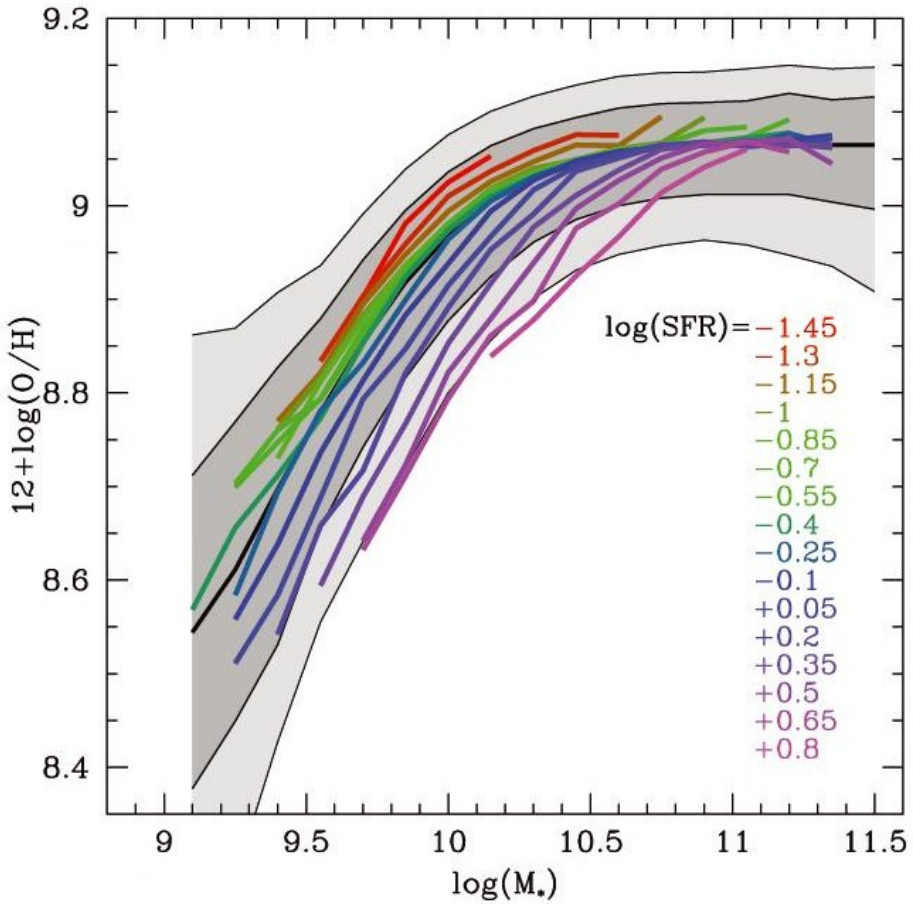
Introduction



Mannucci+(2010)

- Correlation between gas-phase oxygen abundance and $M_\star$.
- At a fixed $M_\star$, galaxies with higher SFR have lower metallicities.
- Information of SF histories and different processes affecting gas evolution.

Introduction

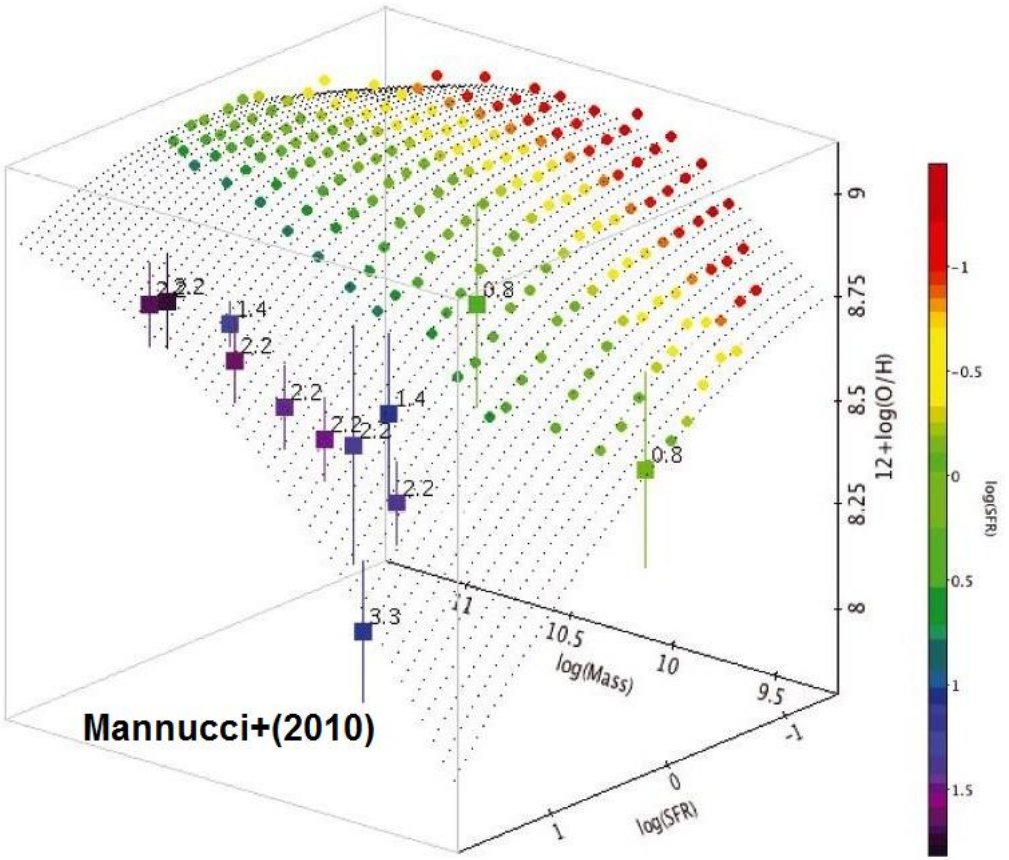


Mannucci+(2010)

Explanations?

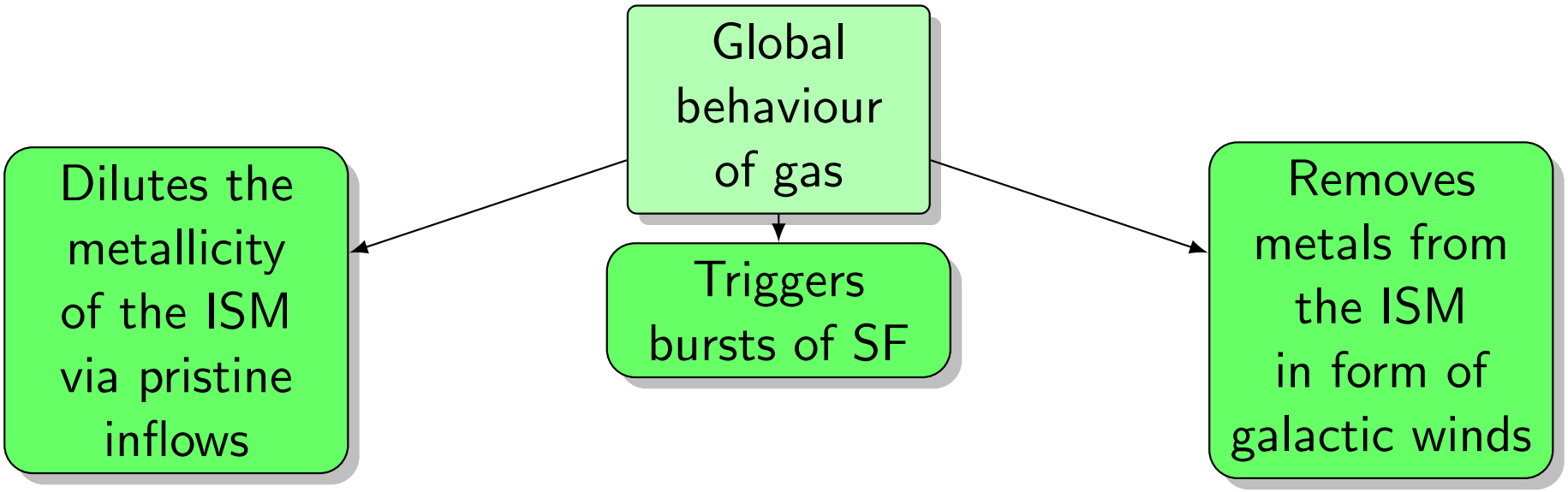
- Ejection of metal-rich gas $\propto$ SFR/$M_\star$.
- Infall of metal-poor gas.
- Downsizing $\rightarrow$ peak of SFR relates with metallicity.

The Fundamental Metallicity Relation (FMR)



- Surface of $M_\star$-SFR-Metallicity.
- Minimizes the scatter of metallicity.
- No evidence of evolution up to $z \sim 2.5$.
- Not so fundamental? $\Rightarrow$ $M_\star$-HI-Metallicity (Bothwell et al. 2011;2013)

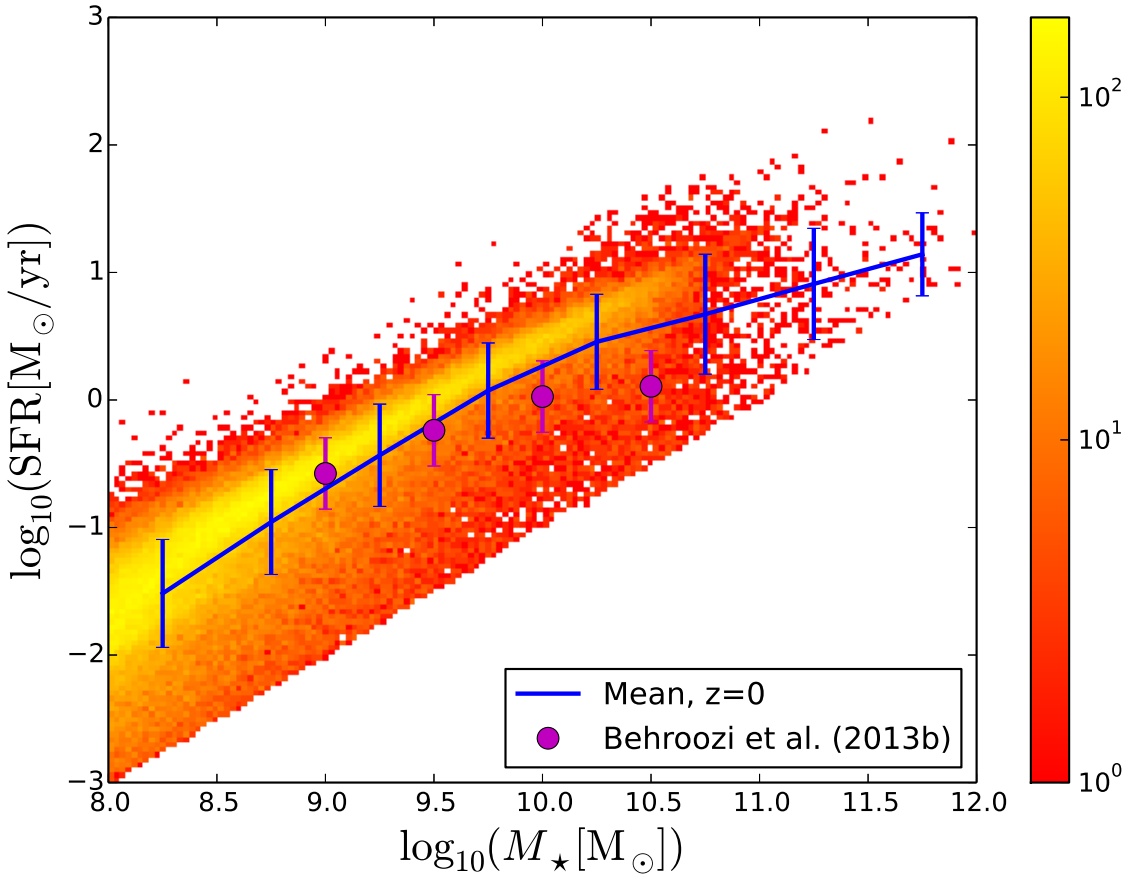
Fundamental Metallicity Relation (FMR)



Results

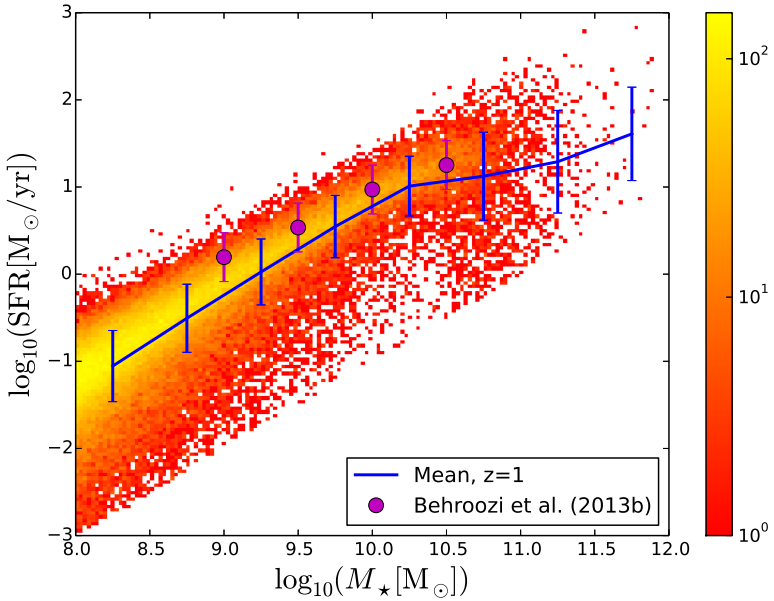
MultiDark Simulation + SAG

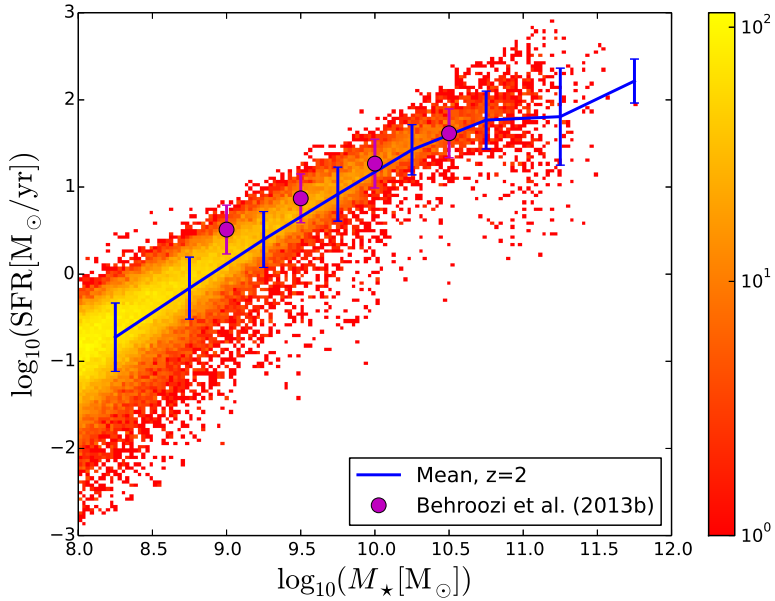
Main Sequence of Galaxies

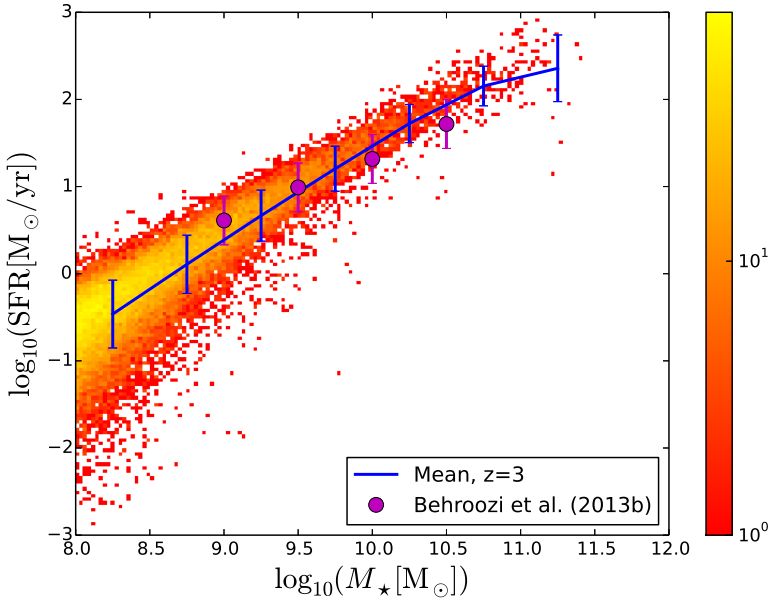


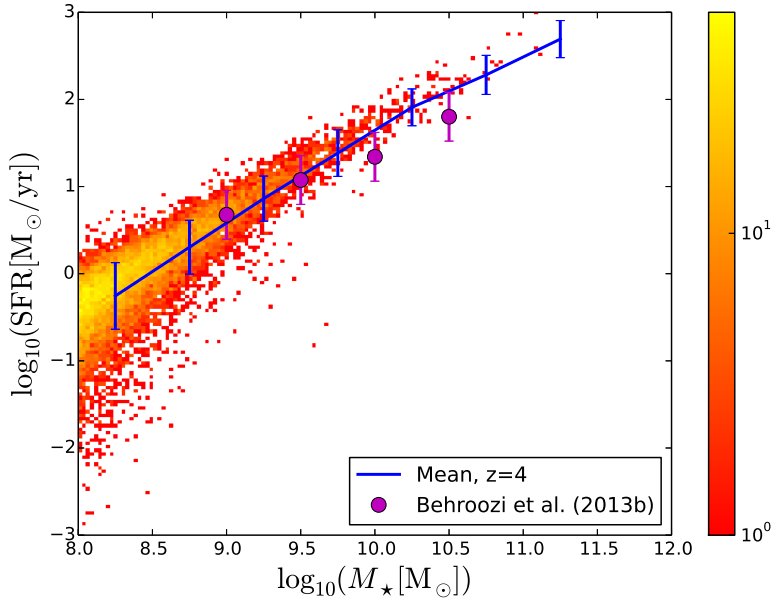
Model agrees with observations at $z = 0$.

Main Sequence of Galaxies: higher z

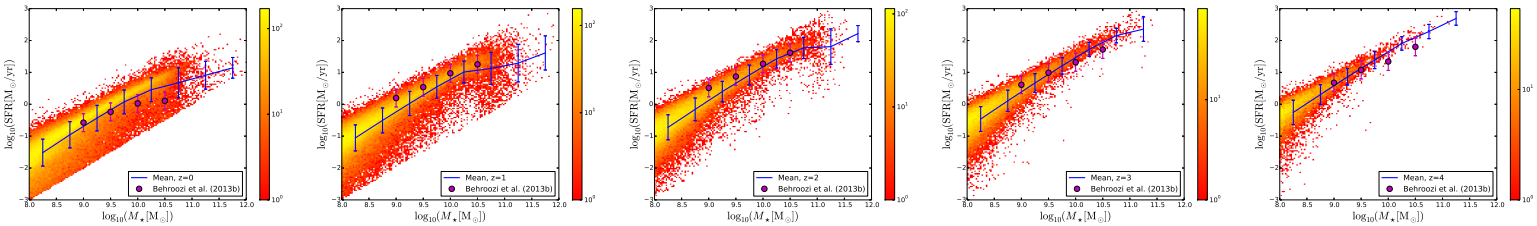


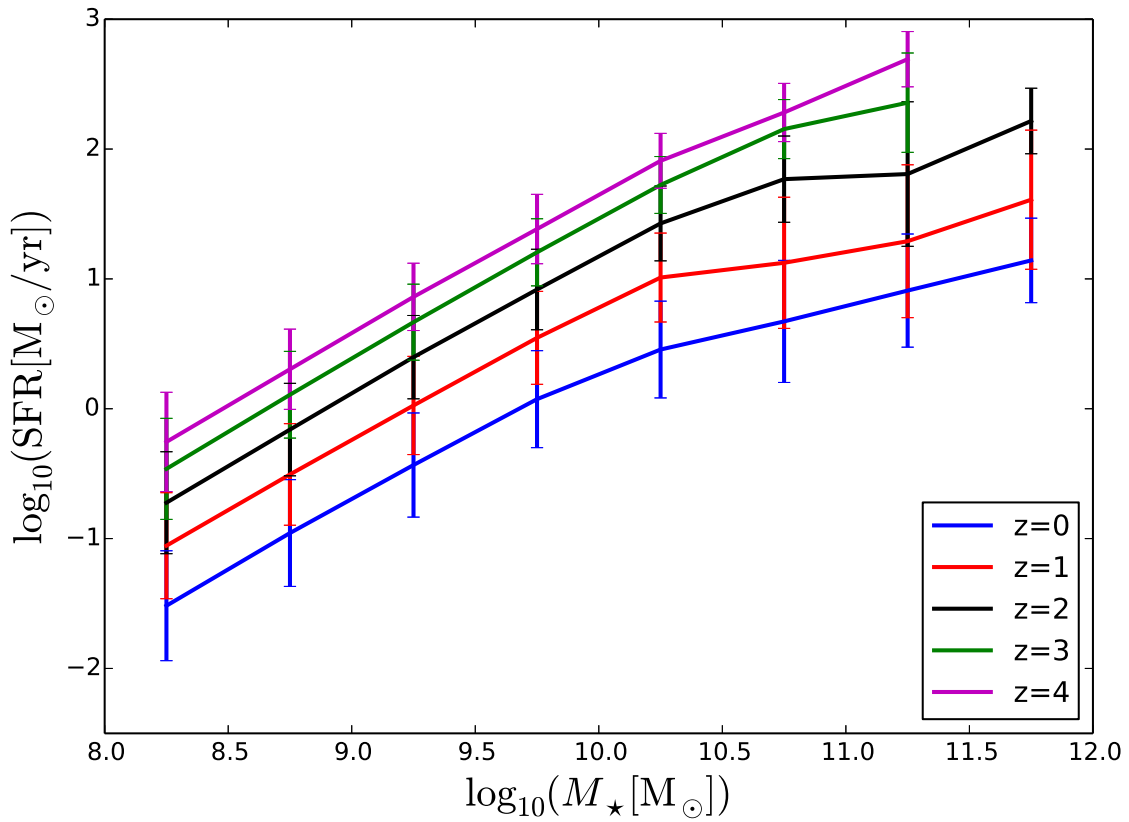






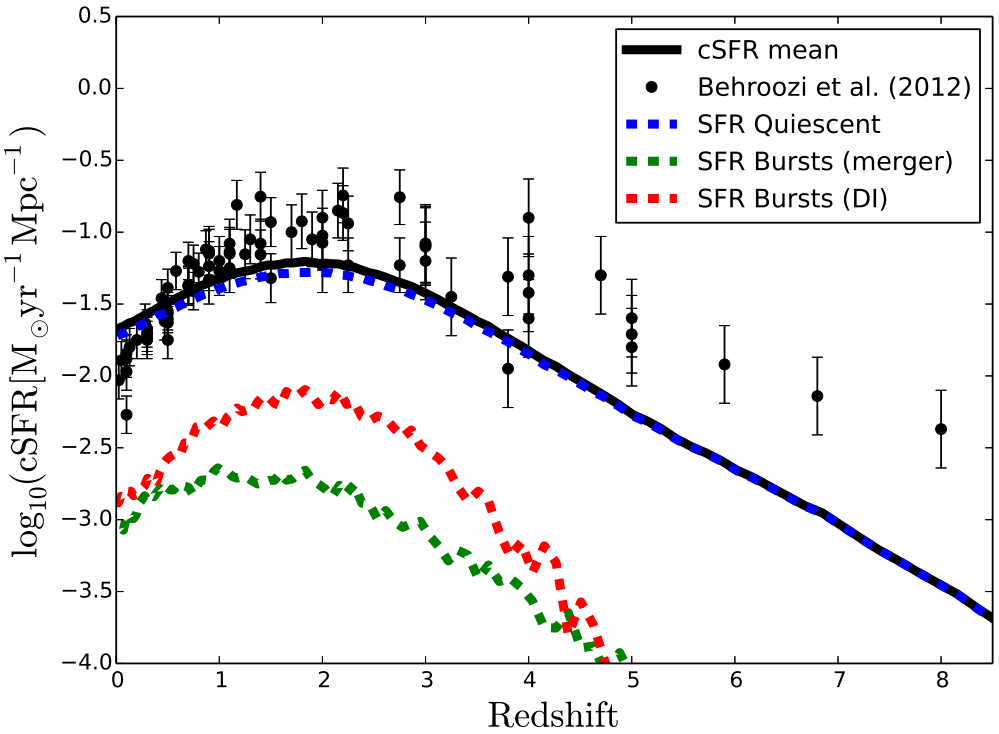
Main Sequence of Galaxies: Evolution





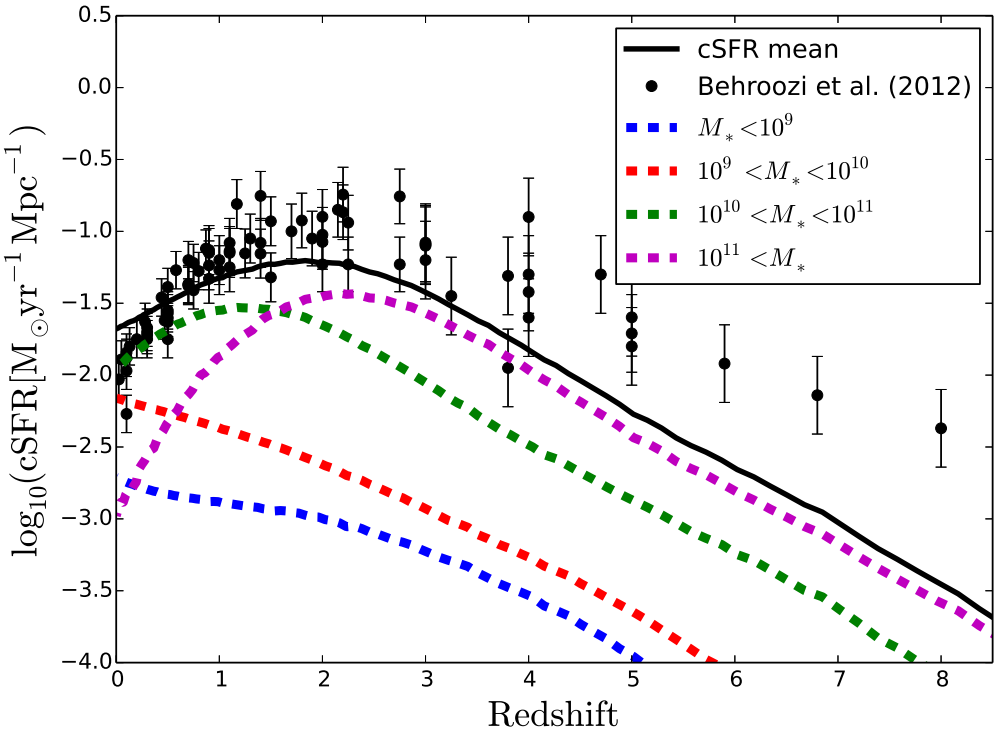
At fixed $M_\star$ galaxies have higher SFR with higher redshift.

Cosmic Star Formation Rate



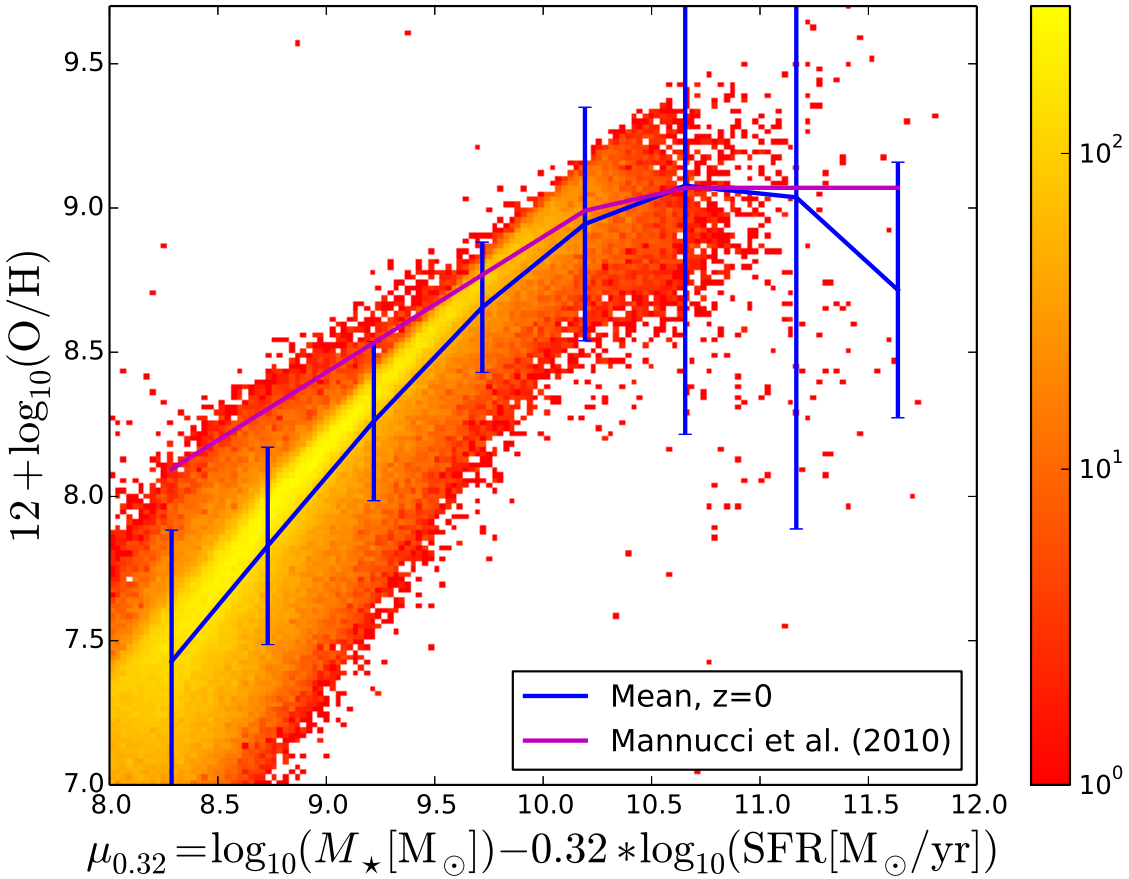
- Model agrees with observations, except at low redshift (mild excess).
- SFR quiescent is dominant process.

Cosmic Star Formation Rate



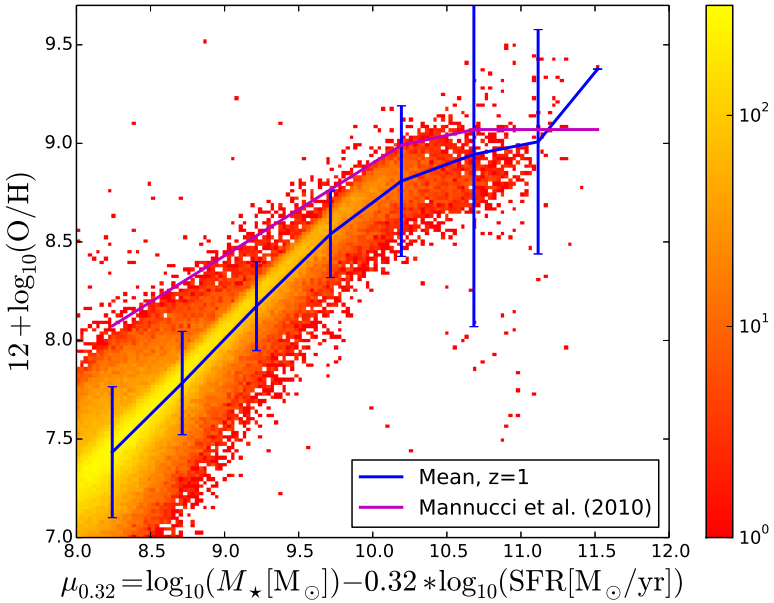
- Model agrees with observations, except at low redshift (mild excess).
- SFR quiescent is dominant process.
- Downsizing is observed.

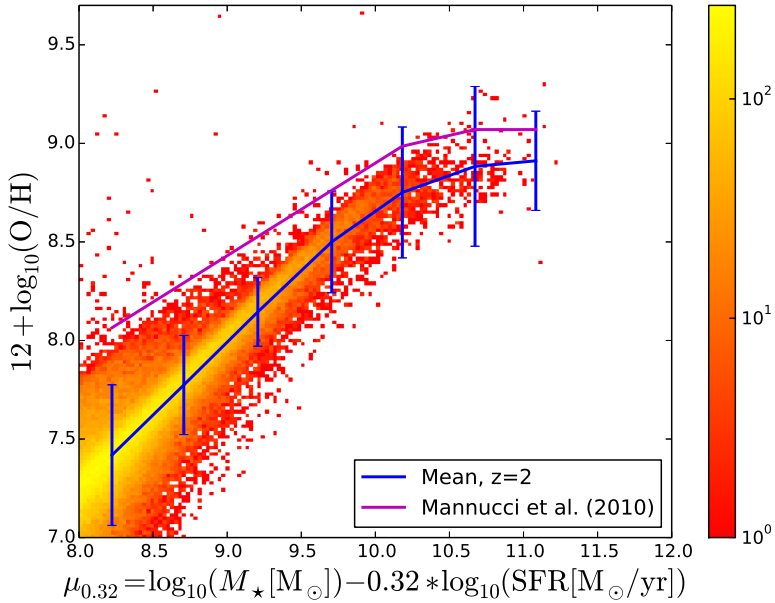
Projection of the FMR: $z = 0$

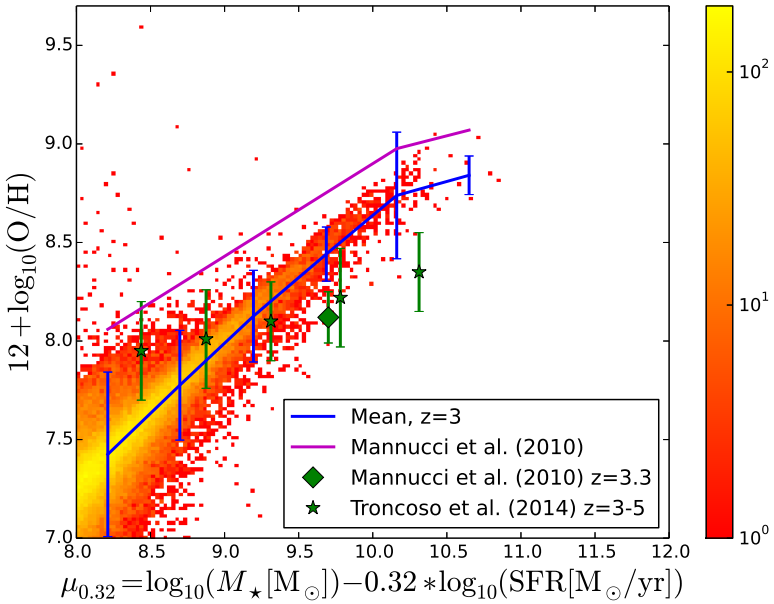


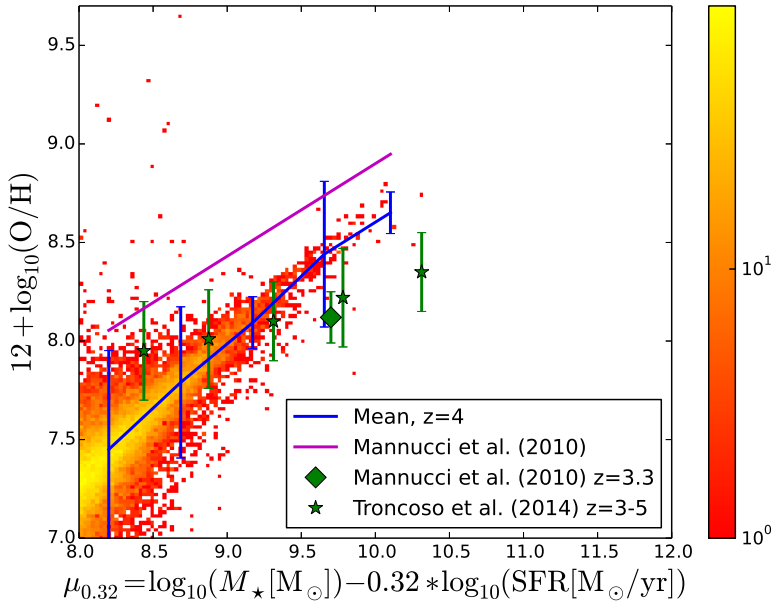
$$12 + \log(\mathrm{O/H}) = \begin{cases} 8.90 + 0.47\,(\mu_{0.32} - 10) & \mu_{0.32} < 10.5 \\ 9.07 & \mu_{0.32} \geq 10.5 \end{cases}$$

Projection of the FMR: higher z

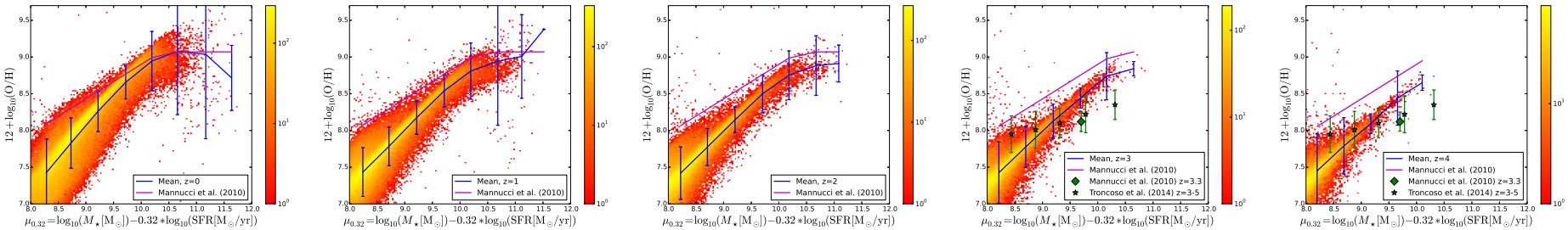


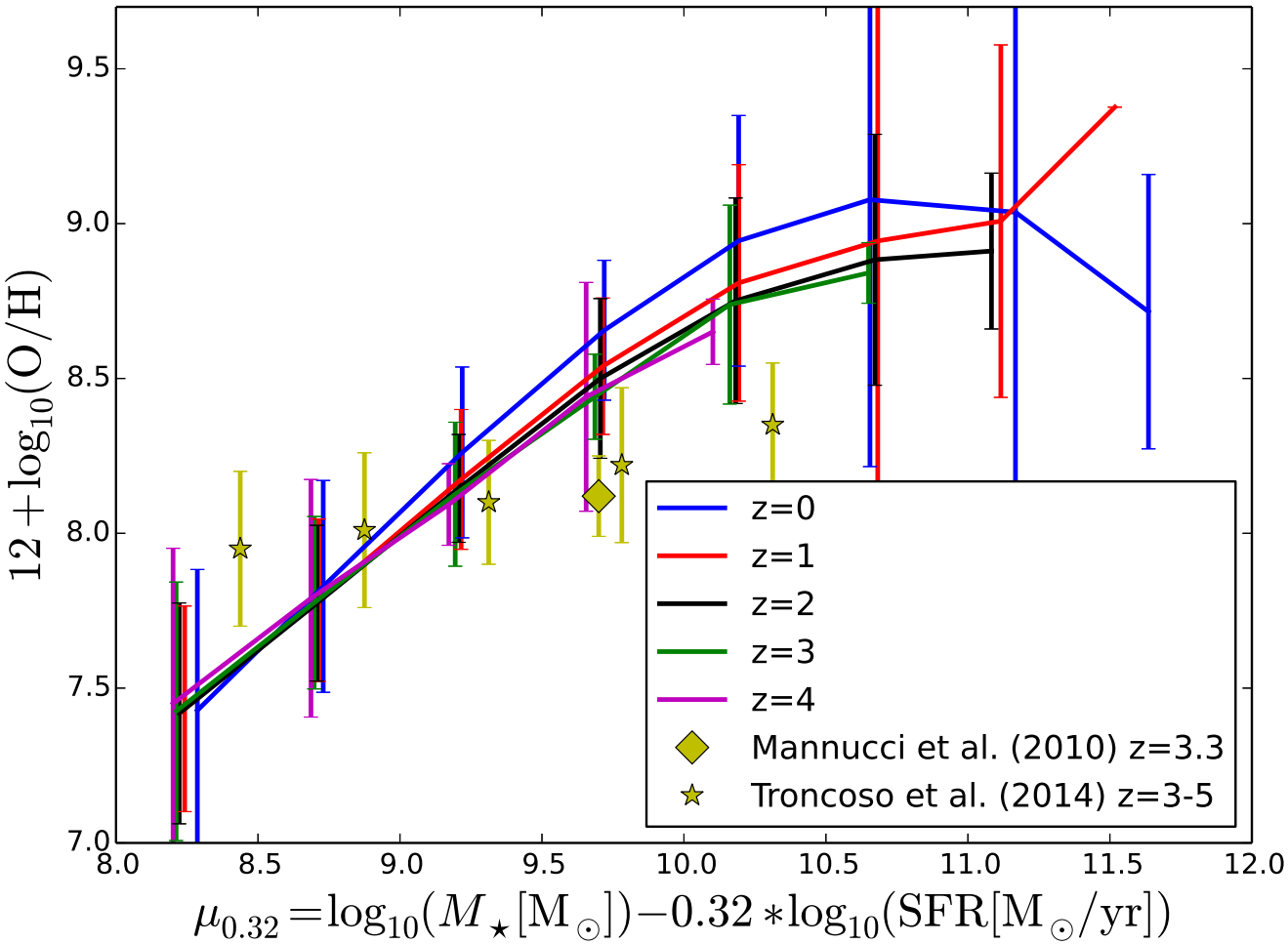




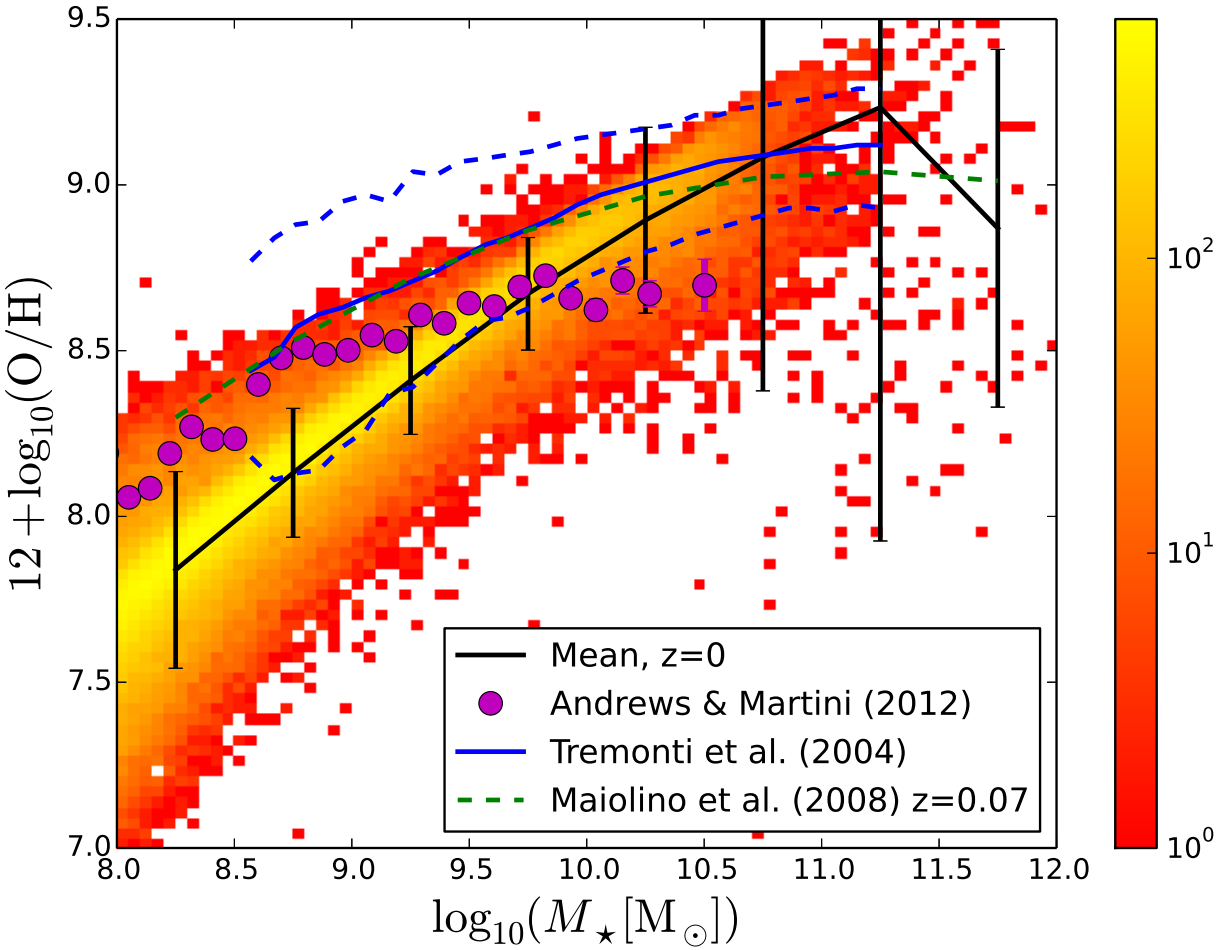


Projection of the FMR: Evolution



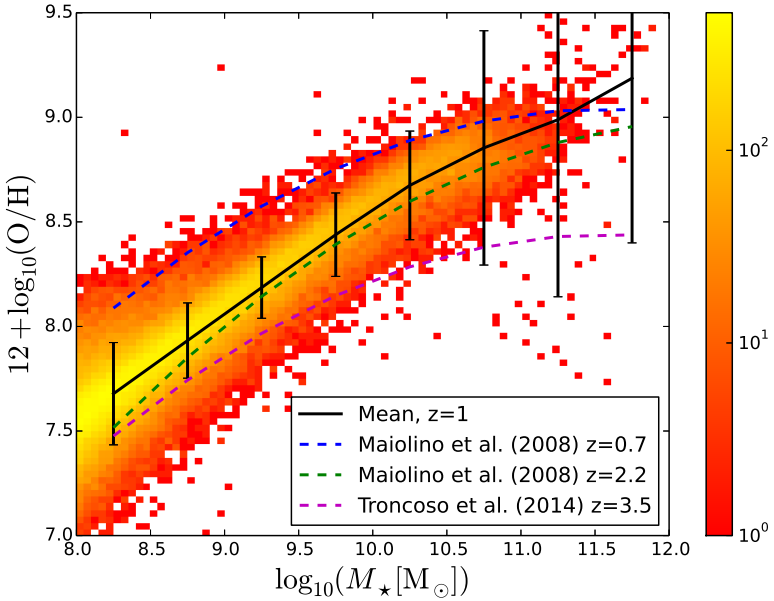


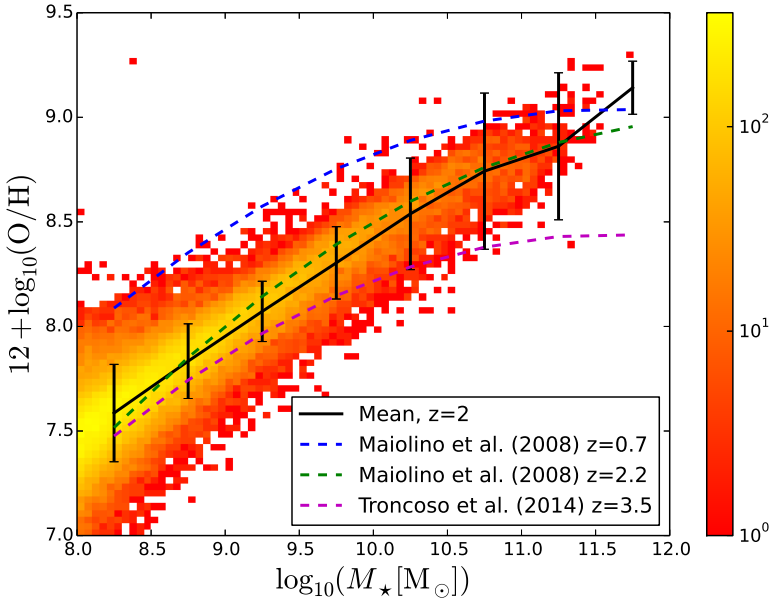
Mass-Metallicity Relation: $z = 0$

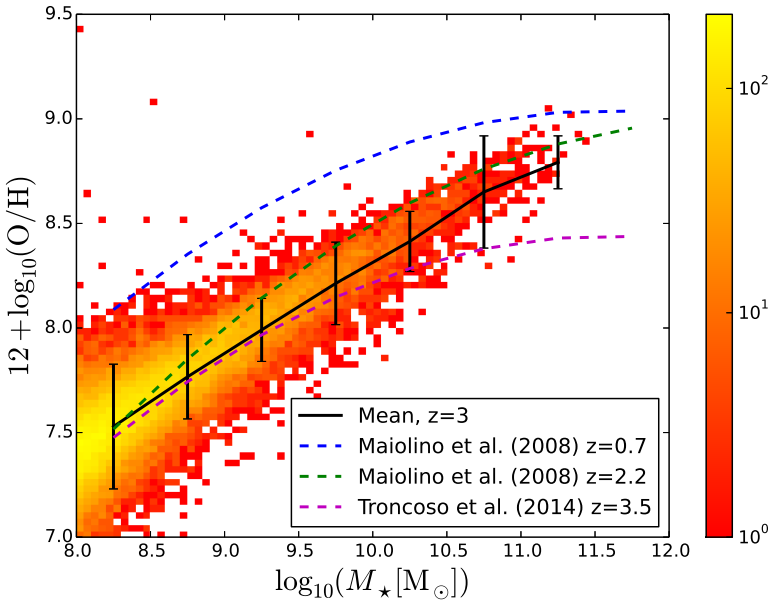


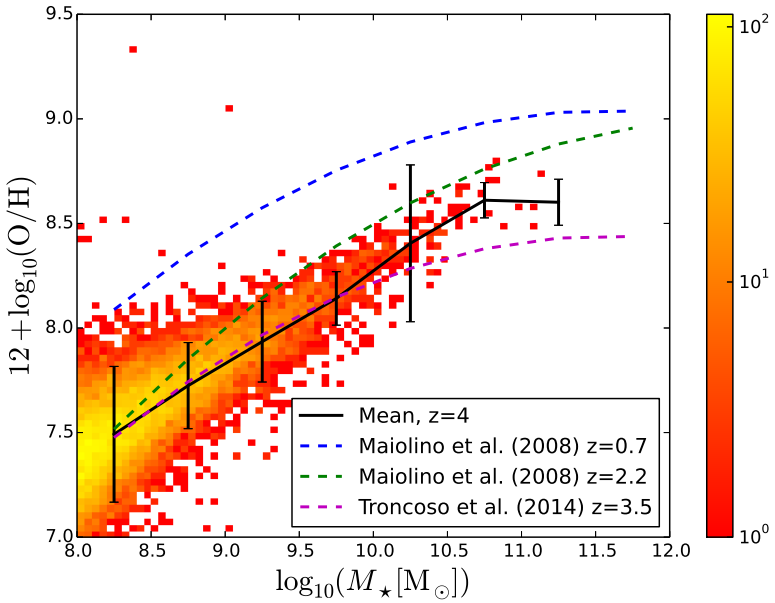
- Steeper slope than observed.
- For galaxies with high $\mathrm{M}_\star$, the relation does not flatten.
- General behaviour: the model agrees with observations at $z = 0$.

Mass-Metallicity Relation: higher z

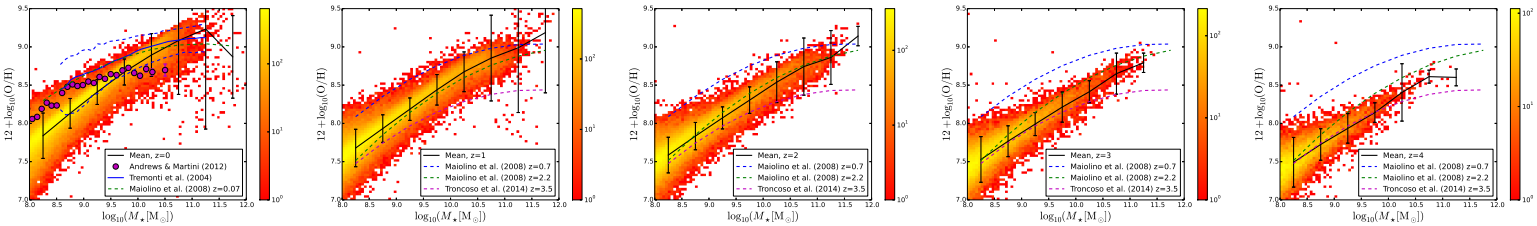


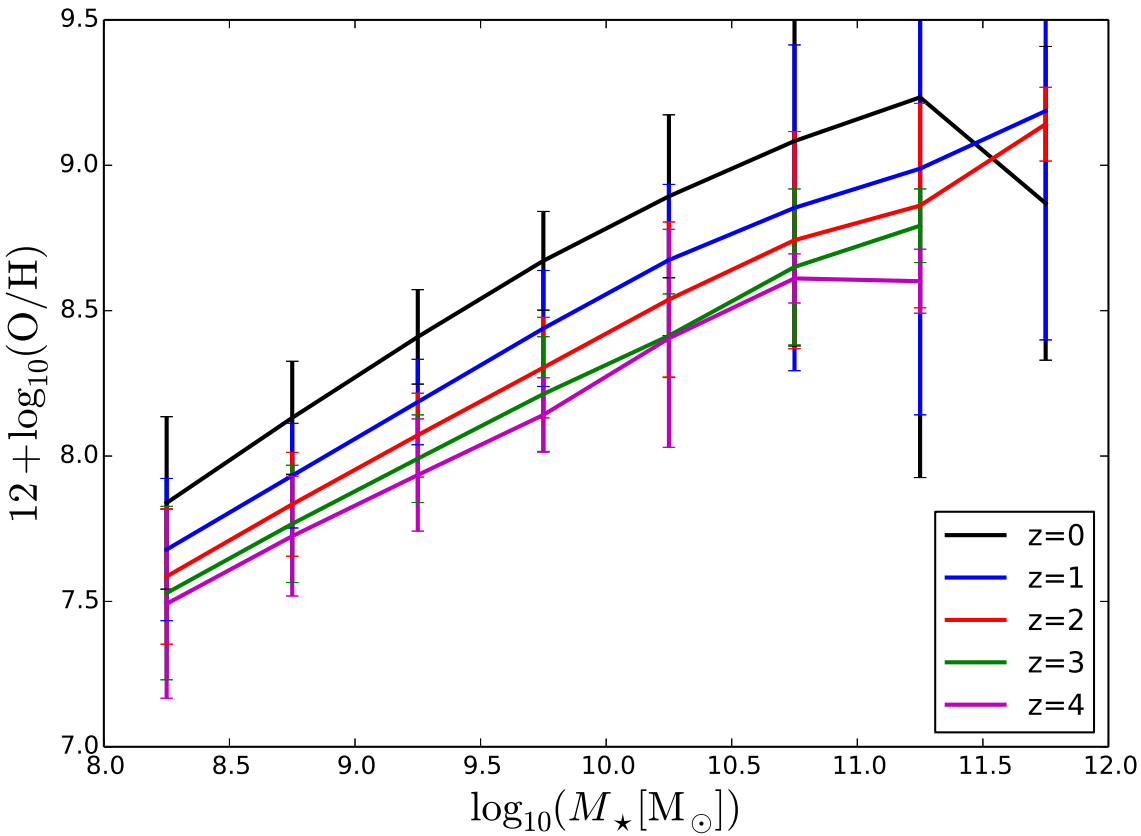






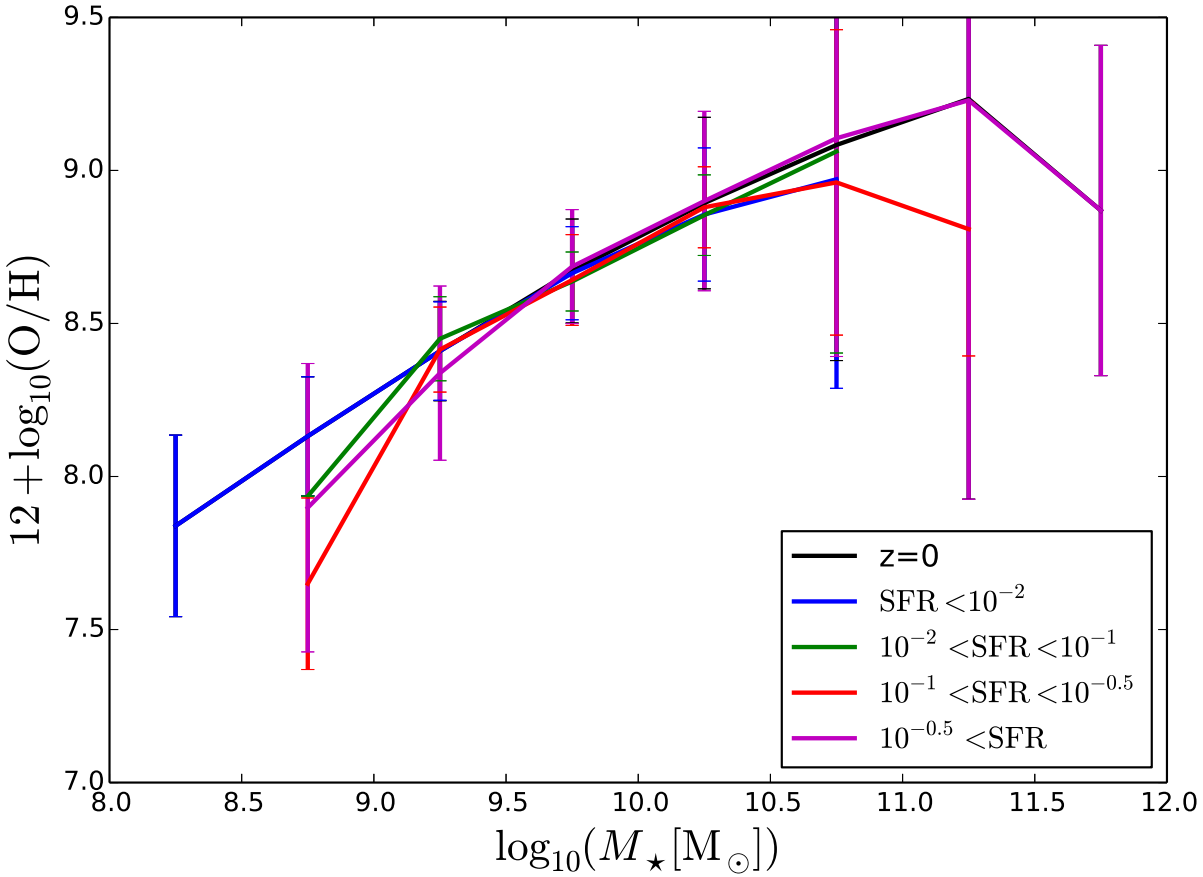
Mass-Metallicity Relation: Evolution





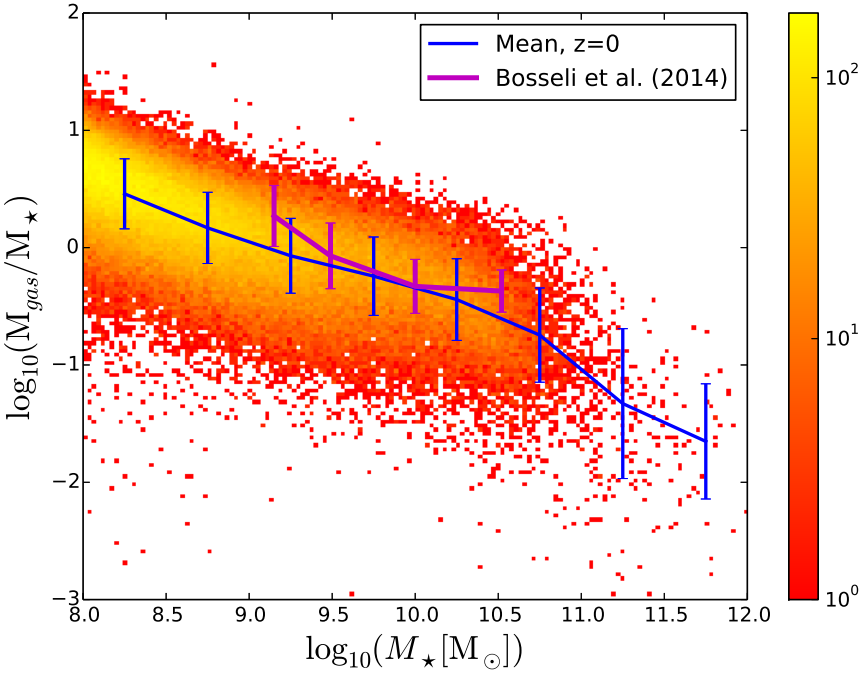
Evolution observed!!

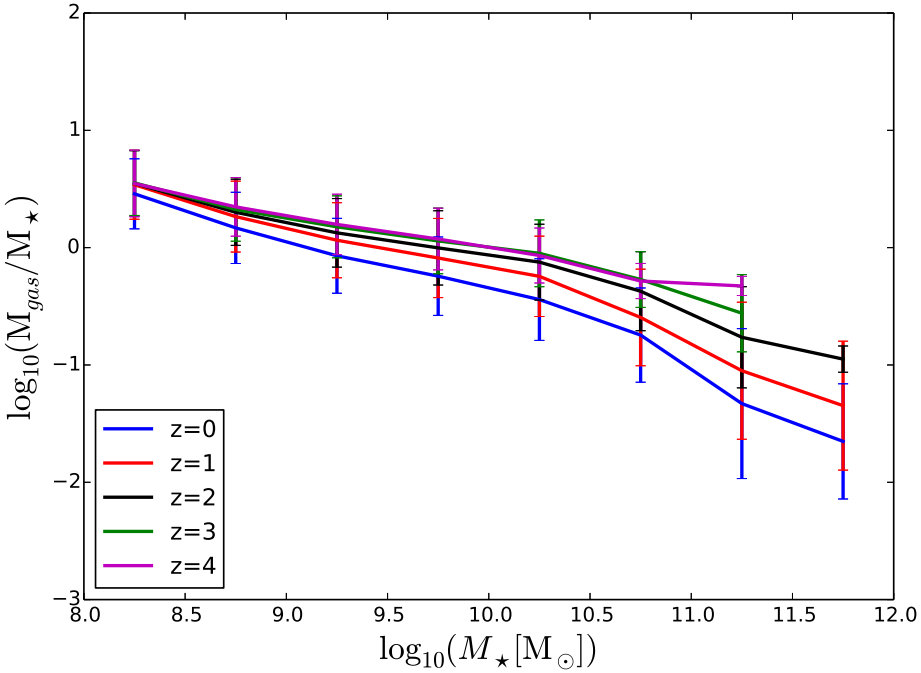
MZR: bin SFR



SFR not enough to justify the scatter.

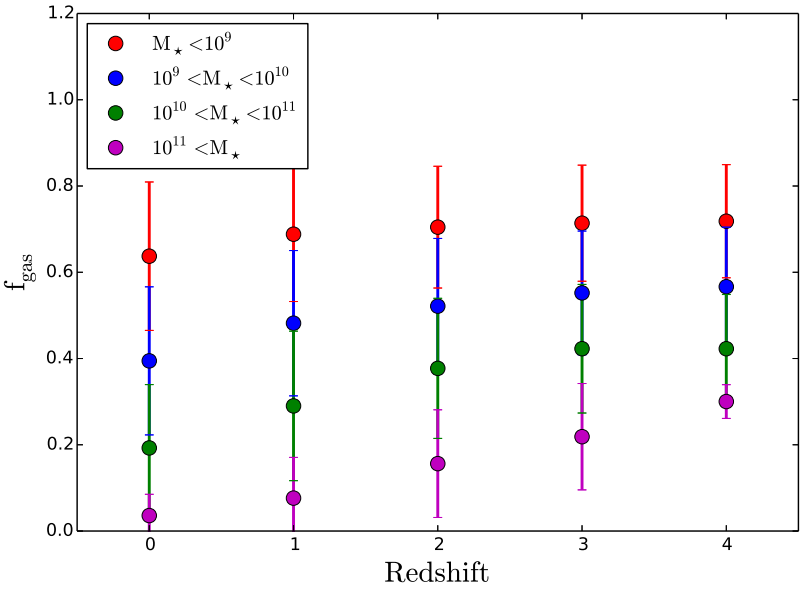
Gas Fraction

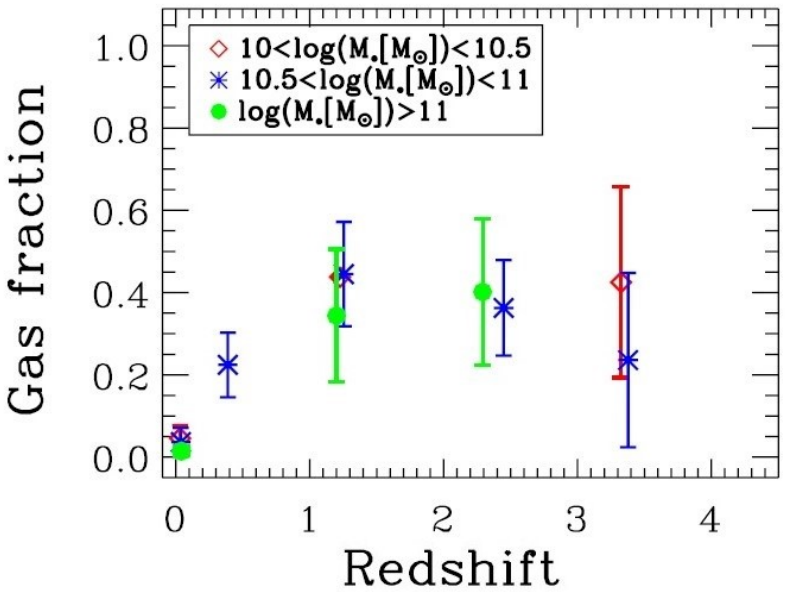




- At $z = 0$ the model agrees with observations from Bosseli et al. (2014).
- At fixed $\mathrm{M}_\star$, the M_{gas} increases with redshift.

Gas Fraction





- At fixed redshift, gas fraction increases with the decrease of $M_\star$.
- The decrease of the f_{gas} with the redshift for intermediate masses is not as pronounced as that observed by Troncoso et al. (2014).

Future Work

- Study of the processes responsable of the mild evoltion at the MZR observed.
- Implementation of modifications in the prescription of physical processes in order to recover the correct slope of the MZR at $z = 0$ and an evolutionary trend in better agreement with observations.
- Continue studying the MZR with other SAM and Hydrodynamical Simulations.
- Try to understand what is causing the scatter of the MZR.
- Suggestions are welcome.


THANK
YOU
GRACIAS
ARIGATO
SHUKURIA
BOLZÏN
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NUHUN
SNACHALHUYA
CHALTU
YAQHANYELAY
TASHAKKUR ATU
WABEEJA
MAITEKA
YUSPAGARÀTAM
HUI
SUKSAMA
EKHMET
SPASIBO
DENKAUJA
NENACHALHYA
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GUI
HATUR
EKOJU
SIKOMO
MAKETAU
MINMONCHAR
DHANYABAAD
AHHA
ATTO
MAAKE
GRAZIE
MEHRBANI
PALDIES
LAH
SANCO
MERASTAWHY
GAEJTHO
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GOZAIMASHITA
EFCHARISTO
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BAUKA