The impact of the Star Formation Histories on the SFR-M_* relation at z ≥2

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ABSTRACT

In this paper we investigate the impact of different star formation histories (SFHs) on the relation between stellar mass (M_*) and star formation rate (SFR) using a sample of galaxies with reliable spectroscopic redshift $z_{spec} > 2$ drawn from the VIMOS Ultra-Deep Survey (VUDS). We produce an extensive database of dusty model galaxies, calculated starting from the new library of single stellar population (SSPs) models presented in Cassarà et al. (2013) and weighted by a set of 28 different star formation histories based on the Schmidt function, and characterized by different ratios of the gas infall time scale τ_{infall} to the star formation efficiency ν. The treatment of dust extinction and re-emission has been carried out by means of the radiative transfer calculation. The spectral energy distribution (SED) fitting technique is performed by using GOSSIP+, a tool able to combine both photometric and spectroscopic information to extract the best value of the physical quantities of interest, and to consider the Intergalactic Medium (IGM) attenuation as a free parameter. We find that the main contribution to the scatter observed in the SFR-M_* plane is the possibility of choosing between different families of SFHs in the SED fitting procedure, while the redshift range plays a minor role. The majority of the galaxies, at all cosmic times, are best-fit by models with SFHs characterized by a high τ_{infall}/ν ratio. We discuss the reliability of the presence of a small percentage of dusty and highly star forming galaxies, in the light of their detection in the FIR.

z~2—6 M_S-SFR関係
2系統見える。
- second main seq. (higher sSFR)
- classical main seq.

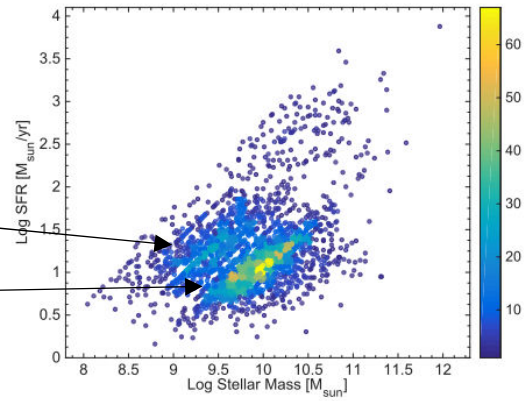


Fig. 6. SFR-M_* density map for the complete sample of VUDS galaxies.

銀河の M_S-SFR 関係の分散の主要因は何か？

- z_spec ~ 2—6 VUDS 銀河に対して、詳細なSED fitting (GOSSIP+) を実施。

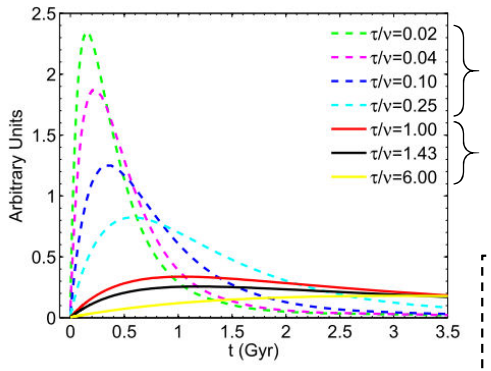
Table 1. Input parameters for SED fitting with GOSSIP+.

SSPs	Range
Metallicities	0.0004, 0.004, 0.008, 0.02, 0.05
Ages	0.03 - 3 Gyr
Optical Depths in the V band τ_V	0.01, 0.03, 0.05, 0.08, 0.1, 0.3, 0.5, 0.8, 1, 1.3, 1.5, 1.8, 2, 2.3, 2.5, 2.8, 3, 3.3, 3.5, 4
IMF	Range
Salpeter law	0.1-100 $M_\odot$
ζ	0.35 - 0.39 - 0.50
slope	-2.35
SFHs	Range
infall time τ_{infall}	5 - 0.30 Gyr
efficiency of the SF ν	14 - 0.35
exponent of the Schmidt function k	1
IGM transmission (seven possibilities at any z_{spec})	19% to 100% at z_{spec}=3.0 5% to 50% at z_{spec}=5.0

ISMのchemical enrichment に関わる星の質量の下限を決める量。

SFHのピークに相当

ガス→星への変換効率



Bulge-like: rapid-rise, short SFH
ガス消費(ν) 速い
ガス供給(τ) 少ない

Disk-like: slow-rise, declining SFH
ガス消費(ν) 遅い
ガス供給(τ) 多い

SFH_{ris} : 破線の上昇部分(younger age)
SFH_{decl} : 破線の下降部分(older age)
SFH_{con} : 実線

Fig. 2. The evolution with time of the seven main families of the SFHs used in this work. Dashed and solid lines represent, respectively, SFHs typical for bulge-like models and disk-like models.

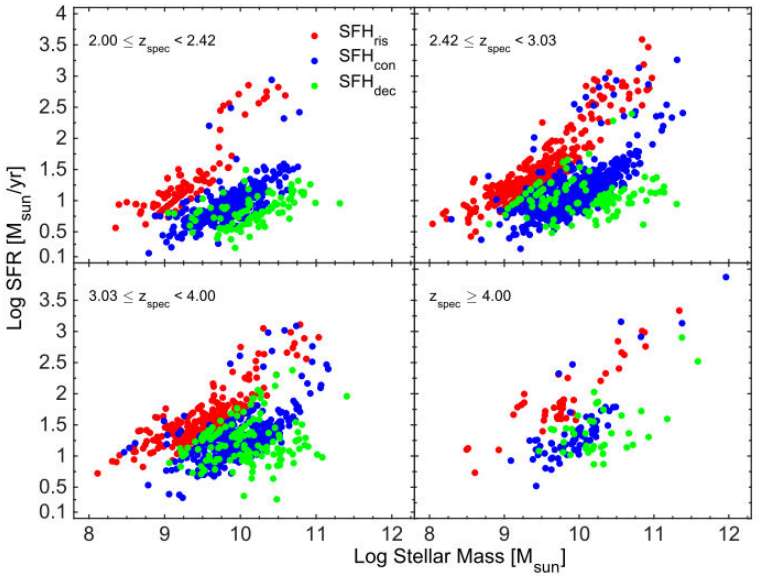


Fig. 9. SFR-M_* plane for galaxies in the different redshift range as the legend in each panel indicates. Galaxies have been color coded according to their best-fit SFH. In blue, galaxies best fit by SFH_{con} models, in red galaxies best fit by SFH_{ris} models and in green galaxies best fit by SFH_{dec} models (see text for more details about these definitions).

z別・SFH別にみると、どのz rangeでも
- Classical MS → SFH_{con}
- Second MS → SFH_{ris}
- (low sSFR側はSFH_{con})

という住み分けになっている。
↓
MSの分散はSFHの違いによるようだ。

Higher z ほどSFHの多様性が強い傾向。
→ モデルSEDの種類、特にτ(ガス供給)、ν(ガス消費率)、に注意が必要。

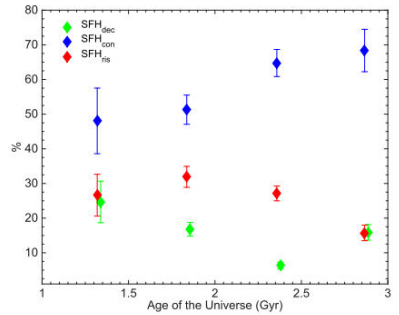


Fig. 10. The variation of the percentage of galaxies fitted by different SFHs with the age of the Universe. The symbols are color coded according to the SFH. The green points have been slightly shifted to avoid overlap with the red ones.