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THE MOSDEF SURVEY: DISSECTING THE STAR-FORMATION RATE VS. STELLAR MASS RELATION USING Hα AND Hβ EMISSION LINES AT $z \sim 2$

Irene Shivaei[1,5], Naveen A. Reddy[1,6], Alice E. Shapley[2], Mariska Kriek[3], Brian Siana[1], Bahram Mobasher[1], Alison L. Coil[4], William R. Freeman[1], Ryan Sanders[2], Sedona H. Price[3], Laura de Groot[1], Mojegan Azadi[4]

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ABSTRACT

We present results on the SFR-M_* relation (i.e., the "main sequence") among star-forming galaxies at $1.37 \le z \le 2.61$ using the MOSFIRE Deep Evolution Field (MOSDEF) survey. Based on a sample of 261 star-forming galaxies with observations of Hα and Hβ emission lines, we have estimated robust dust-corrected instantaneous star-formation rates (SFRs) over a large dynamic range in stellar mass ($\sim 10^{9.0} - 10^{11.5}\,M_\odot$). We find a tight correlation between SFR(Hα) and M_* with an intrinsic scatter of 0.36 dex, 0.05 dex larger than that of UV-based SFRs. This increased scatter is consistent with predictions from numerical simulations of 0.03 – 0.1 dex, and is attributed to Hα more accurately tracing SFR variations. The slope of the log(SFR)−log(M_*) relation, at $1.4 < z < 2.6$ and over the stellar mass range of $10^{9.5}$ to $10^{11.5}\,M_\odot$ is 0.65 ± 0.09. We find that different assumptions for the dust correction, such as using the stellar $E(B-V)$ with a Calzetti et al. (2000) attenuation curve, as well as the sample biases against red and dusty star-forming galaxies at large masses, could yield steeper slopes. Moreover, not correcting the Balmer emission line fluxes for the underlying Balmer absorption results in overestimating the dust correction of Hα and SFR(Hα) at the high-mass end by 2.1 (2.5) at $10^{10.6}\,M_\odot$ ($10^{11.1}\,M_\odot$) and artificially increases the slope of the main-sequence. The shallower main-sequence slope found here compared to that of galaxy evolution simulations may be indicative of different feedback processes governing the low- and/or high-mass end of the main sequence.

Subject headings: galaxies: evolution — galaxies: formation — galaxies: high-redshift — galaxies: star formation

Main Sequencce
- Slope : 星形成効率の質量依存性
- Scatter : gas accretion史 => burstiness

銀河形成のプロセス(AGN feedback, gas accretion, outflow)を反映する => シミュレーションのチェックに使える
でも、観測バイアスがいろいろある

MOSDEF銀河
- 261天体
- 1.4<z<2.6
- Ha 星形成率、Balmer Decrementで補正

⇒ 星形成率の指標や、ダスト吸収補正の手法でどのくらいMSが影響を受けるのかのデモンストレーション

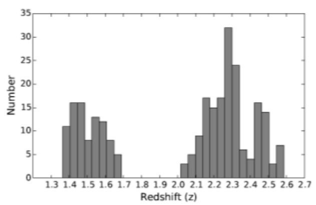

Figure 1. Redshift distribution of 261 star-forming galaxies in our sample with Hα detections and coverage of the Hβ line. There are 88 objects at $z \sim 1.5$ and 173 at $z \sim 2.3$.

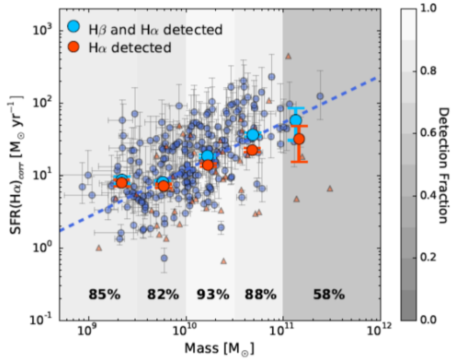

Figure 2. SFR(Hα) as a function of stellar mass for star-forming

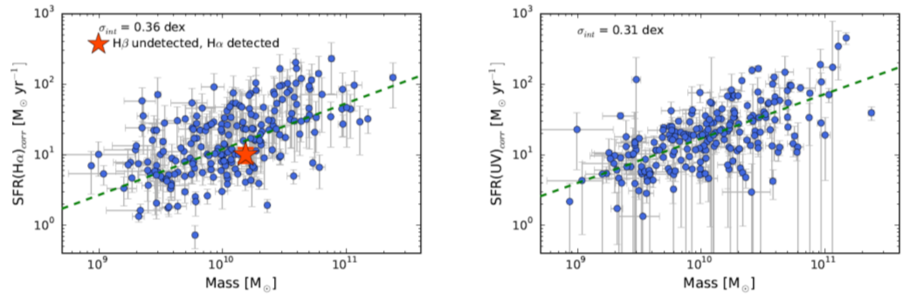

Figure 4. SFR as a function of stellar mass for star-forming galaxies at $z = 1.37 - 2.61$. *Left:* SFR(Hα) – corrected for dust attenuation

Table 1
Parameters of the log(SFR) − log(M_*) Linear Fit [a]

Redshift Range	SFR Indicator	Slope	Intercept	Observed Scatter	Intrinsic Scatter
$z = 1.37 - 2.61$	Hα[c]	0.65 ± 0.09	-5.42 ± 0.88	0.40	0.36
(N = 185)[b]	UV_β[d]	0.63 ± 0.08	-5.07 ± 0.83	0.34	0.31
	SED[e]	0.80 ± 0.06	-6.79 ± 0.56	0.28	0.27
	UV_{SED}[f]	0.79 ± 0.07	-6.57 ± 0.68	0.27	0.21
$z = 2.09 - 2.61$	Hα[c]	0.59 ± 0.11	-4.68 ± 1.06	0.36	0.31
(N = 128)[b]	UV_β[d]	0.71 ± 0.10	-5.82 ± 0.96	0.31	0.27
	SED[e]	0.83 ± 0.07	-7.01 ± 0.74	0.29	0.27
	UV_{SED}[f]	0.74 ± 0.10	-6.07 ± 1.00	0.28	0.20

●MSのscatter : 0.2-0.36dexくらい
HaSFR-M*のscatterがUVSFRにくらべ0.05dex大きい
- UV luminosityはSED-Stellar Massと相関があるため
- Haが出る時間が短い(<10Myr)ので、見ている時期によって大きくばらつく(0.03-0.1dex : Hopkins+14, etc)

HaSFRーM*でみられているintrinsic scatterの原因は？
- シミュレーション予想では0.12dex (Dutton+10)
- ガス降着や星形成史のばらつきが、シミュレーションで考えているよりはるかに大きい？

●MSの傾き : 0.59-0.65
過去の観測では0.3-1まで大きくばらつく
- E(B-V) stellarとE(B-V)lineの違い
- Extinction curveの違い(Calzetti, CCM, Reddy+15)
- 赤い銀河を入れるか入れないか
- Balmer 吸収の補正(Hbで最大15%)
- Dust extinctionが大きいものを落としている

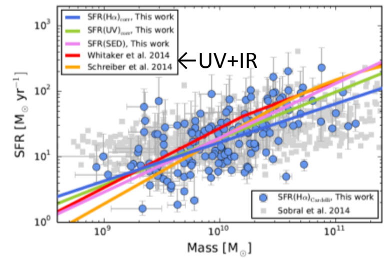

Figure 8. The comparison of SFR-M_* relation for various stud-

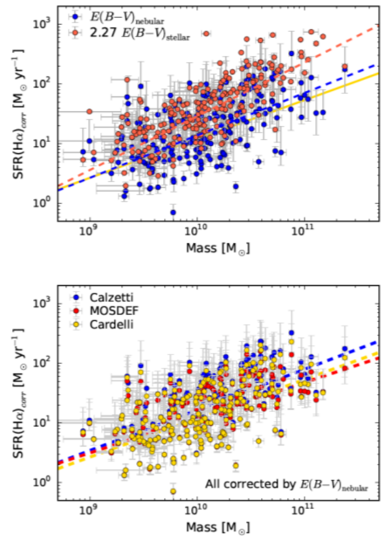

Figure 5. The SFR(Hα)-M_* relation, where the SFR is corrected for dust attenuation by different methods and attenuation curves.