THE MOSDEF SURVEY: THE STRONG AGREEMENT BETWEEN Hα AND UV-TO-FIR STAR FORMATION RATES FOR $z \sim 2$ STAR-FORMING GALAXIES*

Irene Shivaei[1,7], Mariska Kriek[2], Naveen A. Reddy[1], Alice E. Shapley[3], Guillermo Barro[2], Charlie Conroy[4], Alison L. Coil[5], William R. Freeman[1], Bahram Mobasher[1], Brian Siana[1], Ryan Sanders[3], Sedona H. Price[2], Mojegan Azadi[5], Imad Pasha[2], Hanae Inami[6]

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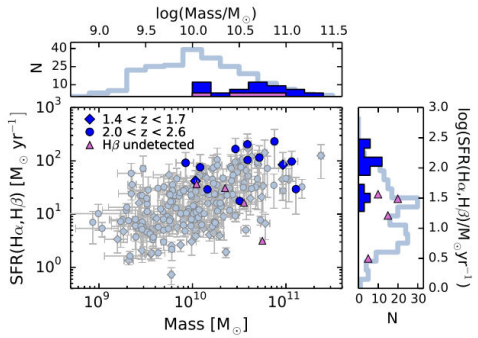
ABSTRACT

We present the first direct comparison between Balmer line and panchromatic SED-based SFRs for $z \sim 2$ galaxies. For this comparison we used 17 star-forming galaxies selected from the MOSFIRE Deep Evolution Field (MOSDEF) survey, with 3σ detections for Hα and at least two IR bands (*Spitzer*/MIPS 24 μm and *Herschel*/PACS 100 and 160 μm, and in some cases *Herschel*/SPIRE 250, 350, and 500 μm). The galaxies have total IR ($8-1000$ μm) luminosities of $\sim 10^{11.4}-10^{12.4}$ $L_\odot$ and star-formation rates (SFRs) of $\sim 30-250$ $M_\odot$ yr^{-1}. We fit the UV-to-far-IR SEDs with flexible stellar population synthesis (FSPS) models – which include both stellar and dust emission – and compare the inferred SFRs with the SFR(Hα,Hβ) values corrected for dust attenuation using Balmer decrements. The two SFRs agree with a scatter of 0.17 dex. Our results imply that the Balmer decrement accurately predicts the obscuration of the nebular lines and can be used to robustly calculate SFRs for star-forming galaxies at $z \sim 2$ with SFRs up to ~ 200 $M_\odot$ yr^{-1}. We also use our data to assess SFR indicators based on modeling the UV-to-mid-IR SEDs or by adding SFR(UV) and SFR(IR), for which the latter is based on the mid-IR only or on the full IR SED. All these SFRs show a poorer agreement with SFR(Hα,Hβ) and in some cases large systematic biases are observed. Finally, we show that the SFR and dust attenuation derived from the UV-to-near-IR SED alone are unbiased when assuming a delayed exponentially declining star-formation history.

SFR(Ha) vs. SFR(UV-FIR SED) @ z~2

- ❑ MOSDEF data: Hα, Hβ (if detected)
- ❑ CANDELS multi-λ data: UV~Opt, IRAC, MIPS 24um, PACS 100/160um, SPIRE 250/350/500um
- ❑ Sample selection: 13 (with Hβ), 4 (without Hβ)
  - ❑ Hα (S/N>3), 24um (S/N>3), 100 or 160um detected
- ❑ UV-FIR SED fitting (**F**lexible **S**tellar **P**opulation **S**ynthesis)
  - ❑ Dustによる「UV光吸収」と「FIR再放射」のenergy balance
  - ❑ Delayed tau star-formation history

Balmer decrementで減光補正したSFR(Hα)は、UV-FIRのfull SED fittingから推定されるSFR(full SED) と~0.2 dex で一致した。



MOSDEF全サンプルと今回の17天体のMs-SFR上での分布

今後詰めるべきSFRの不定性:

- extinction curve, IMF, metallicity, SFH
- dust emission model

→MOSDEF/PACS/SPIRE sample が増えればstackingで見てみる。

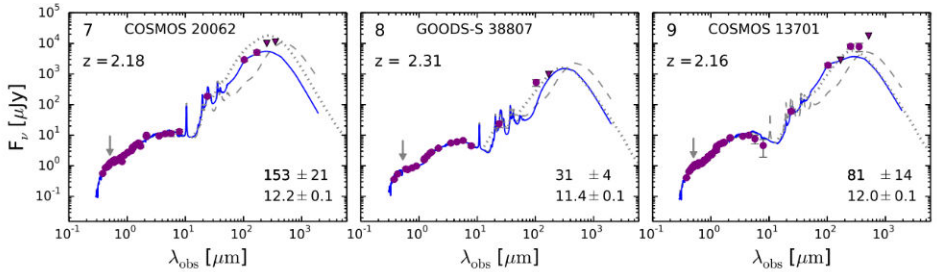


Figure 2. The best-fit panchromatic FSPS SED models (solid curves) to the observed photometry (purple symbols) of 9 of our Hα+Hβ-detected galaxies. The rest-frame optical emission lines are excluded from both the photometry and the models. The triangles show 3σ upper limits on the fluxes; in the fitting process, the actual photometry with the corresponding errors were used. The dashed and dotted lines represent the FSPS SED fits up to 24 μm and the Chary & Elbaz (2001) best-fit templates to the 24, 100, and 160 μm data, respectively. The ID numbers are from the 3DHST v4.1 photometric catalog. The galaxies are shown in order of increasing mass (continued in Figure 3).

UV-FIR full SED-fittingの例

SFRの比較

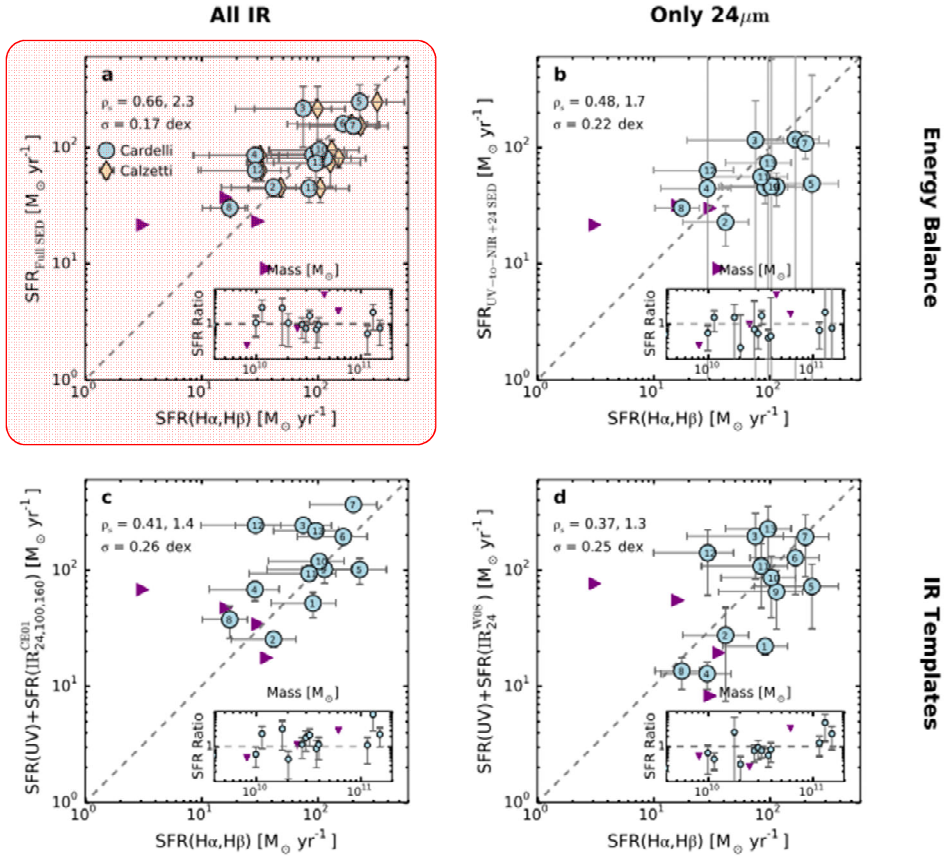


Figure 4. SFR comparisons for the 13 Hα+Hβ-detected galaxies (circles) and the 4 Hβ-undetected galaxies (triangles). In all plots, the horizontal axis is the SFR(Hα,Hβ), assuming the Cardelli curve, and the dashed lines denote one-to-one relationships. In panel a, diamonds indicate SFR(Hα,Hβ) assuming the Calzetti curve. The vertical axis is the SFR derived from modeling the UV-to-FIR photometry (a), the UV-to-24 μm photometry (b), and SFR(UV)+SFR(IR), in which SFR(IR) is derived from 24 – 160 μm (c) or 24 μm only photometry (d), using the CE01 and W08 templates, respectively. Each subplot shows the ratio of the SFR in the main plot's vertical axis to SFR(Hα,Hβ) as a function of M_*. The masses are inferred from the best-fit SEDs. The Spearman coefficient (ρ_s), its significance, and scatter about the unity line (σ) are listed in the plots. The galaxies' numbers correspond to the SEDs in Figures 2,3.