THE MOSDEF SURVEY: STELLAR CONTINUUM SPECTRA AND STAR FORMATION HISTORIES OF ACTIVE, TRANSITIONAL, AND QUIESCENT GALAXIES AT 1.4<z<2.6

arXiv.1810.07204

Tom O. Zick[1,2], Mariska Kriek[1], Alice E. Shapley [3],Naveen A. Reddy [4], William R. Freeman [4],Brian Siana [4], Alison L. Coil[5], Mojegan Azadi[6], Guillermo Barro[7], Tara Fetherolf[4], Francesca M. Fornasini[5], Laura de Groot[8], Gene Leung[7], Bahram Mobasher[4], Sedona H. Price[9], Ryan L. Sanders[3], and Irene Shivaei[10]

ABSTRACT

Using the MOSDEF rest-frame optical spectroscopic survey, we investigate the star-formation histories (SFHs) of different galaxy types, ranging from actively star forming to quiescent at $1.4 \leq z \leq 2.6$. SFHs are constrained utilizing stellar continuum spectroscopy, specifically through a combination of Balmer absorption lines, the 4000 Å break, and the equivalent width of the Hα emission line. To attain a sufficiently high signal-to-noise ratio (S/N) to conduct these measurements we stack spectra of galaxies with similar spectral types, as determined from their rest-frame $U-V$ and $V-J$ colors. We bin the MOSDEF sample into five spectral types, subdividing the quiescent and star-forming bins to better explore galaxies transitioning between the two. We constrain the average SFHs for each type, finding that quiescent and transitional galaxies in the MOSDEF sample are dominated by an SFH with an average star-formation timescale of $\tau \sim 0.1-0.2$ Gyr. These findings contrast with measurements from the low-redshift Universe where, on average, galaxies form their stars over a more extended time period ($\tau > 1$ Gyr). Furthermore, our spectral index measurements correlate with mass surface density for all spectral types. Finally, we compare the average properties of the galaxies in our transitional bins to investigate possible paths to quiescence, and speculate on the viability of a dusty post-starburst phase.

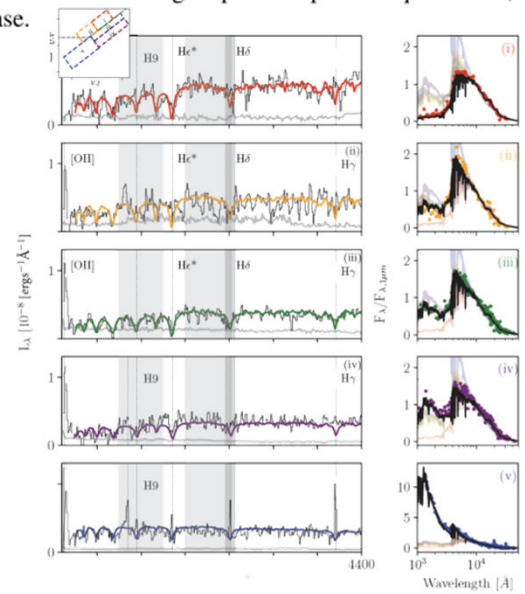

Figure 2. Left: Stacked spectra for galaxies binned in UVJ space and ordered by rest-frame UV emission relative to 1 μm. Each stack (black) and composite noise spectrum (grey) is shown median binned by 2.5 Å. The colored lines are the FAST fits to the stacked spectra. The bandpasses from which we measure D_n4000 and $H\delta_A$ are shown in grey and dark grey respectively. Right: Composite SEDs for each UVJ bin. The colored circles correspond to binned photometric measurements, the black line shows the best fit to the composite SED, while the best fits for the other bins are plotted according to their respective bin color.

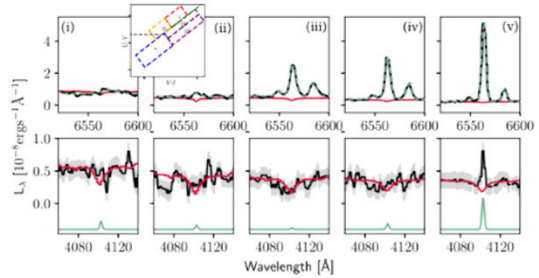

Figure 3. Top: The Hα region for each stacked spectrum (black). The triple Gaussian fit for the spectra is shown in the dashed teal lines, the best fit FAST model is shown in red. Bottom: Zoom in of the $H\delta_A$ region, with the best fit for the absorption shown in red and the best fit for the emission (fixed to the Hα width), shown in teal. The noise spectrum is also plotted (grey). The emission Hδ in (i) is most likely due to AGN activity, as we only remove AGN from our EW(Hα) measurements.

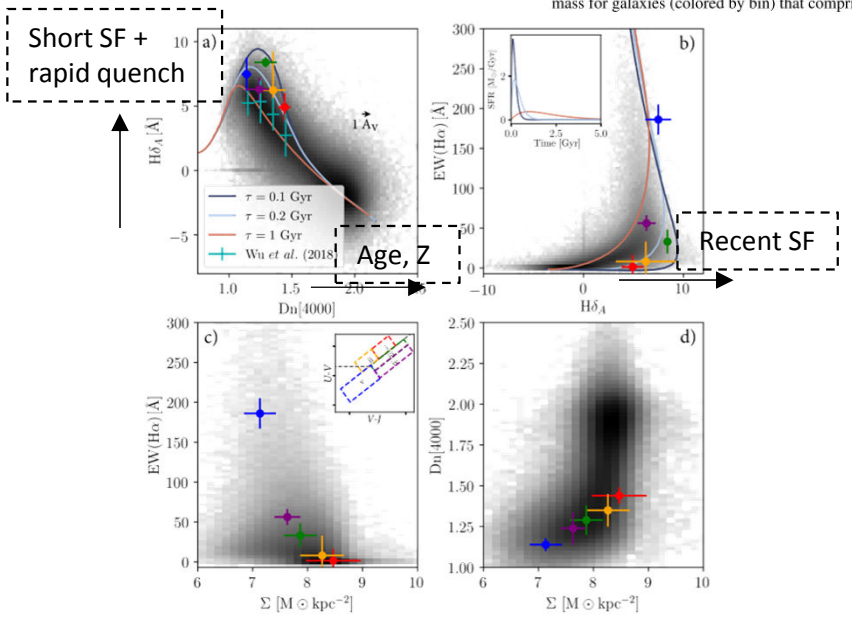

Figure 4. $H\delta_A$, D_n4000, EW(Hα), and Σ measurements for our stacks at $z \sim 2$ colored by their respective UVJ bin, compared to low-redshift values from SDSS, shown in greyscale. Where applicable, we overplot the FSPS model tracks for three delayed exponential SFHs with $\tau = 0.1$, 0.2, 1.0 Gyr. Panel a: $H\delta_A$ vs. D_n4000, finding higher $H\delta_A$ than at low redshift for fixed values of D_n4000. We also show the $z = 0.8$ Wu et al. (2018) distribution where the error bars in D_n4000 and $H\delta_A$ correspond to bin size and standard deviation of the distribution, respectively. As our D_n4000 measurements are not corrected for reddening, we illustrate the effect of 1 A_V of extinction with an arrow. Panel b: EW(Hα) vs. $H\delta_A$ measurements confirming that the star formation timescales of transitional galaxies are most consistent with a short $\tau = 100-200$ Myr SFHs. Panels c-d: EW(Hα) and D_n4000 vs. Σ, illustrating a sequence in decreasing EW(Hα) and increasing D_n4000 as a function of Σ. Error bars in Σ correspond to the standard deviation of the galaxy ensemble in each bin.

SF銀河からQuiescent銀河への進化パスを調査

- MOSDEF分光データ、z~2
- UVJ2色図で銀河を5グループに分けてスペクトルをそれぞれスタック。
  - (i) quiescent, (ii) post SB
  - (iii) low-sSFR dusty, (iv) dusty, (v) non-dusty
- Dn4000、Hδ吸収線、Hα輝線を用いてz~2銀河の星形成史を導出・比較する。

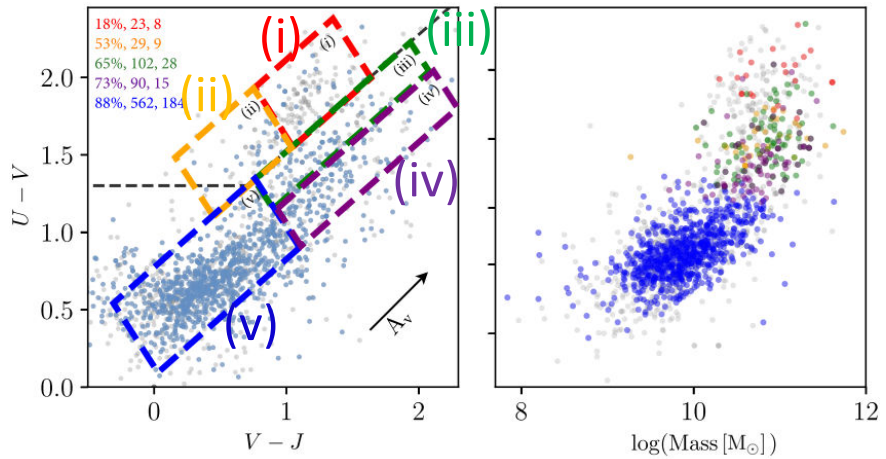

Figure 1. Left: The full MOSDEF sample (grey) and our selected sample (blue) in UVJ space, where each box color corresponds to a distinct typical SED shape. On the top left we detail the percent of targets with MOSDEF redshift measurements, the number of spectra with a MOSDEF redshift, and the average number of galaxies per pixel in our composite spectra, colored by corresponding bin. Right: $U-V$ color vs. stellar mass for galaxies (colored by bin) that comprise each stack.

- Region (iv), (v)はτ~0.2-1Gyrの緩やかなSFH。
- Region (i), (ii), (iii)はshort timescale (τ~0.1—0.2Gyr)のSFHとconsistent。
  - 近傍 (SDSS)やz~0.8 (Lega-C) では同種族は~1Gyr。
  - High-zほどtimescaleが短い傾向。
- Region (iii)はdusty種族、かつ強Hδ弱EW→region (ii)へ移行する種族(dusty post-SB) かもしれない。
- Mass density (Σ)、SFR、ageの間に相関（進化段階）が見られる。

- MOSDEFデータによりcontinuumの情報を残した解析が出来るようになった。
- 依然としてregion (i), (ii)のサンプルが少なく、明るい銀河にstackが偏ってしまう。