# Nature of Hα Selected Galaxies at z > 2.
# I. Main Sequence and Dusty Star-forming Galaxies

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The star formation rate (SFR) is one of the most important parameters to characterize galaxy properties and its redshift evolution as stars are newly formed through cooling and collapse of molecular clouds in galaxies. The sketch of the cosmic evolution of star formation activities is known as the "Madau plot" [1]. The cosmic SFR density increases by a factor of 10 from $z = 0$ to $z \sim 1$ and comes to its peak at $z \sim 2$, which indicates that a large fraction of stars in galaxies at $z = 0$ were formed at $z > 1$. Therefore, star-forming galaxies at the peak epoch are the key population for understanding the formation and early evolution of galaxies.

We have been conducting a large and systematic H$\alpha$ narrow-band (NB) imaging campaign with MOIRCS on Subaru Telescope called "*MAHALO – Subaru*" project (MApping HAlpha and Lines of Oxygen with Subaru [2]). As part of this project, we observed a general field, CANDEL-SXDF, where high-resolution optical and near-infrared images by ACS/WFC3 on HST are publicly available (Figure 1). At $z = 2.2$ and $z = 2.5$, a H$\alpha$ emission line is redshifted to be $\lambda_c = 2.09\mu$m and $\lambda_c = 2.315\mu$m, respectively. To capture them, two narrow-band filters, namely NB209 and NB2315 are used. NB2315 survey is especially unique because $z \sim 2.5$ is the highest redshift where we can observe H*** lines with ground-based telescopes. 63 star-forming galaxies at $z = 2.2$ and 46 at $z = 2.5$ are identified on the basis of flux excesses in a NB and rest-frame optical colors [3]. Moreover, we have made a follow-up spectroscopy for 13 H$\alpha$ emitters (HAEs) at $z = 2.2$ and successfully detected the H$\alpha$ emission line from 12 ones.

We found that about 42% of the red, massive HAEs with $M_* > 10^{10.8} M_\odot$ contain AGNs and most of the blue, less massive ones are likely to be star-forming galaxies. The AGNs may play an important role at the late stage of galaxy evolution. For the star-forming HAEs, the gasphase metallicities are estimated on the basis of [N II]/H$\alpha$ ratios. We found that the metallicities of our sample are significantly lower than those of local star-forming galaxies at given stellar mass. This result is consistent with previous studies [4]. Moreover, we investigated the so-called "main sequence" of star-forming galaxies at $z > 2$ based on our unique sample of HAEs [5]. The dustiness of star formation is correlated with the offset from the main sequence, suggesting that there are two kinds/modes of dusty star-forming galaxies: star-bursting galaxies and metal-rich normal star-forming galaxies.

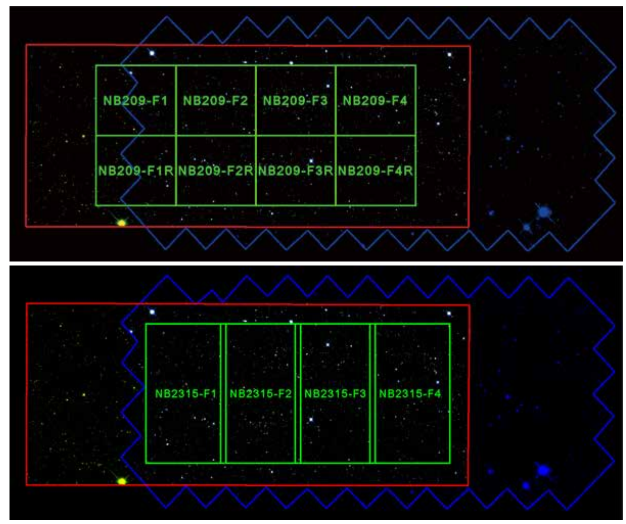


**Figure 1**: The field coverages of our NB surveys with MOIRCS are shown by green squares. Red squares and blue polygons indicate the areas covered by CANDELS WFC3 and ACS surveys, respectively.

## References

[1] Madau, P., et al.: 1996, *MNRAS*, **283**, 1388.
[2] Kodama, T., et al.: 2013, in "The intriguing life of massive galaxies", proceedings of IAUS **295**, ed., D. Thomas, in press.
[3] Tadaki, K., et al.: 2013, *ApJ*, **778**, 114.
[4] Erb, D. K., et al.: 2006, *ApJ*, **644**, 813.
[5] Daddi, E., et al.: 2007, *ApJ*, **670**, 156.