KMOS^{3D} REVEALS LOW-LEVEL STAR FORMATION ACTIVITY IN MASSIVE QUIESCENT GALAXIES AT $0.7 < z < 2.7$

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ABSTRACT

We explore the Hα emission in the massive quiescent galaxies observed by the KMOS^{3D} survey at $0.7 < z < 2.7$. The Hα line is robustly detected in 20 out of 120 UVJ-selected quiescent galaxies, and we classify the emission mechanism using the Hα line width and the [N II]/Hα line ratio. We find that AGN are likely to be responsible for the line emission in more than half of the cases. We also find robust evidence for star formation activity in nine quiescent galaxies, which we explore in detail. The Hα kinematics reveal rotating disks in five of the nine galaxies. The dust-corrected Hα star formation rates are low ($0.2 - 7\ M_\odot$/yr), and place these systems significantly below the main sequence. The 24μm-based infrared luminosities, instead, overestimate the star formation rates. These galaxies present a lower gas-phase metallicity compared to star-forming objects with similar stellar mass, and many of them have close companions. We therefore conclude that the low-level star formation activity in these nine quiescent galaxies is likely to be fueled by inflowing gas or minor mergers, and could be a sign of rejuvenation events.

arXiv.1703.07778

Quiescentな銀河ではどんな活動が起きているのか？

- KMOS-3Dサンプルから UVJ 2色図で z~1-2 Quiescent 銀河を選択。
  → 輝線強度、輝線比、SED fit情報、力学情報を抽出。
- 星形成由来の非常に弱いHα輝線を示すものが存在。
  - 特徴：Rotating gas disk, metal poor gas, close companion
  → low-metal gas inflow / minor merger による活動と考えられる。

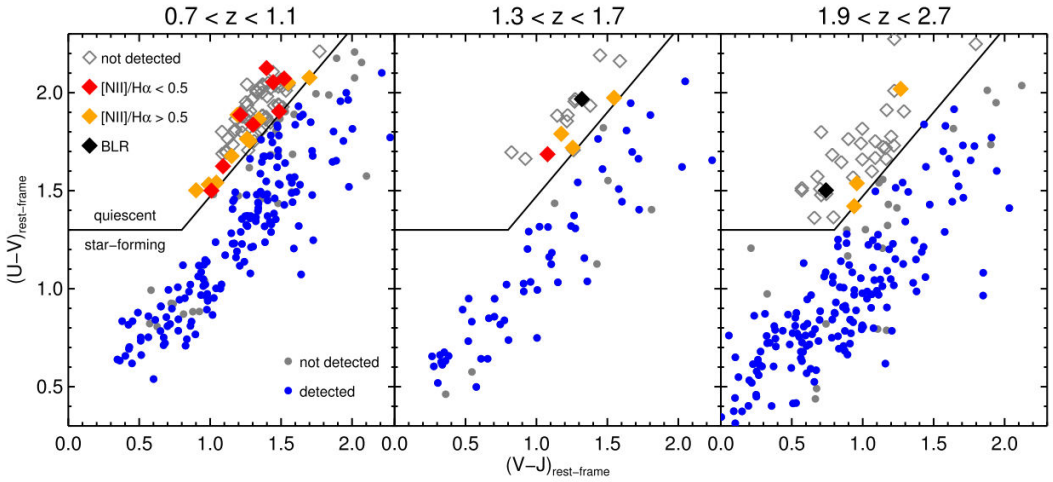
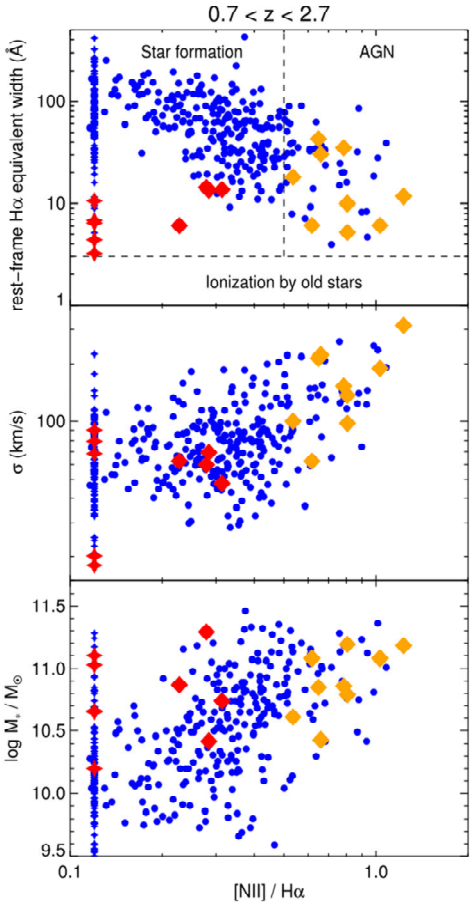


Figure 1. UVJ diagram for the KMOS^{3D} sample, split into redshift bins. The solid line separates quiescent (diamonds) from star-forming galaxies (circles). Filled diamonds mark quiescent galaxies detected in Hα, with colors indicating the type of emission. Star-forming galaxies detected in Hα are shown in blue.

560銀河 → 120 Quiescent 銀河 → 20 Hα-detected。
[NII]/Hα比を使って、[NII]-weak (9) と –strong (11) に細分。



gure 2. Rest-frame Hα equivalent width (top), velocity spersion (center), and stellar mass (bottom) as a function the [N II]/Hα flux ratio. Symbols as in Figure 1; stars ark those galaxies for which [NII] is not detected, to which assign an arbitrary value of [NII]/Hα= 0.12.

[NII]-weak 銀河
- 電離源は星形成
  - だがHα強度は弱い
- 半数はrotating gas diskを持つ
- low [NII]/Hα → metal poor gas
  - Gas inflow / minor merger ?
- 多くはclose companionを持つ
  - 大きな密度超過環境にいるわけではない。

[NII]-strong 銀河
- 電離源はAGN
- 速度分散が大きい
  - AGN outflowの影響か？

↓ SFR指標の比較

[NII]-weak 銀河では、SFR(24um)は古い星による dust heating が混入してしまい overestimateする。
一方、SFR(Hα) はMS～Quiescentに連続的に分布。
Burst による一時的な変化か？

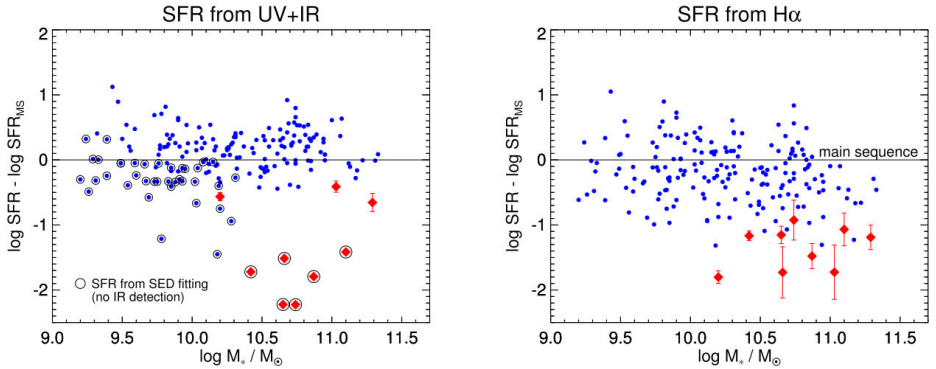


Figure 5. Vertical distance from the main sequence (as given by Whitaker et al. 2014), in logarithmic units, as a function of stellar mass. Star formation rates are derived from UV+IR luminosities (left panel) and dust-corrected Hα fluxes (right panel). The error bars in the right panel include conservative estimates of the uncertainty in the underlying Hα absorption and dust extinction (a factor of two for each contribution); in the left panel the SED-derived values are dominated by systematic uncertainties. Symbols and colors as in Figure 1; only galaxies at $z < 1.7$ and with [N II]/Hα< 0.5 are shown.