

A Post-Starburst Pathway to Forming Massive Galaxies and Their Black Holes at $z > 6$

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JWST observations of two quasar host galaxies at $z > 6$

- J2236+0032 @ $z=6.40$
- J1512+4422 @ $z=6.18$

(1) JWST-NIRSpec : rest-optical spectra

- Stellar components extracted by subtraction model
- QSO component

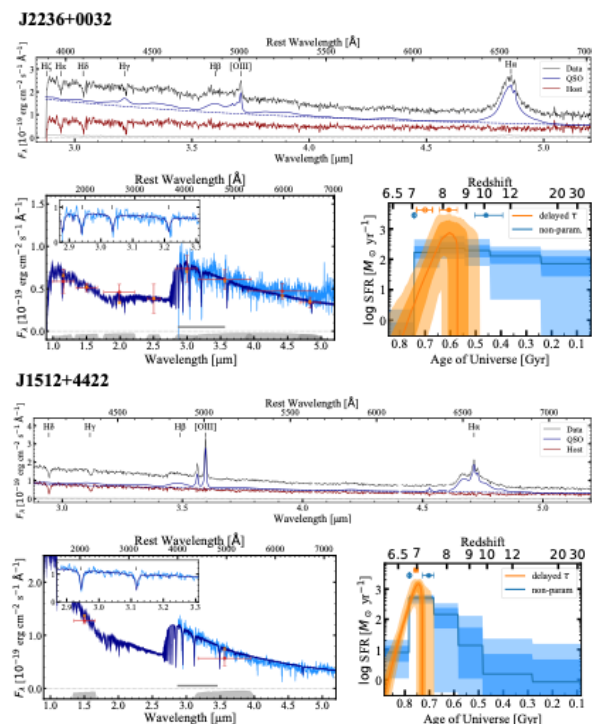


Figure 1. JWST NIRSpec G395M spectra of J2236+0032 and J1512+4422 with Balmer absorption

SED fitting by Bagpipes

- Delayed-tau model
- $M^* = 1e10.81 M_{\odot}$ (J2236) / $1e10.63 M_{\odot}$ (J1512)
- Peak SFR = 2120 M_{\odot}/yr / 1800 M_{\odot}/yr @ $\sim 100\text{-}200\text{Myr}$ before
- $Z_{\text{form}} = 8.2 / 7.0$
- Ongoing (past 100Myr) SFR = 0.69 M_{\odot}/yr / 47 M_{\odot}/yr
- => past 10Myr SFR = 3.7 M_{\odot}/yr for J1512
- $Z_{\text{quench}} = 7.4 / 8.0$
- Quasar SMBH mass = 1.4e9/1.3e9 M_{\odot}

=> Both are massive galaxies transforming to quiescent phase,
=> Most distant massive quiescent galaxies known.

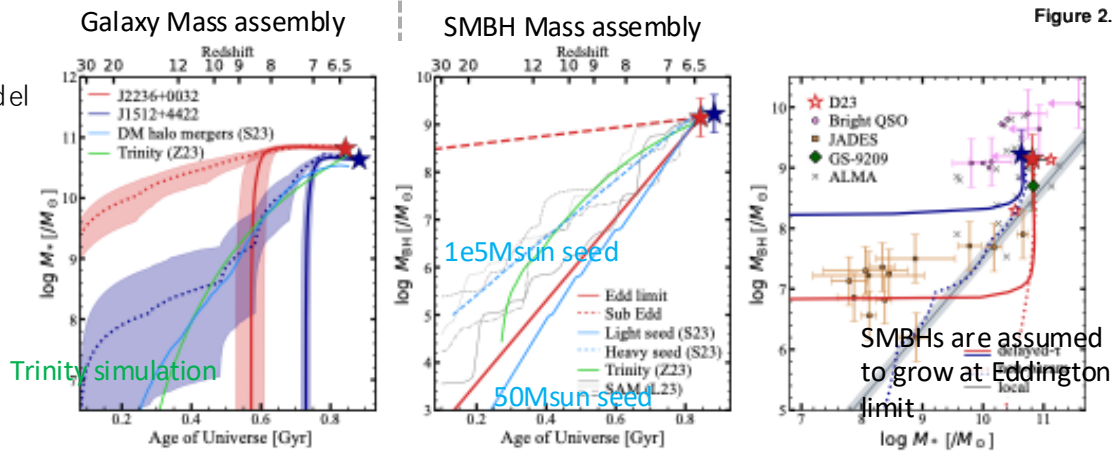


Figure 3. Growth pathways of the two quasar host galaxies and their SMBHs. (Left:) Stellar mass

$M_{\text{BH}}-M^*$ relation

- Currently somehow above the local relation
- During the starburst phase, they approached the local relation once / still depending on growth history of SMBH

$M_{\text{BH}}-\sigma$ relation

- Velocity dispersion : 180 km/s / 190 km/s : first direct measurement at $z > 6$ QSO hosts
- Slightly higher than local relation : consistent wot $M_{\text{BH}}-M^*$ relation

Host galaxies undergoing rapid transition to quenched post starburst phase, Possibly driven by feedback of SMBH

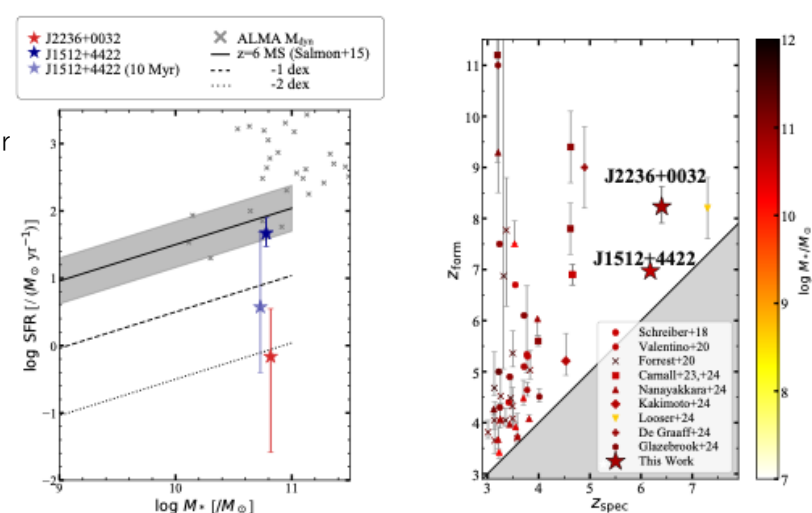


Figure 2. The quiescence of the two quasar host galaxies. (Left:) The stellar mass – star formation rate

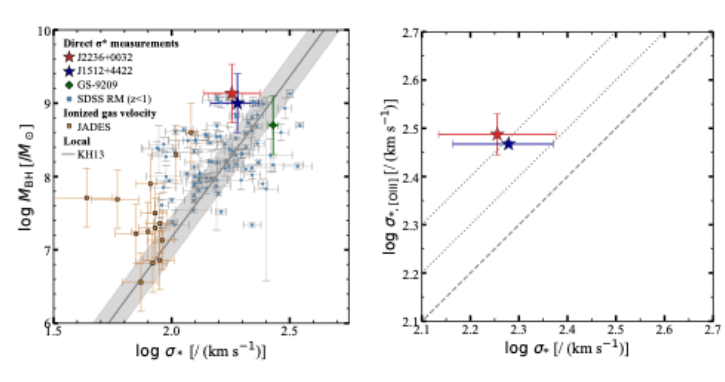


Figure 4. Stellar velocity dispersion measurements. (Left:) The relationship between M_{BH} and stellar