

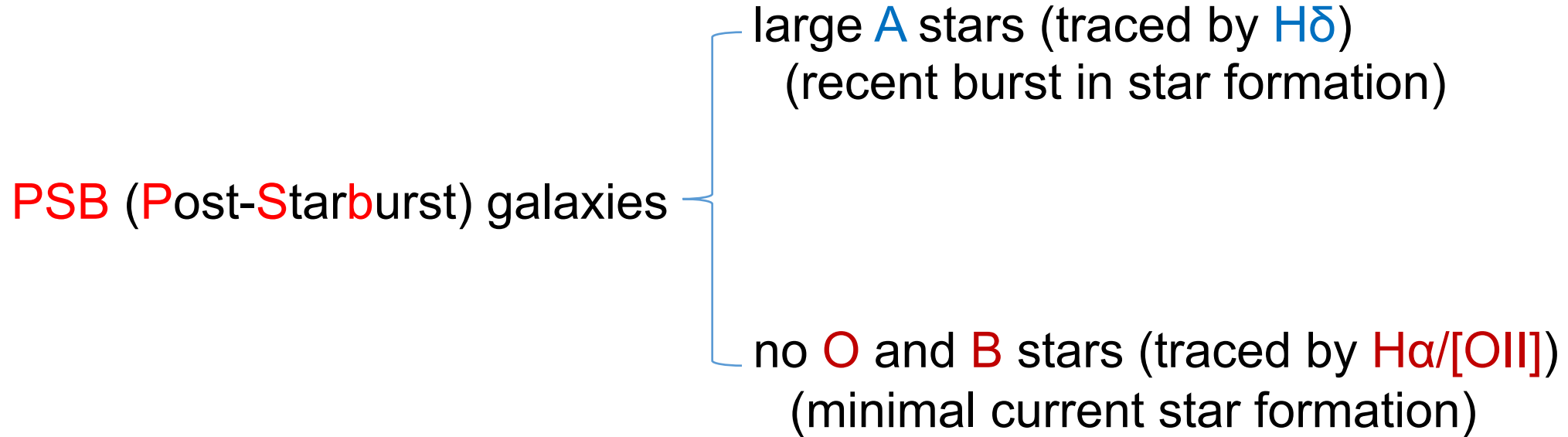


Evidence for Multiple Types of Post-Starburst Galaxies

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1. What is **PSB** galaxies?



2. How PSB galaxies produced?

merger-driven (**not all**)

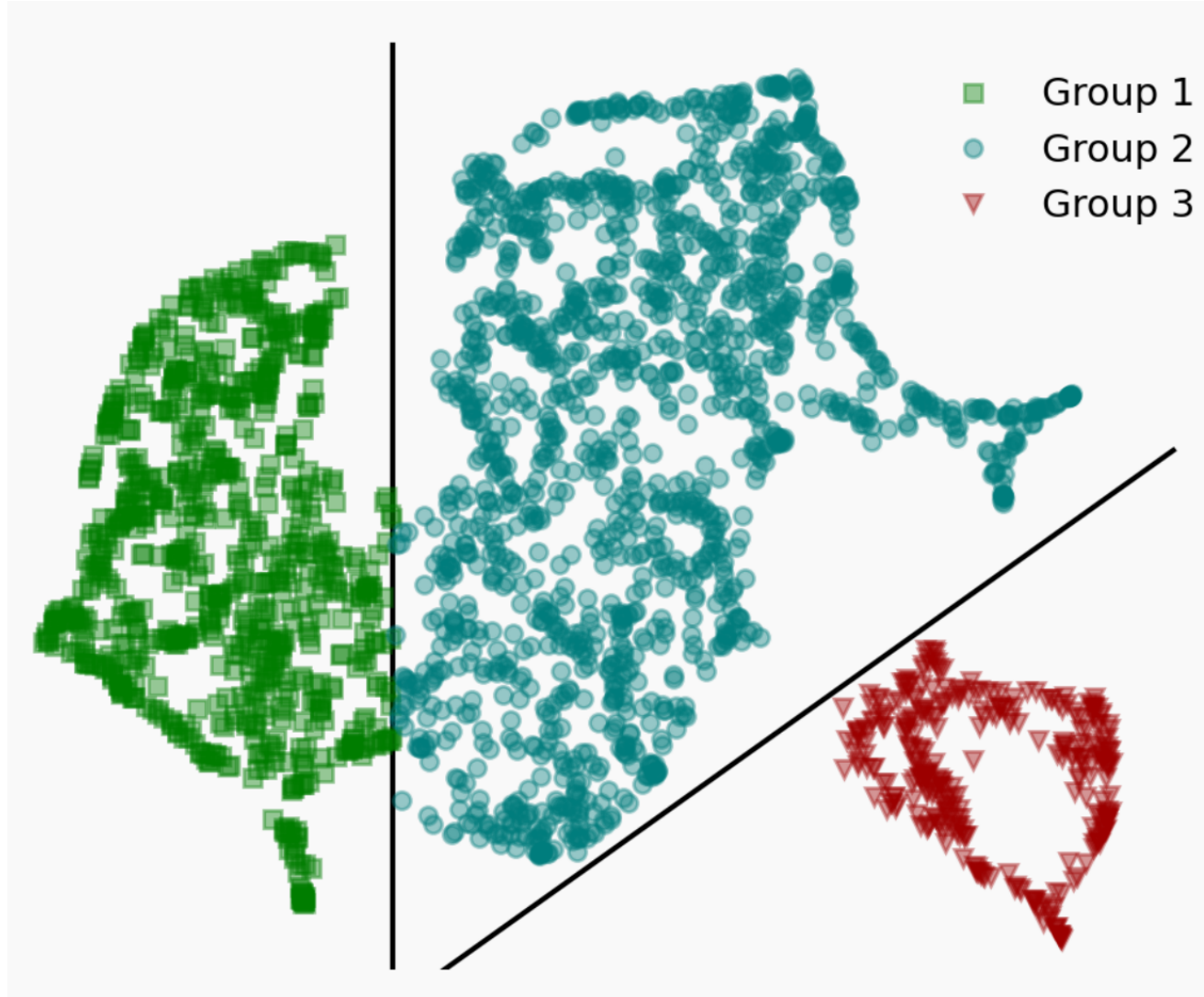
multiple distinct mechanisms (produce different classes of PSB galaxies)(Pawlik et al.), even **if** the PSB phase is **entirely merger-driven**:

1. a transition from star-forming to quiescent
2. the galaxy resumes its star formation after the PSB phase
3. a quiescent galaxy is rejuvenated by a minor merger

This work: examines whether multiple types of post-starburst galaxies actually exist.

3. Dissimilar groups of PSB galaxies

total sample: 2665 PSB galaxies (strong H δ absorption, almost no H α or [OII] emission) from Meusinger et al. (2017) catalog



Method:

UMAP (Uniform Manifold Approximation and Projection) (an **unsupervised machine learning**)

input:

equivalent widths (EWs) of **H α** , **H δ** , **[OII] λ 3727** and **[OII] λ 3729** from Meusinger et al. (2017) catalog

output:

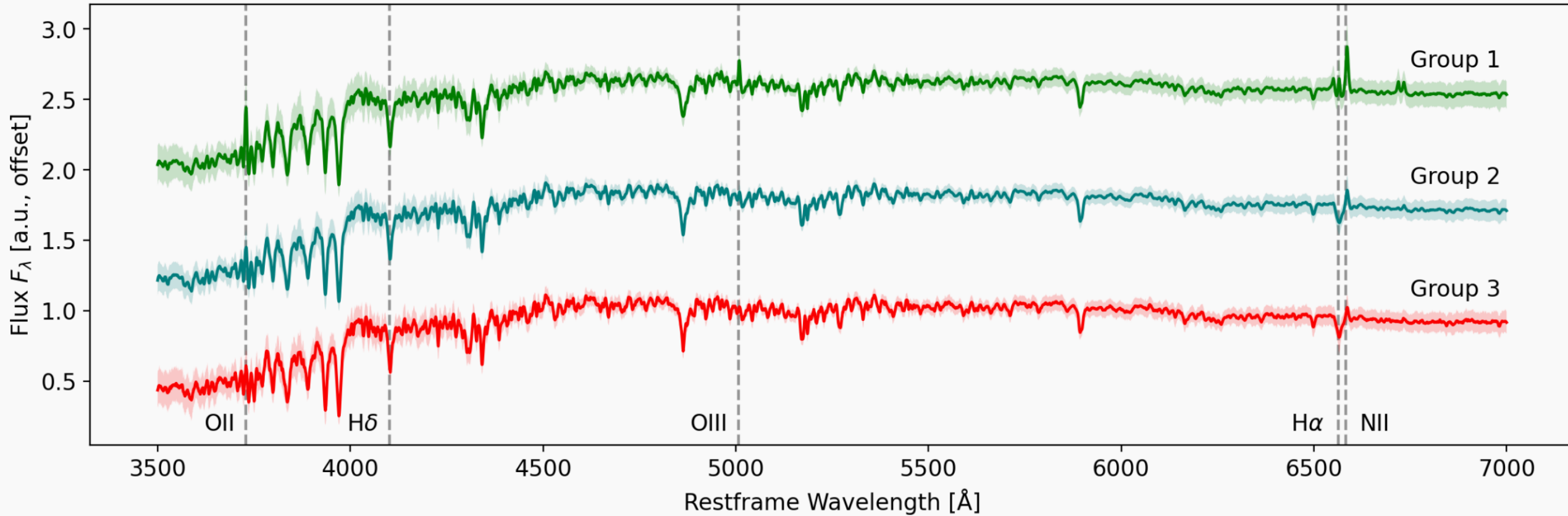
Group 1: 831

Group 2: 1506

Group 3: 328

4. Spectral Energy Distributions

Stacked SEDs for the PSB groups:

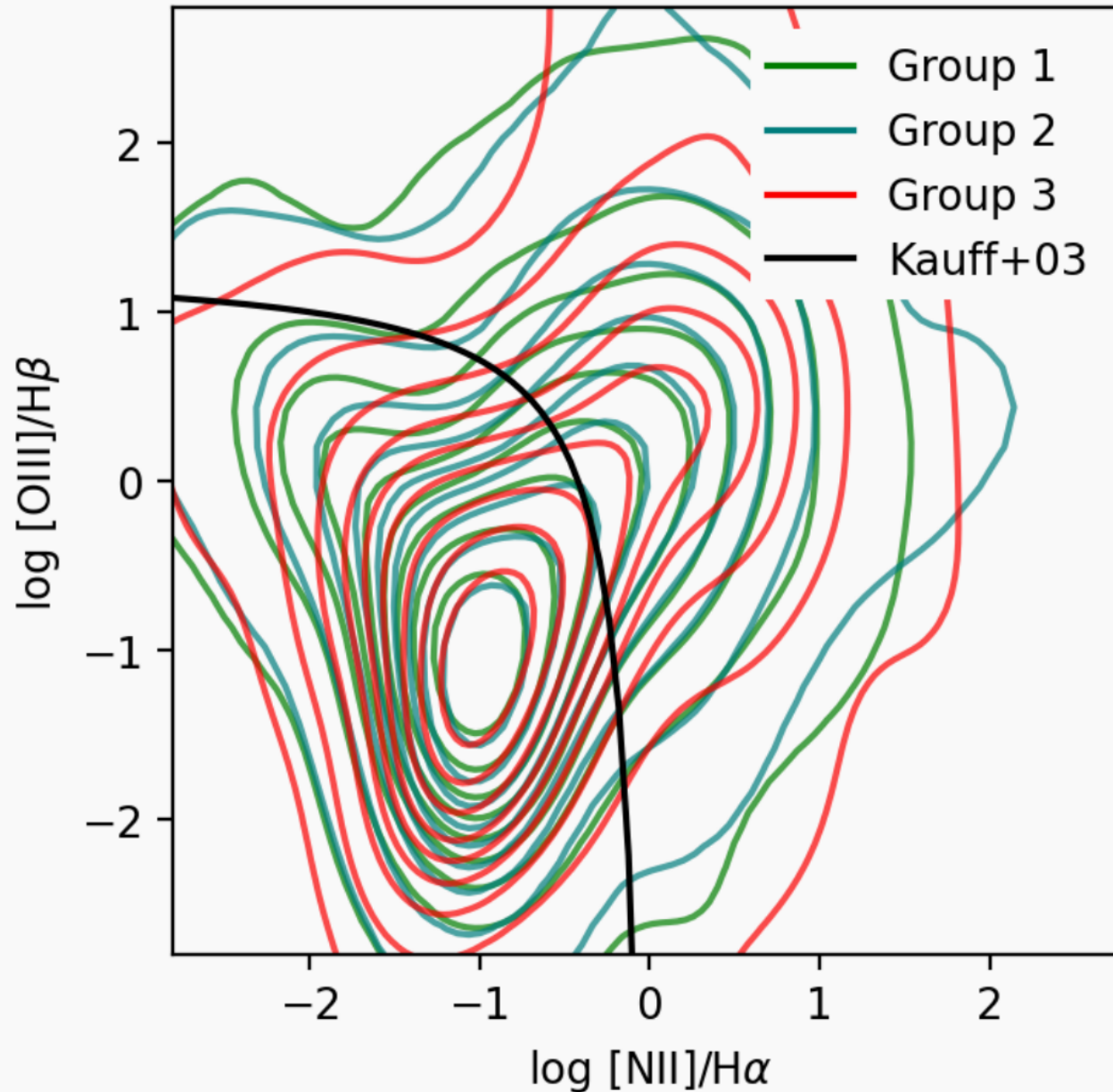


Group 1: emits H α and [OII]

Group 2: emits [OII] absorbs H α

Group 3: absorbs H α and [OII]

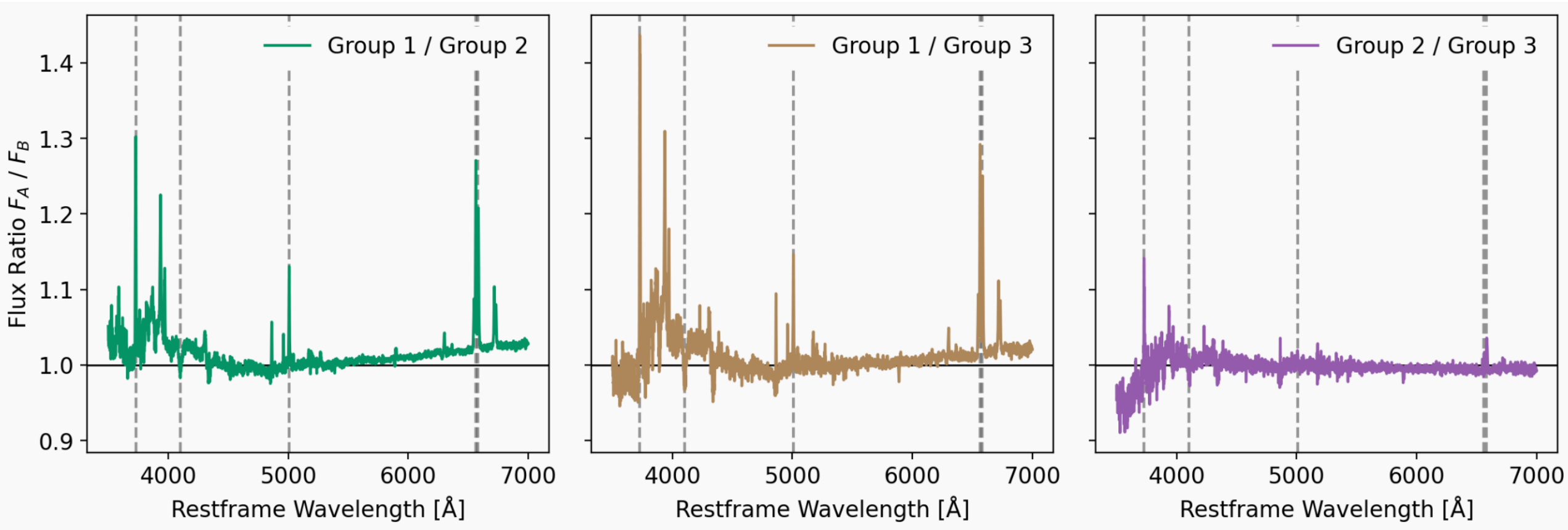
4. Spectral Energy Distributions



AGN: **above** the black line

Result: AGN activity does **not** cause this grouping.

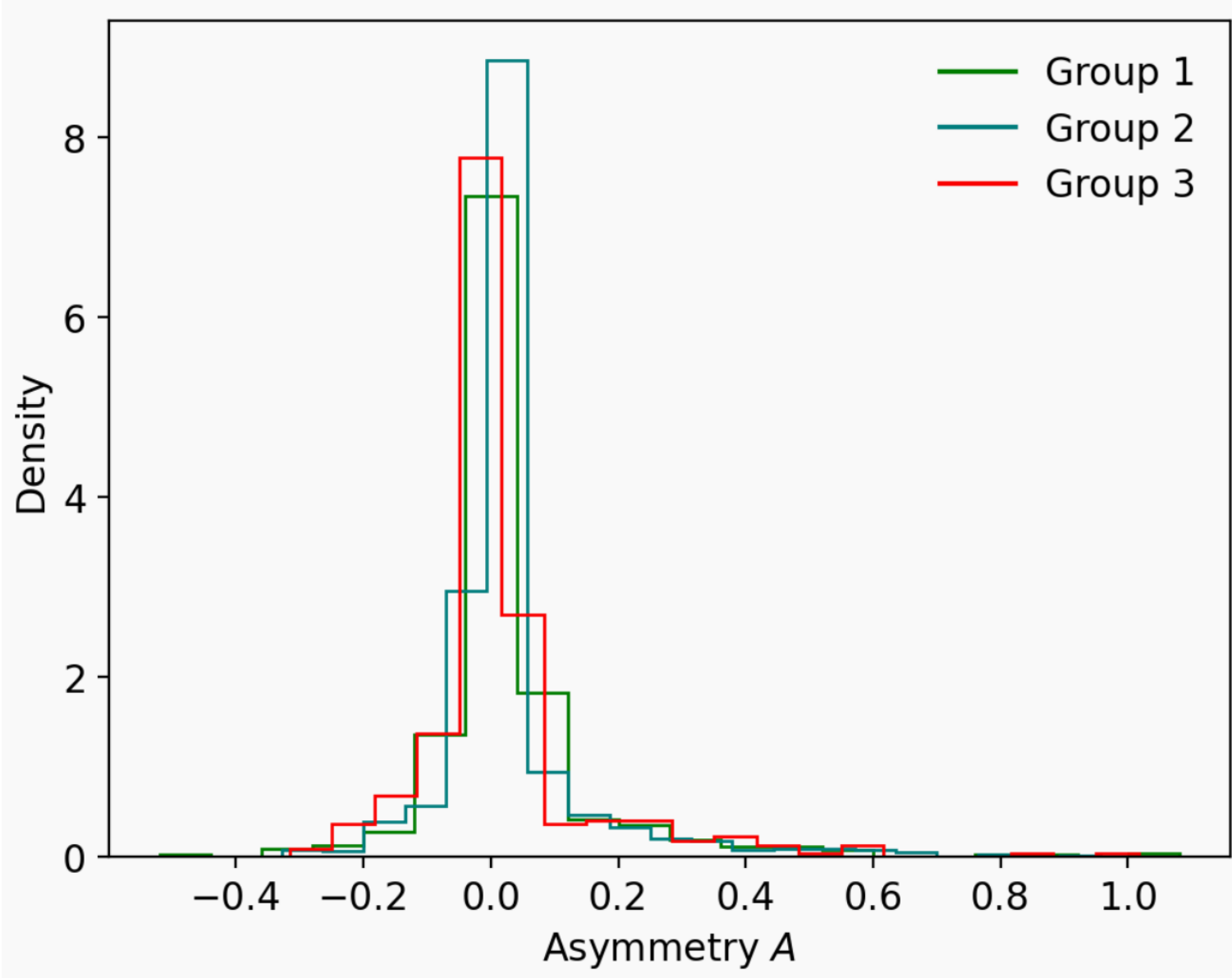
4. Spectral Energy Distributions



Group 1: stronger spectral lines, dustier

Group 2 and Group 3: similar, different in lower wavelengths

5. Morphologies and Merger Histories



quantitative morphological parameters:

CAS-statistics,
Gini/M20,
 χ^2 of Sersic fits

(not clearly divided between the groups)

Asymmetry:

Group 3 < Group 1, 2

KS test:

Group 3: inconsistent with Groups 1 and 2

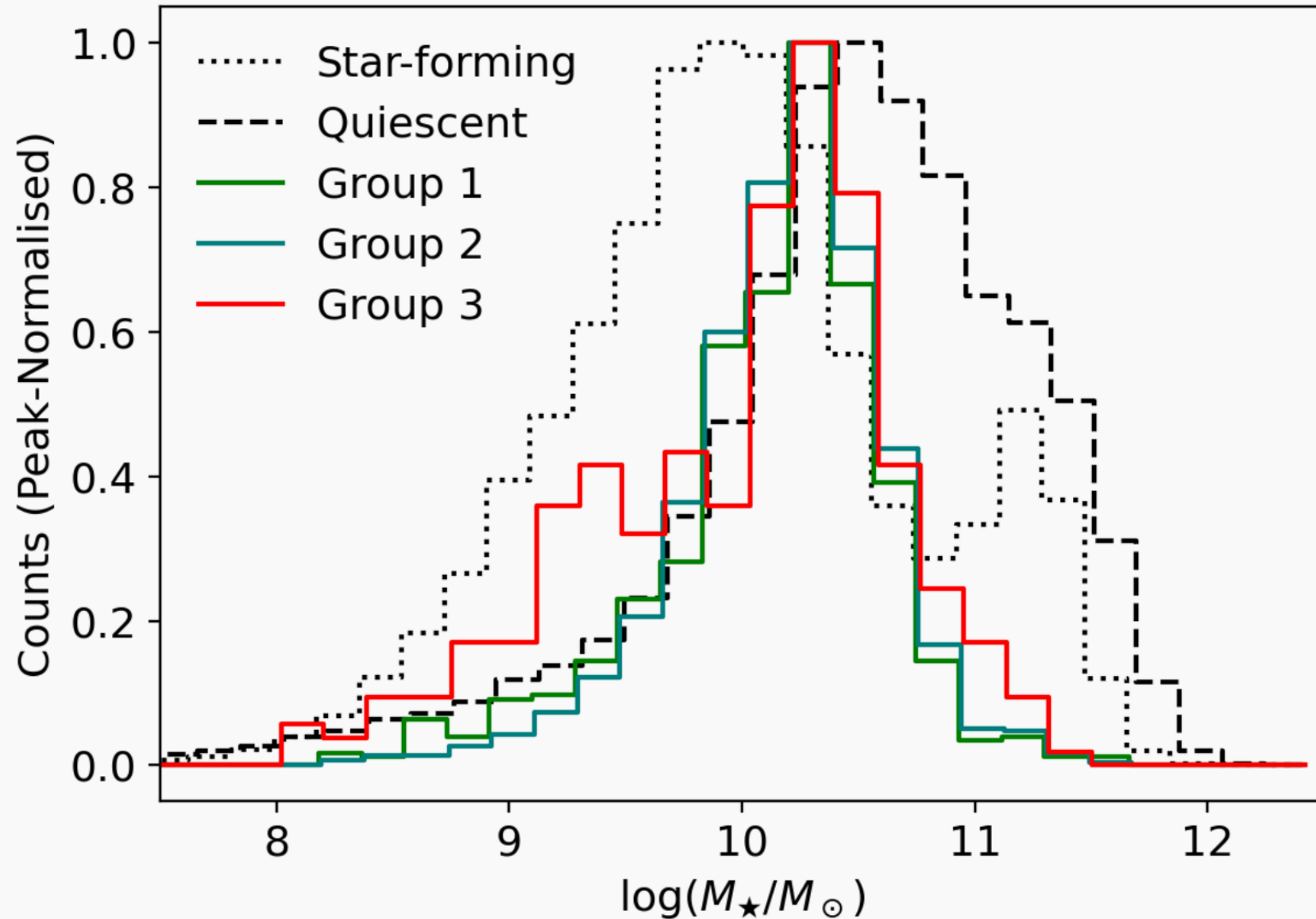
Group 3: minor merger or no merger at all

6. Potential Origins of PSB Galaxy Types

Several possibilities for explaining the origins of these distinct types:

1. The grouping could be an **evolutionary sequence** where Group 1 is the youngest and Group 3 is the oldest.
2. The groups could all be merger-driven, but produced by **different types of mergers**.
3. Some of the groups could instead evolve secularly through the PSB phase, such as in the **red star-forming galaxy** scenario (Steinhardt 2024).

7. Stellar Mass distribution of PSB galaxies



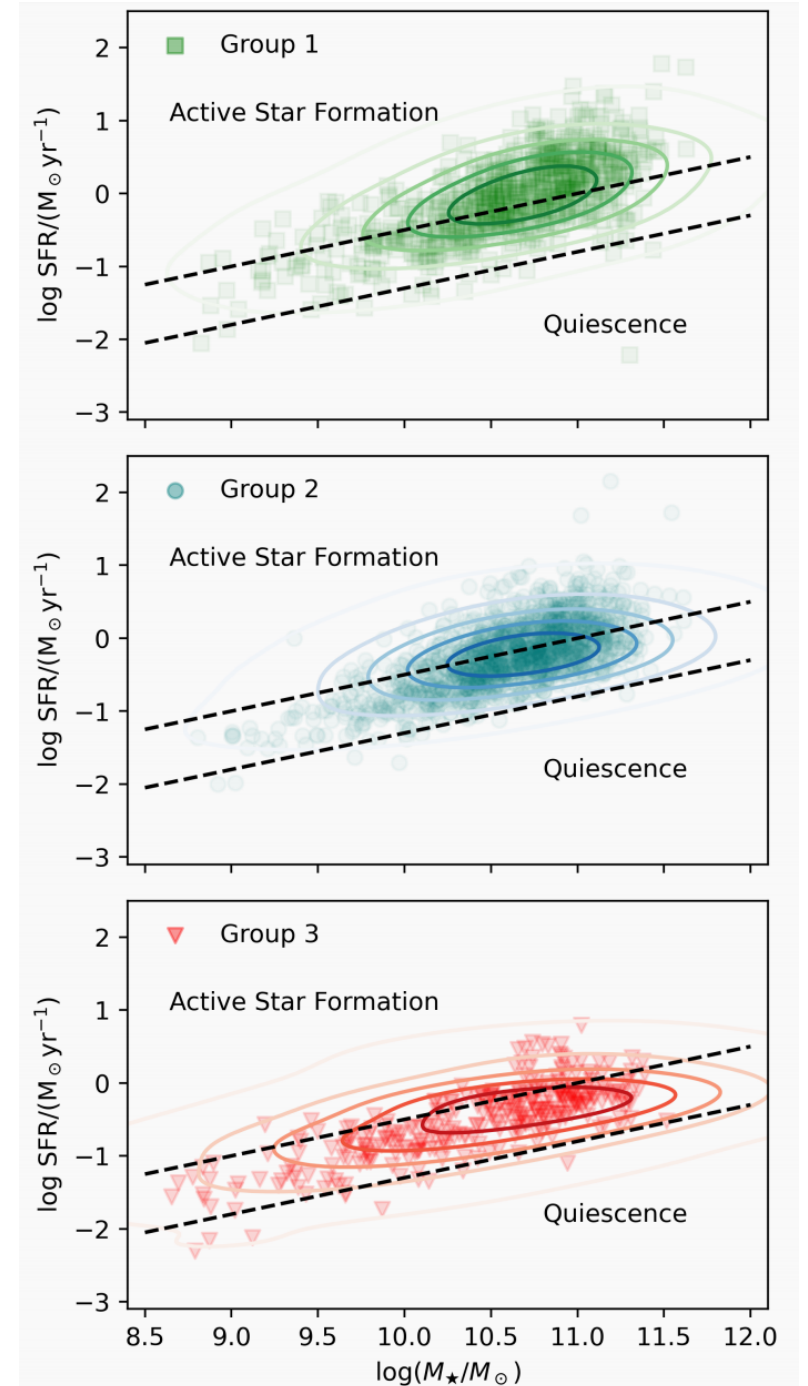
evolutionary sequence (no)

8. Distinct Merger-Driven Origins

Group 1: blue to blue cycle (Pawlik et al. (2019)), the galaxies resume their star formation after the PSB phase.

Group 2: transition from star-forming to quiescent.

Group 3: been rejuvenated by minor mergers. Or contains red star-forming galaxies (**RSFGs**)



9. Discussion

1. **PSB Galaxy Clustering**: UMAP clustering of PSB galaxies reveals three distinct types with different origins, correlating with galaxy properties and merger histories rather than just age.
2. **Astrophysical Origins**: Groups 1 and 2 likely result from mergers, while Group 3 may be red star-forming galaxies (RSFGs) not immediately quenching.
3. **RSFG Hypothesis**: Requires further testing, especially comparing quenching directions to determine triggers.
4. **Mass Distribution**: All PSB groups span from massive star-forming to low-mass quenched galaxies, suggesting they are near turnoff and supporting downsizing.
5. **Downsizing and Mergers**: Downsizing implies a transition from star-forming to quiescent. The presence of post-mergers suggests at least one PSB group is merger-associated.