The evolution of post-starburst galaxies from $z = 2$ to $z = 0.5$

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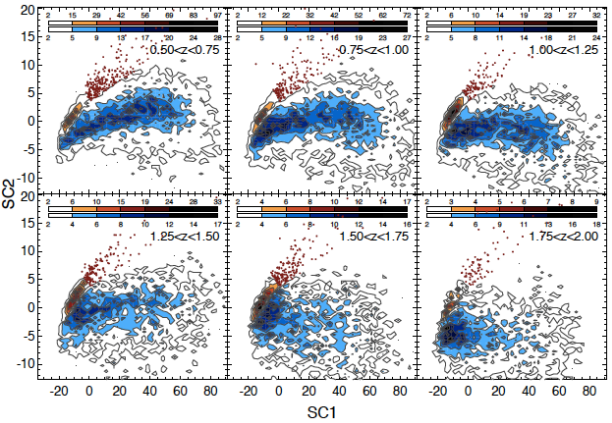
ABSTRACT

We present the evolution in the number density and stellar mass functions of photometrically selected post-starburst galaxies in the UKIDSS Deep Survey (UDS), with redshifts of $0.5 < z < 2$ and stellar masses $\log(M/M_\odot) > 10$. We find that this transitionary species of galaxy is rare at all redshifts, contributing ∼5% of the total population at $z \sim 2$, to <1% by $z \sim 0.5$. By comparing the mass functions of quiescent galaxies to post-starburst galaxies at three cosmic epochs, we show that rapid quenching of star formation can account for 100% of quiescent galaxy formation, if the post-starburst spectral features are visible for ∼250 Myr. The flattening of the low mass end of the quiescent galaxy stellar mass function seen at $z \sim 1$ can be entirely explained by the addition of rapidly quenched galaxies. Only if a significant fraction of post-starburst galaxies have features that are visible for longer than 250 Myr, or they acquire new gas and return to the star-forming sequence, can there be significant growth of the red sequence from a slower quenching route. The shape of the mass function of these transitory post-starburst galaxies resembles that of quiescent galaxies at $z \sim 2$, with a preferred stellar mass of $\log(M/M_\odot) \sim 10.6$, but evolves steadily to resemble that of star-forming galaxies at $z < 1$. This leads us to propose a dual origin for post-starburst galaxies: (1) at $z \gtrsim 2$ they are exclusively massive galaxies that have formed the bulk of their stars during a rapid assembly period, followed by complete quenching of further star formation; (2) at $z \lesssim 1$ they are caused by the rapid quenching of gas-rich star-forming galaxies, independent of stellar mass, possibly due to environment and/or gas-rich major mergers.

- z~4から近傍に至るにつれ、quiescent銀河が増加
  - 星形成銀河のquenching
- 過渡期にあたるpost-starburst (PSB)銀河を調べることでquenching processに関する手がかりが得られる
- PSB銀河はBalmer breakなどA,F型星の特徴が顕著

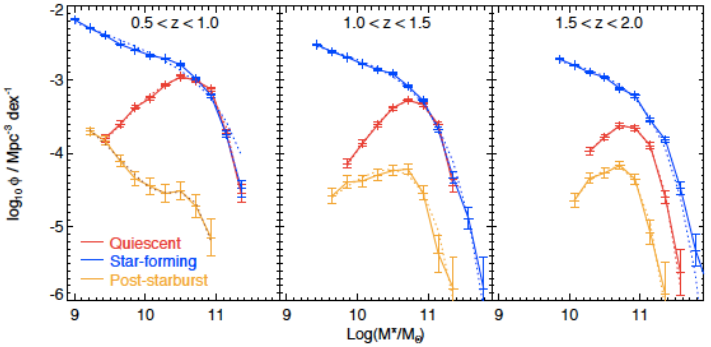
❖ Sample

- UKIDSSのUDS DR8 他 (K<24)
- “super color” (Wild+14) を用いて銀河種族を分類(PSB86個)

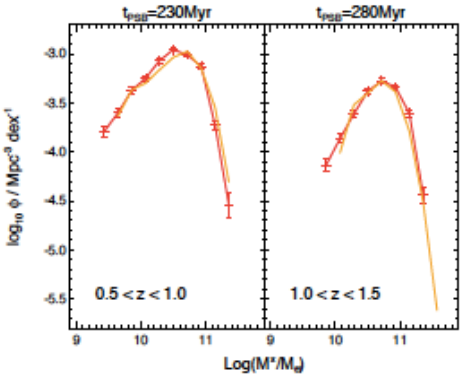


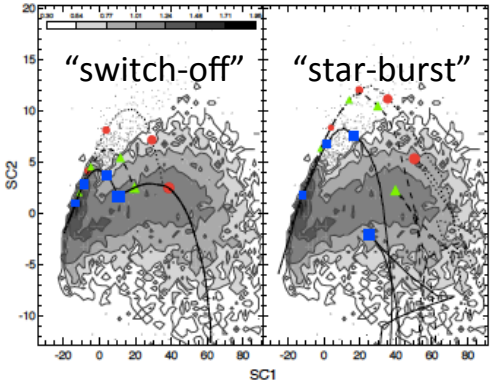
SC1はageとdust
SC2は金属量と過去1Gyrにburstで作られた星の質量と関係

❖ Result



PSB銀河のSMFはhigh-zでquiescent、low-zでSFと同じ形をしている





左：赤はそのredshift binでのquiescent SMF。橙はひとつ前のbinのquiescentとPSBのSMFを足し合わせたもの
右：fast quenchingに関連する“switch-off”とstar-burstを経験する銀河の進化経路。赤緑青の順に左は星形成終了までの時間、右は金属量が小さい

- high-zでは大質量の銀河、z<1では低質量の銀河がPSBを経てquiescent銀河となる
- PSBとquiescentのSMFを足し合わせたものがlow-z側のquiescent SMFと一致することから、**fast quenching (<1Gyr)のみでquiescent銀河の形成を説明できる**
  - fast: mass quenching, merger など
  - slow: cluster内のharassment など