THE SPLASH SURVEY: QUIESCENT GALAXIES ARE MORE STRONGLY CLUSTERED BUT ARE NOT NECESSARILY LOCATED IN HIGH-DENSITY ENVIRONMENTS

LIHWAI LIN [1], P. CAPAK [2], C. LAIGLE [3], O. ILBERT [4], BAU-CHING HSIEH [1], HUNG-YU JIAN, [1,5], B. C. LEMAUX, [4], J. D. SILVERMAN [6], JEAN COUPON, [7], H. J. MCCRACKEN [3], G. HASINGER [8], O. LE FÈVRE, [4], N. SCOVILLE [9]

ABSTRACT

We use the stellar mass-selected catalog from the Spitzer Large Area Survey with Hyper-Suprime-Cam (SPLASH) in the COSMOS field to study the environments of galaxies via galaxy density and clustering analyses up to $z \sim 2.5$. The clustering strength of quiescent galaxies exceeds that of star-forming galaxies, implying that quiescent galaxies are preferentially located in more massive halos. When using local density measurement, we find a clear positive quiescent fraction – density relation at $z < 1$, consistent with earlier results. However, the quiescent fraction – density relation reverses its trend at intermediate redshifts ($1 < z < 1.5$) with marginal significance ($<1.8\sigma$), and is found to be scale dependent (1.6σ). The lower fraction of quiescent galaxies seen in large-scale dense environments, if confirmed to be true, may be associated with the fact that the star formation can be more easily sustained via cold stream accretion in 'large-scale' high-density regions, preventing galaxies from permanent quenching. Finally at $z > 1.5$, the quiescent fraction depends little on the local density, even though clustering shows that quiescent galaxies are in more massive halos. We argue that at high redshift the typical halo size falls below 10^{13} solar mass, where intrinsically the local density measurements are so varied that they do not trace the halo mass. Our results thus suggest that in the high-redshift Universe, halo mass may be the key in quenching the star formation in galaxies, rather than the conventionally measured galaxy density.

❖ Introduction

- z < 1においてquiescent銀河は密度の大きな領域で多く見つかることが知られているが、z > 1でどうなるかはよくわかっていない
- 多くのquiescent銀河がstar-forming銀河よりも大質量のハローを持つことも示唆されている
- 局所密度は環境効果を研究する際によく用いられるが、ハロー質量と直接結びつけることは難しい
- この論文では局所密度と銀河のクラスタリングを用いて銀河の性質と環境の関係を調べている

ハロー質量の良いtracer

❖ Sample

- The COSMOS Ultra Deep Infrared Catalog (Laigle et al.2015) の銀河のうち、Ultra VISTAのNIR imageがあるもの (0.25–7.7 μm)
- $K_s < 24$, S/N > 2, $M_* > 10^{10.5}$, 0.3 < z < 2.5
- NUV-r^+ vs r^+-Jでstar-formingかquiescentか決定

❖ 結論

- z > 1のquiescent fractionと密度の関係はスケール依存
  → 大スケールの高密度環境にある銀河は小スケールのものに比べて星形成の停止がless efficient
- z ~ 2.5までquiescent銀河はstar-forming銀河よりもクラスタリング強
  → quiescent銀河は大質量のハローを持つ
- high-zにおけるquenching mechanismは大質量のハローを持つ銀河でのみeffectiveなのかもしれない

❖ Result

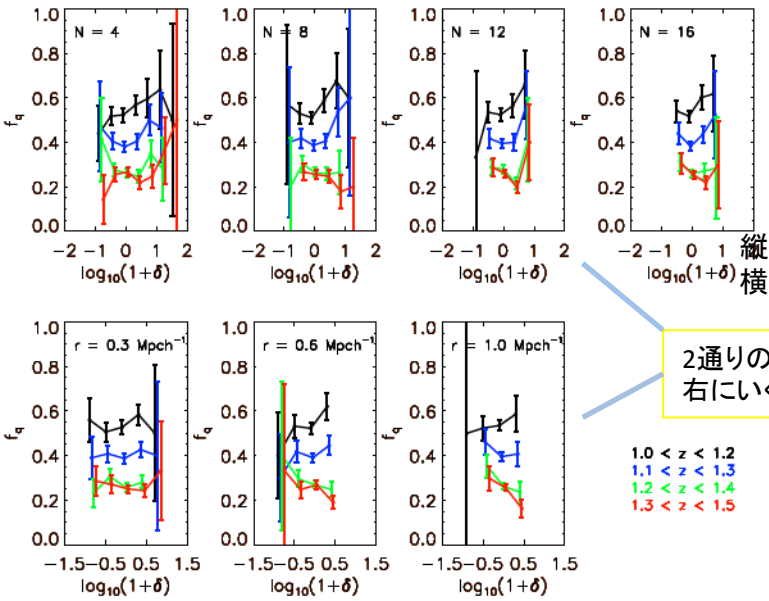


Fig. 9

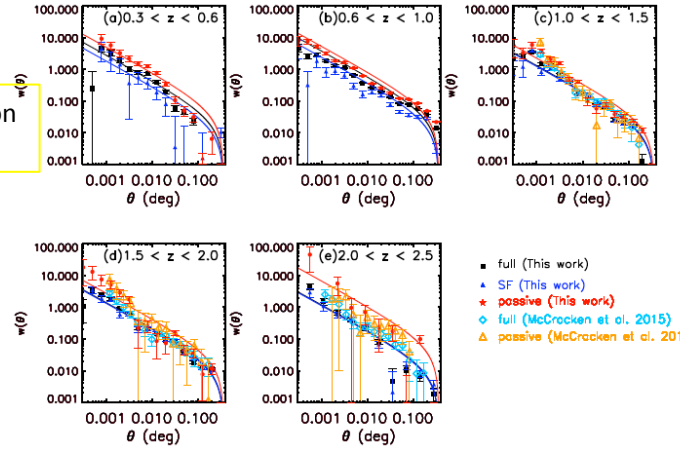
縦軸：quiescent fraction
横軸：over density

2通りの方法で密度を測定
右にいくほどスケール大

1.0 < z < 1.2
1.1 < z < 1.3
1.2 < z < 1.4
1.3 < z < 1.5

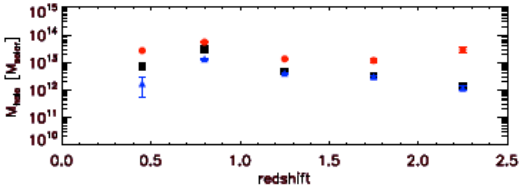
Fig. 11

angular correlation function
クラスタリングの強さ？



青：star-forming
赤：quiescent

Fig. 13



今回のサンプルに対してMo & White (2002) prescriptionで求められるハロー質量のredshift進化