X33a A systematic search for galaxy protocluster cores at the transition epoch of star formation activity

Makoto Ando, Kazuhiro Shimasaku, Rieko Momose (U.Tokyo), and the HSC-project 394 members

At $z > 2$, galaxies in proto-clusters (PCs) are actively star forming, while matured clusters at $z < 1$ are dominated by quenched galaxies, suggesting that $z \sim 1.5$ is the transition epoch of (proto)clusters from star forming phase into quenching phase. To investigate star formation quenching in this epoch, we search for PC cores at $z \sim 1.5$. Here, a "core" is defined as the most massive halo in a given PC, where environmental effects are likely to work most effectively. Using a photo-z catalog of large and deep optical survey data with Subaru Hyper-Suprime Cam, we search for PC cores in a very wide field that reaches $\sim 22\,\mathrm{deg}^2$. Regarding galaxies more massive than $\sim 2 \times 10^{11}\,M_\odot$ as the central galaxies of PC cores, we detect more than 1000 core candidates. Then, we estimate their average halo mass by clustering analysis and find it to be $\sim 3 \times 10^{13}\,M_\odot$. From a comparison with the Illustris TNG simulation, we confirm that these massive halos at $z \sim 1.5$ are progenitors of present-day clusters comparable to or more massive than Fornax-type clusters. Classifying our galaxy sample into red and blue galaxies, we calculate the red fraction of the member galaxies of our PC core candidates. Interestingly, although cores with red and blue centrals have similar halo masses, only those with red centrals show a red fraction excess compared to the field, suggesting a conformity effect. We also find that the red fraction excess is an increasing function of stellar mass. Combining with the Illustris TNG simulation, we discuss galaxy quenching in PC cores at $z \sim 1.5$.