Revealing environmental dependence of massive galaxy formation in the most distant known X-ray cluster at z=2.51

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I got my PhD from Department of Astronomy, Nanjing University in 2012. During my PhD I spent two years in CfA as a visiting student. After my PhD I went to CEA, Saclay, France for my first post-doc during 2013-1016, and then moved to University of Tokyo, Japan as a project researcher since 2017. My main interests are galaxy formation and evolution, especially focusing on the early universe. I am also interested in the co-evolution of galaxies and supermassive blackholes across cosmic time.

Galaxy clusters trace the densest galaxy environment and the most massive dark matter halos, hence are ideal laboratories to study environmental effects on galaxy evolution. One of the most prominent features of local galaxy clusters is the presence of a predominant population of giant ellipticals in cluster core. Both galaxy cluster archaeology and cosmological simulations suggest that these galaxies formed their stars in a short time scale at z>~2, however, clear evidence for structures in such a rapid formation phase has been lacking so far, and the (trans)formation mechanisms of cluster ellipticals remain a mystery. In this talk I will present our recent discovery of the most distant galaxy cluster known to date at z=2.51 (named “CLJ1001”). In addition to its record-breaking distance, CLJ1001 is the first X-ray cluster discovered so far that is dominated by massive star-forming galaxies in the core (instead of massive ellipticals found in low-redshift clusters). With an exceptional star formation rate of ~3400 Msun/yr and a gas depletion time of ~200 Myrs, CLJ1001 was caught in a rapid formation phase of central cluster ellipticals, a missing link between previously-discovered young, proto-clusters and mature clusters. Based on extensive follow-up studies of CLJ1001 from VLA, NOEMA, and ALMA, I will discuss what we have learned so far on the influence of the dense environment on massive galaxy formation at z>2.