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Evolution of large-scale outflow over the past 9 billion years of the Universe

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In the present-day universe, galaxies can be divided into two main categories: young blue disk galaxies that are actively forming new stars, and old red elliptical galaxies that are passively evolving and forming no new stars any further. It is known that some of star-forming disk galaxies should evolve into passively-evolving ellipticals in the past. However, due to its relatively short timescale, the galaxy in the middle of this transforming phase had not been observed yet. In this talk, I will introduce a systematic approach to identify high-redshift galaxies with large-scale outflow. With Subaru telescope, we have discovered 12 galaxies at $z \sim 1.2$ (8.4 Gyr ago) showing a largely extended (> 30 kpc) [OII]λ3727 nebula, which we call [OII] blobs (OIIBs). Some of these galaxies are probably experiencing the final phase of star formation with their gas heated and expelled out by active galactic nuclei or supernova feedback, and quenching star formation whose process is a key to produce passively-evolving ellipticals. As a systematic search, we could derive the number density of these blobs and found that only 3% of star-forming galaxies at z˜1 are facing the star-formation quenching process involving spatially extended [OII] emission. We are currently extending our search to cover 9 billion years of the universe ($z = 0.1 - 1.5$) and find that the number densities of blobs tend to decline toward low redshifts consistent with the cosmic star formation history. In contrast, the fraction of galaxies experiencing large-scale outflow remains constant over time, suggesting that the phase of large-scale outflow is probably short in an order of hundred million years. Detailed study of large-scale outflow in these blobs are performed by ongoing spectroscopic observations with world largest telescopes such as Subaru and Keck. Their physical properties will also be discussed in this talk.

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