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論文要旨集

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Exploring Outflows of Very Low-Mass Galaxies by Deep Optical Spectroscopy

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We investigate low-mass galaxies in the local universe that can be analogs of the first galaxies. These galaxies are in the epoch of early star formation characterized by low gas-phase metallicity of Z<0.2 Zsun and high specific star-formation rates of sSFR~100-1000 Gyr^-1. We conduct deep medium-high resolution slit spectroscopy with Magellan/MagE and integral field spectroscopy with Subaru/FOCAS-IFU. We study emission line profiles of 21 low-mass galaxies with slit spectroscopy. We conduct double Gaussian profile fitting to the Hα and [OIII] emission, and find that the broad-line components have line widths significantly larger than those of the narrow-line components, indicative of galactic outflows in 14 out of the 21 galaxies. We estimate the maximum outflow velocities v_max and obtain values of ~60-200 km s^-1, which are found to be comparable to or slightly larger than the escape velocities. Positive correlations of v_max with star-formation rates, stellar masses, and circular velocities, extend down into this low-mass regime. We derive the mass loading factors η to be as small as 0.1 - 1 or below, in contrast to the large η of energy-driven outflows predicted by numerical simulations. To tackle with the spatially extended outflows that are possibly missed by the slit spectroscopy, we include the integral field spectroscopy for 6 galaxies, two of which have outflow detection with the slit spectroscopy. We apply double Gaussian profile fitting to the Hα emission in each spaxel and obtain spatially resolved outflows in 4 out of the 6 galaxies. We find the outflow properties are characterized by inhomogeneous distribution, which does not largely impact the η estimation. We also investigate what triggers the star formation that drives outflows. We discuss the scenarios of merger and gravitational instability that may lead to early star formation in low-mass galaxies. We measure the kinematic asymmetry of the ionized gas (K_asym) via the harmonic expansion of line-of-sight velocity and velocity dispersion, which is called Kinemetry. We find high asymmetry of K_asym>0.5 that does not agree with the disk rotation, but can be explained by merger or gravitational instability.