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Identifying Protoclusters in Distant Universe

Properties of galaxies, such as color, age and star formation activity, appear to be associated with the environment in which they are immersed. To investigate how environment influences galaxy evolution, astronomers study galaxies in dense regions (i.e., galaxy clusters), where the environmental effects become more intense and evident. However, to study how the environment-galaxy relation is established, we need to study the early stages of cluster formation. This can be done through the study of protoclusters, which are numerically dense environments of galaxies in the early Universe, and which give rise to galaxy clusters today. In these environments we can find galaxies with intense star formation, and often heavily obscured by dust, resulting in great luminosities in the infrared bands. A class of objects that draws our attention due to their extreme star formation capacity is that of the submillimetric galaxies (SMGs). SMGs are very dusty and distant galaxies with their copious infrared emission redshifted to the submillimetric region of the electromagnetic spectrum. Less extreme star-forming galaxies also inhabit protoclusters and can be identified through Hydrogen emission of the Lyman alpha (Lyα) line. These galaxies are referred to as Lyα emitters (LAEs). In this work, we use SMGs as lampposts to identify potential sites for protocluster regions. We undertook deep observations of the environment of SMGs with well-established spectroscopic redshifts in the range of z˜1-5. We made a combination of deep imaging and spectroscopic observations to identify LAEs as a means to asses the more typical star-forming galaxies in these regions. We identified more than 300 LAEs candidates in 4 potential protocluster regions. Of these, ˜ 200 have already been spectroscopically confirmed to be at the SMGs redshifts. This is consistent with them being part of the same structure. By probing the redshift range z ˜ 1-5, which corresponds to a time interval of more than 4 Giga years, we seek insights on the evolution of protoclusters over this time interval. Furthermore, we seek to use the broad wavelength coverage in these regions to gauge galaxy properties as a function of protocluster maturity, in an effort to understand how does the galaxy-environment relation evolves within a growing cluster structure.

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