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Exploring the correlations between galaxy properties and environment in the large-scale structure of the Universe

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Galaxies are gravitationally bound systems composed of stars, gas, dust, and dark matter. Various galaxy properties—such as luminosity, stellar mass, and star formation rate—are significantly correlated with their local environment, such as whether they reside in dense clusters or more isolated regions. Understanding these environmental correlations is crucial for studying galaxy evolution within the large-scale structure of the universe. Traditionally, such studies rely on local density measurements defined at a specific separation scale around galaxies. However, to fully capture the impact of environment, it is essential to examine correlations across a wide range of scales. This approach helps investigate environmental effects that operate at different scales while minimising the impact of an arbitrarily chosen density estimation scale.

In this talk, I will demonstrate how marked correlation functions effectively trace the environmental correlations of various galaxy properties as a function of separation scale. I will present results from our studies on the correlations of luminosities (from optical to mid-IR bands), stellar mass, and star formation rate with local environment. Additionally, I will show how marked correlation functions offer advantages over traditional two-point correlation functions in probing the environmental dependence of galaxy mergers. Our analysis is based on stellar-mass-selected, volume-limited galaxy samples from the Galaxy And Mass Assembly (GAMA) survey. We also compare our measurements from GAMA with those from CosmoDC2, a simulated sky catalogue designed for the Rubin Observatory LSST Dark Energy Survey Collaboration. Finally, I will present our recent results on the environmental correlations of low-surface-brightness galaxies (LSBGs) identified in the Dark Energy Survey and North Ecliptic Pole Wide field.

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