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Abstract for an Invited Paper
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Understanding correlated and disordered materials using quantum cluster theories.[1]

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Numerical analysis has become a powerful tool for studying strongly correlated systems with electron-electron interactions and disorder. Electron localization (driven by electron interactions or disorder) is the key phenomenon featured in many quantum materials. Various complex phases of matter find their roots near such electron localized states. Hence, its understanding and numerical modeling is critical for the further control and application of quantum systems. Quantum cluster theories, such as the dynamical cluster approximation, have emerged as powerful numerical tools for describing the many-body correlation effects near the electron localized states. In this talk, I will show how the cluster extension of the DMFT can be used to successfully describe the electron localization near the Mott and charge order phase transitions in two-dimensional Hubbard model and beyond. I will also present the recent results on the electron localization in disordered systems using the typical medium quantum cluster approach. I will demonstrate how it can be used to describe the Anderson localized states in models and materials.

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