

# Tunable quantum phase transitions in Rydberg-based quantum simulators and beyond

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Arrays of Rydberg atoms have emerged as a remarkably rich playground to study quantum phase transitions in one dimension. One of the biggest puzzles that was brought forward in this context are chiral phase transitions out of density waves. Theoretically predicted chiral transition out of period-four phase is still pending experimental verification mainly due to the extremely short interval over which this transition is realized in a conventional Rydberg array. In my talk I will discuss two routes to overcome this. Firstly, I will show that multicomponent Rydberg arrays with extra experimentally tunable parameters provide a mechanism to manipulate quantum critical properties without breaking translation symmetry explicitly. I will show that relative ratio of the Rabi frequencies of the two components can effectively tune the nature of the multicritical point that in turn affects the extent of the chiral transition.

Furthermore, I will show that the same chiral transition can be realized in the effective model of spin-1 quantum magnets. I will argue that the nature of the transition in this case can be tuned by the population of plaquette states, which eventually destroys the chiral transition and leads to the new type of quantum multicritical point.

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