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Characterizing boson density wave and valence bond orders in a lattice by its dual vortex degree of freedoms YAN CHEN, Fudan University, China, JINWU YE, Mississippi State University — A duality transformation in quantum field theory is usually established first through partition functions. It is always important to explore the dual relations between various correlation functions in the transformation. Here, we explore such a dual relation to study quantum phases and phase transitions in an extended boson Hubbard model at 1/3 (2/3) filling on a triangular lattice. We develop systematically a simple and effective way to use the vortex degree of freedoms on dual lattices to characterize both the density wave and valence bond symmetry breaking patterns of the boson insulating states in the direct lattices. In addition to a checkerboard charge density wave (X-CDW) and a stripe CDW, we find a novel CDW-VBS phase which has both local CDW and local valence bond solid (VBS) orders. Implications on QMC simulations are addressed. The possible experimental realizations of cold atoms loaded on optical lattices are discussed.

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