

TITLE: 'A Generalized Slave-Particle Formalism for Extended Hubbard Models'

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ABSTRACT:

Correlated electron properties, such as Mott transitions, are long-standing areas of interest in condensed matter physics. Canonical models in this field are (extended) Hubbard models containing localized electronic correlation effects. Slave-boson approaches have long been used for approximate solutions of such models. However, recently, there has been a renaissance of low-cost slave-boson approaches for dealing with correlated transition metal oxide systems.

Two specific models have been used in recent years: the slave-rotor method^{1,2,3,4} and the slave-spin approach^{5,6}. We introduce a new, general formalism that, in appropriate limits, reproduces these two methods but also permits the creation of a larger variety of other slave-particle approaches and models. The approach corrects a number of errors of the slave-rotor approach due to its inclusion on "unphysical states" while also permitting to employ less complex and detailed descriptions of the slave modes than the slave-spin approach requires. We describe results for Mott transitions in single- and multi-orbital Hubbard models. We also describe how this method can be used to set up and solve many-body models extracted from Wannier analysis of realistic materials such as oxides of nickel.

References:

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