Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Spin-orbital entanglement or separation? Understanding elementary excitations in a spin-orbital chain KRZYSZTOF WOHLFELD, Stanford University / SLAC, CHENG-CHIEN CHEN, Argonne National Laboratory, MICHEL VAN VEENENDAAL, Argonne National Laboratory / Northern Illinois University, THOMAS P. DEVEREAUX, Stanford University / SLAC — Recent theories have suggested *separation* of elementary spin and orbital excitations in anisotropic spin-orbital chains with evidence coming from a number of experiments on various copper oxides [1]. However, it is well-known that elementary excitations in an idealized spin-orbital chain with isotropic SU(4) symmetric interactions contain *entangled* spin and orbital quantum numbers [2]. Using a combined analytical and numerical approach, we show that a common description of the excitations in these two limits is possible: the spin and orbital spectra can be described in terms of fractionalized 'RVB-like' spinons and antispinons where each excitation carries both spin and orbital quantum numbers, thus showing spin-orbital entanglement. Spin-orbital separation occurs solely in the highly anisotropic limit, and such a description is allowed only due to a particular choice of the spin and orbital basis.

[1] Nature 485, 82 (2012); PRL 107, 147201 (2011); arxiv:1307.6180; arxiv:1310.8346.
[2] PRL 81, 3527 (1998).

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Date submitted: 11 Nov 2013 Electronic form version 1.4