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**Rényi entropy of  $d$ -wave Bose metal phases on multi-leg ladders** JAMES R. GARRISON, RYAN V. MISHMASH, MATTHEW P.A. FISHER, University of California, Santa Barbara — In recent years, much progress has been made toward understanding 2D Bose metal-type phases by accessing them through a series of controlled quasi-1D ladder studies [1]. Crucially, such quasi-1D descendants of these exotic phases are expected to have a number of gapless Luttinger modes,  $c$ , that grows with the width of the ladder. Therefore, characterizing scaling of the entanglement entropy has become an essential tool for establishing the existence of these phases, as it provides a direct measure of  $c$ . With density-matrix renormalization group (DMRG) methods, it is easy to calculate the entanglement entropy but the results converge prohibitively slowly as the ladder becomes wider. Here, we present results where we have calculated, using Variational Monte Carlo (VMC), the Rényi entropy  $S_2$  for Gutzwiller-projected  $d$ -wave Bose metal (DBM) [2] trial wave functions on ladders, following the method employed in [3]. We compare with DMRG results (where they are available), and comment on what our findings mean for the ability of our trial wave functions to faithfully represent the DBM phase.

[1] D. N. Sheng et. al., PRB **78**, 054520 (2008).

[2] O. I. Motrunich and M. P. A. Fisher, PRB **75**, 235116 (2007).

[3] Y. Zhang et. al., PRL **107**, 067202 (2011).

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