Monte Carlo Study of a $U(1) \times U(1)$ Loop Model with Modular Invariance[1] SCOTT GERAEDTS, OLEXEI MOTRUNICH, California Institute of Technology — We study a $U(1) \times U(1)$ system in (2+1)-dimensions with long-range interactions and mutual statistics. The model has the same form after the application of operations from the modular group, a property which we call modular invariance. Using the modular invariance of the model, we propose a possible phase diagram. We obtain a sign-free reformulation of the model and study it in Monte Carlo. This study confirms our proposed phase diagram. We use the modular invariance to analytically determine the current-current correlation functions and conductivities in all the phases in the diagram, as well as at special "fixed" points which are unchanged by an operation from the modular group. We numerically determine the order of the phase transitions, and find segments of second-order transitions. For the statistical interaction parameter $\theta = \pi$, these second-order transitions are evidence of a critical loop phase obtained when both loops are trying to condense simultaneously. We also measure the critical exponents of the second-order transitions.

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Date submitted: 05 Nov 2012   Electronic form version 1.4