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An Experimental Apparatus for Studying Strongly Correlated States of Rydberg Polaritons ALEX GEORGAKOPOULOS, ALBERT RYOU, JIA NINGYUAN, JONATHAN SIMON, University of Chicago — We describe a hybrid apparatus for generation and manipulation of strongly correlated states of Rydberg polaritons. By combining a high-finesse optical resonator with a Rydberg-dressed gas of 87Rb atoms, it will be possible to achieve optical depths per blockade radius of order 10^4, permitting, for the first time, strong, lossless interactions between polaritons. We will discuss accessible physics, including quantum crystallization, topological phases, and high-fidelity quantum information processing. Furthermore, we will present, in detail, technical pitfalls and their resolutions, focusing in particular on electric-field- and vibration- suppression, and a state-of-the art laser system for generating the Rydberg excitations, controlling the cavity, and detecting the resulting manybody states.

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