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Quantum phase transitions, fluctuations, and stripe ordering in many-body cavity QED BENJAMIN LEV, SARANG GOPALAKRISHNAN, PAUL GOLDBART, University of Illinois at Urbana-Champaign — An ultracold bosonic gas of atoms, trapped in an optical cavity, crystallizes at either the even or the odd antinodes of the cavity mode if the atoms are pumped with a laser oriented transverse to the cavity axis. For a single-mode cavity, the transition to a crystalline state has been observed [1] and is well described by mean-field theory [2]. However, in multimode cavities, i.e., ring, confocal, and concentric, fluctuations and geometrical effects change the character of the transition and of the ordered state. If the atoms are confined to a quasi-two-dimensional (pancake-shaped) cloud transverse to the pump laser, the ordering transition is a version of Brazovskii's layering transition; since the threshold persists to zero temperature, it is a quantum phase transition of this unusual universality class. We calculate the pump threshold for the single-mode, ring, and concentric cases, and show how the effects of mode structure along the pump direction lead to the formation of domains even at the level of mean field theory. We discuss these phenomena as well as possibilities for detecting a smectic superfluid phase. [1] A.T. Black et al, Phys. Rev. Lett. 91, 203001 (2003). [2] J.K. Asboth et al, Phys. Rev. A 72, 053417 (2005).

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