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Quantum fluctuations and self-organization of a BEC in a multimode optical cavity SARANG GOPALAKRISHNAN, BENJAMIN LEV, PAUL GOLDBART, University of Illinois at Urbana-Champaign — An ultracold bosonic gas, trapped in an optical cavity, crystallizes at either the even or the odd antinodes of the cavity mode, if the cavity is pumped transversely with a strong laser beam. Spontaneous symmetry breaking between even and odd antinodes is favored because atoms spaced one wavelength apart coherently emit the light absorbed from the laser, populate the cavity with photons, and thus trap themselves in attractive optical potential wells. 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, either confocal or concentric, fluctuations are enhanced and change the character of the transition, resulting in a quantal version of the Brazovskii transition in layering systems. We derive a field-theoretic description of the atom- cavity system near the transition, and describe how fluctuations and defects imprint themselves on the correlations of the light leaking out of the cavity. [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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