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Imaging of diverging correlations close to a quantum phase transition in optical lattices[1] A.B. KUKLOV, Department of Physics, College of Staten Island, CUNY, NY 10314, Q. NIU, Department of Physics, University of Texas, Austin, TX 78712 , I. CARUSOTTO, BEC-CNR-INFM and Dipartimento di Fisica, Universita di Trento, I-38050 Povo, Italy — We suggest real space determination of diverging space-time correlations close to a quantum phase transition from Bose Mott insulator to superfluid in optical lattices. The method relies on interference of either the released cloud or the outcoupled atomic beam with some reference Bose-Einstein condensate. Upon approaching the transition from the Mott phase, the resulting interference pattern represents a set of uncorrelated domains, with a typical size determined by the correlation length ξ as long as it is smaller than a system size L. Repetition of the measurements in a progression of L for $\xi > L$ provides crucial information on the critical behavior in the context of the finite size scaling approach. The Hanbury Brown & Twiss type measurements allow extracting the average spatial correlator, which is insensitive to the expansion time and decaying on distances $\approx \xi$ (for $\xi < L$). The non- destructive scheme employing two outcoupling pulses separated by some time τ can probe both the spatial and time correlations.

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