with the radiation intensity, see Fig. 2d.

An extra modulation of the beam intensities $h\cos(\omega_F t/2+\phi_h)$ leads to factors $\exp(h_{12})$ and $\exp(-h_{12})$ in the switching rates W_{12} and W_{21}, with $h_{12}\propto h/T$ [21]. In calculating these factors one can disregard the weak atom-atom interaction. As a result, $P_1^{\rm st}$ is multiplied by $\exp(N_{\rm tot}h_{12}x)$. This gives $\eta\propto h^{1/3}$ at criticality ($\theta=0$), in agreement with the experiment. If the frequency of the extra modulation is slightly detuned from $\omega_F/2$, the linear response does not diverge at criticality. The result of the mean-field calculation in the Supplementary Material is in excellent agreement with the experiment, as seen from Fig. 3.

An independent estimate of the interaction strength can be obtained from the dependence of the vibration amplitudes of the clouds on the cloud populations. For comparatively weak interaction, the interaction-induced change of the amplitude of an nth cloud should be proportional to the number of atoms in the other cloud N_{3-n} ($n=1,2$). This is indeed seen in Fig. 1c. The main contribution comes from the long-range interaction, the shadow effect [4, 23, 24]. This interaction also gives the main contribution to the parameters α,β and thus determines the critical total number of atoms N_c. The value of N_c obtained in a simple one-dimensional model [16, 21] that assumes sinusoidal vibrations is within a factor of 2 from the experimental data, as are also the slopes of the straight lines in Fig. 1c.

In the experiment, the total number of trapped atoms was slowly fluctuating. The mean-field theory still remains applicable, but needs to be extended, see Supplementary Material. An important consequence is that in the low-symmetry phase, $1\gg\theta\gg N_c^{-1/2}$, the variance σ^2 is modified, $N_c\sigma^2=(2\theta)^{-1}+3(4\theta+\varepsilon)^{-1}$, where $\varepsilon=W_{\rm out}/W^{(0)}\exp(\beta N_c)$, $\varepsilon\ll 1$, with $W_{\rm out}$ being the probability for an atom to leave the trap per unit time. The variance is larger than in the symmetric phase for the same $|\theta|$ by factor 5/4 for $\theta\gg\varepsilon$ and is smaller by factor 2 for smaller θ, i.e., closer to N_c. The scaling $\sigma^2\propto\theta^{-1}$ holds in the both limits. This is the scaling seen in Fig. 2b; we could not come close enough to N_c to observe the crossover; σ^2 in the broken-symmetry phase remained larger than in the symmetric phase.

In conclusion, we demonstrate the occurrence of an ideal mean-field transition far from equilibrium, the spontaneous breaking of the discrete time-translation symmetry in a system of periodically modulated trapped atoms. The mean-field behavior is evidenced by the critical exponents of the order parameter and its variance, as well as the nonlinear resonant response at criticality and the susceptibility as a function of the distance to the critical point. We explain the effect as resulting from the interplay of the interaction and nonequilibrium fluctuations, where the interaction, even though comparatively weak, is strong enough to affect the rates of fluctuation-induced transitions between coexisting vibrational states. The proposed theory is in full agreement with the observations.

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