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Supersolidity and tunable symmetries with ultracold atoms in optical cavities PHILIP ZUPANCIC, JULIAN LEONARD, ANDREA MORALES, TILMAN ESSLINGER, TOBIAS DONNER, ETH Zurich — By coupling a Bose-Einstein condensate to two optical cavities we gain experimental access to new phases of matter. For large detuning of the cavities from the atomic resonance, the combination of self-organisation processes with Z_2 symmetry in each cavity gives rise to one enhanced U(1) symmetry that corresponds to translational invariance of the atoms in one direction. We report on the observation of a phase transition to a supersolid state that breaks this continuous symmetry, and show spectroscopic measurements of the Nambu-Goldstone and Higgs modes present in this phase. The light fields leaking from the cavities enable real-time surveillance of the system dynamics. Approaching the atomic resonance, the continuous invariance is lifted as cavity-cavity coupling comes into play.

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