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## **【511】 A free space selfordered atom-photon crystal**

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Coherent scattering of light from ultracold atoms involves exchange of energy and momentum so that particles can spontaneously form periodic configurations that simultaneously maximize light scattering and minimize the atomic potential energy. Similar to self-ordering with Bose-Einstein condensates (BECs) inside an optical resonator we study periodic pattern formation in free space by off-resonant counterpropagating, noninterfering lasers. As no spatial light modes are preselected the transition from homogeneous to periodic order amounts to a crystallization of light and ultracold atoms breaking a continuous translational symmetry. In the crystallized state the BEC acquires a phase similar to a supersolid with emergent length scale allowing gapped phononic excitations gapped due to infinite-range interactions.

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