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Super-quasicrystal stripe phases in optical superlattices with Raman-assisted tunneling JUNPENG HOU, HAIPING HU, KUEI SUN, CHUANWEI ZHANG, Univ of Texas, Dallas — Quasicrystal is a class of ordered structures defying conventional classification of solid crystals and may carry classically forbidden (e.g. 5-fold) rotational symmetries. In view of long-sought supersolids, a nature question is whether the quasicrystal order can also coexist with superfluidity, forming "super-quasicrystals", which spontaneously break $U(1)$ symmetry due to superfluidity and forms quasicrystalline order that is not possessed by the underlying Hamiltonian. Here we show that a super-quasicrystal stripe state with the minimum 5-fold rotational symmetry can be realized as the ground state of a Bose-Einstein condensate in an optical superlattice with Raman-assisted tunneling. There exists a rich phase diagram consisting of various super-quasicrystal, supersolid, plane-wave phases, and their phase transitions. Our scheme can be generalized for generating other higher-order (e.g., 7-fold) quasicrystal states, and provides a platform for investigating such new exotic quantum matter.

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