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Self-organization of active spinners in liquid metamaterials JEAN-BAPTISTE GORCE, HUA XIA, NICOLAS FRANCOIS, HORST PUNZMANN, MICHAEL SHATS, Australian Natl Univ — The new concept of liquid metamaterials opened new ways of engineering surface flows with adjustable properties at microscales. The liquid-interface metamaterials are generated by the superposition of two orthogonal standing surface waves. Fluid particles exhibit different type of trajectories depending on the phase shift between the two orthogonal waves. Circular orbits can be created when the two orthogonal waves are phase shifted by 90 degrees. The liquid metamaterials are periodic arrays of unit cells, somewhat analogous to optical lattices. The similarity with optics triggered recent investigation into the trapping of surface magnetic spinners within the liquid metamaterials. A single spinner exhibits stable orbits in a unit cell and can be guided by changing the spinning frequency and the spin direction. The spinner's motion arises from the coupling between the spinner angular momentum and the wave angular momentum. Multiple spinners self-organize into stable configurations around the centre of the unit cells. The results offer novel methods of manipulation and confinement of actively moving surface particles at the fluid interfaces using waves and suggest new analogies between surface wave physics and confinement of nano- and micro-particles and atoms by optical fields.

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