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Spatial phase patterns in locally coupled Kuramoto oscillators with repulsive interactions ZAHERA JABEEN, MICHAEL GIVER, DAPENG BI, BULBUL CHAKRABORTY, Martin A. Fisher School of Physics, Brandeis University — Recent experiments in microfluidic arrays of interacting Belousov-Zhabotinsky droplets, which belong to the class of active emulsions, show a rich variety of spatial patterns [J. Phys. Chem. Lett. 1, 1241-1246 (2010)]. The predominant coupling between these droplets is inhibitory. Motivated by this experimental system, we study repulsively coupled Kuramoto oscillators with nearest neighbor interactions on a triangular lattice in two dimensions. We show that the geometry of the lattice constrains the phase difference between two neighboring oscillators to $2\pi/3$. We report the existence of domains with either clockwise or anticlockwise helicity, leading to defects in the lattice. We study the time dependence of these domains and show that at large coupling strengths the domains freeze due to frequency synchronization. A variant of this model, in which amplitude variations are introduced by an additional Ising-like coupling between the oscillators, explores the strong coupling limit phenomenon in the experimental system. We discuss these results in the context of the experiments.

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