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Synchronization of self-propelled units carrying an internal oscillator DEMIAN LEVIS, IGNACIO PAGONABARRAGA, ALBERT DIAZ-GUILERA, Univ de Barcelona — We adress the question of how self-propulsion, and the dynamical patterns emerging from it, affects the synchronization of motile physical entities, like moving cells synchronizing their intracellular genetic oscillators. In order to do that, we introduce a simple model of self-propelled hard disks moving in 2D carrying an internal variable which follows a Kuramoto dynamics. We find that, in the absence of particle-particle interactions, self-propulsion promotes the synchronization of the particles up to a saturation threshold that we identify with the parameters of the model. However, the presence of steric interactions give rise to an optimal self-propulsion for synchronization as a consequence of the clustering of the particles. This new effect shows that the interplay between the oscillators coupling and the topology of the underliying network, arising from particle interactions, plays an important role for the performance of mobile systems. We single out several dynamic regimes controlled by different processes that we describe. We analyse the relaxation of the system and show that synchronization proceeds throught a mechanism that, despite being out-of-equilibrium, verifies the dynamical scaling hypothesis.

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