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Synchronization in systems with linear, yet nonreciprocal interactions — •Christoph Räth, Michael Haslauer, and Ingo Laut — DLR, Institut für Materialphysik im Weltraum, Müncher Str. 20, 82234 Wessling

Synchronization of oscillatory subsystems is a widespread phenomenon in science. It is argued that the presence of nonlinearities is a necessary prerequisite for synchronization. Here, we study synchronization in complex plasmas consisting of microparticles in addition to the plasma. The particles can form 2D crystalline structures. They can melt via mode-coupling instability (MCI), which is a consequence of the effective nonreciprocal interactions. Synchronized particle motion during MCI-melting of 2D plasma crystal was reported in [1]. To disentangle the effects of nonlinearity and nonreciprocity on the emergence of synchronization, we solved numerically the nonlinear and the linearized system. Analyzing the synchronization with a new order parameter [2] reveals that a linearized version of the interaction model exhibits the same synchronization patterns as the full, nonlinear one. Further, theoretical considerations show that nonreciprocal interactions among particles generally provide a mechanism for the selection of dominant wave modes causing the system to show synchronized motion. Thus, we demonstrate numerically and analytically that also linear systems can synchronize and that the nonreciprocity of the interaction is the more decisive property for a n-body system to synchronize [3].

[1] L. Couëdel et al., Phys. Rev. E, 89, 053108 (2014) [2] I. Laut et al., EPL, 110, 65001 (2015) [3] C. Räth et al. (in preparation)

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