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Ratchet Effects, Negative Mobility, and Phase Locking for Skyrmions on Periodic Substrates CHARLES REICHHARDT, DIPANJAN RAY, CYNTHIA OLSON REICHHARDT, Los Alamos National Laboratory — We examine the dynamics of skyrmions interacting with 1D and 2D periodic substrates in the presence of dc and ac drives. We find that the Magnus term strongly affects the skyrmion dynamics and that new kinds of phenomena can occur which are absent for overdamped ac and dc driven particles interacting with similar substrates. We show that it is possible to realize a Magnus induced ratchet for skyrmions interacting with an asymmetric potential, where the application of an ac drive can produce quantized dc motion of the skyrmions even when the ac force is perpendicular to the substrate asymmetry direction. For symmetric substrates it is also possible to achieve a negative mobility effect where the net skyrmion motion runs counter to an applied dc drive. Here, as a function of increasing dc drive, the velocity-force curves show a series of locking phases that have different features from the classic Shapiro steps found in overdamped systems. In the phase locking and ratcheting states, the skyrmions undergo intricate 2D orbits induced by the Magnus term.

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