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Clustering of cold polar molecules in arrays of one-dimensional tubes MICHAEL KNAP, Graz University of Technology, EREZ BERG, EUGENE DEMLER, Harvard University — Cold polar molecules allow to study exciting new phenomena which arise from the long-range and anisotropic nature of their mutual interactions. Here, we demonstrate that a Wigner crystal of polar molecules confined in planar arrays of one-dimensional tubes can be made unstable with respect to the formation of clusters of particles. By controlling the orientation of the external electric field which aligns the dipolar moments, increasingly complex structures with a varying number of particles per cluster and thus varying periodicity are formed. The spatial agglomeration of multiple polar molecules results from the interaction and can be described classically. However, we show that the effect survives when quantum fluctuations are present. For systems of a finite number of tubes, the result is a sequence of "clustered" Luttinger liquid states. Finally, we determine the ratio between the interaction and the kinetic energy which is necessary for the spatial agglomeration of polar molecules. We find that the requirements for clustering are reachable in current experiments with cold polar molecules.

Michael Knap
Graz University of Technology

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