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Transport dynamics and dissipation in polariton ring condensates and cold atoms

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Recent progress in experiments has opened new contexts in which to observe and explore out-of-equilibrium quantum transport dynamics. On the side of cold atoms, significant advances are made possibile by the ability to control and measure atomic dynamics time-dependently, as well as to explore the effects of strong interactions. This is especially true in recent experiments with quantum gas microscopes, which now provide single-site and single atom measurement and control. At the same time, new methods for control and longer coherence times have been realised in condensates of exciton polaritons. This has enabled the development of ring geometries for these systems, and corresponding quantised circulation. I will discuss our recent theoretical work looking at the interplay between coherent dynamics and dissipation in these systems. For polaritons in a ring trap, half-quantum vortices are allowed in which there is a phase rotation of π and a corresponding polarisation vector rotation of π around the ring. The observed half-quantum state in current experiments is novel, in that the handedness of the spin flips from one side of the ring to the other side in addition to the rotation of the linear polarization component. This type of state is not possible for vortices in a simply connected geometry, and we investigate how the interplay between the polariton production and dissipation can give rise to this state in a ring trap. I will also discuss the transport dynamics of cold atoms in tilted optical lattices, in the presence of decoherence from sources including spontaneous emissions.