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Dissipative Spin Systems Far From Equilibrium

Cold atomic gases are a versatile platform for the study of quantum many-body phenomena. Especially atoms excited to highly-lying electronic states --- so-called Rydberg atoms --- offer rather intriguing possibilities for the exploration of strongly correlated dynamics of interacting spin systems.

I will present recent results which schow that the out-of-equilibrium behaviour of Rydberg gases is governed by emergent kinetic constraints. Such constraints are often used to mimic dynamical arrest or excluded volume effects in idealised models of glass forming substances and lead to a remarkably rich physics including non-equilibrium phase transitions and localisation phenomena. Moreover, Rydberg gases offer intriguing opportunities for the systematic exploration of the role of competing quantum and classical dynamical effects on non-equilibrium phase transitions.

I will conclude by discussing how the above findings can be employed to gain a new perspective on the physics of Dynamic Nuclear Polarisation in interacting electronic and nuclear ensembles, which is an out-of-equilibrium method to drastically enhance the performance of Magnetic Resonance Imaging applications.