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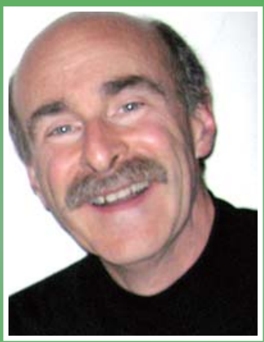
Possible manifestations of quantum disordered dynamics in the arrested relaxation of a molecular ultracold plasma



Prof. Edward Grant

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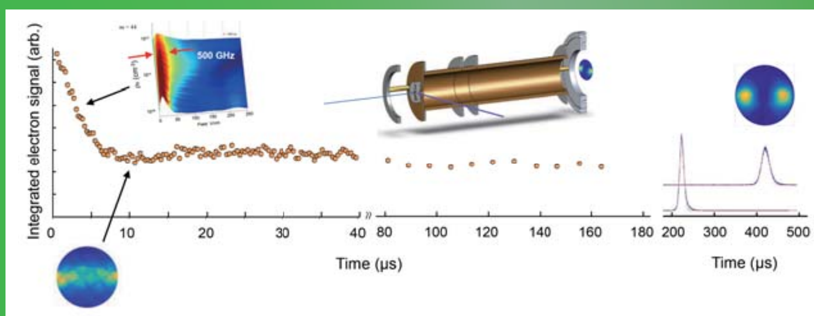
Date & Time: 6 Jul. 2018 (Fri.) 16:00-
Place: IMS Research Building Room 201

Spontaneous avalanche to plasma splits the core of an ellipsoidal Rydberg gas of nitric oxide. Ambipolar expansion first quenches the electron temperature of this core plasma. Then, long-range, resonant charge transfer from ballistic ions to frozen Rydberg molecules in the wings of the ellipsoid quenches the centre-of-mass ion/Rydberg molecule velocity distribution. This sequence of steps gives rise to a remarkable mechanics of self-assembly, in which the kinetic energy of initially formed hot electrons and ions drives an observed separation of plasma volumes. These dynamics redistribute ion momentum, efficiently channeling electron energy into a reservoir of mass-transport. This starts a process that evidently anneals separating volumes to a state of cold, correlated ions, electrons and Rydberg molecules. Shorttime electron spectroscopy provides experimental evidence for complete ionization.

The long lifetime of this system, particularly its stability with respect to recombination and neutral dissociation, suggests that this transformation affords a robust state of arrested relaxation, far from thermal equilibrium. We argue that this state of the quenched ultracold plasma offers an experimental platform for studying quantum many-body physics of disordered systems in the long-time and finite energy-density limits. The qualitative features of the arrested state fail to conform with classical models. We propose a microscopic quantum description for the arrested phase based on an effective many-body spin Hamiltonian that includes both dipole-dipole and van der Waals interactions. This effective model offers a way to envision the quantum disordered non-equilibrium physics of this system.



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