

Prof. **John Goold** from TCD will present the latest research from his group on the topic of **Taking the temperature of a pure quantum state**.

**Abstract:** Temperature is a deceptively simple concept that still raises deep questions at the forefront of quantum physics research. The observation of thermalisation in completely isolated quantum systems, such as cold-atom quantum simulators, implies that a temperature can be assigned even to individual, pure quantum states. Here, we propose a scheme to measure the temperature of a pure state through quantum interference. Our proposal involves Ramsey interferometry of an auxiliary qubit probe, which is prepared in a superposition state and subsequently undergoes decoherence due to weak coupling with an isolated many-body system. Using only a few basic assumptions about chaotic quantum systems -- namely, the eigenstate thermalisation hypothesis and the equations of diffusive hydrodynamics -- we show that the qubit undergoes pure exponential decoherence at a rate that depends on the temperature of its surroundings. We verify our predictions by numerical experiments on a quantum spin chain that thermalises after absorbing energy from a periodic drive. Our work provides a general method to measure the temperature of isolated, strongly interacting systems under minimal assumptions.

Reference: <https://arxiv.org/abs/2103.16601>

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