Robust Quantum Control & Adiabatic Sensing

In this talk, I will discuss two distinct topics: robust quantum control and adiabatic quantum sensing.

Firstly I will describe a new method known as universally robust quantum control [1]. I will show that the fidelity susceptibility, which quantifies the perturbative error to leading order, can be expressed in superoperator form and use this to derive control pulses which are robust to any class of systematic unknown errors. The proposed optimal control protocol is equivalent to searching for a sequence of unitaries that mimics the first-order moments of the Haar distribution, i.e. it constitutes a 1-design.

Secondly, I will describe how one can calculate the quantum fisher information (which determines the precision of a quantum sensor) for an adiabatically driven perturbation [2]. I will show how this expression can be related to linear-response transport coefficients. This allows for efficient numerical computation of the maximum precision achievable for applied voltages and magnetic fields in a quantum dot nano electronic device.

[1] P. Poggi, G. De Chiara, S. Campbell, **A. Kiely** *Physical Review Letters* **132** 193801 (2024)

[2] G. Mihailescu, **A. Kiely**, and A. K. Mitchelll *In Prep.*