**Adaptive learning for enhanced quantum sensing**

**Cristian Bonato**

Heriot-Watt University / Institute of Photonics and Quantum Sciences

In the past decade, remarkable progress has been achieved in nanoscale quantum sensing using individual spins. A single spin is the smallest possible magnetometer: due to the localized nature of magnetic interaction, a single electronic spin can precisely estimate magnetic fields with a spatial resolution on the few nanometres level. Such sensors have been used in many practical applications, for example to measure the magnetic spectrum of a single molecule, mapping the nanoscale stray magnetic field of a hard drive’s write head, as well as studies on spin textures in condensed matter physics.

A major bottleneck for this quantum technology is, however, signal acquisition time. High frequency resolution requires longer and longer pulse sequences, which push acquisition times to the order of hours or days. This highlights the importance of optimised signal processing to make sure all information available from the measurements is included in the most efficient way. Bayesian techniques are particularly interesting, in this respect, since they are compatible with adaptive experiment design: preliminary information from the measurement sequence will be used adaptively to optimise settings for later measurements. I will discuss several examples of sequential adaptive experiment design applied to quantum sensing, highlighting the advantages in terms of sensitivity and bandwidth.