Filippo Caruso

Noise-robust quantum sensing via optimal multi-probe spectroscopy

The dynamics of quantum systems are unavoidably influenced by their environment, but in turn observing a quantum system (probe) can allow one to measure its environment: Measurements and controlled manipulation of the probe such as dynamical decoupling sequences as an extension of the Ramsey interference measurement allow to spectrally resolve a noise field coupled to the probe. Here, we introduce fast and robust estimation strategies for the characterization of the spectral properties of classical and quantum dephasing environments. These strategies are based on filter function orthogonalization, optimal control filters maximizing the relevant Fisher Information and multi-qubit entanglement. We investigate and quantify the robustness of the schemes under different types of noise such as finite-precision measurements, dephasing of the probe, spectral leakage and slow temporal fluctuations of the spectrum.