Modelling phonon effects in resonance fluorescence of quantum dot emitters

Mateusz Salamon*[1], Jake Iles-Smith[2], and Ahsan Nazir[1]

[1]The University of Manchester – United Kingdom
[2]University of Sheffield – United Kingdom

Abstract

The emission spectrum of semiconductor quantum dots (QDs) is affected by the phonon environment, in particular through the appearance of the phonon sideband (PSB). However, the standard quantum-optical method of calculating the emission spectrum using the quantum regression theorem fails to correctly capture the PSB unless the polaron master equation is employed.

In this work I present a new method of modelling the PSB relying on the recently developed 'sensor theory'. The method introduces an additional 'sensor' to the description of the system. This allows for a simple calculation of correlation functions of the frequency-filtered emitted light. However, previous studies utilising the senor theory have not considered the influence of the phonon environment.

I will demonstrate an extension of the sensor theory and show that it successfully captures the PSB even when using a simplistic weak-coupling master equation for the phonon environment. Extensions to higher-order frequency-filtered correlations will also be discussed.

*Speaker