

Cathodoluminescence Light Excitation spectroscopy

Promotors: STEM Group at the LPS, Orsay, France and Attolight, Lausanne, Switzerland

Location: LPS, Orsay, France

Duration: 2 years

Opening: Now

The STEM group is active in the development of new electron spectroscopy techniques in electron microscopes. In particular, it explores the use of electron spectroscopy for nanooptics.

Attolight is a Swiss company developing quantitative cathodoluminescence.

Recently, research in electron-based spectroscopy has focused on the optical properties of materials for nanooptics and quantum nanooptics. Understanding such materials require the development of novel instrumentation, which allies the power of optical and quantum optical tools with the unbeaten spatial resolution of electrons. As an example, the LPS has demonstrated the possibility of detecting single photon sources using electron excitation through cathodoluminescence (CL). This was achieved for individual Nitrogen-Vacancy centers in diamond and a defect at 4.1 eV in h-BN.

Despite being a benefit in many aspects, the broadband excitation spectrum associated with the electrons leads to an important question concerning CL: what is the precise excitation pathway that leads to light emission after electron excitation? And where do the differences observed between photoluminescence and CL of the same objects arise? In purely optical techniques, excitation mechanisms can be unveiled by performing photoluminescence excitation spectroscopy (PLE). Here, we would like to take inspiration from these experiments to dig deeper into the light emission process of materials under fast electron irradiation.

In this project, supported by the European project ESTEEM3, we will develop a totally new type of experiments to measure temporal correlations between specific electron energy loss events and photon emission in fixed energy ranges. This development will be attached to an ultra-high spectral resolution scanning electron microscope fitted with a CL detection system. The observed correlations will help us understand the energy transfer pathways that lead to CL emission. Initially experiments will be performed in different semiconductors and wide-bandgap materials, such as III-N layers and diamonds.

The project involves mostly instrumentation development.

Expected profile:

*Knowledge in one or more of these fields: 1) Electron microscopy and spectroscopy, with emphasis on Electron Energy Loss Spectroscopy and CL; 2) time-correlation experiments; 3) Time-resolved spectroscopy

*Instrumentation or willingness to learn it;

*Python programming;

