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Toward Ultrafast Scintillators with Fluorescent Colloidal Nanocrystals

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Colloidal nanocrystals combine the flexibility of solution-processed materials with the enhanced stability of inorganic semiconductors. They are typically composed of heavy-metal chalcogenides and have a high fluorescence quantum efficiency, which makes them suitable for the detection of high-energy photons and subsequent conversion into visible radiation.

In this presentation, I will discuss the opportunities and challenges when using colloidal nanocrystals for scintillation with a targeted resolution of 10 picoseconds. By controlling the shape, and embedding the emitting core in a second, protective semiconductor shell, we can tune the emission rate and efficiency, and reach nanosecond fluorescence decay times. In addition, the nanocrystal core/shell architecture allows for minimizing nonradiative Auger recombination, so that we can also exploit nonlinear emission processes, which yield a sub-nanosecond fluorescence decay time. However, to obtain a high overall light outcoupling, we also need to focus our attention on the elimination of reabsorption losses of the emitted light. This is, for instance, mediated again by the proper design of the nanocrystal heterostructure.

Primary authors: Ms MYSLOVSKA, Alina (Ghent University); Prof. MOREELS, Iwan (Ghent University)

Presenters: Ms MYSLOVSKA, Alina (Ghent University); Prof. MOREELS, Iwan (Ghent University)

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