PHYSICAL CHEMISTRY SEMINAR

Excitons and Excitation Energy Transport in Supramolecular Assemblies

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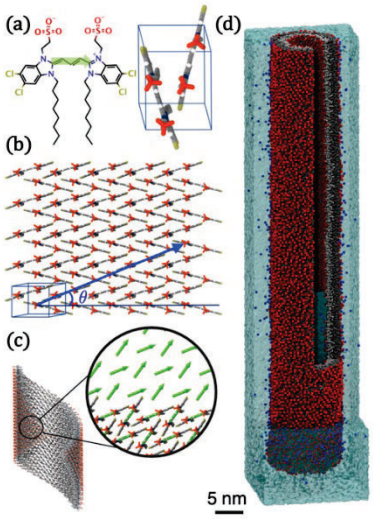
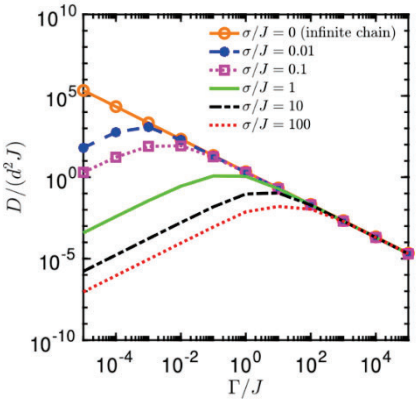
Abstract: Supramolecular assemblies are self-organized structures of tens to many thousands of synthetic molecules or biomolecules. In Nature supramolecular assemblies occur as photosynthetic light-harvesting systems, while synthetic analogues have been designed for their intriguing (nonlinear) optical properties, including tunable spectral properties, superradiance, and ultrafast energy transport. These various properties result from Frenkel excitons, collective optical excitations that arise in assemblies of strongly coupled molecules. The properties of these excitons result from the complex interplay between intermolecular coupling, static and dynamic disorder, and coupling to vibrations.

In this seminar, I will introduce excitons and their basic optical properties, illustrated by examples from various experiments on dye aggregates. Next, I will address exciton transport. Here, I will present results from a systematic study of the complex interplay between static and dynamic disorder on the exciton diffusion constant, revealing scaling relations that can be understood from simple physical arguments. I will also report on the theory of exciton transport between large molecular assemblies, in particular, on a new implementation of the multichromophore Förster Resonance Energy Transfer (MC-FRET) method and its application to natural light-harvesting systems.





Left: Tubular molecular aggregate of cyanine dye aggregates generated in an MD simulation [Chem. Sci. 2020, 11, 11514].
Right: Exciton diffusion constant in a linear chain as function of dephasing rate for various static disorder strengths, demonstrating the existence of an optimal dephasing rate [J. Chem. Phys. 2021, 155, 134305].

Wednesday, March 12th, 2025 **10:30am** **BRWN 4102**

PURDUE UNIVERSITY | James Tarpo Jr. and Margaret Tarpo Department of Chemistry

Knoester Bio

Jasper Knoester received his PhD in 1987 in Theoretical Physics, University of Utrecht, The Netherlands. From 1987-1989 he was postdoc at the University of Rochester, NY, USA. In 1989 he received a Huygens Fellowship from the Netherlands Organization for Scientific Research (NWO) and started his own line of research at the University of Groningen, The Netherlands. In 1993 he was appointed as full professor of Theory of Condensed Matter Physics at this university. In the year 2001-2002 Knoester was visiting professor at the Chemistry Department of MIT. From 2003-2009 he was Director of the Zernike Institute for Advanced Materials (University of Groningen). In the period 2010-2021, Knoester was Dean of the Faculty of Science and Engineering at the University of Groningen and Pro-Rector at that university. He moved to Leiden University in 2022, to occupy the office of Dean of Science, maintaining an affiliation as professor at Groningen as well. In the same year he was knighted in the Order of the Dutch Lion for his contributions to science, academic governance, and the organization of the natural sciences in The Netherlands.

The research interests of Jasper Knoester concern optical properties of natural and synthetic materials, a.o. photosynthetic systems, nanomolecular aggregates, polypeptides and proteins, and nanophotonic devices. He has (co)authored over 200 peer reviewed publications and presented invited talks at over 125 international conferences and workshops.

Knoester is chair/member of numerous national and international boards and committees, amongst which the Assembly of Deans of Science of The Netherlands, Board Dutch Physical Society, Board Foundation Physica, Board of Governors Dutch Research School for Astronomy (NOVA), Institute Advisory Board of Space Research Netherlands (SRON), Supervisory Board NL Space Campus, International Board ICL conference, and International Board EXCON conference.