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Séminaire AXE 1 - Sciences et Matériaux Quantiques

Mardi 07 Octobre 2025 | 11:00 | Auditorium de l'IPCMS

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Resonance energy transfer in molecular aggregates

We investigate theoretically how energy dissipates and migrates from one place to another in complex and bi-dimensional molecular aggregates. In this context, a key role is played by resonance electronic energy transfer (RET) processes [1] through which an excitation initially stored onto a donor molecule (D) can be transferred to an acceptor molecule (A). Despite its long history, the mechanism of RET is still not completely understood and is the object of intense research activities and debates [2].

In this presentation, we address the question of how to describe **collective and non-equilibrium effects** in RET processes after all the donor molecules have been excited by a pump laser. We predict that, due to the dimensionality of the network, the effective rate of RET scales as $\langle R \rangle^{\alpha}$, with $\langle R \rangle$ the average distance between individual excited donors and their nearest-neighbor acceptor molecules, and $\alpha \in [-6, -2]$ an exponent depending on the spatial distribution of molecular pairs in the 2D sample [3]. We show departures from this mean-field description arising from **fluctuations and spatial correlations** between several molecules involved in the RET process. We expect this prediction to be relevant for both molecular science and biology, where the control and optimization of the RET dynamics is a key issue.

References

[1] T. Förster. "Transfer mechanisms of electronic excitation energy" (1960).
[2] S. Jang, M. D. Newton, and R. J. Silbey. Phys. Rev. Lett. **92**, 218301 (2004).
[3] R. Avriller, A. Marché, and G. Jonusauskas, Phys. Rev. B **108**, 205419 (2023).

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