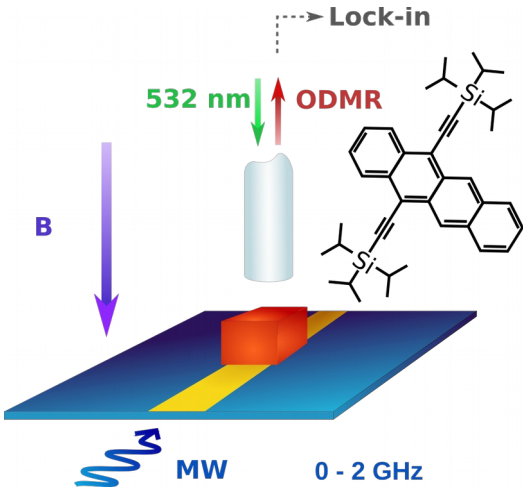
SPIN PROPERTIES OF BI-EXCITON STATE FORMED THROUGH SINGLET FISSION

A.D. Chepelianskii[1], K. Yunusova[1], S. Bayliss[1], and L. Weiss[2]
[1,] *Laboratoire de physique des solides, Universite Paris Sud, France*
[2] Optoelectronics Group, *Cavendish Laboratory, Cambridge University, UK*

ABSTRACT

From organic electronics to biological systems, understanding the role of intermolecular interactions between spin pairs is a key challenge. Here we show how such pairs can be selectively addressed with combined spin and optical sensitivity. We demonstrate this for bound pairs of spin-triplet excitations formed by singlet fission, with direct applicability across a wide range of synthetic and biological systems. We show that the site-sensitivity of exchange coupling allows distinct triplet pairs to be resonantly addressed at different magnetic fields, tuning them between optically bright singlet (S=0) and dark triplet, quintet (S=1,2) configurations: this induces narrow holes in a broad optical emission spectrum, uncovering exchange-specific luminescence. Using fields up to 60 T, we identify three distinct triplet-pair sites, with exchange couplings varying over an order of magnitude (0.3-5 meV), each with its own luminescence spectrum, coexisting in a single material. Our results reveal how site-selectivity can be achieved for organic spin pairs in a broad range of systems. We then show how broadband optically detected magnetic resonance can allow to find the microscopic positions of the triplet exciton that for a strongly bound quintet state within the crystal structure of TIPS-Tetracene.



REFERENCES

[1] Sam L Bayliss, Leah R Weiss, Anatol Mitioglu, Krzysztof Galkowski, Zhuo Yang, Kamila Yunusova, Alessandro Surrente, Karl J Thorley, Jan Behrends, Robert Bittl, John E Anthony, Akshay Rao, Richard H Friend, Paulina Plochocka, PCM Christianen, Neil C Greenham, Alexei D Chepelianskii, Site-selective measurement of coupled spin pairs in an organic semiconductor, PNAS **115**, 5077 (2018)

[2] Sam L. Bayliss, Alexei D. Chepelianskii, Alessandro Sepe, Brian J. Walker, Bruno Ehrler, Matthew J. Bruzek, John E. Anthony, and Neil C. Greenham, Phys. Rev. Lett. **112**, 238701 (2014)