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Triplet states of organic emitter molecules: problem for electroluminescence, opportunity for photonics

Organic light-emitting diodes (OLEDs) have come a long way since they have been introduced in 1987. What has been realized very early on is the fact that excitonic triplet states strongly limit the electroluminescence efficiency, calling for strategies to harvest such spin-1 configurations radiatively. Here, both phosphorescence from organometallic complexes and thermally-activated delayed fluorescence (TADF) from organic donor-acceptor molecules are widely studied molecular concepts. For OLEDs, the corresponding excited state lifetime should be as short as possible to comply with the switching time and intensity requirements of displays and similar applications. Stepping away from electroluminescence, the long excited-state lifetime of triplet states, which can be as long as few seconds, offers an additional dimension for functional photonic systems. Here, fluorescence and phosphorescence easily span 7 to 8 orders of magnitude in lifetime.
In this presentation, I will discuss some recent OLED results that make use of high efficiency emitter concepts at the beginning and then turn to some photonic applications that specifically make use of long-lived triplet excited states.