Long range charge diffusion length

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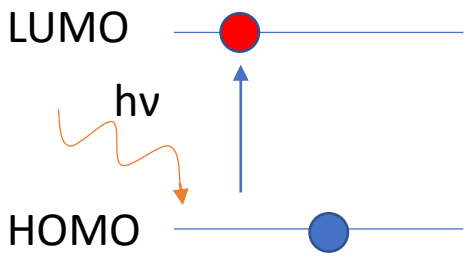
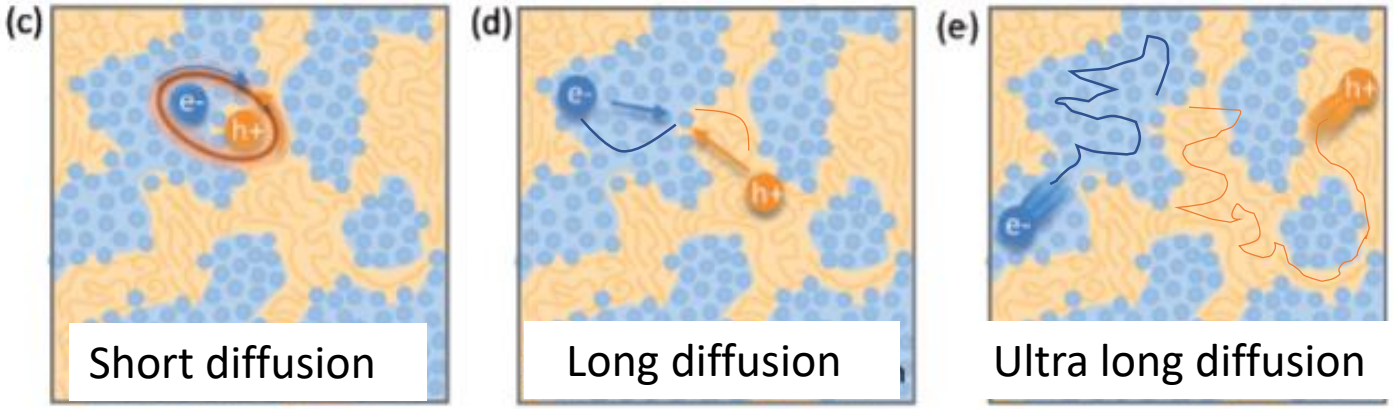
Charge diffusion after photoexcitation

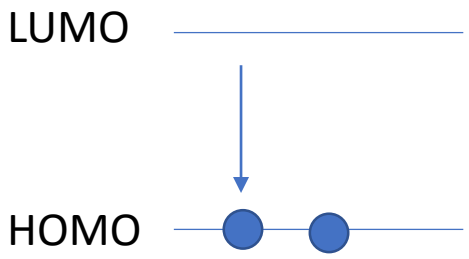
Step 1: Photoexcitation



Step 2: Charge diffusion



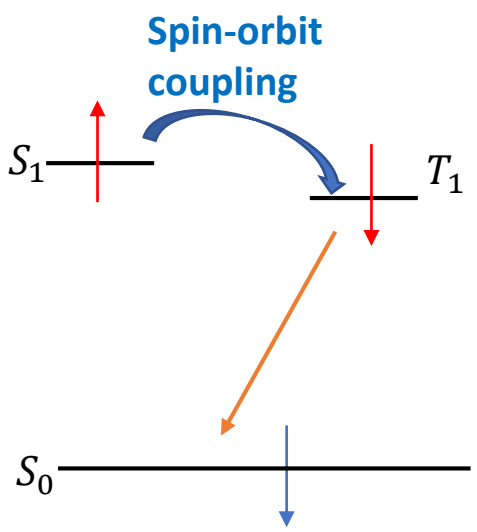
Step 3: Recombination



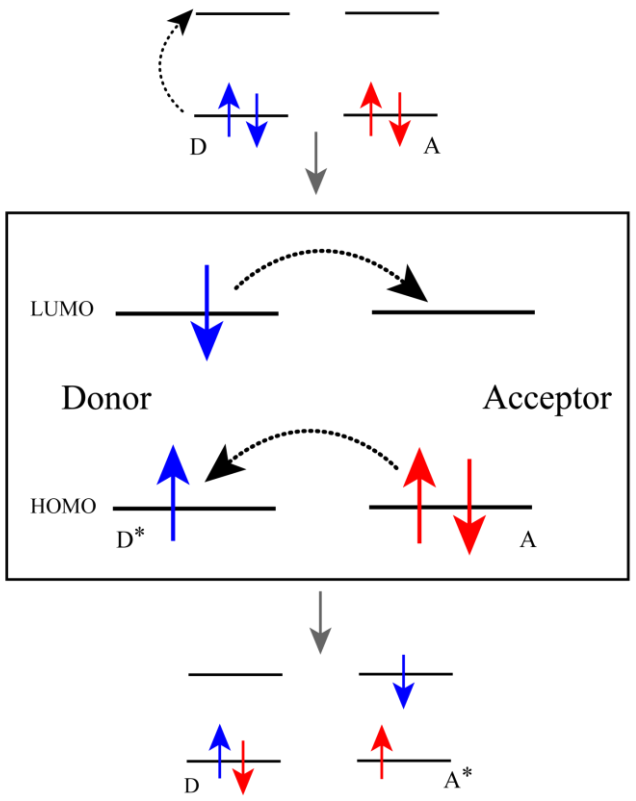
Long range diffusion due to small recombination rate

Method 1: singlet -> triplet

Single molecule transition

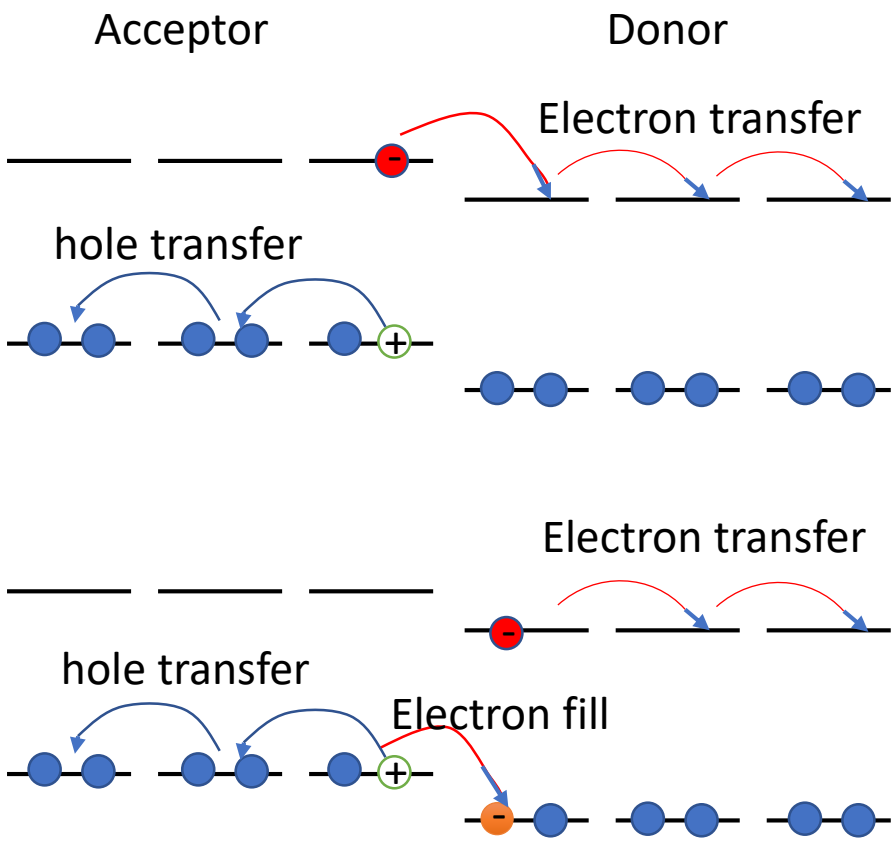


Double molecules transition



Long diffusion ~100nm to um

Method 2: charge separation

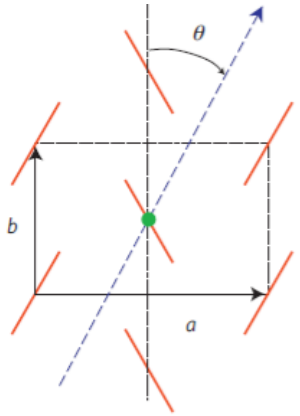


Ultra long diffusion ~um to cm

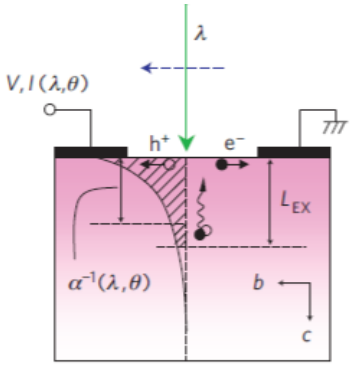
Triplet excitons diffusion

H. Najahov, etc., *Nature Materials*, **9**, 938–943 (2010)

Rubrene structure



device



Bulk conductivity, relatively small

Quantum efficiency of exciton dissociation

Quantum efficiency of exciton generation

Absorption coefficient

$$\sigma(\theta,\lambda) = \sigma_0 + \sigma_{surf} = \sigma_0 + \gamma_0 \chi_0 \Phi_0 \alpha$$

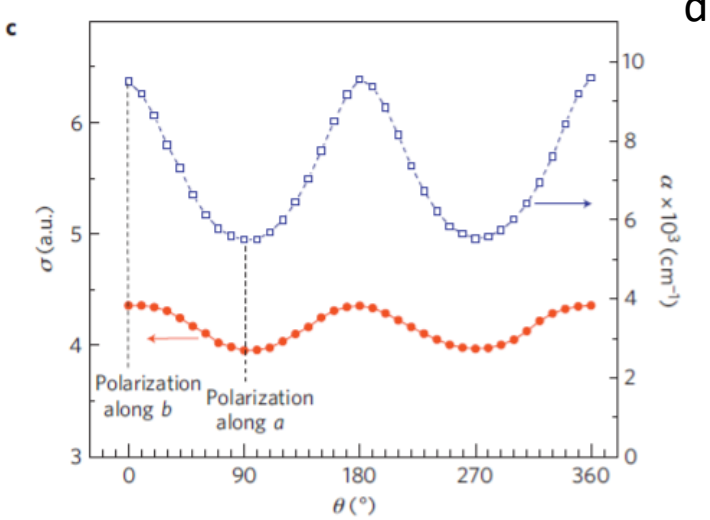
photon flux

Light intensity decay in media

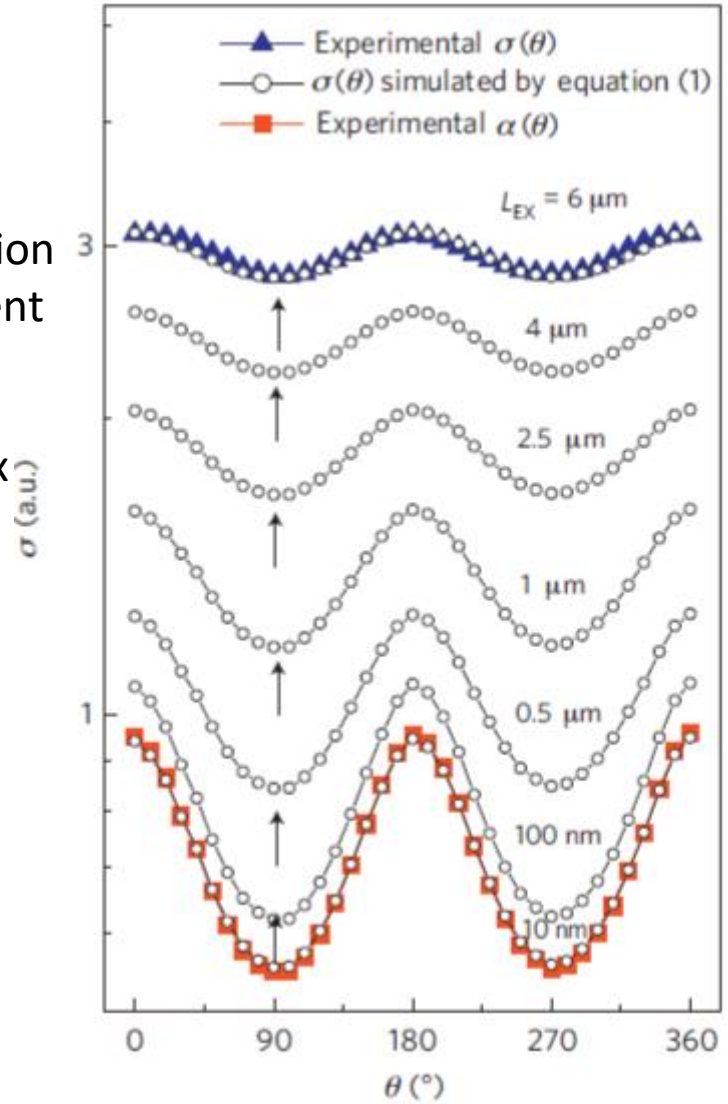
$$\times \int_0^\infty \exp(-\alpha \cdot x)$$

$$\cdot \exp(-x/L_{EX}) \cdot dx \approx \gamma_0 \chi_0 \Phi_0 \cdot \frac{\alpha L_{EX}}{\alpha L_{EX} + 1}$$

Excitons diffusion

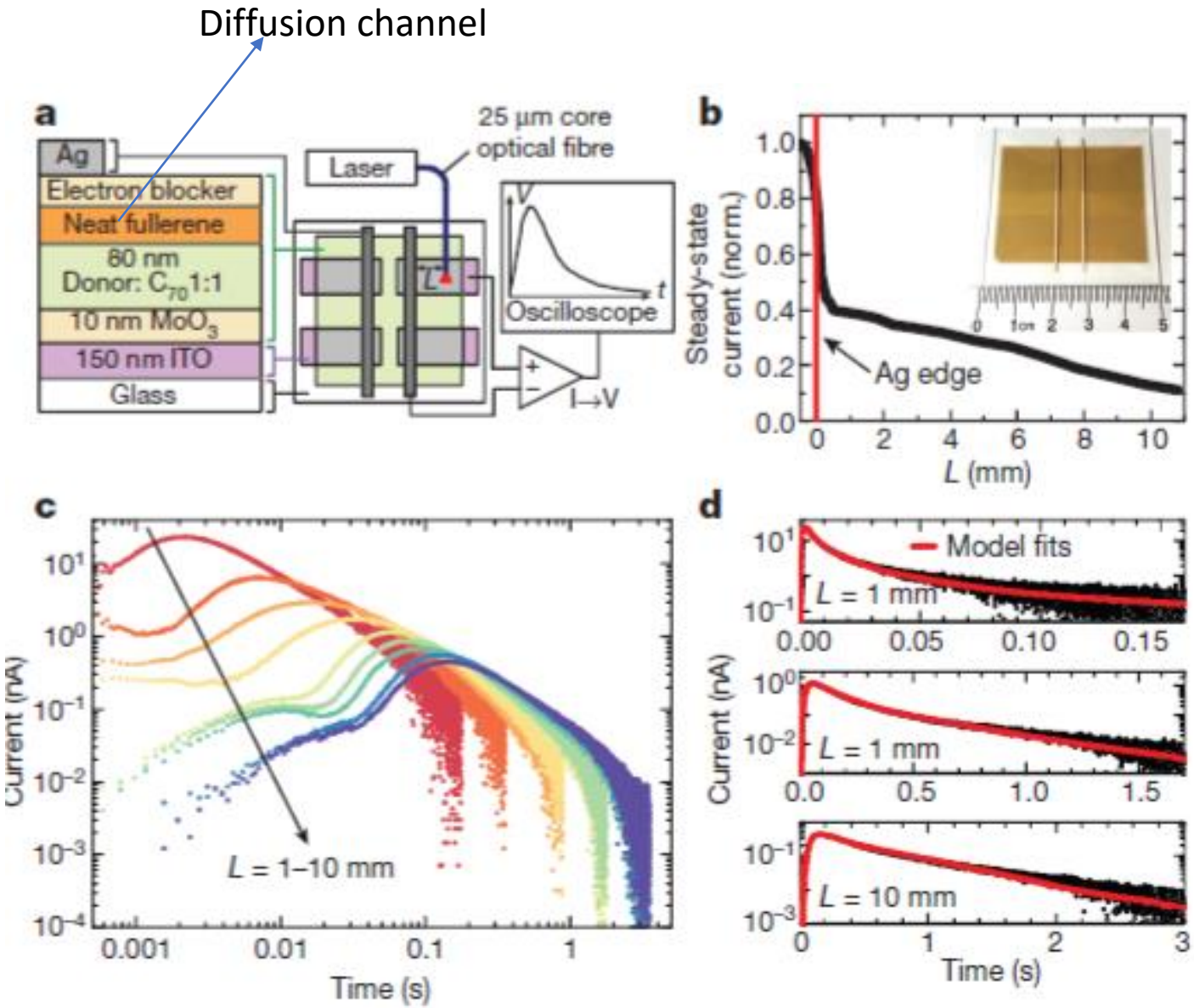


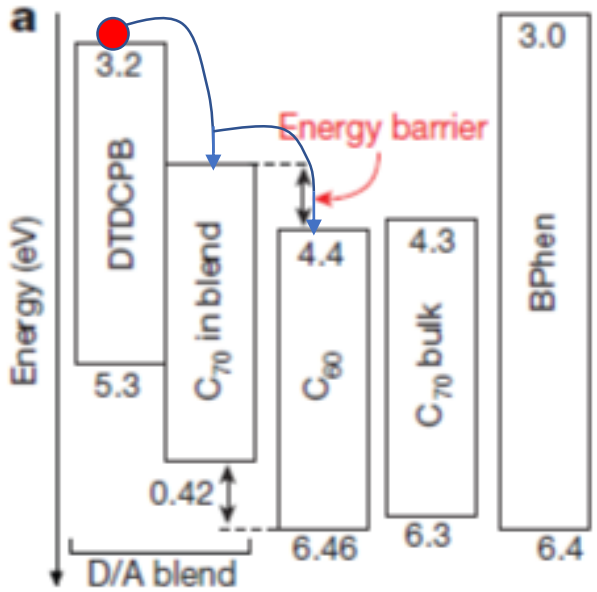
Polarization dependent photocuductivity and absorption coefficient



Charge separation

Q. Burlingame, etc., *Nature*, **554**, 77–80 (2018)





Diffusion equ

$$\dot{N}(x,y,t) = D\nabla^2 N(x,y,t) - kN(x,y,t) + G(x,y,t)$$

Generation rate

$$G(x,y,t) = \frac{Q}{qt_{pulse}} \frac{1}{2\pi\sigma^2} \exp\left(\frac{(x-x0)^2+(y-y0)^2}{2\sigma^2}\right)$$

Photocurrent

$$I(t) = q\int D \frac{\mathrm{d}N(x,y,t)}{\mathrm{d}x}\bigg|_{x\to 0} \mathrm{d}y$$