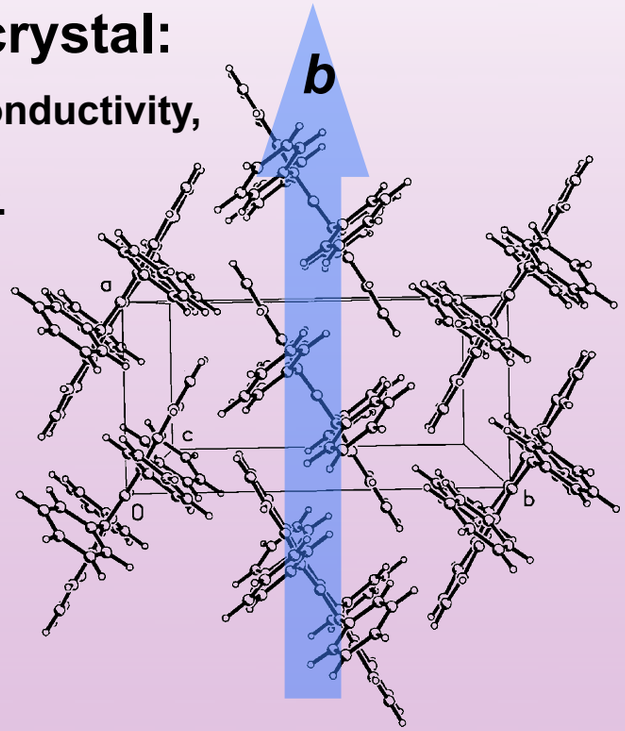
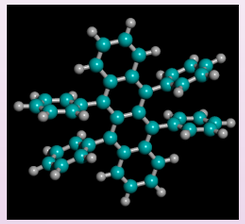
Photoexcitation and Free-Carrier Transport Phenomena for Organic Optoelectronics and Photovoltaics

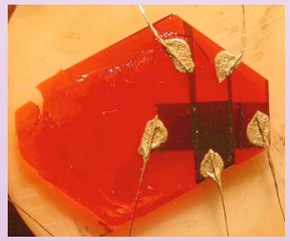
I. Biaggio, Department of Physics, Lehigh University

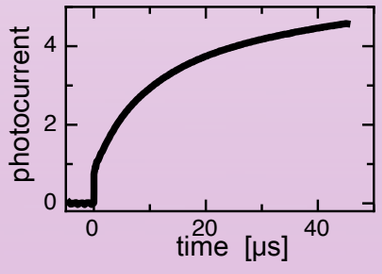
Rubrene crystal:

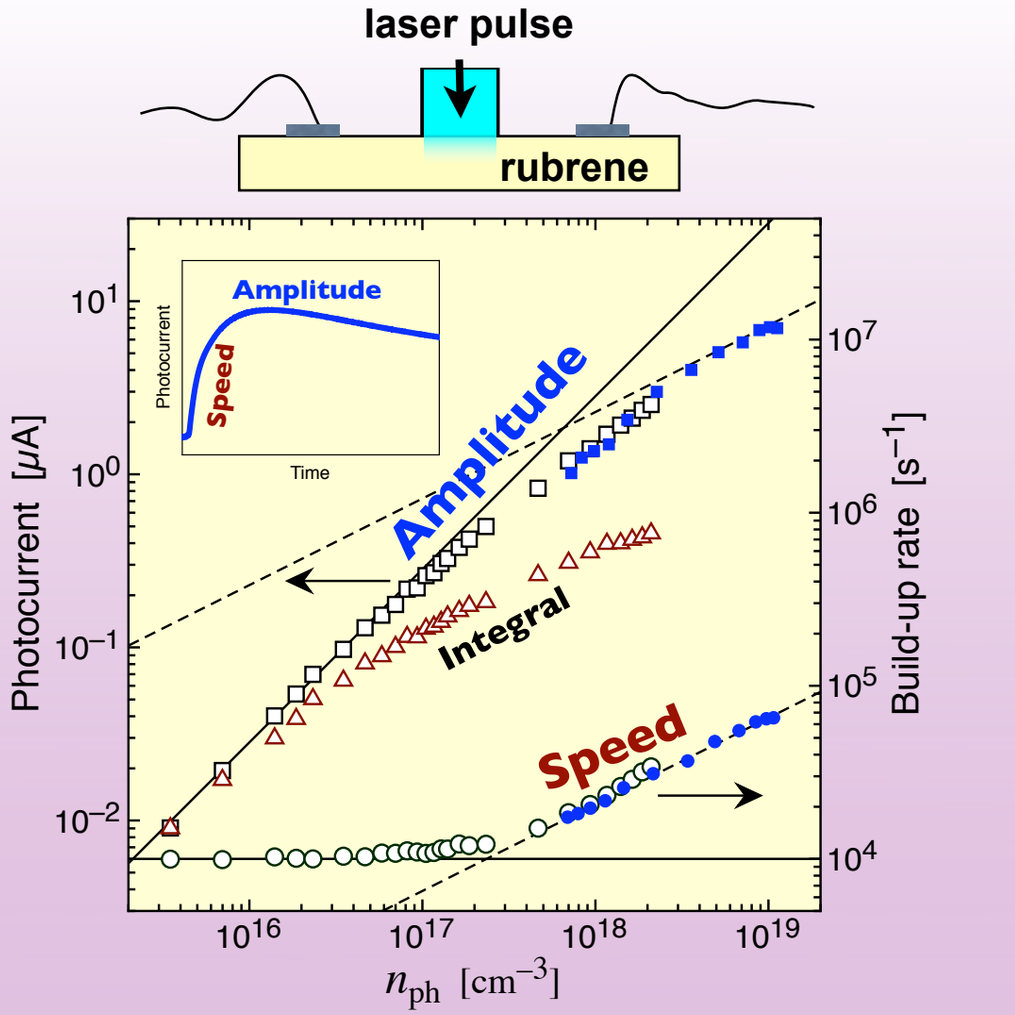
large photoconductivity,
high quality,
large mobility.





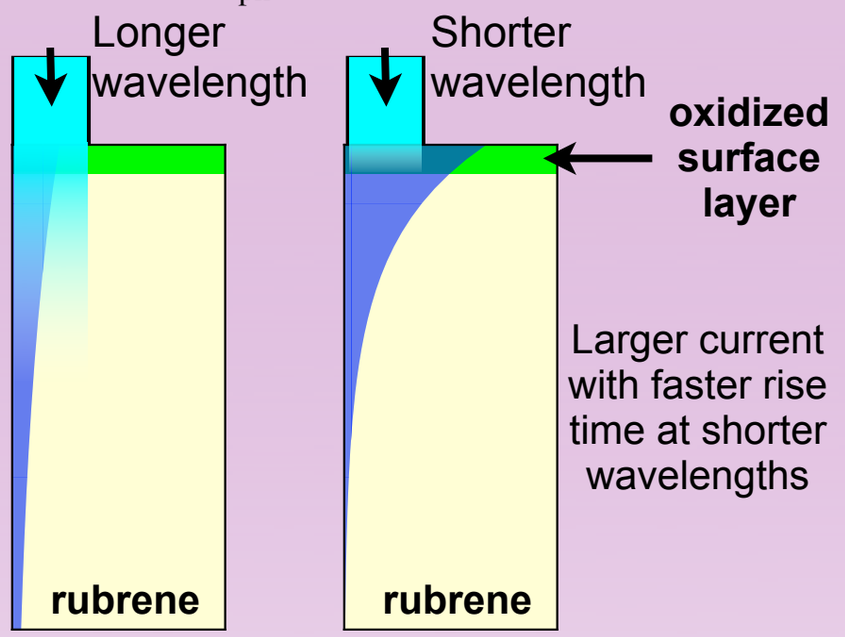






Studying the fundamental limits of organic photovoltaics: Exciton dissociation in organic single crystals.

- Photoexcitation results in singlet excitons that then transform into long lived triplet excitons.
- In rubrene one observes a small photocurrent arising during the nanosecond lifetime of the singlets and a **large delayed photocurrent** that appears ~100 microseconds later.
- The largest portion of photoexcited excitons are stabilized at defect centers close to the surface that then lead to the delayed photocurrent via thermal excitation.
- This exciton ionization process has a **quantum efficiency close to one**.
- The small, fast photocurrent has a different origin, probably related to bulk defects that lead dissociation of singlet excitons.



H. Najafov, B. Lyu, I. Biaggio, V. Podzorov, Appl. Phys. Lett. 96, 183302 (2010).

H. Najafov, B. Lyu, I. Biaggio, V. Podzorov, PRB 77, 125202 (2008)

H. Najafov, I. Biaggio, V. Podzorov, M. F. Calhoun, M. E. Gershenson, Phys. Rev. Lett. 96, 0566004 (2006).