Prof. Ferenc Simon
Vice-Dean

Budapest University of Technology and Economics
Faculty of Natural Sciences
Institute of Physics

Background and Motivation

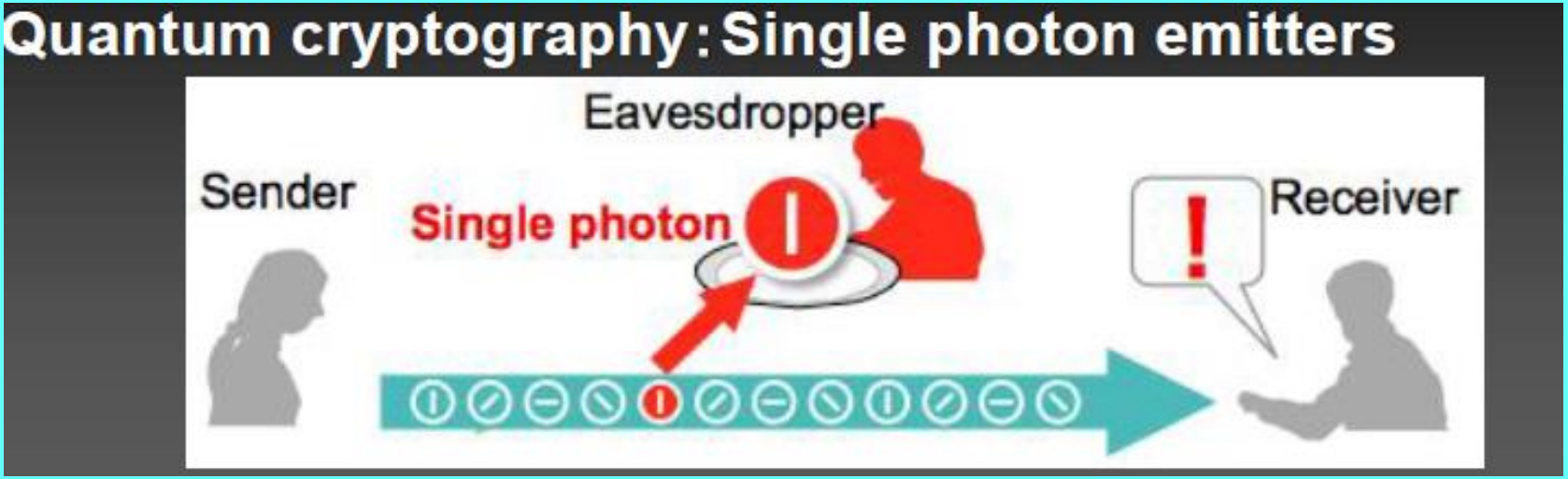
Information society

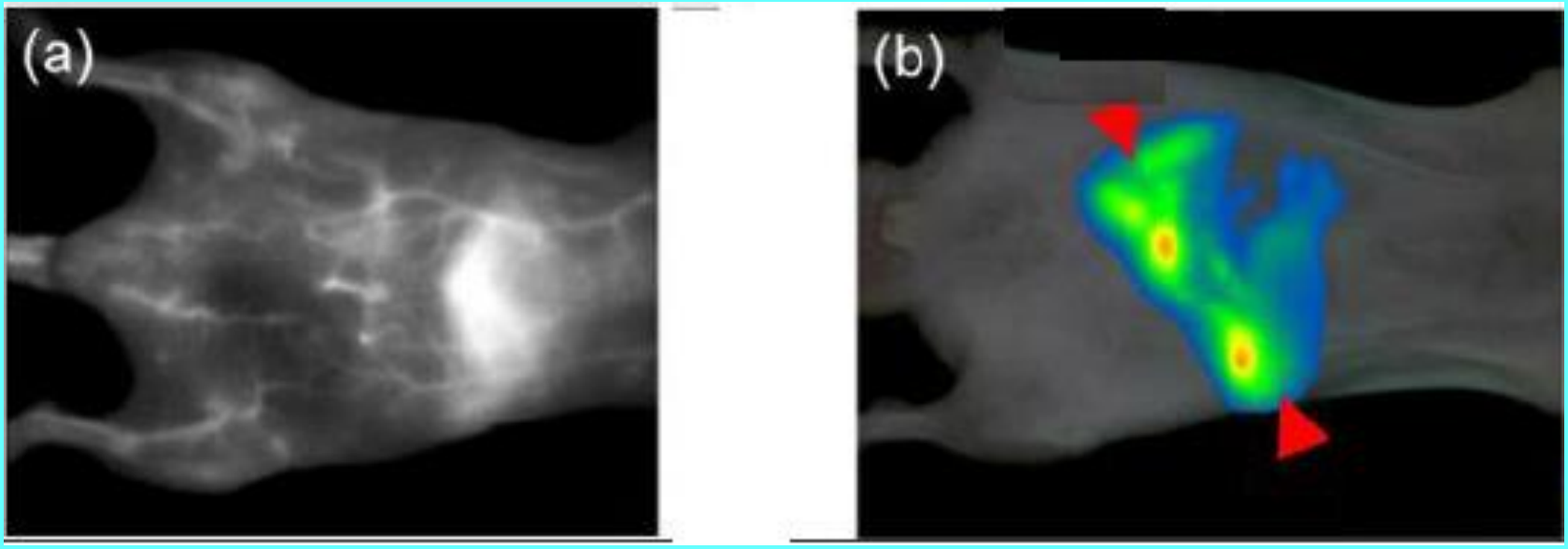
Secret communication

Aging society

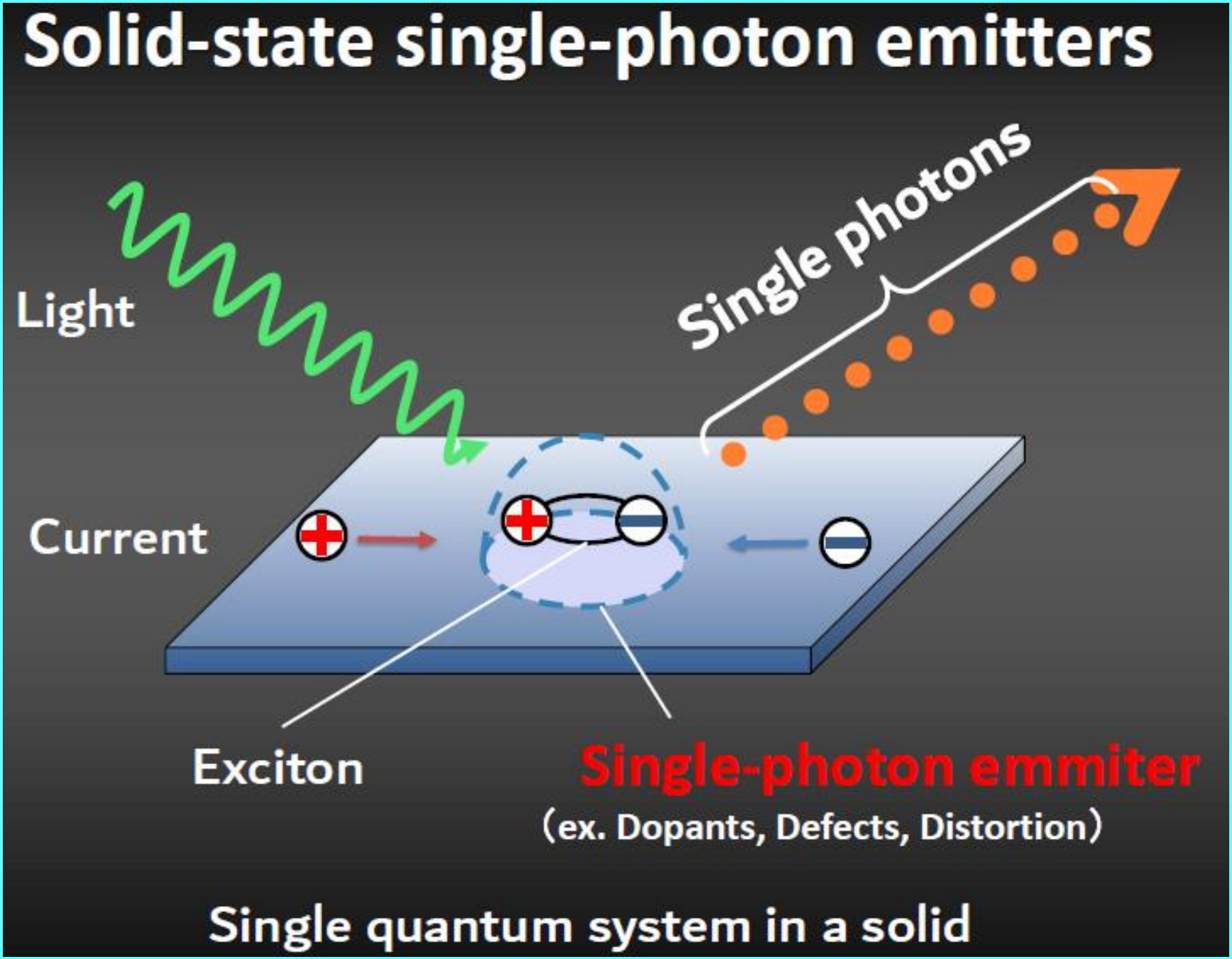
Medical examination

Novel luminescent materials





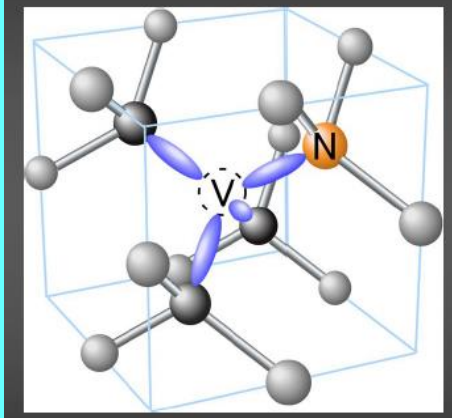
Solid-state single-photon emitters



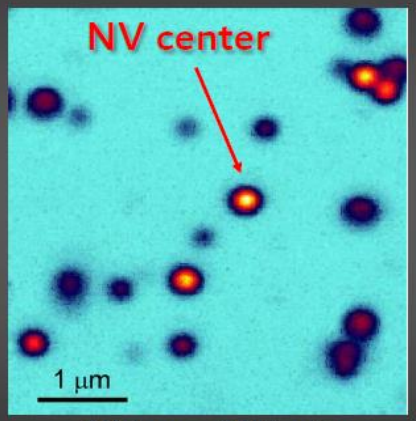
Single quantum system in a solid

Diamond NV centers

T. Fukui, *et al*, ***Appl. Phys. Express***, 7, 055201 (2014)

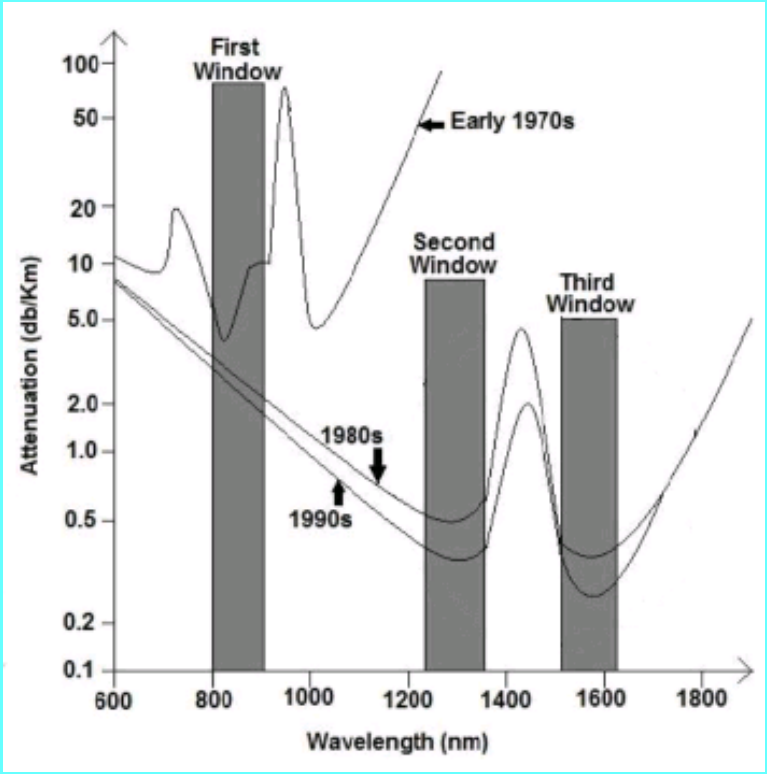


Structure of a NV center



A PL image of NV centers

NV center works in the Vis range



For 100 km transfer: 14 dB (factor 25 power loss)

Fidelity loss/increased BER/ Lower BW: 10-100 fold

Outside Telecom Window: 300 dB (10^{-30} power loss)

WR (Sumitomo 2017): 0.14 dB/km

Goals and objectives

1. To achieve NIR single-photon emitters

2. To achieve NIR PL active materials for bio-labelling

Target materials:

NV-diamond, hBN, MOF, TMDCs

Methodology:

Synthesis	**WP1 (SK)**
Spectroscopy	**WP2 (HU)**
Time-resolved spec.	**WP3 (CZ)**
Devices	**WP4 (JP)**
Theory	**WP5 (PL)**

The groups

Prof. Ryo Kitaura
Nagoya Univ.
2D materials

Dr. Hidetsugu Shiozawa
J. Heyrovsky Inst. Prague
MOFs

Dr. Viera Skakalova
Slovak Acad. Sci., Brat.
Growth

Dr. Marcin Kurpas
Silesia Univ., Katowice
Theory

Prof. Ferenc Simon
TU-Budapest
Spectroscopy

Hungary

WP2: Spectroscopy

Leader:
V4 Budapest Univ.
ESR, NMR

V4 Heyrovsky Inst.
Raman,
Luminescence

V4 Slovak Academy
TEM, XRD, XPS

WP5: Theory

Leader:
V4 University of Silesia
DFT

Poland

WP1: Synthesis

Leader:
V4 Slovak Academy
Diamonds, doping

JP Nagoya Univ.
TMDC, hBN, doping

V4 Heyrovsky Inst.
CP. MOF

Sample

Data

WP3: Time-resolved

Leader
V4 Heyrovsky Inst.
Luminescence life-time,
photon statistics

WP4: Device

Leder:
JP Nagoya Univ.
LED, FET

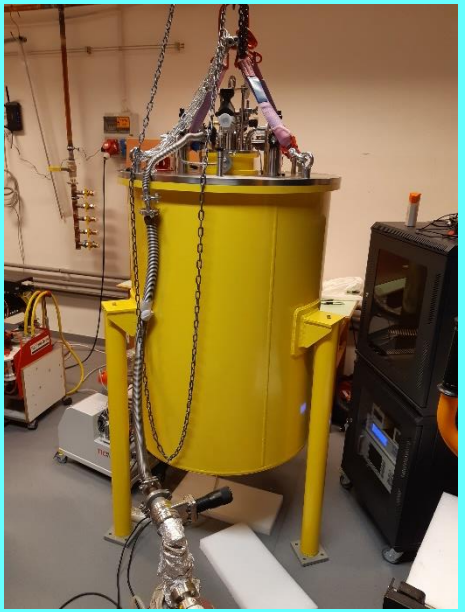
V4 Slovak Academy
Transport

Experimental facilities, TU-Budapest

1994-, μw transport

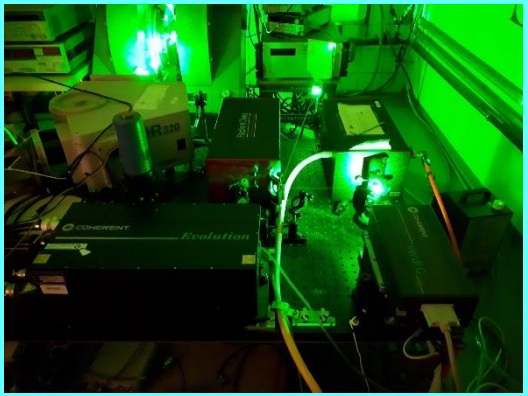
2012-, NMR/MRI

2013-, high field ESR



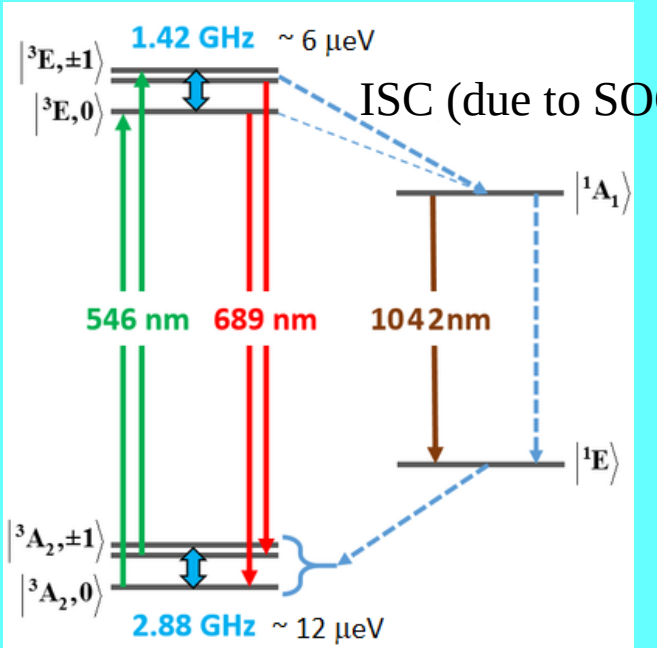
2021-, high-field ODMR

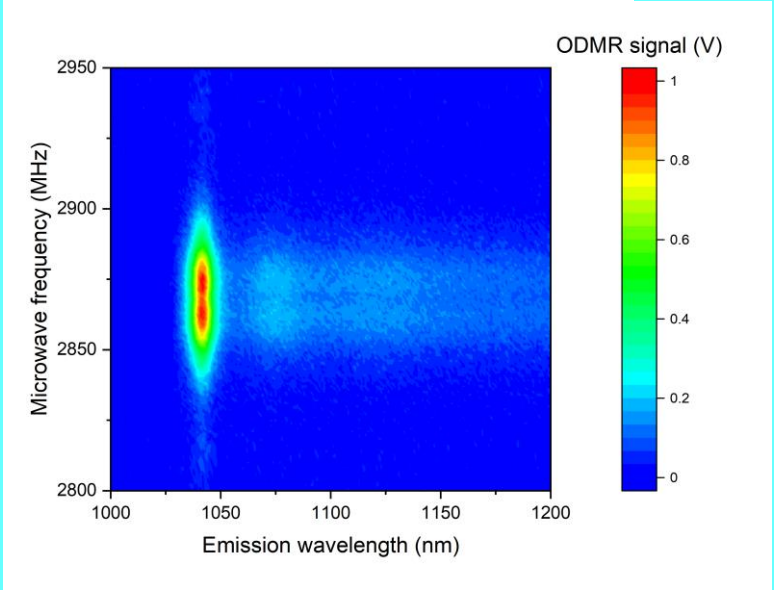
Commercial ESR



home-built ODMR

I. NIR optical transitions in NV-diamond

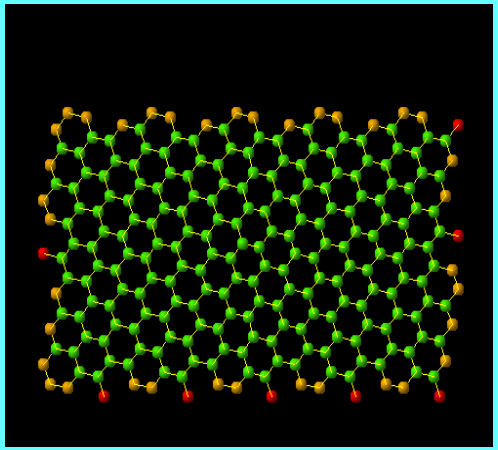




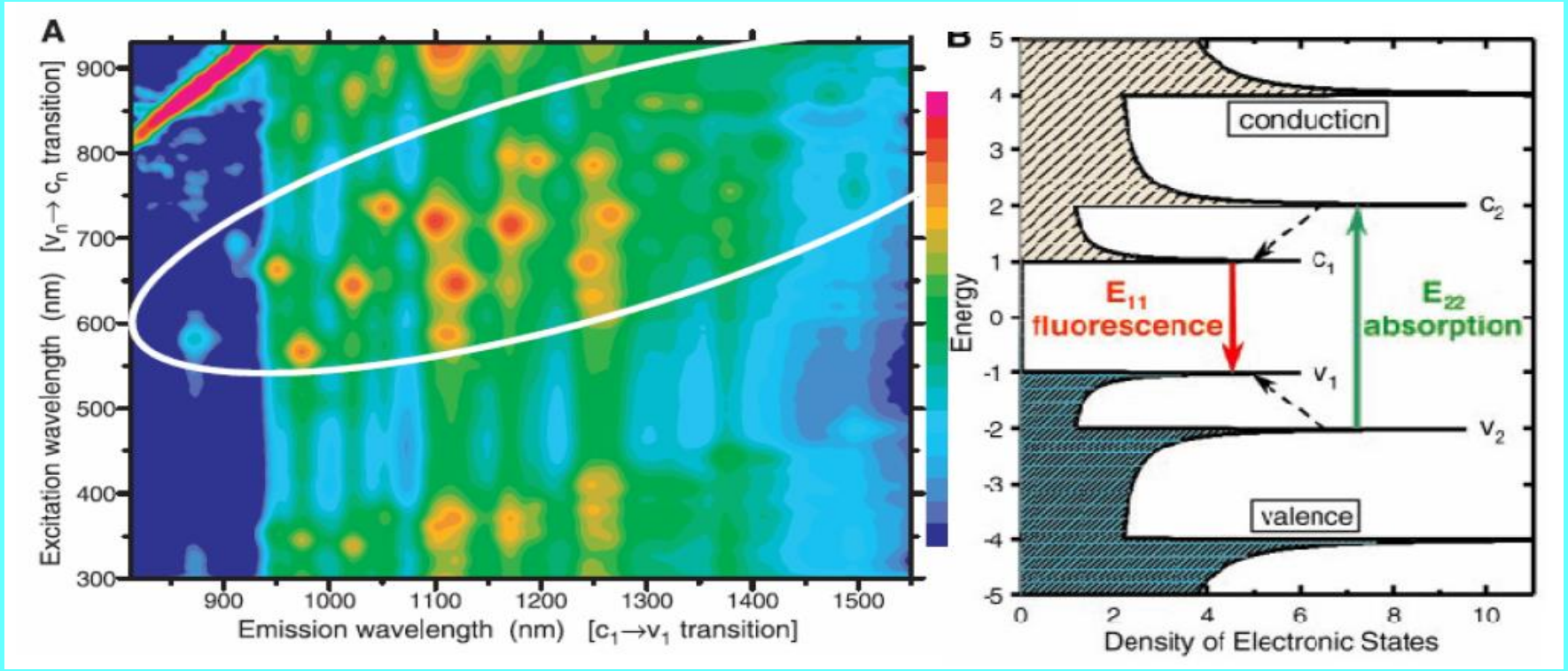
Sample growth with heteroatoms: **SK**
Irradiation: **HU**
Time resolved opt. Spec: **CZ**
Band structure prediction **PL**
Diamond+TMDC devices **JP**

Preliminary data

II. NIR optical transitions in chirality selected carbon nanotubes



Courtesy of S. Maruyama

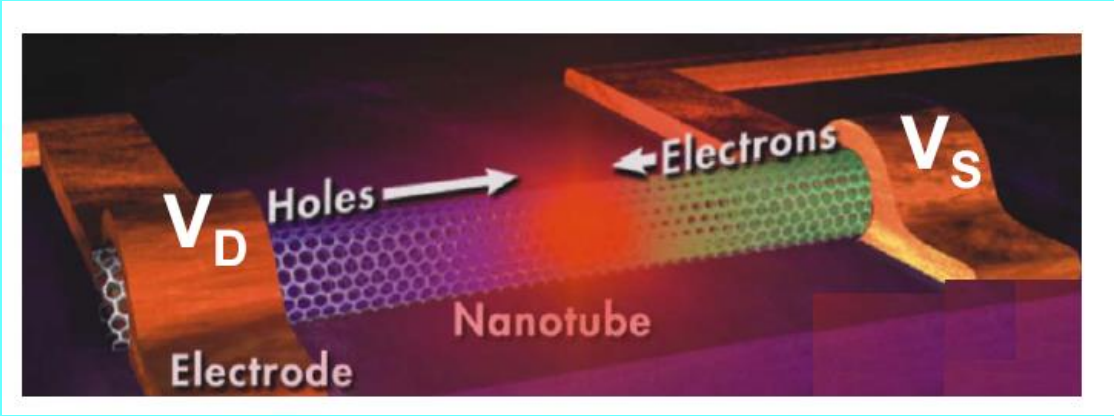


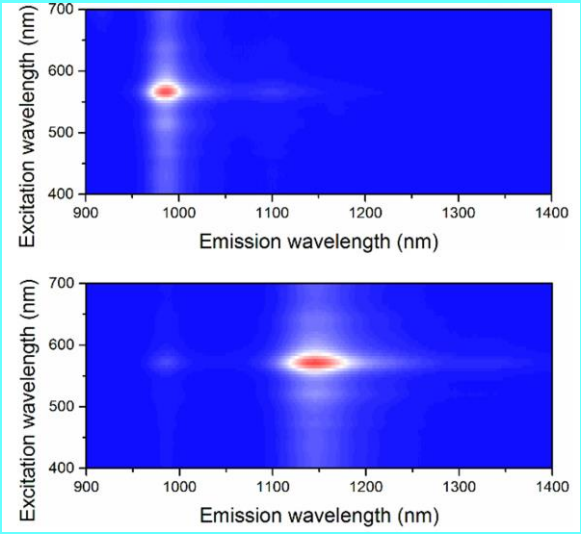
Bachilo et al., Science 2002

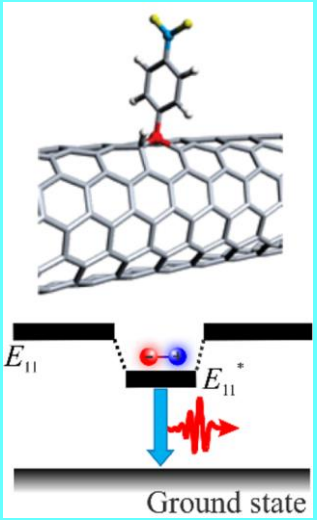
II. NIR optical transitions chirality selected carbon nanotubes

Excitons are important:

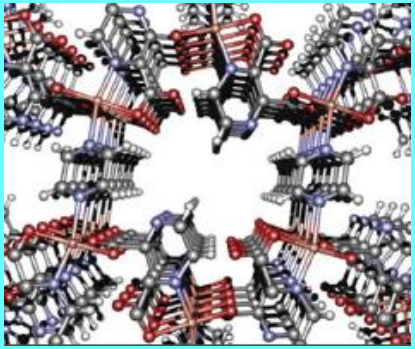
- Hinders photovoltaic applications
- Light emission: 3/4th of excitons are triplets, spin-forbidden recombination!
- Long-living triplet excitons for QC

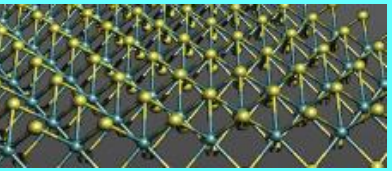






ACS Nano 2020, 14, 12, 17675–17682





Thank you for your attention

どうもありがとうございました