DD WG Friday: summary

(only a small selection)

Ranny Budnik

Rouven Essig

- several possible targets identified that have good prospects for observable DM signals
- backgrounds unknown in all (to different degrees), but need experimental work to identify issues (and deal with them)
- detector backgrounds much more important than “classical” (e.g. radioactive) backgrounds

- xenon/LZ
- xenon bubble chamber
- superfluid helium
- semiconductors
- scintillators
- color centers
- graphene sheets
- carbon nanotubes
- superfluid helium

10:00 Jeremy Mock – Xenon Bubble Chambers for Direct Dark Matter Detection

BubXe_Vfinal.pdf

10:15 Tien-Tien Yu – LDM detection using electron scattering in scintillators

Scintillator_SLACw...

10:30 Aaron Manalaysay – Towards the ultimate ionization threshold in semiconductor detectors

SLAC_darkSectors...

10:45 Lauren Hsu – Low Energy Nuclear Recoil Ionization Yield and SuperCDMS Sensitivity (k vs threshold effects)

darksectors_calibr...

11:00 Ranny Budnik – Color Centers as radiation detectors

CC_SLAC.pdf

13:30 Maria Elena Monzani – Perspectives for low-mass dark matter searches with the LZ experiment

DarkSectors_Monz...

13:45 Tien-Tien Yu – LDM detection with electron recoils in with semiconductor targets

14:00 Yoni Kahn – Searching for sub-GeV DM with Graphene Target

GrapheneDM-2.pdf

14:15 discussion

15:15 Antonio Polosa: Carbon nanotubes for DM directional detection

15:30 Dan McKinsey – DM detection in liquid Helium

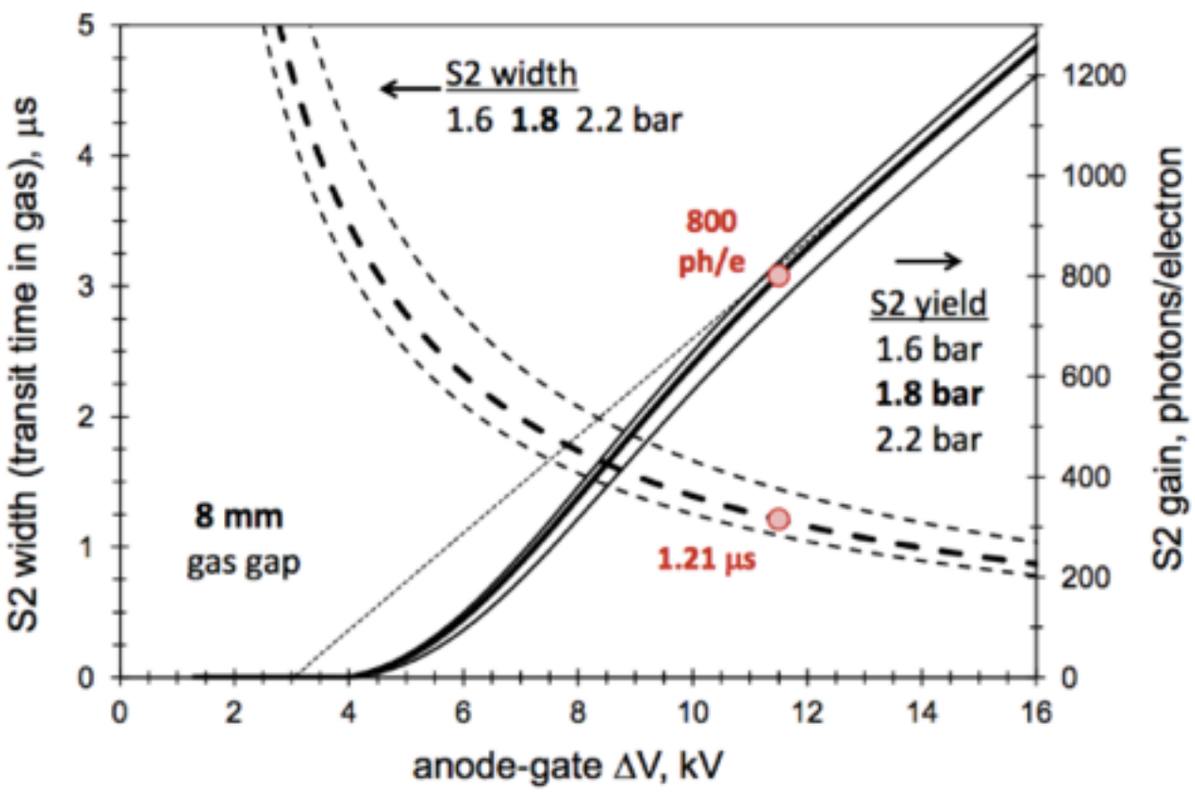
15:45 Scott Hertel – Helium part II

16:00 discussion

Maria-Elena Monzani

Single Electron Sensitivity in LZ

- **Single electron signal depends on field configuration:**
  - **expected >50 p.e./electron (x2 higher than Xenon10)**
  - **expected 97.6% extraction efficiency for electrons**



Parameter	value
Gate-Anode separation (and tolerance)	13.0 mm (±0.2 mm)
Gas gap (and tolerance)	8.0 mm (±0.2 mm)
Field in LXe (GXe)	5.2 kV/cm (10.2 kV/cm)
Electron emission probability	97.6 %
S2 photon yield	820 ph/e
S2 width FWHM	1.2 μs
Detailed modeling	
S2 photon yield	910 ph/e
S2 photon *rms*	2.0 %
S2 width FWHM	1.0 μs to 2.0 μs[a]

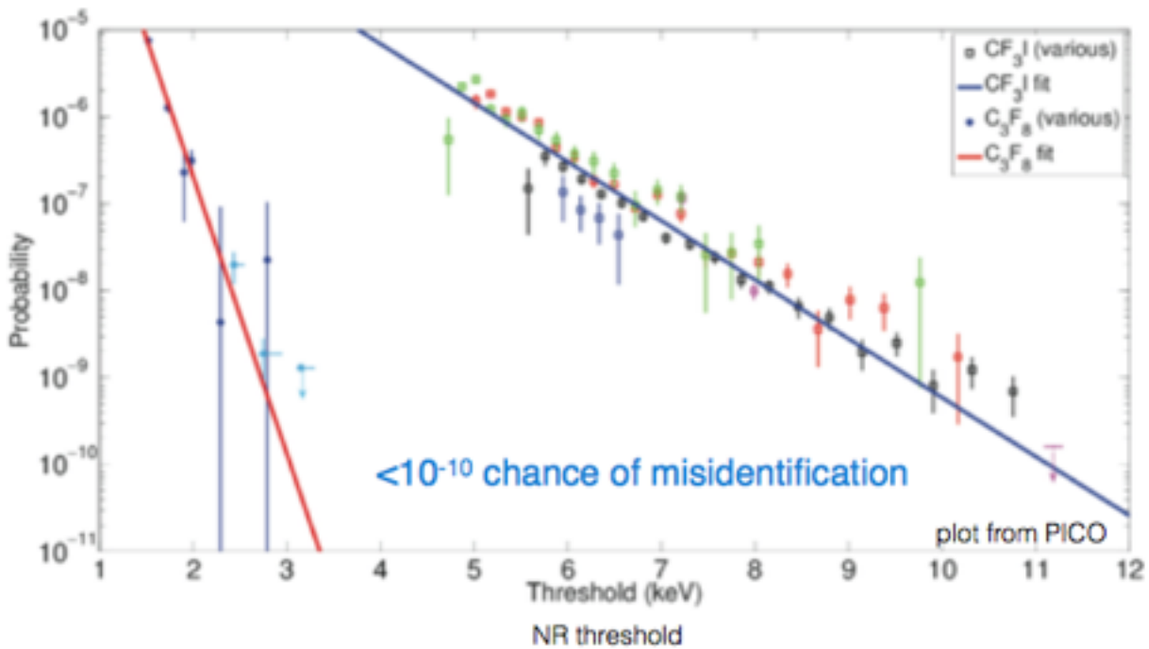
[a] The larger value is for diffusion-broadened S2 pulses from interactions near the cathode (see Figure 3.6.4).

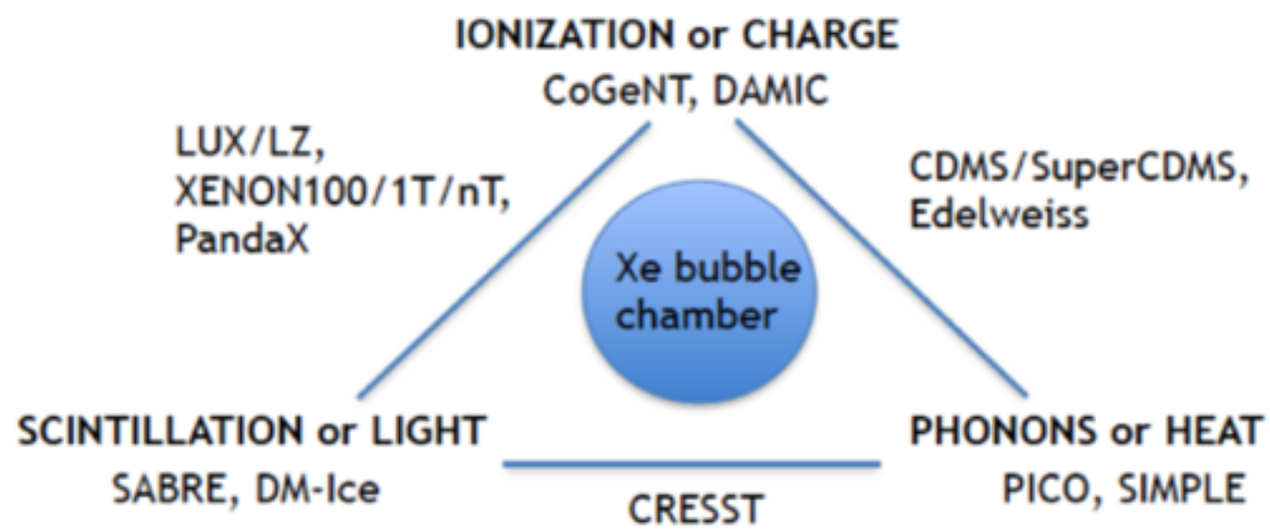
LZ TDR, in preparation

- **Reaching HV specs has proven elusive in all LXe detectors**
  - **very extensive fields/grid R&D/testing in progress at SLAC**

BubXe: xenon bubble chamber

Jeremy Mock





LXe detector + bubble chamber = LXe bubble chamber

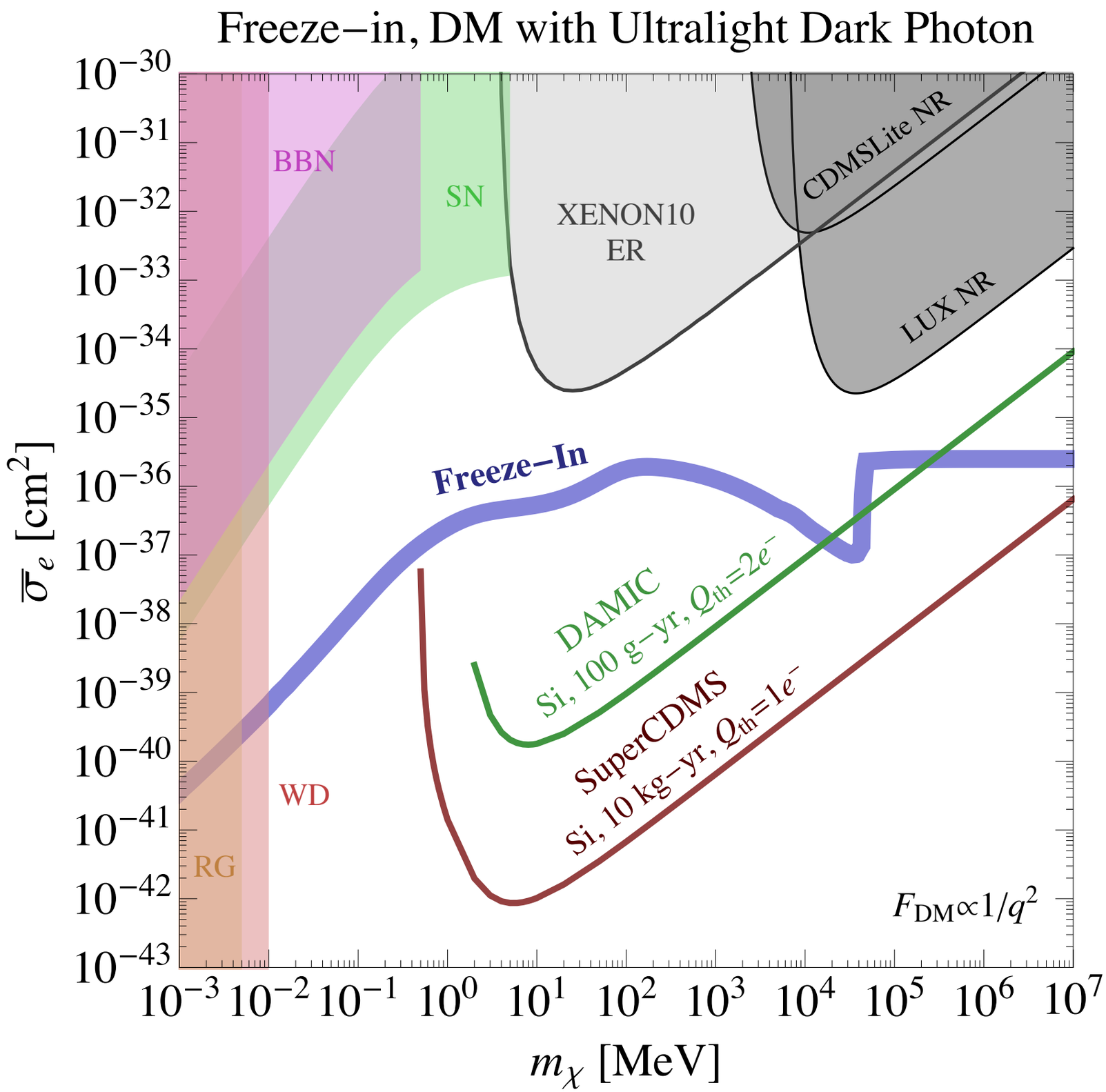
⟶ has energy information

⟶ has great misidentification probability

⟶ active on all 3 channels at a time!

Semiconductors: Ge, Si

Tien-Tien Yu



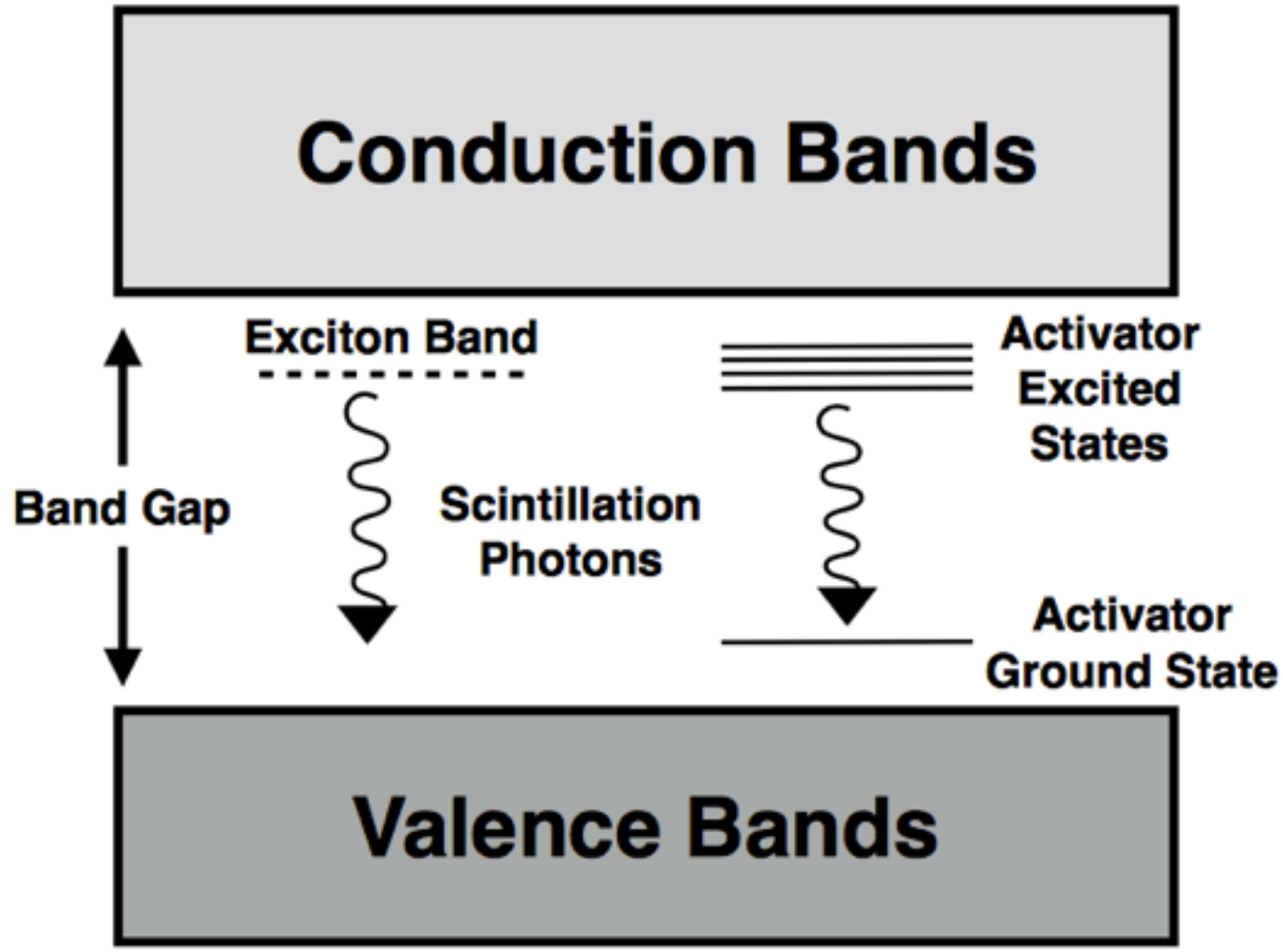
3.6 events in a DAMIC-like or SuperCDMS-like experiment

work in progress to reach ~eV sensitivity (currently at ~40-50 eV)

scintillators

Tien-Tien Yu

A scintillator is a material that, when struck by an incoming particle, absorb its energy re-emits the absorbed energy in the form of light

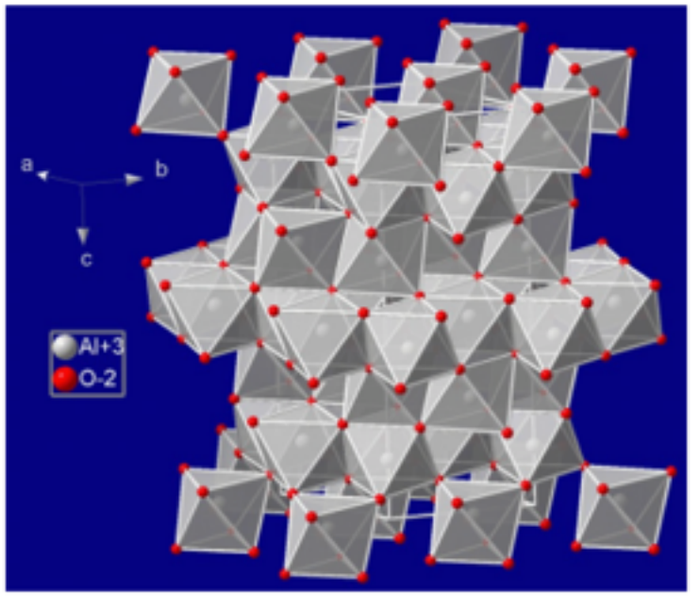


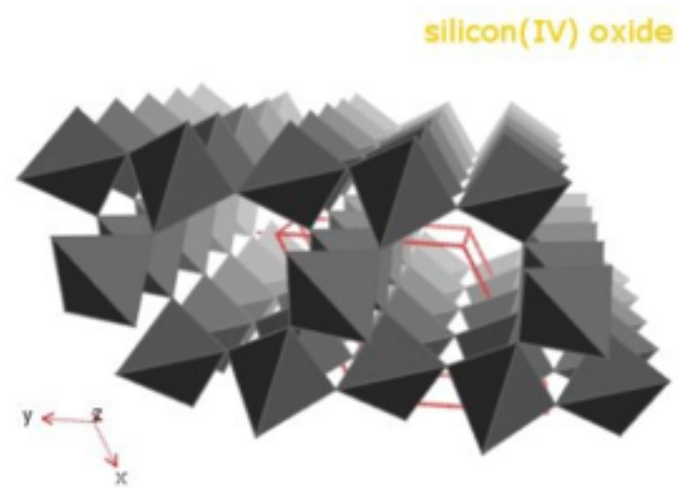
material: e.g. TlBr, NaI, CsI

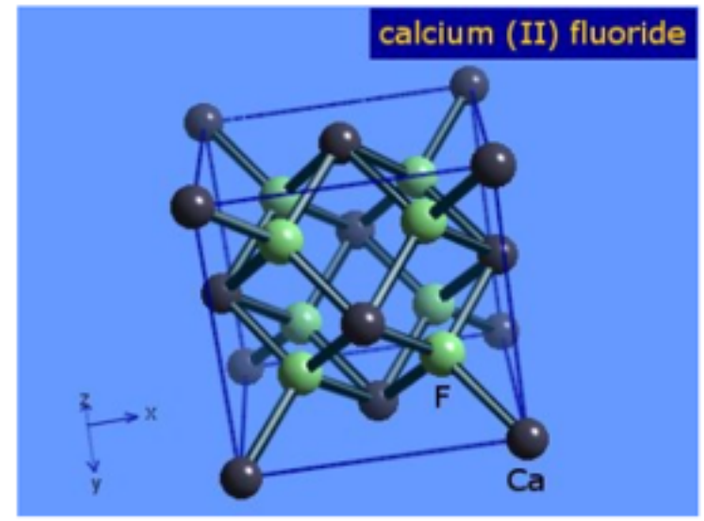
Need array of TES w/ single photon sensitivity ~few eV (R&D in progress)

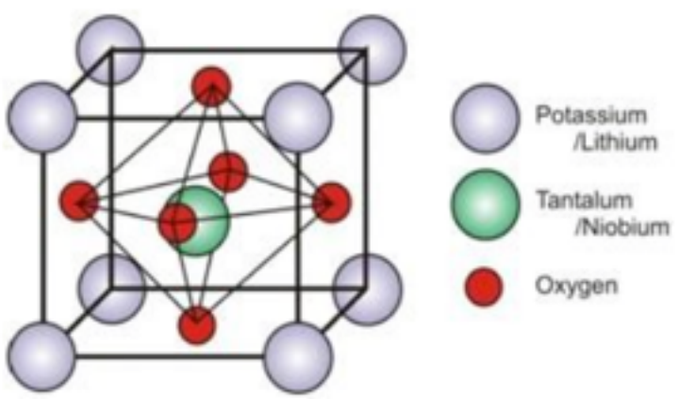
Color centers as NR radiation detectors

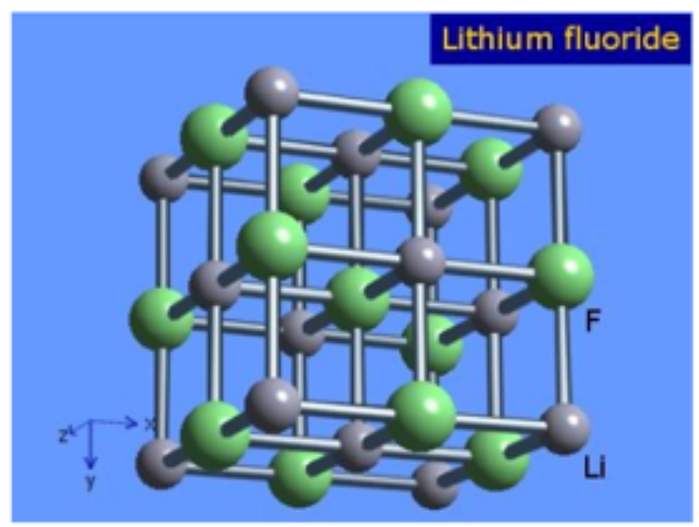
Ranny Budnik

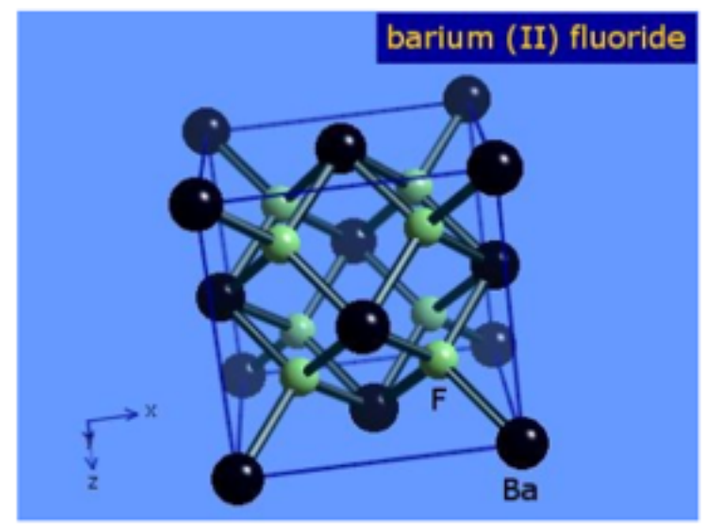








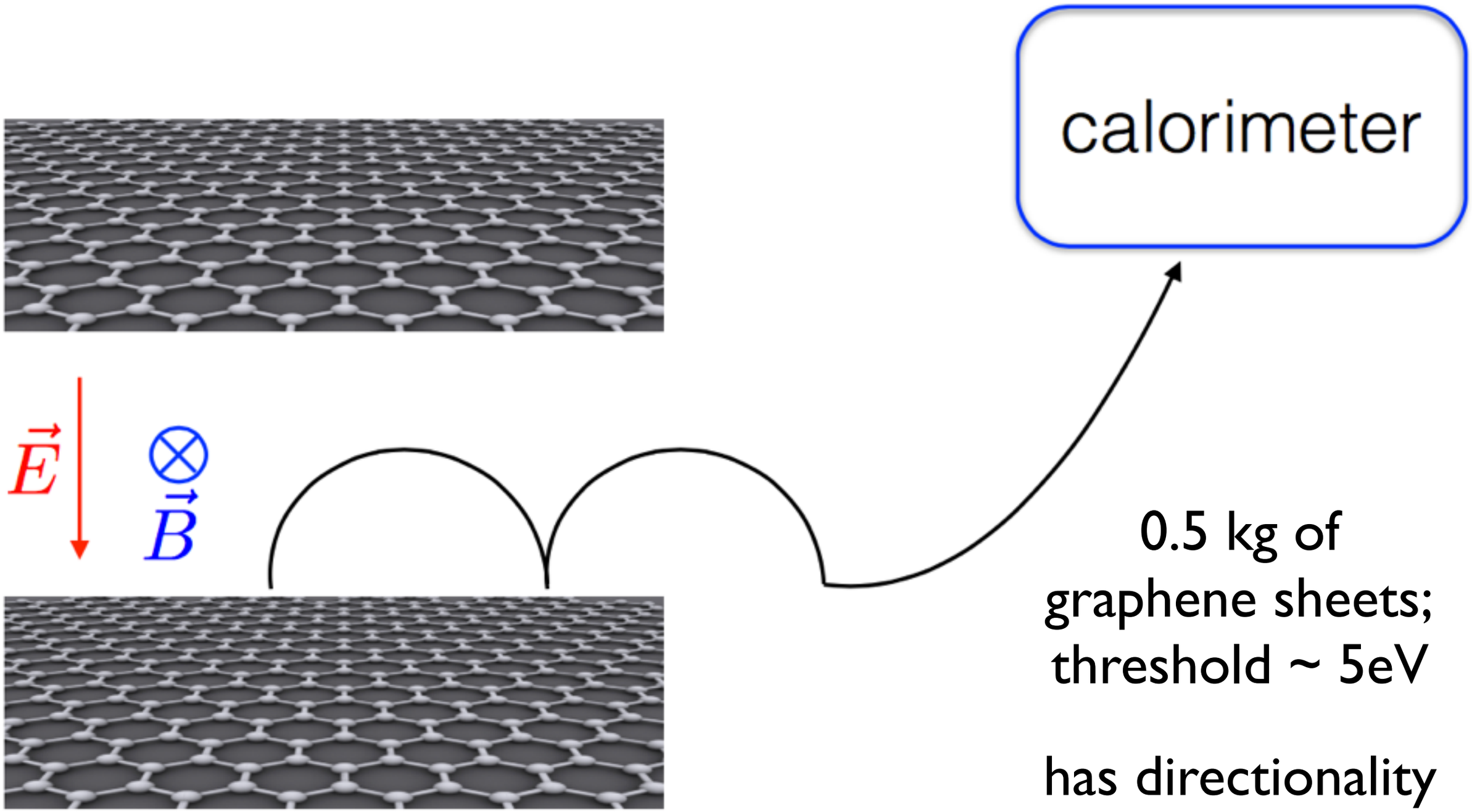




O(10eV) threshold, long lived signals
(experimental work in progress)

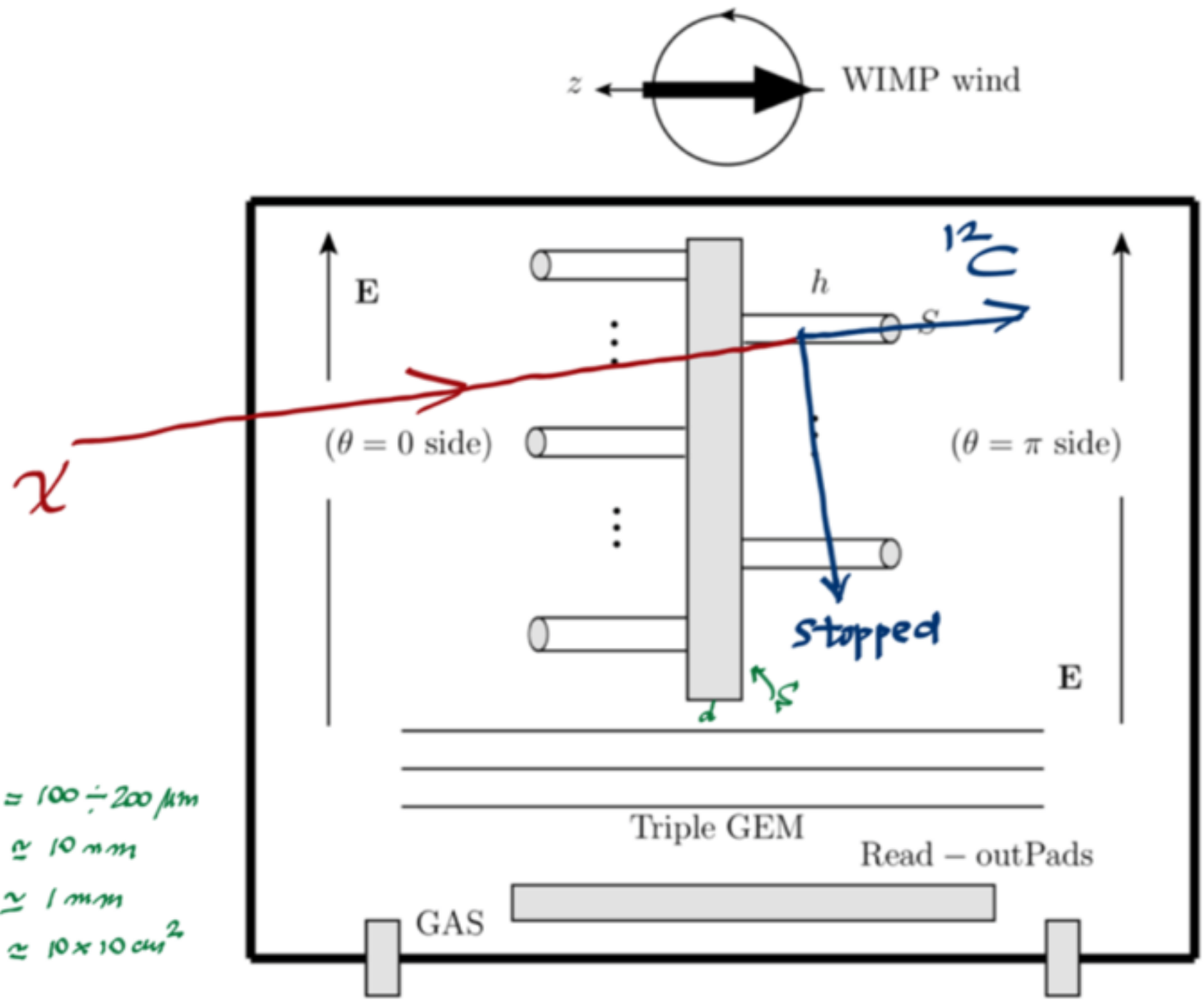
Graphene: adapt PTLOEMY

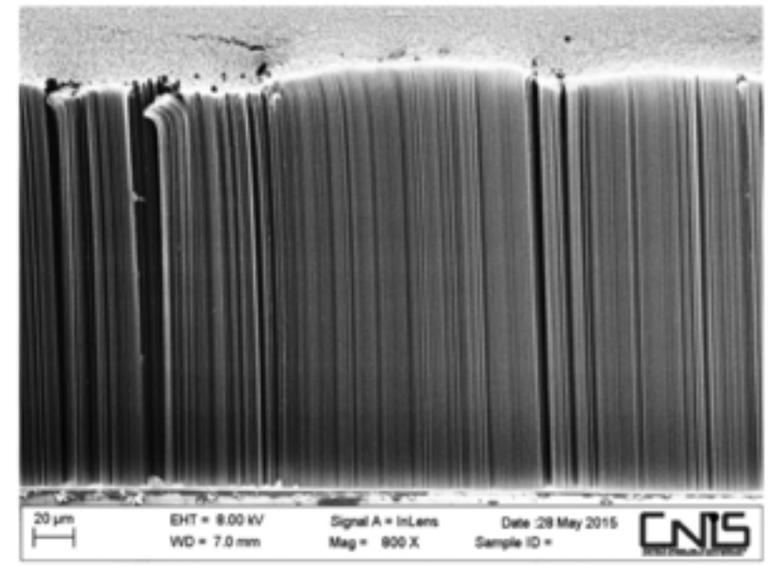
Yoni Kahn



Carbon nanotubes

A Polosa





~ keV NR threshold

has directionality

Superfluid Helium

Dan McKinsey, Scott Hertel

	Liquid density (g/cc)	Boiling point at 1 bar (K)	Electron mobility (cm^2/Vs)	Scintillation wavelength (nm)	Scintillation yield (photons/MeV)	Long-lived radioactive isotopes	Triplet molecule lifetime (μs)
LHe	0.145	4.2	low	80	19,000	none	13,000,000
LNe	1.2	27.1	low	78	30,000	none	15
LAr	1.4	87.3	400	125	40,000	^{39}Ar, ^{42}Ar	1.6
LKr	2.4	120	1200	150	25,000	^{81}Kr, ^{85}Kr	0.09
LXe	3.0	165	2200	175	42,000	^{136}Xe	0.03

experimental work in progress studying helium's properties

good NR/ER discrimination