sub-GeV Dark Matter with Scintillating Targets

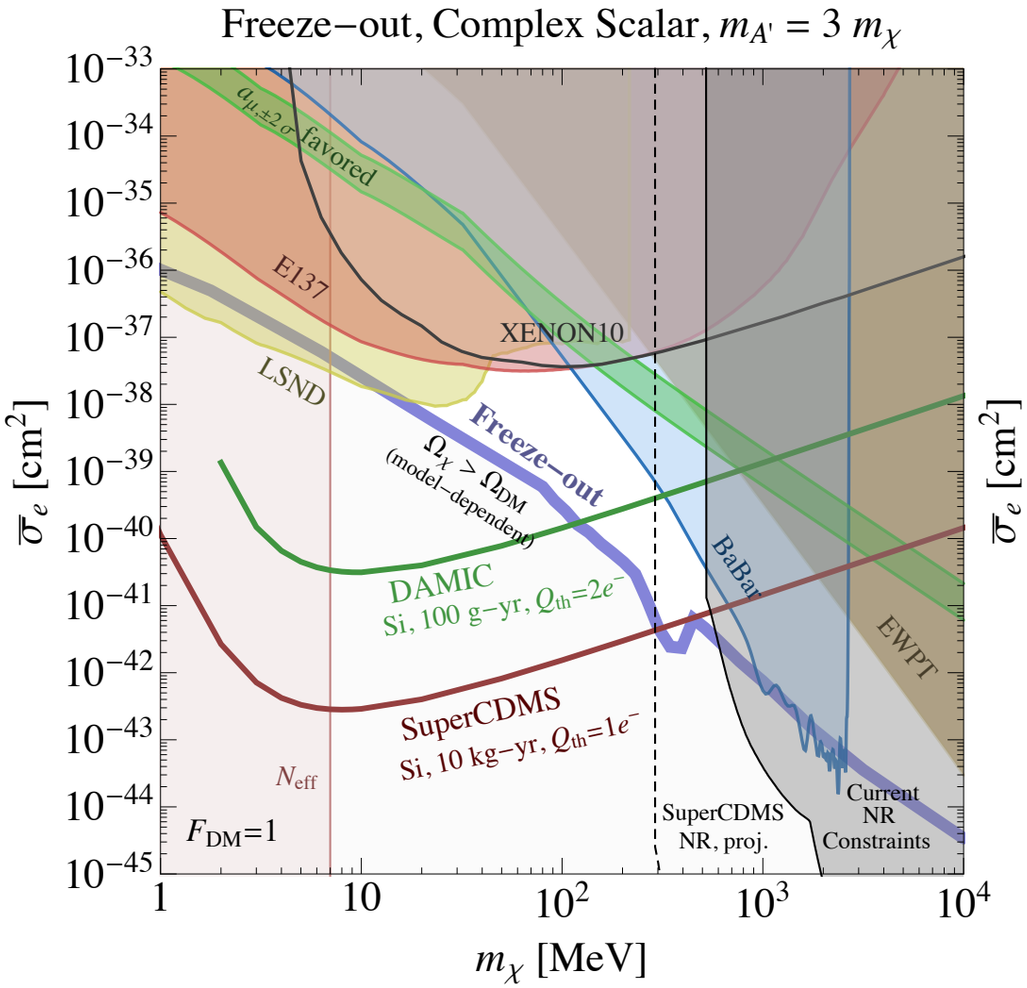
Stephen Derenzo, Rouven Essig, Andrea Massari,
Adrian Soto, Tien-Tien Yu

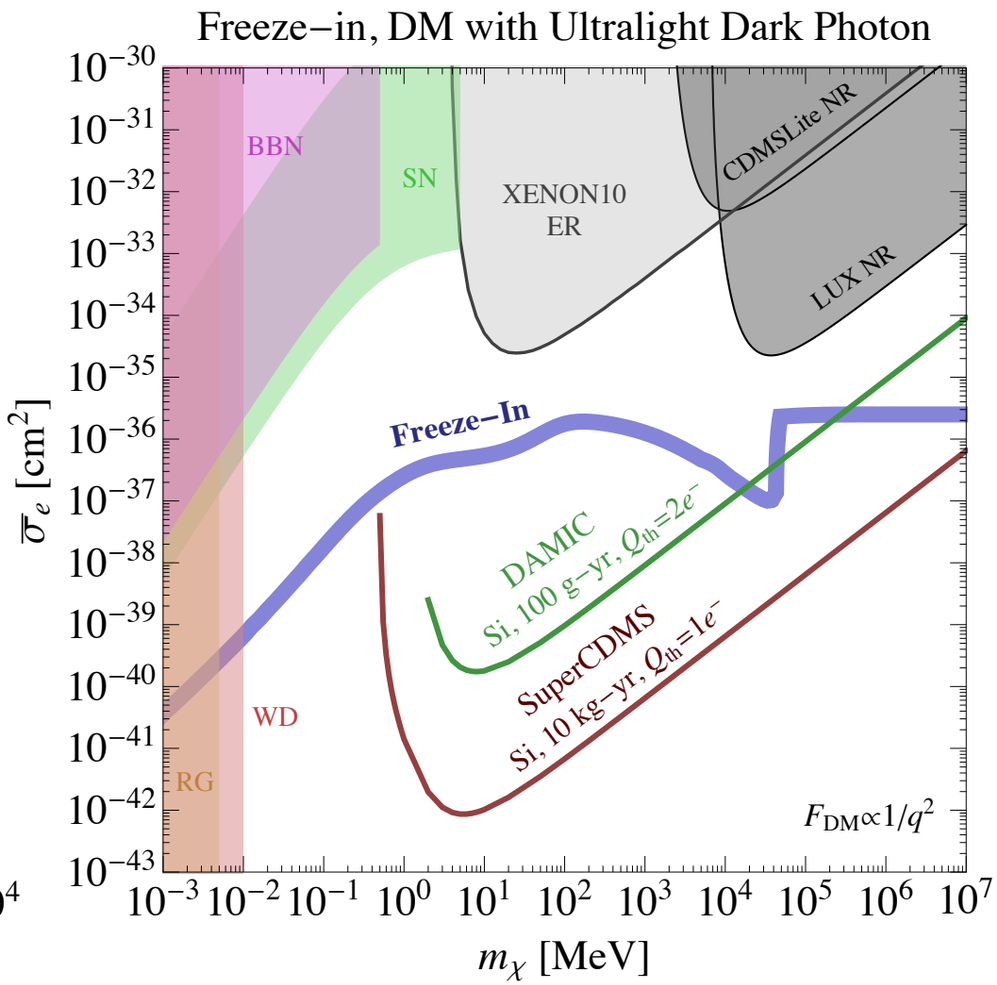
1605.XXXXX

Tien-Tien Yu, YITP Stony Brook University
April 29, 2016

sub-GeV DM direct detection with semiconductors

1509.01598





sub-GeV DM direct detection with semiconductors

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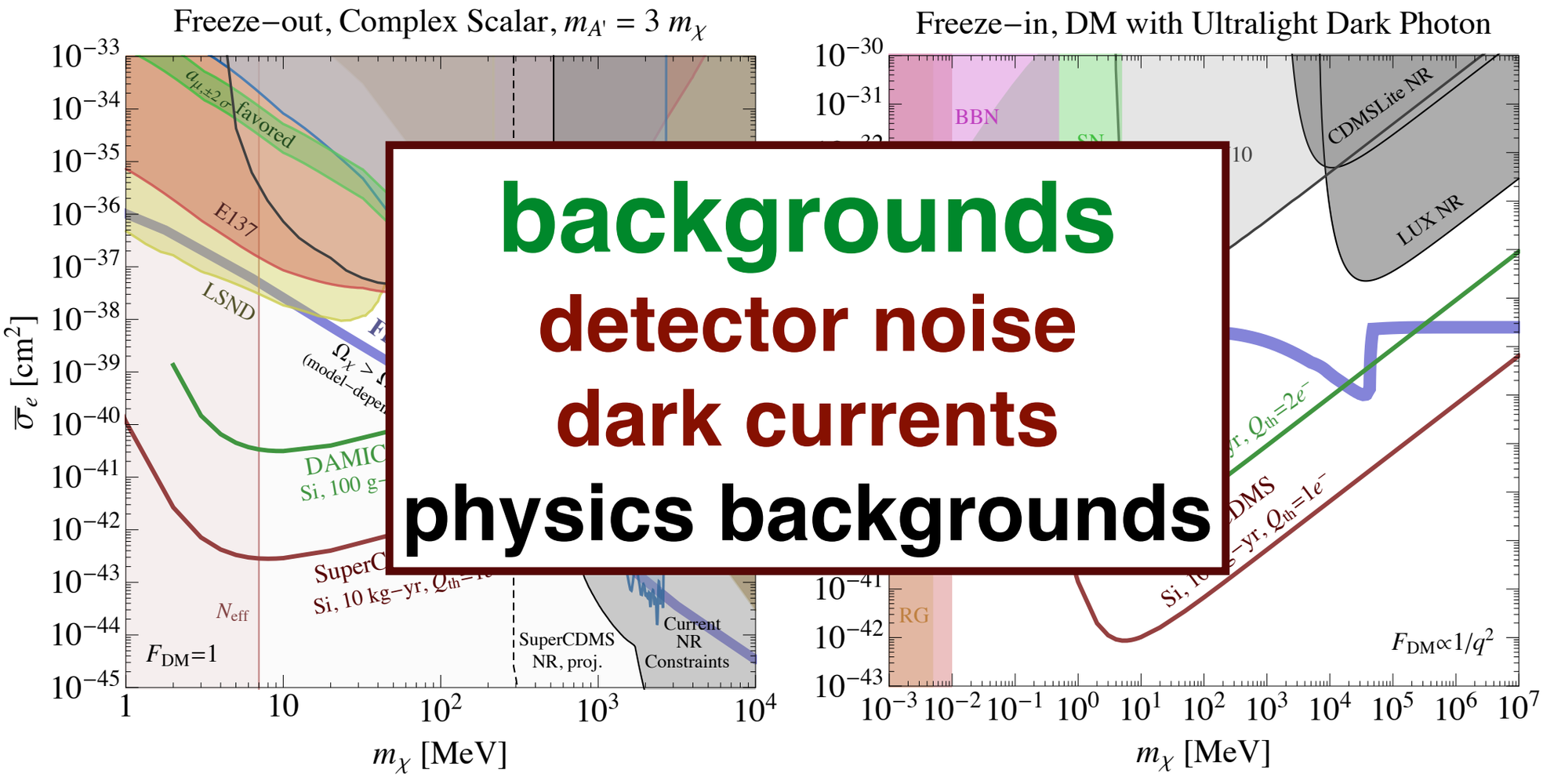


backgrounds

detector noise

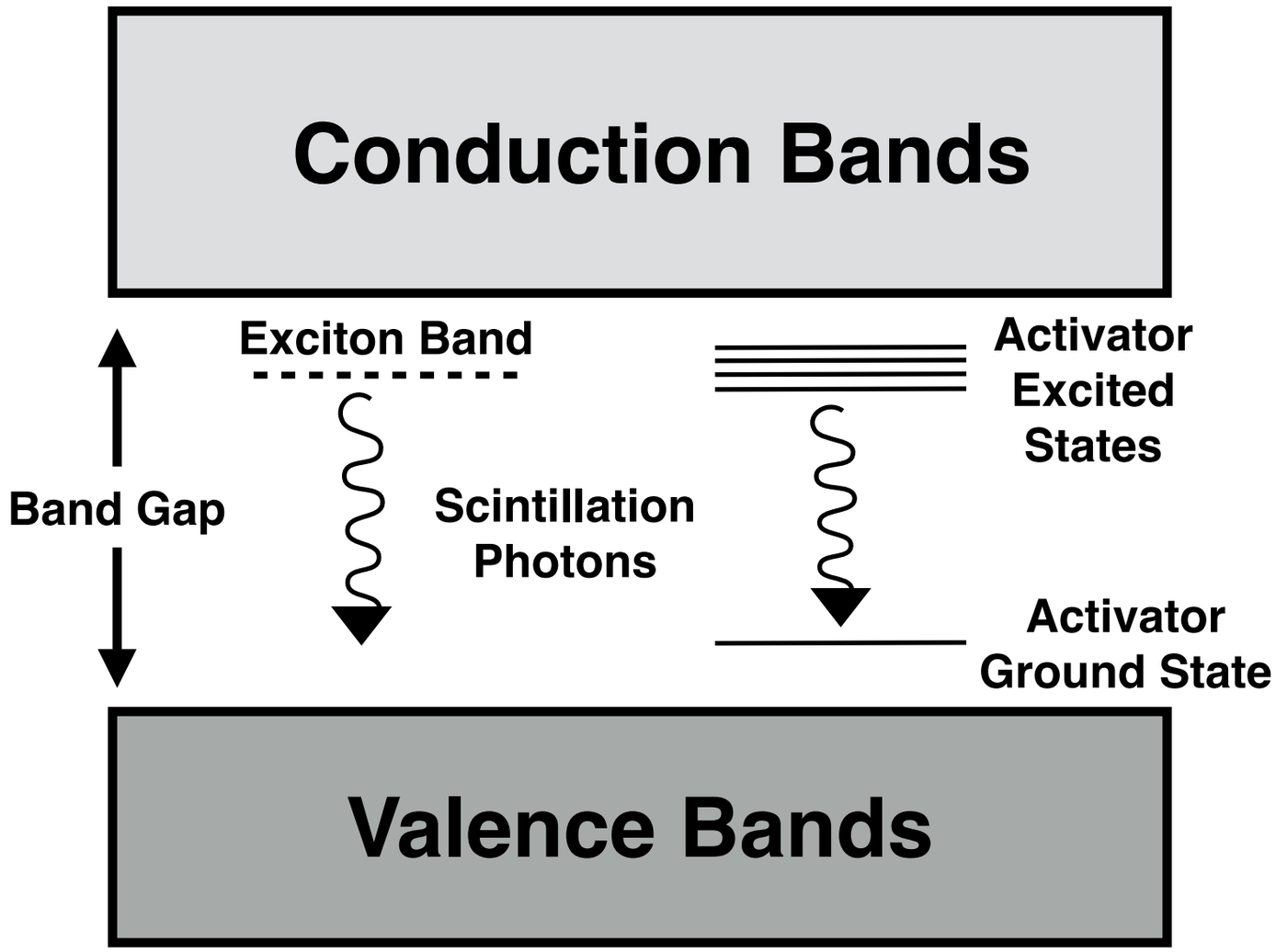
dark currents

physics backgrounds

single photon detection with scintillating targets

scintillators

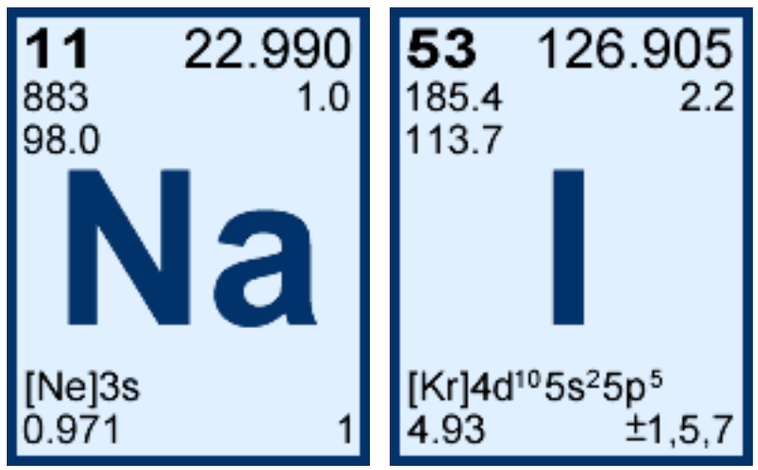
A scintillator is a material that, when struck by an incoming particle, absorb its energy re-emits the absorbed energy in the form of light



figures of merit

- fraction of electrons in crystal that are in valence bands
- density: number of electrons/cubic cm
- band gap: not too large
- scintillation efficiency: high at low temperatures

I: sodium iodide

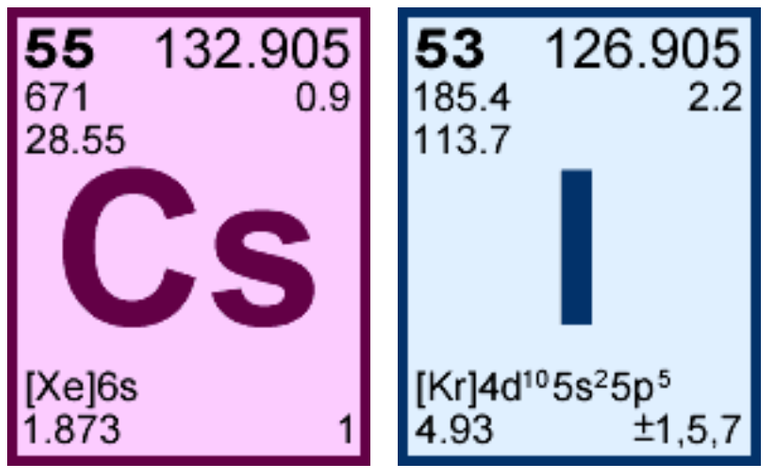


used in DAMA

5.9 eV band gap

very bright (80 photons/keV)

II: cesium iodide

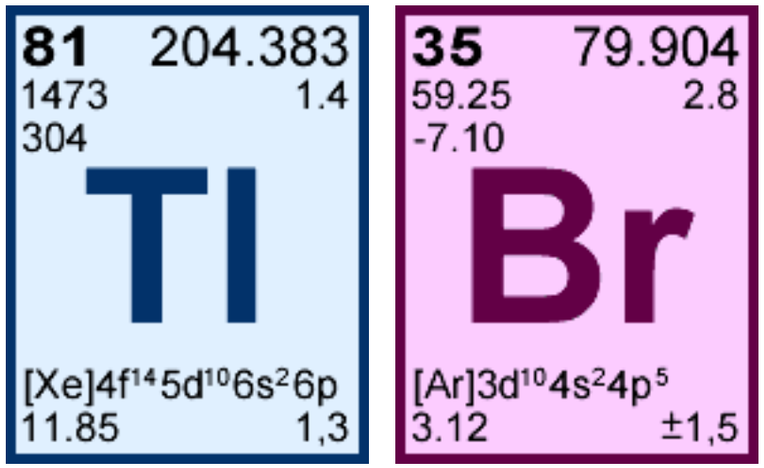


used in CRESST

6.4 eV band gap

even brighter (100 photons/keV)

III: thallium bromide

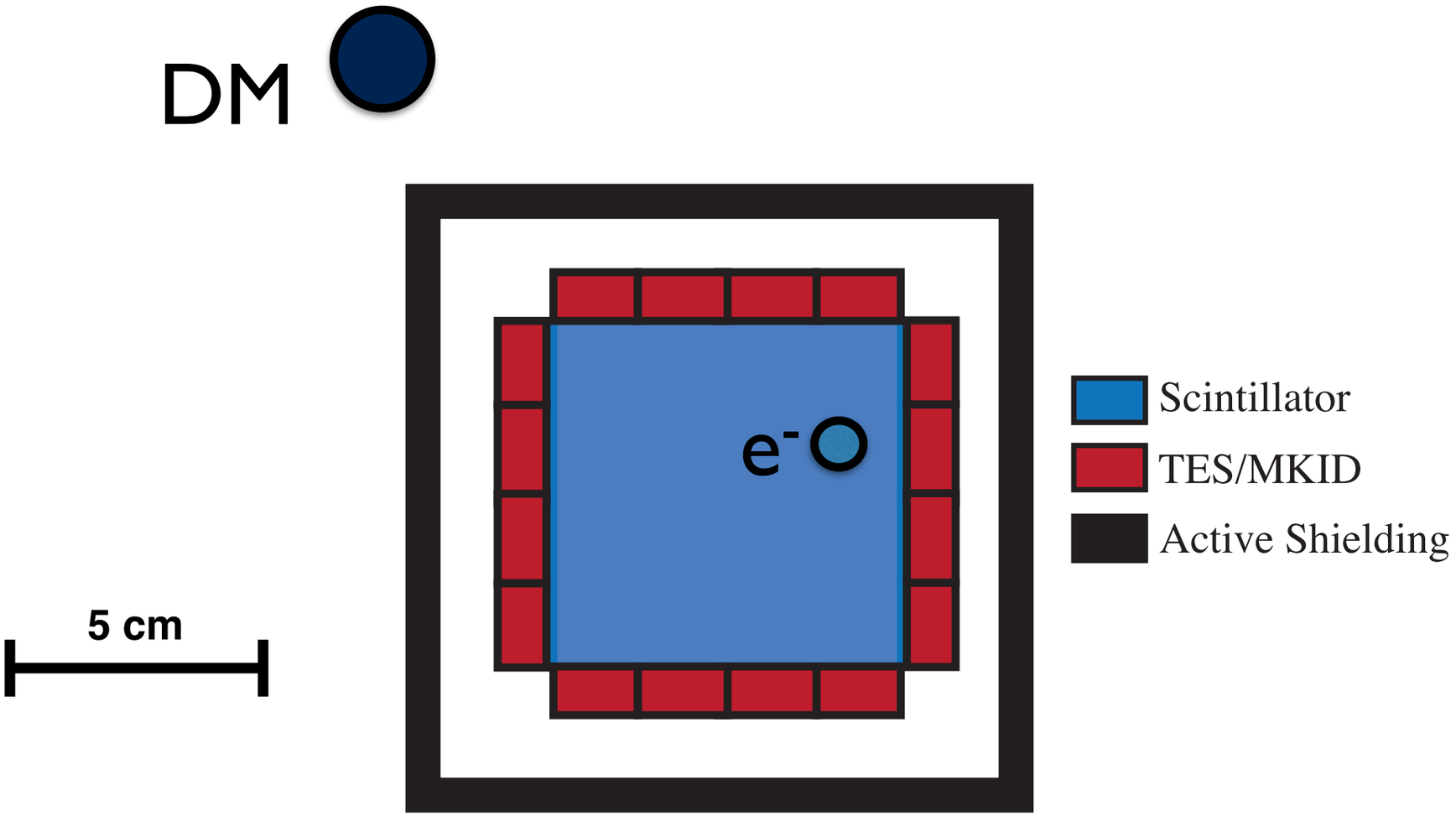


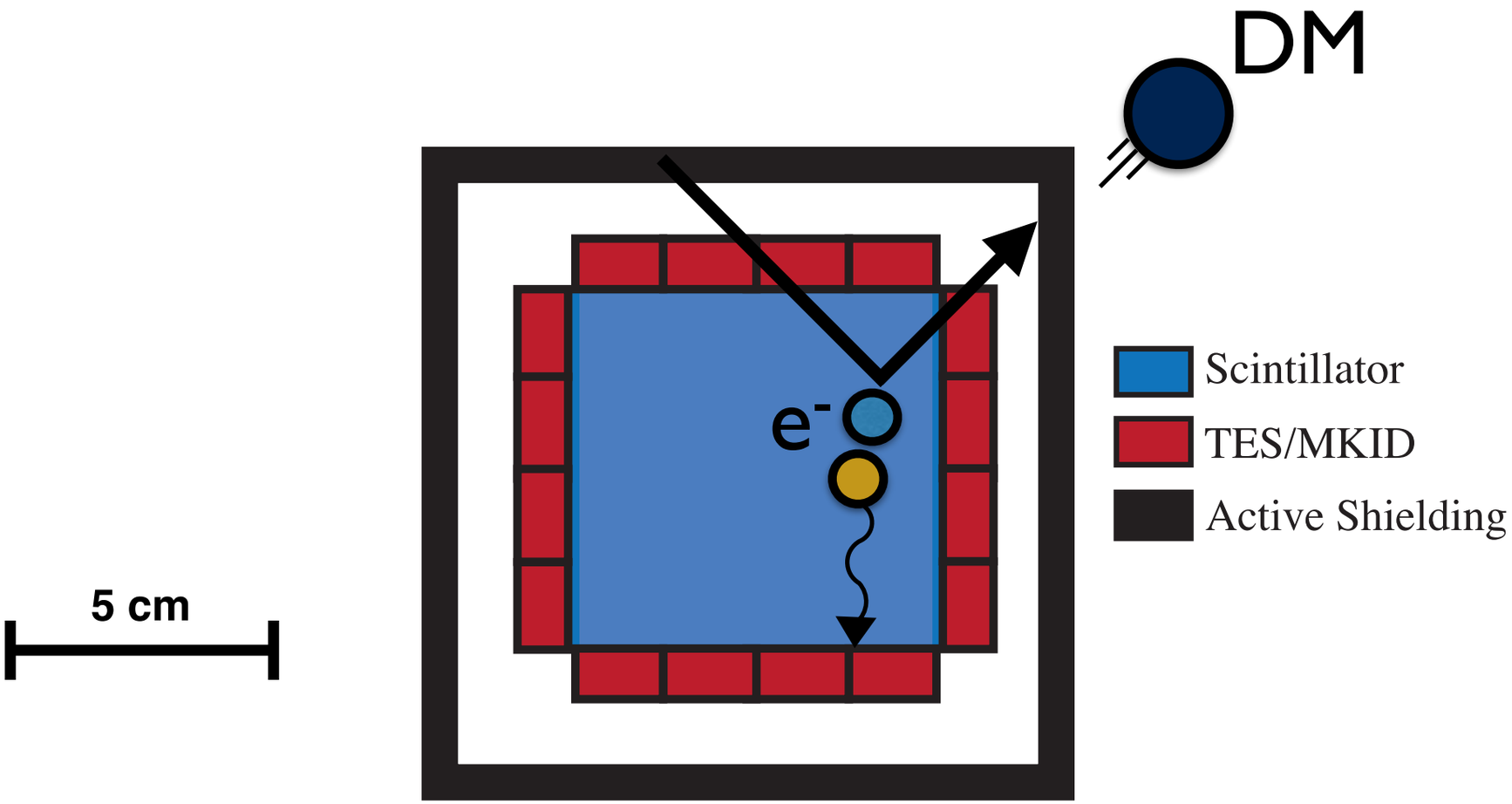
Can be grown as clear crystals

Very good semiconductor

2.68 eV band gap

***Good scintillator at cryogenic temperatures (40 photons/keV)**


DM
e-
5 cm
Scintillator
TES/MKID
Active Shielding


DM
e-
Scintillator
TES/MKID
Active Shielding
5 cm

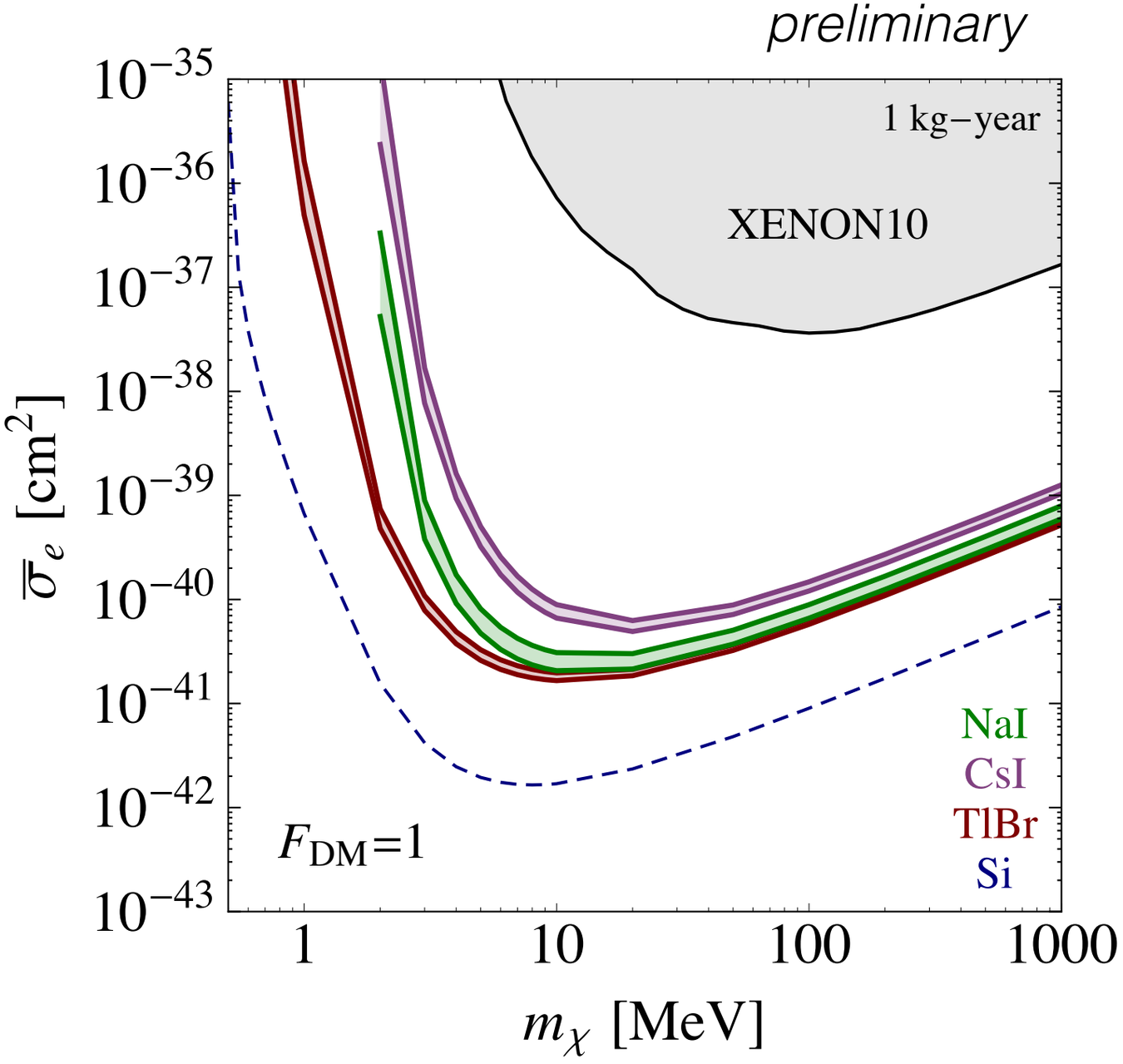
Efficiencies:

NaI 0.95

CsI 1.00

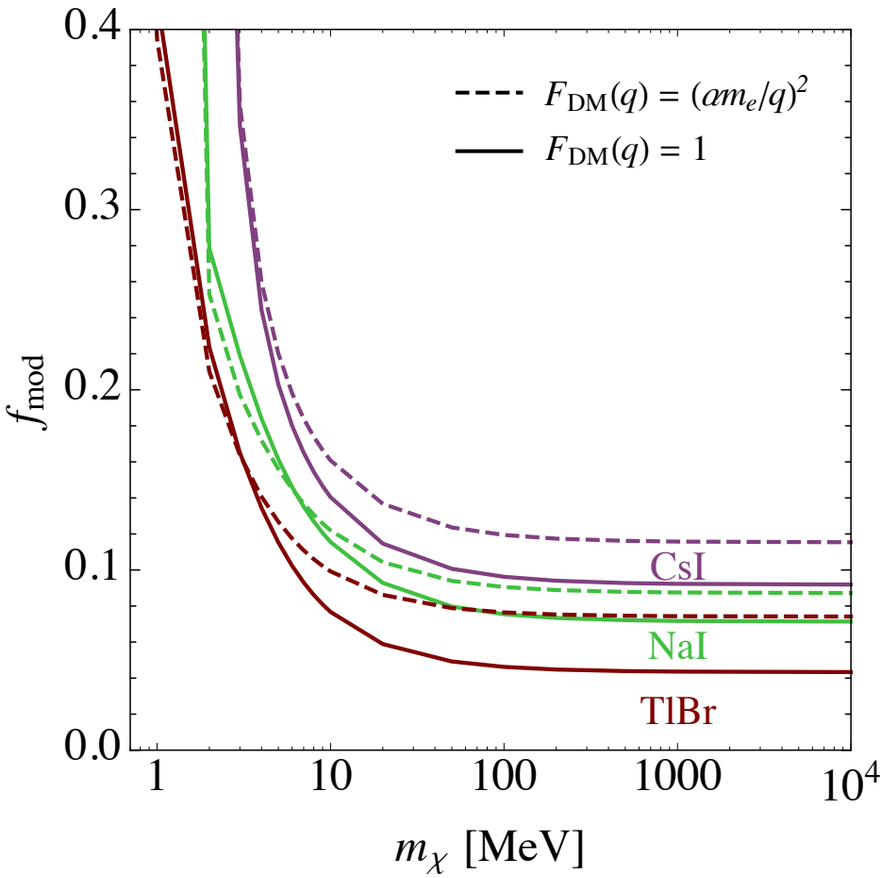
TlBr 0.25

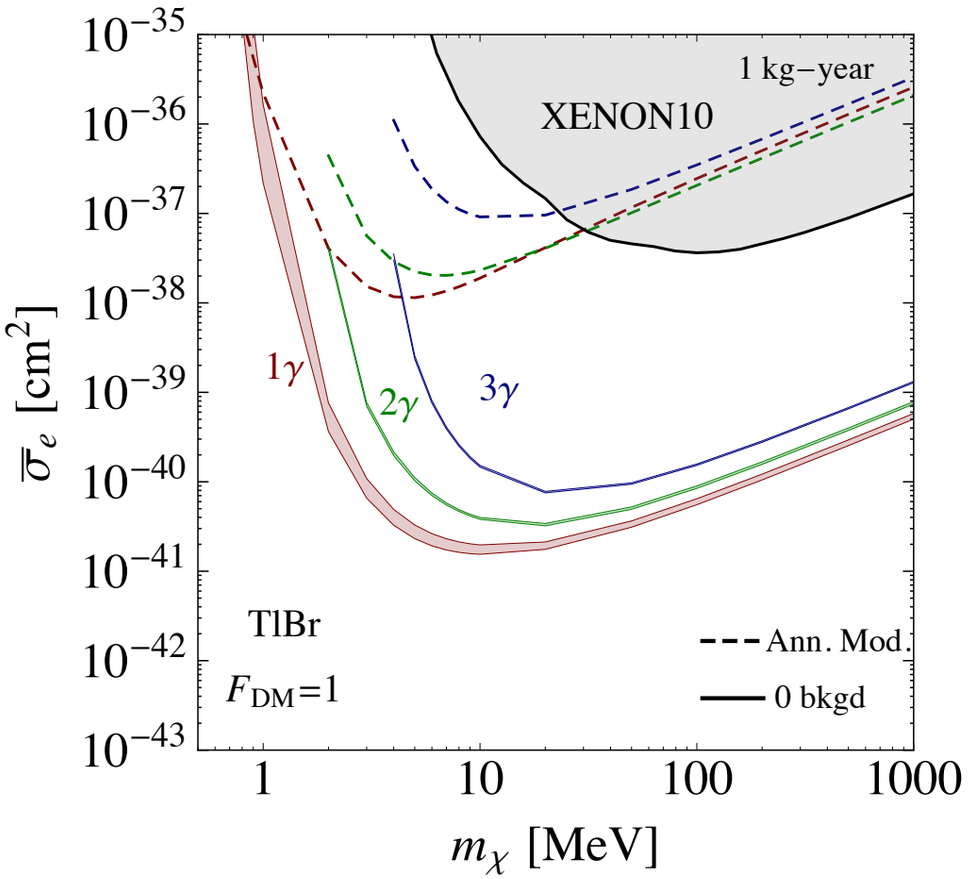
Si 1.00



annual modulation

preliminary





challenges

- growing the crystals
- purity of crystal
- BACKGROUNDS

backgrounds

- contaminants in detector material
- TlBr, NaI, CsI have no long lived isotopes
- but Rb, K can be present in trace amounts
- 1 microgram of Rb-87 can produce several single photon events per year