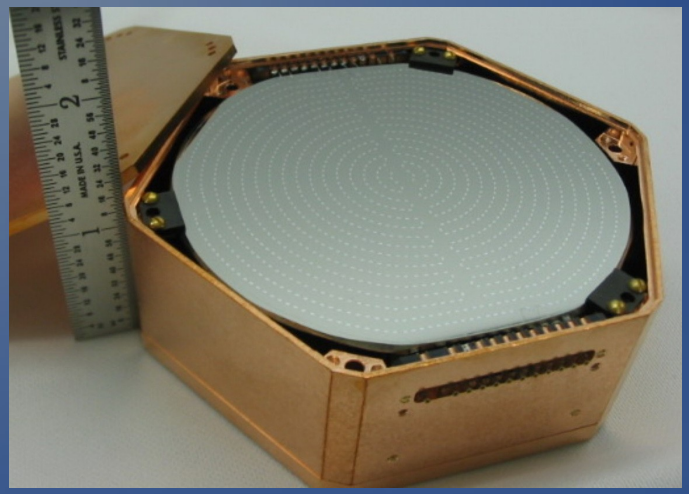
Cryogenic Dark Matter Search

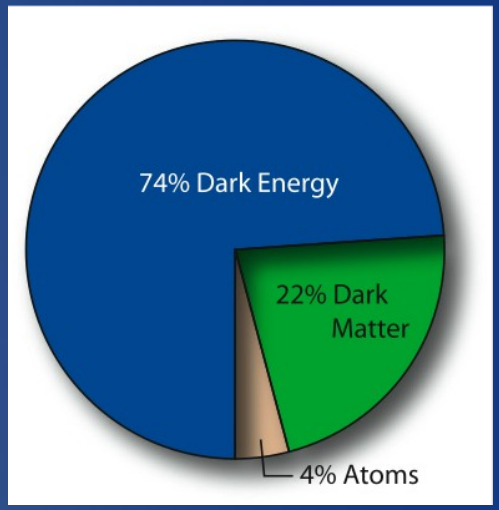
Current Status & Future Plans



Todd Doughty
Cosmology in Northern California
Lawrence Berkeley National Laboratory
October 22, 2010

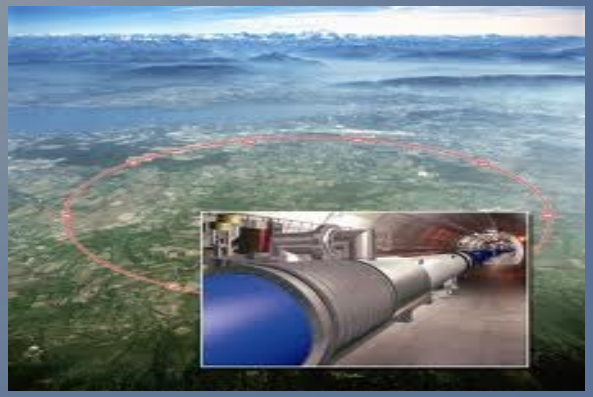
Motivation for WIMP Search

- Significant Portion of Mass Density of Universe

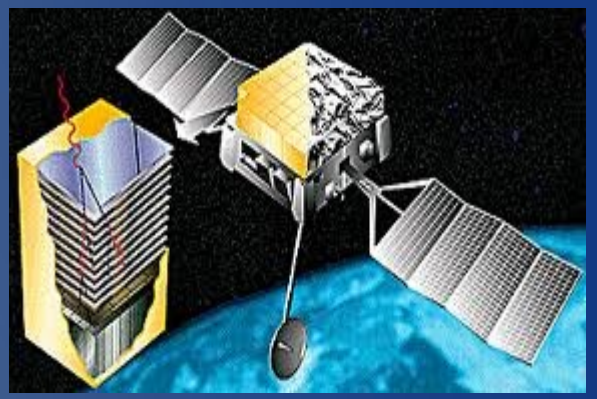


- Convergence of Particle Physics & Cosmology
  - Relic DM Density $\longrightarrow \sigma_{DM} \approx \sigma_{WF}$

Three Types of Searches



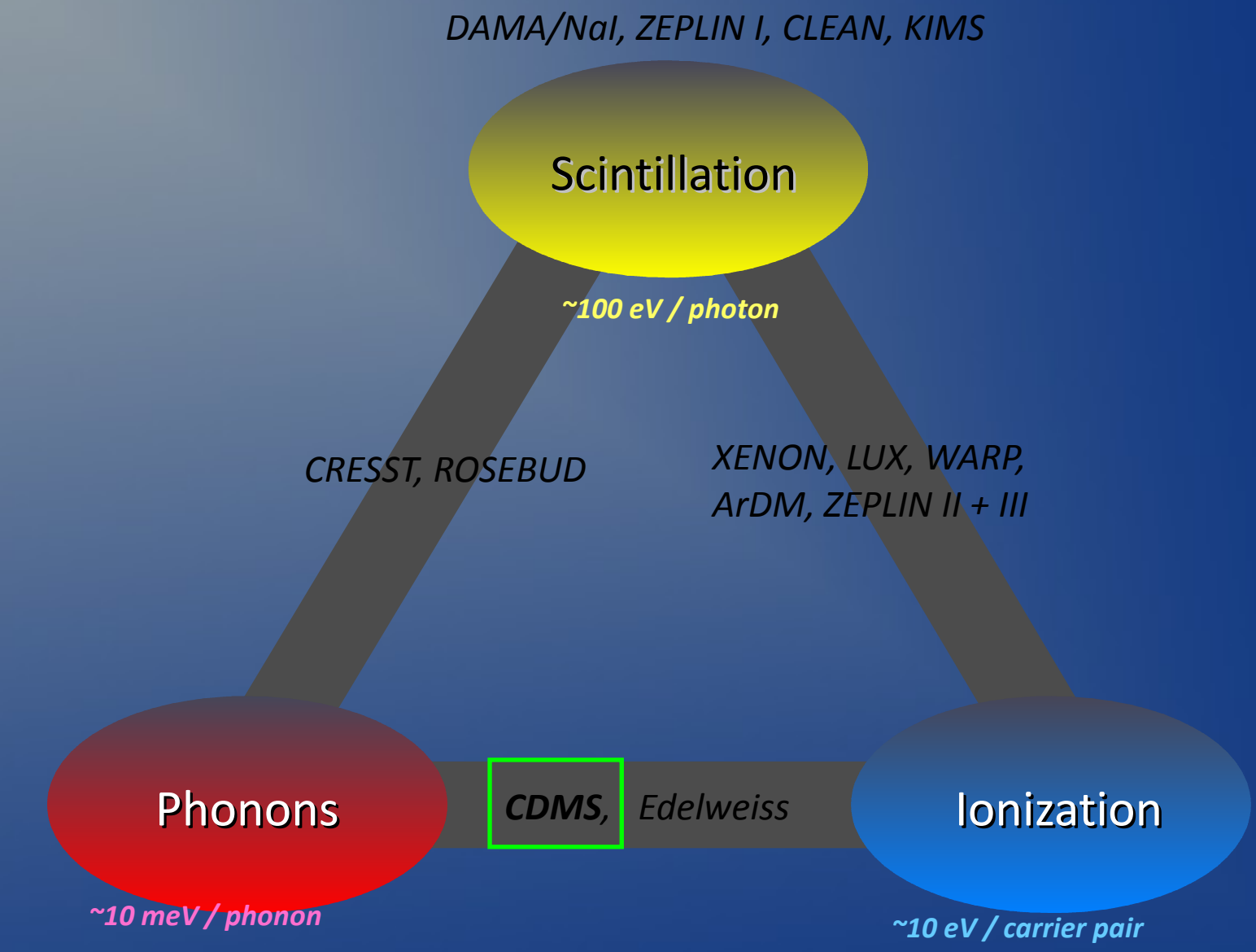
Production
(LHC)



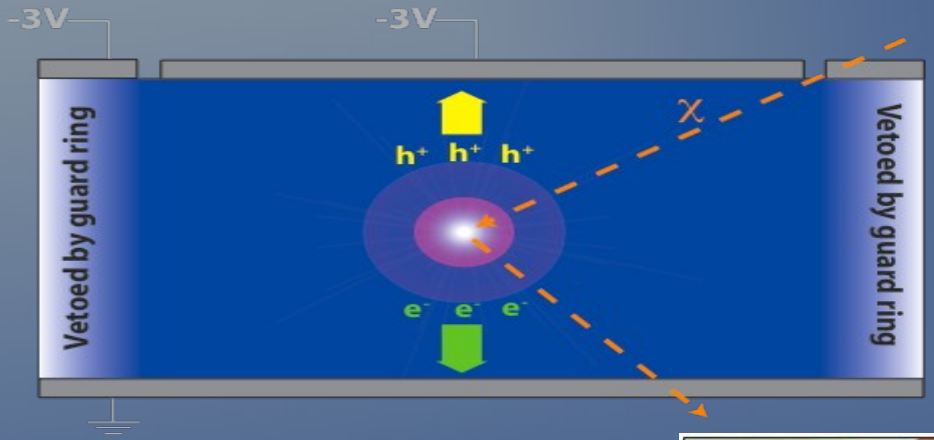
Indirect Detection
(Fermi, Pamela)

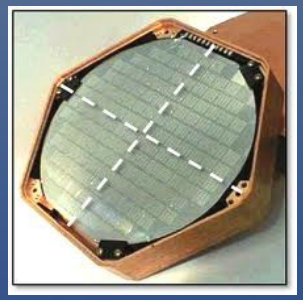
Direct Detection
(CDMS, XENON)

Direct Detection Methods



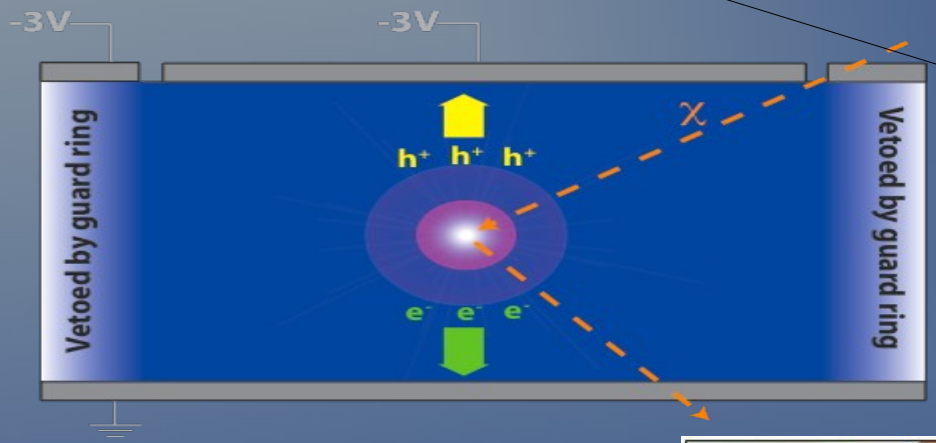
CDMS Detectors

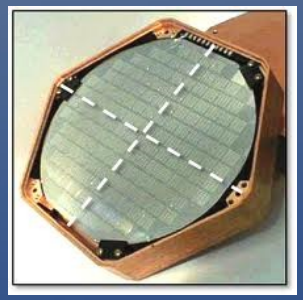


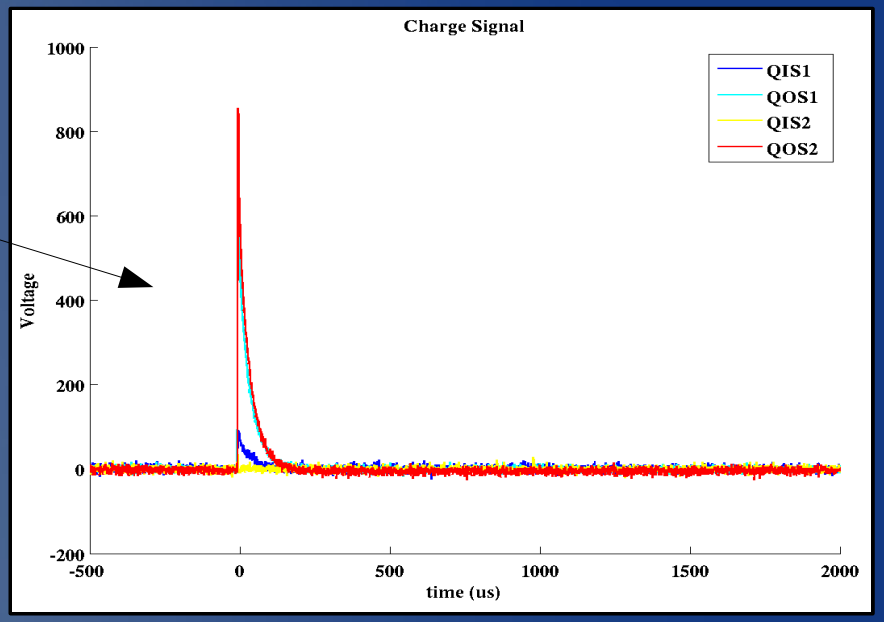


CDMS Detectors

Charge Signal

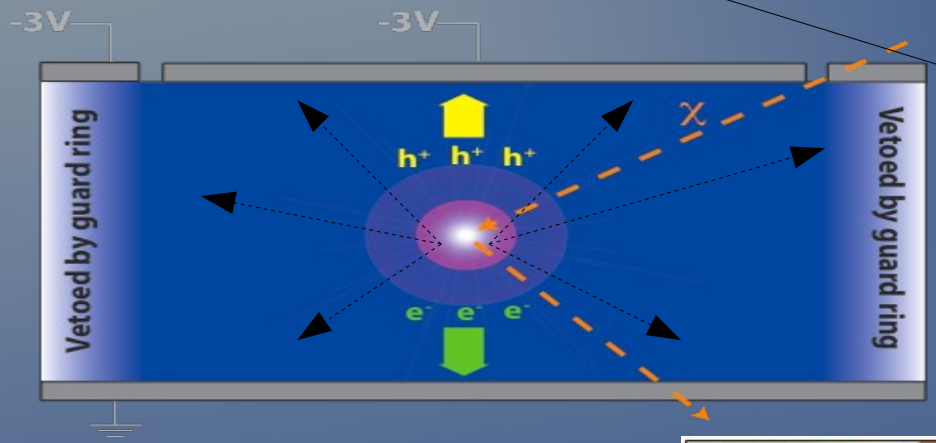




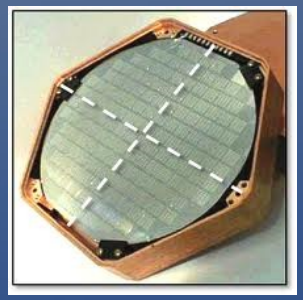


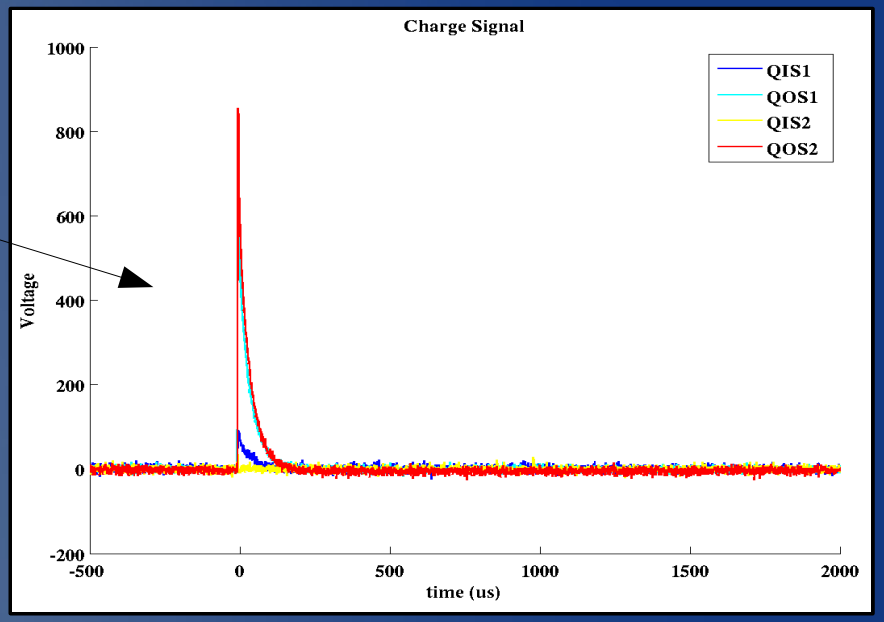
CDMS Detectors

Charge Signal



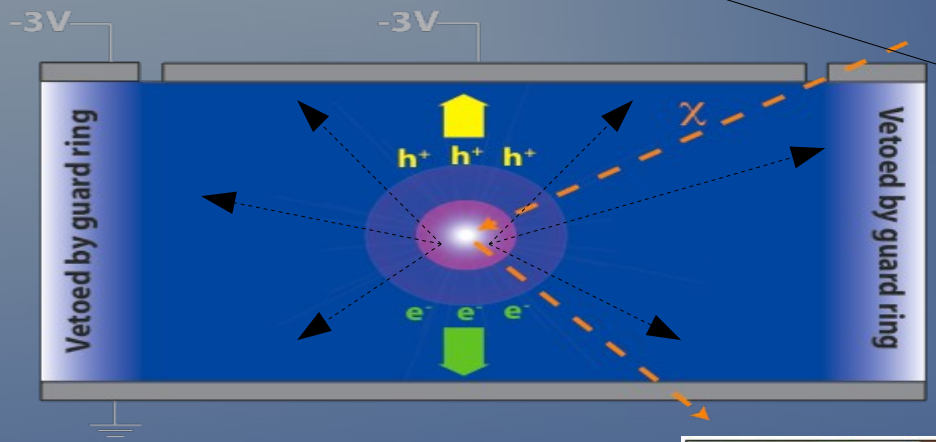
Phonon Signal

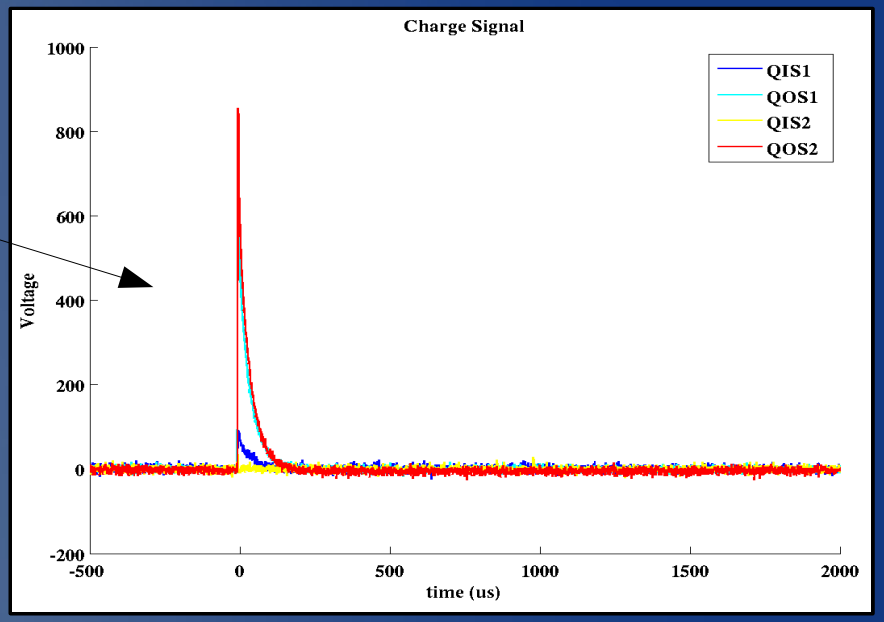




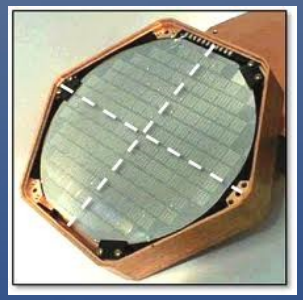
CDMS Detectors

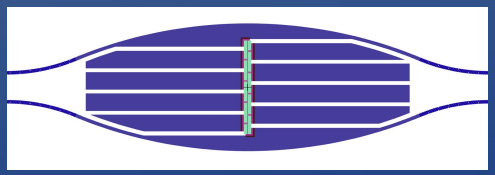
Charge Signal





Phonon Signal

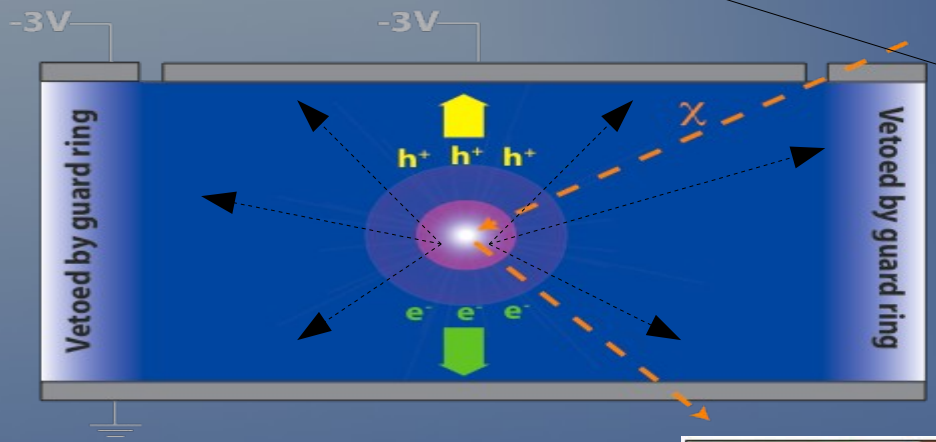




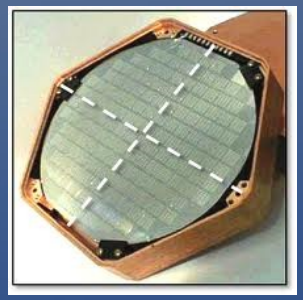
Transition Edge Sensor

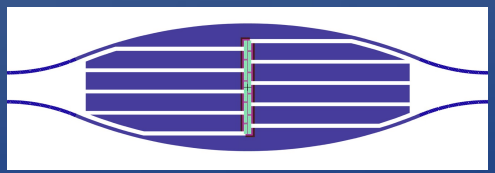
CDMS Detectors

Charge Signal

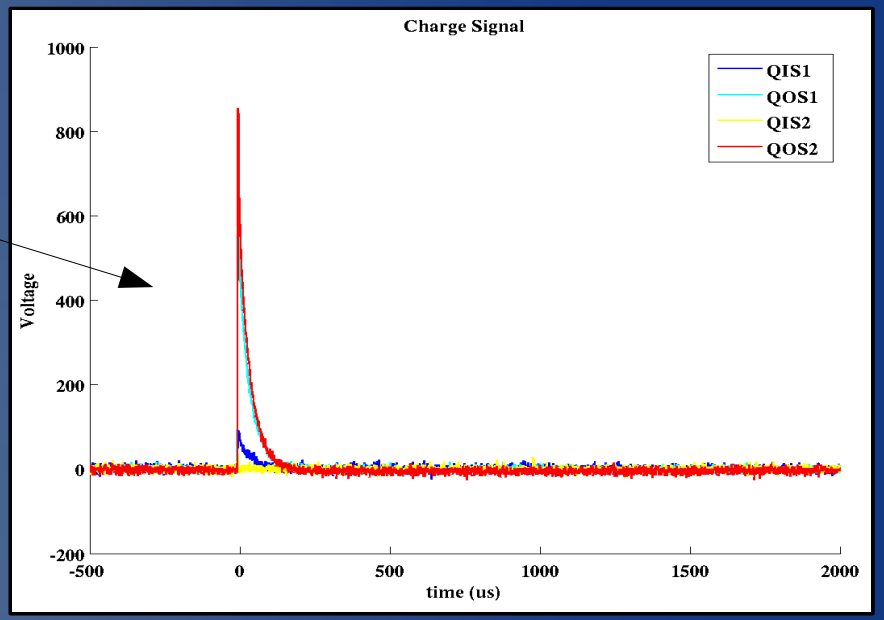


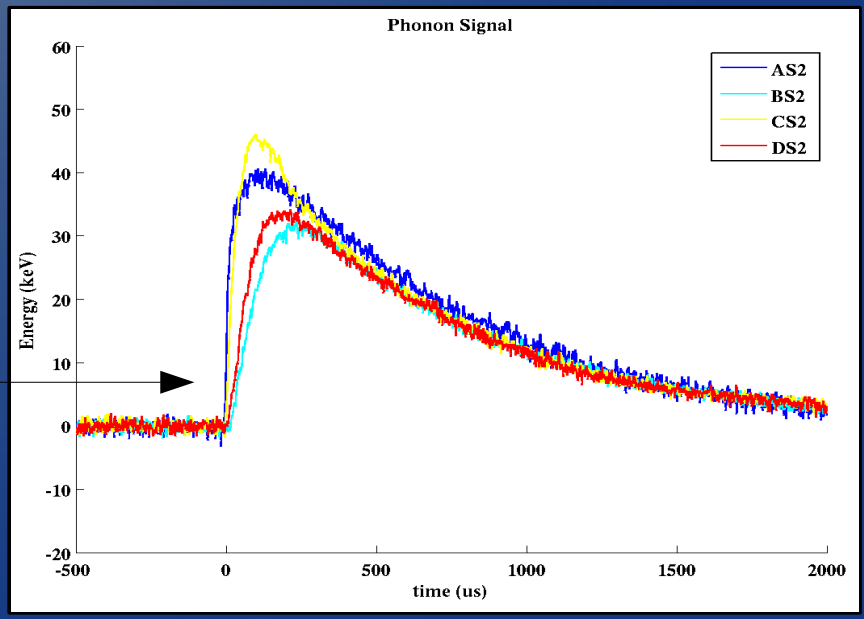
Phonon Signal





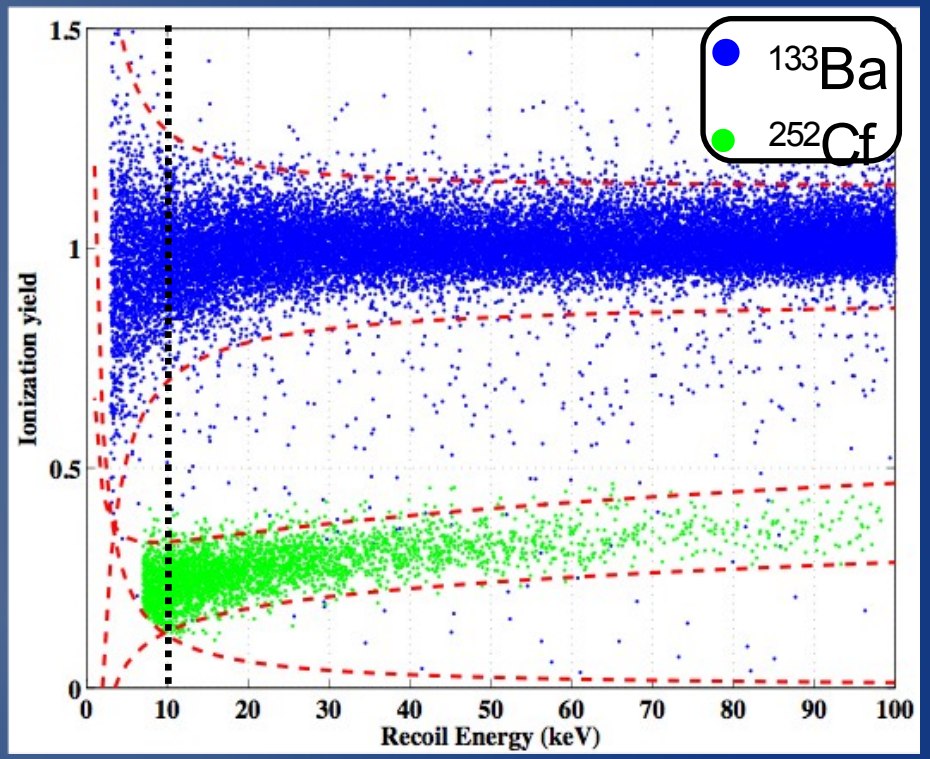
Transition Edge Sensor





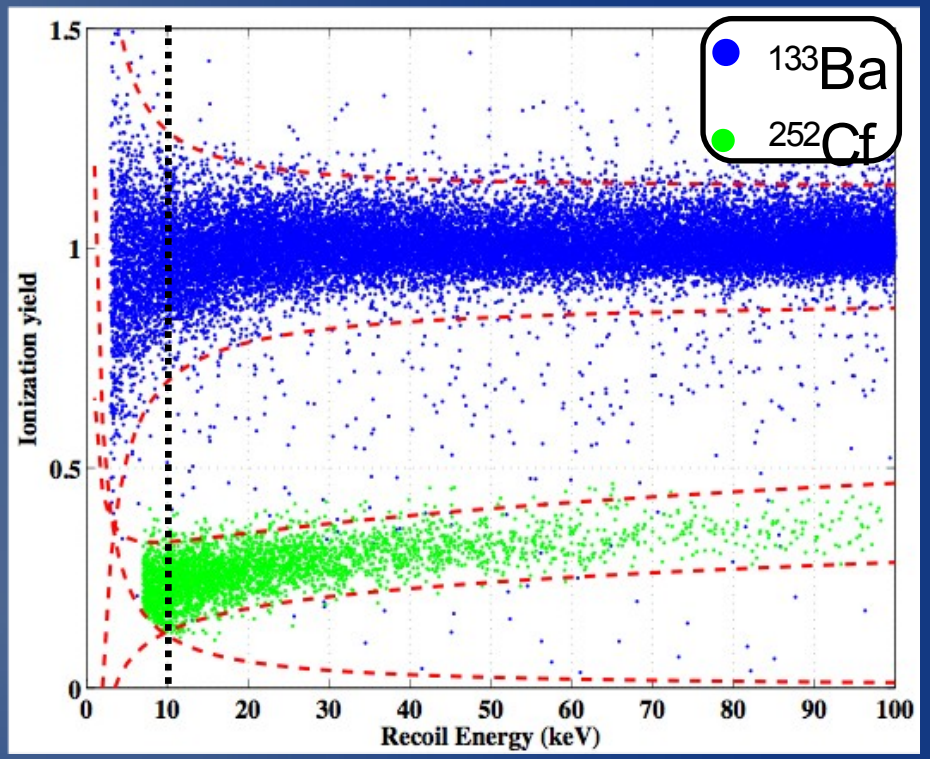
Background Discrimination

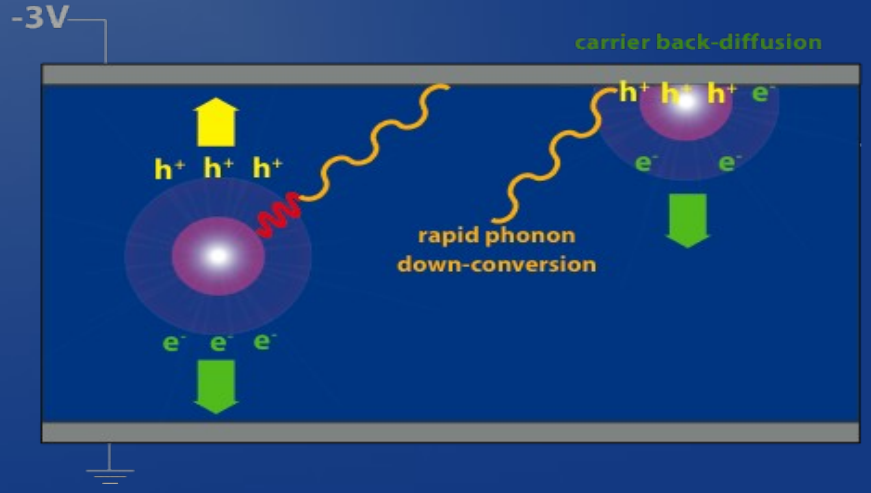
- Each Event
- Multiple Dimensions
  - Ionization Yield



Background Discrimination

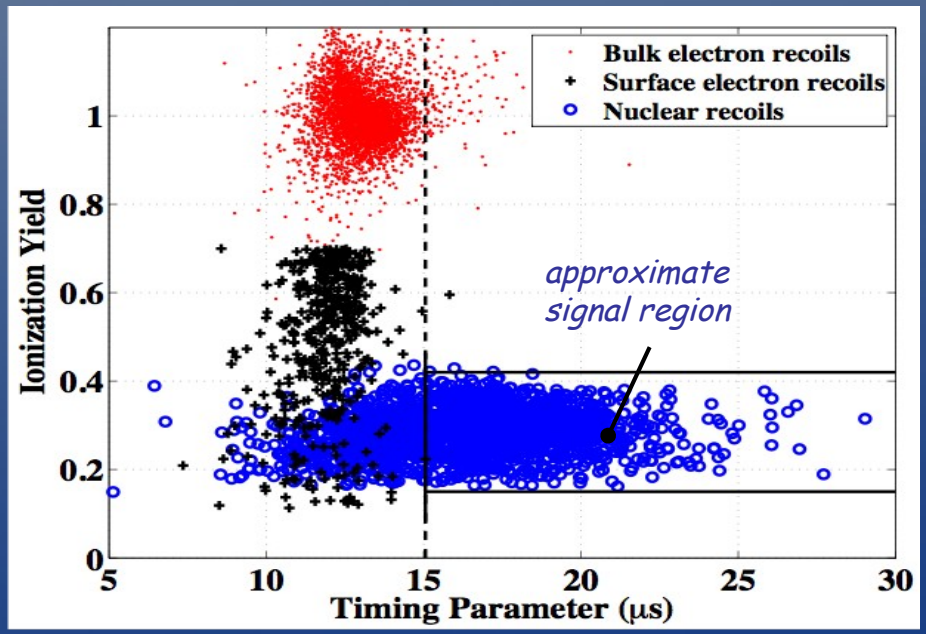
- Each Event
- Multiple Dimensions
  - Ionization Yield

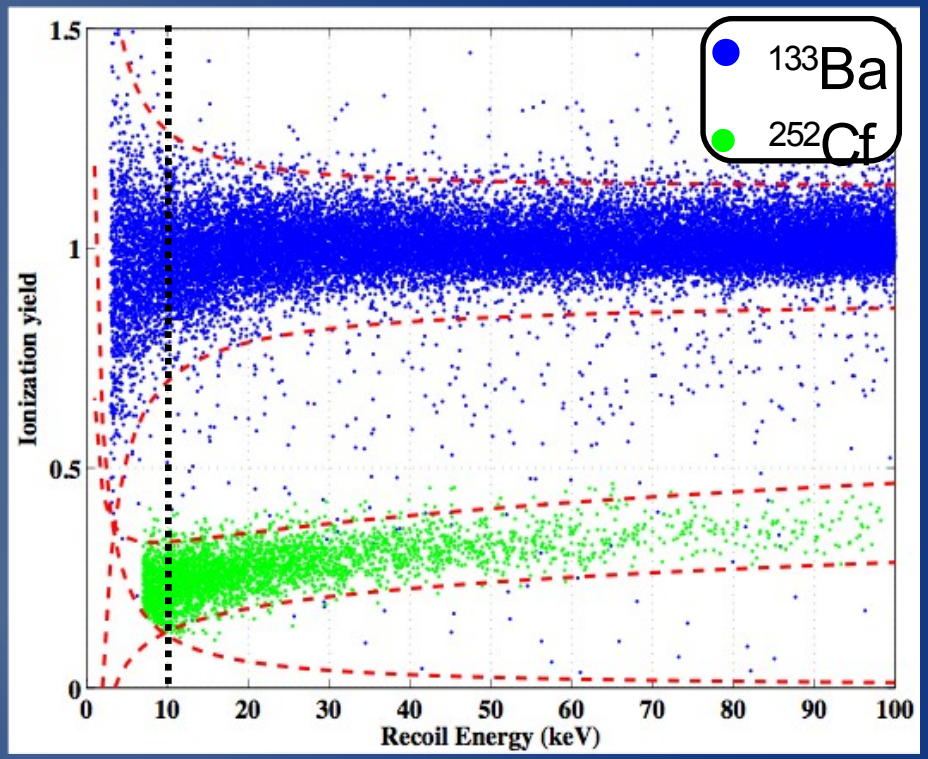


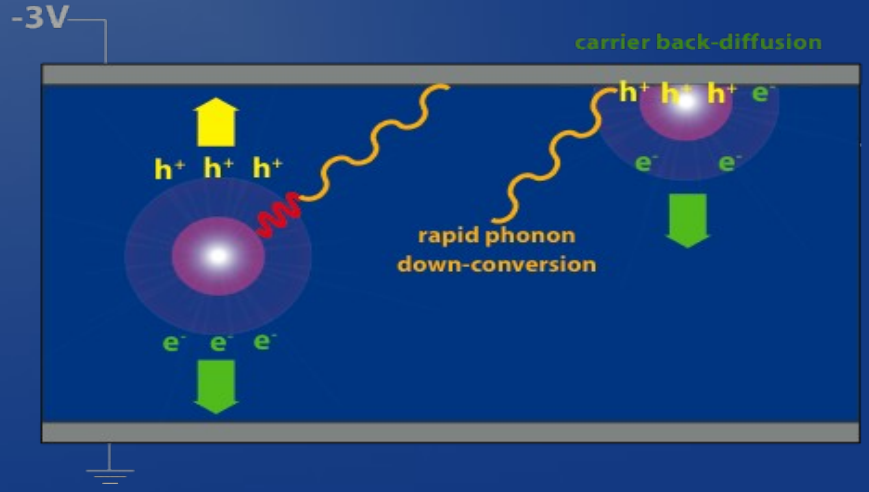


Background Discrimination

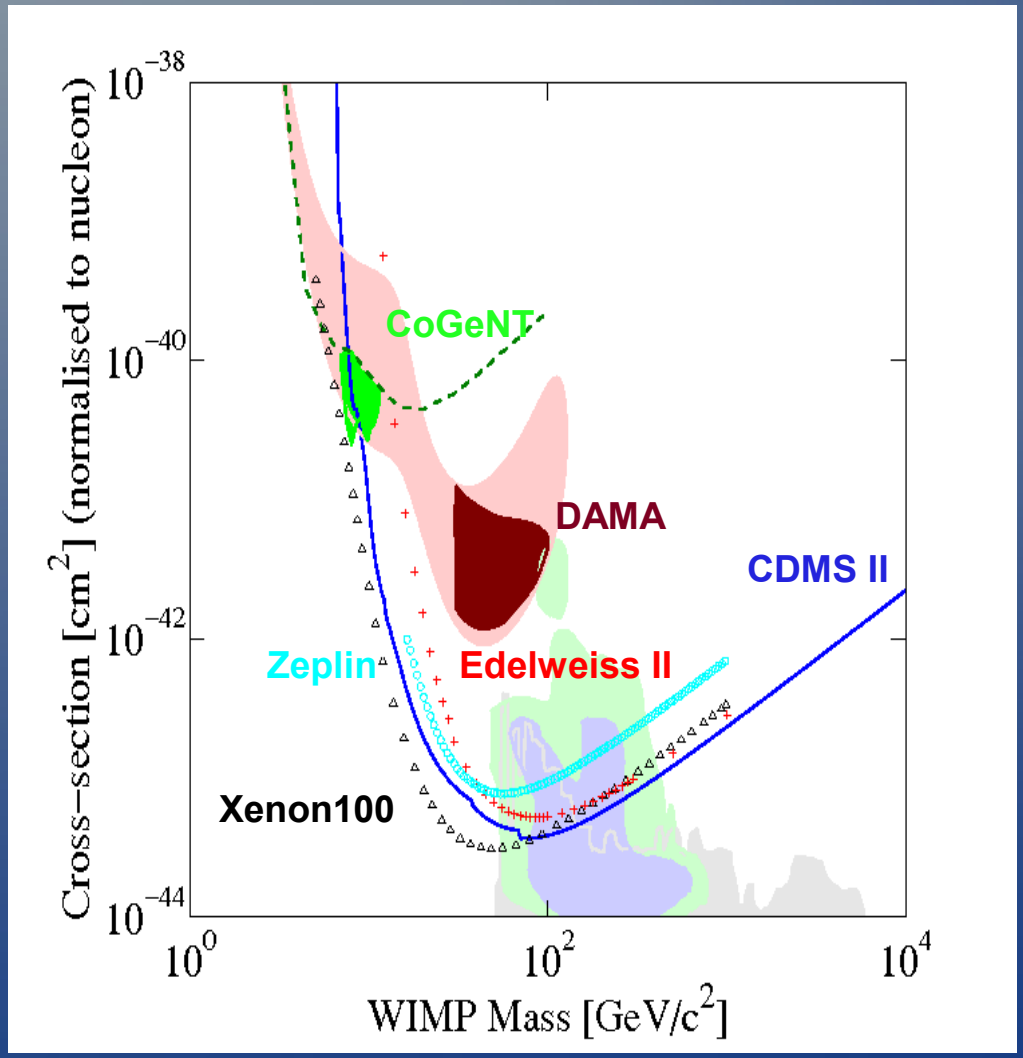
- Each Event
- Multiple Dimensions
  - Ionization Yield
  - Phonon Timing







CDMS II: Results



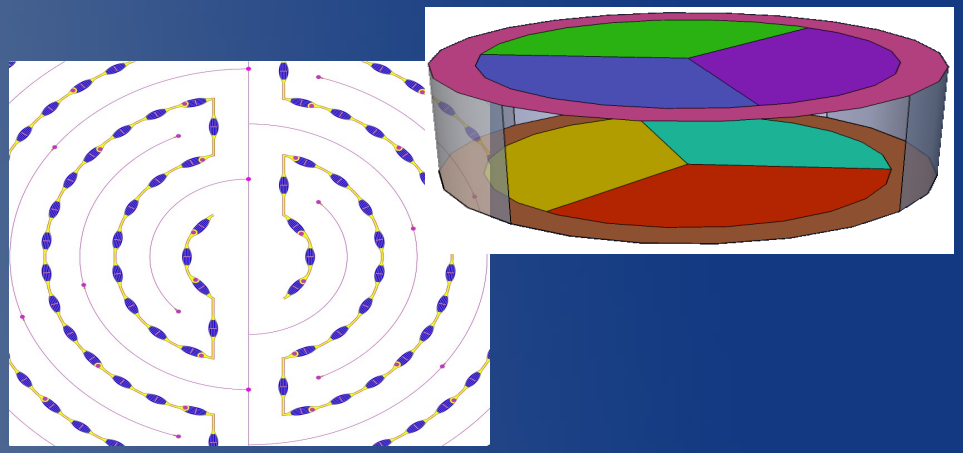
- Final Results – 2009
  - 2 events in NR Band
  - Estimate Leakage: 0.9 ± .3 events
  - 23% chance both events not Wimps
- Analysis can't be significant evidence for Wimps, but neither event can be rejected
- Z. Ahmed et al., *Science* Vol. 327, no. 5973 (2010)

IZIP Detector

- Primary background
  - Surface Events

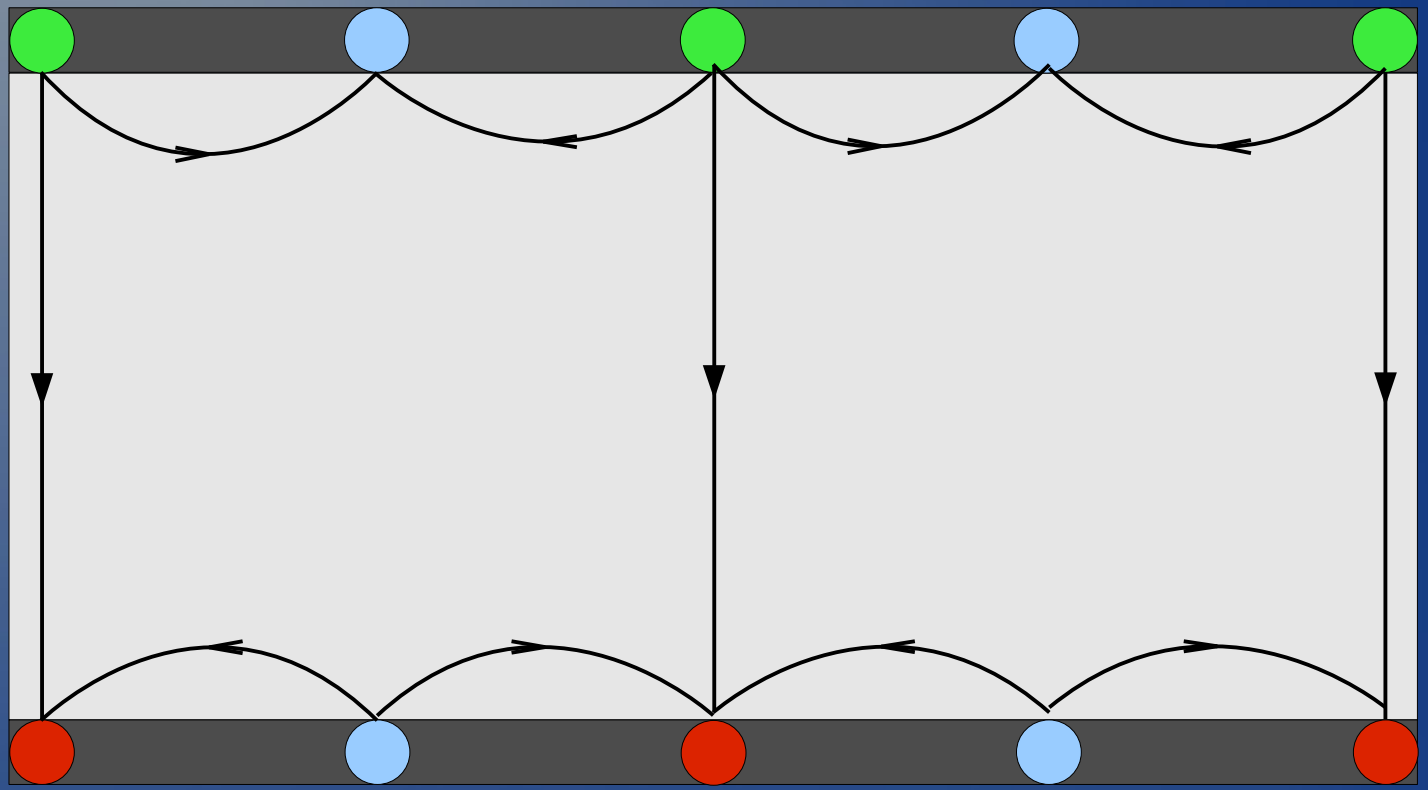
IZIP Detector

- Primary background
  - Surface Events
- New Detector - IZIP
  - Interdigitated Electrodes



IZIP Detector

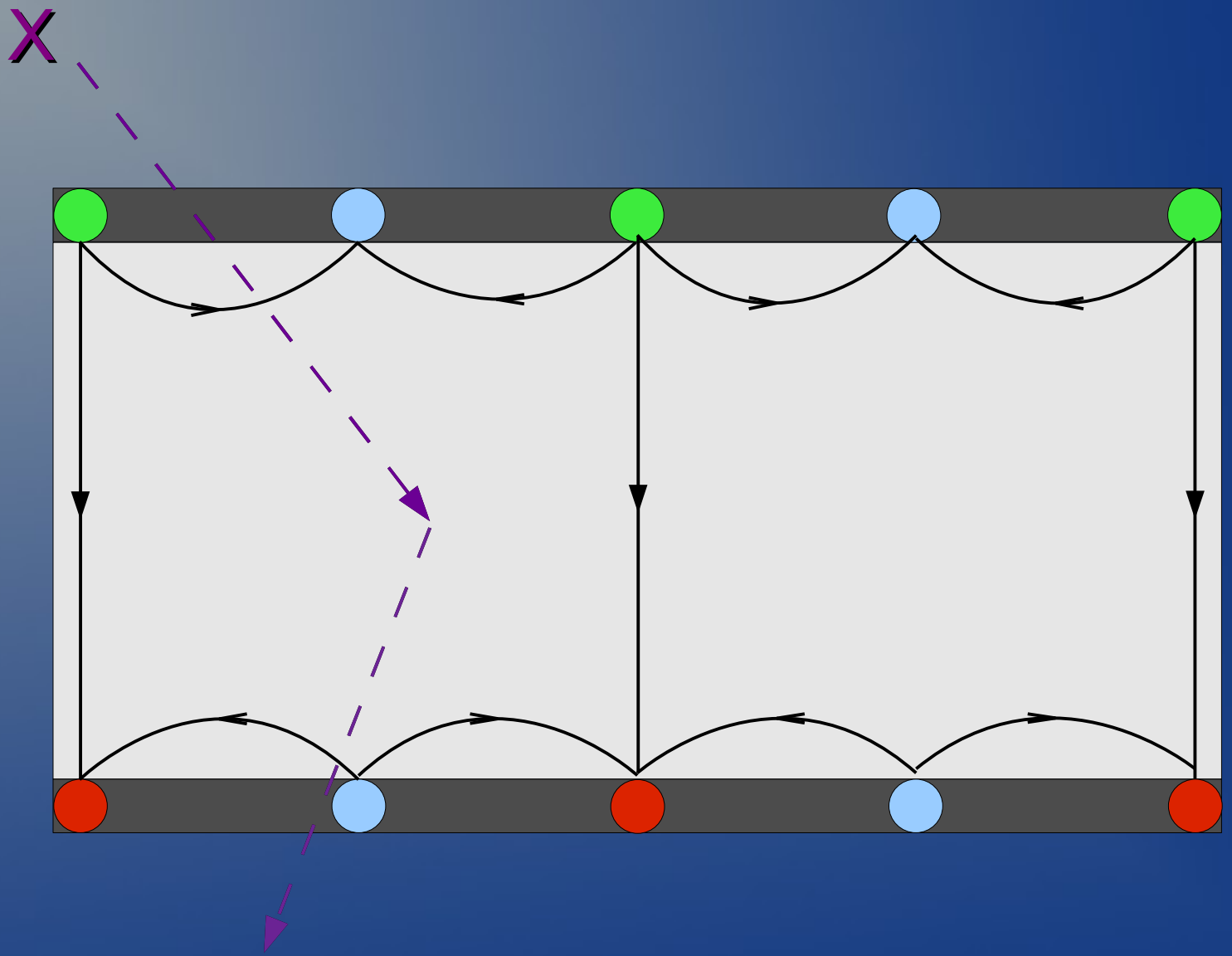
Side 1 Charge Electrode +2V



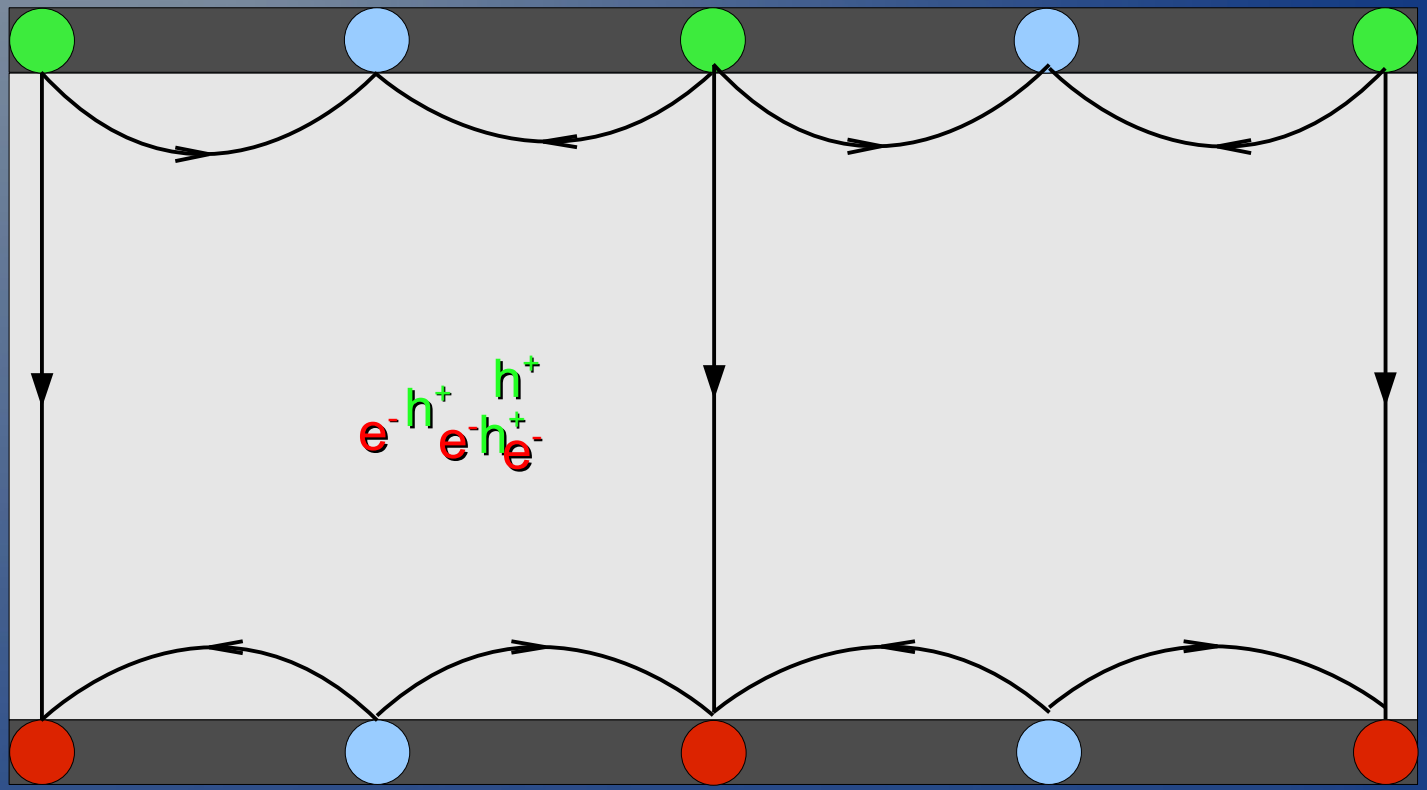
Phonon Rail 0V

Side 2 Charge Electrode -2V

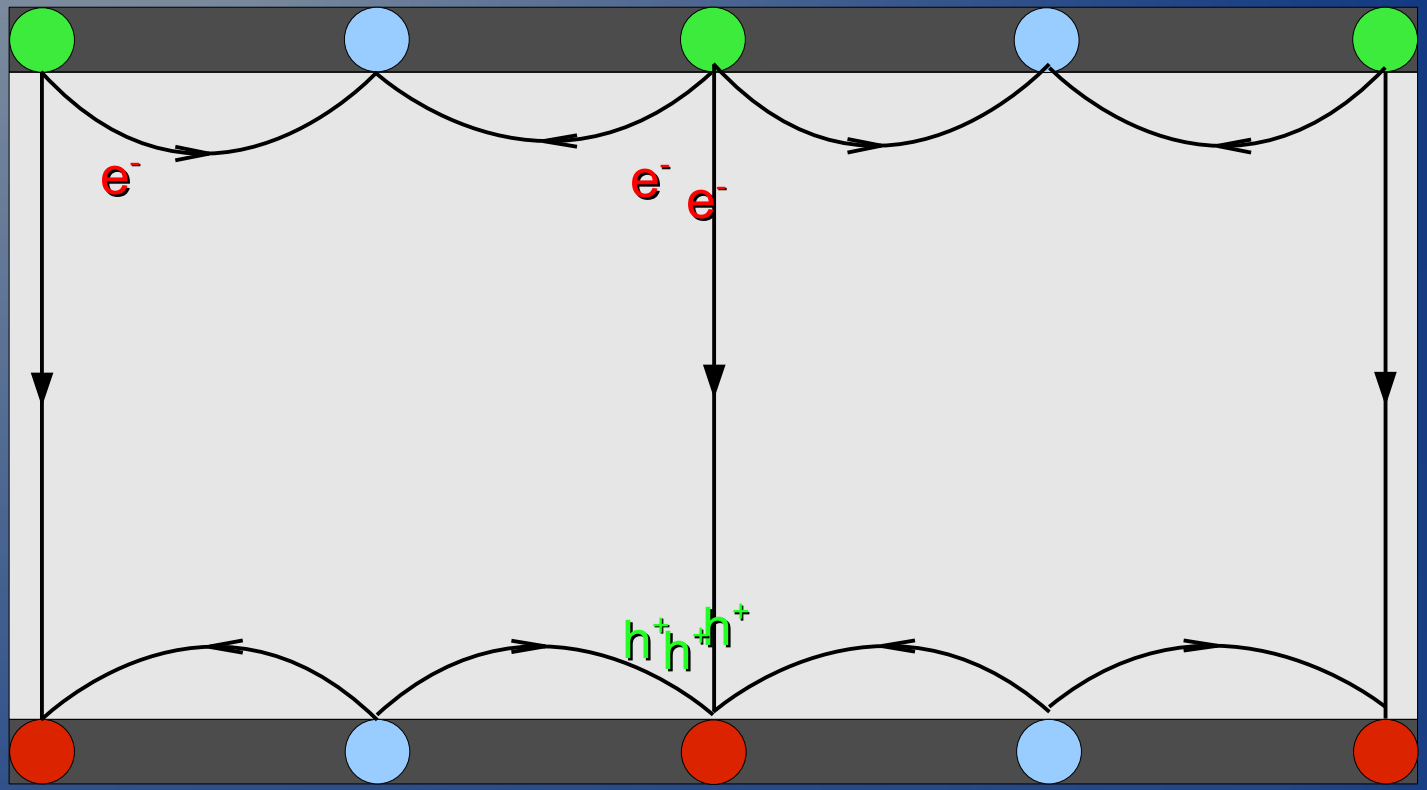
IZIP Detector



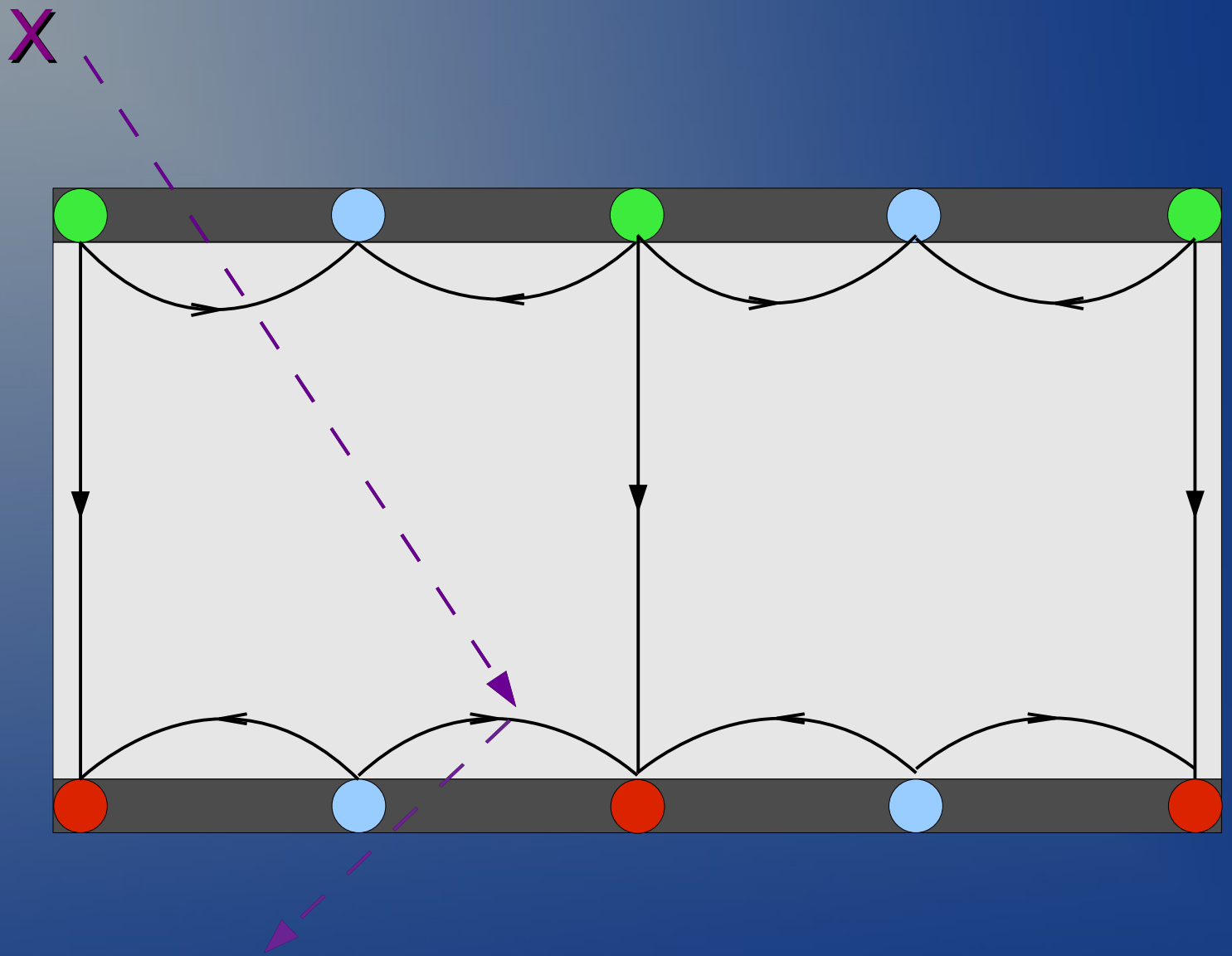
IZIP Detector



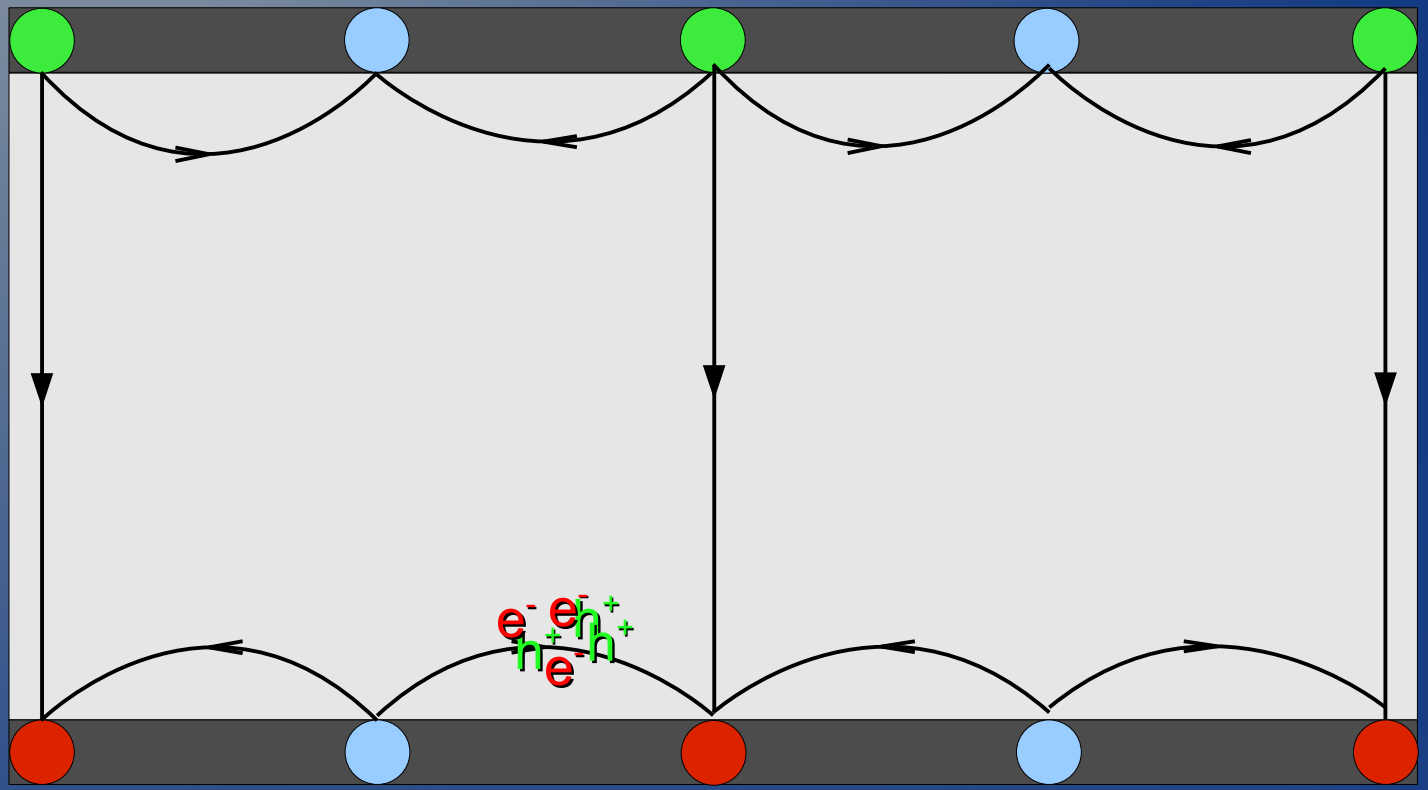
IZIP Detector



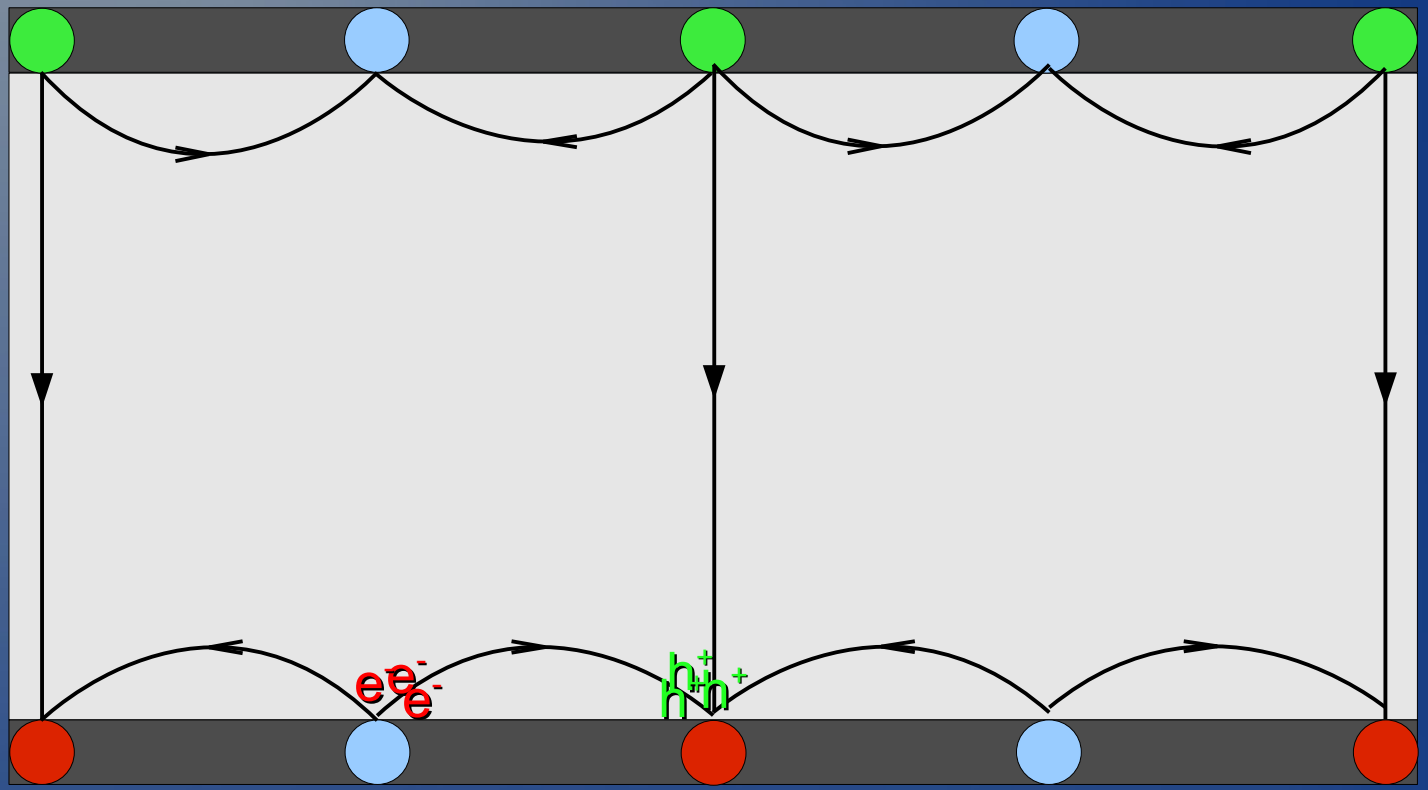
IZIP Detector



IZIP Detector

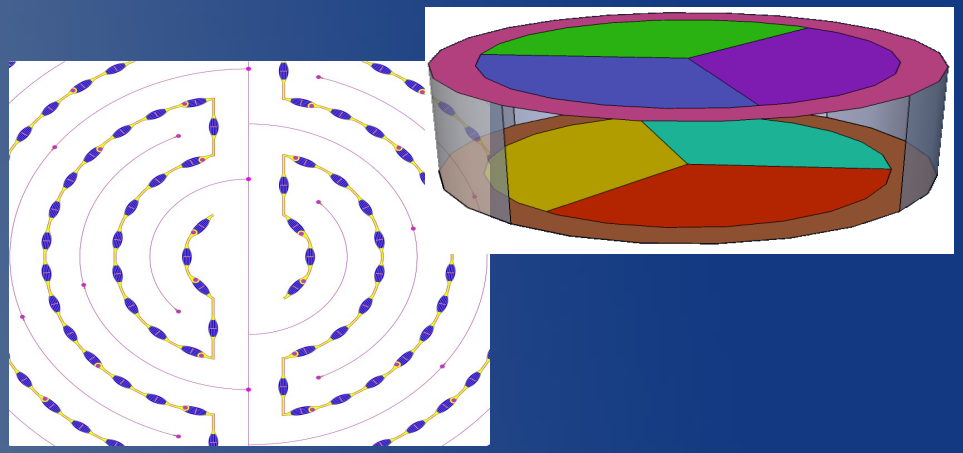


IZIP Detector



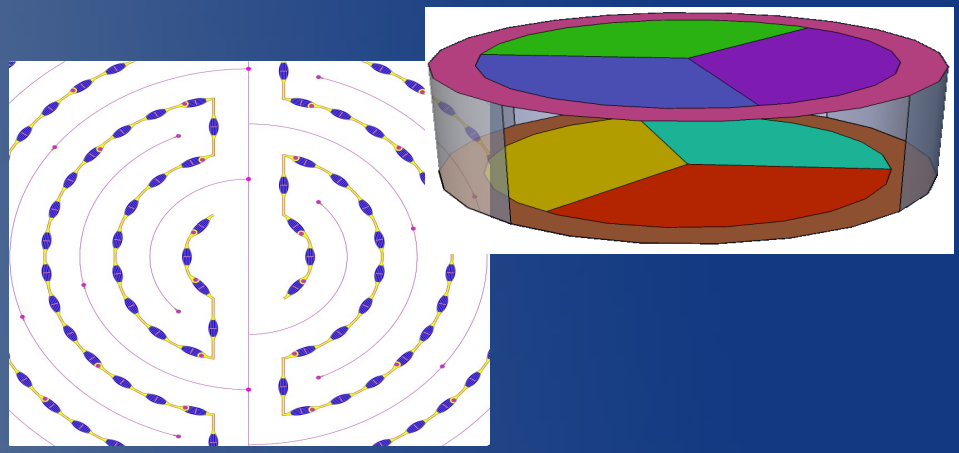
IZIP Detector

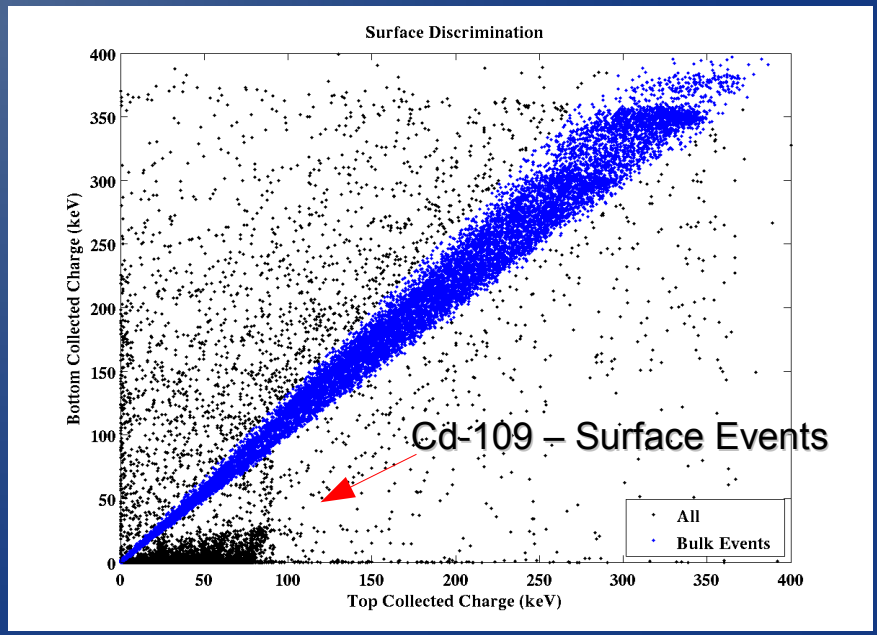
- Primary background
  - Surface Events
- New Detector - IZIP
  - Interdigitated Electrodes



IZIP Detector

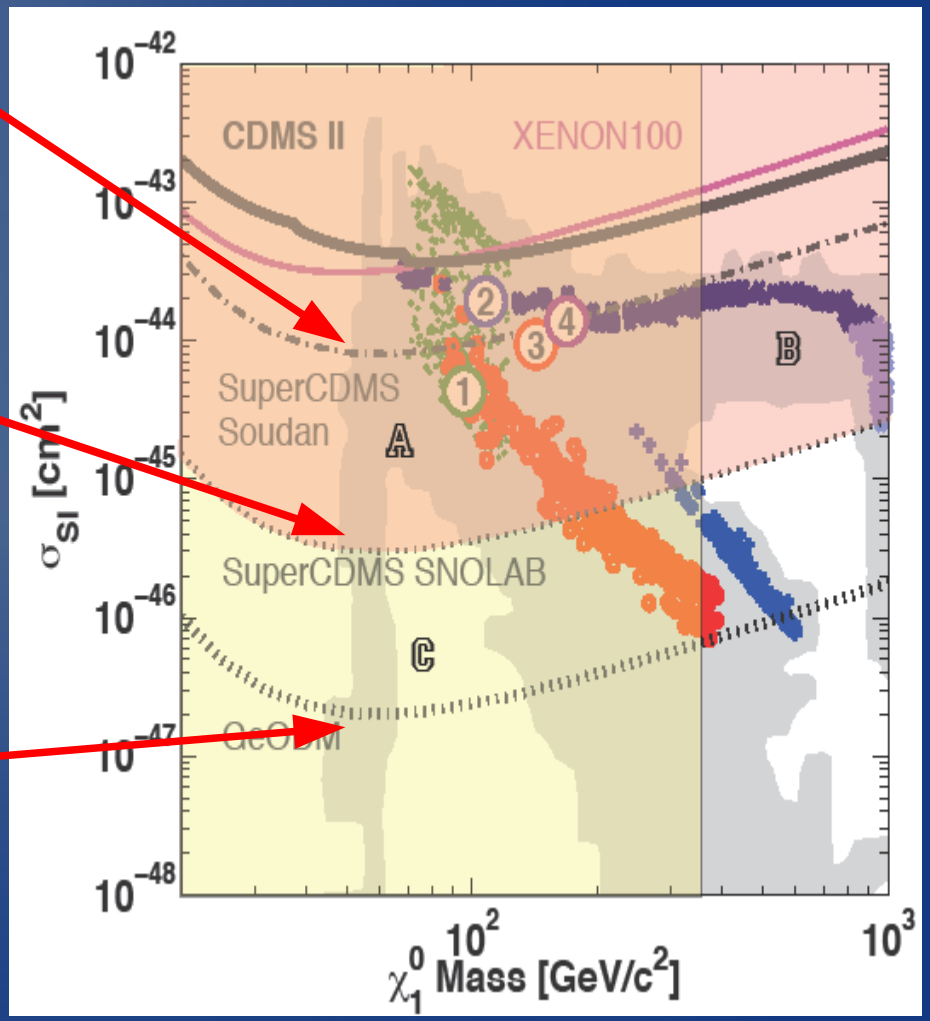
- Primary background
  - Surface Events
- New Detector - IZIP
  - Interdigitated Electrodes
  - 1000:1 rejection





Future Plans

- SuperCDMS Soudan
  - 10 kg Ge
  - 2 years
- SuperCDMS SNOLab
  - 100 kg Ge
  - 3 years
- GEODM DUSEL
  - 1.5 Tons Ge



SuperCDMS Collaboration

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