GEODM SCREENING REQUIREMENTS

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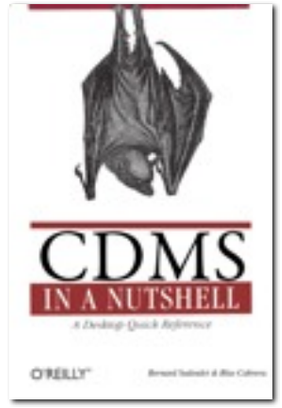
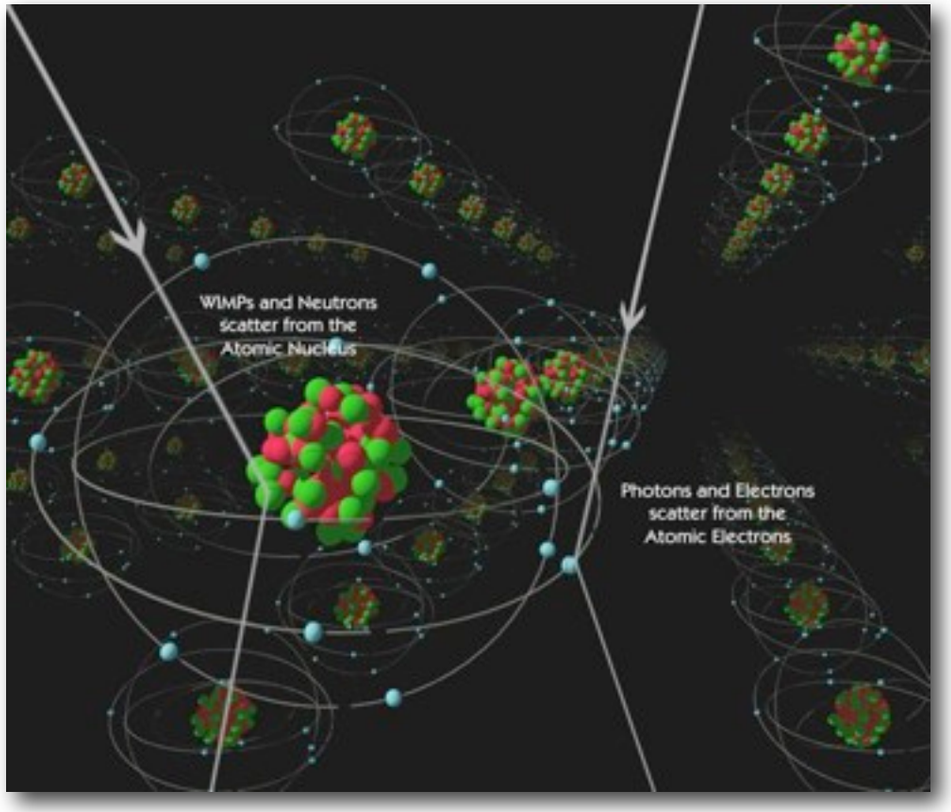
GEODM COLLABORATION

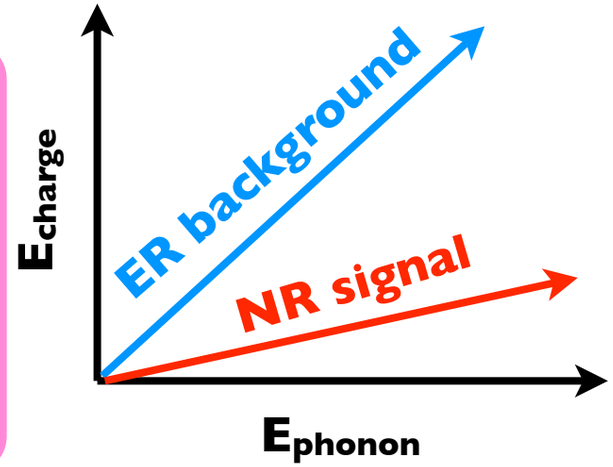
THE BIG PICTURE



Use a combination of **discrimination** and **shielding** to maintain a **<1 event expected background** experiment with **low temperature** semiconductor detectors



Discrimination from measurements of **ionization** and **phonon energy**.



Keep backgrounds low as possible through shielding and material selection.

PROGRAM OVERVIEW

- **CDMS II (finished)**
  - **Last cdms II data taken March 18, 2009**
- **SuperCDMS @ Soudan (funded)**
  - **March 19, 2009: warm up to install and commission first SuperCDMS detectors**
  - **Currently commissioning detectors for an engineering run**
  - **Fabrication of remaining detectors for SuperCDMS Soudan (~12 kg Ge) project underway**
- **SuperCDMS SNOLAB (PASAG endorsed)**
  - **Project proposal in 2011 for ~100 kg Ge experiment**
- **GEODM (NSF DUSEL S4 funded)**
  - **1.5 ton Ge experiment [proposed for DUSEL]**

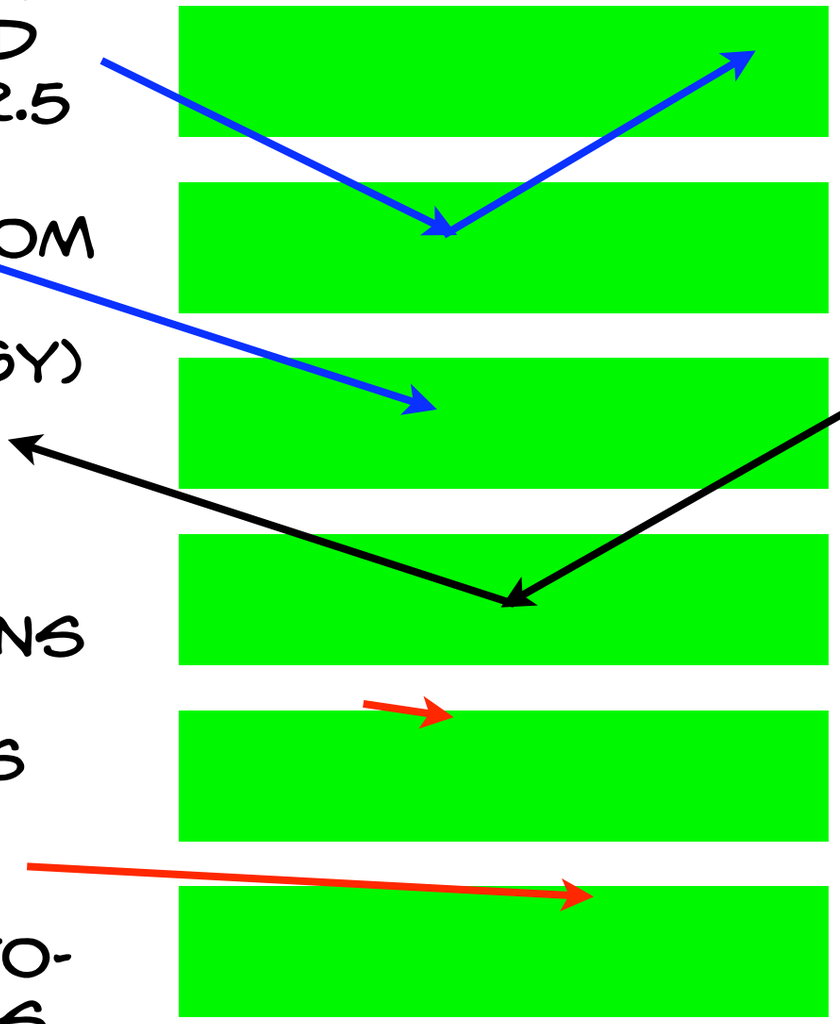
BACKGROUND TYPES

PHOTONS

- PRIMARILY COMPTON SCATTERING (BROAD SPECTRUM UP TO 2.5 MEV)
- SMALL NUMBER FROM PHOTOELECTRIC EFFECT (LOW ENERGY)

SURFACE EVENTS

- RADIOGENIC: PHOTONS/ELECTRONS EMITTED MOSTLY FROM ^{210}PB DECAYS
- PHOTON INDUCED: INTERACTIONS OF PHOTONS OR PHOTO-EJECTED ELECTRONS IN DEAD LAYER



NEUTRONS

- RADIOGENIC: FISSION AND α-N INTERACTIONS MATERIALS SURROUNDING DETECTORS
- COSMOGENIC: SPALLATION OF NUCLEI IN SURROUNDING MATERIALS BY COSMIC RAYS

BACKGROUND TARGETS

Background Type	Current Level [/kg/d]	Desired Level [/kg/d]
Bulk EM	296	45
Surface EM	3.4	0.10
Radiogenic Neutrons	1.2×10^{-4}	4.0×10^{-7}

EM BACKGROUNDS

- **Photon Backgrounds**
  - **Significant reductions due to surface area/volume ratio via increased detector mass**
  - **Improvement in rejection capability of advanced iZIP detector design**
- **Beta Backgrounds (Surface Events)**
  - **Significant reduction due to surface area/volume ratio via increased detector mass**
  - **Improvement in rejection capability of advanced iZIP detector design**
  - **No reduction in ^{210}Pb needed beyond what has been achieved with the CDMS II detectors**

BIGGEST CONCERNS
(SNOLAB & GEODM)

- **Copper - Will OFHC copper be good enough or do we need electroformed copper to meet the requirements for radiogenic neutrons.**
  - **Copper is used as a gamma shield and for the cryostat.**
- **Which moderator to use.**
  - **Gammas resulting from U/Th (in poly) not such a big issue as it would reside outside the shield.**
  - **Neutrons from U/Th could be troubling if they are emitted close in to the inner edge of the moderator**
  - **Study of contamination levels in poly**
  - **Consideration of using a water tank or active scintillator moderator**

RADIOGENIC NEUTRON BACKGROUNDS

GEODM Goal:
4×10^{-7} [single n/kg/d]

	Measured Level CDMS II	Predicted bkgd [single n/kg/d]
Cryostat Cu	0.2 ppb U 0.6 ppb Th	7.4×10^{-5}
Pb in shield (upper limit)	(50 ppt U) (200 ppt Th) [1 ppt U/Th Heusser]	(3×10^{-4})
Polyethylene (upper limit)	0.2 ppb U 0.2 ppb Th	1.6×10^{-5}

WHAT ARE WE USING?

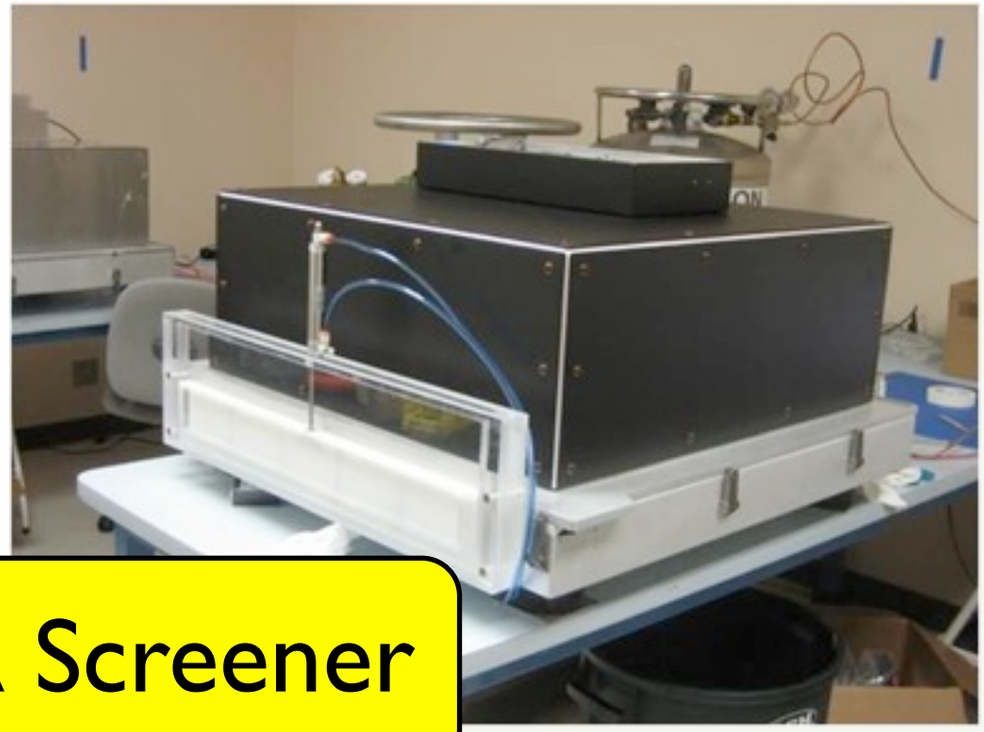
- **Gamma Screening at Soudan (Gopher)**
  - **Sensitivity: ~ 1 mBq/kg**
  - **Limited by ^{210}Bi in shield, rebuild planned for 12/2010**
- **Alpha Screening at Fermilab (XIA prototype)**
  - **Sensitivity: ~ 0.002 counts/cm^2/day**
  - **Study radon plate-out, Copper Cleaning, Witness Samples, etc.**
- **ICPMS**
  - **~5 ppt U/Th (Laurentian University), limited resources**

IN THE FUTURE WE PLAN TO ADD

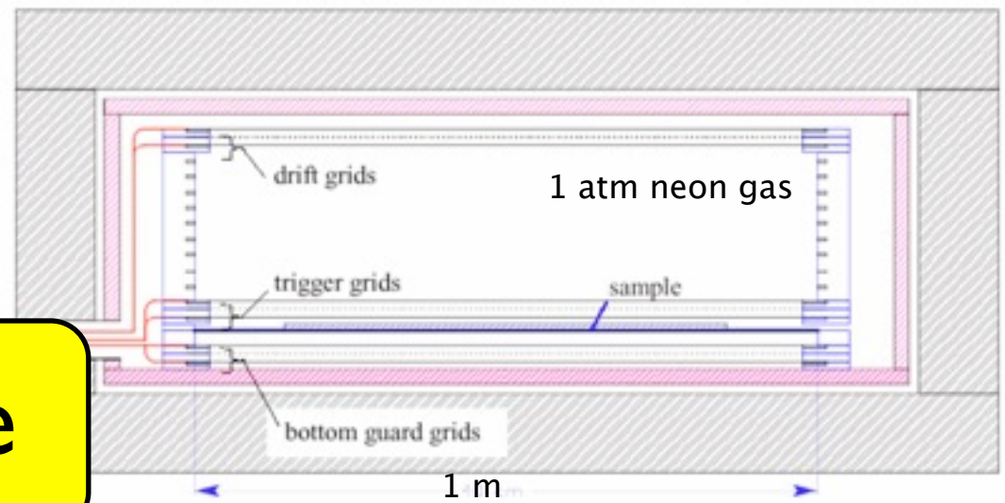
- **Betacage**
  - **Direct counting of surface contamination**
  - **Prototype starts summer 2011 in Soudan**
  - **Radiopure version expected Oct 2011 with sensitivity ~10^{-5} counts/kg/cm^2/day for $E_\beta \approx 0$ - 200 keV**
- **Second Alpha Screener**
  - **Initially located at SMU**
  - **Production model with adjustable inner electrode.**

OUR SCREENERS

Gopher



XIA Screener



Betacage

WHAT WOULD WE LIKE FOR EARLY SCREENING?

- **Betacage**
- **HPGe counters**
- **???**