Cryogenic Dark Matter Search (CDMS)

Progress at Soudan since last summer
  Successful run with 5 towers

Prospects at Soudan
  Continued data taking with 5 towers (4 kg Ge)

The Future - SuperCDMS at SNOLAB
  Larger target mass (25 kg) and lower backgrounds

All experimenters meeting - April 23, 2007
Dan Bauer - CDMS Project Manager
Cryogenic and Detector Upgrades

- **Cryogenics Upgrades**
  - Better vacuum to improve stability, decrease maintenance
  - Better control and monitoring, more robust against power outages (UPS and generator installed)
  - Improve cooling at 4K with cryocooler on electronics stem; reduce LHe consumption, costs; had to deal with vibration problems

- **Detectors**
  - Three new towers installed (each with 6 detectors); total of 4.5 kg Ge, 1 kg Si
  - Thermal connections to refrigerator improved
Commissioning of the 5 Tower System
July-September 2006

- **Detector Tuneup**
  - Optimize SQUID, TES settings
  - Neutralize crystals with LEDs
  - LOTs of calibration data

- **DAQ and online analysis**
  - Handle 80 Hz calibration rate
  - Robust data pipeline to surface
  - Near realtime analysis for data quality monitoring

- **Electronic noise reduction**
  - Systematic work to eliminate unnecessary grounding
  - Eliminate a few strong sources of RF (cordless phones)
  - Reduce 60 Hz harmonics
Data run with 5 towers
October 2006 - March 2007

• Vital statistics
  – Base temperature (40 mK) for ~ 9 months
  – 5 months of high-efficiency data taking (430 kg-days Ge)
    • 107.4 live days for WIMP search (2.7 million events)
    • 36 million gamma calibration events
    • 0.76 million neutron calibration events
    • 4 TB of data

• Blind analysis underway
  – Cuts set using calibration data
  – Expect to open nuclear recoil region this summer
  – Present results at fall conferences
  – Sensitivity should be at least x3 better than present
First Five Tower Run Summary

Published CDMS results

Current sensitivity

Maximum livetime = 85% (limited by cryo servicing need for calibration data)

Average livetime ~ 75%

Dan Bauer - CDMS Project Manager

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A short break for maintenance

- **Warmed up to 4K in mid-March**
  - Serviced vacuum pumps, clean 3He/4He mixture
  - Eliminated partial obstruction in dilution unit
- **Successfully back to base temperature by end of March**
  - Addressing some low-level electronics noise (60 Hz harmonics)
  - Minor detector retuning; new triggers
  - Backup power completed
Second data run with 5 towers
April 2007 - April 2008

• Aim for another x3 improvement in sensitivity (~1200 kg-d)
  – Combined x10 better than present limits
  – Or perhaps we might start to see signal

• May start to run into backgrounds at Soudan in 2008
  – Beta backgrounds on some detectors
  – Neutrons from cosmic rays

• If background-free, run 5 towers into 2009
  – Possible to insert first two SuperCDMS towers in 2009
The Future of CDMS at Soudan

The graph shows the cross-section in $cm^2$ (normalized to nucleon) on the y-axis and the WIMP Mass in GeV on the x-axis. The graph includes the CDMS II, Edelweiss, ZEPLIN-1, and DAMA experiments, with SUSY Models and current sensitivity indicated.

Good chance that a WIMP signal begins to appear here!
Vital to remain background-free

- no subtraction
- bkgd subtraction
- zero background

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SuperCDMS Soudan 2009
SuperCDMS 25kg 2012
SuperCDMS 150kg
CDMS II
CDMS 2007
**Current limit T1-2 Aug 04**

**T1 Jan 04**

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SuperCDMS 25 kg at SNOLAB

- Cosmic-induced neutron background will appear at Soudan
  - SNOLAB is x3 deeper; no fast neutrons
  - SNOLAB available in early 2008 (DUSEL much later)
- Further reductions in backgrounds necessary
  - Whole lab is class-2000 cleanroom at SNOLAB
- Increase detector mass by x6 (4 ---> 25 kg)
  - Improved volume to surface (reduce surface backgrounds)
  - Entire detector mass will be Ge (Si no longer needed)
- Improved design for cryogenics system
  - Cryocoolers allow cryogen-free dilution refrigerators!
  - Considerably cheaper to operate, less maintenance
- Goal is x15 improvement in sensitivity
  - We hope to be exploring a WIMP signal by then!