Recent Updates at the Black Hills State University Underground Campus (BHUC)

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Presented by Alan Poon
May 24, 2017
BHUC Location

4850 Level (4300 mwe)

BHUC is at 4380 mwe

BHUC Overview

- Work Area
- Class 1,000 Cleanroom
- Class 10,000 Cleanroom
- Entrance/Bootwash
BHUC Cavern: Dec 2014

Construction time lapse: https://vimeo.com/183890905
Surface Coatings

- Shotcrete
- Two coats of Loxon® Masonry Coating Block Surfacer
- One coat of Macropoxy® 646 Fast Cure Epoxy

BHUC Work Area
BHUC Work Area
BHUC Counting Room

Morgan
Maeve
SOLO
Mordred
Electrical and Network Connections
LN$_2$ Distribution
Purge Nitrogen Distribution
BHUC Sample Purge System
BHUC Care and Feeding

- BHSU faculty and students are currently underground twice a week for sample changes and any troubleshooting that users may require.

- BHSU also tracks training required for underground access and provides guides.
Detector Queue System

- **BHUC tasks**
  1. Grab bio slides
  2. Morgan sample swap: bring MS 123 underground
  3. Increase purge flow to Mordred

- **My Queues**
  - Home
  - Work

- **Smart Queues**
  - Shared with me
    - kjthomas@lbl.gov
      - Mordred (SURF) (1)
      - SOLO (SURF) (1)
      - Morgan (SURF) (1)
      - Maeve (SURF) (1)
      - BHUC tasks (3)
      - Merin (LBNL) (2)
Detectors Underground
Morgan and Maeve

- Operated by Berkeley Low Background Facility
- Pre-screening at LBNL followed by counting underground
- Counting at BHUC since fall 2015

Opening Morgan
SOLO

- Previously at Soudan
- Hosted by LZ collaboration (but may be open to more counting in the future)
- Counting at BHUC since April 2016

Mordred

- Originally operated by CUBED
- Reconfigured with remote pre-amp
- Currently at BHUC since August 2016
Twins

- Two crystals (one movable) in one lead shield
- Operated by BHSU and BLBF
- Expected by the end of 2017, both crystals currently at SURF
Twins
Ge IV

- Operated by USD and UA
- Initially reserved for nEXO use
- Expected by the end of 2017
MALBEK/MAVRACS

- Operated by Majorana Collaboration
- Previously at KURF
- Currently at SURF
- MALBEK will continue noise and DAQ studies and once finished, will be transformed into a low background counting station (MAVRACS)

BetaCage

- Prototype operational at SDSMT
- Neon-gas drift chamber constructed from ultrapure materials.
- The placement of samples inside the chamber, directly under a multiwire proportional counter, provides low threshold, high detection efficiency, and track reconstruction that should greatly reduce backgrounds.
- Sensitivity expected to be $0.1 \text{ betas keV}^{-1} \text{ m}^{-2} \text{ day}^{-1}$ and $0.1 \text{ alphas m}^{-2} \text{ day}^{-1}$. (100x better than existing surface screeners)

XIA Ultra-low 1800

- Operated by LZ Collaboration
Room for more!

...but it’s going fast!

Place your detector here
Current, planned and nearby low background capabilities

<table>
<thead>
<tr>
<th>Detector</th>
<th>Detector Type</th>
<th>[U] mBq/kg</th>
<th>[Th] mBq/kg</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Currently at BHUC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morgan</td>
<td>2.1 kg p-type, HPGe</td>
<td>0.2</td>
<td>0.2</td>
<td>BLBF</td>
</tr>
<tr>
<td>Maeve</td>
<td>1.7 kg p-type, HPGe</td>
<td>0.1</td>
<td>0.1</td>
<td>BLBF</td>
</tr>
<tr>
<td>Mordred</td>
<td>1.4 kg n-type, HPGe</td>
<td>0.7</td>
<td>0.7</td>
<td>USD/BLBF</td>
</tr>
<tr>
<td>SOLO</td>
<td>0.6 kg, p-type, HPGe</td>
<td>0.6</td>
<td>0.3</td>
<td>LZ</td>
</tr>
<tr>
<td><strong>Planned</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twins</td>
<td>2 x 2.1 kg, p-type, HPGe</td>
<td></td>
<td></td>
<td>BHSU/BLBF</td>
</tr>
<tr>
<td>MALBEK/MAVRACS</td>
<td>0.5 kg, p-type, HPGe</td>
<td></td>
<td></td>
<td>MJD</td>
</tr>
<tr>
<td>Ge IV</td>
<td>p-type, HPGe</td>
<td></td>
<td></td>
<td>nEXO</td>
</tr>
<tr>
<td>BetaCage</td>
<td>alpha and beta counter</td>
<td></td>
<td></td>
<td>SDSMT</td>
</tr>
<tr>
<td>Alpha Counter</td>
<td>XIA UltraLo 1800</td>
<td></td>
<td></td>
<td>LZ</td>
</tr>
<tr>
<td><strong>Nearby</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHSU ICP-MS</td>
<td>Agilent 7900</td>
<td></td>
<td></td>
<td>BHSU</td>
</tr>
</tbody>
</table>

Limits listed above are average sensitivities for ~1-2 kg sample for 2 weeks sample time.
Counting Consortium

- All current and planned counters in the BHUC have agreed to join the counting consortium
- Each counter retains autonomy, but free time on the counter is made available
- Single point of contact for anyone needing analysis
Acknowledgements

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