



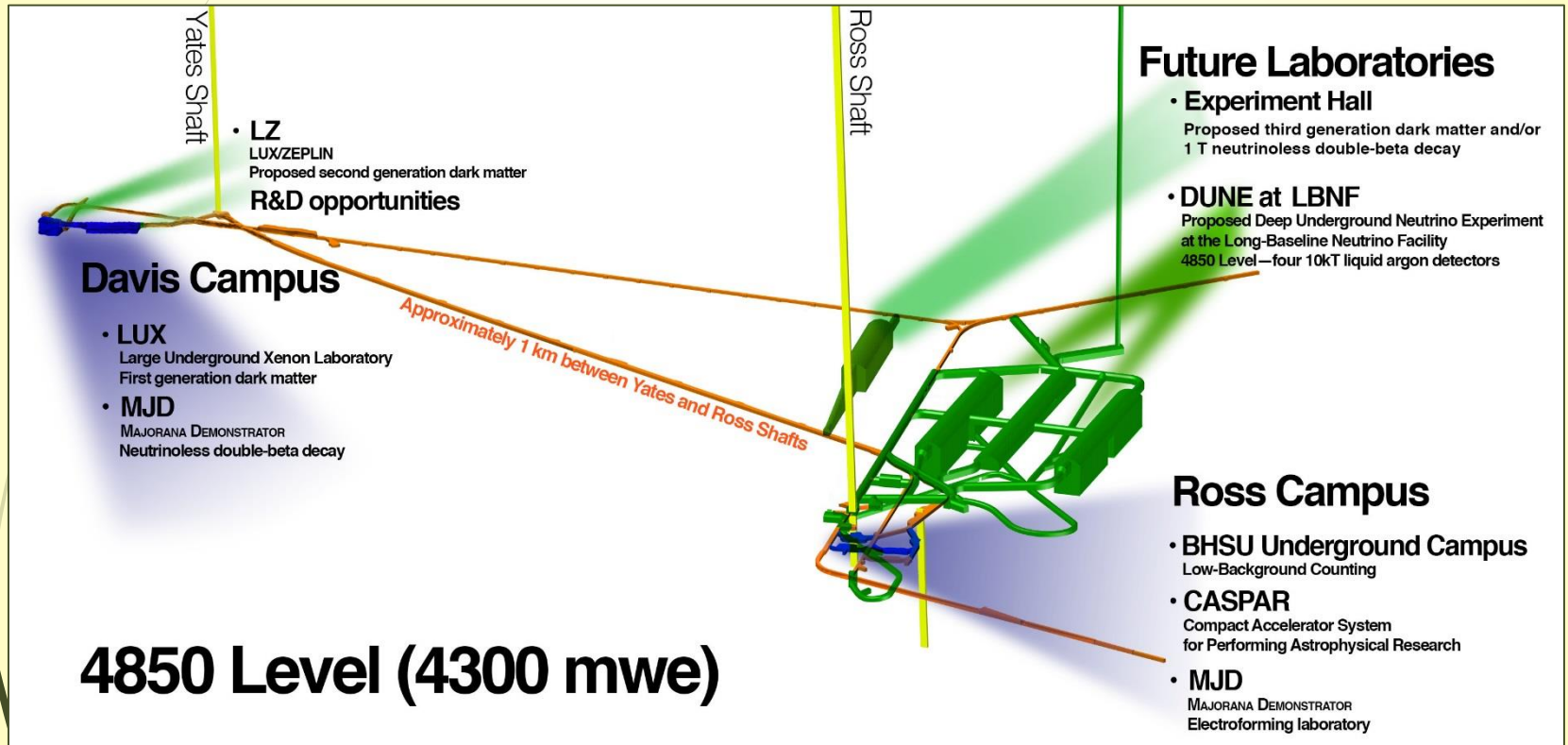
Recent Updates at the Black Hills State University Underground Campus (BHUC)

Brianna Mount, Kevin Lesko, Kelsey Oliver-Mallory, Keenan Thomas, Richard Schnee, Eric Miller, Ryan MacLellan, Dongming Mei, Jaret Heise, John Keefner, Markus Horn, Oren Loken, Dave Taylor, Wenqin Xu, Cabot-Ann Christofferson, J.F Wilkerson, Matthew Busch, Reyco Henning

Presented by Alan Poon

May 24, 2017

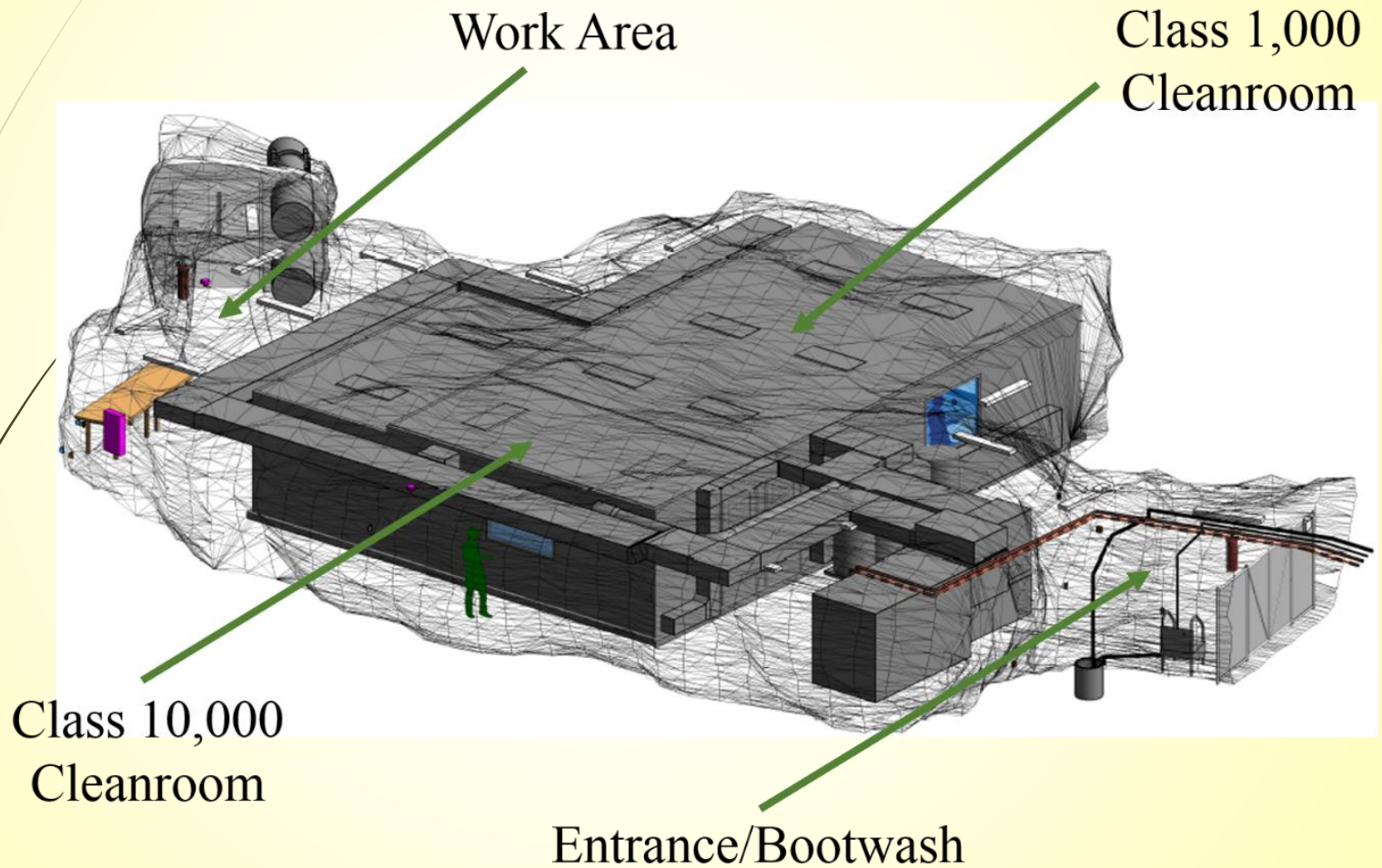
BHUC Location



BHUC is at 4380 mwe

More on Sanford Lab: Heise, J., J. Phys.: Conf. Ser. 606 (2015).

BHUC Overview



BHUC Cavern: Dec 2014



Construction time lapse: <https://vimeo.com/183890905>

Surface Coatings



Maas, J.J., Renken, K.J., Int. Radon Symp., 3, 1.1 (1997).



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

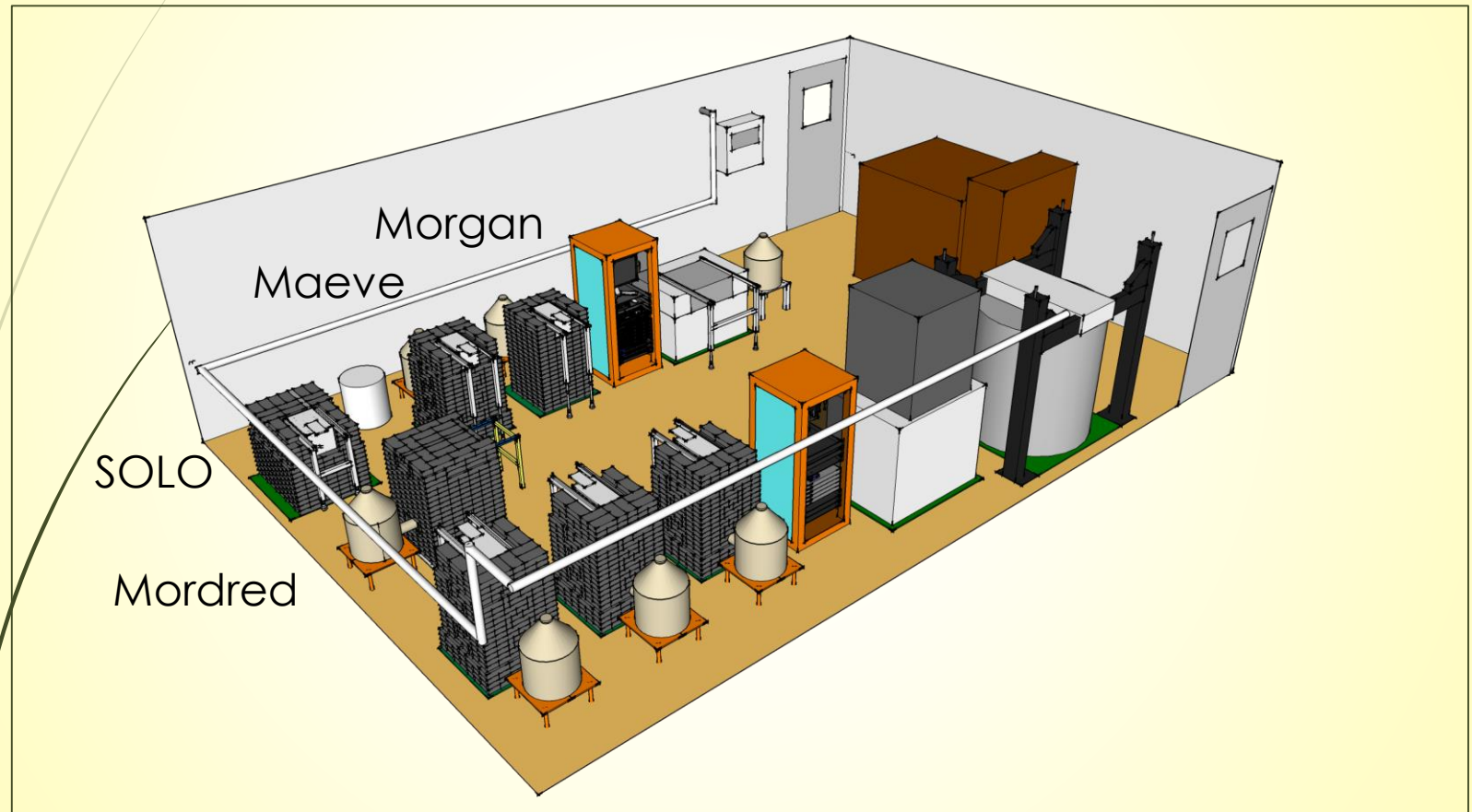
BHUC Work Area



BHUC Work Area



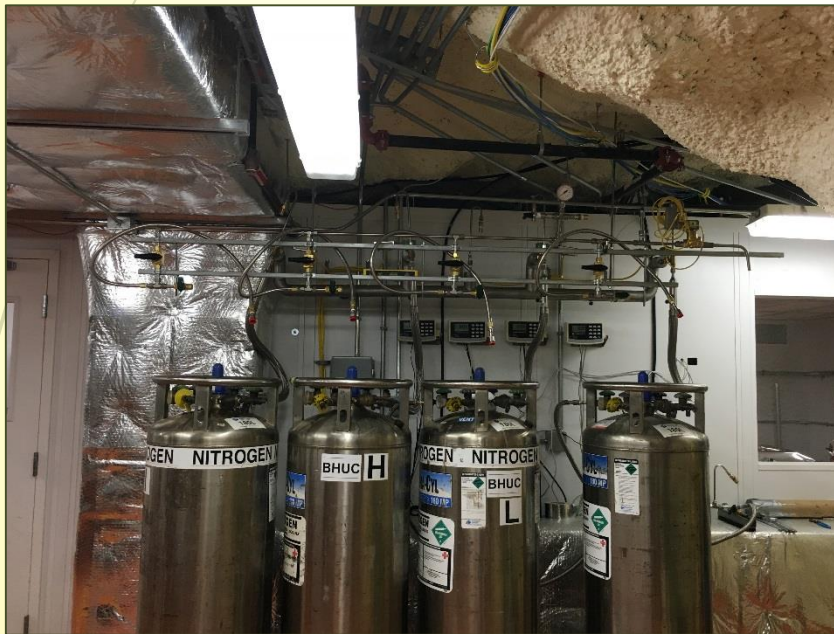
BHUC Counting Room



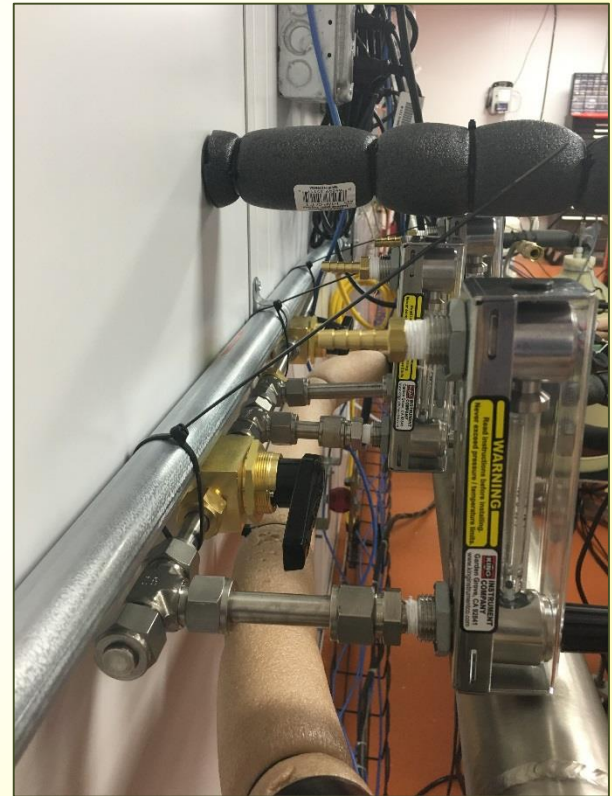
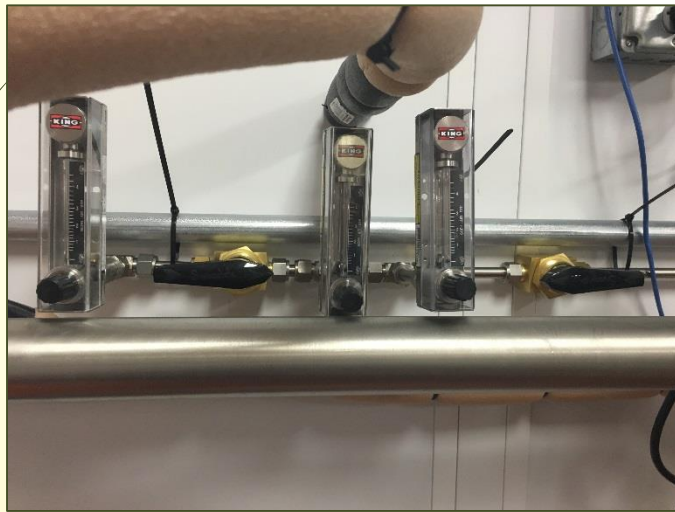
Electrical and Network Connections



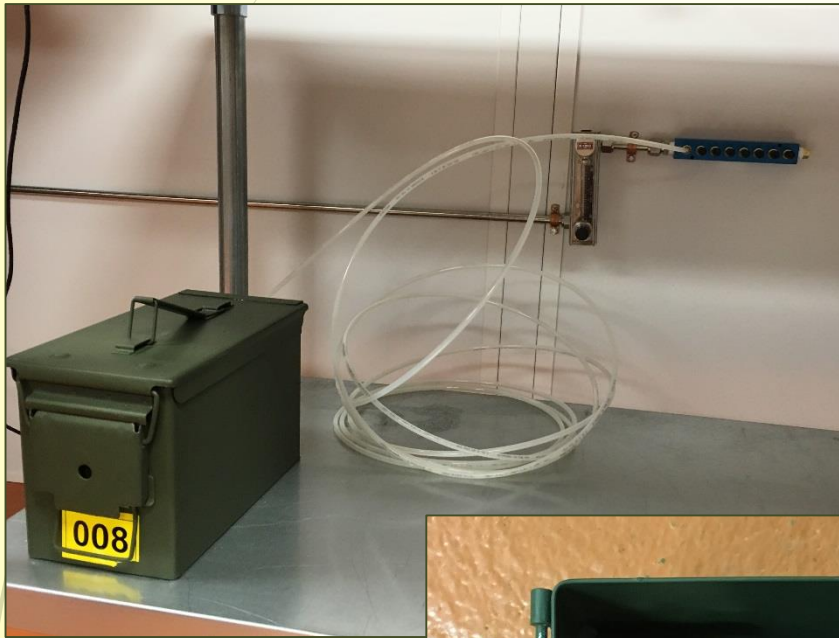
LN₂ Distribution



Purge Nitrogen Distribution

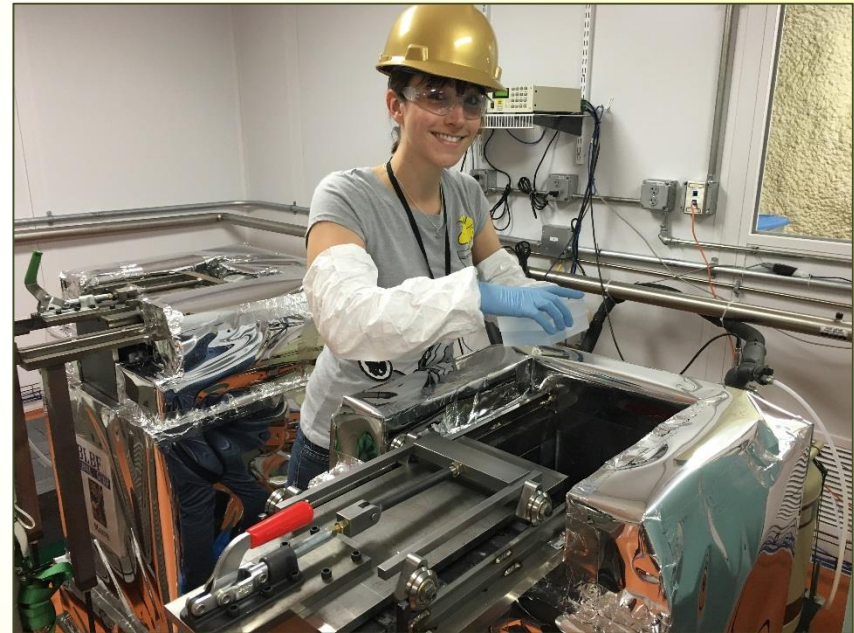


BHUC Sample Purge System

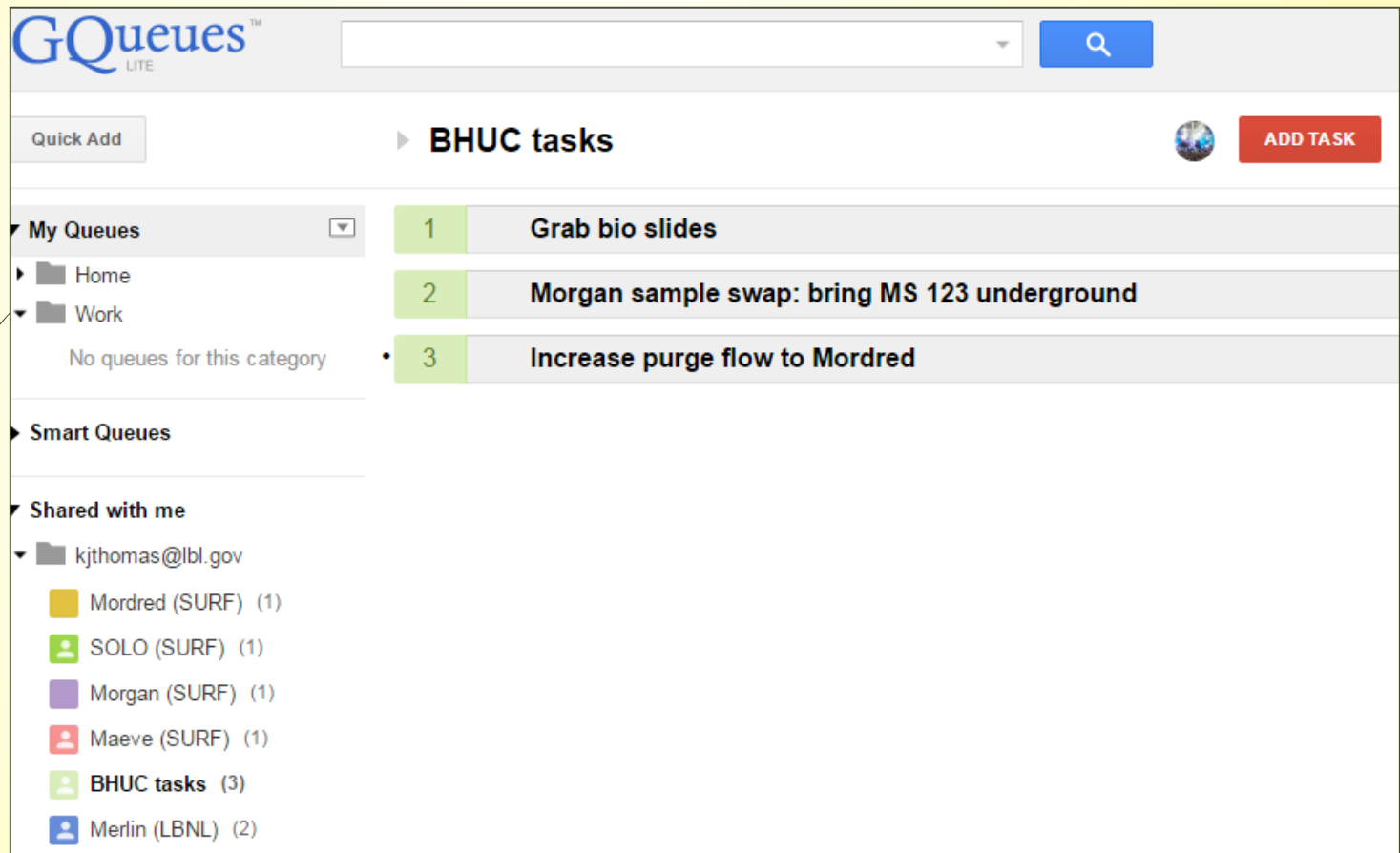


BHUC Care and Feeding

- 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



The screenshot displays the GQueues LITE web interface. At the top left is the logo "GQueues LITE". To its right is a search bar and a blue search button. Below the logo is a "Quick Add" button. The main content area is titled "BHUC tasks" with a right arrow icon. To the right of this title is a user profile icon and a red "ADD TASK" button. On the left side, there is a sidebar with several sections: "My Queues" (with a dropdown arrow), "Smart Queues", and "Shared with me". Under "My Queues", there are links for "Home" and "Work", and a note "No queues for this category". Under "Shared with me", there is a list of users and their associated queues: "kjthomas@lbl.gov" (with a yellow icon), "Mordred (SURF) (1)" (with a yellow icon), "SOLO (SURF) (1)" (with a green icon), "Morgan (SURF) (1)" (with a purple icon), "Maeve (SURF) (1)" (with a red icon), "BHUC tasks (3)" (with a green icon), and "Merlin (LBNL) (2)" (with a blue icon). The main task list on the right shows three tasks, each with a green square containing a number and a description: "1 Grab bio slides", "2 Morgan sample swap: bring MS 123 underground", and "3 Increase purge flow to Mordred".

GQueues LITE

Quick Add

► **BHUC tasks**  **ADD TASK**

▼ **My Queues**

- Home
- Work
- No queues for this category

► **Smart Queues**

▼ **Shared with me**

- kjthomas@lbl.gov
 - Mordred (SURF) (1)
 - SOLO (SURF) (1)
 - Morgan (SURF) (1)
 - Maeve (SURF) (1)
 - BHUC tasks (3)
 - Merlin (LBNL) (2)

1 Grab bio slides

2 Morgan sample swap: bring MS 123 underground

3 Increase purge flow to Mordred

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

Thomas, K.J., et al., AIP Conf Proc, 1672, 020004 (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

Attisha, M., et al., AIP Conf. Proc. 785, 75 (2005).

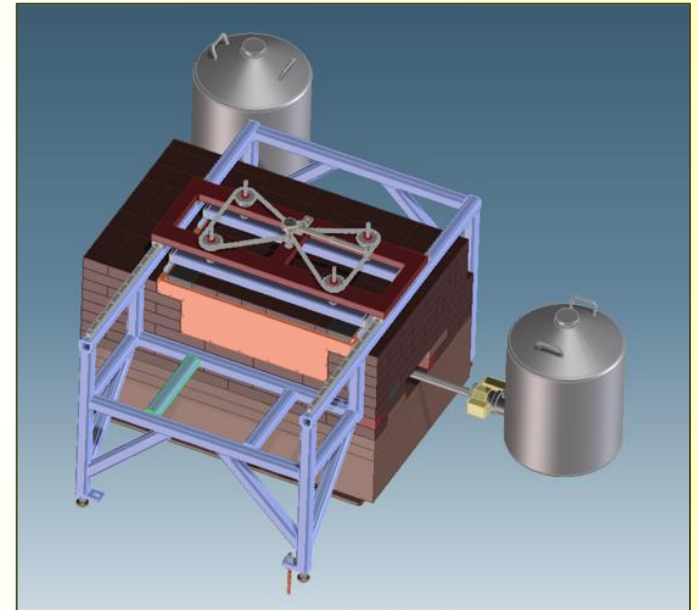
Mordred



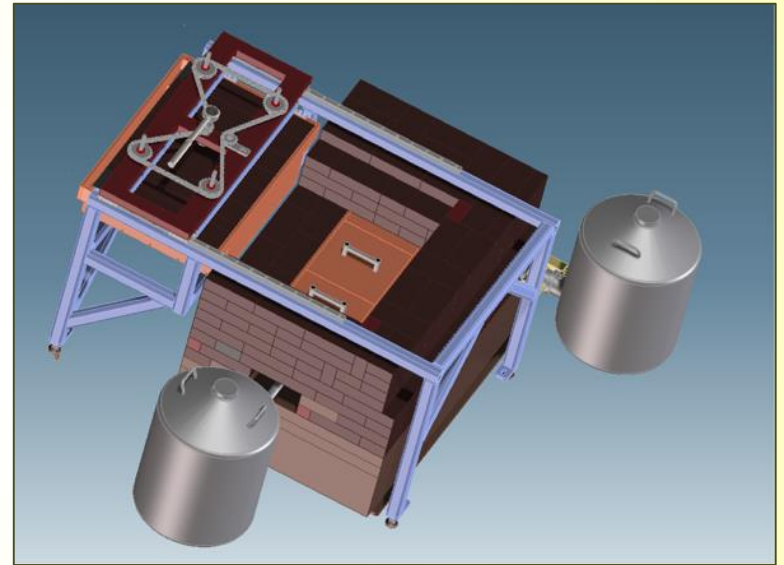
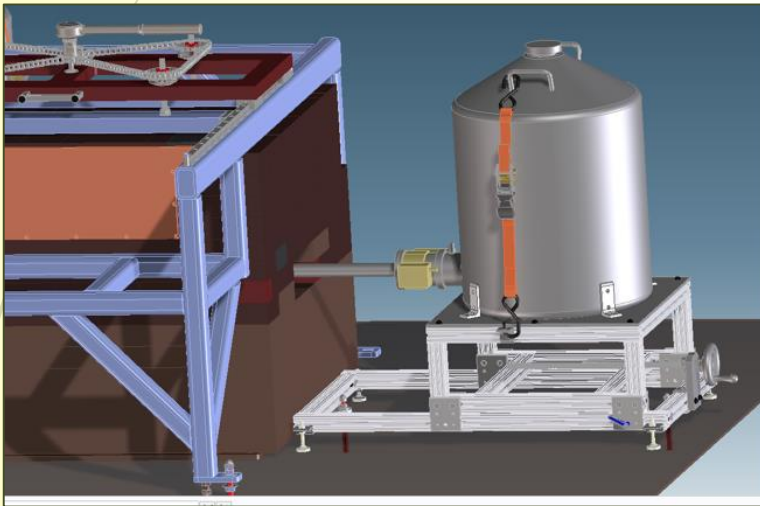
- Originally operated by CUBED
- Reconfigured with remote pre-amp
- Currently at BHUC since August 2016

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

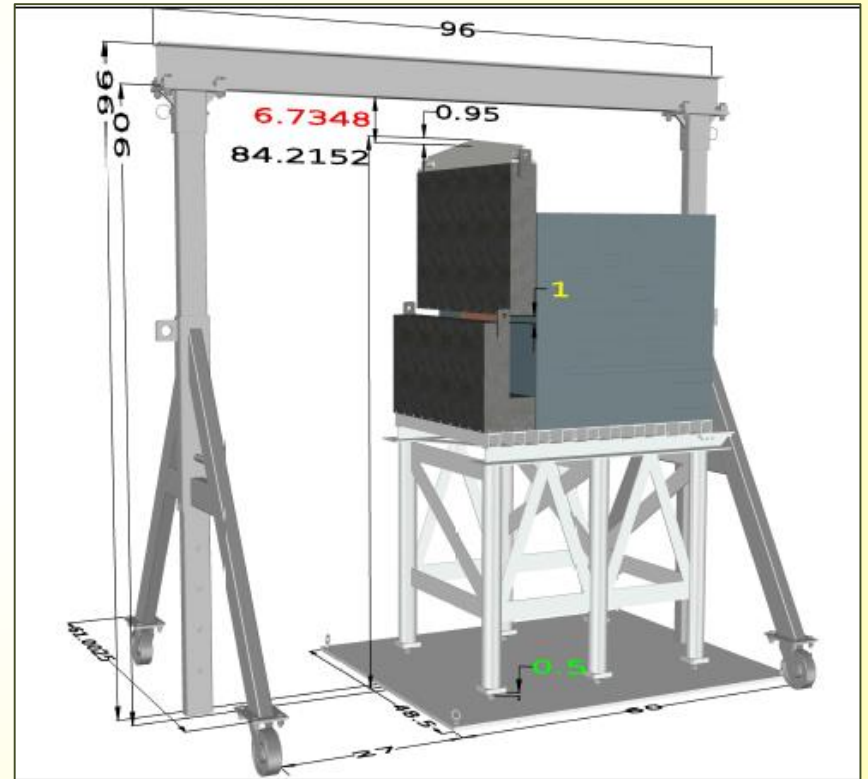


Twins



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)



Giovanetti, G., et al., Physics Procedia, 61, 77 (2015). Abgrall, N., [The Majorana Collaboration], Adv.High Energy Phys. 365432 (2014).

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)



See Eric Miller's poster and Ahmed, Z., et al., JINST 9, 1009P (2014). Bunker, R., et al., AIP Conf. Proc. **1549**, 132 (2013).

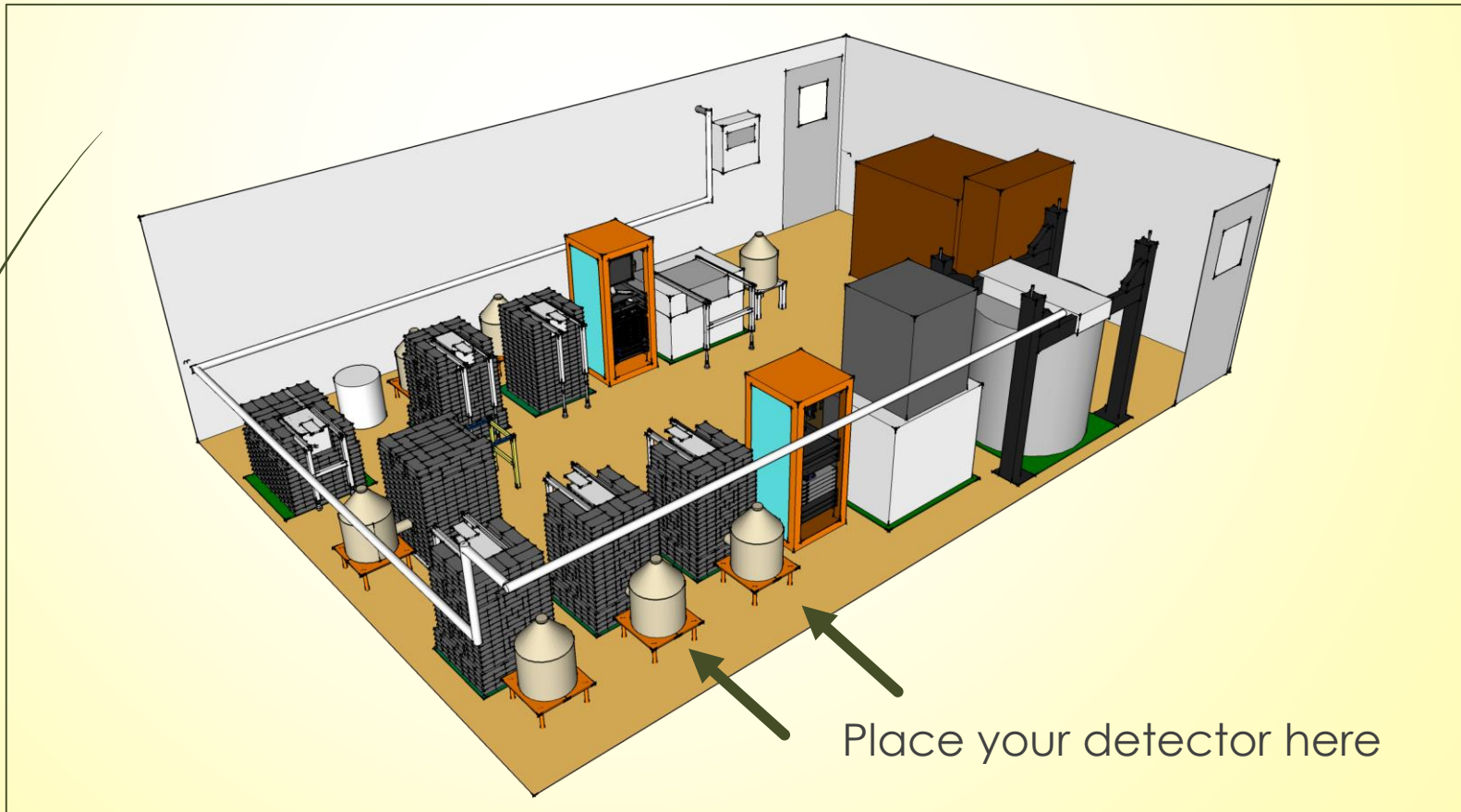
XIA Ultra-low 1800

- Operated by LZ Collaboration



Room for more!

- ...but it's going fast!



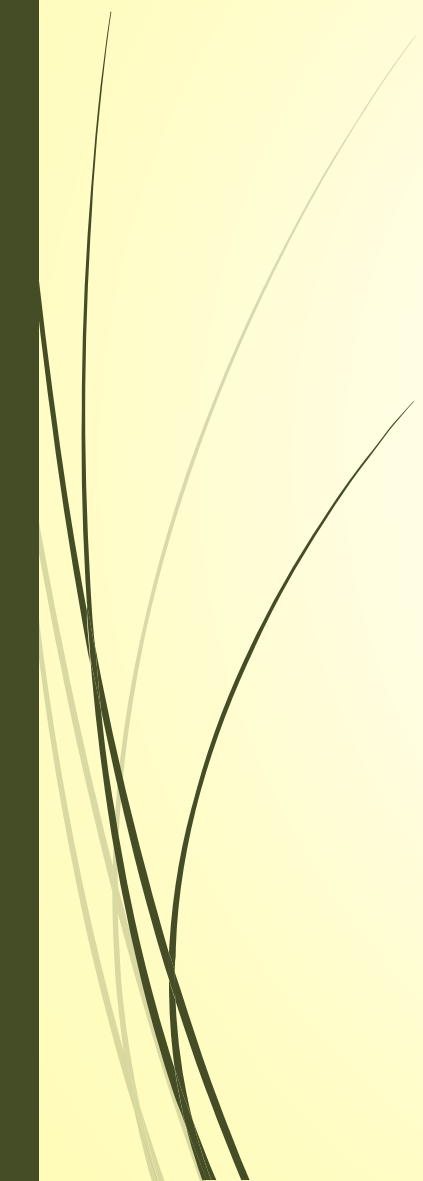
Current, planned and nearby low background capabilities

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

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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- This work was also supported in part under the US Department of Energy contract DE-AC02-05CH11231 and DE-SC0014223 and by National Science Foundation grant PHY-1506033.
- We gratefully acknowledge the logistical and technical support and the access to laboratory infrastructure provided to us by the Sanford Underground Research Facility

