



# Rare Low Energy Event Searches in the MAJORANA DEMONSTRATOR

Gulden Othman on behalf of the MAJORANA Collaboration  
University of North Carolina at Chapel Hill



U.S. DEPARTMENT OF  
**ENERGY**

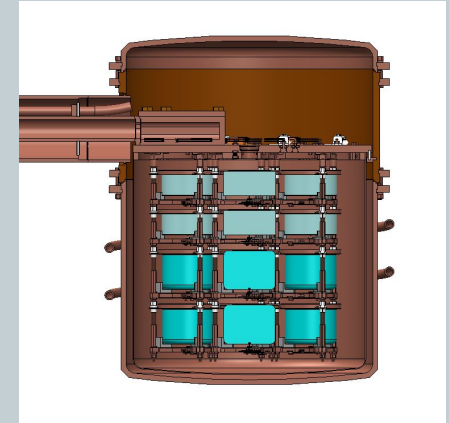
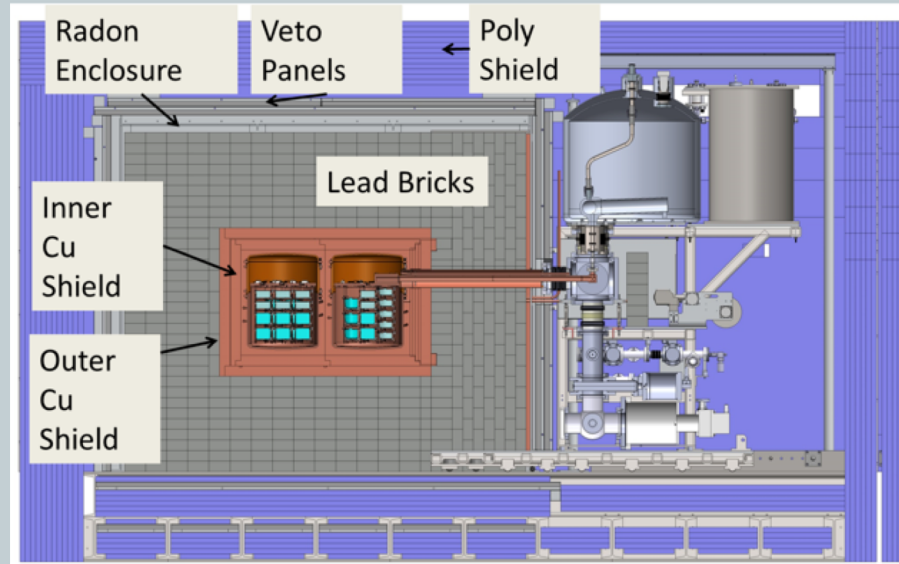
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Operating underground at the 4850' Sanford Underground Research Facility

- Goals:**
- Demonstrate backgrounds low enough to justify building a tonne scale experiment.
  - Establish feasibility to construct & field modular arrays of Ge detectors.
  - **Searches for additional physics beyond the standard model.**

- ❖ **Energy resolution of 2.5 keV FWHM @ 2039 keV is the best of any  $\beta\beta$ -decay experiment**
- ❖ Background Goal in the  $0\nu\beta\beta$  peak after analysis cuts with the achieved resolution: 2.5 counts/(FWHM t yr)
  - Projected backgrounds based on assay results  $\leq 2.2$  counts/(FWHM t yr)
- ❖ 44.1-kg of Ge detectors
  - 29.7 kg of 88% enriched  $^{76}\text{Ge}$  crystals
  - 14.4 kg of  $^{\text{nat}}\text{Ge}$
  - Detector Technology: P-type, point-contact.
- ❖ 2 independent cryostats
  - Ultra-clean, electroformed Cu
  - 22 kg of detectors per cryostat
  - Naturally scalable
- ❖ Compact Shield
  - Low-background passive Cu and Pb shield with active muon veto



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N. Abgrall et al. (Majorana Collaboration), *Advances in High Energy Physics*, 2014, 1 (2014).  
C. E. Aalseth et al. *Phys. Rev. Lett.*, 120(13):132502, 2018.



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❖ Low Energy program is interested in analysis of events in the energy region  $< 100$  keV ( $Q_{\beta\beta}$  for  $^{76}\text{Ge}$  is 2039 keV)

❖ MAJORANA PPC HPGe detector advantages:

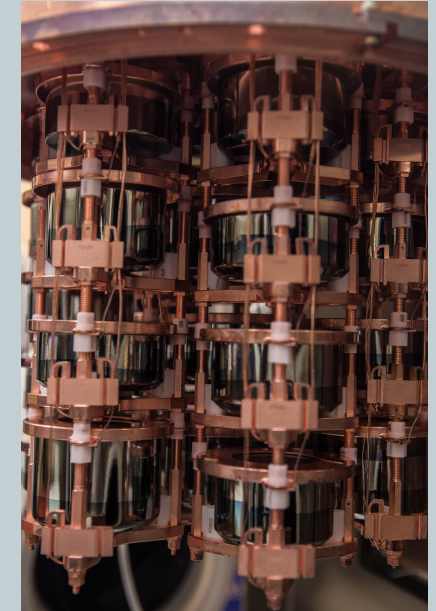
- Sub-keV trigger thresholds possible
- Excellent energy resolution (0.4 keV FWHM at 10.4 keV)
- Excellent pulse shape discrimination
- Ultra-low background components, including underground electroformed Cu
- Reduced cosmogenic activation in our enriched detectors from surface exposure control

❖ Physics reach:

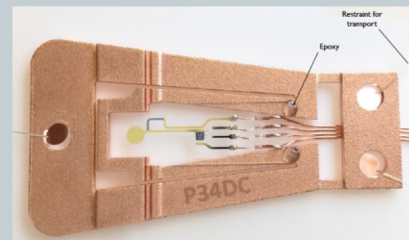
- **Bosonic dark matter**
- **Low mass WIMPs**
- Solar axions



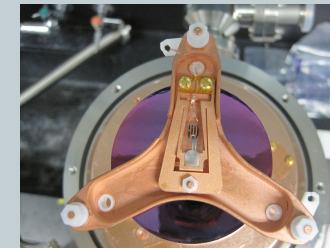
Modules in compact shielding



Detector string



Low-Mass Front-End



Detector unit

