The Scintillating Bubble Chamber

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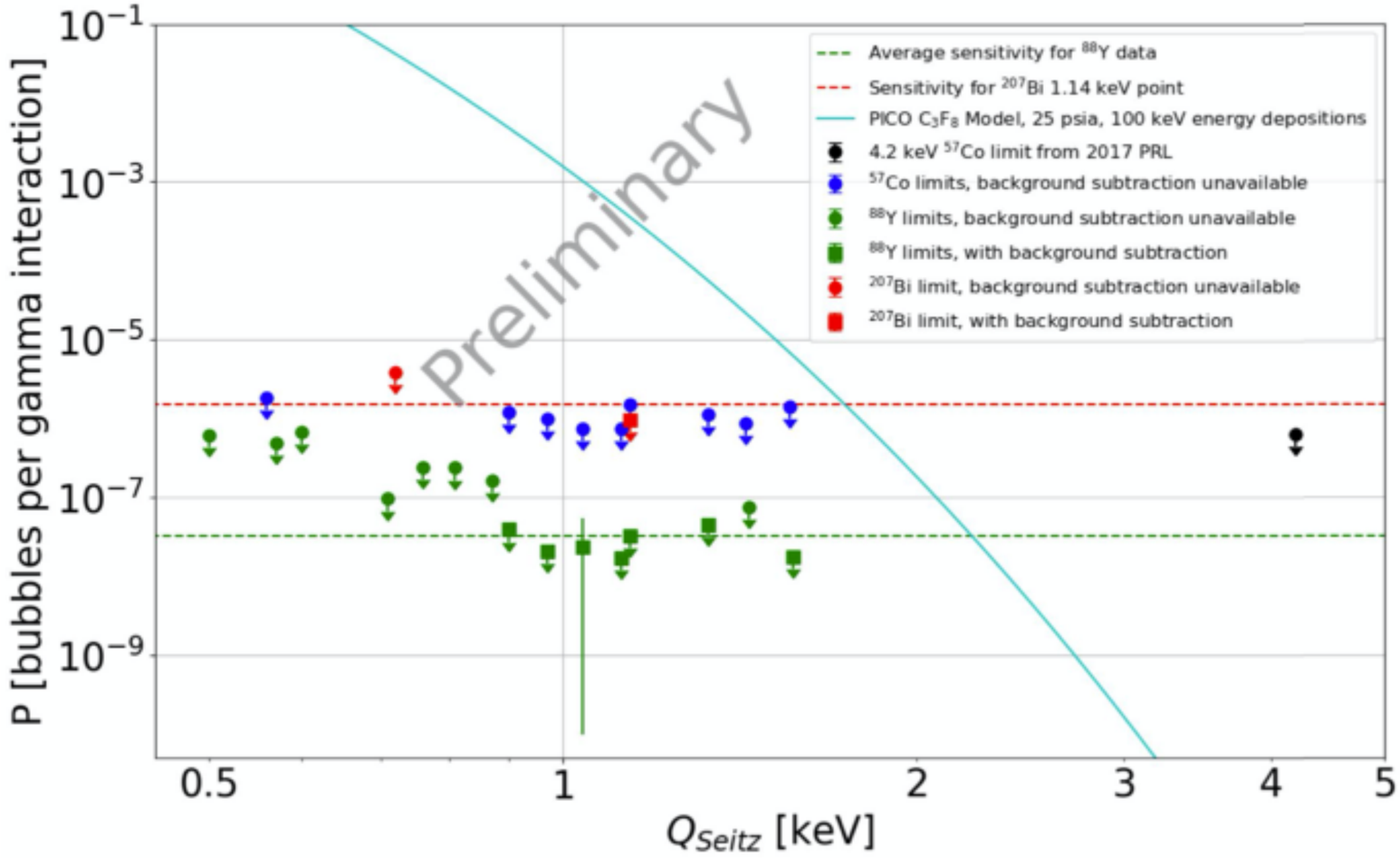
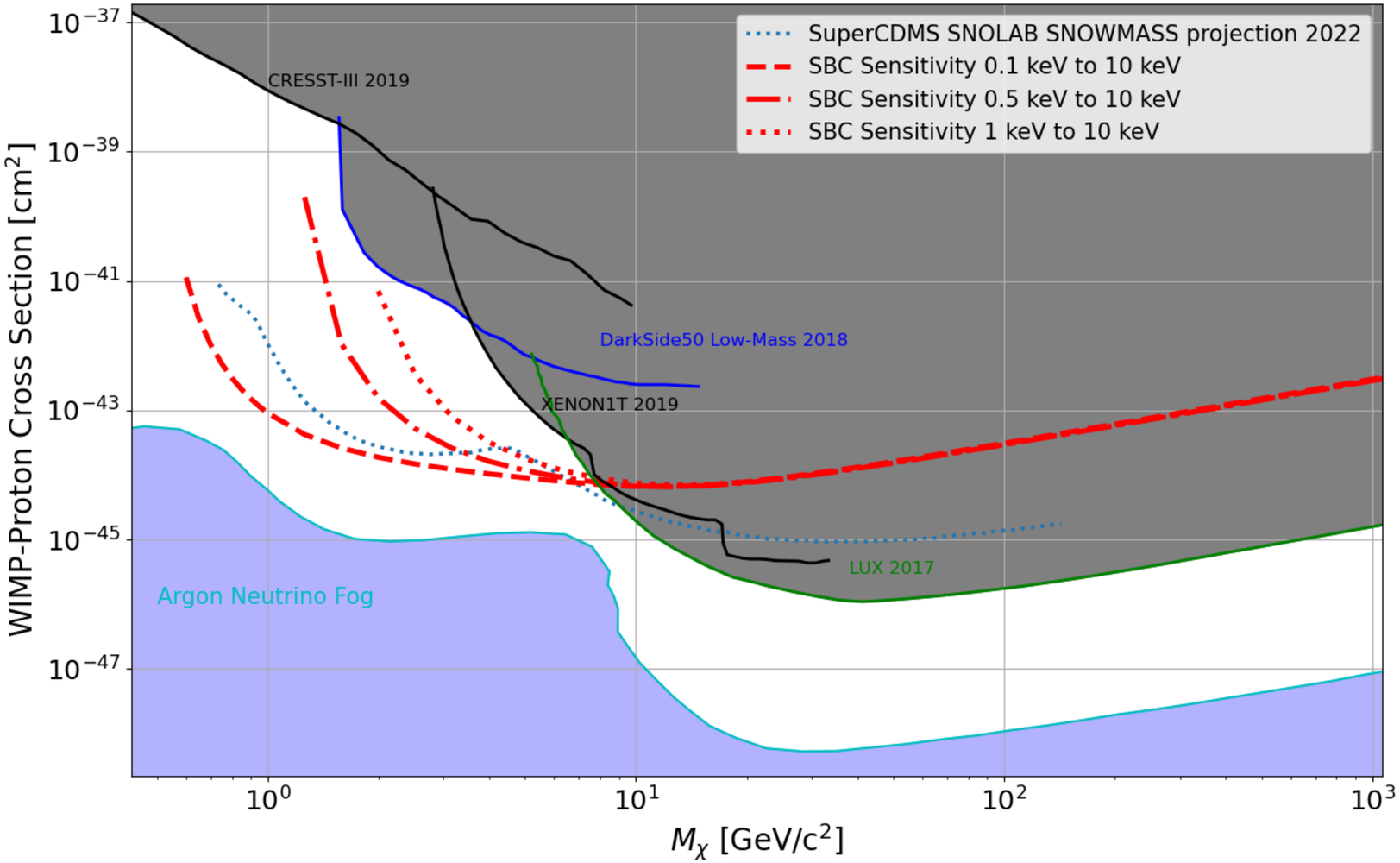
Experiment Overview

- Bubble chambers have been used for dark matter searches with success (see: PICO)
- Low mass region remained out of reach due to increased electron recoils with a lowered threshold
- Not an issue for SBC with the changed energy deposit channels



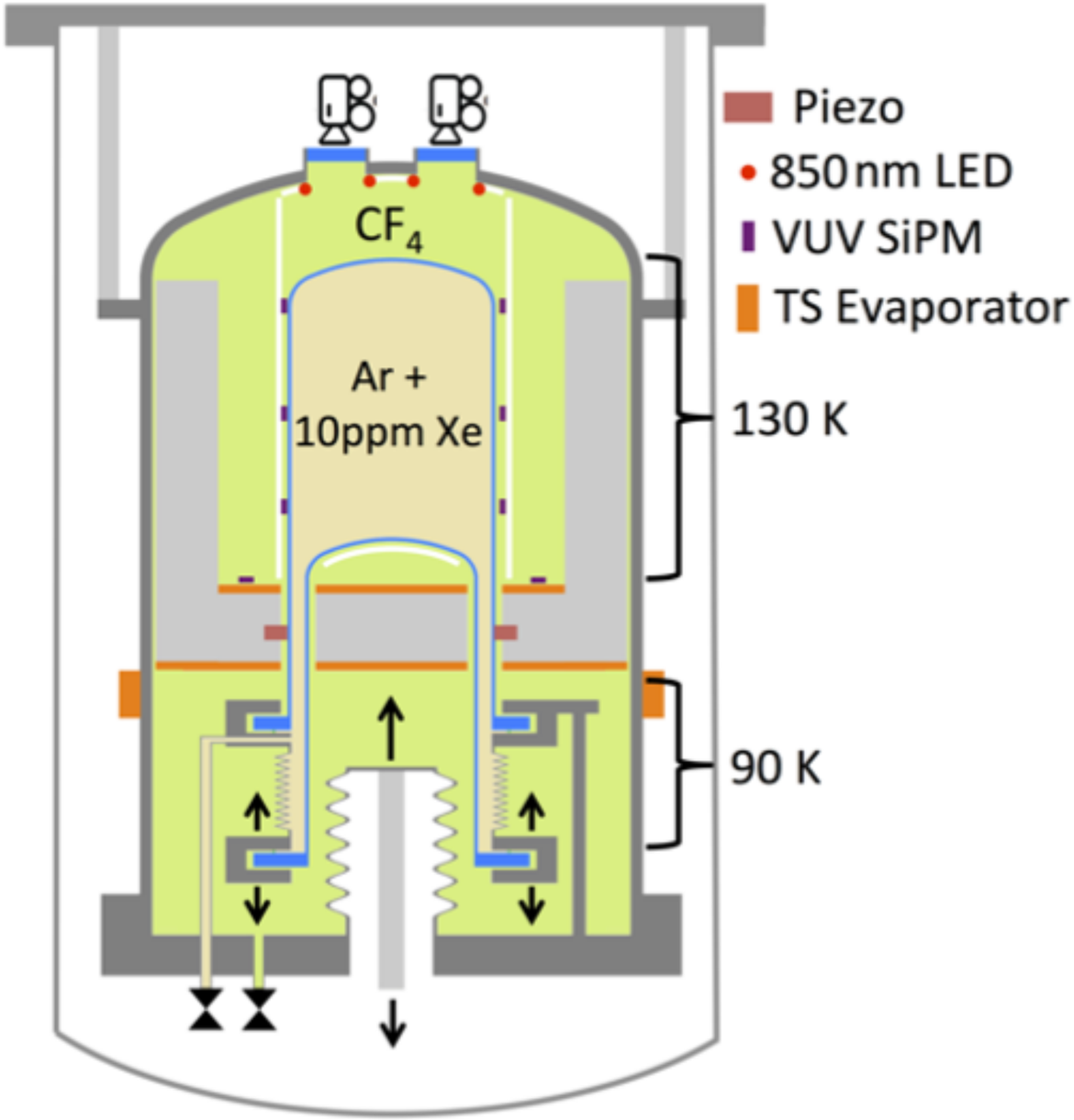
Why push this threshold?



- The ability to reach lower thresholds opens up the lower-mass phase space
- Note that this plot includes only CEvNS backgrounds and a 10kg-year live time

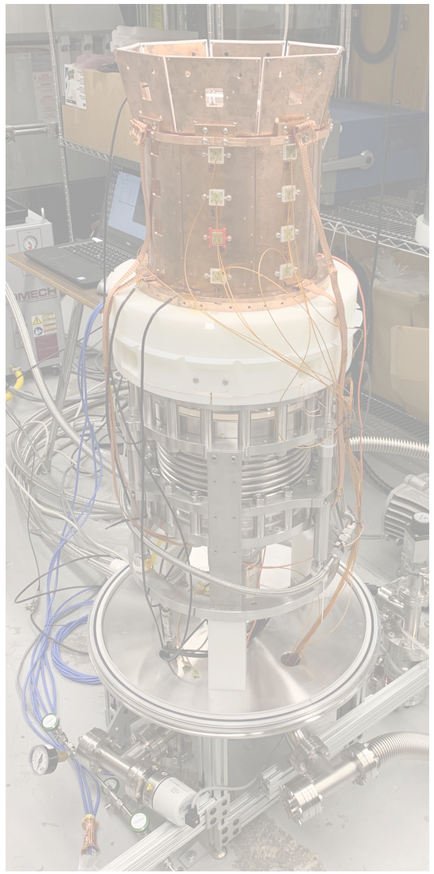
How will we do this?

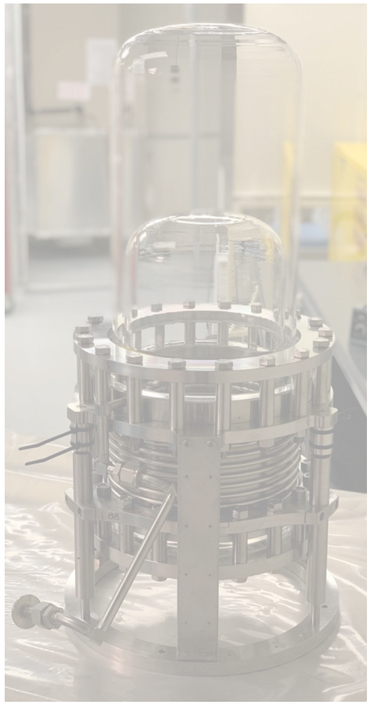
- Roughly 10kg of argon
- SiPMs used for scintillation detection
- Much of the internal detail modelled on PICO 500
- “Only” added challenge is to keep it cold

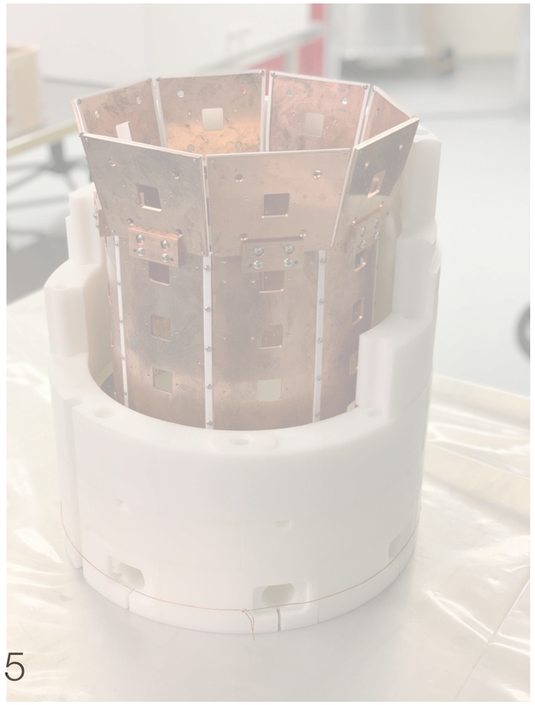


Developments

- Lots of positive developments
  - We have spent the past six months investigating and reducing risks
- Will go through these individually, as this is important







Progress: SBC and the TSSA

Status as of February 2024

Item (manufacturer)	Status	Notes
Sapphire windows (Ceramtec)	Purchased 4 (one for testing), sent for testing	PVEng consulting, redesigned to survive 10x burst test (5250 psi)
Electrical feedthroughs (Ceramtec)	Existing feedthrough sent for testing	PVEng suggested making them thicker, we will test the ones we currently have to 10x first
HV Feedthrough (Solid Sealing Tech)	Existing feedthrough sent for testing	PVEng suggested thicker flange, needs to be tested to 10x pressure
Argon getter (SAES/Entergis)	Removed from panel	P&ID redone to avoid being connected to pressure vessel
CF4 Purifier (Pall/NuPure)	Use PICO's C3F8 purifier, for which they are getting CRN	Overkill for what we need, but thanks PICO!
Pressure Vessel	In talks with fabricator	Will be certified
Pressure Vessel Relief Valve	Investigating options, Aquatrol very promising	Only available with triclamp, tested at Queen's to survive cold and pressure
Gas Panels Orbital Welding (SNOLAB?)	Looking for manufacturer that won't take all the money we've ever had	SNOLAB looking into becoming certified, which would alleviate this entirely
Cryovalve (Stohr)	They are "looking into how much it would cost to let us get a CRN"	Probably going to use another solution here, likely solenoid valve
Dome loaded pressure balancing regulator (?)	Redesigning P&ID	No suppliers found with CRN or any interest in getting them registered

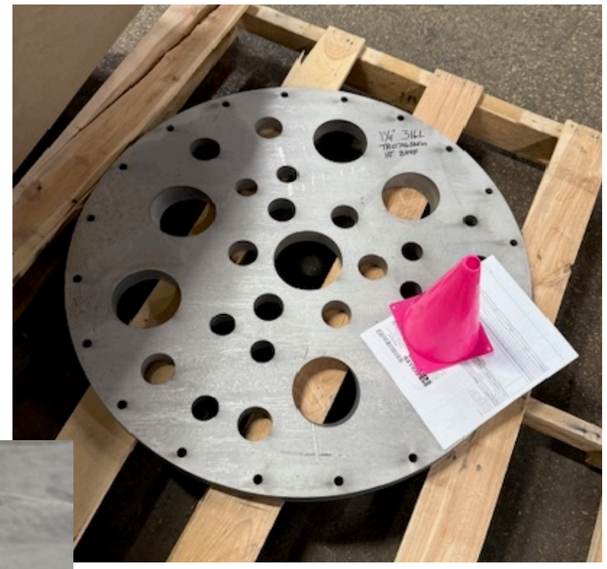
Progress: SBC and the TSSA

Status as of February 2025

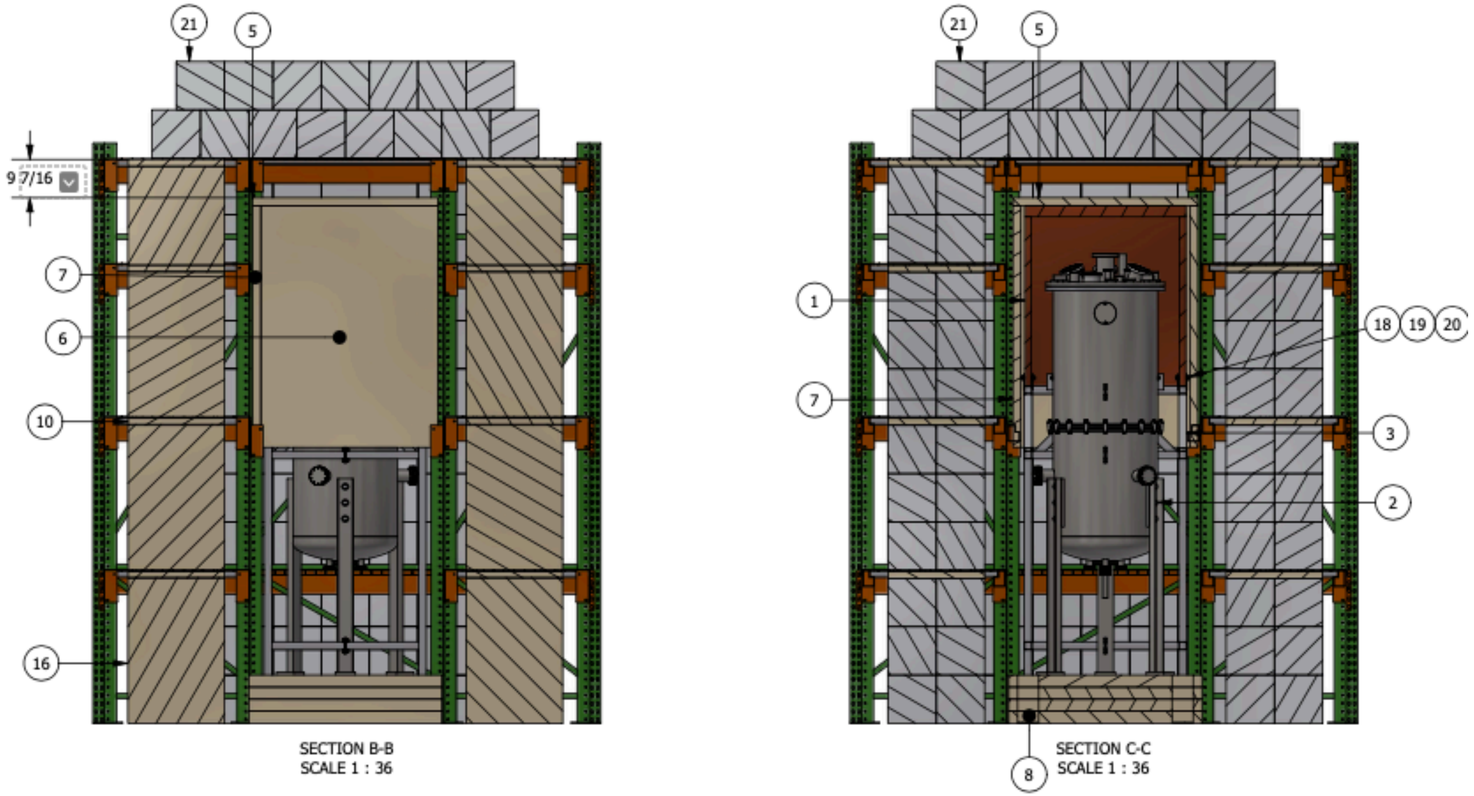
Item (manufacturer)	Status	Notes
Sapphire windows (Ceramtec)	Purchased 4 (one tested)	PVEng tested, sufficiently passed 10x burst test (5250 psi)
Electrical feedthroughs (Ceramtec)	Existing feedthrough tested	PVEng tested, sufficiently passed 10x burst test (5250 psi)
HV Feedthrough (Solid Sealing Tech)	Existing feedthrough tested	PVEng tested, sufficiently passed 10x burst test (5250 psi)
Argon getter (SAES/Entergis)	Removed from panel	P&ID redone to avoid being connected to pressure vessel
CF4 Purifier (Pall/NuPure)	Use PICO's C3F8 purifier, for which they are getting CRN	Overkill for what we need, but thanks PICO!
Pressure Vessel	Being fabricated	TSSA certification obtained by Ability
Pressure Vessel Relief Valve	One choice picked	Solution found
Gas Panels Orbital Welding (SNOLAB?)	Quotes obtained	Funding application submitted to have Swagelok finish this and take all the money we've ever had.
Cryovalve (Stohr)	All paperwork obtained, in the process	PVEng has this in their hands, don't predict any issues (thanks SNOLAB!)
Dome loaded pressure balancing regulator	Redesigning P&ID	Redesign complete, solution achieved

Progress: Pressure Vessel & Vacuum Jacket

- Vendor has completed many pieces, assembly has started
- Full delivery still anticipated in March
- TSSA has also issued CRN for the pressure vessel

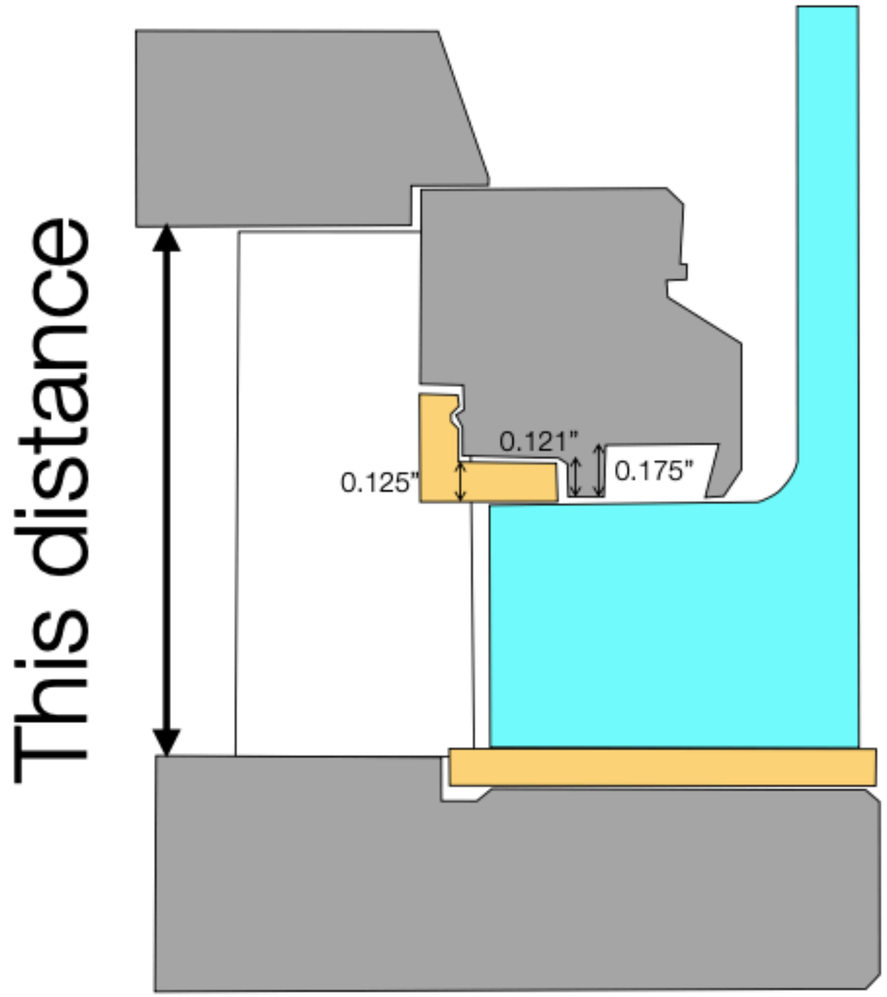


Progress: Shielding



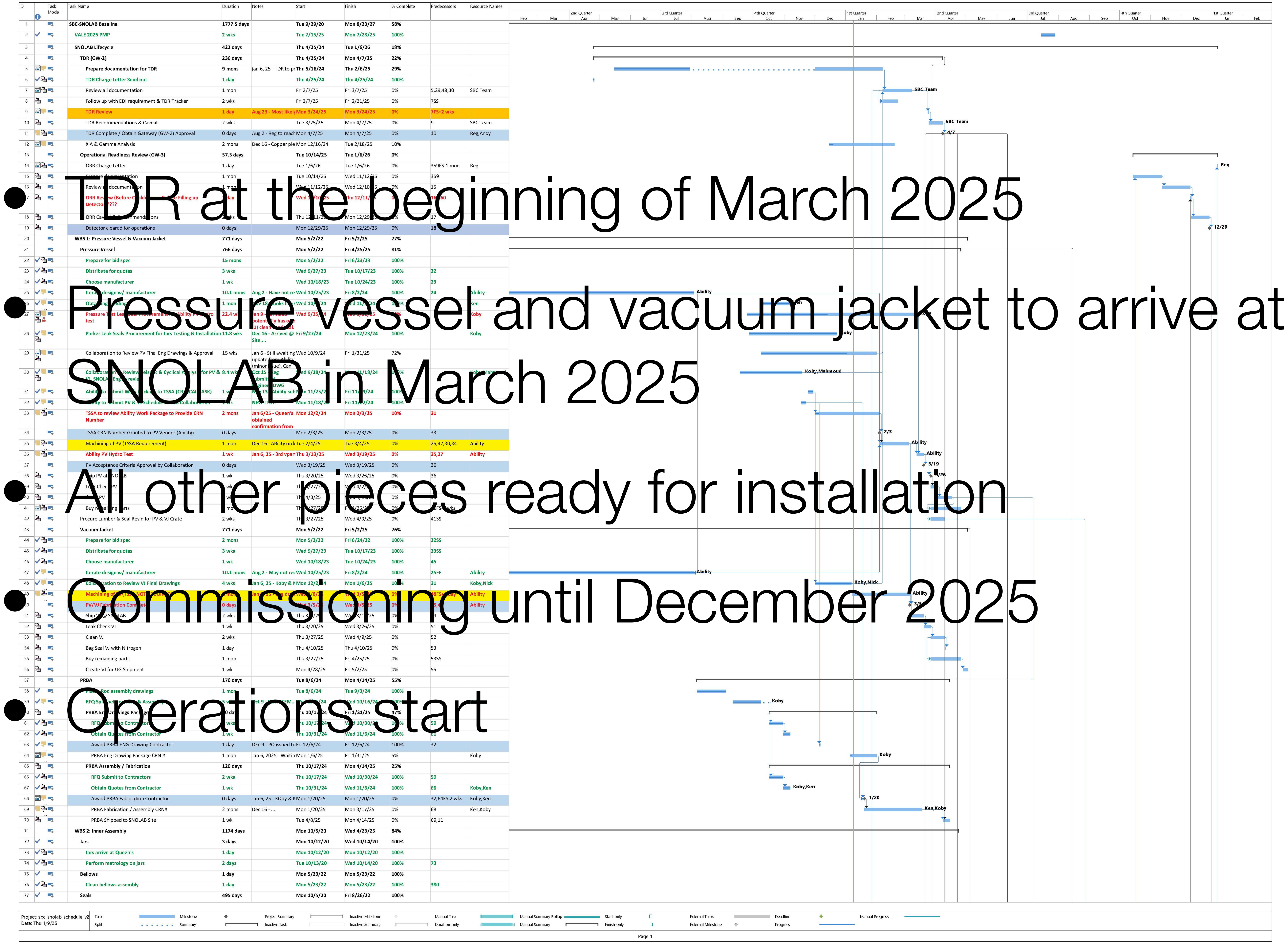
- Multilayer shield being designed by SNOLAB engineering, backed by simulation from the collaboration
- Preliminary design complete, after some hiccups the final design is close

Progress: Fermilab commissioning



- Great experience gained at Fermilab in the construction of the entire assembly
- Some issues found with the design of the custom seal, have now been mitigated with additional testing at Queen's

Schedule



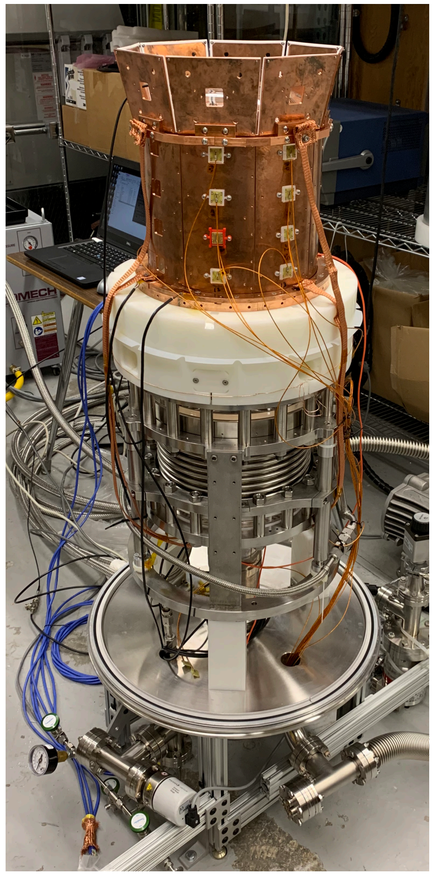
- TDR at the beginning of March 2025
- Pressure vessel and vacuum jacket to arrive at SNOLAB in March 2025
- All other pieces ready for installation
- Commissioning until December 2025
- Operations start

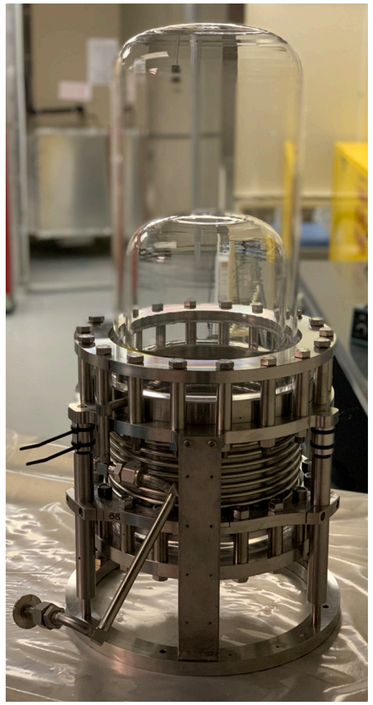
Challenges

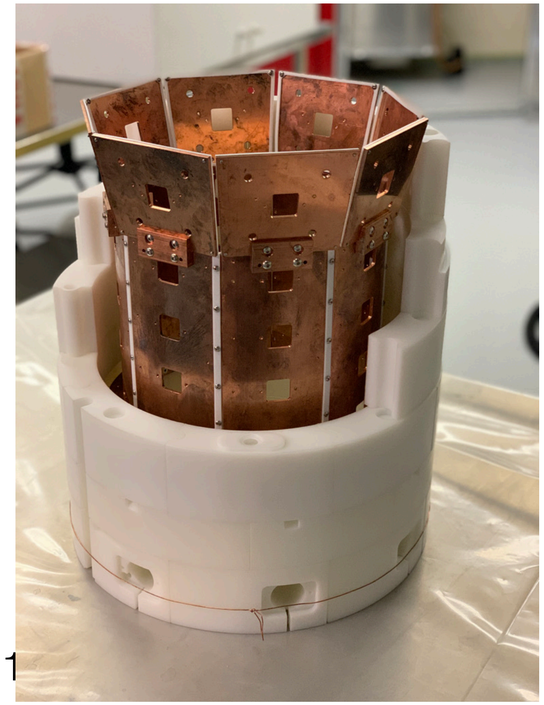
- The TSSA dealings remain, and take up quite a bit of effort from many people
- The PV & VJ procurement needs to move ahead, but has to get through Queen's finance first
- Focus will shift to the Fermilab chamber where the achievable threshold will be tested (being assembled April 11)

Conclusion

- SBC continues to make progress, although faster than in the past
- The conclusion of the Fermilab tests will push more focus onto the SNOLAB chamber
- The next update should continue this positive trend







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