

Liquid Nobles Test Facility (LNTF) @ SLAC

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For the SLAC Team
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A Look Ahead

- IR2 Complex Overview
- LNTF: past, present and FUTURE
- Ongoing R&D efforts

IR2 Complex Overview

Former site of the BaBar detector

Large hall with office and benchtop lab space

Experimental hut inside

Large clean room

Crane

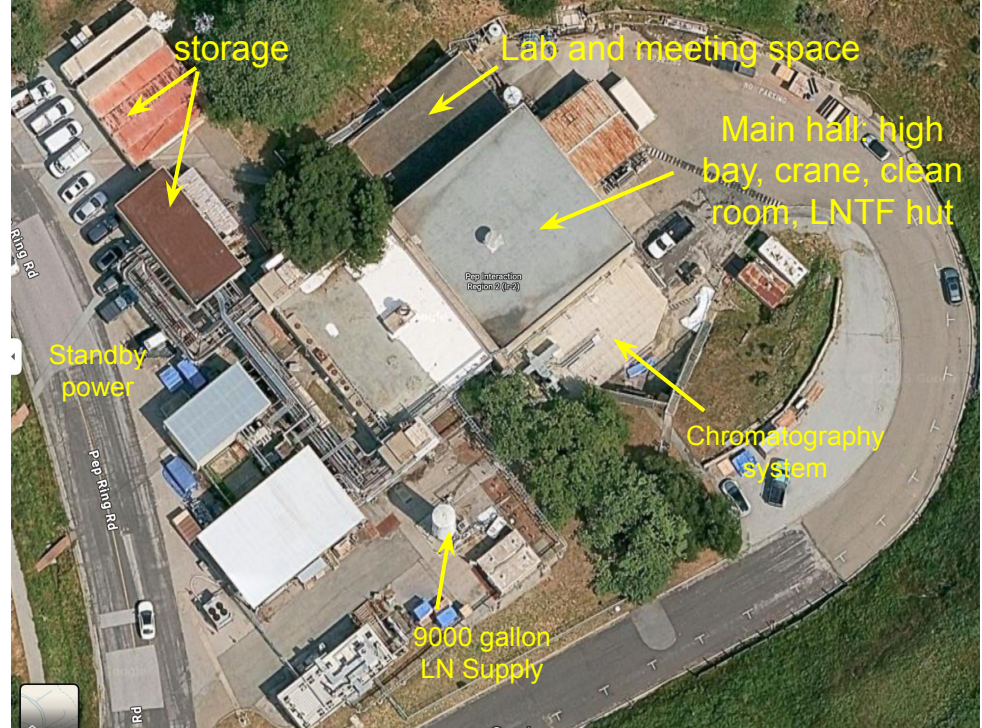
Storage space and support buildings

Access to LN/N₂

Support from SLAC

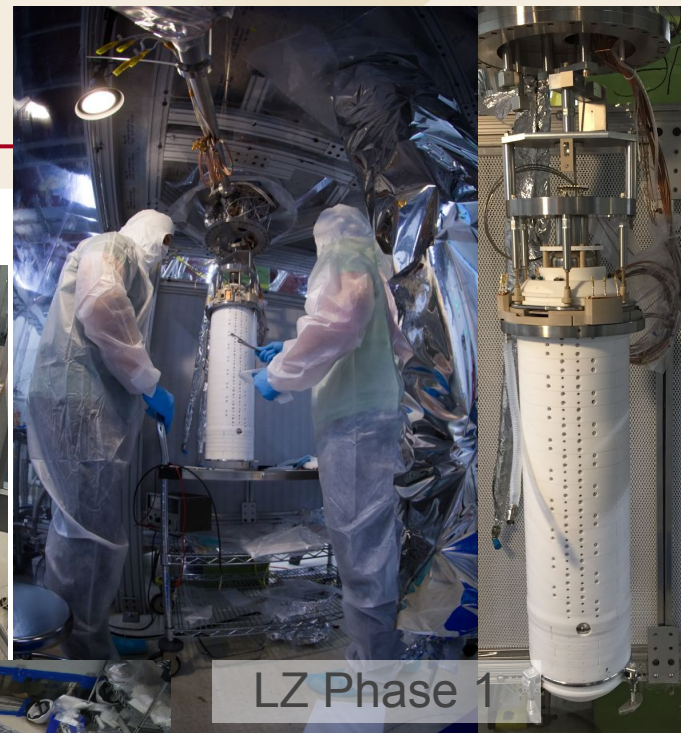
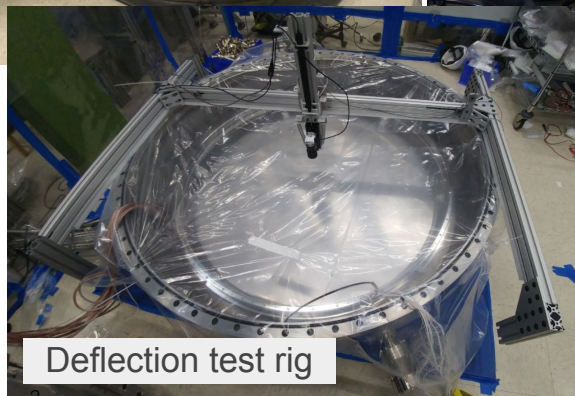
Backup generator power

IR2 complex



LNTF Past: the LZ System Test

- Kr removal R&D
 - Improve on LUX-era technology to remove ^{85}Kr
 - Demonstrate the capability to achieve the desired purity
- Gas test and small test chambers
 - Tests of small HV grids
- Phase 1
 - 50cm tall TPC, 100 kg of liquid Xe
 - Prototyped the LZ circulation system
 - Tests of (small) HV grids in gas and liquid
 - Tests of the field cage
 - Tests of Xe space sensors
 - Development of the LZ slow control
- Phase 2 (warm Xe gas)
 - Tests of full size LZ HV grid prototypes and final products
 - Tests of the extraction region
 - Deflection measurements



LNTF Past: the LZ Deliverables

Remove ^{85}Kr from 10 tonnes of Xe. Goal of 300 ppq g/g

- Also commission a high-sensitivity Kr sampling system (from University of Maryland)
- Achieved 90 ppq g/g

HV grid production

- Produce all LZ HV grids and qualify them for use
- Extraction region in gas held the LZ required voltage difference
- Passivated the gate grid at a vendor

“Accidental” deliverable: debug the liquid handling system

- LZ separated the ICV from the cryogenic/heat-exchange tower which had unintended negative consequences for circulation
- This was discovered, studied and mitigated in Phase 1. Mitigations were applied to LZ



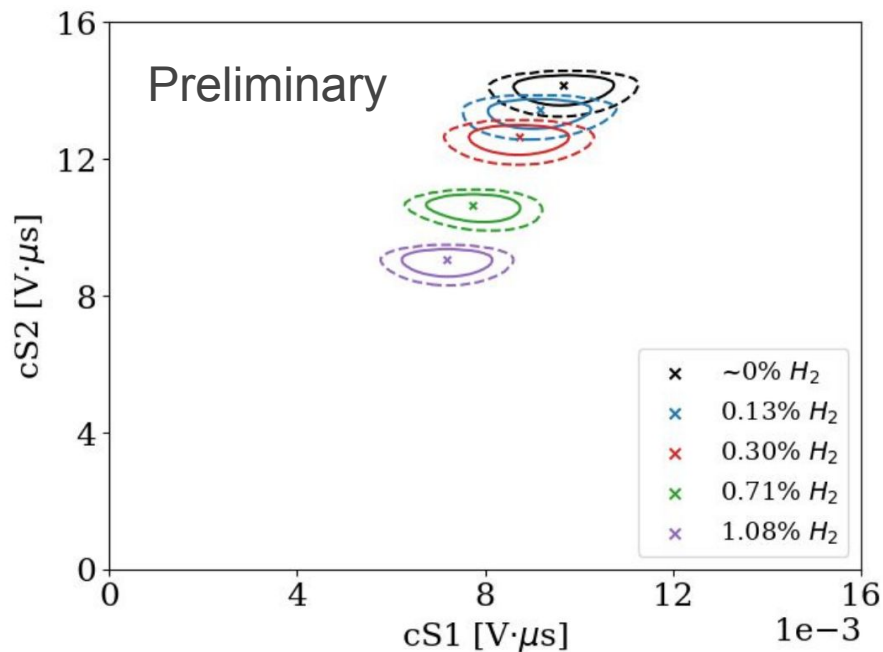
HydroX

- Goal: extend dual-phase TPC sensitivity to low mass WIMPs
- At SLAC: Investigate charge signal degradation vs Hydrogen doping

Rn Distillation

- Rn-removing distillation column for nEXO with minimal LXe inventory in the column
 - Chat to Brian Mong if interested

HydroX: ^{222}Rn Contours in S1/S2 Space



Ongoing Xe R&D

ReLIC

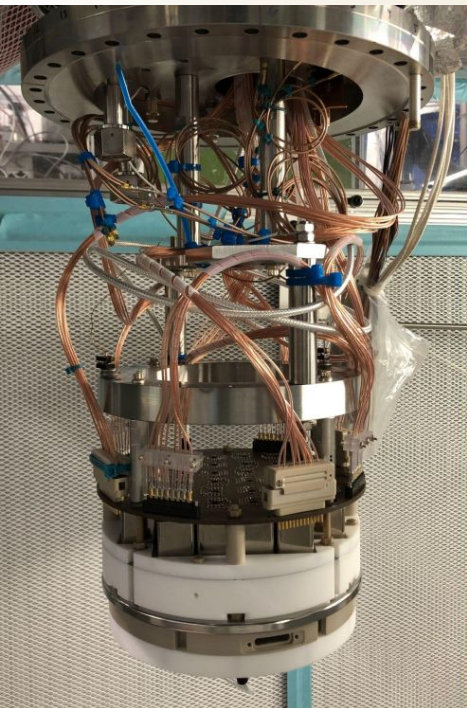
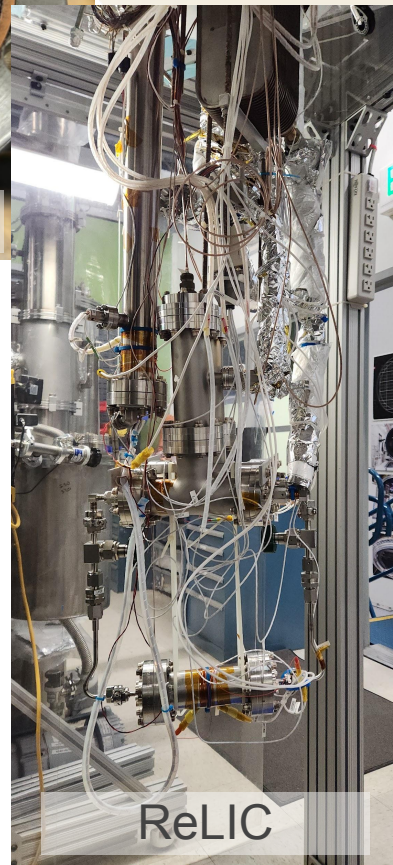
- Can we efficiently remove Rn from liquid Xe via chromatography?
 - Stay tuned...

Phase 1 (we need a new name...)

- Investigate small-scale HV grid charge/light emission in gas and later liquid
- Continuation of the previously-LZ focused effort

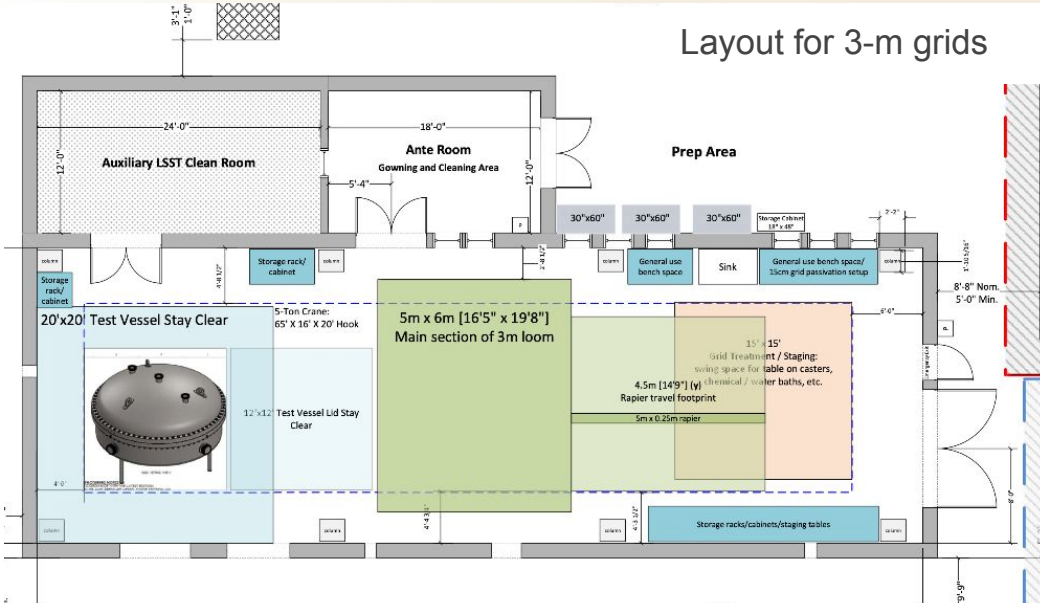
Also, DUNE and GammaTPC/GAMPix R&D

- Focused on liquid Ar handling (with applications to liquid Xe handling), cryogenic readout, and other technologies



Phase 1* TPC

* actually HydroX



Infrastructure upgrades:

- Sufficient space for expanded grid production at 3m scale, including chemical treatment and xenon gas testing
- Possible Rn-removal from air using LZ gas-charcoal chromatography system: repurpose from Kr removal from Xe to Rn removal from air
- Assembly of large-scale components

Planned R&D efforts, in cooperation with SLAC-based DUNE groups and other expertise from SLAC directorates

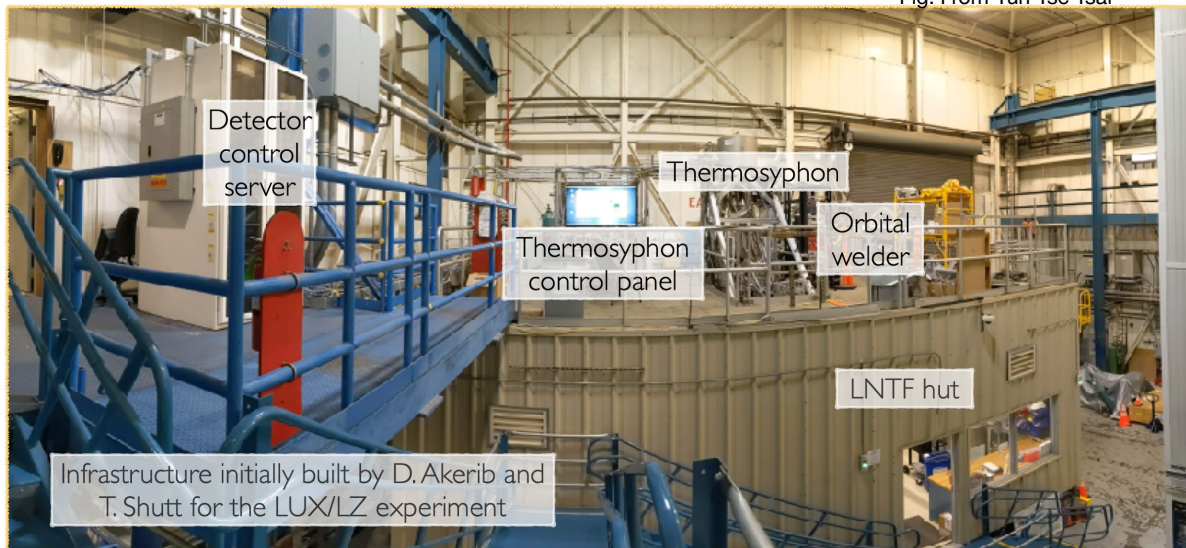
- Light and charge emission studies
- Liquid handling and purification studies
- Cold electronics (see Ann Wang tomorrow)



Appendix

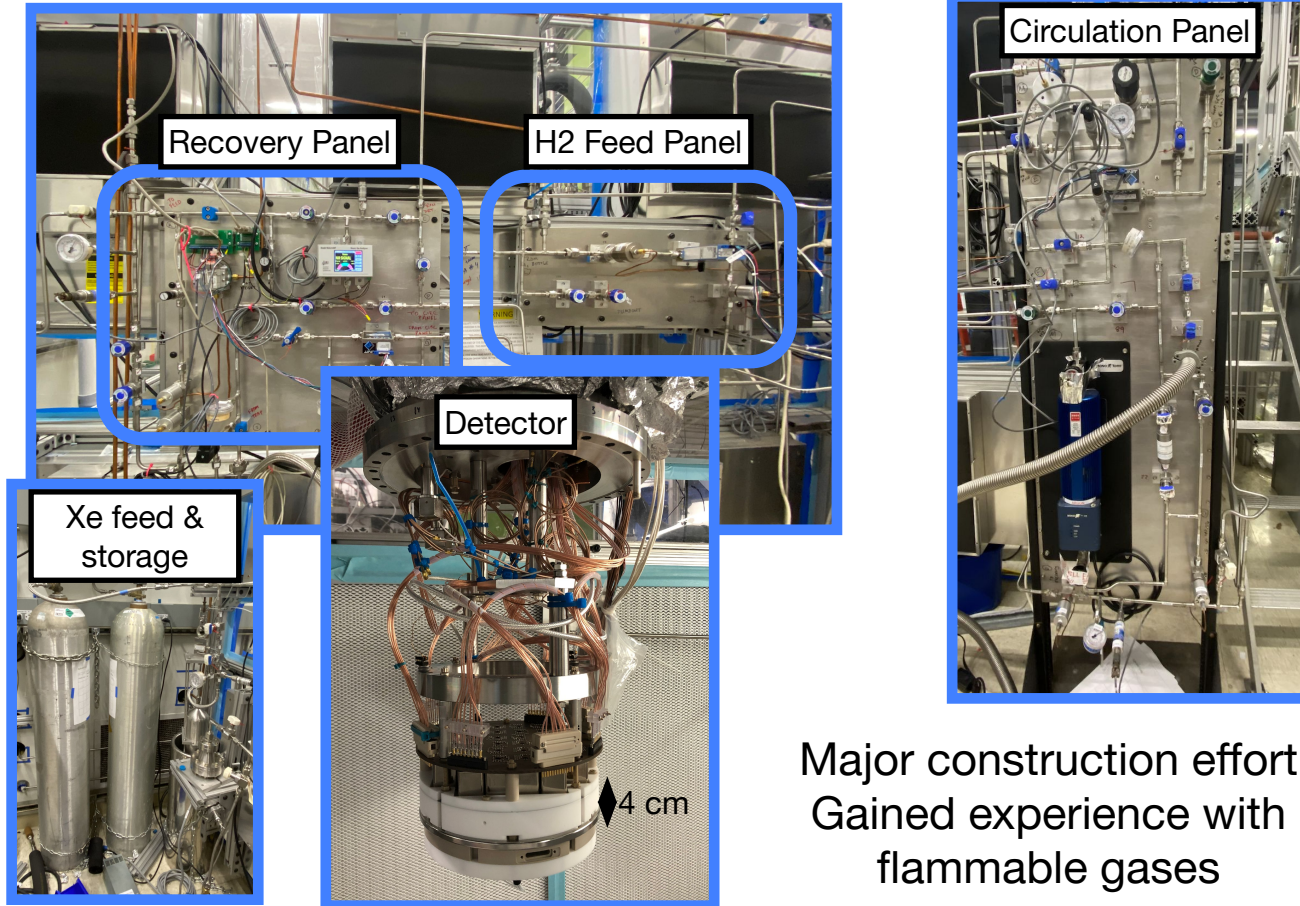
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Fig. From Yun-Tse Tsai



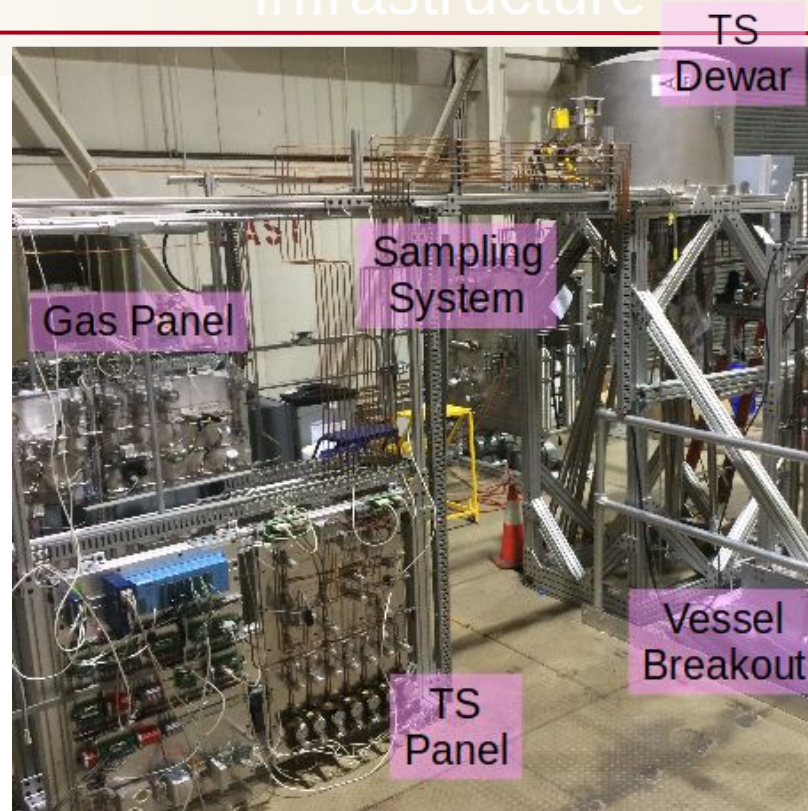
- Located at IR2 at SLAC
- R&D Experiment Facility for xenon and argon (DUNE, nEXO collaborators)
- Shared infrastructure
- Shared knowledge!

Hydrox/Phase 1 Gas handling system & detector



Major construction effort
Gained experience with
flammable gases

SLAC Test Platform Infrastructure



- 2 floors (the “hut”) within the former BaBar hall
- Circulation pump housed in a separate building