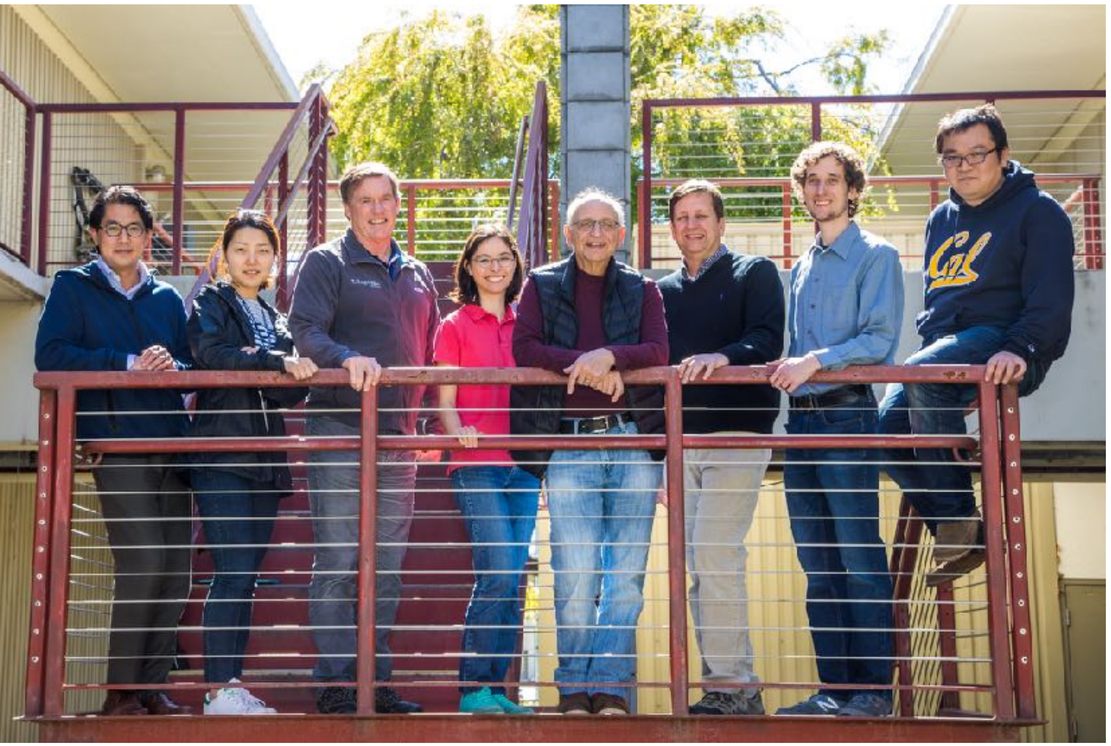
H. A. TANAKA

SLAC ACTIVITIES ON DUNE ND

OVERVIEW

- SLAC beam neutrino group
  - members, status
- Current LArTPC-related activities
  - starting point for potential contributions/activities on ArgonCube
  - some new/different directions (prototyping, DUNE PRISM, etc.)

SLAC NEUTRINO GROUP



Hirohisa Tanaka | Ji Won Park | Tracy Usher | Laura Domine | Leon Rochester | Mark Convery | Brandon Eberly | Kazu Terao

- Diverse background
  - ν: Double Chooz, Daya Bay, Minerva , MiniBooNE, T2K
  - Other: SLD, BaBar, D0, Fermi LAT, E787, and more . . . .

Gianluca Petrillo

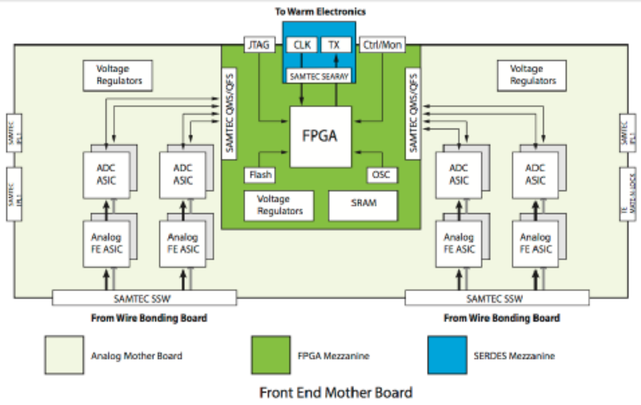
Yun-Tse Tsai

Patrick Tsang

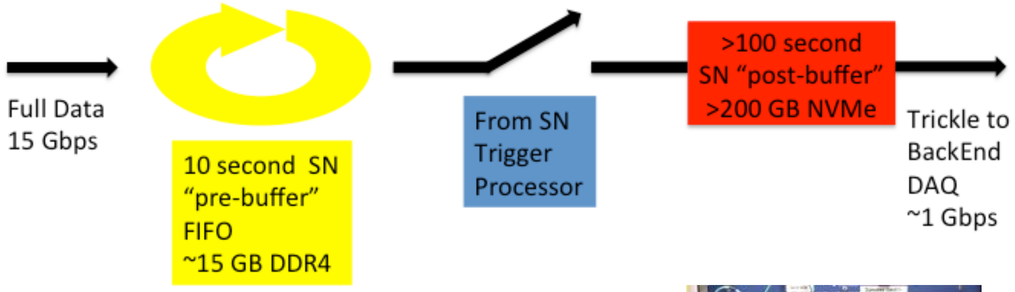
- Group has roughly doubled in size over the past year and may continue to grow

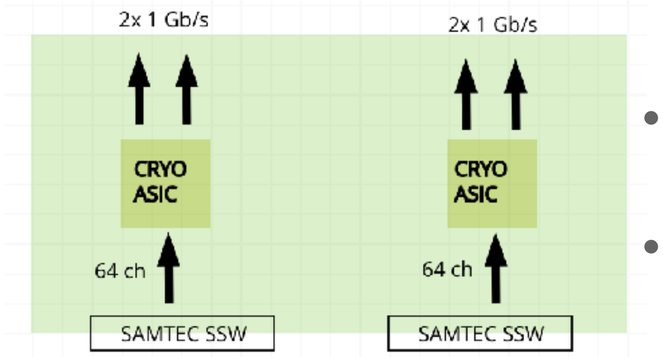
NAME		RESPONSIBILITIES
M. CONVERY	Staff	DUNE: 35 T analysis co-coodrinator, cold electronics
D. DOERING	Engineer	DUNE: CRYO cold basic
L. DOMINE	Grad. student	Machine learning, physics analysis
B. EBERLY	RA	μB: Calibration+Det. Physics co-convener
M. GRAHAM	Staff	DUNE: ProtoDUNE/DUNE DAQ HW coordinator
G. PETRILLO	Assoc. Staff	Just arrived!
H. A. TANAKA	Faculty	DUNE: Near Detector, Cold Electronics
K. TERAO	Assoc. Staff	μB: Machine Learning, physics analysis
Y.-T. TSAI	Assoc. Staff	μB: (DAQ leader), Astrophysics/Exotics co-convener
P. TSANG	Proj. Scientist	DUNE : ProtoDUNE DAQ integration
T. USHER	Staff	μB: Analysis tools co-convener

ELECTRONICS, DATA ACQUISITION



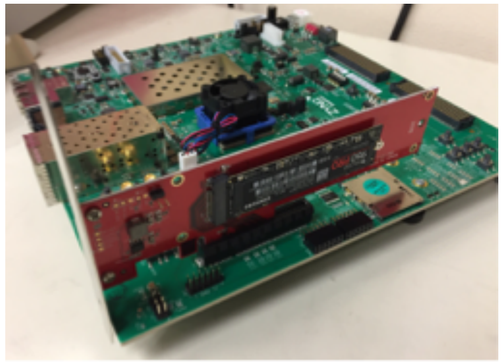
current baseline

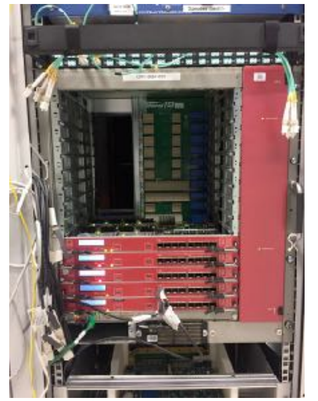




SLAC "CRYO"

- 18 main elements reduced to 2 ASICS
- Aim to reduce cost, simplify testing, improve reliability, longevity

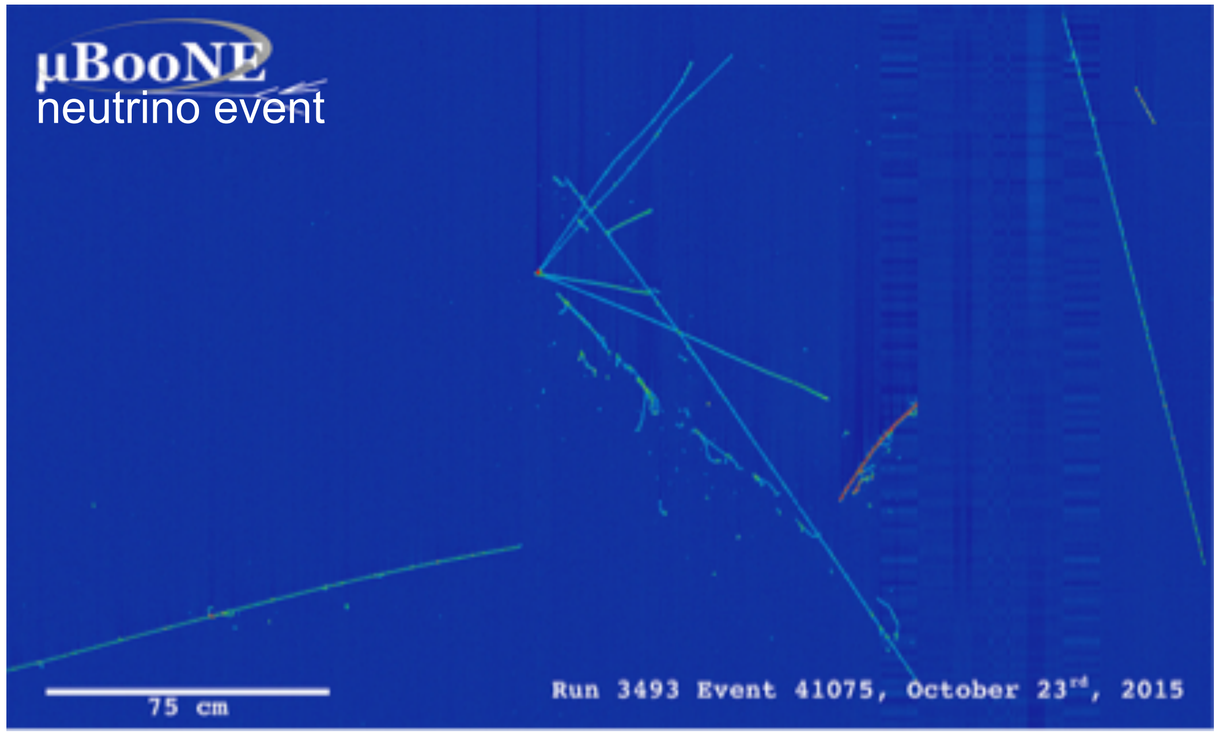




- Single-ASIC readout electronics "CRYO" for DUNE
- Challenge: 2MHz readout of O(10^4) channels for decades in LAr
- Leverage:
  - TID/AIR expertise, including Fermi-LAT
  - joint effort with nEXO, university partners

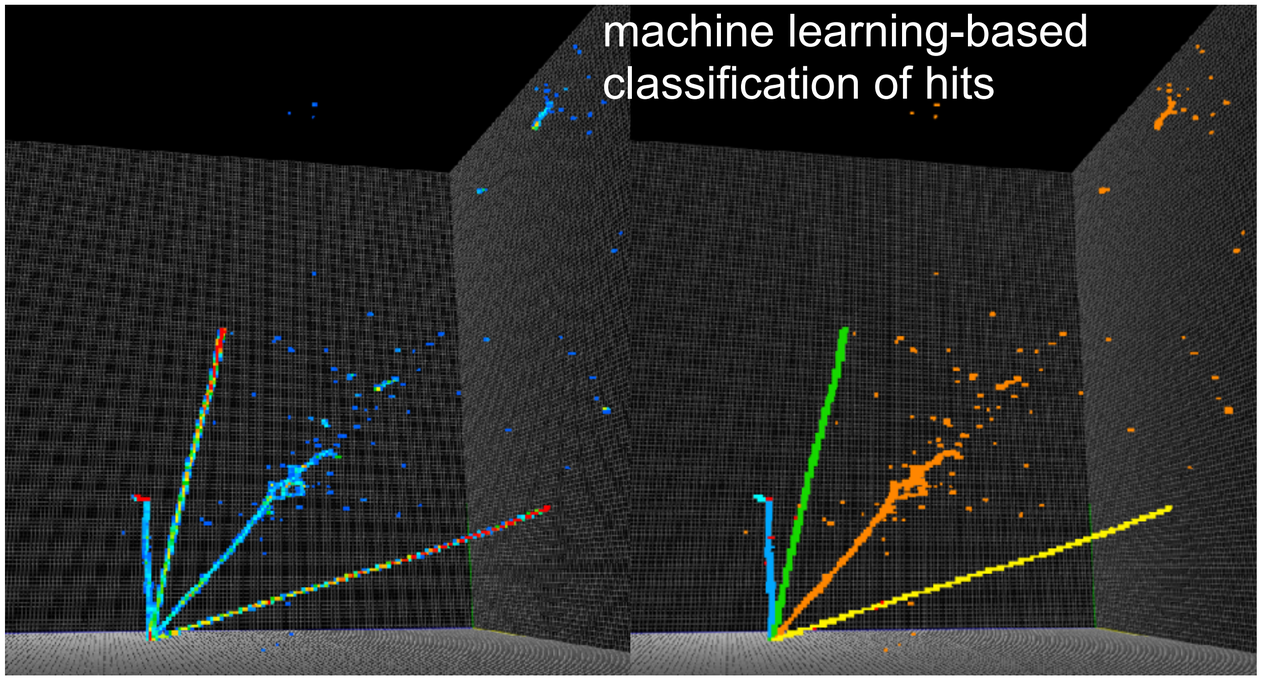
- Data acquisition for ProtoDUNE and DUNE
- Challenge: recording ~10 minutes of raw data from supernova neutrino burst
- Leverage:
  - SLAC-developed RCE system (hardware)
  - TID/AIR, collaboration with UK groups

SOFTWARE AND ANALYSIS



- More from Kazu and Tracy on some of this

- Various related activities
  - calibration and signal processing
  - reconstruction with “traditional” methods + LArSoft
  - reconstruction with modern machine learning methods
  - optical simulation (scintillation, photosensors)
- lots of enthusiasm for native 3D space points!
- most activities are on SBN program (μBooNE, ICARUS)



SOME PERSONAL THOUGHTS:

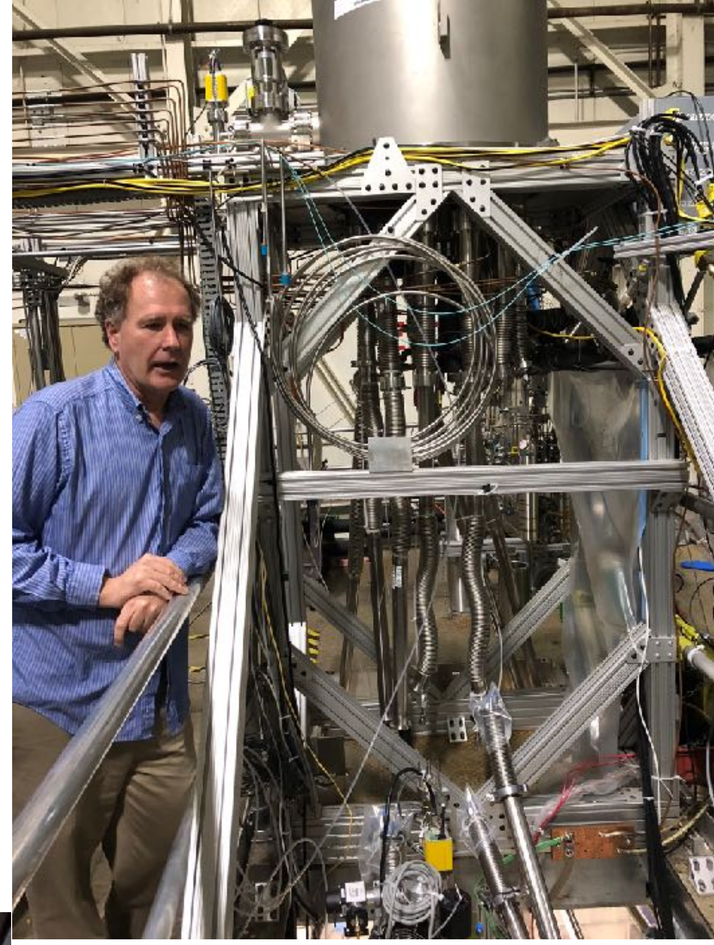
- Technical/Contribution view;
  - SLAC is involved with many things across any projects
    - DAQ, software, calibration, reconstruction, electronics, analysis
    - MicroBooNE, ICARUS, (Proto)DUNE and now DUNE ND
  - we would be looking to maximize synergy with existing activities and expertise
  - would need to think separately about two time scales:
    - contributions to 2x2 prototype (~year)
    - longer term development for DUNE ND
- Goals:
  - optimize overall detector design with respect to physics performance and cost/complexity
  - fully integrate with other components of near detector (MPT, calorimeter, side detectors, whatever else . .)

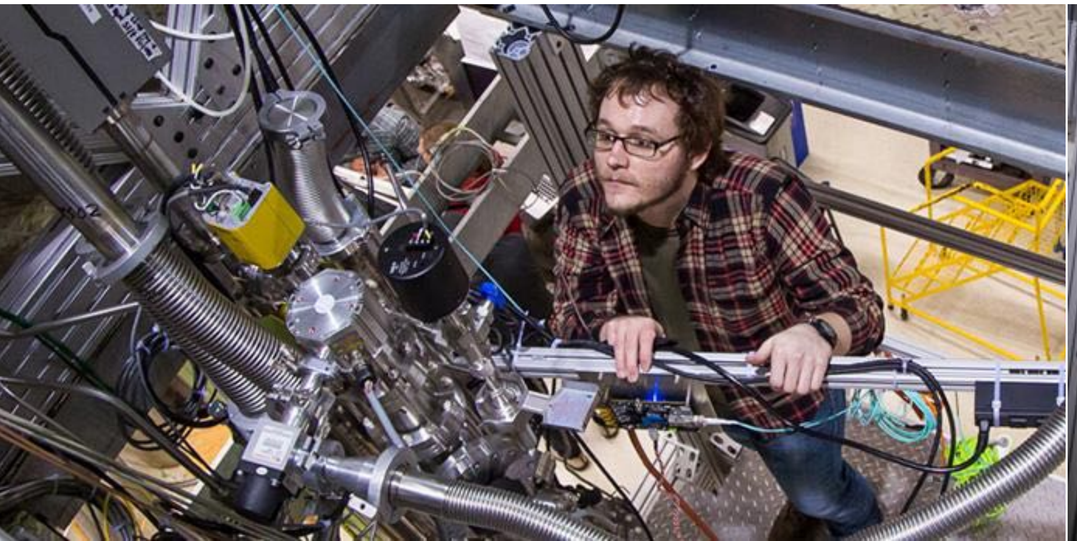
POTENTIAL DIRECTIONS

- Software/Analysis :
  - Pixel reconstruction and analysis:
    - do pixels and segmentation deliver on their “promise”?
  - Optical system simulation
  - Optimization studies for detector design guided by full(er) simulation:
    - module size, pixel geometry, minimization of dead material, etc.
    - check that expectations hold up with simulation/reconstruction
- Hardware:
  - build LAr capability towards operating TPCs for development/testing
  - prototyping, tests, etc.
  - electronics, DAQ
  - ideally, significant fraction of a module for the 2x2 prototype
    - need to build up technical expertise in group to operate cryogenics
  - DUNE PRISM Demonstrator (e.g. movable module)
- Organizational:
  - HO: Near detector design/strategy is one of the most important and challenging scientific issues in DUNE
  - it is important for US groups to have a major role
    - look forward to coordinating with US groups towards making a fundamental role in this effort.

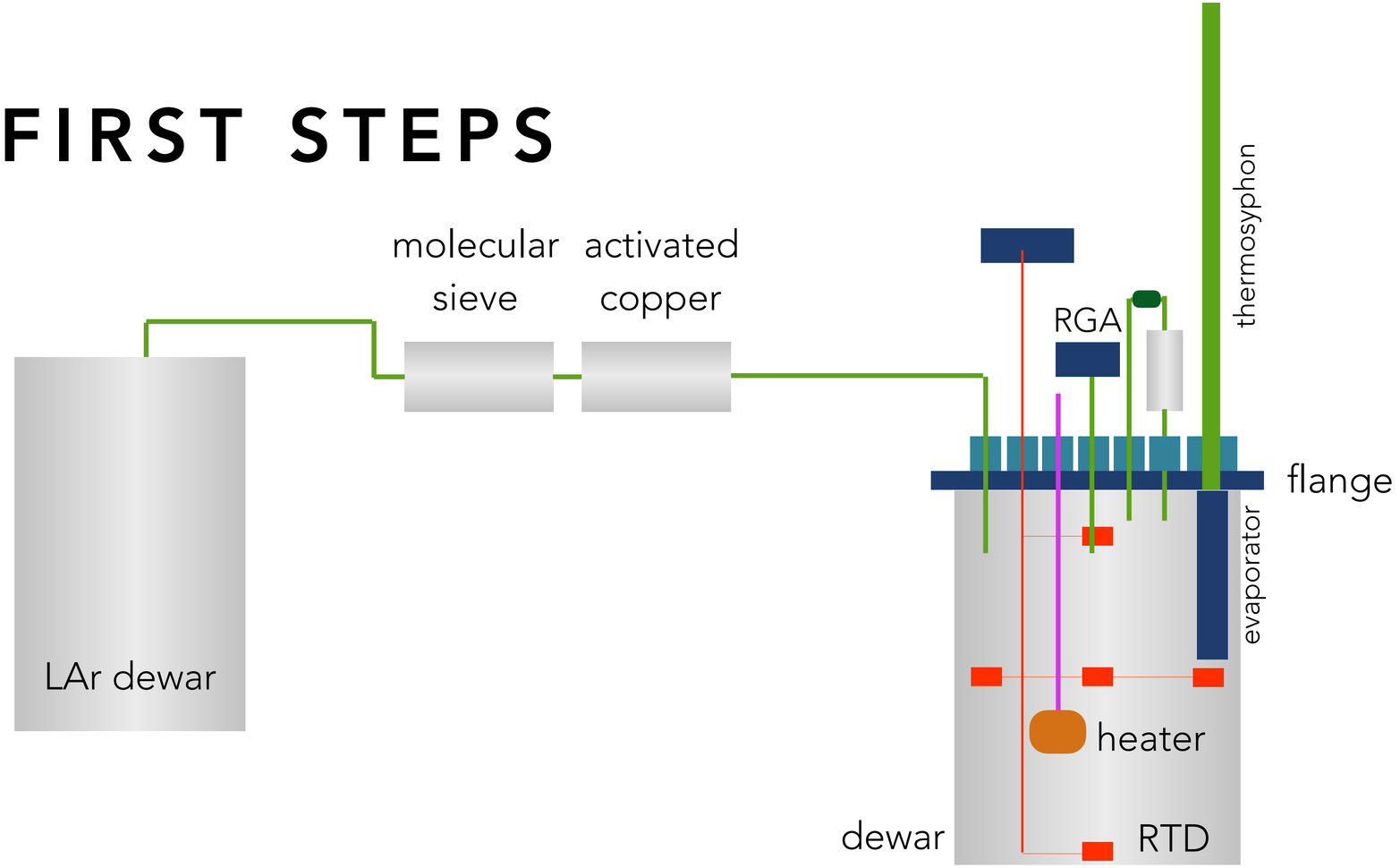
LIQUID NOBLE GAS TEST STAND

- Cryogenic facility at SLAC IR2 (former site of BaBar detector)
- Built by LZ group (D. Akerib, T. Shutt)
- Large LN thermosyphon system to cool independent cryostats
  - extensive and extendible control and monitoring infrastructure
- Two level ~10 x 10 m^2 deployment area for cryogenic setups
  - large areas occupied by LZ work, but still can accommodate additional setups
  - LZ work will wind down over the next several months.
- Extensive experience in cryogenics and HV (LZ, nEXO) in LXe





FIRST STEPS



- Steps:
  - Fill and cool LAr
  - Introduce heater, verify cooling power
  - study uniformity of temperature
  - introduce RGA to measure contamination
  - purification on initial fill
  - purification in recirculation
  - deploy purity monitor/small TPC

- LAr has never been cooled with the LNTF, only LXe
- Start with a small ~50 liter demonstrator to develop basic capabilities
  - first step: evaporator for LAr under design
  - design flange to accommodate successive steps
  - think about larger "industrial" setup and what is required to make meaningful R&D contributions

THINKING AHEAD

- Eventually aim to operate a full module at IR2
- Suggestion from D. Akerib and T. Shutt:
  - flange at fixed level on top platform supporting modules
  - dewar “lifted” into place
  - avoid movement/interference of cabling, etc.