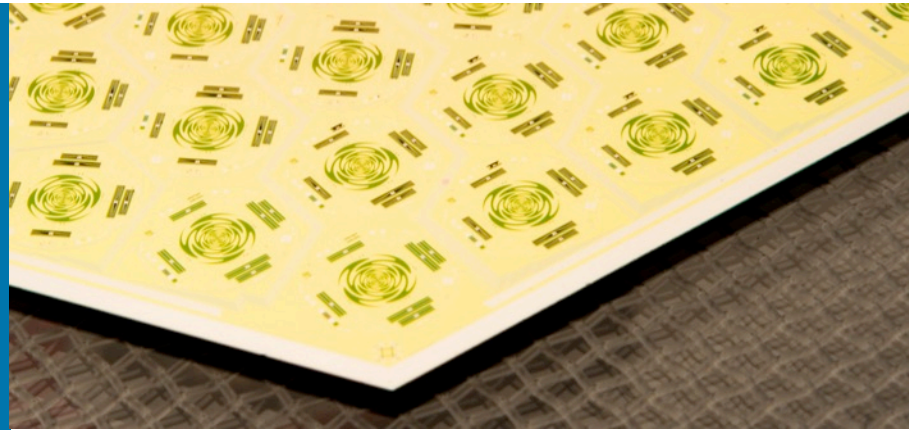
CRYOGENIC TESTING



CLARENCE CHANG
Assistant Physicist
High Energy Physics Division

High Energy Physics (HEP) Independent Safety Review
September 24-25, 2018

OUTLINE

- Program overview
- Cryogenic testbed overview
- High level breakdown of lab activities
- Safety

SUPERCONDUCTING DETECTORS & DEVICES

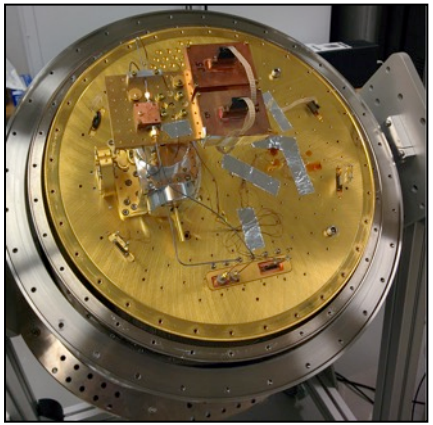
Developing new superconducting materials, devices and detectors to advance the DOE HEP mission and beyond.

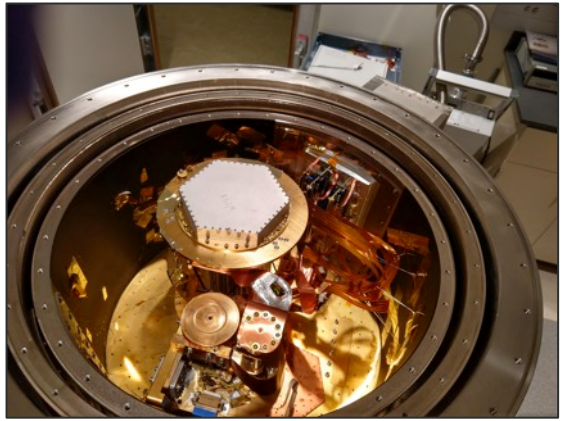
- Develop detectors and readout for leadership Cosmic Microwave Background experiments (DOE-HEP CF priority)
- Develop detectors for studies of Neutrinoless Double Beta Decay (DOE-NP priority)
- Explore new materials and devices for Quantum Information Science

CRYOGENIC TESTING

Characterize devices at appropriate sub-Kelvin temperatures

- Three test beds in HEP cryogenic testing
  - 30 mK test bed - building 360: RF and DC measurements (CMB, QIS)
  - 7 mK test bed - building 223: SQUID and DC measurements (NLDBD)
  - 250 mK test bed – building 241: multiplexed SQUID (CMB)





TYPICAL MEASUREMENT

- Assembly of small parts into test device (rubber cement, wirebonding, small hand tools, soldering)
- Mounting of test device into cryostat (small hand tools)
- Assembly of cryostat radiation shields and vacuum jacket (small hand tools, lifting)
- Evacuate air from cryostat (vacuum pump)
- Cooldown: turn-key cryogen-free systems, automated sub-Kelvin cycling
- Tests (computer controlled, commercial hardware e.g. scopes, VNA)
- Warm up (turn off sub-Kelvin system, turn off compressor)
- Slow vent of cryostat

SAFETY IN CRYOGENIC TESTING

- ZERO safety incidents (11 year program)
- Upgraded cryogenic systems to cryogen free – NO LIQUID CRYOGENS
- Lab activities listed in Work Control Document
- Additional hard copies of manuals and procedures kept in lab with equipment
- Identified hazards (e.g. vacuum systems, small hand tools) mitigated through engineering controls (e.g. pressure relief valves), personal protective equipment (e.g. gloves) and administrative controls (e.g. training with staff)
- Regular safety walkthrough by Division Director and ESH personnel together with scientific staff
- Cryostat assembly is the largest hardware handled. Always work with team of at least two people.
- New personnel always work with experienced staff for 1-3 months prior to leading a cooldown run. Go through multiple (>4) cooldowns under supervision.

THANK YOU.