NSCL CRYOGENICS DISTRIBUTION SYSTEM RECONFIGURED FOR THE FRIB ERA

Contributed by Nusair Hasan

The Coupled Cyclotron Facility (CCF) at NSCL was shut down in 2020 after successfully operating and supporting user program for 20 years. Following the completion of the CCF program, work has begun to reconfigure and integrate the beamlines, instruments, detectors and other components of this facility in FRIB.

In the NSCL era, the cryostats of the K1200 and K500 cyclotrons, A1900 fragment separator, S800 spectrograph and other experimental vaults were supported by a network of cryogenic distribution systems fed from the NSCL cryogenic helium refrigerator (known as the ‘Green Cold Box’). This cryogenic refrigerator along with the main trunk of the distribution transfer line was commissioned in 2000 as part of the NSCL cryogenic system upgrade project. Due to the organic evolution of NSCL over half a century, the cryostats were supported by a complex distribution system stemming from this main cryogenic distribution line(s). Reconfiguration of the A1900 fragment separator for the FRIB era requires re-routing, rebuilding, and in some cases adding cryogenic distribution lines for these cryostats. After careful evaluation of several different options, it was decided to segregate the cryostats based on their operational requirements and location. So, adopting a similar philosophy used for the FRIB linac, valve boxes with easily removable interconnects (colloquially called “U-tubes”) are used to accomplish the segregation. A sketch of the post- A1900 reconfiguration cryogenic distribution system for A1900 fragment separator, along with FRIB target vessel and fragment pre-separator cryogenic distribution is shown in figure A below.

According to the reconfiguration plan, the NSCL main transfer line (figure A, in pink) will be connected to a new cryogenic distribution segment (figure A, in green), approx. 50 ft. long and branching out to support different cryostats. Altogether, this cryogenic distribution system will support over 55 cryostats, with a total liquid helium inventory of over 10,000 liters. A 3D model of this new cryogenic distribution segment along with the branch connections and interface point with the existing NSCL main transfer line is shown in figure B. The branches from this cryogenic distribution segment will support more than 50 cryostats, with potential for future expansion without significant reconfiguration effort.

Interfacing this new cryogenic distribution with the legacy system poses some challenges - such as, supporting different styles of cryostats (e.g., ‘continuously filled’ and ‘batch-filled’ types), connecting the new circular cross-section distribution lines with existing square cross-section lines,
and incorporating liquid nitrogen phase separators in the branches to mitigate blockage in the thermal shield circuit (and waste of liquid nitrogen). Solutions to the challenges were incorporated into the overall conceptual design. Integration of this legacy system into the newly designed FRIB system presented a great learning opportunity for students. Several undergraduate engineering students from the MSU Cryogenic Initiative took part in the design effort for this project under the close supervision of FRIB cryogenic staff engineers. Presently, an interdisciplinary team of engineers and students are working to realize this project with the goal of cryogenic availability to these cryostats by the end of November 2021.

![Figure B- 3D model of the cryogenic distribution segment (new) with the branch connections. This segment is interfaced with the existing NSCL main transfer line at point A.](image)

**REA UPDATE**

After achieving the ReA6 commissioning goals last week, ReA is shut down to refurbish the EBIT electron gun. We will use the time to in parallel make reliability upgrades, make improvements in the alarm system, and further develop auto-turn-on programs. This work is on track to be ready for the forthcoming first experiment, which will start May 12 on the ReA6 Experimental Vault general purpose beam line. Preparations to experimental setup is progressing. The plexi-glass shields around the SOLARIS superconducting solenoid are completed. The ReA6 Experimental Vault was nearly cleaned up to accommodate the first experiment setup next week. The integration of the experimental system vacuum control with the ReA6 accelerator has started this week.

**SEMINARS**

- **TUESDAY MAY 4, AT 11AM EST**
  - Online via Zoom, passcode 48824
  - Virtual Theory Seminar
  - Yinu Zhang, Western Michigan University
  - 'Nuclear EDFs: Particle vibration coupling to superfluid nuclei in axial deformation'

- **FRIDAY MAY 14, AT 1 PM EST**
  - Online via Zoom, Passcode: woop
  - Retirement Celebration for Gary Westfall

**PROTON’S DUCKLINGS**

Contributed by Jon Bonofilgio

Proton’s ducklings started hatching on Tuesday around noon. On Wednesday afternoon, she started marching them around the courtyard so Marty Mugerian and Jon shepherded them down to the river.

The ducklings are named:
1. Bianchi
2. Campagnolo
3. Castelli
4. Cinelli
5. Colnago
6. Pinarello
7. Santini
8. Triestina