Introduction
April 1, 2022 – March 31, 2023

Progress in research and operations at the Texas A&M Cyclotron Institute is summarized in this report for the period April 1, 2022 through March 31, 2023. The CI has had a remarkably productive year and I am indebted to the dedicated operations staff that keeps the facility running. The discovery science program continues to produce exciting results as outlined in the chapters that follow. At-211 has successfully been shipped overnight to collaborators at the University of Alabama – Birmingham.

Cyclotron physicist Dr. Ralf Rapp is the PI for a new Topical Theory Collaboration Heavy-Flavor Theory (HEFTY) for QCD Matter. The collaboration will develop a theoretical framework for describing the behavior of some of the heaviest particles within a unique form of matter that characterized our universe in its earliest stages.

Funding for the DOE – NP Center of Excellence that supports the Cyclotron Based Nuclear Science program has been renewed for an additional 3 years. Additionally, the DOE/NNSA Center of Excellence CENTAUR has also been selected for a 5-year renewal. With funding from the radiation effects community we have initiated a project to enhance the range of beams from the K150 and reliability of K500.

During this period the K500 provided 5292 hours and the K150 provided 3912 hours of beam for both science and radiation-effects testing. For the first time, both the new ECR4 ion source and the repaired ECR1 ion source were used to supply injected beam for the K500. Development has continued with the K150, most notably the testing of the effect of the internal helium cryopanel on extracted beam. The intensity of a 3 MeV/u gold beam increased by over a factor of thirty when the cryopanel was cooled down. Also, the MIVOC (Metal Ions from VOlatile Compounds) method was tried for introducing metallocene compounds into ECR2 for the production of metallic ions to be accelerated by the K150. Metallocenes are organometallic compounds with high vapor pressures, so they require higher conductances and sometimes heating elements to gain enough flow of vapor into the ion source. They should enable much longer periods of uninterrupted beam production than the micro-ovens usably used to vaporize metals inside the ion source.

Institute scientists remain active in a number of collaborative research efforts around the world. Major programs include: measurements of beta decays with the TRINAT collaboration at TRIUMF; nuclear structure measurements with TexAT at TRIUMF; continued work with the STAR collaboration at RHIC; and participation in the SAMURAI collaboration at RIBF in Tokyo, Japan.

The format of this report follows that of previous years. Sections I through III contain reports from individual research projects. Operation and technical developments are given in Section IV. Section V lists the publications with Cyclotron Institute authors and outside users and the Appendix gives additional information including talks presented by members of the Institute during the past year. Once again, the full volume of this year's Progress in Research is available only on our web site (http://cyclotron.tamu.edu).

Since most of the contributions presented here are truly reports on progress in research, results and conclusions should not be quoted from the report without the consent of the authors.

I am indebted to Dr. Y.-W. Lui for assembling this report.

S.J. Yennello
Sept 13, 2023