Introduction
April 1, 2023 – March 31, 2024

Progress in research and operations at the Texas A&M Cyclotron Institute is summarized in this report for the period April 1, 2023 through March 31, 2024. The CI has had a 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. Texas A&M officially became a member of the National Isotope Development Center, as a source of astatine-211.

Longtime Cyclotron Institute professor Carl Gagliardi retired, but continues to remain active as his cycling calendar allows. Additionally, Dr. Akram Zhanov retired after over 20 years as a senior scientist at the Cyclotron Institute. Fortunately, we had very successful faculty searches and will be welcoming Dr. Jonas Karthein as an Assistant Professor and Dr. Baishan Hu as an Assistant Research Professor this coming year.

Congratulations are due to the following students who completed their graduate degrees: Dr. Stefania Dede, Dr. Andrew Hannaman, Ryan Rinderknecht, Dr. Stephen Robicheaux, Dr. Isaac Sarver, Dr. Dustin Scriven, Dr. Arun Sengupta, Zachary Tobin, Dr. Giaogang Wu.

The Texas A&M Cyclotron Institute continues to be the world's premier facility for testing semiconductor chips for resilience to radiation, with over 4386 hours provided to 60 institutions. The third bootcamp for radiation effects testing was successfully held in March, with instructors from the Cyclotron Institute, Renesas Electronics America, NASA GSFC, NASA JPL and NASA JSC.

The faculty at the Texas A&M Cyclotron Institute continue to lead multiple multi-institutional programs including the DOE/NNSA Center of Excellence CENTAUR; the DOE Topical Theory Collaboration Heavy-Flavor Theory (HEFTY); The DOE-IP Horizon Broadening Isotope Production Pipeline Opportunities (HIPPO) program and the DOE-NP Texas Research Enhancing Nuclear Development (TREND) program.

The TREND program and the HIPPO program brought undergraduates to the Cyclotron Institute for summer research. They joined with the 20th class of REU students to form the Tron Summer Scholars program.

During this period, the K500 provided 6192 hours and the K150 provided 4959 hours of beam for both science and radiation-effects testing. Some of the new beams that were developed included transition metal beams, such as Iron and Titanium, produced with the ECRs with Metal Ion Volatile Compounds, or MIVOC. The refurbishment of ECR1 was completed, and ECR1 was used extensively during the latter half of 2023 to provide beam to the K500. The ability to quickly switch from ECR1 and ECR4 on the K500 for either science or radiation effects beams reduced the typical single ECR changeover time by over 200 hours. During the first quarter of 2024, a new filament ion source capable of producing both H^- and He^+

light ion beams was installed for the K150, replacing the previous H- source. This new filament ion source, manufactured by D-Pace, Inc., will allow more intense H and He beams to be accelerated with the K150. The intensity of 4He beam for the production of ^{211}At continues to be improved, with a new maximum intensity of 20μA. The new injection scheme on the light ion guide yielded positive results from the CBECR including the development of ^{89}Nb, ^{89}Zr, ^{114}In, ^{106}In and ^{105}Cd. The re-accelerated radioactive beam of ^{105}Cd was used to study the structure of ^{106}Sn by the resonance elastic scattering p+^{105}In. The CBECR was also outfitted with a sputtering fixture to produce ^{64}Zn(25^{+}) ions which were accelerated to 47 MeV/u by the K500. Progress was made on the first full year of the DoD funded K150 upgrade project. Orders on major components were placed with various vendors such as Pantechnik for the 18 GHz ECR, Alpha Magnetics for the injection line magnets and Negative One-Eighty for the LHe cryopanel cryogenics system. The upgrade project has also procured $400K of replacement legacy items and spare parts including Pfieffer vacuum system equipment, cyclotron power tubes and ECR microwave transmitter repair equipment. 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
Aug 11, 2024