Introduction
April 1, 2010 – March 31, 2011

Progress in research and operations at the Texas A&M Cyclotron Institute is summarized in this report for the period April, 1, 2010 through March 31, 2011. The format follows that of previous years. Sections I through IV contain reports from individual research projects. Operation and technical developments are given in Section V. Section VI lists the publications with Cyclotron Institute authors 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.*

We have now completed 6 1/2 years of the Upgrade Project, which ultimately will give us accelerated radioactive beams at intermediate energies. The progress on the project continues to be good. The K150 cyclotron is operational for both positive-ion and negative-ion beams. In the fall of 2010, we completed the installation and testing of new radiation monitoring equipment and during our January, 2011 shutdown we integrated the two accelerators and all of the beam lines into a single interlock system. We have used the K150 cyclotron for several test experiments in the spring. The ion-guide cave shielding was installed starting in late November, 2010. The shielding was tested for radiation leaks with a high intensity proton beam in the spring of 2011. Work is now underway to mount all of the power supplies needed for the ions guides and the Charge Breeding ECR ion source on top of the shielding blocks. We are anticipating beam into the light-ion guide during the fall of 2011.

The Nuclear Solutions Institute was approved by the TAMU Board of Regents in September, 2010. With the approval, we have begun searches for two senior level radiochemistry faculty members and a senior level experimental nuclear physics faculty member. We hope to fill those positions during this next year. Starting in summer, 2010, an architect firm began developing plans for adding a second floor to the office wing of our building. As is typical, it has taken longer than anticipated to move from the plans to the start of construction. The most likely time now for a construction start is October, 2011.

As in previous reports, I have pulled out some highlights of work over the past year. Those that are noteworthy are given below.

Research highlights:

(1) New measurements of half-lives for ^{38}Ca, ^{38}K^{m} and ^{46}V have been completed along with improvements in QEC values for ^{10}C, ^{34}AR, ^{38}Ca and ^{46}V. These measurements provide substantial improvement in the precision of known super-allowed transitions.

(2) A new value for the ANC of $^{14}C+n \rightarrow ^{15}C$ has been determined from several different neutron transfer reactions. The ANC is used to obtain the $^{14}C(n,\gamma)^{15}C$ capture cross section. The new result is in good agreement with the most recent direct measurement.

(3) A thermal-rate equation approach with in-medium charmonium spectral properties has been used to predict J/ψ observables at the Large Hadron Collider; first ALICE data presented at Quark Matter 2011 confirm these predictions.

(4) Experimental investigations of cluster formation in low-density nuclear matter have been employed to derive equilibrium constraints for cluster formation. The data have been used to test predictions of several theoretical astrophysical EOS models and provide important new constraints on these model calculations. Measurements of the density dependence of the free symmetry-energy coefficients in this low-density clustered matter have been found to be in very good agreement with values calculated using a quantum statistical model which incorporates in-medium effects on the binding energies.

(5) New measurements of the γ decay of ^{32}Cl have revealed the largest ever observed isospin-symmetry breaking in a super-allowed Fermi transition of 5.4(8)%. The result is in good agreement with shell-model calculations and it validates the calculations for other *sd*-shell nuclei.

(6) The $^{162}Dy(^{54}Cr,4n)^{212}Th$ reaction has been studied as an anlog for the production of element 120 in the $^{248}Cm(^{54}Cr,4n)^{298}120$ reaction. The results suggest that the cross section for this new element will be extremely sensitive to the size of its fission barrier.

(7) The role of isospin asymmetry of the fragmenting source in multi-fragmentation was studied using the Landau free energy approach, which is applicable to systems in the vicinity of a critical point. The mirror-nuclei yield ratios show an exponential dependence on the isospin asymmetry of the fragmenting source, as expected from the model, suggesting that it is an order parameter.

(8) Using a multiphase transport model, we have shown that the triangular flow is appreciable in relativistic heavy-ion collisions as a result of fluctuations in collision geometry and has a significant effect on the away-side structure in the dihadron azimuthal correlations triggered by emitted jets.

(9) A new, high-precision measurement of the longitudinal double-spin asymmetry for inclusive jet production has been completed with STAR that significantly reduces the uncertainty of the gluon polarization in the proton.

(10) A new theory of (d,p) stripping to bound states and resonances has been developed that provides a universal R-matrix approach to treat both binary reactions and stripping in terms of the same observables – reduced widths (ANCs) and R-matrix boundary conditions.

(11) The influence of fluctuations and inhomogeneity on measurements of jet quenching in high energy nuclear collisions has been studied for the first time.

As in the past, Institute scientists remain active in a number of collaborative research efforts around the world. Major programs include: mass measurements using the Penning Traps at Argonne National Laboratory and the University of Jyväskylä; continued work with the STAR collaboration at RHIC; and the measurement of neutron beta decay with the UCNA collaboration.

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

R.E. Tribble
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