Introduction
April 1, 2004 – March 31, 2005

This document summarizes the progress in research and operations at the Texas A&M Cyclotron Institute for the period April, 1, 2004 through March 31, 2005. 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. This volume of Progress in Research continues our new format where publication will be solely 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.*

This past year has been an extremely busy one for us at the Institute. In the spring 2004, we were notified by the Department of Energy that our proposal for upgrading the Cyclotron Institute had been approved and funding would be provided following the completion of a project management plan and a technical review. The upgrade project involves refurbishing our K150 cyclotron and using it as a driver to produce radioactive isotopes. The radioactivity will be slowed down in gas-filled ion guides and then fed to the K500 cyclotron, through a charge breeding electron cyclotron resonance ion source, for reacceleration. During last spring and summer, an Upgrade Management Plan was developed for the project. Following a technical review in September, 2004, the Management Plan was approved by the Department of Energy and the project officially began in December, 2004. Present plans call for the first reaccelerated beams from the K500 to be available in calendar year 2010.

Even with the upgrade effort underway, Cyclotron Institute research programs have continued to make significant progress. Some recent achievements are noted here.

(1) The symmetry energy has been extracted from results of experiments on isoscaling of fragments produced in heavy-ion collisions (A = 58 Fe and Ni on Fe and Ni targets at 30, 40 and 47 MeV/A) and the influence of neutron composition and excitation on fragment production and secondary decay has been investigated via statistical multi-fragmentation model calculations.

(2) Results have been obtained for the ^{22}Mg(p,γ)^{23}Al reaction at stellar energies using charge symmetry and a measurement of the asymptotic normalization coefficient for ^{22}Ne + p $\leftrightarrow$ ^{23}Ne.

(3) A novel method to determine spectroscopic factors from (d,p) reactions has been developed based on information about asymptotic normalization coefficients.

(4) Antisymmetrized molecular dynamics investigations of isoscaling techniques for determinations of the symmetry energy at low density demonstrate that secondary decay can not be ignored as has previously been assumed.

(5) Recent measurements of K and L shell ionization by heavy ions have been used to establish universal scaling parameters for L and M shell spectator vacancy fractions and double to single vacancy population ratios.

(6) Measurements have been completed by the TWIST collaboration producing new results for the Michel parameters ρ and δ with precisions of ≈ 0.001, factors of 2.5-3 better than the previous world averages.

(7) Due to violations of self-consistency in Hartree-Fock based RPA calculations, shifts in the centroid energies of compression modes can be as large at 1 MeV, leading to a shift of 30 MeV in the extracted value of the nuclear compressibility.

(8) Using hadronic (D-meson) resonances in an effective model for a strongly coupled Quark-Gluon Plasma, new results find that charm-quark thermalization times could be reduced by a factor of about 3 compared to predictions from perturbative QCD calculations. This result could change our understanding of D-meson spectra and elliptic flow at RHIC.

(9) Significant constraints on the isobaric incompressibility of asymmetric nuclear matter have been obtained by a comparison of the predictions from an isospin- and momentum-dependent transport model with isospin diffusion data from heavy-ion collisions at intermediate energies.

(10) A major new critical survey of superallowed nuclear beta decay has been completed and published, in which tight constraints have been set on several weak-interactions parameters fundamental to the conservation of the vector current and the Standard Model.

As in the past, Institute scientists remain active in a number of collaborative research efforts around the world. Major programs include: experiments at TRIUMF laboratory to measure heavy ($A > 60$) superallowed β decays and a measurement of Michel parameters in normal μ^+ decay; new mass measurements using the Canadian Penning Trap (CPT) at Argonne National Laboratory; and continued work with both the BRAHMS and STAR collaborations at RHIC.

The K500 cyclotron continues to serve the broader community through testing of radiation effects on electronics components. This past year over 25% of the scheduled accelerator time was devoted to single-event-upset testing. Both U.S. and foreign companies continue to utilize our facility.

As in the past, I am pleased to acknowledge the effort made by Y.-W. Lui in assembling this report. Once again, he has managed it in a very prompt and efficient manner.

R.E. Tribble
July 19, 2005