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On the Radioactive Decay of the Neutron Beta Decay of Neutron-rich 33Mg Neutron Decay Beyond the Standard Model Beta Decay of Neutron-rich Isotopes of Zinc and Gallium The Study of Beta-delayed Neutron Decay Near the Neutron Drip Line Free neutron beta-decay half-life The Gamow-Teller Beta Decay of Neutron-deficient Even Isotopes of Tin Beta Decay Studies of Neutron-rich Nuclei Beta Decay Studies in Neutron Rich Tc, Ru, Rh and Pd Isotopes and the Weak R-process A Calculation of the Proton-electron Angular Correlation for Neutron Decay Beta-decay Studies of 78Ni and Other Neutron-rich Nuclei in the Astrophysical R-process Gamow-teller Beta Decay of Neutron-rich Tc, Ru, Rh and Pd Isotopes Nuclear-decay Studies of Neutron-rich Rare-earth Nuclides Beta Decay of Neutron Deficient Even Mass Indium Isotopes Laser Assisted Nuclear Decay Spectroscopy Cold Fusion Production and Decay of Neutron-deficient Isotopes of Dubnium and Development of Extraction Systems for Group V Elements The Free Neutron B-decay [beta-decay] Neutron Beta Decay as a Probe of Weak Interactions A Test of Time Reversal Violation in Neutron Beta Decay Beta Decay of Neutron-rich Transuranic Nuclei A New Approach to Measuring the Neutron Decay Correlations with Cold Neutrons at LANSCE. ISOTOPES Magnetic Field Decay of Neutron Star A Neutrino Mass Model Relating the Neutron Decay Anomaly Via Dark Matter New Precision Measurements of Free Neutron Beta Decay with Cold Neutrons Beta-decay Studies of Neutron-rich 11LI and 32NA Experiments at Free Neutron Beta Decay and a Validity of the V - A Theory The [beta] Decay of the Free Neutron in Confining Constituent Models The -decay Branching Ratios of the Neutron-rich Nucleus 15B Electron Capture Decay of Neutron Deficient Americium Isotopes Nuclear Spectroscopy of Neutron Rich A Basic Ideas and Concepts in Nuclear Physics, An Introductory Approach Beta Decay Measurements of Neutron Deficient Cesium Isotopes The [Beta] and [Beta]-delayed Neutron Decay Studies of 75CU and 77CU Measurement of the Neutron Beta Decay Asymmetry Using Ultracold Neutrons Two Neutrino Double Beta Decay and the Proton-Neutron Pairing Failure of the Gross Theory of Beta Decay in Neutron Deficient Nuclei Proposed Experiment to Measure the Neutron Spin-electron Angular Correlation in Polarized Neutron Beta Decay with Ultra-cold Neutrons Precision Measurement of the Radiative Decay Mode of the Free Neutron Neutron Decay Electron Injection Into the Magnetosphere

The theory of quantum electrodynamics predicts that beta decay of the neutron into a proton, electron, and anti-neutrino should be accompanied by a continuous spectrum of photons. A recent experiment, RDK I, reported the first detection of radiative decay photons from neutron beta decay with a branching ratio of (3.09 + or - 0.32) x 103 in the energy range of 15 keV to 340 keV. This was achieved by prompt coincident detection of an electron and photon, in delayed coincidence with a proton. The photons were detected by using a single bar of bismuth germanate scintillating crystal coupled to an avalanche photodiode. This thesis deals with the follow-up experiment, RDK II, to measure the branching ratio at the level of approximately 1% and the energy spectrum at the level of a few percent. The most significant improvement of RDK II is the use of a photon detector with about an order of magnitude greater solid angle coverage than RDK I. In addition, the detectable energy range has been extended down to approximately 250

eV and up to the endpoint energy of 782 keV. This dissertation presents an overview of the apparatus, development of a new data analysis technique for radiative decay, and results for the ratio of electron-proton-photon coincident Repg to electron-proton coincident Rep events. Allowance is made for beta-delayed fission in the calculation of the mass yield of underground thermonuclear explosions. This allowance is made by calculating a correction factor by four different methods. These correction factors are applied to a simple model of product yield and the accuracy and potential usefulness of the results are discussed. 19 refs., 3 figs., 1 tab. (DWL). The free neutron beta decay correlation A0 between neutron polarization and electron emission direction provides the strongest constraint on the ratio [lambda] = g[sub-A]/g[sub-V] of the Axial-vector to Vector coupling constants in Weak decay. In conjunction with the CKM Matrix element V[sub-ud] and the neutron lifetime [tau sub-n], [lambda] provides a test of Standard Model assumptions for the Weak interaction. Leading high-precision measurements of A0 and [tau sub-n] in the 1995-2005 time period showed discrepancies with prior measurements and Standard Model predictions for the relationship between [lambda], [tau sub-n], and V[sub-ud]. The UCNA experiment was developed to measure A0 from decay of polarized ultracold neutrons (UCN), providing a complementary determination of [lambda] with different systematic uncertainties from prior cold neutron beam experiments. This dissertation describes analysis of the dataset collected by UCNA in 2010, with emphasis on detector response calibrations and systematics. The UCNA measurement is placed in the context of the most recent [tau sub-n] results and cold neutron A0 experiments. Samenvatting ; Summary. The neutron deficient isotopes 117-121Xe, 117-124Cs, and 122-124Ba were produced by a beam of 28Si from the LBNL SuperHILAC on a target of natMo. The isotopes were mass separated and their beta decay schemes were measured with a Total Absorption Spectrometer (TAS). The beta strengths derived from these data decreased dramatically to levels above ≈1 MeV for the even-even decays; 3-4 MeV for even-Z, odd-N decays; 4-5 MeV for the odd-Z, even-N decays; and 7-8 MeV for the odd-Z, odd-N decays. The decreasing strength to higher excitation energies in the daughters contradicts the predictions of the Gross Theory of Beta Decay. The integrated beta strengths are instead found to be consistent with shell model predictions where the single-particle beta strengths are divided amoung many low-lying levels. The experimental beta strengths determined here have been used calculate the half-lives of 143 neutron deficient nuclei with Z=51-64 to a precision of 20% with respect to the measured values. A model to determine magnetospheric electron fluxes from bomb neutron decay is presented. The source of electrons was determined from a neutron decay model dependent on a 37 group neutron spectrum of a nuclear detonation. Monte-Carlo simulation of the decay process determined the electron energy and angular spectra as a function of neutron energy. The Air Force Weapons Laboratory's PROMPT code generates neutron spectra from a nuclear detonation at an observer. Using this neutron spectrum and the electron energy and angular distributions from neutron decay theory, an algorithm was developed to calculate the electron flux. An example of a 1 kt burst at 20 km shows that fluxes above normal background can be observed as far away as 400 km. Higher bursts or bursts of larger magnitude will produce higher fluxes at this distance. It is thus concluded that neutron decay alone can generate significant numbers of energetic electrons in the magnetosphere. Their effect may prove to be of tactical significance in medium to high altitude burst scenarios where fission debris is a less significant source of electrons. (Author). A study of the beta decay of neutron rich nuclides of the A = 147 chain was carried out at the TRISTAN isotope separator. Half lives of 14'Cs, 147Ba and 147La were measured. Six gamma lines are assigned to 147Cs decay. A decay scheme for 147Ba with levels up to 2 MeV is proposed for the first time. A partial decay scheme for 147La is proposed, which confirms the previously existing one, with five new levels added from the present work. The beta-decay and beta-delayed neutron decay of a radioactive 33Mg beam provided by TRIUMF are presented in this thesis. Interest in the beta-decay daughter, 33Al comes from the fact that it lies between 32Mg, a deformed nucleus, and 34Si, outside the "island of inversion" along the N = 20 shell closure. The

island of inversion around N = 20 refers to a region of the chart of the nuclides where the ground states are dominated by deformed intruder states from the fp shell, instead of the spherical sd shell states naively expected from the shell model. While originally thought to be outside the island of inversion, some 33Al studies suggest up to a 50% intruder configuration. Previously published decay schemes for 33Al, however, differ significantly. The improved efficiency of the new high purity germanium gamma-ray spectrometer, GRIFFIN, was used to perform detailed spectroscopy of 33Al following 33Mg beta-decay. Half-lives of the parent (33Mg), daughters (33Al and 32Al) and granddaughter (33Si) were determined using gamma-gated data for prominent peaks of each species present in the decay with values of 91.7(15) ms, 41.8(42) ms, 32.3(59) ms and 5.90(14) s determined, respectively. Detailed level schemes for both 33Al and 32Al were also constructed and resolve discrepancies between the previous works. Precision measurements in free neutron beta decay serve to determine the coupling constants of beta decay, and offer several stringent tests of the standard model. This study describes the free neutron beta decay program planned for the Fundamental Physics Beamline at the Spallation Neutron Source at Oak Ridge National Laboratory, and finally puts it into the context of other recent and planned measurements of neutron beta decay observables. This dissertation, "Magnetic Field Decay of Neutron Star: Effects of Interpinning of 3P2 Neutron Superfluid and 1S0 Proton Superconducting Fluid" by □□□, Kwan-ying, Winnis, Ding, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. DOI: 10.5353/th_b3121076 Subjects: Magnetic fields (Cosmic physics) Neutron stars Superfluidity [Beta] decay studies of nuclei at the limits of stability are essential in evaluating the physical aspects behind the structural changes, particle configurations and interactions in neutronor proton-rich systems. Isobarically purified beams were used at the Holifeld Radioactive Ion Beam Facility at Oak Ridge National Laboratory to study the [Beta] decays of 75Cu and 77Cu. Two different experiments were performed. In the first study, only concerning the decay of 77Cu, the 25-MV tandem accelerated ions were time-tagged using a micro-channel plate detector, passed through a six-segment ion chamber, and implanted on the tape of a moving tape collector. The passage through an ion chamber insured the ion identification by energy loss in the six segments. The Low Energy Radioactive Ion Beam Spectroscopy Station consisting of a universal detector support with four Ge clover detectors, two [Beta] detectors and a moving tape collector of 10 gain in beam intensity for both 75Cu and 77Cu. These experiments resulted in considerable information on the previously unknown level structure of 75Zn with some 120 [gamma]-ray transitions placed in a level scheme containing 59 levels including two above the neutron separation energy. We have also identified the previously unknown 1/2- isomeric state at 127 keV. A total of 64 [gamma] rays were placed in a level scheme for 77Zn containing 35 excited states including one state above the neutron separation energy, while two [gamma] rays were observed for the [Beta]n branch to states in 76Zn. The growth and decay curves of some prominent [gamma] rays indicate a single [beta]-decaying state with a half-life of 480(9)ms. The decay pattern for 77Cu, with observed feeding of 8(3)% to the 7/2 77Zng and 6(3)% to the 1/2- 77Znm, in contrast to the large feeding observed for decay of [Pi]p3/2 73Cug to 1/2- 73Zng, strongly suggests a {Pi]5/2 ground state for the studied 77Cu activity. Results will be presented and the prospects for future possible studies will also be discussed. This work details an application of collinear resonance ionization spectroscopy for the separation of short-lived isomeric states and their subsequent study with decay spectroscopy. It reports the successful construction of a novel decay spectroscopy apparatus that can operate at pressures below 1 x 10^-9 mbar. The method is demonstrated by separating the nuclear ground and isomeric states of 204Fr and performing alpha-decay spectroscopy. An equivalent mass spectrometer would require 4.6 million times as much resolution to achieve the same result. This work

unambiguously confirms the existence of a second isomeric state in 204Fr. The author also demonstrates the effectiveness of this method for laser spectroscopy and identification of hyperfine-structure components with energy tagging. This method was successfully used in 202Fr to identify ground and isomeric states. The measurement of 202Fr reported in this thesis demonstrates a factor of 100 improvement in sensitivity compared to state-of-the-art fluorescence techniques. The work reported in this thesis won the author the IOP Nuclear Physics Group Early Career Prize. The authors discuss [beta] decay interactions in extensions of the Standard Model, and the role of [beta] decay experiments in obtaining information on them. Nuclear and neutron [beta] decay played an important role in the development of the Standard Model (SM). Today a major motivation for their further experimental study is the importance of searching for new-interactions. Despite the remarkable success of the SM, for many theoretical reasons the existence of new physics is expected. In fact, we have already the first strong experimental evidence, in the form of neutrino oscillations, that some extension of the SM is required. In this talk we shall discuss [beta] decay interactions in extensions of the SM [1]. We shall review the existing bounds on new interactions provided by [beta] decay experiments, and consider the constraints on them from other sources. In the next section we focus on time-reversal (T) invariant contributions. In Section 3 we discuss briefly the contributions from the T-violating components of the new interactions. Section 4 contains our conclusions. Precision measurements of the neutron beta-decay correlations A, B, a, and b provide important tests of the standard model of electroweak interactions: a test of the unitarity of the first row of the CKM matrix, a search for new weak interactions, a test of the theory of nuclear beta decays, and a test of the conserved-vector-current hypothesis. The authors are designing an experiment at the LANSCE short-pulse spallation source to measure all four correlations to an order of magnitude better accuracy than the existing measurements. The accuracy of the previous measurements was limited by systematics. The design of the proposed experiment makes use of the pulsed nature of the LANSCE source to reduce systematic errors associated with the measurement of the neutron polarization as well as other systematic errors. In addition, the authors are developing silicon strip detectors for detecting both the proton and electron from the neutron decay. Beta-decays of neutron-rich nuclei near the doubly magic 78Ni [78Ni] were studied at the Holield Radioactive Ion Beam Facility. The half-life and the gamma-gamma coincidence spectra were used to study the nuclear structure. A new 82,83Zn [82Zn, 83Zn] decay-scheme was built, where a 71±7% beta-delayed neutron branching ratio was assigned in 82Zn [82Zn] decay. New gamma-ray lines and energy levels observed in 82,83Ga [82Ga, 83Ga] beta-decay were used to update previously reported decayschemes. The experimental results were compared to shell model calculations, which postulate the existence of Gamow-Teller transitions in these decays. The half-lives of 155±17 and 122±28 ms were determined for 82,83Zn, respectively. In order to enable future studies of very neutron rich isotopes a new detector was developed as a second project. This detector is intended for use in fragmentation type experiments, which require segmentation in order to enable implantation-decay correlations. In addition, the detector requires good timing resolution for neutron time-of-ight experiments. A Position Sensitive Photo-Multiplier Tube (PSPMT) from Hamamatsu coupled with a 16x16 fast pixelated plastic scintillator was used. The PSPMT's anodes form 8x8 segment panel used for position reconstruction. Position localization has been achieved for energies range of 0.5-5 MeV. A single signal dynode (DY12) shows a sufficient time resolution between this signal and the anode's signals, which enable us to used DY12 signal alone as a trigger for timing purposes. The detector's DY12 signals was tested with reference detectors and it provided a sub-nanosecond time resolution through the use of a pulse-shape analysis algorithm, which is sufficient for use in experiments with the requirement for the fast timing. The detector ability to survive after implanting high-energy ions was tested using a laser that simulated energy of 1 GeV. The recovery time of the detector in this situation was 200 nanosecond. This is the second edition of an established textbook on nuclear physics for senior undergraduates and postgraduate students. Professor Heyde has taken

the opportunity to make the book more useful for students and teachers by adding an extensive set of problems. To bring the book up to date, he has revised several chapters and added a new chapter on nuclei at the extremes of stability. The book has evolved from a course taught by the author and gives a balanced account of both theoretical and experimental nuclear physics. It is also ideal for researchers wanting an accessible introduction to the subject. Emphasis is given to depth of treatment rather than skimming over topics and there are many diagrams as well as box inserts illustrating particular topics. Inside the nucleus, there are protons and neutrons and they form the bound states. When neutron leave the nucleus, it will become an unstable particle which is called a free neutron. The free neutron lifetime is predicted to be 881.5±1.5 s by the Standard Model. For years the experimental measurement are basically consistent with the theoretical results. However, recently laboratories in USA (Beam experiment) and France (Bottle experiment) were shown that the neutron lifetime anomaly, namely a discrepancy of about 1% is found between the experimental measurements and the theoretical prediction. Regarding the neutron lifetime anomaly. We propose an new gauge U(1) symmetry portal to dark matter to resolve the neutron lifetime anomaly. The symmetry breaking pattern of this new gauge symmetry will also shed light on the neutrino mass generation through the quantum radioactive corrections. One area in which the Standard Model can be probed is neutron beta decay. In particular, measurements of angular correlations in neutron beta decay can place constraints on the existence of right-handed currents, the presence of scalar and tensor terms in the weak interaction, and for evidence of Time Reversal Violation, which is expected from the observed violation of CP invariance in kaon decay. A measurement of A, the correlation between the neutron spin and the direction of emission of the electron in neutron decay, can be combined with the neutron lifetime to determine the fundamental vector and axial vector weak coupling constants G{sub A} and G{sub V}. The authors have presented the essential elements of their plans to carry out an A correlation measurement using the UCN source they have constructed at the Manuel Lujan Neutron Scattering Center (MLNSC). Their goal is an initial measurement with an accuracy of about 0.2% of A (which has a value of about -0.114). The count rate expected in the experiment will allow a determination at this statistical accuracy level in a running time of about four months.

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