HK 28: Instrumentation VII

Time: Tuesday 17:30–19:00 Location: HBR 19: C 2

Group Report HK 28.1 Tue 17:30 HBR 19: C 2

τSPECT - a magnetic storage bottle for measuring the puzzling free neutron lifetime — •Noah Yazdandoost[1], Martin Fertl[2], and Dieter Ries[3] for the tauSPECT-Collaboration — [1]Department of Chemistry - TRIGA site, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Institute of Physics, JGU Mainz, Mainz, Germany — [3]Paul Scherrer Institut, Villigen PSI, Switzerland

The free neutron lifetime holds significance in understanding the production of light elements in the early universe and in determining the matrix element V_{ud} within the quark mixing matrix, which can be used to probe the Standard Model of Particle Physics. Previous measurements of the free neutron lifetime using two distinct methods have yielded incompatible results, emphasizing the need for a complementary approach.

In response, the τSPECT experiment offers a unique approach to measure the free neutron lifetime. The spin of neutrons, with kinetic energies in the nanoelectronvolt range, is flipped while filling those neutrons into τSPECT's storage volume. The neutrons are confined solely by the magnetic interaction, which minimizes systematic uncertainties by eliminating interactions between stored neutrons and wall atoms, providing a more reliable measurement of the neutron lifetime.

This presentation provides a overview of the τSPECT experiment. It will showcase data from the commissioning phase conducted at the TRIGA research reactor in Mainz, followed by the presentation of the latest data obtained after relocating the experiment to the Paul Scherrer Institute in Switzerland.

HK 28.2 Tue 18:00 HBR 19: C 2

Development of an improved adiabatic spin flipper unit for the neutron lifetime experiment tauspect — •Viktoria Ermuth[1], Martin Fertl[1], and Dieter Ries[2] for the tauSPECT-Collaboration — [1]Institute of Physics, Johannes Gutenberg- Universität Mainz, Mainz, Germany — [2]Paul Scherrer Institute, Villigen PSI, Switzerland

To measure the free neutron lifetime the τSPECT experiment stores ultracold neutrons (UCN) using magnetic field gradients. High-field-seeking (HFS) neutrons can overcome higher magnetic potentials whereby low-field-seeking neutrons (LFS) loose kinetic energy when moving to higher magnetic fields. Therefore, the magnetic trap of τSPECT is filled by flipping the spin of HFS neutrons transforming them to the LFS state. For the spin flip an adiabatic fast passage spin flipper unit (SFU) is used which consists of a coil producing a radiofrequency field resonant with the neutron spin precession frequency. The radiofrequency field is perpendicular to the main magnetic field and the neutron spin precession frequency is made position dependent by a small magnetic gradient. With a second SFU UCNs with higher kinetic energies, available in larger numbers, can be made storable. In the next generation of this SFU optimisations are implemented to increase the efficiency of the double spin flip. The optimised design must combine challenging constraints like little available space, cryogenic temperatures and ultra high vacuum compatibility.

This talk will show simulations and first tests on possible spin flipper designs as well as the current status of the development.

HK 28.3 Tue 18:15 HBR 19: C 2

A Multidirectional Magnetic Holding Coil for ELSA — •Victroia Lagerquist and Hartmut Dutz for the CBELSA/TAPS-Collaboration — University of Bonn

The current physics program at ELSA includes the ability to measure either transverse or longitudinal polarization observables through the use of dedicated, single purpose, internal magnetic holding coils. However, the process of changing between these coils requires significant effort and extensive downtime. We propose a single, combined, multi-directional coil which enables polarization at an arbitrary angle without the need for a physical configuration change. This combined coil has been optimized to a comparable efficiency and material budget as each of the original individual coils. I will present the current status of this ongoing project.

HK 28.4 Tue 18:30 HBR 19: C 2

Commissioning of TARLA Injector Line — Abdullah Burkan Bereketoglu[2,3], •Kutlu Kagan Sahbaz[1,3], and Veli Yildiz[3] — [1]Ankara University, Ankara, Turkey — [2]Middle East Technical University, Ankara, Turkey — [3]Turkish Accelerator & Radiation Laboratory, Ankara, Turkey

Turkish Accelerator & Radiation Laboratory (TARLA) is a Free Electron Laser (FEL) facility that is under construction in Ankara, Türkiye. The TARLA electron linac is composed of a 250 keV thermionic electron gun, an injector line with two buncher cavities and two cryomodules containing two 1.3 GHz superconducting TESLA cavities. The electron bunches generated in the electron gun are compressed in the injector line first with a subharmonic buncher (260 MHz) and then with a fundamental bunchar (1.3 GHz) down to 10 ps (σt). The first cryomodule accelerates the beam up to around 20 MeV. The bunch compressor located between the two cryomodules compresses the bunch further down to 0.3 ps (σt). After the bunch compressor, the beam is further accelerated up to 40 MeV using the second cryomodule. The 40 MeV electron beam will be used to produce infrared (IR) laser and bremsstrahlung radiation. The installation of TARLA injector was completed in October 2023 and the beam commissioning was performed in December 2023. In this contribution, the result of the injector beam commissioning will be presented together with the beam dynamics simulations performed for the preparation of the beam tests.

HK 28.5 Tue 18:45 HBR 19: C 2

Ionoacoustic detection of swift heavy ions — •Leon Kirsch[1,2,3], Walter Assmann[1], Sonja Gerlach[1], Anna-Katharina Schmidt[1], Markus Bender[2,4], Katia Parodi[1], Jörg Schreiber[1], and Christina Trautmann[2,3] — [1]Ludwig-Maximilians-Universität München — [2]GSI Helmholtzzentrum — [3]Technische Universität Darmstadt — [4]Hochschule RheinMain, Rüsselsheim

The characteristics of the ionoacoustic detectors were investigated at the SIS18 synchrotron at GSI using Xe, Pb and U ions of energies up to 1 GeV/u [1]. Microsecond-pulsed ion beams stopped in water generate an ultrasonic pressure pulse, which can be detected by a piezoelectric transducer. The analysis of the signal in time and frequency domain allows us to locate the initial position of the ion bunch in 3D space as well as to determine the range and thus the ion energy to an accuracy of 1 %. Over a wide intensity range, the signal amplitude has a linear correlation with the beam intensity. Inserting a target into the ion beam yields precise information on the energy-loss. Combined with their exceptional radiation hardness, ionoacoustic detectors hold tremendous potential as ion beam monitors for upcoming high-energy and high-intensity heavy ion facilities. In fact, they could even serve as a promising 'second generation' Faraday cup.

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[1] L. Kirsch, et al., Nucl. Instrum. Methods Phys. Res., Sect. A 1057 (2023), 168755