T 43: Poster session Particle Physics

Time: Tuesday 17:00–18:30 Location: Grotte

T 43.1 Tue 17:00 Grotte

Quantum Mechanic Analysis of Masses in their Own Gravitational Field: A Model for an Elementary particle? — Hans-Otto Carmesin[1,2,3] and •Maximilian Carmesin[4] — [1]Gymnasium Athenaeum, Harsefelder Straße 40, 21680 Stade — [2]Studienseminar Stade, Bahnhofstr. 5, 21682 Stade — [3]Universität Bremen, Fachbereich 1, Postfach 330440, 28334 Bremen — [4]Arndt Gymnasium, Lindenstraße 52, 47798 Krefeld

The position of masses can be measured and is based on laws describing fundamental interactions among mater. For objects at a very high density, the gravitational force is the most important for describing its interactions. As a result from the Heisenberg uncertainty principle, measurements of complementary properties cannot be exact, examples are position and momentum. Accordingly, such objects have to be investigated in terms of a mass distribution. This is an essential difference to classical mechanics, viewing objects as masses concentrated at a single point. Such a model is not exact, but sufficient in many fields of physics, except quantum physics. This project numerically simulates the gravitational potential of a particle in a 3-dimensional space. Thereby, a mass distribution instead of a concentrated mass is modeled. For this purpose, a computer simulation has been developed. As a result, properties of the gravitational potential and of the wave function of a particle have been examined.

T 43.2 Tue 17:00 Grotte

Measurement of the total cross-section of single top-quark and top-antiquark t-channel production in pp collisions at $\sqrt{s}$ = 13 TeV — Olga Bessidskaia Bylund, Dominic Hirschbuehl, Joshua Aaron Reidelsturz, •Mohsen Reazei Estabragh, and Wolfgang Wagner for the ATLAS-Collaboration — Bergische Universität Wuppertal, Wuppertal, Germany

In leading-order perturbation theory, single top-quark production is described by three sub-processes that are distinguished by the virtuality of the exchanged W boson. In this analysis, t-channel which is the dominant process is the subject of the measurements, using the lepton+jets channel.

Studying the cross-section ratio of top to antitop (R_t) could be helpful for testing different PDF sets from various groups. Calculation of R_t for the newest PDF sets has carried out in the 5-flavour scheme at NLO using the Hathor program. As many systematic uncertainties on R_t are canceled out, we focus on the impact of PDF, α_s and scale uncertainty.

Predictions for the signal process is being compared using different generators, such as POWHEG and aMC@NLO in addition to new predictions from SHERPA and MINLO.

To reduce uncertainty on the jet energy scale (JES), flavour composition and its uncertainty for the signal sample has studied.

T 43.3 Tue 17:00 Grotte

Charakterisierung von unbestrahlten und bestrahlten Silizium-Streifensensoren anhand von Langzeitmessungen — •Jonas Lönker, Andreas Gisen, Kevin Kröninger und Jens Weingarten — TU Dortmund, Experimentelle Physik IV

Für den Einsatz als Spurdetektoren in Experimenten der Hochenergiephysik ist es notwendig, dass Silizium-Sensoren über lange Zeitintervalle zuverlässig betrieben werden können. Zu den Anforderungen zählen unter anderem eine zeitlich stabile Ladungssammlung (Charge Collection Efficiency, CCE) und eine hohe Toleranz gegen Strahlenschäden.

In Labormessungen werden Silizium-Streifensensoren mit einer Fläche von ca. 1 cm^2 anhand von Langzeitmessungen der Interstrip-Kapazität und der CCE während Quellenmessungen mit Sr-90 charakterisiert. Verglichen werden die Ergebnisse von bestrahlten und unbestrahlten Sensoren mit variierenden Designs hinsichtlich Dicke, Pitch, Implantbreite sowie des Bulkmaterials.

T 43.4 Tue 17:00 Grotte

Characterization and quality control methods of petal cores for the ATLAS ITk strip detector end-caps — •Jan-Hendrik Arling — Deutsches Elektronen-Synchrotron DESY, ATLAS group, Hamburg — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, Dortmund

For the high-luminosity LHC, ATLAS will replace its tracking detector by a new, all-silicon tracker, called Inner Tracker (ITk). This is necessary due to the challenging environments in terms of a factor ten higher radiation levels as well as a higher number of proton-proton interactions per bunch crossing (called pile-up). The forward regions of the detector will host the end-caps, structures with disks populated with so-called petals. On the one hand, a petal consists of a core, made of a carbon fiber-based sandwich structure with embedded titanium cooling pipes as well as data and power buses on the surfaces. On the other hand, the silicon modules, assembled out of micro-strip sensors together with readout and power electronics, are directly glued on the core surfaces. The focus of this poster is on the petal core and its requirements in terms of mechanical and thermal properties (e.g. surface flatness and thermal conductance). During production it is necessary to control the quality by dedicated test measurements, but also before in the design phase an extensive verification process took place. The results of the test measurements (e.g. measurement of thermal deformation and cycling) on the recent produced prototype structures shows the ITk requirements fulfilled. The implementation of the tests in the production phase for quality control will be the next step.

T 43.5 Tue 17:00 Grotte

Investigations of systematics on the energy loss measurement of electrons in the KATRIN source — •Lutz Schimpf and Christophe Schwachtgen — ETP, Karlsruhe Institute of Technology (KIT)

The **Ka**rlsruhe **Tri**tium **N**eutrino experiment (KATRIN) is targeted to measure $m(\nu_e)$ with a sensitivity of 200 meV at 90 % confidence level. To determine the neutrino mass, an integrated beta-decay spectrum close to the endpoint is measured and a fit to the data comprising the neutrino mass as a free parameter is performed. A number of systematic effects on the measured spectrum need to be taken into account in the analysis. One of these is the energy loss from inelastic scatterings of beta-electrons with the source gas. A very precise measurement and reliable uncertainty estimate are required for fitting the beta-decay spectrum. This is achieved by measuring the energy loss of quasi-monoenergetic electrons at 18.6 keV traversing the gaseous Tritium source in both an integral and a differential way. To assess the systematic error budget of the measured energy loss function, the uncertainties arising from various parameters, such as source pressure, rate stability, and background need to be investigated by Monte Carlo error propagation. This contribution presents the resulting error estimate and discusses its impact on the neutrino-mass sensitivity. This work is supported by the Helmholtz Association (HGF), the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3), the Helmholtz Alliance for Astroparticle Physics (HAP), KSETA, and the Helmholtz Young Investigator Group (VH-NG-1055).

T 43.6 Tue 17:00 Grotte

Calibration Measurements with $^{83\mathrm{m}}$Kr Conversion Electrons at KATRIN — •Matthias Böttcher for the KATRIN-Collaboration — Institut für Kernphysik, WWU Münster

The Karlsruher Tritium Neutrino Experiment (KATRIN) aims at measuring the effective electron neutrino mass with the unprecedented sensitivity of 0.2 eV by measuring the energy spectrum of tritium β-decay electrons. The non-zero neutrino mass established in oscillation experiments introduces a change of the shape of the electron spectrum near the endpoint energy. The first neutrino mass result published recently by the KATRIN experiment gives a new upper limit of 1.1 eV (90 % C.L.). To improve on this limit, a detailed analysis of systematic effects in the tritium source and the main spectrometer is required. One of the tools to assess systematic uncertainties in KATRIN is the use of Krypton-83m as a calibration source, which provides mono-energetic conversion electrons. Gaseous $^{83\mathrm{m}}$Kr can be injected into KATRIN's windowless gaseous tritium source (WGTS) and can be used, among others, to study the effect of inhomogeneities in the tritium plasma. We describe in this poster the use of $^{83\mathrm{m}}$Kr for investigating WGTS and spectrometer properties and their influence on systematic uncertainties in the neutrino mass measurements.

This work is supported by BMBF under contract number 05A17PM3.

T 43.7 Tue 17:00 Grotte

Performance of fitting methods for the KATRIN neutrino mass analysis — •Wonqook Choi and Stephanie Hickford for the KATRIN-Collaboration — Institute for Experimental Particle Physics, Karlsruhe Institute of Technology

The KATRIN collaboration aims to determine the neutrino mass with a sensitivity of $0.2\,\mathrm{eV/c^2}$ (90 % CL). This will be achieved by measuring the endpoint region of the tritium β-electron spectrum. The spectrum is fit to obtain several parameters of interest, including the squared neutrino mass and the effective tritium endpoint.

The fit can be done by combining individual tritium spectral scans and averaging slow control parameters, event count rates, and live time of the KATRIN detector pixels. The data combination impacts the balance between computing complexity and the fit result precision. Sophisticated and computationally expensive methods of combining data can be done without averaging of slow control parameters or over detector pixels.

The data combination and fitting methods are compared by investigating the neutrino mass and endpoint results on Monte Carlo datasets using the KaFit package. The performance of the fit methods in terms of computing time and memory will also be presented.

This work is supported by the Helmholtz Association (HGF), the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3), the Helmholtz Alliance for Astroparticle Physics (HAP), and the Helmholtz Young Investigator Group (VH-NG-1055).

T 43.8 Tue 17:00 Grotte

Comparison of column density simulation and measurement in KATRINs windowless gaseous tritium source — •Paul Filip and Fabian Block — Institute of Experimental Particle Physics, Karlsruhe Institute of Technology

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims to measure the effective rest mass of the electron anti-neutrino with a sensitivity of $0.2\,\frac{\mathrm{eV}}{\mathrm{c}^2}$ (90 % C.L.). For this purpose, KATRIN utilizes a model-independent approach that relies on a high-accuracy investigation of the endpoint region of the tritium β-decay spectrum.

A key component of KATRIN is the high-luminosity Windowless Gaseous Tritium Source (WGTS) that contains molecular tritium gas. Though the amount of tritium in the WGTS can be controlled precisely, the uncertainty on the absolute calibration of the column density is a dominant systematic factor that impacts the accuracy on the measured neutrino mass.

The comparison between simulated and measured column density during KATRINs second neutrino mass measurement campaign is described in this poster. An improved understanding of gas dynamics inside the WGTS is achieved, which allows for more accurate column density calibrations in future neutrino mass measurement campaigns.

This work is supported by the Helmholtz Association (HGF), the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3), the Helmholtz Alliance for Astroparticle Physics (HAP), and the Helmholtz Young Investigator Group (VH-NG-1055).

T 43.9 Tue 17:00 Grotte

Column density determination in KATRIN's first neutrino mass measurement — •Fabian Block[1], Christoph Köhler[2], and Alexander Marsteller[1] — [1]Karlsruhe Institute of Technology — [2]Technical University of Munich/Max Planck Institute for Physics

The KATRIN experiment aims to probe model-independently the effective electron anti-neutrino mass with a sensitivity of 0.2 eV (90% C.L.) by investigating the endpoint region of the tritium beta decay spectrum. The experimental setup of KATRIN consists of a high-luminosity Windowless Gaseous Tritium Source (WGTS), from which the beta-electrons are magnetically guided to the spectrometer and detector section, which measures the integrated beta decay spectrum.

The neutrino mass analysis requires exact knowledge of the WGTS column density, which is a measure of the gas amount inside the WGTS. The principle of column density measurements and achievements for the precise monitoring of the column density with several monitoring devices during the first neutrino-mass measurement campaign is described. The influence of the column density uncertainty on the neutrino mass is then discussed in light of KATRIN's world-leading direct upper limit on the effective electron anti-neutrino mass.

This work is supported by the Helmholtz Association (HGF), the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3), the Helmholtz Alliance for Astroparticle Physics (HAP), the GRK 1694, and the Helmholtz Young Investigator Group (VH-NG-1055).

T 43.10 Tue 17:00 Grotte

The Radon-induced background in the KATRIN main spectrometer — •Rebekka Kirchgässner for the KATRIN-Collaboration — Karlsruhe Institute of Technology

The Karlsruhe Tritium Neutrino (KATRIN) experiment measures the integral tritium β spectrum with the aim to determine the effective mass of the electron anti neutrino in a model-independent way. To achieve the design sensitivity on the neutrino mass of $m_\nu = 0.2\,\mathrm{eV/c^2}$ (90% C.L.), the study of systematic effects arising from background processes is important.

The background at KATRIN is presently dominated by secondary electrons originating from radioactive decays inside the KATRIN main spectrometer. This poster focuses on the radon-induced background events, their characteristics, and the underlying processes.

This work is supported by the Helmholtz Association (HGF), the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3), the Helmholtz Alliance for Astroparticle Physics (HAP), and the Helmholtz Young Investigator Group (VH-NG-1055).

T 43.11 Tue 17:00 Grotte

Detector upgrade for sterile neutrino search at KATRIN — •Martin Descher for the KATRIN-Collaboration — Karlsruher Institut für Technologie

The KATRIN Experiment is a high precision β-decay experiment which aims to measure the effective electron neutrino mass with a sensitivity of 0.2 eV (90% confidence level). Additionally, the TRISTAN project of the KATRIN experiment aims to search for the signature of keV sterile neutrinos in the β-decay spectrum of tritium. For a three year measurement of the differential β-electron energy spectrum at an event rate of 10^8 counts per second (cps), a sensitivity for sterile mixing angles $\sin^2\theta < 10^{-6}$, within the accessible sterile neutrino mass range, is projected. For this measurement, a detector with improved energy resolution and high rate capabilities is necessary. The development of the envisioned 3500 pixel silicon drift detector, consisting of 21 separate modules, is roughly structured in three stages: Detector prototyping, first module development, and assembly of the full detector. Detectors from the first two development stages are being integrated into the KATRIN beamline for testing purposes while simultaneously serving as upgrades for existing components. A detector from the prototyping stage is already integrated as a radioactive source monitoring device (Forward Beam Monitor), and the first module is planned to replace the current detector of the monitor spectrometer in 2020. Meanwhile, the planning for the final detector assembly with regard to vacuum requirements, electromagnetic field design, and data acquisition is advancing.

T 43.12 Tue 17:00 Grotte

The Dark Matter confusion — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

The Dark Matter problem is known since more than 90 years. As an explanation there are in principle two causes possible for the underlying observations, which means essentially the high rotation speed of certain galaxies.

1) The possible existence of undetected particles

2) An altered understanding of the mechanism of gravitational attraction.

The search for new particles is going on with a lot of effort since long time. But not the faintest indication of such particles was seen. The other way however, a fundamentally reworked theory of gravitation, is missing. Gravity is still seen to be based on the mass (and energy) of gravitating objects; the original approach of Isaac Newton was never questioned but is causing general logical problems in the view of present physics.

As just one example, the fact that the gravitational acceleration is independent of the accelerated mass is explained by an equivalence of inertial and gravitational mass. But this equivalence is not covered by the current Higgs theory of inertia.

We will show that an altered understanding of the role of mass in gravitation will yield a quantitatively working solution for the Dark Matter problem.

For further information: www.ag-physics.org/gravity

T 43.13 Tue 17:00 Grotte

A cryogenic heat pump for the radon removal system of XENONnT — •Philipp Schulte, Christian Huhmann, Michael Murra, Denny Schulte, and Christian Weinheimer for the XENON-Collaboration — Institut für Kernphysik, WWU Münster

In order to lower intrinsic radioactive contaminants in xenon a new radon removal system is being developed and built for the XENONnT Dark Matter detector. The high-flux radon removal system makes use of crygenic distillation based on the difference in vapor pressure between radon and xenon. In order to have a thermodynamically efficient system, a custom-made heat exchanger will be used with xenon as the working gas. As liquefaction of xenon is envisioned, a cryogenic heat pump with high throughput is needed. This is realized as a radon-free, ultra-clean compressor with the absence of oil-based lubrication.

This poster will show the basic concept of the XENONnT radon removal system focussing on the heat pump concept.

The project is funded by BMBF under contract 05A17PM2.

T 43.14 Tue 17:00 Grotte

A new Detector for Beta Spectroscopy with PERKEO III — •Karina Bernert, Matthias Antony, Max Lamparth, Martin Losekamm, Christoph Roick, Heiko Saul, and Bastian Märkisch — Physik Department, Technische Universität München, 85748 Garching b. München, Germany

Neutron beta decay provides an excellent toolkit for the investigation of the structure of the weak interaction and potential deviations from the predictions of the Standard Model of particle physics. Several times, the spectrometer PERKEO III has been used to perform measurements of neutron decay observables at the PF1B beamline at the Institut Laue-Langevin, Grenoble, most recently to measure the Fierz interference b. This term, which is zero within the Standard Model, offers a direct probe for scalar and tensor interactions. To reach the precision required for an improved limit, we developed a new Scintillation detector, which has nearly double the light output of that of previous detectors. The gain of the Photomultiplier tubes is monitored with light pulses from a Kapustinsky flasher, whose intensity is controlled with a Silicon Photomultiplier.

T 43.15 Tue 17:00 Grotte

Exploration of cosmic rays using stratospheric balloons with students — •Jonas Zumkeller[1], Patrick Pohland[1], Marc Hansen[1], Friederike Schattke[1], Lisa Romaneehsen[1], Stephan Böttcher[1], Matti Heise[2], Bernd Heber[1], and Robert Wimmer-Schweingruber[1] — [1]Christian-Albrechts-Universität zu Kiel, Institut für Experimentelle und Angewandte Physik, Abteilung Extraterrestrische Physik, Deutschland — [2]Ricarda-Huch-Schule Kiel, Deutschland

The Earth is continuously exposed to high energy charged particles from galactic cosmic rays. Due to galactic cosmic rays interacting with atmospheric particles, secondary neutrons are generated. The main objective of the Thermal Atmospheric Neutron Observation System (TANOS) is to measure the flux of thermal neutrons in the stratosphere. To characterize the height dependency of the radiation field, TANOS also measures the flux of charged particles. In order to validate the principle of measurement a prototype - TANOS Junior - was built. TANOS Junior was flown twice on a weather balloon from Kiel. A collaboration between the Ricarda-Huch Schule Kiel and the Department of Extraterrestrial Physics of the University of Kiel allowed several senior pupils to participate in the project. With the experience gained, it was even possible to initiate a school project to which also younger students could contribute. The primary goal of this launch was to measure housekeeping data like pressure, temperature, humidity and particulate matter.