T 23: Postersitzung

Zeit: Montag 13:30–14:30 Raum: VMP4 Foyer

T 23.1 Mo 13:30 VMP4 Foyer

Voruntersuchung zu molekularen Clustern in der KATRIN WGTS — •Robin Grössle und Sebastian Mirz für die KATRIN-Kollaboration — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

Ziel des KATRIN Experiments ist die Messung der Neutrinomasse mit einer Sensitivität besser als 200 meV/c^2 (90% C.L.). Hierfür wird der beta-Zerfall des Tritiums untersucht und - da das Neutrino nicht direkt nachgewiesen werden kann - das Energiespektrum des Elektrons genau vermessen. Da die Neutrinomasse im Vergleich zur Zerfallsenergie von 18,6 keV sehr klein ist, wird die Neutrinomasse nur im Bereich des Endpunktes des Energiespektrums sichtbar. Um die gewünschte Sensitivität erreichen zu können, ist es daher notwendig, einzelne systematische Beiträge in der Größenordnung von 10 meV genau zu kennen.

Eine der Herausforderungen besteht darin, dass nicht atomares, sondern molekulares Tritium verwendet wird. Daher müssen systematische Energiebeiträge der Moleküle, wie Rückstoß und innere Anregung, berücksichtigt werden. Hinzu kommt, dass bei tiefen Temperaturen (unter 30 K), wie sie in der KATRIN-Quelle vorherrschen, die Bildung von molekularen Clustern möglich ist.

In diesem Beitrag wird eine Voruntersuchung mittels IR-Absorptionsspektroskopie bezüglich der einfachsten Form dieser Cluster, der Dimere, vorgestellt. Ziel ist es, diese Methode soweit zu kalibrieren, dass quantitative Aussagen über die Zahl der Dimere unter Bedingungen vergleichbar denen in der KATRIN Quelle möglich sind, und so den systematischen Beitrag abzuschätzen.

T 23.2 Mo 13:30 VMP4 Foyer

Overview of recent and current spectroscopic investigations with hydrogen isotopologues for KATRIN — •Tim Brunst, Sebastian Mirz, Robin Grössle, and Bennet Krasch for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institute for Technical Physics (ITEP), Tritium Laboratory Karlsruhe (TLK)

The Karlsruhe Tritium Neutrino Experiment (KATRIN) investigates the energy spectrum of the tritium β decay near its energetic endpoint in order to determine the electron anti-neutrino mass with a sensitivity of 200 meV/c^2 (90 % C.L.). Therefore, molecular tritium gas is decaying in a windowless gaseous tritium source (WGTS). The physical properties of the gas in the WGTS, like composition, ortho/para ratio or rotational population, need to be stabilised on a 10^{-3} level due to their direct impact on the initial state distribution of the investigated β decay. In order to obtain a complete model of the molecular processes in the sample various spectroscopic measurements of mixtures with non-radioactive isotopologues (H_2, HD, D_2) have been using IR spectroscopy in the liquid at temperatures < 25 K and Raman spectroscopy in the gaseous phase at room temperature. This poster presents an overview of recent and current investigations with TApIR: The investigation of dimer and cluster formation under KATRIN conditions, as well as the ongoing task to investigate mixtures beyond the thermal equilibrium with highly concentrated HD and the design of a tritium compatible system for temperatures between $(15 - 293)\,K$.

T 23.3 Mo 13:30 VMP4 Foyer

YAP: Yet Another Partial-Wave-Analysis Toolkit — •Paolo Di Giglio, Daniel Greenwald, and Johannes Rauch — TUM, Munich, Germany

We will present a new C++ library: YAP, the Yet Another Partial-wave-analysis toolkit. The library calculates amplitudes for multibody particle decays in several model frameworks. It is intended for the analysis of spin-0 heavy mesons, but is programmed with the flexibility to handle other decays. The library implements isobar decompositions, K-matrix formalism, and model-independent approaches for mass-dependent amplitudes; and both Wigner rotation and Zemach (for 3 particles) formalism for spin amplitudes. We will introduce the software and give example use cases.

T 23.4 Mo 13:30 VMP4 Foyer

Unbinned likelihood maximisation framework for neutrino clustering in Python — •Stefan Coenders — Technische Universität München, Boltzmannstr. 2, 85748 Garching

Albeit having detected an astrophysical neutrino flux with IceCube, sources of astrophysical neutrinos remain hidden up to now. A detection of a neutrino point source is a smoking gun for hadronic processes and acceleration of cosmic rays. The search for neutrino sources has many degrees of freedom, for example steady versus transient, point-like versus extended sources, et cetera. Here, we introduce a Python framework designed for unbinned likelihood maximisations as used in searches for neutrino point sources by IceCube. Implementing source scenarios in a modular way, likelihood searches on various kinds can be implemented in a user-friendly way, without sacrificing speed and memory management.

T 23.5 Mo 13:30 VMP4 Foyer

Der Mechanismus der Trägheit: Masse — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

Die kleinsten Teile der Materie sind so aneinander gebunden, dass sie einen Abstand einhalten. Ansonsten hätten physikalische Objekte keine Ausdehnung. Diese Bindung auf Abstand führt unweigerlich zu Trägheit. Die Bindungskräfte breiten sich mit (endlicher) Lichtgeschwindigkeit 'c' aus.

Dadurch werden in einem Verbund bei Änderung der Bewegung die elementaren Objekte vom Bindungsfeld zunächst an ihrem ältenÖrt festgehalten, so dass vorübergehend eine Kraft der Bewegungsänderung entgegensteht.

Dieser Effekt ist nicht nur eine qualitative Idee, sondern lässt die Berechnung der Masse realer Teilchen zu. Die Masse des Elektrons z.B. folgt aus seiner Ausdehnung mit der Präzision von fast 10^{-6}. Im Vergleich dazu liefert die Higgs-Theorie keine quantitativen Ergebnisse.

Weitere Info: www.ag-physics.org/rmass

T 23.6 Mo 13:30 VMP4 Foyer

In-situ Kalibrierung der Tritiumanalytik mithilfe tritiierter Kalibriergase — •Simon Niemes — Karlsruhe Institut für Technology, ITEP-TLK, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

Ziel des Karlsruhe Tritium Neutrino Experiments KATRIN ist die modellunabhängige Messung der Elektron-Antineutrinomasse mit einer Sensitivität von 0,2 eV/c^2 mithilfe hochauflösender Spektroskopie nahe der Endpunktsenergie von β-Elektronen aus dem Tritiumzerfall.

Um die geplante Sensitivität zu erreichen, benötigt KATRIN eine Überwachung der Aktivität und Gaszusammensetzung in der Tritiumquelle mit hoher Richtigkeit und Genauigkeit.

Um dies zu gewährleisten, wird am Tritiumlabor Karlsruhe (TLK) das TRIHYDE-Experiment aufgebaut, mit welchem wohldefinierte Gasmischungen aller Wasserstoffisotopologe im thermischen Gleichgewicht hergestellt werden können. Mithilfe von TRIHYDE sollen verschiedene tritiumtaugliche Detektoren in-situ kalibriert und miteinander verglichen werden können.

Das Poster gibt einen Überblick über das Funktionsprinzip sowie die eingesetzten analytischen Methoden in TRIHYDE.

T 23.7 Mo 13:30 VMP4 Foyer

Search for double beta decay processes of ^{124}Xe with XENON100 & XENON1T — •Alexander Fieguth — IKP, Westfälische-Wilhelms-Universität Münster

Driven by the search for dark matter particles the XENON dark matter project recently installed its next stage multi-ton experiment XENON1T at the LNGS, which will probe the spin-indpendent-WIMP-Nucleon cross section down to 2x10^{-47}cm^2. Besides its main purpose different particle physics topics can be addressed by the taken data. One example are the double beta decay processes of natural isotope ^{124}Xe. This isotope is expected to decay via two-neutrino double electron capture (2νECEC) and due to its high Q-value of 2864 keV additionally through $2\nu\beta^+\beta^+$. Since these processes have not been detected so far, there is only a lower limit the respective half-life (e.g.$>$ 4.7x10^{21}yr for 2νECEC). A detection of the 2νECEC is possible using XENON1T data by looking for its clear signature of secondary X-rays or Auger electrons and at least new lower half-life limits for all other decay channels can be obtained. While these processes are expected from standard model physics, a detection of a decay without neutrinos (e.g 0νECEC) would hint towards beyond the standard model physics and could derive conclusions on the neutrino mass. Until XENON1T is taking data, the search for all processes can be tested in the recorded

data of its predecessor XENON100. This work is supported by BMBF under contract number 05A14PM1 and DFG (GRK 2149).

T 23.8 Mo 13:30 VMP4 Foyer

Dark matter analysis of XENON100 data and cut development utilizing the novel PAX raw data processor — •Christian Wittweg — Institut für Kernphysik, Westfälische Wilhelms-Universität, Münster, Germany

The XENON100 experiment located at LNGS is aimed at the direct detection of weakly interacting massive particles (WIMPs). It utilizes an ultra-low background dual-phase xenon TPC which yields two separate scintillation signals that facilitate background discrimination and event selection. Limits on various interaction types have been published by the collaboration (Science 349 (2015) 6250, 851-854).

In the analysis dark matter candidate events have to pass cuts with respect to data quality, consistency and physical features of the interaction. The former ones are implemented with regard to the used data processor's capabilities for noise discrimination and peak-finding. The Processor for Analyzing Xenon (PAX), developed for the XENON1T experiment, enhances these capabilities compared to XENON100. A greater robustness against noise and an increased peak-identification efficiency open up new opportunities for physically motivated cuts while rendering old ones obsolete.

The poster will focus on the implementation of new cuts into the analysis chain. Both PAX and the xenon analysis will be introduced. A planned full-scale dark matter analysis of PAX-processed XENON100 data will be outlined. This work is supported by BMBF under contract number 05A14PM1.

T 23.9 Mo 13:30 VMP4 Foyer

Entwicklung eines Echtzeit-Kontrollsystems zur Herstellung von Fasermatten für das LHCb-Upgrade mithilfe Maschinellen Lernens — •Timon Schmelzer, Robert Ekelhof, Julian Wishahi, Janine Müller und Kevin Heinicke für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Im Zuge des LHCb-Upgrades 2018/2019 werden die derzeitigen downstream Trackingsysteme, welche aus einer Kombination von Silikon-Streifen-Detektor (Inner Tracker) und Driftröhren (Outer Tracker) bestehen, durch Matten aus szintillierenden Fasern ersetzt. Diese werden produziert, indem die Fasern zunächst auf ein mit Rillen versehenes Rad gewickelt und dabei verklebt werden. Um eine konstant hohe Qualität bei dieser Produktion gewährleisten zu können, wird ein Echtzeit-Video-Kontrollsystem entwickelt, das den Wickelvorgang durchgehend überwacht. Konkrete Fehlerquellen wären beispielsweise das Überspringen einer Faser über die dafür vorgesehene Mulde, was durch lokal abweichende Faserdicken verursacht werden kann.

Dieses Poster beschreibt die Funktionsweise des Kontrollsystems, welches auf den Prinzipien eines Maschinellen Lerners, hier eines eigens dafür optimierten Neuronalen Netzes, beruht. Als Trainingsdatensatz dienen Einzelbildaufnahmen von Wickelvorgängen, in denen die Faserpositionen absichtlich manipuliert wurden. Zusätzlich werden die Herausforderungen bei der Entwicklung eines Maschinellen Lerners näher beleuchtet.

T 23.10 Mo 13:30 VMP4 Foyer

Chemical purification of $CaCO_3$ and $CaWO_4$ powders used for $CaWO_4$ crystal production for the CRESST experiment — •H. H. Trinh Thi, X. Defay, A. Erb, R. Hampf, J.-C. Lanfranchi, A. Langenkämper, V. Morgalyuk, A. Münster, E. Mondragon, C. Oppenheimer, W. Potzel, S. Schönert, H. Steiger, A. Ulrich, S. Wawoczny, M. Willers, and A. Zöller — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85748 Garching

CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) uses $CaWO_4$ single crystals as targets for the direct search for dark matter particles. Since several years these $CaWO_4$ crystals are grown at the Technische Universität München. Thereby, commercially available $CaCO_3$ and WO_3 powders are used for the synthesis of $CaWO_4$ powder. For the experiment low intrinsic contaminations of the crystals play a crucial role. In order to improve the radiopurity of the crystals it is necessary to reduce potential sources for radioactive backgrounds such as U and Th. In this poster we will present our studies of the chemical purification of the $CaCO_3$ and $CaWO_4$ powders. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the Helmholtz Alliance for Astroparticle Physics, by the Maier-Leibnitz-Laboratorium (Garching), by the BMBF.

T 23.11 Mo 13:30 VMP4 Foyer

Characterization of Scintillating Plastic Fibers and Silicon Photomultipliers for their Usage in a Particle Telescope — •Lea Prüfer, Martin Losekamm, Thomas Pöschl, Daniel Greenwald, and Stephan Paul — Technische Universität München, 85748 Garching, Deutschland

The Multi-purpose Active-target Particle Telescope (MAPT) is a newly developed compact charged-particle detector. It can be used for space applications, such as radiation monitoring on spacecraft or for stratospheric research balloons.

Its core consists of scintillating plastic fibers coupled to silicon photomultiplier (SiPMs). The energy reconstruction of the incoming particles is based on an extended Bragg curve spectroscopy technique, requiring a good measurement of the energy deposition. Therefore, non-linearities of the measured light output -such as quenching effects of the scintillating material or saturation of the SiPMs at high light yields- have to be known quantitatively.

To investigate these effects, two scaled-down prototypes were built, consisting of 128 and 16 channels. The first one was tested at a stationary proton beam at Paul Scherrer Institute.

We determine Birk's coefficient describing the ionization quenching of the scintillator and calculate the characteristic photon detection efficiency of the SiPMs. We will explain the results of the first prototype tests and the characterization of the SiPMs. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 23.12 Mo 13:30 VMP4 Foyer

Characterization of scintillating $CaWO_4$ crystals for the CRESST experiment using two-photon excitation — •Raphael Hampf, Thomas Dandl, Andrea Münster, Lothar Oberauer, Sabine Roth, Stefan Schönert, and Andreas Ulrich — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85747 Garching

In the CRESST experiment for direct dark matter search, phonon and photon signals from cryogenic $CaWO_4$ crystals are used to search for WIMP-induced nuclear recoil events. We present a novel table-top setup in which the scintillation of $CaWO_4$ is induced by 0.7ns laser pulses of 355nm wavelength. The excitation occurs via two-photon absorption in the bulk material. The scintillation light is observed by time resolved optical spectroscopy. By varying the focusing of the laser-beam the excitation density can be made high enough to study quenching effects due to exciton-exciton annihilation. This allows to perform experiments to test models for the quenching factors of different ionizing projectiles in $CaWO_4$ which are used to identify these projectiles on an event by event basis.

This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 23.13 Mo 13:30 VMP4 Foyer

Raman spectroscopic determination of the molecular constants of the hydrogen isotopologues with high accuracy — •Bennet Krasch, Sebastian Mirz, and Robin Grössle for the KATRIN-Collaboration — Karlsruhe Institute for Technology (KIT), Institute for Technical Physics (ITEP), Tritium Laboratory Karlsruhe (TLK)

The interest in the thermodynamic properties of gases as the chemical equilibrium is faced by the challenge of time-consuming and technical extensive experimental setups. One possible solution is the derivation of these properties from the molecular constants. The rotational and vibrational movement of diatomic molecules, as the hydrogen isotopologues, is described by the concept of the rotational anharmonic oscillator. The molecular constants are the free parameters of this concept. Molecular constants themselves can be determined by measuring the line position of rotational and/or rotational transitions e.g. with Raman spectroscopy for hydrogen as it has been done since several years. In this contribution a Raman method was development to measure the molecular constant of the hydrogen isotopologues with high accuracy to obtain reliable results. But not only the method was development but also a complete measurement uncertainty budget was set up. The uncertainty budget contains all possible sources for uncertainties from the measurement period or the analysis process as well the contribution of each single uncertainty. The method and the uncertainty budget were exemplary tested on Deuterium.

T 23.14 Mo 13:30 VMP4 Foyer

The OPERA Experiment - $\nu_\mu \rightarrow \nu_\tau$ oscillation discovered in appearance mode — •Benjamin Büttner for the OPERA-Hamburg-Collaboration — Universität Hamburg, Institut für Experimentalphysik

The primary goal of the OPERA long-baseline neutrino oscillation experiment is the first direct detection of $\nu_\mu \rightarrow \nu_\tau$ oscillations.

The hybrid OPERA detector consists of a large-mass target made from lead and photo emulsions - providing micrometric resolution - and electronic detector parts for online readout. It is located in the LNGS underground laboratory, at a distance of 730km from the SPS at CERN, where the CNGS ν_μ beam is produced.

The measurement of ν_τ appearance relies on the detection of the decay of τ leptons which are created in ν_τ charged current reactions. Data acquisition lasted from 2008 to 2012. With the collected data the OPERA experiment discovered ν_τ appearance in the CNGS neutrino beam with a significance of 5.1 σ .

This poster will give an overview about the OPERA experiment and the discovery of τ neutrino appearance in the CNGS neutrino beam.

T 23.15 Mo 13:30 VMP4 Foyer

VUV-sensitive Silicon-Photomultipliers for the nEXO-Experiment — •Gerrit Wrede, Reimund Bayerlein, Patrick Hufschmidt, Ako Jamil, Judith Schneider, Michael Wagenpfeil, Tobias Ziegler, Jürgen Hössl, Gisela Anton, and Thilo Michel — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

The nEXO (next Enriched Xenon Observatory) experiment will search for the neutrinoless double beta decay of Xe-136 with a liquid xenon TPC (Time ProjectionChamber). The sensitivity of the experiment is related to the energy resolution, which itself depends on the accuracies of the measurements of the amount of drifting electrons and the number of scintillation photons with their wavelength being in the vacuum ultraviolet band. Silicon Photomultipliers (SiPM) shall be used for the detection of the scintillation light, since they can be produced extremely radiopure. Commercially available SiPM do not fulfill all requirements of the nEXO experiment, thus a dedicated development is necessary. To characterize the silicon photomultipliers, we have built a test apparatus for xenon liquefaction, in which a VUV-sensitive photomultiplier tube can be operated together with the SiPM.

In this contribution we present our apparatus for the SiPM characterization measurements and our latest results on the test of the silicon photomultipliers for the detection of xenon scintillation light.

T 23.16 Mo 13:30 VMP4 Foyer

Characterization of Silicon Photomultiplier — •Judith Schneider, Ako Jamil, Reimund Bayerlein, Jürgen Hössl, Patrick Hufschmidt, Michael Wagenpfeil, Gerrit Wrede, Tobias Ziegler, Gisela Anton, and Thilo Michel — Erlangen Centre for Astroparticle Physics, 91058 Erlangen

Silicon Photomultipliers (SiPMs) typically offer excellent photon number resolution. Thus they can be an excellent choice for photo detection in experiments for which energy resolution of a signal - derived from scintillation light detection - is crucial. In addition to that they offer a large ratio of sensitive surface to total mass and high radio purity which makes them a good choice for photosensors of the nEXO experiment (next Enriched Xenon Observatory) to search for the neutrino less double beta decay of 136Xe. We measured internal gain, dark current, dark count rate and crosstalk probability of a SiPM with a special view on their dependence on temperature and bias voltage. This contribution explains the working principle of a SiPM and their basic characteristics. Futhermore, characterization results are presented.