T 9: Dunkle Materie 1

Zeit: Montag 11:00–12:25 Raum: P11

T 9.1 Mo 11:00 P11

Statistical wavelet analysis to detect keV-neutrinos with a KATRIN-like experiment — •Marc Korzeczek — Karlsruhe Institute of Technology (KIT), Institute for Nuclear Physics (IKP)

One possibility to look for Dark Matter is the search for sterile keV-neutrino signatures in the tritium beta decay spectrum. Such a spectrum can be measured at the KArlsruhe TRItium Neutrino experiment (KATRIN), whose primary goal is the determination of the effective mass of the electron antineutrino.

With the help of a modified KATRIN experiment and the Discrete Wavelet Transformation it would be possible to detect and quantify the kink-like signature, left by a keV-neutrino in the electron energy spectrum of tritium beta decay.

In this talk the analysis method will be presented and statistical as well as systematical influences will be discussed. It will be shown that even large systematical effects barely affect the sensitivity.

This work was supported by the BMBF under grant no. 05A11VK3 and by the Helmholtz Association.

T 9.2 Mo 11:15 P11

Wavelet analysis as a promising tool to detect the kink-signature of keV-neutrinos in the tritium beta spectrum — •Kai Dolde for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institute for Nuclear Physics (IKP)

The search for viable Dark Matter candidates is a major topic in science nowadays and keV-neutrinos are among the most promising candidates for Warm Dark Matter.
In order to detect keV-neutrinos, the single beta decay of tritium is considered. Since they would contribute with a certain mixing angle to the active neutrinos, they would leave a kink-like signature in the beta energy spectrum.
To analyze and quantify this kink-signature, depending on the keV-neutrino mass and its mixing angle, this talk introduces the Discrete Wavelet Transform as a very promising approach. This multiresolutional analysis method with both time and frequency resolution is shown to be very sensitive to the detection of a kink-like feature caused by keV-neutrinos.

This work was supported by the BMBF under grant no. 05A11VK3, by the Helmholtz Association and the German National Academic Foundation.

Gruppenbericht T 9.3 Mo 11:30 P11

Direct Dark Matter Search with CRESST - A First Glance at New Data — •Raimund Strauss for the CRESST-Collaboration — Max-Planck-Institut für Physik, D-80805 München, Germany

The CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) experiment, located in the Gran Sasso underground laboratory (LNGS) in Italy, aims at the direct detection of Dark Matter in the form of weakly interacting massive particles (WIMPs). Scintillating $CaWO_4$ single crystals operated as phonon detectors at mK temperatures are used as target material. The simultaneously measured scintillation-light output of particle interactions allows an event-by-event discrimination of backgrounds from possible WIMP-induced signals.
A new measuring campaign of CRESST with a total active target mass of ∼5 kg has started in summer 2013. New detector concepts, self-grown $CaWO_4$ crystals with a highly improved radiopurity, and an additional shielding of the setup allow to lower the background level significantly in comparison to previous runs. CRESST, therefore, has the potential to clarify whether the low-mass WIMP scenario is valid or otherwise to set competitive limits for the spin-independent WIMP-nucleon scattering cross section. In this talk, we describe the performance of the present setup and discuss first data.

Gruppenbericht T 9.4 Mo 11:50 P11

Status des XENON1T Experiments zur Suche nach Dunkler Materie — •Sebastian Lindemann — Max-Planck-Institut für Kernphysik, Heidelberg

Der direkte Nachweis dunkler Materie im Labor gehört zu den spannendsten Themengebieten aktueller physikalischer Forschung. Hierbei wird versucht den in einem Streuereignis übertragenen Impuls von Dunkler Materie auf herkömmliche Materie im Labor nachzuweisen.

Zwei-Phasen Flüssig-Xenon Detektoren haben in den letzten Jahren durch unübertroffene Sensitivitäten ihre spezielle Eignung für diese Aufgabe gezeigt. Der XENON1T Detektor stellt hierbei die Fortsetzung der XENON10 und XENON100 Experimente dar. Durch eine weitere Reduktion des Untergrunds um zwei Größenordnungen und eine Vergrößerung der Target-Masse um grob einen Faktor 20 ist das wissenschaftliche Ziel von XENON1T die Sensitivität des Vorgängerexperiments um einen Faktor 100 zu verbessern. Damit wird XENON1T in der Lage sein einen großen Teil des von theoretischen Modellen jenseits des Standardmodells vorhergesagten Parameterraums an Wirkungsquerschnitten von Dunkler Materie mit herkömmlicher Materie zu erforschen und hat damit gute Chancen das Rätsel um die Dunkle Materie zu lösen.

Nach einer kurzen Einführung in das Detektionsprinzip werde ich in meinem Vortrag das Design, die wissenschaftliche Ziele und den aktuellen Stand des XENON1T Experiments besprechen und einen Ausblick auf das Upgrade XENONnT geben.

T 9.5 Mo 12:10 P11

Bayesian applications towards the analysis of XENON100 data — •Stefan Schindler — JGU, Staudingerweg 7, 55128 Mainz

The XENON100 experiment is located in the underground lab at LNGS in Italy. The underground location is necessary to be shielded against cosmic radiation. Since Dark Matter particles will only interact very rare with normal matter, an environment with ultra low background is needed. The analysis for XENON100 data was performed with the profile likelihood method (a frequentist approach) and still provides one of the most sensitive exclusion limits.

Bayesian inference takes a different approach towards probability. Here, probability is interpreted as a degree of believe. In the Bayesian approach a prior probability density function (pdf) is defined which represents the state of knowledge in a parameter of interest. After looking at the data, this knowledge is updated which results in the posterior pdf. All inferences of the problem are obtained following Bayes'theorem. We present the outcome of these Bayesian calculations, compare them to the profile likelihood results for 225 live days data of the the XENON100 detector and give an outlook of future tasks.