T 7: Dunkle Materie I

Zeit: Montag 14:00–16:05 Raum: I.13.65 (HS 26)

Gruppenbericht T 7.1 Mo 14:00 I.13.65 (HS 26)
Dark Matter search with XENON — •Cyril Grignon — JGU, Staudingerweg 7, 55128 Mainz

The XENON program aims for the direct detection of dark matter with a liquid xenon TPC working in a low background environment. We discuss recent results obtained with the XENON100 experiment, the current phase of the program based on a sensitive volume of 62 kg of liquid xenon and operated in the Gran Sasso Underground Laboratory in Italy. We also present the status of XENON1T, the next phase of the program currently under construction at LNGS, which aims to reach a sensitivity for the spin-independent WIMP-nucleon cross section of 2×10^{-47} cm^2 for a WIMP mass of 50 GeV/c2 . The first science run of XENON1T is expected ot start at the end of 2015.

T 7.2 Mo 14:20 I.13.65 (HS 26)
Displaying results of direct detection dark matter experiments free of astrophysical uncertainties — •Ludwig Rauch and Collaboration XENON — Max Planck Institut für Kernphysik, Heidelberg

A number of experiments try to measure WIMP interactions by using different detector technologies and target elements. Hence, energy thresholds and sensitivities to light or heavy WIMP masses differ. However, due to large systematic uncertainties in the parameters defining the dark matter halo, a comparison of detectors is demanding. By mapping experimental results from the traditional cross section vs. dark matter mass parameter-space into a dark matter halo independent phase space, direct comparisons between experiments can be made. This is possible due to the monotonicity of the velocity integral which enables to combine all astrophysical assumptions into one parameter common to all experiments. In this talk the motivation as well as the mapping method will be explained based on the XENON100 data.

T 7.3 Mo 14:35 I.13.65 (HS 26)
Status of the 2D Bayesian analysis of XENON100 data — •Stefan Schindler — JGU, Staudingerweg 7, 55128 Mainz

The XENON100 experiment is located in the underground laboratory at LNGS in Italy. Since Dark Matter particles will only interact very rarely with normal matter, an environment with ultra low background, which is shielded from cosmic radiation is needed. The standart analysis of XENON100 data has made use of the profile likelihood method (a frequentist approach) and still provides one of the most sensitive exclusion limits to WIMP Dark Matter.

Here we present work towards a Bayesian approach to the analysis of XENON100 data, where we attempt to include the measured primary (S1) and secondary (S2) scintillation signals in a more complete way. The background and signal models in the S1-S2 space have to be defined and a corresponding likelihood function, describing these models, has to be constructed.

T 7.4 Mo 14:50 I.13.65 (HS 26)
Commissioning of a Dual-phase Xenon TPC and First Compton Scatter Results — •Pierre Sissol, Bastian Beskers, Melanie Scheibelhut, Cyril Grignon, Christopher Hils, Uwe Oberlack, and Rainer Othegraven — Johannes Gutenberg Universität Mainz

With the MainzTPC, a small 3D position-sensitive dual-phase xenon time projection chamber (TPC), we aim to measure the xenon response for low-energy recoils (few keV) with better precision than previous experiments. Furthermore the setup allows to study the liquid xenon scintillation pulse shape. The goal is to deepen the understanding of xenon as a detection material in the low-energy regime for Dark Matter searches.

Here we report on the commissioning of the MainzTPC and first measurements, including scintillation and charge signals as well as coincidence signals between the TPC and a germanium detector for the Compton scattering.

T 7.5 Mo 15:05 I.13.65 (HS 26)
Design and Commissioning of ReStoX for XENON1T — •Melanie Scheibelhut — Institut für Physik, Johannes Gutenberg Universität Mainz

The XENON1T experiment, currently under construction at the Gran Sasso underground laboratory LNGS, uses the concept of a xenon dual-phase (liquid/gas) time projection chamber to search for Dark Matter particles. This requires cooling to about 175 K and liquefaction of the noble gas. The ReStoX (Recovery and Storage of Xenon) is a novel device to store and recover up to 7 tons of xenon - either in liquid phase at cryogenic temperatures and 1-2 bar of pressure, or in gaseous form at room temperature at about 70 bar of pressure. The ReStoX system consists of a double insulated stainless steel sphere with liquid nitrogen cooling loops distributed across the inner sphere. A condenser on the inside, also operated with liquid nitrogen, provides a cooling power of 3 kW. ReStoX is designed to provide an effective means for various operating modes: to fill the TPC fast, to recover xenon from the TPC under normal and emergency conditions, to store xenon safely in liquid or gaseous form, or to remain in cold standby nearly empty as a safety device. Here we present the design and first commissioning results.

T 7.6 Mo 15:20 I.13.65 (HS 26)
Capacitive liquid level measurement in the XENON1T time projection chamber — •Christopher Geis — Institute of Physics, Johannes Gutenberg University, Mainz, Germany

Two-phase xenon time projection chambers (TPCs) have been operated very successfully in direct detection experiments for dark matter. This kind of detector uses liquid xenon as the sensitive target and is operated in two-phase (liquid/gas) mode, where the liquid level needs to be monitored and controlled with sub-millimeter precision.

We present the design, simulation and the development of two kinds of level meters going to be operated in XENON1T: short level meters are three-plated capacitors measuring the level of the liquid-gas interface with a measurement range $h \approx 5\,\mathrm{mm}$ and a resolution of $\Delta C/h \approx 1\,\mathrm{pF/mm}$. First test results show that based on this values a level resolution of 10^{-2} mm can be reached. Further, we present the different design solutions for the long level meters: a cylindrical double-walled capacitor design as well as a design based on printed circuits, measuring the overall filling level of the XENON1T TPC at a measurement range of $h = 1.4\,\mathrm{m}$ and a resolution of $\Delta C/h \approx 0.1\,\mathrm{pF/mm}$.

T 7.7 Mo 15:35 I.13.65 (HS 26)
Entfernung von Radon aus Xenon für das XENON1T-Experiment — •Stefan Brünner für die XENON-Kollaboration — Max-Planck-Institut für Kernphysik Heidelberg

In Detektoren mit niedriger Ereignisrate wie XENON1T, einem Experiment zum Nachweis Dunkler Materie, stellen Radon und dessen Tochterisotope eine wichtige Untergrundquelle dar. Durch kontinuierliche Emanation aus sämtlichen Materialien gelangt Radon bis in das Innerste des XENON1T Detektors unbeeindruckt durch jegliche äußere Abschirmung. In XENON1T wird die Radon-Problematik auf zweierlei Arten angegangen: Erstens werden die Materialien, die zum Bau des Experiments verwendet werden sorgfaeltig auf ihre niedrige Radon-Emanationsrate hin ueberprueft und ausgewaehlt (im Abstract fuer HD folgt hier noch ein Verweis auf den Lindemann-Talk). Trotz dieser Qualitaetskontrolle werden sich nicht alle Radonquellen gaenzlich ausschliessen lassen. Darum ist zweitens ein System geplant, in dem Radon waehrend des Betriebs von XENON1T permanent aus Xenon entfernt wird. In diesem Vortrag werden Arbeiten zur Realisierung einer solchen Radonreinigungsanlage vorgestellt. Derzeit beruht der vielversprechendste Ansatz auf der Reinigungswirkung, die duch verdampfendes Xenon erzielt wird. Dabei ist ein mehrstufiger Destillationsprozess ebenso denkbar wie eine Reinigung durch einfaches Xenon-Verdampfen (Boil-Off Reinigung).

T 7.8 Mo 15:50 I.13.65 (HS 26)
Testing keV sterile neutrino Dark Matter in future direct detection experiments. — •Miguel D. Campos and Werner Rodejohann — Max-Planck-Institut für Kernphysik, Heidelberg, Deutschland.

In this work we analyse the possibility of measuring sterile neutrino dark matter in direct detection experiments, such as XENON100 and its future stages. In particular we focus on the keV range, studying the interaction of these particles with electrons in bound states.