T 31: Direkte Suche nach Dunkler Materie II

Zeit: Dienstag 16:00–18:15 Raum: H09

T 31.1 Di 16:00 H09

The XENONnT Time Projection Chamber — •Francesco Toschi for the XENON-Collaboration — Albert-Ludwigs-Universität Freiburg

The XENONnT experiment is the next phase of the XENON project and aims at the direct detection of dark matter via WIMP-nucleus scattering. The core of the instrument is the double-phase Time Projection Chamber (TPC) filled with 5.9 t of liquid xenon, allowing position reconstruction and interaction-type discrimination. The talk focuses on the challenges to design a multi-ton double-phase TPC and how they are overcome thanks to the experience coming from the previous phases of the project, dedicated finite elements analyses and extensive mechanical tests in various laboratories.

T 31.2 Di 16:15 H09

Electric field simulations for XENONnT — •Nikolina Sarcevic — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

The XENONnT is the next generation WIMP (Weakly-Interacting Massive Particle) dark matter detector with a 5.9 t liquid xenon (LXe) target. The electric field inside its TPC has to meet certain requirements as important parameters depend on the quality of the field: energy and position resolution, signal reconstruction, particle identification. Electric field simulations provide crucial input for the TPC design. In this talk, I will present the outcome of field simulations which led to the final design of XENONnT TPC field cage. Focus will be on the field shaping elements and how their geometrical and electrostatic characteristics shape the overall field, as well as on the influence of other TPC components.

T 31.3 Di 16:30 H09

Radiogenic Background Simulations for XENONnT — •Diego Ramírez García for the XENON-Collaboration — Albert-Ludwigs-Universität Freiburg, Freiburg im Breisgau, Germany

The XENON1T experiment at the Laboratori Nazionali del Gran Sasso has achieved the world-leading sensitivity in the direct search for dark matter in the form of Weakly Interacting Massive Particles (WIMPs). Its upgrade to XENONnT will use a liquid xenon target of 5.9 t, aiming at further improving this sensitivity by an order of magnitude, and will be operative in 2019.

For a multi ton-scale time projection chamber, the background signals induced by radioisotopes from the detector materials will become relevant in the WIMP search region of interest. Using the material-intrinsic levels of radioactivity measured in screening campaigns, Monte Carlo simulations have been performed in order to estimate this contribution. This talk will briefly describe the utilized framework to model the detector response and summarize the result on the predicted radiogenic background.

T 31.4 Di 16:45 H09

Background modelling for ^{124}Xe double electron capture search with XENON1T — •Christian Wittweg for the XENON-Collaboration — Institut für Kernphysik, WWU Münster

XENON1T located at Laboratori Nazionali del Gran Sasso is the most sensitive WIMP dark matter detector to date. It uses a dual phase time projection chamber with a sensitive liquid xenon volume of $\sim$ 2 tons for detection. The low background and large target mass also make it suitable for investigating other rare phenomena such as double beta decays and alternative dark matter candidates. Analyses in these physics channels require a detailed understanding of the electronic recoil background spectrum at higher energies than for the standard WIMP search. This talk will outline relevant background components, neutron activation studies, as well as the background modelling up to the 100 keV range. In addition, the application in a search for ^{124}Xe two-neutrino double electron capture with XENON1T will be presented. This work is supported by DFG through GRK 2149: Strong and Weak Interactions – from Hadrons to Dark Matter.

T 31.5 Di 17:00 H09

The Münster Dual Phase Time Projection Chamber — •Henning Schulze Eissing — Institut für Kernphysik, WWU Münster

The XENON Dark Matter Project utilizes a dual phase time projection chamber (TPC) to directly search for Weakly Interacting Massive Particles (WIMPs).

A smaller TPC was built in Münster to perform different investigations which include studies on electron lifetime, a measure of the xenon purity, as well as studies on different calibration sources. Additionally, the detector was conceived for teaching purposes.

The Münster TPC uses a cylindrical detector filled with up to 2.6 kg liquid and gaseous xenon as active volume monitored by 14 photomultipliers. The raw data are processed by PAX, the processor for analyzing XENON, which was developed for the XENON1T experiment and adapted for the use with the Münster TPC.

The working principle of the detector will be outlined and different measurements will be shown.

The TPC was built from funds by DFG Großgeräte.

T 31.6 Di 17:15 H09

Construction of a Radon Emanation Chamber — •Daniel Baur — Hermann-Herder-Straße 3

Liquid xenon-based experiments are currently leading the search for WIMP dark matter. Their dominant electronic recoil background in the energy region of interest are naked beta decays of ^{214}Pb, a daughter from ^{222}Rn. Consequently, the precise monitoring of the surface emanation of ^{222}Rn is required for the successful development of next-generation dark matter experiments with a multi-ton xenon target such as DARWIN. The emanation can be measured in a radon emanation chamber, where the daughters of ^{222}Rn are collected electrostatically on a silicon PIN diode and the subsequent alpha decays are detected. The status of the construction of such a detector in Freiburg is presented as well as first measurement results.

T 31.7 Di 17:30 H09

Monte Carlo Simulations for DARWIN R&D — •Alexander Bismark — Physikalisches Institut, University of Freiburg, Hermann-Herder-Str. 3, D-79104 Freiburg

The DARWIN project plans to use a 40t liquid xenon (LXe) time projection chamber to fully probe the experimentally accessible parameter space for the direct detection of WIMP dark matter. This space will be eventually limited by coherent neutrino interactions with atomic nuclei. New LXe detector technologies with a potential application in DARWIN are developed using the R&D platform XEBRA (XEnon Based Research Apparatus) at the University of Freiburg. We will introduce the fully functional baseline detector consisting of a small dual phase TPC following the well-established detection scheme of the XENON experiments which will provide a benchmark for comparison with the novel technological approaches and will be used for measurements of LXe parameters as well. We will focus on the current status of the Geant4 Monte Carlo simulation of the setup and will show first results.

T 31.8 Di 17:45 H09

Proportional Scintillation in liquid xenon — •Patrick Meinhardt — Physikalisches Institut, Hermann-Herder-Straße 3, 79104, Freiburg

Time Projection Chambers (TPCs) filled with liquid xenon are currently leading direct search for WIMP dark matter. The experiments detect a scintillation signal (S1) produced instantaneously by the interacting particle and a time-delayed charge signal (S2). In the commonly used dual-phase TPC, the charge signal is amplified by extracting the ionization electrons into the gas phase above the liquid target where they create a secondary scintillation signal which is proportional to the charge. Scaling this concept to the scale of the ultimate dark matter detector DARWIN leads to challenges regarding mechanics and operation which could be overcome by a paradigm shift towards a single-phase TPC. Here, the proportional scintillation signal S2 is produced in the liquid phase, in the strong electric field around very thin wires. Changing the amplification mechanism also provides the opportunity to reduce detector artefacts observed in dual-phase TPCs and could potentially improve the ER/NR discrimination power. We report on our studies to generate S2 signals in liquid xenon using the XEBRA test platform in Freiburg.

T 31.9 Di 18:00 H09

Surface cleaning for background reduction and its influence on liquid xenon TPC performance — •Natascha Rupp, Dominick Cichon, Guillaume Eurin, Florian Joerg, and Teresa Marrodan Undagoitia — Max-Planck-Institut fuer Kernphysik, Heidelberg

One main challenge in the direct detection of dark matter particles with liquid xenon TPCs (Time Projection Chambers) is the background reduction to a minimal rate. The plate-out of Rn222 daughters on the surfaces in contact with the liquid xenon can cause background events. We investigated different cleaning procedures that mitigate this background source. In order to apply them in future TPCs like DARWIN it has to be verified that they don't affect the xenon purity which strongly influences the signal production and hence the discrimination power of signal and background. This talk presents different cleaning procedures for PTFE and shows first results of the xenon purity evolution after applying them in a TPC.