T 4: Detectors I (Scintillators)

Time: Monday 16:45–18:15 Location: VG 0.110

T 4.1 Mon 16:45 VG 0.110

Track position reconstruction with of a fiber-structured plastic scintillator detector (using a likelihood-based method) — Alessia Brignoli[1], Andrew Picot Conabo[1], Valery Dormenev[2], Christian Dreisbach[3], Karl Eichhorn[3], Jan Friedrich[3], Heiko Markus Lacker[1], Martin J. Losekamm[3], Anupama Reghunath[1], Christian Scharf[1], Ben Skodda[1], Valerian von Nicolai[1], Ida Woestheinrich[1], Hans-Georg Zaunick[2], and •Jasmin Weiss[1] — [1]Humboldt-Universität zu Berlin — [2]Justus-Liebig-Universität Gießen — [3]Technische Universität München

The CheapCal project aims to develop a low-cost, position-sensitive sampling calorimeter based on plastic scintillators. A prototype detector has been developed with 32 wavelength-shifting (WLS) fibers embedded in perpendicular grooves on the front and the back of a $(25 \times 25 \times 0.7)$ cm^3 scintillator plate. The WLS fibers are read out on both ends by Silicon Photomultipliers. The relatively short light attenuation length of the extruded scintillator material limits the photon collection primarily to fibers adjacent to a particle hit. We will present results from 100 GeV muon test beam data, comparing a weighted arithmetic mean hit position reconstruction technique with a likelihood-based approach. We acknowledge funding from BMBF, grant number 05H2021.

T 4.2 Mon 17:00 VG 0.110

Time resolution of a wavelength-shifting fibre structured plastic scintillator detector — Alessia Brignoli[1], Andrew Picot Conaboy[1], Valery Dormenev[2], Christian Dreisbach[3], Karl Eichhorn[3], Jan Friedrich[3], Heiko Markus Lacker[1], Martin J. Losekamm[3], Anupama Reghunath[1], Christian Scharf[1], Ben Skodda[1], Anubandh Sreekeessoon[1], Valerian von Nicolai[1], Jasmin Weiss[1], •Ida Wöstheinrich[1], and Hans-Georg Zaunick[2] — [1]Humboldt-Universität zu Berlin — [2]Justus- Liebig-Universität Gießen — [3]Technische Universität München

The CheapCal project aims to create a cost-effective, position-sensitive sampling calorimeter using extruded plastic scintillators. The prototype detector consists of a $(25 \times 25 \times 0.7)\,\mathrm{cm}^3$ scintillator plate with 32 wavelength-shifting (WLS) fibers embedded in perpendicular grooves on its front and back surfaces. Silicon photomultipliers read out the WLS fibers on both ends. Due to the scintillator's short light attenuation length, photons generated in the scintillator by charged-particle hits are collected primarily by the fibers closest to the particle hit.

We will present the timing measurement results obtained in the lab using a radioactive Sr-90 source and Kuraray Y-11 fibers with charge-sensitive pre-amplifiers. Combining the timing information from the closest fibers to the source position, we achieved a timing resolution below 750 ps(standard deviation). We are performing additional studies on improving time resolution using alternative WLS fibers such as Kuraray YS-2 and alternative pre-amplifiers optimized for time resolution.

T 4.3 Mon 17:15 VG 0.110

Opaque Scintillators for Neutrino Physics — Christian Buck[1], Benjamin Gramlich[1], and •Stefan Schoppmann[2] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]JGU Mainz, Exzellenzcluster PRISMA$^+$, Detektorlabor, Staudingerweg 9, 55128 Mainz, Germany

A new scintillator system was developed based on admixtures of wax in organic scintillators. The opacity and viscosity of this gel-like material can be tuned by temperature adjustment, wax concentration, and wax type. Whereas it is a colourless transparent liquid at high temperatures, it has a milky wax structure below.

Due to its light confinement, the scintillator system is expected to exhibit unprecedented particle ID via the topology of energy depositions. Moreover, a high degree of metal loading is feasible, e.g. in the context of searches for double beta decays or neutron capture.

In this presentation, the production and properties of such a scintillator as well as its advantages compared to transparent scintillator are described.

T 4.4 Mon 17:30 VG 0.110

Wavelength shifting fibers with high photon capture rate — •Bastian Kessler and Sebastian Böser for the NuDoubt-Collaboration — JGU Mainz - Institut für Physik

Wavelength-shifting optical fibers are commonly used to collect light from large detector volumes and guide towards photosensors, making them particularly interesting for water Cherenkov or scintillator based detectors. However, one problem is their low photon capture rate, leading to a degradation in the energy resolution of fiber-based detectors.

Building on previous work, it was shown that the photon capture rate can be increased by optimizing the design of the photon absorption zone. In this work, this concept was applied to wavelength shifting fiber to increase the light output of the hybrid opaque scintillator experiment NuDoubt^{++}.

However, the first prototype fibers suffer still from a relative high attenuation, losing this advantage for fiber lengths over 2 meters and losing efficiency compared to commercial fibers. In this presentation we will discuss about the further development of the fibers and the effect of adapted production methods on the attenuation length.

T 4.5 Mon 17:45 VG 0.110

Development of an integrated photon and phonon detector for use with scintillators — •Ashish Jadhav, Christian Enss, Andreas Fleischmann, Daniel Hengstler, Cagla Mahanoglu, Ioana-Alexandra Nitu, Christian Ritter, Andreas Reifenberger, Daniel Unger, and Loredana Gastaldo — Kirchhoff Institute for Physics, Heidelberg University

The AMoRE project searches for $0\nu\beta\beta$ decay in ^{100}Mo using scintillating crystals coupled with metallic magnetic calorimeters (MMCs) operated at 20mK. The current setup utilizes separate phonon and photon detectors to simultaneously measure the crystal's temperature rise and emitted light. We present the development of an integrated photon-phonon detector (P2) for a potential improvement in energy resolution and background suppression. In the P2 design, the central part of a 3" silicon wafer is separated from the rest of the wafer by trenches produced through silicon etching, leaving only six narrow bridges for thermal connection. This central part serves as a photon detector with the MMC sensor having stripline geometry and thermally isolated from the rest of the wafer by trenches produced through silicon etching techniques. The outer region of the wafer hosts three MMC units that are coupled to the scintillating crystal to monitor temperature changes. This configuration would help study a position-dependent signal shape, improving event discrimination for multi-site events. The primary challenges in developing a P2 detector are the fabrication of the thermally isolated photon absorber area and the reliable, support-free mounting of the scintillating crystal onto the wafer.

T 4.6 Mon 18:00 VG 0.110

Development of a Novel Te-doped Liquid Scintillator with Slow Light Emission for $0\nu\beta\beta$-Decay Searches in a Hybrid Neutrino Detector — •Hans Theodor Josef Steiger[1], Manuel Böhles[2], Matthias Raphael Stock[1], Meishu Lu[1], Ulrike Fahrendholz[1], Ronja Huber[1], Lothar Oberauer[1], Franz von Feilitzsch[1], and Michael Wurm[2] — [1]Physik-Department, Technische Universität München, James-Franck-Str. 1, 85748 Garching, Germany — [2]Johannes Gutenberg Universität, Staudingerweg 7, 55128 Mainz, Germany

It is a long-standing paradigm that organic scintillators allow excellent energy resolution but no directional reconstruction. Here we show the foundation for overcoming this by scintillators with slow light emission, paving the way for hybrid detectors that combine the advantages of Cherenkov and scintillation detectors. In such slow liquid scintillators, it is possible to reconstruct directional and topological information from Cherenkov light, while the high light yield of an organic scintillator ensures excellent energy resolution and low thresholds necessary for many applications in neutrino and particle physics such as the search for the $0\nu\beta\beta$ decay. We also developed a novel loading technique for these scintillators with 130Te and show studies of fundamental properties of these scintillators and the novel dopant. This work is supported by the Clusters of Excellence PRISMA+ and ORIGINS and the Collaborative Research Center 1258.