T 78: Suche nach Neuen Teilchen IV

Zeit: Donnerstag 16:00–17:50 Raum: H07

Gruppenbericht T 78.1 Do 16:00 H07

Measurement of the muon flux and spectrum for the SHiP experiment — •Stefan Bieschke, Caren Hagner, Daniel Bick, Walter Schmidt-Parzefall, Benedict Kaiser, Joachim Ebert, and Björn Opitz — Universität Hamburg, Institut für Experimentalphysik

SHiP is a proposed general purpose beam dump experiment at CERN's SPS 400 GeV proton beam dedicated to the Search for Hidden Particles. A high intensity proton bunch stopped in a target produces a large number of particles, some of which might have evaded detection due to their very low couplings in prior experiments. Among these, a huge amount of muons is produced, considered background. For SHiP, a low background environment is necessary and an active muon shield is needed. In order to optimize this shield, knowledge of the muon spectrum to expect is crucial. Therefore in summer 2018 an experiment at the CERN SPS was performed measuring the muon flux and spectrum from a target replica of the SHiP target with a drift tube spectrometer and RPC detector at the H4 beam line. During the three week experiment $\mathcal{O}(5 \times 10^{11})$ p.o.t were collected. The status of the analysis will be presented.

T 78.2 Do 16:20 H07

Statistical methods and issues in sterile neutrino searches — •Birgit Neumair and Matteo Agostini — Technische Universität München, James-Franck-Straße 1, 85748 Garching bei München

In the last years, several neutrino oscillation experiments reported results not compatible within the 3-neutrino model, which hint at the existence of light sterile neutrinos. To test this hypothesis, a large number of short-baseline neutrino oscillation experiments have been constructed, are currently taking data and releasing new results.

In this talk, the statistical issues related to the search for sterile neutrinos are reviewed with focus on short-baseline appearance and disappearance experiments. The sensitivities for limit setting and signal discovery are discussed along with their dependency on the experimental parameters, including the signal rate and the spectral shape. The baseline analysis is built on a profile-likelihood test statistic that extends the unified approach of Feldman and Cousins by introducing nuisance parameters for the signal and background rate. Further, the differences between methods based on a local and global p-value are examined, and the limitations of approaches relying on a Gaussian approximation are explored.

The work is supported by the German Research Foundation (DFG) via the SFB 1258.

T 78.3 Do 16:35 H07

Background estimation for sub-relativistic particle searches with IceCube — •Jakob Böttcher, Christian Haack, Michael Handt, Timo Stürwald, Christopher Wiebusch, and Simon Zierke for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory is a multi-purpose detector with research programs encompassing neutrinos, muons, and more exotic particles, such as magnetic monopoles. These monopoles are predicted to catalyse proton decays and, depending on their mass, can propagate with sub-relativistic velocities. To find these slow particles, IceCube has a dedicated trigger that is sensitive to time scales a factor 1000 larger than the usual event duration. Since the expected rate of such particles is small, if existent, the estimation of background is crucial for such a search. Explicitly, the challenge lies in simulating correlated noise for the long time scales that have to be considered. We present an efficient way to generate and parametrize the background by reusing actual data from the detector.

T 78.4 Do 16:50 H07

A Geant4 simulation: The detector response of the SHiP Surrounding Background Tagger — •Eva-Rebecca Dietrich genannt Eisermann for the SHiP LScin SBT-Collaboration — JGU Mainz

The SHiP (Search for Hidden Particles) experiment has been proposed as a general-purpose fixed-target facility for the CERN SPS accelerator in order to look for weakly interacting particles which have a mass below 10 GeV/c^2. It will also be used to search for light dark-matter particles and studies of tau neutrino physics.

400 GeV protons impact on the heavy target which may produce weakly interacting particles that are supposed to decay inside a large vacuum vessel ($\sim$ 50 m). To distinguish between external and internal particle interactions, this vessel will be covered by the Surrounding Background Tagger (SBT).

A prototype module with the same dimensions as a final SBT detector cell was exposed to a test beam at the CERN PS in October 2018. It consisted of a liquid scintillator-filled steel box equipped with Wavelength-shifting Optical Modules and SiPM readout. To study the detector response, the same module was simulated in Geant4, allowing for comparison with the test beam measurements. Furthermore, different geometries can be implemented in the simulation which will be used to optimise the detector design.

This talk will give details on the Geant4 detector simulation and summarise its performance.

T 78.5 Do 17:05 H07

Signatures of sub-relativistic magnetic monopoles in IceCube — •Timo Stürwald, Jakob Böttcher, Christian Haack, Michael Handt, Jöran Stettner, Christopher Wiebusch, and Simon Zierke for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen

The IceCube Neutrino Observatory is a km^3 scale Cherenkov light detector that also searches for signatures of particles beyond the standard model. Sub-relativistic magnetic monopoles may catalyze proton decay via the Rubakov-Callan effect. Icecube can detect the Cherenkov light induced by this process. However, the cross-section for this process is model dependent and ranges over several orders of magnitude. This results in diverse signatures of monopoles, slowly moving through the detector. Thus, it is important to find significant variables that characterize the signal with respect to background. In this talk, we present a new selection method based on machine learning.

T 78.6 Do 17:20 H07

Search for Q-balls with IceCube — •Sarah Pieper for the IceCube-Collaboration — Bergische Universität Wuppertal, Deutschland

Many field theories include nonlinear, nondissipative solutions, which are stabilised by the existence of a Noether charge. These so called non-topological solitons behave like other standard model particles, as they have a finite shape in space and can travel with a constant velocity. Due to their spherical shape, they are also called Q-balls.

All supersymmetric generalisations of the standard model predict the existence of Q-balls. Produced in the early universe, Q-balls are candidates for cold dark matter. Additionally, they could yield an explanation for the baryon asymmetry in the universe.

Since Q-balls, like magnetic monopoles postulated in Grand Unified Theories, can catalyse nucleon decay, they can be detected by neutrino telescopes. Results for flux limits for non-relativistic magnetic monopoles can therefore be reinterpreted as flux limits for Q-balls. A new calculation of flux limits for Q-balls will be performed using IceCube data. The present status of signal simulations for Q-balls in IceCube will be presented.

T 78.7 Do 17:35 H07

Search for low relativistic magnetic monopoles utilizing luminescence light with IceCube* — •Frederik Lauber — Bergische Universität Wuppertal, Gaußstraße 20, 42117 Wuppertal

Magnetic monopoles are hypothetical particles predicted by many Beyond the Standard Model theories. They are carriers of single elementary magnetic charge. This work considers intermediate mass monopoles which have been created shortly after the Big Bang.

While there have been current results in the mild and high relativistic regime ($0.5\,c - 1\,c$), there is no recent search in the low relativistic range ($0.1\,c - 0.5\,c$). This is due to the predominant usage of Cherenkov light as a detection mechanism and the usage of detection media with a Cherenkov threshold above the aforementioned velocity range in current experiments. However, utilizing luminescence light produced by highly ionizing particles such as magnetic monopoles in water and ice, the low relativistic range becomes measurable for current water and ice based neutrino detectors. This has been demonstrated in simulation for IceCube and conservative luminescence light yield.

The current status on the ongoing search in the low relativistic range, utilizing luminescence light as a detection method with IceCube for the first time, is presented. Signal simulation is compared to data and background simulation on different cut levels. Signal and background are separated with a machine learning approach including neural networks and boosted decision trees. * *Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik*