T 99: Dark Matter IV

Time: Friday 11:00–13:00 Location: H-HS XIV

T 99.1 Fri 11:00 H-HS XIV

Search for dark matter produced in association with a hypothetical dark Higgs boson with the ATLAS detector — •Philipp Gadow, Sandra Kortner, and Hubert Kroha — Max-Planck-Institut für Physik, München, Deutschland

Searches for particle dark matter produced in association with a hypothetical dark Higgs boson are performed using the Run-2 proton-proton collision data recorded with the ATLAS detector. The presence of such a dark Higgs boson is motivated both by the need of a generation mechanism for the mass of dark matter particles and by the need of relaxing constraints on models of dark matter production due to the observed dark matter relic abundance. The dark Higgs boson mixing with the Standard Model Higgs boson allows to probe visible dark Higgs boson decays to b-quarks or pairs of vector bosons. Dark Higgs candidates are reconstructed as jets of hadronic activity enhanced by tracking information, allowing to exploit precision jet substructure information to identify dark Higgs decays. This contribution discusses constraints on dark Higgs models placed by searches exploring signatures of missing transverse momentum due to the invisible dark matter particles and dark Higgs decays to either b-quarks or pairs of W bosons. The signature of missing transverse momentum and a pair of resonantly produced W bosons is explored for the first time at the Large Hadron Collider.

T 99.2 Fri 11:15 H-HS XIV

Estimation of non-prompt and fake leptons in searches for dark matter associated production with Wt+MET — •Marianna Liberatore — DESY

In regions with multiple leptonic final states, estimating the number of events containing non-prompt (leptons inside a jet) and misidentified (fake) leptons (other particles faking leptons) represents a crucial issue. Given that Monte Carlo simulations of processes with fake leptons are unreliable or computationally expensive, data-driven methods are considered instead. In this talk are presented the first results of fake leptons background estimation using one of these methods, called the matrix method. The estimation is done for a search for dark matter in associated production with a single top quark. The search is focused on final states including one or two leptons and high missing transverse energy. Data collected with the ATLAS experiment at $\sqrt{s}$=13 TeV during LHC Run-2 (2015-2018) are used and correspond to an integrated luminosity of 139 fb^{-1}.

T 99.3 Fri 11:30 H-HS XIV

Sensitivity studies for Dark Matter models — •Martin Habedank, Priscilla Pani, and David Berge — Humboldt-Universität zu Berlin, Deutsches Elektronen-Synchrotron (DESY)

There is overwhelming evidence for the existence of Dark Matter, yet despite all efforts in direct, indirect and collider searches no suitable candidate has been found so far. To advance activities in the right direction in collider searches it is therefore informative to assess the parameter space already excluded for Dark Matter models by the various searches.

This talk will present sensitivity studies conducted in order to constrain existing Dark Matter models like the 2HDM+a model that introduces an extended Higgs sector. The work thereby focusses mainly on LHC results and makes use of the open-source tool Contur that allows straightforward comparisons of the parameter space excluded by different analyses available as Rivet routines.

T 99.4 Fri 11:45 H-HS XIV

Background Estimation for Sub-Relativistic Particles in IceCube — •Jakob Böttcher, Sukeerthi Dharani, Christian Haack, Timo Stürwald, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut, RWTH Aachen

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 usual event durations. 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 and low energy atmospheric muons for the long time scales that have to be considered. This talk presents an efficient way to generate and parametrize the background with a data-based approach. This method re-shuffles short snips of actual data and adds de-correlated noise back in by appending to existent launches. The disagreements of this background estimation with data are on a percentage scale.

T 99.5 Fri 12:00 H-HS XIV

Search for Sub-Relativistic Magnetic Monopoles in IceCube — •Sukeerthi Dharani, Jakob Böttcher, Christian Haack, Timo Stürwald, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

Grand Unified Theories predict magnetic monopoles as one of the remnants of the very early universe. The IceCube Neutrino Observatory searches for high-energy astrophysical neutrinos as well as exotic particles like magnetic monopoles. A slowly moving (sub-relativistic) magnetic monopole could catalyze nucleon decays in matter via the Rubakov-Callan effect. When passing through the IceCube detector, the decay products of the nucleon produce Cherenkov light along the monopole's track. The experimental signature is a characteristic light pattern which lasts up to milliseconds. In order to separate monopole events from the background, an event selection based on a Boosted Decision Tree has been developed. In this talk, updates on the search for sub-relativistic monopoles are presented.

T 99.6 Fri 12:15 H-HS XIV

Signatures of Q-balls in IceCube* — •Sarah Pieper for the IceCube-Collaboration — Bergische Universität Wuppertal, Deutschland

Supersymmetric generalisations of the Standard Model predict the existence of extended objects that are coherent states of squarks, sleptons and the Higgs fields. Those objects, called Q-balls, are comparable to other Standard Model particles, as they have mass, a finite shape in space and can travel through the universe with a constant velocity. Produced in the early universe, Q-balls are possible dark matter candidates. Additionally, their existence could yield an explanation for the observed baryon asymmetry.

Q-balls can interact with ordinary matter, resulting in the decay of nucleons or the production of luminescence light. Light produced in those processes can be detected by various experiments, including the IceCube Neutrino Observatory.

In order to enable a first search for Q-balls with IceCube, signatures of Q-balls in the detector have been investigated by transfering theoretical models into simulations of event signatures. This has been done for different parameters, including zero and non-zero electric charge. An overview over the analysis, as well as the calculated detector sensitivity will be presented.

** Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik*

T 99.7 Fri 12:30 H-HS XIV

Search for low relativistic magnetic monopoles utilizing luminescence light with IceCube* — •Frederik Lauber for the IceCube-Collaboration — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal

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

Due to the predominant usage of Cherenkov light as a detection mechanism and the usage of detection media with a high Cherenkov threshold, in recent years magnetic monopole searches were only conducted in the mild and high relativistic regime ($0.5\,c - 1\,c$) or at non relativistic velocities ($< 0.1\,c$). This work connects these two regimes by utilizing luminescence light in ice to cover the low relativistic range ($0.1\,c - 0.5\,c$). Luminescence becomes the dominant light production mechanism in the low relativistic regime. While the light yield for low charged particles is neglectable in most contexts, highly ionizing particles such as magnetic monopoles have a much higher light yield due to the quadratic nature of the charge dependency of luminescence to the incident particle.

New results on the search for magnetic monopoles in the low relativistic regime utilizing multiple years of IceCube data are presented.

* *Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik*

T 99.8 Fri 12:45 H-HS XIV

Constraining minimal Dark Matter models with data from the IceCube Neutrino Observatory — •Raffaela Busse[1], Sybrand Zeinstra[2], and Michael Klasen[2] — [1]Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster — [2]Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, Münster

Dark matter is one of the biggest puzzles of modern physics. Since SUSY and other prominent theories remain unconfirmed to this day, alternative models start to shift more into focus, for example so-called minimal dark matter models which extend the Standard Model only by very few new particles. The WIMP dark matter predicted by these models accumulates in the cores of celestial bodies like the Sun, where it annihilates and generates a neutrino flux that might be measurable by means of neutrino telescopes. The IceCube detector with its large instrumented volume and the densely instrumented DeepCore region is well suited to search for neutrinos from the annihilation of dark matter in the GeV to TeV mass range. In this talk, the current status of neutrino flux calculations from minimal models is presented, and an outlook on the analysis of IceCube data is given.