T 3: Search for new particles 2

Time: Monday 16:00–18:00 Location: Geb. 20.30: 2.058

T 3.1 Mon 16:00 Geb. 20.30: 2.058

Feebly Interacting Particles in Numerous Instances Simulated and Tabulated — •Jonathan Schubert[1,2], Babette Döbrich[2], Jan Jerhot[2], and Tommaso Spadaro[3] — [1]Technical University of Munich; TUM School of Natural Sciences, Department of Physics, Garching, Germany — [2]Max Planck Institut for physics, Garching, Germany — [3]Istituto Nazionale di Fisica Nucleare; Laboratori Nazionali di Frascati, Frascati, Italy

Feebly interacting particles are a commonly considered extension to the Standard Model of Particle Physics. In many theoretical frameworks these particles can explain observed physical phenomena which are at tension with the current model. Beam dump facilities are a natural experimental setup for direct searches of Feebly Interacting Particles. The high intensities and low expected backgrounds provide great parameter reach for searches of decays back into standard model particles. ALPINIST is a simplified Montecarlo framework aimed at evaluating past and future experiments for their sensitivities to different models of Axion Like Particles. We present the extension of this framework to accommodate new classes of Feebly Interacting Particles with emphasis on Heavy Neutral Leptons. This extension is especially well motivated, solving multiple of the standing issues with the Standard Model at the same time. The fundamental importance of inputs on the resulting parameter sensitivity, and thus the need for a unified simulation setup, is highlighted.

T 3.2 Mon 16:15 Geb. 20.30: 2.058

Search for the $K^+ \to \pi^+\pi^0 A$ decay — •Marco Ceoletta — Johannes Gutenberg University Mainz

This search aims to provide a new state-of-the art estimation for the branching ratio (BR) of the ultra-rare $K^+ \to \pi^+\pi^0 A$ decay, where A is Feebly-Interacting Particle (FIP) like an Axion-like particle, at the NA62 experiment (CERN). Obtaining a stringent upper limit on BR($K^+ \to \pi^+\pi^0 A$) is important for the verification of BSM theories; in particular the BR is sensitive to axial-vector coupling of hypothetical pseudoscalar particles to quarks. A search on $K^+ \to \pi^+\pi^0 A$ will therefore complement the extensive work already performed on the associated two-body decay $K^+ \to \pi^+ A$, that is sensitive only to the polar-vector coupling current. A preliminary estimation of the BR, as part of a feasibility study done in 2022, already outperformed the best previous limit by two orders of magnitude using less than 20% of the available data. The NA62 search is based on a Monte Carlo event generator exploiting a full differential rate model of the channel. The processing relies on the tried and tested NA62 analysis framework.

T 3.3 Mon 16:30 Geb. 20.30: 2.058

BDF/SHiP @CERN: Search for Hidden Particles at a Future Beam Dump Facility — •Annika Hollnagel for the SHiP-Collaboration — JGU Mainz (DE)

In conjunction with the CERN North Area Consolidation, an upgrade of the existing ECN3 experimental hall will enable a diverse physics program at the CERN SPS, complementing research at the energy frontier. At a dedicated Beam Dump Facility (BDF), the Search for Hidden Particles (SHiP) experiment has been proposed to exploit the full potential of the 400 GeV proton beam, covering a wide range of the Hidden Sector while also offering a rich neutrino physics program.

In line with the European Strategy for Particle Physics, BDF/SHiP has been identified as a frontrunner proposal by the CERN Physics Beyond Colliders (PBC) initiative. With the final CERN Research Board decision being imminent, this is the ideal time for new groups to join the project.

This talk will give an overview of the detector technologies and physics capabilities of the proposed experiment.

T 3.4 Mon 16:45 Geb. 20.30: 2.058

Searches for BSM physics at a gamma-gamma collider with Energy $<$ 12 GeV based on European XFEL — •Marten Berger[1], Gudrid Moortgat-Pick[1,2], and Monika Alexandra Wüst[1] — [1]Universität Hamburg, Hamburg, Germany — [2]DESY, Hamburg, Germany

The possibility of a GammaGamma collider extension to the Beam dump of the 17.5 GeV European XFEL has been discussed before as a first high energy collider of its sort. It would not just be to study the concept of a gamma-gamma collider but this collider would also be without competition in the region of $5-12$ GeV for gamma-gamma collision. In this range $b\bar{b}$ and $c\bar{c}$ resonances, tetraquarks as well as mesonic molecules can be observed. Furthermore some BSM processes can also be reached in this range. In this talk we want to discuss the possibility of observing ALPs at this collider as well as an extension to a mixed model of ALPs and dark photon (dark axion portal), that introduces the new couplings not as a product of the individual couplings and therefore offers a rich phenomenology.

T 3.5 Mon 17:00 Geb. 20.30: 2.058

Signatures of strongly interacting dark sectors — •Nicoline Hemme and Felix Kahlhoefer — Institute for Theoretical Particle Physics (TTP), Karlsruhe Institute of Technology (KIT), Germany

The nature of dark matter continues to be one of the biggest unanswered questions in physics, and many years of null results from experiments looking for the postulated weakly interacting massive particle (WIMP) has sparked interest in other dark matter theories with new and unexplored signatures. One such example is the strongly interacting massive particle (SIMP), which is a composite dark matter particle made up of quark-like dark particles that interact via gluon-like mediators. In analogy to the Standard Model (SM), the dark pseudo-scalar meson, π_D, is the lightest composite particle. It can be stabilised in the theory, thereby making it the dark matter candidate. The dark vector meson, ρ_D, can mix with SM particles, and if the mass of the ρ_D does not exceed twice the mass of the π_D, as is favored by cosmological and astrophysical arguments, the ρ_D will decay into SM final states. The decays can lead to novel signatures in particle colliders such as the LHC and future beam-dump experiments. In this talk, I will present the model along with the arguments for the light ρ_D case and discuss some of these exciting signatures such as semi-visible jets and displaced vertices.

T 3.6 Mon 17:15 Geb. 20.30: 2.058

Search for Inelastic Dark Matter with a Dark Higgs at Belle II — •Patrick Ecker, Giacomo De Pietro, Jonas Eppelt, Torben Ferber, and Pablo Goldenzweig — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

Belle II has a unique reach for a broad class of models that postulate the existence of Dark Matter particles in the MeV-GeV mass range. One highly motivated scenario is a model which involves inelastic Dark Matter, consisting of two Dark Matter states with a mass splitting between them, and the presence of a Dark Higgs boson. This model has a signature of up to two displaced vertices, one from the resonant decay of the Dark Higgs and another non-resonant one emerging from the decay of the involved Dark Matter particles. This talk will demonstrate the reach of the search for such signatures, which is not only challenging due to the presence of displaced vertices but also because of the seven-dimensional parameter space of the model.

T 3.7 Mon 17:30 Geb. 20.30: 2.058

Exploring dark sector physics at a high energy photon-photon collider — •Monika Wüst, Marten Berger, and Gudrid Moortgat-Pick — Universität Hamburg, Hamburg, Germany

We study the prospects of a future high energy gamma-gamma collider to probe dark sector models. The existence of a dark sector can be explored through different portal interactions, known portals include couplings of SM particles to dark photon, dark Higgs and Axion-Like-Particles (ALPs). We consider combined scenarios such as the Dark-Axion-Portal, where both the dark photon (γ') and ALP coexist in the hidden sector, given rise to a rich phenemology.

Probing these models with a gamma-gamma collider via processes such as photon fusion to ALPs is investigated, where the high energy photons can be generated using backward Compton scattering of laser photons off high-energy electron beams.

T 3.8 Mon 17:45 Geb. 20.30: 2.058

Renormalization of the Dark Abelian Sector Model — Stefan Dittmaier[1], •Jonas Rehberg[1], and Heidi Rzehak[2] — [1]Albert-Ludwigs-Universität Freiburg, Physikalisches Institut, Hermann-Herder-Straße 3, D-79104 Freiburg, Germany — [2]Institute for Theoretical Physics, University of Tübingen, Auf der Morgenstelle 14, 72076

Tübingen, Germany

The Dark Abelian Sector Model (DASM) extends the SM by a rather generic dark sector with an additional $U(1)_{\mathrm{d}}$ gauge symmetry. In detail, this dark sector contains a complex Higgs field and a Dirac fermion, which only carry the charge of the additional $U(1)_{\mathrm{d}}$, as well as right-handed neutrinos. Using the only two feasible SM operators—the SM Higgs mass operator and the field-strength tensor of the $U(1)_{\mathrm{Y}}$ of electroweak hypercharge—and the right-handed neutrino fields, allows us to open three portals of the SM, which is a singlet with respect to the $U(1)_{\mathrm{d}}$, to the dark sector of the DASM.

After a brief introduction of the model, we present the renormalization of the DASM at NLO with a special emphasis on the mixing angles of the model. Finally, we conclude by presenting the W-boson mass prediction derived from muon decay in the DASM at NLO as a first step towards confronting the model with experimental data.