T 15: Search for new particles I

Time: Monday 16:30–18:00 Location: H-HS XVI

T 15.1 Mon 16:30 H-HS XVI

Search for new physics at BESIII — •Riccardo Aliberti — Insitut für Kernphysik, Johannes Gutenberg-Universität, Mainz

The Standard Model of particle physics (SM) is a very successful theory providing an elegant, precise, and consistent mathematical description of the nature at the elementary particles level. However, the experimental observations of neutrinos oscillations, dark matter and dark energy as well as the tension between measurement and prediction of the anomalous magnetic momentum of the muon, pointed out that the SM is incomplete and new physics processes are still waiting to be uncovered.
The BESIII experiment, located on the Beijing Electron–Positron Collider (BEPCII), provides an ideal environment for the search of particles beyond the standard model in the MeV to few GeV mass region. The search for new particles is carried out for production channels directly associated to e^+e^- collisions as well as for those involving particle decays (J/Ψ, ω, Φ, ...). In this talk, the latest results and prospects for the search of dark photon and Z' in visible and invisible final state at BESIII will be presented.

T 15.2 Mon 16:45 H-HS XVI

Searching for Dark Sector Particles in Muon Pair Production at BESIII — •Daniela Becker, Achim Denig, and Christoph Florian Redmer for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Germany

Discrepancies between the Standard Model prediction and the results of precision measurements, such as the Muon (g-2)-anomaly, may hint at the limits of the otherwise successful theory. Models proposed to compensate the observed discrepancies suggest a so-called Dark Sector of new fundamental particles and interactions with a suppressed coupling to the Standard Model.

The BESIII experiment at the BEPCII electron-positron collider in Beijing, China, has collected large samples within the τ-charm region, providing excellent requirements for the study of muonic final states. The talk will report on such a study on the search for the massive Dark Photon (Z'), postulated to couple to the heavy Standard Model leptons and thus might be identified as a narrow resonance in the invariant mass spectrum of muon pairs. — Supported by DFG SFB1044.

T 15.3 Mon 17:00 H-HS XVI

Searches for long-lived particles produced in Higgs decays with b-quark like signature — •Melanie Eich, Lisa Benato, Gregor Kasieczka, Karla Pena, and Jörg Schindler — Institut für Experimentalphysik, Universität Hamburg

Beyond Standard Model (BSM) theories including neutral, long-lived particles (LLP) can solve the hierarchy problem. In these theories, a mirror version of all or some SM gauge group exists alongside additional fermions. The particles of SM and mirror group are connected via a discrete symmetry. In our analysis the Higgs boson is assumed to be the mediator between the two groups, because it mixes with its mirror partner. It is expected that the Higgs boson decays into a pair of long- lived scalars π_ν.

We show results for the case that each π_ν decays into two b-quarks, while the lifetime of the π_ν is in the order of a few millimetres. Such a lifetime results in a displaced vertex (DV), mimicking a b-quark like signature. The search for such π_ν requires new analysis techniques to distinguish between decay products coming from DV and background events. We present a comparison of different reconstruction techniques including machine learning methods and show the achievable sensitivity to twin Higgs production as a function of the mass and lifetime of the π_ν. In this talk an overview of the analysis and its current status and results will be presented, using data recorded with the CMS detector in Run2.

T 15.4 Mon 17:15 H-HS XVI

Observation of an excess at 30 GeV in the opposite sign di-muon spectra of $Z \to b\bar{b} + X$ events recorded by the ALEPH experiment at LEP — •Arno Heister — privat

The re-analysis of the archived data recorded at the Z^0 resonance by the ALEPH experiment at LEP during the years 1992-1995 shows an excess in the opposite sign di-muon mass spectra at 30.40 ± 0.46 GeV in events containing b quarks. The excess has a natural width of 1.78 ± 1.14 GeV.

The di-muon excess has a local significance around $5\,\sigma$ (Z_{asym}), depending on the background model used. The significances for background models based on a kernel density approximation stay close to $3\,\sigma$ ($Z_{\mathrm{freq,\,lee}}$), when including a look elsewhere effect. Another method to obtain a significance value results in at least $2.6\,\sigma$ (Z_{Bi}). A compatible, but smaller excess is visible in the opposite di-electron mass spectrum as well.

Several experiments have data samples that include the di-lepton mass region discussed here. The excess described in the paper arXiv:1610.06536 may be present in data of other experiments at LEP, the Tevatron and the LHC. Former members of the L3 collaboration as well as the ATLAS and CMS collaborations have published the result of their searches for this excess. The L3 data and the CMS data shows a noteworthy excess. The ATLAS experiment did not find anything in its data, yet.

T 15.5 Mon 17:30 H-HS XVI

Results of the muon flux and spectrum measurement from a target replica for the SHiP experiment — •Stefan Bieschke, Daniel Bick, Caren Hagner, and Walter Schmidt-Parzefall — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

SHiP is a proposed, general purpose beam dump experiment using CERN's SPS 400 GeV proton beam dedicated to the Search for Hidden Particles. A high intensity proton beam which is stopped in a massive target produces a large number of particles, possibly including particles from the dark sector, which have evaded detection so far. Among these, a huge amount of muons is produced. For SHiP, a low background environment is necessary and muons will be diverted utilizing an active magnetic shield. For the optimization of this shield, knowledge about the muon flux and spectrum 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 at the H4 beam line. During the three week experiment $\mathcal{O}(5 \times 10^{11})$ p.o.t were collected. The results of the analysis will be presented.

T 15.6 Mon 17:45 H-HS XVI

Search for long lived particles produced in Higgs decays with lifetimes up to the muon system — •Jörg Schindler, Lisa Benato, Melanie Eich, Gregor Kasieczka, and Karla Peña — Institut für Experimentalphysik, Universität Hamburg

Traditionally, searches for new physics at the LHC focused on already established objects, like photons, leptons, jets or missing energy. A different approach is to look for signatures in the detector which up until now were not considered. One such signatures are long lived particles, which have a macroscopic lifetime ranging from a few micrometers up to several kilometers. Such particles are for example predicted by twin Higgs models, where a dark sector mirroring the SM particles is introduced. The Higgs boson mixes with its dark partner, acting as a mediator between the SM and dark sector and therefore can decay into non-SM particles. These non-SM particles are the long-lived neutral scalars π_ν, which later decay back into SM particles, predominantly b quarks.

In this talk the search for long lived particles which decay after the tracker is presented. These signatures can be observed with close to no background, but require the development of new reconstruction and analysis tools.

The status of the current search for LLPs with long lifetimes is shown, using data collected by the CMS detector in run 2.