T 58: QCD (Exp.) 2

Time: Wednesday 16:15–18:00 Location: T-H17

T 58.1 Wed 16:15 T-H17

Measurements of the total charm and beauty cross sections with the CMS detector — •Josry Metwally, Achim Geiser, Nur Zulaiha Jomhari, and Yewon Yang — DESY, Hamburg, Germany

The aim of this project is the determination of the total cross section for inclusive charm and beauty production at the LHC with different center-of-mass energies down to very low transverse momentum, and the comparison with QCD predictions in next-to-next-leading order of perturbation theory. The measurement of the cross sections for the production of heavy quarks at the LHC is one important test of QCD, and can, as has already happened in the case of top quark production, be used for a measurement of the quark masses.

Other experiments as ATLAS and ALICE covered only small fractions of the available phase space while the LHCb experiment fully covered the forward region, $2.0 < y < 4.5$. For this project, we measure cross sections in the full phase space complementary to LHCb of prompt D mesons, and D mesons from b hadron decays through the decays $B \to D^*X \to D^0\pi_s X \to K\pi\pi_s X$ and $B \to D^0 X \to K\pi X$. One of the challenges is the separation of prompt D mesons and D mesons from b hadron decays near the production threshold. In this talk, the details of this separation and resulting cross sections including a comparison with theory are presented in the accessible phase space of CMS for different center-of-mass energies and, where it can be performed, a comparison with other experiments is shown.

T 58.2 Wed 16:30 T-H17

Low mass Drell-Yan measurement in p-p collision at $\sqrt{s}$ = 13 TeV using the ATLAS detector at the LHC — •Alessandro Guida — DESY (Hamburg)

High energy physics experiments are performed at the Large Hadron Collider at CERN colliding bunches of protons at energies up to 13 TeV. The ATLAS experiment, with its multipurpose detector, studies the products of these collisions and compares the experimental measurements with the predictions of the Standard Model. This talk presents the study of the process $Z/\gamma^* \to \mu\mu$ at low invariant mass of the di-muon pair, in the region between 7 GeV and 60 GeV, below the the Z boson resonance mass peak (m_Z = 91.2 GeV). The single and double differential cross sections $d\sigma/dm_{\mu\mu}$, $d^2\sigma/dm_{\mu\mu}\, d|y_{\mu\mu}|$ and $d^2\sigma/dm_{\mu\mu}\, dp_T^{Z/\gamma^*}$ of the process are measured in 13 TeV proton-proton collisions at the LHC, using the ATLAS detector. The measurement explores an extreme region of the phase space and is sensitive to resummation results in the theoretical prediction. The analysis exploits the good resolution of the ATLAS detector in reconstructing low momentum muons. The main difficulties come instead from the high background component that enters in the event selection, the triggering of events and the modelling of some key physical quantities.

The main features of the analysis, the studies done to overcome the main challenges, as well as the first results and comparison to theory predictions are presented in the talk.

T 58.3 Wed 16:45 T-H17

Studies on Monte Carlo tuning using Bayesian Analysis — •Salvatore La Cagnina[1], Andrii Verbytski[2], Johannes Erdmann[1], Kevin Kröninger[1], and Stefan Kluth[2] — [1]TU Dortmund, Fakultät Physik — [2]Max-Plank-Institut für Physik, München

Monte Carlo (MC) simulations are an essential aspect of data analysis at the LHC. One aspect of MC event generation involves hadronisation and parton shower models. Since these models are based on approximations, they introduce a number of parameters. These parameters cannot be inferred from first principles. Therefore, their values have to be optimized using numerical tools and experimental data (MC tuning). Generally, MC tuning is performed by choosing observables that are sensitive to the parameters. Afterwards, a fit of the parameters to data using a simplified MC response function derived from fits to MC events is performed. Though state-of-the-art methods for MC tuning exist, uncertainties are usually treated as uncorrelated. In this talk, MC tuning using a Bayesian approach will be discussed. The EFTfitter tool is used for fitting, which enables the implementation of correlations for different sources of uncertainties. First results using this method on a MC tune with LEP data will be presented.

T 58.4 Wed 17:00 T-H17

LHCb for astroparticle physics: Prompt production of charged particles — Johannes Albrecht[1], •Julian Boelhauve[1], Hans Dembinski[1], and Michael Schmelling[2] — [1]TU Dortmund University, Dortmund, Germany — [2]Max Planck Institute for Nuclear Physics, Heidelberg, Germany

A long-standing issue in the field of cosmic-ray research is the discrepancy in the number of muons produced in high-energy air showers between observations and simulation, which is referred to as the Muon Puzzle. Precision measurements of hadron production in the forward region are required in order to validate and improve the hadronic-interaction models used in the simulation of air showers, aiming at solving the Muon Puzzle. For this, measuring the differential cross-section of prompt production of long-lived charged particles as a function of transverse momentum and pseudorapidity is of great importance.

An analysis in which this differential cross-section has recently been determined in proton-proton collisions recorded with the LHCb experiment at a centre-of-mass energy of 13 TeV is presented in this talk. Moreover, extensions of the analysis towards a measurement of prompt production of identified hadrons are described.

T 58.5 Wed 17:15 T-H17

Potential of Common Data-Taking of the ATLAS, AFP, ZDC and LHCf Detectors in Run 3 of the LHC — •Yusuf Can Çekmecelioğlu, Clara Elisabeth Leitgeb, and Çiğdem Işsever — DESY, Zeuthen, Germany

Studies of air showers induced by highly energetic cosmic particles depend heavily on models for the soft hadronic interactions. Perturbative QCD cannot be applied to these interactions due to the low momentum exchange between particles. Instead, phenomenological models that take inputs from the (ultra-)forward regions of collider experiments are used to better understand these processes. The LHC with a collision energy of $\sqrt{s} = 13.6$ TeV in run 3 can generate such events and provide data to reduce the large uncertainties for hadronic models.

This talk will target the potential of a common data-taking of several forward detectors (so far used independently) that are located at both sides of the ATLAS detector, namely: The ATLAS Forward Proton detector (AFP), the ATLAS Zero Degree Calorimeters (ZDC), and the LHC forward (LHCf) calorimeters. The analysis focuses on the determination and optimisation of the common acceptance between detectors for simulated single diffractive (SD) events at (preliminary) run 3 beam conditions. SD events allow AFP to tag the intact proton and the LHCf and ZDC calorimeters to detect the neutral particles from the dissociated proton. Together with pseudorapidity gap measurements in the central region provided by the ATLAS detector, a joint data-taking between these detectors could improve the identification and kinematic reconstruction of such events.

T 58.6 Wed 17:30 T-H17

Study of the $X(3915)$ at Belle — •Yaroslav Kulii[1], Thomas Kuhr[1], and Boris Grube[2] — [1]Ludwig-Maximilians-Universität München — [2]Technische Universität München

Charmonium states consist of a charm and anti-charm quark. Detailed theoretical predictions of the charmonium excitation spectrum agree well with the experimental data.

However, in recent years experiments discovered a growing number of charmonium-like states that do not fit into the predicted charm-anticharm excitation spectrum. One such state is the $X(3915)$. It has been discovered by the BaBaR and Belle collaborations in the reaction $e^+e^- \to e^+e^-X(3915) \to e^+e^-J/\psi\omega$, where the final-state electron and positron are not detected. The analysis of projections of the decay angular distribution preferred the $J^{PC} = 0^{++}$ hypothesis, but other quantum numbers, in particular $J^{PC} = 2^{++}$, could not be excluded.

Because of this the $X(3915)$ was initially identified as the $\chi_{c0}(2P)$ charmonium state, although its mass and decay width were not in good agreement with the theory predictions. Following the Belle discovery of the $X^*(3860)$, which agrees much better with the $\chi_{c0}(2P)$ hypothesis, opinions shifted towards interpreting the $X(3915)$ as an exotic state. It could be, for example, a meson molecule or a so-called hybrid meson.

We will present the current state of measuring of the spin and parity of the $X(3915)$ at Belle and discuss the prospects of studying the

$X(3915)$ using the Belle II data.

T 58.7 Wed 17:45 T-H17

Partial wave analysis of the $\tau \to 3\pi\nu_\tau$ decay at Belle — •Andrei Rabusov, Daniel Greenwald, and Stephan Paul — TUM, Munich, Germany

The COMPASS collaboration observed a potential new particle, the $a_1(1420)$, that doesn't fit the quark model. An independent study of the existence of this particle, as well as the studies of the light axial and pseudoscalar resonances, can be done in the tauon decay to three pions and a tau neutrino. The latest such study was published by the CLEO II collaboration in 1999 by analyzing 51000 data events. That study can be significantly improved at B-factories, which collected tens of millions events of this decay. We present data selection criteria, acceptance studies, and partial wave analysis of the $\tau \to 3\pi\nu_\tau$ decay with the Belle detector.