**Production of b–quarks and B–mesons in proton–proton scattering   
at the Large hadron collider**

**Народження b–кварків та B–мезонів в розсіянні протонів  
на Великому адронному колайдері**

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Production of b quarks in high energy pp collisions at the LHC provides a sensitive test of models based on quantum chromodynamics [1]. Searches for physics beyond the Standard Model (SM) often rely on the ability to accurately predict the production rates of b quarks that can form backgrounds in combination with other high energy processes [2]. In addition, knowledge of the b-quark yield is essential for calculating the sensitivity of experiments testing the SM by measuring CP-violating and rare decay processes [3].

Mechanisms of beauty quark anti-quark pair and B-meson production in proton scattering at the LHC energies are investigated in the report.

MadGraph5\_aMC@NLO [4] is used to generate programs for simulation of p + p → b + anti-b+ X, where X includes zero, one or two jets originating form gluon or u-, d-, c-, and s-quarks. These quarks are treated as massless, while b-quarks are massive. With obtained programs the parton processes are calculated at next-to-leading order (NLO) accuracy and at NLO and N2LO at the tree level.

The partonic events are showered with Pythia 8 [5] event generator within the approach that agrees with the method of parton-process calculations in MadGraph. Pythia 8 is also used to simulate multi-parton interactions and fragmentation of partons .

The calculations demonstrate that processes with real and virtual particle emission substantially compensate each other. As a result, the integral cross section at NLO accuracy decreases up to 10 times with respect to its value at LO. Contribution of NLO and N2LO processes at the tree level enlarge the cross section in ~11% and ~18%.

The differential cross sections as functions of transverse momentum and rapidity are calculated under the kinematic conditions of ALICE, ATLAS [6], CMS [7], and LHCb [8] experiments and compared with the available data.

**References:**

1. J. Alwall et al., The automated computation of tree-level and next-to-leading order differential cross sections, and their matching to parton shower simulations, JHEP 1407 (2014) 079, arXiv:1405.0301 [hep-ph].
2. M. Cacciari et al., Theoretical predictions for charm and bottom production at the LHC, JHEP 10 (2012) 137, arXiv:1205.6344; B. A. Kniehl, G. Kramer, I. Schienbein, and H. Spiesberger, Inclusive B-meson production at the LHC in the GM-VFN scheme, Phys. Rev. D84 (2011) 094026, arXiv:1109.2472.
3. E. Halkiadakis, G. Redlinger, and D. Shih, Status and implications of beyond-thestandard-model searches at the LHC, Ann. Rev. Nucl. Part. Sci. 64 (2014) 319, arXiv:1411.1427.
4. LHCb collaboration, R. Aaij et al., Implications of LHCb measurements and future prospects, Eur. Phys. J. C73 (2013) 2373, arXiv:1208.3355.
5. T. Sjstrand et al., “An Introduction to PYTHIA 8.2”, Comput. Phys. Commun. 191 (2015) 159–177, doi:10.1016/j.cpc.2015.01.024, arXiv:1410.3012.
6. ATLAS Collaboration, Expected Performance of the ATLAS Experiment, Detector, Trigger and Physics, CERN-OPEN-2008-020, Geneva, 2008, e-print: arXiv:0901.0512.
7. CMS Collaboration, “Identification of b-quark jets with the CMS experiment”, (2013). arXiv:1211.4462. Submitted to JINST.
8. The LHCb Collaboration, R. Aaij et al., “Measurement of σ(pp → bbX) at √ s = 7TeV in the forward region”, Phys. Lett. B 694 (2010) 209, arXiv:1009.2731 [hep-ex].