



UNIVERSITÀ DEL PIEMONTE ORIENTALE

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Final Report on the activity of Dr. Bogdan Vasilishin
Scuola di Dottorato in Scienze Della Natura
Dottorato in Fisica ed Astrofisica, XXXI ciclo

Dottorando: Bogdan Vasilishin
Relatore: Prof. Daniele Panzieri
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Titolo della tesi:

Hadron structure study using polarised pion-induced Drell-Yan process at COMPASS

The goal of Bogdan Vasilishin's PhD is the study of the target spin (in)dependent azimuthal asymmetries (TSAs) appearing in the cross-section of Drell-Yan muon-pair production in pion collisions with transversely polarized nucleon at COMPASS experiment.

Spin dependent azimuthal phenomena play a crucial role in general understanding of the spin structure of the nucleon. They give access to the transverse momentum dependent (TMD) parton distribution functions (PDFs) describing the parton-longitudinal and -transverse momenta distributions and their correlations with nucleon and quark spins. Within the QCD parton model approach the TMD PDFs are expected to be generally universal (process-intendent). In case of two naively time-reversal odd TMD PDFs, i.e. the quark Sivers functions and Boer-Mulders functions, the theory predicts conditional universality: the PDFs are expected to have opposite sign when measured in semi-inclusive deep inelastic scattering (SIDIS) hadron production and in Drell-Yan process. The validation of universality of TMD PDFs is one of the fundamental challenges of modern physics being addressed by the COMPASS experiment performing both SIDIS and Drell-Yan measurements. Recently COMPASS has published the results of 2010 SIDIS measurements of transverse spin dependent asymmetries (TSAs) extracted at different hard scales and results of first ever measurements of TSAs in the Drell-Yan process performed in 2015. The average Sivers asymmetry in Drell-Yan was found to be above zero at about one standard deviation of the total uncertainty, which is consistent with the predicted change of sign for the Sivers function. In order to improve the precision of the measurement, in 2018 COMPASS performed the second year of Drell-Yan data-taking. Bogdan is working on the analysis of both 2015 and 2018 COMPASS Drell-Yan data samples.

During the initial stage of his PhD, Bogdan familiarized with the COMPASS spectrometer in general, as well as with detector system and trigger setup used specifically for Drel-Yan data taking. He also started to practice with COMPASS data analysis software (CORAL, PHAST) and learned how to access COMPASS data and use CERN batch system to run his programs. Later on, Bogdan focused on the study of asymmetry extraction methods and data-analysis techniques used in COMPASS. He worked on optimization of physics event-selection criteria, concentrating on the recently production of 2015 Drell-Yan sample.

Supported by INFN-Torino, this year Bogdan has spent two months at CERN working on the online-analysis of the 2018 Drell-Yan data collected by COMPASS. During this period he also



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took experimental shifts and served as on-call expert for COMPASS-Torino detectors (multi-wire-proportional-chamber and Rich-wall detector-stations).

Currently Bogdan is working on the filtering of 2018 COMPASS Drell-Yan data in the meantime preparing the asymmetry extraction framework. Later he will be focused on the data-stability studies and estimation of possible systematic effects. The analysis of the new COMPASS data is planned to be over by April 2019.

In his research activity, Bogdan Vasilishin has shown a good potential, with a clear attitude to work autonomously and to keep suggestion and hints after discussion with the colleagues. He is really skill in computation that has been precious in his work of simulations and data analysis.

His publication record is good, and is in line with other cases for experiments similar to the one he has been involved.

Considering all his activities in these three years, I think that he is absolutely ready for graduating and I propose that he is given the possibility of defending his thesis.

Torino, 26-11-2018

Daniele Panzieri