

## Jointly-supervised doctoral thesis

**Title:** Nucleon spin structure studies in Drell–Yan process at COMPASS

**Author:** Jan Matoušek

**Department I:** Department of Low Temperature Physics, Faculty of Mathematics and Physics, Charles University

**Department II:** Department of Physics, University of Trieste

**Supervisor I:** prof. Miroslav Finger (Department I)

**Supervisor II:** prof. Anna Martin (Department II)

### Abstract:

The nucleon structure is presently described by Transverse Momentum Dependent (TMD) Parton Distribution Functions (PDFs), which generalise the collinear PDFs, adding partonic spin and transverse momentum degrees of freedom. The recent HERMES and COMPASS data on hadron production in deep inelastic scattering (SIDIS) of leptons off transversely polarised nucleons have provided a decisive validation of this framework. Nevertheless, the TMD PDFs should be studied in complementary reactions, like pp hard scattering and Drell–Yan processes.

In particular the Sivers TMD PDF, which encodes the correlation between the nucleon transverse spin and quark transverse momentum and appears in the Sivers Transverse Spin Asymmetry (TSA), is expected to have opposite sign in Drell–Yan and SIDIS. In 2015 COMPASS measured for the first time the Drell–Yan process on a transversely polarised target  $\pi^- p^\uparrow \rightarrow \mu^- \mu^+ X$  to test this prediction and the results have been recently published. The main topic of my thesis is the first measurement of the TSAs weighted with the dimuon transverse momentum in this data. These asymmetries complement the conventional TSAs and their advantage is that they do not contain convolutions over intrinsic transverse momenta. My analysis work is described in detail and the results are compared with calculations based on the extraction of the Sivers function from the recently measured weighted Sivers asymmetry in SIDIS.

The thesis also contains a theoretical introduction and the description of the apparatus focused on the polarised target and its monitoring system to which I contributed. Finally, a chapter dedicated to the first original analysis in my PhD, the measurement of a Sivers-like asymmetry in the  $J/\psi$  production in SIDIS, which is related to the gluon Sivers function, is included as well.

### Keywords:

nucleon structure, parton distributions, Drell–Yan,  $J/\psi$ , SIDIS, COMPASS