Probing Nucleon Structure in Drell-Yan and J/ψ Production at COMPASS

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Overview
- COMPASS is a fixed target experiment at CERN studying particular Transverse Momentum Dependent (TMD) Parton Distribution Functions (PDFs) that describe the 3D partonic nucleon structure in momentum space
- TMD PDFs can be accessed experimentally via measurements of nucleon spin- (n) dependent asymmetries in hard-scattering reactions, e.g., Semi-Inclusive Deep Inelastic Scattering (SIDIS) and the Drell-Yan (DY) process
- One of the key measurements: Sivers asymmetry in SIDIS and DY to test the theoretically predicted sign change of the Sivers TMD PDFs
- Spin-dependent asymmetries in COMPASS J/ψ events may give information about the gluon Sivers function and the J/ψ production mechanisms
- Parallel computing resources used to reconstruct and analyze real and Monte-Carlo data on a large scale

Setup in 2015 & 2018
- Target has two cells with opposite polarizations, flipped periodically to minimize time-dependent acceptance variation effects
- Two-part spectrometer tracks and identifies outgoing particles
- Muon filters (MF) identify muons, the signature output of DY events
- Hadron absorber reduces spectrometer illumination without disturbing muons

COMPASS Experiment
- Located in the North Area of CERN
- Beam from the SPS via the M2 beam line
- SIDIS data with polarized muon beam and polarized 4LiD or NH3 target taken in 2002-2007 and 2010-2011
- DY data with π⁺ beam and transversely polarized NH3 target taken in 2015 and 2018

Data Production
- Digital information from spectrometer converted to physical quantities using COMPASS Reconstruction and Analysis Libraries (CORAL)
- Monte-Carlo (MC) simulations performed to study and predict spectrometer behaviors
- MC raw data processed with CORAL like real data

• COMPASS has utilized allocations on the Blue Waters supercomputer at NCSA and the Frontera supercomputer at TACC

BW allocation (2016-2019)
- ~14 million node hours, including large PRAC award
- 32 CPUs per node
- Nodes are 3x faster than BW

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