Contribution ID : **120** Type : **parallel talk**

Feasibility studies for nucleon structure measurements with $\bar{P}$ANDA

Monday, 2 June 2014 17:30 (0:20)

Collaboration

PANDA

Abstract content

The $\bar{P}$ANDA detector is a multi-purpose experiment to be installed at the Facility for Antiproton and Ion Research (FAIR). It is currently under active development and will exploit the possibilities offered by the antiproton beam of 1.5 to 15 GeV/c that will be available at the High Energy Storage Ring (HESR) of FAIR. One of the many physics goals of $\bar{P}$ANDA is to explore the structure of nucleons by measuring, among other observables, the time-like electric $G_E\left(q^2\right)$ and magnetic $G_M\left(q^2\right)$ form factors of protons in $\bar{p}p \rightarrow\ e^+e^-$ reactions and the π-nucleon Transition Distribution Amplitudes (TDAs) in $\bar{p}p \rightarrow\ \pi^0 J/\psi,\ J/\psi \rightarrow\ e^+e^-$ reactions. The interpretation of the TDAs in terms of the pionic content of the nucleon wave functions will be discussed. The low cross section of these processes combined with much higher background cross section from multi-pion events impose an excellent electron identification with the ability to reject charged pions by up to a factor of 10^4 as a major design requirement for $\bar{P}$ANDA. Simulation studies in the PANDAROOT framework to explore the level of rejection that is achievable on the $\pi^0\pi^+\pi^-$ as a background to the $\pi^0 J/\psi$ channel, will be presented. Since the main electron identification technique in the relevant momentum range is energy-momentum matching, not only does this imply the need for high acceptance high resolution calorimetery, but also the highest possible precision of momentum reconstruction. A special algorithm for the momentum reconstruction reducing the degrading effect of Bremsstrahlung in the detector material will be presented. In addition the simulations used to study the feasibility of these reactions need to be accurate to within the tolerance allowed for pion rejection. A systematic check of GEANT hadronic physics models to investigate the sensitivity of the background rejection studies to the choice of models will also be covered.

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Session Classification : Parallel Session B4