SEA-NHP 2025

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Contribution ID: **34**   Type: **not specified**

Constraining the proton transverse partonic distribution through coherent J/ψ production at HERA within a three-hotspot model

Tuesday 19 August 2025 14:20 (15 minutes)

We have investigated the transverse parton distribution of the proton through the momentum-transfer squared (t) distribution data of the differential cross section for coherent J/ψ production at HERA. Based on a Gaussian–hotspot model motivated by a three valence quark picture of a proton, we introduce three independent geometric degrees of freedom: (1) the overall impact–parameter size of each hotspot, (2) the radial displacement of constituent quarks from the proton center, and (3) an azimuthal rotation applied to the quark configuration. In our simplest implementation, the three quarks are arranged at equal radial distance. By fitting to HERA data, we demonstrate that variations in quark displacement strongly affect the $|t|$ slope, while the rotational degree of freedom affects only at high momentum transfer ($|t| > 0.6 \text{ GeV}^2$).

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Session Classification: Young researcher session