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Meson Structure Study via Drell-Yan Production at AMBER Experiment

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Understanding meson structure through parton distribution functions (PDFs) remains a fundamental challenge in QCD. Existing pion PDF measurements rely on sparse, decades-old data from heavy nuclear targets, while kaon structure is constrained by only a few hundred events. Valence quark distributions have minimal experimental guidance, and sea quark and gluon content remain essentially unmeasured.

The AMBER experiment at CERN will address these limitations through high-statistics Drell-Yan measurements using 190 GeV hadron beams on light targets. The Drell-Yan program, approved as part of AMBER Phase-I (2023-2031), will conduct production running starting in 2029 following Long Shutdown 3, with approximately 280 days of data collection planned over two years.

Drell-Yan dimuon production directly probes quark distributions, while J/psi and psi' charmonium production provides complementary access to gluon PDFs. J/psi polarization measurements further constrain production mechanisms by distinguishing quark-antiquark annihilation from gluon fusion processes. The natural kaon component in the hadron beam enables simultaneous kaon structure measurements that will exceed existing datasets by an order of magnitude. AMBER will deliver the world's largest pion-induced Drell-Yan and charmonium sample within this decade, providing essential constraints for global PDF analyses and establishing benchmarks complementary to future Electron-Ion Collider measurements.

Collaboration

AMBER

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