

Executive Summary

Future Possibilities on Colour Transparency

Jenson Easo

A facility with several uses, including nuclear and particle physics, is the Japan Proton Accelerator Research Complex (J-PARC). Numerous experiments are conceivable using secondary beams of kaons, pions, neutrinos, muons, and other particles in addition to the primary proton beam. The J-PARC hadron physics has thus far concentrated strangely on low-energy hadron and nuclear physics. By examining the novel taste of degrees of freedom, and strangeness, this effort is exceptional in advancing our understanding of conventional nuclear physics.

The hadron-hall extension is already being thought about, and enchanted hadron physics will also be a fascinating subject at J-PARC. A hadron is anticipated to move easily in the nuclear medium during a significant momentum transfer due to colour transparency. The transparency grew with the beam momentum as predicted in an experimental finding from the BNL-AVA Collaboration in 2004, but it then began to decline at about 10 GeV. This new revelation increases the value of a potential J-PARC experiment for identifying the mechanism. The unique BNL-AVA result plus the fact that the high-momentum beamline at J-PARC is currently operational make this study topical considering recent experimental advancements at JLab. On the other hand, hadron accelerator facilities allow for the same methods to be used to explore GPDs.

For a better understanding of the dynamical characteristics of QCD and its application to high-energy hadron processes, consider hadron interactions in the nuclear medium. A hadron's energy scale at which it forms in a point-like structure and its subsequent evolution through the medium are both factors in colour transparency.

On the other hand, the expansion of the wave packet, which is determined by the coherence length, which is proportional to the proton momentum in the final state, is controlled by the proton momentum. The most powerful proton accelerator facility above the multi-GeV zone is the Japan Proton Accelerator Research Complex (J-PARC). It is possible to conduct novel tests on colour transparency and the generalized Parton distributions using high-momentum beams (GPDs). It should be the primary experiment to explain the puzzling BNL-AVA result on colour transparency.

The smaller- x kinematical region and the time like photon rather than the spacelike photon make the J-PARC GPD experiment on the unique Drell-Yan processes a complementing effort to the JLab research. The discussion of a different potential GPD project at J-PARC on the reaction $pppB$ to investigate the Efremov-Radyushkin-Brodsky-Lepage (ERBL) region of the GPDs also takes place. The GPD research will also shed light on the origins of hadron spins, masses, and internal pressures.



Journal Reference

Kumano, S. J-PARC Hadron Physics and Future Possibilities on Color Transparency. [Physics 2022](#), 4, 565–577.

KEYWORDS

QCD, quark; gluon; color transparency; high-energy hadron reactions; J-PARC

