RJPHY Research Journal of Physics

OPEN ACCESS

News & Comments

Colour Transparency in pA reaction

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A significant portion of the physics program for the upcoming PANDA (anti-Proton Annihilations at Darmstadt) experiment is dedicated to the investigation of antiproton-nucleus reactions at beam velocities of 1.5–15 GeV/c, where c is the speed of light. One can investigate the effects of a nuclear medium on the properties of the antiproton and produced particles, such as antibaryon potentials, new decay channels due to the in-medium thresholds, at low beam momenta or by requiring that the particle of interest slows down in the collision with a nucleon. The interactions of fast hadrons formed in hard processes caused by the antiproton with the nuclear medium, on the other hand, can be studied at high beam momenta.

As a result, it is possible to access nuclei's short-range nucleon-nucleon correlations (NN) and colour transparency (CT). Mesons are typically easier to "squeeze" into point-like configurations (PLC) than baryons; therefore two-meson annihilation presents an excellent opportunity to search for the signals of CT. In contrast to the one-body final state, the beam momentum is not constrained by the mass shell and can be set to be sufficiently high (10-20 GeV/c), allowing the coherence lengths of the produced pions and the incoming antiproton to be comparable to the size of the nucleus.

Although the effects of the nuclear structure, such as neutron skin, should be taken into consideration because the antiproton is strongly absorbed in the nuclear surface region, it is expected that the CT effects in the processes A(p, meson+meson) will be stronger for targets heavier than the deuteron.

The quasi-elastic scattering A (p^-, p^-p)is another intriguing mechanism. Only the (plural) gluon exchange or q annihilation is feasible in the elementary process $p^-p \to p^-p$; quark interchange is not possible. In contrast pp→ppsqueezing to PLC may not be present in this case.

Finally, photon transparency is anticipated in photo-induced reactions A(meson+baryon). In the basic N meson+baryon process, this is the regime of the unresolved (direct) photon that should occur at large |t| and |u|. The asymptotic scaling law reported by the CLAS Collaboration for a significant number of light-meson photoproduction events off the nucleon supports this expectation.

JOURNAL REFERENCE

Larionov AB. Color Transparency in p^-A Reactions. Physics. 2022; 4(1):294-300.

KEYWORDS

Colour transparency,PANDA experiment, antiproton–deuteron interactions,two-pion production