

XXV International Baldin Seminar on High Energy Physics Problems "Relativistic Nuclear Physics and Quantum Chromodynamics"



XXV International Baldin Seminar
on High Energy Physics Problems
Relativistic Nuclear Physics & Quantum Chromodynamics

September 18 - 23, 2023, Dubna, Russia

Contribution ID: 105

Type: not specified

The possibilities of search for the local strong P-symmetry breaking in decay of charged a_0 meson in $3\pi^\pm$ decay channel

Thursday, 21 September 2023 09:00 (20 minutes)

Currently, there is no experimental evidences of the violation of the spatial parity (P) conservation in strong interactions. However, in the QCD theory, the P-breaking term (so-called θ -term) can be included, with tight limits on the θ parameter value. However, in the medium with high temperature and at large topological fluctuations [1] of QCD fields, expected in collisions of the heavy ions at high energy, the effects of the local violation of P-symmetry can appear. The contribution to the QCD Lagrangian of the topological charge can play role of an effective θ -term [2]. As a consequence, some hadrons would decay in channels that forbidden by the global parity conservation.

In particular, search for decays of a charged a_0 meson into charged pion and photon has been proposed [3] as a signature of the local parity breaking in the strong interactions. However the expected electromagnetic cross section of the decay $a_0^\pm \rightarrow \pi^\pm + \gamma$ is rather low making the experimental searches quite challenger [4]. In this work we investigate the hadronic analogue of such process, namely, decay of a charged a_0 meson into three charged pions. Both the direct threeparticle decay and a resonance one, with intermediate ρ^0 meson ($a_0^\pm \rightarrow \rho^0 + \pi^\pm \rightarrow \pi^\pm + \pi^\mp + \pi^\pm$) are considered. We study an invariant-mass spectrum of three charged mesons using PYTHIA Monte Carlo generator with enabled required decay channels. To distinguish the peak of mentioned decay from the background the mixed-event subtracting, kinematic cuts and Dalitz plots analysis were used. As a result we have estimated minimal number of pp collision events for significant signal of the P-breaking decay.

The study was funded by the Russian Science Foundation grant No. 22-22-00493,
<https://rscf.ru/en/project/22-22-00493/>

References:

- [1] D. Kharzeev, *Annals of Physics*, 325, 1. 205 –218 (2010).
- [2] A.Andrianov, D.Espriu and X.Planells, *Eur. Phys. J. C73* (2013) no.1, 2294
- [3] A. Andrianov et al, *EPJ Web of Conferences* 158, 03012 (2017).
- [4] V. Petrov, V. Kovalenko, The possibility of finding the P-symmetry breaking decay of the charged a_0 meson, ICPPA-2022, <https://indico.particle.mephi.ru/event/275/contributions/3360/>

Primary authors: KOVALENKO, Vladimir (Saint Petersburg State University); PETROV, Vitalii (St Petersburg State University (RU))

Presenter: PETROV, Vitalii (St Petersburg State University (RU))

Session Classification: Parallel: Quantum chromodynamics at large distances