OBSERVATION OF THE DEPENDENCE OF THE INTERFERENCE EFFECT OF IDENTICAL PIONS ON PION PAIR VELOCITY IN INCLUSIVE $\bar{p}p$-INTERACTIONS AT 22.4 GeV/c*)


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The Bose-Einstein interference effect is studied using 7333 events of $\bar{p}p$-interactions with $n_{ch} \geq 6$ at 22.4 GeV/c. An essential dependence of the strength of this effect on the pion pair velocity is observed. An indication is obtained that processes with essentially different time characteristics ($\tau < 1$ fm and $\tau > 2$ fm) contribute to $\bar{p}p$-interactions at 22.4 GeV/c. The interpretation based on abundant resonance production in high energy collisions is discussed.

1. Recently many papers have appeared in which Bose-Einstein correlations of identical pions in inclusive reactions are studied by means of the Kopylov-Podgoretzky method [1]. The parameters $R$ and $\tau$ characterizing space-time dimensions of the pion generation region have been found to be about 1 to 2 fm. They seem too large to be considered as the dimensions of the interaction region. This fact as well as the abundant resonance production in high energy reactions indicates that the measured space-time dimensions of the pion emission process are influenced to a large extent by the decay length $R \sim k/M\Gamma$ or the time of flight $\tau \sim k_0/M\Gamma$ of light pion.

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sources, e.g. resonances \((k_0, k, M, \text{ and } \Gamma)\) are the energy, momentum, mass, and width of the pion source). Such a model has been analyzed, e.g., in refs. \([2-7]\). In particular, it has been shown \([5, 6]\) that the movement of sources leads to an essential dependence of the parameters \(R\) and \(\tau\) on the velocity \(v\) of the pairs of identical pions. Besides the presence of sources with essentially different space-time parameters significantly influences the measured form and height of the interference peak \([6, 8]\). Keeping in mind these results, we have analyzed the inclusive \(\bar{p}p\)-interactions at 22.4 GeV/c and observed a strong \(v\)-dependence of the interference effect. At the same time we have used a new, multidimensional, more informative method of analysis and twice as much statistics than earlier \([7]\).

2. The inclusive differential cross section for the production of two like pions with nearly equal four-momenta \(p_1 \approx p_2\) can be written in the form

\[
d\sigma(1, 2) = g(v, q) \, d\sigma(1, 2), \quad g = 1 + a \exp\left(-\frac{R^2}{4} q_T^2 - \tau^2 q_0^2\right),
\]

where \(d\sigma\) is the differential cross section of the background in the hypothetical case when the interference is absent, \(q = p_1 - p_2\), \(q_T\) is the transverse component of vector \(q\) with respect to the pair velocity \(v\). The simple exponential parametrization of the function \(g(v, q)\) only defines the parameters \(R^2/4\) and \(\tau^2\) as corresponding \(q_T^2\) and \(q_0^2\)-slopes at \(q = 0\) (we neglect a possible term \(\sim q_0 q_T\)). At large \(|q|\) this parametrization describes only qualitatively the disappearance of the interference effect. The parameters \(a, R\) and \(\tau\) depend in general on the pion pair velocity \(v\) and on the angle \(\phi\) between \(q_T\) and the plane formed by the reaction axis and the vector \(v\). In the case of a reaction satisfying the requirement of azimuthal symmetry, we have

\[
a = a(v, \theta), \quad R = R(v, \theta, \phi), \quad \tau = \tau(v, \theta),
\]

where \(\theta\) is the angle between the velocity \(v\) and the reaction axis. We recall that the form of the pion generation region can be determined by varying the angles \(\theta, \phi\), i.e., \(R_L = R(\theta = 0, \pi)\) and \(R_B = R(\theta = \pi/2, \phi = 0, \pi)\). The parameter \(a\) is usually assumed to be a constant which is equal to 1 in an ideal case. However, this value may be suppressed if pions are emitted by different types of sources. E.g., if one or both pions from a pair are generated from a large space-time region (e.g., they are decay products of narrow resonances), the width of the interference effect can be smaller than the experimental resolution \(\sigma_v\). On the other hand, the interference effect from "wide" sources is difficult to separate from the background. Consequently, we have \([6, 8]\)

\[
a = \frac{1 - 2\omega_L + \omega_{LL} - \omega_{SS}}{1 + \omega_{SS}},
\]

where \(\omega_{LL}(\omega_{SS})\) is the fraction of pion pairs emitted by pairs of "narrow" ("wide") sources, \(\omega_L = \sum \omega_{LL}\). Further suppression of the parameter \(a\) may occur due to the