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Normalization of partial wave CP asymmetries in three-body decays of heavy hadrons

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CP violation in hadronic multi-body decays has been extensively studied, and the experimental breakthrough in the heavy baryon sector was made recently.
Partial-Wave CP Asymmetries (PWCPAs) in multi-body decays of heavy hadrons, which although provide us with more interference information, suffer from the
normalization problem, as is pointed out in this paper.
We propose a novel solution to this problem.
%We redefine the PWCPAs in such a way that they can be approximately normalized by a set of normalization factors.
We introduce a set of extra factors to rescale the PWCPAs to the proper sizes.
Instead of determining the set of factors according to the normalization requirement, we demand that all the PWCPAs have the same statistical errors.
%These factors are further determined based on reasonable guidelines.
In this way, we obtain a set of quasi-normalized PWCPAs, in the sense that they are close to the ideal normalized ones.
As an application, we perform an analysis of PWCPAs in the decay channel $B^{\pm} \to \pi^{+}\pi^{-}\pi^{\pm}$. We focus on the phase space region where the invariant mass of the $\pi^{+}\pi^{-}$ pair varies around the vector resonance $\rho^{0}(1450)$. Based on the data of the LHCb collaboration, the interference patterns among the resonances $\rho^{0}(1450)$, $f_{2}(1270)$, and $f_{0}(1500)$ and their contributions to the quasi-normalized PWCPAs are analyzed.
The analysis indicates that the quasi-normalized PWCPAs can avoid potential misleading or distorted results comparing with some other alternatively defined ones.

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