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Search for CP violation at Belle by measuring T-odd triple-product asymmetries

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CP violation in charm decays is predicted to be very small, only $\sim 10^{-3}$ or less. Thus, observing significant CP violation could indicate new physics beyond the Standard Model. The Belle experiment has searched for CP violation in charm decays by measuring an asymmetry about zero for the T -odd triple product $\vec{p}_1 \cdot (\vec{p}_2 \times \vec{p}_3)$, where \vec{p}_1 , \vec{p}_2 , and \vec{p}_3 are the momenta of three final-state particles produced in a four-body decay. The difference between this asymmetry for D decays and that for \bar{D} decays is CP -violating and proportional to $\sin \phi \cos \delta$, where ϕ and δ are the weak and strong phase differences, respectively, between two contributing amplitudes. Such CP violation is largest for $\delta = 0$, which differs from the CP asymmetry in partial decay widths: the latter is proportional to $\sin \phi \sin \delta$ and thus vanishes as $\delta \rightarrow 0$. Belle has used its full data set of over 900 fb^{-1} to search for a triple-product CP asymmetry in the following four-body decays: $D^0 \rightarrow K_S^0 K_S^0 \pi^+ \pi^-$, $D^+ \rightarrow K^+ K_S^0 \pi^+ \pi^-$, $D_s^+ \rightarrow K^+ K_S^0 \pi^+ \pi^-$, $D^+ \rightarrow K_S^0 K^+ K^- \pi^+$, $D^+ \rightarrow K^+ K^- \pi^+ \pi^0$, $D^+ \rightarrow K^+ \pi^- \pi^+ \pi^0$, $D^+ \rightarrow K^- \pi^+ \pi^+ \pi^0$, $D_s^+ \rightarrow K^+ \pi^- \pi^+ \pi^0$, and $D_s^+ \rightarrow K^+ K^- \pi^+ \pi^0$. Here we report the results of these searches.

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