A Supplementary material for LHCb-PAPER-2016-044

Figure 1 shows the tree and penguin contributions to the $D^0 \rightarrow \rho^0 \rho^0$ decay. Figures 2 and 3 show the distributions of $p$-values for the ten subsamples of the control channel $D^0 \rightarrow K^- \pi^+ \pi^+ \pi^-$ for the $P$-even and $P$-odd $CP$-violation tests. The results are compatible with a uniform distribution of $p$-values with values between 3% and 87% (8% to 74%) for $P$-even ($P$-odd), which is consistent with the assumption that detection asymmetries are below the current level of sensitivity.

Local asymmetry significance plots for simulation of specific $CP$-violation scenarios and for data, for both the $P$-odd and $P$-even tests, are shown in the paper in Fig. ?? and Fig. ?? as one-dimensional projections onto two of the axes that are used in the tests. Figures 4 and 5 show the $P$-odd test projections onto the other three axes used in the tests in simulation and data, and the 2D projection.

![Feynman diagrams](image)

Figure 1: Feynman diagrams of tree and penguin contributions of $D^0 \rightarrow \rho^0 \rho^0$ decay. Similar diagrams can be drawn for $D^0 \rightarrow a_1^+ \pi^-$. 

![Histogram](image)

Figure 2: Distribution of $p$-values for ten subsamples of the control channel $D^0 \rightarrow K^- \pi^+ \pi^+ \pi^-$ from the $P$-even $CP$-violation test. The red dashed line indicates the expected distribution.
Figure 3: Distribution of $p$-values for ten subsamples of the control channel $D^0 \rightarrow K^- \pi^+ \pi^+ \pi^-$ from the $P$-odd $CP$-violation test. The red dashed line indicates the expected distribution.
Figure 4: Local asymmetry significances in a simulation sample for a $P$-odd $CP$-violation test with $3^\circ$ phase $CP$ violation introduced in the P-wave $\rho^0(770)\rho^0(770)$ resonance (see Sect. ??) projected onto the $m(\pi_1\pi_2\pi_4)$, $m(\pi_1\pi_4)$ and $m(\pi_2\pi_3)$ axes, and onto 2D $m(\pi_1\pi_2)$ versus $m(\pi_1\pi_2\pi_3)$ plot. The grey area corresponds to candidates with a contribution to the $T$-value of less than one standard deviation. The pink (blue) area corresponds to candidates with a positive (negative) contribution to the $T$-value. Light, medium or dark shades of pink and blue correspond to between one and two, two and three, and more than three standard-deviation contributions, respectively.
Figure 5: Local asymmetry significances in data for the $P$-odd CP-violation test projected onto the $m(\pi_1\pi_2\pi_4)$, $m(\pi_1\pi_4)$ and $m(\pi_2\pi_3)$ axes, and onto 2D $m(\pi_1\pi_2)$ versus $m(\pi_1\pi_2\pi_3)$ plot. The positive (negative) asymmetry significance is set for sample I + IV having positive (negative) contribution to the measured $T$ value (see Sect. ??). The grey area corresponds to candidates with a contribution to the $T$-value of less than one standard deviation. The pink (blue) area corresponds to candidates with a positive (negative) contribution to the $T$-value. Light, medium or dark shades of pink and blue correspond to between one and two, two and three, and more than three standard-deviation contributions, respectively.