respectively, equivalent to $17\sigma$ and $0.3\sigma$, consistent with CP violation and CPT invariance.

![Graph](image)

**FIG. 3:** (color online). The central values (blue point and red square) and two-dimensional CL contours for $1 - CL = 0.317, 4.55 \times 10^{-2}, 2.70 \times 10^{-3}, 6.33 \times 10^{-5}, 5.73 \times 10^{-7},$ and $1.97 \times 10^{-9}$, calculated from the change in the value of $-2\Delta \ln \mathcal{L}$ compared with its value at maximum $(-2\Delta \ln \mathcal{L} = 2.3, 6.2, 11.8, 19.3, 28.7, 40.1)$, for the pairs of $T$-asymmetry parameters $(\Delta S_T^+, \Delta C_T^+)$ (blue dashed curves) and $(\Delta S_T^-, \Delta C_T^-)$ (red solid curves). Systematic uncertainties are included. The $T$-invariance point is shown as a $+$ sign.

In summary, we have measured $T$-violating parameters in the time evolution of neutral $B$ mesons, by comparing the probabilities of $\bar{B}^0 \rightarrow B_-, B_+ \rightarrow B^0, \bar{B}^0 \rightarrow B_+,$ and $B_- \rightarrow B^0$ transitions, to their $T$ conjugate. We determine for the main $T$-violating parameters $\Delta S_T^+ = -1.37 \pm 0.14$ (stat.) $\pm 0.06$ (syst.) and $\Delta S_T^- = 1.17 \pm 0.18$ (stat.) $\pm 0.11$ (syst.), and observe directly for the first time a departure from $T$ invariance in the $B$ meson system, with a significance equivalent to $14\sigma$. Our results are consistent with current CP-violating measurements obtained invoking CPT invariance. They constitute the first observation of $T$ violation in any system through the exchange of initial and final states in transitions that can only be connected by a $T$-symmetry transformation.

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[22] See “CP violation in meson decays” review in [8].
[23] See supplementary material for breakdown of the main systematic uncertainties on the asymmetry parameters, CP- and CPT-violating asymmetries, and complete $(S^\pm, C^\pm)$ analysis results.