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Search for the forbidden charm meson decays $D^0 \to hh'll'$

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Decay modes with two oppositely charged leptons of different flavor correspond to lepton flavor violating (LFV) decays and are essentially forbidden in the Standard Model (SM) because they can occur only through lepton mixing. Decay modes with two leptons of the same charge are lepton-number violating (LNV) decays and are forbidden in the SM. Hence, decays of the form $D^0 \to hh'll'$ provide sensitive tools to investigate new mediators or couplings in physics beyond the SM. Charmed mesons were copiously produced in $e^+e^- \to c\bar{c}$ continuum events at the PEP-II e^+e^- collider at the SLAC National Accelerator Laboratory. In this talk, we report on a search for the three LFV and nine LNV decays of the type $D^0 \to hh'll'$ (with $h, h' = K/\pi$ and $l, l' = e/\mu$) using data taken by the $BABAR$ experiment which had comparable sensitivity to both muons and electrons in the final state. Upper limits on the branching fractions are improved by up to two orders of magnitude.

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