



Contribution ID: 349

Type: **Parallel Sessions**

Tau decays at BaBar

Saturday, 7 July 2012 10:15 (15 minutes)

We present a set of new results in tau-lepton physics using the full BABAR data set. This includes a new limit on the branching fraction of the isospin-forbidden, second-class-current decay $\tau \rightarrow \pi \eta' (958) \nu_\tau$; a first study of high-multiplicity tau decays with charged kaons; and measurements of the branching fractions of 3- and 5-prong tau decays.

Using the full BABAR dataset, we measure the branching fractions of the decays $\tau \rightarrow h (n\pi^0)$ and $h K_s(\pi^0)$, where h indicates a charged kaon or pion and n may be up to 3. We also report the invariant-mass distributions of the decays $\tau \rightarrow \pi \pi \pi \nu$, $\tau \rightarrow K \pi \pi \nu$, $\tau \rightarrow K K \pi \nu$, and $\tau \rightarrow K K K \nu$, where events with $K_s \rightarrow \pi^+ \pi^-$ decays are excluded. We use these measurements to update the value of the magnitude of the CKM matrix element V_{us} .

Within the standard model, tau-lepton decays conserve CP, so searches for CP violation in this system are sensitive to new physics. We report the results of a search for CP violation in the decay $\tau \rightarrow \pi^- K_s^0$ using the full BABAR data set. In this mode a decay-rate asymmetry of $(0.36 \pm 0.01)\%$ is expected within the standard model due to CP violation in the neutral kaon system. After accounting for effects due to the different interaction cross sections of K^0 and anti- K^0 mesons with the detector material, we find a decay-rate asymmetry of $(-0.36 \pm 0.23 \pm 0.11)\%$, approximately 2.8 standard deviations from the standard model expectation.

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Session Classification: Room 220 Lattice QCD / B-Physics / CP Violation, etc -TR5&7&10

Track Classification: Track 1 - The Standard Model and EW Symmetry Breaking - Higgs Searches