Measurements of τ hadronic spectra

Rocky So, University of British Columbia, Canada, for the *BABAR* Collaboration

Introduction

We use 3.16 x 10^8 $\tau^+\tau^-$ pairs to study $\tau^- \to \pi^-\pi^+\pi^-\nu_\tau$, $\tau^- \to K^-\pi^+\pi^-\nu_\tau$, $\tau^- \to K^-K^+\pi^-\nu_\tau$, and $\tau^- \to K^-K^+K^-\nu_\tau$ using the Babar detector. Charge conjugation is implied.

We tag one τ using leptonic decays and use Bayesian Unfolding (NIM A 362, 487 1995) to remove detector effects in the mass distributions.

Event Selection and Analysis

We divide each event into two hemispheres perpendicular to the thrust axis, which is defined as the axis that maximizes the total momentum of all the particles detected The tag hemisphere is required to have an e or μ in it. The signal hemisphere is required to have 3 charged track candidates. We reject events with particles that are consistent with a K_s or a π^0

An efficiency correction, initially obtained from Monte Carlo and corrected using data control samples, is used to correct for efficiency losses from the event selection for each bin in the invariant mass distribution.

We subtract the background and correct for detector efficiencies in the two-dimensional Dalitz distributions.

Our systematic uncertainties include potential bias from Bayesian unfolding, backgrounds, Monte Carlo statistics, particle identification and other selection efficiencies, and modeling of the detector response.

Motivation

•The spectral density functions (SDF) can be used to extract $|V_{us}|$ (JHEP 10 004 1999) and α(s) (EPJ C4 409 1998) using Finite Sum Energy Rules.

Backgrounds

Preliminary

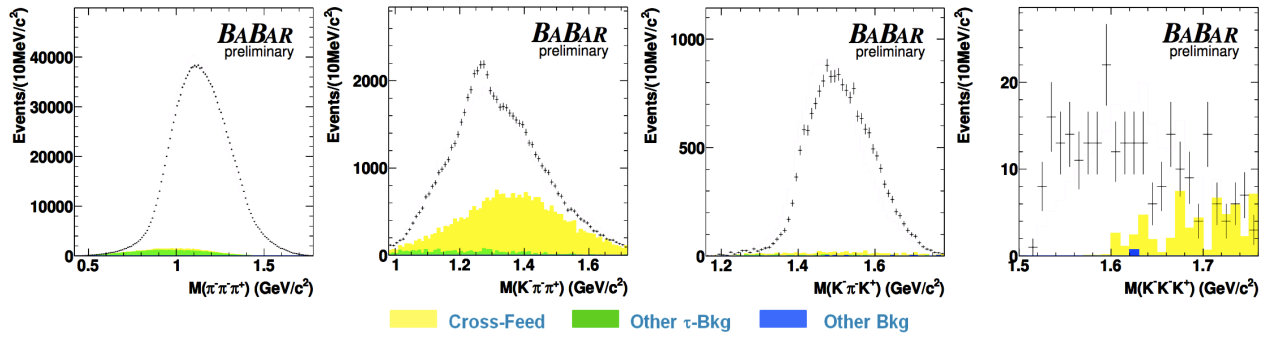
The Monte Carlo estimate of the cross-feed is corrected using a multi-dimensional reweighting procedure, while the non-τ backgrounds are estimated with data-driven methods.

Channel	Cross-feed background (%)	$\tau^- \to h^-h^+h^-\pi^0\nu_\tau$ background (%)
$\pi^-\pi^+\pi^-\nu_\tau$	0.85 ± 0.01	3.6 ± 0.3
$K^-\pi^+\pi^-\nu_\tau$	38.5 ± 0.2	2.3 ± 0.4
$K^-K^+\pi^-\nu_\tau$	2.9 ± 0.1	0.4 ± 0.1
$K^-K^+K^-\nu_\tau$	27.7 ± 3.0	< 5.0

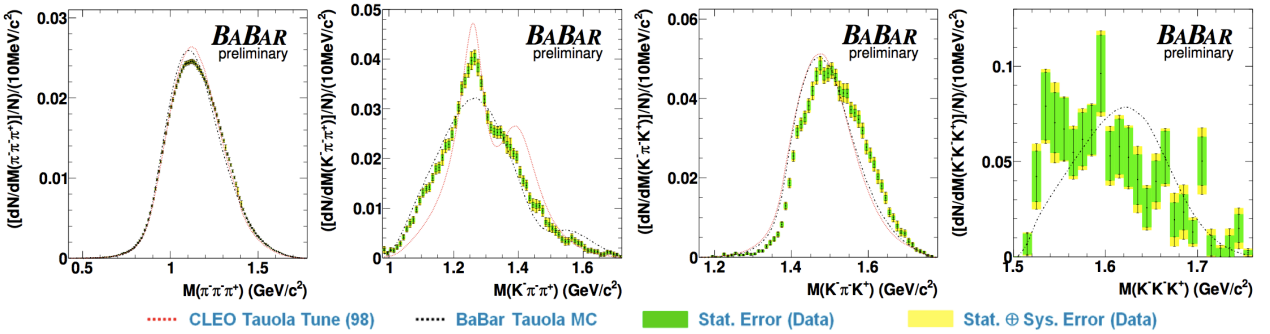
Results

In this work, we measure the invariant mass distributions for $\tau^- \to \pi^-\pi^+\pi^-\nu_\tau$, $\tau^- \to K^-\pi^+\pi^-\nu_\tau$, $\tau^- \to K^-K^+\pi^-\nu_\tau$, and $\tau^- \to K^-K^+K^-\nu_\tau$ decay modes. The SDF, will be useful for updating the total strange and non-strange spectral density functions for the extractions of $|V_{us}|$ and α(s).

Reconstructed three-hadron mass spectra



Bayesian unfolded three-hadron mass spectra



Background Subtracted and Efficiency Corrected Dalitz Plots