

# The $\tau \rightarrow \eta \pi \pi^0 \nu$ decay

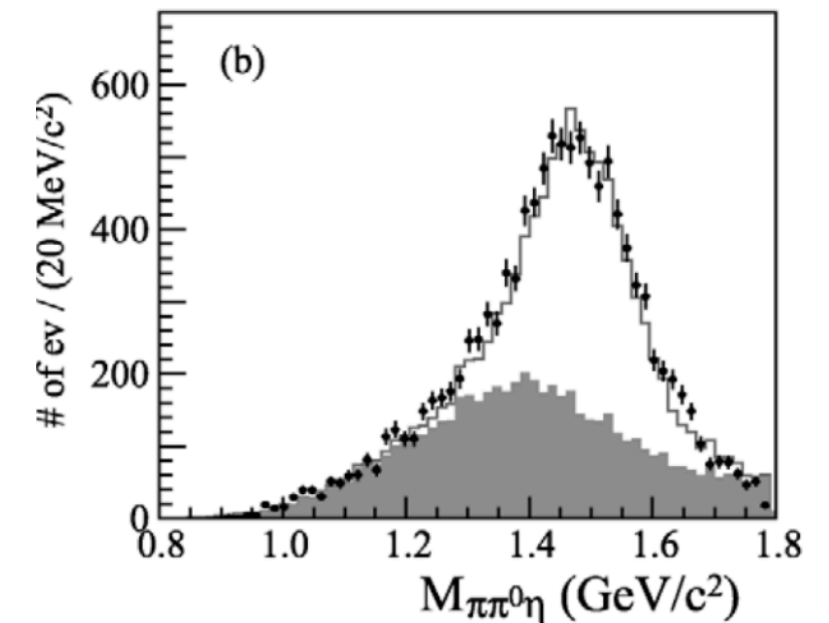
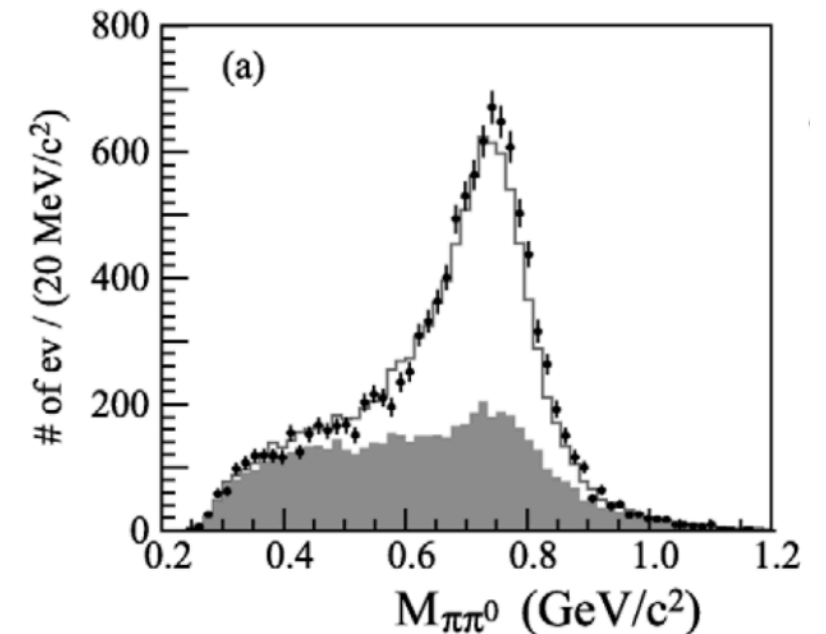
- Previously measured by BELLE, ALEPH and CLEO.

**$M_{\eta\pi}$  not yet measured**

- The PDG reports:

$$\text{BR}(\tau \rightarrow \eta \pi \pi^0 \nu) = (1.39 \pm 0.07) \times 10^{-3}$$

- The contributions of scalar and pseudoscalar resonances are expected to be negligible. So, the corresponding amplitudes are driven by the vector current, allowing a precise study of the couplings in the odd-intrinsic parity sector.



**K. Inami et.al (BELLE)  
Phys.Lett. B672 (2009)**

# Estimation @ 1 ab<sup>-1</sup>

- $BR(\tau \rightarrow \eta\pi\pi^0\nu) = (1.39 \pm 0.07) \times 10^{-3}$

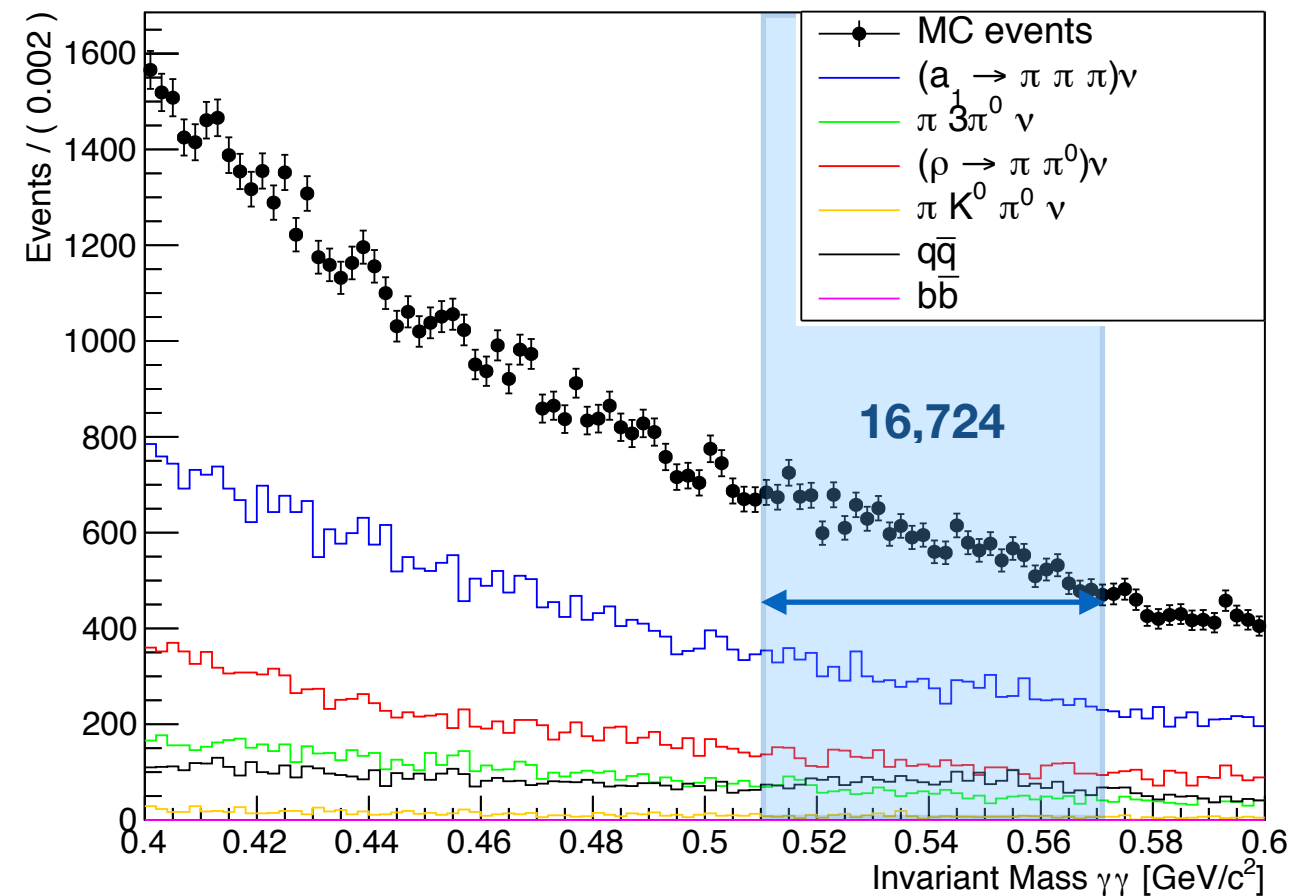
$$N_{sig} = \epsilon \cdot \sigma_{\tau\tau} \cdot BR(\tau \rightarrow \ell\nu\bar{\nu}) \cdot L \cdot BR(\tau \rightarrow \eta\pi^0\pi\nu)$$

In the mass window of  $\eta$ :

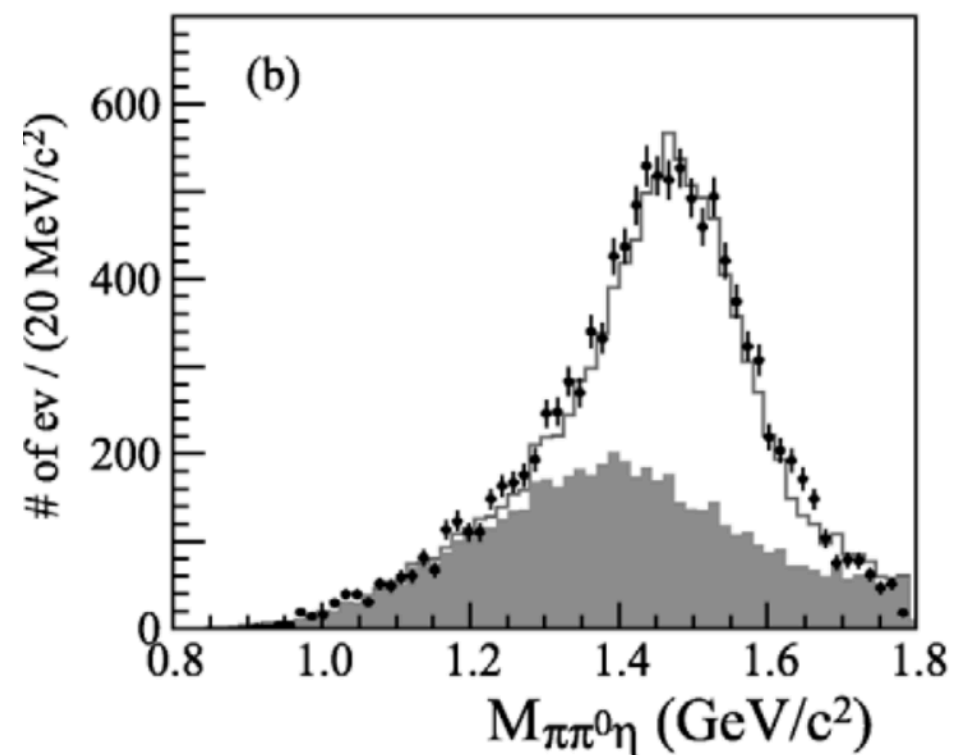
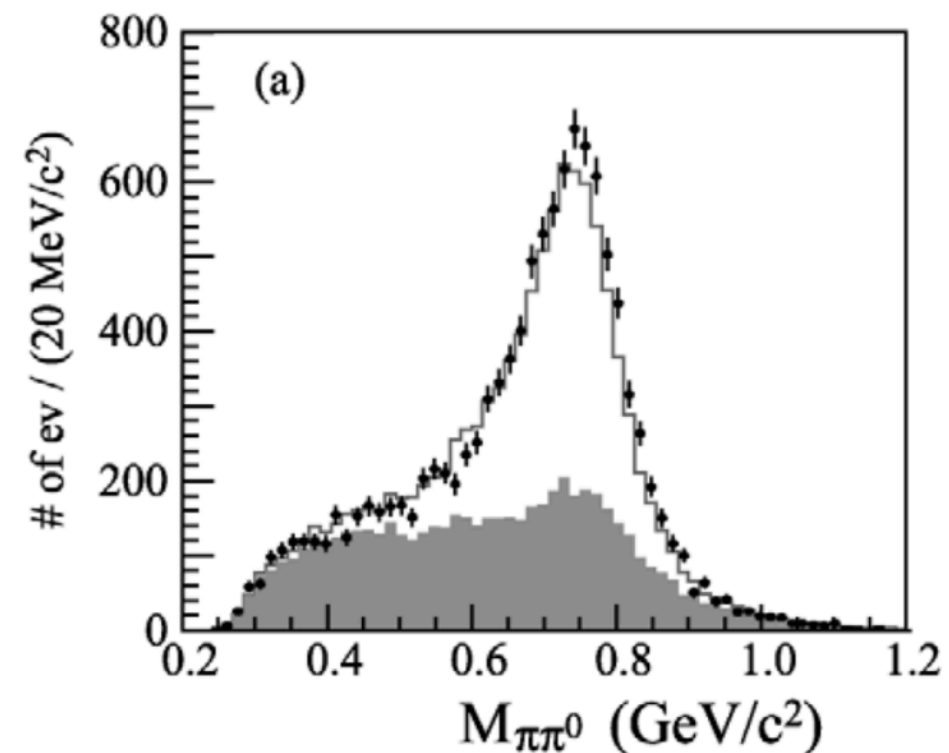
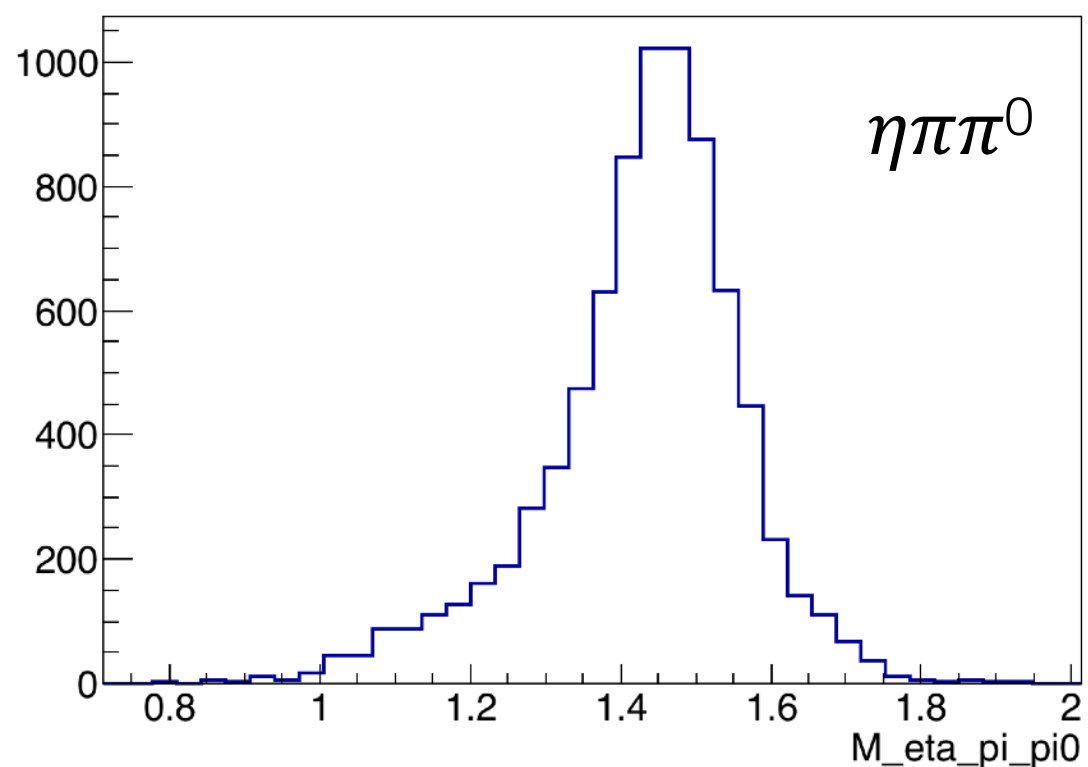
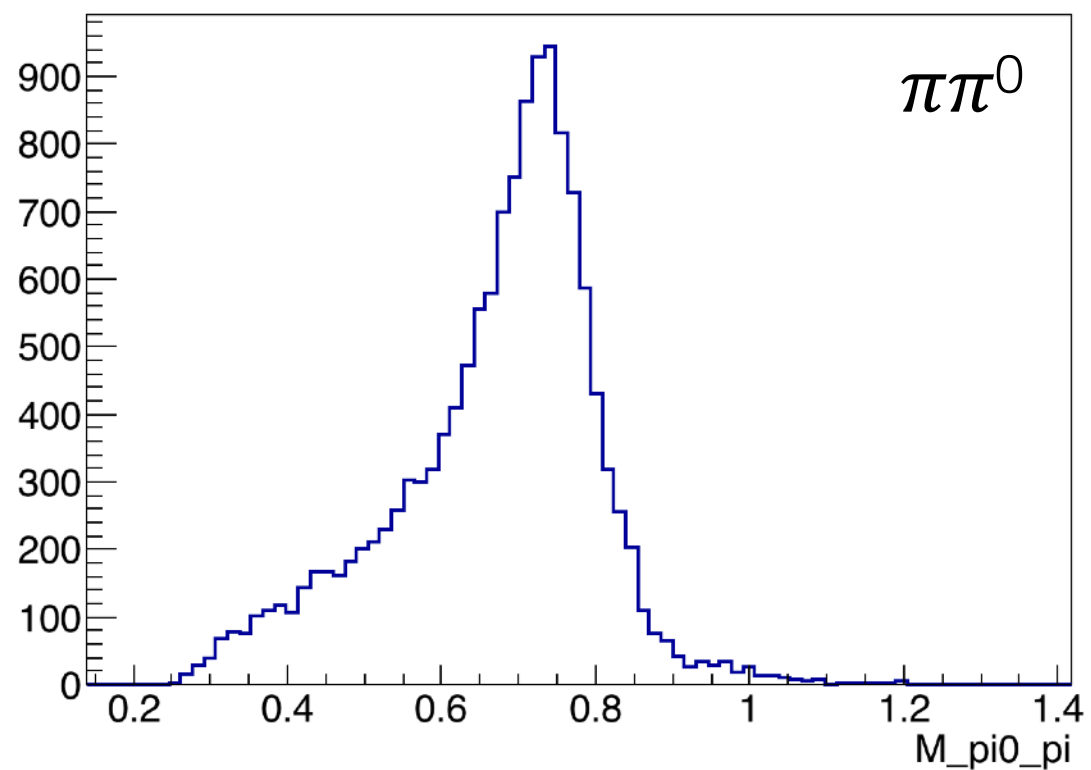
- $N_{bkg} = 16,724$

$$\frac{N_{sig}}{\sqrt{N_{sig} + N_{bkg}}} = 18.24$$

**Tighter cuts can be tested.**



# Invariant mass distributions



# CP violation in $\tau \rightarrow K_S \pi (\geq 0 \pi^0) \nu$

- The decay of the  $\tau$  lepton to final states containing a  $K_S$  meson will have a nonzero decay-rate asymmetry due to CP violation in the kaon sector.

$$A_Q = \frac{\Gamma(\tau^+ \rightarrow \pi^+ K_S^0 \bar{\nu}_\tau) - \Gamma(\tau^- \rightarrow \pi^- K_S^0 \nu_\tau)}{\Gamma(\tau^+ \rightarrow \pi^+ K_S^0 \bar{\nu}_\tau) + \Gamma(\tau^- \rightarrow \pi^- K_S^0 \nu_\tau)}$$

- The SM prediction<sup>1,2</sup> is

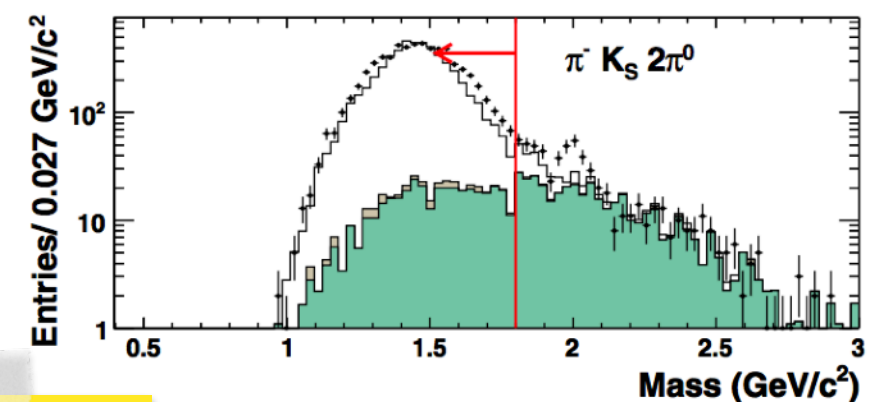
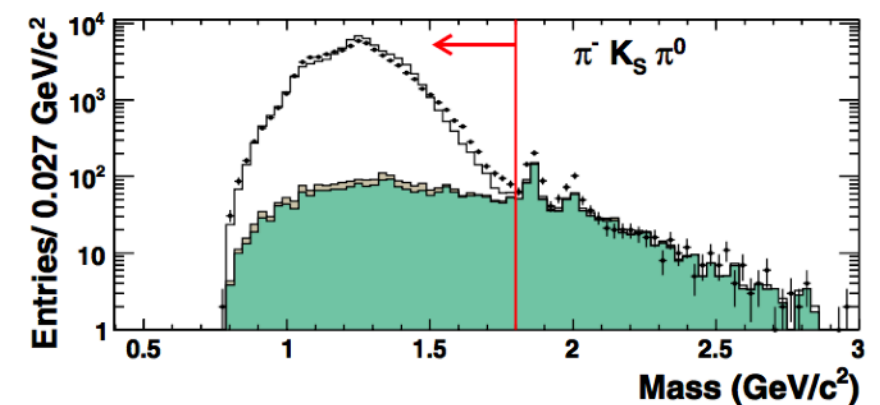
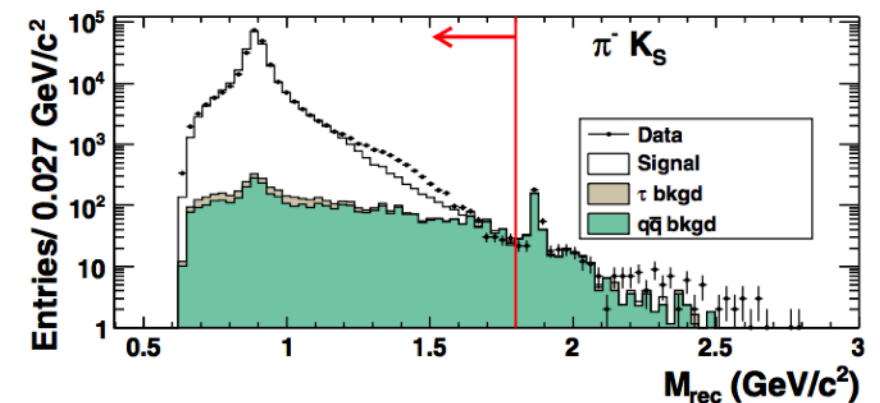
$$A_Q = (3.6 \pm 0.1) \times 10^{-3}$$

- BaBar has measured

$$A_Q^{BaBar} = (-3.6 \pm 2.3 \pm 1.1) \times 10^{-3}$$

<sup>1</sup>I. I. Bigi and A. I. Sanda, Phys. Lett. B 625, 47 (2005).

<sup>2</sup>Y. Grossman and Y. Nir, JHEP 2012.4 (2012).

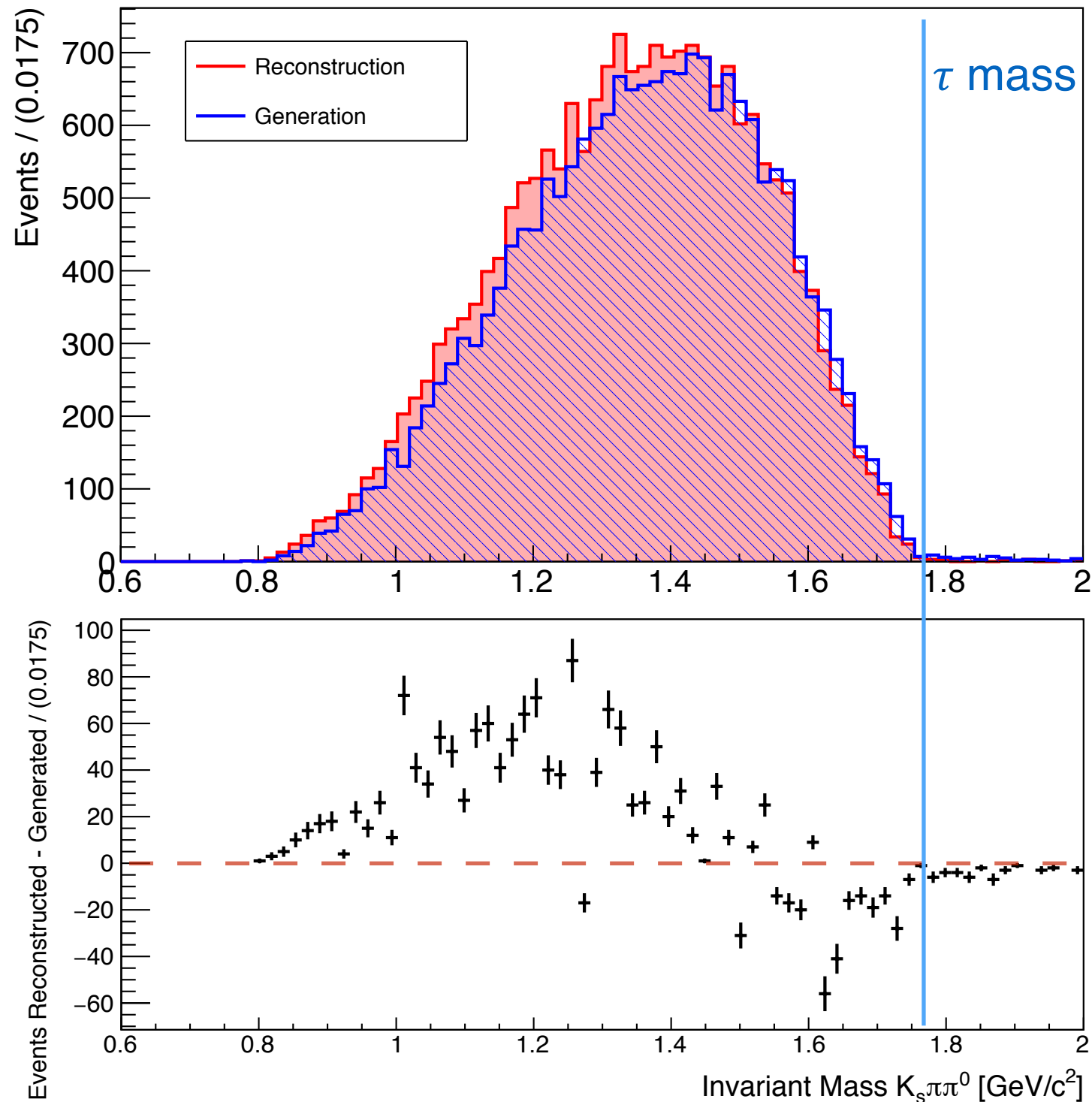


**2.8  $\sigma$  away  
from SM**

J.P. Less et.al (BaBar)  
Phys.Rev.D D85 (2012)



# The $\tau \rightarrow K_S \pi^0 \pi \nu$ channel



- As a test, we apply the cuts used by BaBar to study the  $K_S \pi^0 \pi$  invariant mass distribution.
- In reconstruction, energy lost in the ECL is an expected effect.