$K^+ \rightarrow \pi^+\gamma\gamma\gamma$

T. Nakano (RCNP, Osaka Univ.)

$K^+ \rightarrow \pi^+\gamma\gamma\gamma$

- Current upper limit: 1×10^{-4} 90%C.L. (117<T_π<127 MeV)

  above Kp2!

- No limit below $K\pi 2$

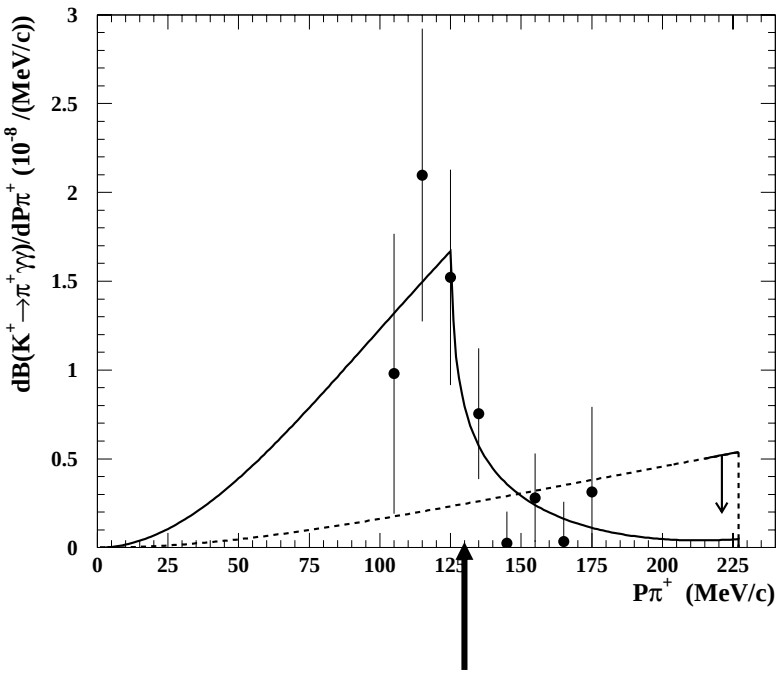
- Major Backgrond: $\boldsymbol{K^+ \rightarrow \pi^+ \pi^0 \gamma}$

$$B=2.75 \times 10^{-4} \quad (55<T_\pi<90 \text{ MeV})$$

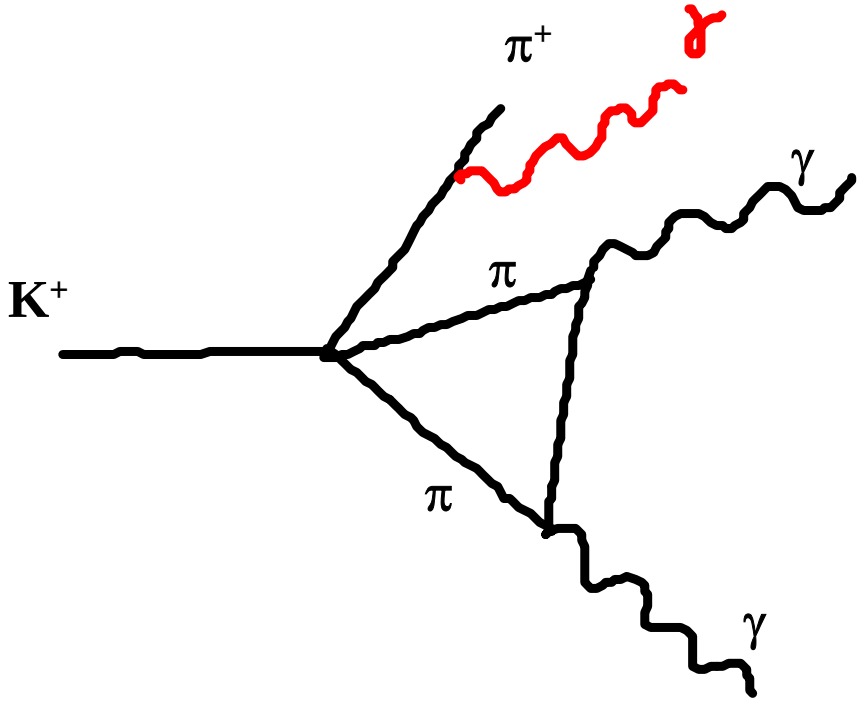
- We expect (at least)

$$\mathbf{B(}\boldsymbol{K}^+ \rightarrow \pi^+\gamma\gamma\gamma\mathbf{)} \sim \mathrm{B}(\boldsymbol{K}^+ \rightarrow \pi^+\gamma\gamma\mathbf{)} \times \alpha \sim \underline{\mathbf{1 \times 10^{-8}}}$$

$K^+ \rightarrow \pi^+\gamma\gamma$ (γ)



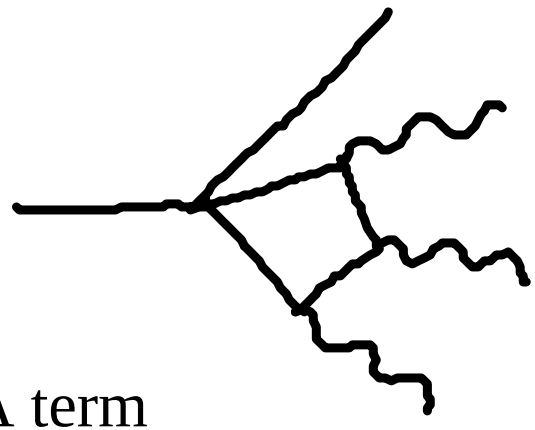
Kπ3 threshold



Peak at Mγγ~280 MeV (Pπ~133MeV)

Direct Emission

- pion loop

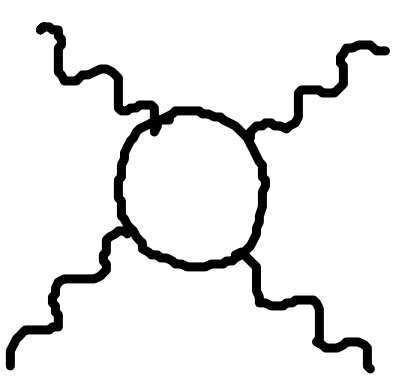


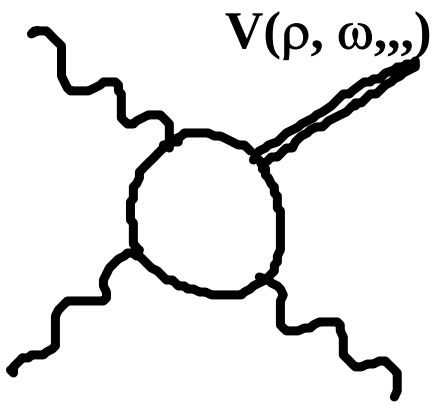
- off-shell U(1)A term

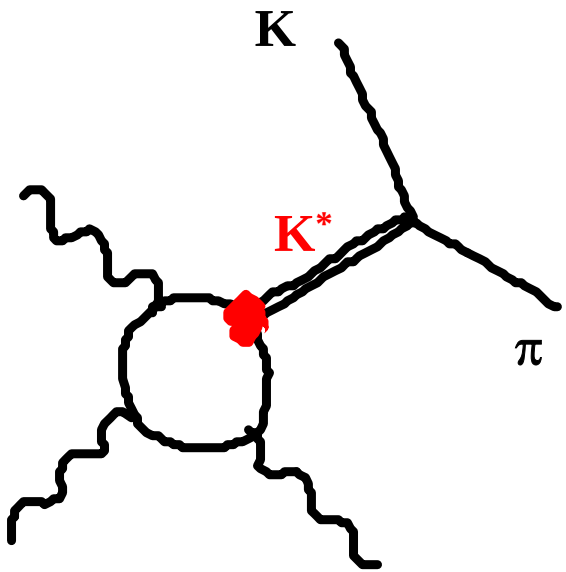
$$K^+ \rightarrow \pi^+ \pi^0 \gamma(\mathrm{DE})$$

$$K^+ \rightarrow \pi^+ \pi^{0*} \gamma \rightarrow \pi^+ \gamma \gamma \gamma$$

- photon-photon scattering

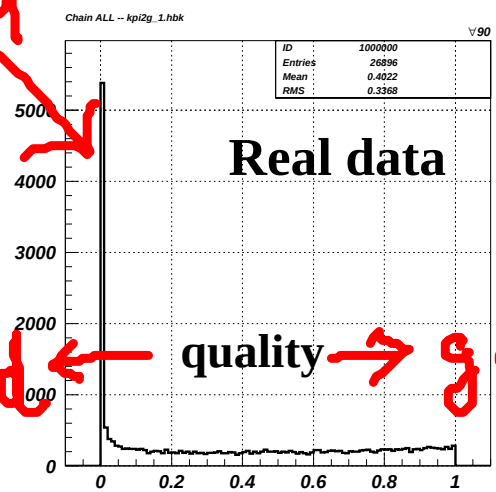






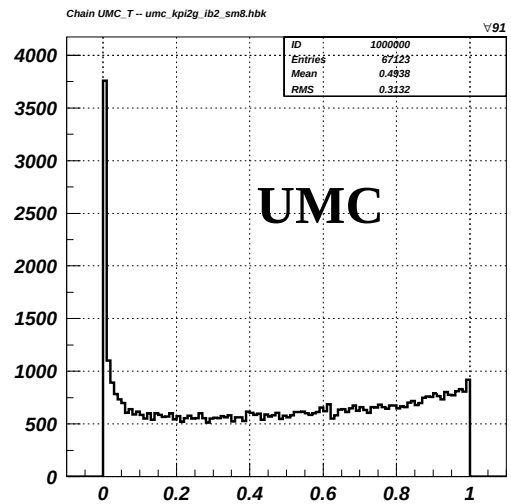
Kπ2γ kinematic fit

BG



bad ← quality → good

prob_rkp2(1)

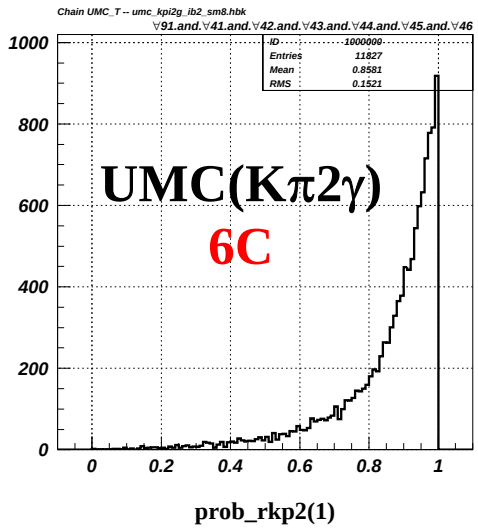


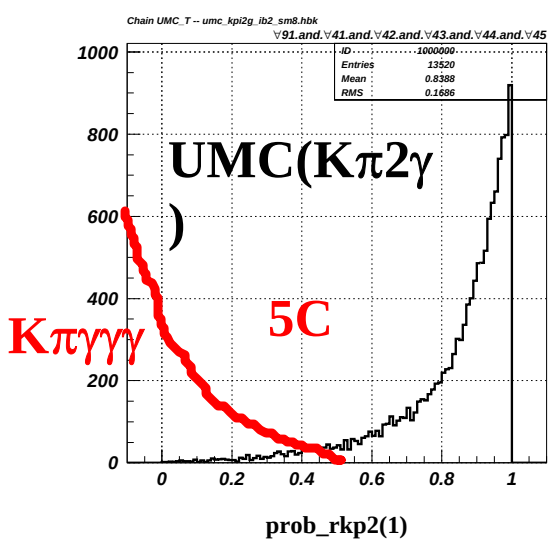
prob_rkp2(1)

'95 Kπ2γ sample
All cuts applied except for Prob(χ^2) cuts.

1. $\Sigma p_x = 0$
2. $\Sigma p_y = 0$
3. $\Sigma p_z = 0$
4. $\Sigma E = m_K$
5. $(p_\pi^2 - T_\pi^2)/2T_\pi = m_\pi$
6. $m_{\gamma\gamma} = m_\pi$

Identification of Kπγγγ





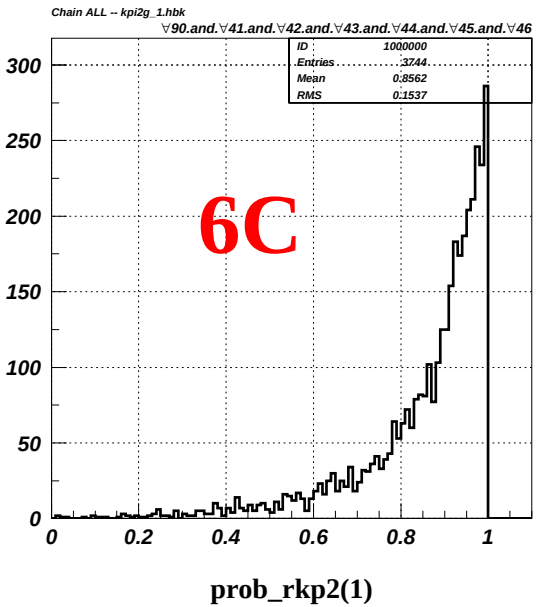
1σ cuts

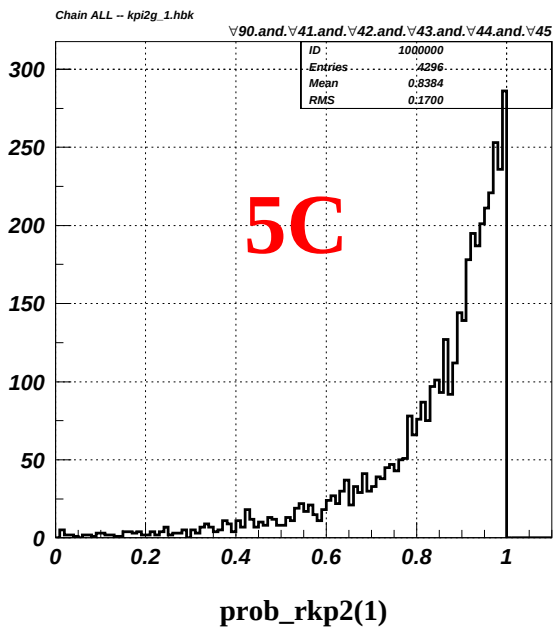
1. $|\Sigma p_x| < 21\text{MeV}$
2. $|\Sigma p_y| < 21\text{MeV}$
3. $|\Sigma p_z| < 13\text{MeV}$
4. $|\Sigma E - m_K| < 28\text{MeV}$
5. $|(p_\pi^2 - T_\pi^2)/2T_\pi - m_\pi| < 9\text{MeV}$
6. $|m_{\gamma\gamma} - m_\pi| < 16\text{MeV}$

6C = 1*2*3*4*5*6

5C = 1*2*3*4*5

Real data

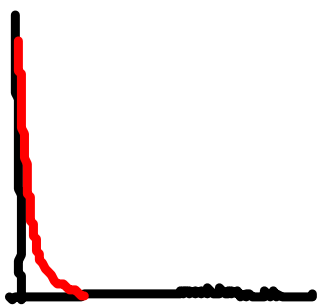




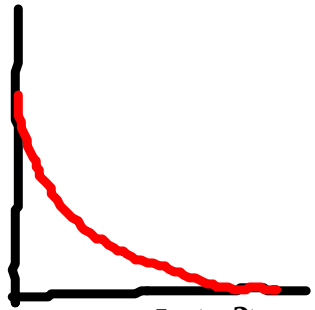
- ~4300 events passed 5C cut.
- No significant enhancement near Prob(χ^2)=0.
- No event below Prob(χ^2)=0.005.

Next things to do

- **Signal acceptance estimation (Likelihood analysis?)**



Prob(χ^2)



Prob(χ^2)

- **Lower π^+ momentum region**

  98 E787-3γ trigger data?

  Install new (better) trigger?

- **Kπ2 region**

  p0 → 3γ: current upper limit 3.1x10^{-8}

- **Higher π^+ momentum region**

  Upper limit may be obtained from $\pi\gamma\gamma$(1) analysis

- **Theoretical calculations**