Status Report on $\phi \to \eta'\gamma \to \pi^+\pi^- 7\gamma$

Last checks

- Raw selected with filfo/par=1: TRK & VTX efficiency, data vs MC
- MC RAD'04 with T. & M. efficiency curve for clusters
- $K\rho$
- Mixing angle

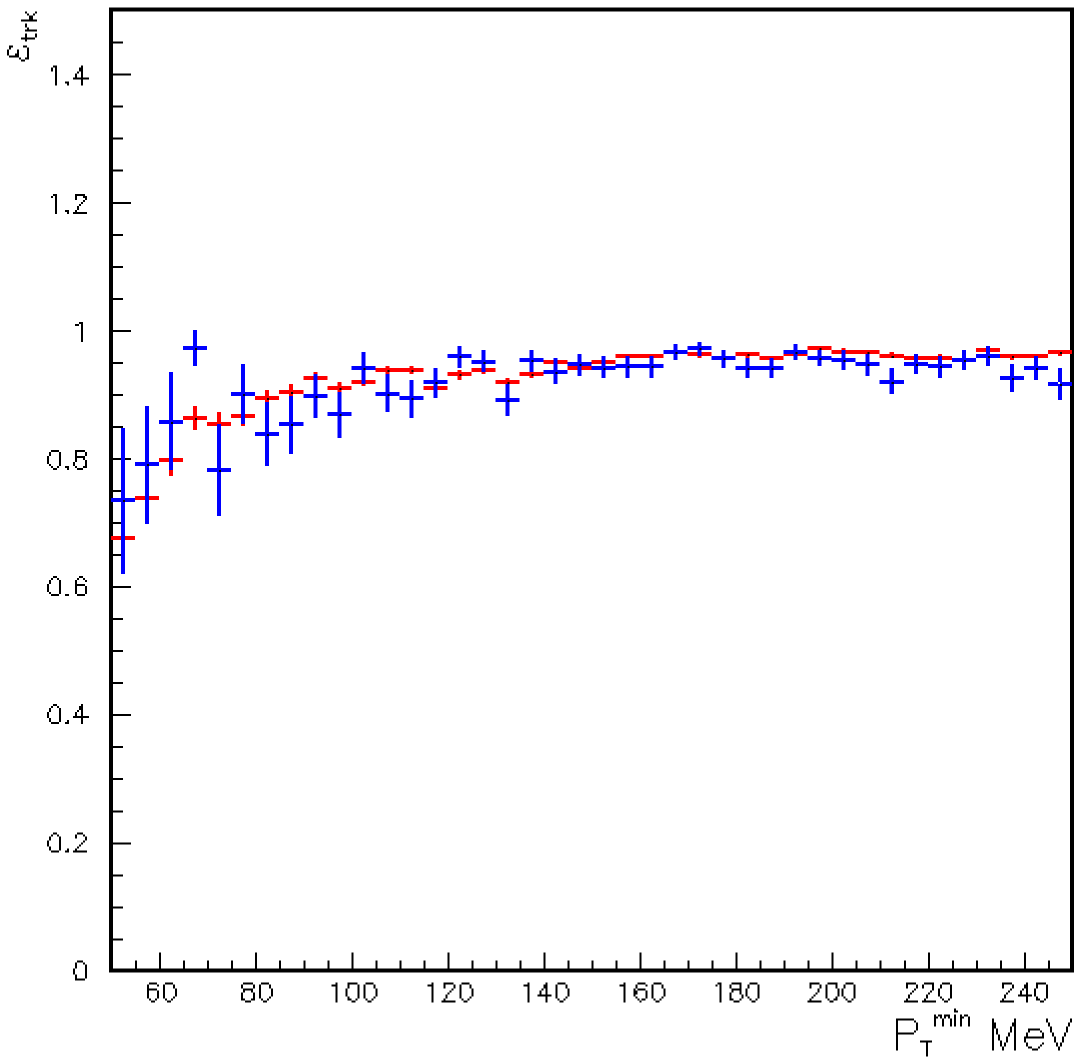
TRK efficiency

- Cut on clusters E_{clu}<400 MeV
- 2 prompt neutral clusters θ_{clu}>25° & E_{clu}>50 MeV
- $|M_{\gamma\gamma} - M_{\pi}|$<20 MeV
- 2 clusters 0.8<β<0.95 & E_{clu}>100 MeV
- one track θ_{trk}>40° & 200MeV<P_{tot}<400 MeV

$\Rightarrow$ We look if there is a track in a cone of 35° around P_{miss}

$$\vec{P}_{miss} = \vec{P}_{\phi} - \vec{P}_{\gamma 1} - \vec{P}_{\gamma 2} - \vec{P}_{trk}$$

TRK efficiency

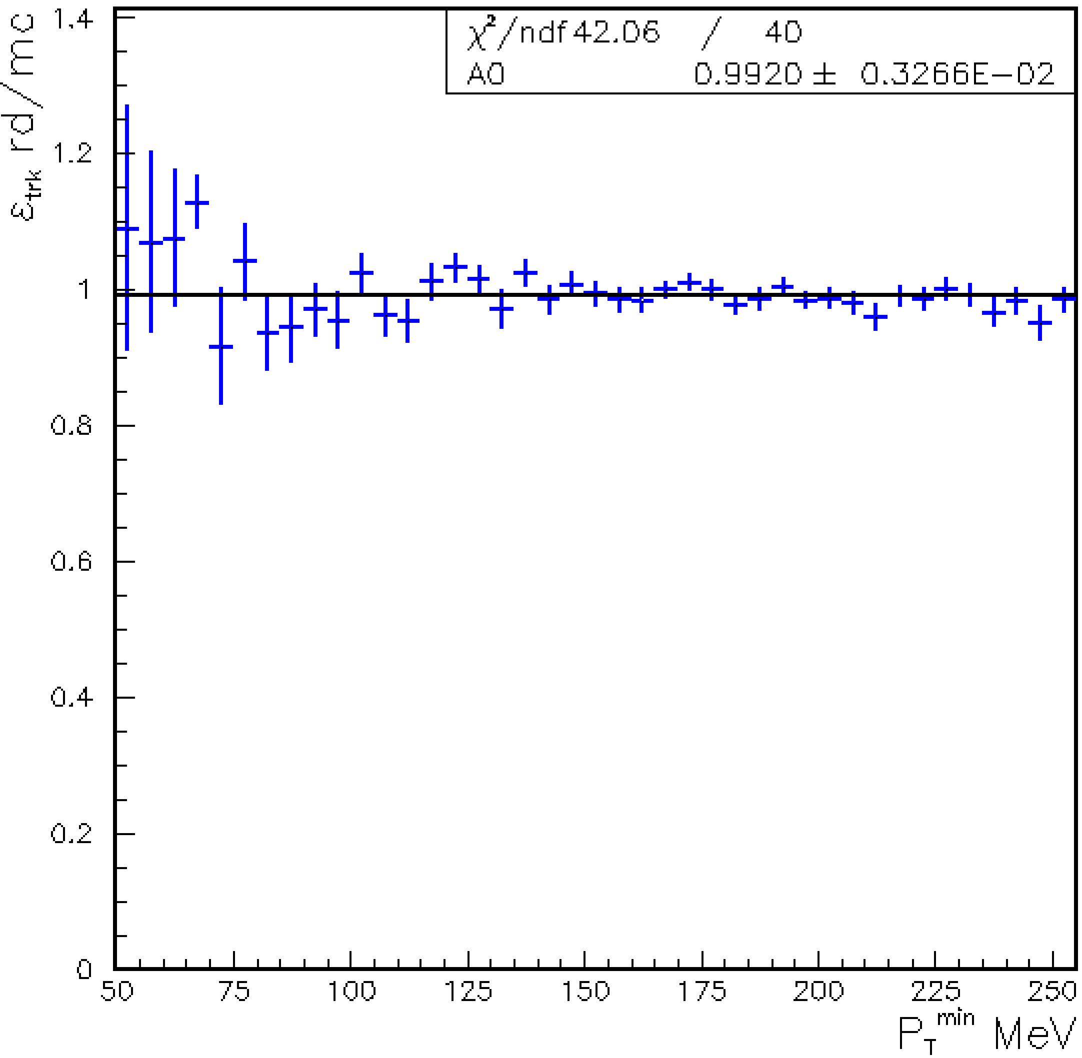


+ MC

+ Data

Background contamination
at level of 1%

TRK efficiency



$\varepsilon_{trk}(Data)/\varepsilon_{trk}(MC)$

= 0.992±0.003

⇓

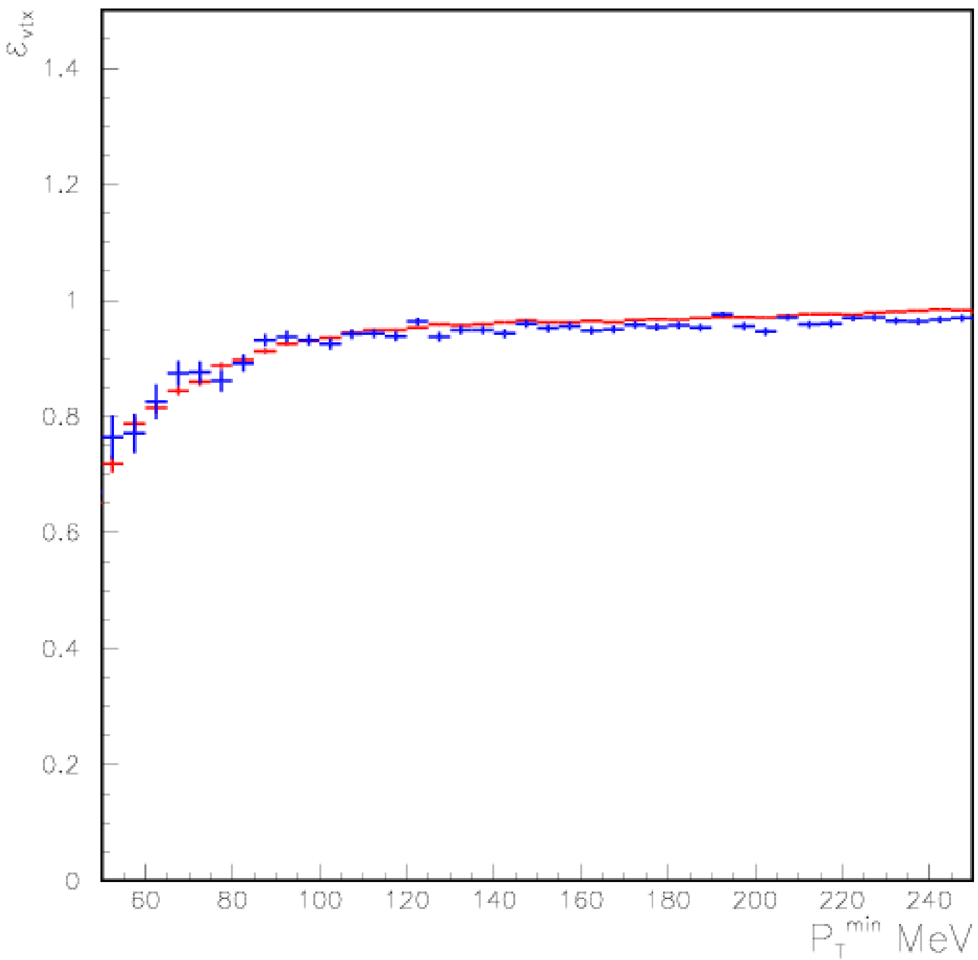
1%

VTX efficiency

- Cut on clusters E_{clu}<400 MeV
- 2 prompt neutral clusters θ_{clu}>25° & E_{clu}>50 MeV
- 100MeV < $M_{\gamma\gamma}$ < 170 MeV
- two tracks θ_{trk}>40° & 50MeV<P_{tot}<400MeV
- 850 MeV<Etot<1200MeV

⇒ We look for a vertex as a function of the minimum momentum

VTX efficiency

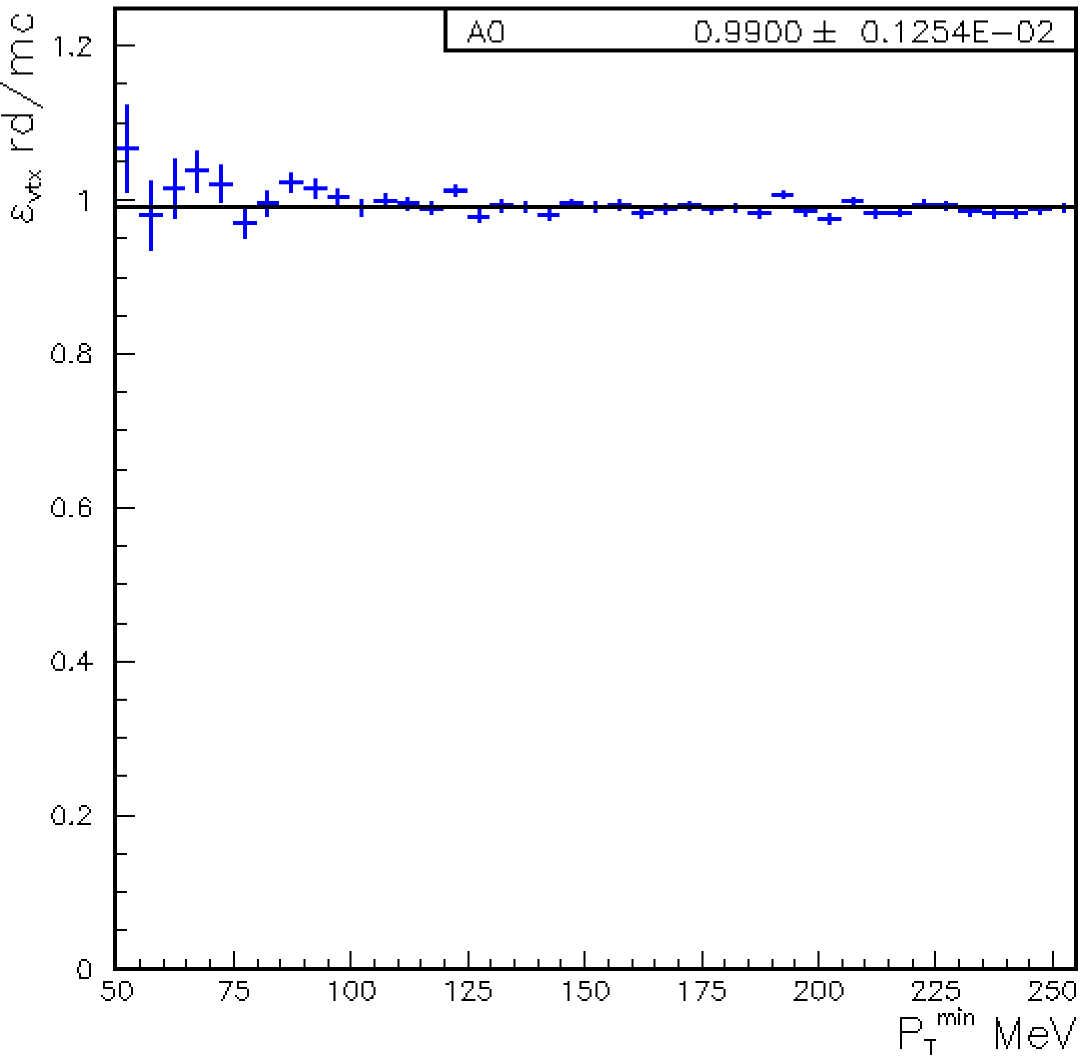


+ MC

+ Data

Background contamination at level of 1.5%

VTX efficiency



$\varepsilon_{vtx}(\text{Data})/\varepsilon_{vtx}(\text{MC})$

$= 0.990 \pm 0.001$

⇓

1%

The factor K_ρ

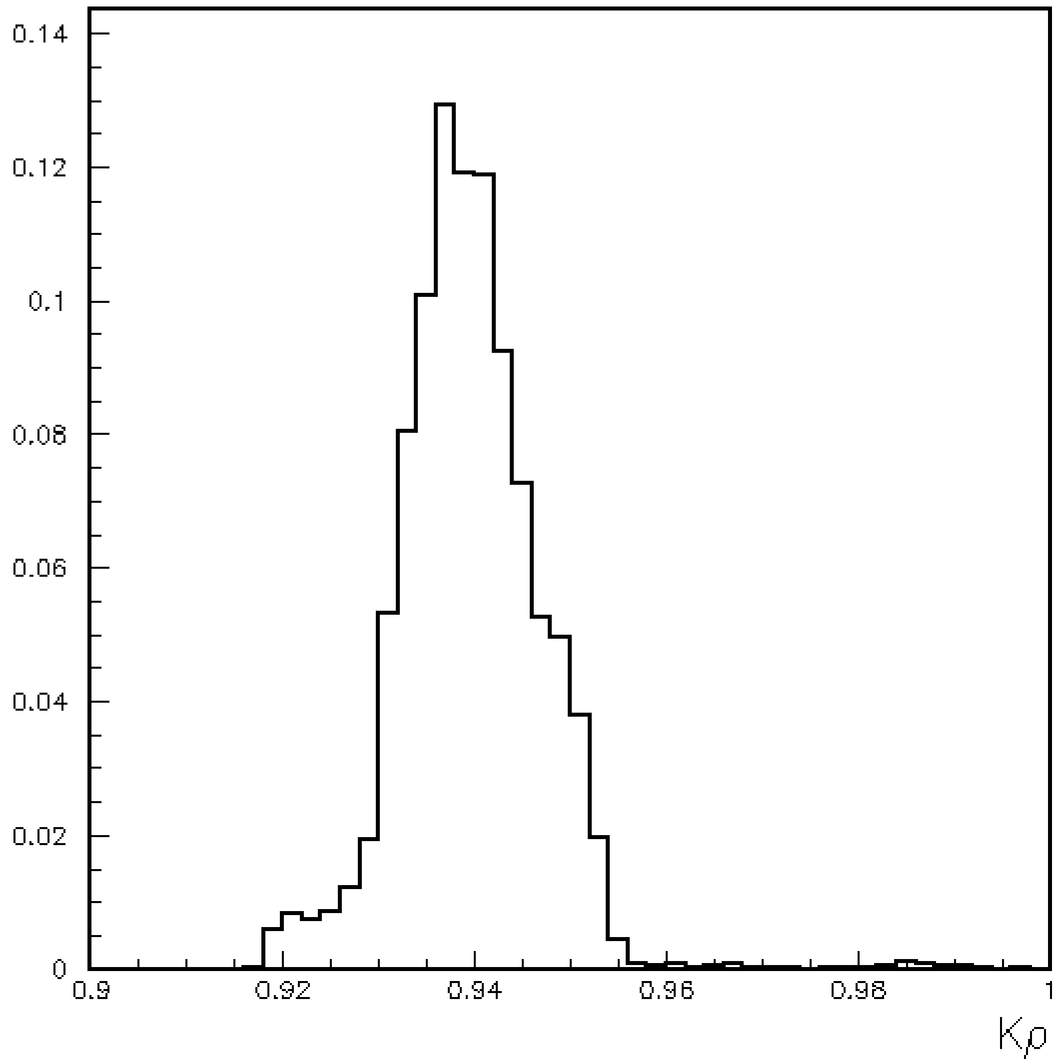
$$R = \frac{BR(\phi \to \eta'\gamma)}{BR(\phi \to \eta\gamma)} = \frac{N^{\eta'\gamma}}{N^{\eta\gamma}} \frac{\varepsilon_{MC}^{\eta\gamma} \cdot BR(\eta \to 3\pi^0)}{\left[BR_{crg}\varepsilon_{crgMC} + BR_{ntr}\varepsilon_{ntrMC}\right]} \cdot \frac{\varepsilon_{FE\,RD}^{\eta\gamma}}{\varepsilon_{FE\,RD}^{\eta'\gamma}} \cdot K_\rho$$

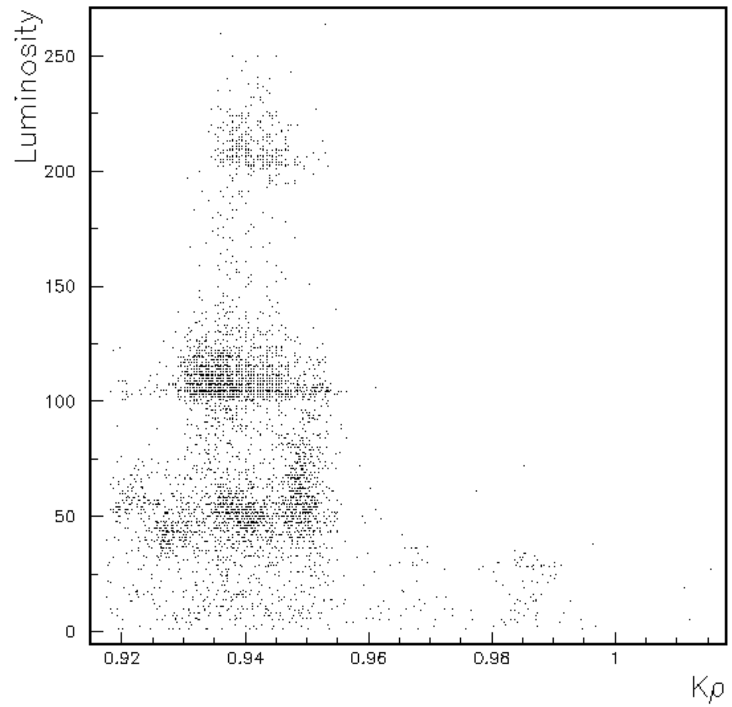
$$BR_{crg} = BR(\eta' \to \pi^+\pi^-\eta) \cdot BR(\eta \to \pi^0\pi^0\pi^0)$$

$$BR_{nrt} = BR(\eta' \to \pi^0\pi^0\eta) \cdot BR(\eta \to \pi^+\pi^-\pi^0)$$

We study K_ρ vs $\sqrt{s}$ for the analyzed runs and take the mean value

The factor K_ρ





$K_\rho = 0.94 \pm 0.01$

$\Downarrow$

1%

MC RAD'04

- New cluster efficiency curve (T.&M.)

$$\varepsilon^{\eta'\gamma}_{eff.crv.} = 23.45\%; \varepsilon^{\eta\gamma}_{eff.crv.} = 33.66\%$$

$$\varepsilon^{\eta'\gamma}_{no\_crv} \Big/ \varepsilon^{\eta\gamma}_{no\_crv} = 0.70 \pm 0.02 \Rightarrow \varepsilon^{\eta'\gamma}_{eff.crv.} \Big/ \varepsilon^{\eta\gamma}_{eff.crv.} = 0.697 \pm 0.007$$

$$R_{\phi}^{no\_crv} = 4.71 \cdot 10^{-3} \Rightarrow R_{\phi}^{eff.crv} = 4.69 \cdot 10^{-3}$$

In summer conference we show:

$$R = \frac{BR(\phi \to \eta'\gamma)}{BR(\phi \to \eta\gamma)} = \frac{N^{\eta'\gamma}}{N^{\eta\gamma}} \frac{\varepsilon_{MC}^{\eta\gamma} BR(\eta \to 3\pi^0)}{\left[BR_{crg}\varepsilon_{crgMC} + BR_{ntr}\varepsilon_{ntrMC}\right]} \cdot \frac{\varepsilon_{F/E\,RD}^{\eta\gamma}}{\varepsilon_{F/E\,RD}^{\eta'\gamma}} \cdot K_\rho$$

where

$$\begin{cases} BR_{crg} = BR(\eta' \to \pi^+\pi^-\eta) \cdot BR(\eta' \to \pi^0\pi^0\pi^0) \\ BR_{nrt} = BR(\eta' \to \pi^0\pi^0\eta) \cdot BR(\eta' \to \pi^+\pi^-\pi^0) \end{cases}$$

$$R = (4.76 \pm 0.08 \pm 0.20) \cdot 10^{-3}$$

$$1\% \oplus 1.3\% \oplus 1.4 \oplus 0.08\% \oplus 0.4\% \oplus 1.5\% \oplus 3\%$$

Filfo-EVCL TRK VTX Bg $\varepsilon\eta/\varepsilon\eta'$ $\chi 2$ BR"

Now we have:

$$R = (4.74 \pm 0.09 \pm 0.20) \cdot 10^{-3}$$

$$1\% \oplus 1\% \oplus 1 \oplus 0.08\% \oplus 0.4\% \oplus 1.5\% \oplus 3\% \oplus 1\%$$

Filfo-EVCL TRK VTX Bg $\varepsilon\eta/\varepsilon\eta'$ $\chi 2$ BR" $K\rho$

- No changes in systematic evaluation: 4%
- $K\rho$ correction from 0.95 to 0.94

Mixing angle

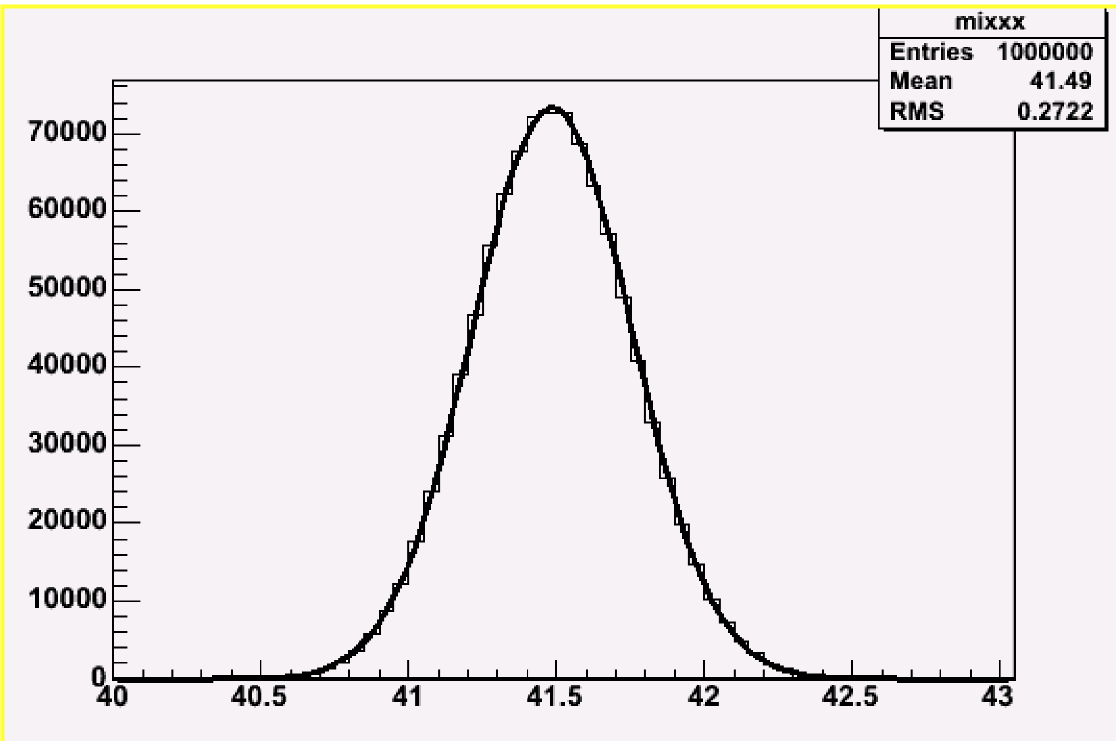
$$R_{\phi} = \frac{BR(\phi \to \eta'\gamma)}{BR(\phi \to \eta\gamma)} = \cot^2 \varphi_P \left(1 - \frac{m_s}{\overline{m}} \cdot \frac{Z_{NS}}{Z_S} \cdot \frac{\tan \varphi_V}{\sin 2\varphi_P}\right)^2 \cdot \left(\frac{p_{\eta'}}{p_\eta}\right)^3$$

- stat. uncertainty: mc extraction of R with Gaussian distribution
- syst. unc.: mc extraction of R with flat distribution
- th. unc.: difference between angle extractions using different values for parameters.

$$\varphi_P = \left(41.5 \pm 0.3_{stat} \pm 0.7_{sys} \pm 0.6_{th}\right)^{\circ}$$

Statistical uncertainty

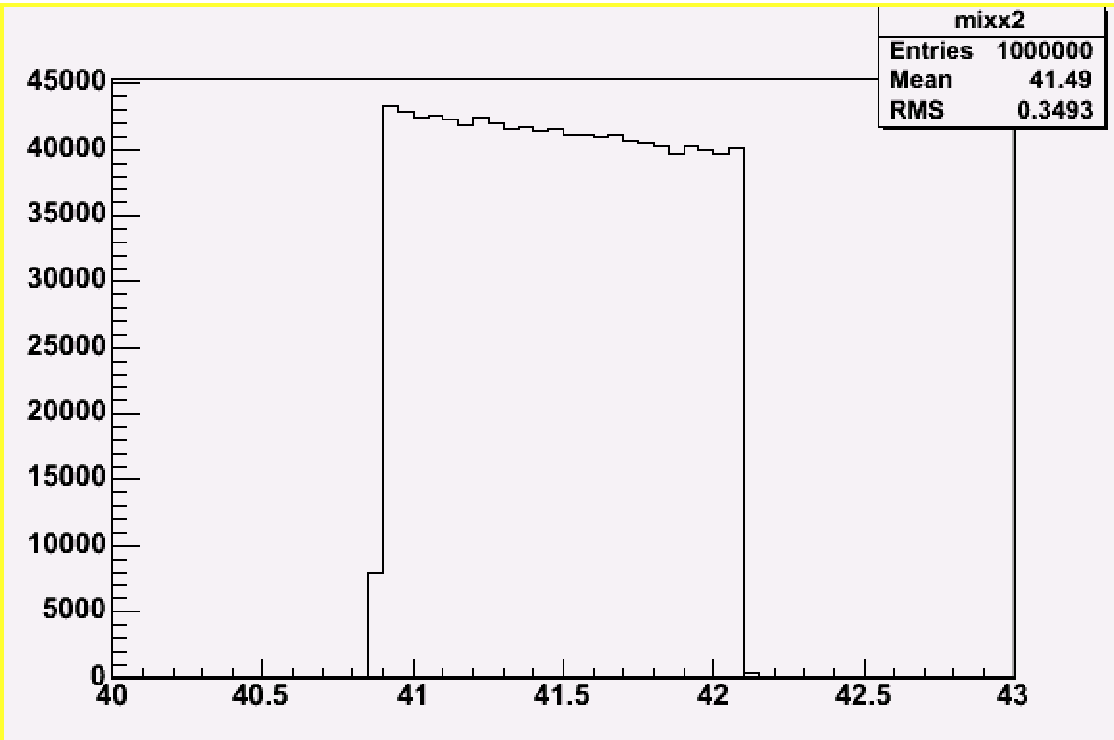
$$R_{\phi} = \frac{BR(\phi \to \eta'\gamma)}{BR(\phi \to \eta\gamma)} = \cot^2 \varphi_P \left(1 - \frac{m_s}{\overline{m}} \cdot \frac{Z_{NS}}{Z_S} \cdot \frac{\tan \varphi_V}{\sin 2\varphi_P}\right)^2 \cdot \left(\frac{p_{\eta'}}{p_{\eta}}\right)^3$$



$$\varphi_P = (41.5 \pm 0.3_{stat})^\circ$$

Systematic uncertainty

$$R_\phi = \frac{BR(\phi \to \eta'\gamma)}{BR(\phi \to \eta\gamma)} = \cot^2\varphi_P \left(1 - \frac{m_s}{\overline{m}} \cdot \frac{Z_{NS}}{Z_S} \cdot \frac{\tan\varphi_V}{\sin 2\varphi_P}\right)^2 \cdot \left(\frac{p_{\eta'}}{p_\eta}\right)^3$$



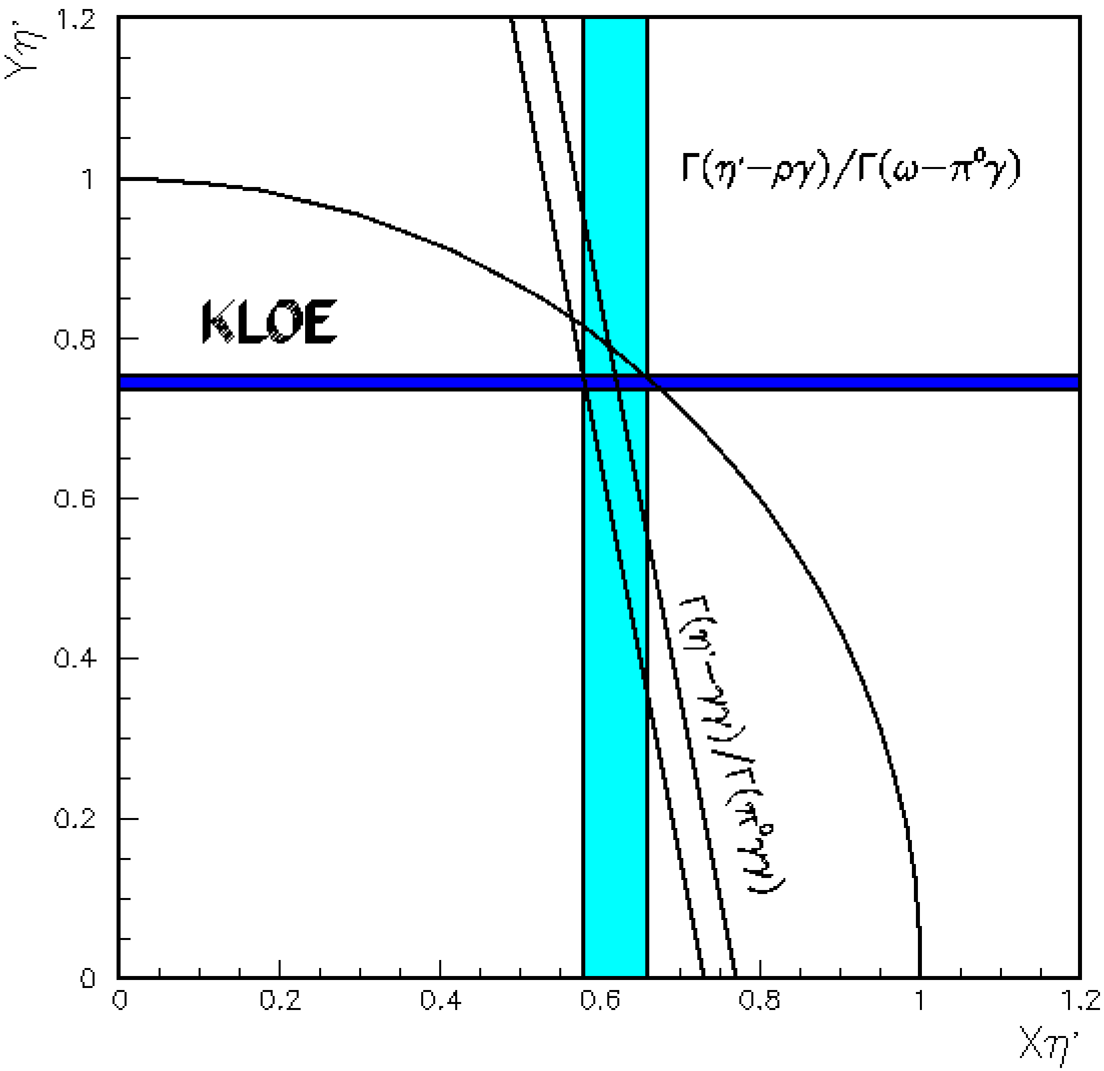
$$\varphi_P = (41.5 \pm 0.7_{sys})^\circ$$

Theoretical uncertainty

$$R_\phi = \frac{BR(\phi \to \eta'\gamma)}{BR(\phi \to \eta\gamma)} = \cot^2 \varphi_P \left(1 - \frac{m_s}{\overline{m}} \cdot \frac{Z_{NS}}{Z_S} \cdot \frac{\tan \varphi_V}{\sin 2\varphi_P}\right)^2 \cdot \left(\frac{p_{\eta'}}{p_\eta}\right)^3$$

- VP Wave function overlaps: Z_{NS}=0.91±0.05; Z_S=0.89±0.07;
  Z_{NS}/Z_S =1.02±0.10 $\Rightarrow$ ±10%
  $\Rightarrow$ maximum variation $\Delta\varphi_P$=±0.3°
- m_s/m= (1.24-1.45)
  $\Rightarrow$ maximum variation $\Delta\varphi_P$=±0.5°
- Theo. unc. $\Delta\varphi_P$=±0.6°

Gluonic content



$$X^2 + Y^2 = 0.92 \pm 0.06$$