KLOE results on the pseudoscalar mixing angle and the η' gluonium content

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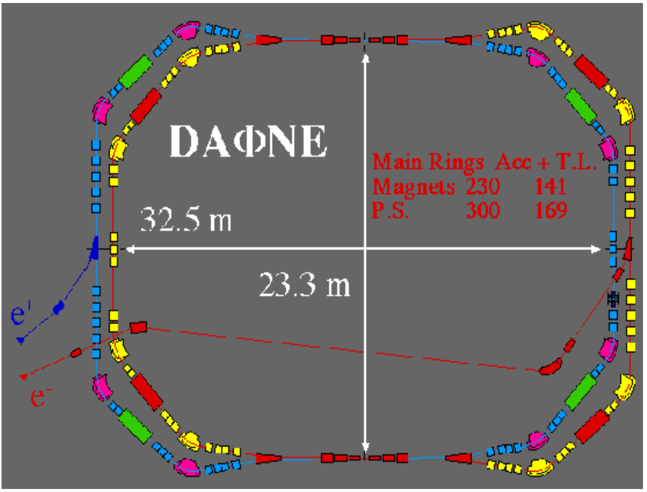
The DAΦNE machine and the KLOE detector



- $\sigma(e^+e^- \to \phi) \sim 3\ \mu b$ $\sqrt{s} = m(\phi) = 1019.4 MeV$
- Independent e^+e^- rings to reduce beam-beam interactions
- crossing angle: 25 mrad, $p_x(\phi) \sim 12{,}6$ MeV/c
- Bunch crossing every 2.7 ns $\int \mathcal{L}\, dt = 2.5\ fb^{-1}$
- injection during acquisition

$\mathcal{L}_{peak} = 1.5 \times 10^{32}\ cm^{-2} s^{-1}$

Electromagnetic Calorimeter (EMC)

- Fine sampling Pb / Scifi
- Hermetical coverage
- High efficiency for low energy photons

$\sigma_E/E = 5.7\%/\sqrt{E(GeV)}$

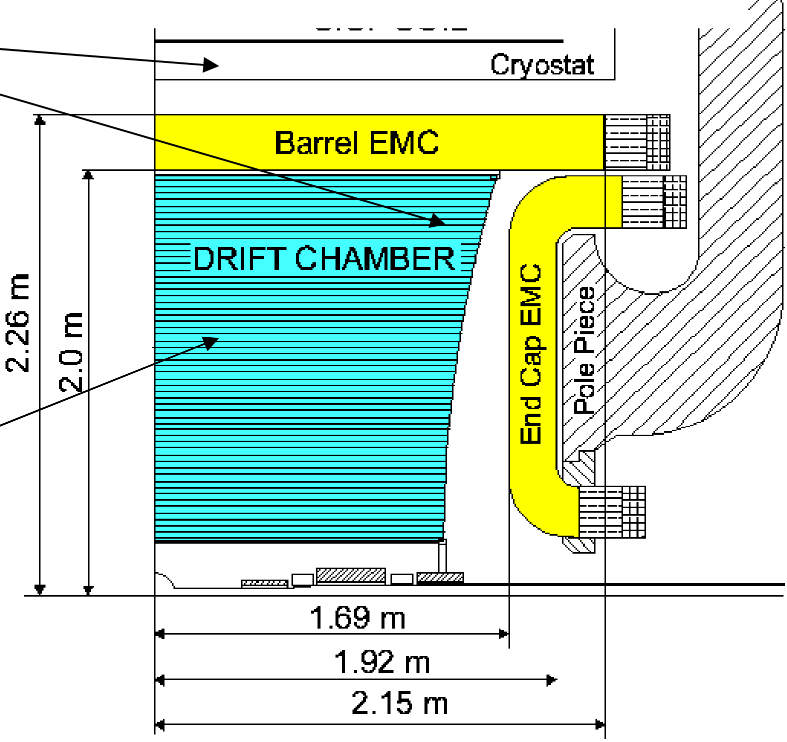
$\sigma_t = 54ps/\sqrt{E(GeV)} \oplus 140\ ps$

Central drift chamber (DCH)

Helium based gas mixture

$\sigma_v = 1\ mm$ $\sigma_{pt}/p_t = 0.5\%$

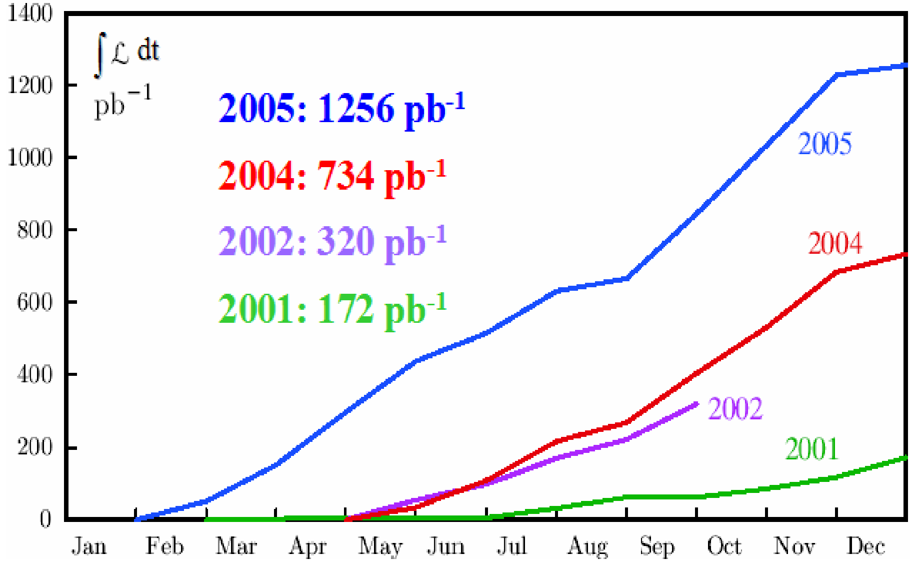
$\sigma_{r\phi} = 200\ \mu m$ $\sigma_z = 2\ mm$

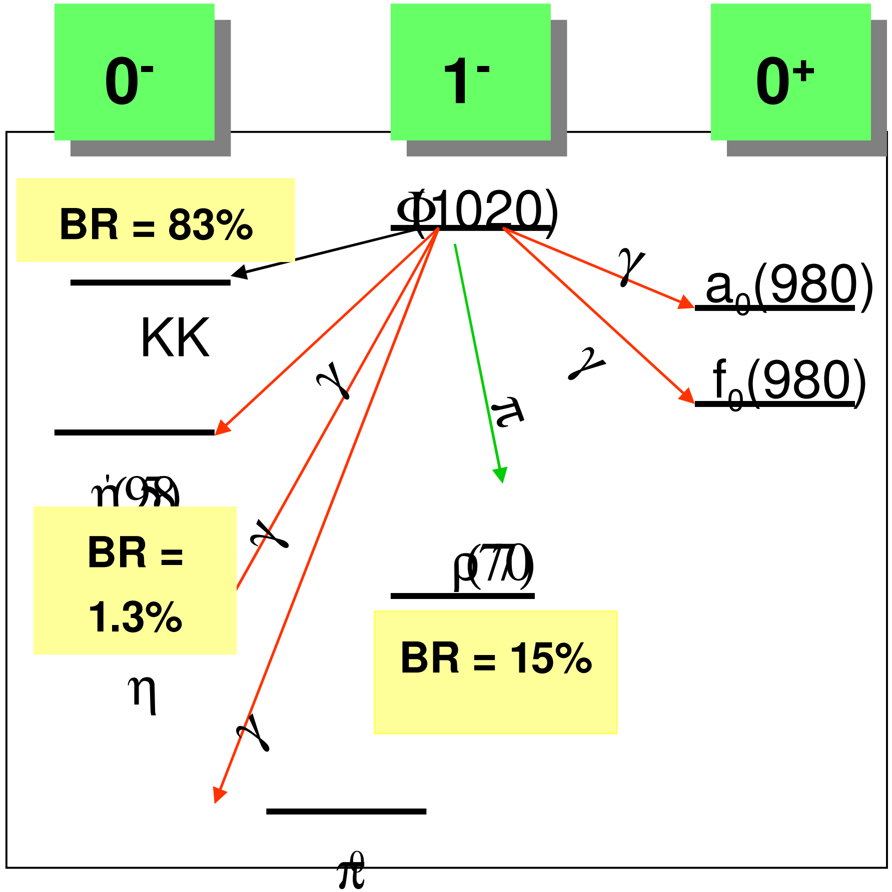


DAΦNE: the meson factory

Acquired data

2001-2006 data taking





2.5 fb^{-1} on tape @ $\sqrt{s}$=M$_\phi$

≈ 8×10^9 φ   1×10^8 η   500.000 η' produced

250 pb^{-1} @ $\sqrt{s}$=1000 MeV + 4 scan points around the φ

$Br(\phi\to\eta'\gamma)/Br(\phi\to\eta\gamma)$

427 pb^{-1} ('01-'02 data)
$N(\eta\gamma) = 1.665\times10^{6}$ (no bck)

$N(\pi^{+}\pi^{-}7\gamma's) = 3750\pm60$ ($N_{bckg} = 345$)

$N(\eta'\gamma) = 3405 \pm 61_{stat} \pm 43_{syst}$

Decay channel topology

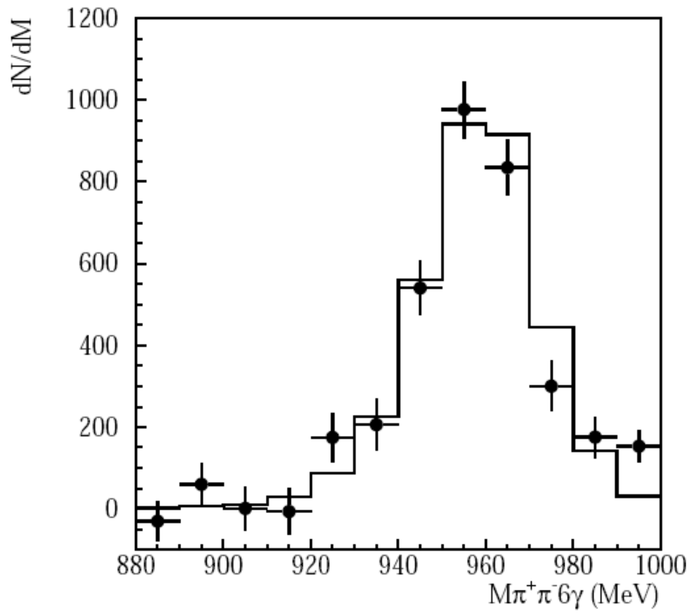
$\eta' \to \pi^{+}\pi^{-}\eta,\ \eta \to 3\pi^{0}$

$\eta' \to \pi^{0}\pi^{0}\eta,\ \eta \to \pi^{+}\pi^{-}\pi^{0}$

$R_{\phi} = (4.77 \pm 0.09_{stat.} \pm 0.19_{syst})\times10^{-3}$

Dominated by the η' Br uncertainty

Using PDG BR(φ→ηγ) $Br(\phi\to\eta'\gamma) = (6.20 \pm 0.09_{stat.} \pm 0.25_{syst.})\times10^{-5}$



In perfect agreement with previous KLOE result Phys. Lett. B541 (2002)

$\eta' \to \pi^{+}\pi^{-}\eta,\ \eta \to \gamma\gamma$ (~20 pb^{-1})

$$R = (4.70 \pm 0.47_{stat} \pm 0.31_{sys})\cdot 10^{-3}$$

$$BR(\phi \to \eta'\gamma) = (6.10 \pm 0.61 \pm 0.43)\cdot 10^{-5}$$

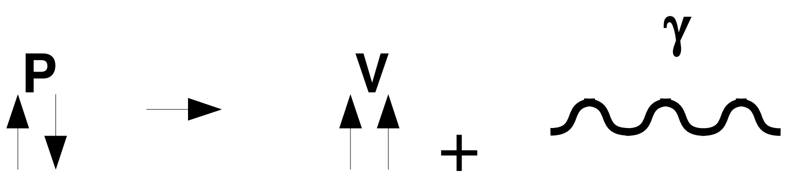
η,η': mixing and gluonium

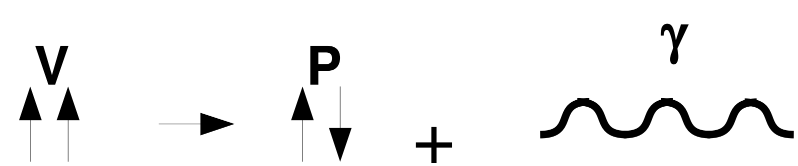
The η,η' mesons wave function can be decomposed in the quark mixing base as in the folowing (J. L. Rosner, Phys. Rev. D 27 (1983) 1101.).

$$|\eta'\rangle = X_{\eta'}|q\bar{q}\rangle + Y_{\eta'}|s\bar{s}\rangle + Z_{\eta'}|G\rangle \qquad |\eta\rangle = \cos\varphi_P|q\bar{q}\rangle - \sin\varphi_P|s\bar{s}\rangle \qquad |q\bar{q}\rangle = \frac{|u\bar{u}\rangle + |d\bar{d}\rangle}{\sqrt{2}}$$

$$X_{\eta'} = \sin\varphi_P \cos\varphi_G$$
$$Y_{\eta'} = \cos\varphi_P \cos\varphi_G$$
$$Z_{\eta'} = \sin\varphi_G$$

The $\phi \rightarrow \eta,\eta'\,\gamma$ transition is modelled according a spin flip transition





$$\Gamma(P \rightarrow V\gamma) = \frac{g^2}{4\pi}|p_\gamma|^3$$

$$\Gamma(V \rightarrow P\gamma) = \frac{1}{3}\frac{g^2}{4\pi}|p_\gamma|^3$$

Only quarks participate to the electromagnetic transition, gluonium is spectator.
It appears in the η' decay amplitudes only through the normalisation to 1 ($Y_{\eta'} \sim \cos\varphi_G$)

KLOE [Phys. Lett. B648 (2007) 267] has fitted:

$$\frac{\Gamma(\eta'\to\rho\gamma)}{\Gamma(\omega\to\pi^0\gamma)}=\frac{z_q^2}{\cos^2\phi_V}\cdot 3\left(\frac{m_{\eta'}^2-m_\rho^2 m_\omega}{m_\omega^2-m_\pi^2 m_{\eta'}}\right)^3 X_{\eta'}^2$$

$$\frac{\Gamma(\eta'\to\omega\gamma)}{\Gamma(\omega\to\pi^0\gamma)}=\frac{1}{3}\left(\frac{m_{\eta'}^2-m_\omega^2 m_\omega}{m_\omega^2-m_\pi^2 m_{\eta'}}\right)^3\left[z_q X_{\eta'}+2\frac{m_s}{\bar{m}} z_s\cdot\tan\phi_V\cdot Y_{\eta'}\right]^2$$

together with the measured branching ratio:

$\phi\to\eta'\gamma$

$\eta'\to\pi^+\pi^-\eta,\ \eta\to3\pi^0$

$\eta'\to\pi^0\pi^0\eta,\ \eta\to\pi^+\pi^-\pi^0$

$R_\phi = (4.77 \pm 0.09 \pm 0.19)\times 10^{-3}$ ~ 4000

~ 1.7×10^6

$\phi\to\eta\gamma\quad \eta\to3\pi^0$

$$R_\phi=\frac{Br(\phi\to\eta'\gamma)}{Br(\phi\to\eta\gamma)}=\cot^2\phi_P\cdot\cos^2\phi_G\left(1-\frac{m_s}{\bar{m}}\frac{z_q}{z_s}\cdot\frac{\tan\phi_V}{\sin 2\phi_P}\right)^2\cdot\left(\frac{p_{\eta'}}{p_\eta}\right)^3$$

and the ratio:

$$\frac{\Gamma(\eta'\to\gamma\gamma)}{\Gamma(\pi^0\to\gamma\gamma)}=\frac{1}{9}\left(\frac{m_{\eta'}}{m_\pi}\right)^3\left(5X_{\eta'}+\sqrt{2}\frac{f_q}{f_s}Y_{\eta'}\right)^2$$

E. Kou, Phys. Rev. D 63 (2001) 54027

V P γ and Pγγ transitions

KLOE [Phys. Lett. B648 (2007) 267] has fitted:

$$\frac{\Gamma(\eta'\rightarrow\rho\gamma)}{\Gamma(\omega\rightarrow\pi^0\gamma)}=\frac{z_q^2}{\cos^2\phi_V}\cdot 3\left(\frac{m_{\eta'}^2-m_\rho^2 m_\omega}{m_\omega^2-m_\pi^2 m_{\eta'}}\right)^3 X_{\eta'}^2$$

$$\frac{\Gamma(\eta'\rightarrow\omega\gamma)}{\Gamma(\omega\rightarrow\pi^0\gamma)}=\frac{1}{3}\left(\frac{m_{\eta'}^2-m_\omega^2 m_\omega}{m_\omega^2-m_\pi^2 m_{\eta'}}\right)^3\left[z_q X_{\eta'}+2\frac{m_s}{\bar{m}}z_s\cdot\tan\phi_V\cdot Y_{\eta'}\right]^2$$

Were taken from a global fit without gluonium:

A. Bramon, R. Escribano, M.D. Scadron
Phys. Lett. B503 (2001) 271

together with the measured branching ratio:

R_ϕ = (4.77 ±0.09±0.19)×10^{-3}

$\phi\rightarrow\eta'\gamma$ ~ 4000

$\eta'\rightarrow\pi^+\pi^-\eta,\ \eta\rightarrow 3\pi^0$

$\eta'\rightarrow\pi^0\pi^0\eta,\ \eta\rightarrow\pi^+\pi^-\pi^0$

~ 1.7× 10^6

$\phi\rightarrow\eta\gamma\quad \eta\rightarrow 3\pi^0$

$$R_\phi=\frac{Br(\phi\rightarrow\eta'\gamma)}{Br(\phi\rightarrow\eta\gamma)}=\cot^2\phi_P\cdot\cos^2\phi_G\left(1-\frac{m}{\bar{m}}\frac{z_q}{z_S}\cdot\frac{\tan\phi_V}{\sin 2\phi_P}\right)^2\cdot\left(\frac{p_{\eta'}}{p_\eta}\right)^3$$

and the ratio:

$$\frac{\Gamma(\eta'\rightarrow\gamma\gamma)}{\Gamma(\pi^0\rightarrow\gamma\gamma)}=\frac{1}{9}\left(\frac{m_{\eta'}}{m_\pi}\right)^3\left(5X_{\eta'}+\sqrt{2}\frac{f_q}{f_s}Y_{\eta'}\right)^2$$

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$$\frac{\Gamma(\eta'\to\omega\gamma)}{\Gamma(\omega\to\pi^0\gamma)}=\frac{1}{3}\left(\frac{m_{\eta'}^2-m_\omega^2 m_\omega}{m_\omega^2-m_\pi^2 m_{\eta'}}\right)^3\left[z_q X_{\eta'}+2\frac{m_s}{\bar{m}}z_s\cdot\tan\phi_V\cdot Y_{\eta'}\right]^2$$

T. Feldmann, Int. J. Mod. Phys. A 15 (2000) 159

together with the measured branching ratio:

$\phi\to\eta'\gamma$

$\eta'\to\pi^+\pi^-\eta,\ \eta\to3\pi^0$

$\eta'\to\pi^0\pi^0\eta,\ \eta\to\pi^+\pi^-\pi^0$

$R_\phi = (4.77 \pm 0.09 \pm 0.19)\times 10^{-3}$ ~ 4000

~ 1.7× 10⁶ $\phi\to\eta\gamma$ $\eta\to3\pi^0$

$$R_\phi=\frac{Br(\phi\to\eta'\gamma)}{Br(\phi\to\eta\gamma)}=\cot^2\phi_P\cdot\cos^2\phi_G\left(1-\frac{m_s}{\bar{m}}\frac{z_q}{z_S}\cdot\frac{\tan\phi_V}{\sin2\phi_P}\right)^2\cdot\left(\frac{p_{\eta'}}{p_\eta}\right)^3$$

and the ratio:

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E. Kou, Phys. Rev. D 63 (2001) 54027

Fit result

Fit results:

$\phi_P = (39.7 \pm 0.7_{tot})^\circ$

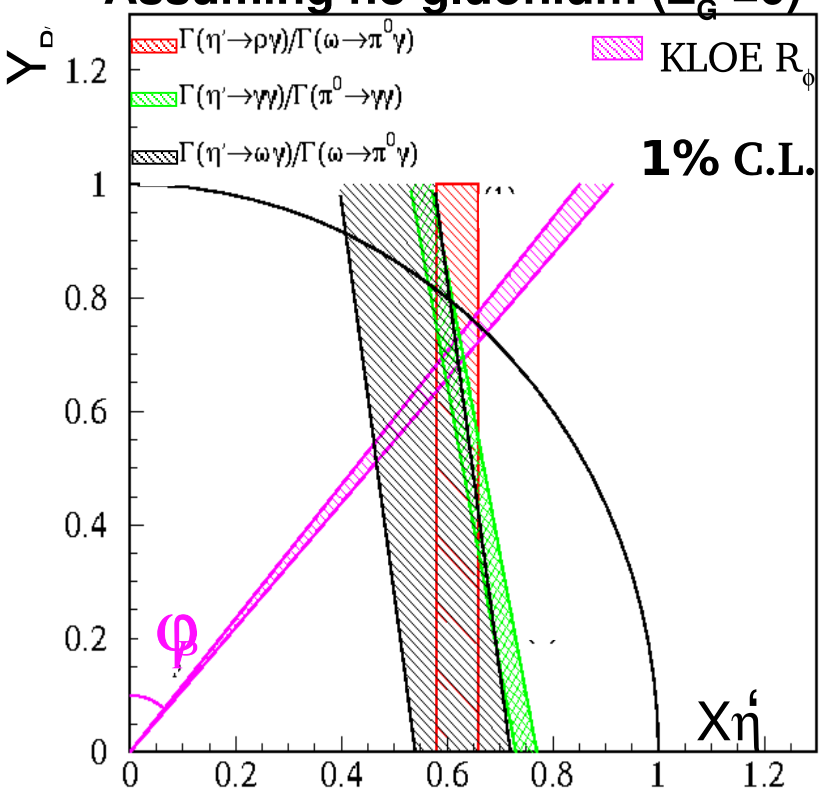
$|\phi_G| = (22 \pm 3)^\circ$

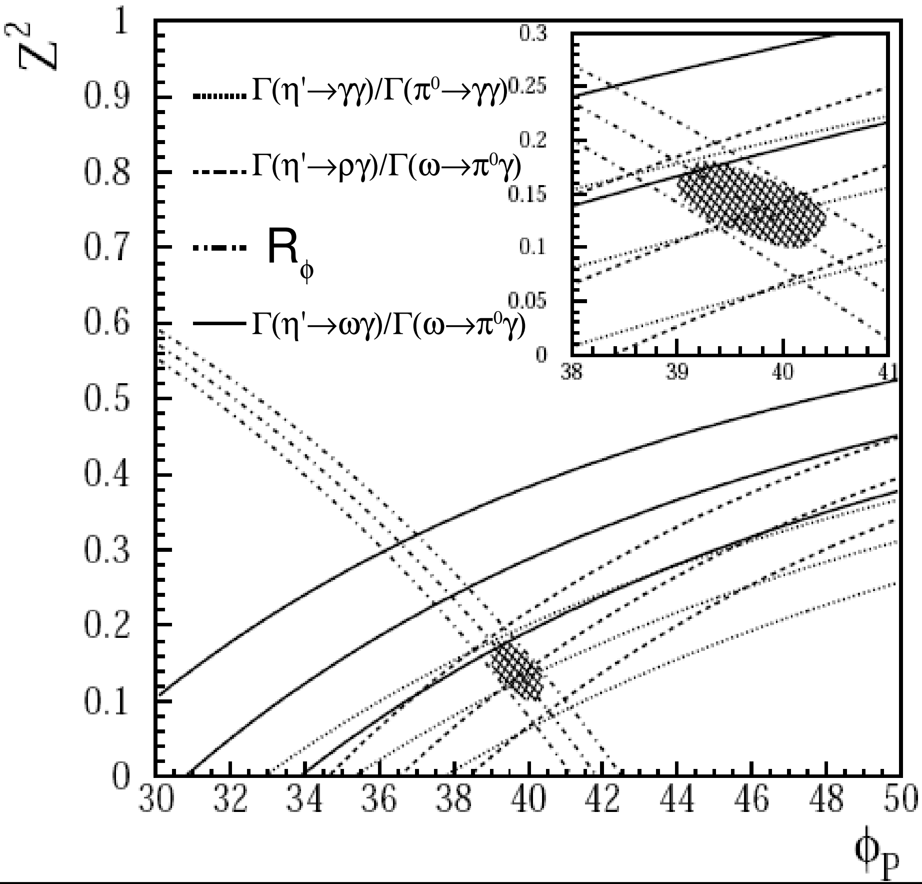
$\sin^2\phi_G = Z^2 = 0.14 \pm 0.04$

Gluonium at 3σ

49% C.L.

Assuming no gluonium (Z_G =0)





Objections...

In Escribano et al. (JHEP 0705:006,2007) different conclusions were found:

KLOE
(Phys. Lett. B648 (2007) 267)

$\phi_P = (39.7 \pm 0.7_{tot})^\circ$
$|\phi_G| = (22 \pm 3)^\circ$

$\sin^2\phi_G = Z^2 = 0.14 \pm 0.04$

Escribano
(JHEP 0705:006,2007)

$\phi_P = (41.4 \pm 1.3)^\circ$
$|\phi_G| = (12 \pm 13)^\circ$

$\sin^2\phi_G = Z^2 = 0.04 \pm 0.09$

The difference was attributed to the choice to fix the z_q and z_s parameter from a fit without gluonium.

Slightly different fit:

1) All theoretical parameters are left free;
2) Use of the couplings instead of the Γ ratios;
3) $\eta' \rightarrow \gamma\gamma / \pi^0 \rightarrow \gamma\gamma$ is not used in the fit.

To answer the objections.

1) Leave the z's parameter free;
2) Add more constraints (needed to perform the fit with larger number of parameters);
3) Check the contribution from $\eta' \to \gamma\gamma$ / $\pi^0 \to \gamma\gamma$

$$\frac{\Gamma(\omega\to\eta\gamma)}{\Gamma(\omega\to\pi^0\gamma)}=\frac{1}{9}\left[z_q\cos(\phi_p)-2\frac{m_s}{\bar{m}}z_s\tan(\phi_V)\sin(\phi_p)\right]^2(1-z_G^2)\left(\frac{m_\omega^2-m_\eta^2}{m_\omega^2-m_{\pi^0}^2}\right)^3$$

$$\frac{\Gamma(\rho\to\eta\gamma)}{\Gamma(\omega\to\pi^0\gamma)}=z_q^2\frac{\cos^2(\phi_p)}{\cos^2(\phi_V)}\left(\frac{m_\rho^2-m_\eta^2}{m_\omega^2-m_\pi^2}\frac{m_\omega}{m_\rho}\right)^3$$

$$\frac{\Gamma(\phi\to\eta\gamma)}{\Gamma(\omega\to\pi^0\gamma)}=\frac{1}{9}\left[z_q\tan(\phi_v)\cos(\phi_p)+2\frac{\bar{m}}{m_s}z_s\sin(\phi_p)\right]^2\left(\frac{m_\phi^2-m_\eta^2}{m_\omega^2-m_\pi^2}\frac{m_\omega}{m_\phi}\right)^3$$

$$\frac{\Gamma(\phi\to\pi^0\gamma)}{\Gamma(\omega\to\pi^0\gamma)}=\tan^2\phi_V\cdot\left(\frac{m_\phi^2-m_{\pi^0}^2}{m_\omega^2-m_{\pi^0}^2}\cdot\frac{m_\omega}{m_\phi}\right)^3,\quad \frac{\Gamma(K^{+*}\to K^+\gamma)}{\Gamma(K^{*0}\to K^0\gamma)}=\left(\frac{2\frac{m_s}{\bar{m}}-1}{1+\frac{m_s}{\bar{m}}}\right)^2\cdot\left(\frac{m_{K^{*+}}^2-m_{K^{+0}}^2}{m_{K^{*0}}^2-m_{K^0}^2}\cdot\frac{m_{K^{*0}}}{m_{K^{*+}}}\right)^3$$

Fit procedure.

The χ^2 is defined as follows:

$$\chi^2 = \Sigma_{i,j=1,3} \left(y_i - y_i^{th}\right) \times V_{ij}^{-1} \left(y_j - y_j^{th}\right)$$

V_{ij} is the error matrix which is a function of theoretical uncertainties, as well as the experim

$$V_{ij} = [B_{ij} + (A_{ik} \times C_{kl} \times A_{lj}^{T})]$$

Experimental covariance matrix

Theoretical parameters covariance matrix

B_{ij} **Full covariance matrix (correlation comes from the constrained fit to η' Br)**

$$; A_{ik} = \begin{pmatrix} \frac{\partial y_1^{th}}{\partial f_s} & \frac{\partial y_1^{th}}{\partial f_q} & \frac{\partial y_1^{th}}{\partial C_{NS}} & \frac{\partial y_1^{th}}{\partial C_S} & \frac{\partial y_1^{th}}{\partial \frac{m_s}{m}} \\ \frac{\partial y_2^{th}}{\partial f_s} & \frac{\partial y_2^{th}}{\partial f_q} & \frac{\partial y_2^{th}}{\partial C_{NS}} & \frac{\partial y_2^{th}}{\partial C_S} & \frac{\partial y_2^{th}}{\partial \frac{m_s}{m}} \\ \frac{\partial y_3^{th}}{\partial f_s} & \frac{\partial y_3^{th}}{\partial f_q} & \frac{\partial y_3^{th}}{\partial C_{NS}} & \frac{\partial y_3^{th}}{\partial C_S} & \frac{\partial y_3^{th}}{\partial \frac{m_s}{m}} \end{pmatrix}$$

$$C_{kl} = \begin{pmatrix} \sigma_{f_q}^2 & 0 \\ 0 & \sigma_{f_s}^2 \end{pmatrix}$$

Re-evaluated at each minimization step

The experimental covariance matrix B contains correlation among common used quantities in the fitted relations:

$$\frac{\Gamma(\omega\to\eta\gamma)}{\Gamma(\omega\to\pi^0\gamma)}, \frac{\Gamma(\rho\to\eta\gamma)}{\Gamma(\omega\to\pi^0\gamma)}, \frac{\Gamma(\phi\to\eta\gamma)}{\Gamma(\omega\to\pi^0\gamma)} \longrightarrow$$

Introduces a correlation in the fitted quantities

$$\frac{\Gamma(\eta'\to\gamma\gamma)}{\Gamma(\pi^0\to\gamma\gamma)} = \frac{Br(\eta'\to\gamma\gamma)\Gamma_{\eta'}}{\Gamma(\pi^0\to\gamma\gamma)} \qquad \frac{\Gamma(\eta'\to\rho\gamma)}{\Gamma(\omega\to\pi^0\gamma)} = \frac{Br(\eta'\to\rho\gamma)\Gamma_{\eta'}}{\Gamma(\omega\to\pi^0\gamma)}$$

x_2	−34					
x_3	−78	−29				
x_4	−35	−24	32			
x_5	−26	−12	26	8		
x_6	−28	−11	35	11	9	
Γ	32	−2	−24	−5	−88	−8
	x_1	x_2	x_3	x_4	x_5	x_6

	Mode	Rate (MeV)	Scale factor
Γ_1	$\pi^+\pi^-\eta$	0.090 ±0.008	1.2
Γ_2	$\rho^0\gamma$ (including non-resonant $\pi^+\pi^-\gamma$)	0.060 ±0.005	1.2
Γ_3	$\pi^0\pi^0\eta$	0.042 ±0.004	1.6
Γ_4	$\omega\gamma$	0.0062 ±0.0008	1.2
Γ_5	$\gamma\gamma$	0.00430±0.00015	1.1
Γ_6	$3\pi^0$	$(3.2 \pm 0.6) \times 10^{-4}$	1.1

Br and Γ strongly correlated (above all Γ(η'→γγ))

the Γ is measured using:

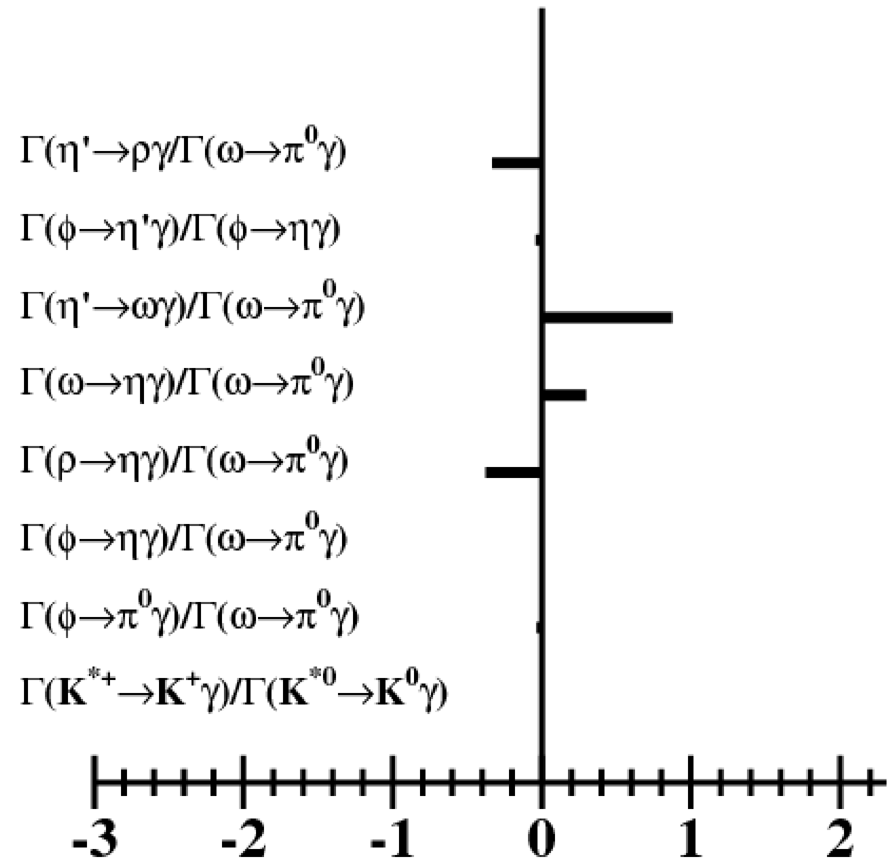
$$e^+e^-\to\eta' e^+e^-$$

An independent measurement of the η' total width is welcome.

Fit results without $\eta'\to\gamma\gamma$ / $\pi^0\to\gamma\gamma$

	This fit $\chi^2/\text{ndf} = 1.8/2$	**Escribano et al.** (JHEP 0705:006,2007) $\chi^2/\text{ndf} = 4.0/4$
Z^2	0.03 ± 0.06	0.04 ± 0.09
ϕ_p	$(41.6 \pm 0.8)°$	$(41.4 \pm 1.3)°$
Z_q	0.85 ± 0.03	0.86 ± 0.03
Z_S	0.78 ± 0.05	0.79 ± 0.05
ϕ_V	$(3.16 \pm 0.10)°$	$(3.2 \pm 0.1)°$
$\frac{m_s}{\bar{m}}$	1.24 ± 0.07	1.24 ± 0.07

$$Pulls = \frac{Measure - Fit}{\sigma_{Measure}}$$

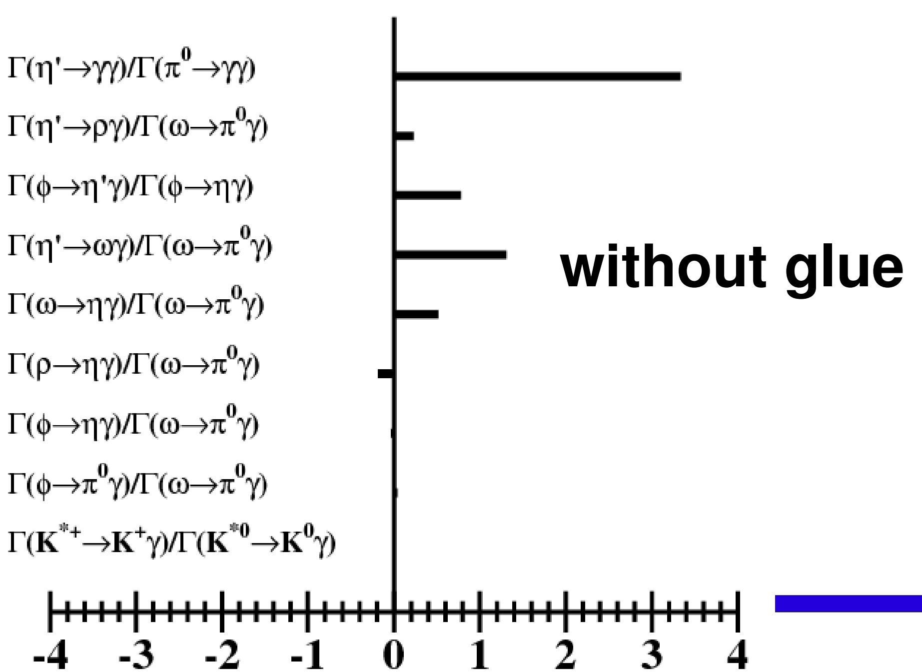


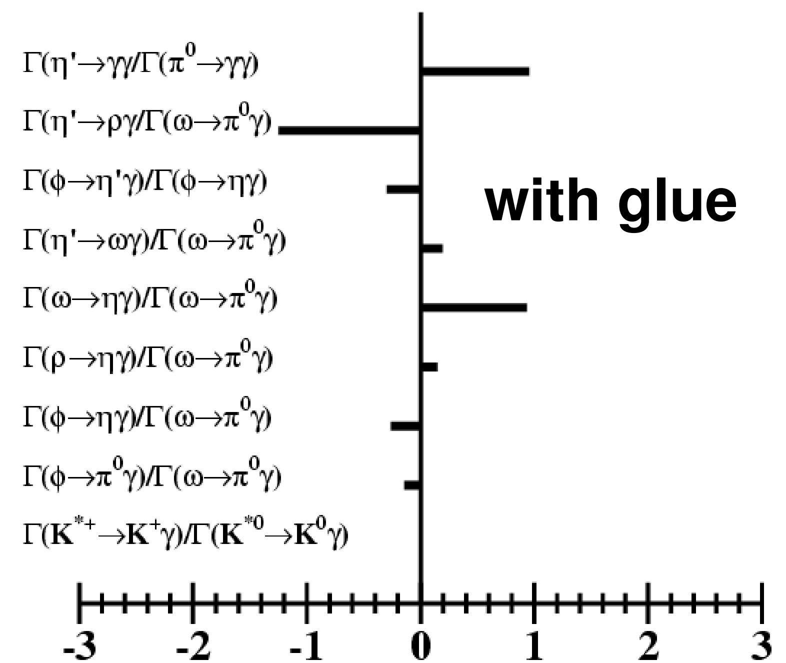
If we include the P→γγ constraint

$$\frac{\Gamma(\eta'\to\gamma\gamma)}{\Gamma(\pi^0\to\gamma\gamma)}=\frac{1}{9}\left(\frac{m_{\eta'}}{m_\pi}\right)^3\left(5\sin(\phi_P)\cos(\phi_G)+\sqrt{2}\frac{f_q}{f_s}\cos(\phi_P)\cos(\phi_G)\right)^2$$

	without glue $\chi^2/ndf = 13/4$ (1.1%)	**with glue** $\chi^2/ndf = 5/3$
Z^2	fixed 0	0.105 ± 0.037
ϕ_P	$(41.6 \pm 0.5)°$	$(40.7 \pm 0.7)°$
Z_q	0.863 ± 0.024	0.866 ± 0.025
Z_S	0.78 ± 0.05	0.79 ± 0.05
ϕ_V	$(3.17 \pm 0.10)°$	$(3.15 \pm 0.10)°$
$\frac{m_s}{\bar{m}}$	1.24 ± 0.07	1.24 ± 0.07

$$Pulls=\frac{Measure-Fit}{\sigma_{Measure}}$$





Fitting the couplings...

The fit is performed directly on the coupling "g" that are derived from PDG06 using the formula:

$$\Gamma(P \to V\gamma) = \frac{g^2}{4\pi}|p_\gamma|^3 \qquad \Gamma(V \to P\gamma) = \frac{1}{3}\frac{g^2}{4\pi}|p_\gamma|^3$$

$$g_{\rho^0\pi^0\gamma} = g_{\rho^+\pi^+\gamma} = \tfrac{1}{3}g \;, \quad g_{\omega\pi\gamma} = g\cos\phi_V \;, \quad g_{\phi\pi\gamma} = g\sin\phi_V \;,$$

$$g_{K^{*0}K^0\gamma} = -\tfrac{1}{3}g\, z_K\left(1 + \frac{\bar{m}}{m_s}\right) \;, \quad g_{K^{*+}K^+\gamma} = \tfrac{1}{3}g\, z_K\left(2 - \frac{\bar{m}}{m_s}\right) \;,$$

$$g_{\rho\eta\gamma} = g\, z_q\, X_\eta \;, \quad g_{\rho\eta'\gamma} = g\, z_q\, X_{\eta'}$$

$$g_{\omega\eta\gamma} = \tfrac{1}{3}g\left(z_q\, X_\eta\cos\phi_V + 2\frac{\bar{m}}{m_s}z_s\, Y_\eta\sin\phi_V\right) \;,$$

$$g_{\omega\eta'\gamma} = \tfrac{1}{3}g\left(z_q\, X_{\eta'}\cos\phi_V + 2\frac{\bar{m}}{m_s}z_s\, Y_{\eta'}\sin\phi_V\right) \;,$$

$$g_{\phi\eta\gamma} = \tfrac{1}{3}g\left(z_q\, X_\eta\sin\phi_V - 2\frac{\bar{m}}{m_s}z_s\, Y_\eta\cos\phi_V\right) \;,$$

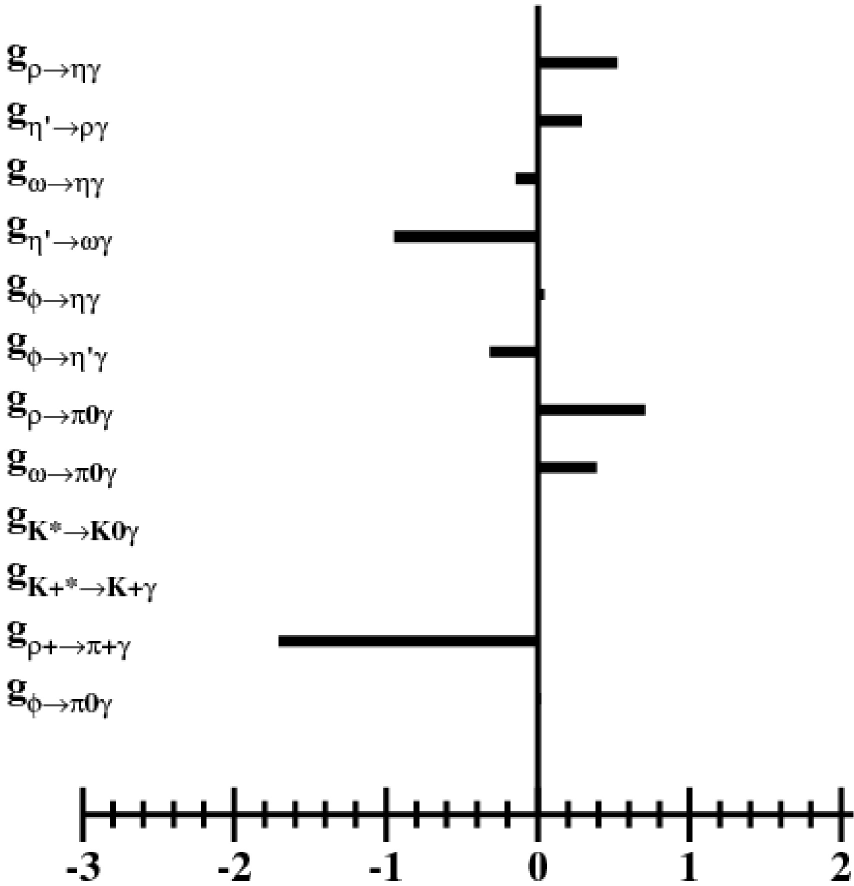
$$g_{\phi\eta'\gamma} = \tfrac{1}{3}g\left(z_q\, X_{\eta'}\sin\phi_V - 2\frac{\bar{m}}{m_s}z_s\, Y_{\eta'}\cos\phi_V\right) \;,$$

1) No correlation taken into account

2) Some parameters added (g, Z_K), they disappear in the ratio.

No P→γγ measurement. Fit done with gluonium.

	this fit	escribano (JHEP 0705:006,2007)
	$\chi^2/ndf = 4.7/4$	$\chi^2/ndf = 4.4/5$
ϕ_G	$(11\pm11)^\circ$	$(12\pm13)^\circ$
ϕ_P	$(41.5 \pm 1.1)^\circ$	$(41.4 \pm 1.3)^\circ$
Z_q	0.86 ± 0.03	0.86 ± 0.03
Z_S	0.78 ± 0.05	0.79 ± 0.05
ϕ_V	$(3.18 \pm 0.10)^\circ$	$(3.2\pm 0.1)^\circ$
$\frac{m_s}{\bar{m}}$	1.24 ± 0.07	1.24 ± 0.07
Z_K	0.89 ± 0.03	0.89 ± 0.03
g	0.719 ± 0.010	0.72 ± 0.01



$P\to\gamma\gamma$ measurement included in the fit.

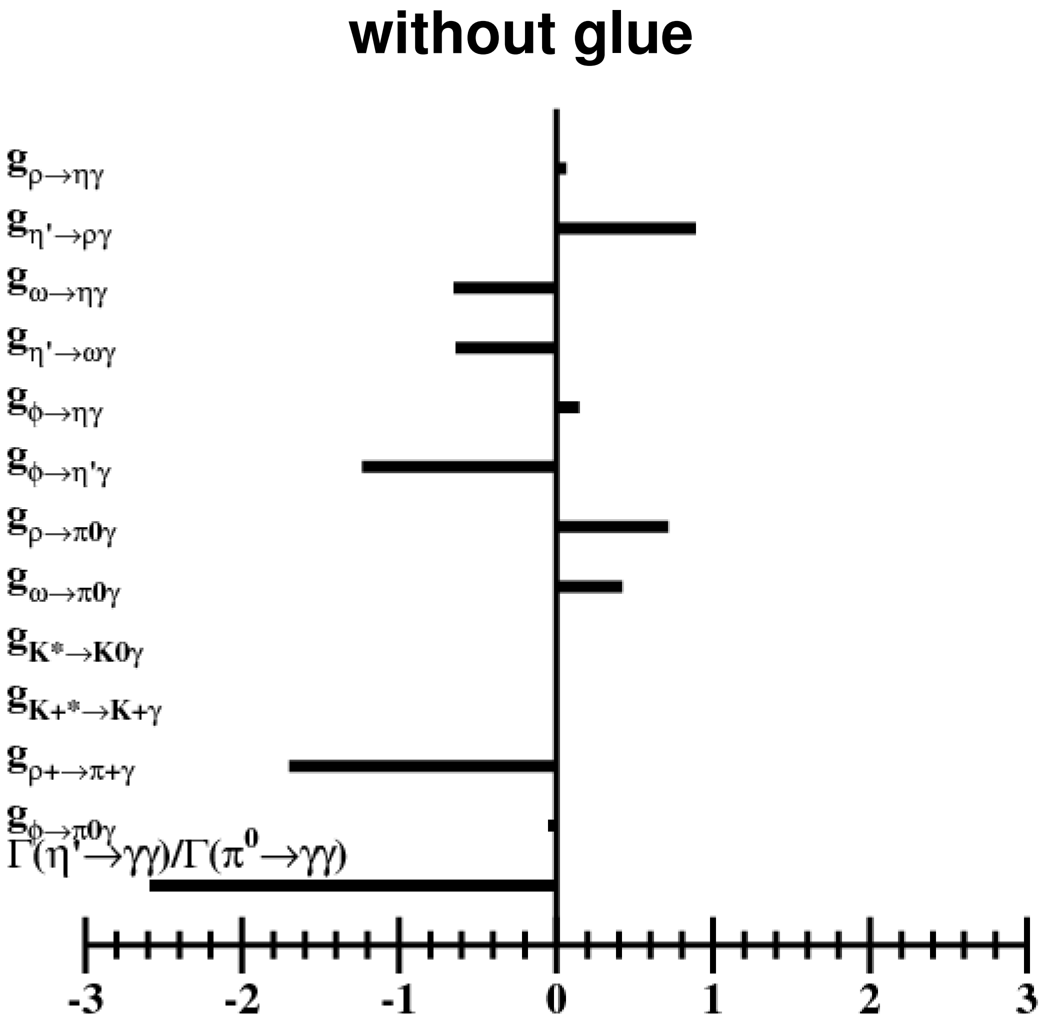
$$\frac{\Gamma(\eta'\to\gamma\gamma)}{\Gamma(\pi^0\to\gamma\gamma)}=\frac{1}{9}\left(\frac{m_{\eta'}}{m_\pi}\right)^3\left(5\sin(\phi_P)\cos(\phi_G)+\sqrt{2}\frac{f_q}{f_s}\cos(\phi_P)\cos(\phi_G)\right)^2$$

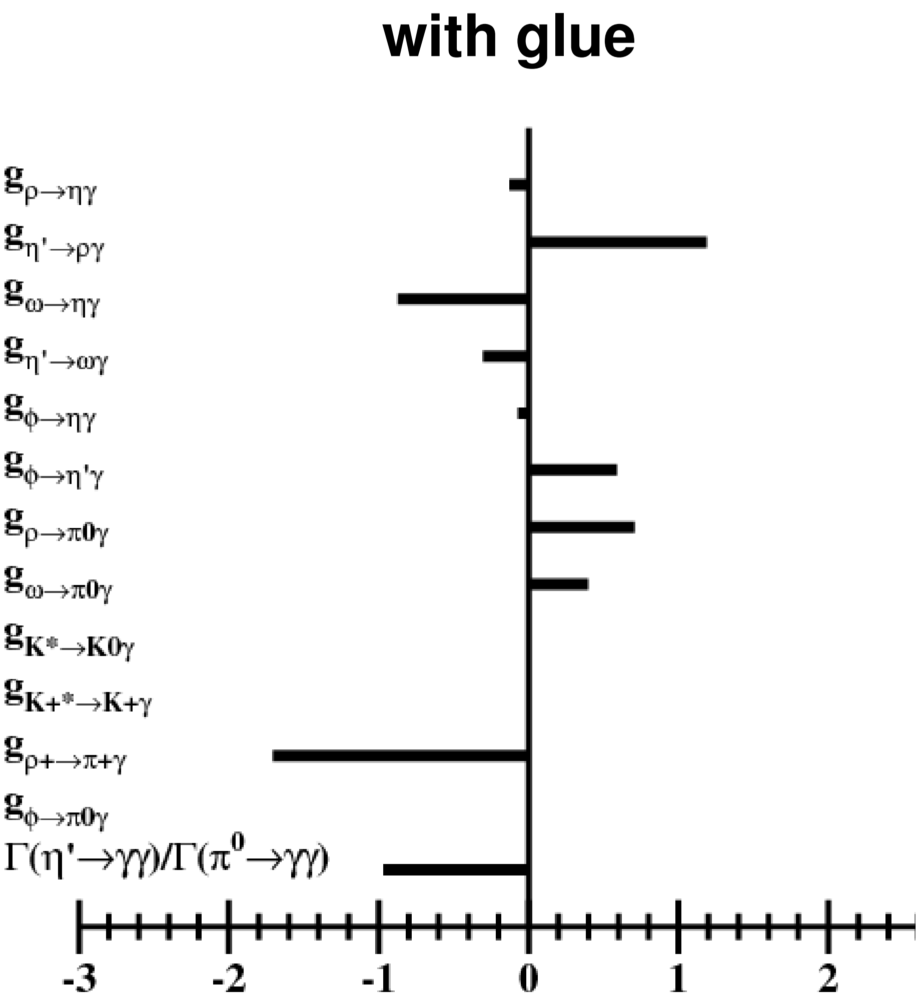
E. Kou, Phys. Rev. D 63 (2001) 54027

	without glue	**with glue**
	χ^2/ndf = 13/5 (2.3%)	χ^2/ndf = 7.2/4
ϕ_G	fixed at 0	$(20\pm4)^\circ$
ϕ_P	$(40.1 \pm 0.9)^\circ$	$(41.2 \pm 1.1)^\circ$
Z_q	0.85 ± 0.024	0.88 ± 0.03
Z_s	0.80 ± 0.05	0.79 ± 0.05
ϕ_V	$(3.2\pm 0.1)^\circ$	$(3.18 \pm 0.10)^\circ$
$\frac{m_s}{\bar{m}}$	1.24 ± 0.07	1.24 ± 0.07
Z_K	0.89 ± 0.03	0.89 ± 0.03
g	0.72 ± 0.01	0.719 ± 0.010

$Z_{\eta'}^2 = 0.11\pm 0.05$

Fit pulls comparison.





Conclusions

- The difference between KLOE and Escribano result due to the choice to include $P\to\gamma\gamma$

- Leaving free z_q and z_s parameter doesn't have important effects

- A question to Bass
  Could the glue involved in $V\to P\gamma$ different than the one seen in $\eta'\to\gamma\gamma$?