Test of FSR in the process $e^+e^- \to \pi^+\pi^-\gamma$ at DAFNE and extraction of F_π at threshold

G. Pancheri, O. Shekhovtsova, G. Venanzoni

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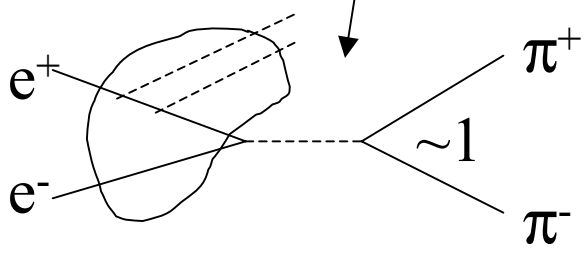
•Usually many parameters for the general amplitude:
$\geq$9 in the cases of our model for RPT +ϕ (4(ISR)+5(FSR))

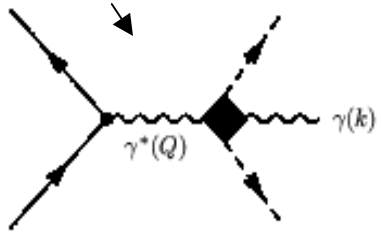
•Very difficult to extract simultaneously all these parameters from the same set of data ($\pi^+\pi^-\gamma$), expecially at threshold

•We suggest an alternative approach:

Model independent test of FSR out of sQED

$$\left(\frac{d\sigma_T}{dQ^2}\right)_s = |F_\pi(Q^2)|^2 \, H_s(Q^2) + \left(\frac{d\sigma_F}{dQ^2}\right)_s, \qquad \left(\frac{d\sigma_F}{dQ^2}\right)_s = \left(\frac{d\sigma_{sQED+\phi}}{dQ^2}\right)_s + \Delta\Im$$





contribution to FSR **beyond** sQED,
(including interference with the ϕ)

We construct the following quantity

$$\Upsilon_s(Q^2) = \frac{(d\sigma_T/dQ^2)_s - (d\sigma_{sQED+\phi}/dQ^2)_s}{H_s(Q^2)} \equiv |F_\pi(Q^2)|^2 + \Delta F_s(Q^2)$$

If no contribution beyond sQED is present, $\Upsilon_s(Q^2) \equiv |F_\pi(Q^2)|^2$ **independently of the energy s at which is evaluated**

For two different beam energies: ($s=1\,GeV^2$ and $s=m_\phi^2$)

$$\Delta Y(Q^2) = Y_{s1}(Q^2) - Y_{s2}(Q^2)$$

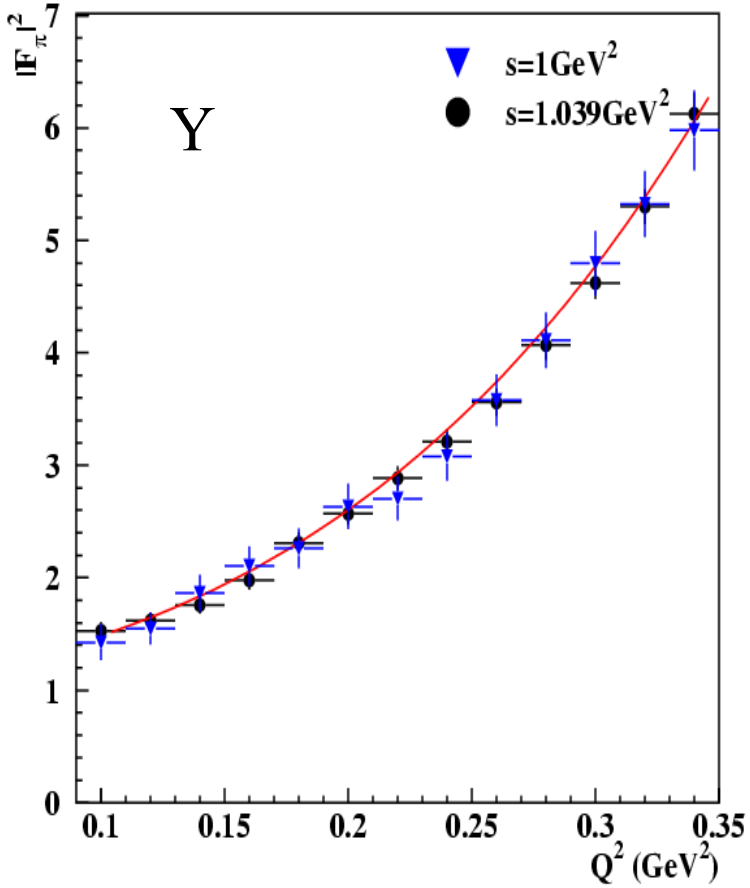
For **sQED** $\Delta Y=0$, any deviation from **0** shows **FSR out of sQED**

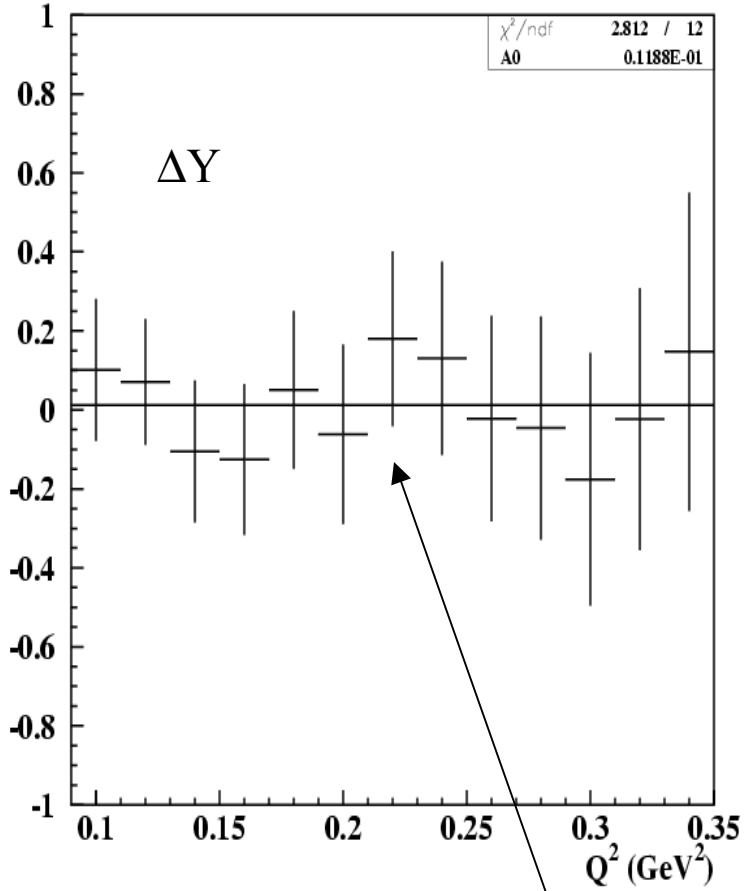
- Pro's of the method:
  - NLO corrections to ISR can be computed by MC via H (which is an input parameter of the procedure);
  - $(d\sigma_{sQED+\phi}/dQ^2)$ is an input parameter of the procedure and is computed by MC
  - The $\phi\to\pi\pi\gamma$ amplitude is taken from neutral channels $\phi\to\pi^0\pi^0\gamma$ (therefore its description is **not** restricted to f_0 only, like in our simulation)
  - A MC procedure allows fine tuning and to keep control over efficiencies and resolution effects

Application to KLOE (2fb^{-1} at 1.02 GeV, 200 pb^{-1} at 1 GeV)

$50^o < \theta_\gamma < 130^o$, $50^o < \theta_\pi < 130^o$

FSR in the framework of sQED





$$F_\pi(Q^2) \cong 1 + p_1 Q^2 + p_2 Q^4$$

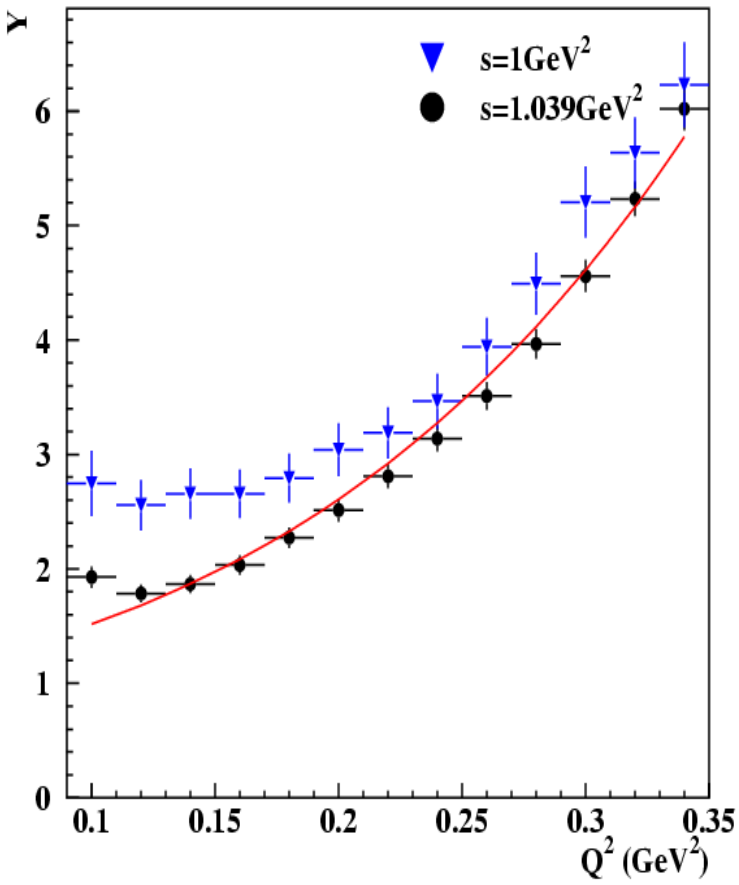
p1=1.4±0.19GeV^{-2},
p2=8.8 ± 0.73GeV^{-4}, χ^2=0.2
consistent with theory

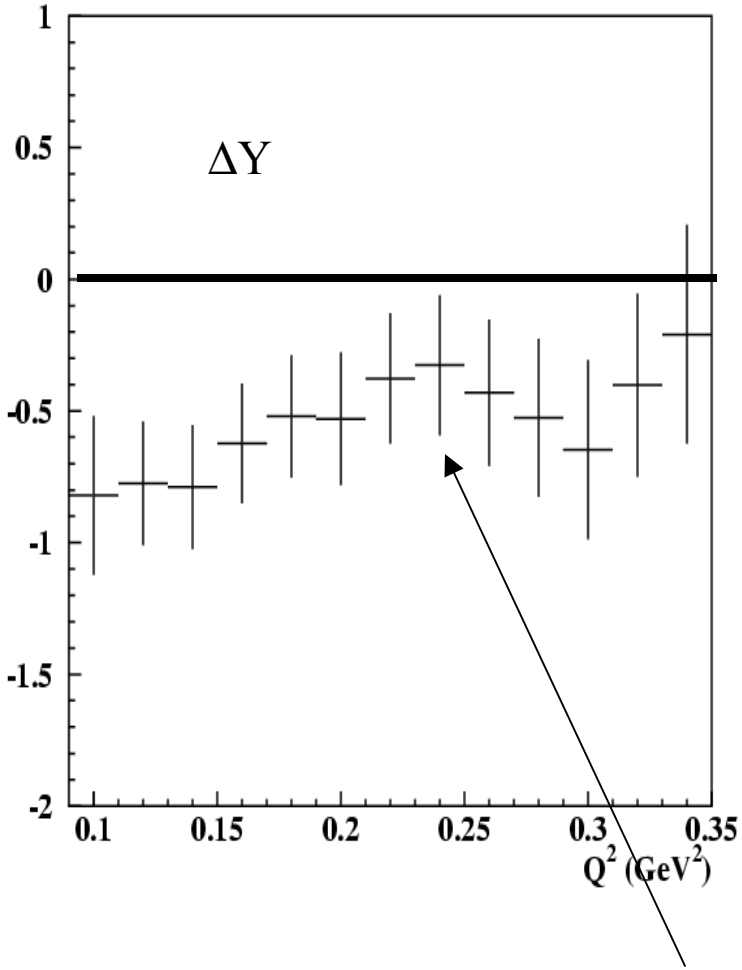
ΔY =0 as expected

Application to KLOE ($2fb^{-1}$ at 1.02 GeV, $200\ pb^{-1}$ at 1 GeV)

$50^o < \theta_\gamma < 130^o$, $50^o < \theta_\pi < 130^o$

FSR in the framework of RPT





No possible to fit simultaneously Y for the two different energy points

$\Delta Y \neq 0$

Evidence of FSR beyond of sQED

Conclusion

•Proposal to test FSR out of sQED in a model independent way, by using two different energy points. Useful for the extraction of F_π at threshold.

• KLOE can observe deviation from sQED predicted by RPT with the collected statistics at $s=1\ GeV^2$, and $1.02 GeV^2$.

•Very important to cross check what is found with charge asymmetry!