

KLOE hadronic cross section data in the HepDATA repository

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HZDR



KLOE05 in HEPData repository

<https://www.hepdata.net/record/ins655225>

◀ Hide Publication Information

Measurement of $\sigma(e^+e^- \rightarrow \pi^+\pi^-\gamma)$ and extraction of $\sigma(e^+e^- \rightarrow \pi^+\pi^-)$ below 1-GeV with the KLOE detector

The KLOE collaboration

Alasio, A., Ambrosino, F., Antonelli, A., Antonelli, M., Bacci, C., Barva, M., Bencivenni, G., Bertolucci, S., Bini, C., Blisio, C.

Phys.Lett.B606 (2005) 12-24, 2005.

<https://doi.org/10.17182/hepdata.41901>

Journal INSPIRE HepData Resources

Rivet Analysis

Abstract (data abstract)
FRASCATI-DAPHNE. Measurement of the cross section for the process $E + E^- \rightarrow \pi^+\pi^-\gamma$. The cross section for the $E + E^- \rightarrow \pi^+\pi^-$ process is extracted from the dependence on the invariant mass of the two-pion system. The form factor is also calculated.

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Filter 3 data tables

Table 1 >

Data from T 1
10.17182/hepdata.41901.v1/t1
The differential cross section as a function of the invariant mass of the di-pion system in the angular region $\text{THETA}(\text{PIPI}) < 15$ DEGREES or $\text{THETA}(\text{PIPI}) > 165$ DEGREES and $\text{THETA}(\text{PI})$ in the region 0 to 180 DEGREES.

cmenergies observables phrases reactions

0.023 DSIG/DM Exclusive E+ E- >> PI+ PI-

Single Differential E+ E- Scattering

Showing 50 of 60 values Show All 60 values

Table 2 >

Data from T 1
10.17182/hepdata.41901.v1/t2
The physical cross section for $E + E^- \rightarrow \pi^+\pi^-$ including FSR and vacuum polarization effects.

Table 3 >

Data from T 1
10.17182/hepdata.41901.v1/t3
The pion form factor with FSR and vacuum polarization effects removed.

Visualize

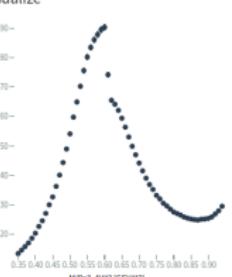
RE $E + E^- \rightarrow \pi^+\pi^-\text{GAMMA}$

SQRT(S) 0.023 GeV

M(P=3_4)**2 [GeV**2] $D(\text{SIG})/\text{DM}(P=3_4)**2 [\text{NB}/\text{GeV}**2]$

0.35	$13.4_{-0.24}^{+0.39} \pm 0.3$ sys, additional experimental systematic ± 0.3 sys, additional theory systematic error
0.36	$14.59_{-0.24}^{+0.39} \pm 0.3$ sys, additional experimental systematic ± 0.3 sys, additional theory systematic error
0.37	$15.78_{-0.24}^{+0.39} \pm 0.3$ sys, additional experimental systematic ± 0.3 sys, additional theory systematic error
0.38	$17.04_{-0.24}^{+0.39} \pm 0.3$ sys, additional experimental systematic

Sum errors Log Scale (X)



KLOE05 in HEPData repository

The entry contains 3 tables:

- the differential cross section $d\sigma(e^+e^- \rightarrow \pi^+\pi^-\gamma)/ds_\pi$ as a function of the invariant mass of the di-pion system, s_π , in the angular region $\theta_{\pi\pi} < 15^\circ$ or $\theta_{\pi\pi} > 165^\circ$, $0^\circ < \theta_\pi < 180^\circ$
 - 60 points with (diagonal) stat. uncertainty and a flat syst. uncertainty of $0.9\%(exp) \oplus 0.9\%(th)$
- the physical cross section $\sigma(e^+e^- \rightarrow \pi^+\pi^-)$ including FSR and vacuum polarization effects
 - 60 points with (diagonal) stat. uncertainty and a flat syst. uncertainty of $0.9\%(exp) \oplus 0.9\%(th)$
- the pion form factor with FSR and vacuum polarization effects removed.
 - 60 points with (diagonal) stat. uncertainty

The syst. uncertainties given are not correct - the $0.9\%(exp) \oplus 0.9\%(th)$ uncertainty is on the a_μ -value, not on the individual points.

No covariance matrices are listed, and no breakdown of systematical contributions (additional tables in the paper).

KLOE08 in HEPData repository

<https://www.hepdata.net/record/ins797438>

[◀ Hide Publication Information](#)

Measurement of $\sigma(e^+e^- \rightarrow \pi^+\pi^-\gamma(\gamma) \text{ and the dipion contribution to the muon anomaly with the KLOE detector}$

The KLOE collaboration

Ambrosino, F., Antonelli, A., Antoninelli, M., Archilli, F., Bacci, C., Beltrame, P., Bendivieni, G., Bertolucci, S., Bini, C., Bloise, C.

Phys.Lett. B670 (2009) 285–291, 2009.
<https://doi.org/10.1171/hepdata.57088>

[Journal](#) [INSPIRE](#) [HepData](#) [Resources](#)

[RivetAnalysis](#)

Abstract (data abstract)
FRASCATI-DAPHNE. Measurement of the cross section for the process $E^+ E^- \rightarrow \pi^+ \pi^- \text{ GAMMA} (\text{GAMMA})$ in the energy region 0.35 to 0.95 GeV. The data set has an integrated luminosity of 240 pb⁻¹. The four DSYs errors in the tables are the systematic errors (in percent) from background subtraction, acceptance, detector resolution and radiator function respectively.

Table 1 Data from T7,F4
10.1171/hepdata.57088.v1/t1
Differential cross section for $E^+ E^- \rightarrow \pi^+ \pi^- \text{ GAMMA} (\text{GAMMA})$

Table 2 Data from T7,F4
10.1171/hepdata.57088.v1/t2
Total cross section for $E^+ E^- \rightarrow \pi^+ \pi^-$.

Table 3 Data from T7,F6
10.1171/hepdata.57088.v1/t3
Pion form factor.

Download All [DSY/DM](#) [Exclusive](#) [Single Differential](#) [E+ E- Scattering](#) [0.51000,0.51000](#) [E+ E- → π+ π-](#)

View Analyses [Filter 3 data tables](#)

Showing 50 of 60 values [Show All 60 values](#)

RE	E+ E- → π+ PION GAMMA (GAMMA)
THETA(P=5)	> 15 DEGREES
M(P=3_4)**2 [GeV**2]	D(SIG)/DM(P=3_4)**2 [NB/GeV**2]
0.35 - 0.36	10.17 ± 0.18 stat ± 0.5% syst,1 ± 0.6% syst,2 ± 0.6% syst,3 ± 0.3% syst,4
0.36 - 0.37	14.21 ± 0.18 stat ± 0.4% syst,1 ± 0.6% syst,2 ± 0.6% syst,3 ± 0.4% syst,4
0.37 - 0.38	15.2 ± 0.18 stat ± 0.4% syst,1 ± 0.6% syst,2 ± 0.6% syst,3 ± 0.3% syst,4
0.38 - 0.39	16.0 ± 0.18 stat ± 0.4% syst,1 ± 0.6% syst,2 ± 0.6% syst,3 ± 0.3% syst,4
0.39 - 0.4	18.23 ± 0.17 stat ± 0.4% syst,1 ± 0.5% syst,2 ± 0.6% syst,3 ± 0.3% syst,4
0.4 - 0.41	19.97 ± 0.18 stat ± 0.4% syst,1 ± 0.5% syst,2 ± 0.6% syst,3 ± 0.3% syst,4

Visualize

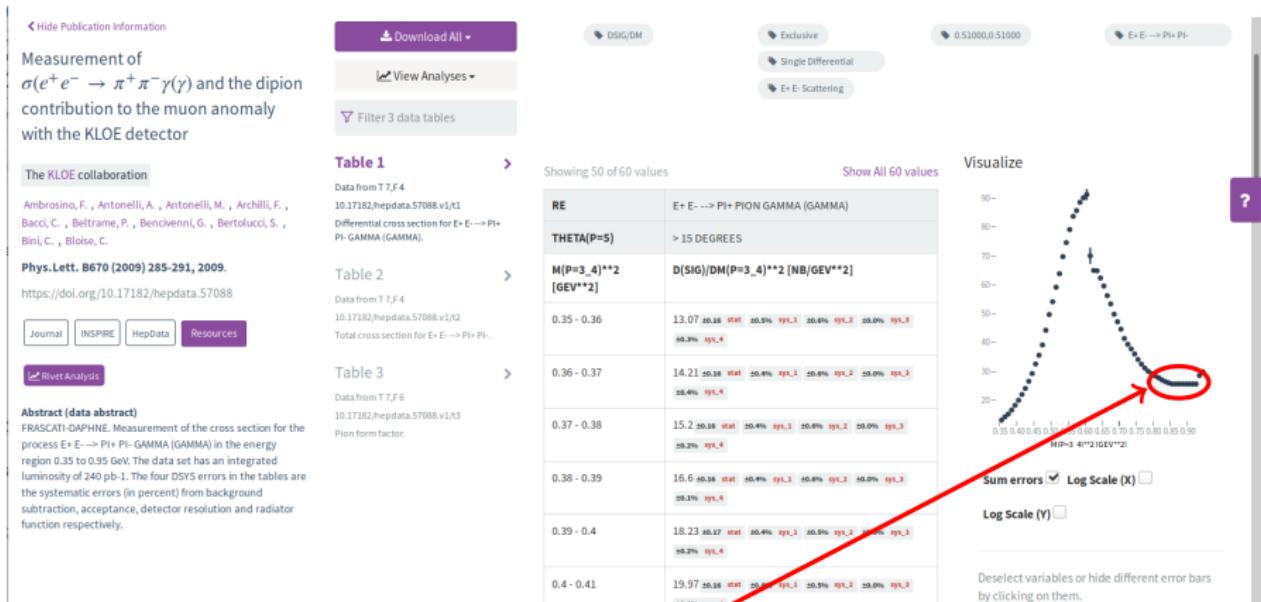
Sum errors Log Scale (X)

Log Scale (Y)

Deselect variables or hide different error bars by clicking on them.

KLOE08 in HEPData repository

<https://www.hepdata.net/record/ins797438>



Values between 0.86 and 0.92 GeV² for diff. cross section are incorrect!

KLOE08 in HEPData repository

The entry contains 3 tables:

- the observed differential cross section $d\sigma_{e^+e^- \rightarrow \pi^+\pi^-\gamma}/dM_{\pi\pi}^2$ as a function of the invariant mass of the dipion system, in the angular region $\theta_{\pi\pi}(\pi - \theta_{\pi\pi}) < 15^\circ$
 - 60 points with (diagonal) stat. uncertainty and 4 contributions to the systematic uncertainty (background subtr., acceptance, unfolding, radiator function)
- the bare cross section $\sigma_{\pi\pi}^0$ inclusive of FSR and with vac. pol. effects removed
 - 60 points with (diagonal) stat. uncertainty and 4 contributions to the systematic uncertainty (background subtr., acceptance, unfolding, radiator function)
- the pion form factor without FSR and with vac. pol. effects included.
 - 60 points with (diagonal) stat. uncertainty and 4 contributions to the systematic uncertainty (background subtr., acceptance, unfolding, radiator function)

No covariance matrices are listed, and no constant systematical contributions.

Update on KLOE10 HEPData preparations

Include radiative corrections in **HEPData** record:

- Correction due to **Vacuum Polarization**

- To go from *dressed* to *bare* cross section
- $\delta_{VP}(s) = (\alpha_{em}(s)/\alpha_{em}(0))^2$
- based on routine from Fred Jegerlehner:
<http://www-com.physik.hu-berlin.de/~fjeger/alphaQEDn.uu>
(2003)

- Correction due to **FSR from pointlike pions**

- To remove the effect from FSR from pion form factor
- Correction defined as $(1 + \eta_{FSR}(s))$
- $\eta_{FSR}(s)$ from F. Jegerlehner, Nucl. Phys. Proc. Suppl. 162 (2006) 22
(originally from Schwinger, but there is a typo in the original publication?)

- Correction due to **ISR photon emission**

- To go from the differential cross section $d\sigma_{e^+e^- \rightarrow \pi^+\pi^-\gamma}/dM_{\pi\pi}^2$ to the *bare* cross section $\sigma_{\pi\pi}^0$
- evaluated with **PHOKHARA5** MC generator (2005)

Update on KLOE10 HEPData preparations

Include radiative corrections in **HEPData** record:

Vacuum polarization correction for KLOE10 in **HEPData**:

The screenshot shows the HEPData interface with the following details:

- Title:** Vacuum polarisation correction
- Description:** Data from Figure 71 in additional documentation KLOE Note 225.
- Plots:** A plot of the vacuum polarization correction $\delta V(x) = \frac{e^2 \alpha}{4 \pi M_\pi^2} x^2$, with $x = p_{\text{beam}}/\delta$, calculated using the routine from E. Jägerleben (<http://www-cern.physik.hu-berlin.de/~ejagerleben/2k08/>) (2008).
- Tables:** A table showing 15 values of M_π^2 (GeV 2) and $\delta V(x)$ for $x = 1.0$.
- Keywords:** The record includes the observable keyword `RADCORR` and the phrases keywords `Vacuum Polarisation` and `Radiative Correction`.

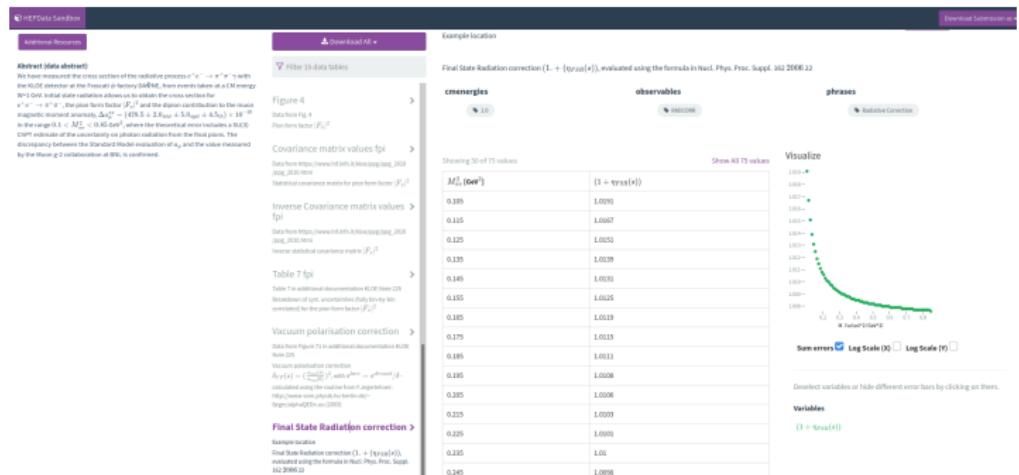
M_π^2 [GeV 2]	$\delta V(x)$
0.105	1.0149 ± 0.0000 ± 0.0000
0.115	1.0147 ± 0.0000 ± 0.0000
0.125	1.0149 ± 0.0000 ± 0.0000
0.135	1.0149 ± 0.0000 ± 0.0000
0.145	1.0149 ± 0.0000 ± 0.0000
0.155	1.0149 ± 0.0000 ± 0.0000
0.165	1.0149 ± 0.0000 ± 0.0000
0.175	1.0149 ± 0.0000 ± 0.0000
0.185	1.0147 ± 0.0000 ± 0.0000
0.195	1.0149 ± 0.0000 ± 0.0000

Using HEPData observable keyword `["RADCORR"]` and phrases keywords `["Vacuum Polarisation"]` and `["Radiative Correction"]`

Update on KLOE10 HEPData preparations

Include radiative corrections in **HEPData** record:

FSR correction ($1 + \eta(s)$) from pointlike pions for KLOE10 in **HEPData**:



Using **HEPData** observable keyword [**‘RADCORR’**] and phrases keywords [**‘Final State Radiation’**] and [**‘Radiative Correction’**]

Update on KLOE10 HEPData preparations

Include radiative corrections in **HEPData** record:

ISR radiator function used in KLOE10 in HEPData:

Abstract (data abstract)
We have measured the cross section of the radiative process $e^+e^- \rightarrow e^+e^- \gamma$ with the KLOE detector at the Frascati or factory DAΦNE. We have taken data at a CM energy $\sqrt{s} = 2.208$ GeV. The differential cross section is $\frac{d\sigma}{dx} = 0.0105 \text{ nb/GeV}^2$. The value used for a in the ISR radiator function is $a = 999.85 \text{ GeV}^2$, corresponding to the mean value of 1600 GeV energy for data collected in 2006. Obtained with the PHOENIX MC generator, see Eur. Phys. J. C77, 663 (2017) and <https://hepdata.net/record/14046>.

Figure 4
Figure 4 shows the differential cross section $H(M_{\pi^0}^2, x) = \frac{d\sigma}{dx}$ inclusive in θ_{π^0} in units of 10^{-3} nb/GeV^2 . The value used for a in the ISR radiator function is $a = 999.85 \text{ GeV}^2$, corresponding to the mean value of 1600 GeV energy for data collected in 2006. Obtained with the PHOENIX MC generator, see Eur. Phys. J. C77, 663 (2017) and <https://hepdata.net/record/14046>.

Covariance matrix values (fp1)
Data from <https://hepdata.net/record/14046> (2010) (2006) (2008) (2009)
Weighted covariance matrix for photon form factor $[F_2]^{(1)}$

Inverse Covariance matrix values (fp1)
Data from <https://hepdata.net/record/14046> (2010) (2006) (2008) (2009)
Inverse statistical covariance matrix $[F_2]^{(1)}$

Table 7 (fp1)
Table 7 is additional documentation KLOE Note 229
Resolution of syst. uncertainties. Both bin-by-bin
renormalized for the photon form factor $[F_2]^{(1)}$

Vacuum polarisation correction
Data from Figure 13 is additional documentation KLOE Note 229

Vacuum polarization correction
 $A(\mu_F) = 1 - \frac{\alpha_F}{4\pi} \ln \left(\frac{\mu_F}{\mu_0} \right)$
Data from Figure 13 is additional documentation KLOE Note 229
https://www.cern.phys.fr/hepdata/hepdata_klo10.html (2009)

Final State Radiation correction
Detailed location
Final State Radiation correction ($1 + (\text{err}_{\text{sys}} \times)$),
evaluated using the formula in Nucl. Phys. Proc. Suppl. 101 (2001) 22

ISR radiator function
Data from Figure 16 is additional documentation KLOE Note 229
Non differential radiator function cross section
 $H(M_{\pi^0}^2, x) = \frac{d\sigma}{dx}$, inclusive in θ_{π^0} , incluses $a=999$
 GeV^2

Filter (data tables)

The differential radiator function cross section $H(M_{\pi^0}^2, x) = \frac{d\sigma}{dx}$, inclusive in θ_{π^0} in units of 10^{-3} nb/GeV^2 . The value used for a in the ISR radiator function is $a = 999.85 \text{ GeV}^2$, corresponding to the mean value of 1600 GeV energy for data collected in 2006. Obtained with the PHOENIX MC generator, see Eur. Phys. J. C77, 663 (2017) and <https://hepdata.net/record/14046>.

cmeasures

cmenergies

Visualize

$M_{\pi^0}^2 \text{ (GeV}^2)$	$H(M_{\pi^0}^2, x) = \frac{d\sigma}{dx} \text{ (nb/GeV}^2)$
0.185	1.059 ±0.000 ±0.000
0.195	1.3708 ±0.000 ±0.000
0.205	1.6123 ±0.000 ±0.000
0.215	1.8534 ±0.000 ±0.000
0.225	2.0327 ±0.000 ±0.000
0.235	2.2028 ±0.000 ±0.000
0.245	2.3771 ±0.000 ±0.000
0.255	2.5227 ±0.000 ±0.000
0.265	2.6428 ±0.000 ±0.000
0.275	2.7779 ±0.000 ±0.000

Show all 75 values

Variables

$H(M_{\pi^0}^2, x) = \frac{d\sigma}{dx} \text{ (nb/GeV}^2)$

Selected error

Sum errors Log Scale (X) Log Scale (Y)

Select variables or hide different error bars by clicking on them.



Using HEPData observable keyword [“RADCORR”] and phrases keywords [“Radiator Function”] and [“Radiative Correction”]

Conclusions/Open questions

- existing HEPData KLOE entries need revision:
 - incorrect systematic uncertainties for KLOE05 entry
 - wrong data points for differential cross section of KLOE08 entry
 - missing covariance matrices
 - additional systematic contributions
 - what if data is considered “superseded”? Entry should be flagged accordingly (or removed?)
- entry for KLOE10 data has been prepared
 - including radiative corrections (VP correction, FSR correction, Radiator function)
- To be done:
 - KLOE17 entry (paper on combination of all 3 relevant KLOE data sets, contains updated individual data sets)
 - KLOE12 entry
 - Update KLOE05 and KLOE08 entries (and point to KLOE17 entry)

Conclusions/Open questions

What about computer codes used to produce the radiative corrections?

- Fred's old routine can still be downloaded, but is not listed anymore on his webpage

The alphaQED package: last update December 30, 2019



Fortran package alphaQED instruction: "[alphaQED19.pdf](#)" see also:

" α_{QED} , eff (s) for precision physics at the FCC-ee/ILC" [Invited Talk](#), 11th FCC-ee workshop: Theory and Experiments, 8-11 January 2019, CERN Geneva. [Proceeding](#) published in [CERN Yellow Reports: Monographs Vol. 3 2020](#) [[arXiv:1905.05078](#)]

- I also had a hard time to find the PHOKHARA webpage - it is now at <https://looptreeduality.csic.es/phokhara/>, v10 has been added in Oct. 2020

The screenshot shows the PHOKHARA website. At the top, there is a banner with a landscape image and the text "PHOKHARA" and "radiative return at flavour factories". Below the banner, there are three main sections: "Physics", "Content", and "Downloads".

- Physics:** Describes electron-positron annihilation into hadrons plus an energetic photon from initial state radiation (ISR) allowing the hadronic cross-section to be measured over a wide range of energies at high luminosity flavour factories [DAPHNE, CESR, PEP-II, KEKB, Super-KEKB, BESIII].
- Content:** Describes PHOKHARA as a Monte Carlo event generator which simulates this process at the next-to-leading order (NLO) accuracy. This includes virtual and soft photon corrections to one photon emission events and the emission of two real hard photons.
- Downloads:** Mentions VERSION 10.0 (October 2020), which includes complete NLO radiative corrections for the extraction of the pion form factor. The new implementation is described in detail in Phys. Rev. D100 (2019) no.7, 076004 [[arXiv:1903.10197 hep-ph](#)]. A link to the manual [PDF] and source [.tar.gz] is provided.

- **STRONG need** to get these codes on a public data repository (CERN Zenodo, RODARE, ...) - also for legacy versions!

