e^+e^- results from BaBar, status of muon (g-2) prediction and τ mass measurement at BESIII

(IHEP-LAL collaboration)

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Outline

- Introduction to hadronic vacuum polarization
- ee→hadrons results from BaBar
- Status of muon (g-2) prediction
- τ mass measurement at BESIII
- summary

IHEP-LAL collaboration

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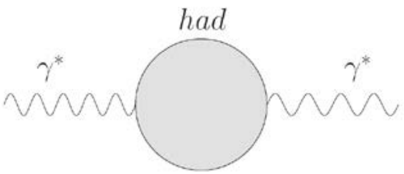
WANG Liangliang (co-PhD thesis defended 2009)
Precision measurement of $e^+e^- \to \pi^+\pi^-$ *cross section using ISR method at BaBar*

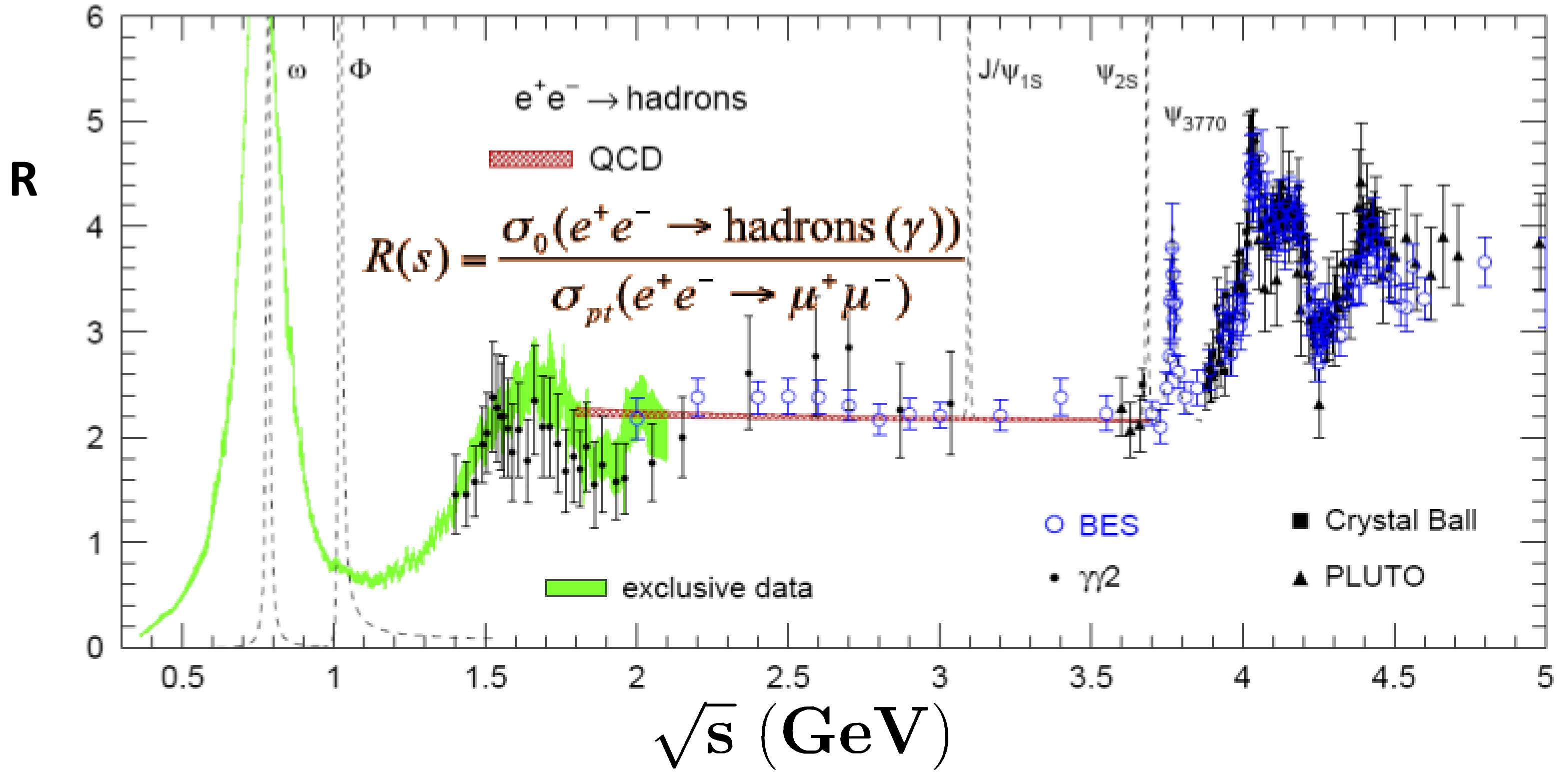
[+A. Höcker (CERN), G. Lopez Castro, G. Toledo (Mexico)]

Hadronic vacuum polarization and R



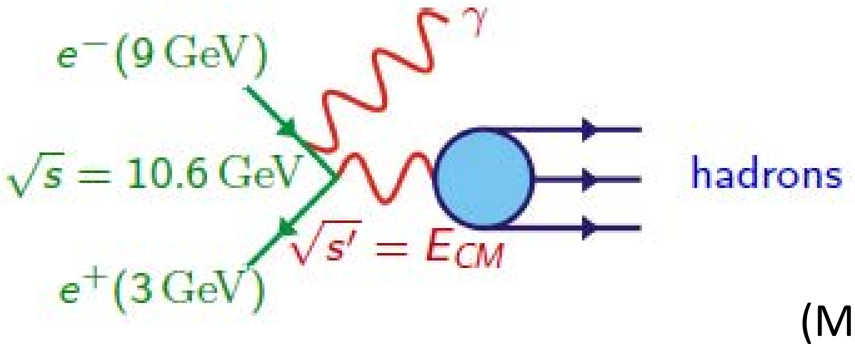
Cannot be calculated from QCD ("first principles")

but: <u>we can use experiment!</u>



$$R(s) = \frac{\sigma_0(e^+e^- \to \text{hadrons}\,(\gamma))}{\sigma_{pt}(e^+e^- \to \mu^+\mu^-)}$$

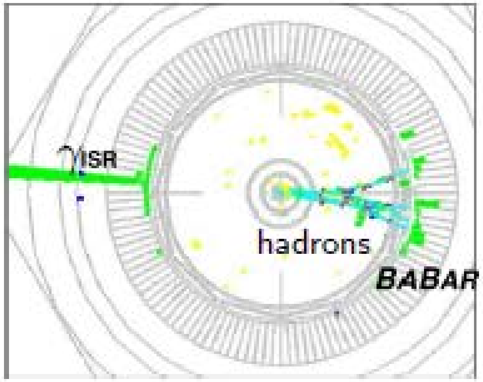
The ISR method at BABAR



$$x = 2E^*_\gamma/\sqrt{s}$$

$$s' = s(1-x)$$

(M^2_{hadrons})



- High energy (E^*_γ >3 GeV) detected at large angle
  → defines $\sqrt{s'} = E_{CM}$ and provides strong background rejection
- Event topology: ISR photon back-to-back to hadrons
- → high acceptance, strong boost to hadrons (measurements from threshold and easier PID)
- Final state can be hadronic or leptonic (QED)
  → $\mu^+\mu^-\gamma(\gamma)$ events used to get ISR luminosity
- Kinematic fit including ISR photon
  → removes multihadronic background; improves mass resolution (a few MeV)
- Continuous measurement from threshold to 3-5 GeV
  →reduces systematic uncertainties compared to multiple data sets with different colliders and detectors

The BaBar ISR program

- cover the almost complete set of significant exclusive e^+e^- annihilation channels up to 2 GeV

- published:

$\pi^+\pi^-$ (topic of my phD thesis)	PRL 2009; PRD 2012
$\pi^+\pi^-\pi^0$	PRD 2004
$2(\pi^+\pi^-)$, $K^+K^-\pi^+\pi^-$, $K^+K^-2\pi^0$, $2(K^+K^-)$	PRD 2007; PRD 2012; PRD 2012
$K^0_S K^{+-}\pi^{-+}$, $K^+K^-\pi^0$, $K^+K^-\eta$	PRD 2005; PRD 2008
$2(\pi^+\pi^-)\pi^0$, $2(\pi^+\pi^-)\eta$, $K^+K^-\pi^+\pi^-\pi^0$, $K^+K^-\pi^+\pi^-\eta$	PRD 2007
$3(\pi^+\pi^-)$, $2(\pi^+\pi^-\pi^0)$, $2(\pi^+\pi^-)K^+K^-$	PRD 2006
$\Phi\, f^0(980)$	PRD 2006; PRD 2007
$p\,\bar{p}$	PRD 2006, PRD 2012
$\Lambda\,\Lambda$, $\Lambda\,\Sigma0$, $\Sigma0\,\Sigma0$	PRD 2007

- New (Preliminary) results at this workshop:

  K^+K^-

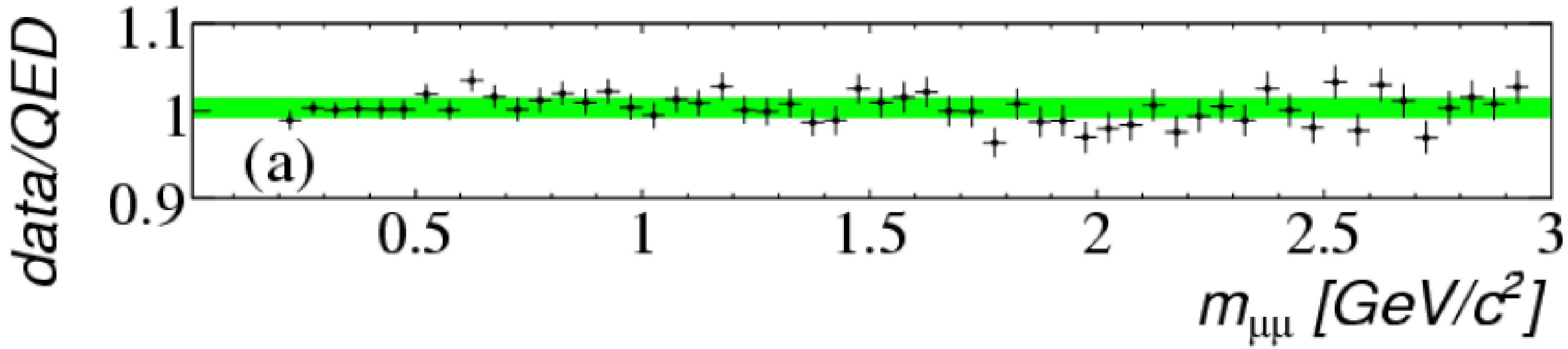
- in progress:

  $\pi^+\pi^-2\pi^0$, $K^0_S K^0_L$, $K^0_S K^0_L\pi^+\pi^-$, $K^0_S K^{+-}\pi^{-+}\pi^0$, $K^0_S K^{+-}\pi^{-+}\eta$

QED Test with μμγ sample

- absolute comparison of μμ mass spectra in data and in simulation (AfkQed based on EVA)
- simulation corrected for data/MC efficiencies
- AfkQed corrected for incomplete NLO using Phokhara
- strong test (ISR probability drops out for ππ)

BaBar



$$\frac{\sigma^{data}_{\mu\mu\gamma(\gamma)}}{\sigma^{NLO\ QED}_{\mu\mu\gamma(\gamma)}} = 1 + (4.0 \pm 1.9 \pm 5.5 \pm 9.4)\ 10^{-3}$$

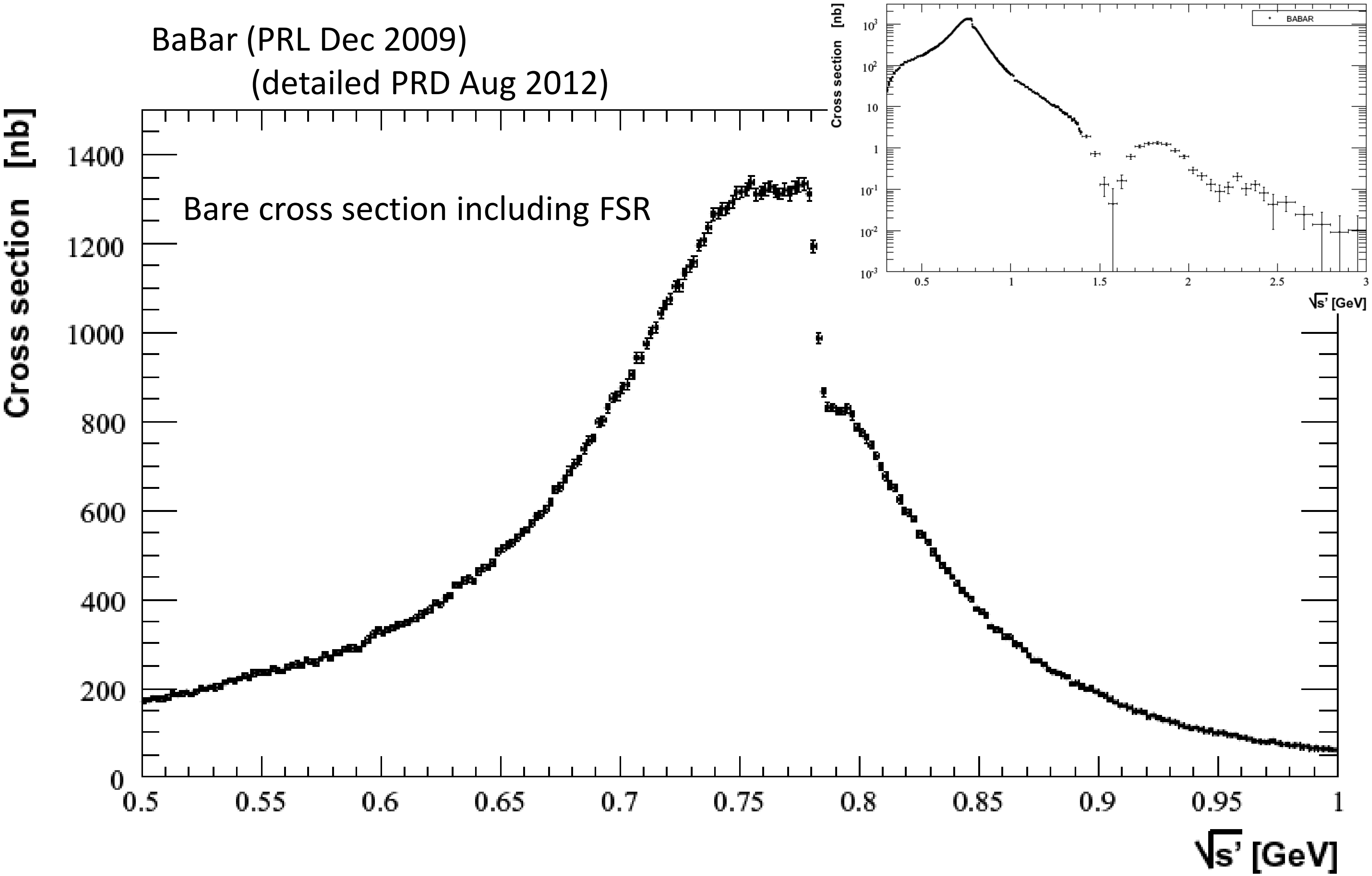
(0.2 – 3 GeV)

ISR γ efficiency 3.4 syst.
trigger/tracking/PID 4.0

BaBar ee luminosity

Results on $e^+e^- \to \pi^+\pi^-(\gamma)$

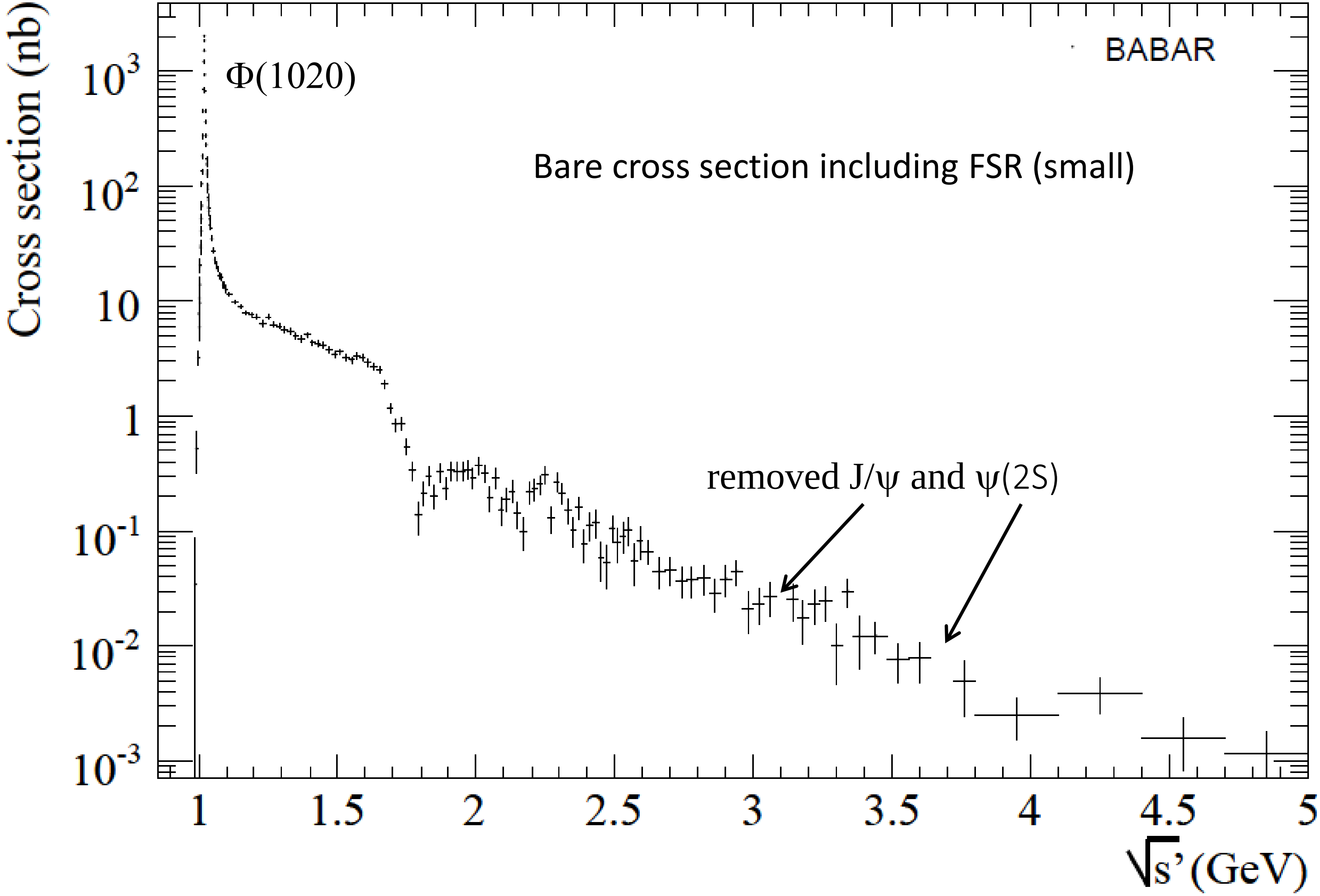
BaBar (PRL Dec 2009)
(detailed PRD Aug 2012)



Bare cross section including FSR

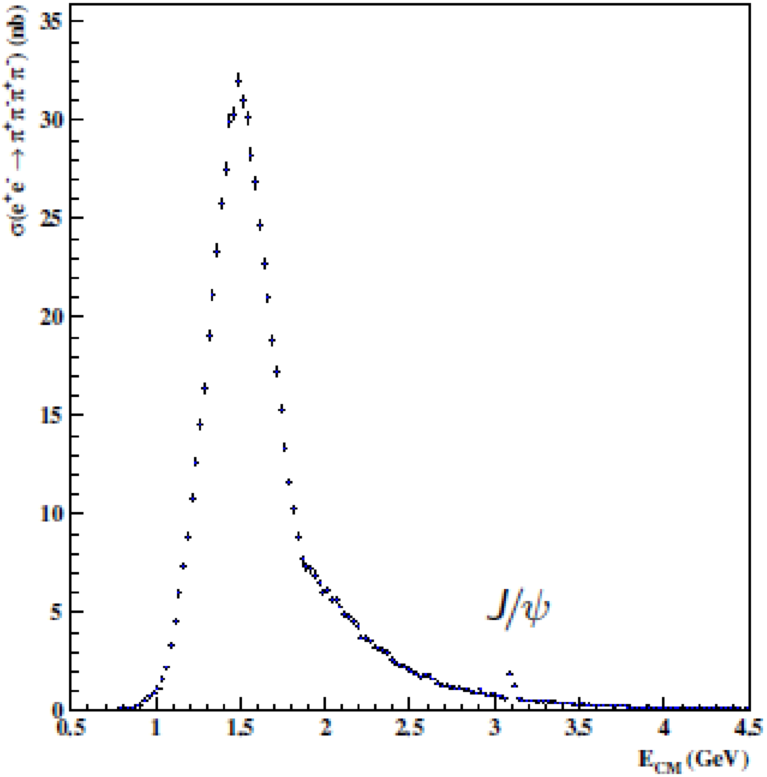
New results on $e^+e^- \rightarrow K^+K^- (\gamma)$ (to be published)

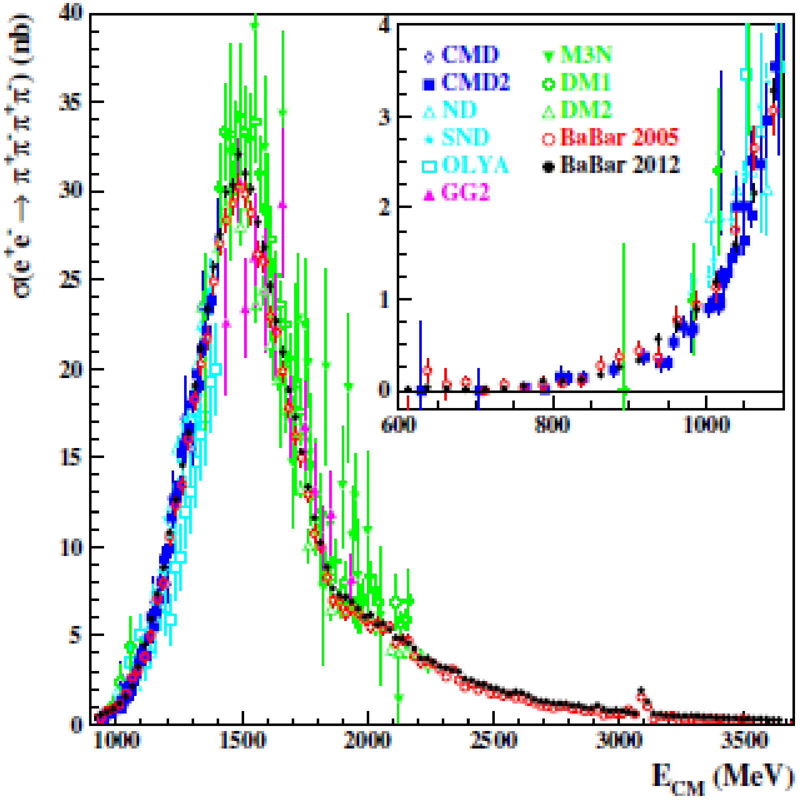
→ Use effective ISR luminosity obtained with μμ sample.



New results: $e^+e^- \to \pi^+\pi^-\pi^+\pi^-$

published in 2012, based on 454 fb^{-1} (previous publication on 89 fb^{-1})



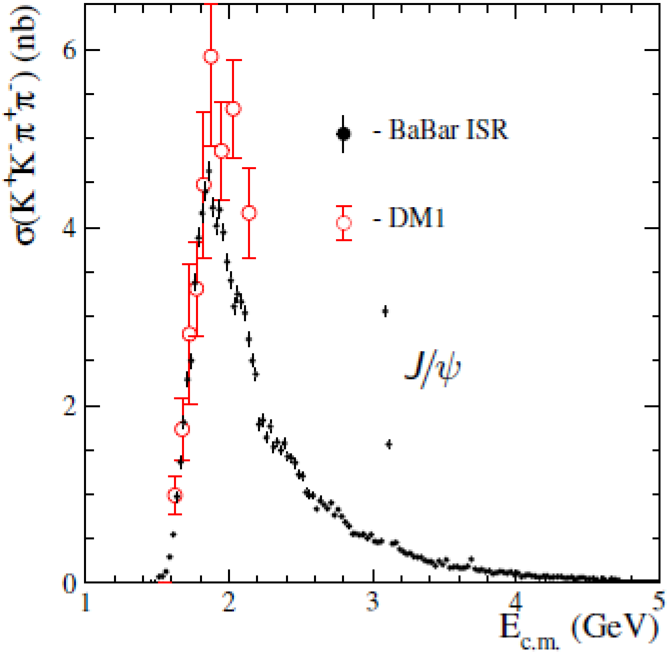


- Systematic uncertainties
  2.4% in peak region (1.1-2.8 GeV)
  11% (0.6-1.1 GeV)
  4% (2.8-4.0 GeV)
- J/ψ visible

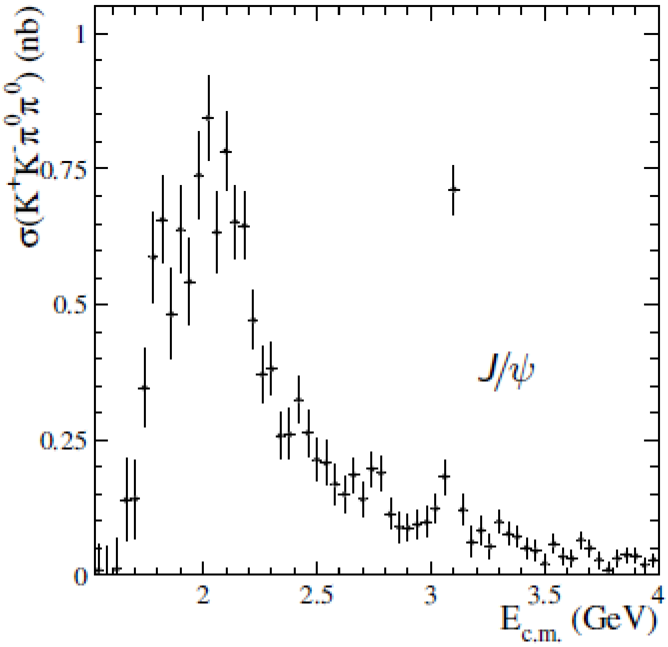
- < 1.4 GeV: agreement with previous *BABAR* results, SND and CMD-2 data
- > 1.4 GeV: highest precision (DM2, 20%)

New results: $e^+e^- \rightarrow K^+ K^- \pi^+\pi^-$, $K^+K^- \pi^0\pi^0$

published in 2012 based on the full BABAR statistics (454 fb^{-1})
→ huge improvement compared to existing data



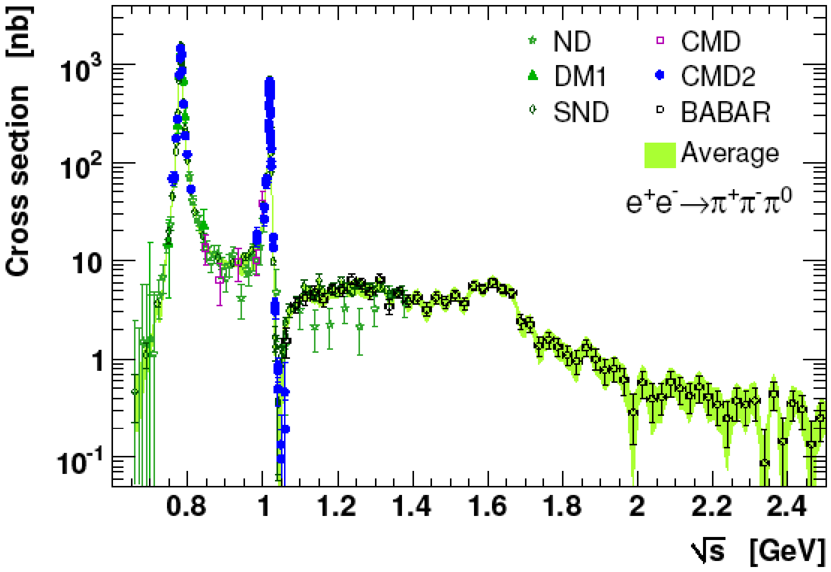
- syst. uncertainty: 4 - 11%
- resolution: 4.2 - 5.5 MeV
- J/ψ clearly visible

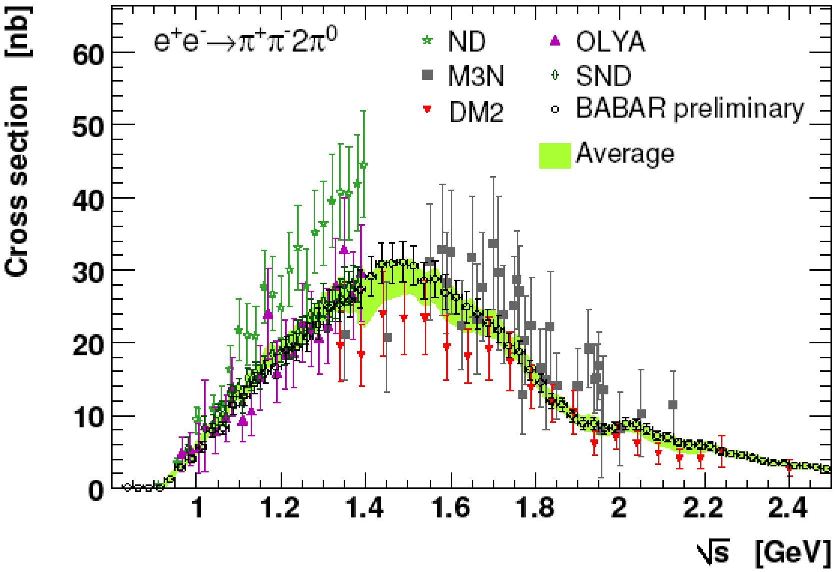


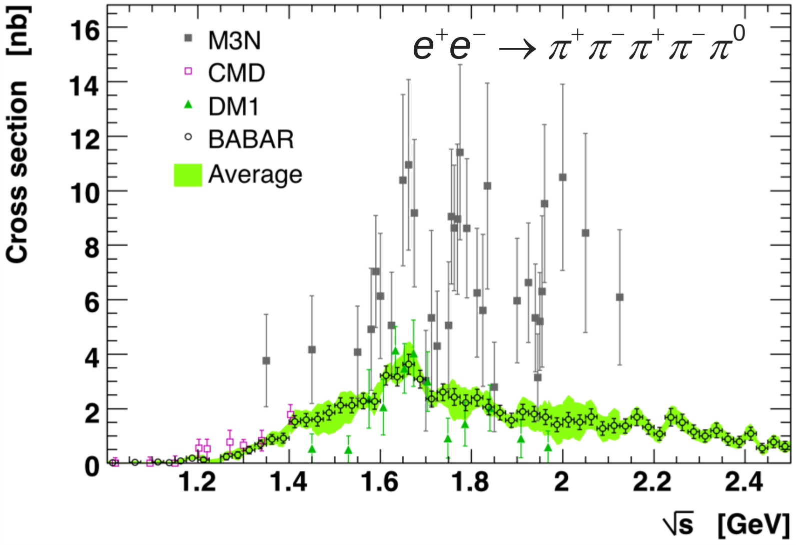
- syst. uncertainty: 7 - 16%
- resolution: 8.8 - 11.2 MeV
- J/ψ clearly visible

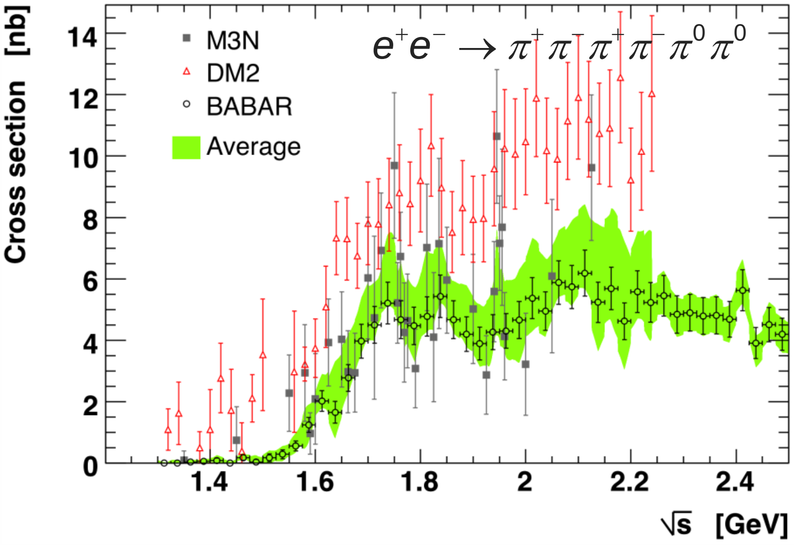
Cross sections dominated below 1.8 GeV by $K^*(892)^0 K^{+-} \pi^{-+}$ (large) and $K^*(892)^{+-} \pi^{-+} \pi^0$
important to know resonance dynamics to estimate unmeasured final states for g-2 integral

more multihadrons









Muon magnetic moment anomaly

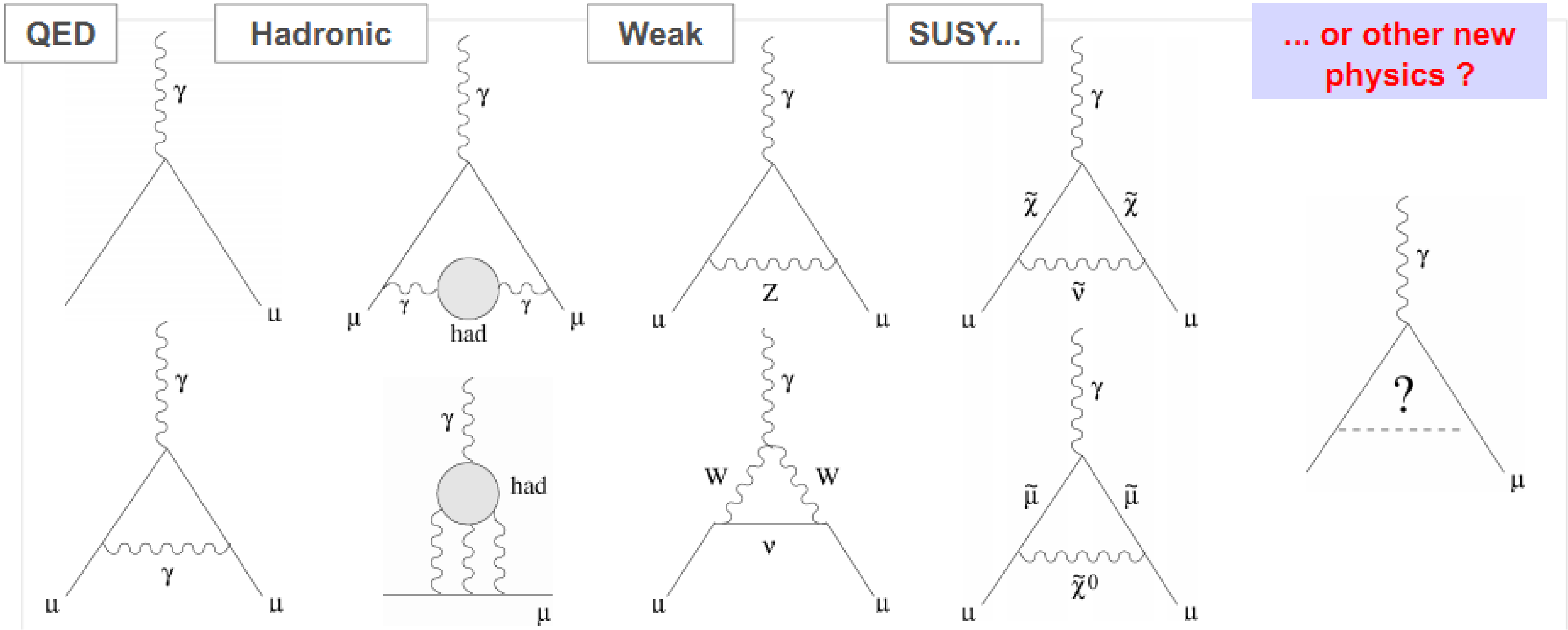
$\vec{\mu} = g\frac{\pm e}{2m}\vec{s}$ $g = 2 + \cdots$ ➔ Magnetic Moment anomaly: $a_l = \frac{g-2}{2}$

a_e is better measured but a_μ is more sensitive to new physics effects by $(m_\mu/m_e)^2 \sim 43000$)

Dominant error

(>99%) (10^{-6})

$$a_\mu^{\text{th}} = a_\mu^{\text{SM}} + a_\mu^{\text{non-SM}}, \qquad a_\mu^{\text{SM}} = a_\mu^{\text{QED}} + a_\mu^{\text{had}} + a_\mu^{\text{Weak}}$$



LO Hadronic Contribution $a_\mu^{\text{had,LO}}$

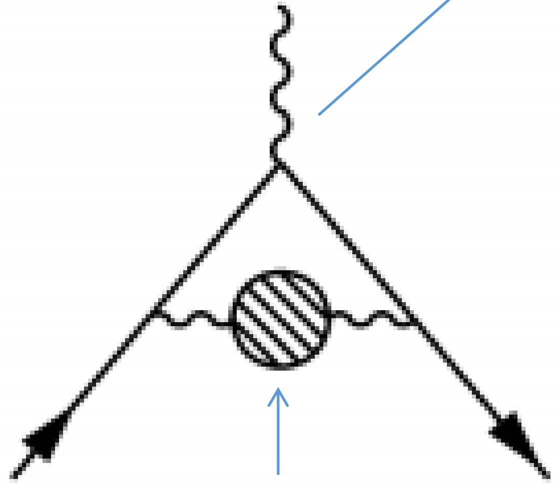
$$a_\mu^{\text{had}} = \underset{\downarrow}{a_\mu^{\text{had,LO}}} + a_\mu^{\text{had,HO}} + a_\mu^{\text{had,LBL}}$$

Dominant error

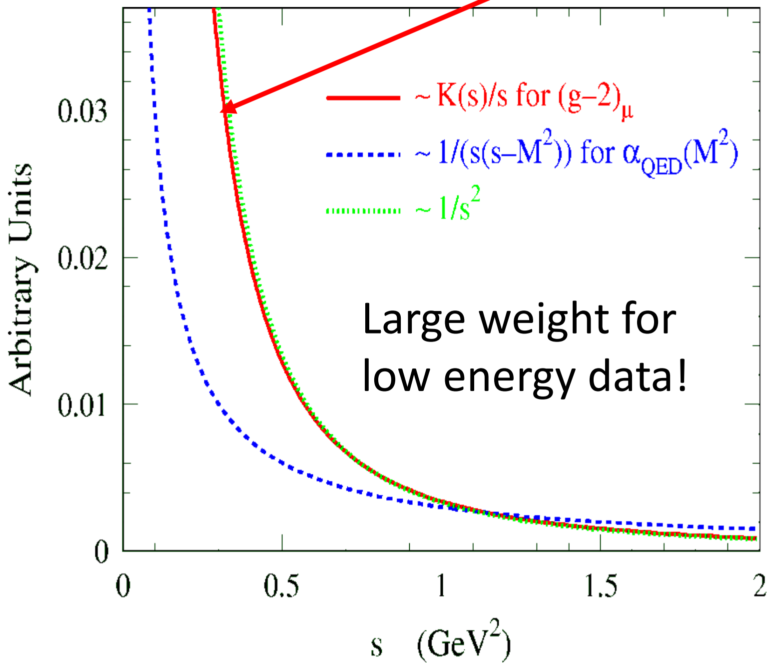
Isospin symmetry connect I=1 e+e- cross section to vector τ spectral functions

Can be rigorously calculated using ee annihilation data via dispersion relation:

$$a_\mu^{\text{had,LO}} = \frac{\alpha^2}{3\pi^2}\int_{4m_\pi^2}^{+\infty} ds \boxed{\frac{K(s)}{s}} R(s)$$



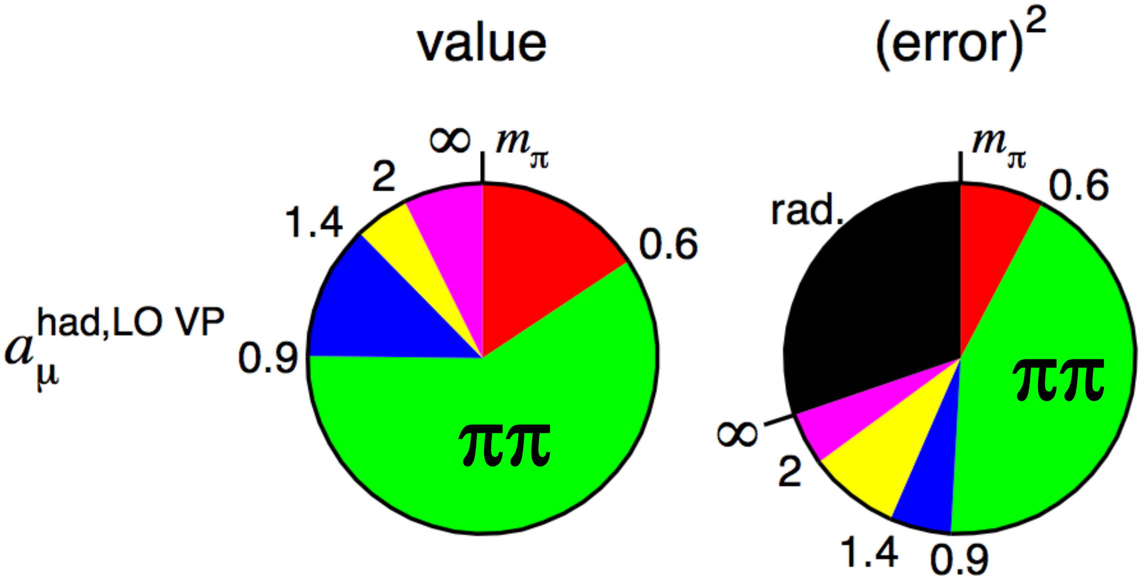
Vacuum Polarization



Large weight for low energy data!

Relative Contribution of Input Data vs Energy

HLMNT 11



➔ Energy region 0.6-0.9 GeV dominates in both value and uncertainty

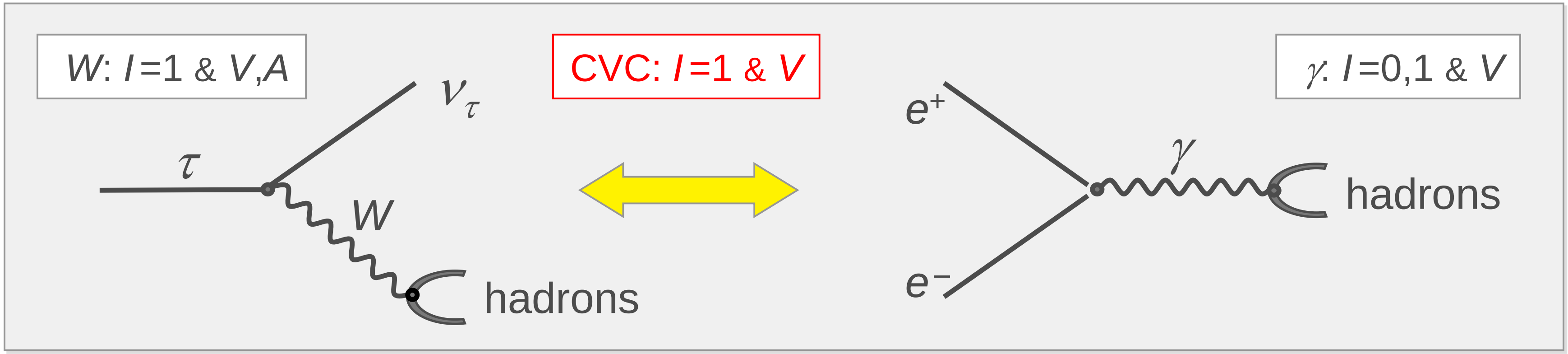
➔ 2π channel contributes more than 70%

➔ The e+e- data precision (was) limited

➔ Use (complement with) tau data

Alemany, Davier, Hoecker 1998

HVP: τ Data through CVC – SU(2)



Hadronic physics factorizes (spectral Functions)

$$\sigma^{(I=1)}\left[e^+e^- \to \pi^+\pi^-\right] = \frac{4\pi\alpha^2}{s}\,\upsilon\left[\tau^- \to \pi^-\pi^0\nu_\tau\right]$$

$$\upsilon\left[\tau^- \to \pi^-\pi^0\nu_\tau\right] \propto \underbrace{\frac{\mathrm{BR}\left[\tau^- \to \pi^-\pi^0\nu_\tau\right]}{\mathrm{BR}\left[\tau^- \to e^-\bar{\nu}_e\nu_\tau\right]}}_{\text{branching fractions}}\;\underbrace{\frac{1}{N_{\pi\pi^0}}\frac{dN_{\pi\pi^0}}{ds}}_{\text{mass spectrum}}\;\underbrace{\frac{m_\tau^2}{\left(1-s/m_\tau^2\right)^2\left(1+s/m_\tau^2\right)}}_{\text{kinematic factor (PS)}}$$

Updated ALEPH Spectral Functions

- Problem identified for the publicly available ALEPH $\pi\pi^0$ covariance matrix: treatment of the statistical correlations from the unfolding

- Redone unfolding of the $\pi\pi^0$, $\pi 2\pi^0$, $\pi 3\pi^0$, $3\pi\pi^0$ and 3π spectral functions, using the same method as in BaBar:

→iterative unfolding (MC truth reweighting) with regularization

→provides a result with small systematic uncertainties (tested through a data-driven method) and full information on uncertainties and correlations

→allows for an improved treatment of structures (reduced effects of the regularization) comparing to the SVD method used before

- Updated spectral functions to be released soon

g-2 with updated unfolding (ALEPH τ)

Previous: M. Davier et al. Eur. Phys. J. C **66**, 127 (2010).

Experiment	$a_\mu^{\mathrm{had,LO}}[\pi\pi,\tau]$ (10^{-10})	
	$2m_{\pi^\pm} - 0.36\,\mathrm{GeV}$	$0.36 - 1.8\,\mathrm{GeV}$
ALEPH	$9.46 \pm 0.33_{\mathrm{exp}} \pm 0.05_{\mathcal{B}} \pm 0.07_{\mathrm{IB}}$	$499.19 \pm 5.20_{\mathrm{exp}} \pm 2.70_{\mathcal{B}} \pm 1.87_{\mathrm{IB}}$
CLEO	$9.65 \pm 0.42_{\mathrm{exp}} \pm 0.17_{\mathcal{B}} \pm 0.07_{\mathrm{IB}}$	$504.51 \pm 5.36_{\mathrm{exp}} \pm 8.77_{\mathcal{B}} \pm 1.87_{\mathrm{IB}}$
OPAL	$11.31 \pm 0.76_{\mathrm{exp}} \pm 0.15_{\mathcal{B}} \pm 0.07_{\mathrm{IB}}$	$515.56 \pm 9.98_{\mathrm{exp}} \pm 6.95_{\mathcal{B}} \pm 1.87_{\mathrm{IB}}$
Belle	$9.74 \pm 0.28_{\mathrm{exp}} \pm 0.15_{\mathcal{B}} \pm 0.07_{\mathrm{IB}}$	$503.95 \pm 1.90_{\mathrm{exp}} \pm 7.84_{\mathcal{B}} \pm 1.87_{\mathrm{IB}}$
Combined	$9.76 \pm 0.14_{\mathrm{exp}} \pm 0.04_{\mathcal{B}} \pm 0.07_{\mathrm{IB}}$	$505.46 \pm 1.97_{\mathrm{exp}} \pm 2.19_{\mathcal{B}} \pm 1.87_{\mathrm{IB}}$

New:

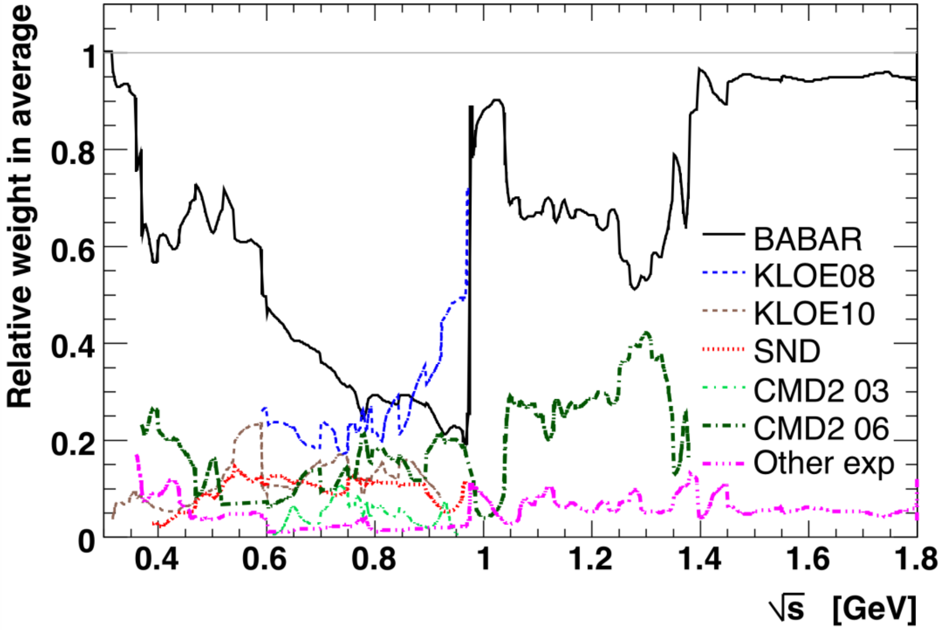
ALEPH	$9.82 \pm 0.40_{\mathrm{exp}}$	$501.32 \pm 4.97_{\mathrm{exp}}$
Combined	$9.80 \pm 0.13_{\mathrm{exp}}$	$506.65 \pm 1.89_{\mathrm{exp}}$

→ Small changes in physics results (QCD & g-2) due to the updates in the unfolding

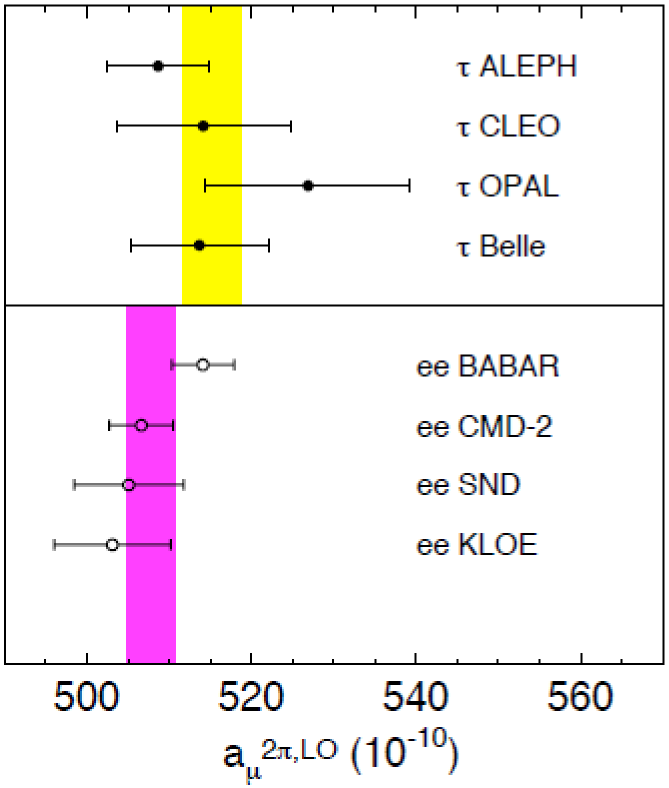
Impact of BABAR data for g-2: $\pi^+\pi^-$

Weights of different experiments in combining their results (DHMZ 2009-2010

BABAR dominates everywhere, except between 0.8 and 0.93 GeV where KLOE is the most precise



Integral from threshold to 1.8 GeV



BABAR most precise (with CMD-2) reduces tension between e^+e^- and τ

Impact of BABAR data for g-2: other channels

a_μ^{LO} [0.98,1.8]GeV (10^{-10})

channels	All results but BaBar 2012	BaBar
K^+K^-	$21.63 \pm 0.27_{stat} \pm 0.68_{syst}$ (3.4%)	$22.95 \pm 0.14_{stat} \pm 0.22_{syst}$ (1.1%)
$2(\pi^+\pi^-)$	$13.35 \pm 0.10_{stat} \pm 0.52_{syst}$ (4.0%)	$13.64 \pm 0.03_{stat} \pm 0.36_{syst}$ (2.6%)

Status of a_μ

- E-821 updated result* $(11\,659\,208.9 \pm 6.3)\ 10^{-10}$

- Including latest BaBar 4π; $2K2\pi$ and $2K2\pi^0$ results in the e+e– combination + latest QED calculation (Kinoshita et al.) yields**

$$a_\mu^{SM}[e{+}e{-}] = (11\,659\,180.4 \pm 4.1 \pm 2.6 \pm 0.2)\ 10^{-10}$$

HVP LBL EW (±4.9)

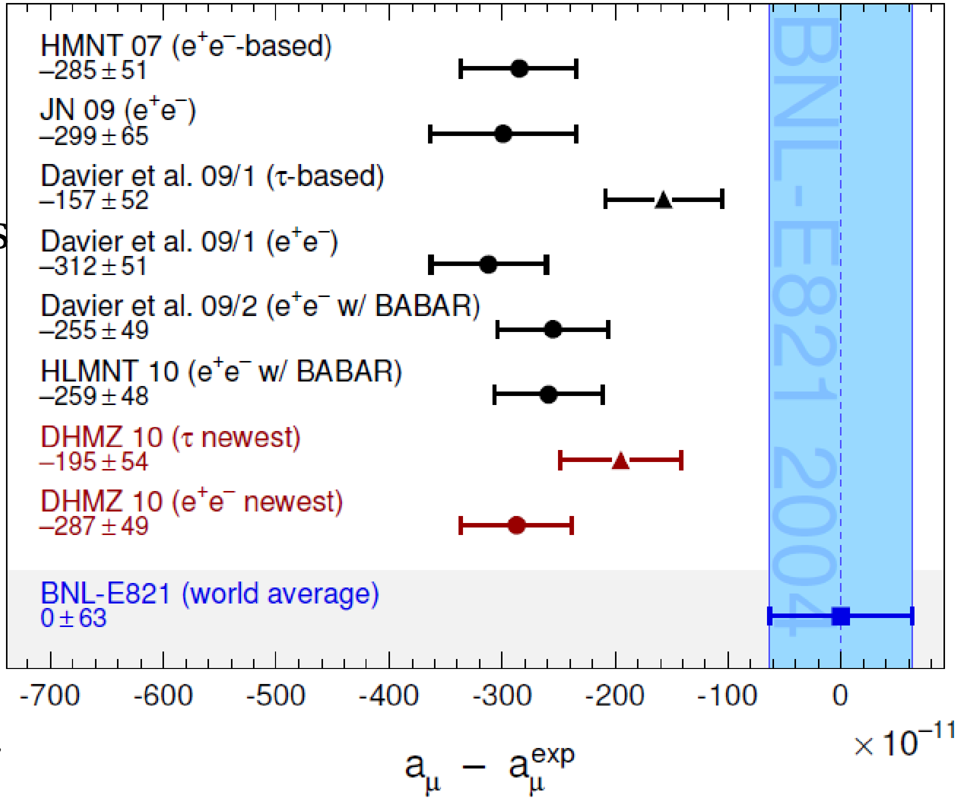
✓ Deviation (ee) $(28.5 \pm 8.0)\ 10^{-10}$ $(3.6\ \sigma)$

- Including latest update of the τ analysis+Belle +revisited IB corrections

✓ Deviation (τ) $(20.7 \pm 8.3)\ 10^{-10}$ $(2.5\ \sigma)$

* new project at Fermilab & JPARC to improve accuracy by a factor 4

** new data from KLOE (2012), and more from VEEP-2000, BESIII in future…



Precision measurement of τ mass at BESIII

- Why high precision τ mass measurement?
- Method
- Beam energy measurement system
- Scan optimization
- First round of scan

Why high precision τ mass measurement

Elementary parameter in SM (PDG2012)

- M_e=0.510998910±0.000000013 (2.6×10^{-8})
- M_μ=105.658367±0.000004 (3.8×10^{-8})
- M_τ=1776.82 ±0.16 (9.0×10^{-5})

Lepton universality testing

$$\left(\frac{g_\tau}{g_\mu}\right)^2=\frac{\tau_\mu}{\tau_\tau}\left(\frac{m_\mu}{m_\tau}\right)^5\frac{B(\tau\to e\nu_e\nu_\tau)}{B(\mu\to e\nu_e\nu_\mu)}\left(1+\Delta_e\right)$$

g_τ and g_μ : coupling constants;

τ_τ and τ_μ :life time of τ and μ ;

B $(\tau\to e\nu_e\nu_\tau)$ and ***B*** $(\mu\to e\nu_e\nu_\mu)$: decay branching ratio;

Δ_e:correct factor (phase factor, radiative correction factor of QED , correct factor of propagator of W-meson etc.)

Method: Pseudo-mass and threshold scan

τ lepton mass measurement [value+statistic + systematic error]	Year	Ex. Group	Data sample	Method
$1776.68 \pm 0.12 \pm 0.41$	**2009**	**Babar**	$423\ \mathrm{fb}^{-1}$	Pseudo-mass
$1776.81\left({}^{+0.25}_{-0.23}\right) \pm 0.15$*	**2007**	**KEDR**	$6.7\ \mathrm{pb}^{-1}$	Scan
$1776.61 \pm 0.13 \pm 0.35$	**2007**	**Belle**	$414\ \mathrm{fb}^{-1}$	Pseudo-mass
$1776.96\ {}^{+0.18}_{-0.21}\ {}^{+0.25}_{-0.17}$	**1996**	**BES**	$5.1\ \mathrm{pb}^{-1}$	Scan

* an infra-red Compton backscattering technique (CBS)

Threshold scan

Fit the observed ττ cross section around threshold:

$$\sigma^{\mathrm{obs}}(W,\ m_\tau,\ \varepsilon,\ \sigma_{\mathrm{B}}) = \varepsilon \cdot \sigma(W) + \sigma_{\mathrm{B}}$$

$$= N^{\mathrm{obs}}/\boldsymbol{L}$$

- Three free parameters (m_τ, ε, σ_B): at least 3 energy points

  => optimization of data taking

- Luminosity measurement
- Energy measurement
- Energy calibration (energy spread) from J/ψ, ψ' scan
- Theoretical uncertainty (0.1%)

optimization of data taking

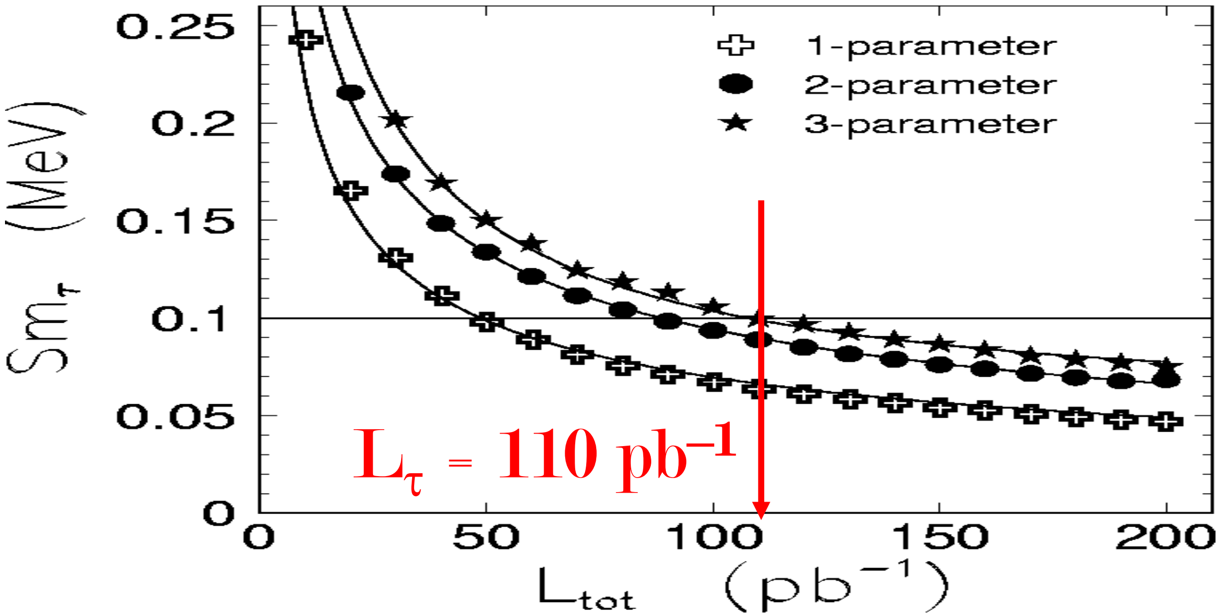
Chin. Phys. C 2009, 33:501-507

- three energy points

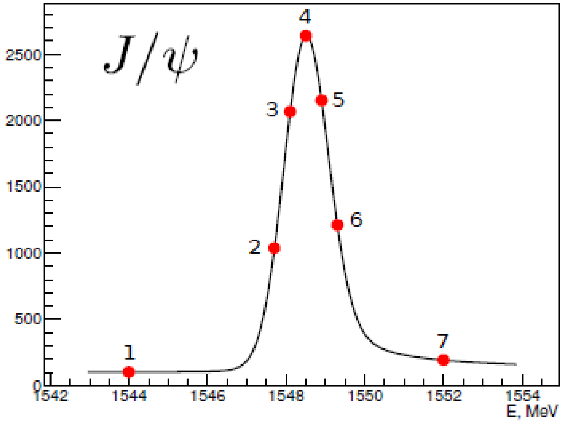
  Point 1: at the large derivative region (m_τ), $L_1=67.5\%L_{tot}$

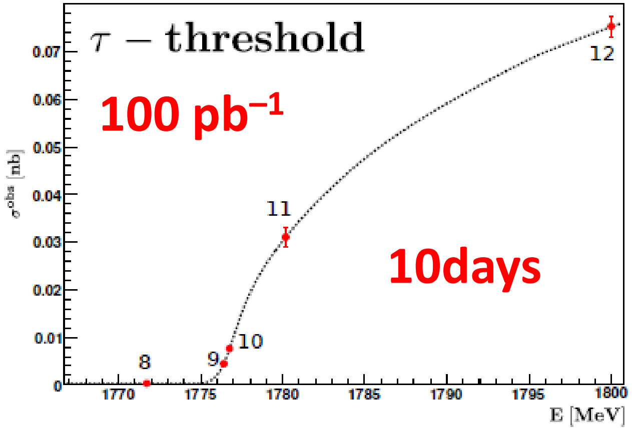
  Point 2: above the threshold (ε), $L_2=22.5\%L_{tot}$

  Point 3: bellow the threshold (σ_B), $L_3=10\%L_{tot}$
- $\delta M \sim 1/L_{tot}$
- if only eμ events are used:



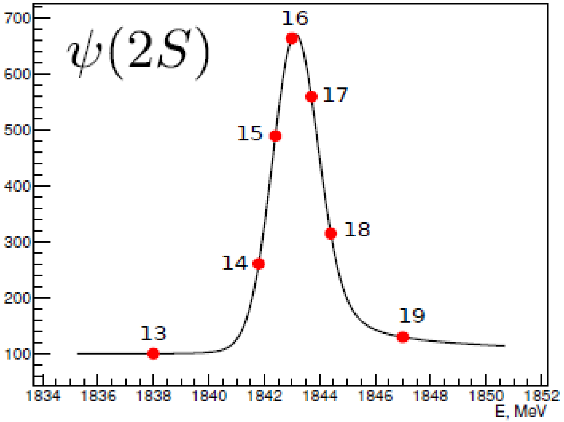
τ scan plan





$100\ pb^{-1}$

10days



- **First circle:**

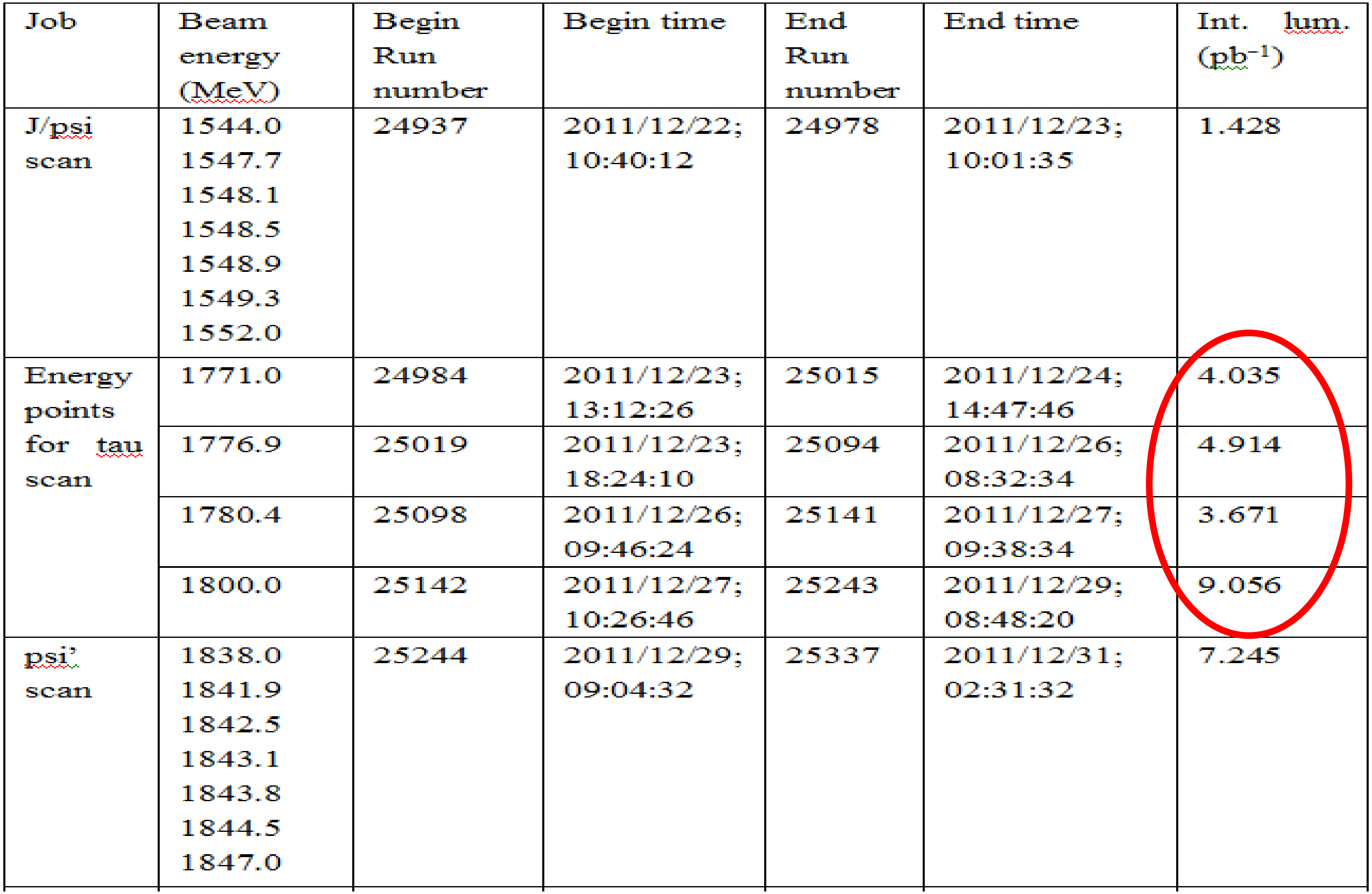
  J/ψ scan (7 pts) → τ scan (5 pts) → ψ' scan (7 pts)

- **Second circle:**

  J/ψ scan (7pts) → τ scan (pt.9&10) → ψ'scan (7 pts)

Final uncertainty
(sta. ⊕ sys.)< 0.1MeV

τ scan in December 2011

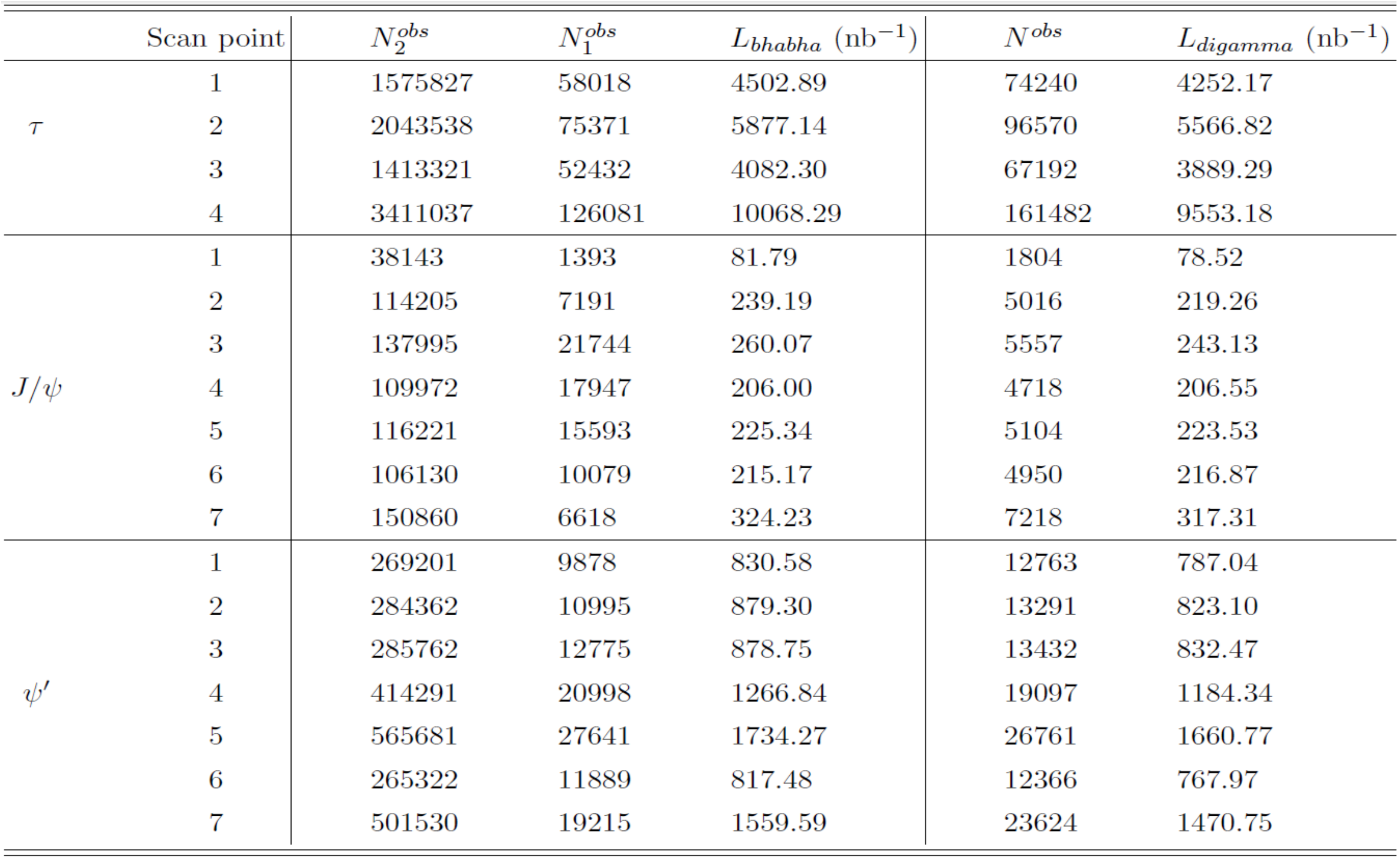


Job	Beam energy (MeV)	Begin Run number	Begin time	End Run number	End time	Int. lum. (pb^{-1})
J/psi scan	1544.0 1547.7 1548.1 1548.5 1548.9 1549.3 1552.0	24937	2011/12/22; 10:40:12	24978	2011/12/23; 10:01:35	1.428
Energy points for tau scan	1771.0	24984	2011/12/23; 13:12:26	25015	2011/12/24; 14:47:46	4.035
	1776.9	25019	2011/12/23; 18:24:10	25094	2011/12/26; 08:32:34	4.914
	1780.4	25098	2011/12/26; 09:46:24	25141	2011/12/27; 09:38:34	3.671
	1800.0	25142	2011/12/27; 10:26:46	25243	2011/12/29; 08:48:20	9.056
psi' scan	1838.0 1841.9 1842.5 1843.1 1843.8 1844.5 1847.0	25244	2011/12/29; 09:04:32	25337	2011/12/31; 02:31:32	7.245

21.75 pb^{-1}

Luminosity measurements

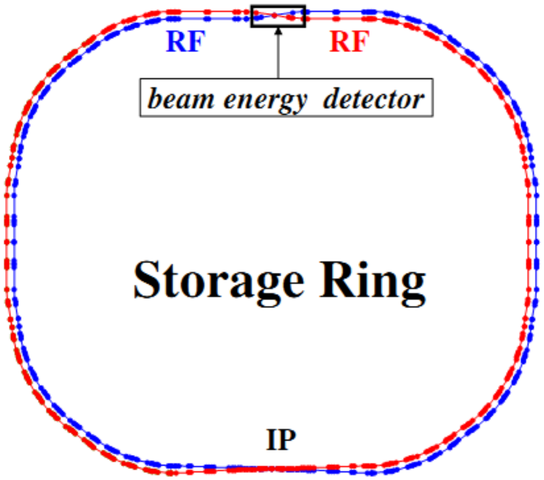
Using Bhabha and di-gamma events



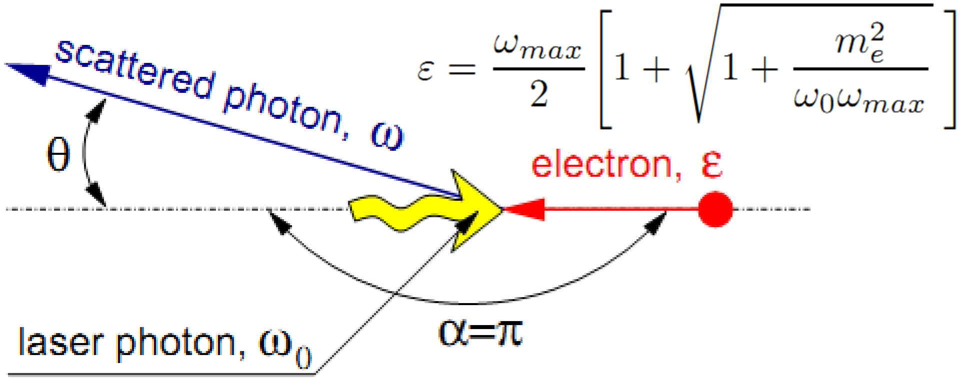
	Scan point	N_2^{obs}	N_1^{obs}	L_{bhabha} (nb^{-1})	N^{obs}	$L_{digamma}$ (nb^{-1})
τ	1	1575827	58018	4502.89	74240	4252.17
	2	2043538	75371	5877.14	96570	5566.82
	3	1413321	52432	4082.30	67192	3889.29
	4	3411037	126081	10068.29	161482	9553.18
J/ψ	1	38143	1393	81.79	1804	78.52
	2	114205	7191	239.19	5016	219.26
	3	137995	21744	260.07	5557	243.13
	4	109972	17947	206.00	4718	206.55
	5	116221	15593	225.34	5104	223.53
	6	106130	10079	215.17	4950	216.87
	7	150860	6618	324.23	7218	317.31
ψ'	1	269201	9878	830.58	12763	787.04
	2	284362	10995	879.30	13291	823.10
	3	285762	12775	878.75	13432	832.47
	4	414291	20998	1266.84	19097	1184.34
	5	565681	27641	1734.27	26761	1660.77
	6	265322	11889	817.48	12366	767.97
	7	501530	19215	1559.59	23624	1470.75

Beam energy measurement for BEPCII

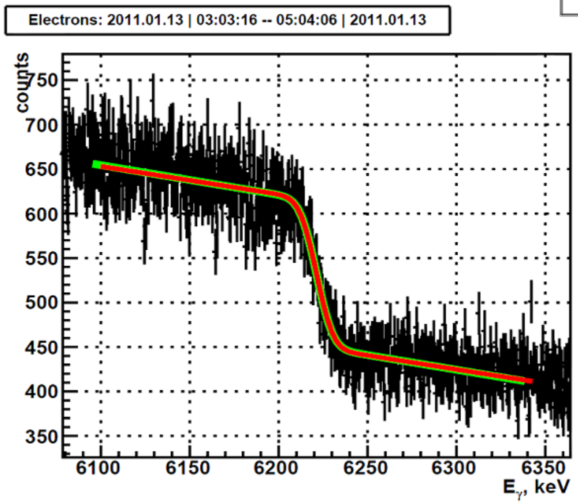
NIMA 659,21 (2011)

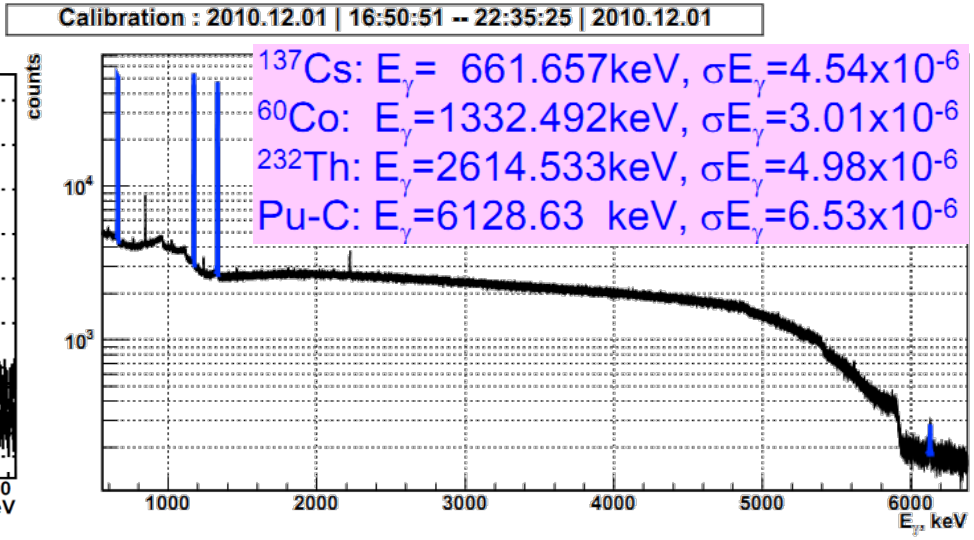


Compton back-scattering technique



$$\varepsilon = \frac{\omega_{max}}{2}\left[1+\sqrt{1+\frac{m_e^2}{\omega_0\omega_{max}}}\right]$$





^{137}Cs: E_γ= 661.657keV, $\sigma E_\gamma=4.54\times10^{-6}$

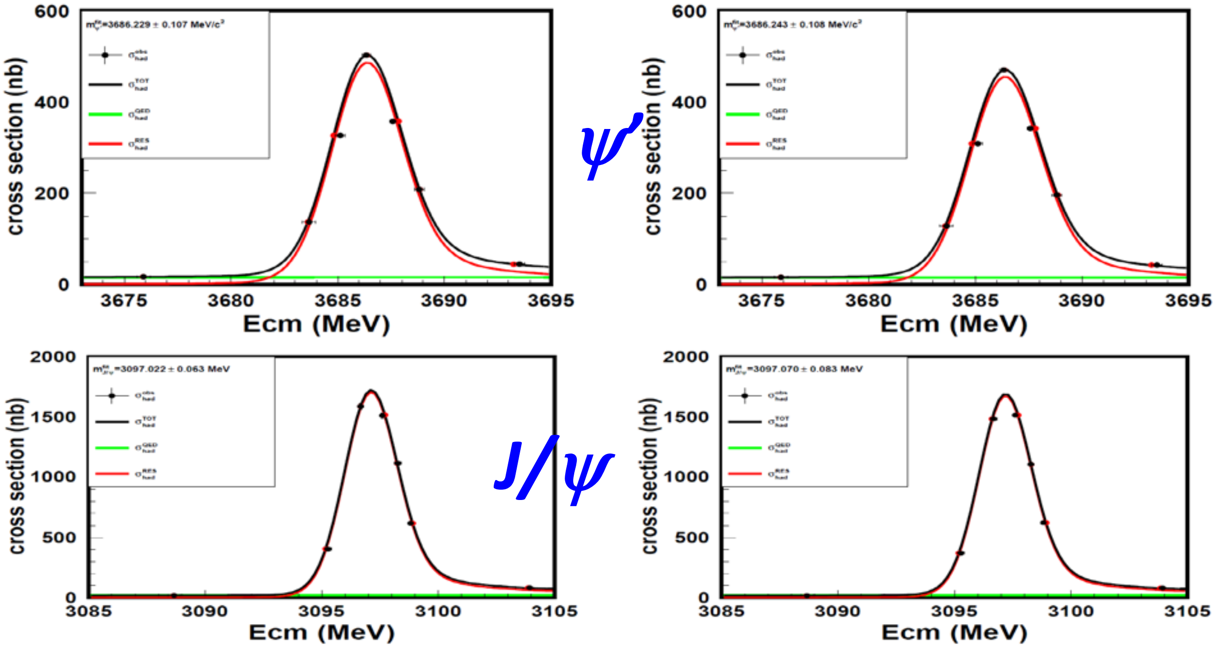
^{60}Co: E_γ=1332.492keV, $\sigma E_\gamma=3.01\times10^{-6}$

^{232}Th: E_γ=2614.533keV, $\sigma E_\gamma=4.98\times10^{-6}$

Pu-C: E_γ=6128.63 keV, $\sigma E_\gamma=6.53\times10^{-6}$

Sys. Error
$2*10^{-5}$

J/ψ, ψ' scan



	J/ψ	3096.916 ± 0.011	ψ'	3686.09 ± 0.04
Lumi.	di-gamma	Bhabha	di-gamma	Bhabha
$\mathrm{M(MeV/c^2)}$	3097.022 ± 0.063	3097.070 ± 0.083	3686.229 ± 0.107	3686.243 ± 0.108
$\Delta_E\mathrm{(MeV)}$	1.086 ± 0.055	1.109 ± 0.029	1.556 ± 0.060	1.567 ± 0.058
ϵ	$(67.29 \pm 1.69)\%$	$(65.76 \pm 1.56)\%$	$(84.83 \pm 2.65)\%$	$(79.85 \pm 2.47)\%$
$\chi^2/ndof$	$2.48/3$	$3.05/3$	$6.17/3$	$5.21/3$
Δm	0.106 ± 0.064	0.154 ± 0.084	0.139 ± 0.114	0.153 ± 0.115

Event selection

PID	p (GeV/c)	EMC	TOF	MUC	other
e	$p_{min} < p < p_{max}$	$0.8 < E/p < 1.05$	$\|\Delta tof(e)\| < 0.2$ $0 < tof < 4.5$		
μ	$p_{min} < p < p_{max}$	$E/p < 0.7$ $0.1 < E < 0.3$	$\|\Delta tof(\mu)\| < 0.2$	($depth > 80 \times p$-50 or $depth > 40$) and $numhits > 1$	
π	$p_{min} < p < p_{max}$	$E/p < 0.6$	$\|\Delta tof(\pi)\| < 0.2$ $0 < tof < 4.5$		not μ
K	$p_{min} < p < p_{max}$	$E/p < 0.6$	$\|\Delta tof(K)\| < 0.2$ $0 < tof < 4.5$		not μ

Partial information, not the full list !

$$PTEM = \frac{P_T}{E_{miss}^{max}} = \frac{(\vec{P}_1 + \vec{P}_2)_T}{W - |\vec{P}_1| - |\vec{P}_2|}$$

No good photon: N_γ=0

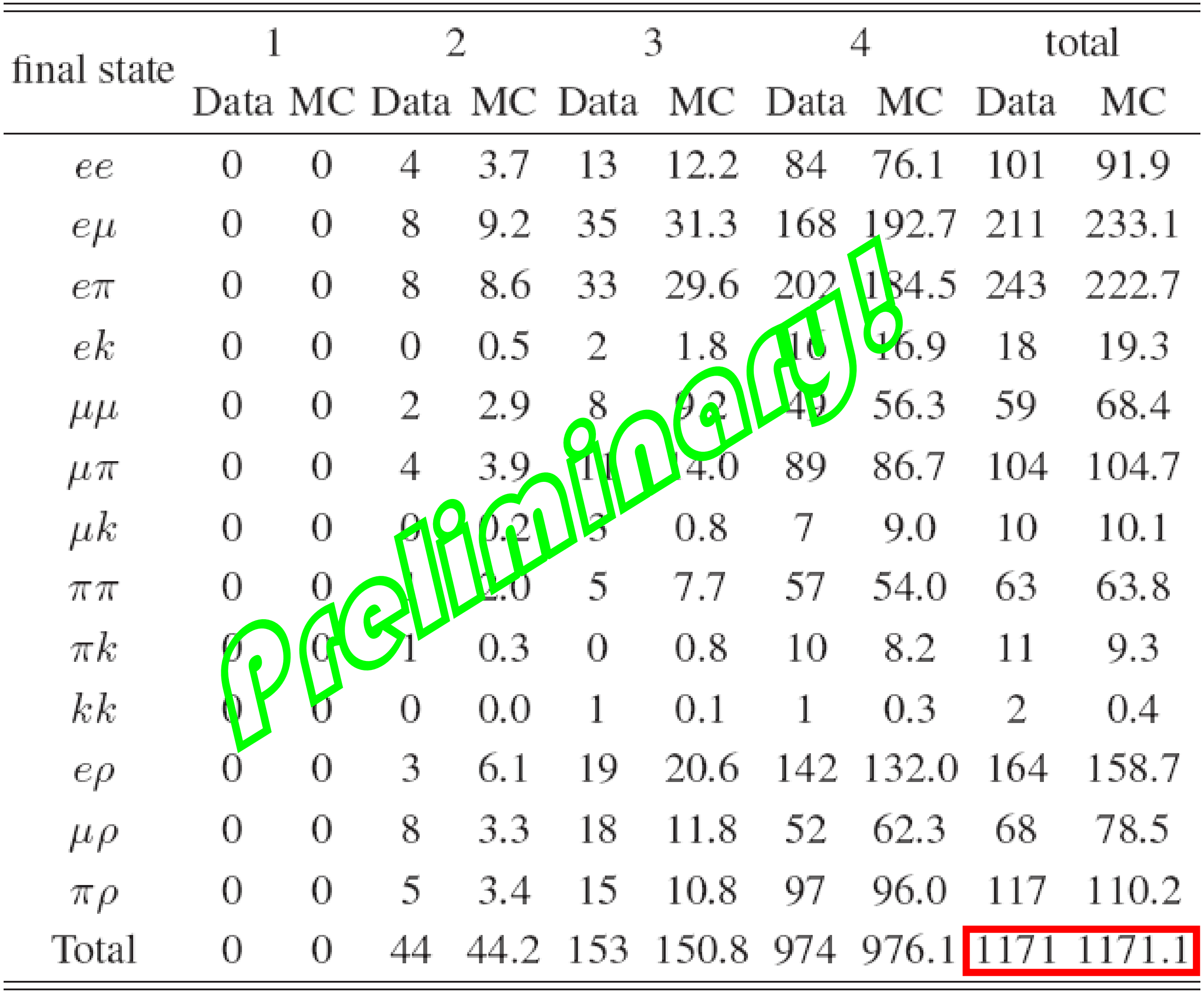
Good photon:

1) 0<TDC<14, (unit: 50ns)
2) |cosθ|<0.8, E>25MeV
3) 0.84<| cosθ |<0.92, E>50MeV
4) θγc >20

The detection efficiency for different final states at different scan points

scan point	Efficiency (%)								
	ee	$e\mu$	eh	$\mu\mu$	μh	hh	$e\rho$	$\mu\rho$	$\pi\rho$
2	17.1	21.8	32.4	14.2	15.3	25.6	9.9	5.5	9.1
3	17.6	23.2	34.9	14.0	16.9	29.3	10.4	6.1	8.9
4	17.8	23.1	36.2	13.9	17.7	34.5	10.8	5.3	12.8

data vs MC



final state	1		2		3		4		total	
	Data	MC	Data	MC	Data	MC	Data	MC	Data	MC
ee	0	0	4	3.7	13	12.2	84	76.1	101	91.9
$e\mu$	0	0	8	9.2	35	31.3	168	192.7	211	233.1
$e\pi$	0	0	8	8.6	33	29.6	202	184.5	243	222.7
ek	0	0	0	0.5	2	1.8	16	16.9	18	19.3
$\mu\mu$	0	0	2	2.9	8	9.2	49	56.3	59	68.4
$\mu\pi$	0	0	4	3.9	11	14.0	89	86.7	104	104.7
μk	0	0	0	0.2	3	0.8	7	9.0	10	10.1
$\pi\pi$	0	0	1	2.0	5	7.7	57	54.0	63	63.8
πk	0	0	1	0.3	0	0.8	10	8.2	11	9.3
kk	0	0	0	0.0	1	0.1	1	0.3	2	0.4
$e\rho$	0	0	3	6.1	19	20.6	142	132.0	164	158.7
$\mu\rho$	0	0	8	3.3	18	11.8	52	62.3	68	78.5
$\pi\rho$	0	0	5	3.4	15	10.8	97	96.0	117	110.2
Total	0	0	44	44.2	153	150.8	974	976.1	1171	1171.1

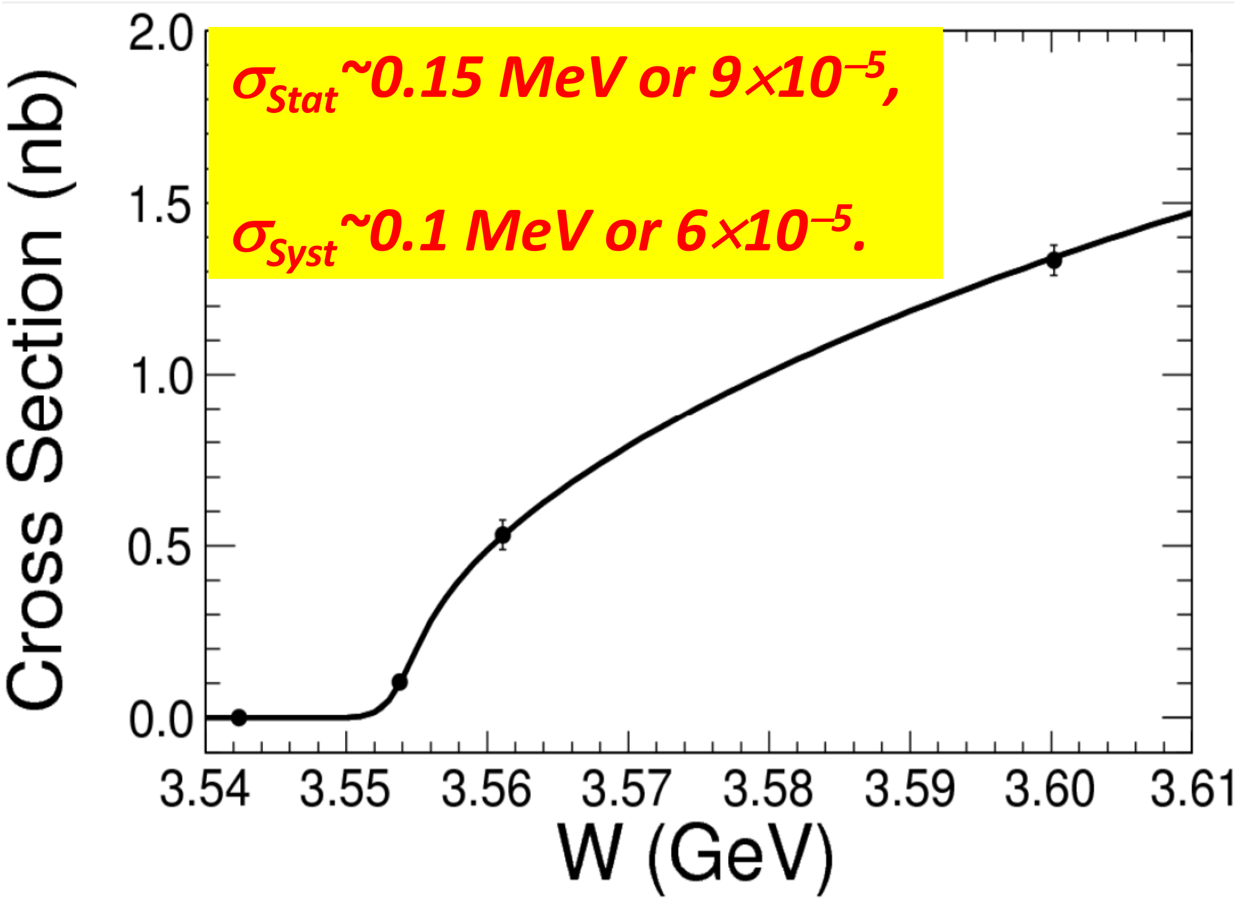
Preliminary!

Total consistency is fairly well!

Data 1171

MC 1171.1

τ mass



σ_{Stat}~0.15 MeV or 9×10^{-5},

σ_{Syst}~0.1 MeV or 6×10^{-5}.

M_τ = 1776.??? ± 0.??? MeV

Summary

- ISR project at BaBar:

  dominant contributions to the world averages of $\sigma(ee \rightarrow hadrons)$ bellow 1.8GeV

- Updates ALEPH τ spectral function: small impact on physics

- Previous τ/ee disagreement strongly reduced:

  2.9σ(2006) → 2.4σ(τ update) → 1.5σ(including BaBar-2π);
  1.8σ(including the 2010 KLOE 2π)

- Evidence for a_μ deviation between exp. and SM prediction (2~4σ): not sufficient to establish new physics, but more results coming from both sides

- First round of τ mass scan done at BESIII: good result to be released

✓ **The collaboration between IHEP and LAL is quite active and fruitful !**