Recent Results from the KEDR Detector

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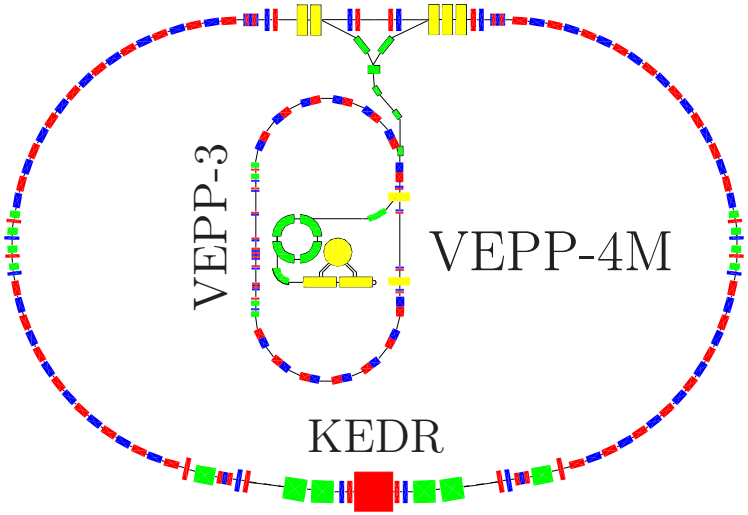
Outline

1. J/ψ and $\psi(2S)$ masses
2. Test of leptonic universality in J/ψ decays
3. Plans

VEPP–4M collider

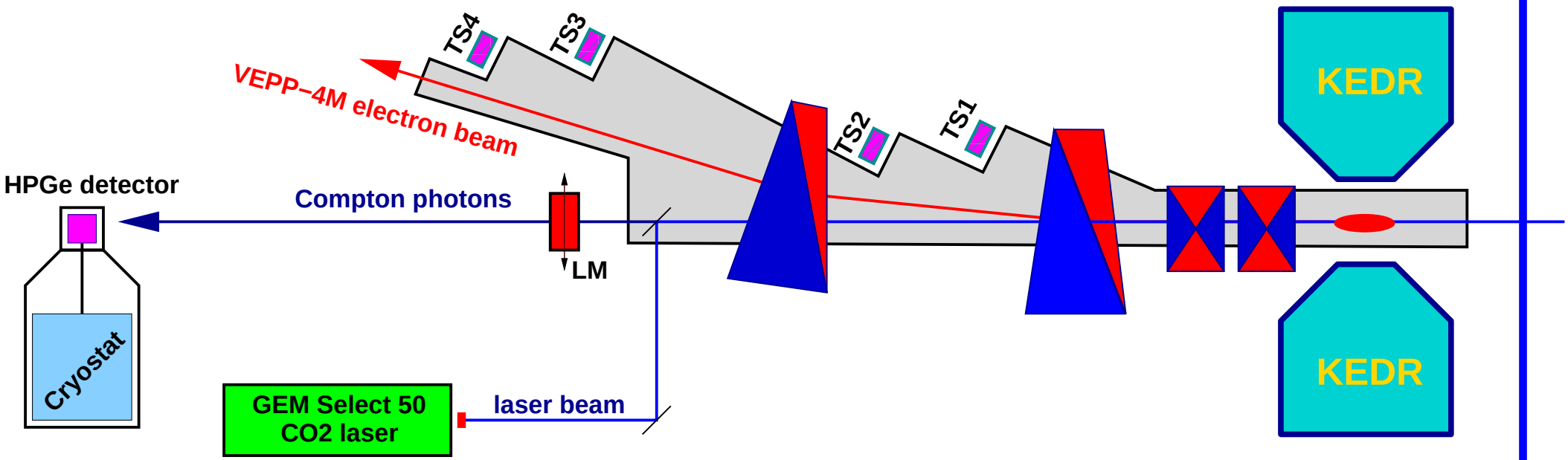


Circumference	366 m
Beam energy	$1 \div 5$ GeV
Number of bunches	2×2
Luminosity, $E = 1.5$ GeV	2×10^{30} cm^{-2}s^{-1}
Luminosity, $E = 5.0$ GeV	2×10^{31} cm^{-2}s^{-1}

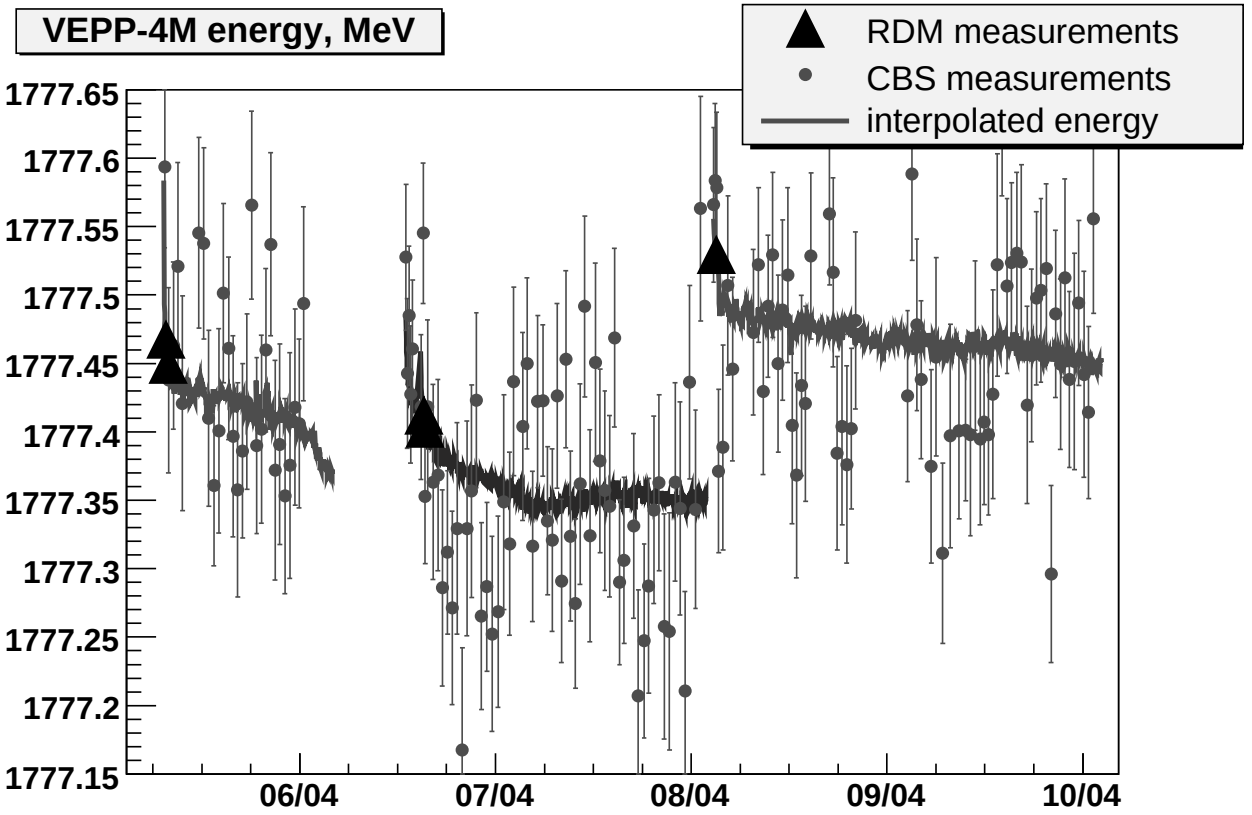
- Resonant depolarization technique:
  Instantaneous measurement accuracy $\simeq 1 \times 10^{-6}$
  Energy interpolation accuracy $(5 \div 15) \times 10^{-6}$ $(10 \div 30$ keV$)$
- Infrared light Compton backscattering:
  Statistical accuracy $\simeq 5 \times 10^{-5}$ / 30 minutes
  Systematic uncertainty $\simeq 3 \times 10^{-5}$ $(50 \div 70$ keV$)$

Compton Backscattering Monitor

Realized at BESSY-I in 1987

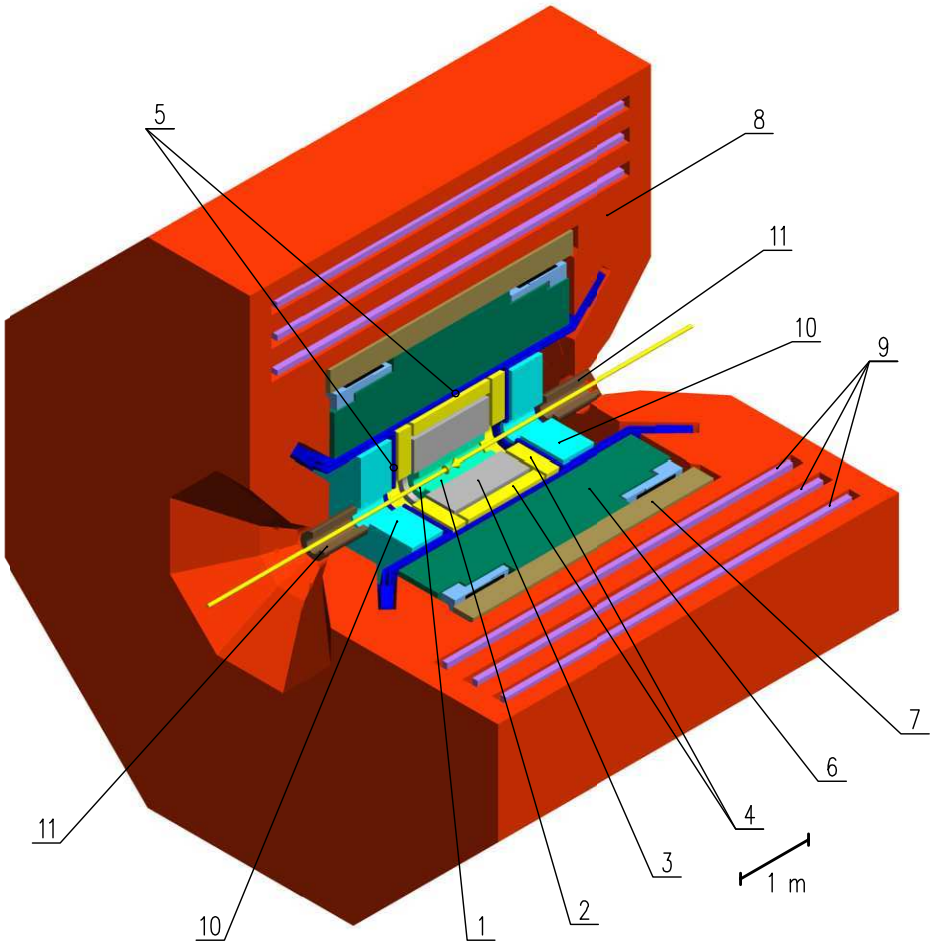


VEPP-4M Energy Behaviour



During the run, E measured by CBS and from interpolation

KEDR detector

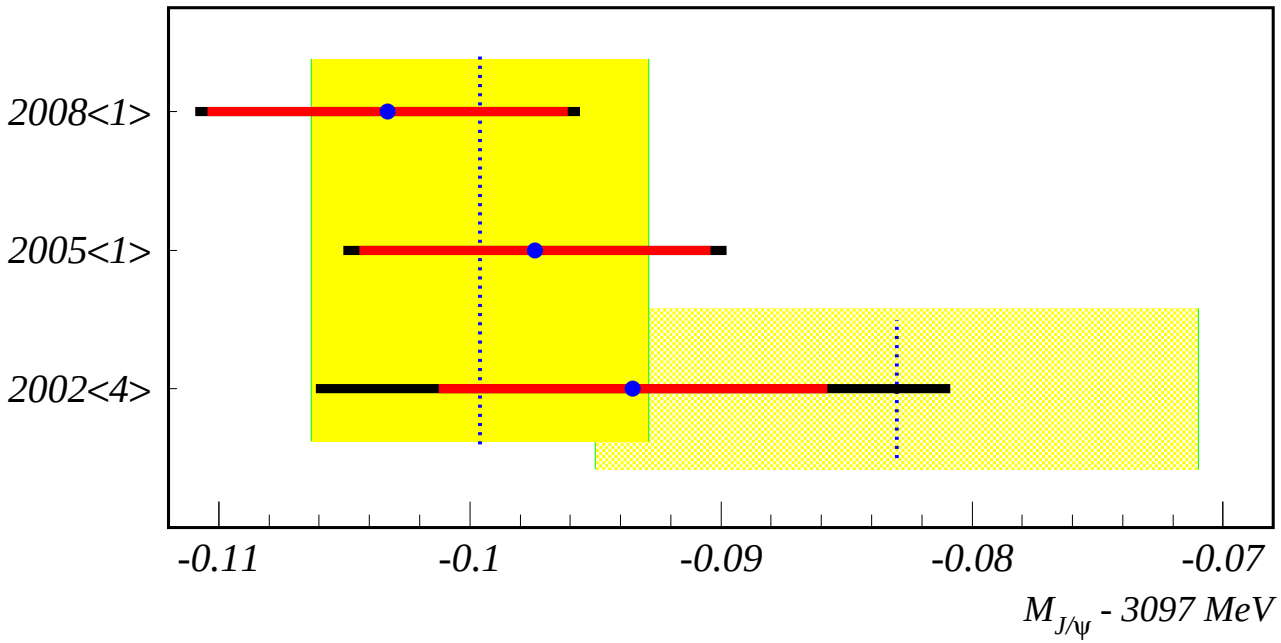


1. Vacuum chamber
2. Vertex detector
3. Drift chamber
4. Threshold aerogel counters
5. ToF counters
6. Liquid krypton calorimeter
7. Superconducting coil
8. Magnet yoke
9. Muon tubes
10. CsI calorimeter
11. Compensating s/c solenoid

J/ψ and $\psi(2S)$ Mass Measurement – General

- Combined analysis of all scans:
  6 at J/ψ – 2002 (4), 2005 (1) and 2008 (1);
  7 at $\psi(2S)$ – 2002 (3), 2004 (2), 2006 (1), 2008 (1)
- Possible correlations taken into account
- Interference with multihadronic continuum:
  $\lambda = \sqrt{\frac{R\mathcal{B}_{\mu\mu}}{\mathcal{B}_h}}$ (0.38 at J/ψ and 0.13 at $\psi(2S)$)
- Previous publications used a fraction of the full data sample:
  J/ψ and $\psi(2S)$ – V.M. Aulchenko et al., Phys. Lett. B573 (2003) 63;
  $\psi(2S)$ – V.V. Anashin et al., Phys. Lett. B711 (2012) 280
- Based on 7×10^5 J/ψ and 2×10^5 $\psi(2S)$ multihadronic events
- More than 1000 calibrations performed!

J/ψ Mass Measurement – I



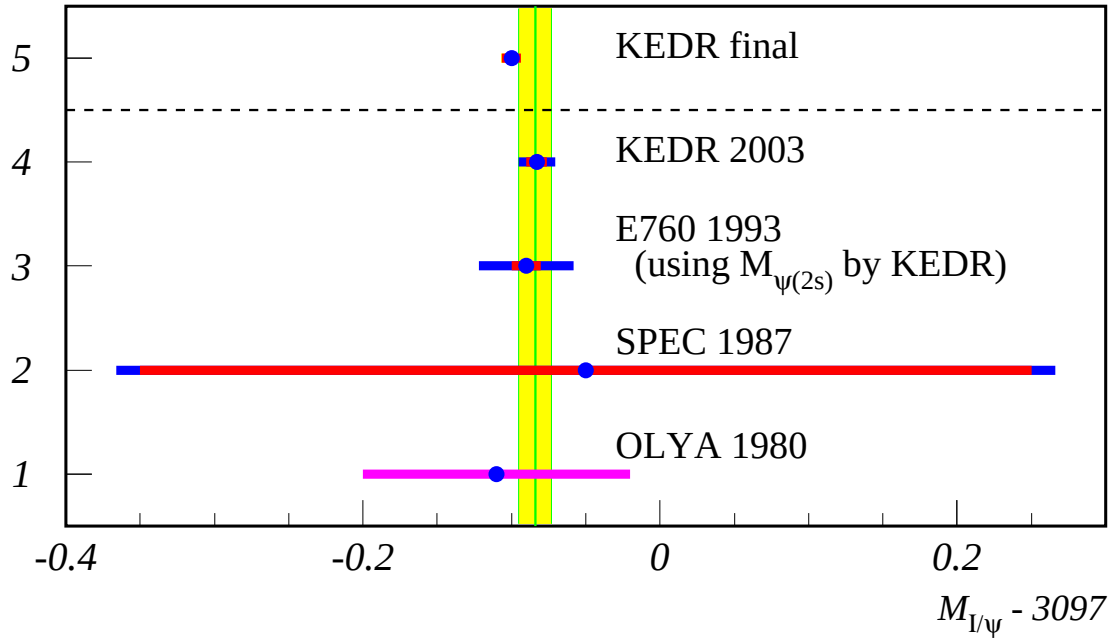
$$M = 3096.900 \pm 0.002 \pm 0.006 \text{ MeV}$$

$$\lambda = 0.43 \pm 0.07 \pm 0.08 \quad \text{(prelim.)}$$

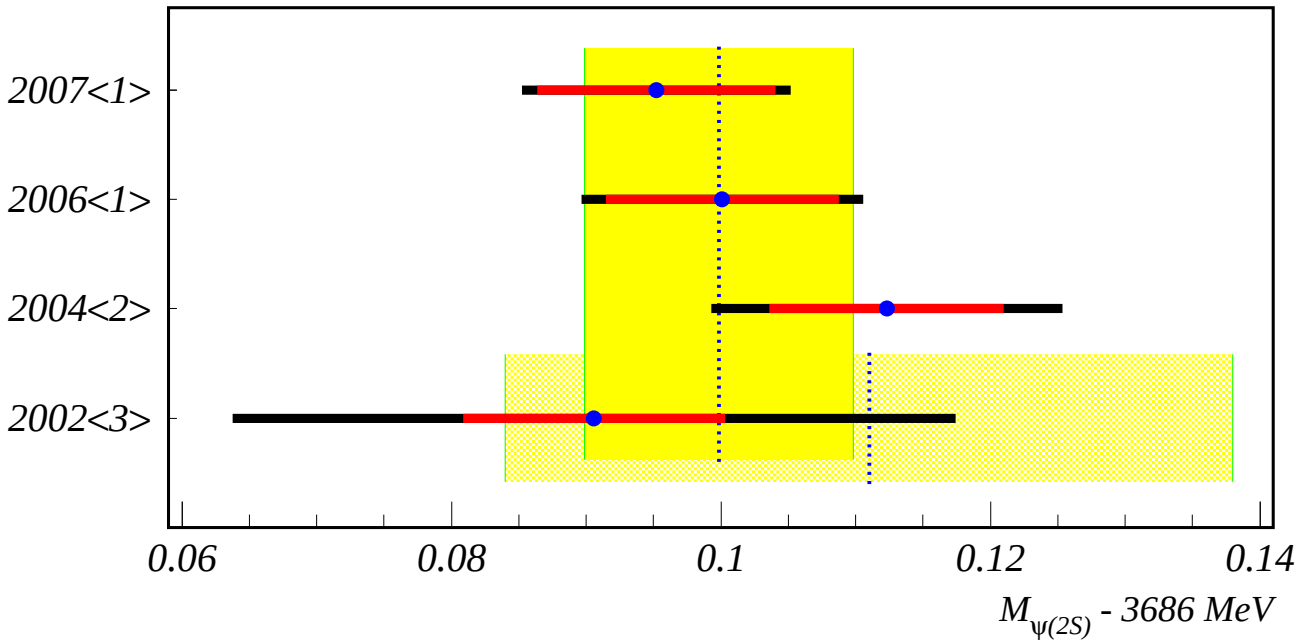
J/ψ Mass Measurement – II

Uncertainty source	2002	2005	2008	Common
Energy spread variation	3.0	1.8	1.8	1.8
Energy assignment to DAQ runs	3.7	3.5	3.5	2.5
Energy calibration accuracy	1.6	1.9	1.9	1.6
Beam separation in parasitic I.P.	0.9	1.7	1.7	0.9
Beam misalignment in the I.P.	1.8	1.5	1.5	1.5
e^+-, e^--energy difference	1.2	1.3	1.2	1.2
Symmetric dL/dE shape distortion	1.5	1.3	2.1	1.3
Asymmetric dL/dE shape distortion	2.1	1.9	1.9	1.9
Beam potential	2.0	2.0	2.0	2.0
Luminosity measurement	2.2	1.7	1.7	1.1
Interference in the hadronic channel	2.7	2.7	2.7	2.6
Total	≈ 7.7	≈ 7.0	≈ 7.2	≈ 5.8

J/ψ Mass Measurement – III



$\psi(2S)$ Mass Measurement – I



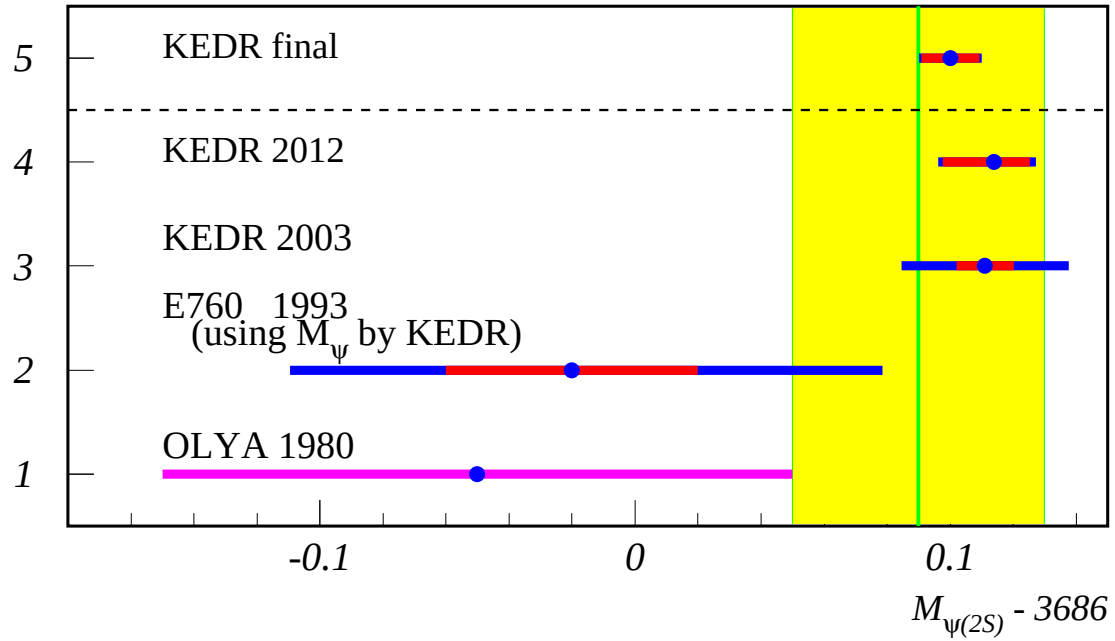
$$M = 3686.100 \pm 0.004 \pm 0.009 \text{ MeV}$$

$$\lambda = 0.18 \pm 0.06 \pm 0.08 \quad \text{(prelim.)}$$

$\psi(2S)$ Mass Measurement – II

Uncertainty source	2002	2004	2006	2008	common
Energy spread variation	2.0	1.5	1.5	1.5	1.5
Energy assignment to DAQ runs	3.9	3.9	3.8	2.4	1.5
Energy calibration accuracy	1.9	2.3	2.3	2.3	1.9
Beam separation in parasitic I.P.	0.5	1.2	1.7	1.7	0.5
Beam misalignment in the I.P.	5.1	3.3	3.3	3.3	2.5
e^+-, e^--energy difference	1.6	2.1	2.1	1.6	1.6
Symmetric dL/dE shape distortion	1.8	1.6	1.6	1.6	1.6
Asymmetric dL/dE shape distortion	2.1	1.9	1.9	1.9	1.9
Beam potential	2.0	2.2	2.2	2.2	2.0
Luminosity measurement	3.0	2.1	2.1	1.5	1.2
Interference in the hadronic channel	4.1	4.1	4.11	4.1	4.1
Total	≈ 9.7	≈ 8.7	≈ 8.6	≈ 8.4	≈ 7.0

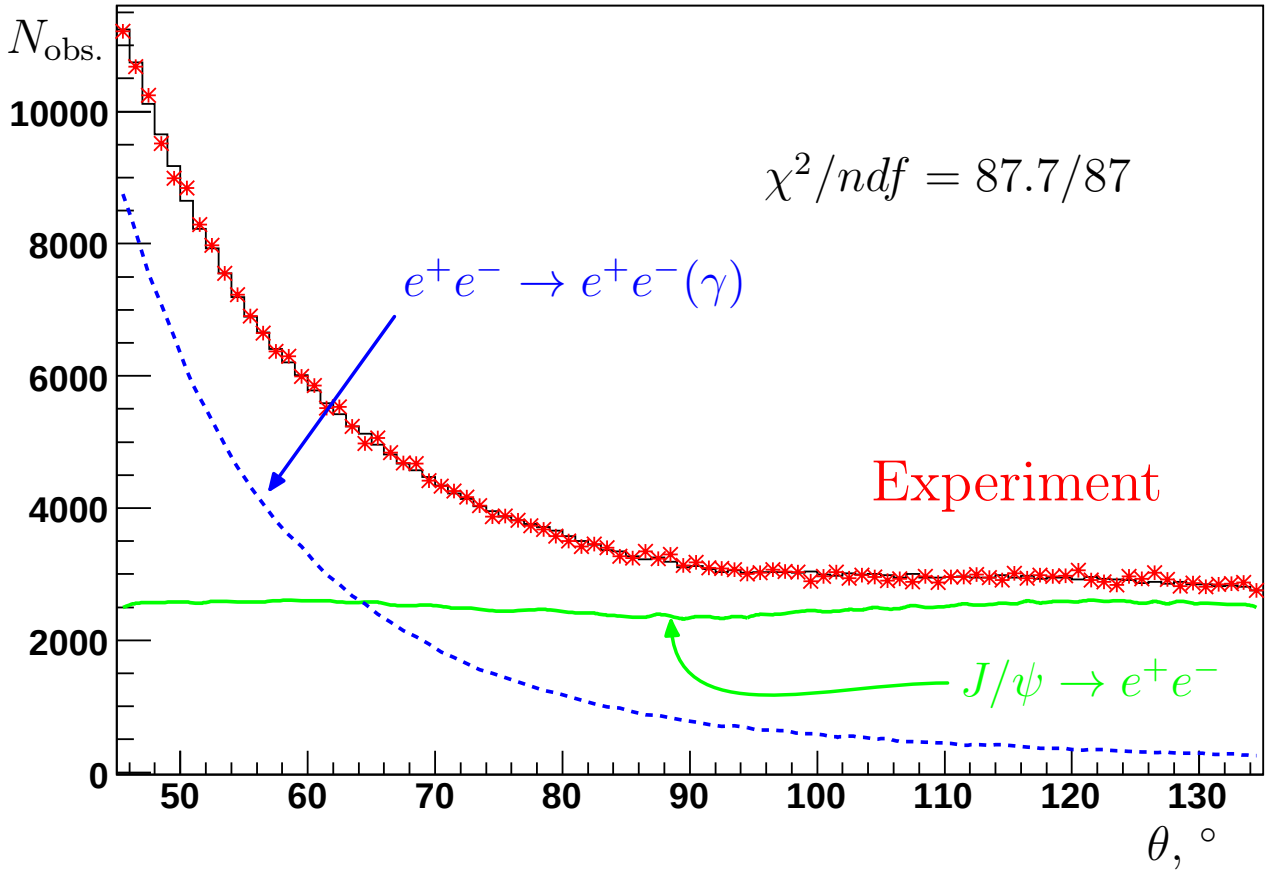
$\psi(2S)$ Mass Measurement – III



Test of Leptonic Universality in J/ψ – I

- Reanalysis of the 2008 data sample:
  V.V. Anashin et al., Phys. Lett. B685 (2010) 134
- 2.2 pb^{-1} or $\approx 7 \times 10^6$ J/ψ
- 382×10^3 e^+e^- and 170×10^3 $\mu^+\mu^-$ detected
- The best result was from CLEO:
  Z. Li et al., Phys. Rev. D71 (2005) 111103

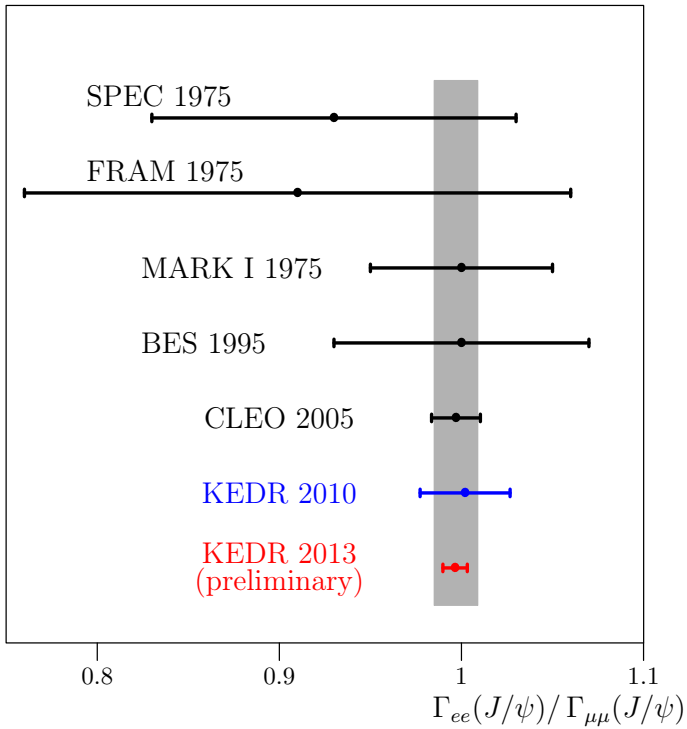
Test of Leptonic Universality in J/ψ – II



Test of Leptonic Universality in J/ψ – III

Source	Uncertainty,%
Interference	0.10
Background ($J/psi \rightarrow$ hadrons)	0.10
Monte Carlo	0.11
1st level trigger	0.14
2nd level trigger	0.13
Selection	0.33
TOF	0.25
Total	0.50

Test of Leptonic Universality in J/ψ – IV



KEDR: $\mathcal{B}(e^+e^-)/\mathcal{B}(\mu^+\mu^-) = 0.9965 \pm 0.0045 \pm 0.0050$

CLEO: $\mathcal{B}(e^+e^-)/\mathcal{B}(\mu^+\mu^-) = 0.997 \pm 0.012 \pm 0.006$

Conclusions and Plans

- Final results on J/ψ and $\psi(2S)$ masses presented
- Record accuracy of 0.5% for $\Gamma(e^+e^-)/\Gamma(\mu^+\mu^-)$ achieved
- Determination of $\mathcal{B}(J/\psi \to \eta_c\gamma)$ close to completion
- R measurement for $\sqrt{s}$ from 1.85 GeV to J/ψ and from J/ψ to $\psi(2S)$ with 4-5% accuracy in progress
- New data taking between 4 and 6 (8) GeV for R measurement