Published for SISSA by Springer

Received: March 6, 2020
Revised: June 4, 2020
Accepted: June 17, 2020
Published: July 17, 2020

Addendum: Measurement of $\Gamma_{ee}(J/\psi)$ with KEDR detector

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Addendum to: JHEP05(2018)119

ArXiv ePrint: 1801.01958

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https://doi.org/10.1007/JHEP07(2020)112

JHEP07(2020)112

Free parameter	Fit 1	Fit 2	Fit 3	Fit 4
Γ (keV)	—	—	—	92.45 ± 1.40
Γ_{hadrons} (keV)	—	—	81.37 ± 1.36	—
Γ_{ee} (keV)	5.550 ± 0.056	—	5.550 ± 0.056	5.549 ± 0.056
$\Gamma_{ee} \cdot \mathcal{B}_{\text{hadrons}}$ (keV)	—	4.884 ± 0.048	—	—
$\Gamma_{ee} \cdot \mathcal{B}_{ee}$ (keV)	0.3331 ± 0.0066	0.3331 ± 0.0066	—	—
m (MeV/c^2)	3096.902 ± 0.004			
R_L	0.973 ± 0.008			
σ_W (MeV)	0.692 ± 0.004			
σ_0 (nb)	28.70 ± 1.48			

Table 1. Results of four different data fits performed for determination of J/ψ-meson parameters. Only statistical errors are shown. This table supersedes table 1 of [1].

The electronic width of the J/ψ meson and its product by the branching fractions of J/ψ meson decay to hadrons and electrons measured with the KEDR detector at the VEPP-4M e^+e^- collider have been reported in ref. [1]. As a continuation of this analysis, the total $\Gamma(J/\psi)$ and hadronic $\Gamma_{\text{hadrons}}(J/\psi)$ widths were also measured. The fits were performed in the same way and on the same data set as in ref. [1]. The systematic uncertainties to $\Gamma(J/\psi)$ and $\Gamma_{\text{hadrons}}(J/\psi)$ were estimated. The results were compared with previous measurements.

The statistical uncertainties of the quantities $\Gamma(J/\psi)$, $\Gamma_{\text{hadrons}}(J/\psi)$, $\Gamma_{ee}(J/\psi)$, $\Gamma_{ee}(J/\psi) \cdot \mathcal{B}_{ee}(J/\psi)$, $\Gamma_{ee}(J/\psi) \cdot \mathcal{B}_{\text{hadrons}}(J/\psi)$ are strongly correlated. To determine uncertainties for all quantities accurately, the fit was performed with four different sets of free parameters. For the determination of the total $\Gamma(J/\psi)$ and hadronic $\Gamma_{\text{hadrons}}(J/\psi)$ widths, two additional fits were performed with respect to [1]. All sets contained auxiliary free parameters: the absolute luminosity calibration factor R_L, the resonance mass $m(J/\psi)$, the beam energy spread σ_W and the continuum contribution σ_0. The results for the J/ψ-meson parameters obtained from the four fits are shown in table 1.

The major sources of the systematic uncertainties associated to the $\Gamma(J/\psi)$ and $\Gamma_{\text{hadrons}}(J/\psi)$ measurements were estimated in the same way as in ref. [1]. The impact of all uncertainties was re-evaluated with the same procedure and the major sources are summarized in table 2. The luminosity systematic uncertainties arise mainly from the selection of electrons, the detection efficiency determination, the LKr calorimeter calibration, the $e^+e^- \to e^+e^-$ cross section calculation according to eq. (4.7) in [1]. The MC generator tuning and tracking efficiency contribute to the uncertainty of the simulation of J/ψ decays. The detector response uncertainty includes trigger efficiency, nuclear interactions, hadronic selections. Accelerator-related effects result from uncertainties of beam energy determination, collider background, non-gaussian beam energy spread. The theoretical uncertainties are due to the interference model and accuracy of radiative-correction

JHEP07(2020)112

Source	Uncertainty, %
Luminosity	1.0
Simulation of J/ψ decays	0.7
Detector response	0.8
Accelerator-related effects	0.4
Theoretical uncertainties	0.4
Total	1.6

Table 2. Dominant systematic uncertainties in the $\Gamma(J/\psi)$ and $\Gamma_{\rm hadrons}(J/\psi)$ measurements.

calculation and analytical expressions used in the data analysis. The total systematic uncertainty for $\Gamma(J/\psi)$ and $\Gamma_{\rm hadrons}(J/\psi)$ equals 1.6%. This value is of the same order of the total systematic uncertainties for $\Gamma_{ee}(J/\psi)$ and $\Gamma_{ee} \cdot B_{\rm hadrons}(J/\psi)$ parameters [1].

Following the analysis published in [1], we obtained the total and hadronic widths of the J/ψ meson:

$$\Gamma(J/\psi) = 92.45 \pm 1.40 \pm 1.48\,\text{keV},$$
$$\Gamma_{\rm hadrons}(J/\psi) = 81.37 \pm 1.36 \pm 1.30\,\text{keV}.$$

The first and second uncertainties are statistical and systematic, respectively. The result on $\Gamma(J/\psi)$ has statistical uncertainty larger than in ref. [1] because correlations between electronic and hadronic channels are taken into account. The total width obtained in our analysis is a direct measurement involving data only from the KEDR experiment and is independent of the total width $\Gamma = 92.94 \pm 1.83\,\text{keV}$ calculated in [1] using the measured electronic width and world average B_{ee} [2]. The difference between the measured $\Gamma(J/\psi)$ value and the world average of the electronic width $\Gamma = 92.9 \pm 2.8\,\text{keV}$ [2] is $0.45 \pm 0.76\,\text{keV}$ that we consider as good agreement.

Our result for the $\Gamma_{\rm hadrons}(J/\psi)$ value is consistent with and four times more precise than the previous direct measurement of the hadronic width by the BES collaboration in 1995 [3]. Figure 1 shows comparison of the measured $\Gamma(J/\psi)$ and $\Gamma_{\rm hadrons}(J/\psi)$ values with those obtained in previous experiments.

Acknowledgments

The authors are grateful to Vladimir Druzhinin (BINP) for useful discussions. This work was partially supported by Russian Science Foundation under project N 20-52-12056. SE acknowledges support of the Ministry of Science and Higher Education of the Russian Federation, Agreement 14.W03.31.0026.

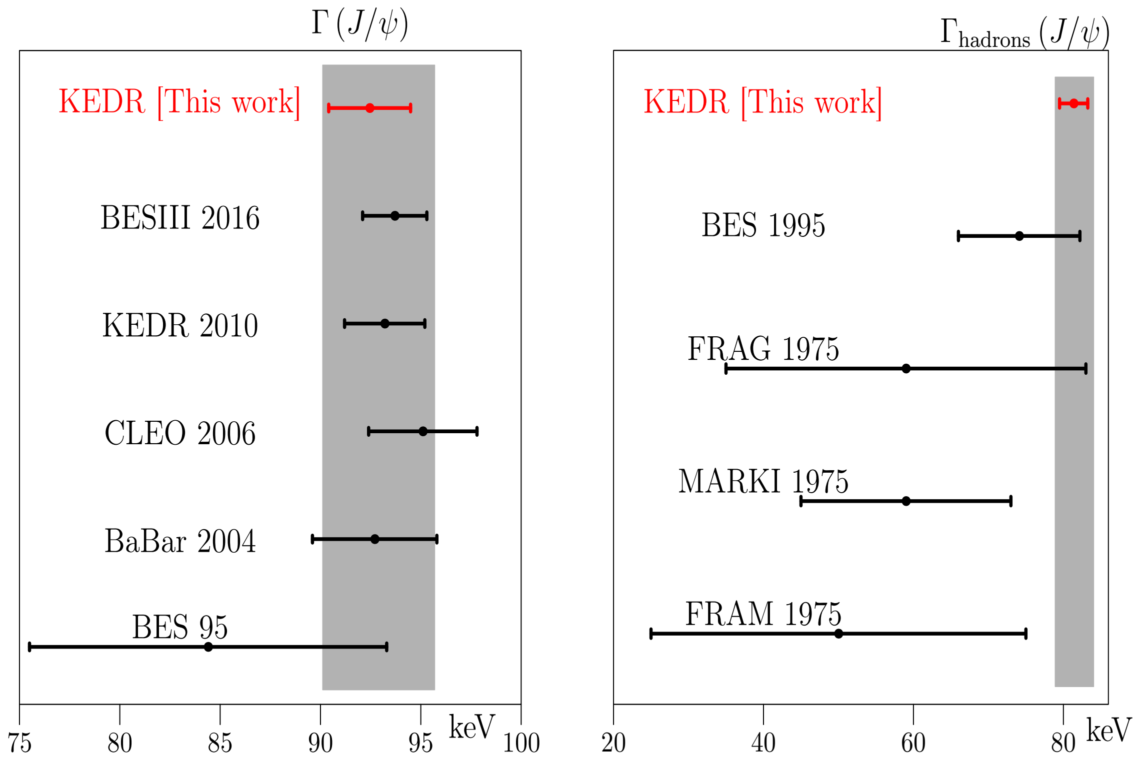

Figure 1. Comparison of $\Gamma(J/\psi)$ and $\Gamma_{\text{hadrons}}(J/\psi)$ measured in the most precise experiments. The $\Gamma(J/\psi)$ values from BESIII, KEDR (2010), CLEO (2006), BaBar(2004) experiments were calculated using the world-average lepton branching fraction [2]. The gray band corresponds to the world-average value with allowance for its uncertainty.

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JHEP07(2020)112