

Recent Results from the KEDR detector at the VEPP-4M e^+e^- -collider

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We report results of experiments performed with the KEDR detector at the VEPP-4M e^+e^- collider. They include final results for $\psi(2S)$ and preliminary results for $\psi(3770)$ parameters, combined analysis of all 2002-2006 scans on J/ψ and $\psi(2S)$ masses, and a search for narrow resonances in e^+e^- annihilation at center-of-mass energies between 1.85 and 3.1 GeV.

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1. VEPP-4M collider

The VEPP-4M collider can operate in the wide range of beam energy from 1 to 6 GeV. The peak luminosity in the J/ψ energy region is about $2 \times 10^{30} \text{ cm}^{-2} \text{ s}^{-1}$. One of the main features of the VEPP-4M is its capability to precisely measure the beam energy using two techniques [1]: resonant depolarization and infrared light Compton backscattering.

2. $\psi(2S)$ parameters measurement

A high-precision determination of the main parameters of the $\psi(2S)$ resonance has been performed with the KEDR detector at the VEPP-4M e^+e^- collider in three scans of the $\psi(2S)$ – $\psi(3770)$ energy range [2]. Fitting the energy dependence of the multihadron cross section in the vicinity of the $\psi(2S)$ we obtained the mass value which is discussed in sec. 4 and the product of the electron partial width by the branching fraction into hadrons

$$\Gamma_{ee} \times \mathcal{B}_h = 2.233 \pm 0.015 \pm 0.037 \pm 0.020 \text{ keV}.$$

The third error quoted is an estimate of the model dependence of the result due to assumptions on the interference effects in the cross section of the single-photon e^+e^- annihilation to hadrons explicitly considered in this work. Implicitly, the same assumptions were employed to obtain the charmonium leptonic width and the absolute branching fractions in many experiments.

Using the result presented and the world average values of the electron and hadron branching fractions, one obtains the electron partial width and the total width of the $\psi(2S)$:

$$\begin{aligned} \Gamma_{ee} &= 2.282 \pm 0.015 \pm 0.038 \pm 0.021 \text{ keV}, \\ \Gamma &= 296 \pm 2 \pm 8 \pm 3 \text{ keV}. \end{aligned}$$

These results are consistent with and more than two times more precise than any of the previous experiments.

3. Measurement of $\psi(3770)$ parameters

We report the final results of a study of the $\psi(3770)$ meson using a data sample collected with the KEDR detector at the VEPP-4M electron-positron collider [3]. The data analysis takes into account the interference between the resonant and nonresonant $D\bar{D}$ production, where the latter is related to the nonresonant part of the energy-dependent form factor F_D . The vector dominance approach and several empirical parameterizations have been tried for the nonresonant $F_D^{NR}(s)$.

Our *preliminary* results for the mass and total width of $\psi(3770)$ assuming $\psi(2S)$ dominance in $F_D^{NR}(s)$, are

$$\begin{aligned} M &= 3779.1^{+1.8}_{-1.7} \pm 0.6^{+0.2}_{-0.3} \text{ MeV}/c^2, \\ \Gamma &= 25.2^{+4.6}_{-4.1} \pm 0.5^{+0.5}_{-0.2} \text{ MeV}, \end{aligned}$$

where the first, second and third uncertainties are statistical, systematic and model, respectively. The results agree with these from BABAR [4] also taking into account interference and disagree with all results obtained ignoring this effect including that by BES [5].

For the electron partial width two possible solutions have been found:

$$(1) \quad \Gamma_{e^+e^-} = 147_{-62}^{+97} \pm 13_{-10}^{+11} \text{ eV},$$

$$(2) \quad \Gamma_{e^+e^-} = 415_{-58}^{+59} \pm 38_{-10}^{+160} \text{ eV}.$$

Our statistics are insufficient to prefer one solution to another. The solution (2) is strongly disfavored by potential models.

4. J/ψ and $\psi(2S)$ masses

The data analysis of the J/ψ - and $\psi(2S)$ -meson masses measurement has been performed with additional statistics. Systematic errors in mass measurements are the main issue. More than 20 different effects considered: Energy spread, energy assignment, energy difference of e^+ and e^- , beam misalignment, luminosity etc. No significant improvement for the J/ψ because the additional scan had bigger systematics. New mass measurements will replace the old results [6].

The following *preliminary* mass values have been obtained:

$$M(J/\psi) = (3096.913 \pm 0.006 \pm 0.009) \text{ MeV},$$

$$M(\psi(2S)) = (3686.126 \pm 0.007 \pm 0.011) \text{ MeV}.$$

5. Search for narrow resonances

We report results of a search for narrow resonances in e^+e^- annihilation at center-of-mass energies between 1.85 and 3.1 GeV performed with the KEDR detector at the VEPP-4M e^+e^- collider [7]. The upper limit on the leptonic width of a narrow resonance $\Gamma_{ee}^R \cdot Br(R \rightarrow hadr) < 120$ eV has been obtained (at 90% C.L.).

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