Progress

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Comments

to be $\Lambda = 2.81 \pm 0.10$ GeV/c^2. The systematic uncertainty of Λ is computed as $\Delta\Lambda^2_{syst} = \Delta\Lambda^2_1 + \Delta\Lambda^2_2$, where $\Delta\Lambda_1$ ($\Delta\Lambda_2$) is the quadratic difference between the uncertainties of the two Λ values computed with and without including the systematic uncertainties in the TFF vs. $m_{e^+e^-}$ curve (ρ resonance in the fit function of the formula of Equation 1) during the fit. The resulting pole mass including the systematic uncertainty is determined to be $\Lambda = 2.81 \pm 0.10(stat) \pm 0.06(syst)$ GeV/c^2.

http://docbes3.ihep.ac.cn/DocDB/0005/000553/013/paperV2.pdf

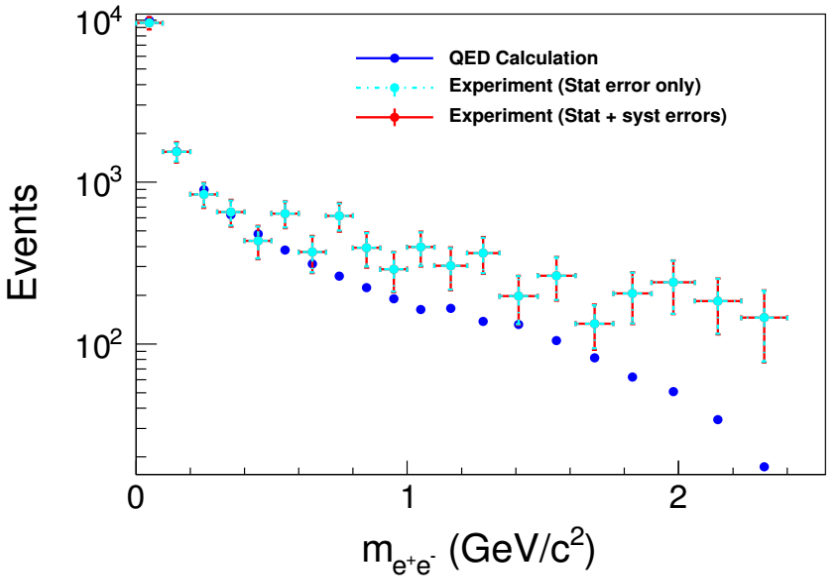
Comments

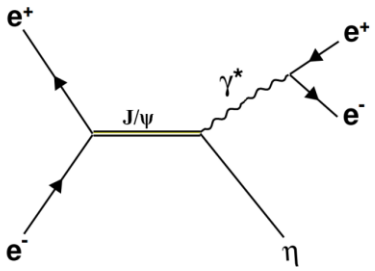
>>It is not a common practice to do this. The meaning of difference of two statistical uncertainties is not so clear in concept and it is hard to elate this quantity to systematic uncertainties. The same is true for the next one \Delta \Lambda2.

>I have taken this idea from this BESIII paper https://journals.aps.org/prd/pdf/10.1103/PhysRevD.92.012001 >to evaluate the systematic uncertainty of Lambda. Please read the paragraph of this paper just above the summary section. Since you have suggested me to also consider the systematic uncertainty due to the fit function, so I introduce the other term \Delta Lambda2. For the case of \Delta Lambda2, I can consider as the difference between two Lambda values evaluated using two different fit functions (as did for the dark photon)

I understand how you calculate, but seems too complex to general reader. The key problem, as already stated earlier, is the lack of principle and poor readability when you have two such terms and add them quadratically . It is more complex than the etaâ€™gamma e e case because the influence of resonances almost does not exist there.My proposal would be you re-formulate the TFF systematic evaluation in a more clear manner. It may need some efforts, but necessary.

Comments





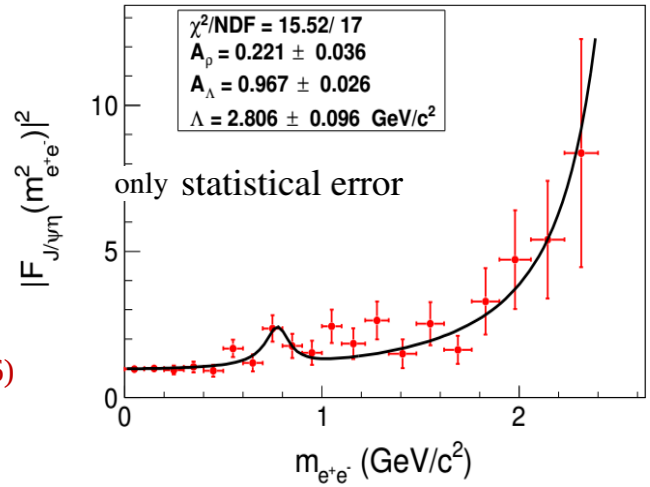
$$\frac{d\Gamma(J/\psi \to \eta e^+e^-)}{dq} = \Gamma(J/\psi \to \eta\gamma)\frac{\alpha_{em}}{3\pi}|F_{J/\psi\eta}(q^2)|^2\frac{2}{q}\left(1-\frac{4m_e^2}{q^2}\right)^{1/2}\left(1+\frac{2m_e^2}{q^2}\right)\times$$
$$\left[\left(1+\frac{q^2}{m_{J/\psi}^2-m_\eta^2}\right)^2-\frac{4m_{J/\psi}^2q^2}{(m_{J/\psi}^2-m_\eta^2)^2}\right]^{3/2}$$
$$= \quad |F_{J/\psi\eta}(q^2)|^2 \times [QED(q^2)]$$

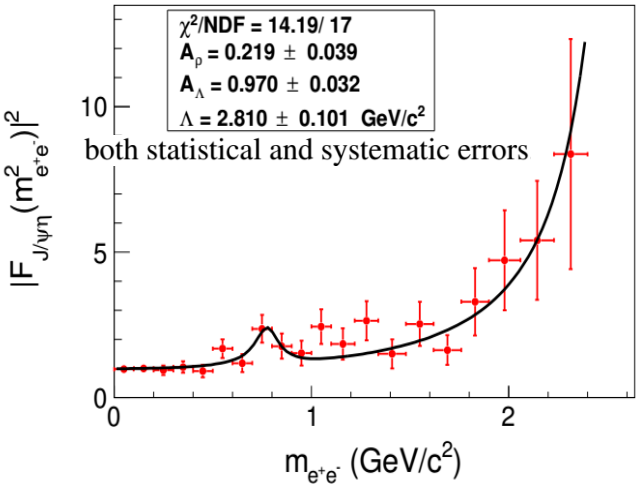
$$F_{J/\psi\eta}(q^2) = N\sum_V \frac{g_{J/\psi\eta V'}}{2g_{V'\gamma}}\frac{m_{V'}^2}{m_{V'}^2-q^2-i\Gamma_{V'}m_{V'}}$$

Using a simple pole approximation,

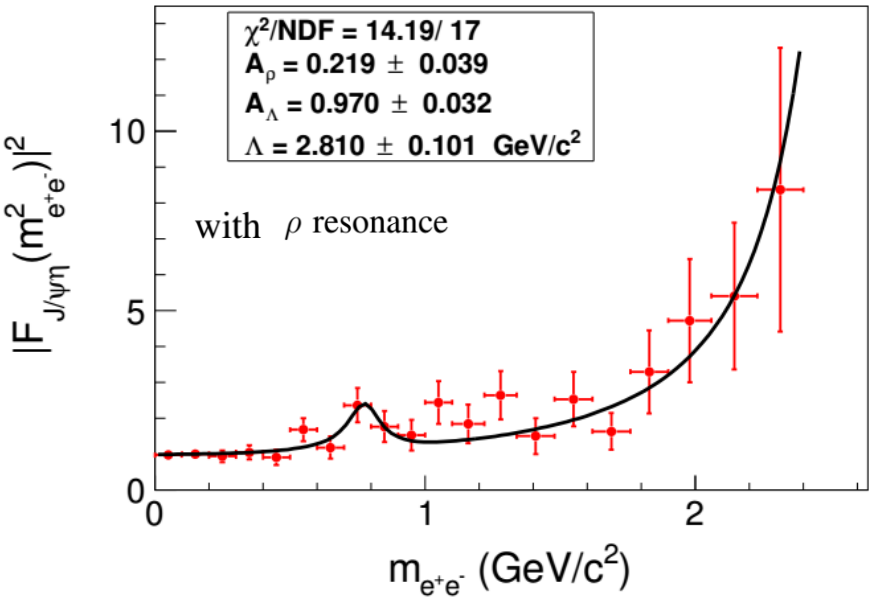
$$F_{J/\psi\eta}(q^2) = \frac{1}{1-q^2/\Lambda^2}$$

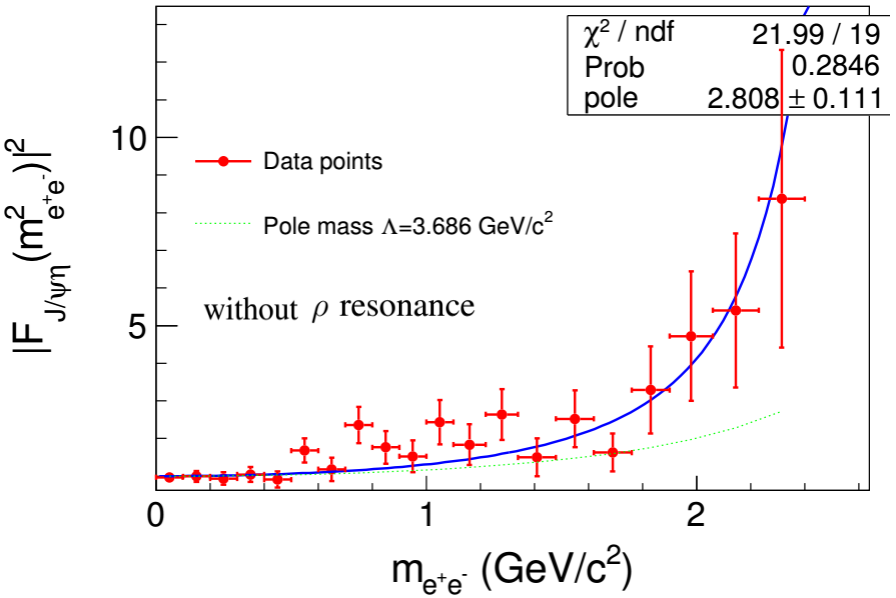
σ_1 = TMath::Sqrt(0.101*0.101-0.096*0.096)
= 3.13847096529504543e-02





Comments





σ_2 = 2.810-2.808=0.02

σ_{Tot} = TMath::Sqrt(3.13847096529504543e-02**2+0.02**2)=**3.72155881318568110e-02**

Zhang Jielei suggestion

I think the accurate way is to perform a fit with correlation terms from TFF systematic uncertainty considered by constructing chisq formula: chisq=(Delat x)^T M^-1 (Delta x), M is covariance matrix.

While I notice that in your systematic table, the systematic error is mainly come from correlation terms,

so all points in fig.6 should move up or down simultaneously when considering systematic error.

So I think you can only use statistical error to get nominal results, and move all points up or down 1 systematic error simultaneously

to get the Lambda error from TFF systematic uncertainty.

Of course, the Lambda error from fit function also should be considered.

And the two systematic error items should be independent.

What do you think? Dayong? Haiping?

Source	$J/\psi \to e^+e^-\eta$			$J/\psi \to A'\eta$	
	$\eta \to \gamma\gamma$	$\eta \to 3\pi$	TFF measurement	$\eta \to \gamma\gamma$	$\eta \to 3\pi$
Additive systematic uncertainties (events)					
Fixed PDFs	0.0	0.90	negligible	0.02 – 0.96	0.0 – 0.61
Fit Bias	1.62	0.10	0.10	0.13	0.14
Background modeling	13.0	1.40	0.001 – 0.59	0.0 – 12.0	0.0 – 5.0
Total	13.10	1.67	0.10-0.59	0.13 – 12.04	0.14 – 5.0
Multiplicative systematic uncertainties (%)					
$\mathrm{Cos}\theta_\gamma^{hel}$	1.86	—	—	1.86	—
Charged tracks (* for e track only)	2.40	4.80	4.80	2.40	4.80
Photon detection efficiency*	2.00	2.0	2.00	2.00	2.00
χ^2_{4C}	0.90	0.90	0.90	0.90	0.90
e^- PID*	1.20	1.20	1.20	1.20	1.20
J/ψ counting*	0.50	0.50	0.50	0.50	0.50
η reconstruction*	1.0	1.0	1.0	1.0	1.0
TFF	1.52	0.9	—	1.52	0.9
$\mathcal{B}(J/\psi \to \gamma\eta)$	—	—	3.08	3.08	3.08
$\mathcal{B}(\eta \to \gamma\gamma)$	0.50	—	—	0.50	—
$\mathcal{B}(\eta \to \pi^+\pi^-\pi^0)$	—	1.22	1.22	—	1.22
Veto of gamma conversion*	1.0	1.0	0.0 – 1.50	0.0 – 1.50	0.0 – 1.50
$\mathcal{B}(A' \to e^+e^-)$*	—	—	—	0 – 14	0 – 14
Total	4.50	5.81	6.443 – 6.616	5.46 – 15.03	6.58 – 15.47

Zhang Jielei suggestion

Hi Vindhy,

It should be:
1) Fit to the TFF curve while including the statistical error only to obtain Lambda \pm Delta Lambda value

2) Vary all the TFF points simultaneously with either TFF + 1 sigma syst or TFF - 1 sigma syst

3) Fit to the TFF curve once again and compute following values:
a) Lambda+ \pm \Delta Lambda+ // when all the points are floated for +1 syst
b) Lambda- \pm Delta Lambda- // when all the points are floated for -1 syst

4) Then we have to compute \Delta Lambda = Lambda - Lambda+ or Lambda -Lambda-, and consider one of the maximum value as the Lambda's sys. error from TFF measurement sys. error.

Hello Jielei,
Okay, thanks for your information. If I understand clearly, I need to use following method to evaluate the systematic uncertainty.

1) Fit to the TFF curve while including the statistical error only and obtain the correlation matrix as well as Lambda \pm Delta Lambda value

2) Vary all the TFF points simultaneously with either TFF + 1 sigma syst or TFF - 1 sigma syst (for example from table 23 in memo V13 of first bin 0.969 + 0.062 or 0.969 - 0.062, I have to do the same thing for other points too).

3) Fit to the TFF curve once again and compute following values:
a) Lambda+ \pm \Delta Lambda+ // when all the points are floated for +1 syst
b) Lambda- \pm Delta Lambda- // when all the points are floated for -1 syst

4) Then we have to compute \Delta Lambda = Lambda - Lambda+ or Lambda -Lambda-, and consider one of the maximum value as the final result.

Then finally compute the chi2 = (Delta Lambda)^T M^- (Delta Lambda)

Please clarify me if I am wrong at some points.

Maybe my explanation has some confuse.
In your fig.6, all form factor point has common systematic error (such as tracking, photon, branching fraction...) and not common systematic error(such as backgrund modeling....).
While the common systematic error is dominant.
So every point(in fig.6)'s systematic error is correlated, you can't add systematic error with statistic error as the total error in fit.

Hello Jielei,
Thanks for your suggestion. But, the decay mode J/psi --> e+e- eta, eta --> 3pi is only used for the form factor measurement. So the systematic uncertainties are not correlated in this study. The correlated systematic uncertainty means the common sources of the systematic uncertainty in both the eta decay modes of eta --> gamma gamma and eta --> 3pi.
So I think there is no need to construct a chisq formula for this.