Last achievements In J/Psi->K+K- via Psi(2S)

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Corbis

Outline

- Recap
- Fitting issue
- new idea for fitting procedure
- Preliminary results
- Conclusions and Perspectives

Recap

Mantegna

RECAP

Use the precision of di-muon BR measurement, and measure the ratio :

$$R = \frac{BR_{KK}}{BR_{\mu\mu}}$$

I.e.

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The signal and di-muon yields are determined by integration of the fitting function (di-muon or KK)

WHERE?

$$R = \frac{BR_{KK}}{BR_{\mu\mu}} = \frac{N_{KK}}{\epsilon_{KK}} \cdot \frac{\epsilon_{\mu\mu}}{N_{\mu\mu}}$$

The signal and di-muon yields are determined by integration of the fitting function (di-muon or KK)
WHERE?

in an interval
-3 sigma/+2 sigma for KK
and +- 3 sigma for dimuon
-First evaluation Sigma from FWHM→then fixed to DATA VALUE

Efficiency determined using exc MC samples,
fit and integral in the same range, same corresponding function

Previous fitting procedure

Mantegna

Until now:

KK signal: FFT convolution of MC-shape and one gaussian (res effect)

Di-muon signal: FFT convolution of MC-shape and a double gaussian(common mean)(res.effect)

Peaking bkg:

KK range: gaussian

(parameters fixed to inclusive MC ones)

(fixed Number of events, evaluated by means of no-pipijpsi fraction from recoiling mass fitting)

Di-muon range:

MC-shape from inclusive MC matched by MCTruth

fixed Number of events, evaluated by means of INCMC

IDEA

Use directly the evaluated fractions of peaking background
(peaking in KK range from DATA fitting in recoiling mass spectrum fraction in KK range
and peaking in di-muon range from INC-MC)
IN THIS WAY ...we avoid to use fixed number of events

ISSUE:

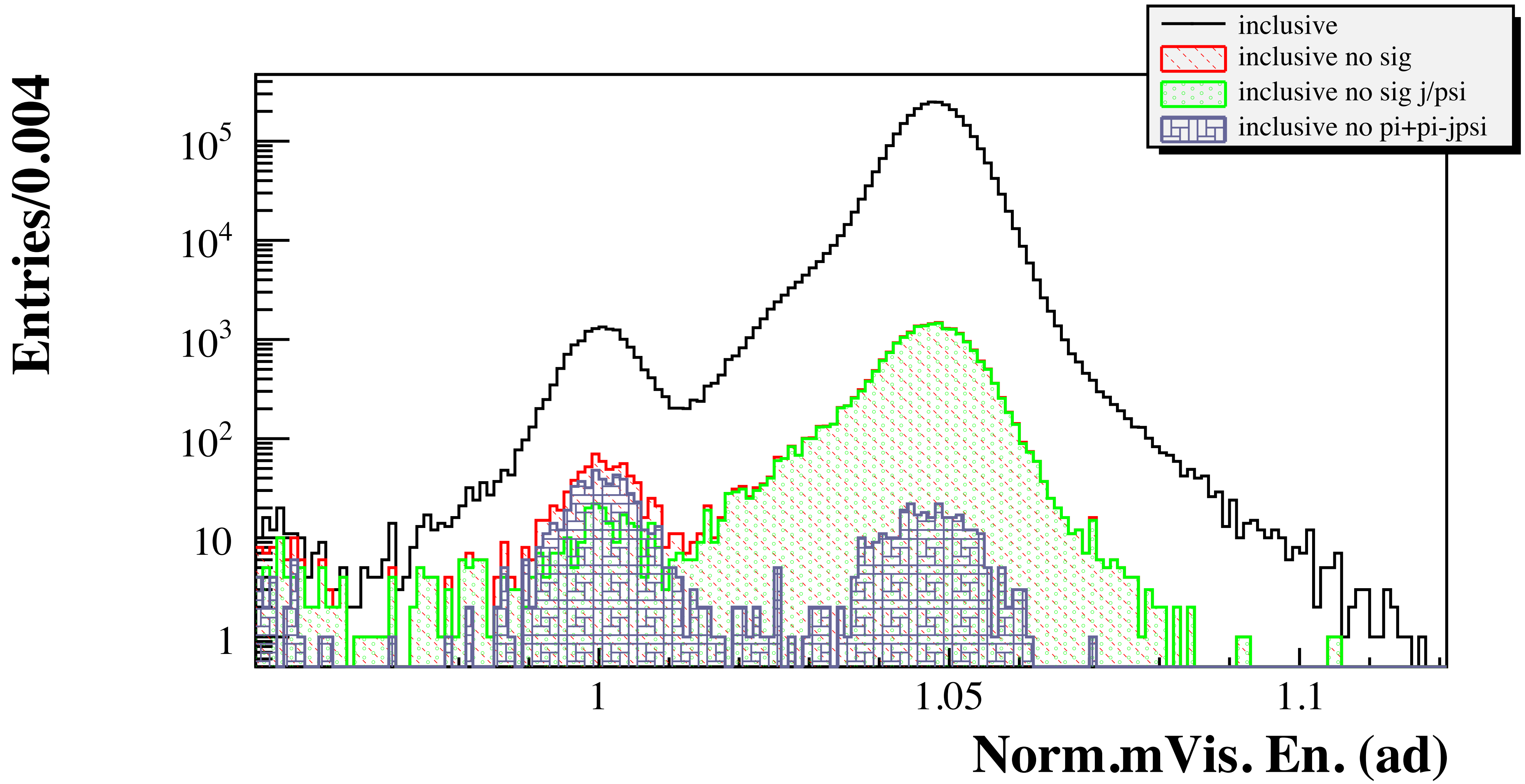
How to manage the total PDF

Chagall

Recap background

Mantegna

Reminder :

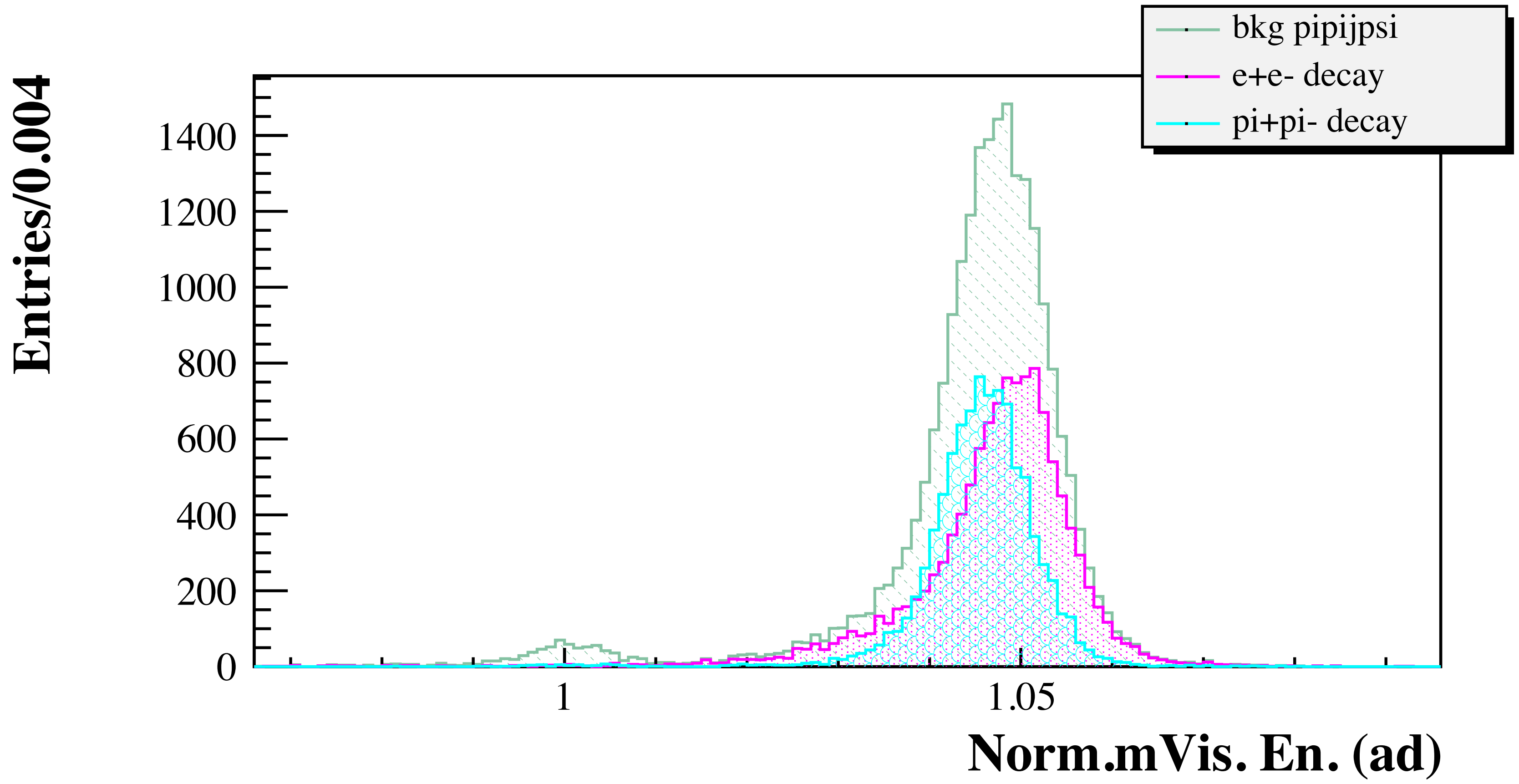


In kk range mainly no-pipijpsi bkg

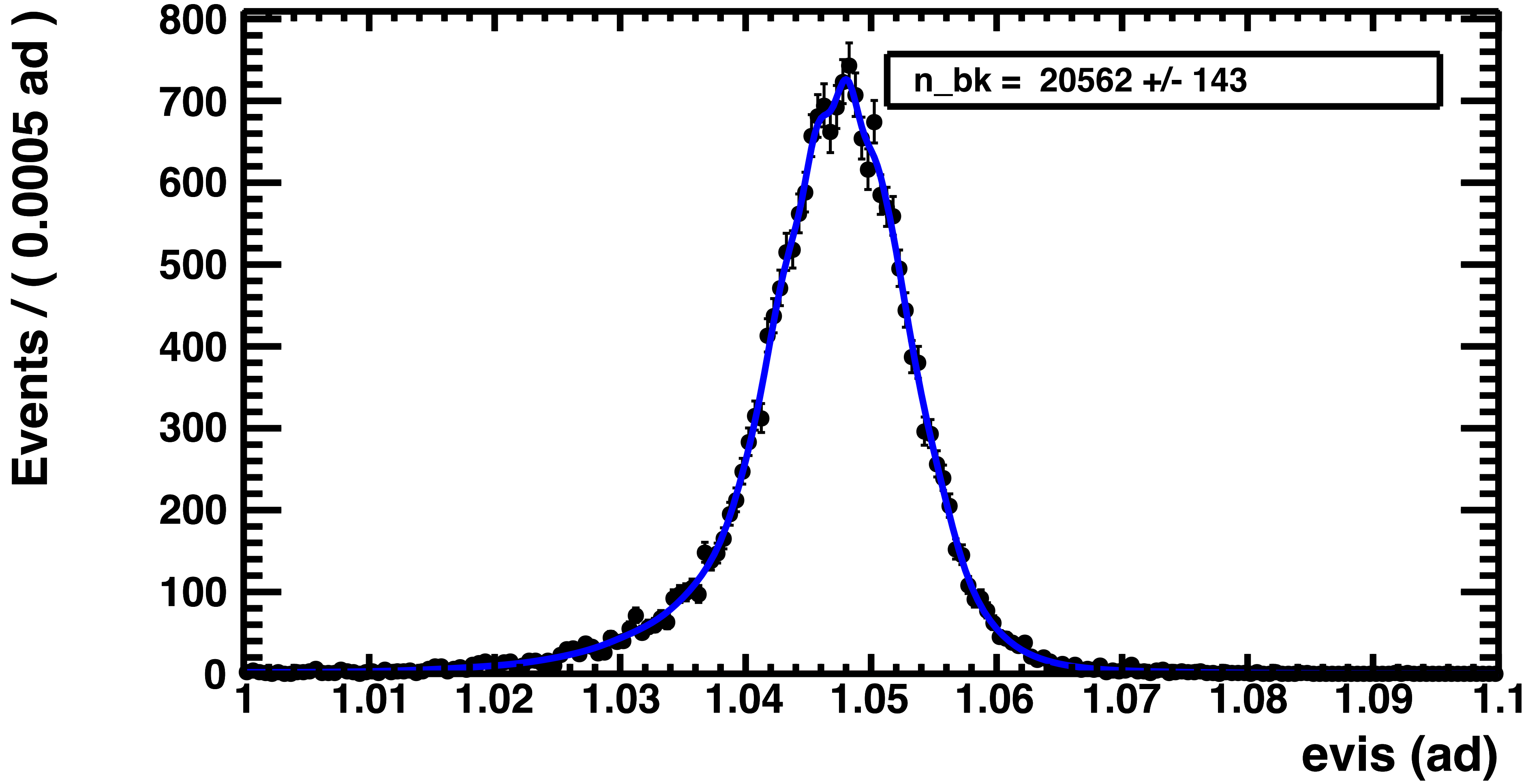
In di-muon range mainly pipijspi bkg à in both cases it is peaking ☹

Not useful fraction in full range for nonpipijpsi, negligible in di-muon range—add complexity

Plots from inclusive(channels)



e+e- and pi+pi- decay show different shape and central value, as expected
Larger tail at lower values for e+e-



Mc-shape used in fitting from skimmed INC-datasample

THE BUILDING BLOCKS OF TOTAL FUNCTION

```
RooKeysPdf musig_mc
RooFFTConvPdf musig("musig","musig", evis, musig_mc, mugmsum);
RooKeysPdf eesig_mc

RooRealVar fracee("fracee","fracee",0.007,0,0.009);
        RooAddPdf func_emu("func_emu","func_emu", RooArgList(eesig_mc,musig),fracee);
```

```
 RooKeysPdf sig_mc("sig_mc","sig_mc", evis, *cutdata_sig,RooKeysPdf::MirrorBoth);
RooFFTConvPdf sig("sig","sig",evis, sig_mc, gauss1);
RooRealVar psigma1("psigma1","psigma1", 0.0004, 0.0, 0.007);
        RooRealVar presMean1("presMean1", "presMean1",0.999, 0.998,1.002);
        RooGaussian pgauss1("pgauss1", "pgauss1", evis, presMean1, psigma1);
RooRealVar peakfrac("peakfrac","frac peaking bkg",0.0112,0,0.015);
        RooAddPdf sigkk("sigkk"," kk sig+peaking bkg",RooArgList(pgauss1,sig),peakfrac);
```

```
RooAddPdf tot("tot", "tot", RooArgList(sigkk,func_emu), RooArgList(n_kk,n_mumu));
```

THE BUILDING BLOCKS OF TOTAL FUNCTION

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    RooAddPdf tot("tot", "tot", RooArgList(sigkk,func_emu), RooArgList(n_kk,n_mumu));
```

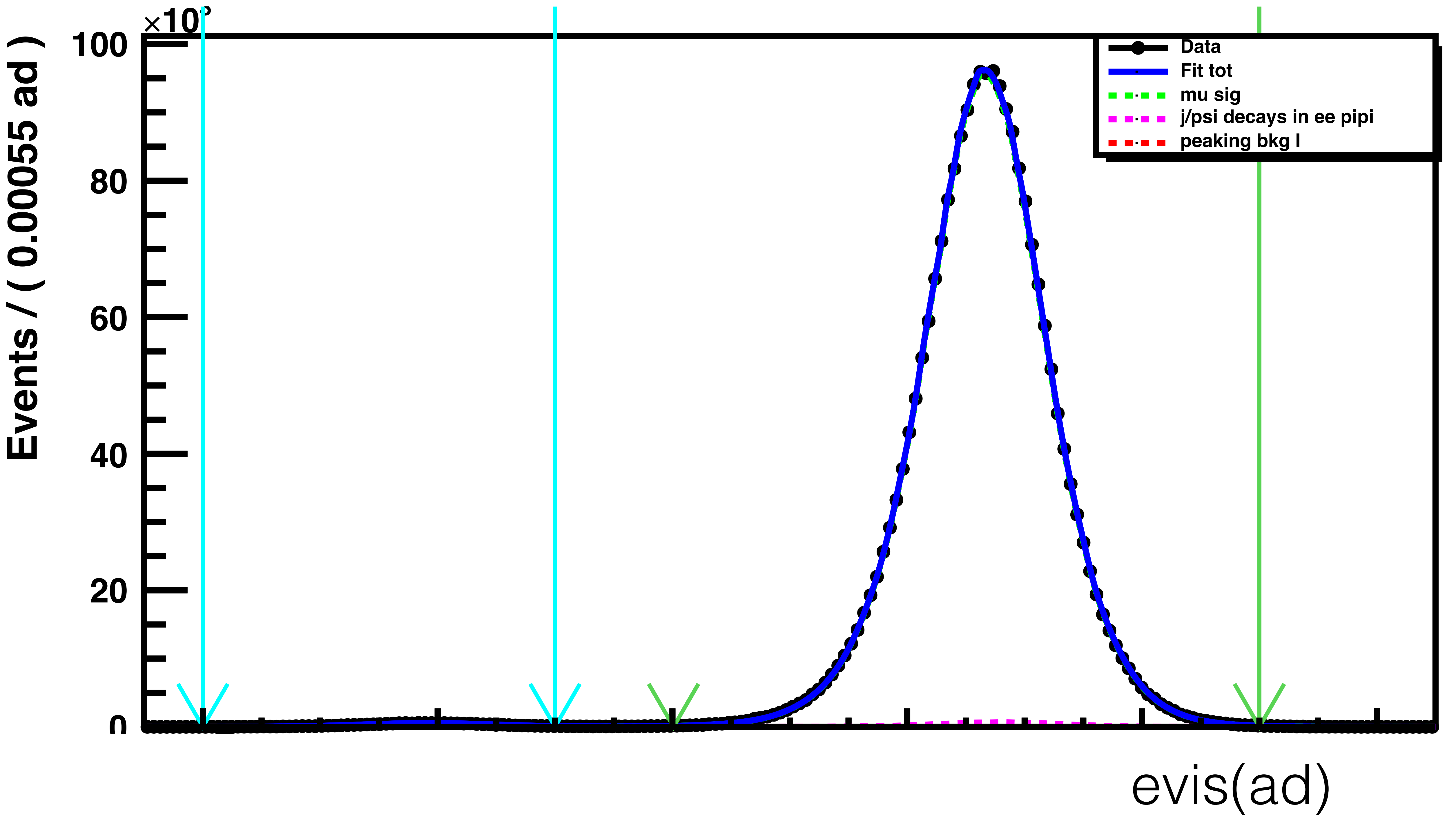
Constant parameters:

fracee,peakfrac,psigma1-presMean1(peaking bkg in kk)

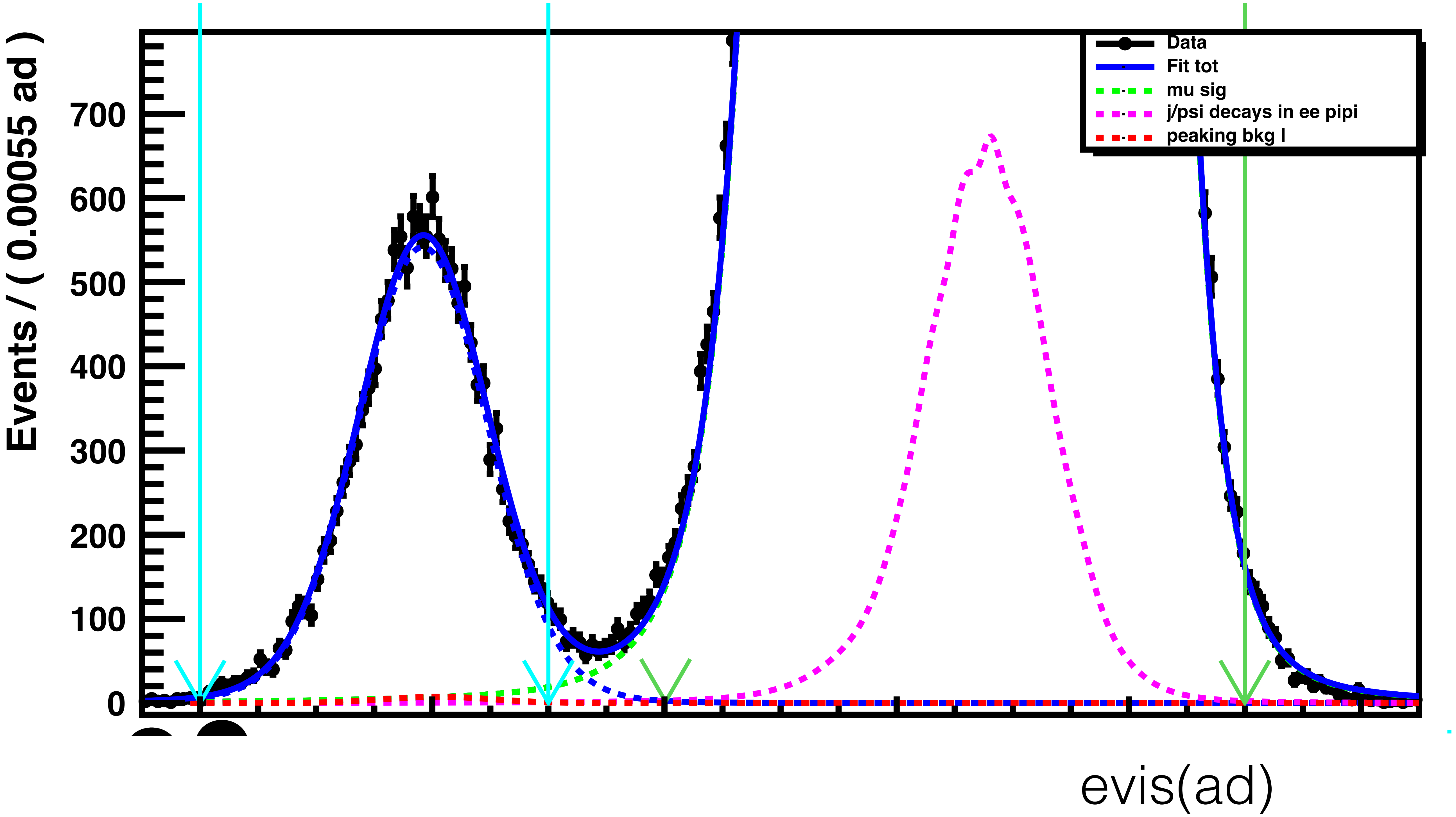
8 Floating parameters—>the others

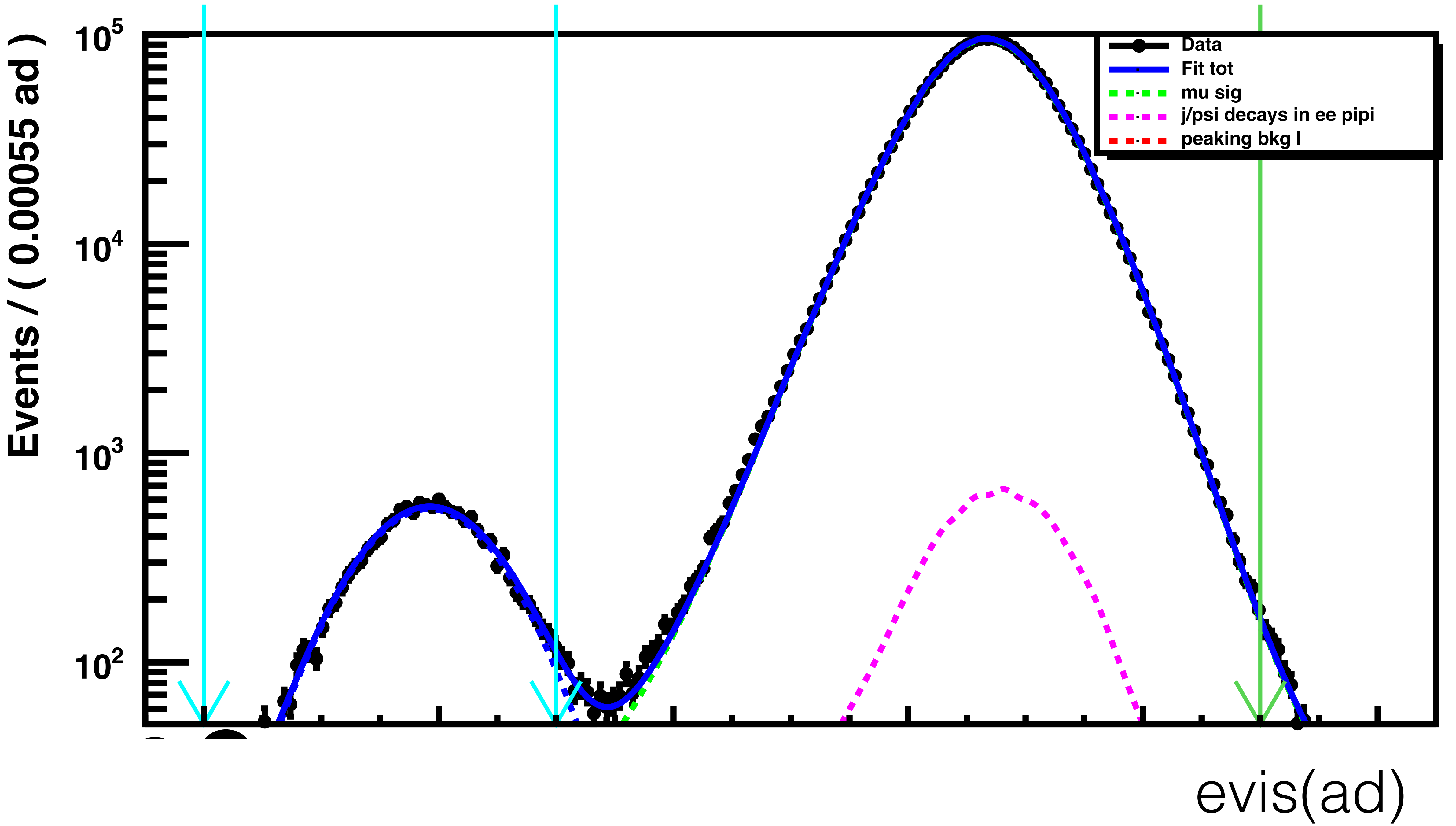
Preliminary results on 2012 data-sample

!!!!!!!!!!!!!!!!!!!!!!!



covariance matrix quality: Full, accurate covariance matrix


Events / (0.00055 ad)
700
600
500
400
300
200
100
0
Data
Fit tot
mu sig
j/psi decays in ee pipi
peaking bkg I
evis(ad)



Events / (0.00055 ad)
10^5
10^4
10^3
10^2
Data
Fit tot
mu sig
j/psi decays in ee pipi
peaking bkg I
evis(ad)

Constant Parameter	Value
fracee	7.0000e-03
peakfrac	1.1200e-02
presMean1	1.0005e+00(peaking kk range parameters)
psigma1	4.7200e-03 (peaking kk range parameters)

Floating Parameter	InitialValue	FinalValue ±	Error
mufrac	9.0000e-01	5.0000e-01 ±	3.00e-04
muresMean1	-2.0000e-03	-1.2518e-03 ±	1.16e-06
musigma1	1.4000e-03	4.4138e-03 ±	9.62e-06
musigma2	5.0000e-03	1.7372e-04 ±	2.34e-06
Total number (bkg+kk)n_kk	1.4000e+04	1.4358e+04 ±	1.22e+02
Total number (bkg+mumu)n_mumu	2.4872e+06	2.3422e+06 ±	1.53e+03
KK resMean1	-8.7000e-04	-1.1931e-03 ±	5.39e-05
KK sigma1	4.0000e-04	3.6549e-03 ±	6.96e-05

12291+-122 Signal events kk

2323416+-1530 mu events

Ranges Choice

range_kk 0.9848 <evis< 1.009

from FWHM (-3sigma,2sigma)

range_mu 1.021 <evis< 1.072

From FWHM (-3sigma,3sigma)

Now, for next results

0.98-1.01 e 1.02-1.07

$$R = \frac{BR_{KK}}{BR_{\mu\mu}} = \frac{N_{KK}}{\epsilon_{KK}} \cdot \frac{\epsilon_{\mu\mu}}{N_{\mu\mu}}$$

Statistical uncertainties

1% $N_{kk,}$ 1 per mille N_{mumu}

Efficiency uncertainties

Dimu 0.15% ;kk 0.15%

$$R = \frac{BR_{KK}}{BR_{\mu\mu}} = \frac{N_{KK}}{\epsilon_{KK}} \cdot \frac{\epsilon_{\mu\mu}}{N_{\mu\mu}}$$

N_{KK}=13675+-122
N_{mumu}=2323416+-1530

e_{mumu}=0.3447+-0.0005

e_{kk}=0.3886+-0.0006

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e_{kk}=0.3886+-0.0006

$$\frac{N_{KK}}{N_{\mu\mu}} = 0.00529 \pm 0.00005$$

$$\frac{\epsilon_{\mu\mu}}{\epsilon_{KK}} = 0.8793 \pm 0.0019$$

Statistical uncertainties

1% N_{kk}, 1 per mille N_{mumu}

Efficiency uncertainties

Dimu 0.15% ;kk 0.15%

$$R = \frac{BR_{KK}}{BR_{\mu\mu}} = \frac{N_{KK}}{\epsilon_{KK}} \cdot \frac{\epsilon_{\mu\mu}}{N_{\mu\mu}}$$

N_{KK}=13675+-122
N_{mumu}=2323416+-1530

e_{mumu}=0.3447+-0.0005

e_{kk}=0.3886+-0.0006

$$R = 0.00465 \pm 0.00005$$

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N_{mumu}=2323416+-1530

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e_{kk}=0.3886+-0.0006

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BR_{mumu}=(5.961 ± 0.033)%

from PDG

$$R = \frac{BR_{KK}}{BR_{\mu\mu}} = \frac{N_{KK}}{\epsilon_{KK}} \cdot \frac{\epsilon_{\mu\mu}}{N_{\mu\mu}}$$

N_{KK}=13675+-122
N_{mumu}=2323416+-1530

e_{mumu}=0.3447+-0.0005

e_{kk}=0.3886+-0.0006

$$R = 0.00517 \pm 0.00005$$

BR_{mumu}=$(5.961 \pm 0.033)\%$
from PDG

BR_{KK}=$(3.08 \pm 0.03 \pm 0.06) \times 10^{-4}$

CAVEAT: Systematics to be studied, here from previous analysis, w/o tracking eff and PID

$BR_{KK}=(3.08 \pm 0.03 \pm 0.06) \times 10^{-4}$

To be compared with PDG $(2.86 \pm 0.21) \times 10^{-4}$

And to BABAR (PRD92,072008 (2015))
BR=$(3.22\pm0.20\pm0.12) \times 10^{-4}$ with positive phase
=$(3.50\pm0.20\pm0.12) \times 10^{-4}$ with negative phase

BR_{KK}=(3.08 ± 0.03 ± 0.06) × 10^{-4}

To be compared with PDG (2.86 ± 0.21)× 10^{-4}

…and to be compared toPID analysis (same channel)

$$BR_{KK} = \frac{N_{KK}}{N_{J/\psi}} = \frac{N_{KKobs}/\epsilon_{KK}}{N_{\psi'}BR_{\pi\pi J/\psi}}$$
$$= (3.21 \pm 0.03 \pm 0.17)\times 10^{-4}$$

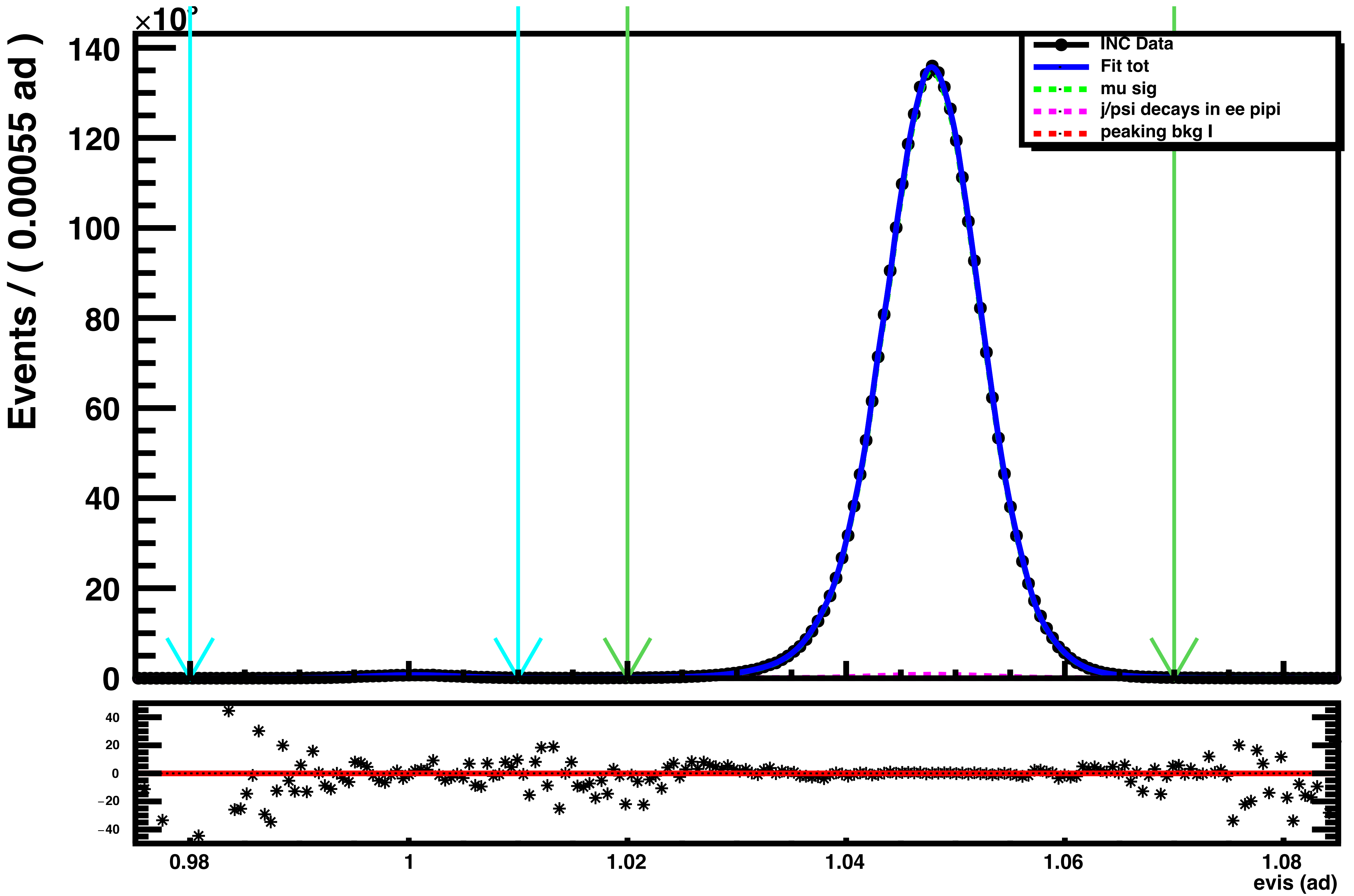
$BR_{KK}=(3.08 \pm 0.03 \pm 0.06) \times 10^{-4}$

To be compared with PDG $(2.86 \pm 0.21)\times 10^{-4}$

…and to be compared to our phase fitting results:

$B_{out} \times 10^{-4}$	ϕ	$\sigma_c(pb)$
2.98 ± 0.08	88.4 ± 9.1	24.8 ± 1.3

I/O check (yesterday results)



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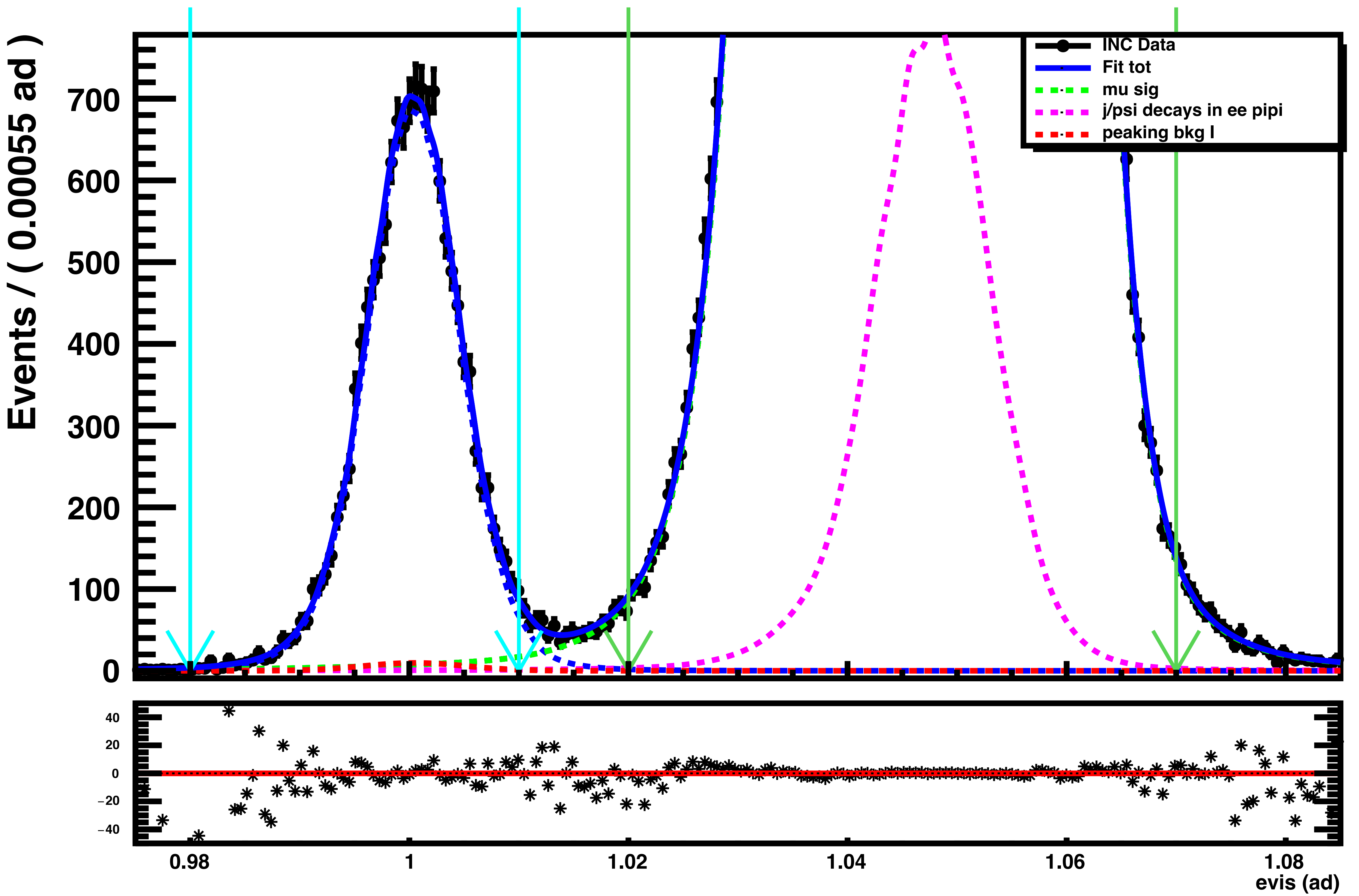

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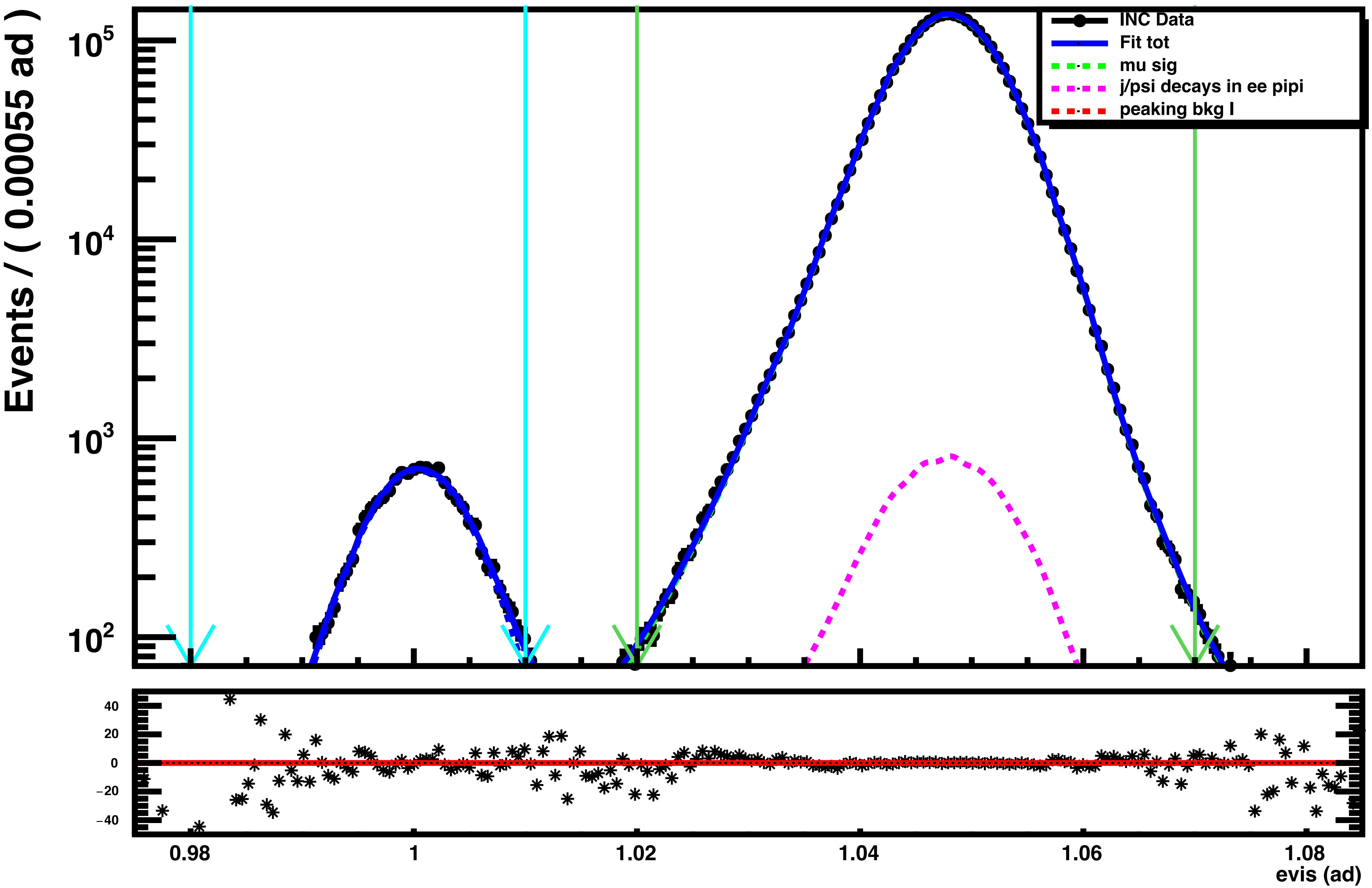

The fitting is working…

No.	decay chain	final states	iTopo	nEvt	nTot
0	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to K^-K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	0	13022	13022
1	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \mu^-\mu^+$	$\psi' \to \pi^+\mu^+\mu^-\pi^-$	3	270	13292
2	$\psi' \to K^-K_1(1270)^+,\ K_1(1270)^+ \to \pi^+K_0(1430)^{*0},\ K_0(1430)^{*0} \to \pi^-K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	7	128	13420
3	$\psi' \to K_1(1270)^-K^+,\ K_1(1270)^- \to \bar{K}_0(1430)^{*0}\pi^-,\ \bar{K}_0(1430)^{*0} \to K^-\pi^+$	$\psi' \to K^+\pi^+\pi^-K^-$	2	110	13530
4	$\psi' \to K^-K_1(1270)^+,\ K_1(1270)^+ \to \pi^+K^*(892)^0,\ K^*(892)^0 \to \pi^-K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	11	39	13569
5	$\psi' \to K_1(1270)^-K^+,\ K_1(1270)^- \to \bar{K}^*(892)^0\pi^-,\ \bar{K}^*(892)^0 \to K^-\pi^+$	$\psi' \to K^+\pi^+\pi^-K^-$	5	35	13604
6	$\psi' \to K^-\pi^+K^*(892)^0,\ K^*(892)^0 \to \pi^-K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	1	26	13630
7	$\psi' \to K^-\pi^-\pi^+K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	8	26	13656
8	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to e^-e^+$	$\psi' \to \pi^+e^+e^-\pi^-$	6	26	13682
9	$\psi' \to \bar{K}^*(892)^0K^*(892)^0,\ \bar{K}^*(892)^0 \to K^-\pi^+,\ K^*(892)^0 \to \pi^-K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	16	25	13707
10	$\psi' \to K^-K_1(1270)^+,\ K_1(1270)^+ \to \pi^-\pi^+K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	9	23	13730
11	$\psi' \to \bar{K}^*(892)^0\pi^-K^+,\ \bar{K}^*(892)^0 \to K^-\pi^+$	$\psi' \to K^+\pi^+\pi^-K^-$	10	19	13749
12	$\psi' \to K_1(1270)^-K^+,\ K_1(1270)^- \to K^-\pi^-\pi^+$	$\psi' \to K^+\pi^+\pi^-K^-$	18	15	13764
13	$\psi' \to K^-K_1(1270)^+,\ K_1(1270)^+ \to \rho^0K^+,\ \rho^0 \to \pi^-\pi^+$	$\psi' \to K^+\pi^+\pi^-K^-$	12	14	13778
14	$\psi' \to K_1(1270)^-K^+,\ K_1(1270)^- \to K^-\rho^0,\ \rho^0 \to \pi^-\pi^+$	$\psi' \to K^+\pi^+\pi^-K^-$	13	13	13791
15	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \rho^-\pi^+,\ \rho^- \to \pi^-\pi^0$	$\psi' \to \pi^+\pi^+\pi^0\pi^-\pi^-$	19	11	13802
16	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \pi^-\rho^+,\ \rho^+ \to \pi^0\pi^+$	$\psi' \to \pi^+\pi^+\pi^0\pi^-\pi^-$	20	9	13811
17	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \gamma f_4(2050),\ f_4(2050) \to K^-K^+$	$\psi' \to \gamma K^+\pi^+\pi^-K^-$	21	9	13820
18	$\psi' \to K_2^{*0}K^*(892)^0,\ K_2^{*0} \to K^-\pi^+,\ K^*(892)^0 \to \pi^-K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	24	7	13827
19	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \gamma f_2(1950),\ f_2(1950) \to K^-K^+$	$\psi' \to \gamma K^+\pi^+\pi^-K^-$	15	6	13833
20	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \pi^0\rho^0,\ \rho^0 \to \pi^-\pi^+$	$\psi' \to \pi^+\pi^+\pi^0\pi^-\pi^-$	23	5	13838
21	$\psi' \to K^-\rho^0K^+,\ \rho^0 \to \pi^-\pi^+$	$\psi' \to K^+\pi^+\pi^-K^-$	4	5	13843
22	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \gamma f_0(1710),\ f_0(1710) \to K^-K^+$	$\psi' \to \gamma K^+\pi^+\pi^-K^-$	14	4	13847
23	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \pi^-\pi^+$	$\psi' \to \pi^+\pi^+\pi^-\pi^-$	17	2	13849
24	$\psi' \to \bar{K}^*(892)^0K_2^{*0},\ \bar{K}^*(892)^0 \to K^-\pi^+,\ K_2^{*0} \to \pi^-K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	22	2	13851
25	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \gamma f_2(1270),\ f_2(1270) \to K^-K^+$	$\psi' \to \gamma K^+\pi^+\pi^-K^-$	30	2	13853
26	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to \pi^-\pi^0\pi^+$	$\psi' \to \pi^+\pi^+\pi^0\pi^-\pi^-$	26	1	13854
27	$\psi' \to \pi^-\pi^+ J/\psi,\ J/\psi \to K^-K(892)^{*+},\ K(892)^{*+} \to \pi^0K^+$	$\psi' \to K^+\pi^+\pi^0\pi^-K^-$	27	1	13855
28	$\psi' \to K^-\pi^+K_2^{*0},\ K_2^{*0} \to \pi^-K^+$	$\psi' \to K^+\pi^+\pi^-K^-$	28	1	13856
29	$\psi' \to K^-K_1(1270)^+,\ K_1(1270)^+ \to \rho^+K_S,\ \rho^+ \to \pi^0\pi^+,\ K_S \to \pi^-\pi^+$	$\psi' \to \pi^+\pi^+\pi^0\pi^-K^-$	29	1	13857
30	$\psi' \to \pi^-b_1^+,\ b_1^+ \to \pi^+\omega,\ \omega \to \pi^-\pi^0\pi^+$	$\psi' \to \pi^+\pi^+\pi^0\pi^-\pi^-$	25	1	13858

Table 1:

13022 KK 490 no pipijpsi 3.7% 13597 in kkregion(13094+-114 kk)

2801959 mumu, 18981 ee pipi (7 per mille) 2801739+-1673 dal fit (OK)

The first look to I/O check

Is

OK!!!!!!!!!!!!!!!

$$R = 0.00412 \pm 0.00005$$

$$BR_{kk} = (2.46 \pm 0.03 \pm 0.06) \times 10^{-4}$$

to be compared to the BR in INC-MC

$2.37\ 10^{-4}$,

in BOSS 6.6.4.p03 DECAY.DEC for INC MC

Perspectives &Outlook

- Further checks needed on efficiencies and fitting procedure(in progress)
- Next step I/O check with inclusive DATA (further checks needed)
- Improvement on fitting speed
- Update of 2009 results

(new environment on Chinese machines—>to be updated) started

- Systematics study

Plan to give a parallel talk to CM

Afterwards: memo update and P&S meeting to proceed to RC