muon momentum scale calibration in CMS

"Precision Electroweak Physics at the CERN Large Hadron Collider"

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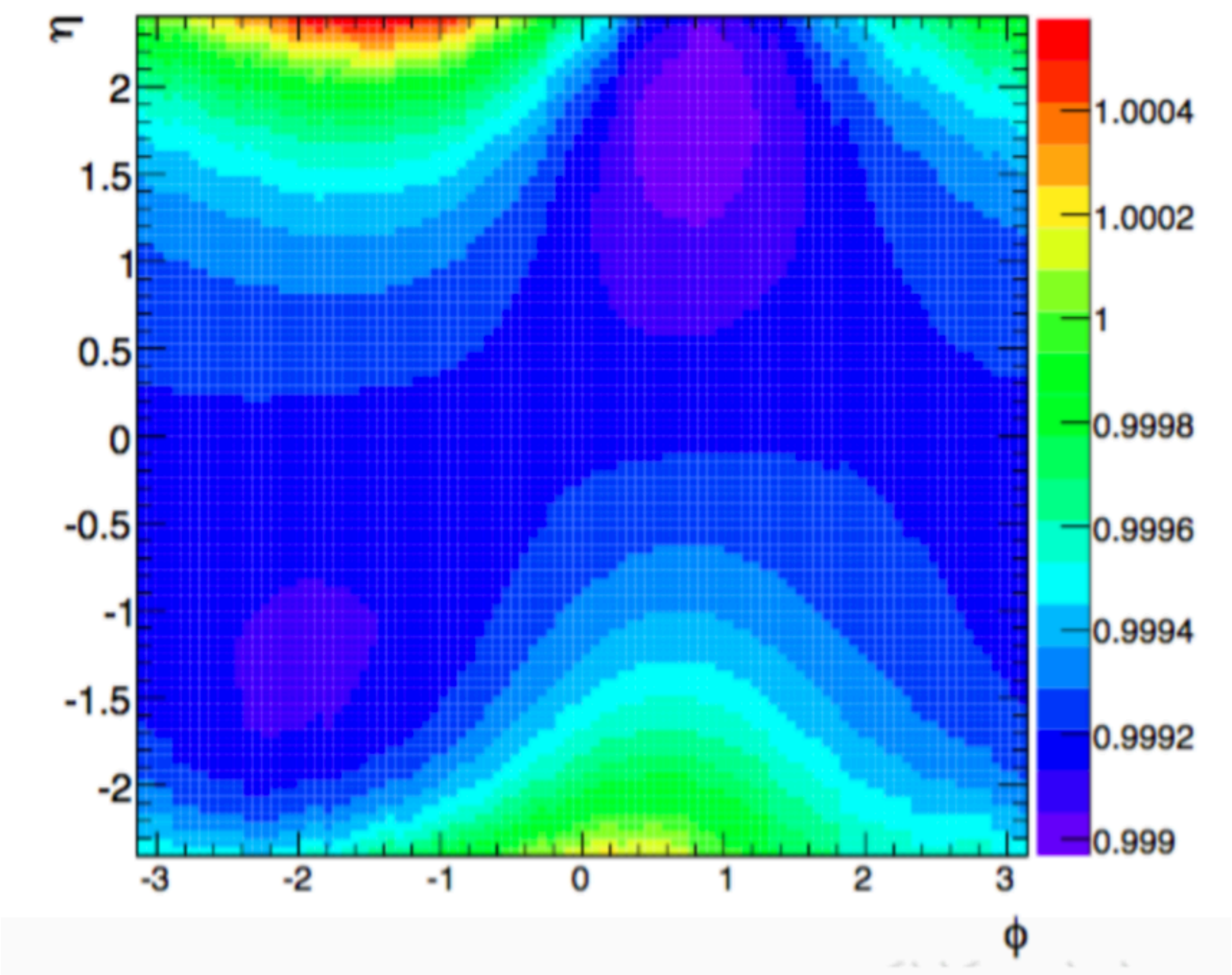
correct k = 1/pT using a physics-driven model

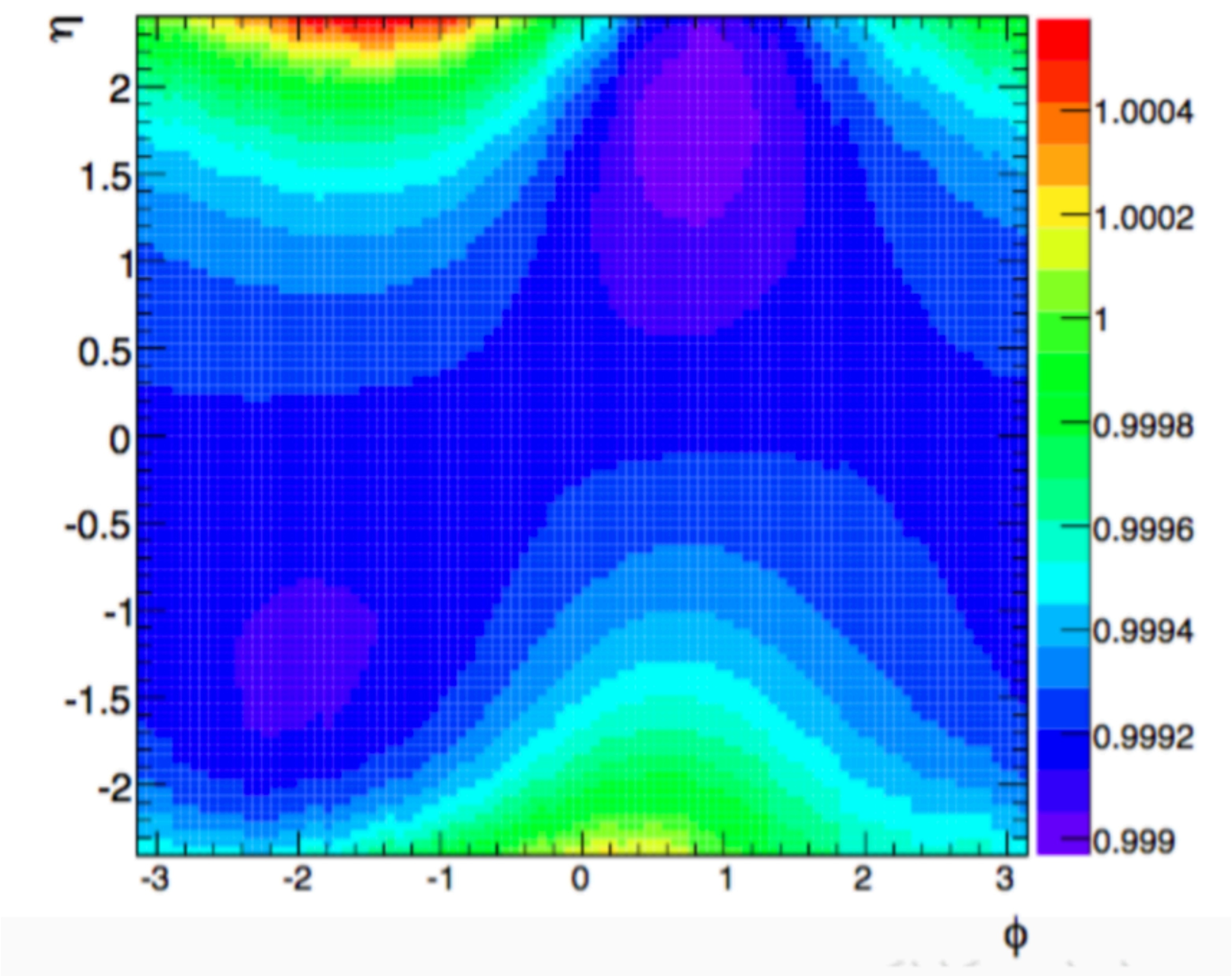
magnetic field



multiplicative factor
and 3D/2D map correction

correct k = 1/pT using a physics-driven model

magnetic field



multiplicative factor
and 3D/2D map correction

material mismodelling

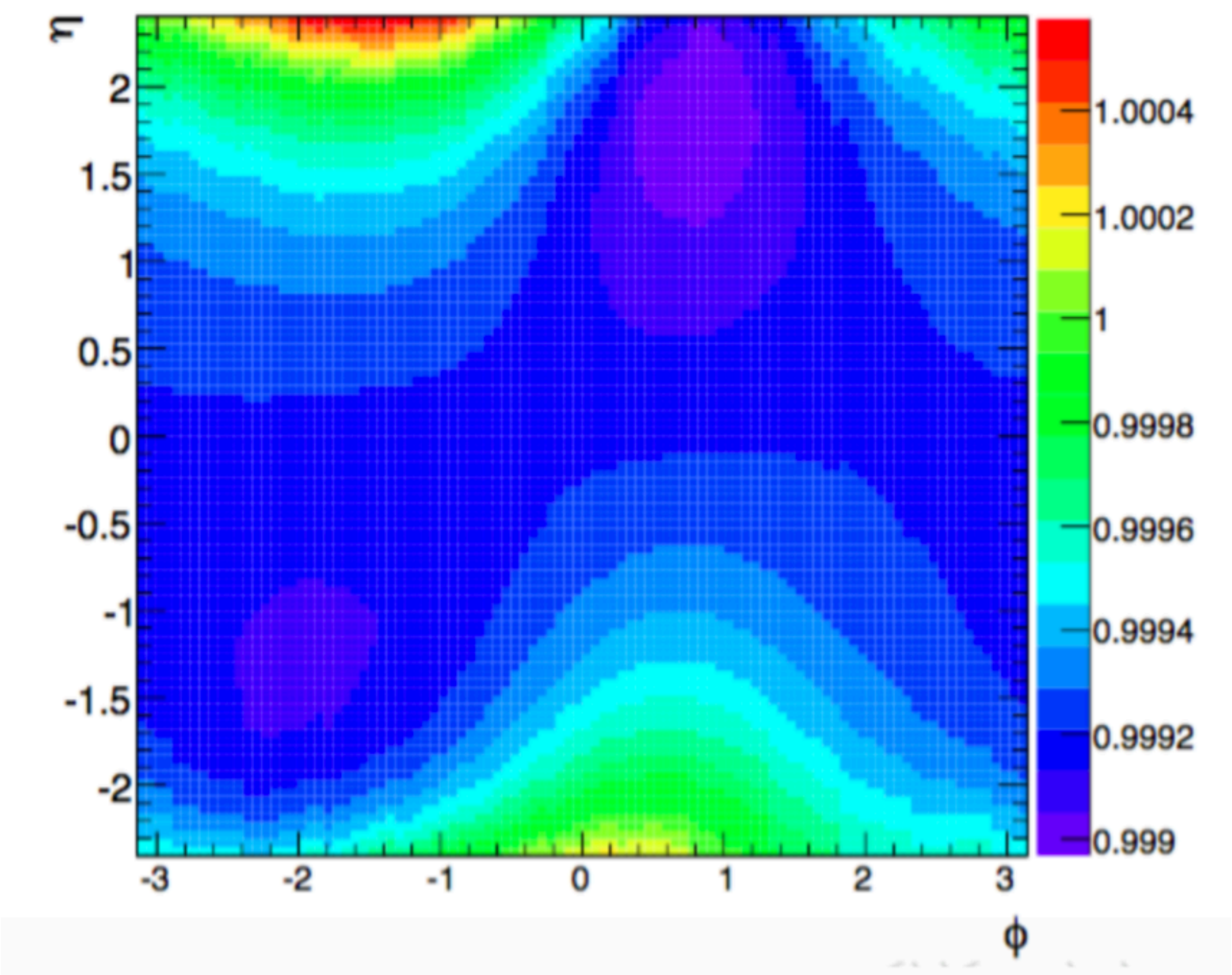
corrected k

$$k^c = \frac{1}{E\sin\theta + \epsilon\sin\theta} = \frac{k}{1 + k\epsilon\sin\theta}$$

charge independent addictive factor

correct k = 1/pT using
a physics-driven model

magnetic field



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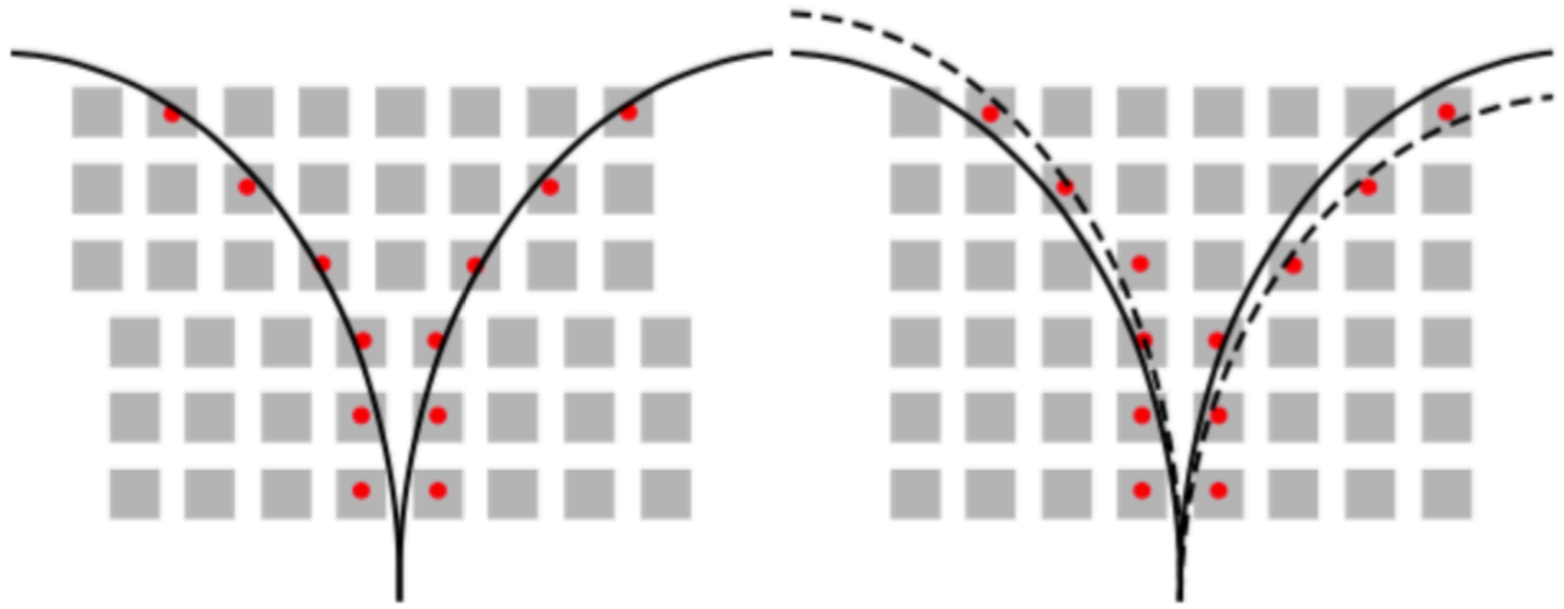
misalignment



charge dependent addictive factor

extract corrections from our model

material

$$\frac{k_{true}}{k} = A + \epsilon k + \frac{qM}{k}$$

B field

misalignment

extract corrections from our model

$$\frac{k_{true}}{k} = A + \epsilon k + \frac{qM}{k}$$

B field (A)

material (ϵk)

misalignment ($\frac{qM}{k}$)

make use of dimuon events

$$\frac{M}{M_{target}} = \sqrt{\frac{k_{1,true}}{k_1}\frac{k_{2,true}}{k_2}}$$

extract corrections from our model

$$\frac{k_{true}}{k} = A + \epsilon k + \frac{qM}{k}$$

B field

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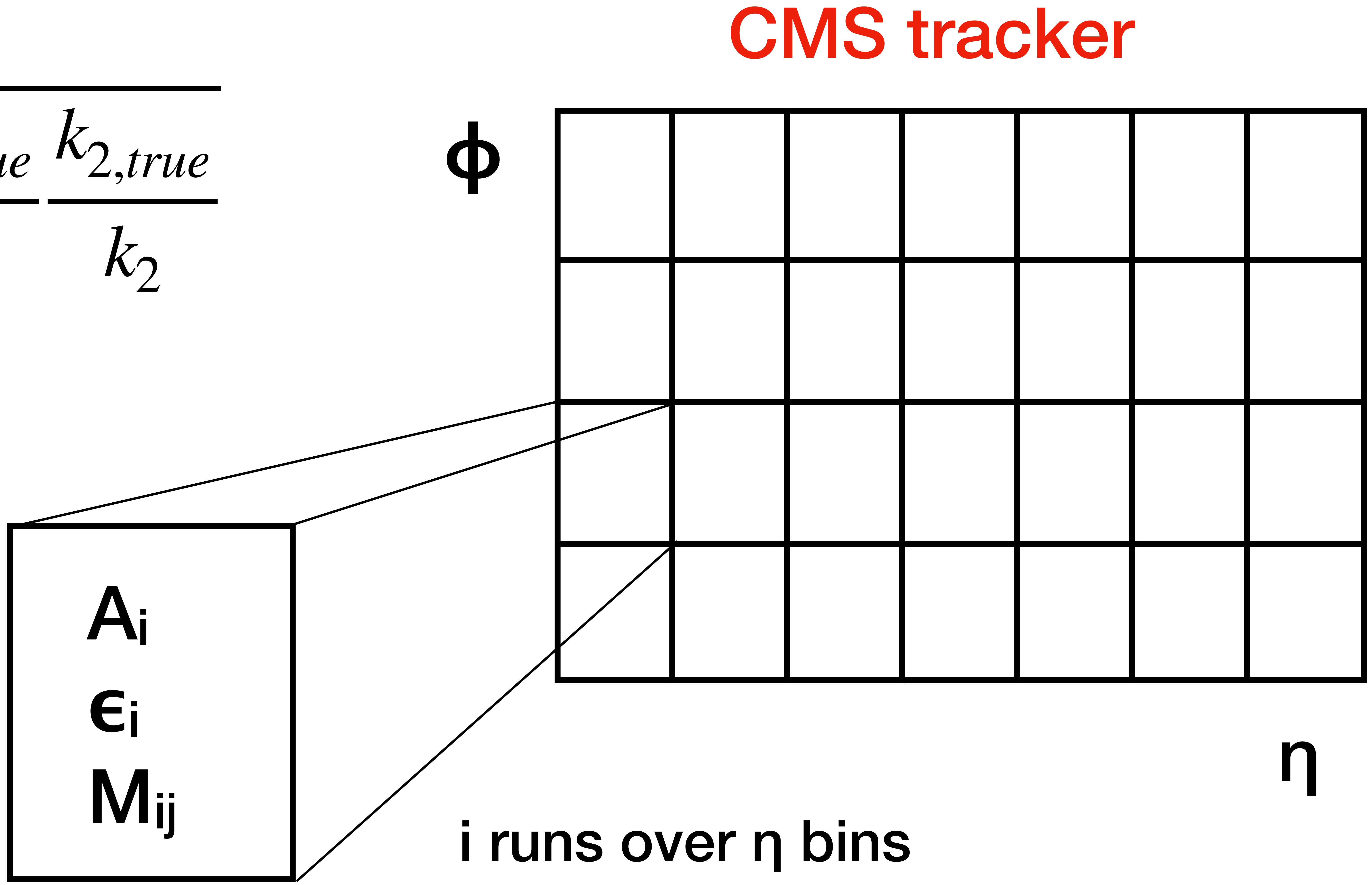


i runs over η bins
j runs over ϕ bins

which dimuon resonance to use

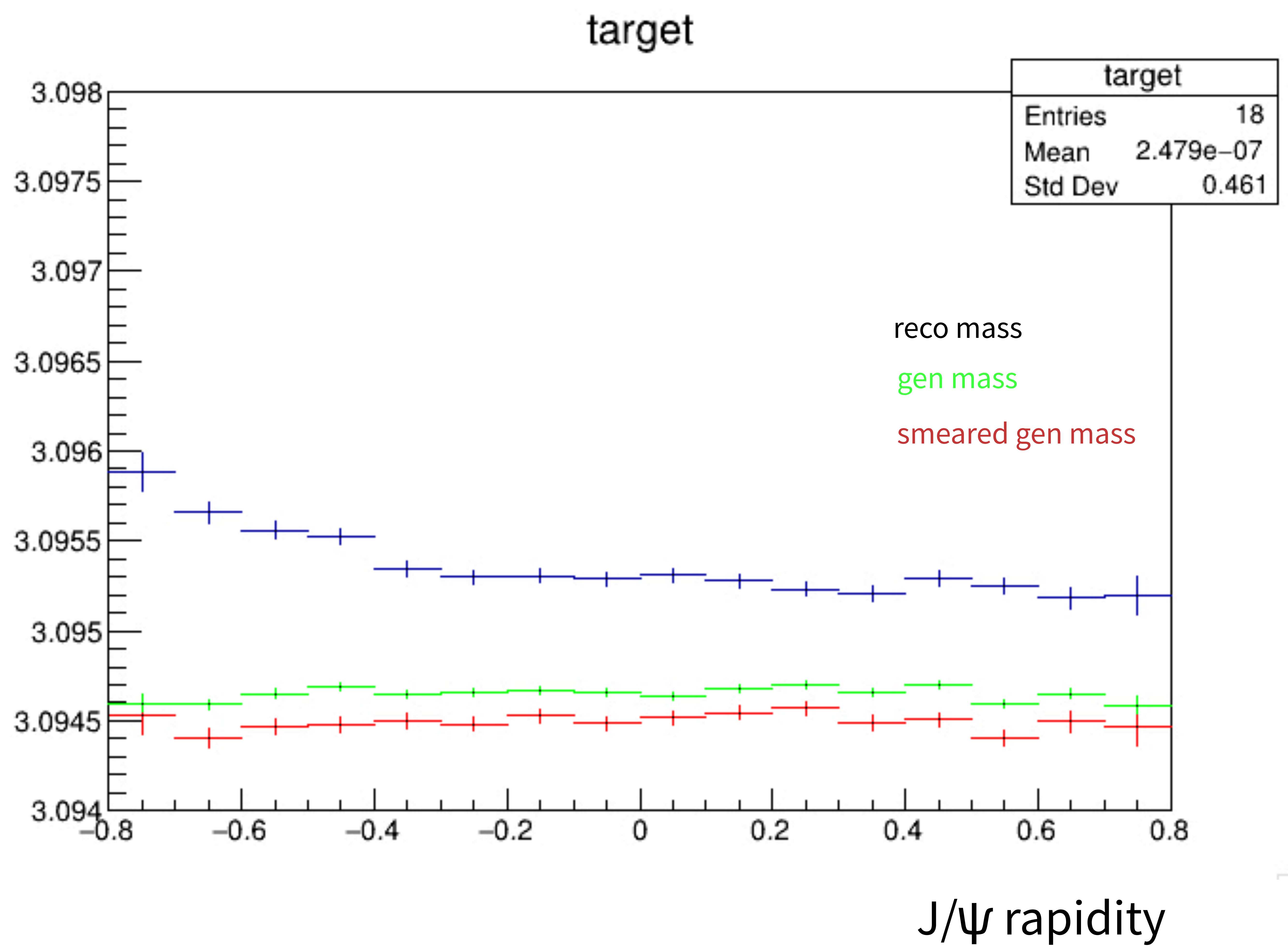
how to choose the target mass

how to technically extract the corrections

which dimuon resonance to use

J/ψ	Z
mass is a standard candle	difficult to define a target mass
is narrow	has natural width
has background	has very low background
muons are close in angle	

how to choose the target mass in J/ψ events



compute the arithmetic mean
of the mass
in a window (3.0-3.2)

how to technically extract the corrections

Kalman Filter: our first attempt

$$\frac{M}{M_{target}} = \sqrt{\frac{k_{1,true}}{k_1}\frac{k_{2,true}}{k_2}}$$

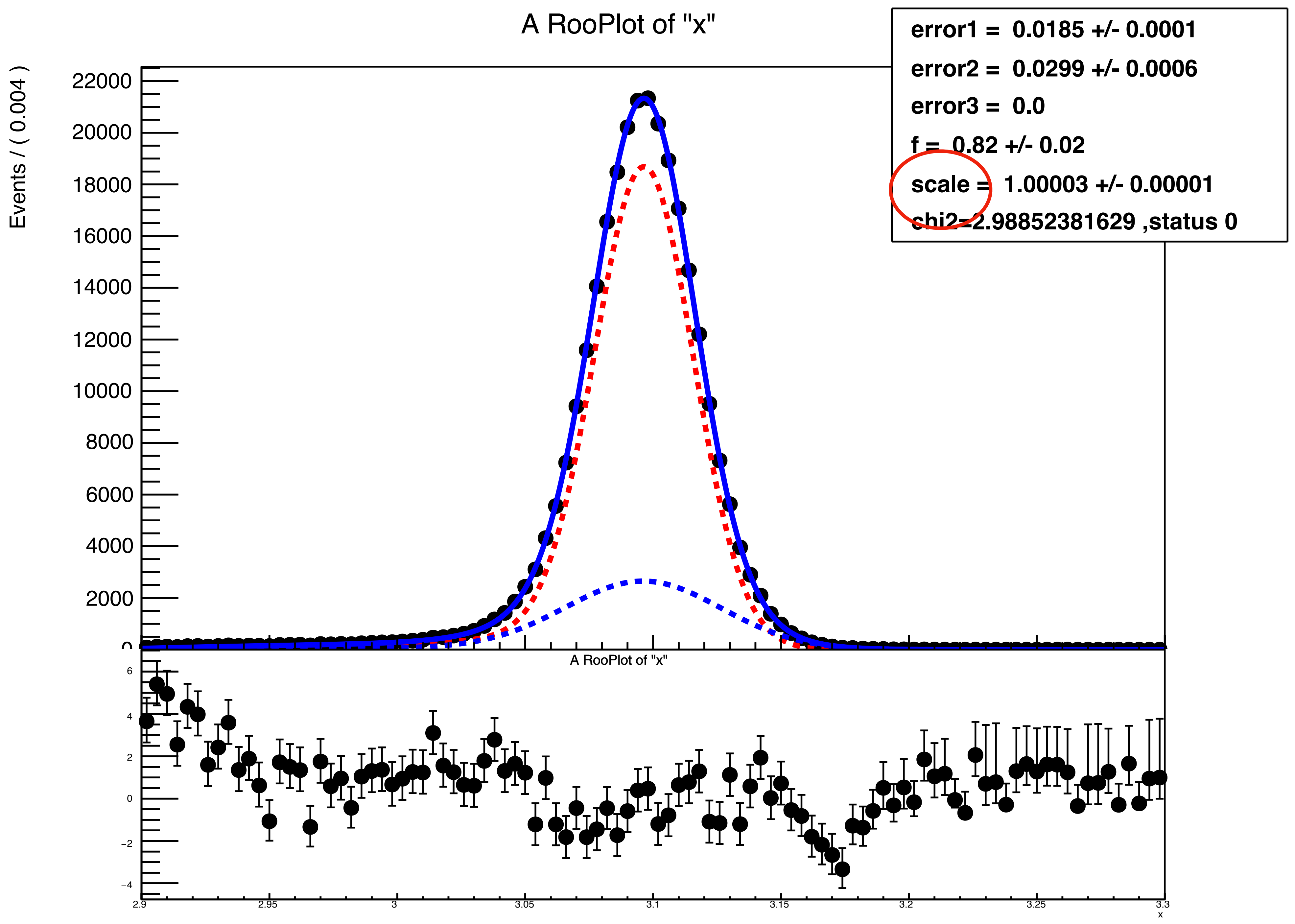
calibrate on J/ψ
close on Z

update the vector
of the parameters
looking at one
event at a time

kernel model for closure test

test validity of the procedure fitting the invariant mass with a kernel model

$$P(m,\mu,\sigma) = \sum_{i=1}^{N} \frac{1}{\sqrt{2\pi}\sigma} \exp\left(-\frac{1}{2}\left(\frac{m-\mu\cdot m_i}{\sigma}\right)^2\right)$$

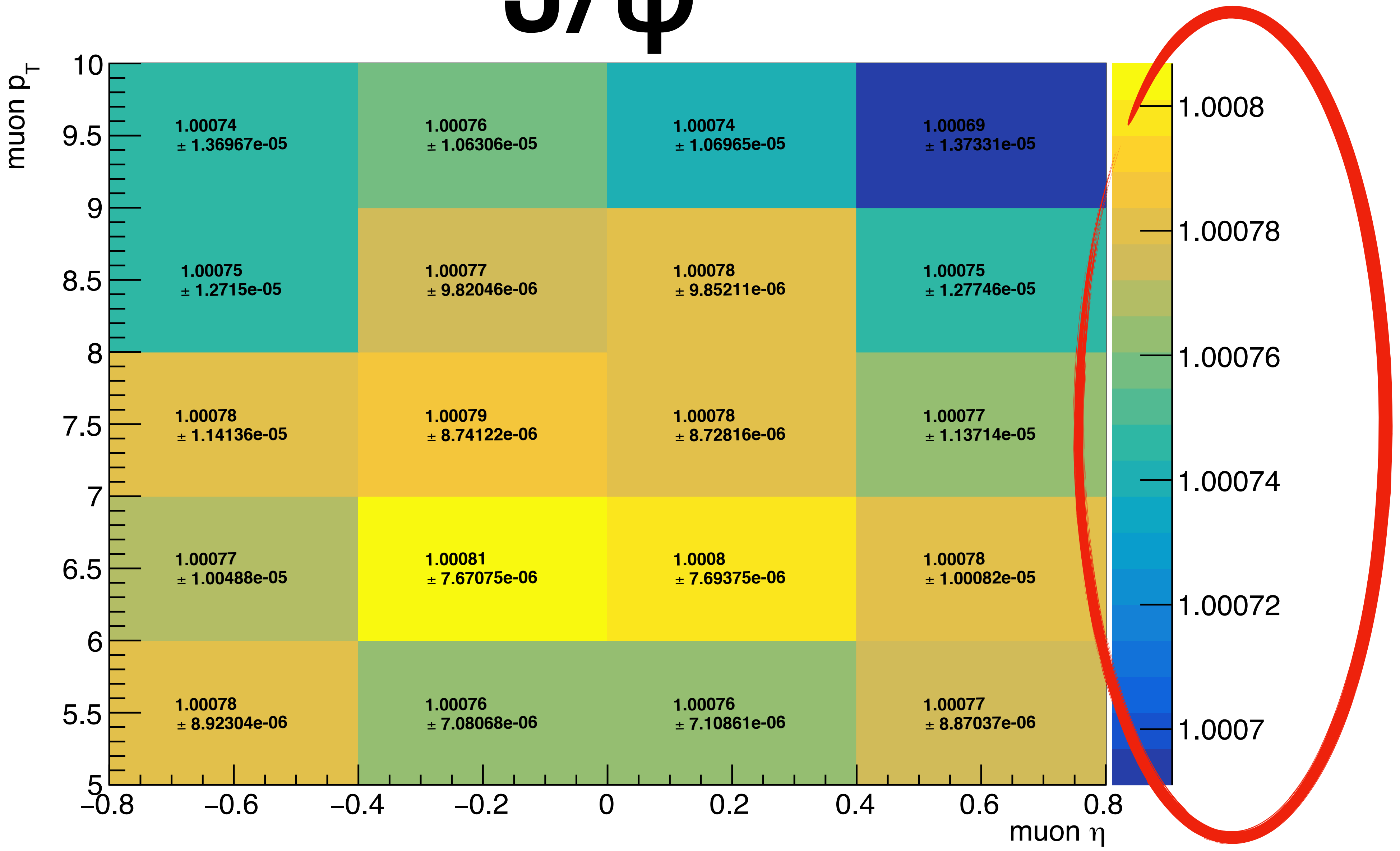


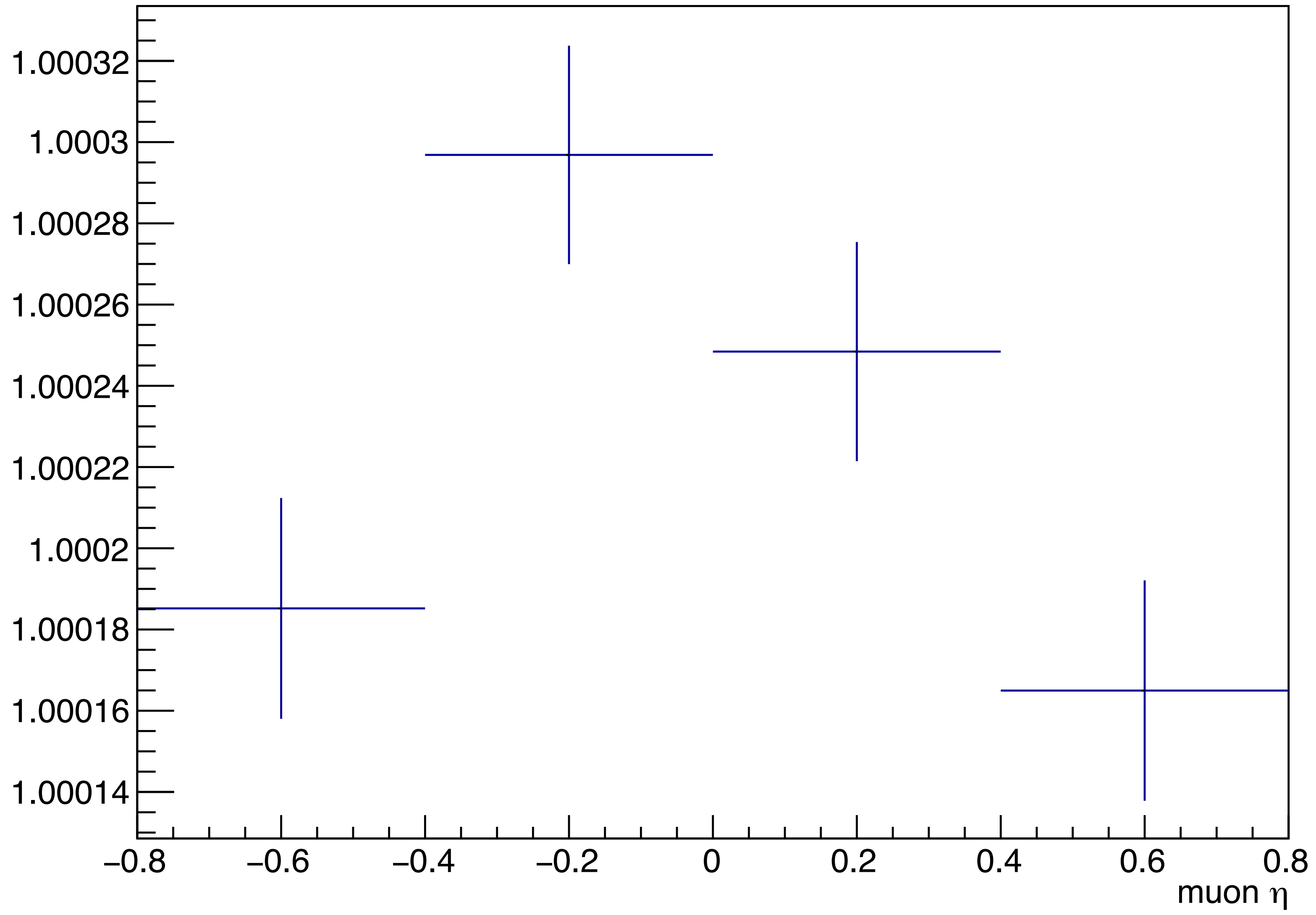
closure results with Kalman Filter

J/ψ

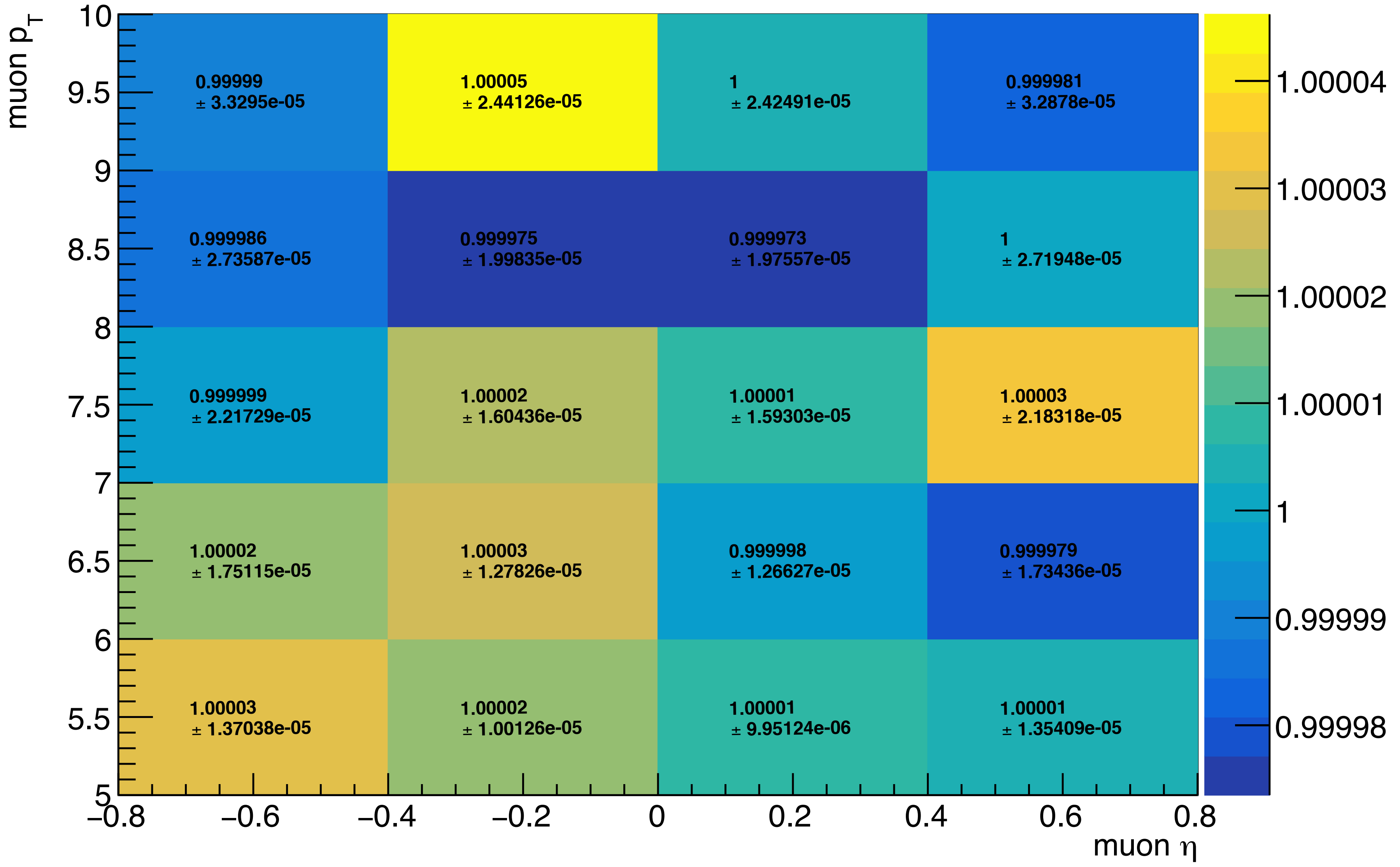
Z

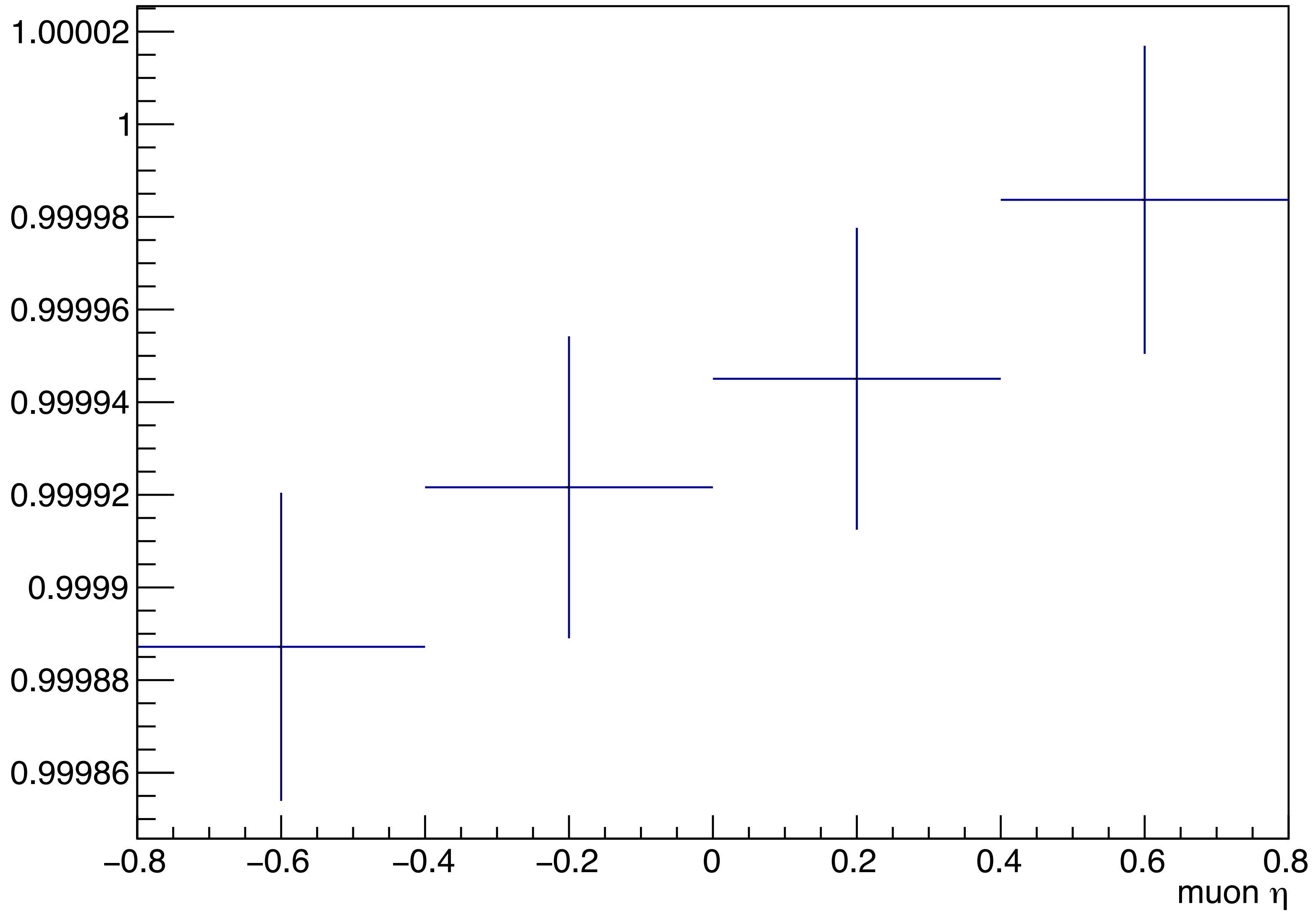
data



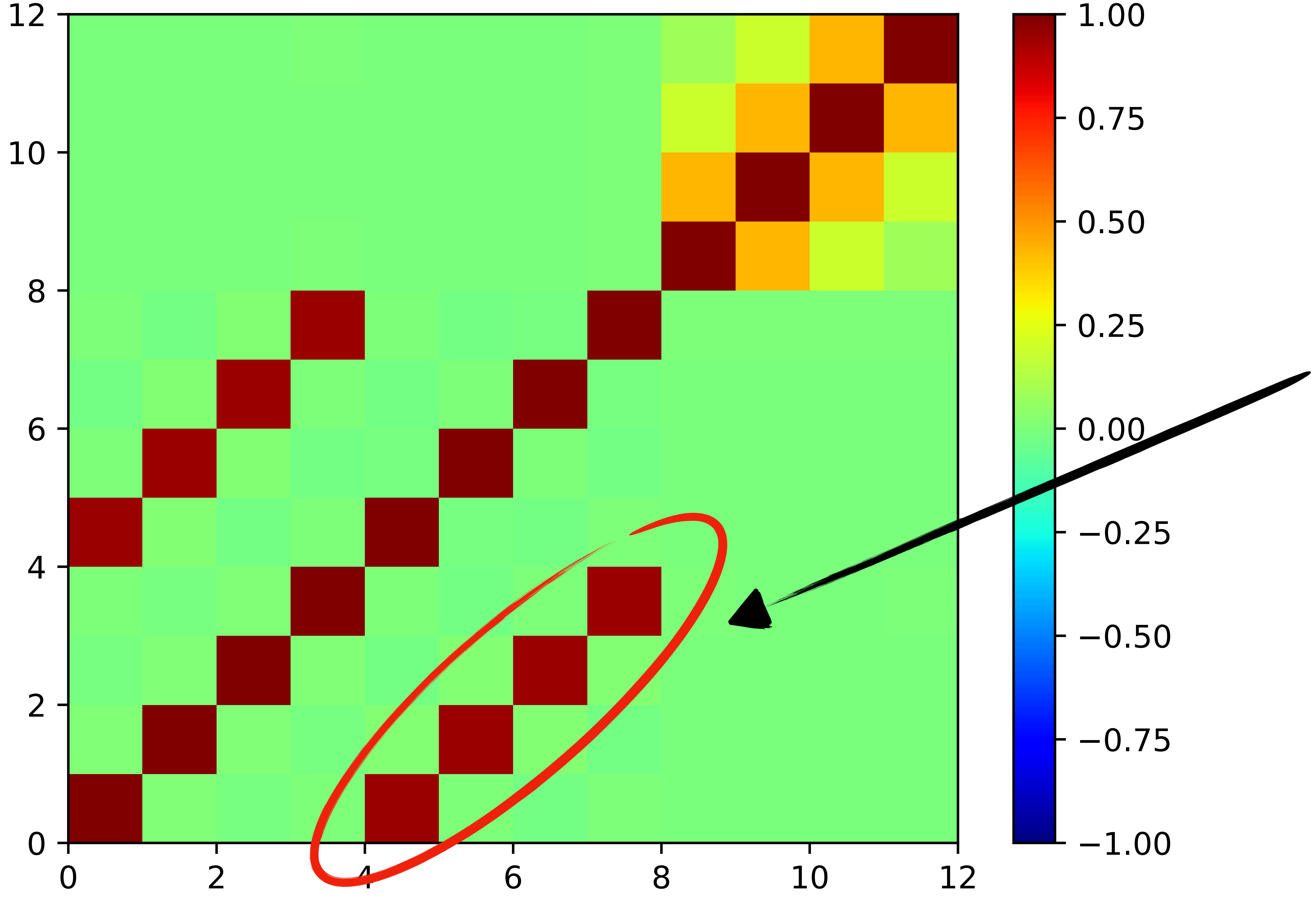


MC reco





a matter of correlations

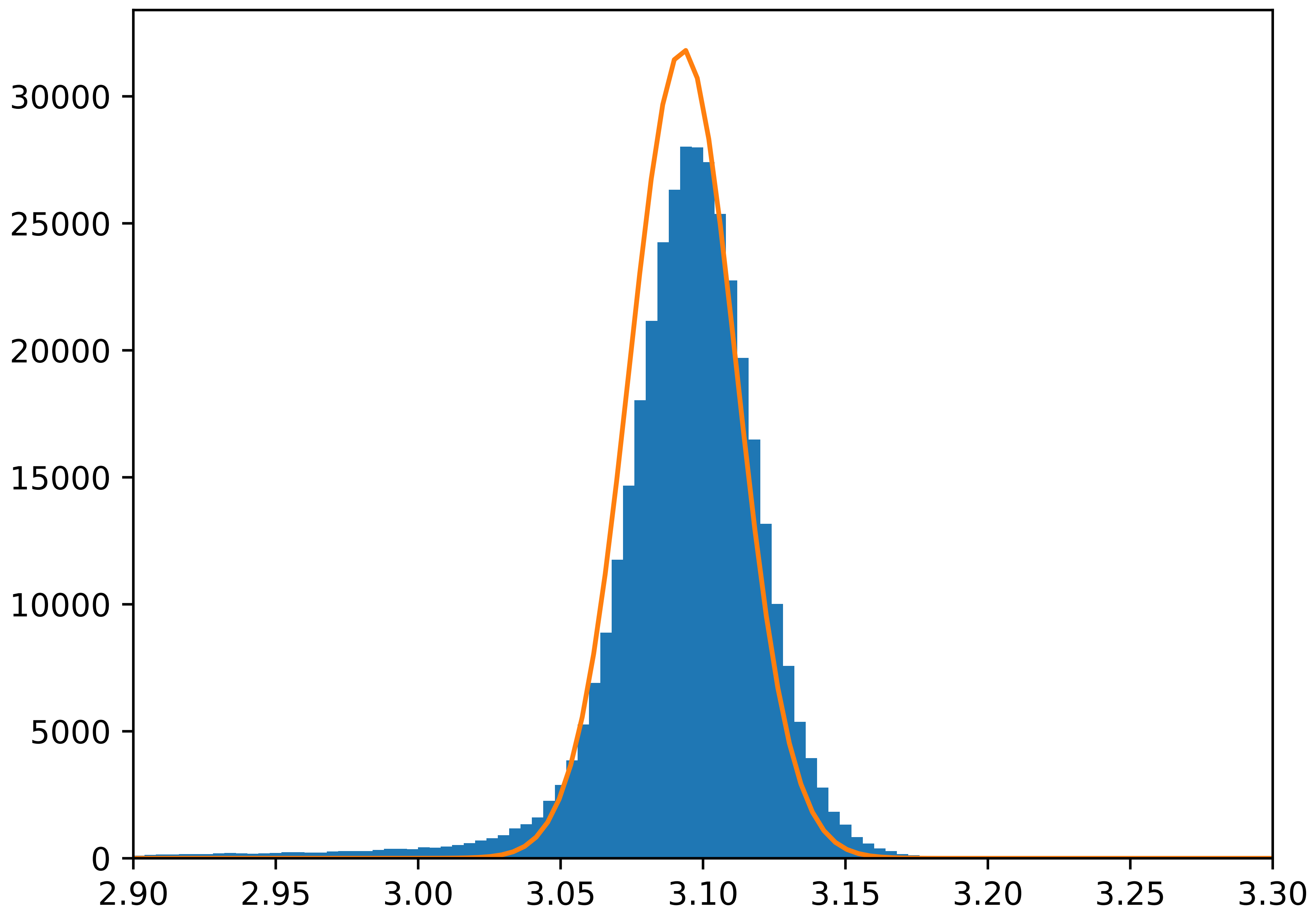


huge correlation between B field and material prevents from fitting B correctly

what's behind the Kalman Filter

$$\frac{M}{M_{target}} = \sqrt{\frac{k_{1,true}}{k_1}\frac{k_{2,true}}{k_2}}$$

assumes
a Gaussian lineshape in mass!



plot the fitted Gaussian vs
J/ψ mass and realise it's off

probably due to background

why not fitting the whole lineshape?

fitting Z mass and parameters with the kernel model

$$P(m,\mu,\sigma) = \sum_{i=1}^{N} \frac{1}{\sqrt{2\pi}\sigma} \exp\left(-\frac{1}{2}\left(\frac{m-\mu\cdot m_i}{\sigma}\right)^2\right)$$

work in progress…..