Ke3 Form Factor

The NA62 Collaboration Meeting

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Outline

- FF fit method
- FF fit method validation
- First look on FF
- Problems
- Plan

FF fit method

Two dimentional fit function for the Dalitz plot density:

$$\rho(E_l^*, E_\pi^*) = \frac{d^2N(E_l^*, E_\pi^*)}{dE_\mu^* dE_\pi^*} \propto A f_+^2(t) + B f_+(t)(f_0 - f_+)\frac{m_K^2 - m_\pi^2}{t} + C\left[(f_0 - f_+)\frac{m_K^2 - m_\pi^2}{t}\right]^2$$

Pole parametrization used this time: $\overline{f_+}(t) = \frac{M_v^2}{M_v^2 - t}$

$$\chi^2 = \sum \frac{(data - mc * w)^2}{\sigma_{data}^2 + \sigma_{mc}^2 * w^2}$$

$$w = \frac{\rho_{fit}}{\rho_{fix}}$$

FF fit method

User fit minimization function

MINUIT

Result

The KLOE MC sample with includes radiative effects

Cut on kinematics boundaries was applied

Minimum number of events > 1000

FF fit validation

- For the validation purposes **TRUE MC** events have been used
- After selections MC contains nearly **225** M ke3 events
- 225M events divided in two parts (data 1:5 MC):
  - Small part used as “data” (first 20% of the events)
  - Large part used as MC (remaining 80% of the events)
- Different size of bins used:
  - 1 x 1, 2 x 2, 4 x 4, 5 x 5, 8 x 8, 10 x 10 (MeV^2)

FF fit method validation

- **1 x 1 MeV bins:**
  - mv 8.951e-01 6.22e-04
  - chi2/ndf 14310.8/13329 = 1.07366

Expected: 0.892 GeV

- **2 x 2 MeV bins:**
  - mv 8.95253e-01 5.79638e-04
  - chi2/ndf 5222.39/4086 = 1.27812

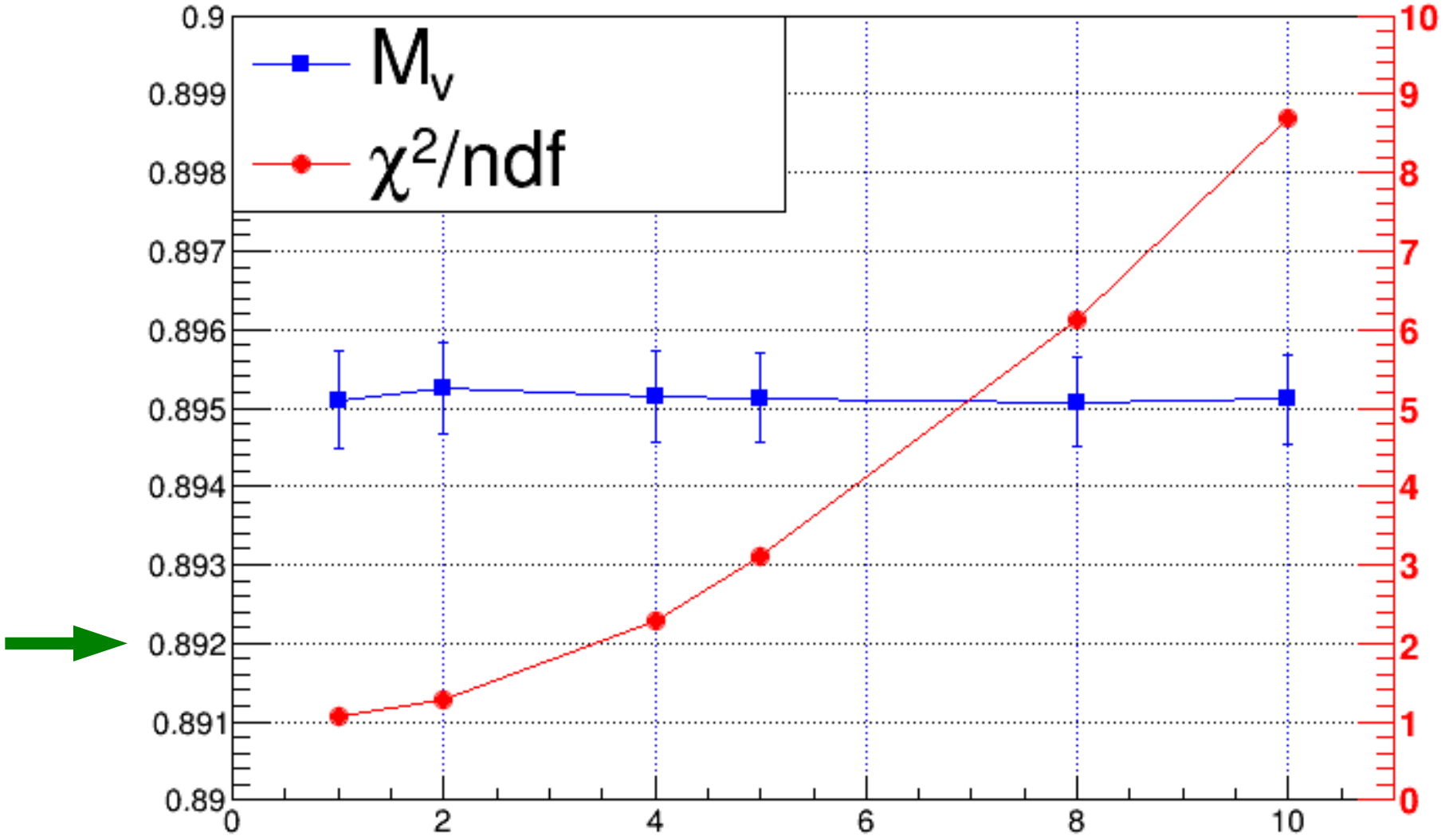
- **4 x 4 MeV bins:**
  - mv 8.95149e-01 5.76549e-04
  - chi2/ndf 2531.75/1102 = 2.29742

- **5 x 5 MeV bins:**
  - mv 8.95129e-01 5.76120e-04
  - chi2/ndf 2265.96/729 = 3.10831

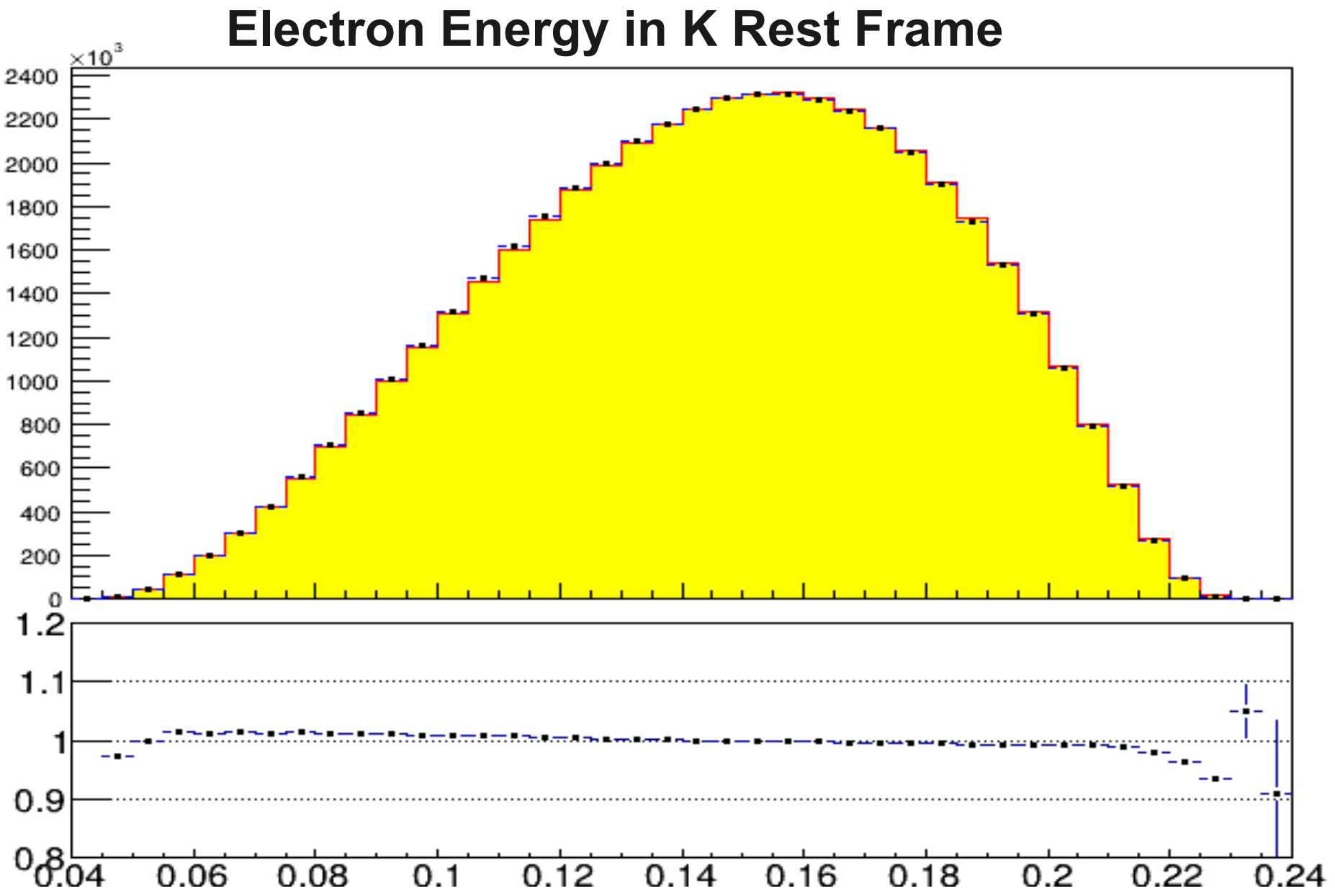
- **8 x 8 MeV bins:**
  - mv 8.95074e-01 5.75387e-04
  - chi2/ndf 1848.69/302 = 6.1215

- **10 x 10 MeV bins:**
  - mv 8.95113e-01 5.75057e-04
  - chi2/ndf 1729.56/199 = 8.69127

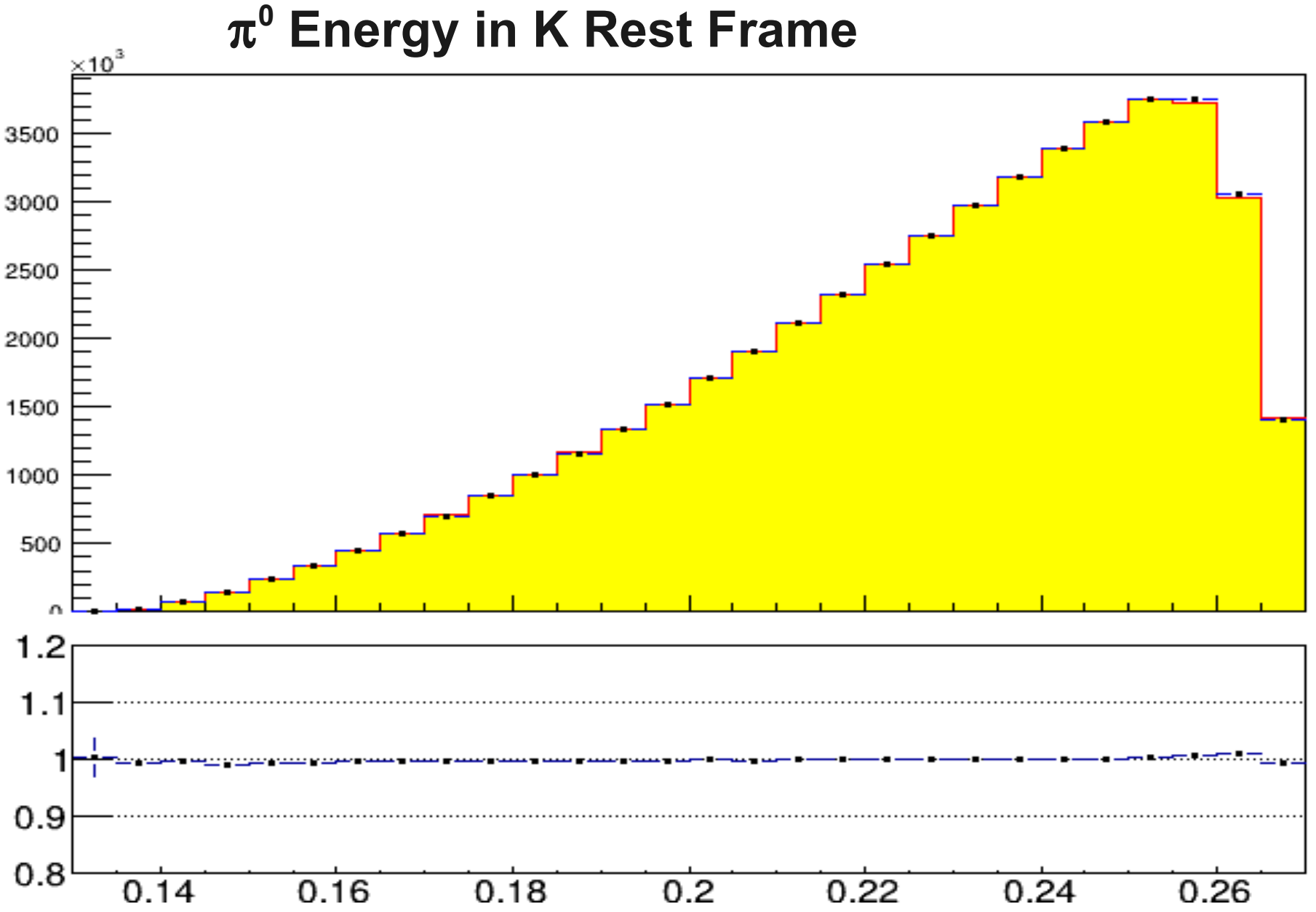
FF fit method validation



FF fit method validation



FF fit method validation



FF fit method validation

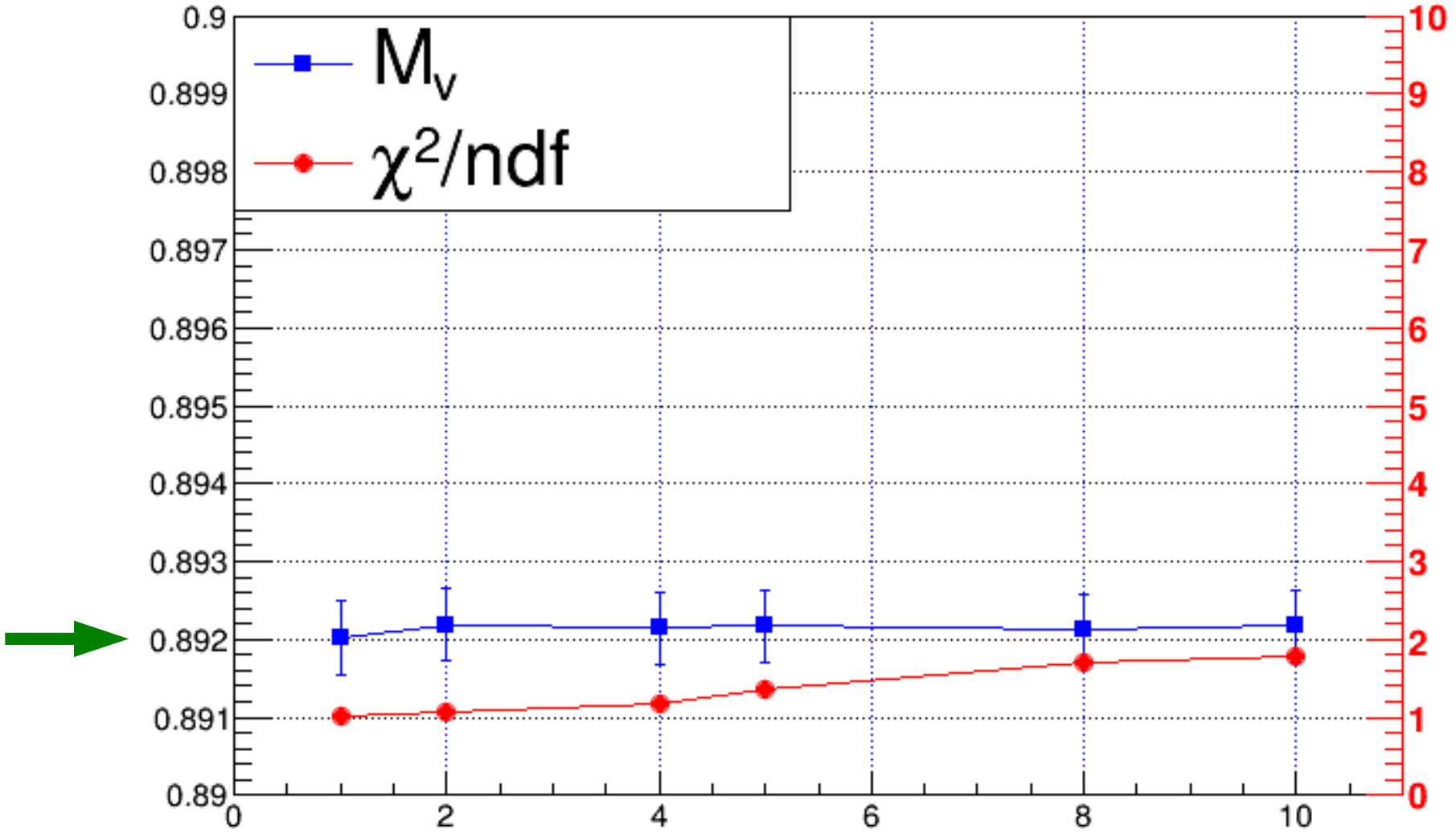
Next step:

- 225e6 MC sample divided in two halfs
- First 50% of events fitted with another 50% of events

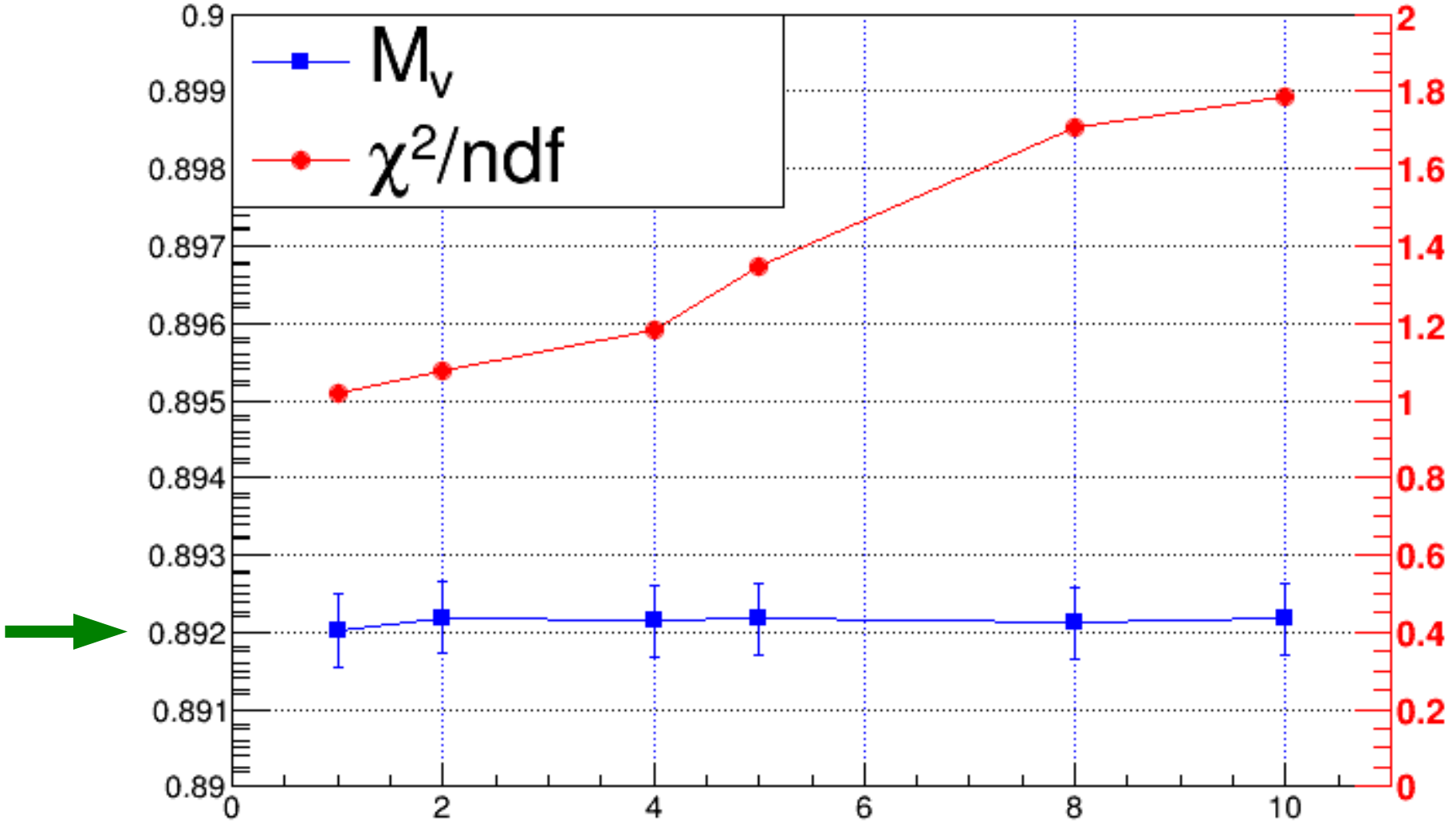
50% (11e8) with 50% (11e8)

- **1 x 1 MeV bins:**
  - mv 8.92023e-01 4.70105e-04
  - chi2/ndf 15919/15666 = 1.01615
- **2 x 2 MeV bins:**
  - mv 8.92183e-01 4.64411e-04
  - chi2/ndf 4588.78/4259 = 1.07743
- **4 x 4 MeV bins:**
  - mv 8.92151e-01 4.63822e-04
  - chi2/ndf 1332.74/1126 = 1.1836
- **5 x 5 MeV bins:**
  - mv 8.92171e-01 4.63707e-04
  - chi2/ndf 1002.16/744 = 1.34699
- **8 x 8 MeV bins:**
  - mv 8.92121e-01 4.63193e-04
  - chi2/ndf 524.035/307 = 1.70695
- **10 x 10 MeV bins:**
  - mv 8.92177e-01 4.62950e-04
  - chi2/ndf 359.499/201 = 1.78855

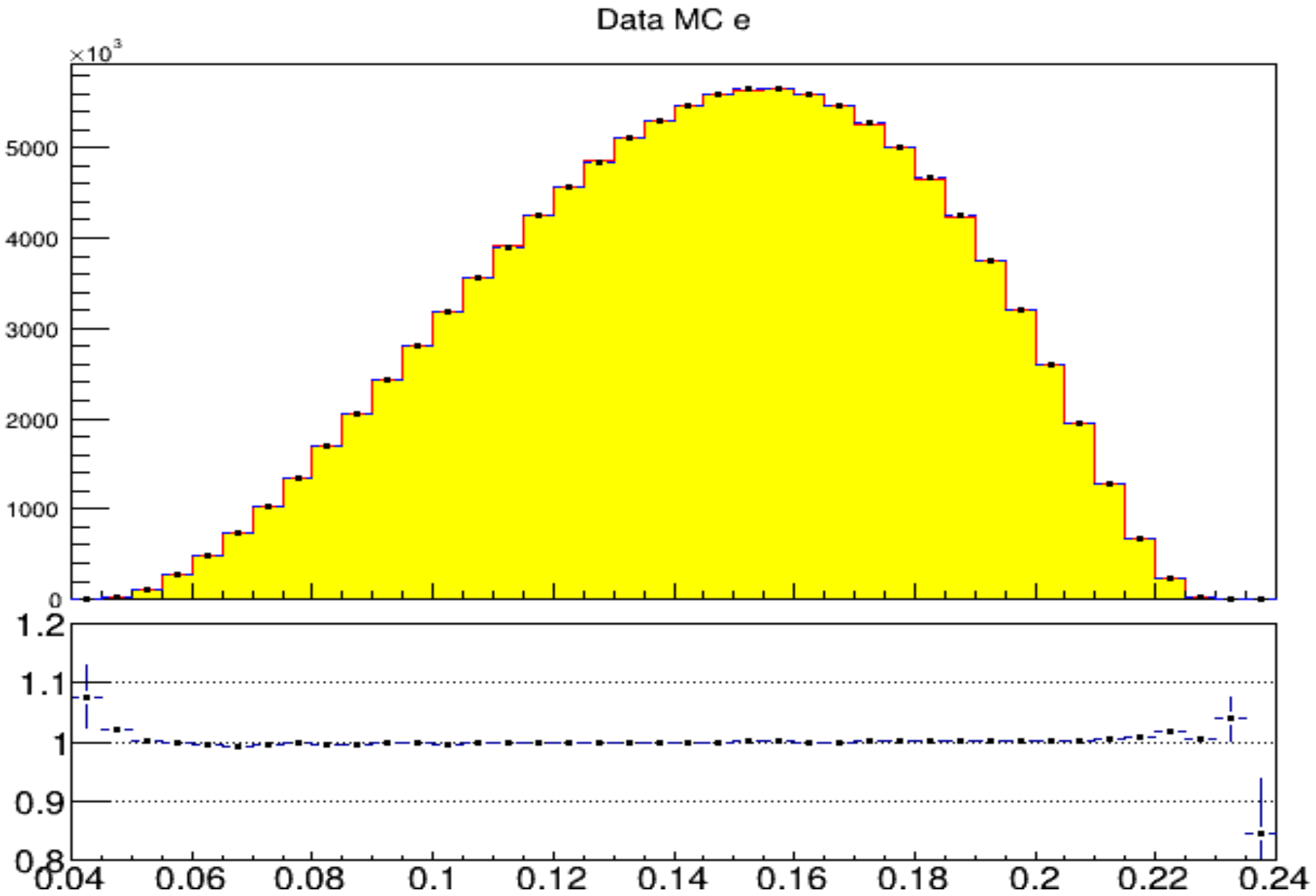
50% (11e8) with 50% (11e8)



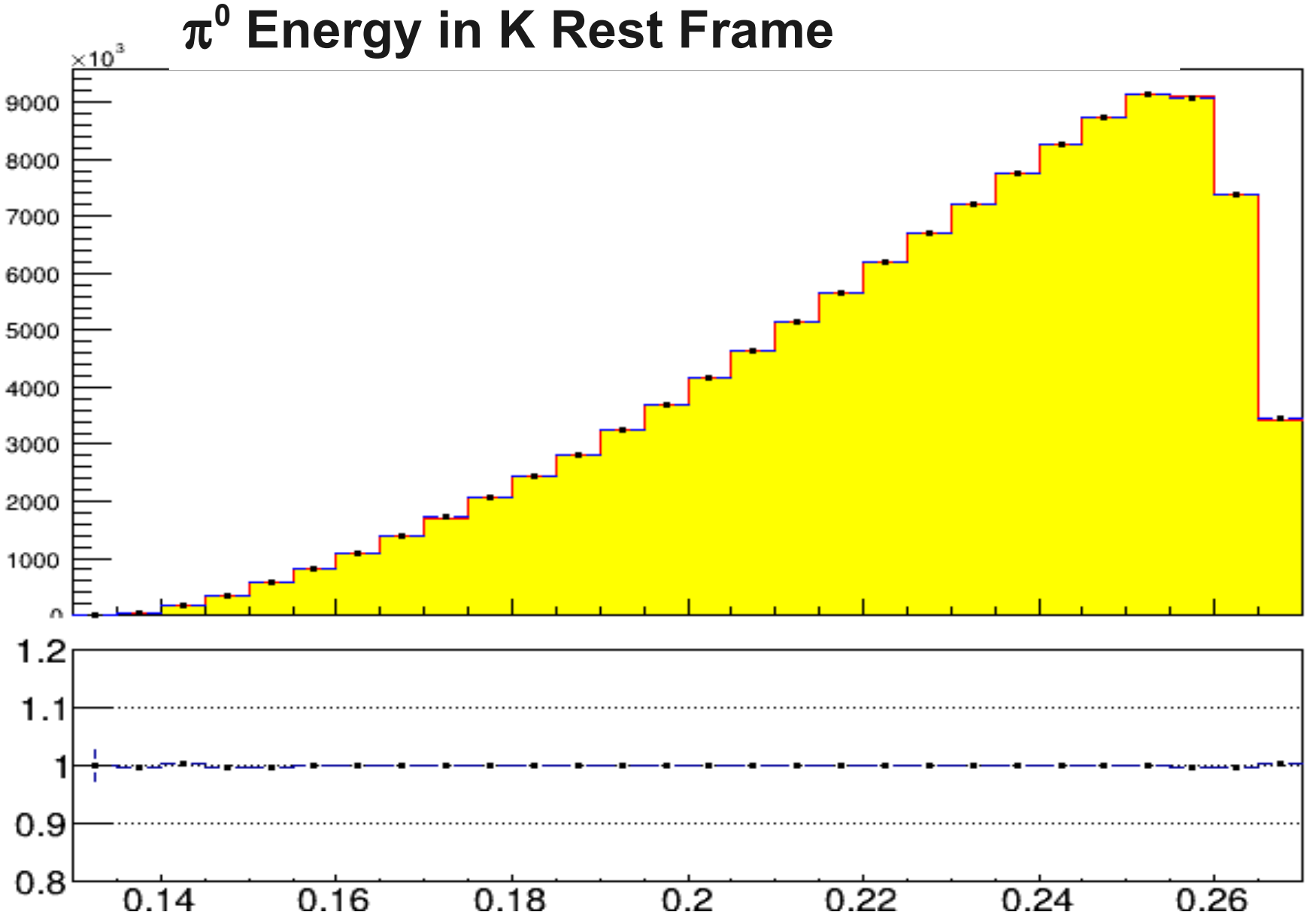
50% (11e8) with 50% (11e8)



50% (11e8) with 50% (11e8)



50% (11e8) with 50% (11e8)



FF fit method validation

- Conclusion: MC is run depended
- Must not fit first fraction with second fraction

- Uniform division needed:
  - Each 5th event used a data sample (20%)
  - 1st to 4th events used as a “MC” sample (80%)

FF fit method validation

- **1 x 1 MeV bins:**
  - mv 8.92471e-01 6.30718e-04
  - chi2/ndf 13479.6/13145 = 1.02545
  - Probability: 0.0201727

- **2 x 2 MeV bins:**
  - mv 8.92299e-01 5.83518e-04
  - chi2/ndf 4145.96/4078 = 1.01666
  - Probability: 0.224903

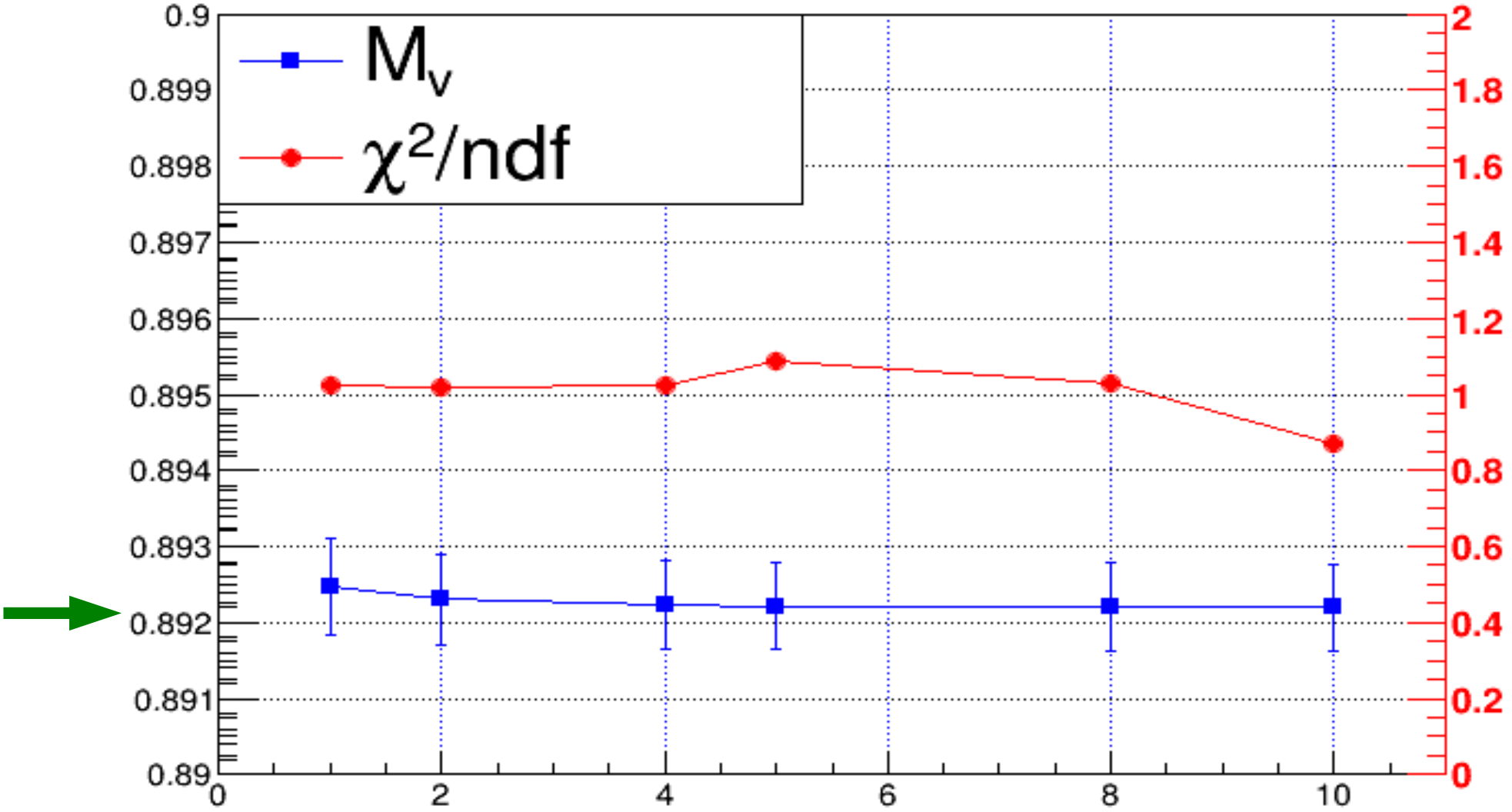
- **4 x 4 MeV bins:**
  - mv 8.92234e-01 5.80210e-04
  - chi2/ndf 1127.83/1101 = 1.02437
  - Probability: 0.28052

- **5 x 5 MeV bins:**
  - mv 8.92218e-01 5.79754e-04
  - chi2/ndf 791.969/727 = 1.08937
  - Probability: 0.0471711

- **8 x 8 MeV bins:**
  - mv 8.92206e-01 5.79104e-04
  - chi2/ndf 310.755/302 = 1.02899
  - Probability: 0.352011

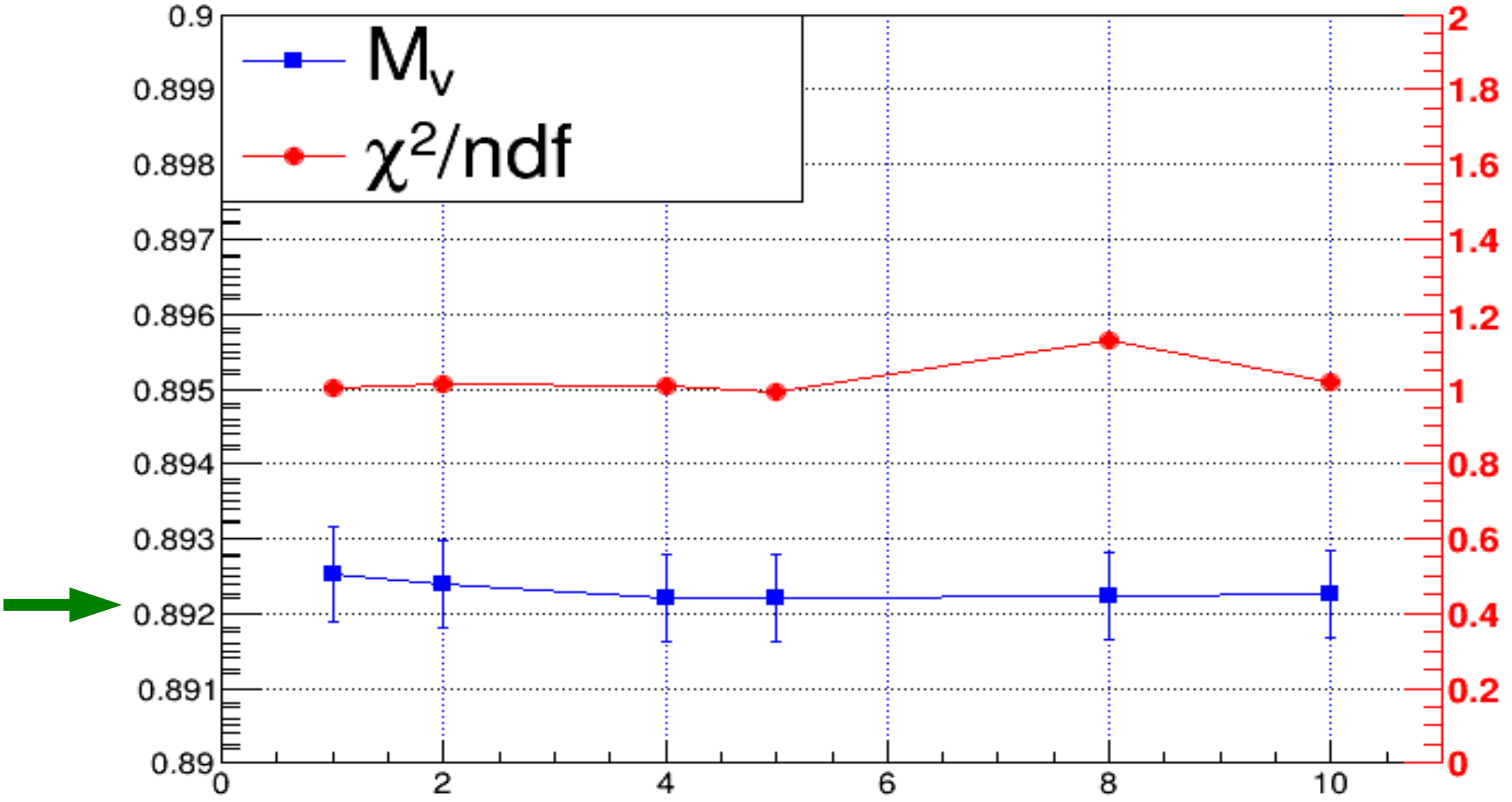
- **10 x 10 MeV bins:**
  - mv 8.92196e-01 5.78655e-04
  - hi2/ndf 173.139/199 = 0.870047
  - Probability: 0.907134

FF fit method validation



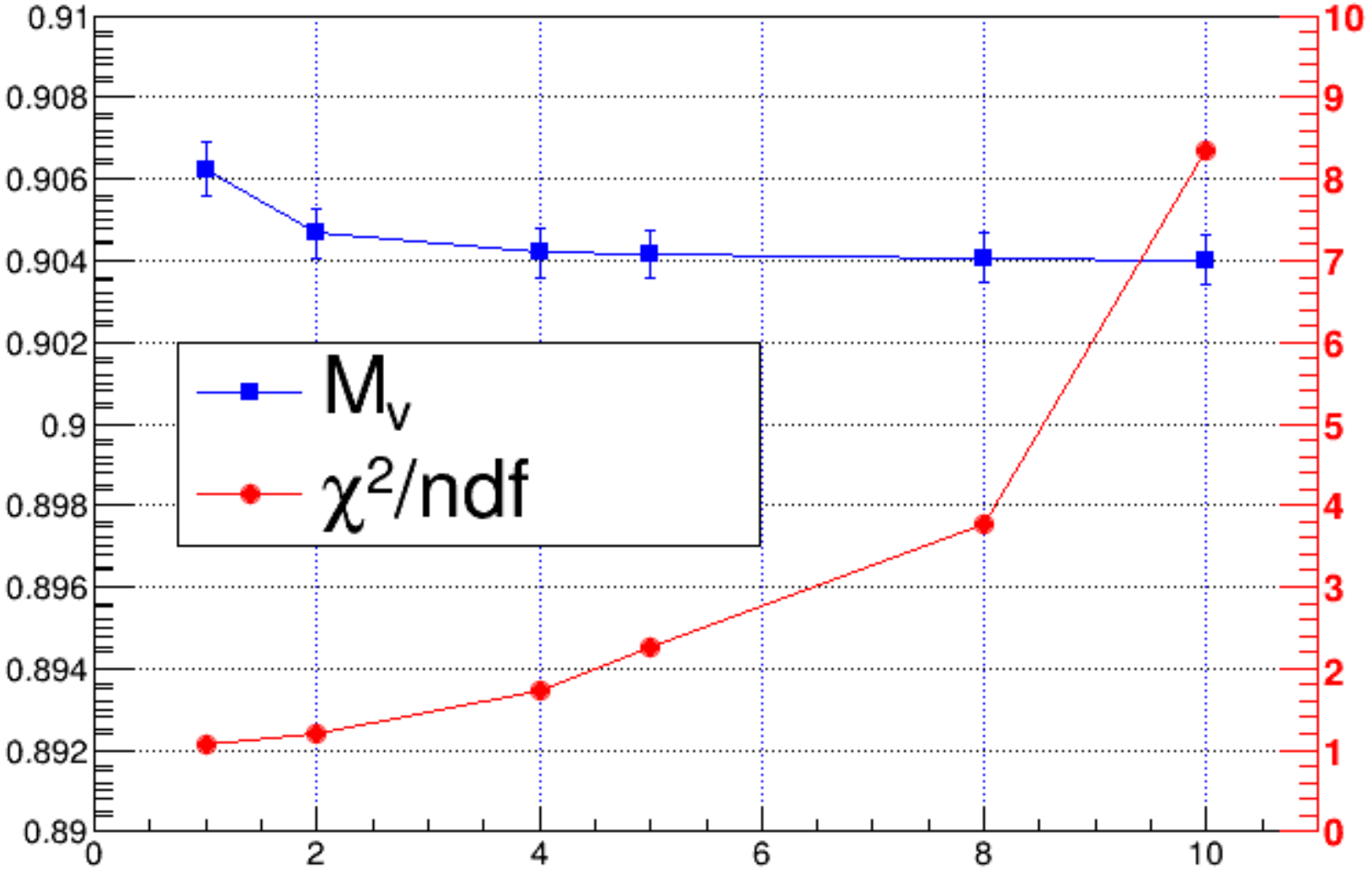
TRUE MC with TRUE MC (1:5)

FF fit method validation

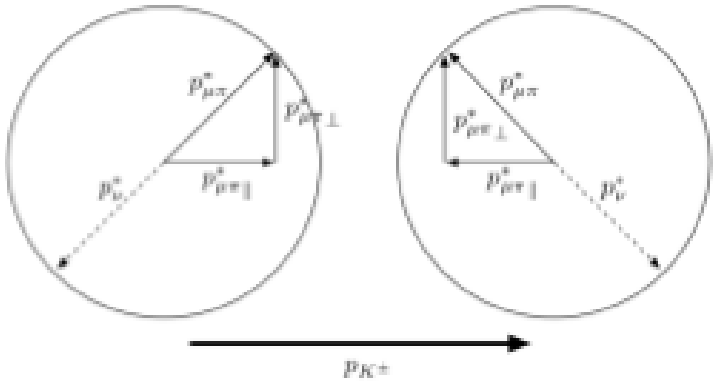


Reco. MC with reco. MC (1:5)

Fitting **data** with **MC**



Type2 events



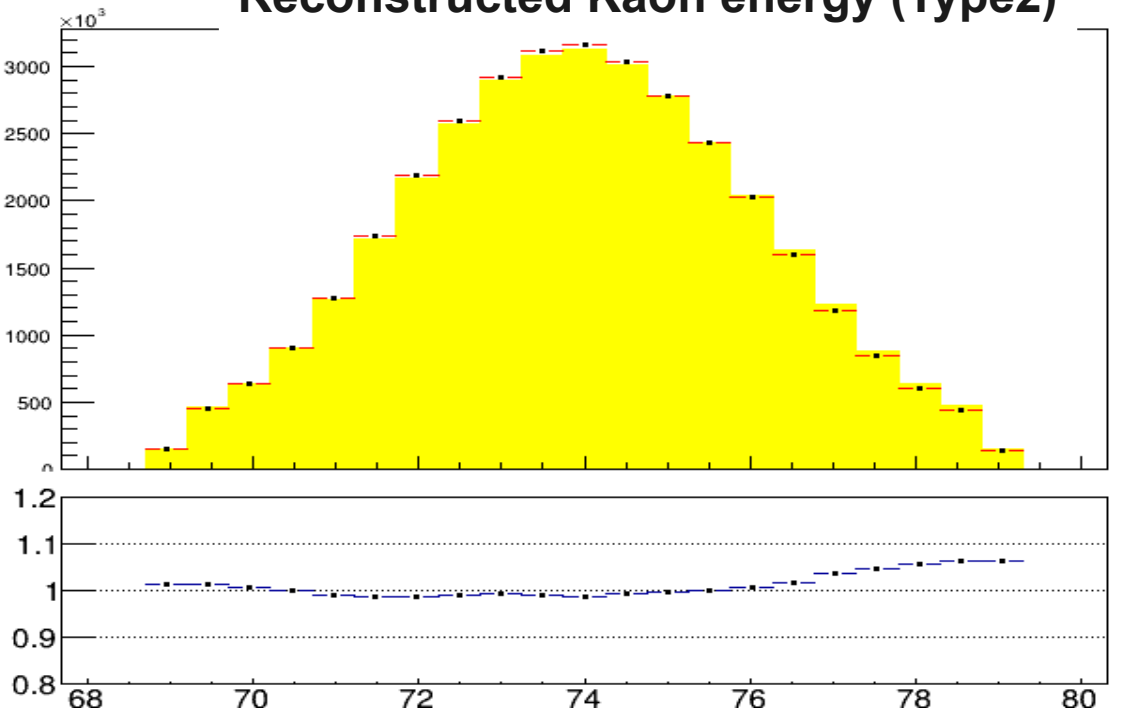
$$E_K^{\pm} = E_{e\pi} \frac{m_k}{E^*_{e\pi} \pm \beta p_{\nu\parallel}}$$

Type2:
Two solutions, the best one chosen

Type1:
One solution

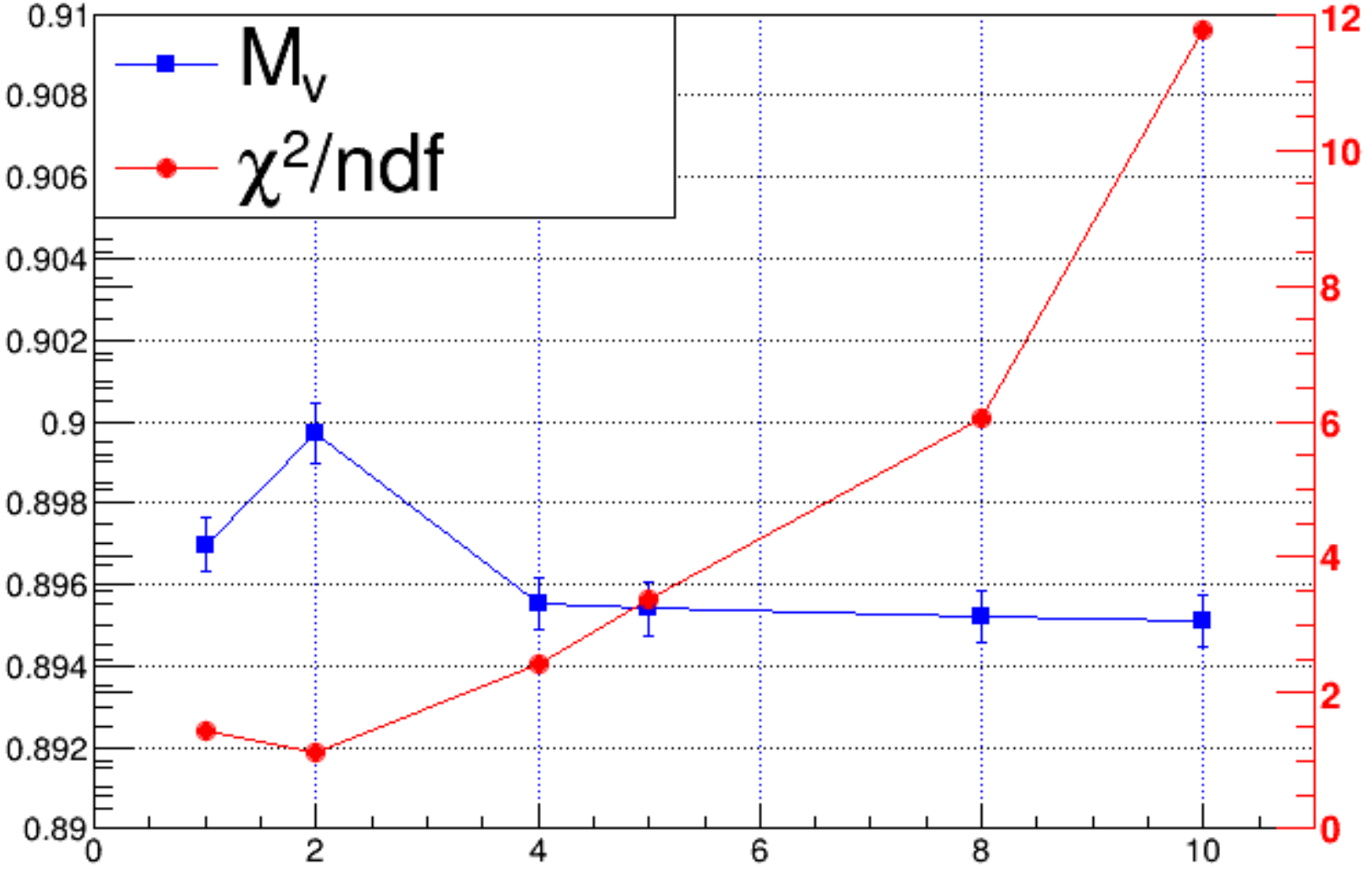
Type0:
Energy(K) <69
or
Energy(K) > 79

Reconstructed Kaon energy (Type2)



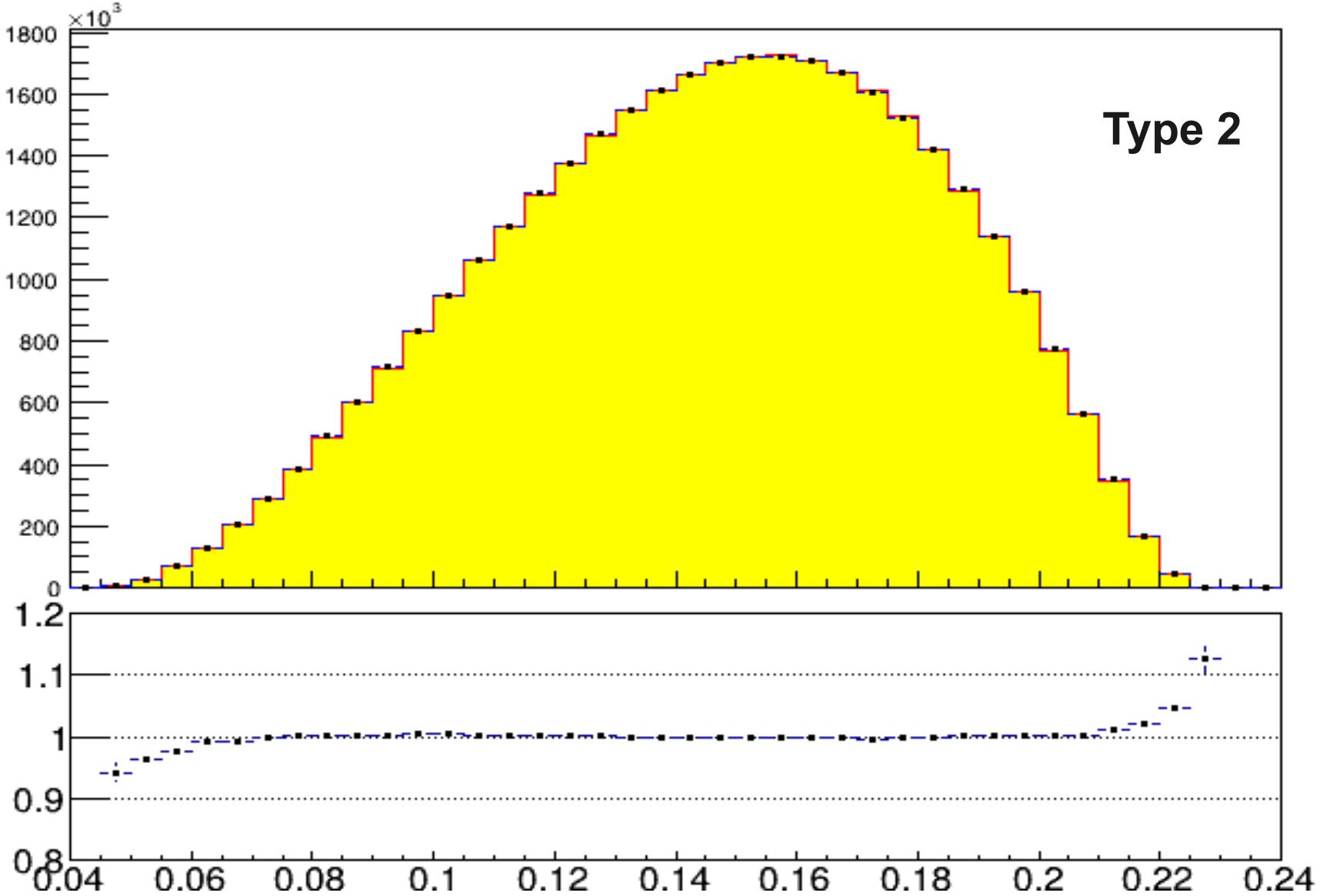
Fitting **data** with **MC**

Type 2 events only

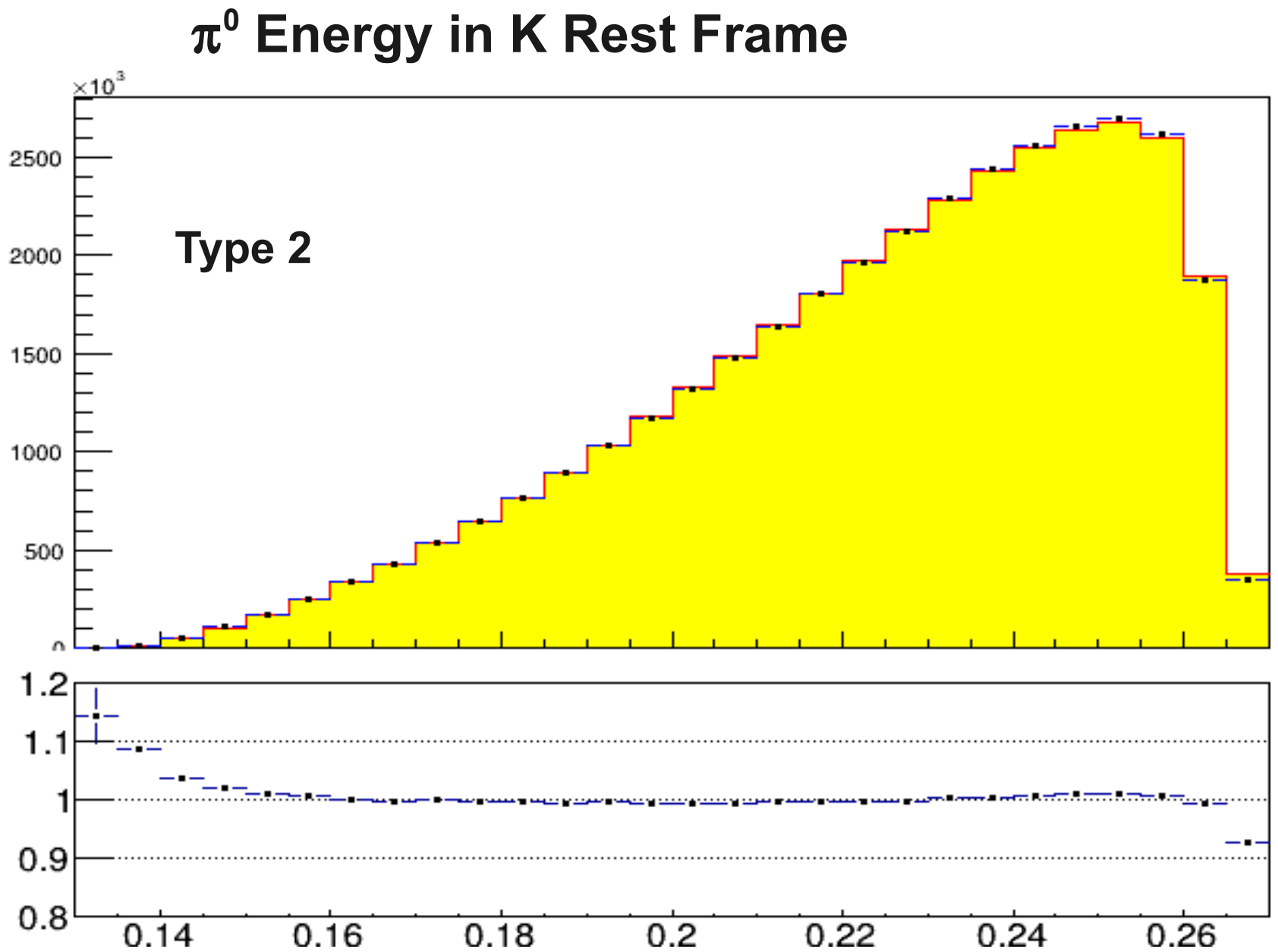


Fitting **data** with **MC**

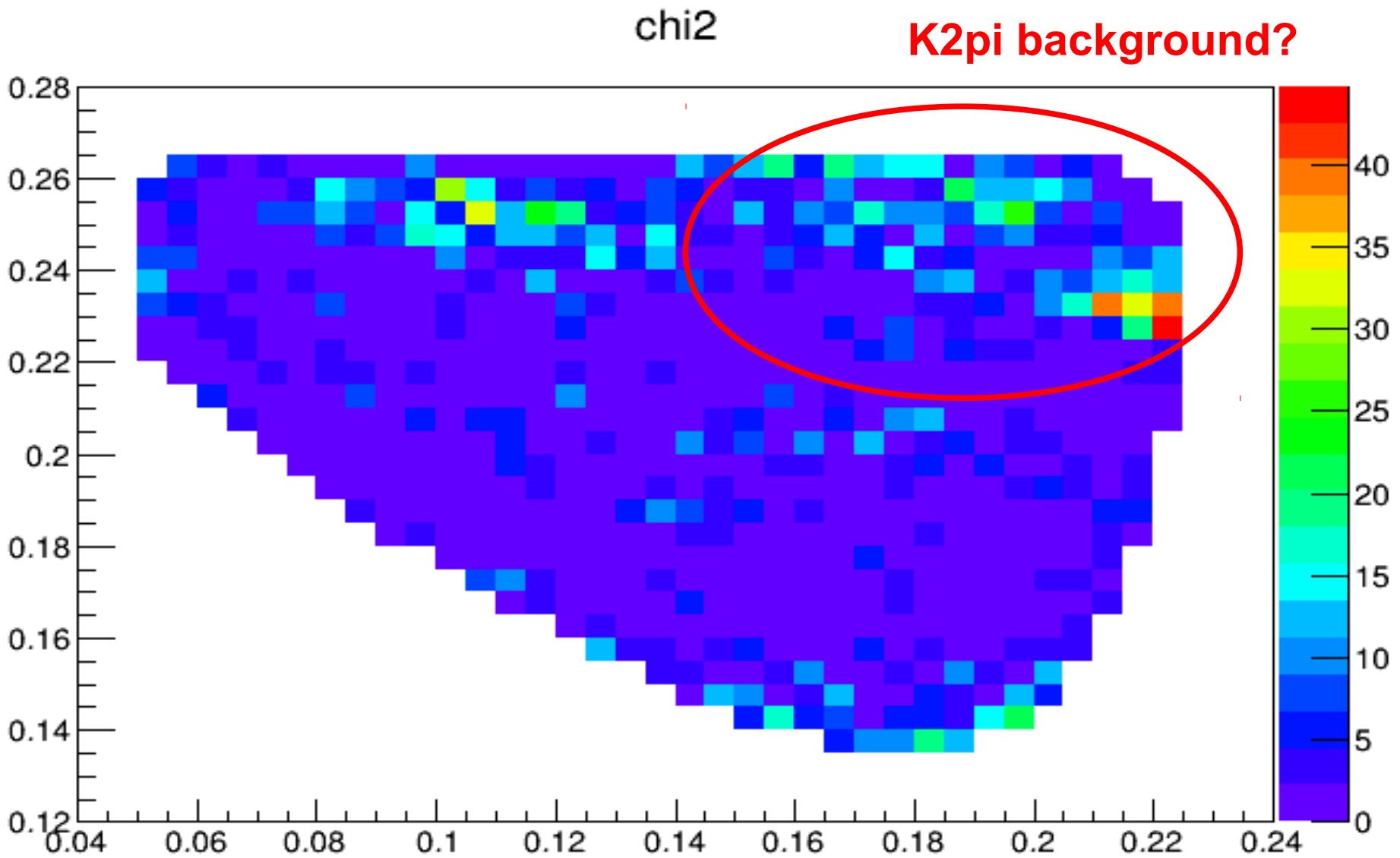
e Energy in K Rest Frame



Fitting **data** with **MC**



Fitting **data** with **MC**



Outlook

- Fitting method validated
- Pole parametrization gives supposed value
- Taylor expansion: is working, must be validated too

- Data needs more studies
- Proper handling of background is needed