Determination of the differential cross section of the reaction $pp \to \{pp\}_s\pi^0$ in the energy region of 1.5–2.5 GeV

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Introduction

The main method of studying strong interactions at intermediate energies:

$$NN \to NN\pi$$

A classic example of this channel:

$$pp \to d\pi^+ \ (I = 0, S = 1, L = 0, 2)$$

Spin isospin partner:

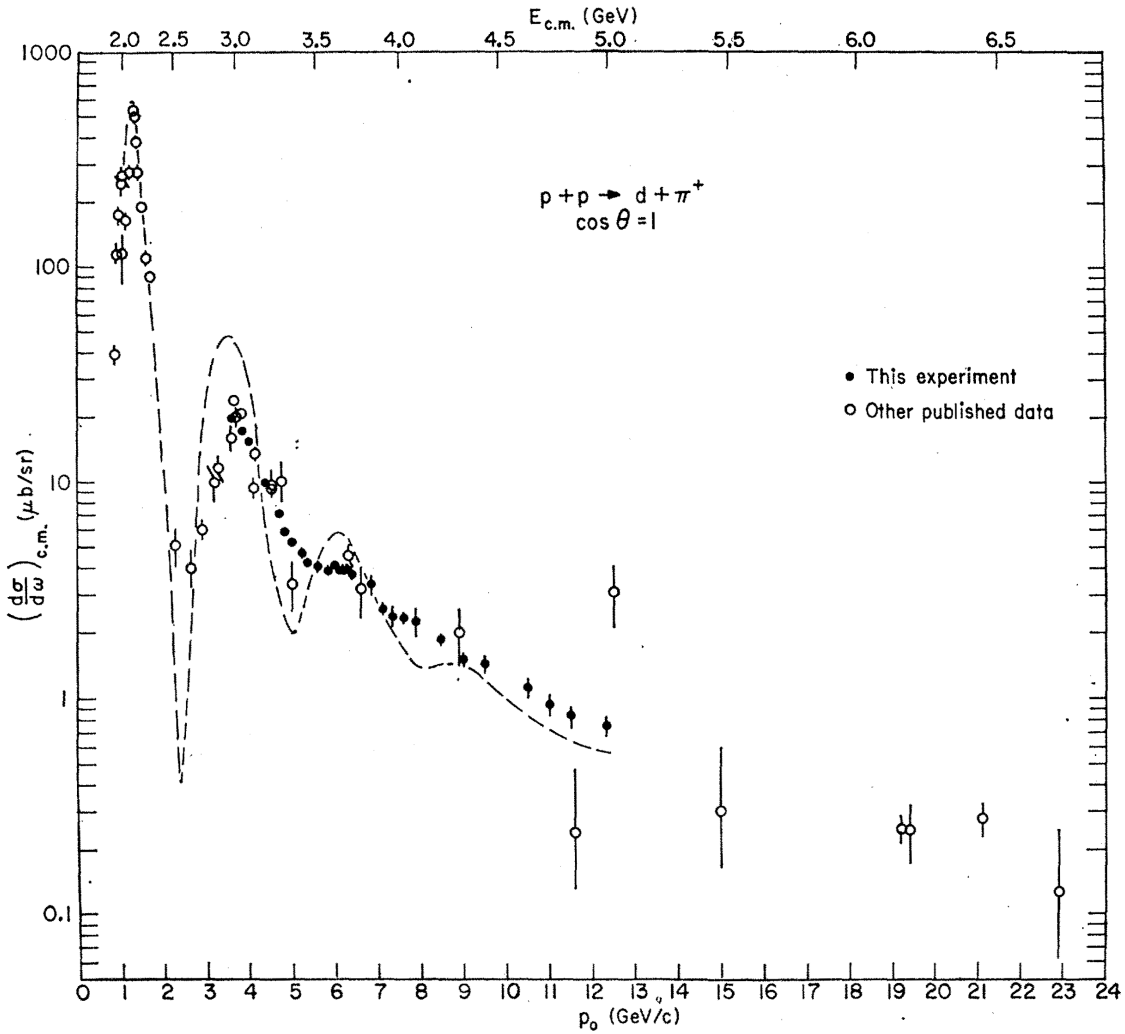
$$pp \to \{pp\}_s\pi^0 \ (I = 1, S = 0, L = 0),$$

where $\{pp\}_s$ — diproton in final state $^1S_0$

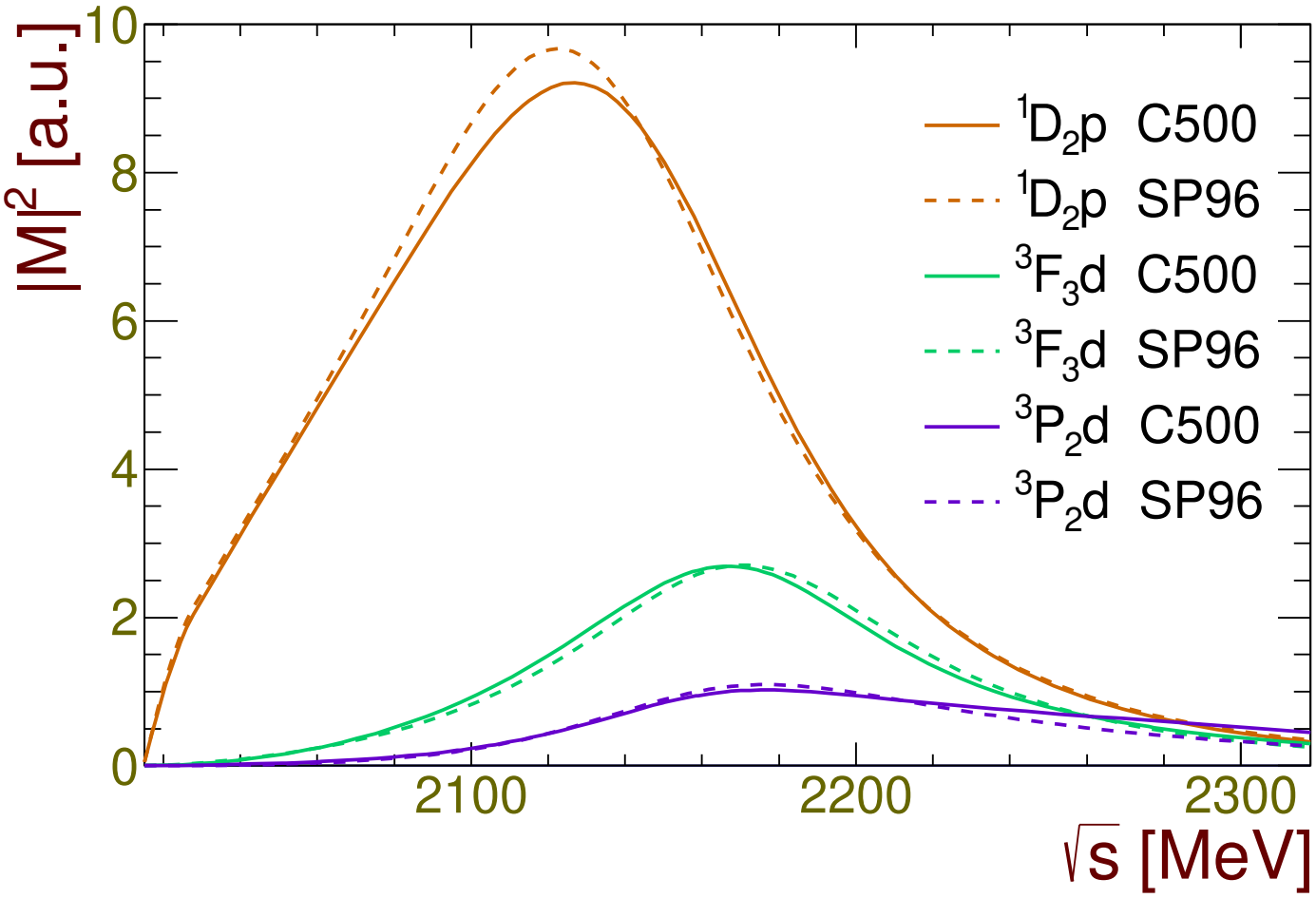
O. Imambekov, Yu.N. Uzikov, Sov. J. Nucl. Phys. **52** 862 (1990)
Formation of a singlet NN pair in the $p + d \to N + (NN)$ reaction at large momentum transfer.

Forward Differential Cross Sections for the Reaction $pp \to d\pi^+$ in the Range 3.4–12.3 GeV/c

H. L. Anderson *et al.*, Phys. Rev. D **3** 1536 (1971)



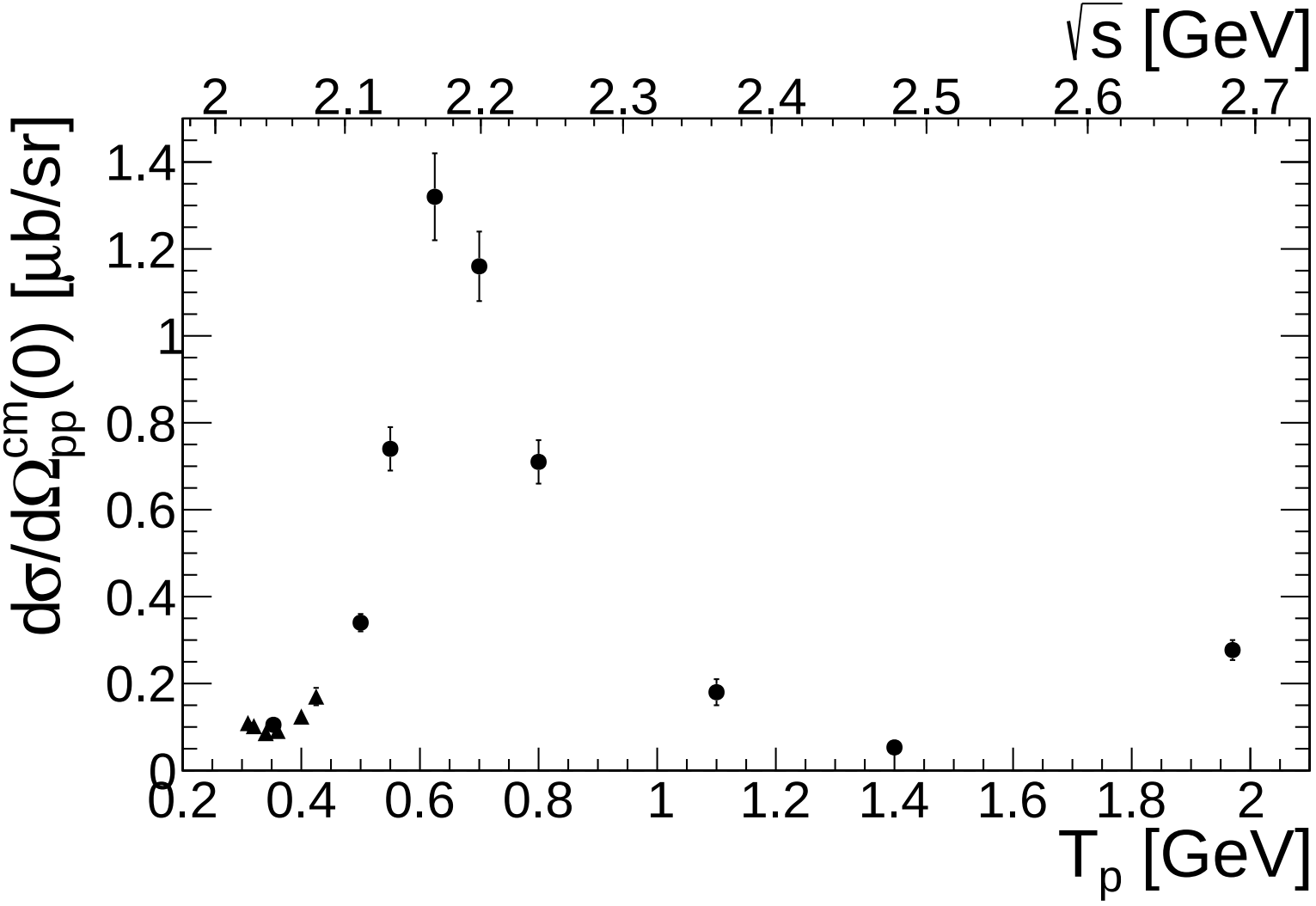
Dibaryon resonances in the reaction $pp \to d\pi^+$



$^1D_2 - D_{12}^+$ $^3F_3 - D_{13}^-$ $^3P_2 - D_{12}^-$ $[^{2S+1}L_J - D_{IJ}^P]$

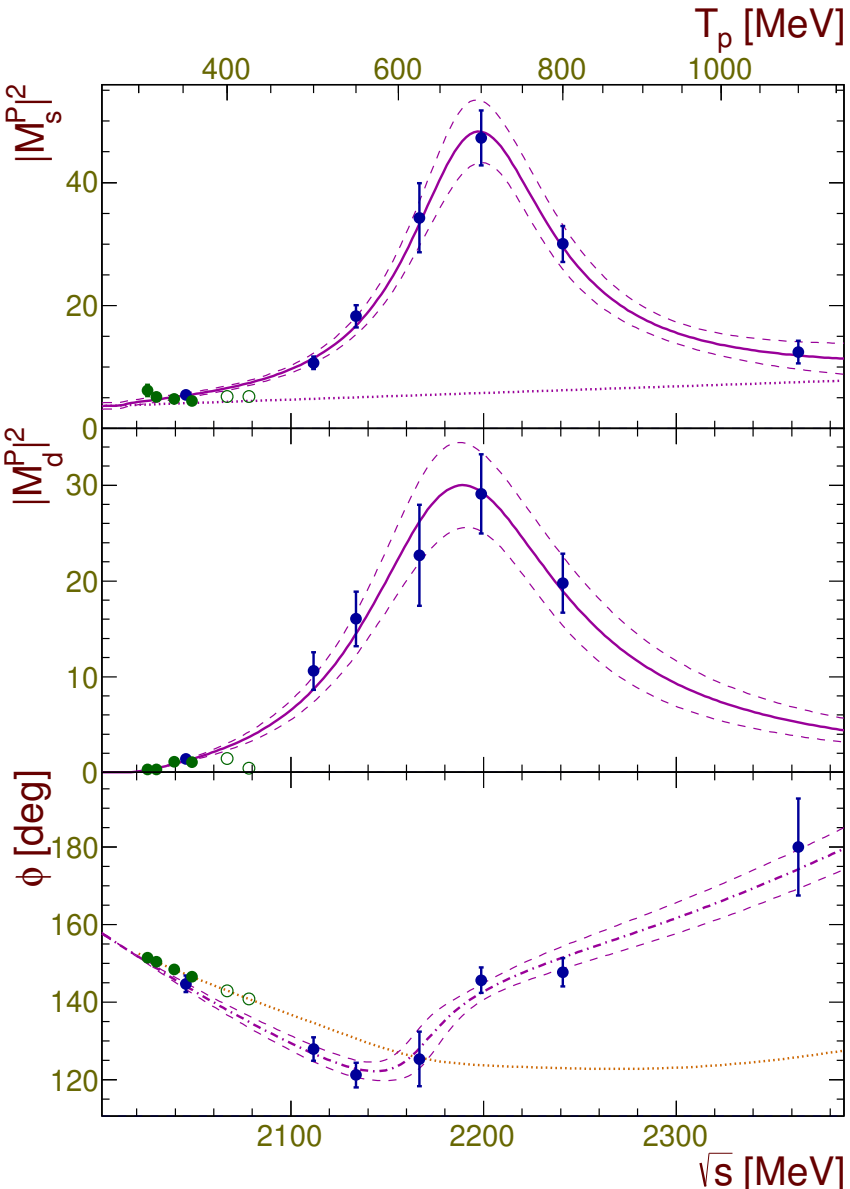
Width of resonance peak ~ 120 MeV.

The second peak in the spectrum of forward differential cross section $pp \to \{pp\}_s\pi^0$?



V. Kurbatov *et al.*, Phys. Lett. B **661** 22 (2008)
V. Komarov *et al.*, Phys. Rev. C **93** 065206 (2016)

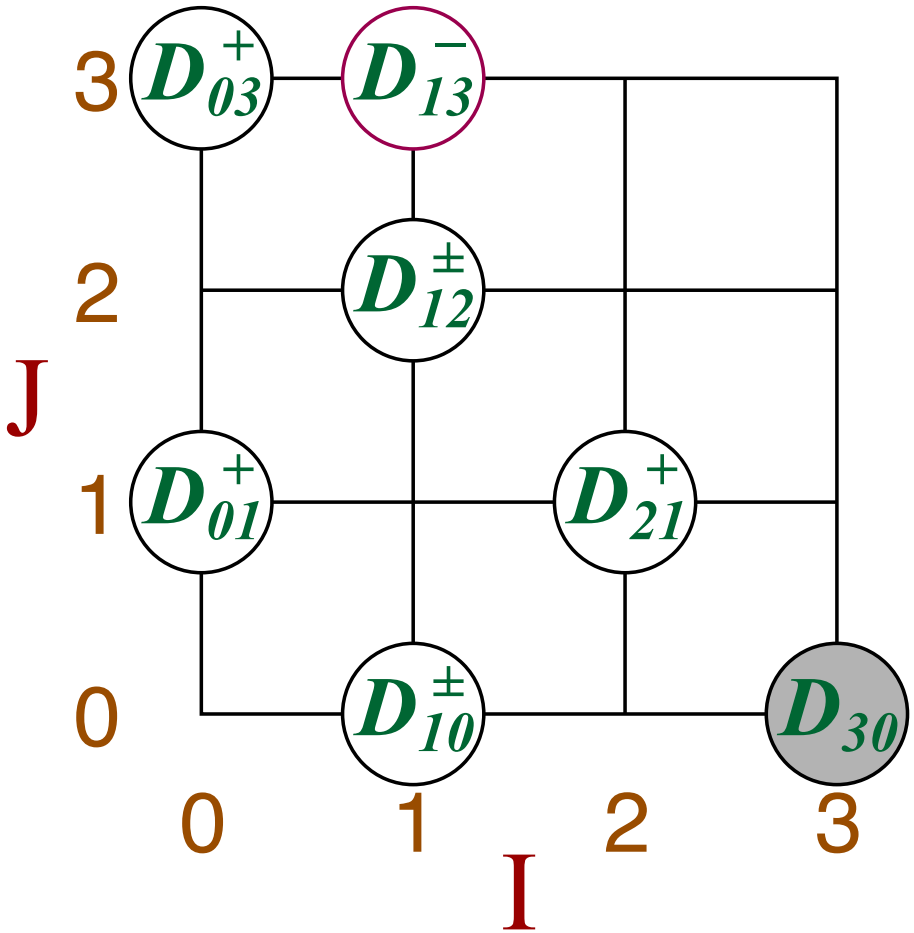
The first peak in the spectrum of forward differential cross section $pp \to \{pp\}_s\pi^0$



- ^3P_2d resonance parameters:
  $E_R = 2195 \pm 8$ MeV$/c^2$,
  $\Gamma = 134 \pm 22$ MeV$/c^2$
  with $\chi^2/\text{ndf} = 8/6$
- ^3P_0s resonance parameters:
  $E_R = 2199 \pm 5$ MeV$/c^2$,
  $\Gamma = 94 \pm 11$ MeV$/c^2$
  with the $\chi^2/\text{ndf} = 6.5/6$

V. Komarov *et al.*,
Phys. Rev. C **93** 065206 (2016)

Known dibaryons



D_{01}^{+} deuteron

D_{10}^{+} ${}^1S_0$ diproton, ${}^1S_0$ $\{pp\}_s$-pair

D_{10}^{-} ${}^3P_0$ $(pp \to \{pp\}_s\pi^0)$

D_{03}^{+} ${}^3D_3$ $(pd \to pd\pi\pi)$

D_{12}^{+} ${}^1D_2$ $(pp \to d\pi^+)$

D_{12}^{-} ${}^3P_2$ $(pp \to d\pi^+/\{pp\}_s\pi^0)$

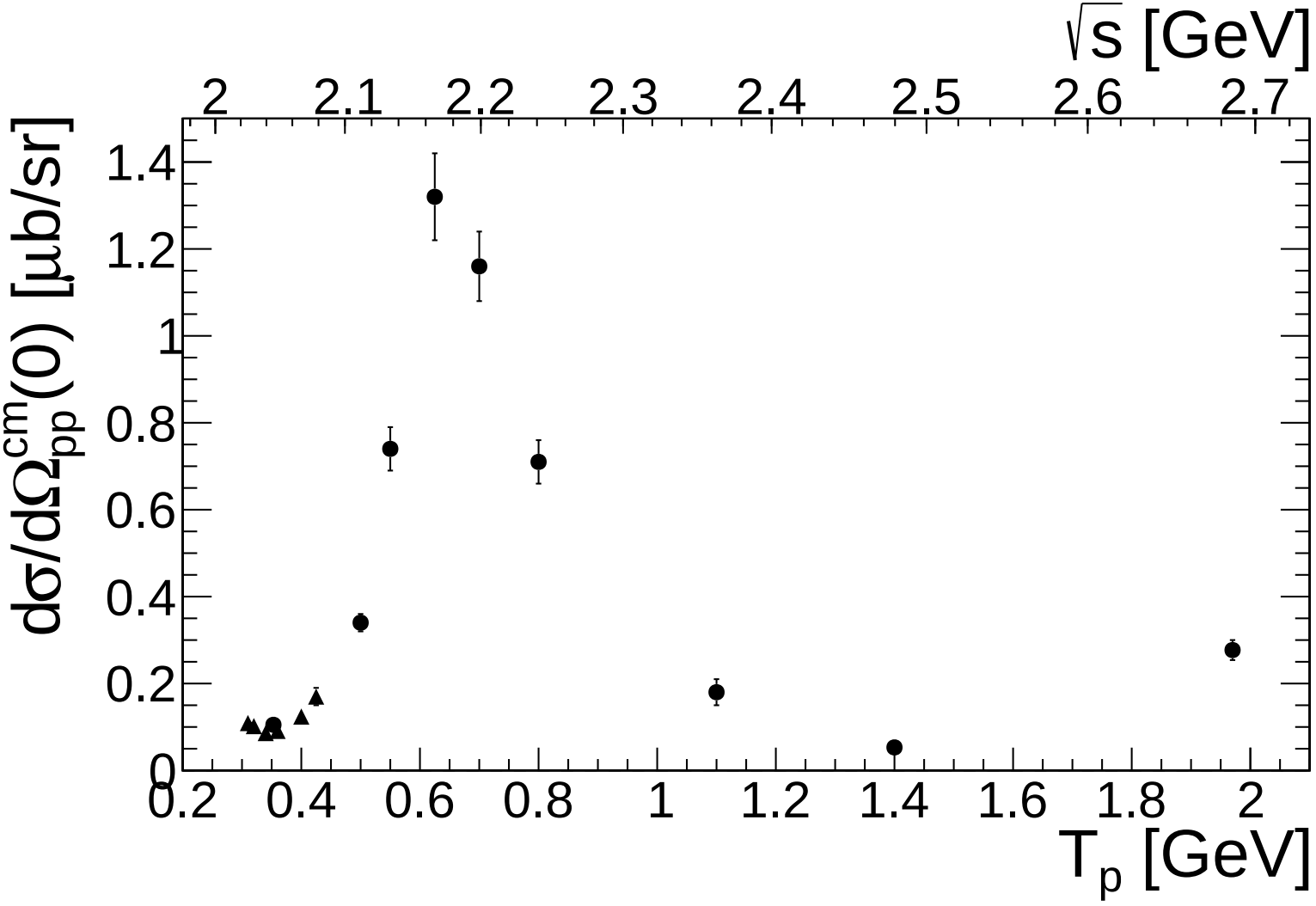
D_{21}^{+} with charge 3 $(pp \to pp\pi^+\pi^-)$

D_{13}^{-} ${}^3F_3$ $(pp \to d\pi^+)$

D_{30} with charge 4 (???)

We are at the birth of dibaryon spectroscopy.

The second peak in the spectrum of forward differential cross section $pp \to \{pp\}_s\pi^0$?



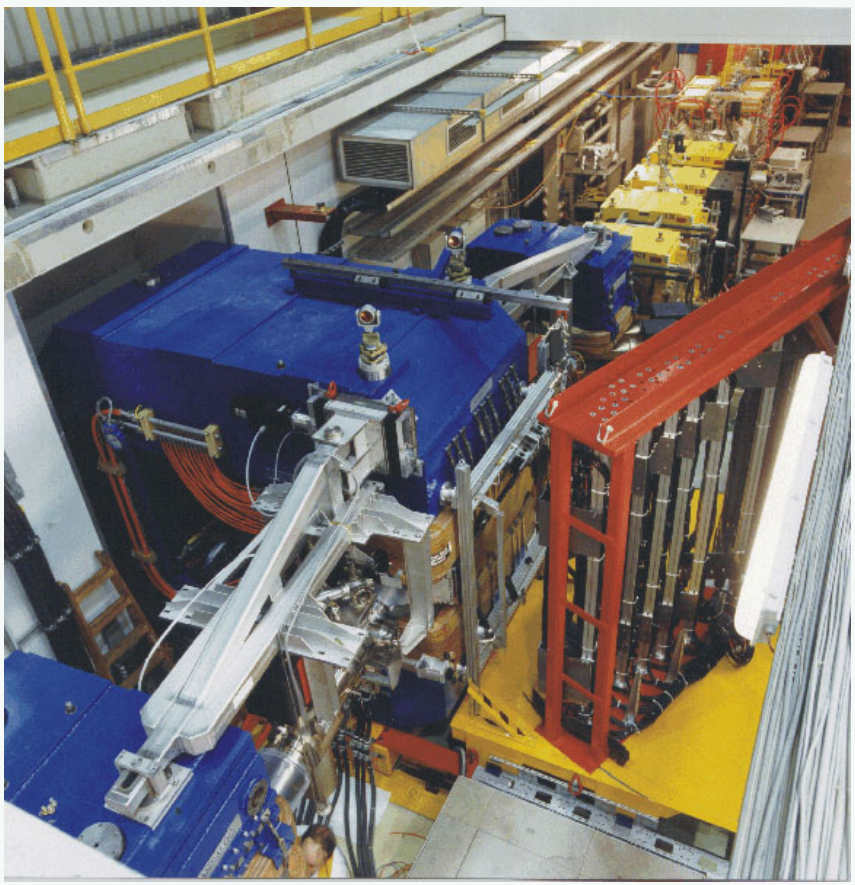
V. Kurbatov *et al.*, Phys. Lett. B **661** 22 (2008)
V. Komarov *et al.*, Phys. Rev. C **93** 065206 (2016)

Experimental setup

Experimental setup

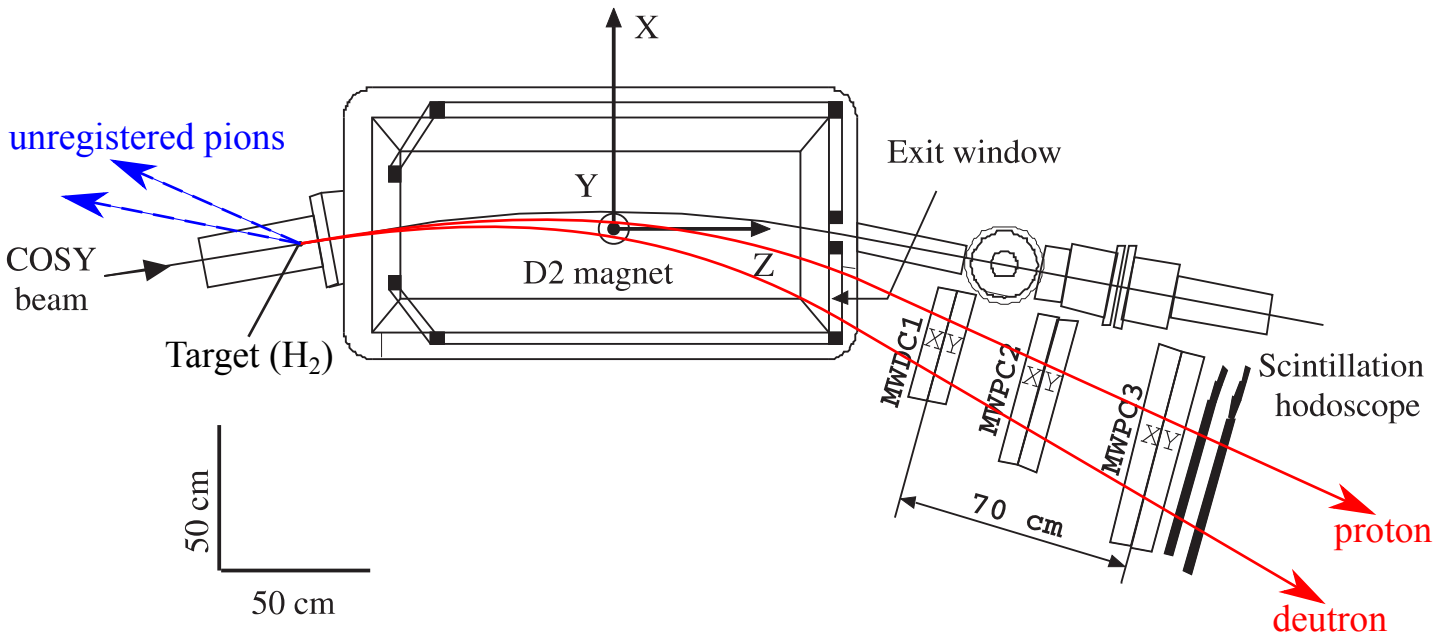
Synchrotron COSY

Spectrometer ANKE



Experimental setup

- Forward detector of the spectrometer ANKE at the synchrotron COSY–Jülich
- Proton/deuteron beam, hydrogen/deuterium target

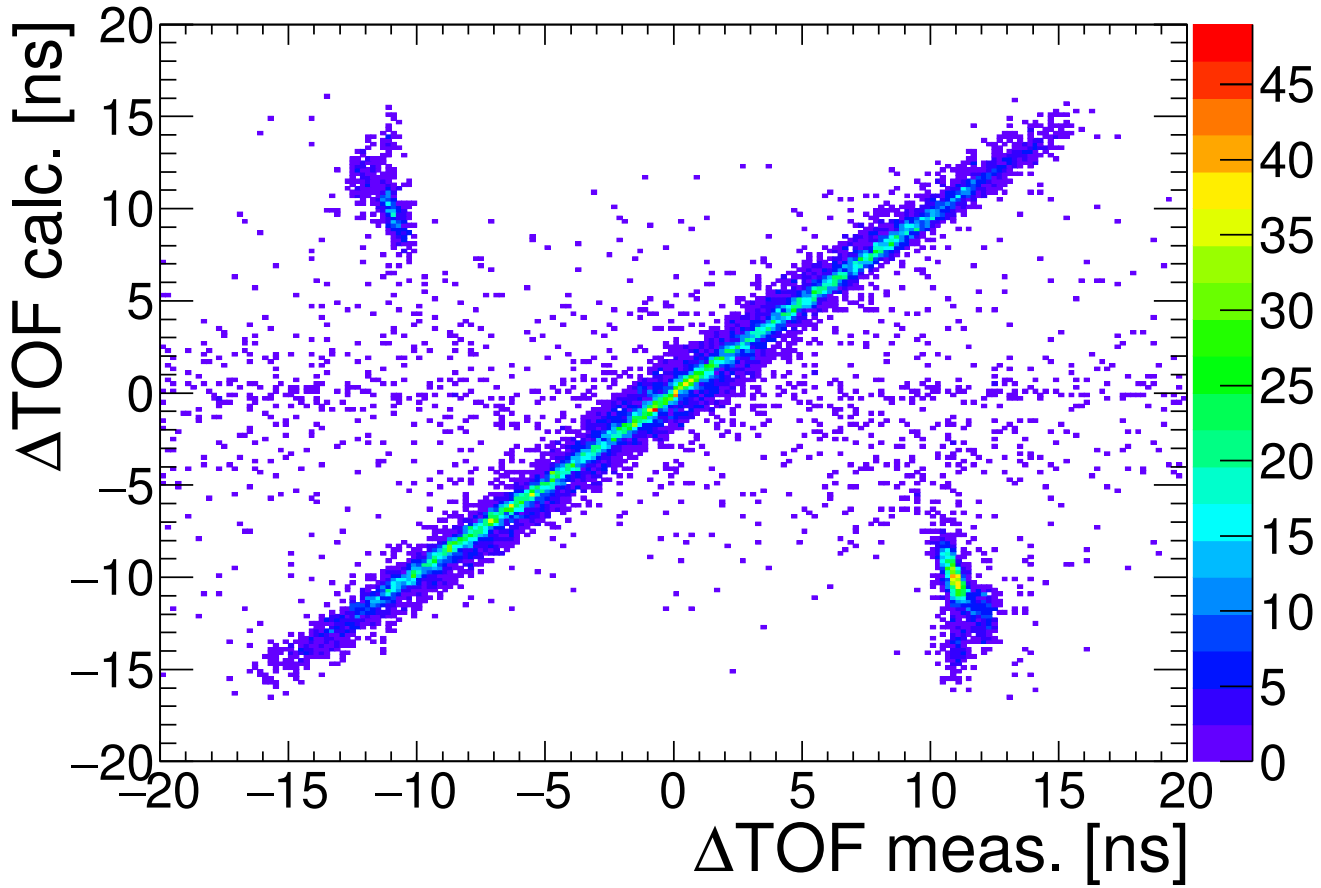


Possible measurements

- Differential cross section $d\sigma/d\Omega$

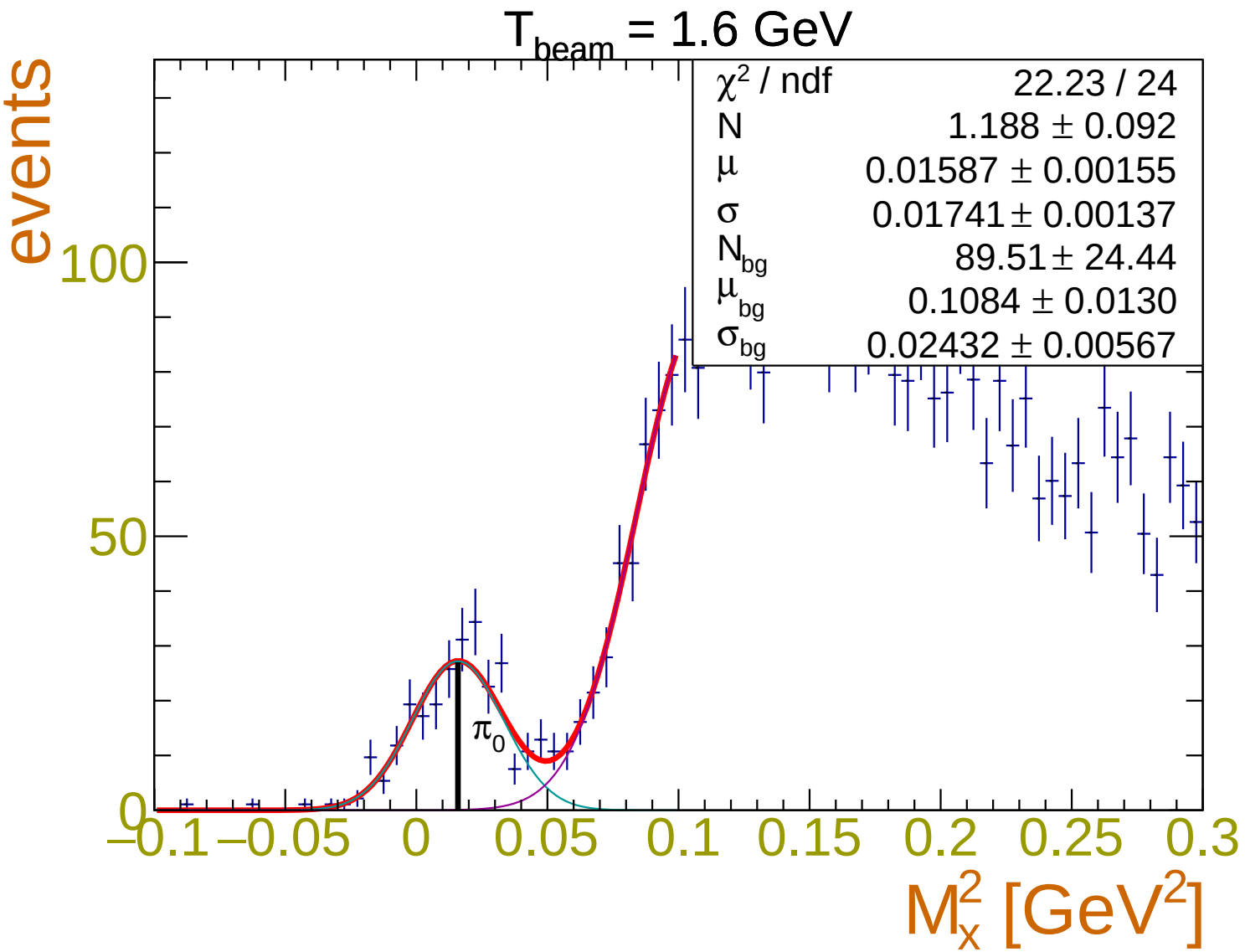
Data processing and analysis

Measured vs. Calculated time dif of flight

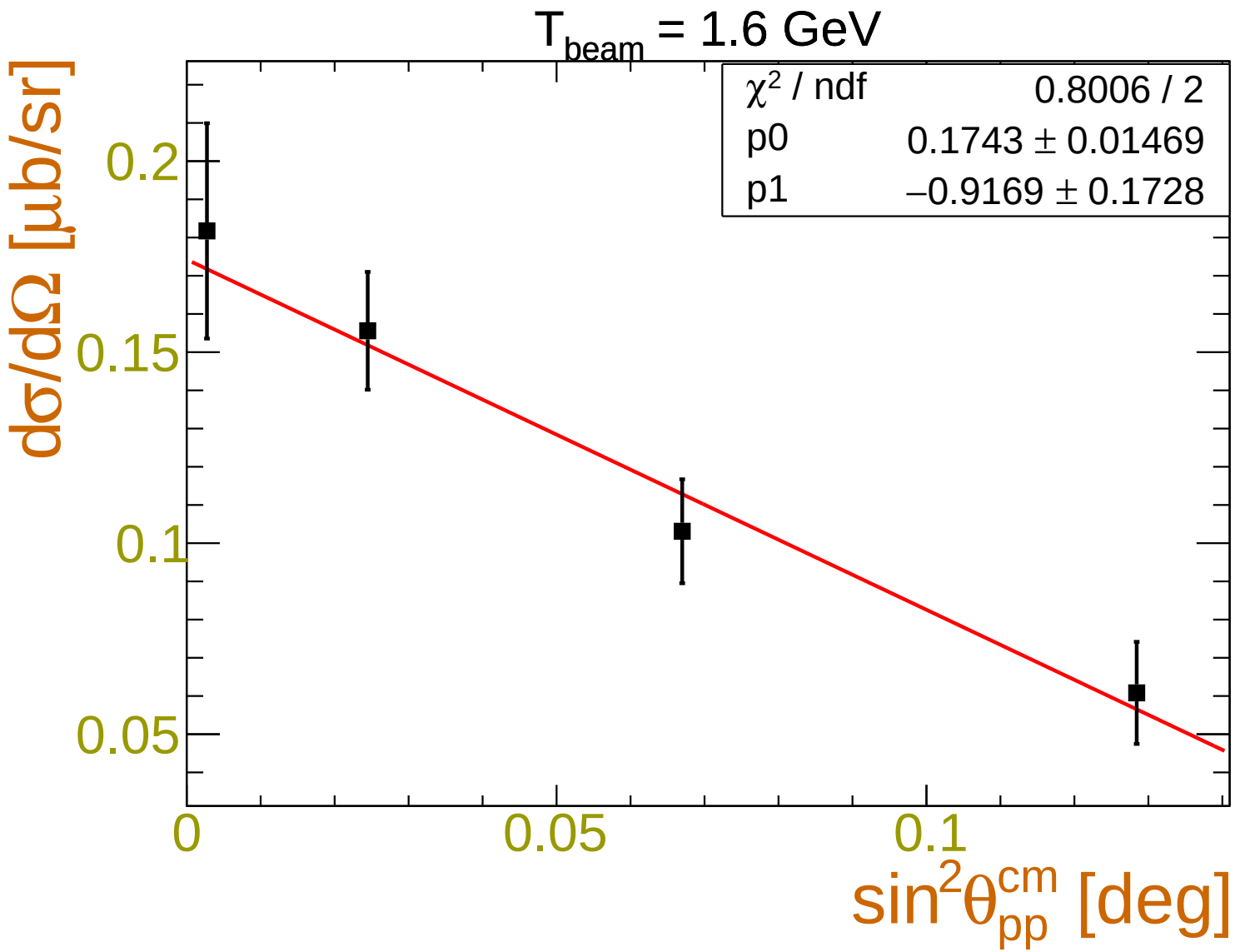


- $\Delta\mathrm{TOF}_{\mathrm{meas}}$ — using scintillation counters
- $\Delta\mathrm{TOF}_{\mathrm{calc}}$ — using measured momenta and trajectories
- excitation energy of proton pair $E_{pp} < 3$ MeV

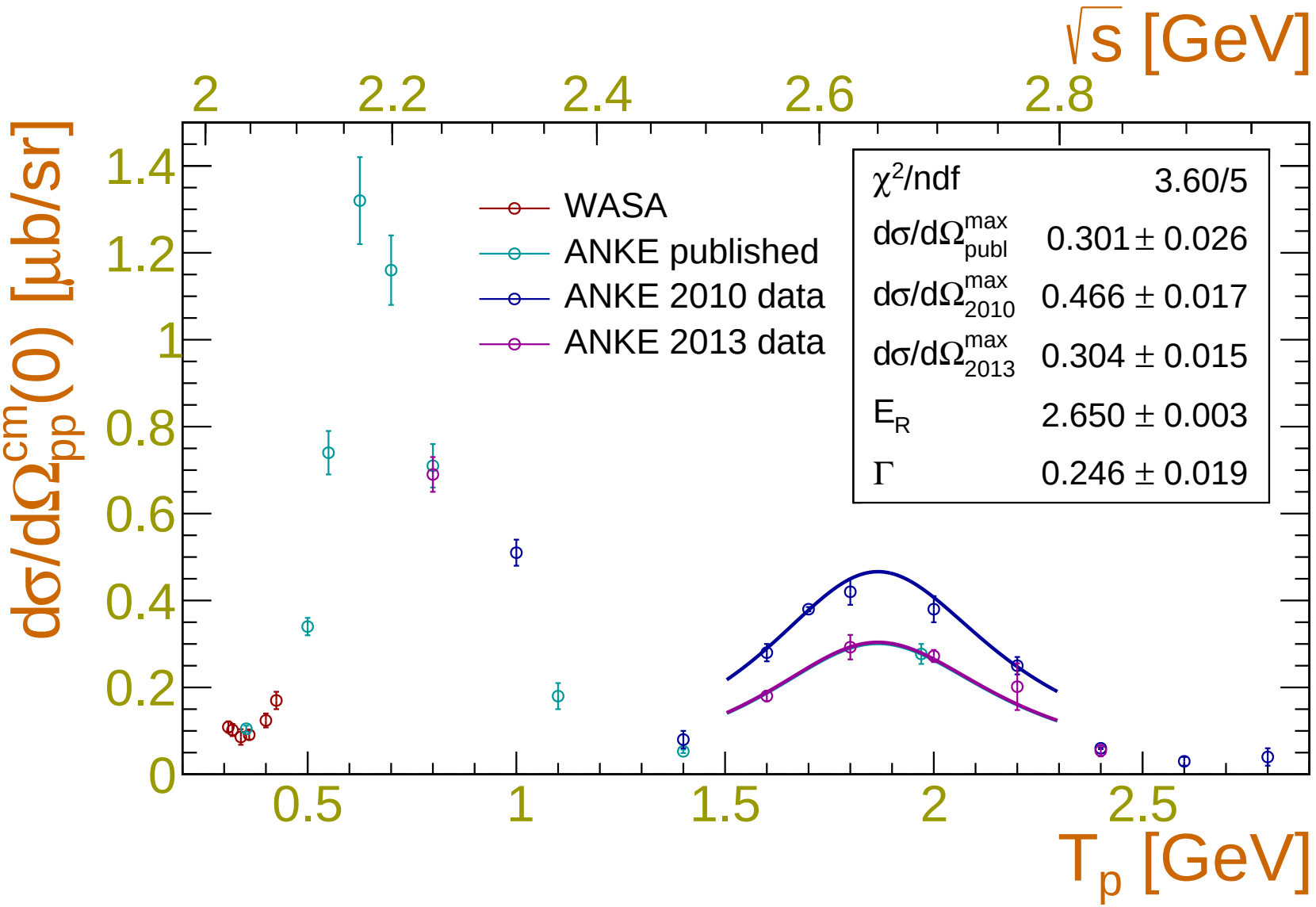
Missing mass squared distribution



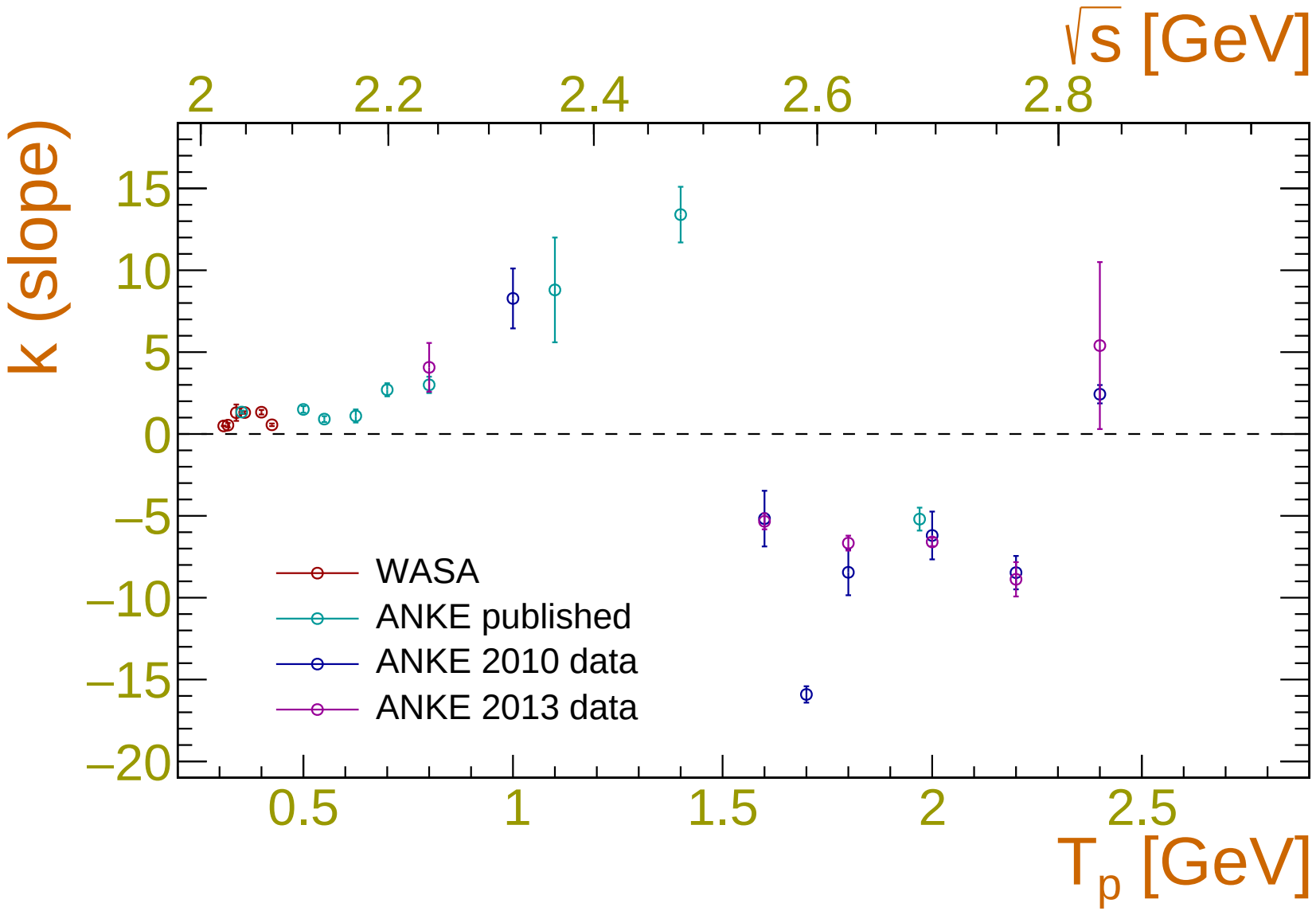
Differential cross section angular dependence



Forward cross section energy dependence



Cross section slope energy dependence



Further plans

- Clarify the parameters of the second peak
- Consider its possible nature
- Publish the results

Thank you for your attention!