# Status of Calibration Studies at COSY

Lukas Linzen

Ruhr-Universität Bochum
Institut für Experimentalphysik I

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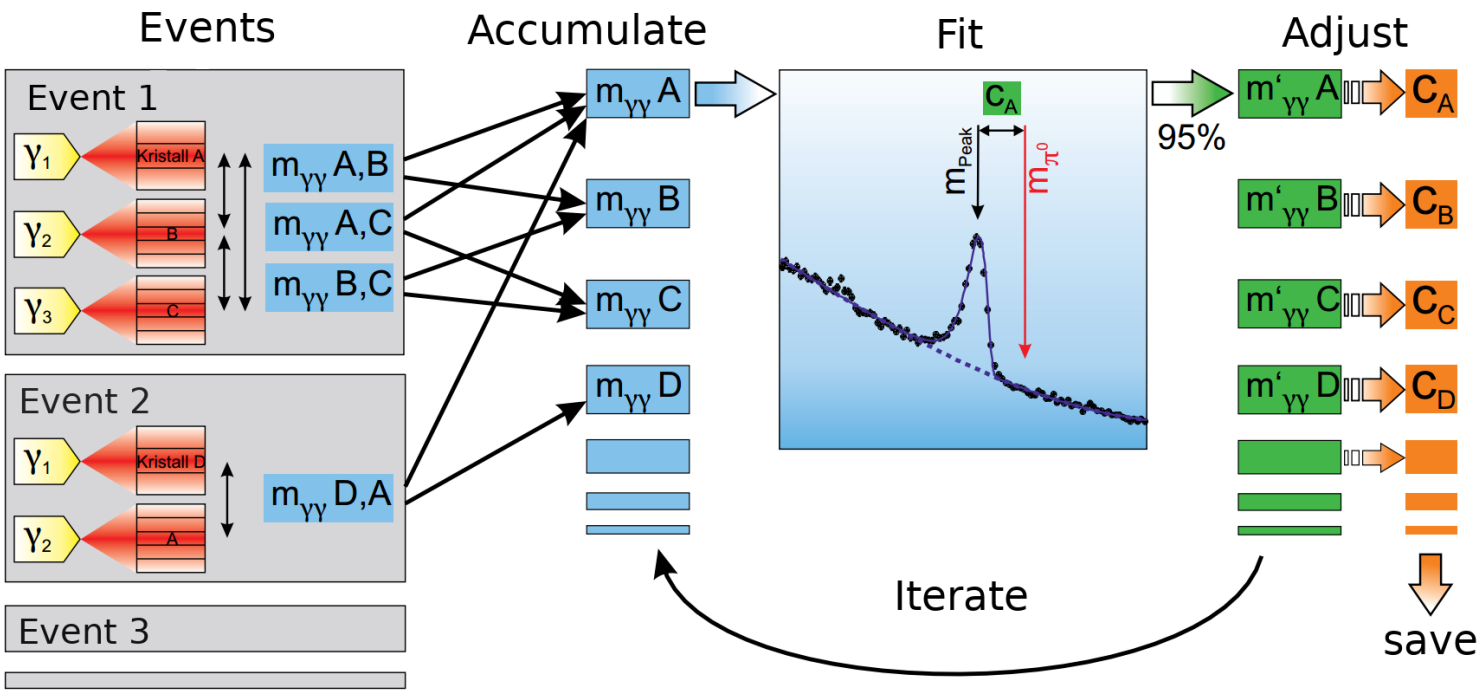
# Overview

- $\overline{\text{P}}$ANDA calibration algorithm
- Pre-calibration of the forward endcap in Jülich with $\gamma$ from $\pi^0$ decays
- pp and pn cross sections
- Event generation with Pluto (used and developed by HADES)
- First look to angular distributions of photons

# Calibration Algorithm



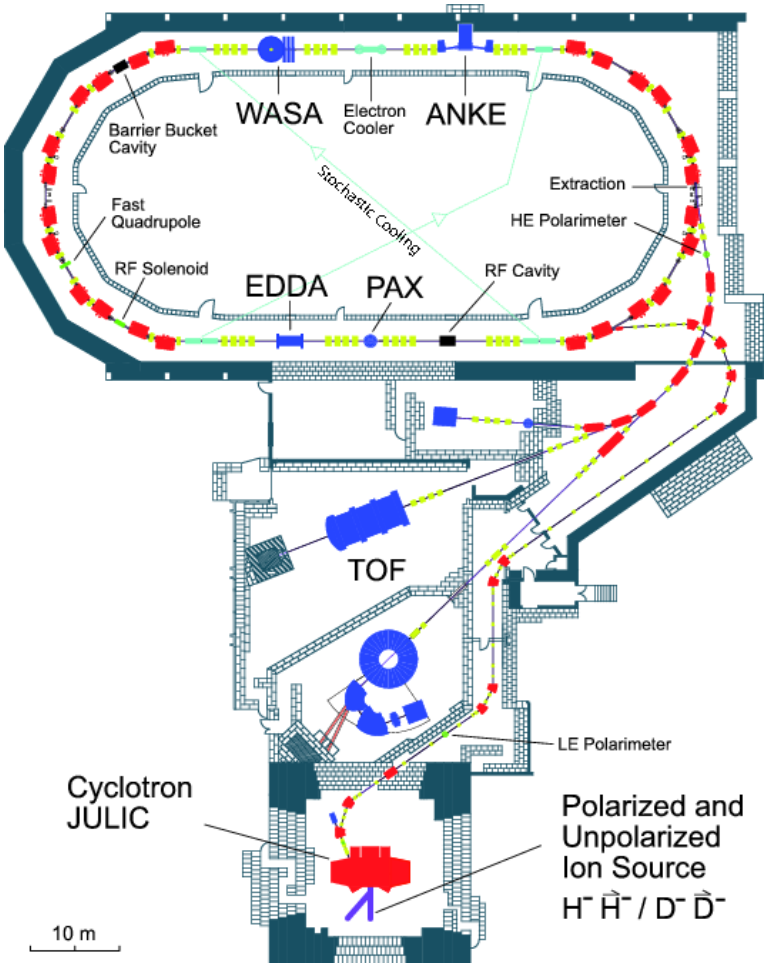

Roth, Phd thesis Bochum, 2012

- Must accumulate sufficient statistics for central crystals of clusters
- Must obtain reasonable signal to (combinatoric) background ratio

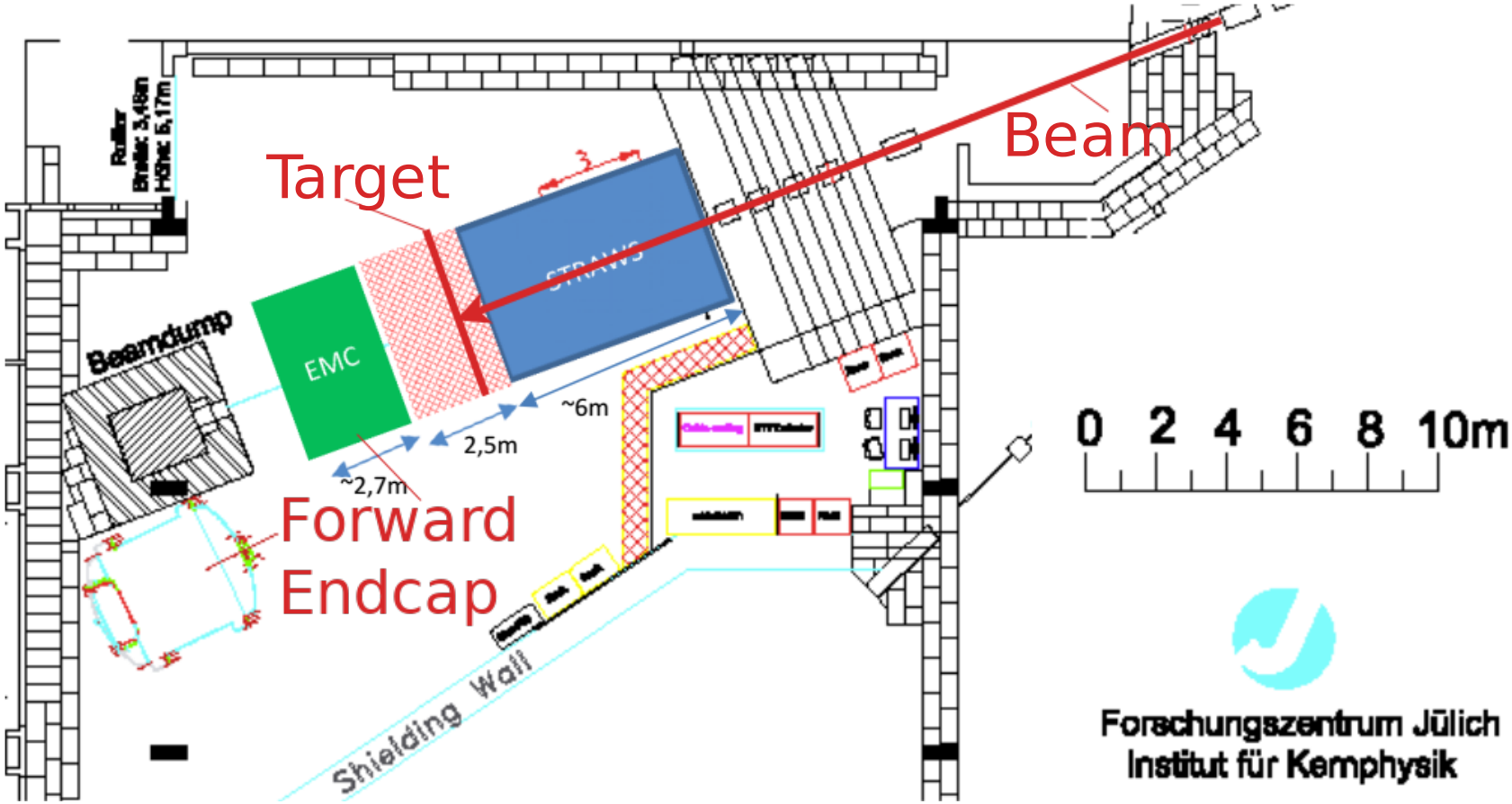
# Pre-calibration at COSY

- Pre-calibration at Cooler Synchrotron in Jülich
- Forward endcap in TOF hall:
- $p_\mathrm{p} = 0.3\,\mathrm{GeV/c} - 3.4\,\mathrm{GeV/c}$
- $\dot{N}_\mathrm{p} = 10^5\,\mathrm{s}^{-1} - 10^{10}\,\mathrm{s}^{-1}$
- $d_\mathrm{beam} \simeq 1\,\mathrm{cm}$
- Likely PET $[(C_2H_4)_n]$ as string or foil target

$\rightarrow$ pp and pn scattering



# Installation of the Forward Endcap in Jülich



# Triggerless Readout

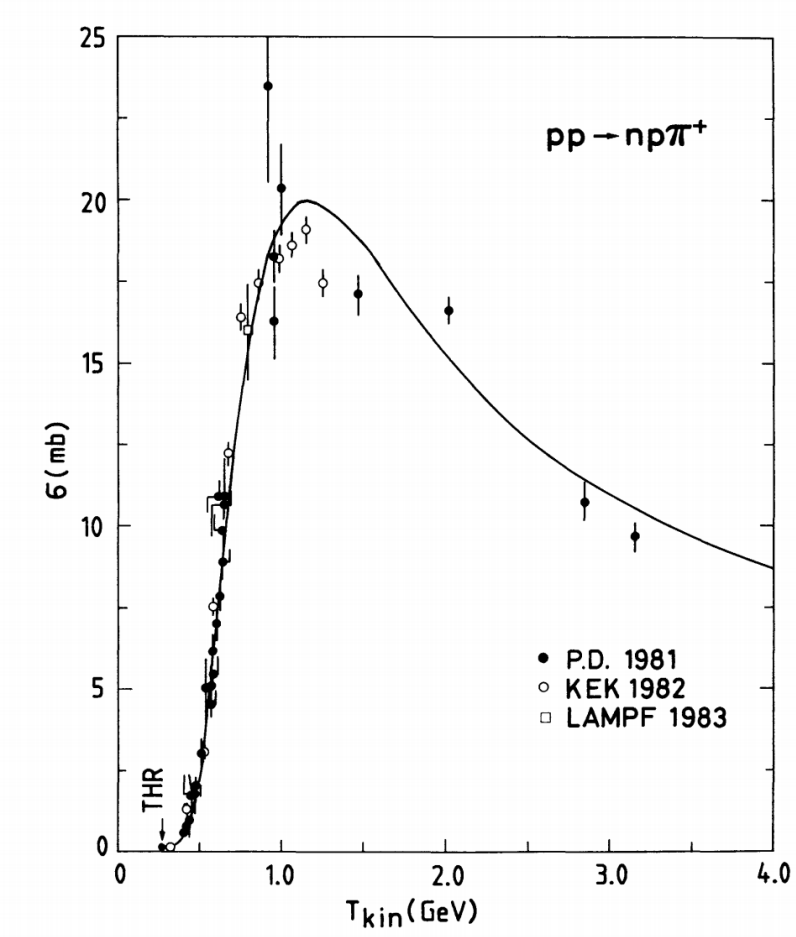
- Triggerless readout of endcap
  - $\rightarrow$ Limitation assumed to be in the order of 1000 events per second written to disk
    - Target geometry will be chosen according to expected rates

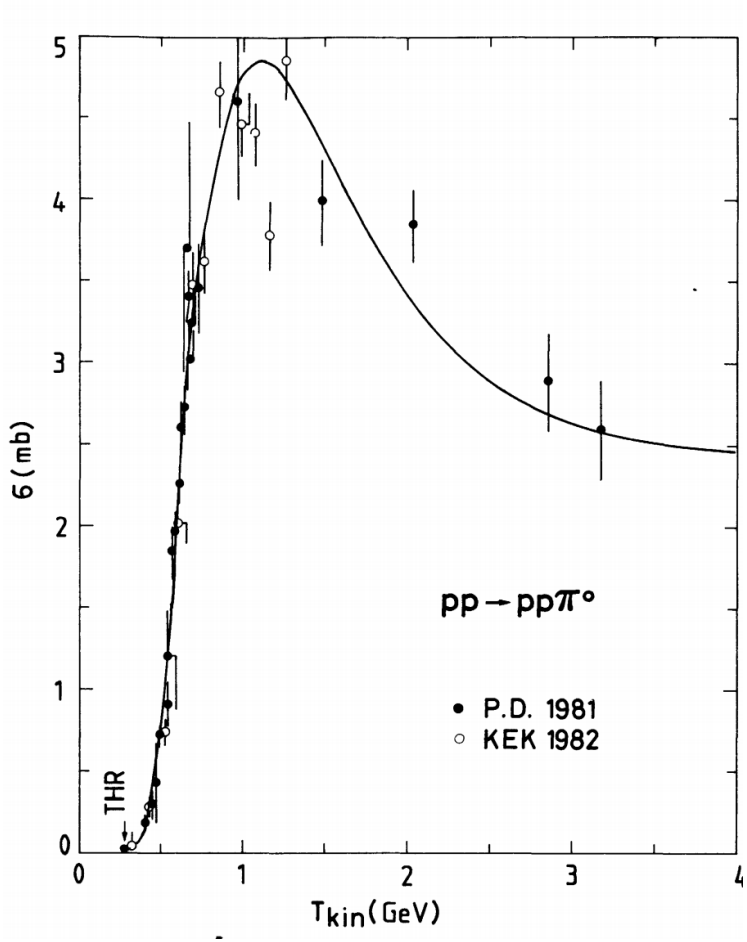
$\Rightarrow$ Study differential cross sections of $\pi^0$ production in pp and pn scattering at COSY energies

# Cross Sections

- Generalized Laguerre polynomials fitted to published cross sections
- Parametrizations implemented as Pluto plugin
- Cross section for any given energy and process can be calculated and used in Pluto

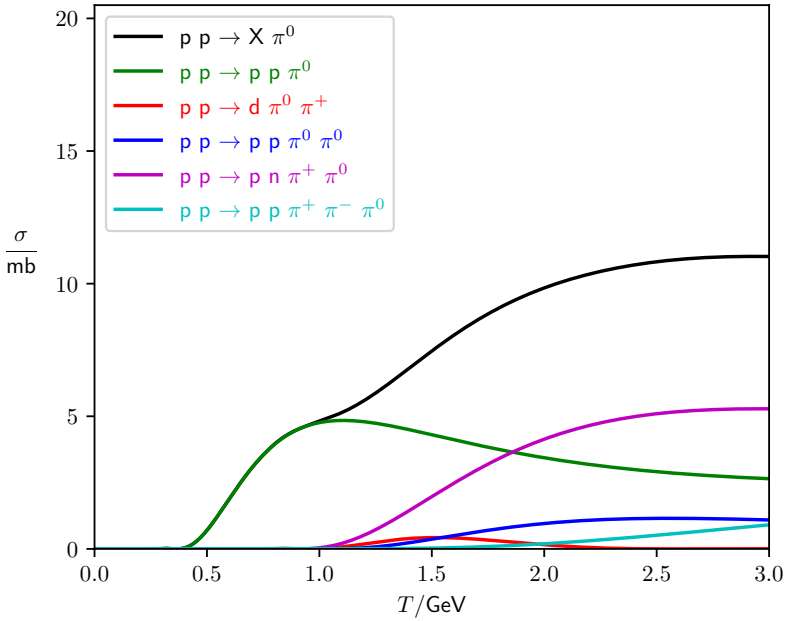
# Implemented **pp** Cross Sections



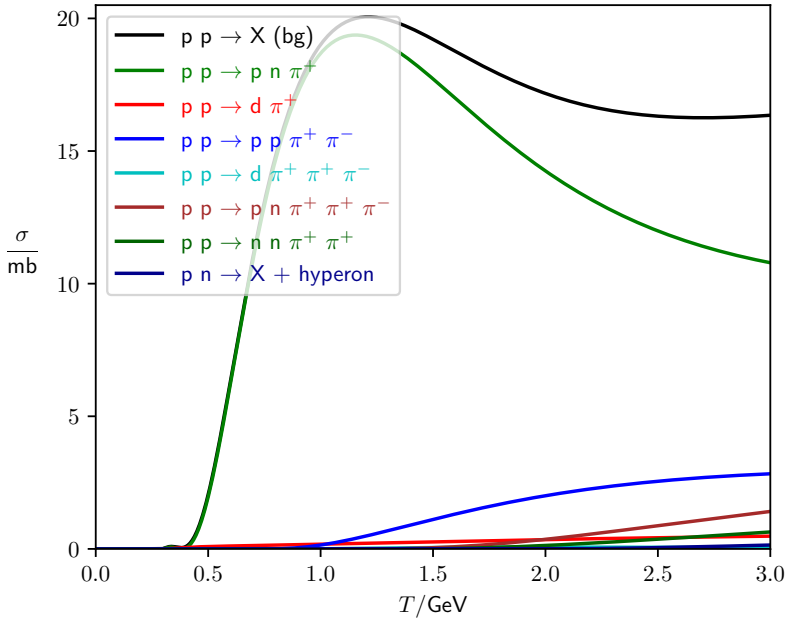




Bystricky et al., J. Phys. France 48, 1901-1924 (1987)

# Implemented **pp** Cross Sections



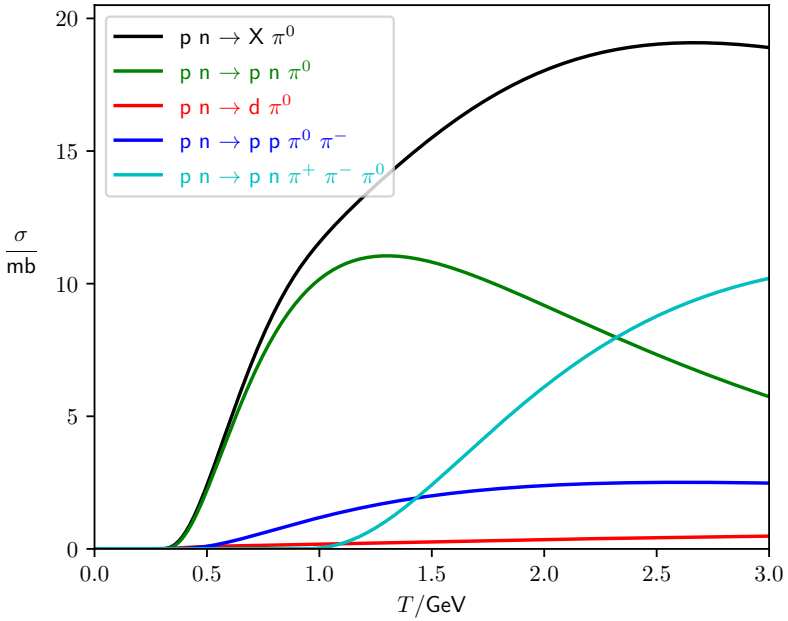

signal



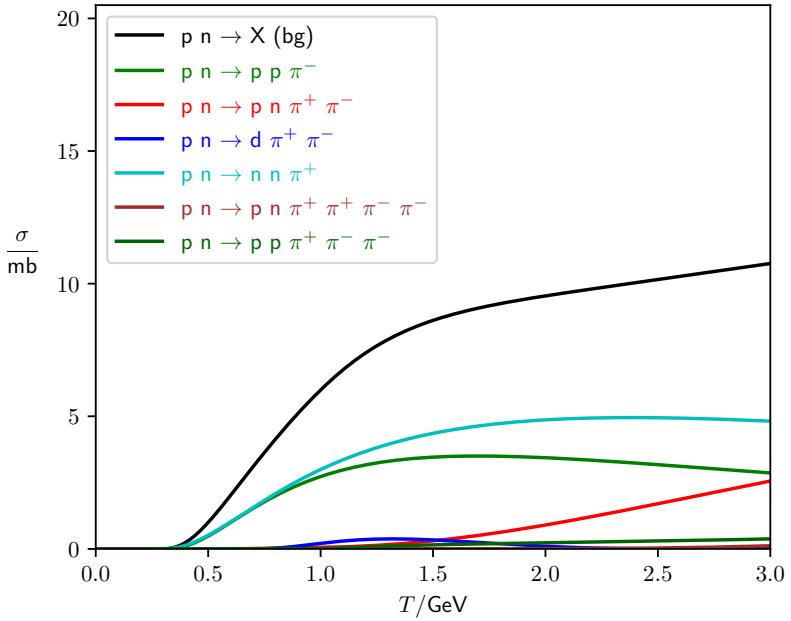

background

Bystricky et al., J. Phys. France 48, 1901-1924 (1987)

# Implemented **pn** Cross Sections




signal

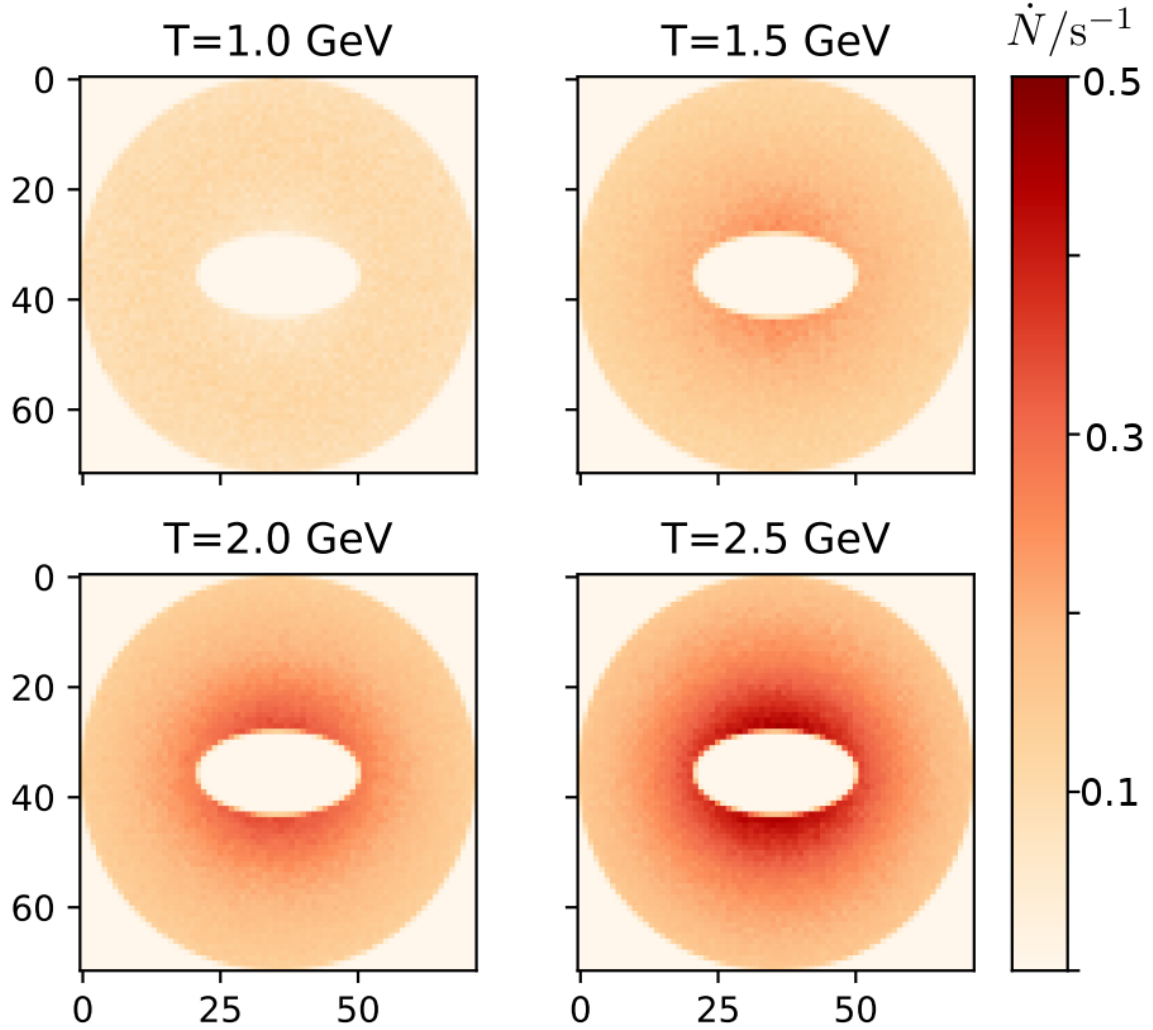



background

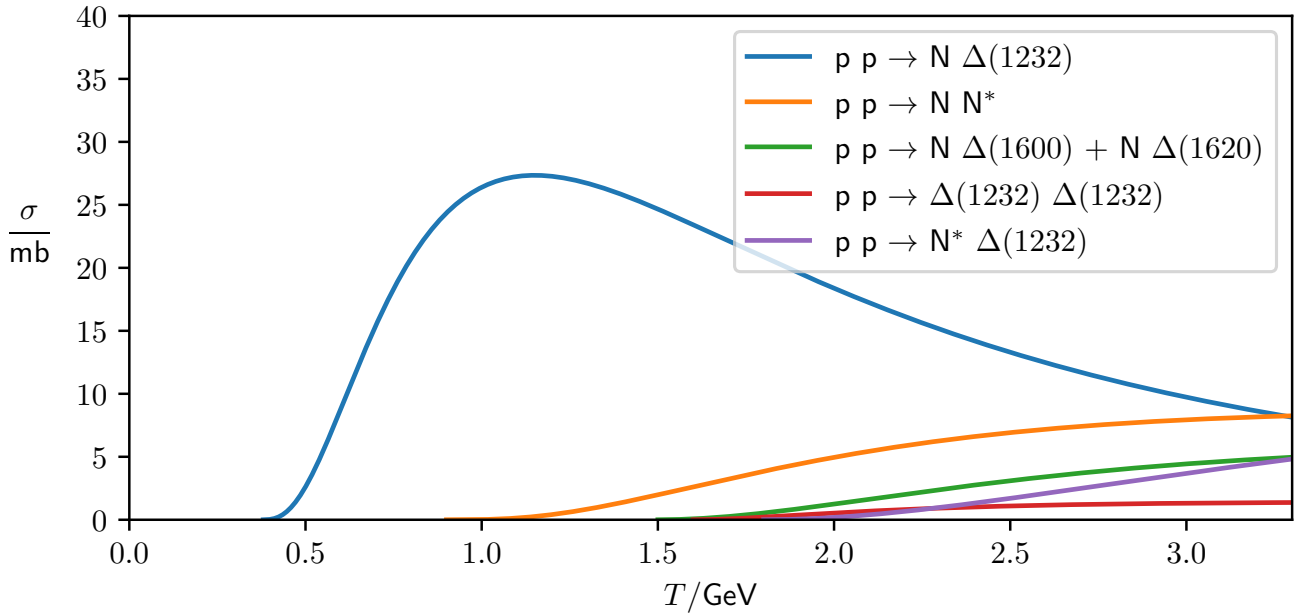
Bystricky et al., J. Phys. France 48, 1901-1924 (1987)

# Differential Rates of 2$\gamma$-Events

- For first analysis differential rates calculated based on $\gamma$ kinematics from generator
- Luminosity assumed to be in the order of $\mathcal{L} \simeq 10^{29}\,\mathrm{cm}^{-2}\,\mathrm{s}^{-1}$
- Bin size approximately represents crystal size
- Needs detailed simulations including detector response



# $N^*$ and $\Delta$ Resonance Production in **pp** Scattering




Bleicher et al., J. Phys. G 25, 1859-1896, (1999); Jain et al., Nucl. Phys. A 519, 697-720, (1990); Shimizu, Nucl.Phys. A 386, 571-588, (1982)

- Angular distributions for $\pi^0$ (and $\gamma$) produced in $\Delta$ and $N^*$ decays differ from those obtained from PHSP events
- Parametrizations also implemented as Pluto plugin

# Summary and Outlook

- Goal: Study optimal beam energy and needed beam time for successful pre-calibration using pp and pn scattering at COSY
- pp and pn cross sections implemented for use with Pluto
  - including $\Delta$ and $N^*$ production in pp scattering
- To be done:
  - Generate resonant production events for pn
  - Simulation of detector response with Panda Root
  - Choose target geometry according to luminosity