

First results from the commissioning of the BGO-OD experiment at ELSA

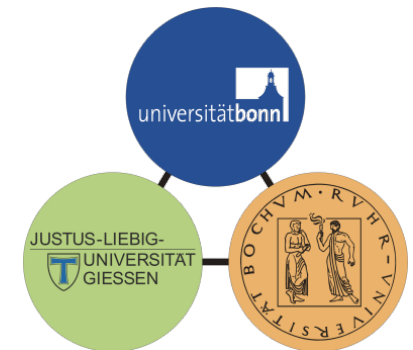
Andreas Bella on behalf of the BGO-OD Collaboration

Physikalisches Institut der Universität Bonn

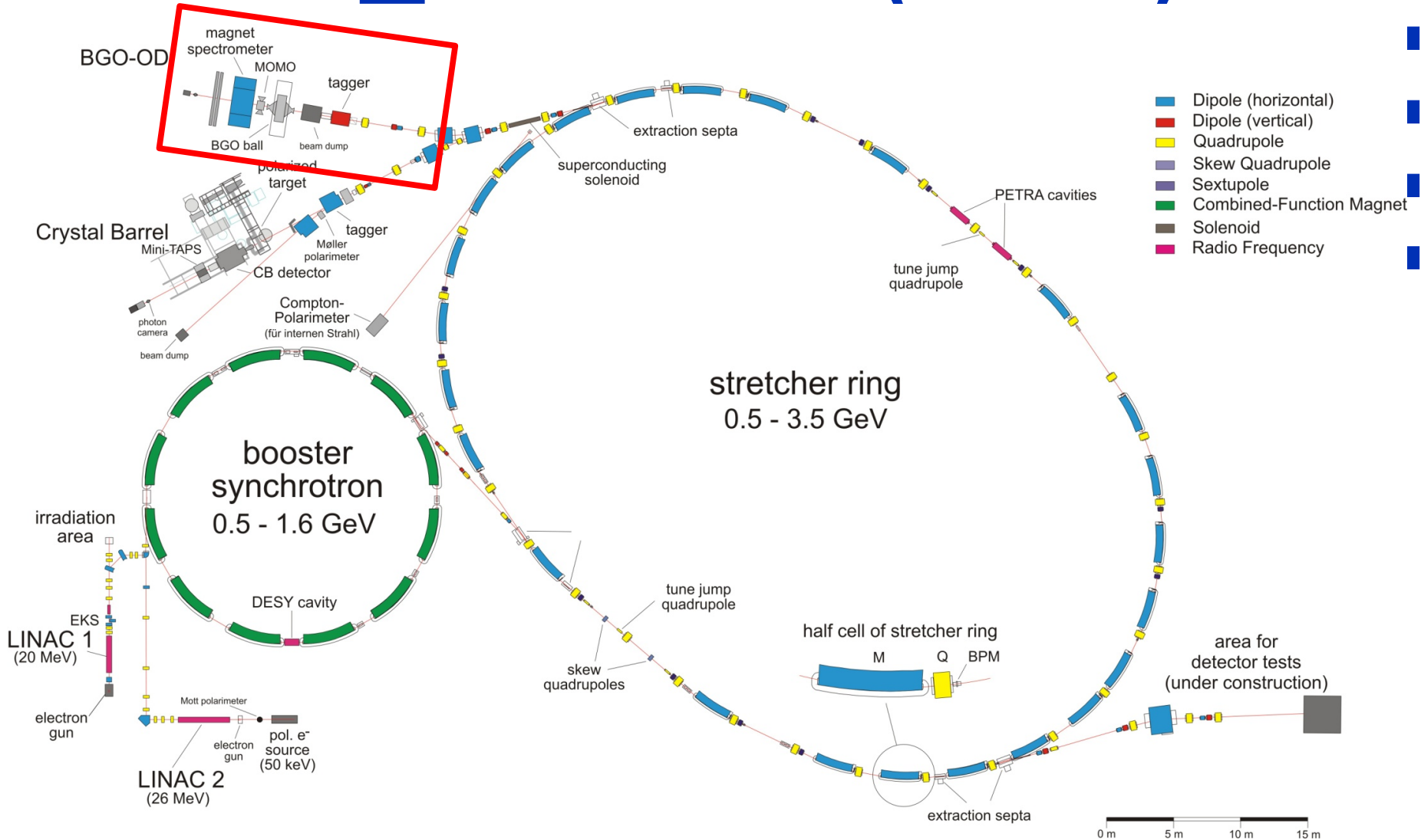
Supported by the DFG / TR-16

- ELSA / BGO-OD Experiment
- Physics program
- Commissioning results

Meson 2014, Krakow, 29.05.2014

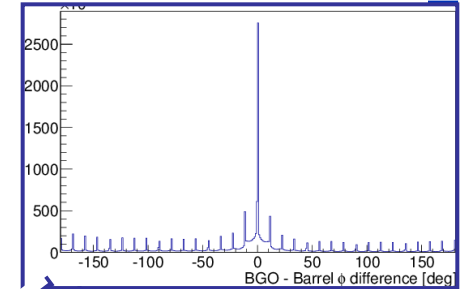
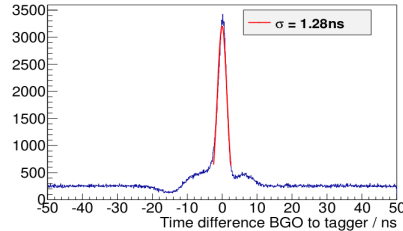


Electron Stretcher Accelerator (ELSA)



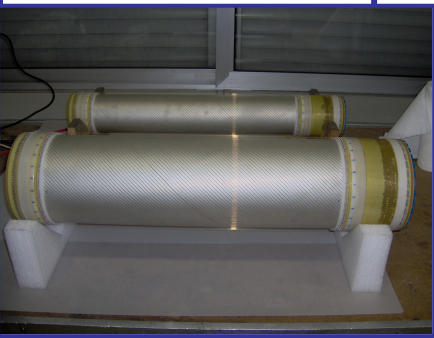
BGO-OD Experiment

BGO calorimeter
 Bismuth germanate
 480 crystals, $0.9 \times 4\pi$
 $\theta_{\text{lab}} = 25^\circ, \dots, 155^\circ$,
 trigger logic, sADC



32 strip
 scintillator
 Barrel, charge id

MWPC
 inner tracking
 2 layers,
 $\theta_{\text{lab}} = +8^\circ, \dots, 163^\circ$,
 $\Delta\phi = 2^\circ$,
 $\Delta z = 300\mu\text{m}$



Target system
 LH_2 , LD_2

Tagging system
 120 scintillator bars,
 $10\%, \dots, 90\% E_{\text{beam}}$

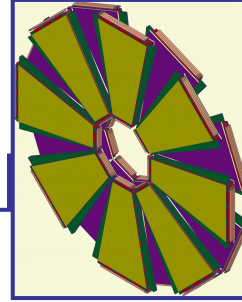
Goniometer with radiators
 → tools for lin. pol. beam:
 Working
 → tools for circ. pol. beam:
 In preparation

BGO-OD Experiment

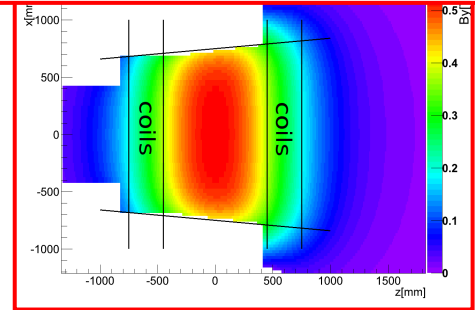


ToF, ~3m x 3m,
2 walls ~500ps
2 walls ~250ps

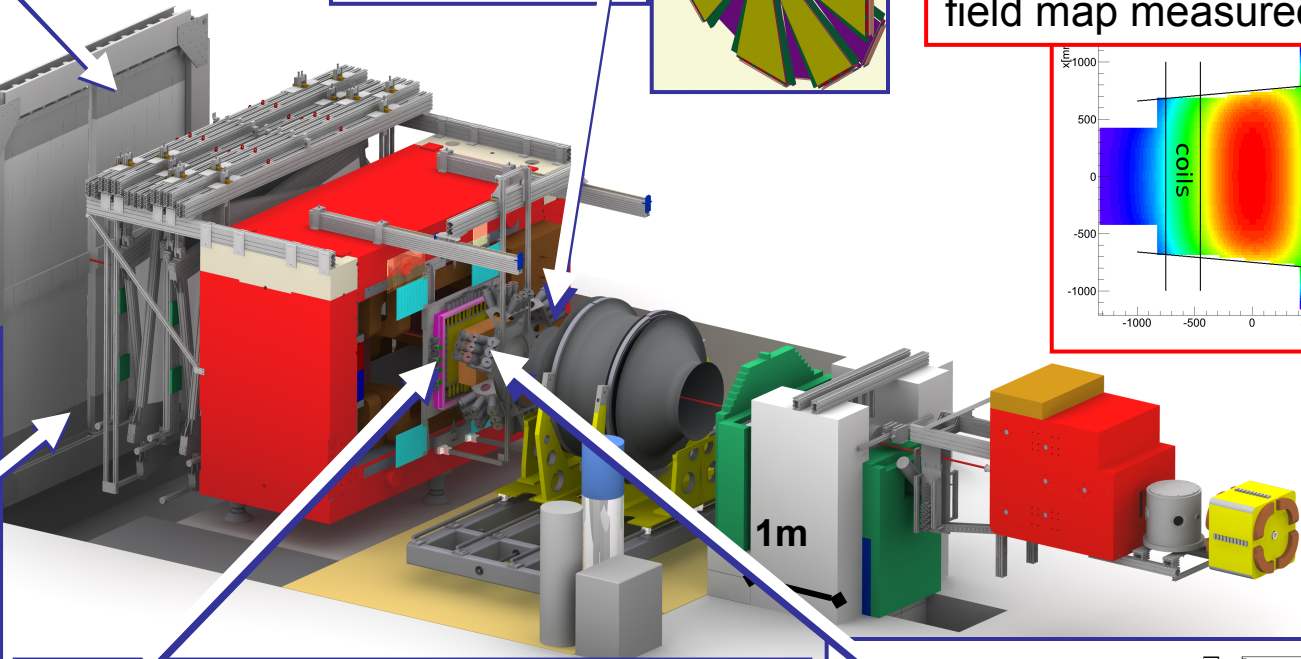
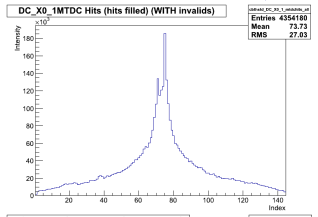
MRPC, 480ch
 $\theta_{lab} = 8^\circ - 25^\circ$,
~50ps



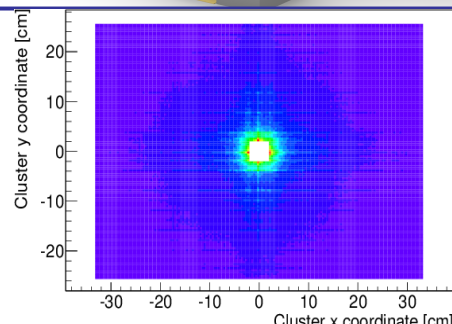
Open Dipole magnet, 94 t,
 $\theta_{vert,max} \approx 8.2^\circ$, $\theta_{hori,max} \approx 12.1^\circ$,
 $2.2 \times 3.9 \times 1.5 \text{ m}^3$, $B_{max} \approx 0.5 \text{ T}$,
permanent loan from DESY
field map measured at GSI



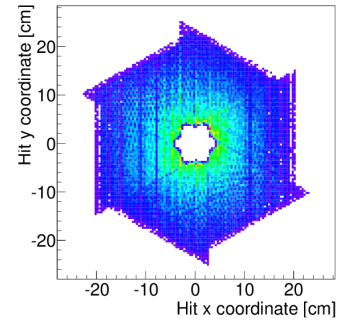
Drift chambers,
8 double layers
in 4 orientations,
res. $\approx 300 \mu\text{m}$



SciFi2 detector,
640 scint. fibres,
 $\varnothing_f = 3 \text{ mm}$,
 $66 \times 51 \text{ cm}^2$,
v- & h-plane



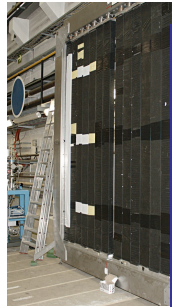
MOMO,
672 scint. fibres,
 $\varnothing_f = 2.5 \text{ mm}$,
 $\varnothing 44 \text{ cm}$
3 layers, 6 mod.



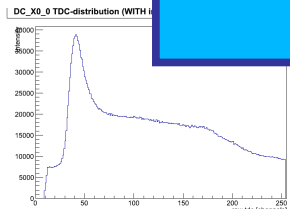
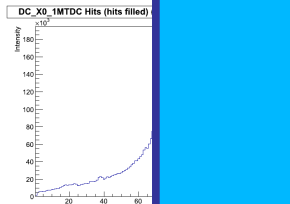
Investigation of low t processes

Optimised for the detection of mixed final states

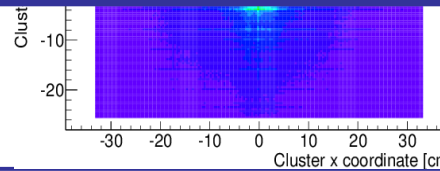
charged and neutral



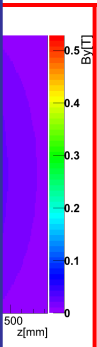
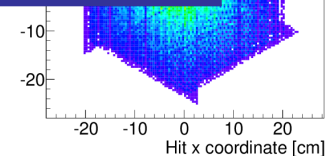
Drift chamber
8 double
in 4 orientations
res. ≈ 300



$\varnothing_f = 3$ mm,
66x51cm²
v- & h-plane

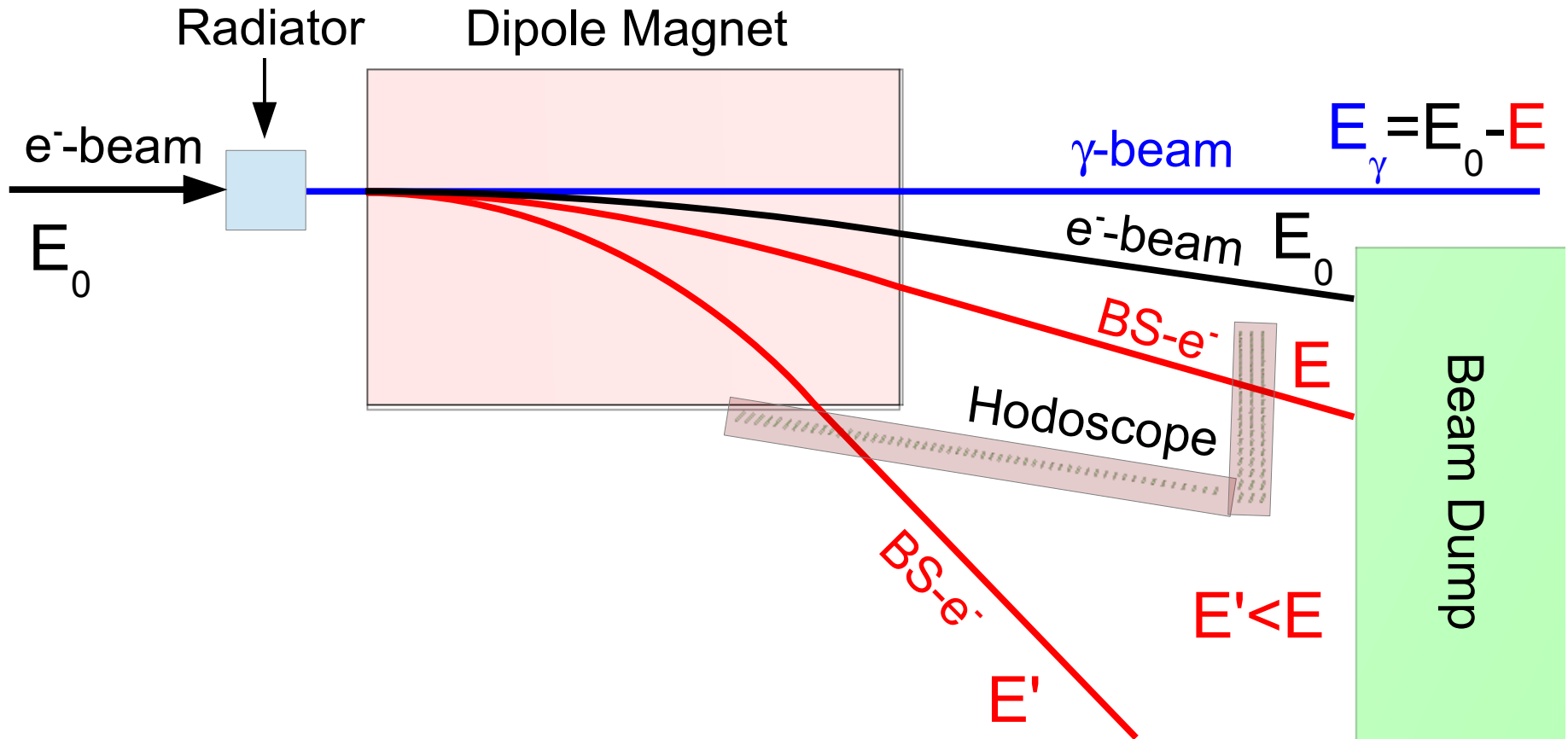


$\varnothing_f = 2.5$ mm,
 \varnothing 44cm
3 layers, 6 mod.

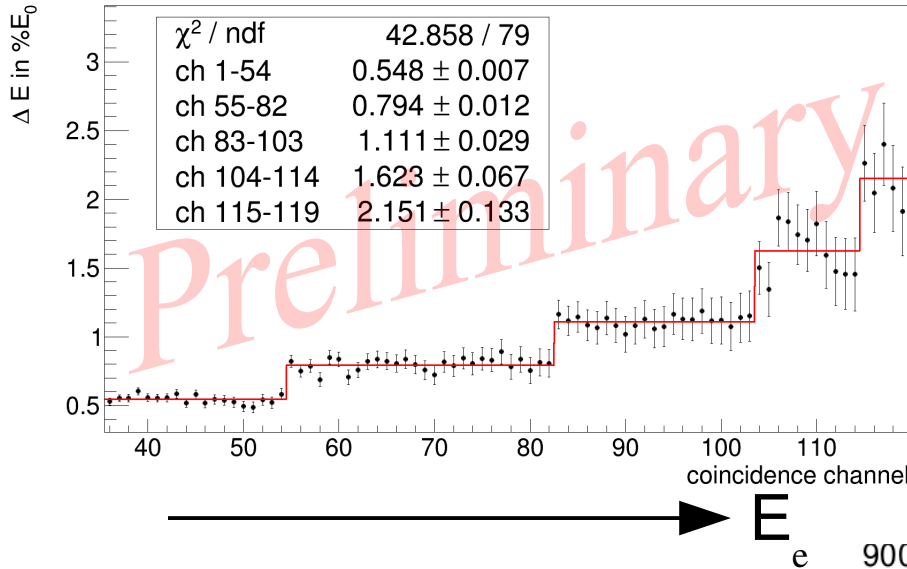


- Strangeness photoproduction:
 - K^0 , K^+ t-channel exchange mechanism
 - Search for missing Σ states
 - Investigation of $\Lambda(1405)$
- Vector meson photoproduction:
 - Cross section (3 GeV) and beam asymmetry (1.7 GeV) for ω and ϕ photoproduction
- η mesic states and η -nucleus potential
- η and η' photoproduction:
 - Beam asymmetry up to 1.7 GeV

Tagging principle

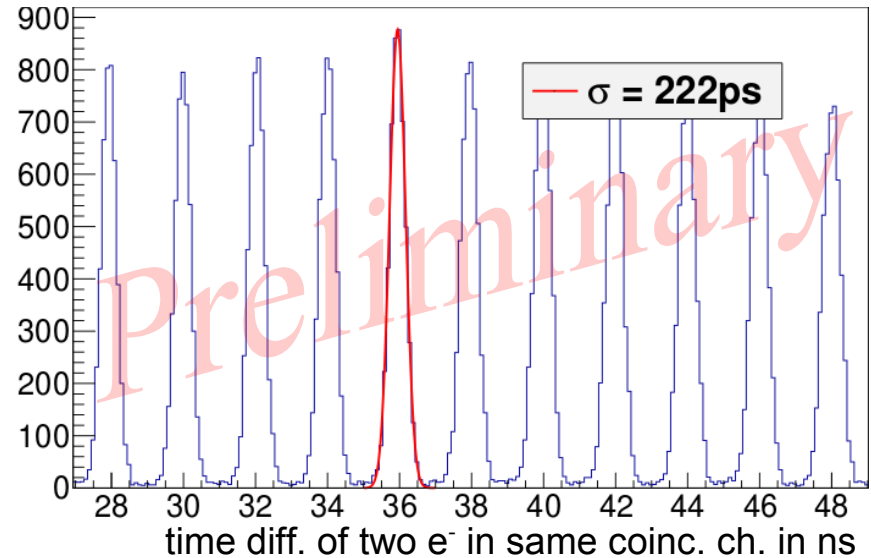


Photon tagger



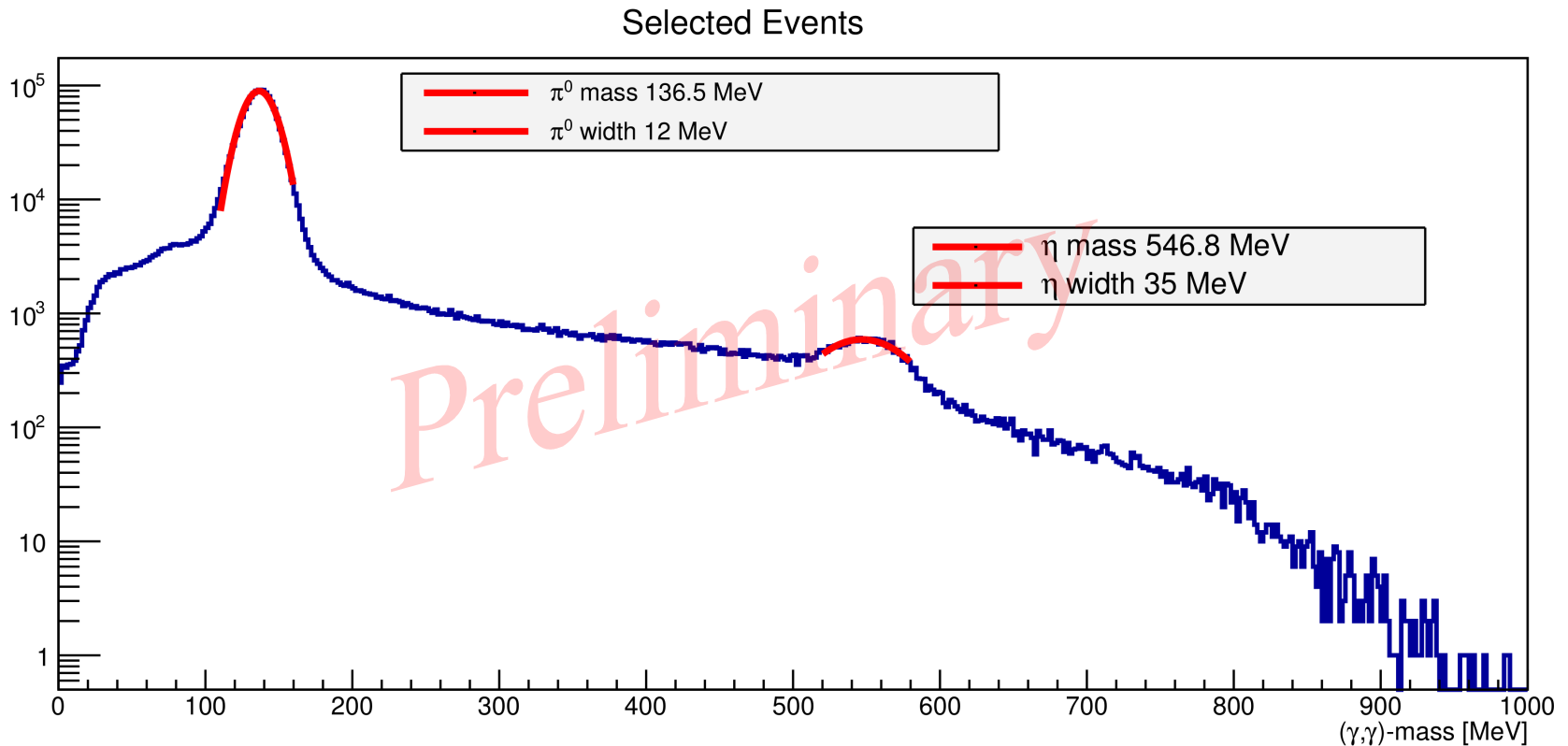
- Energy width between $0.55\%E_0$ and $2.15\%E_0$
- SciFi detector in front of the tagger planned

- Accelerator bunches every 2ns
- Bunch length < 80ps
- Bunch selection → event timing better than 80ps

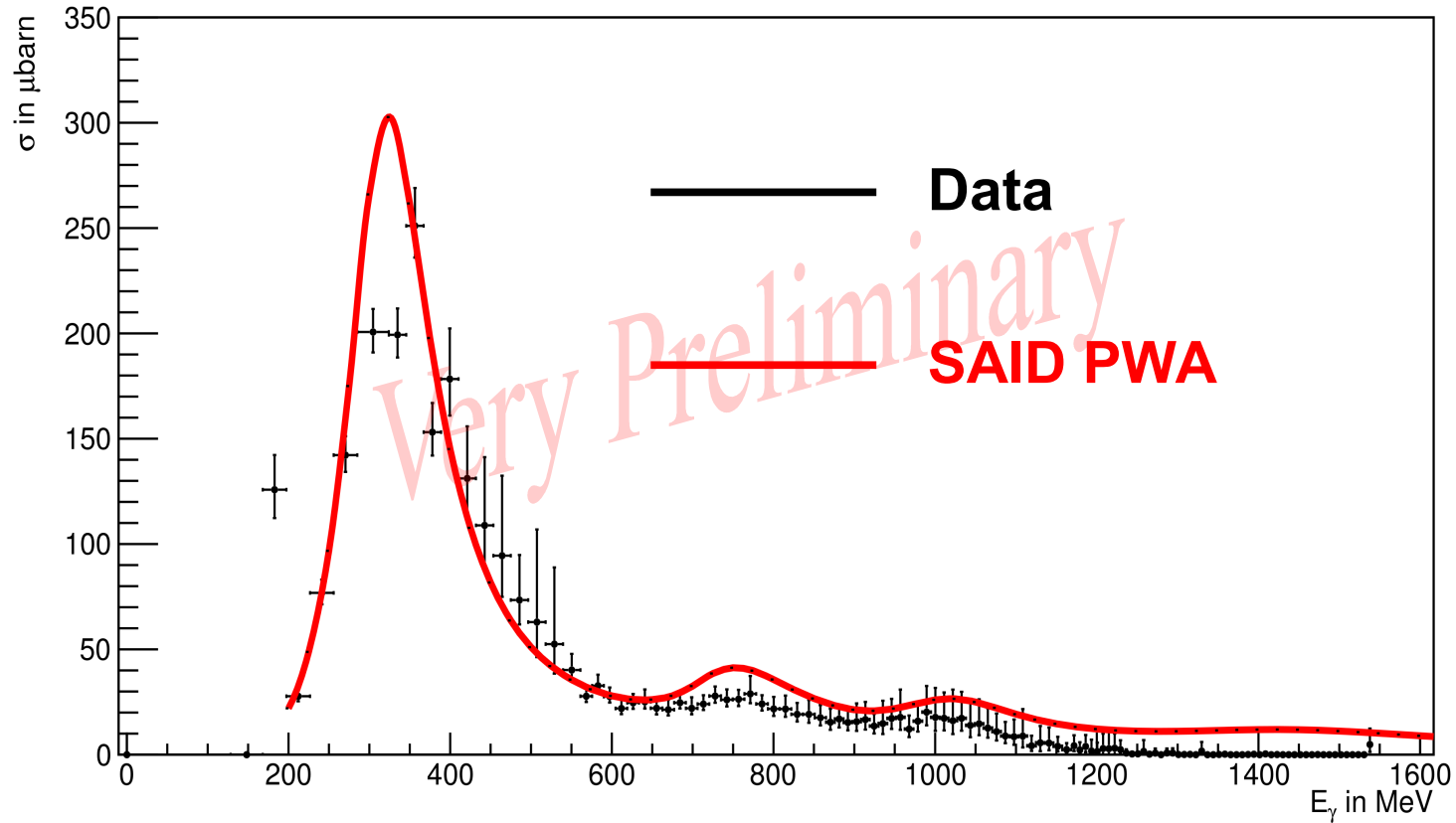


Neutral meson detection with the BGO ball

- 2γ invariant mass
- Pre-calibration with sodium source



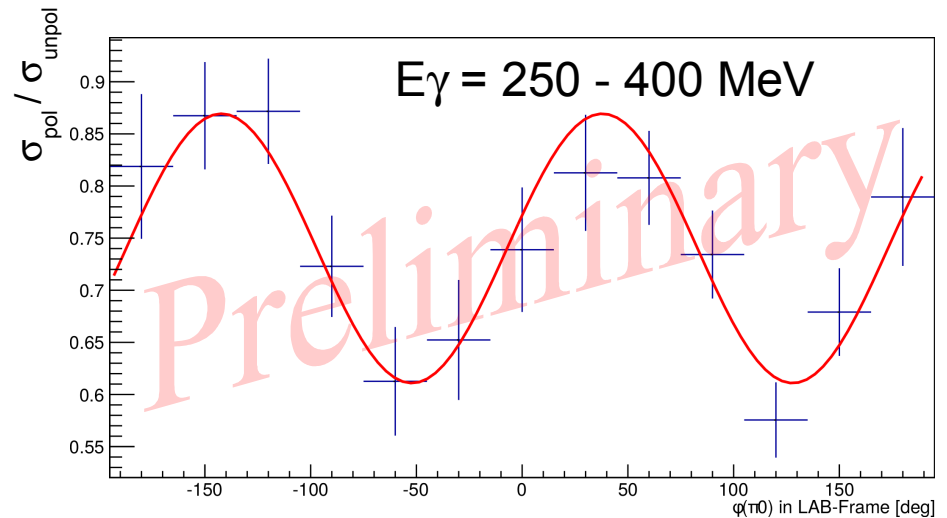
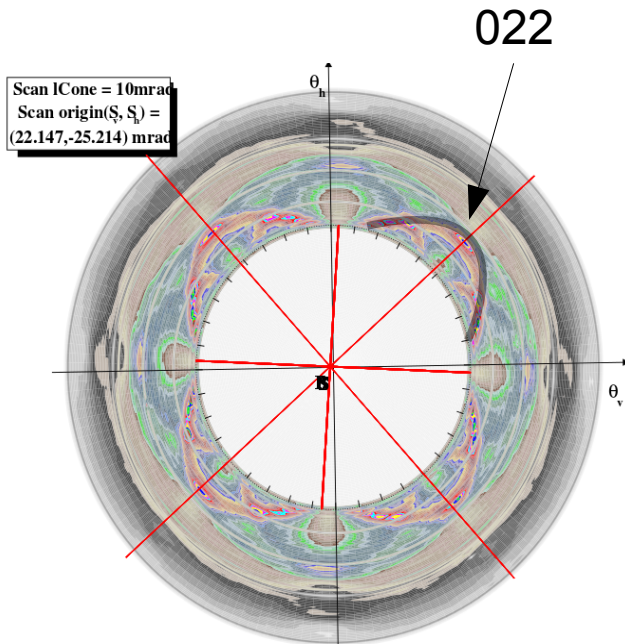
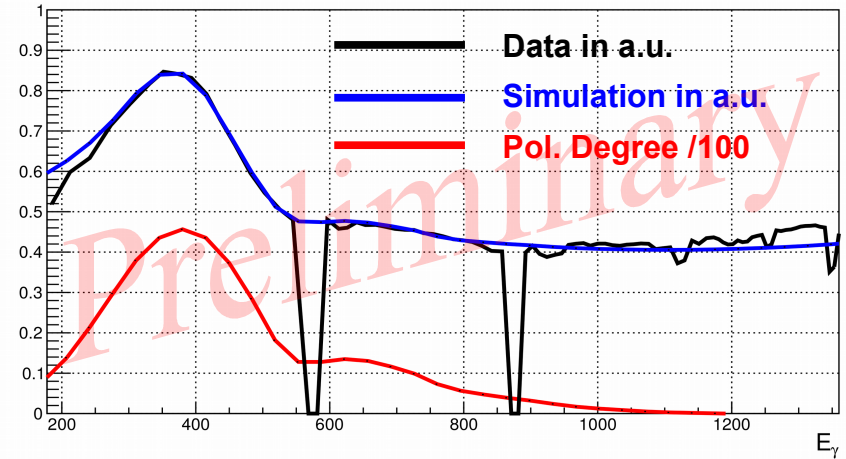
Absolute cross section



- Analysis performed within two Bachelor theses, M. Bleckwenn and D. Geffers

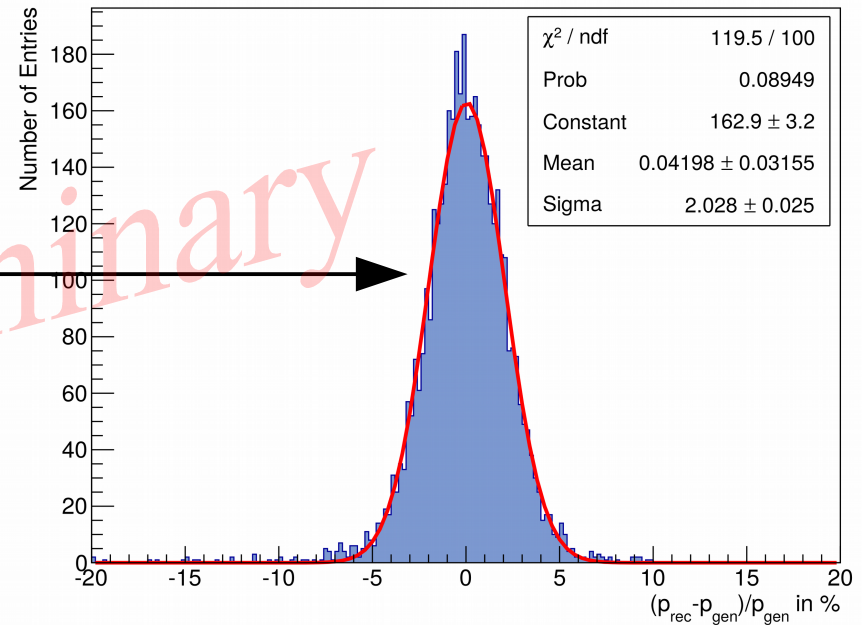
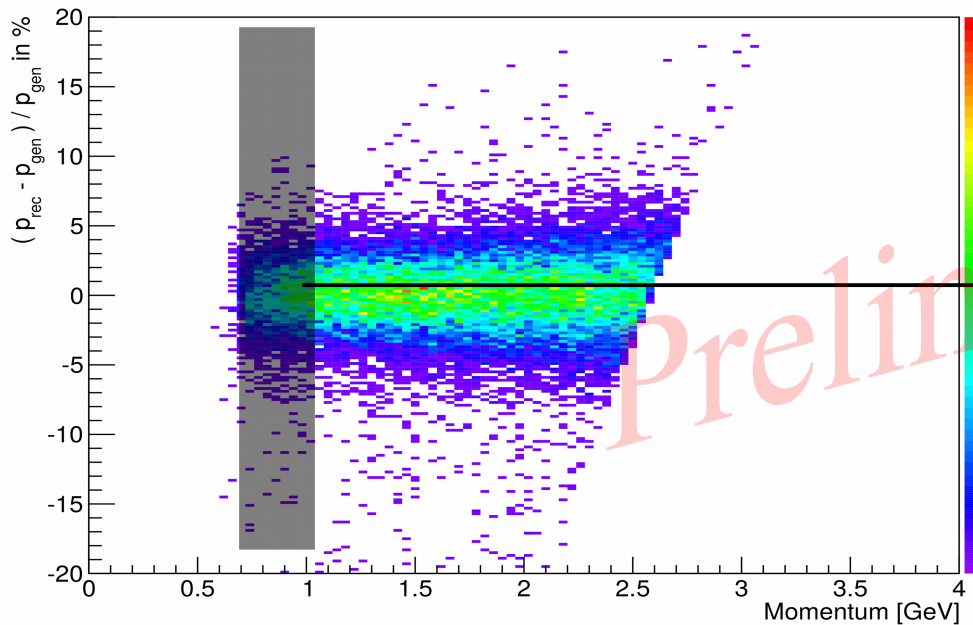
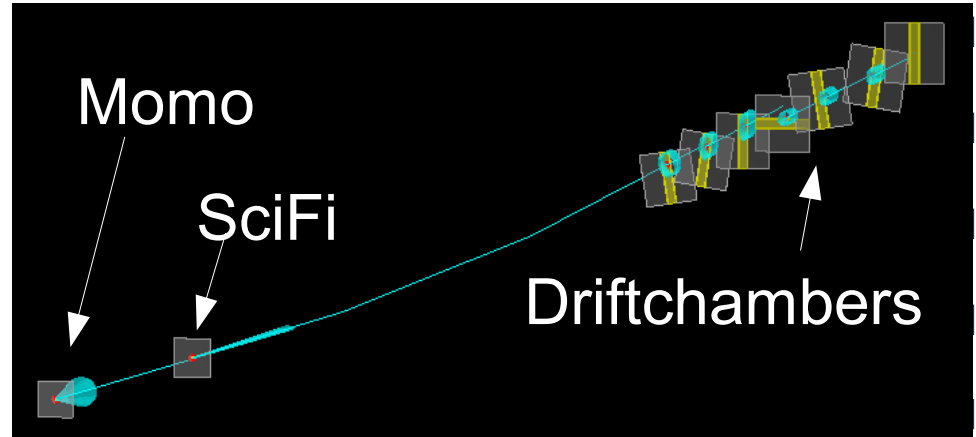
First test with linearly polarised photon beam

- Diamond radiator → coherent BS
- Fit to BS spectrum → extract degree of polarisation
- Beam asymmetry Σ for $\gamma p \rightarrow p \pi^0$



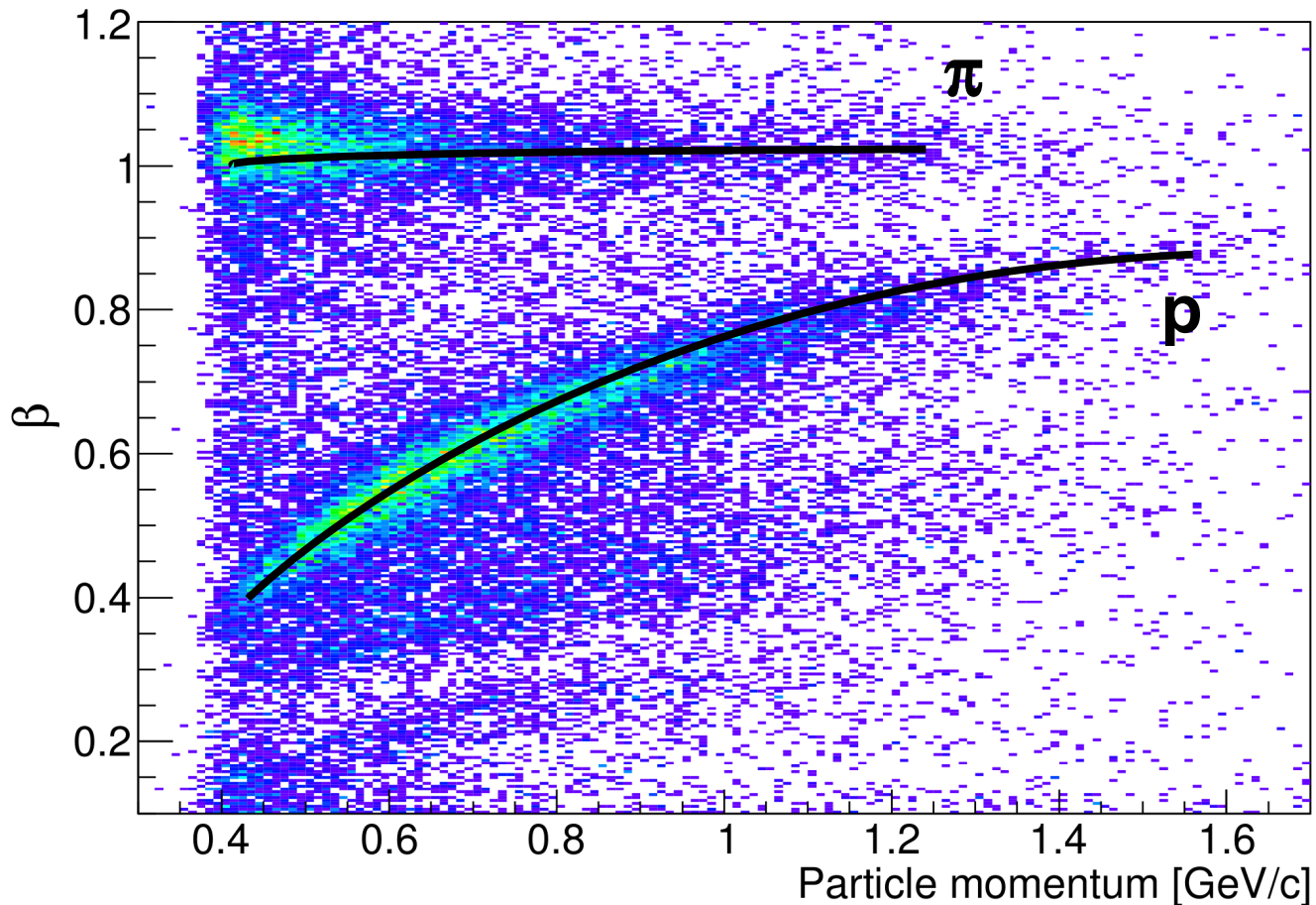
Momentum reconstruction

- GenFit developed within Panda, C++ library
- Automatic energy loss correction
- Multiple scattering

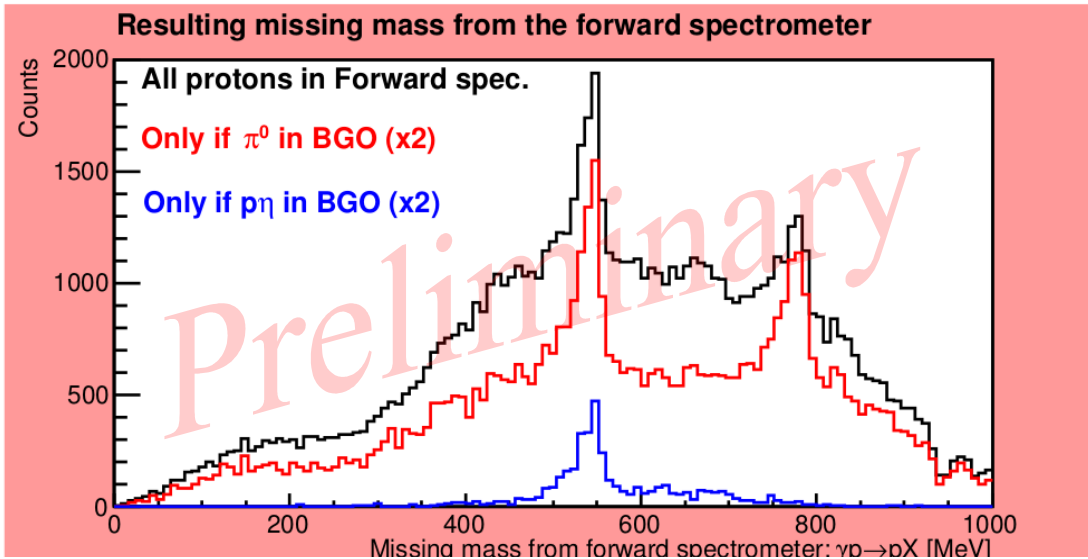


Particle ID in the forward spectrometer

- Combine reconstructed tracks and momentum with time from ToF
- Track time \rightarrow velocity

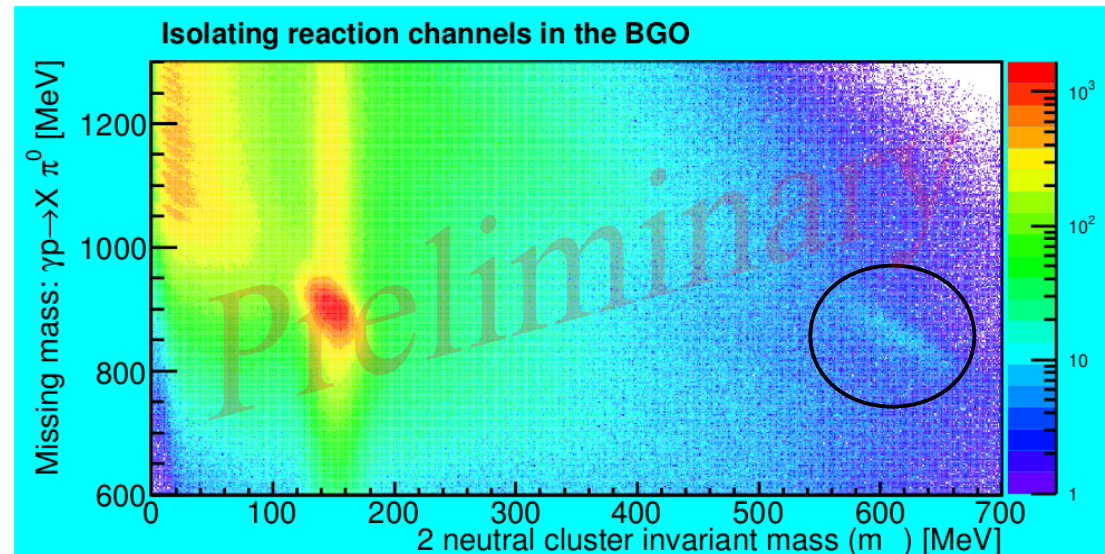


Missing mass from detected protons in the forward spectrometer



- Detected proton in forward spectrometer
- Combine forward spectrometer with tagger and central detector

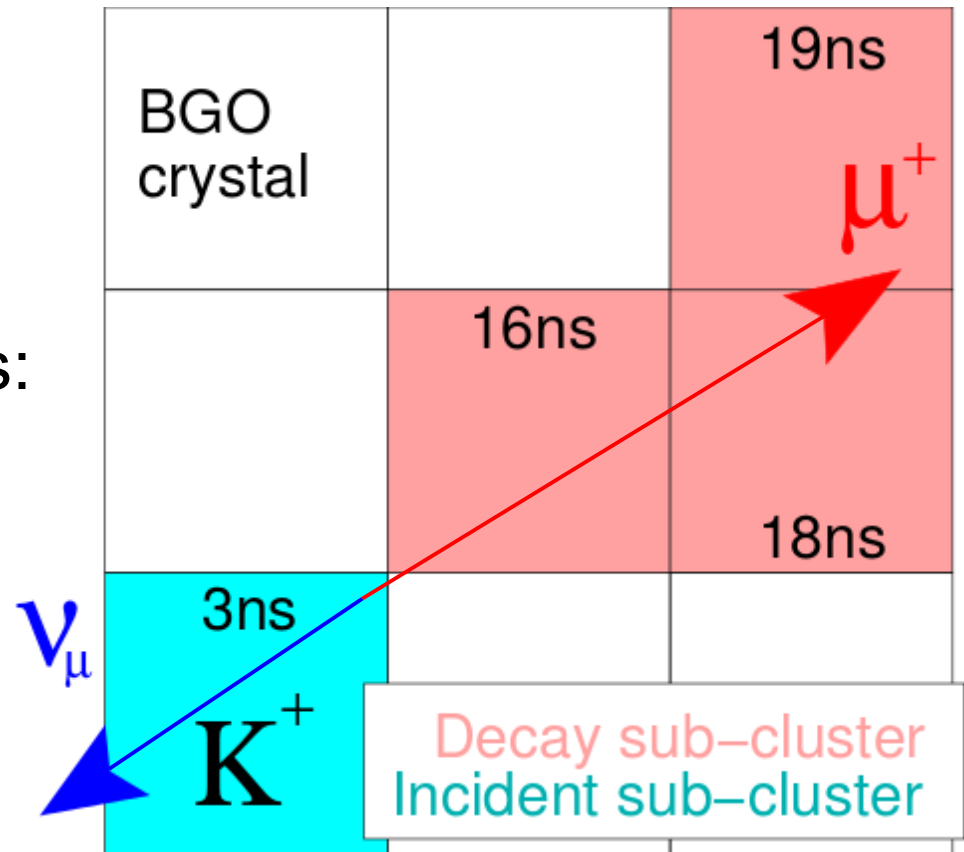
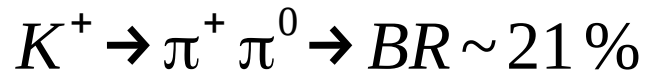
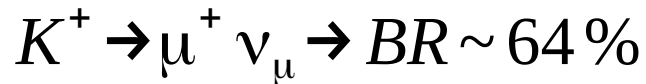
- 2γ invariant mass
- No charged particle ID
- Including tagged photon energy



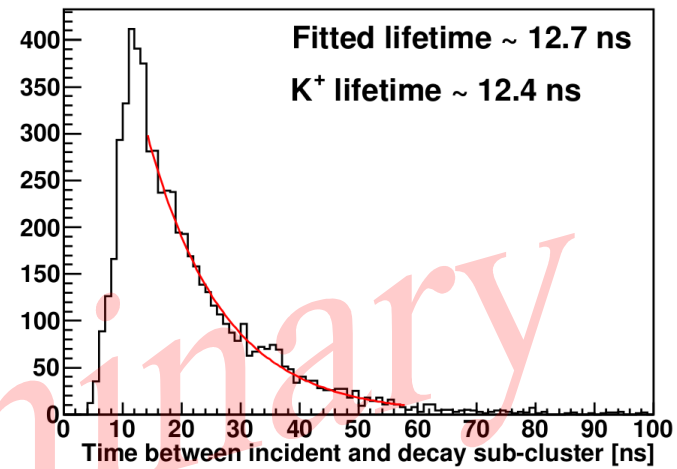
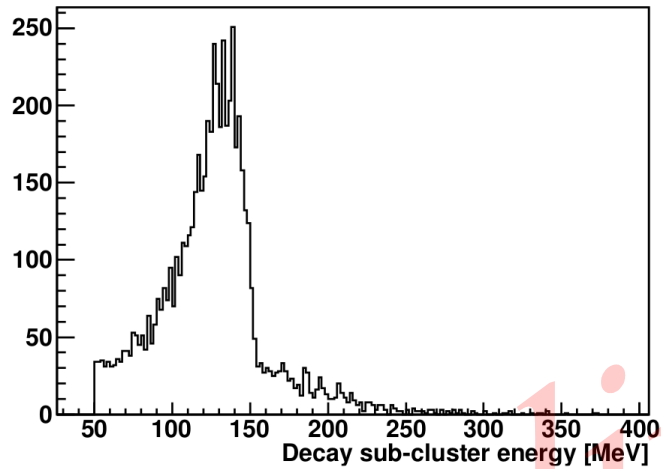
K⁺ identification with BGO ball

- Technique developed and proven by T. Jude with the Crystal ball at Mainz

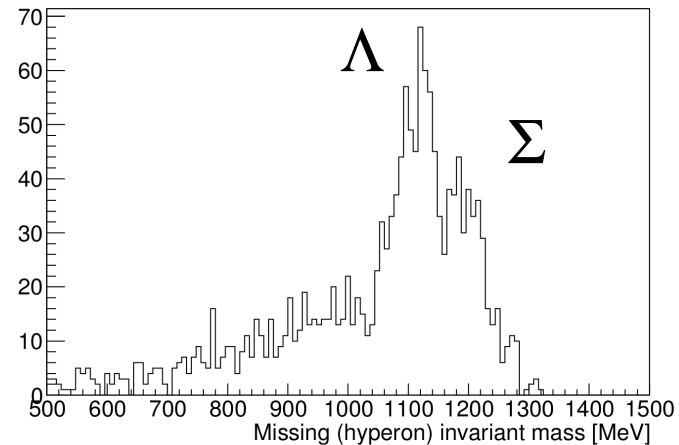
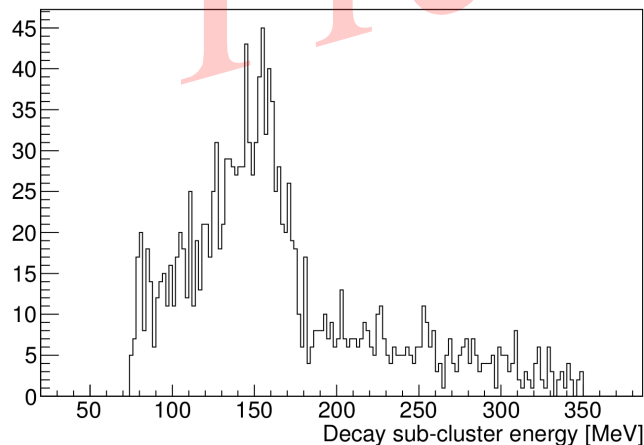
- Life time 12ns
- Two main decay modes:



Simulated Data

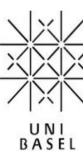


Experimental Data



Summary

- BGO-OD – a unique experiment complementary to CBarrel, CBall, CLAS, LEPS, GRAAL
 - Identify complicated mixed charged final states
 - Sensitive to low t processes
- Strangeness (K^0 , K^+), vector (ω , ϕ), pseudoscalar (η , η') meson photoproduction
- Meson reconstruction over large solid angle
- High resolution in momentum reconstruction at forward angles
- Linearly and circularly polarised incident photon beams
- Commissioning almost done, first data taking in July



- **Physikalisches Institut, Bonn, Germany**
- **Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany**
- **Justus-Liebig-Universität Gießen, II. Physikalisches Institut, Gießen, Germany**
- **INFN sezione di Pavia, Pavia, Italy**
- **INFN sezione di Roma, Rome, Italy**
- **Istituto Superiore di Sanità, Rome, Italy**
- **INFN sezione Catania, Catania, Italy**
- **Università degli Studi di Messina, Messina, Italy**
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- **Petersburg Nuclear Physics Institute, Gatchina, Russia**
- **Russian Academy of Sciences Institute for Nuclear Research, Moscow, Russia**
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