Mitglied der Helmholtz-Gemeinschaft

Status of PANDA

Oct. 5th 2011 8th International Workshop on Heavy Quarkonium 2011 Jim Ritman

Overview

Summary of PANDA physics potential

Facility

- FAIR
- PANDA

Charmonium Benchmark Channels

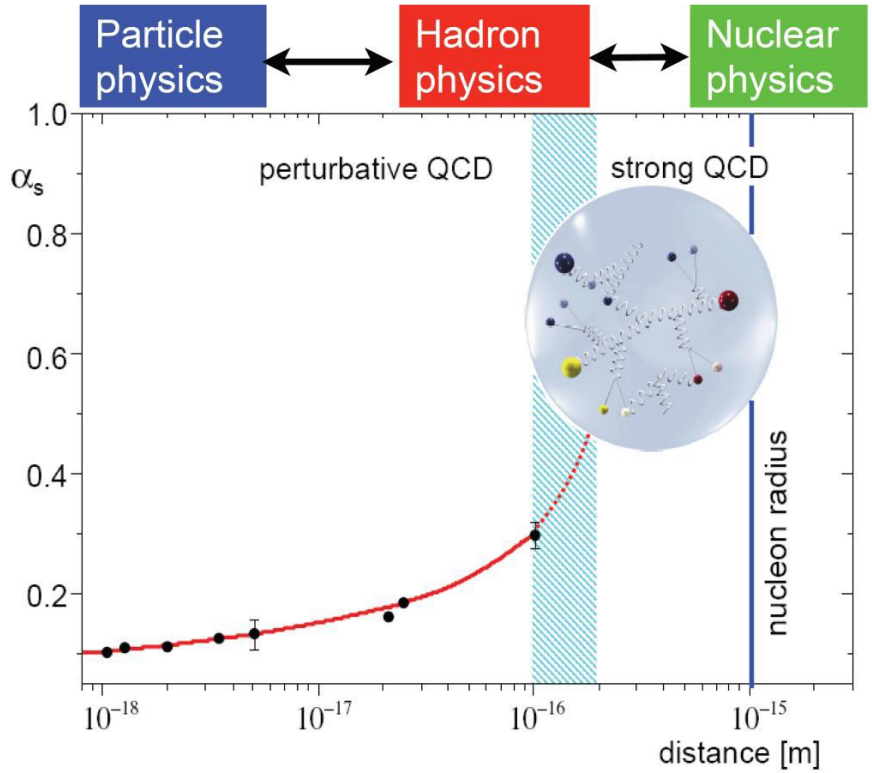
- $\eta_c \rightarrow \phi\phi \rightarrow K^+K^- K^+K^-$
- $\Psi(3770) \rightarrow D^+D^-$
- X(3872)

Width Determination of the $D_{s0}^*(2317)$

Conclusions

Summary of PANDA physics potential

- Confinement
  Why are there no free quarks?
- Hadron mass
  Where is the mass of the proton coming from?
- Are there other color neutral objects?
- What is the structure of the nucleon?
- What are the spin degrees of freedom?



Summary of PANDA physics potential

Meson spectroscopy:

- D mesons
- charmonium
- glueballs, hybrids, tetraquarks, molecules

Charmed and multi-strange baryon spectroscopy

Electromagnetic processes ($\bar{p}p \rightarrow e^+e^-$, $\bar{p}p \rightarrow \gamma\gamma$, Drell-Yan)

Properties of single and double hypernuclei

Properties of hadrons in nuclear matter

FAIR Facility

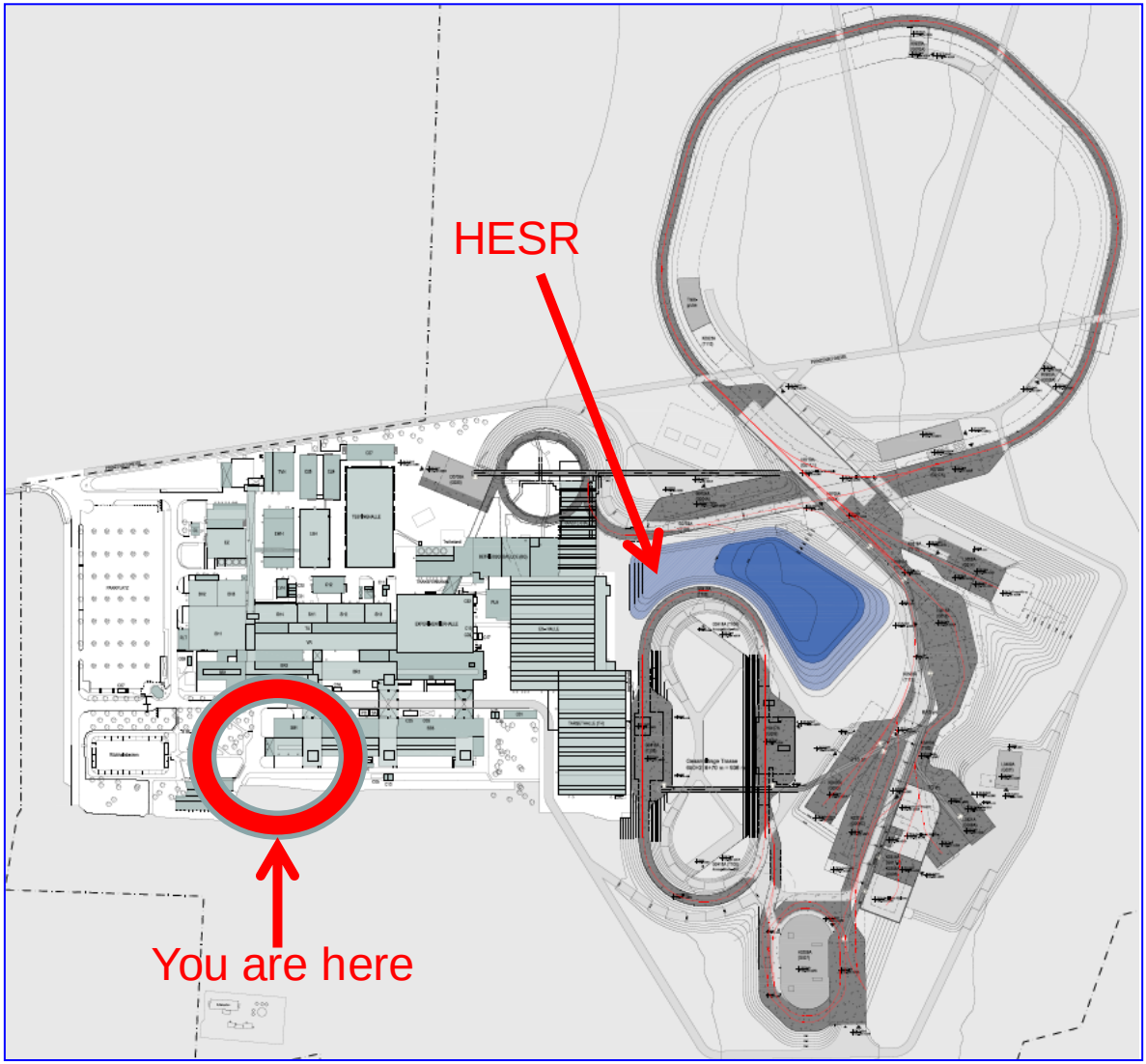
FAIR → L. Schmidt's talk on Oct. 4th

Founding of FAIR: Oct. 2010

Submission of building permits: Aug. 2011

Financing of HESR Jun/Oct 2011

(RESR !)

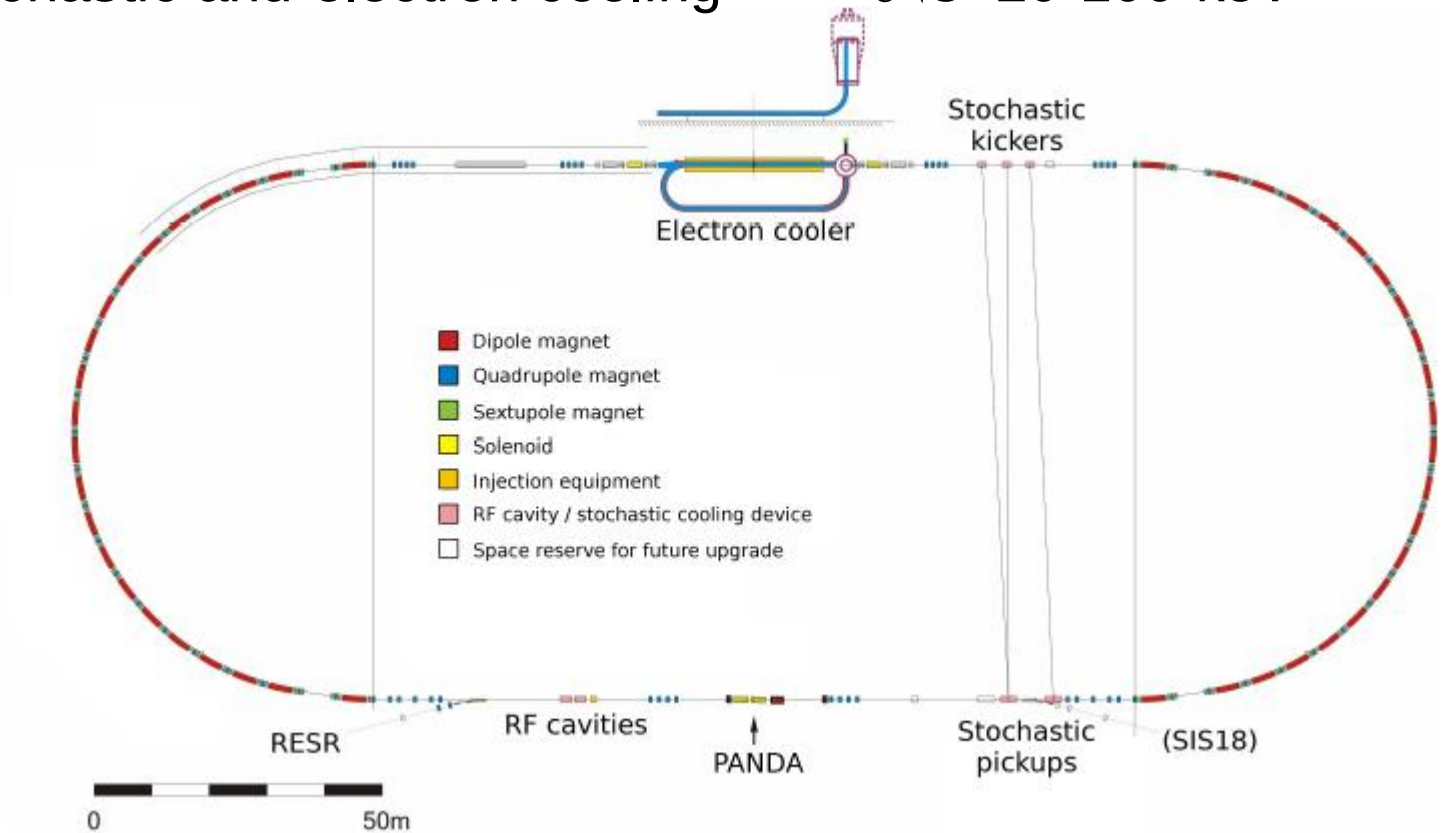


HESR

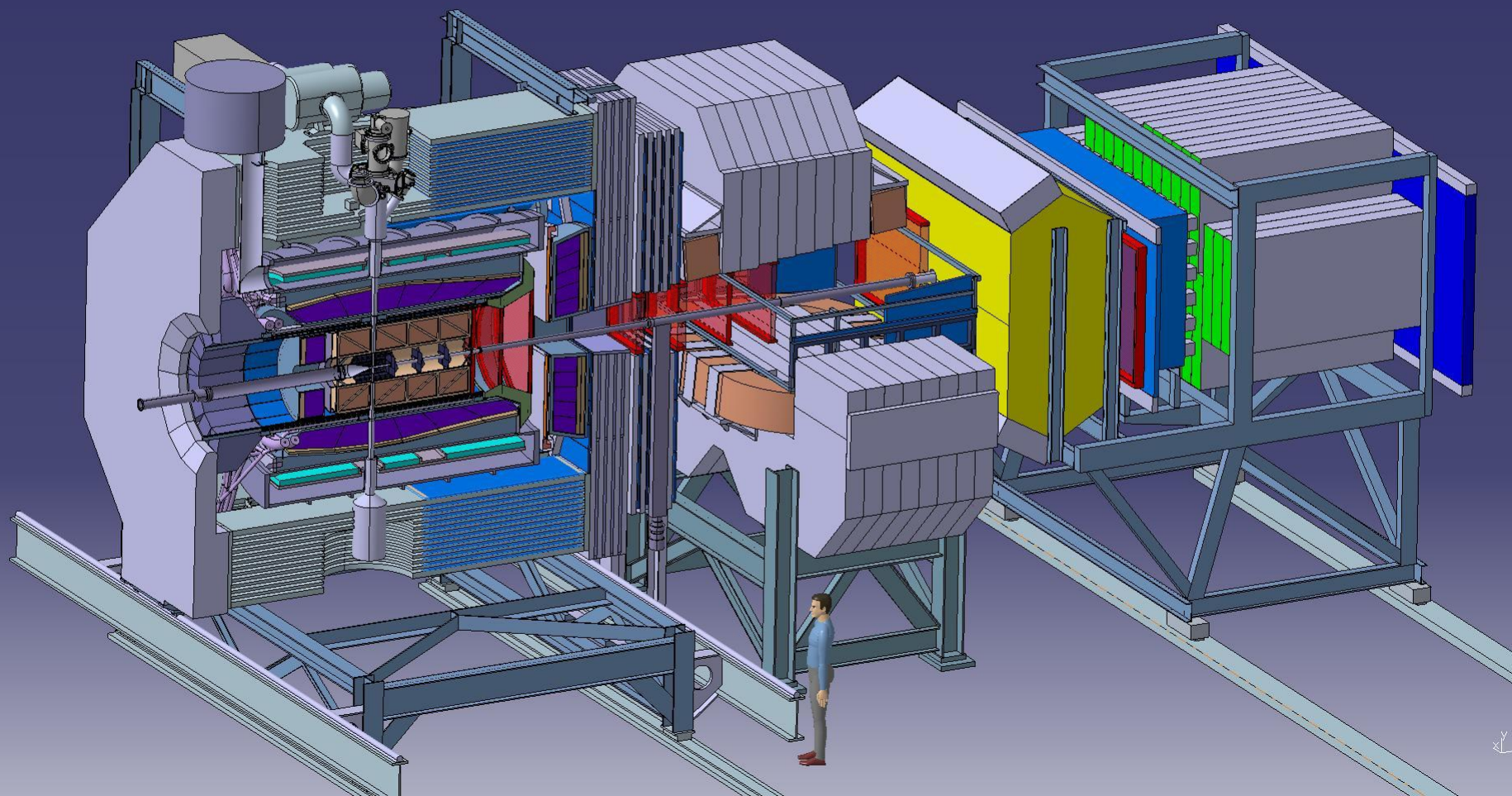
10^{11} Antiprotons from 1.5-15 GeV/c, fixed target $L=10^{32}$

(Initially without RESR, stacking in HESR)

Stochastic and electron cooling $\delta\sqrt{s}$=20-100 keV



PANDA

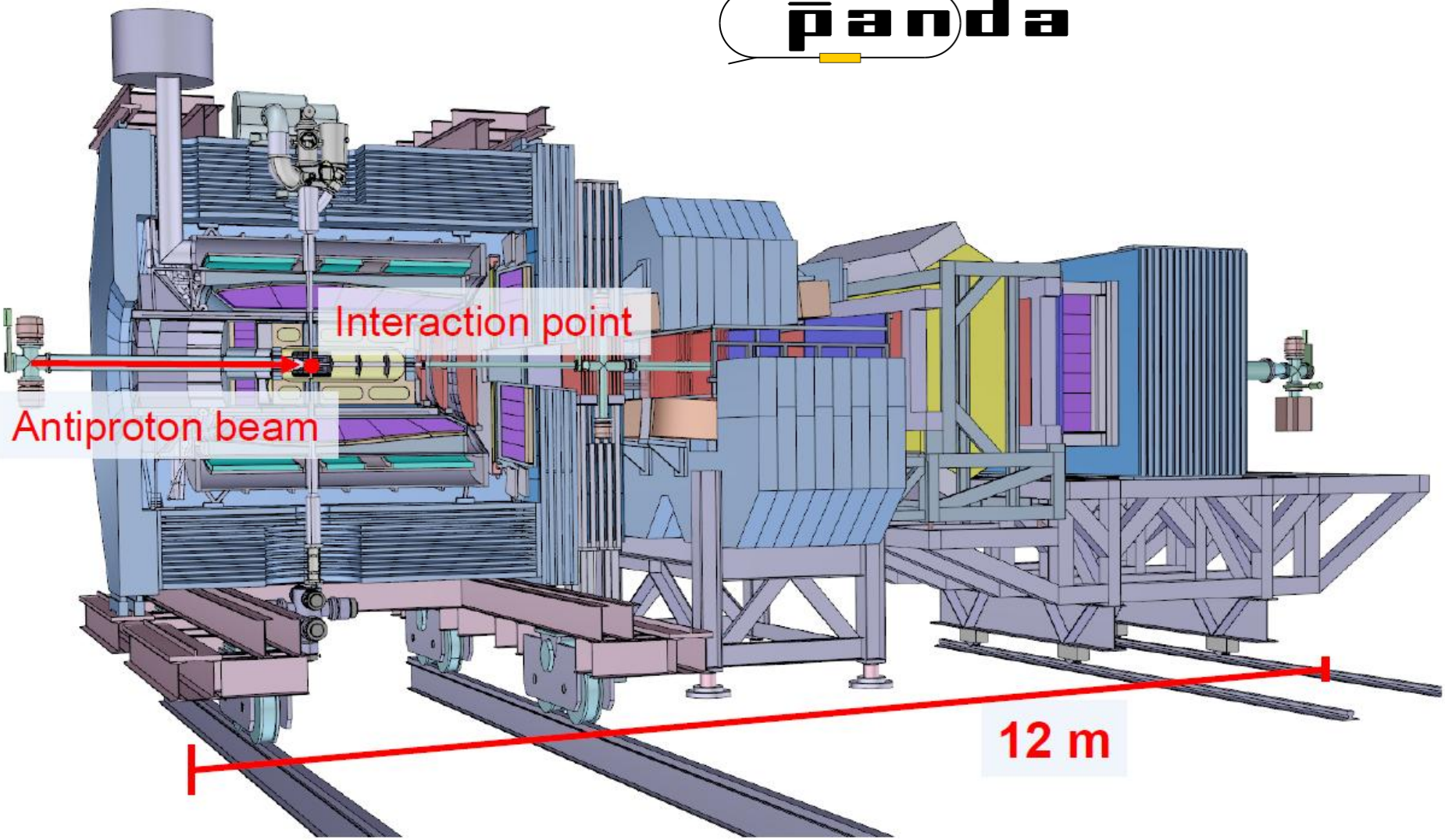


$\bar{P}$ANDA Spectrometer

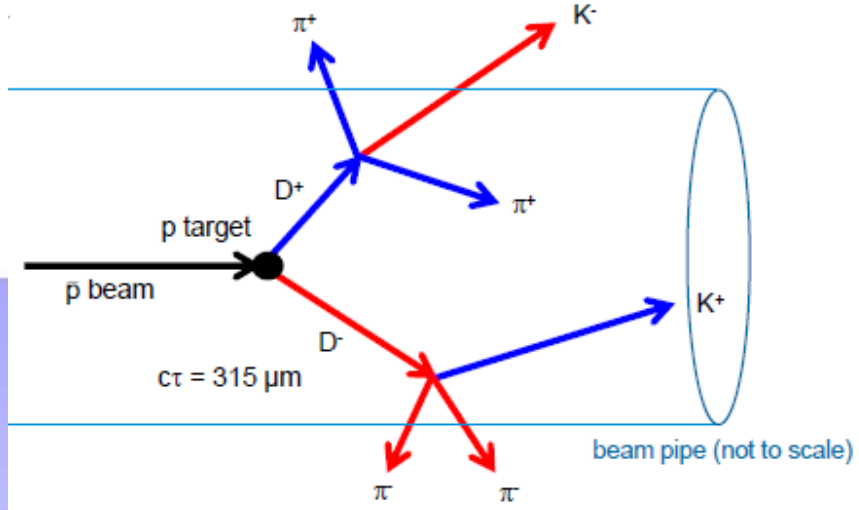
Detector requirements:

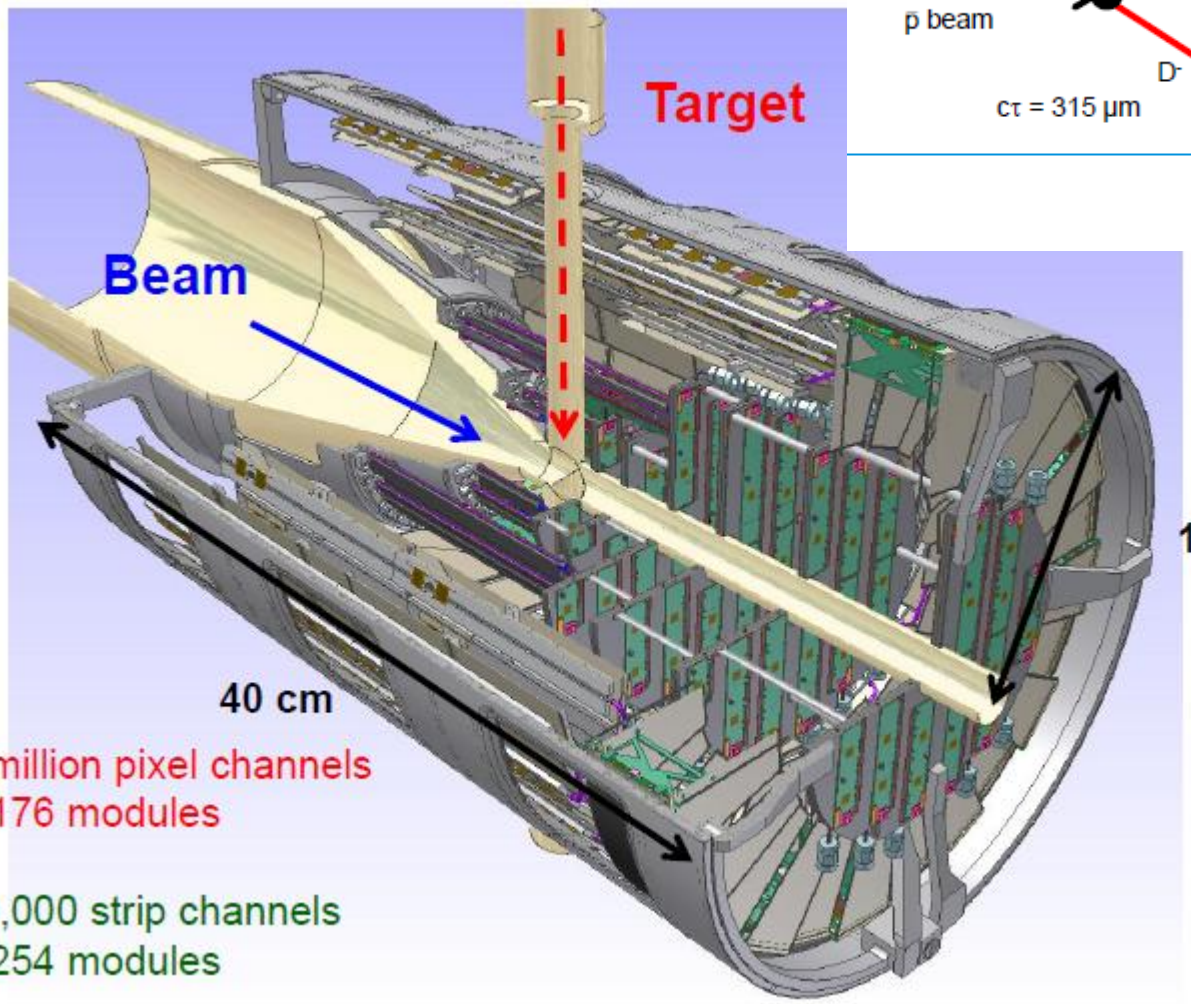
- 4π coverage (partial-wave-analysis)
- high rates (2×10^7 annihilations/s)
- good PID (γ, e, μ, π, K, p)
- momentum res. (~1%)
- vertexing für D, K^0_S, Λ ($c\tau$ = 123 μm for D^0, p/m ≈2)
- efficient trigger (e, μ, K, D, Λ)
- no hardware trigger (raw data rate ~TB/s)

PANDA Spectrometer



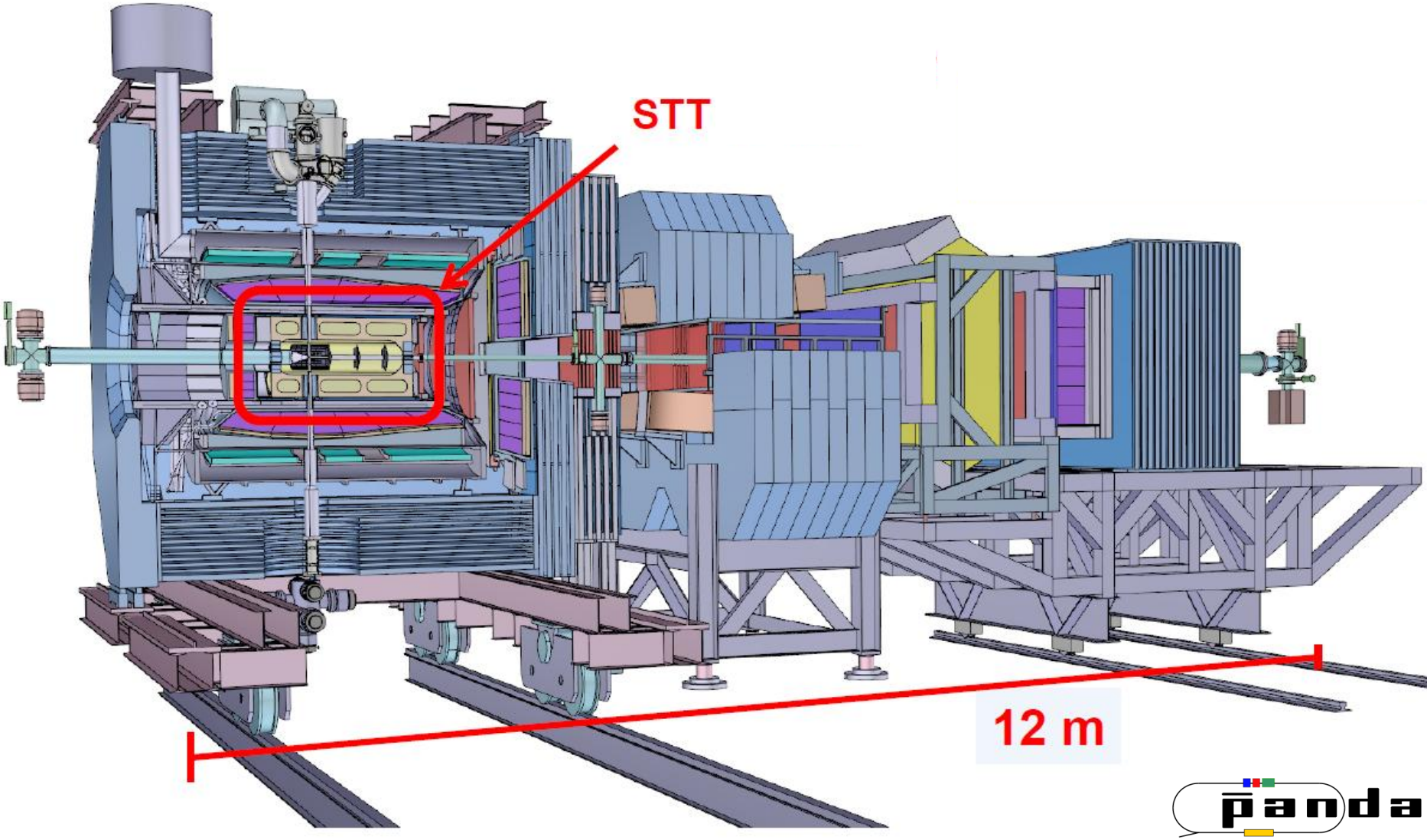
Micro-Vertex-Detector



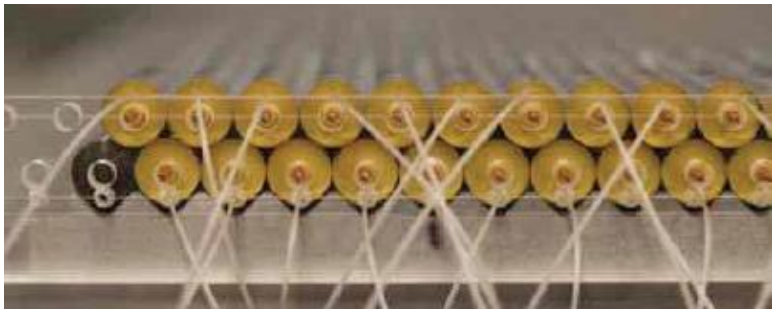


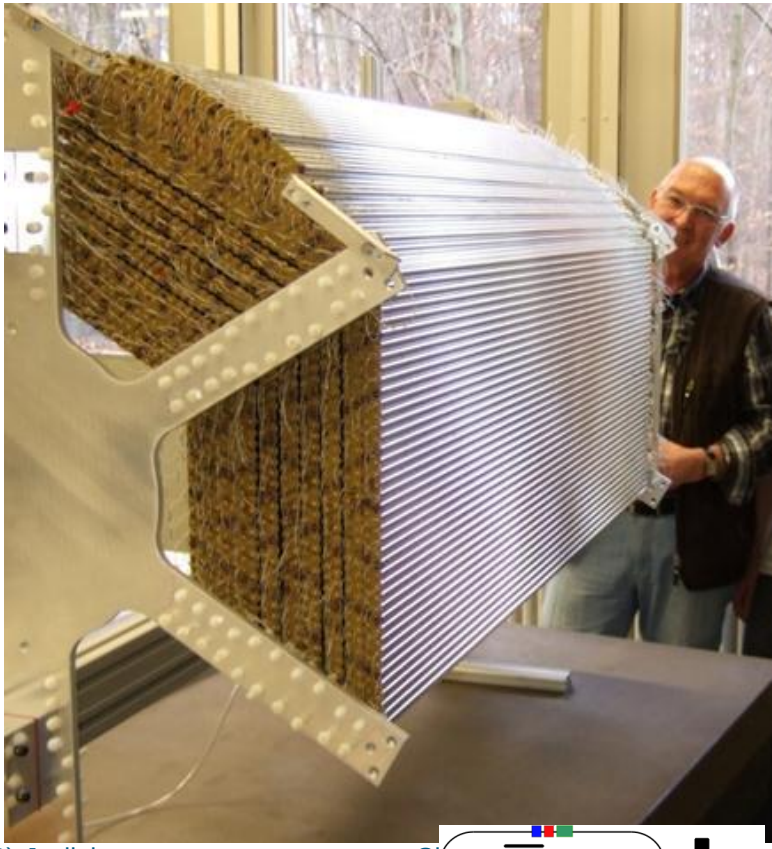
- 10 million pixel channels on 176 modules
- 200,000 strip channels on 254 modules

Central Tracker



Central Tracker





Low mass, X/X_0~1%

- 1.5 kg Straw tubes (4580×2.5g)
  - Close-packed layers
  - pressurized p=2bar
- 9 kg Mechanical frame
- $\sigma_{r\phi}$ ~ 150 μm, σ_z ~ 2.9 mm
- σ_p ~ 1% at B = 2 Tesla
- dE/dx (~8%) measurement for PID

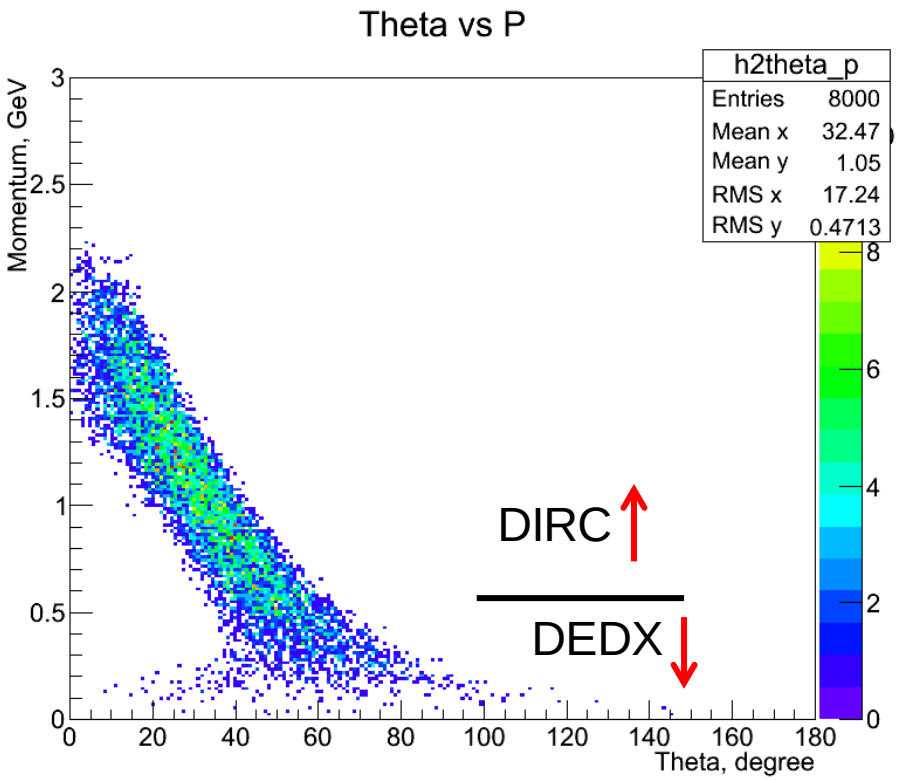
Simulations of Charmonium Benchmark Channels

Performance Simulations for $\eta_c \rightarrow \phi\phi \rightarrow K^+K^- K^+K^-$

Benchmark channel to study kaon tracking performance
MC-PID

P_{beam} = 3.677 GeV/c

BR = 0.0027×0.5×0.5

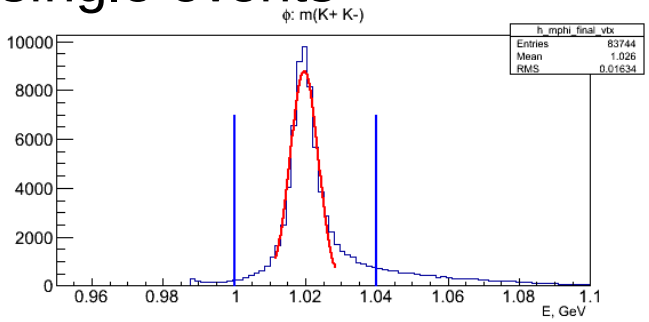


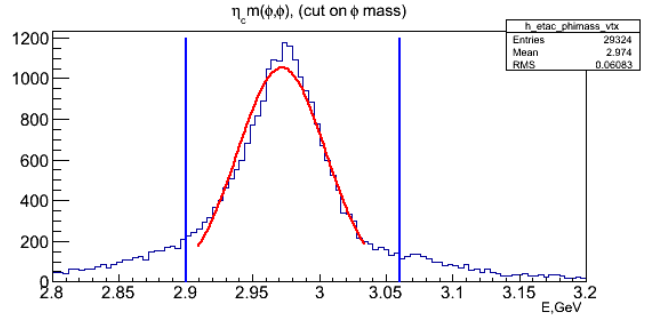
D. Melnychuk, Warsaw

Performance Simulations for $\eta_c \rightarrow \phi\phi \rightarrow K^+K^- K^+K^-$

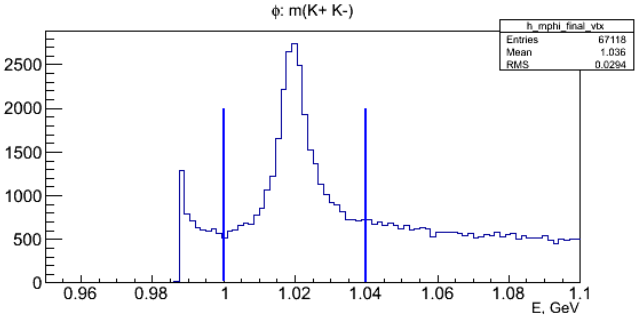
Invariant mass distributions

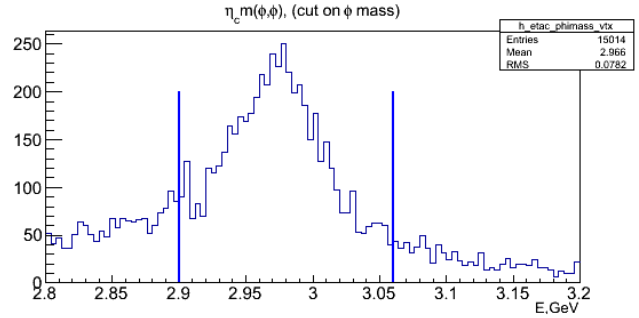
single events





20 MHz Rate





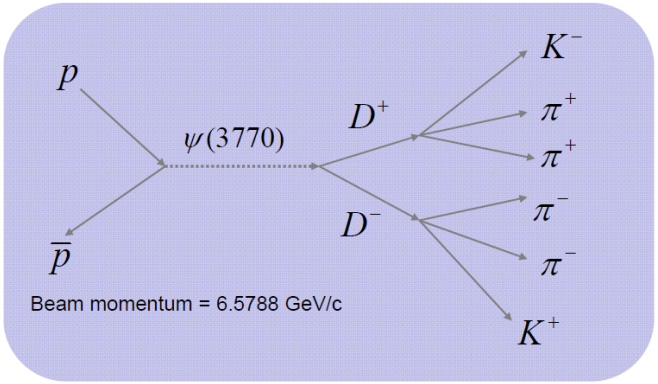
- $\sigma(\phi)$= 3.92 $\pm$ 0.02 MeV
- $\sigma(\eta_c)$= 33.1 $\pm$ 0.2 MeV
- ε_{ff}=22.8 $\pm$ 0.2%

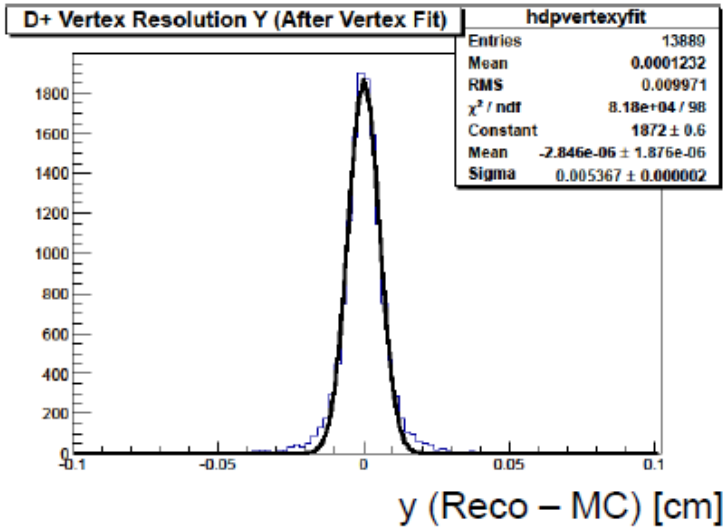
Performance Simulations for $\Psi(3770) \rightarrow D^+D^-$

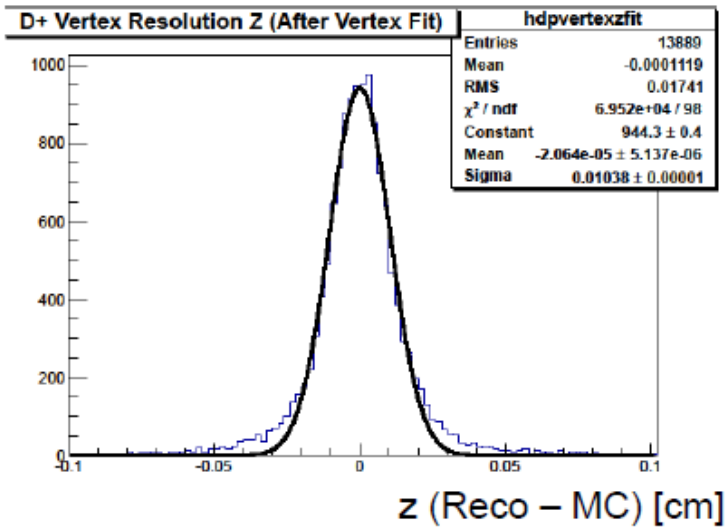
Benchmark channel to study vertexing

P_{beam} = 6.579 GeV/c

BR = 0.30×0.095×0.095







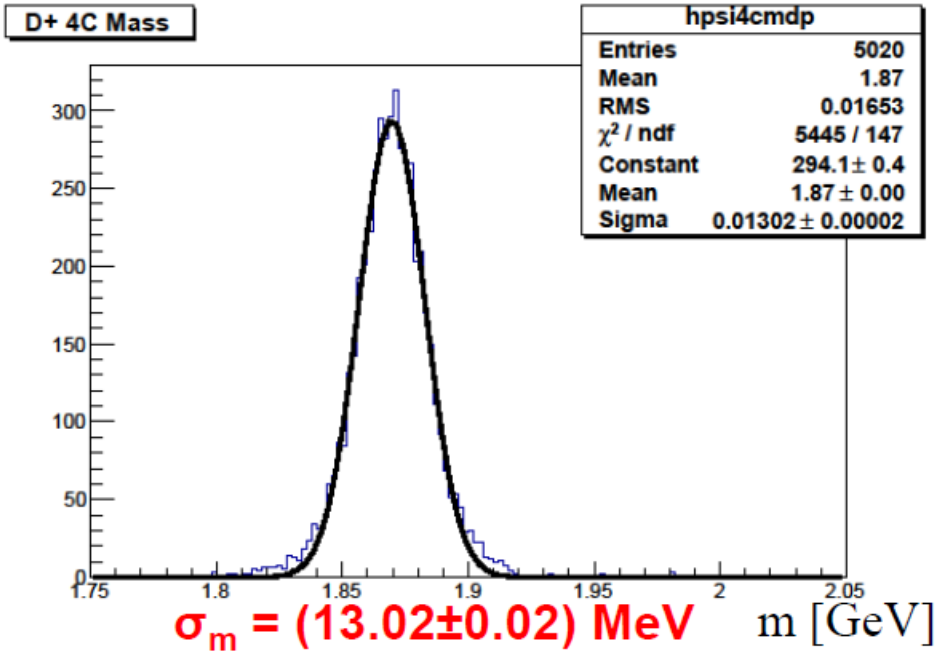
σ_y = (53.67±0.02) μm σ_z = (103.8±0.1) μm

M. Mertens, Juelich and D. Kang, Mainz

Performance Simulations for $\Psi(3770) \rightarrow D^+D^-$

4C Kinematic fit applied

Acc.×Eff. = 5.0%



σ_m = (13.02±0.02) MeV

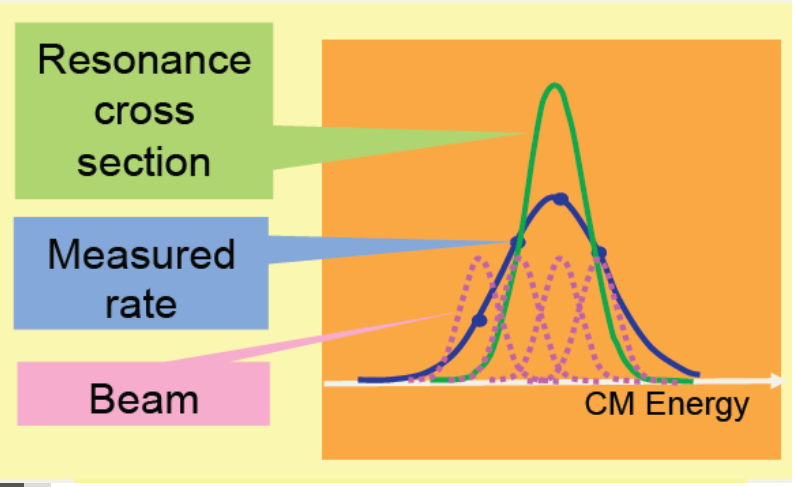
Only VTX-fit

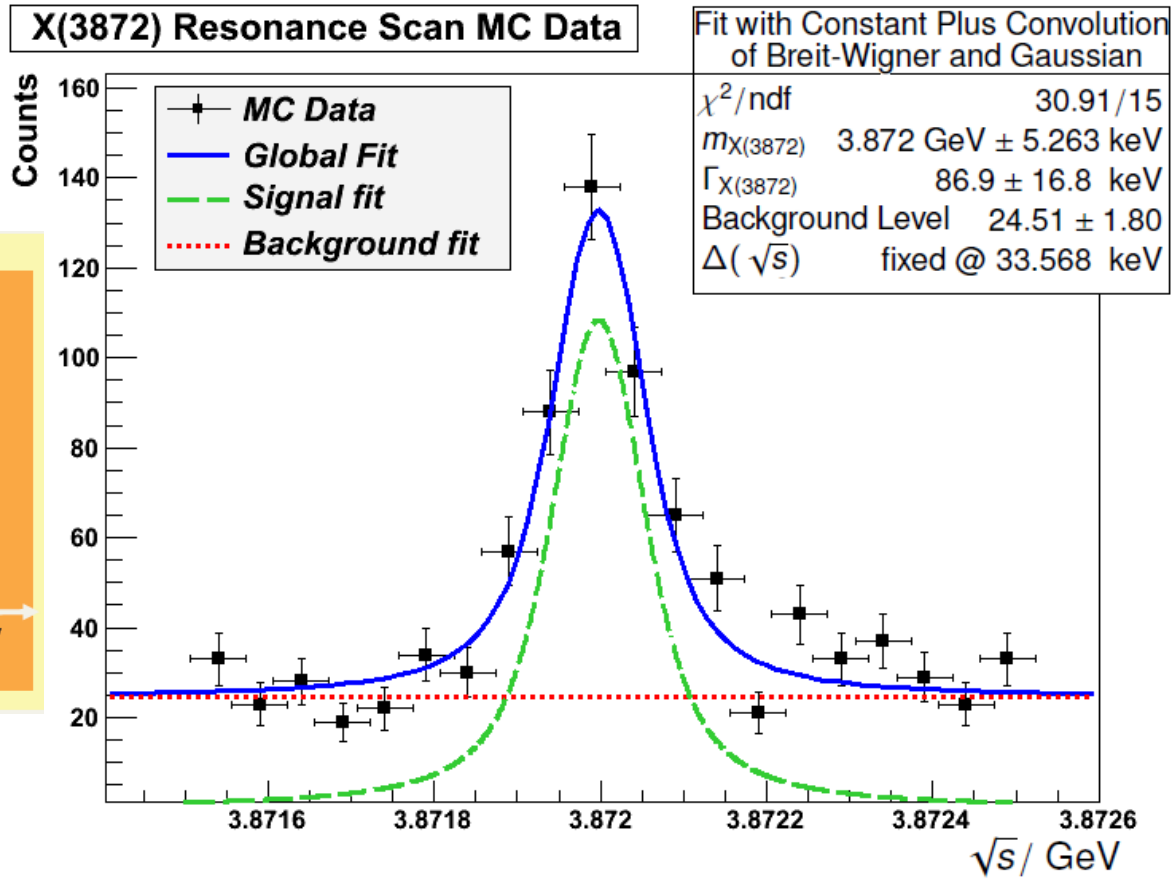
σ_Ψ ~ 30 MeV

X(3872)

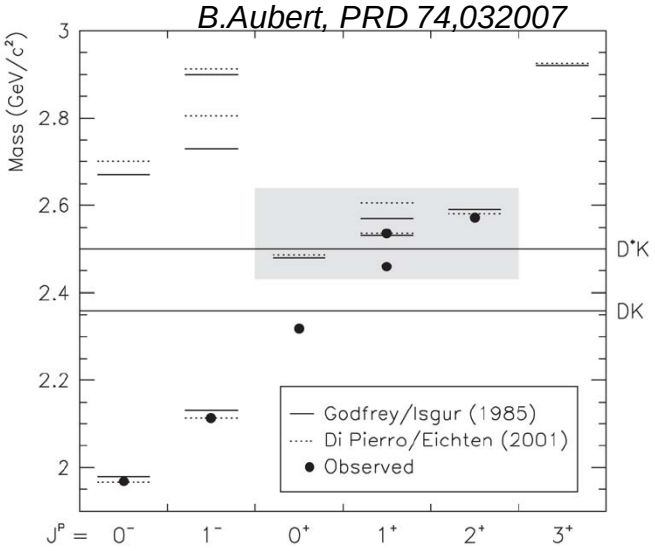
Detailed presentation this afternoon by M. Galuska, Giessen

(40 days)





Width Determination of the $D_{s0}^*(2317)$



Nature of $D_{s0}^*(2317)$ unclear

Interpretation very sensitive to width
~ keV - MeV

Current upper limit $\Gamma < 3.8$ MeV
does not discriminate interpretations

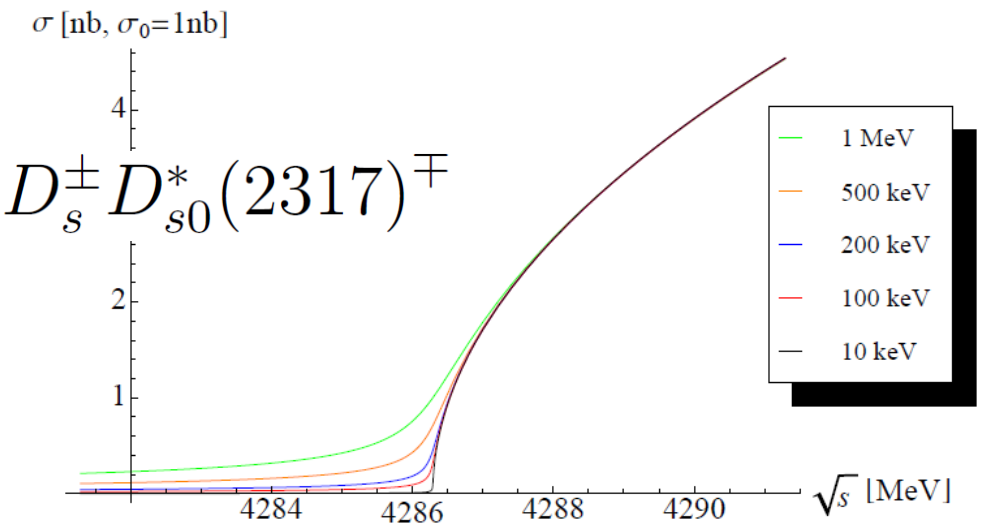
PANDA will do a resonance scan to achieve a precision
better than 100 keV

Excitation Function Scan of the D_{s0}*(2317)

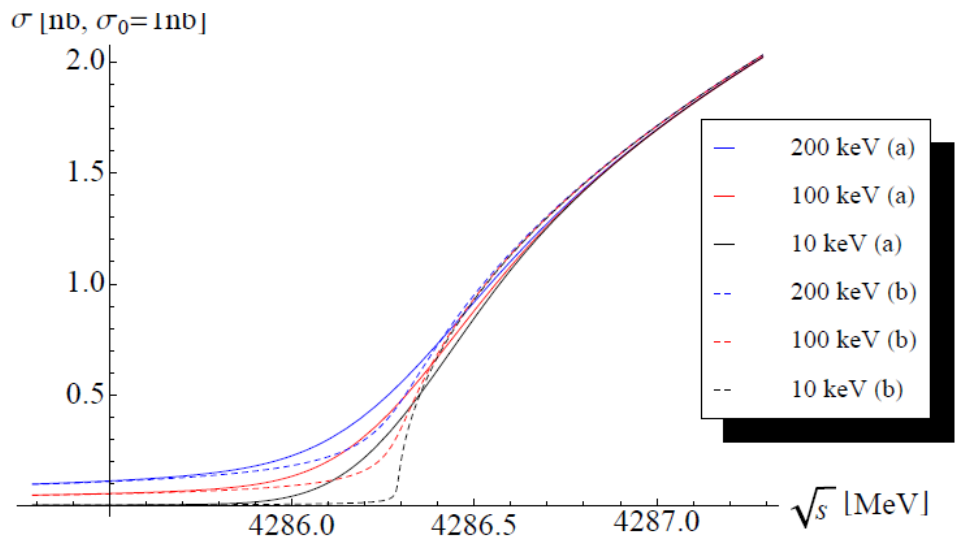
Method

$$\bar{p}p \rightarrow D_s^{\pm} D_{s0}^{*}(2317)^{\mp}$$

Sensitivity to width



Effect of the beam resolution $\Delta p/p \sim 10^{-4}$



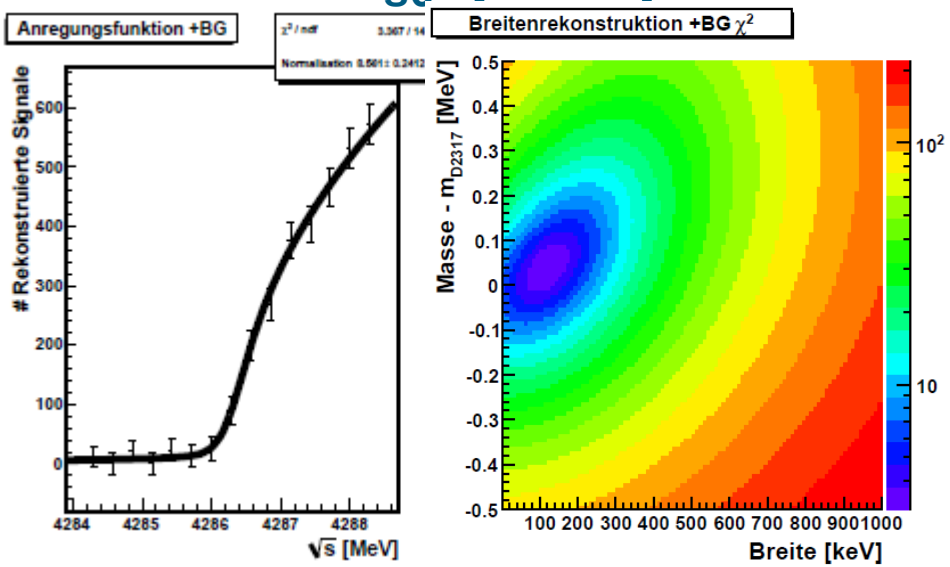
M. Mertens, Juelich

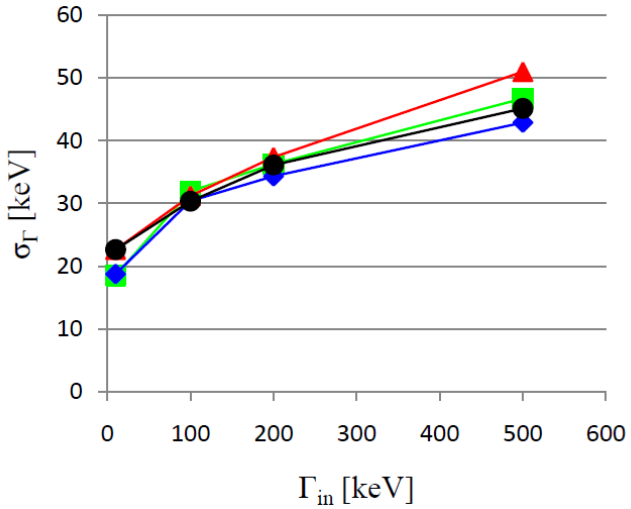
Excitation Function Scan of the D_{s0}*(2317)

Simulated excitation function

χ^2-contour

Resolution of the width





Summary/Conclusions

- FAIR is on-track
- HESR is funded, calls for tender ready to go
- PANDA going into construction phase
- Despite competion, PANDA has unmatched physics reach