Charm Production at HERMES

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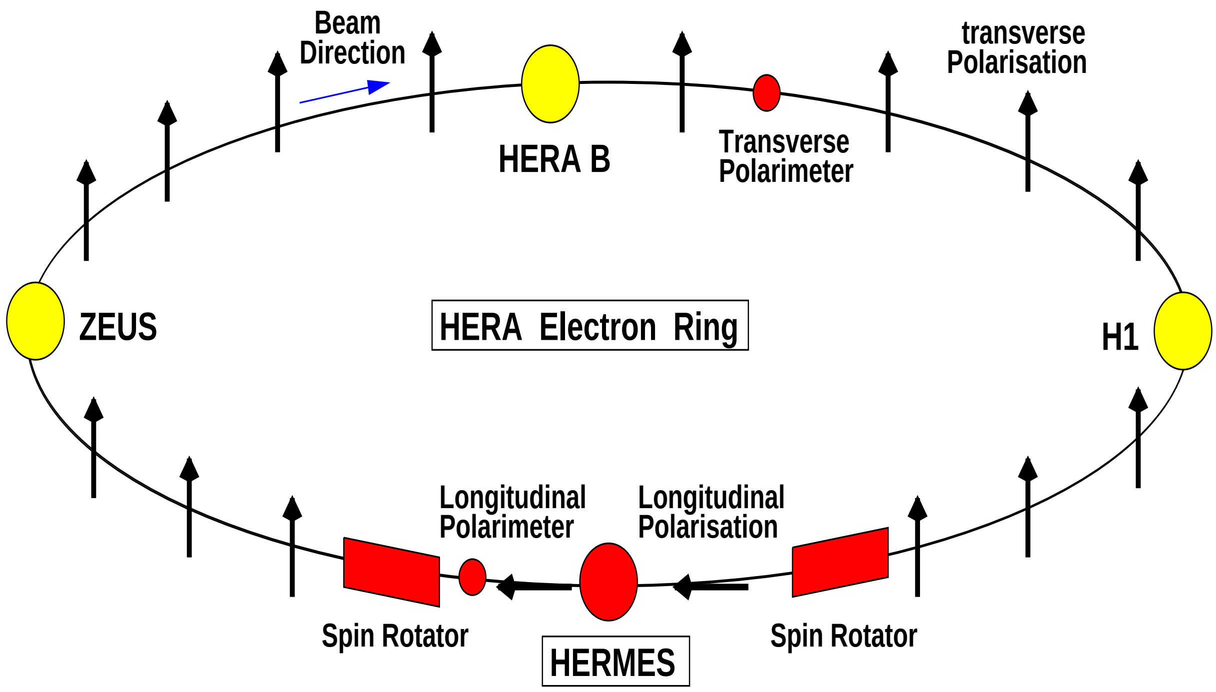
The HERMES Experiment



- **Polarised 27.5 GeV/c e^+ beam**

  $\rightarrow$ $I_{beam} \approx 30$ mA, $P_{beam} = 50 - 60$ %
  $\rightarrow$ $c\bar{c}$ production cross section ≈ 1 n$barn$

- **Internal gas target** $(H^\uparrow, D_2^\uparrow, {}^3He^\uparrow$ and $H_2, D_2, {}^3He, N_2)$

  $\rightarrow$ $P_{H^\uparrow, D_2^\uparrow} > 90$ %, $P_{{}^3He^\uparrow} \approx 55$ %
  $\rightarrow$ $\rho = 10^{14} - 10^{15}$ atoms/cm^2
  $\rightarrow$ $L_{\text{Target}} = 20$ cm, $\delta Z_{\text{Vertex}} \approx 1$ cm

- **Deep Inelastic Scattering experiment**

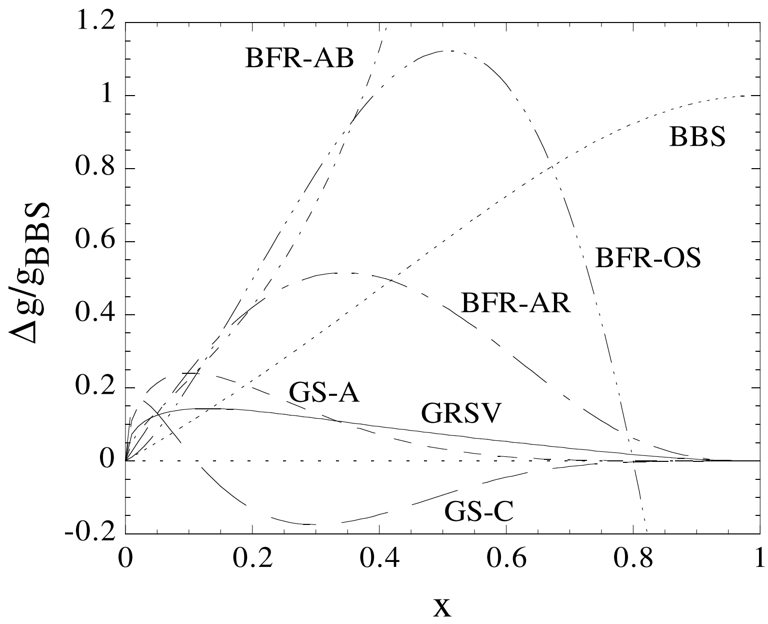
  $\rightarrow$ Excellent Particle Identification and Trigger for $e^\pm$
  $\rightarrow$ Limited $\pi^\pm / K^\pm$ separation in Threshold Cherenkov

Probing ΔG

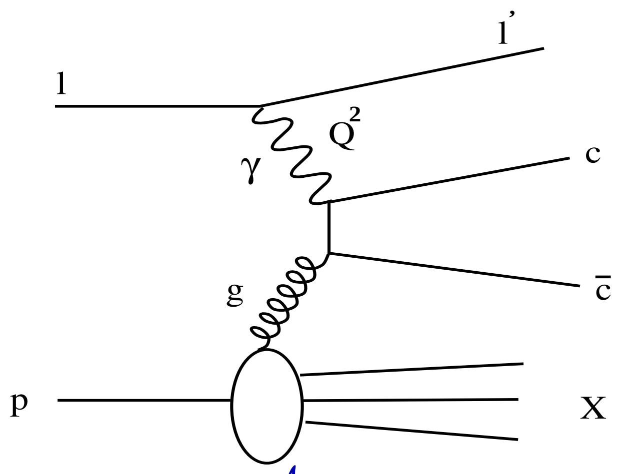
Spin of the Nucleon:

$$\boxed{\langle S_z \rangle = \frac{1}{2} = \frac{1}{2}(\Delta u + \Delta d + \Delta s) + \Delta G + \langle L \rangle}$$

ΔG poorly known :



Inelastic Charm production (Photo Gluon Fusion) :



Clean probe of ΔG !

Unpolarised Charm Physics

$\gamma p \to c$ production cross sections near threshold :

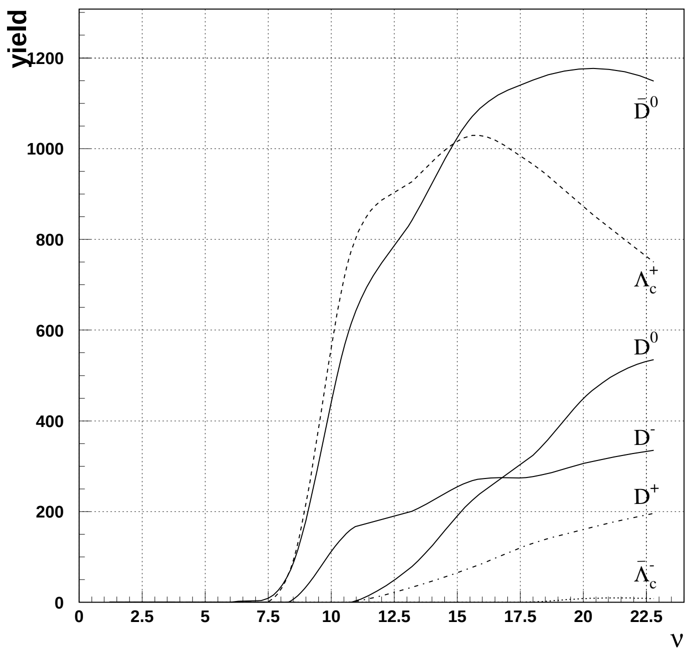
- $\to$ Total $\gamma p \to c\bar{c}$ cross section at $E_\gamma = 18\ GeV$
- $\to$ $\gamma p \to J/\Psi$ cross section

Hadronization at low $\nu\,(\sim m_{c\bar{c}})$:

LUND prediction :

Yield(Λ_c^+) > Yield$(D^\pm)$

$\longrightarrow$ Sensitive test of Hadronization Models

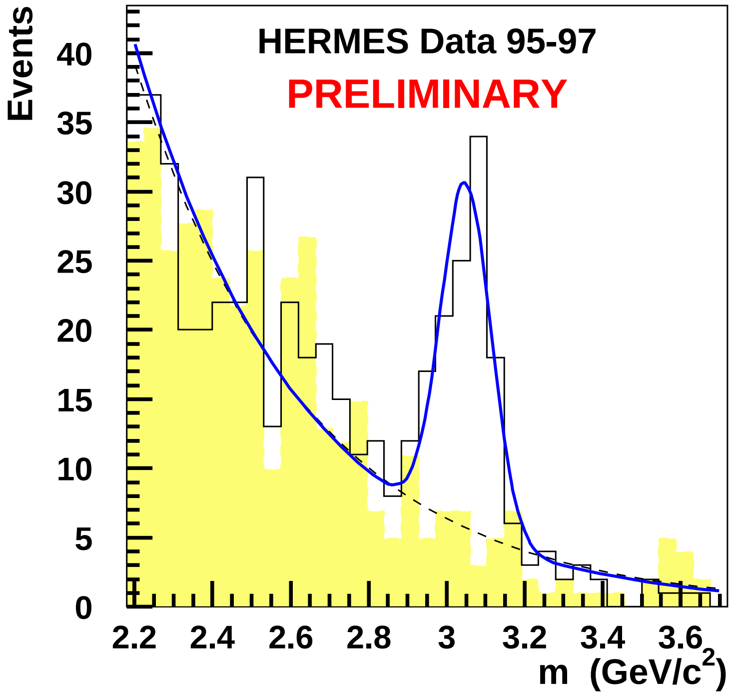


Transition hard–soft in VM production :

- $\to$ $\sigma(\gamma^* p \to J/\Psi)$ vs. $\sigma(\gamma^* p \to \rho^0, \omega, \Phi)$
- $\to$ J/Ψ polarisation

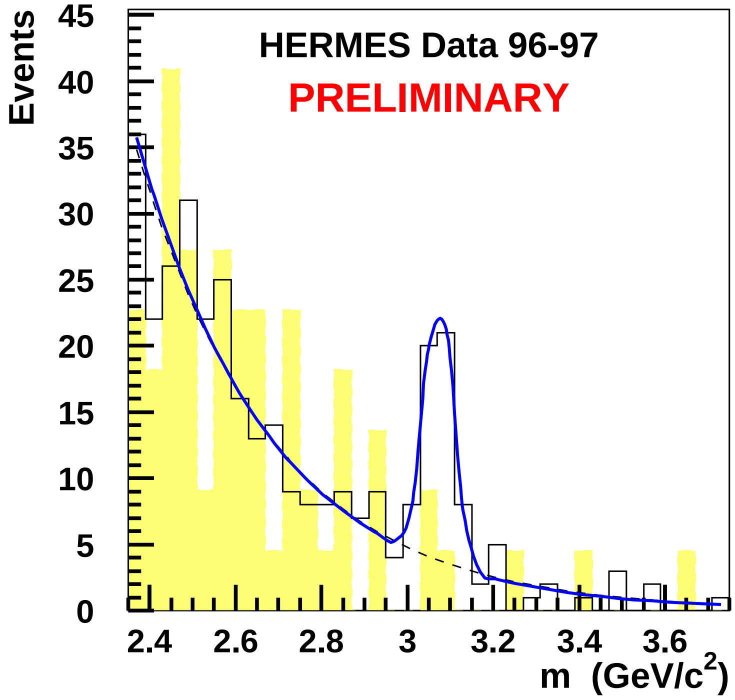
J/Ψ Signals

$J/\Psi \rightarrow e^+e^-$



Signals from all data taking periods

$J/\Psi \rightarrow \mu^+\mu^-$

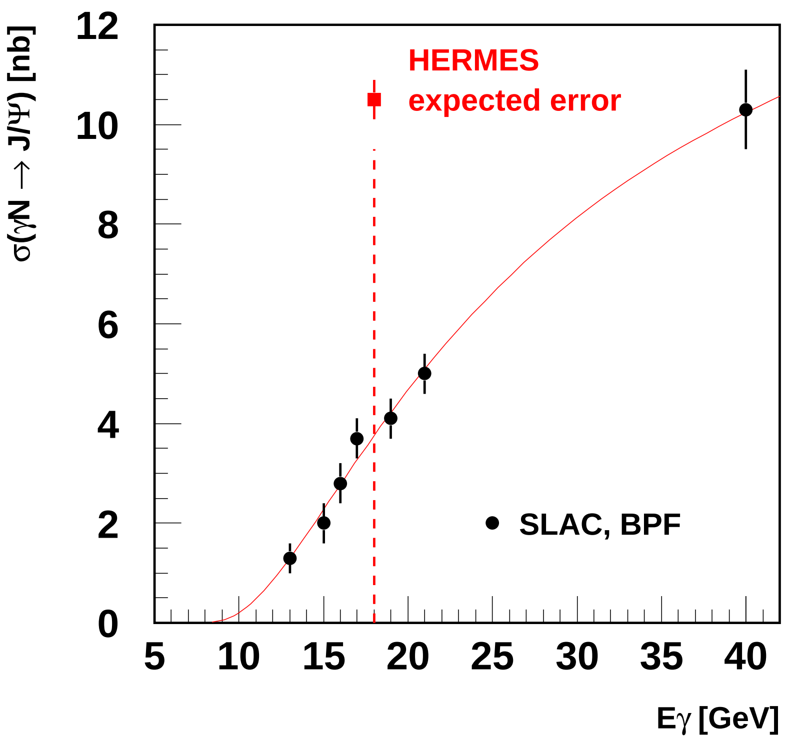


Signals from 1997 and part of 1996 data

NB: Most of the data are unpolarised

J/Ψ Cross Section

Total J/Ψ Cross Section



→ Competitive measurement at $\bar{\nu} = 18\ GeV$

→ Small error ($\leq$10 %) on absolute normalisation scale

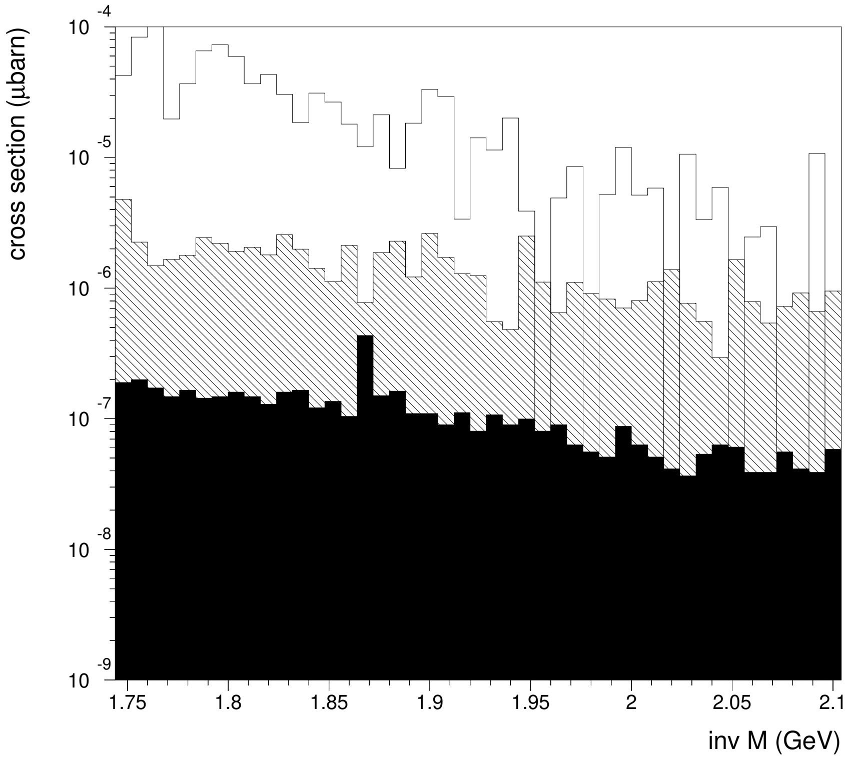
$\sigma_{elastic}$ / $\sigma_{inelastic}$:

→ Model dependent result from dN/dE unfolding

→ Full separation, if J/Ψ kinematics known (**FQS**)

Open Charm

$D^0 \to K^- \pi^+$:



MC prediction (PYTHIA +LEPTO +AROMA)

$\rightarrow$ High background, reproduced by MC

$\rightarrow$ Not possible to resolve within present HERMES setup

$D^{*+} \to D^0 \pi^+$:

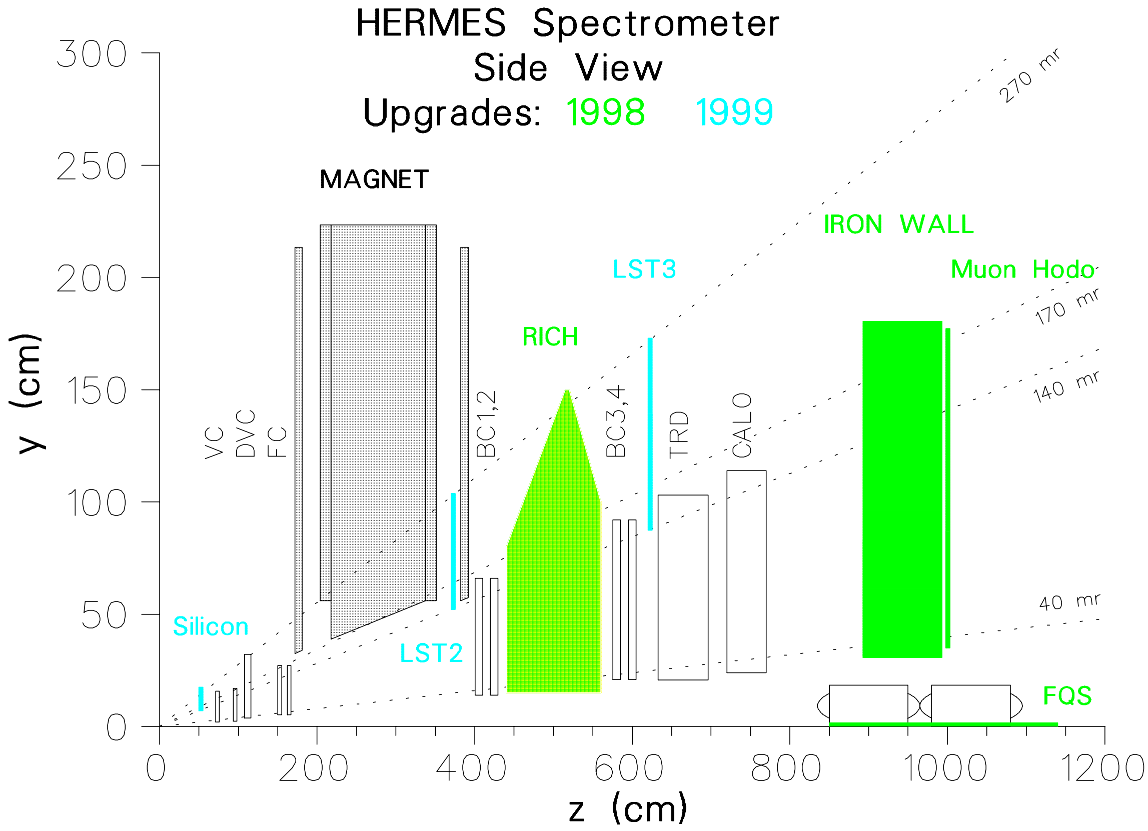
$\rightarrow$ has very low acceptance (< 1 %)

$\Lambda_c^+ \to \Lambda \pi^+$:

$\rightarrow$ Λ has low acceptance (≈ 3 %)

$\Longrightarrow$ Detector Upgrade Program for improved charm reconstruction

Future Prospects for Charm at HERMES



Dual radiator **RICH**:

- $p/K/\pi$ separation over full momentum range

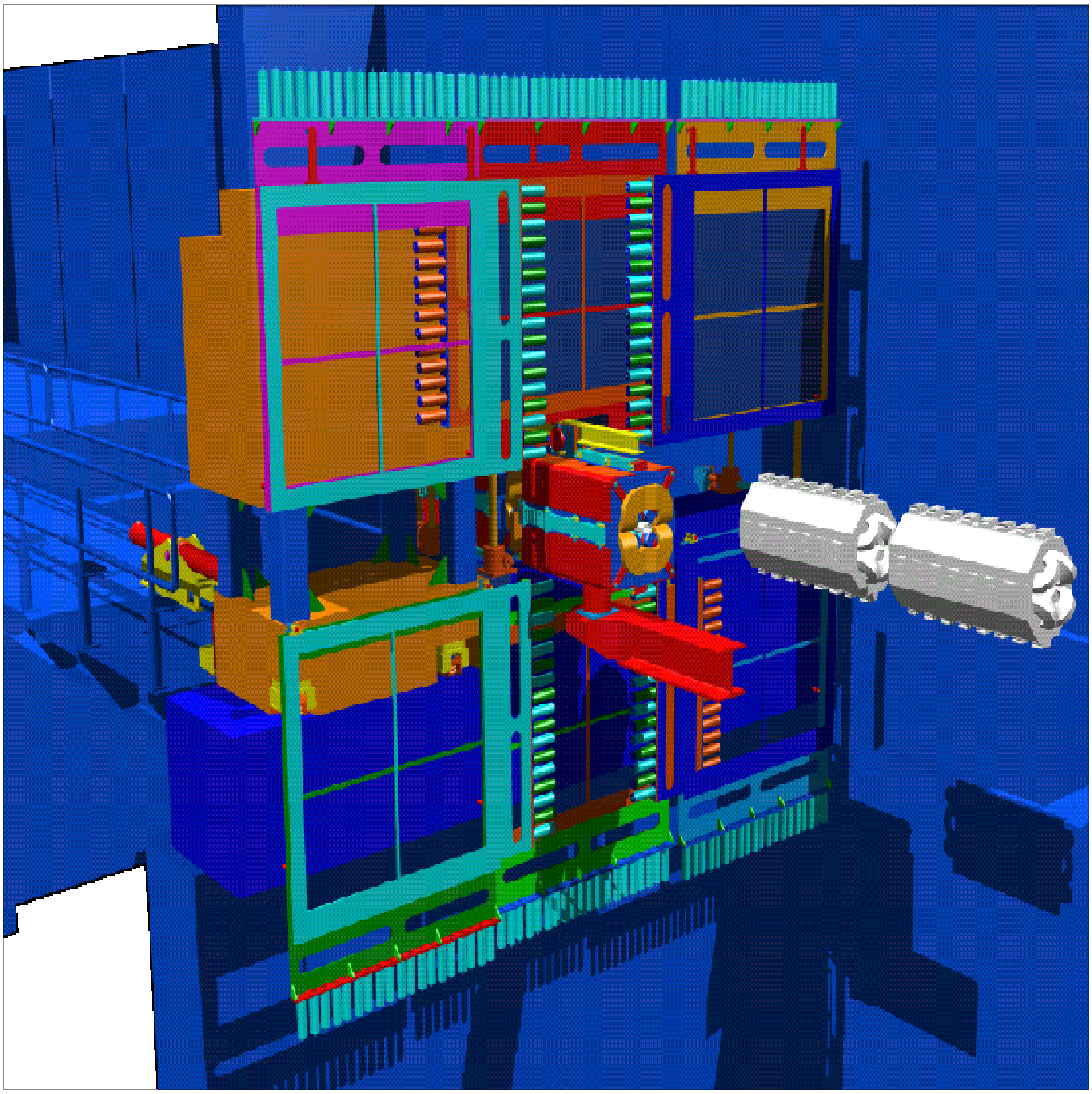
μ Wall & Hodoscopes :

- $K^- \mu^+ X$ detection
- Enlarged acceptance for $J/\Psi \rightarrow \mu^+\mu^-$

Forward Quadrupol Spectrometer **FQS**:

- Full kinematics of low Q^2 events

The HERMES μ–Wall



The Forward Quadrupol Spectrometer