Hall-B 12 GeV Overview: the CLAS12 experiment

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for the CLAS Collaboration

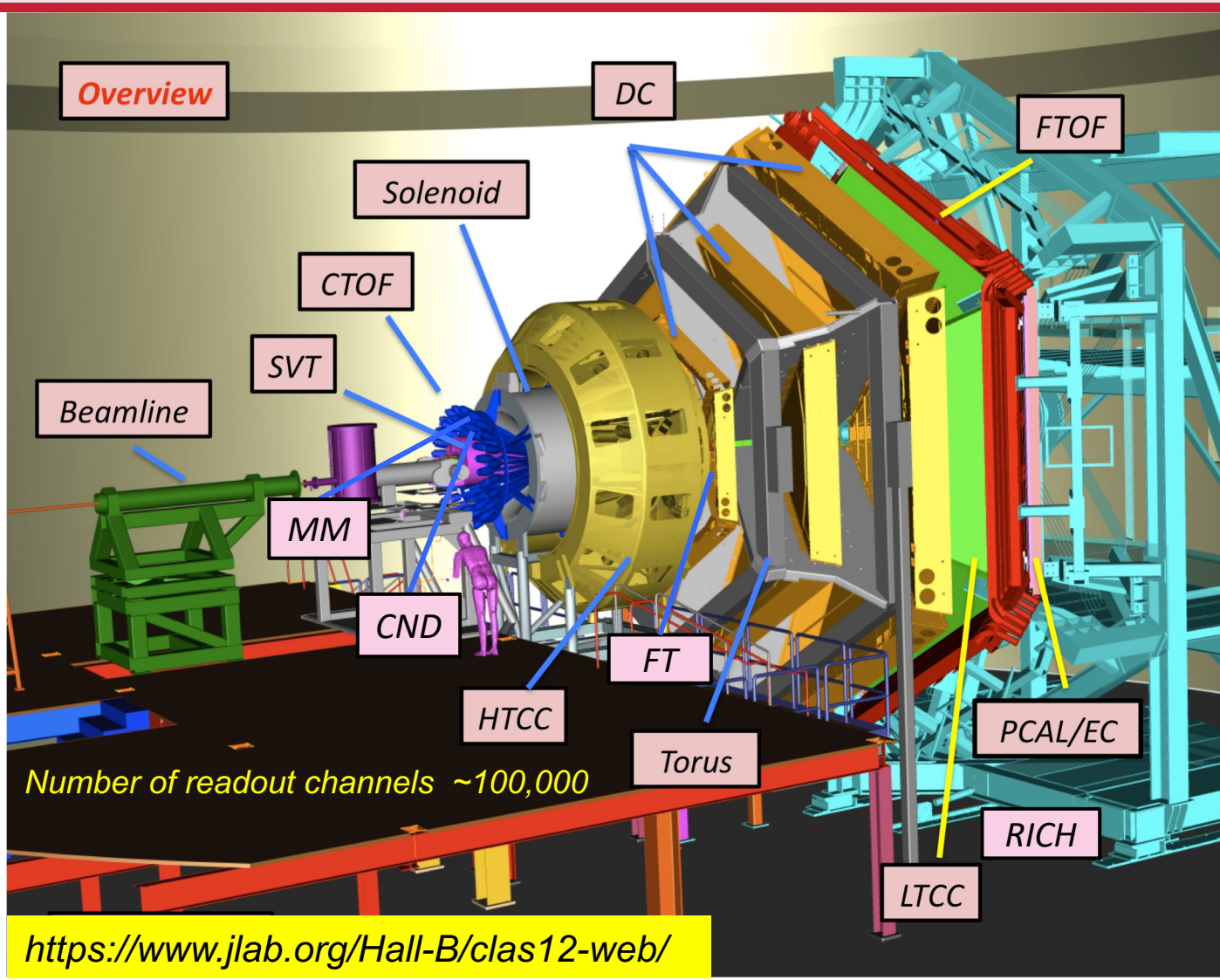
CLAS12

Forward Detector:

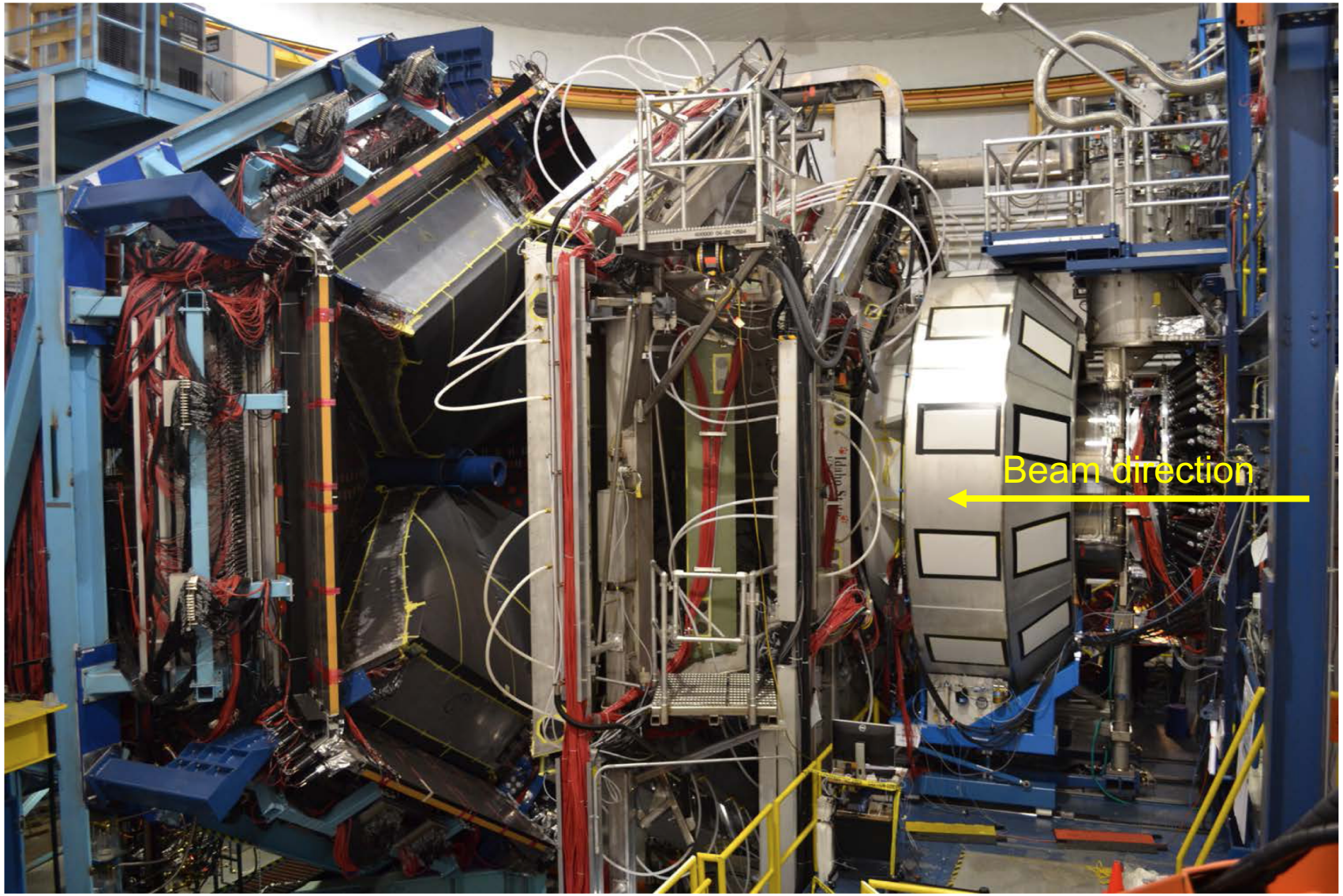
- *TORUS magnet*
- *HT Cherenkov Counter*
- *Drift chamber system*
- *LT Cherenkov Counter*
- *RICH detector*
- *Forward ToF System*
- *Pre-shower calorimeter*
- *E.M. calorimeter (EC)*
- *Forward Tagger*

Central Detector:

- *SOLENOID magnet*
- *Barrel Silicon Tracker*
- *Micromegas*
- *Central ToF system*
- *Neutron detector*
- *Backward Angle Neutron detector*

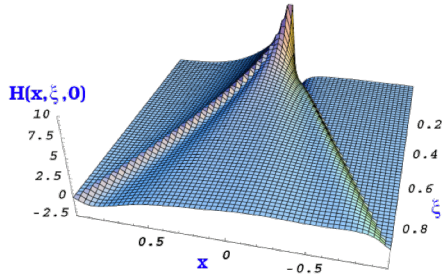


CLAS12 installation complete

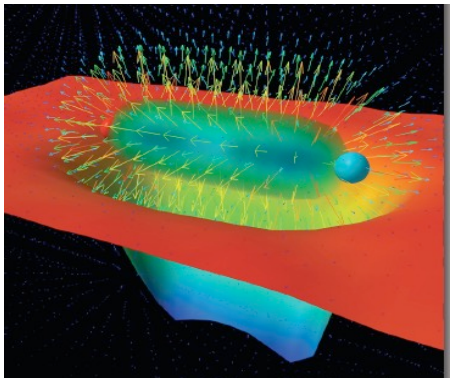


The CLAS12 physics program

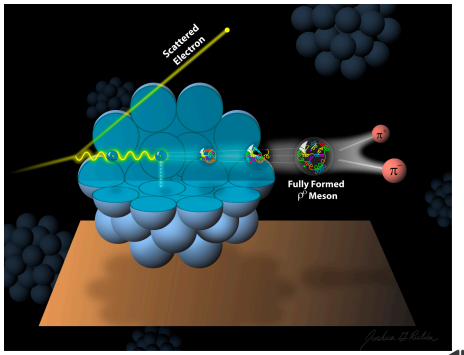
- The multidimensional structure of the nucleon – from form factors and PDFs to GPDs and TMDs



- Quark confinement and the role of the glue in meson and baryon spectroscopy



- The strong interaction in nuclei – evolution of quark hadronization, nuclear transparency of hadrons, short range correlation



CLAS12 in numbers

Collaboration:

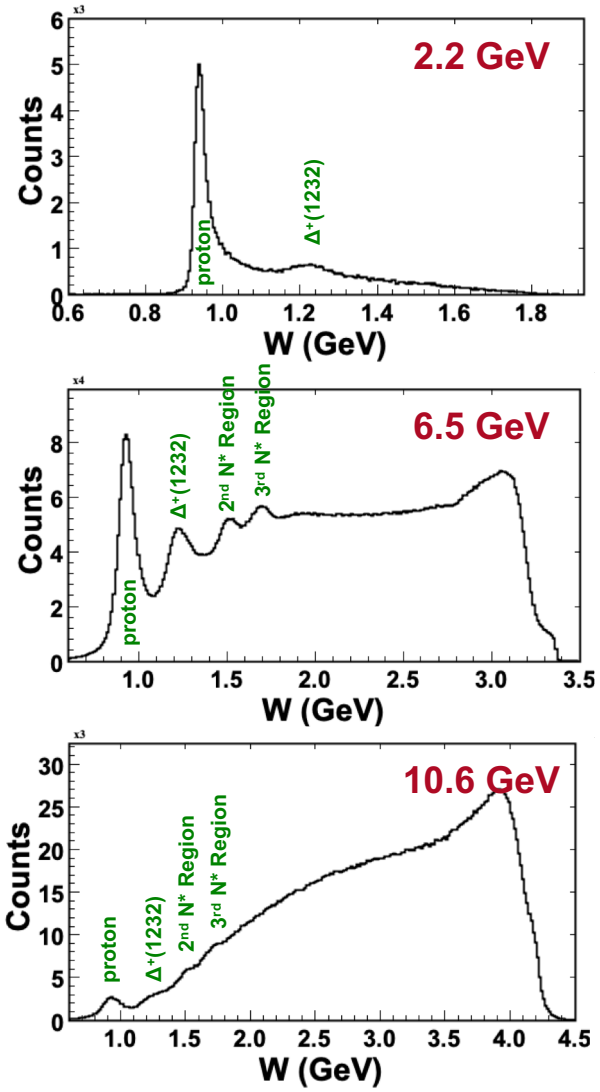
- More than 195 members
- 43 institutions
- 9 countries

Experimental program:

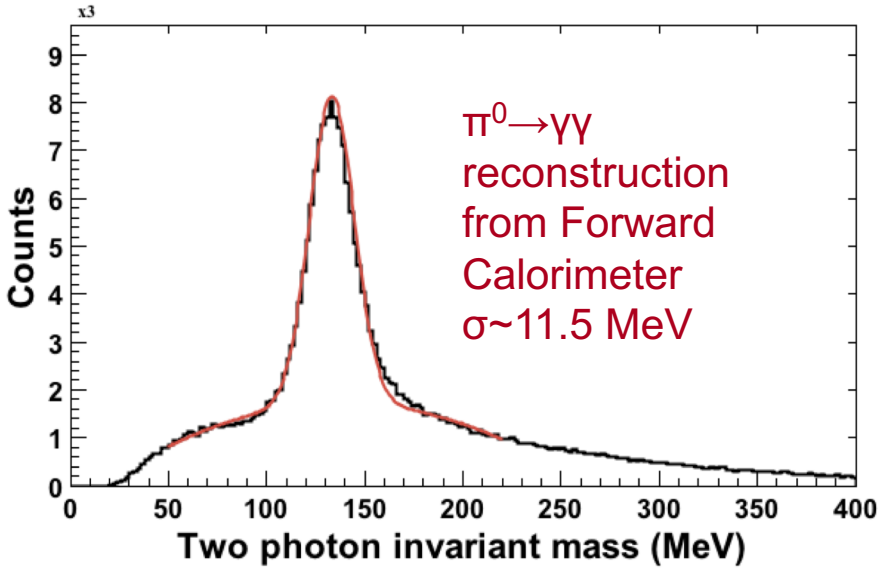
- 41 approved proposals:
  - targets:
    - proton, deuteron and nuclei
    - unpolarized, longitudinally and transversally polarized
    - solid, liquid and gas
  - beam:
    - highly polarized electron beam
    - linearly polarized quasi-real photons
  - final states: inclusive, semi-inclusive and exclusive
  - luminosity up to 10^{35} $cm^{-2}s^{-1}$
- 3173 PAC days
- 11 Run Groups
- 1021 Run Group days
- **10 years of approved data taking**

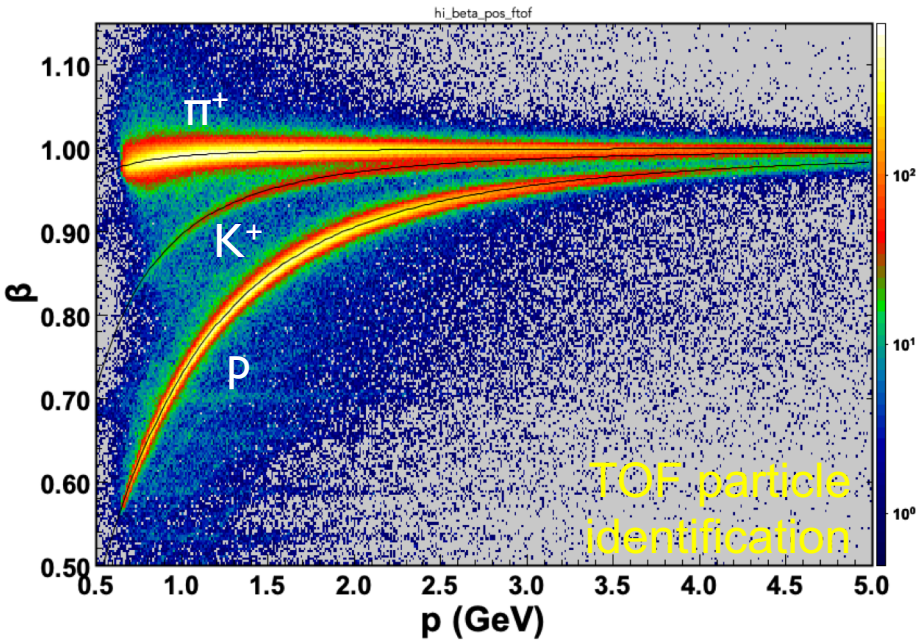
CLAS12 data taking

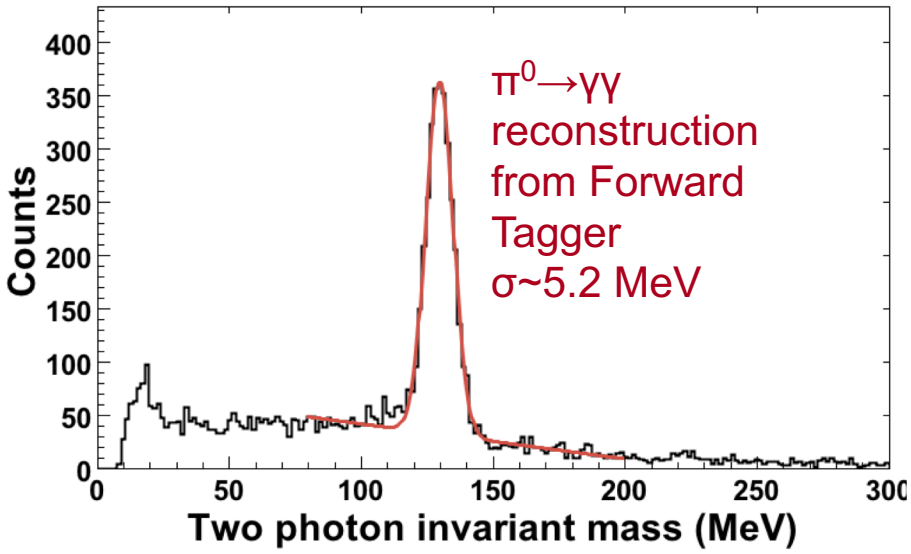
- **First commissioning run** (KPP) in February 2017
- **Engineering run** in December 2017-February 2018
- Physics data taking start in February 2018:
  - **Run Group A**:
    - 13 experiments
    - 10.2-10.6 GeV polarized electrons
    - Liquid-hydrogen target
    - ~300 mC, ~50% of approved beam time
  - **Run Group K**:
    - 3 experiments
    - 6.5, 7.5 GeV polarized electrons
    - Liquid-hydrogen target
    - ~45 mC, ~12% of approved beam time
  - **Run Group B**:
    - 7 experiments
    - 10.2-10.5 GeV polarized electrons
    - Liquid-deuterium target
    - ~84 mC, ~24% of approved beam time

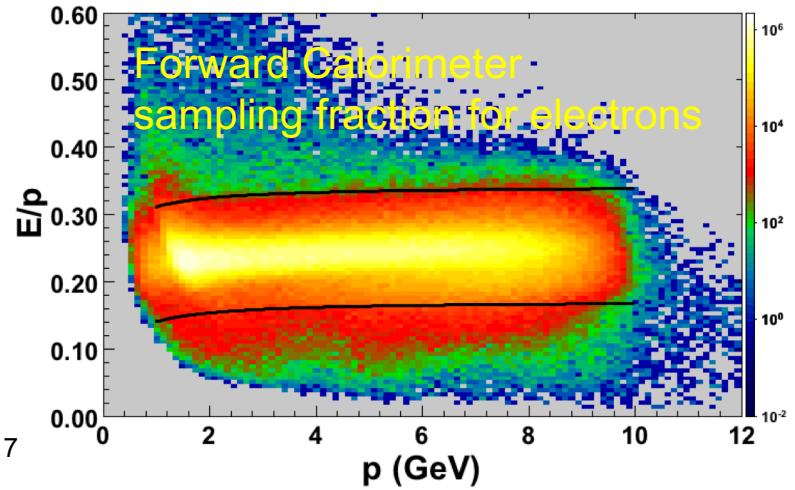


Event reconstruction





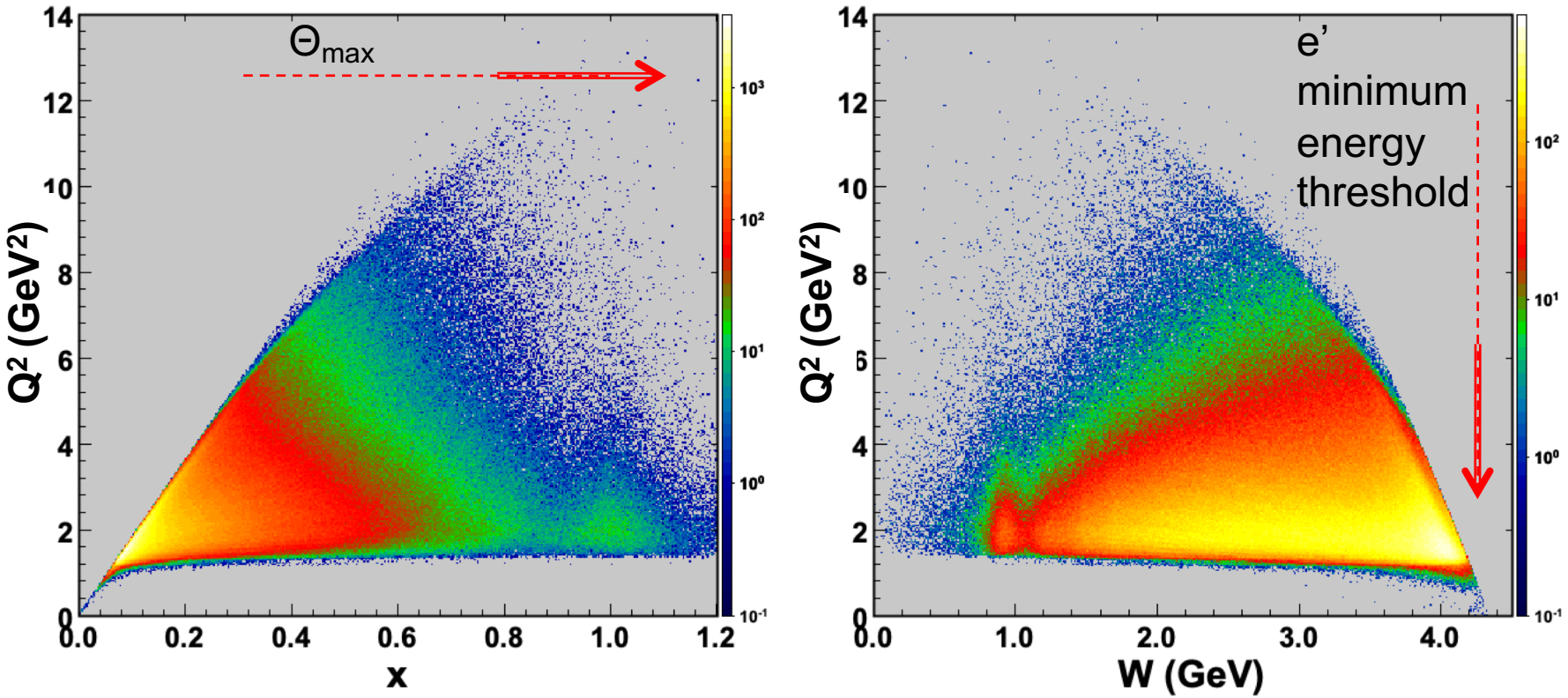




CLAS12 kinematic reach

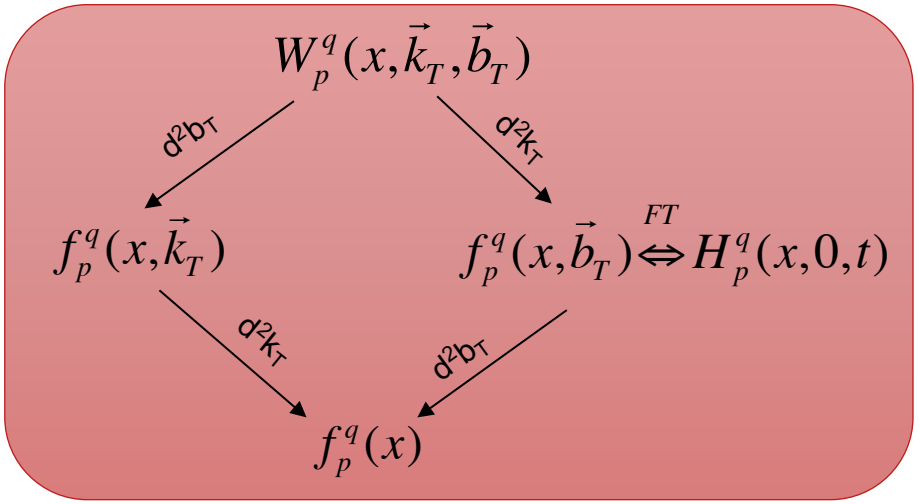
Beam energy at 10.6 GeV Torus current 3770 A, electrons in-bending, Solenoid magnet at 2416 A.

p(e,e')X



Plots based on 100 min. of data taking

The 3D structure of the nucleon



Confinement Scale

Transverse momentum

$\vec{k}_T$

$\vec{b}_T$

Transverse position

High Energy Probe
Hard Scale

Longitudinal momentum
$k^+ = xP^+$

Spin

l

l

Photon Virtuality
Q^2

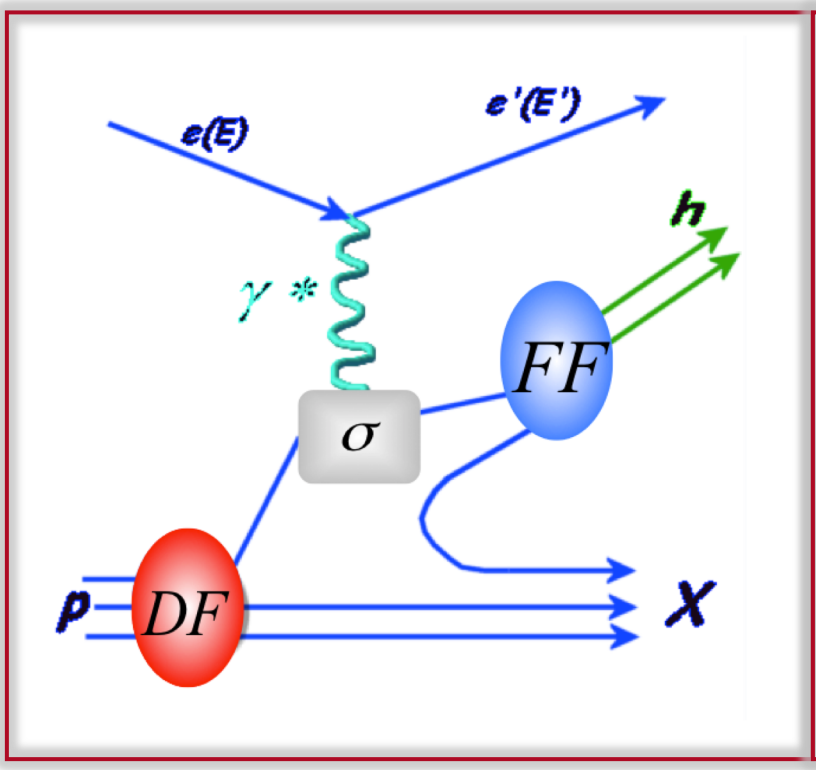
Transverse plane

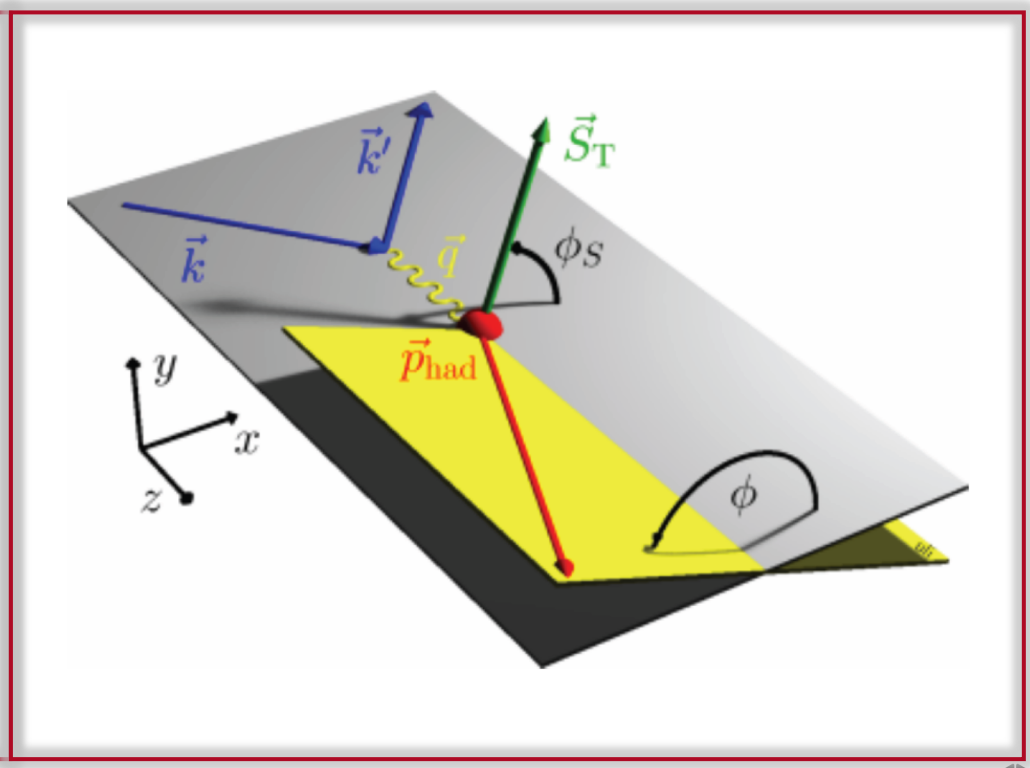
SIDIS & TMDs

3D momentum and spin-orbit effect:
Parton kinematics and flavor from observed hadron kinematics and type

Distribution and fragmentation convoluted:

$$d^6\sigma^h \propto \sum_q e_q^2 q(x,k_T) \otimes D_q^h(z,p_T)$$

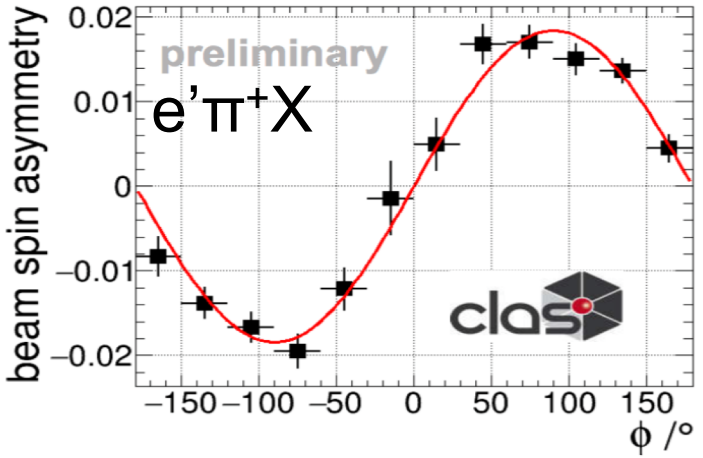


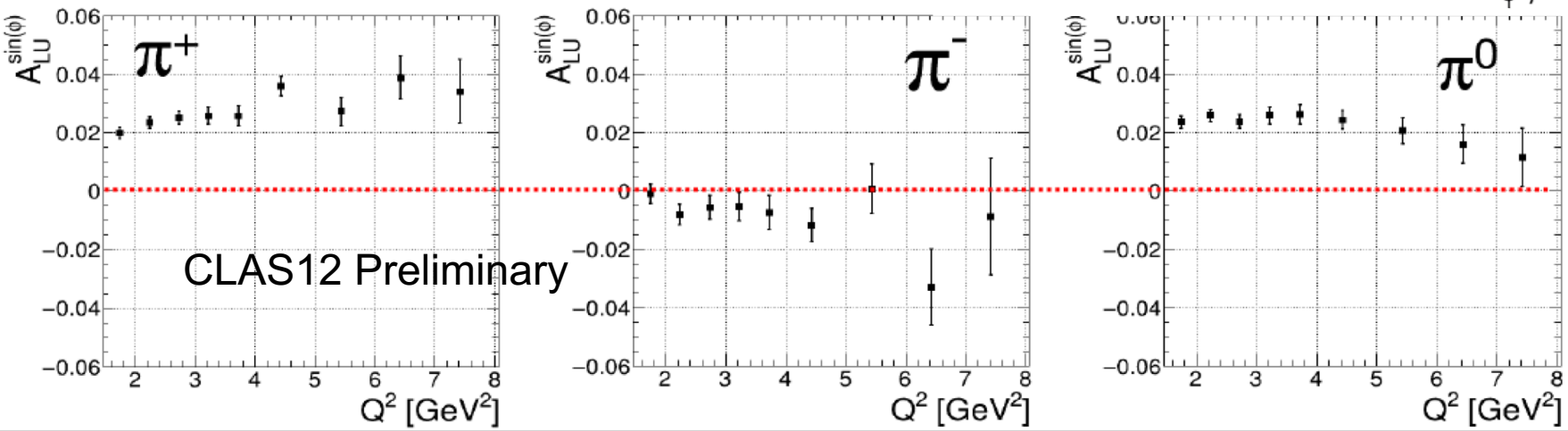


SSA measurements with CLAS12

SSA in SIDIS sensitive to quark-gluon interactions and color forces

$$BSA_i = \frac{1}{P_e} \cdot \frac{N_i^+ - N_i^-}{N_i^+ + N_i^-}$$

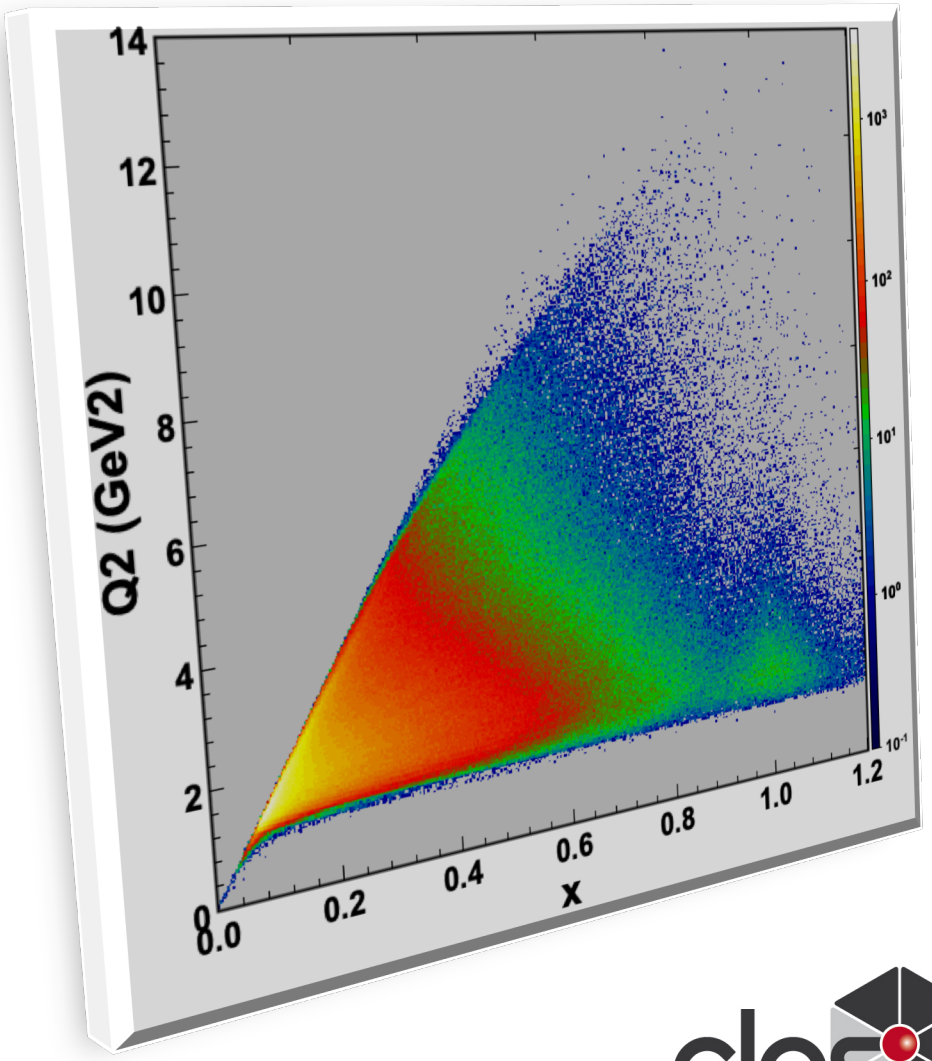




- With <2% of expected unpolarized target data, CLAS12 already provides a measurement comparable to previous experiments
- Will allow fine multidimensional binning to study the dependence on Q^2 and other variables

Summary

- G. Christiaens: "*Deeply Virtual Compton Scattering at 10.6 GeV with CLAS12*"
- J. Newton*: "J/Psi Photoproduction Near Threshold*"
- J. A. Tan: *"Highlights of Run Group K experiments"*
- K. Price*: "Highlights from Run Group B"*



Summary

- CLAS12 spectrometer successfully commissioned and in operation
- Data taking for realization of extensive physics program in progress
- Tuning of calibrations and reconstruction algorithms for optimal performances
- Physics analyses started, toward high-impact physics!