Inclusive Electron Scattering off Protons with CLAS12

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for the CLAS collaboration

CEBAF Large Acceptance Spectrometer

Jefferson Lab

Introduction and motivation

- Measurement of the unpolarized inclusive electron scattering cross section in the resonance and deep inelastic regimes;
- Kinematic coverage: 1.1 GeV < W < 4.0 GeV and Q^2 up to 12 GeV^2 combines interests of the CLAS12 N* structure and DIS physics groups;
- Extension of the inclusive electron scattering data in the resonance region towards photon virtualities of $Q^2 > 4.0$ GeV^2 and evaluation of the resonant contributions from the CLAS6 results on resonance electrocouplings;
- Gain insight into the parton distributions in the ground nucleons at large x_B in the resonance region;
- New opportunities in exploration of the transition between the resonance and DIS regions and in the studies of quark-hadron duality;
- Offering the tests for normalization and electron detection efficiencies.

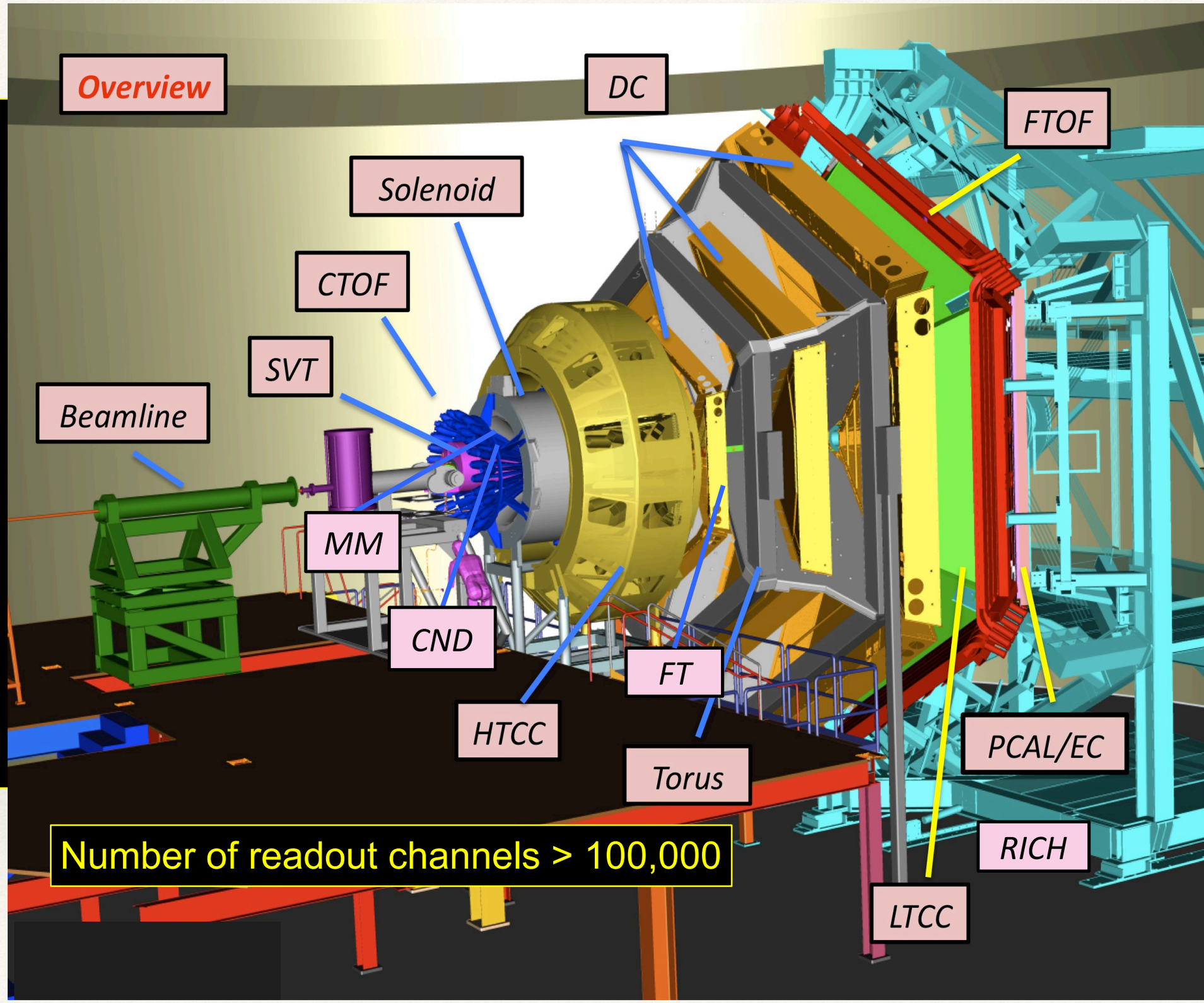
CLAS12 Detector

<u>Forward Detector (FD)</u>

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

<u>Central Detector (CD)</u>

- Solenoid magnet
- Silicon Vertex Tracker
- Central Time-of-Flight
- Central Neutron Detector
- MicroMegas



Number of readout channels > 100,000

Data overview

- 10.6 GeV electron beam
- 5 cm liquid hydrogen target
- 5% of currently available data analyzed

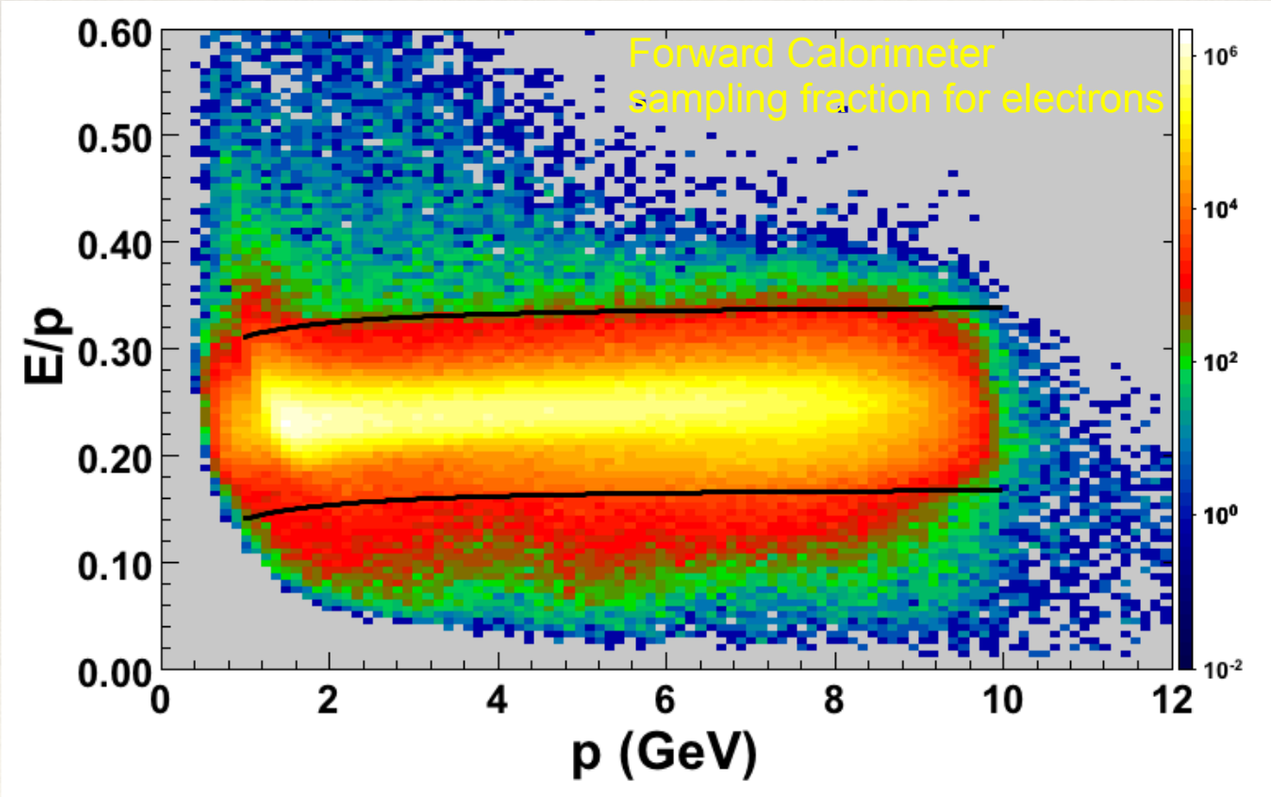
Analysis schematics

- Electron inclusive events from the data
- Acceptance correction based on the simulation
- Luminosity correction

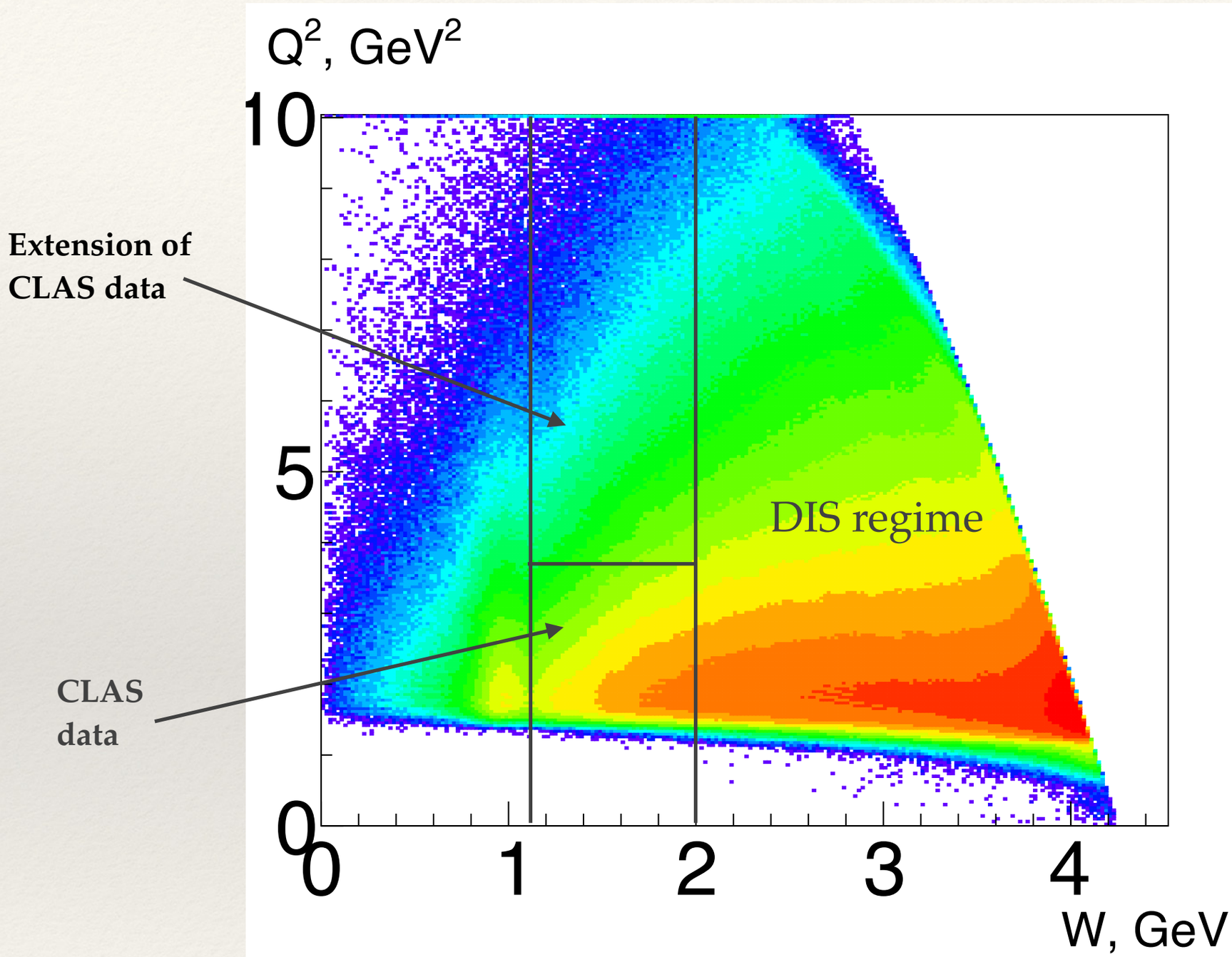
Several important steps, for example radiative corrections, are not part of this analysis.

Electron ID

- Limited to Forward Detector (5 -35 degrees coverage in polar angle)
- Electrons are selected by the CLAS12 Event Builder
  - Negative track with a hit in TOF, ECAL and HTCC and a highest momentum;
  - 2.0 photoelectrons in HTCC;
  - 60 MeV in PCAL;
  - 5-sigma cuts on a parameterized momentum-dependent sampling fraction.



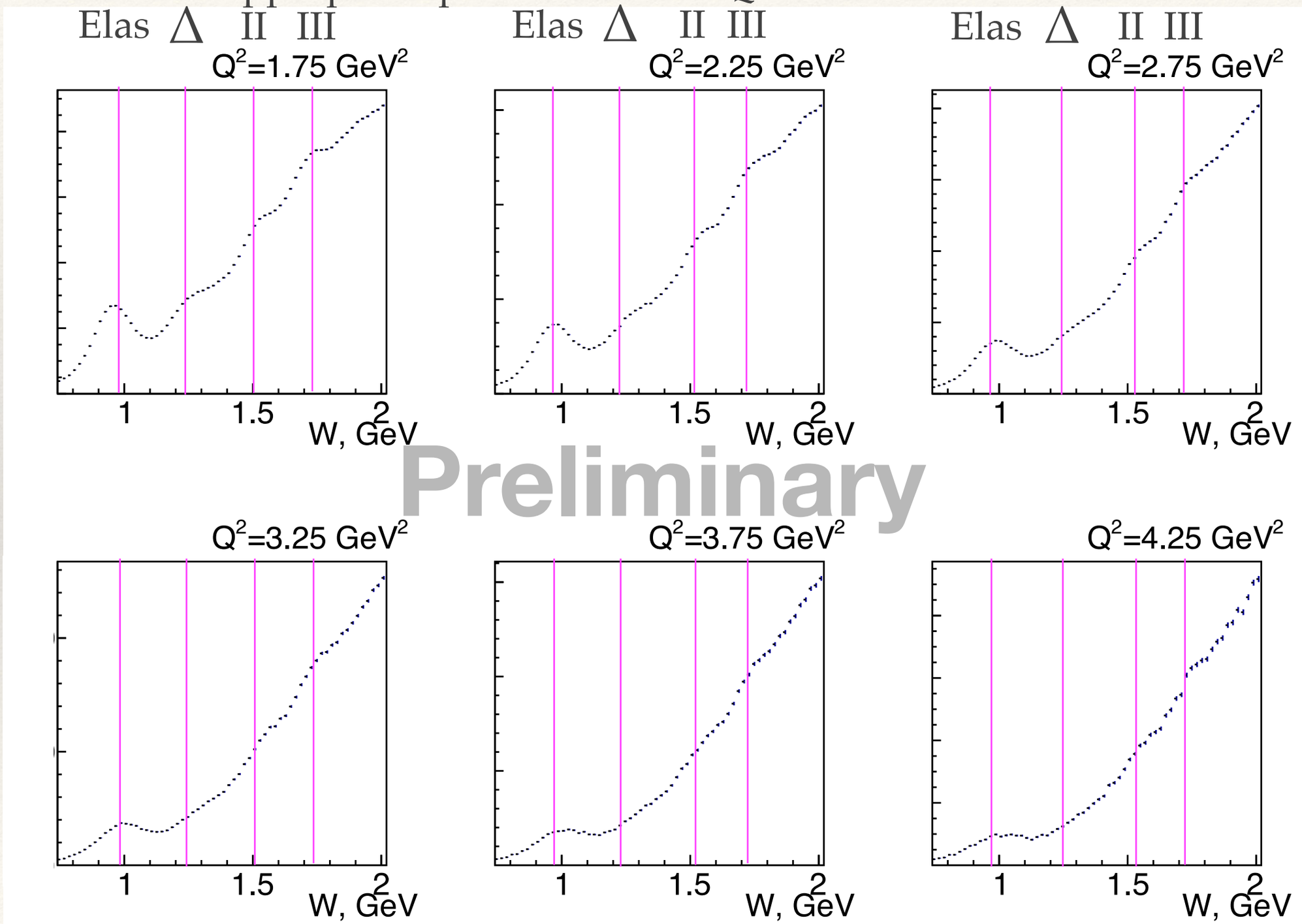
Kinematics Coverage



We significantly extend the kinematical coverage in the resonance region compared to the previously available data

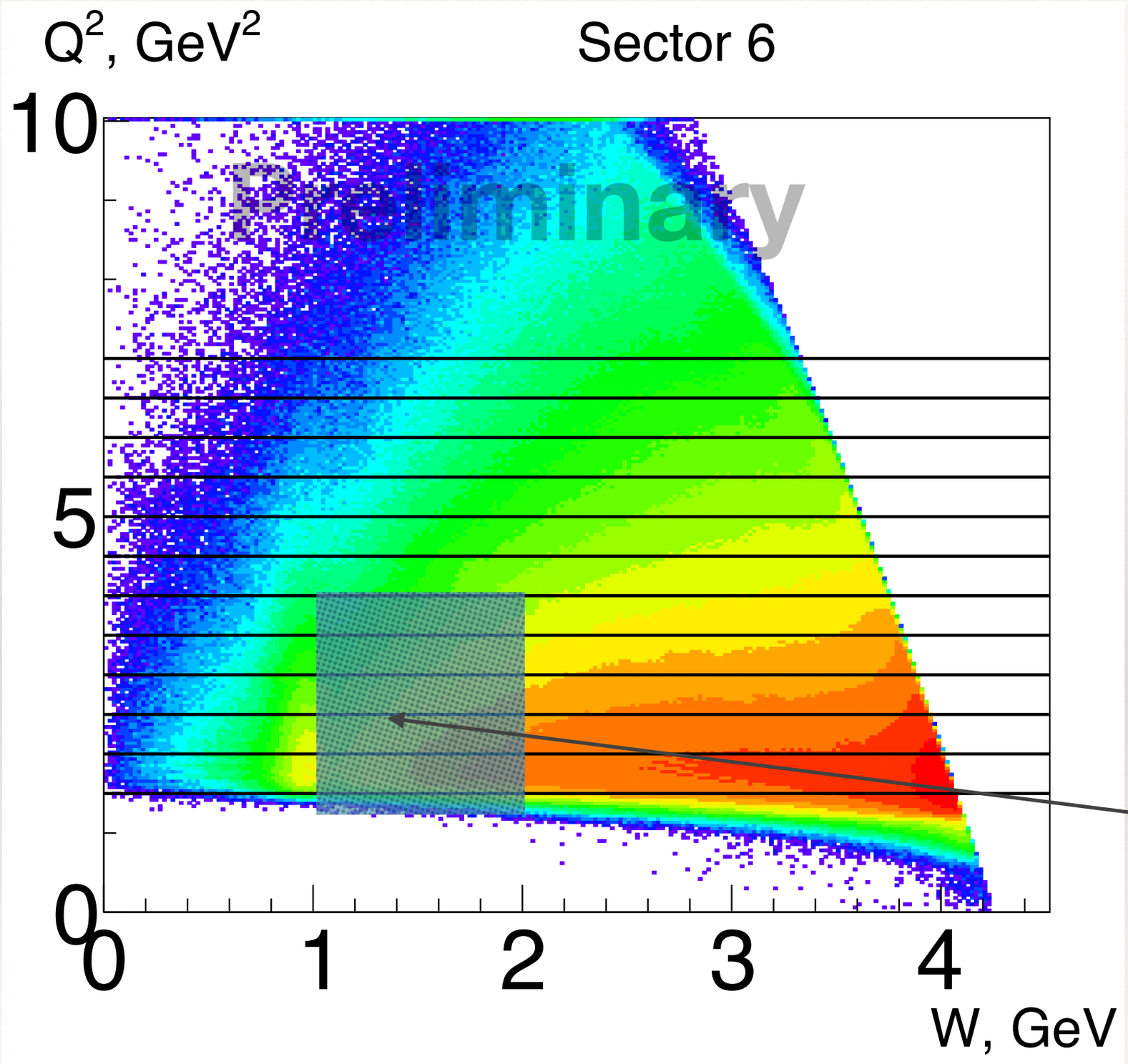
Resonance structures

We clearly see resonance structures at their appropriate places and their Q2 evolution



Bumps getting less prominent as Q^2 goes up.

Coverage and Binning



Binning:
Δ W: 0.025 GeV
Δ Q2: 0.5 GeV2

We will report data in the Q^2 region up to 7 GeV^2, but there is a possibility to extend it with increased statistics.

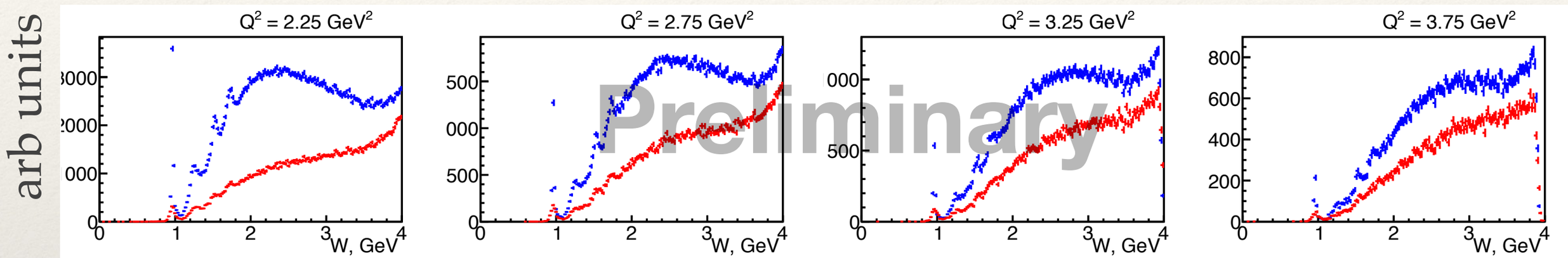
Acceptance and Luminosity Corrections

Generated events

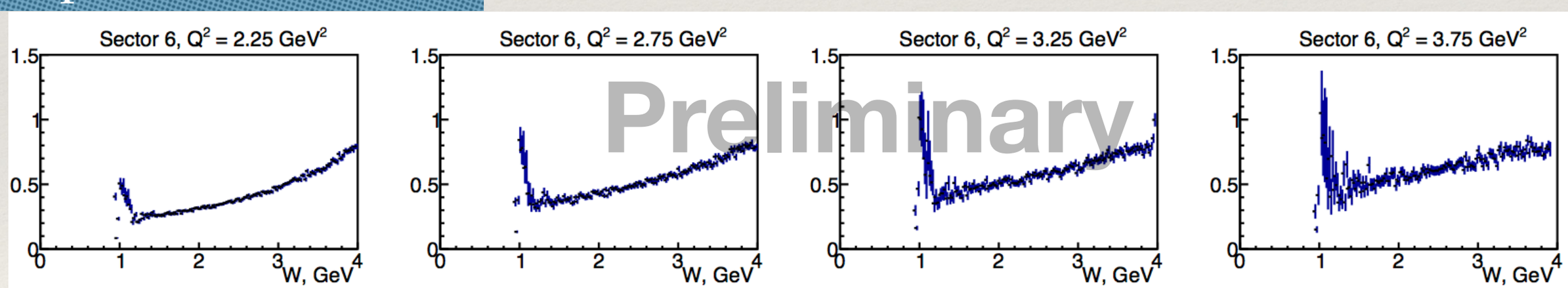
Reconstructed simulation events

Inclusive event generator: M. Sargsyan, CLAS-NOTE 90-007 (1990).
Includes elastic and radiative effects

Same reconstruction algorithms are used between data and simulation. Both generated and reconstructed event display main features of inclusive electron cross section, namely elastic peak, resonance region with "bumps" and smooth DIS region.



Acceptance Correction



Sample of the acceptance correction for a few Q^2 bins

Luminosity Correction

Luminosity correction is based on the geometry and properties of the target (5 cm length liquid hydrogen) and integrated beam charge collected on the Faraday cup. It is accounted for the Live Time of the Data Acquisition system.

CLAS12 vs World data Comparison

CLAS12

Parameterization of World data

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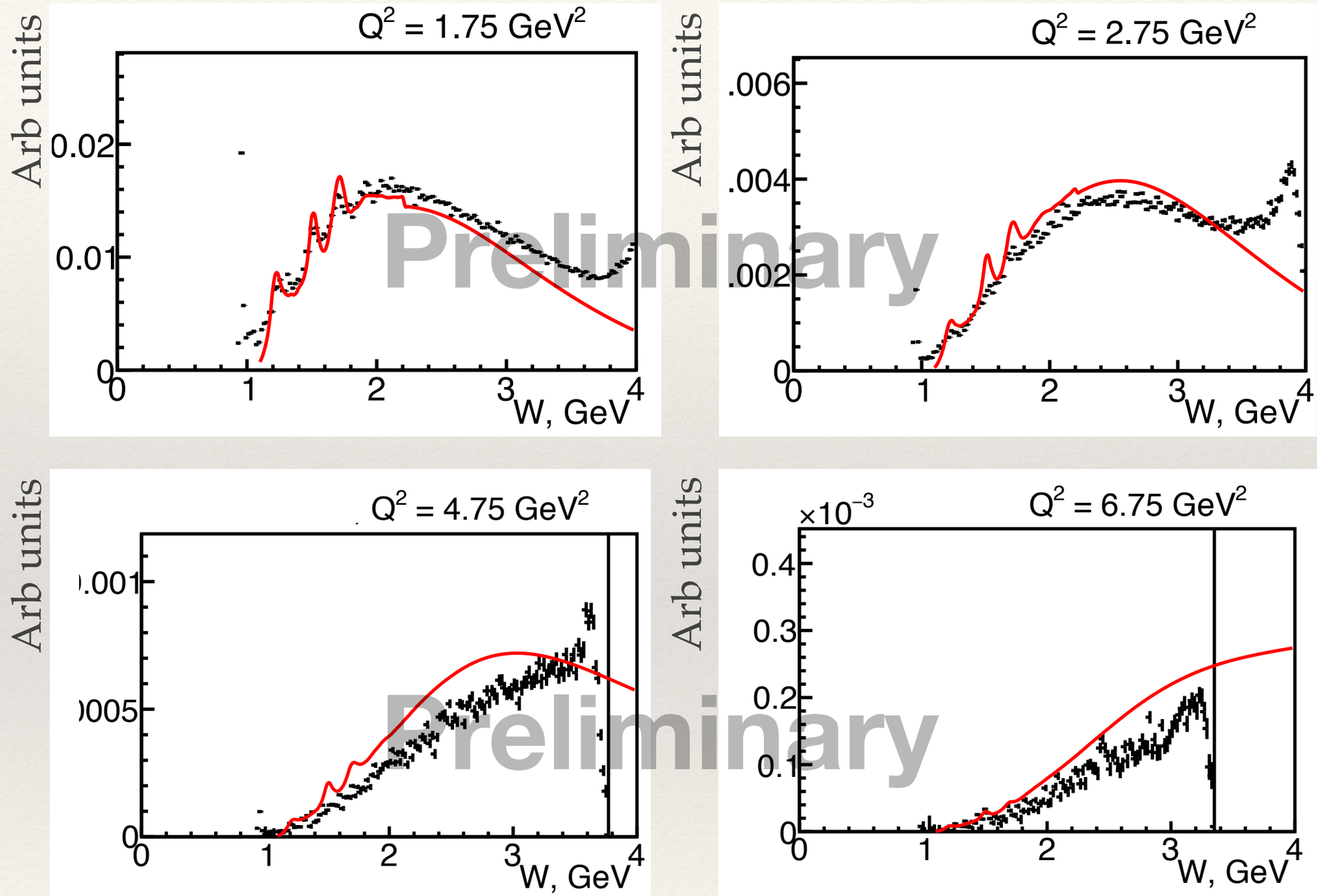


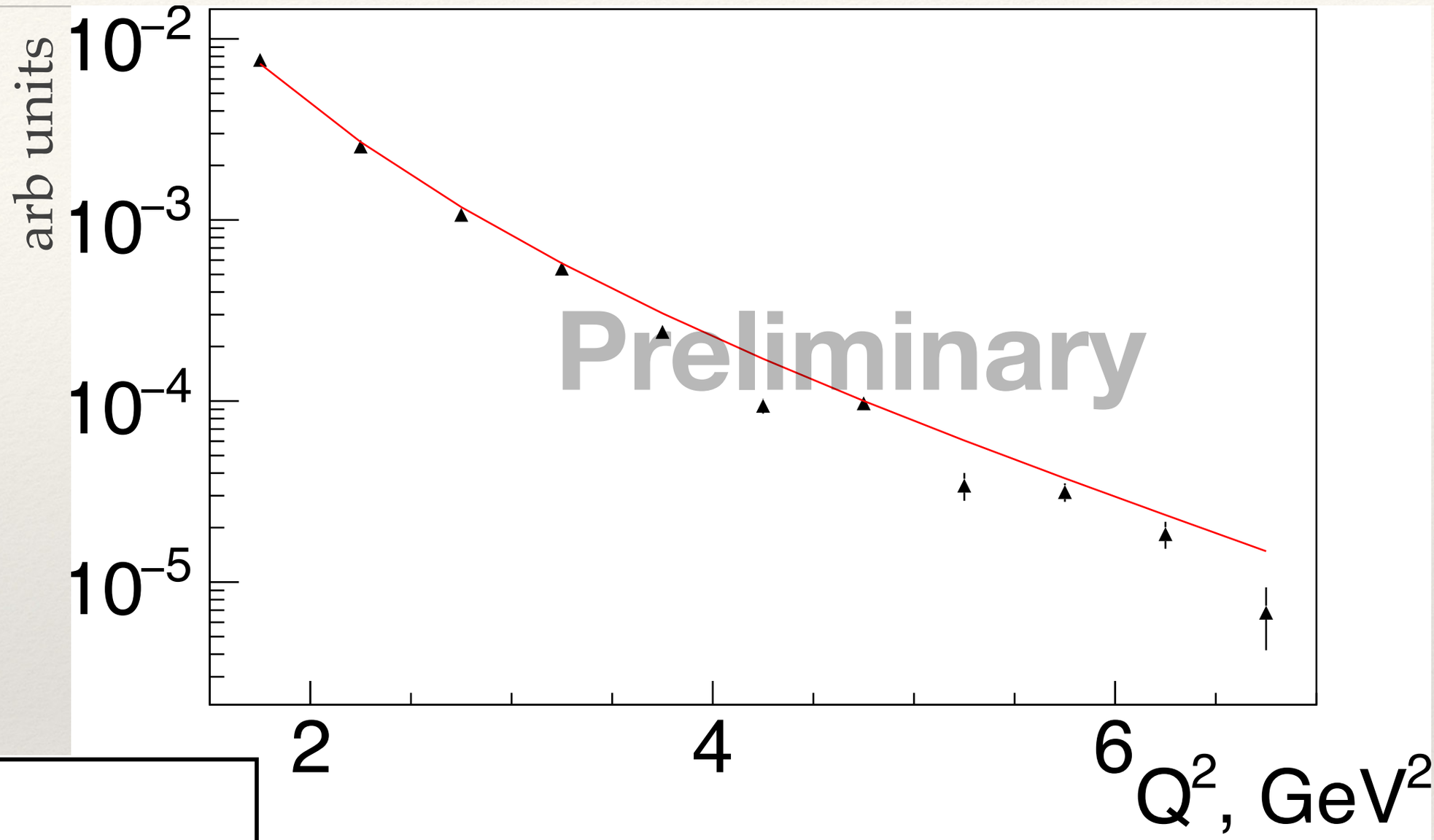
Experimental data (CLAS12) is only acceptance and luminosity corrected.
Displays a reasonable agreement in a wide kinematical range with a world data.

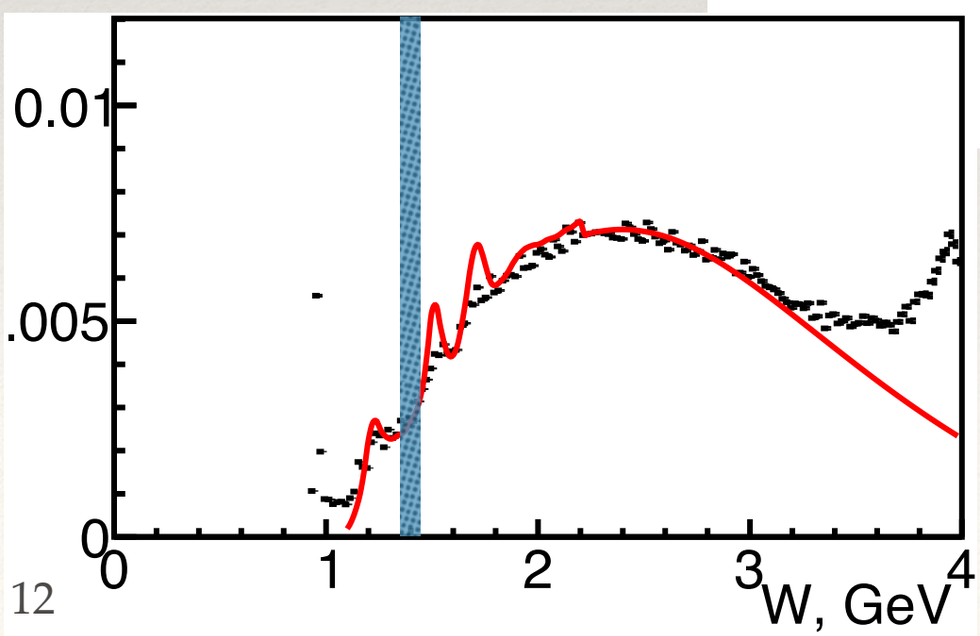
CLAS12 vs World data Comparison (as a Function of Q^2)

CLAS12

Parameterization of World data

W = 1.4 GeV



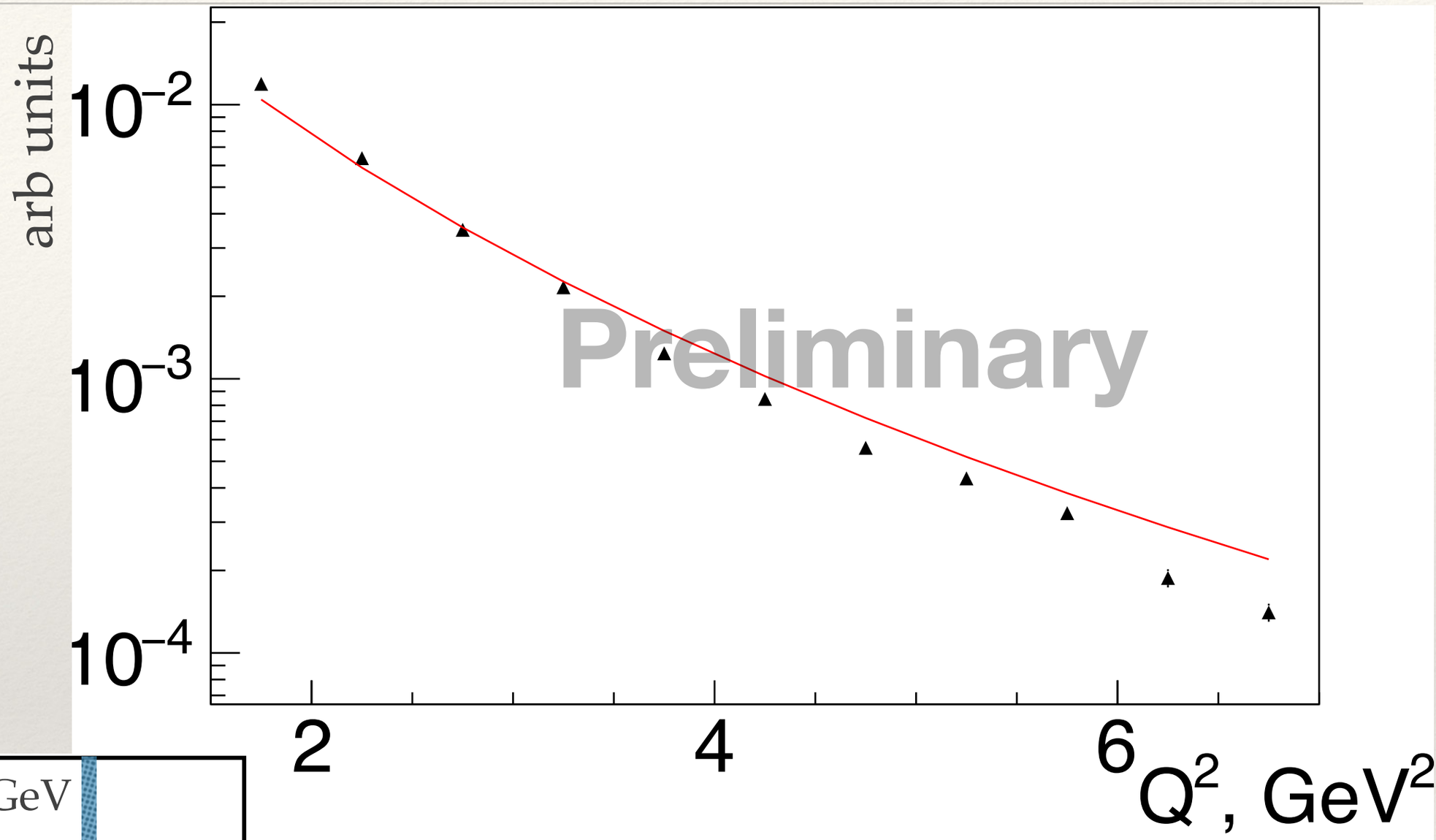


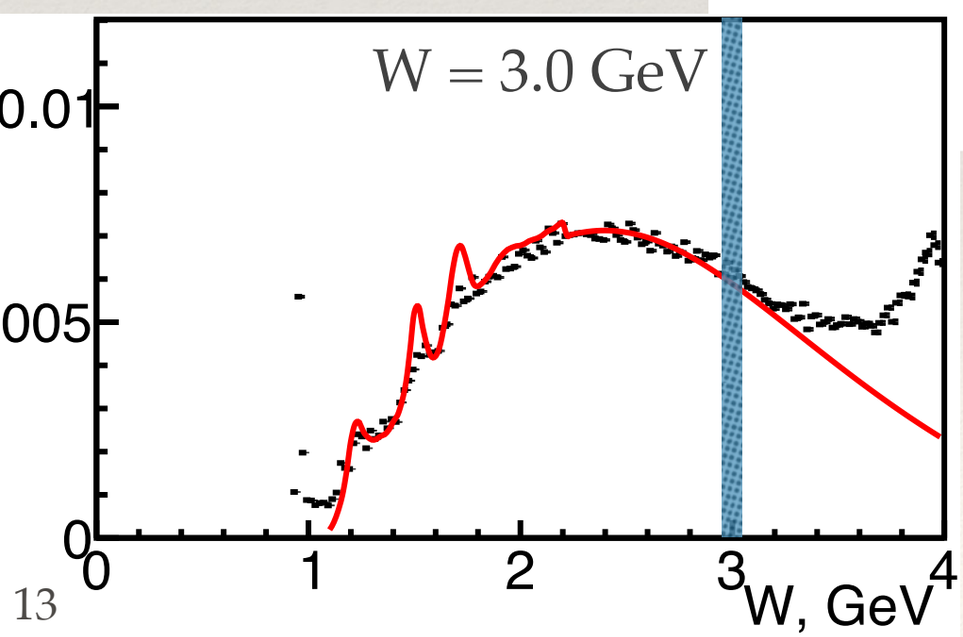
Experimental data (CLAS12) is only acceptance and luminosity corrected. Displays a reasonable agreement in a wide kinematical range.

Data to Model Comparison (as a Function of Q^2)

CLAS12
Parameterization of
World data

W = 3.0 GeV





Experimental data (CLAS12) is only acceptance and luminosity corrected. Displays a reasonable agreement in a wide kinematical range.

Future plans

- Improvement of electron ID procedure;
- Better understanding of detector efficiency;
- Radiate corrections;
- Bin centering corrections.

Summary

- Preliminary results on the acceptance corrected and luminosity normalized yields of inclusive electron scattering events have become available from the CLAS12 in the kinematic area of 1.1 GeV <W< 4.0 GeV and 1.5 $GeV^2 < Q^2 < 8$ GeV^2;
- The shapes of the W-dependencies of the event yields are in a reasonable agreement with the obtained from the interpolation of the CLAS/world data on inclusive electron scattering;
- The next step is the extraction of the inclusive electron scattering cross sections;
- The approach for the evaluation of the resonance contributions to inclusive electron scattering based on the CLAS results on $\gamma_v pN^*$ electrocouplings has been developed and published. It is ready to use in the inclusive data analysis.

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