Dispersion relation results for VCS at JLab

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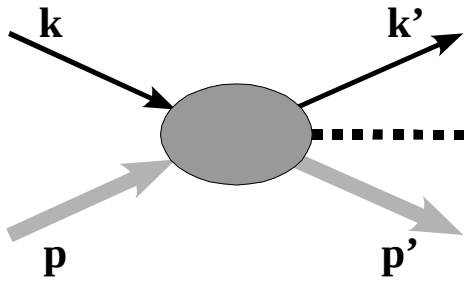
Virtual Compton Scattering @ Jefferson Lab

Extraction of Proton Generalized Polarisabilities
at Q^2=1.0 and 1.9 GeV^2
using a Dispersion Relations formalism

Compton Scattering from low to high momentum transfer
Trento, Italy, April 2003

Electroproduction of photons experiment: analysis below and above π^0 production threshold

H(e,e'p)γ



$$d\sigma^0_{exp} = \frac{N_{exp}}{N_{sim}} \times \frac{L_{sim}}{L_{exp}} \times d\sigma^0_{sim}.$$

We need an accurate Monte Carlo simulation in order to obtain the experimental cross section.

First order Generalized Polarisabilities are not valid in the Δ region.

Low E_γ	Around π^0 threshold	Δ region
Bethe−Heitler + Born	1^{st} Order GP	Dispersion Relations

We need a new model to describe the cross sections in the resonance region.

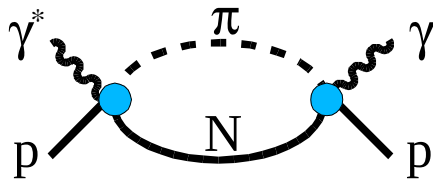
Proton Generalized Polarisabilities extraction above π^0 production threshold

Analyticity
+
Crossing Rules
+
Unitarity

Dispersion Relations

Non−Born Amplitudes
<=>
Generalized Polarisabilities

Intermediate States πN Amplitudes



This formalism has 2 free parameters: the 2 generalized polarisabilities

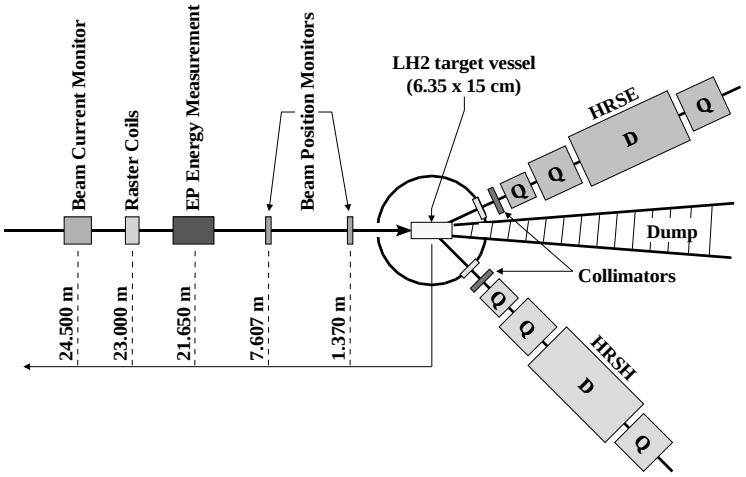
$\alpha(Q^2)$ and $\beta(Q^2)$

=> valid until the 2 pions production threshold

=> related to the structure functions $P_{LL} - P_{TT}/\varepsilon$ and P_{LT}

B. Pasquini, M. Gorchtein, D. Drechsel, A. Metz and M. Vanderhaeghen, Eur. Phys. J. A11 (2001) 185

Jlab E93050



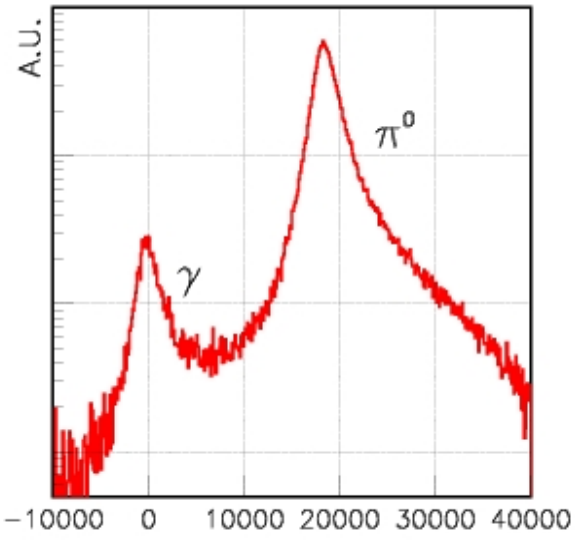
Absolute cross sections measurement

Coincidence e/p

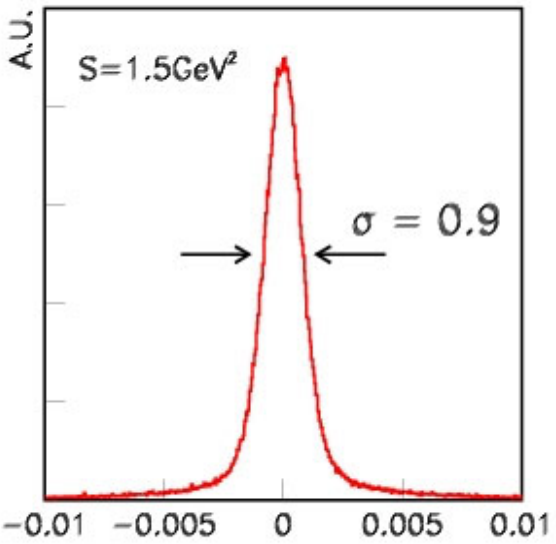
Need good resolution for γ/π^0 separation

Normalization controled at low E_γ

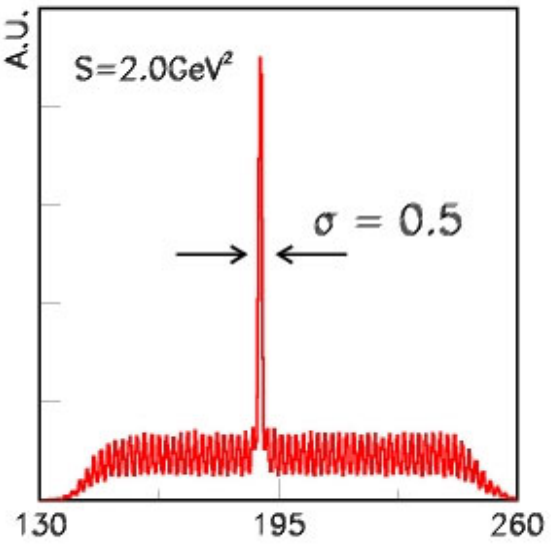
Missing mass (MeV^2)



Vertex Reconstruction (mm)



Coincidence Time (ns)



Analysis

BELOW π^0 THRESHOLD

Low Energy Theorem Analysis ⟶ VCS Structure functions

$Q^2 = 0.923\ GeV^2$ $\varepsilon = 0.950$

$Q^2 = 1.760\ GeV^2$ $\varepsilon = 0.879$

$\mathbf{P_{LL} - P_{TT}/\varepsilon}$, $\mathbf{P_{LT}}$

ABOVE π^0 THRESHOLD

Dispersion Relations Analysis ⟶ 2 DR Parameters

$Q^2 = 0.923\ GeV^2$ $\varepsilon = 0.950$

$Q^2 = 1.760\ GeV^2$ $\varepsilon = 0.879$

Λ_α , Λ_β related to α and β via a dipole form:

$$\alpha(Q^2) - \alpha^{\pi N}(Q^2) = \frac{\alpha - \alpha^{\pi N}}{(1 + Q^2 / \Lambda_\alpha^{\,2})^{\,2}}$$

$\Delta(1232)$ REGION

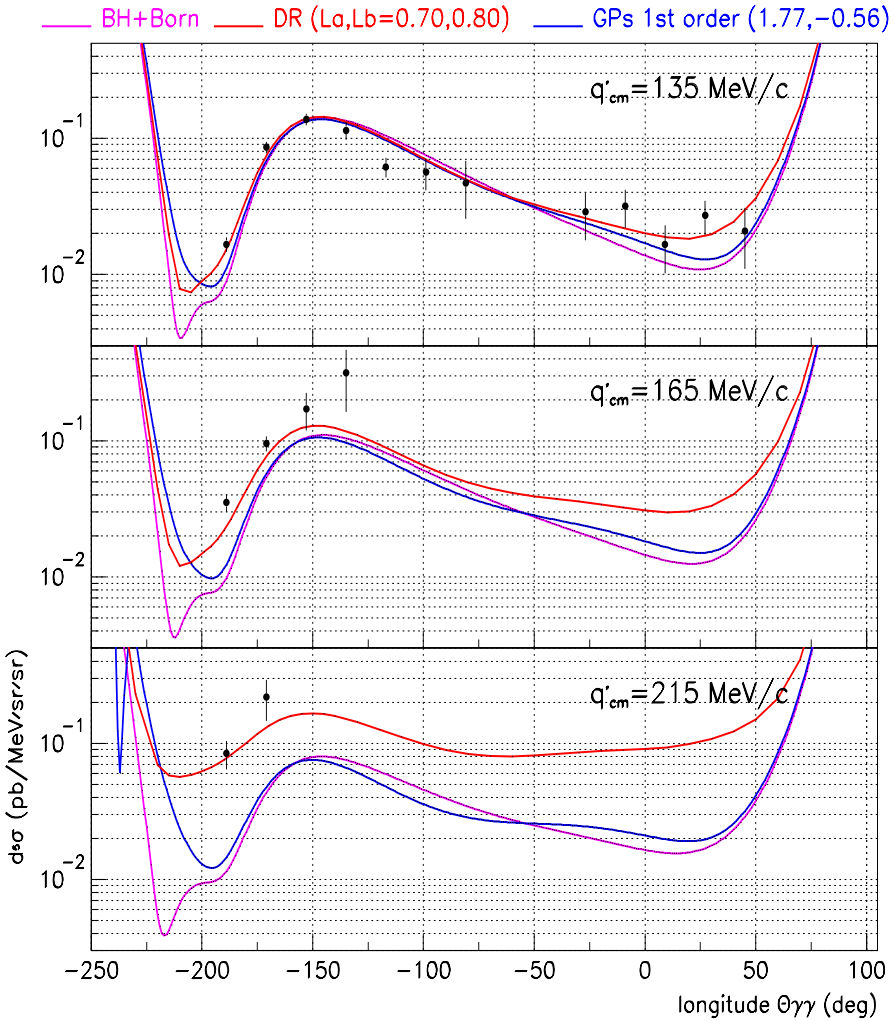
Dispersion Relations Analysis ⟶ 2 DR Parameters

$Q^2 = 0.923\ GeV^2$ $\varepsilon = 0.950$

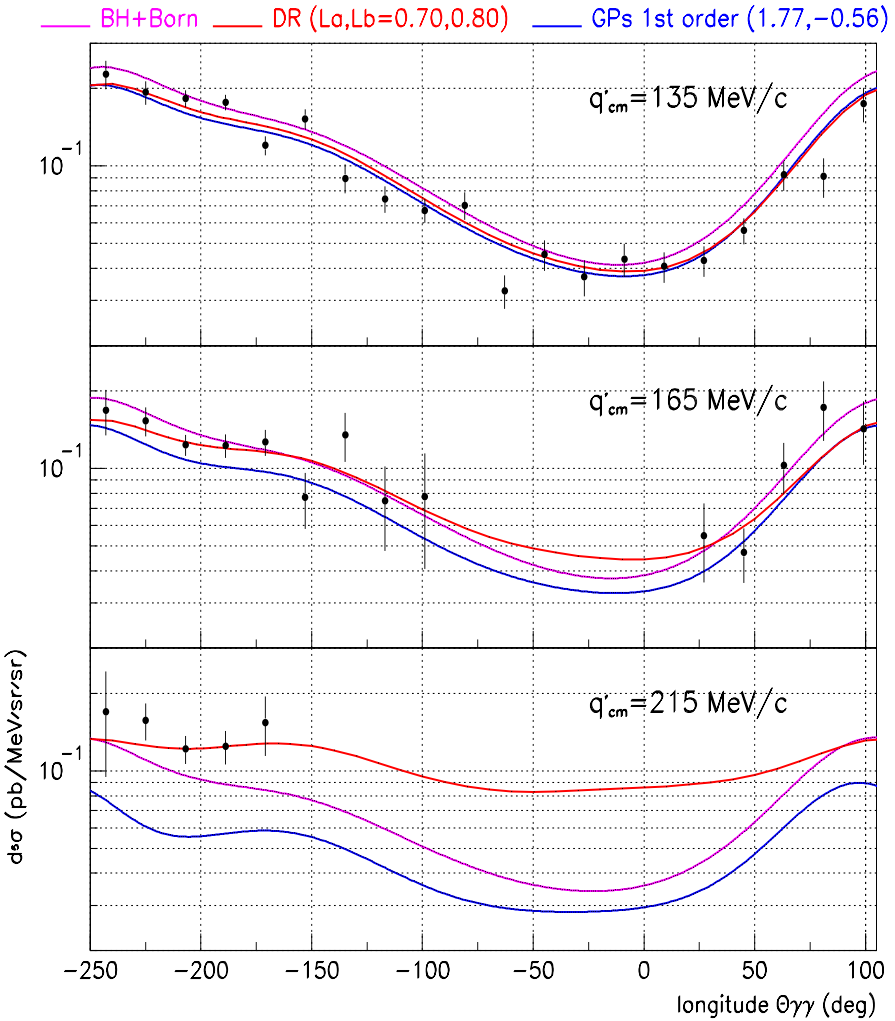
Λ_α , Λ_β

Cross sections at $Q^2 = 0.923$ GeV^2 above π^0 production threshold

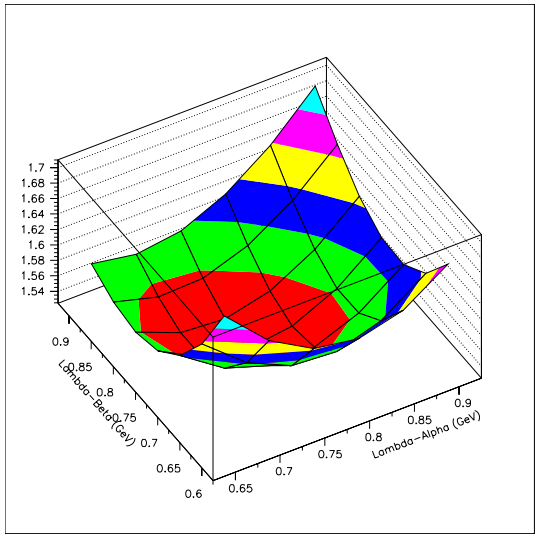
Lepton Plane

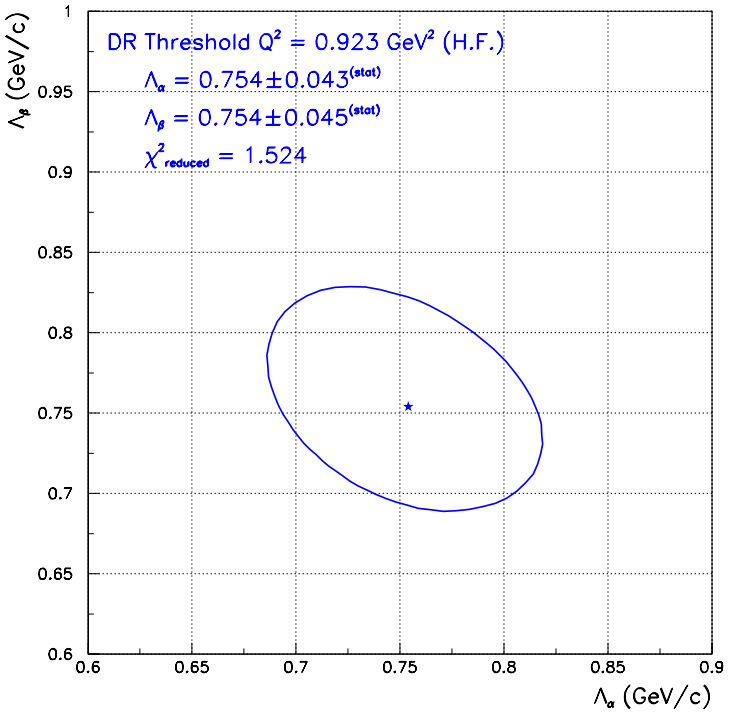


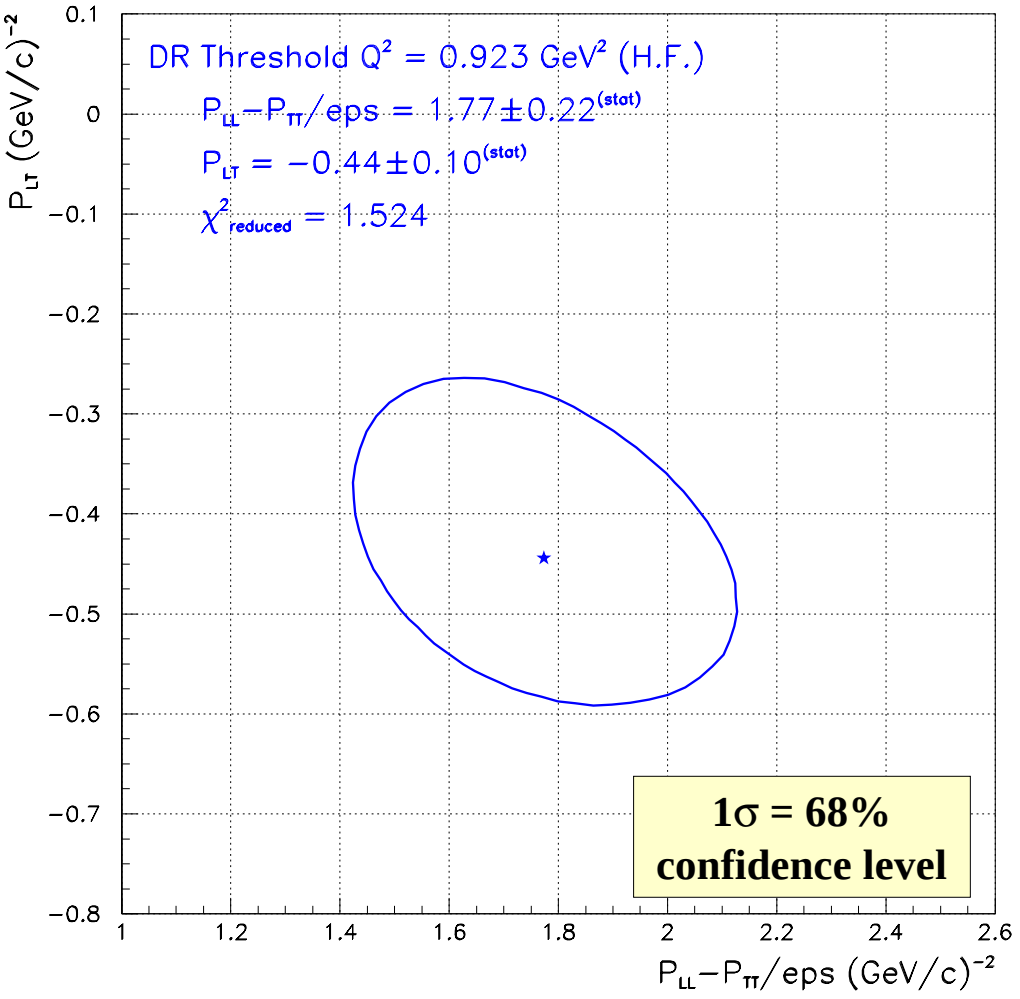
40° Out−Of−Plane



Dispersion relations fit at $Q^2 = 0.923$ GeV^2 above π^0 production threshold

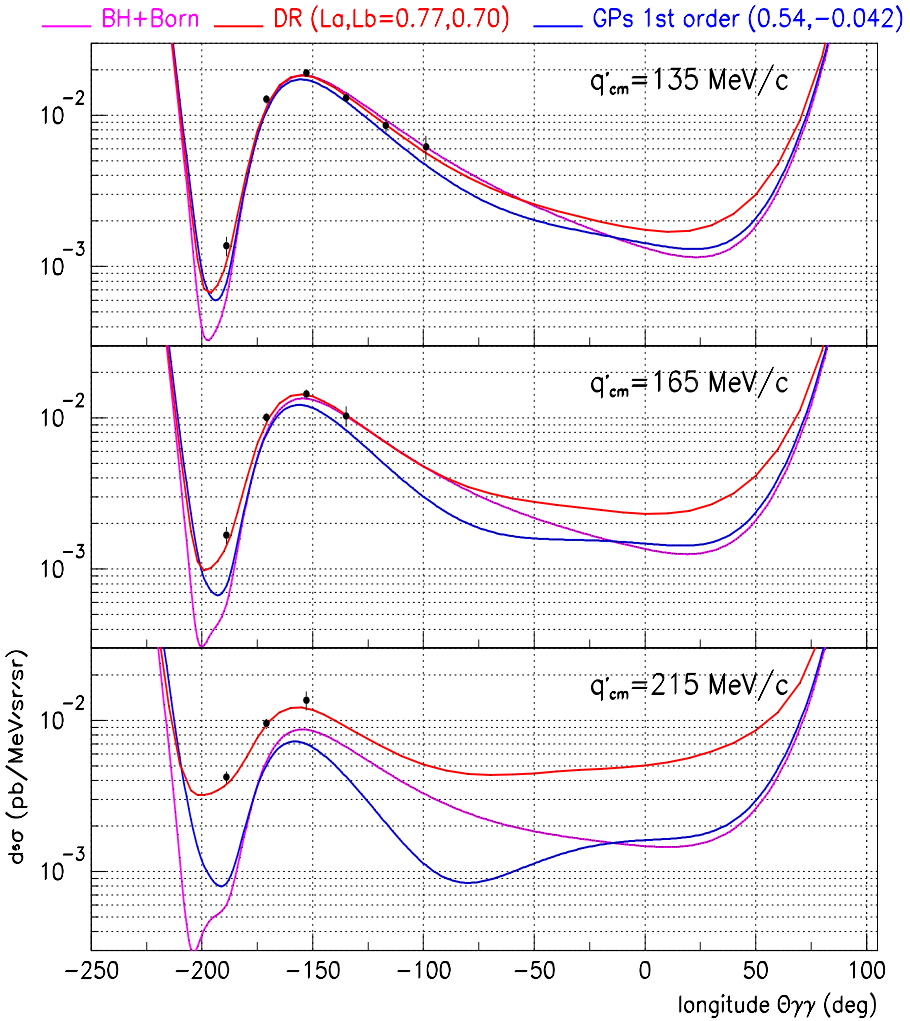




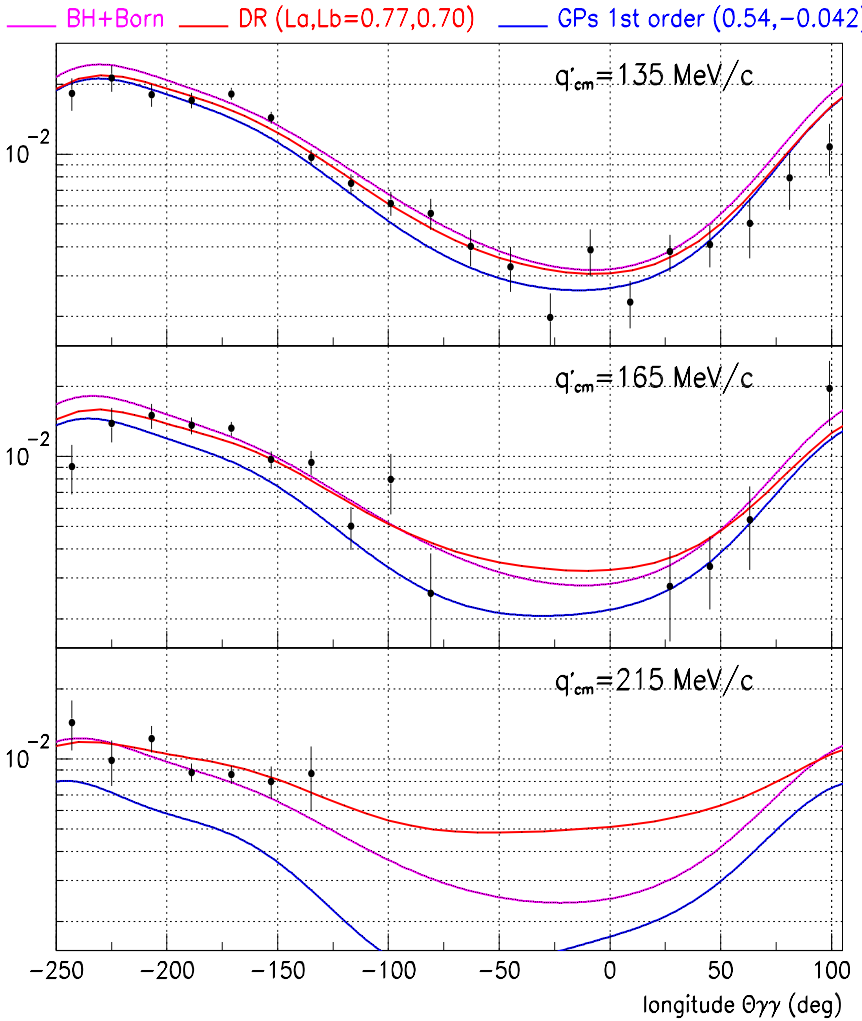


Cross Sections at $Q^2 = 1.760$ GeV^2 above π^0 production threshold

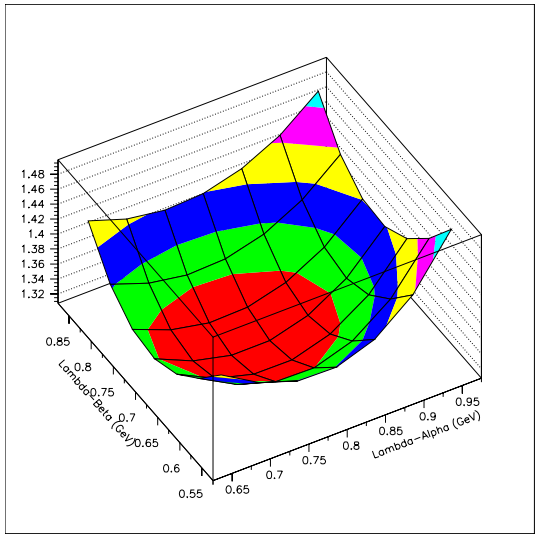
Lepton Plane

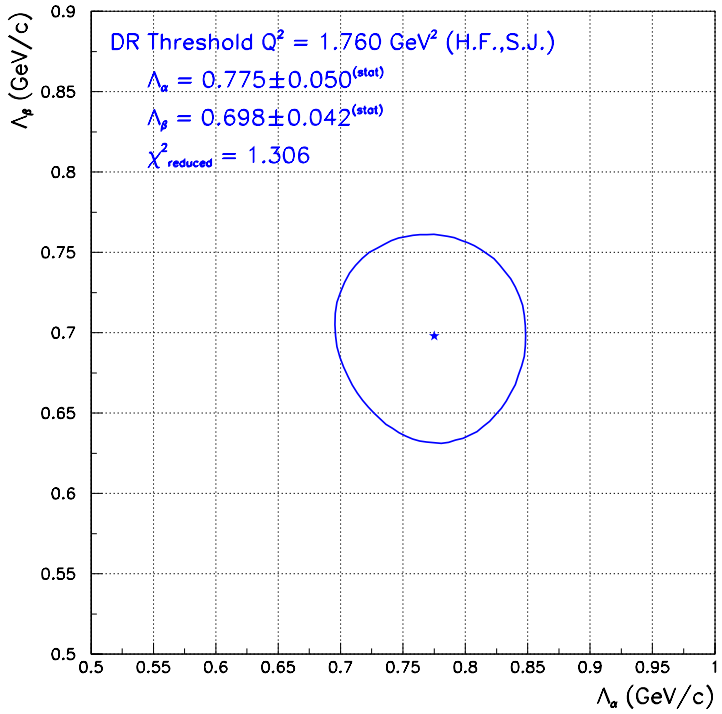


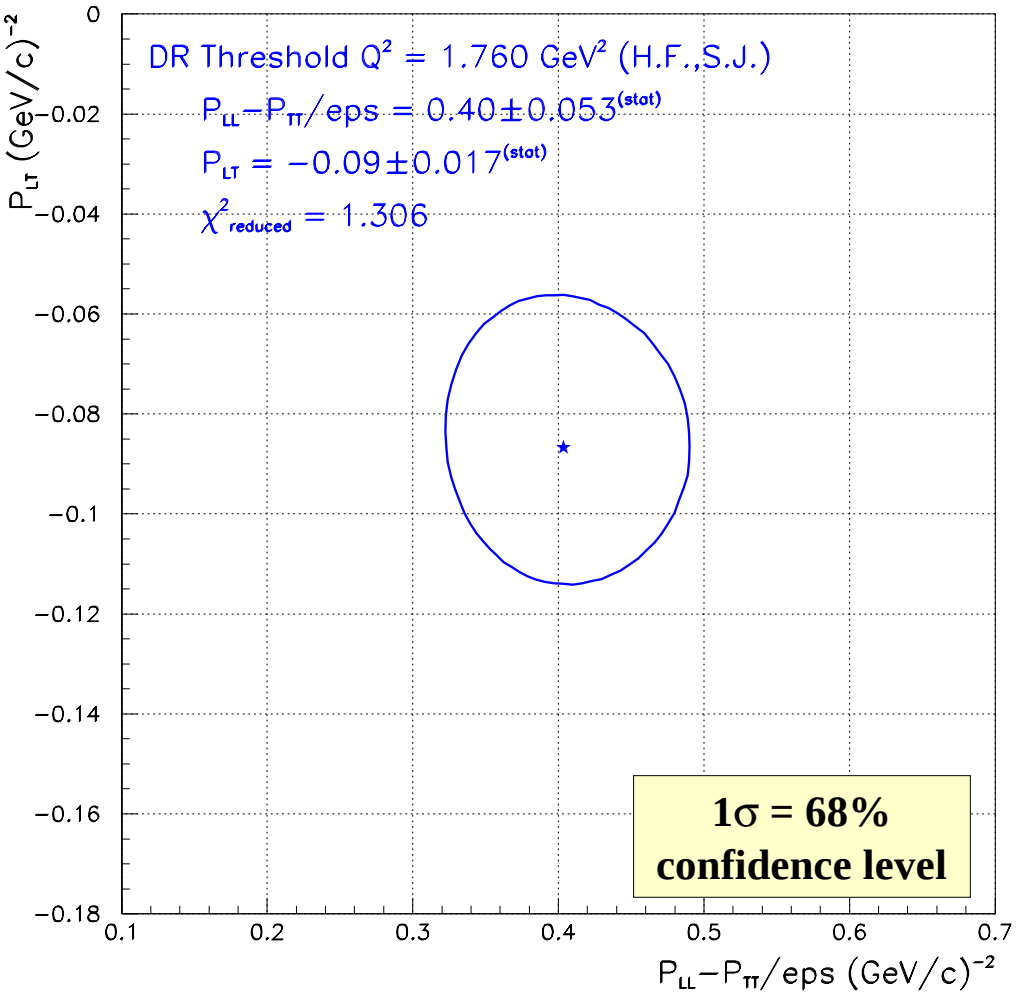
40° Out−Of−Plane



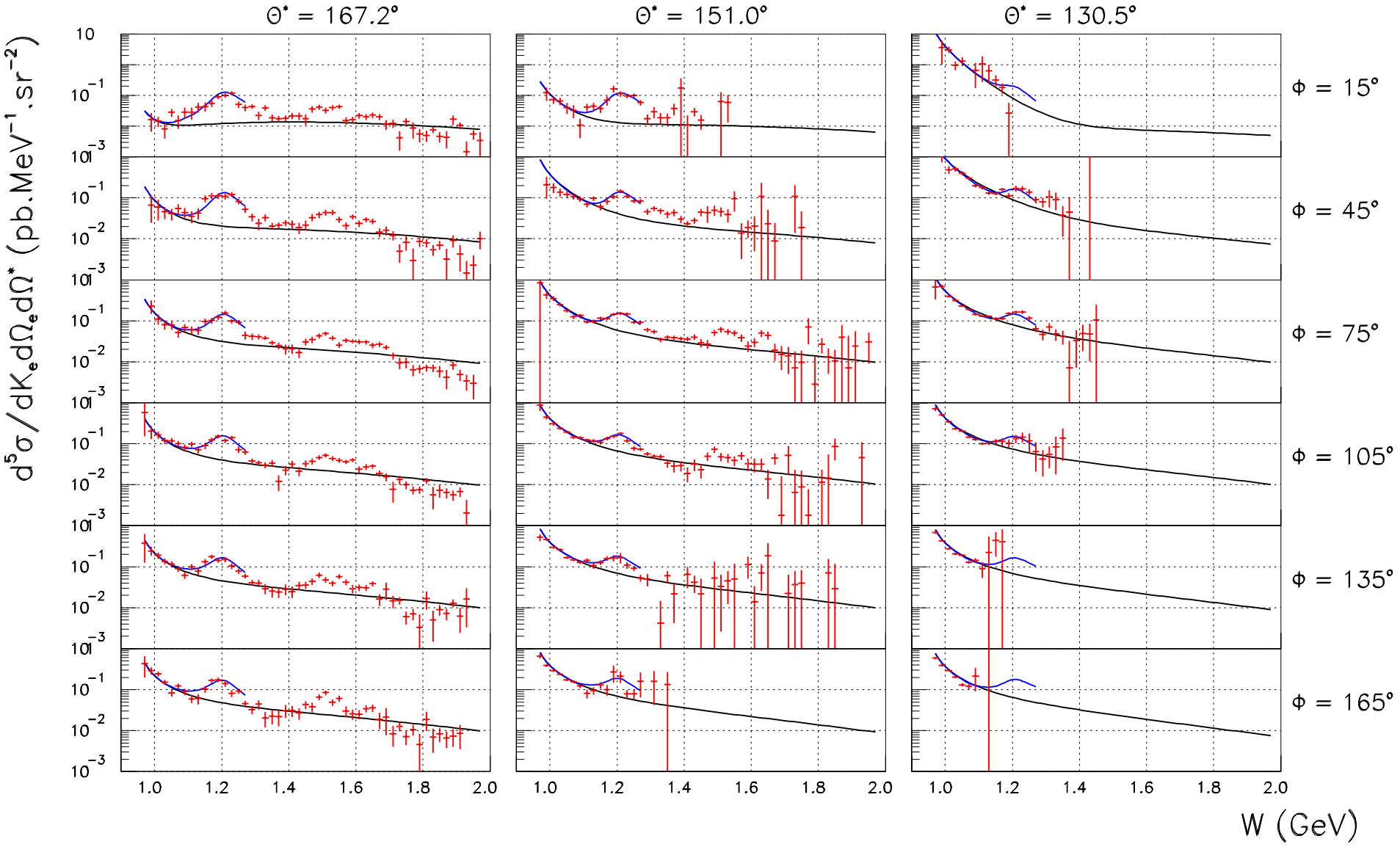
Dispersion relations fit at $Q^2 = 1.760$ GeV^2 above π^0 production threshold



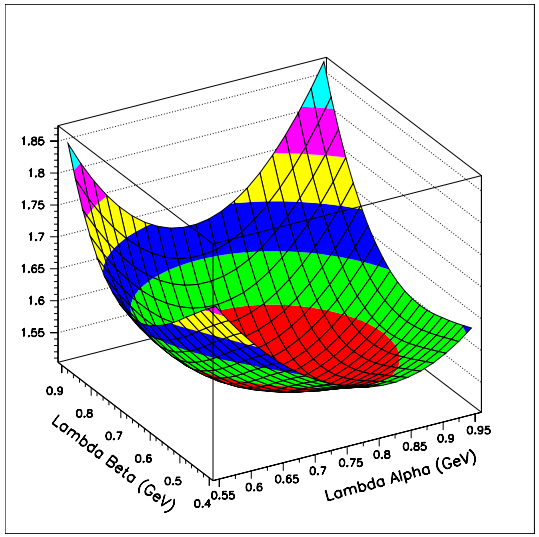


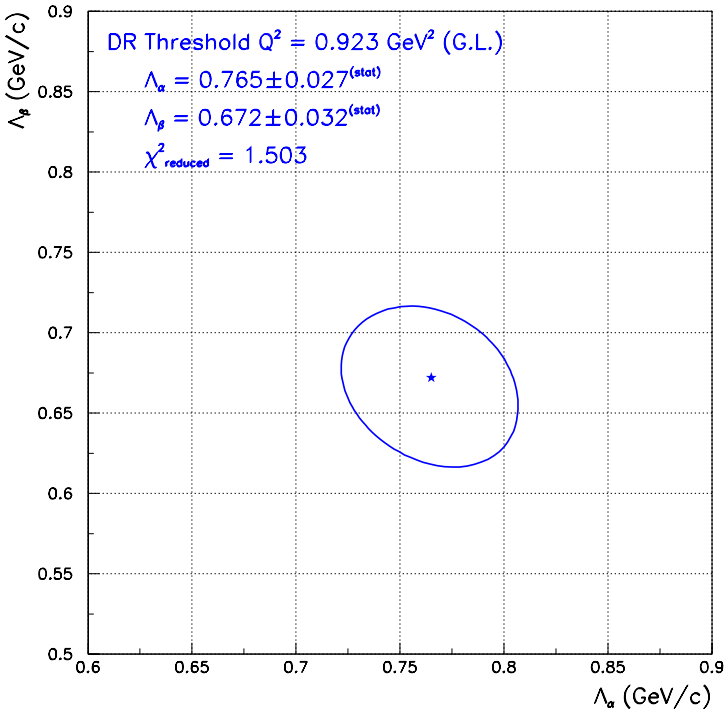


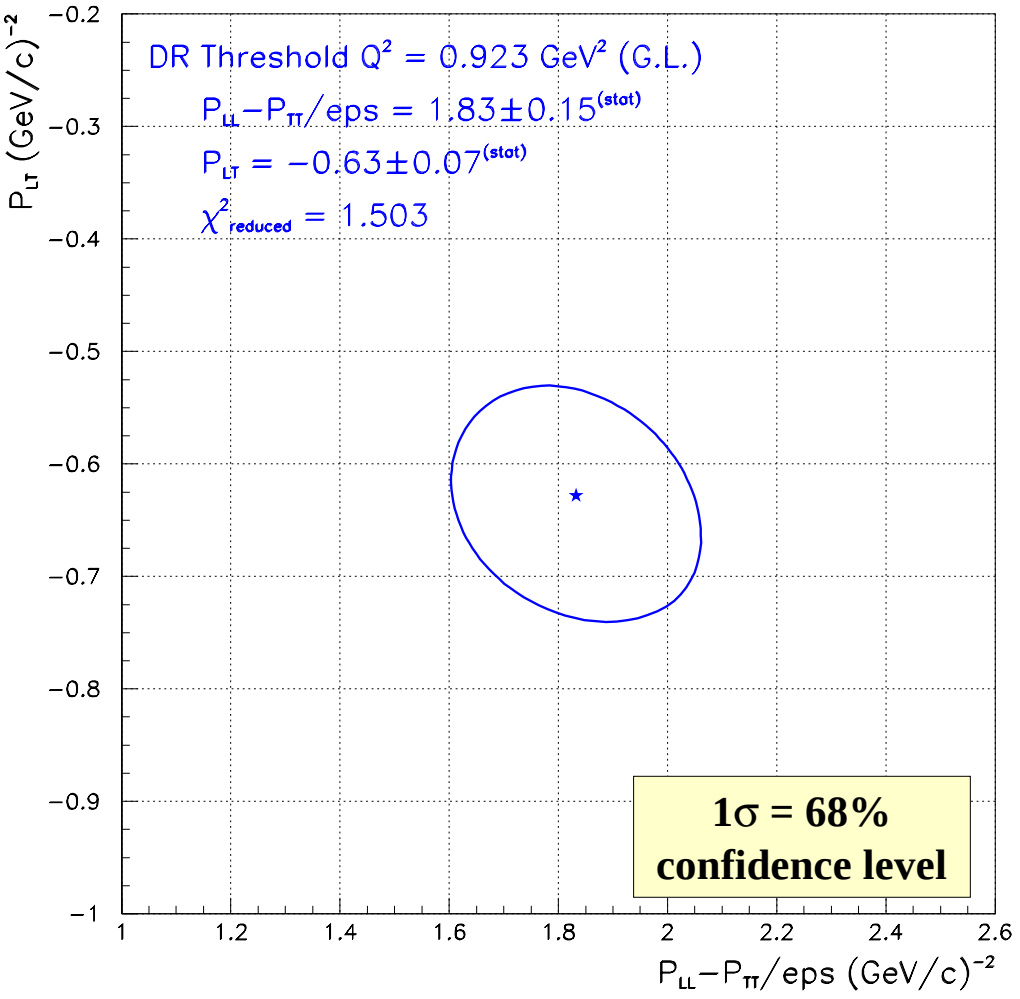
Cross sections at $Q^2 = 0.923$ GeV^2 in the Δ resonance region



Dispersion relations fit at $Q^2 = 0.923$ GeV^2 in the $\Delta(1232)$ region



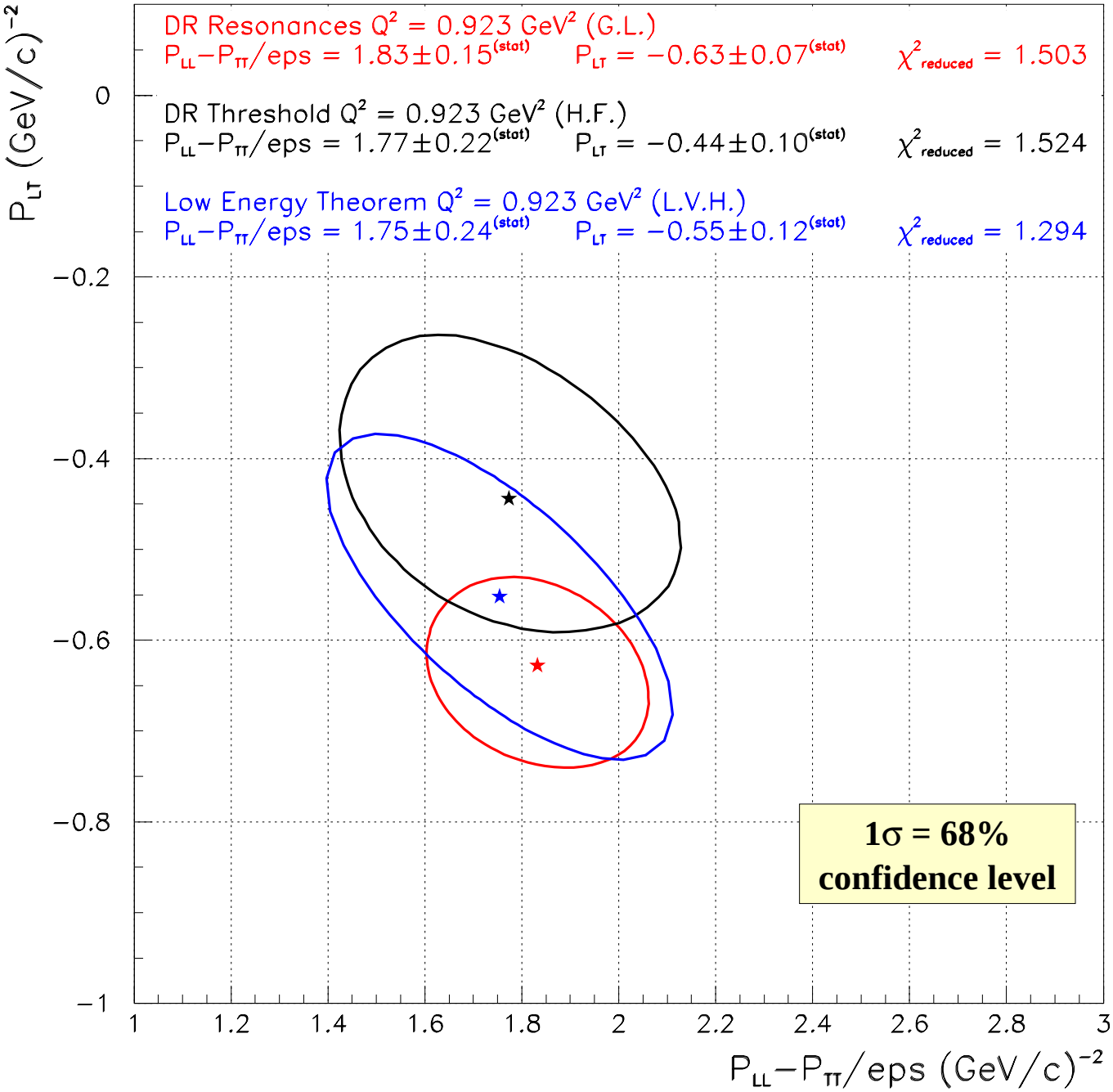




Comparison of structure functions

3 different analysis

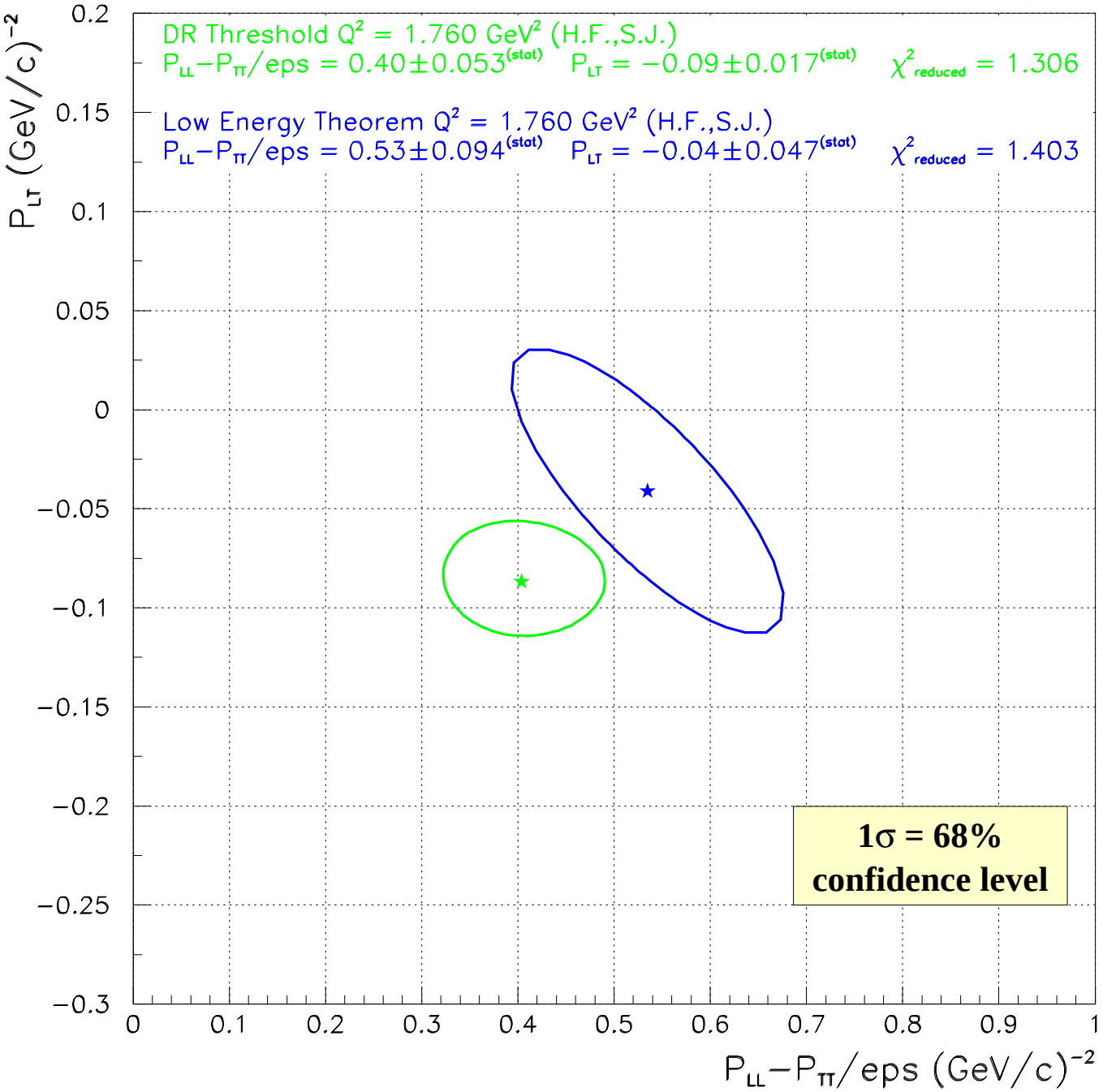
$Q^2 = 0.923$ GeV^2



Comparison of structure functions

LEX and DR analysis

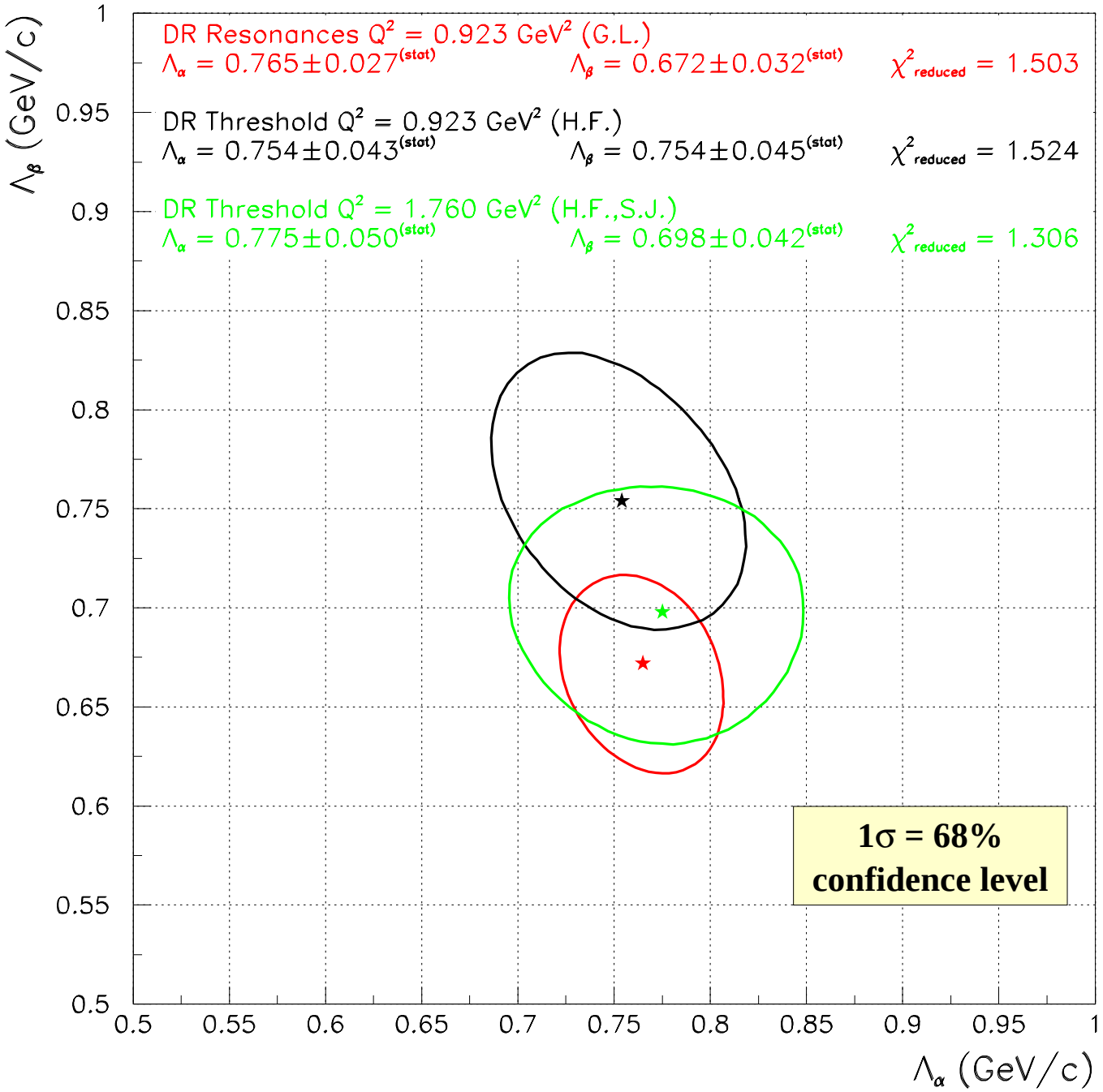
$Q^2 = 1.760$ GeV^2



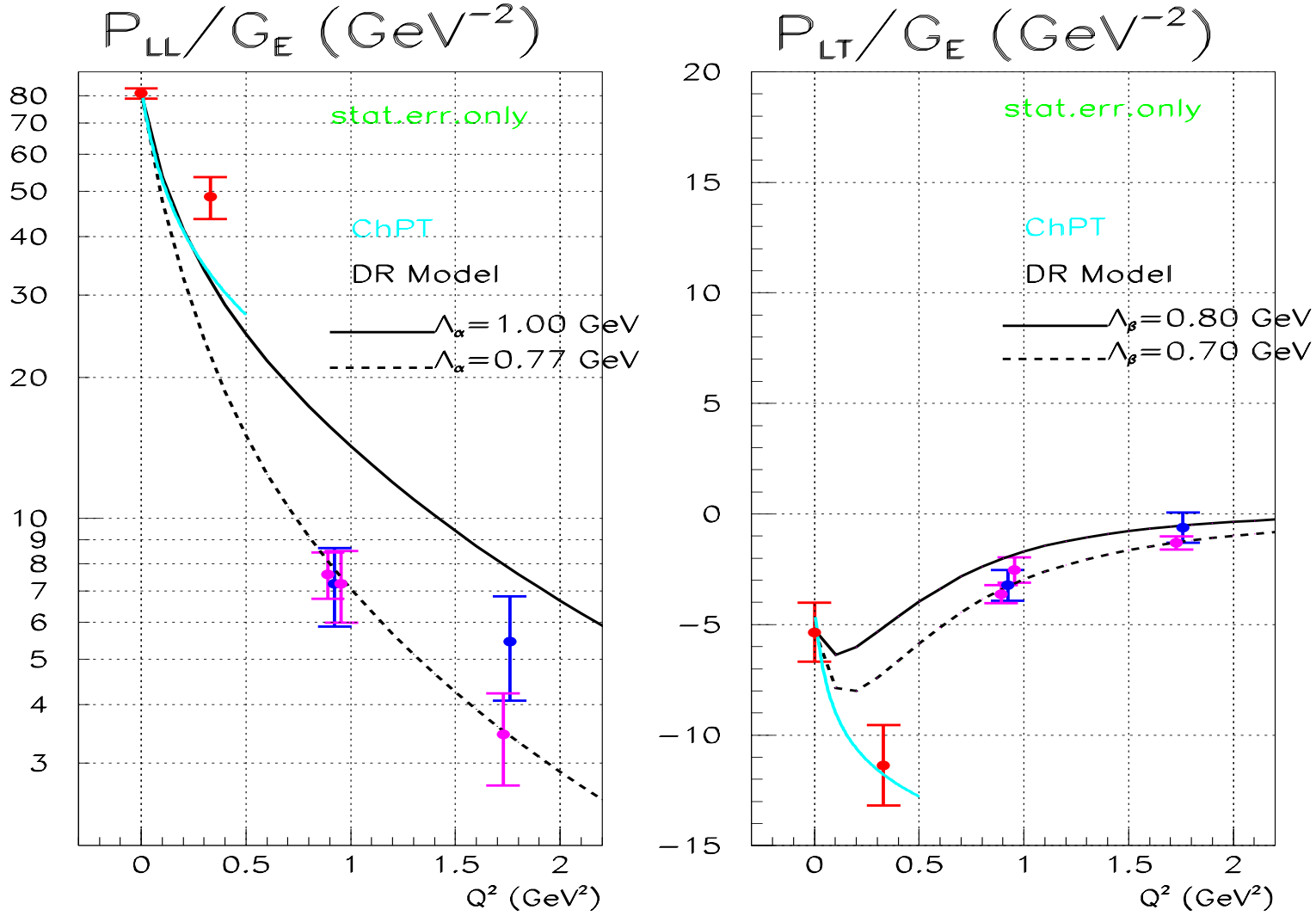
Comparison of dispersion relations parameters

3 different analysis

Dipole form is pretty good !!



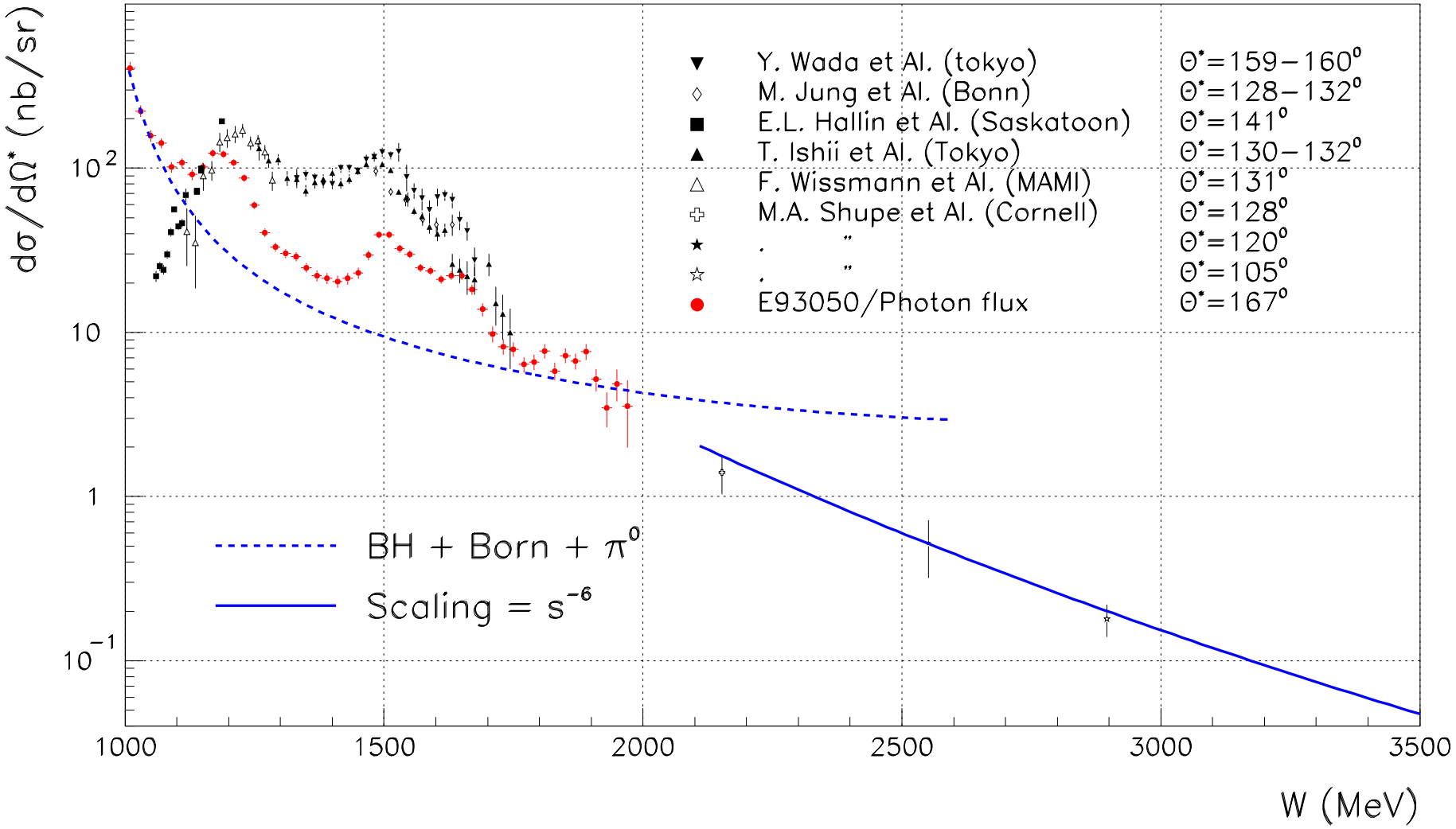
Summary



proton EM Form factors = parametrization of Brash et al.

exp. point at Q^2=0.00 / (RCS) V.Olmos de Leon et al., Eur.Phys.J.A10 (2001) 207
exp. point at Q^2=0.33 / VCS (Mami) J.Roche et al, Phys.Rev.Lett.85 (2000) 798
exp. point at Q^2=0.92 and 1.76 / VCS JLab E93050 LEX analysis
exp. point at Q^2=0.92,0.92 and 1.76 / VCS JLab E93050 DR analysis

VCS / RCS Comparison



Cross sections of the same order (Q^2), Identical Resonances VCS follows « scaling »?