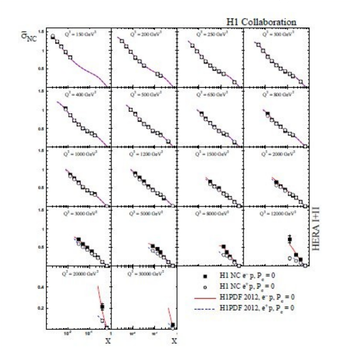
20 years of DIS at HERA

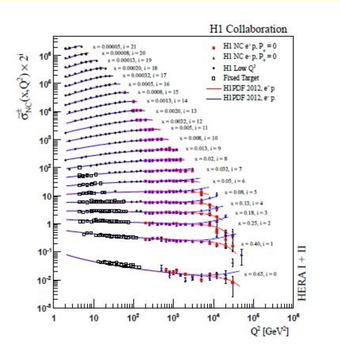
The Proton under the HERA Microscope

Proton Structure $F_2(x, Q^2)$



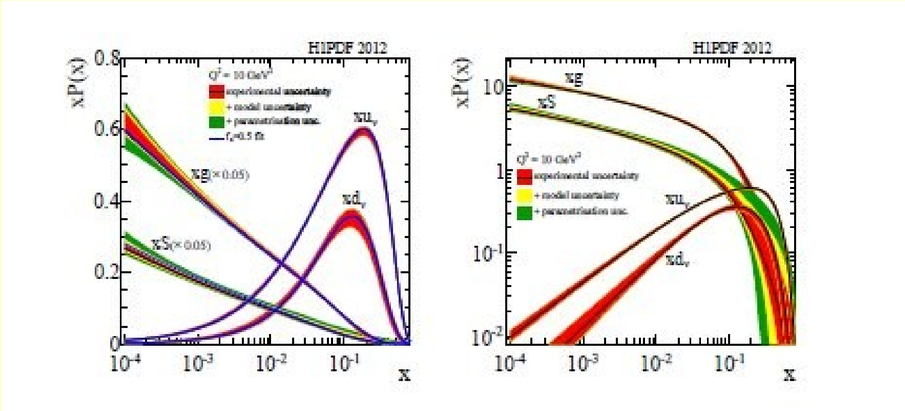
High precision in wide x, Q^2 range

Scaling violations



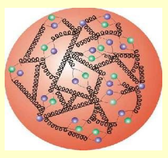
Well described by QCD evolution

Proton PDF's

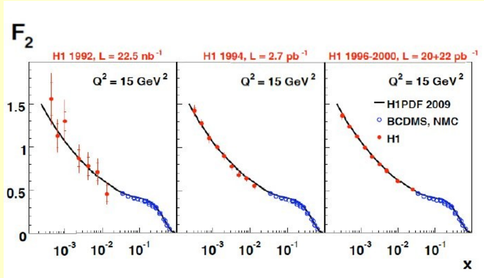


The QCD analysis of the DIS cross sections determine the proton PDFs, using the HERA FITTER framework.

Summary plot of the H1PDF2012 showing the distributions of u and d valence quarks, of the gluon and the sea quarks, at the evolved scale of 10 GeV^2

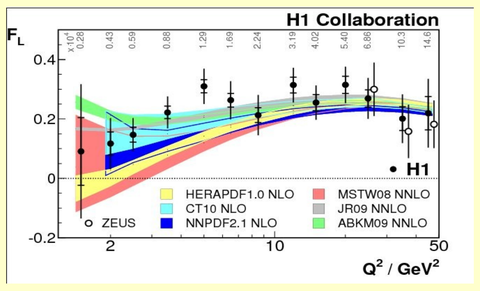


$F_2(x, Q^2)$



1993 – 2007: impressive improvement in precision

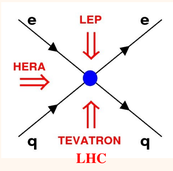
F_L



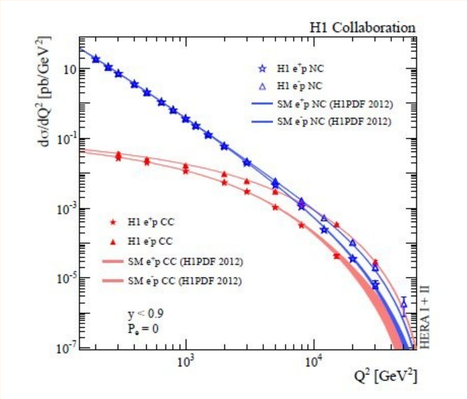
Direct measurement of the Longitudinal Structure Function F_L with the H1 detector at HERA

HERA – Energy Frontier

Resolution Power ~ 10^{-18} m

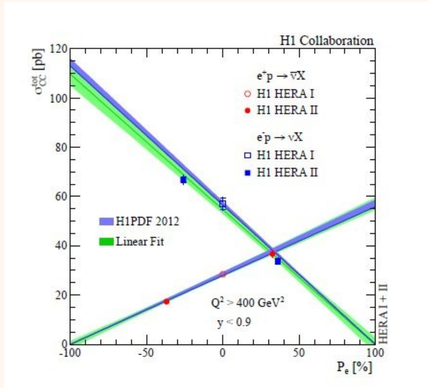


ElectroWeak Unification



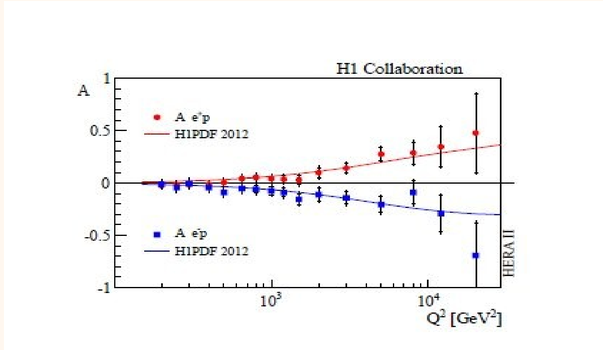
The measurements illustrate the Unification of the Electromagnetic and the Weak interactions in DIS: Electromagnetic (NC) and Weak (CC) interactions become of similar strength at high energies (Q^2)

Direct Observation of the Chiral Structure of the ElectroWeak Interaction



CC Cross Section:
Measurements with different Helicity and Charge states of the polarised lepton beam

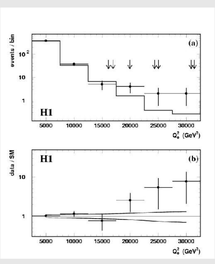
NC Polarisation Asymmetry

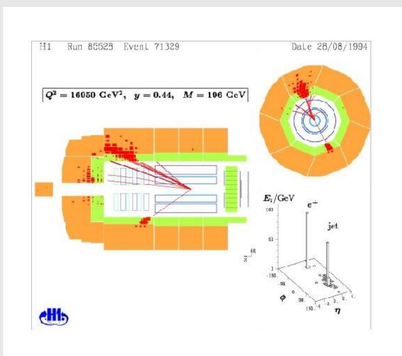


The Standard Model expectation using H1PDF2012 is in good agreement with the data.
The measurements confirm the Parity Violation effects in NC ElectroWeak interactions at large Q^2.

New Physics beyond the Standard Model?

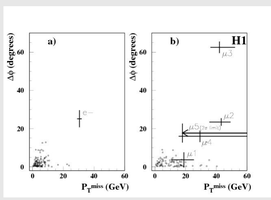
Leptoquarks ?



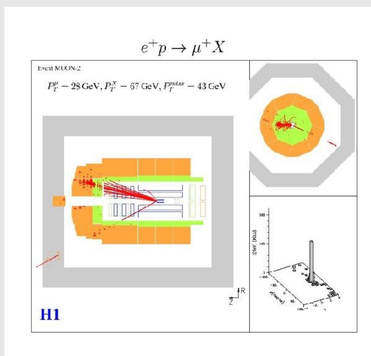


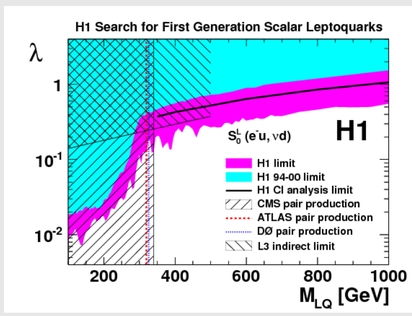
High Q^2 NC events:
at first, rate in excess of Standard Model ...

SUSY ?

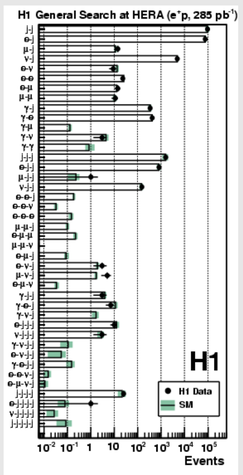


"Isolated Lepton events:
a charged Lepton,
a Jet and missing P_T





Limits for Leptoquark production

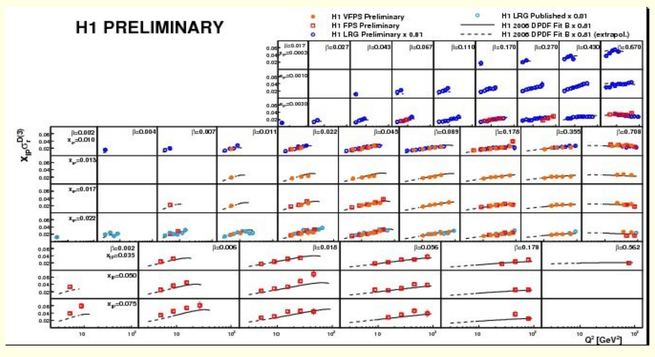


General search for New Physics

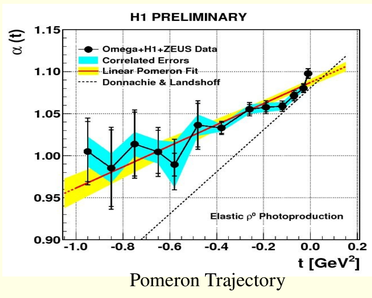
With growing statistics, in the end, the Standard Model rules !

HERA – QCD Laboratory

Diffractive Structure

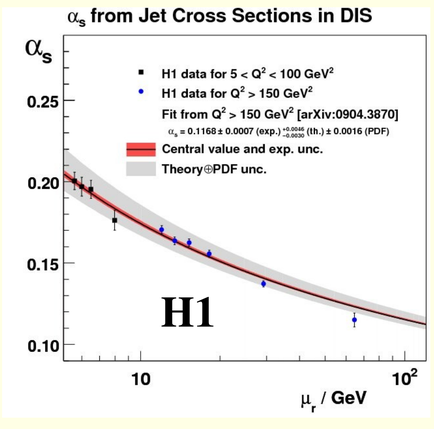


Vector Meson production



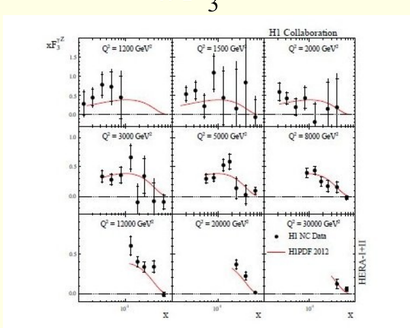
Pomeron Trajectory

Running Strong Coupling



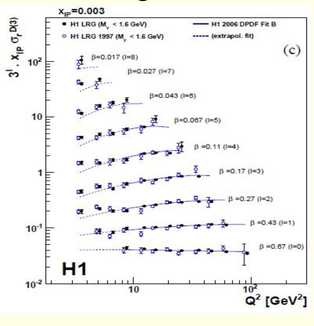
Observed within one experiment

$x F_3^{\gamma Z}$

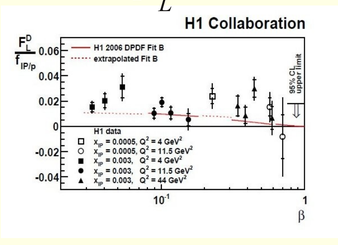


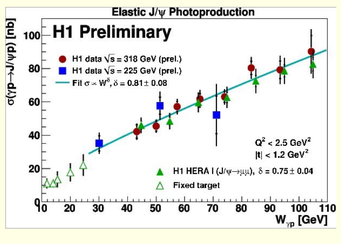
Valence Quarks

Scaling Violations



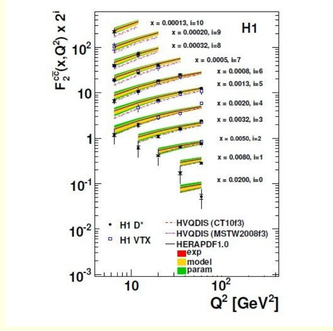
F_L^D





Originally not expected, diffraction in DIS became one of the highlights of HERA physics

CHARM in Proton



C. Diaconu, J. Feltesse, N. Gogitidze, S. Levonian, J. Meyer, J. Olsson – on behalf of the H1 Collaboration