

The H1 collaboration at DESY

Special colloquium
for summer students 2011

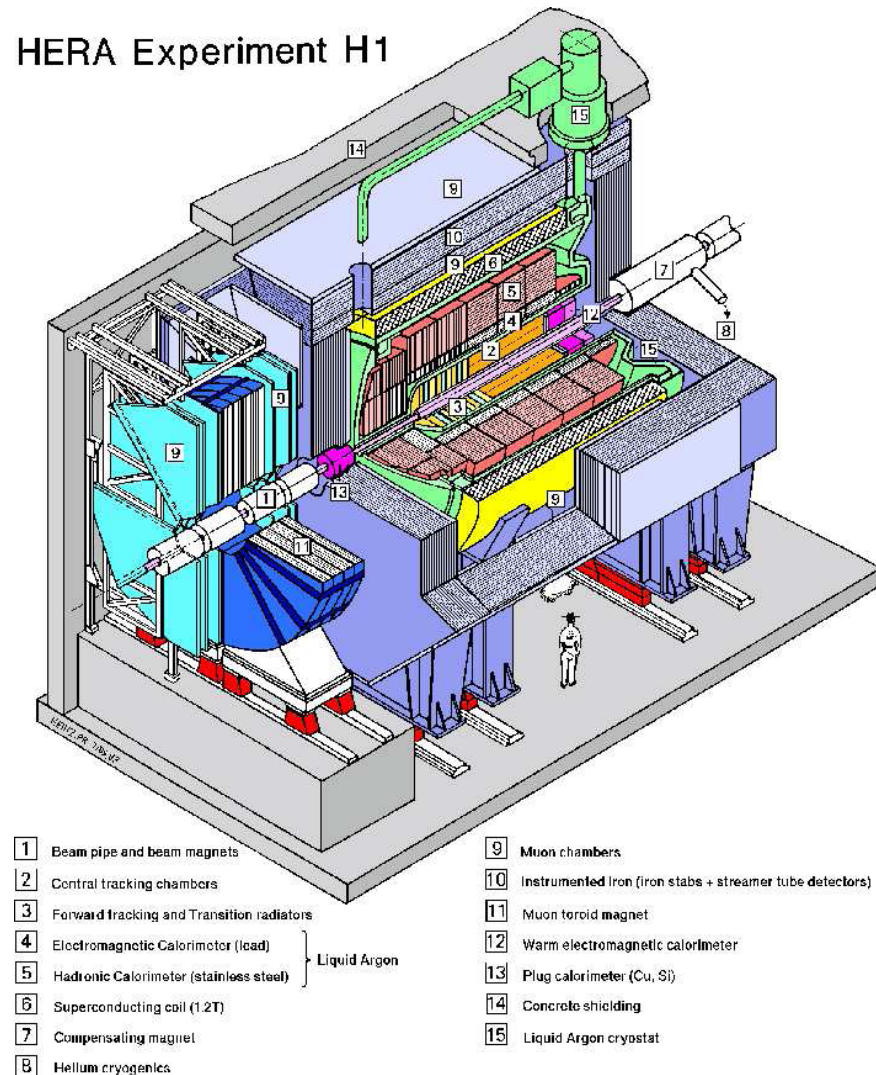


- The H1 experiment
- The H1 collaboration
- Activities of the H1 collaboration
- Example: PDF determination

August 24, 2011, Stefan Schmitt, DESY

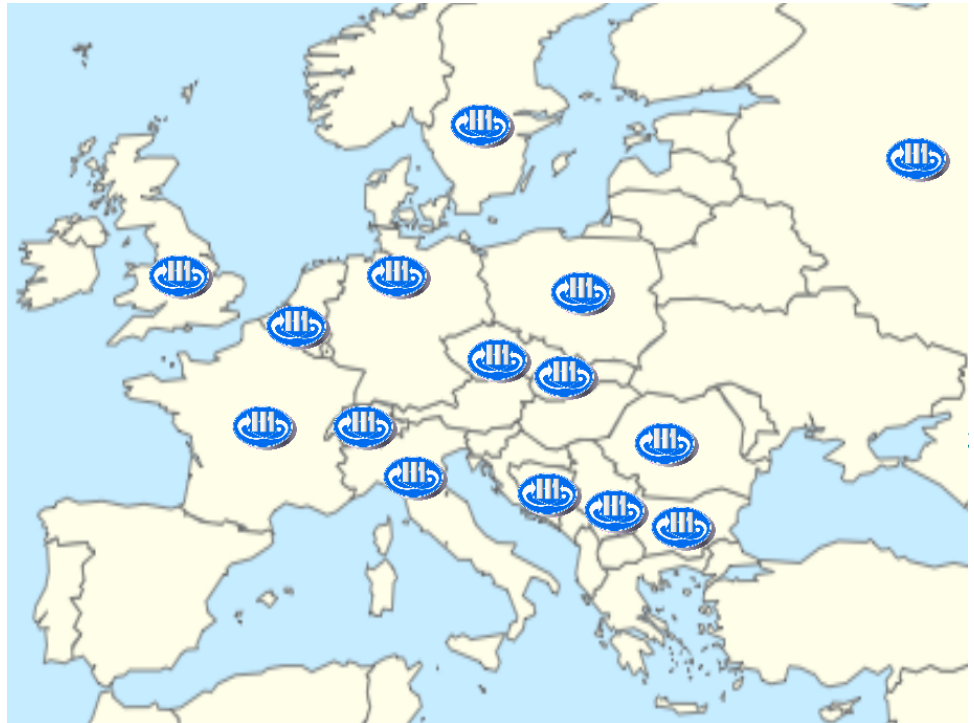
The H1 experiment

- Tracker; LAr calorimeter with EM and hadronic section; muon chambers
- Operated from 1992-2007 at the HERA ring
- Deep-inelastic scattering at $\sqrt{s}=320$ GeV, $E(p)=920$ GeV, $E(e)=27.6$ GeV
- Lepton beam e^+ or e^- , since 2003 with longitudinal polarisation for H1/ZEUS
- Rich physics program: data analysis still in full swing



The H1 collaboration

- 43 institutes from 18 countries
- Presently 200 authors
- Strong H1 Group at DESY



+Armenia, Mongolia, Mexico

Spokesperson: Cristi Diaconu

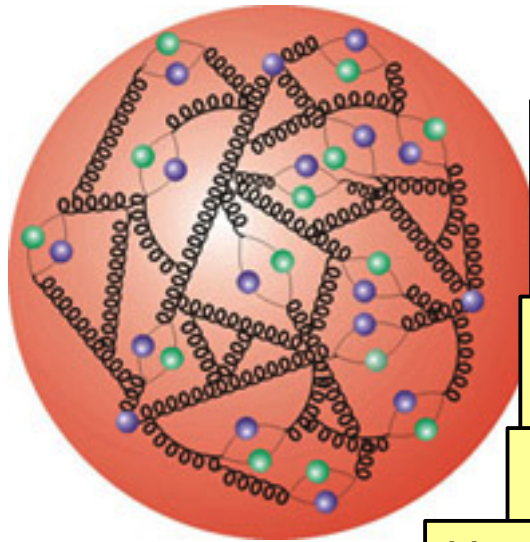
Deputy: Stefan Schmitt

Physics coordinators: Katja Krüger, Karin Daum

Computing coordinator: David South

H1 activities

Deep inelastic scattering:
What happens inside the proton?



Inclusive DIS
PDF fits
Searches

QCD: jets
Final states

Diffraction

Heavy flavour

H1 Physics output:
205 publications so far,
~30 more planned

www-h1.desy.de

H1/ZEUS combination group

Combine data from H1 and ZEUS
Obtain best possible precision
for the HERA legacy

www.desy.de/h1zeus

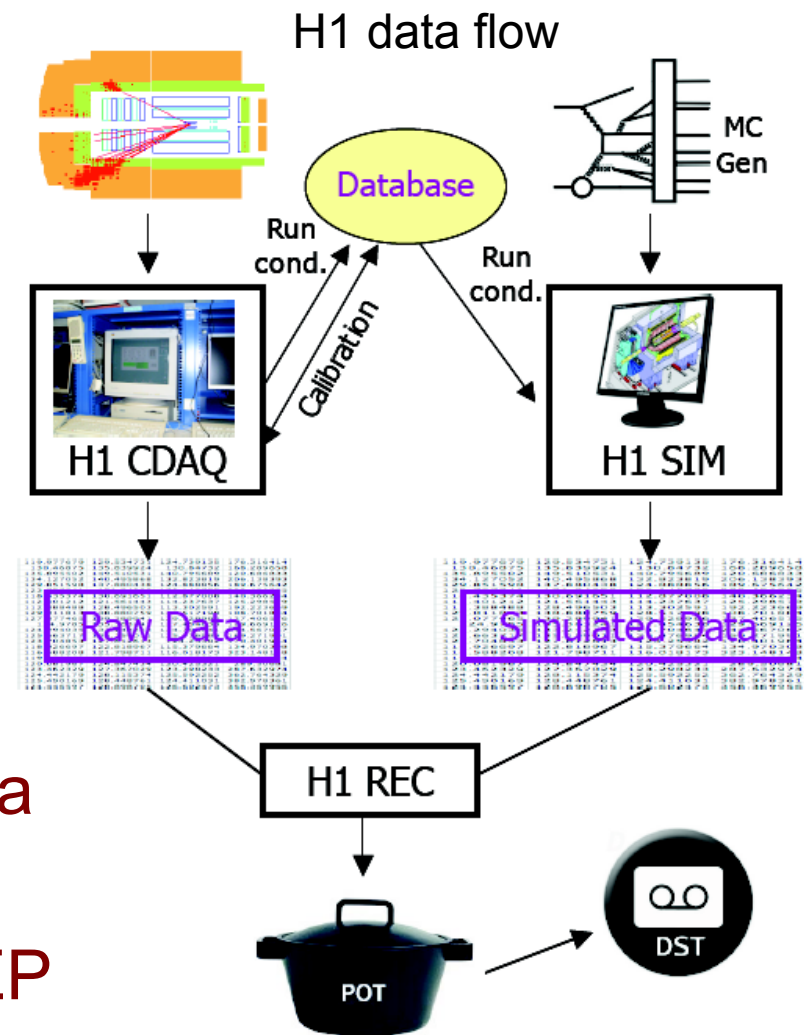
Data preservation

International group DPHEP to
preserve data of HEP
experiments.
Strong H1 participation

www.dphep.org

H1 Data preservation

- Data taking ended 2007
- Data analysis still ongoing
- How to preserve data, software, documentation, ... such that data analysis is still possible in $\gtrsim 10$ years?
- Data preservation:
 - H1 tries to preserve the full analysis chain from raw data to publication
 - Leading role of H1 in DPHEP



H1 analysis environment

- Object oriented H1 analysis framework H1OO, tied to the ROOT framework
- Fast turnaround for Monte Carlo production, typical delay is 1 week for 50 million events
- Total MC production 2.8 billion events in 2010

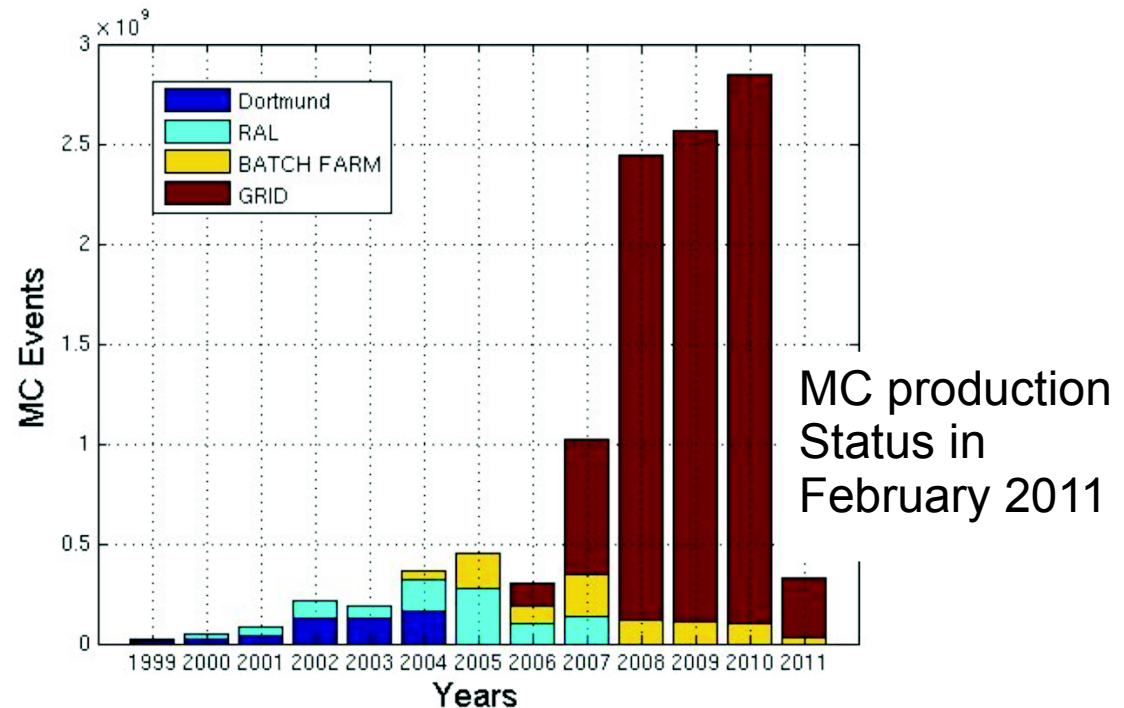
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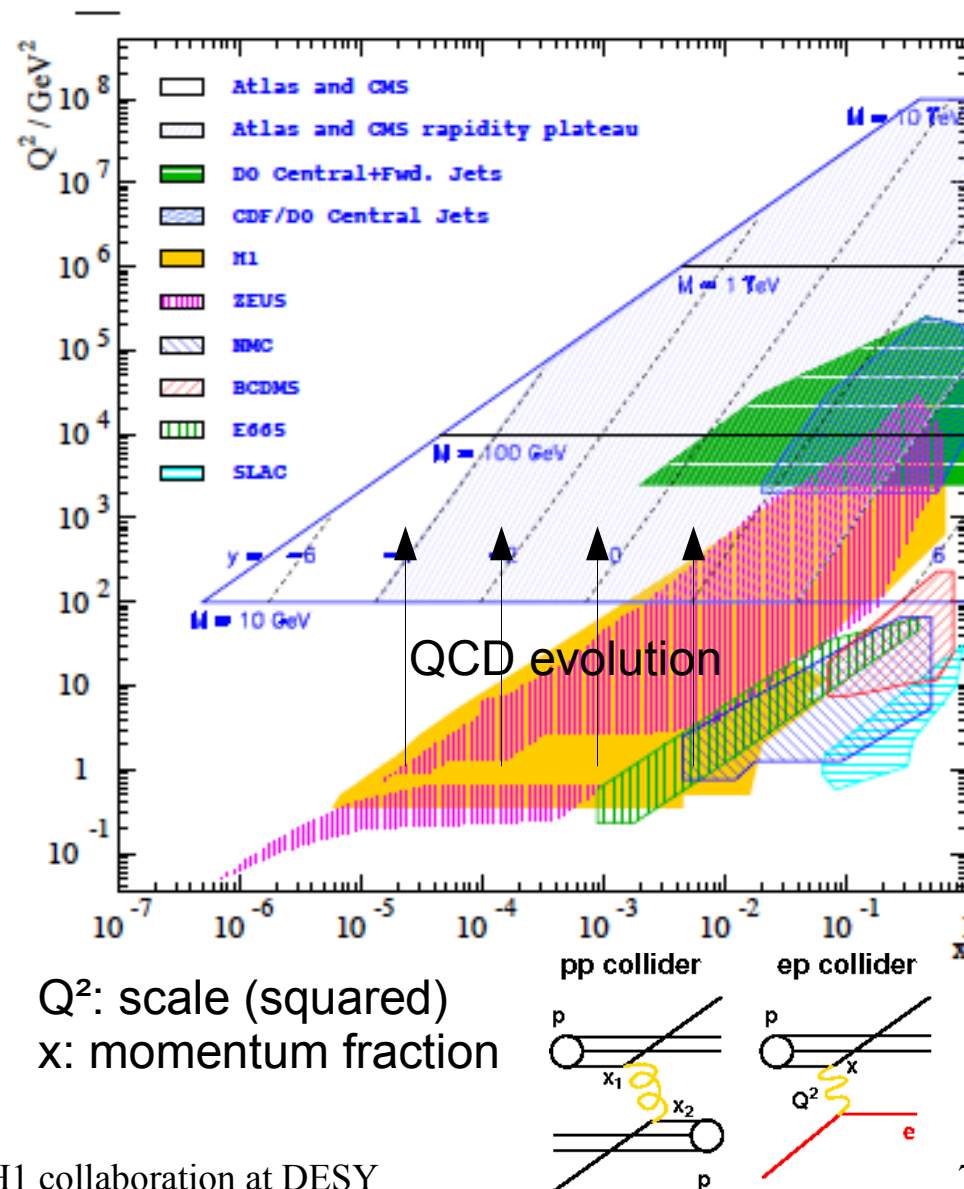
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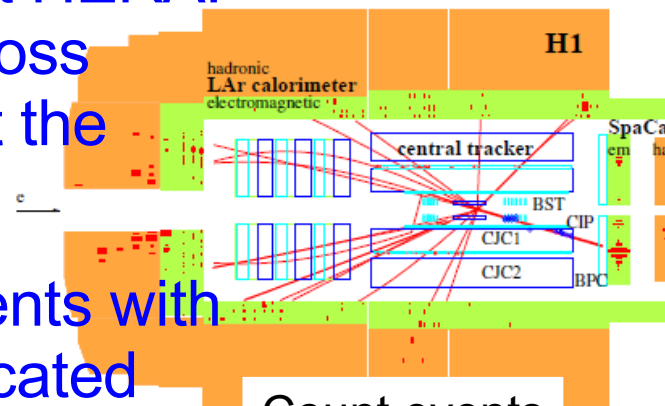
Example analysis: parton densities

- Proton parton density functions (PDFs): required for cross section calculations at hadron colliders
- QCD evolution: connects pdf at one scale with pdf at a different scale
- HERA: measure structure functions as a function of Bjorken x and scale Q^2
- PDF fit: extract PDFs from measurement, making use of QCD evolution

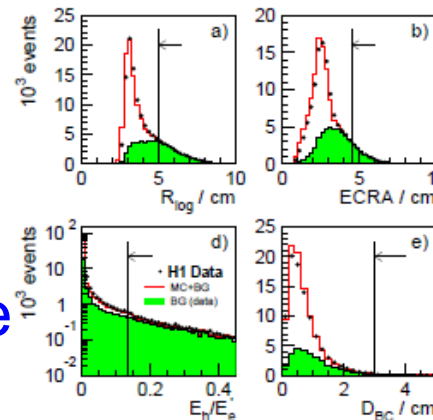


Step 1: measure cross sections

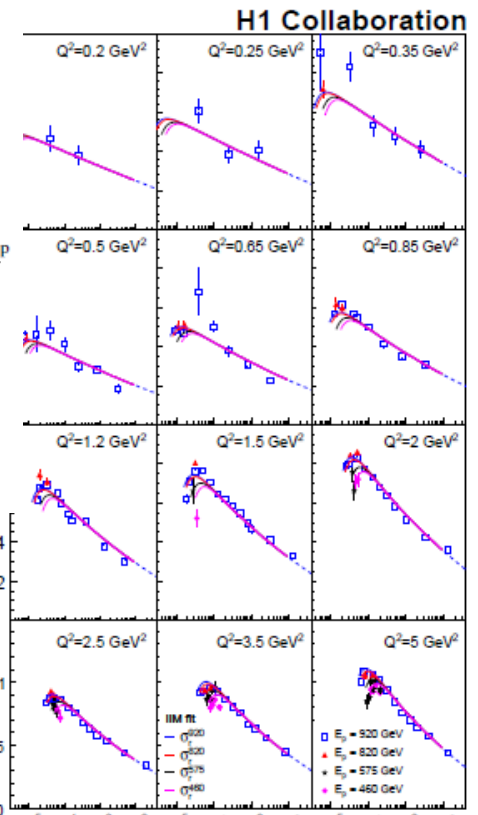
- PDF determination at HERA: measure **inclusive** cross sections: only look at the **scattered lepton**
- Start by counting events with an electron in a dedicated phase-space region ("cuts")
- Difficult part: understand detector effects, systematic uncertainties
- Final cross section: compare to theory predictions



Count events



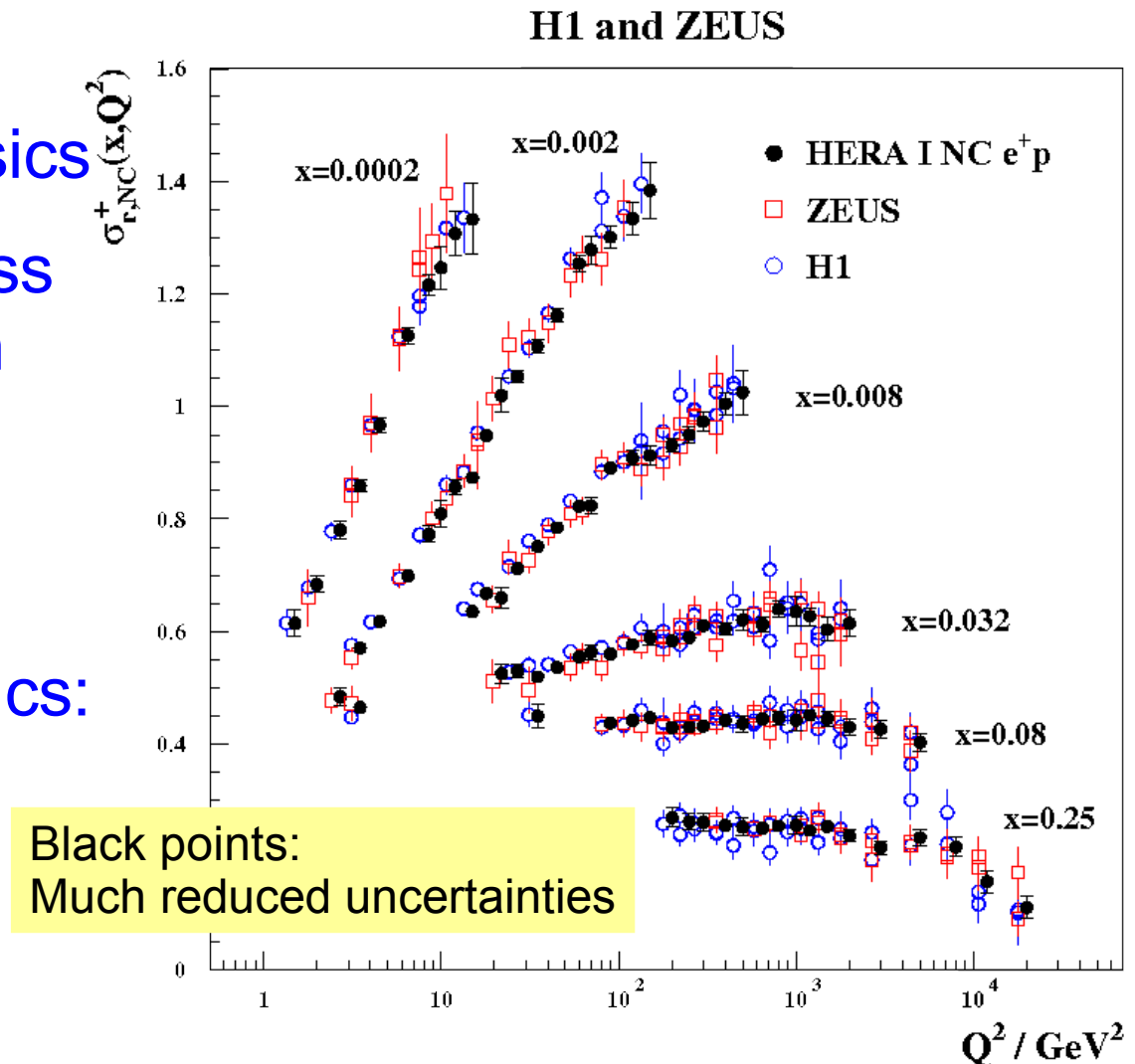
Apply selection cuts



Cross section
Compared to
theory

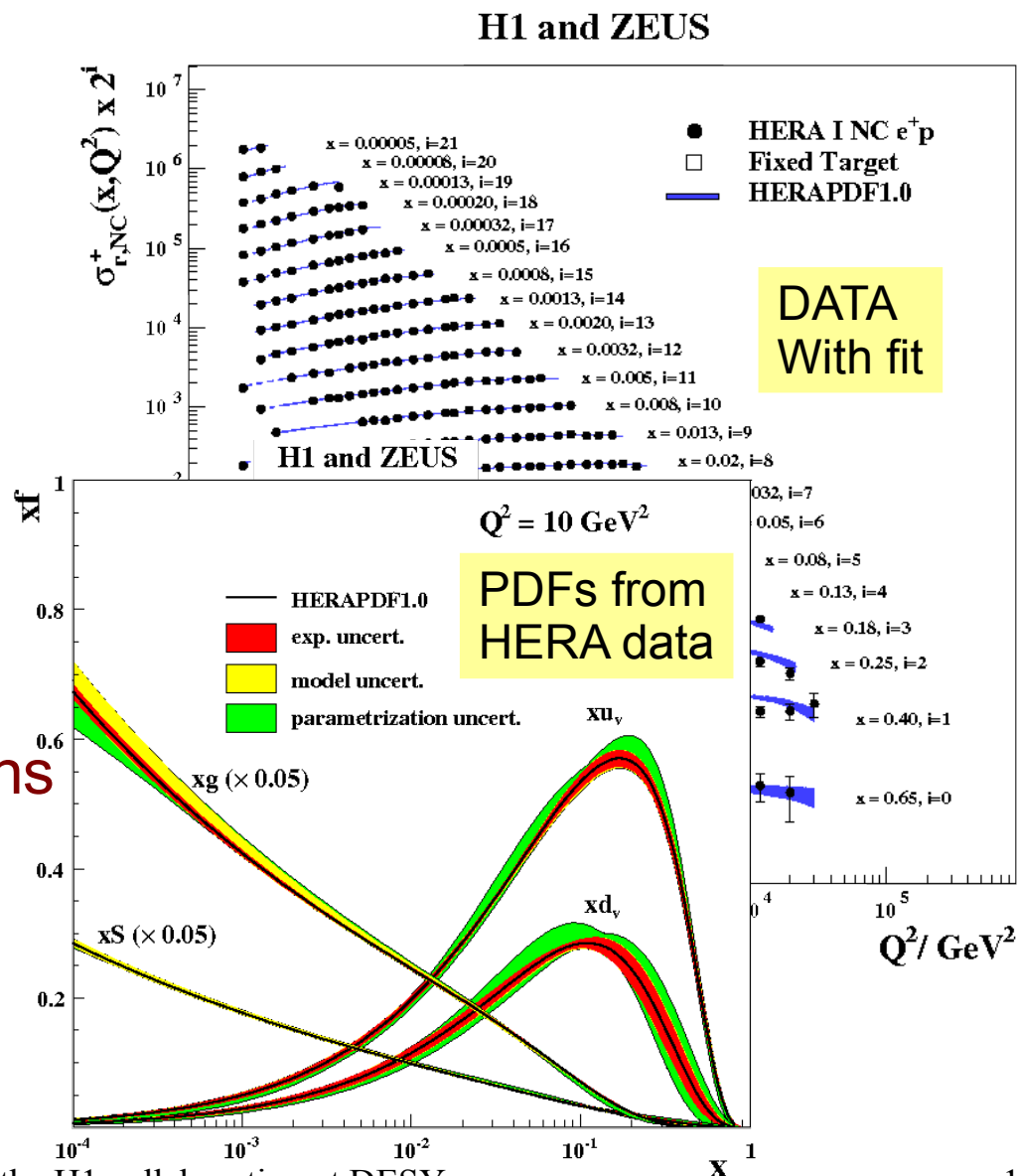
Step 2: combine H1+ZEUS data

- H1 and ZEUS: different detectors but same physics
- Data combination at cross section level gives much reduced uncertainties (“cross-calibration”)
- Combination group is active for all physics topics: inclusive, heavy flavour, QCD, diffraction







Step 3: QCD fit, extract PDFs

- QCD fit to inclusive HERA cross sections
- Uses e+p and e-p data and both neutral current and charged current for flavour separation
- Result: precise parton densities down to small x, also used for LHC predictions
- Ongoing activities: include more data (jets, heavy flavour), improve theory (NNLO)



Students at H1

- Much of the scientific work in H1 is done by students:
PhD thesis → H1 paper
- Students should work at least part-time at DESY, in cooperation with seniors
- H1 authorship starts 6 month after joining H1
- H1 results are shown at major HEP conferences; where possible PhD students present their results themselves
- Service work: computing, software, data preservation, ...

	Sort 	H1 Students As of: 23.8. 011 14:58 (For printing from netscape use "Landscape" mode!)				H1 Help 	
Student (ST or DIP) (Click name to edit!)	Inst	PWG	Subject of Thesis	Service Work	Supervisor	Start	
Bohdanecan			Jet Production in DIS at		Anton		

Summary

- H1 is a unique place to do data analysis at DESY
- H1 data taking ended in 2007, still there is a rich physics program to be continued
- **Students play a vital role at H1**
- Object oriented analysis, fast and efficient MC production
- Combination of H1 and ZEUS: most precise input to PDFs
- Data preservation: keep option to (re-)analyse the HERA data in 10 years from now
- H1 also plays a leading role in the international study group for data preservation (DPHEP)