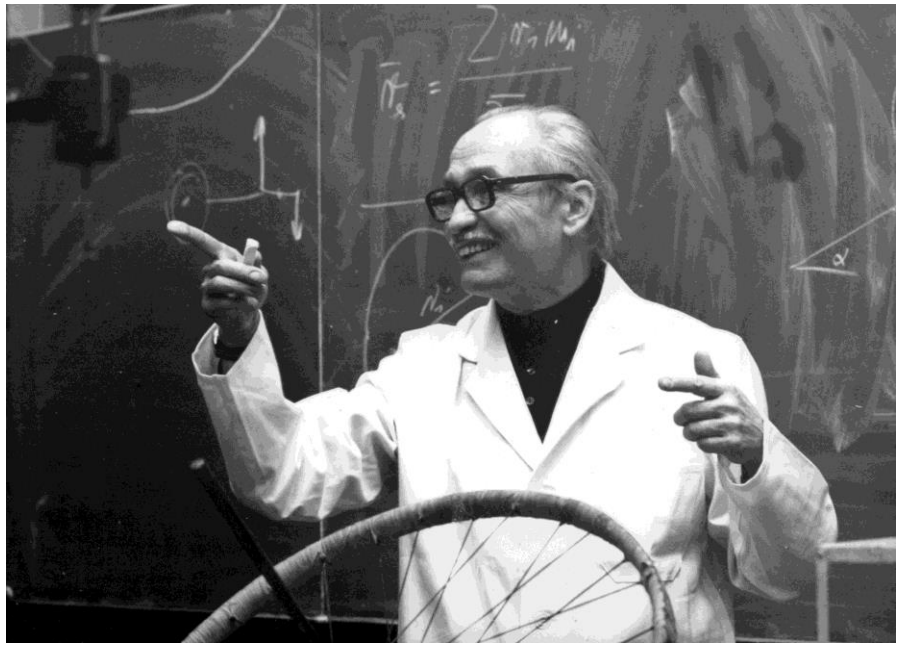
Max and H1

- The road to H1
- HERA and H1
- H1 and Zeuthen
- Developments in Germany, Zeuthen and DESY
- First H1 physics
- Upgrades
- H1 and Max
- The beginning of the end of H1
- Final remarks

The road to H1

- One of first steps taken in 1969 when Max started studying physics at Humboldt University in Berlin.
- Rumours suggest Prof. Bernhard was responsible for teaching him classical mechanics.



- Another significant step was his work at the Joint Institute for Nuclear Research in Dubna…

- …for which he was awarded a PhD by the Institute of High-Energy Physics, Zeuthen in 1977.
- Max then continued work in Dubna.

The road to H1

- From where he went to CERN and BCDMS…

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN/EP/83-204
23 December 1983

MEASUREMENT OF THE INTERFERENCE STRUCTURE FUNCTION $xG_3(x)$ IN MUON-NUCLEON SCATTERING

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ABSTRACT

The interference structure function $xG_3(x)$ has been measured for the first time scattering positive and negative muons of opposite helicity off a carbon target. The x dependence observed for Q^2 between 40 and 180 (GeV/c^2) is in good agreement with predictions of the quark-parton model. The measured ratio $2(a_uQ_u+a_dQ_d)/(Q_u^2+Q_d^2) = 1.87 \pm 0.25(stat) \pm 0.42(syst)$ is consistent with the hypothesis of fractional quark charges and determines the sign of Q_u-Q_d to be positive.

- …and then back to Zeuthen.

(*) Now at Institut für Hochenergiephysik der ADW, Berlin-Zeuthen, DDR.
(**) Now at Nuclear Centre of Charles University, Prague, Czechoslovakia.
(***) On leave from E. Kardelj University and the J. Stefan Institute, Ljubljana, Yugoslavia.
(+) Supported by BMFT
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- He was already thinking about HERA.

At ep collider machines reaching four-momentum transfers of the order of 10^4 (GeV/c^2) the contributions due to the Z_0 exchange will be comparable to the one-photon exchange part [4]. Therefore the axial-vector interference structure function xG_3 will essentially play the role of xF_3 measured in neutrino experiments [5].

- Max was a member of L3 (LEP) and worked on analysis of MARK-J data.
- Habilitation at Humboldt University in 1984, based on work at BCDMS.
- Awarded the Max von Laue medal.
- Member of H1 from 1985.

The road to H1

- Following joint statement of Erich Honecker and Helmut Kohl on 12th March 1985 regarding "cultural cooperation", door was opened for stronger collaboration between IfH and DESY

Bekanntmachung
des Abkommens zwischen der Regierung der Bundesrepublik Deutschland und der Regierung der Deutschen Demokratischen Republik über kulturelle Zusammenarbeit

Vom 4. Juni 1986

In Berlin ist am 6. Mai 1986 das Abkommen zwischen der Regierung der Bundesrepublik Deutschland und der Regierung der Deutschen Demokratischen Republik über kulturelle Zusammenarbeit unterzeichnet worden. Durch Notenwechsel ist gemäß Artikel 15 des Abkommens vereinbart worden, daß das Abkommen mit der Unterzeichnung in Kraft tritt. Das Abkommen ist damit

am 6. Mai 1986

in Kraft getreten. Das Abkommen, der gemeinsame Protokollvermerk zu Artikel 6 des Abkommens und die gemeinsame Protokollerklärung zum Abkommen werden nachstehend veröffentlicht.

Bonn, den 4. Juni 1986

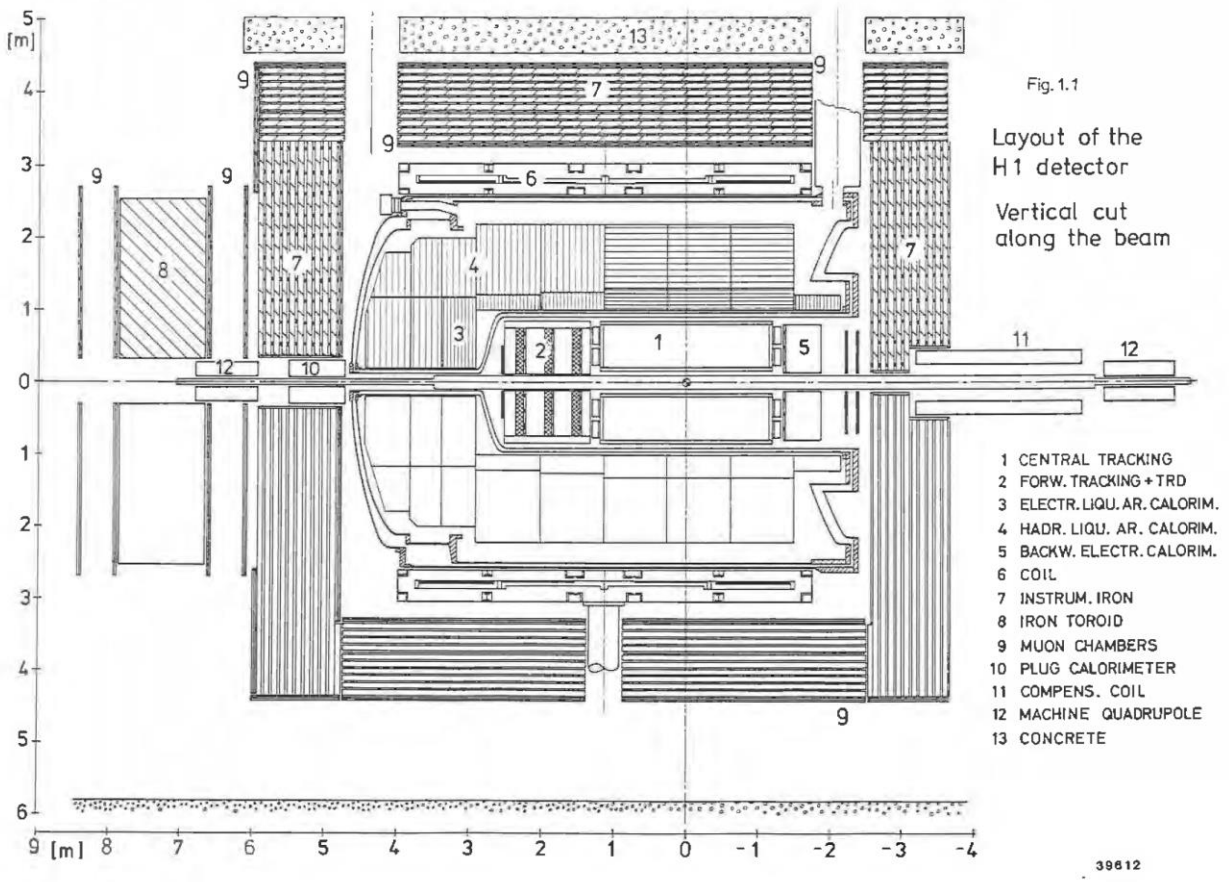
Der Bundesminister
für innerdeutsche Beziehungen
In Vertretung
Rehlinger

- Max put together a team of people at Zeuthen to work on H1.
- And in 1987, helped the IfH to celebrate its 25th birthday.

HERA and H1

- HERA revolutionised deep inelastic scattering experiments.
- Accelerating the proton (to 820 GeV) allowed much higher momentum transfers (Q^2) between the e^+ or e^- (26.7 GeV) and the proton than possible at fixed target experiments.
- But it meant the detectors had to be completely rethought.
- Not fixed target, but not e^+e^- either!

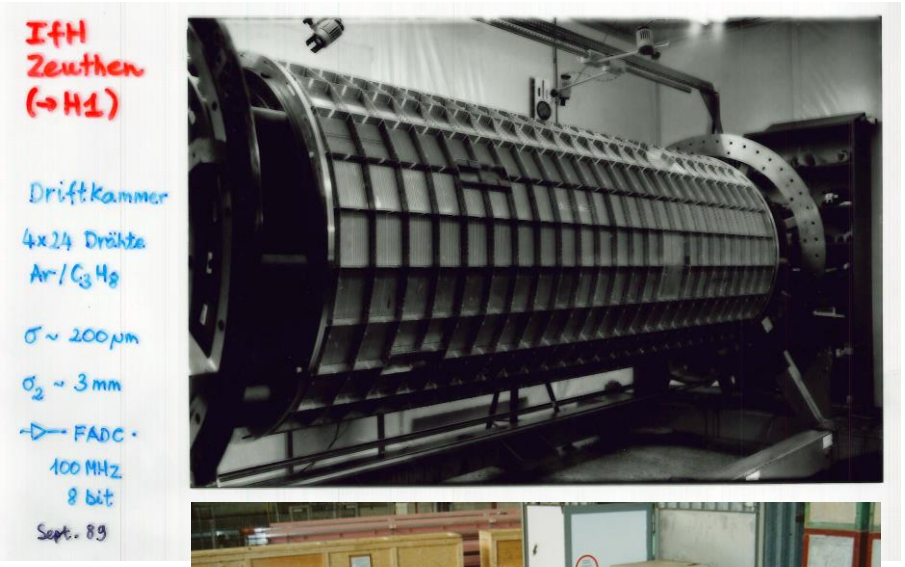
- Detector figure in H1 Proposal, March 1986:



H1 and Zeuthen

- The Zeuthen group, led by Max, designed, prototyped and constructed the Central Outer Z Chamber (COZ) and worked on the Backward Proportional Chamber (BWPC).
- Made more difficult by CoCom export controls which limited access to electronic components…
- …for which various creative solutions where found by people who will remain nameless!

- The COZ and the Zeuthen team:



Developments in Germany, Zeuthen and DESY

- While all this was going on, the world in general and Germany in particular, was worrying about other even more significant events.
- These culminated in the fall of the Berlin Wall on 9th November 1989 five days after a protest involving half a million people in East Berlin.

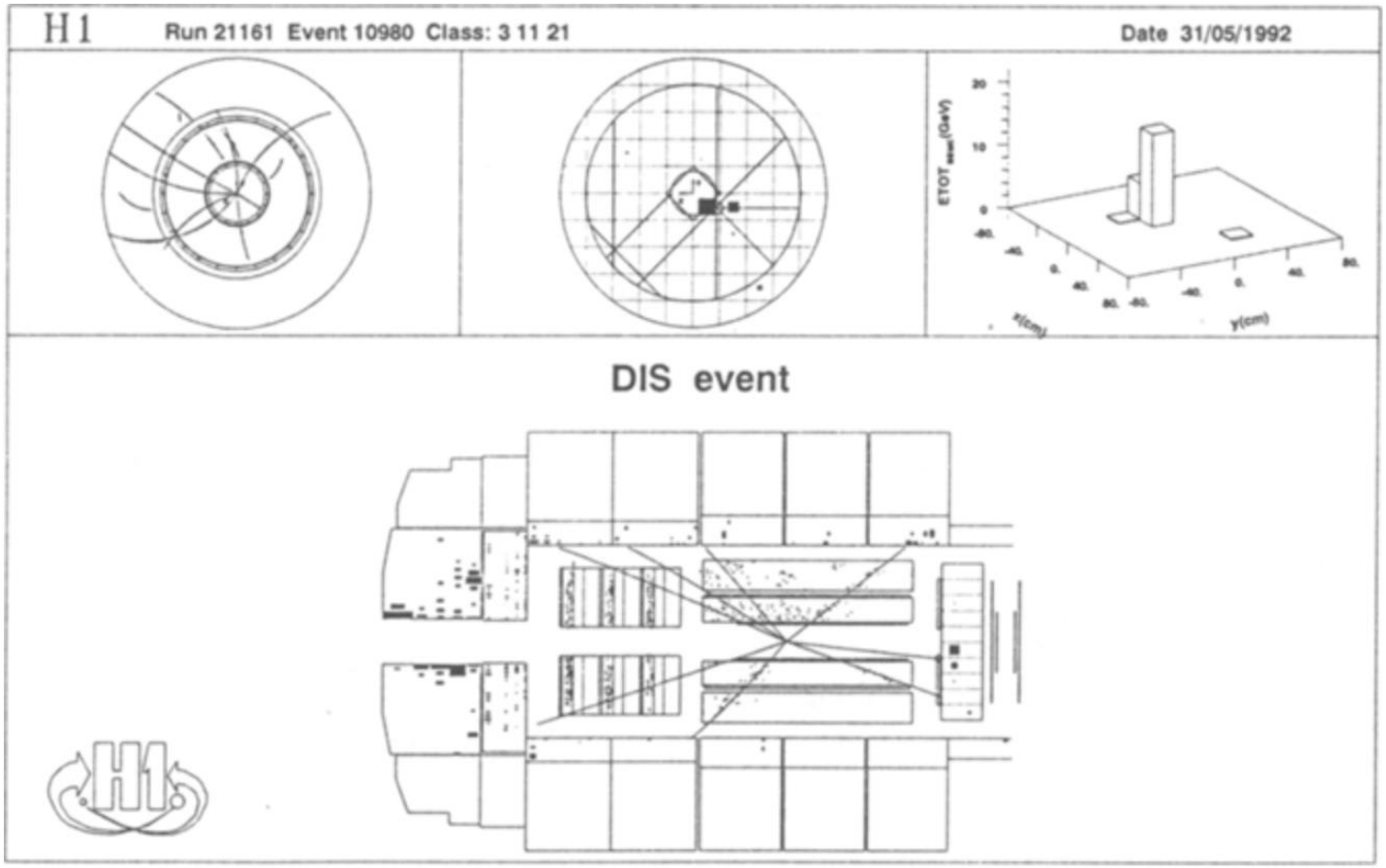
- Zeuthen was not unaffected by this.
- Max, as Leader of the IfH Scientific Council, was involved in discussions with the BMBF which led to the affiliation of Zeuthen with DESY in November 1991.
- Max with Soergel in 1988(?):

First H1 physics

- The COZ (and BWPC) were installed in H1 in 1991.
- Running started in 1992.
- The first H1 results were produced by the Electron Analysis group (ELAN) which Max formed and led.

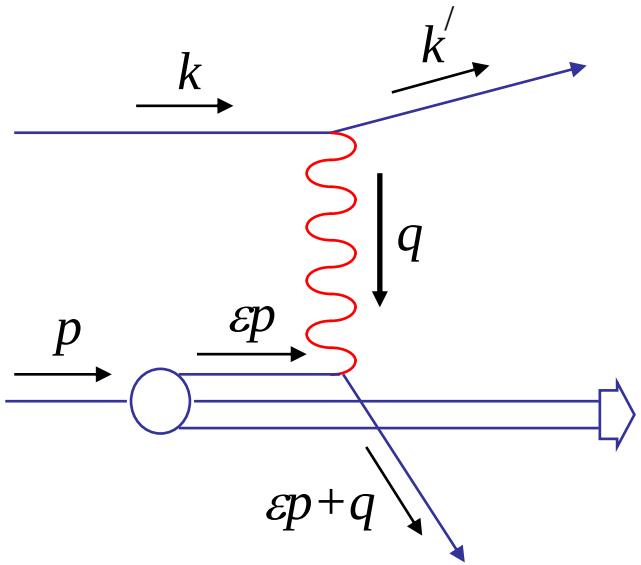
First H1 physics

- One of first low Q2 DIS events seen at H1.

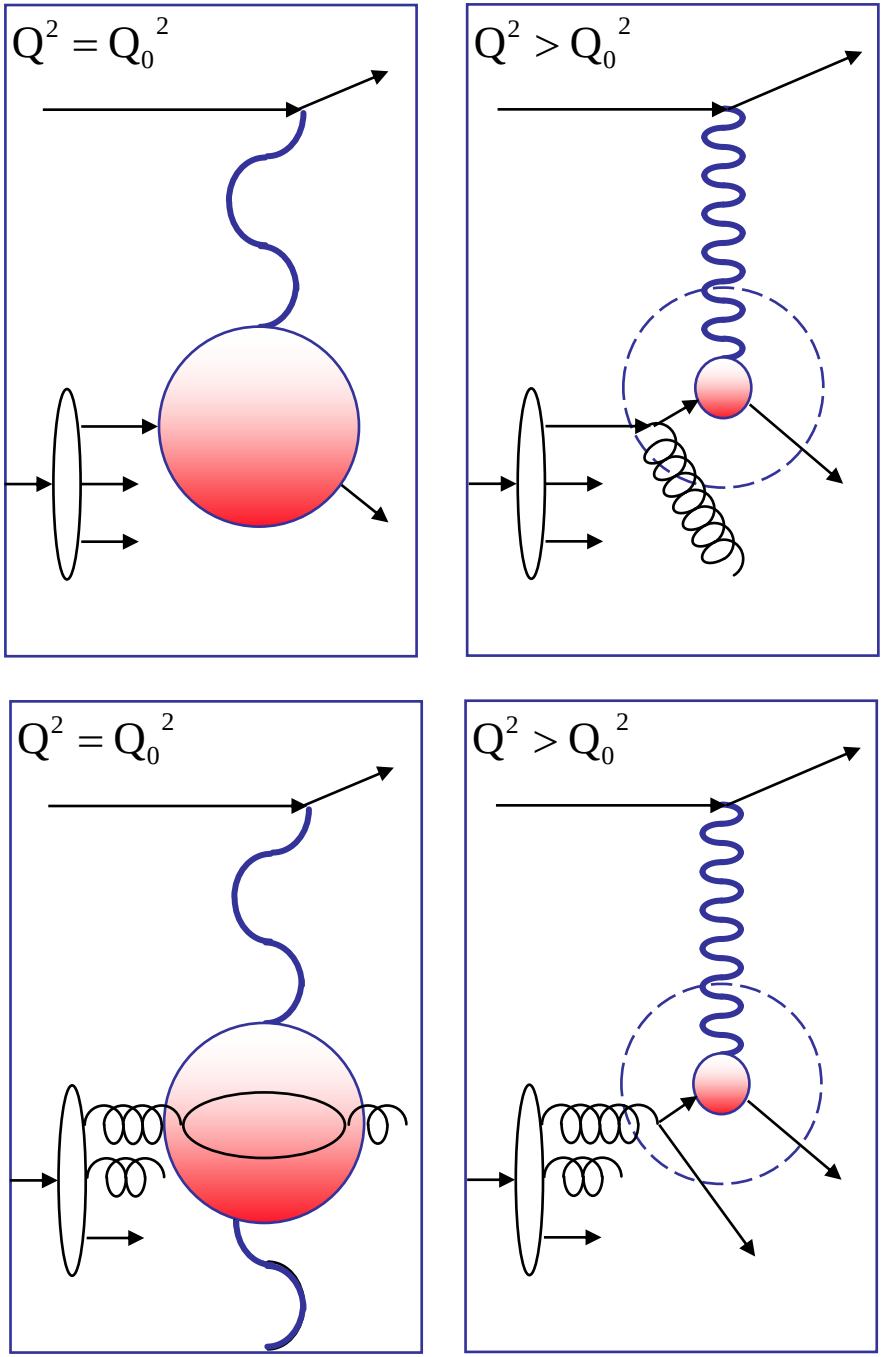


First H1 physics

- The increased lever arm in $Q^2 = -q^2$ at HERA enabled a step-change in the understanding of proton structure.

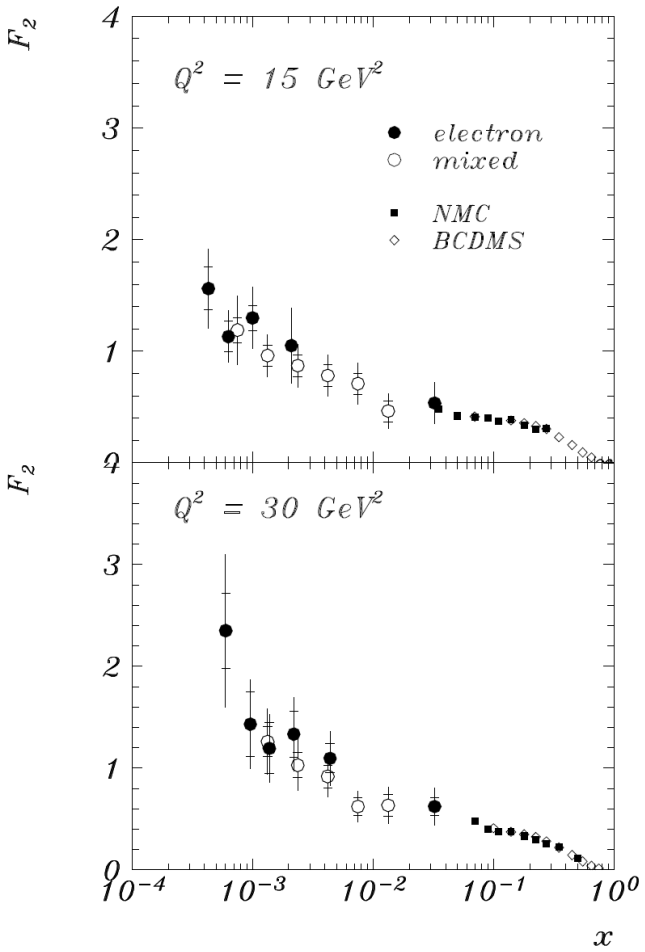


- Measuring F_2 counts the number of quarks visible at a given wavelength ~ $1/Q$ and $\varepsilon = \dfrac{Q^2}{2p \cdot q} \equiv x$.

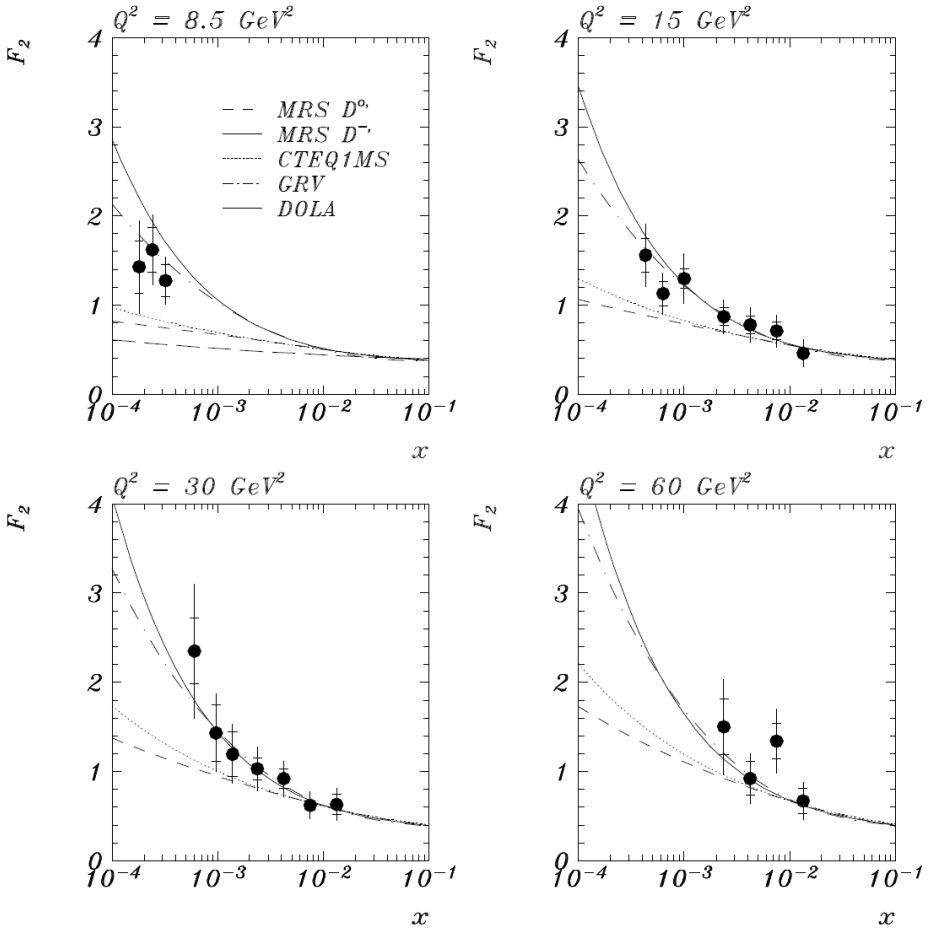


First H1 physics

- So what did H1see in 1993? As a function of x…

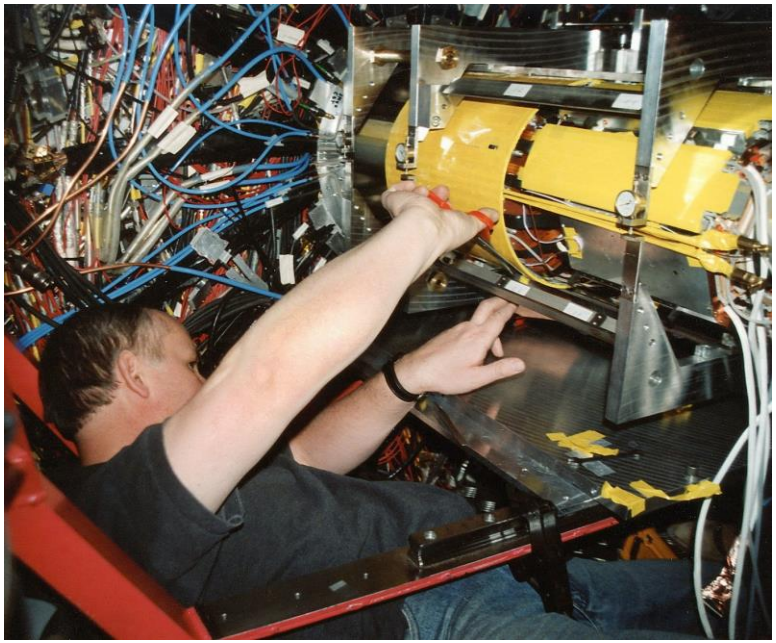


- …and as a function of Q^2.



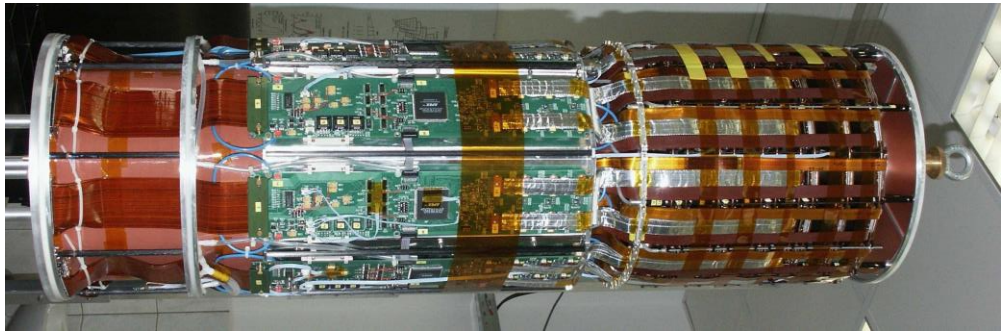
H1 upgrade part one

- Following the first experience of operating an experiment at an ep collider, H1 realised some things could be done better.
- In particular, better detectors in the backward direction could improve the precision and range of measurements of Q^2 and x.
- In 1991, Max presented a proposal for a Backward Silicon Tracker (BST) to the DESY Physics Research Council.
- And then the Zeuthen team built and installed it.

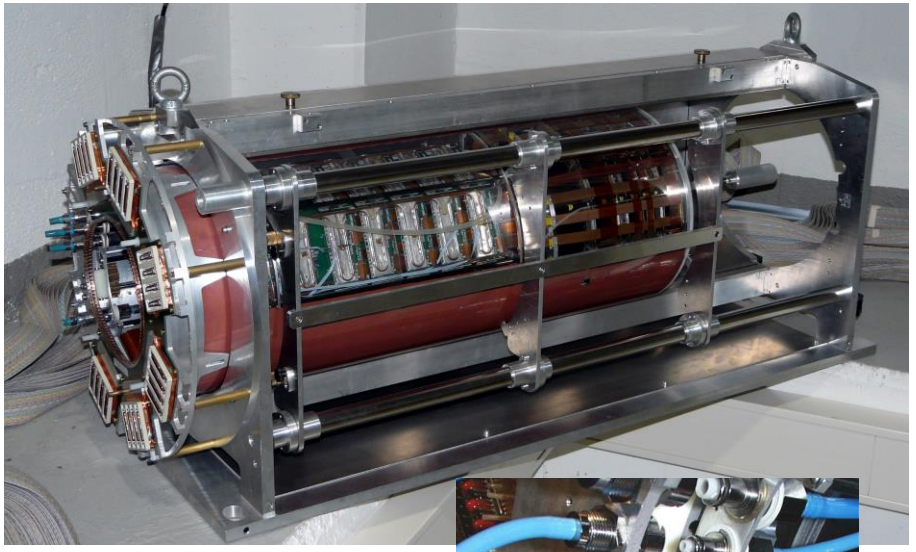


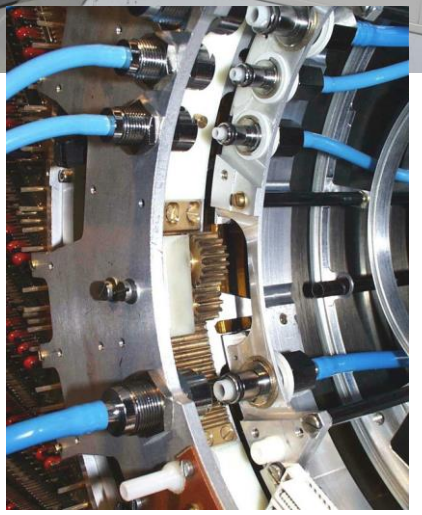
HERA upgrade and H1 upgrade part two

- After six years, HERA had reached its design luminosity (with E_p increased to 920 GeV in 1998).
- A luminosity upgrade (×3) was due.
- In parallel, H1 decided to improve many of its existing subdetectors and to add new detectors to better exploit the increased luminosity.
- Max and Zeuthen worked on an improved BST…



- …and a Forward Silicon Tracker (FST):



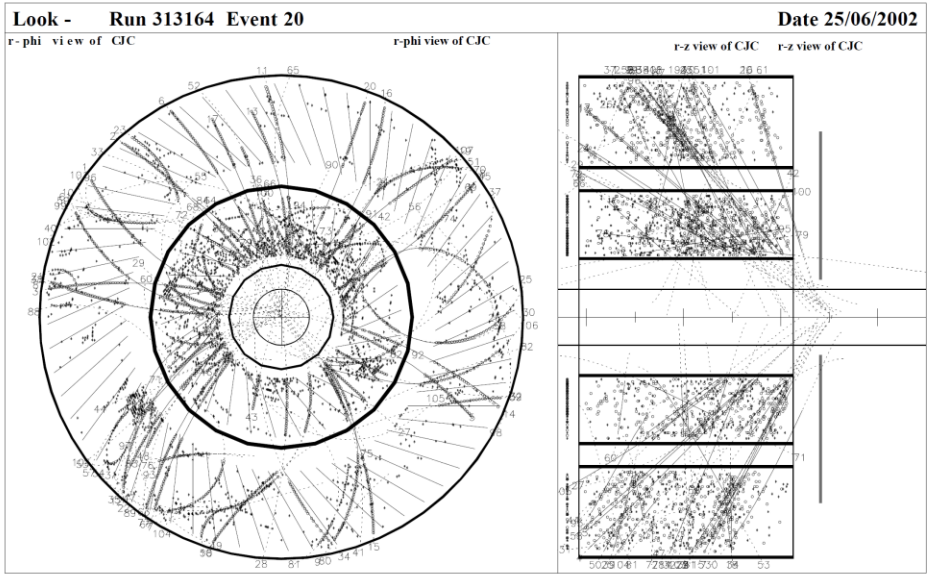


HERA II background

I UPGRADE IT AND IT BECOMES WORSE??

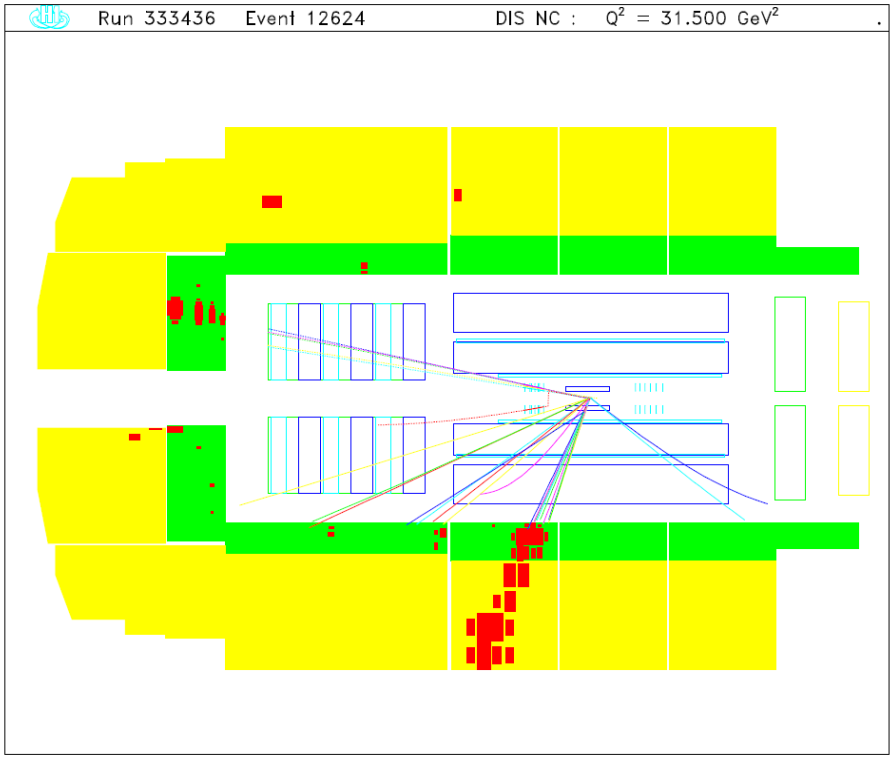
YouTube · Hera - Age of Empires 2
3 days ago

- The HERA restart did not proceed as hoped.



- After months of work, the backgrounds were understood and mitigations planned.

- Highest Q^2 H1 event in 2002.



- BG solutions were implemented and HERA II running restarted in 2003.

H1 and Max

- Not surprisingly, given his contributions to the hardware and physics analysis of the experiment, Max was elected Spokesperson of H1 in 2002, a position he held until 2006.
- During this time, he displayed a real talent for herding cats.
  - Pick the right job for the person, rather than the right person for the job.
  - Help and encourage rather than threaten and pressurize.
  - Have fun.
  - And have a sense of humour.

- In no small part due to his leadership, the H1 ship not only survived, but flourished.

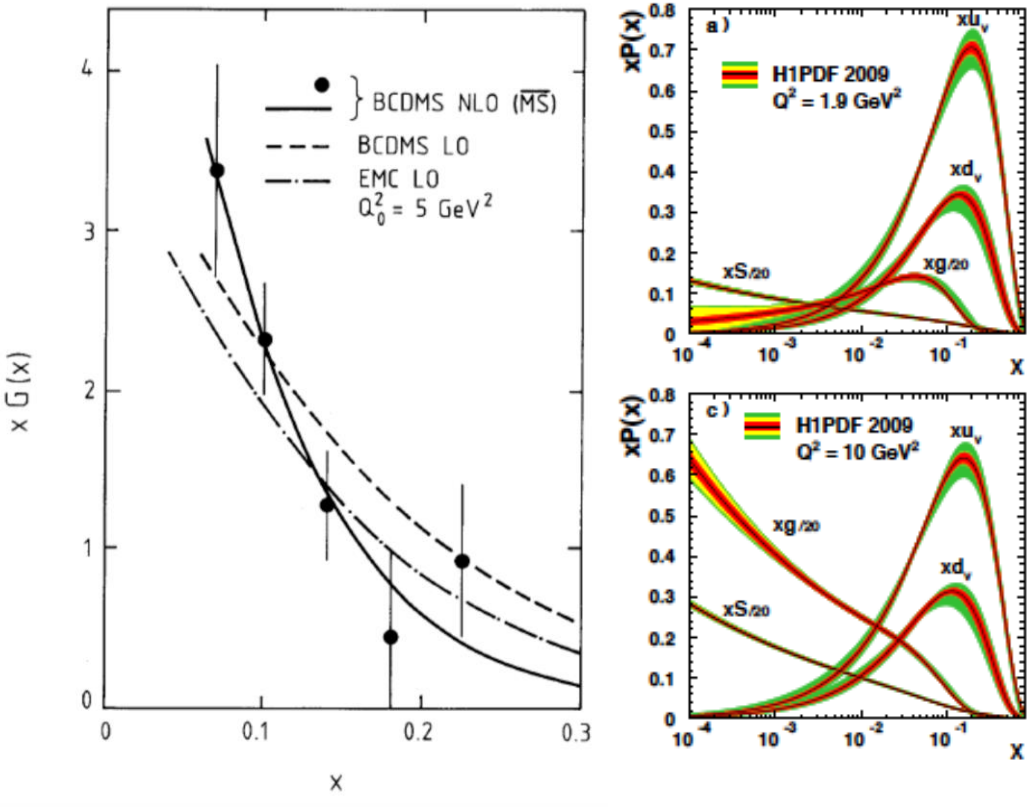
The beginning of the end of H1

- At the end of June 2007, HERA and H1 shut down for the last time.

- And the Zeuthen (and Liverpool) subdetectors were dismantled.

Last words

- The progress from BCDMS to H1 overseen by Max was remarkable.
- Compare the BCDMS gluon distribution with the results of H1.



- He was awarded the Max Born prize in 2013 by the German Physical Society and the IoP.
- The citation read: “For fundamental experimental contributions to our understanding of the structure of protons using Deep Inelastic Scattering.”