John Dainton and the H1 Experiment

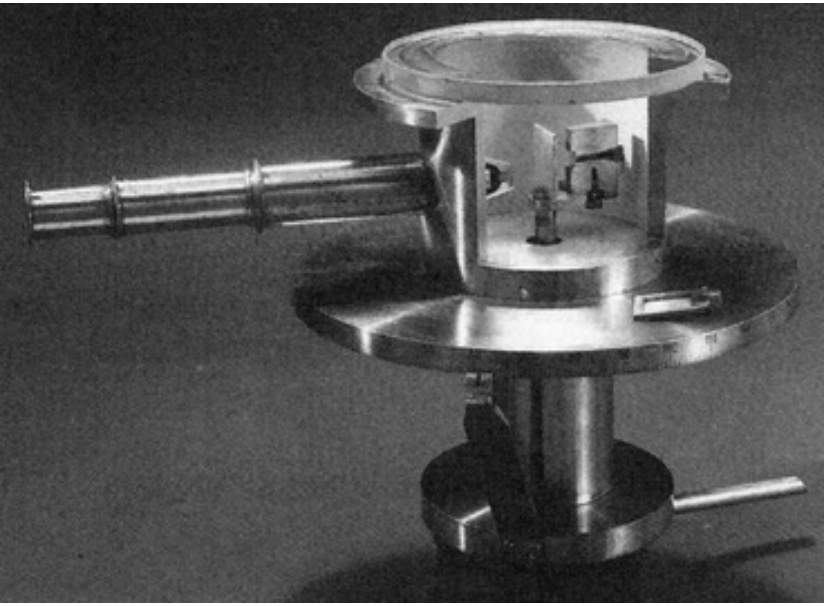
Paul Newman (University of Birmingham)

Dainton-fest, Fri 7 July 2023

… with thanks to Tim Greenshaw, Max Klein, Sergey Levonian, Girish Patel and (in particular) Jan Olsson …

Virtual H1 Archive

A quote I 'nicked' from John



"It would be of great scientific interest if it were possible to have a supply of electrons … of which the individual energy of motion is greater even than that of the alpha particle."

Ernest Rutherford,
Royal Society, London, (as PRS)
30 Nov 1927

HERA, DESY, Hamburg

(Data taking 1992-2007)

$\sqrt{s_{ep}}$ ~ 300 GeV

… so far still the only collider of electron and proton beams ever

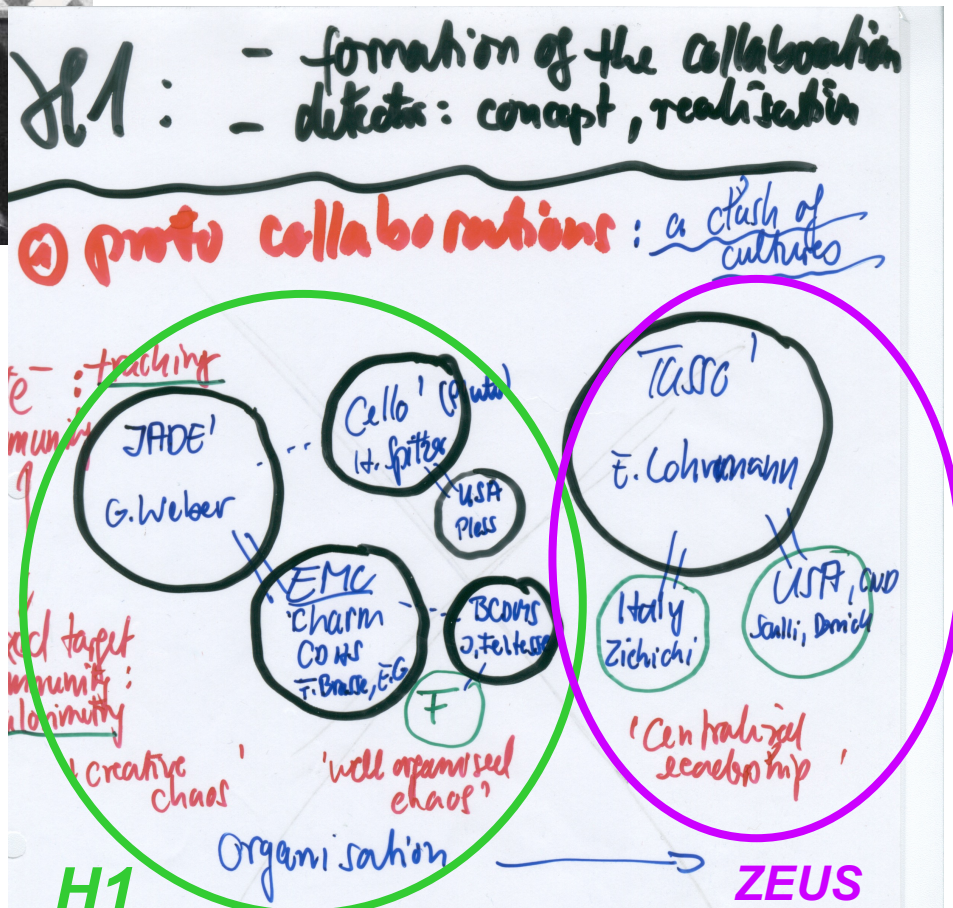
Equivalent to a 50 TeV beam on a fixed target proton

Where did all this start?

2004: Genoa Discussion Meeting on HERA Experiments …

…formation of collaborations

[Franz Eisele]



Towards an LOI

… but times got hard …

- Only minor US, Italy involvement,
- Karlsruhe withdrew
- …

Study group for HERA-detector

contributors: (people which have been actively engaged in the working groups)

Aachen : Braunschweig, Martyn

DESY : Bartel, Brasse, Eisele, Felst, Flauger, Gayler, Haidt, Krehbiel, Korbel, Meinke, Meyer, Narcska, Olsson

Dortmund : Wegener

Glasgow : Bussey, Dainton, Stilliccrn

Univ. Hamburg : Blobel, Büsser, Heinzelmann, Ueber

~~Heidelberg : Heintze, Rieseburg, van Krogh~~

Lancaster : Clegg, Newton

Liverpool : Gabathuler, Hayman

Manchester : Ellison, Lafferty, Ibbotson

~~Milano : Rancoita~~

Palaiseau : Brisson, Petiau

~~Pisa : Laricela~~

Rutherford Lab. : Marshall, White, Clark

Saclay : Feltesse

SIN/Zürich : Domingo, Eichler

Wuppertal : Stoolihausen

LETTER OF INTENT

FOR AN EXPERIMENT AT HERA

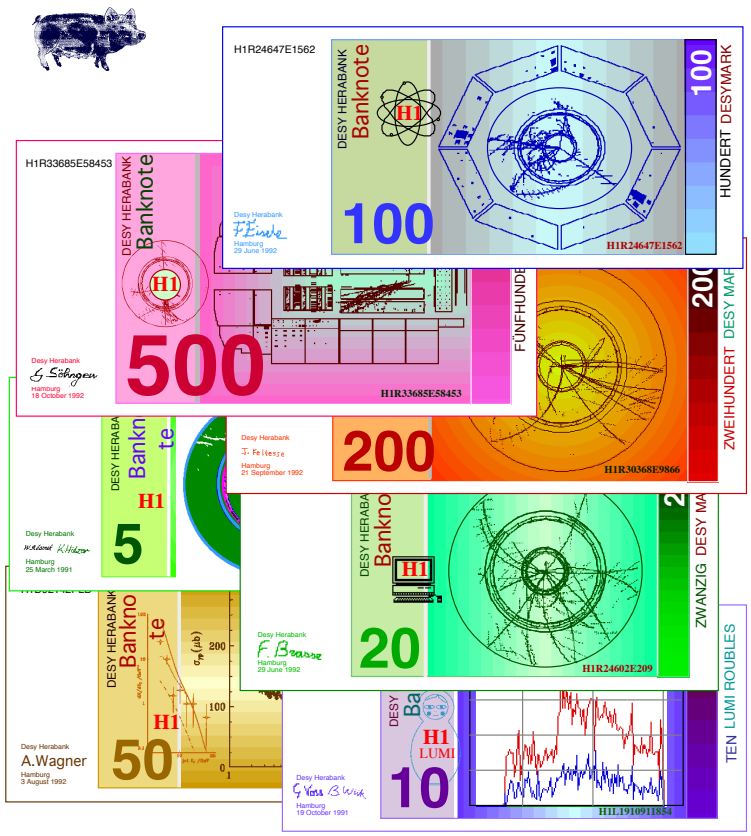
Aachen-~~Brown~~-Davis-DESY-Dortmund-Ecole Polytechnique-Glasgow-Hamburg-~~Houston-Indiana-Karlsruhe~~-Lancaster-Liverpool-Manchester-MPI München-~~Northeastern~~- Orsay-Paris-Rome-Rutherford-Saclay-Wuppertal-Zürich

JUNE 28, 1985

Rescuing H1

- Attempts at Quantitative Easing failed

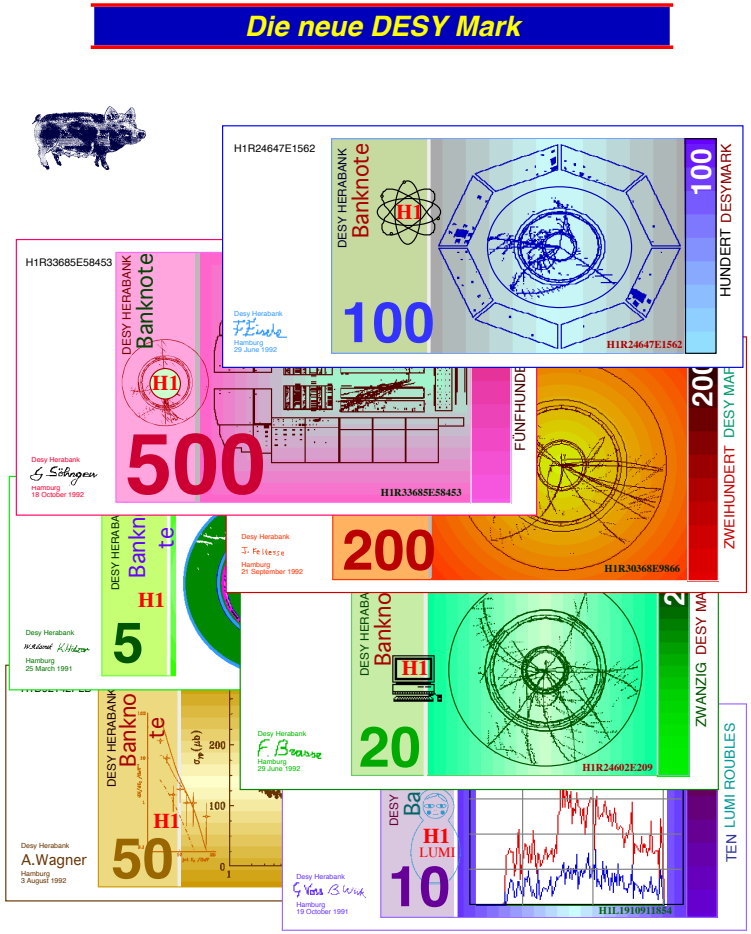
Die neue DESY Mark



[Bill Haynes]

Rescuing H1

- Attempts at Quantitative Easing Failed



[Bill Haynes]

- Engagement with Eastern Europe pivotal in realising H1
- A programme supported and continued by John

1 *I. Physikalisches Institut der RWTH, Aachen , Germany*
2 *III. Physikalisches Institut der RWTH, Aachen , Germany*
3 *School of Physics and Space Research, University of Birmingham, Birmingham, UK*
4 *Inter-University Institute for High Energies ULB-VUB, Brussels, Belgium*
5 *Rutherford Appleton Laboratory, Chilton, Didcot, UK*
6 *Institute for Nuclear Physics, Cracow, Poland*
7 *Physics Department and IIRPA, University of California, Davis, California, USA*
8 *Institut für Physik, Universität Dortmund, Dortmund, Germany*
9 *DAPNIA, Centre d'Etudes de Saclay, Gif-sur-Yvettes, France*
10 *Department of Physics and Astronomy, University of Glasgow, Glasgow, UK*
11 *DESY, Hamburg, Germany*
12 *I. Institut für Experimentalphysik, Universität Hamburg, Hamburg, Germany*
13 *II. Institut für Experimentalphysik, Universität Hamburg, Hamburg, Germany*
14 *Institut f. Reine und Angewandte Kernphysik, Universität Kiel , Germany*
15 *Institute of Experimental Physics, Slovak Academy of Sciences, Kosice , CSFR*
16 *School of Physics and Materials, University of Lancaster, Lancaster, UK*
17 *Department of Physics, University of Liverpool, Liverpool, UK*
18 *Queen Mary and Westfield College, London, UK*

19 *Physics Depa[redacted]t, University Lund , Lund, Sweden*
20 *Physics Depar[redacted]nt, University of Manchester, Manchester, UK*
21 *Institute for Theoretical and Experimental Physics, Moscow, Russia*
22 *Lebedev Physical Institute, Moscow, Russia*
23 *Max-Planck-Institut für Physik, München, Germany*
24 *LAL, Universite de Paris-Sud, Orsay, France*
25 *LPNHE, Ecole Polytechnique, IN2P3-CNRS, Palaiseau, France*
26 *Universites Paris VI and VII, LPNHE, Paris, France*
27 *Institute of Physics, Czechoslovak Academy of Sciences, Praha, CSFR*
28 *Nuclear Center, Charles University, Praha, CSFR*
29 *INFN Roma and Dipartimento di Fisica, Universita "La Sapienzia", Roma, Italy*
30 *Fachbereich Physik, Bergische Universität Gesamthochschule Wuppertal, Wuppertal, Germany*
31 *DESY, Institut für Hochenergiephysik, Zeuthen, Germany*
32 *Institut für Mittelenergiephysik, ETH, Zürich, Switzerland*
33 *Physik-Institut der Universität Zürich, Zürich, Switzerland*
34 *Stanford Linear Accelerator Center, Stanford Californa, USA*

+ later … Montenegro, Bulgaria, Armenia

Origins of the Forward Tracker

(Minutes by Girish Patel)

Minutes of H1/UK meeting at Lancaster, 19 November 1984

Attendance

Glasgow: J.B. Dainton, I.O. Skillicorn
Lancaster: A.B. Clegg (chairman), R.C.W. Henderson
Liverpool: E. Gabathuler, G.D. Patel
Manchester: R.J. Ellison, R.E. Hughes-Jones, M. Ibbotson, D. Mercer, R.J.Thompson
RAL: D. Clarke, R. Marshall, J.V. Morris

(a) Transition radiation by J.V. Morris (5 transparencies)
(b) Some thoughts on forward chambers by J.B. Dainton (7 transparencies)
(c) Fibre detectors by M. Ibbotson (5 transparencies)

The problems involved in making an early decisions - on all three areas were emphasized. The problem of electron identification (aiming at a level of identifying electrons, particularly forward of 30°, with π/e ratios of 10^3-10^4) was emphasized: questions of how much-one could use transition radiation, dE/dX, longitudinal and transverse profiles of showers in e.m. calorimeter. A subgroup was set up to discuss and form views on all these problems: RM (convener), RJE, JBD, DC, JVM, MI + someone from Liverpool (action on EG). There were definite positive views that we should have interest in developing the forward chamber,

Minutes of H1/UK Meeting Liverpool 10 May 1985

Present

Glasgow: P.Bussey, J.B.Dainton
Lancaster: A.B.Clegg, D.Darvill, D.Newton
Liverpool: J.R.Fry, E.Gabathuler, R.Gamet, J.Morton, G.D.Patel
Manchester: R.J.Ellison, R.E.Hughes-Jones, M.Ibbotson, H.McCann, R.J.Thompson
RAL: D.Clarke, R.Marshall

JBD reported on the tracking solution chosen by CDF for the FNAL collider. They have the same forward problems as at HERA - but on both sides - with similar magnetic field configuration. They have opted for a long central tracker with a longish VTPC. This was "preferred over shorter central + forward because of gamma conversions in central end-plate and reality of tracking behind such a device". Suggestion is that we need full simulation studies to check our thinking for correct solution.

A later summary [Robin Marshall]

Contributions to H1 from UK

- Glasgow: Tracker software (I Skillicorn & P Bussey) & DAQ (A Campbell)
- Lancaster: Tracker software and build. (D Newton & D Darvill)
- Liverpool: Radial chamber layers in forward tracker. (J Dainton et al)
- Manchester: Planar chamber layers in forward tracker and then the Forward muon chambers. (M Ibbotson & R Thompson). Electronic R/O for all H1 trackers (J Ellison, D Mercer & S Kolya)
- Birmingham & QMW: Triggers (J Dowell, E Eisenhandler, G Thompson et al.
- RAL: S/C coil construction. (P Clee, E Baynham). Tracker build. DAQ (Bill Haynes). Electronics (Stan Jaroslawski).

Developing Collaboration

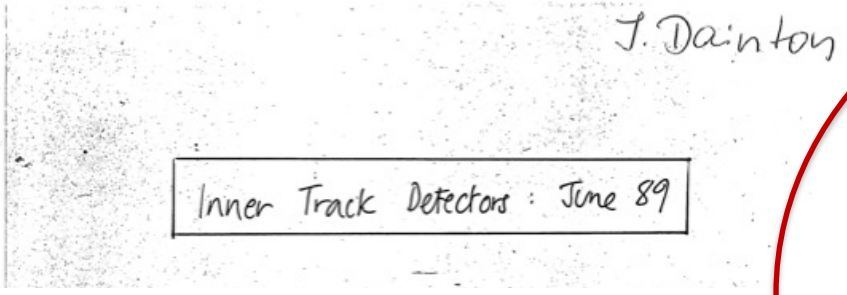
April 1986,
DESY

Developing Collaboration

April 1986,
DESY

April 1989,Manchester

Dainton's 1st H1 plenary talk?



J. Dainton

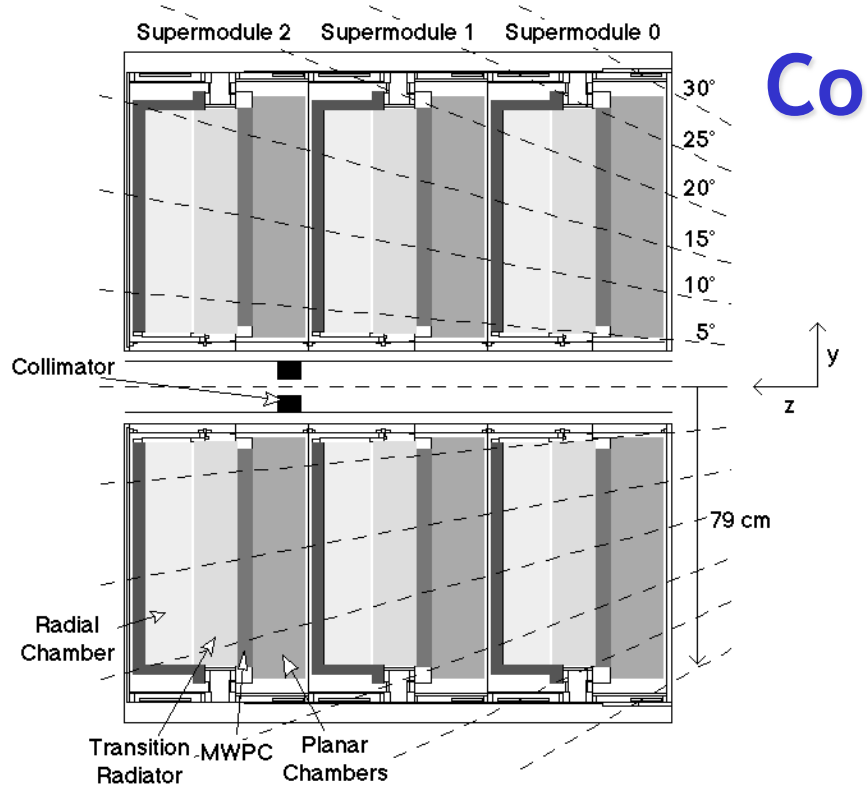
Inner Track Detectors : June 89

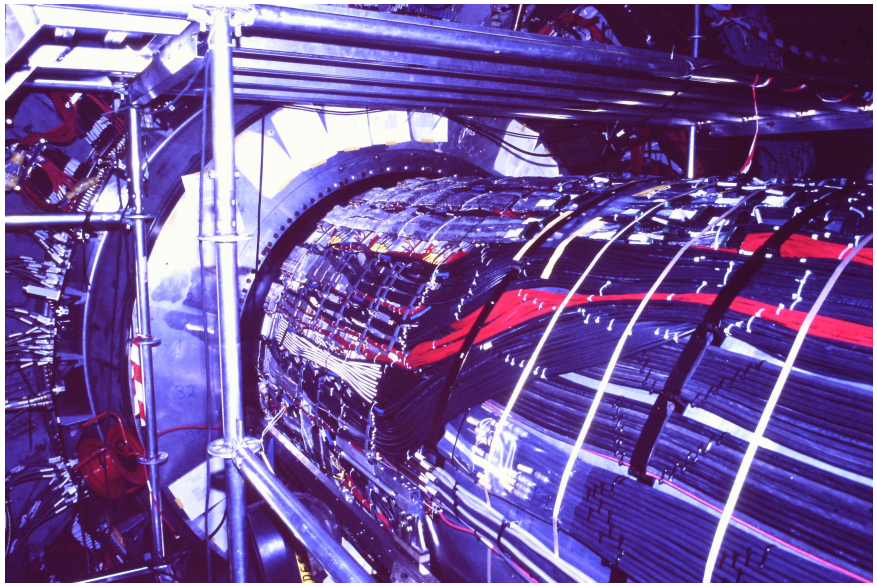
… and an early example of 'Dainton-speak'?

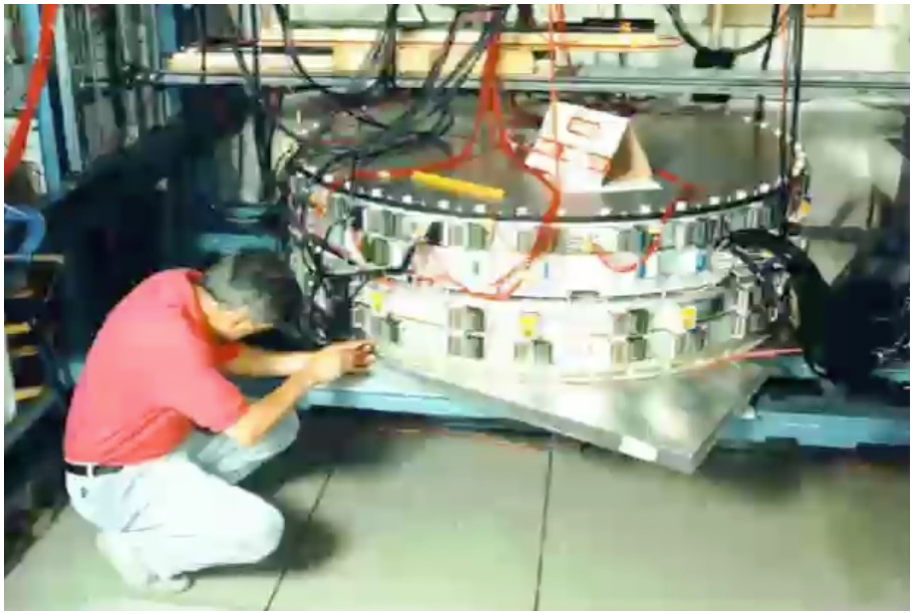
Summary

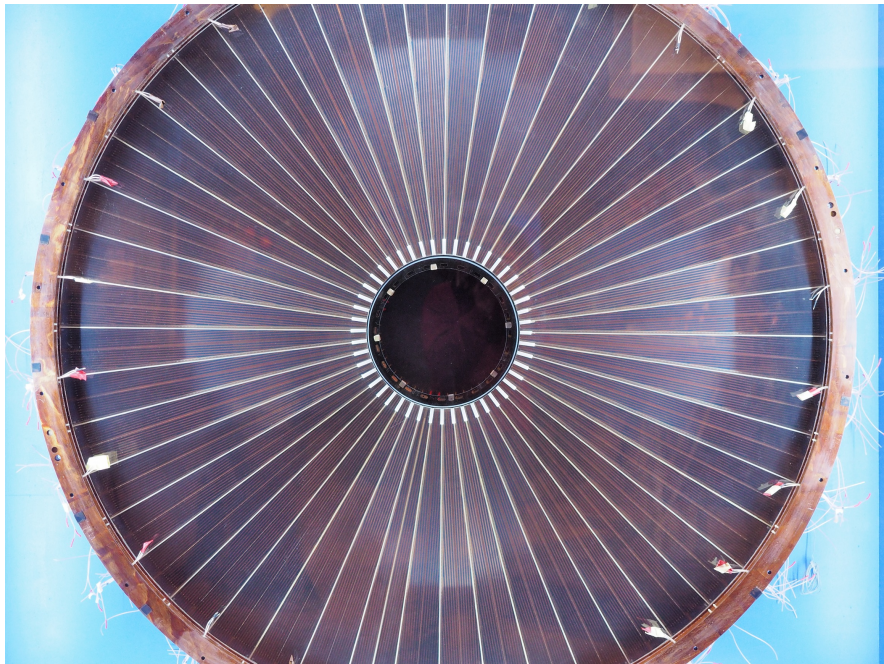
- inner track detectors in good shape as proven systems
  (one or two open questions still nag a little)
- time scale for production modules is
  either well under control
  CTD - COZ, CIP, CIZ
  FTD - planar, TR
  or tight (for well understood reasons)
  CTD - CJC, COP (started late)
  FTD - radial, MWPC
  BPC - (started even later)
- assembly and testing of modules together very tight in time
  m'power logistics tricky
- co-ordination and planning of installation at DESY not yet planned

Completed Forward Tracker



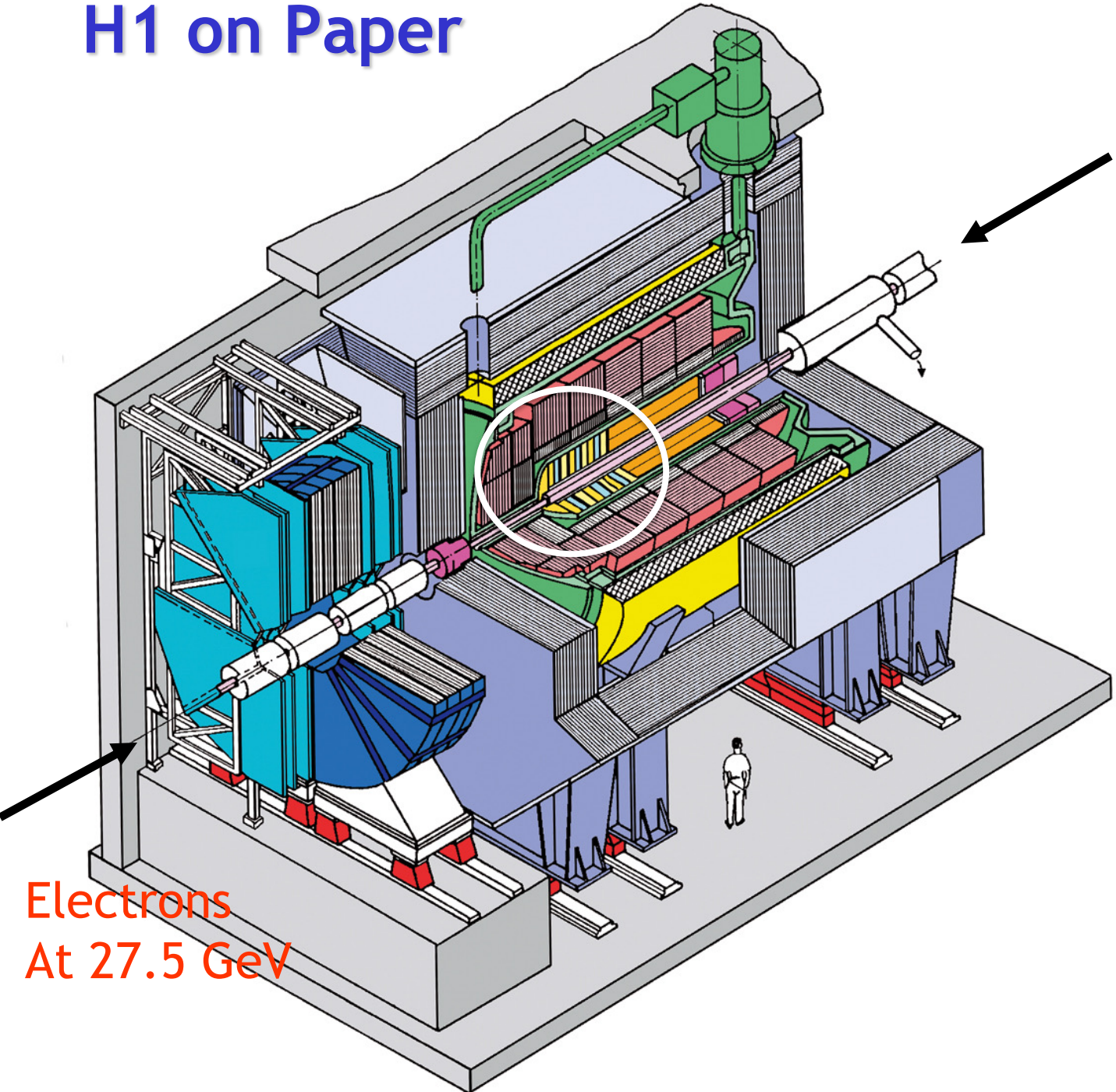




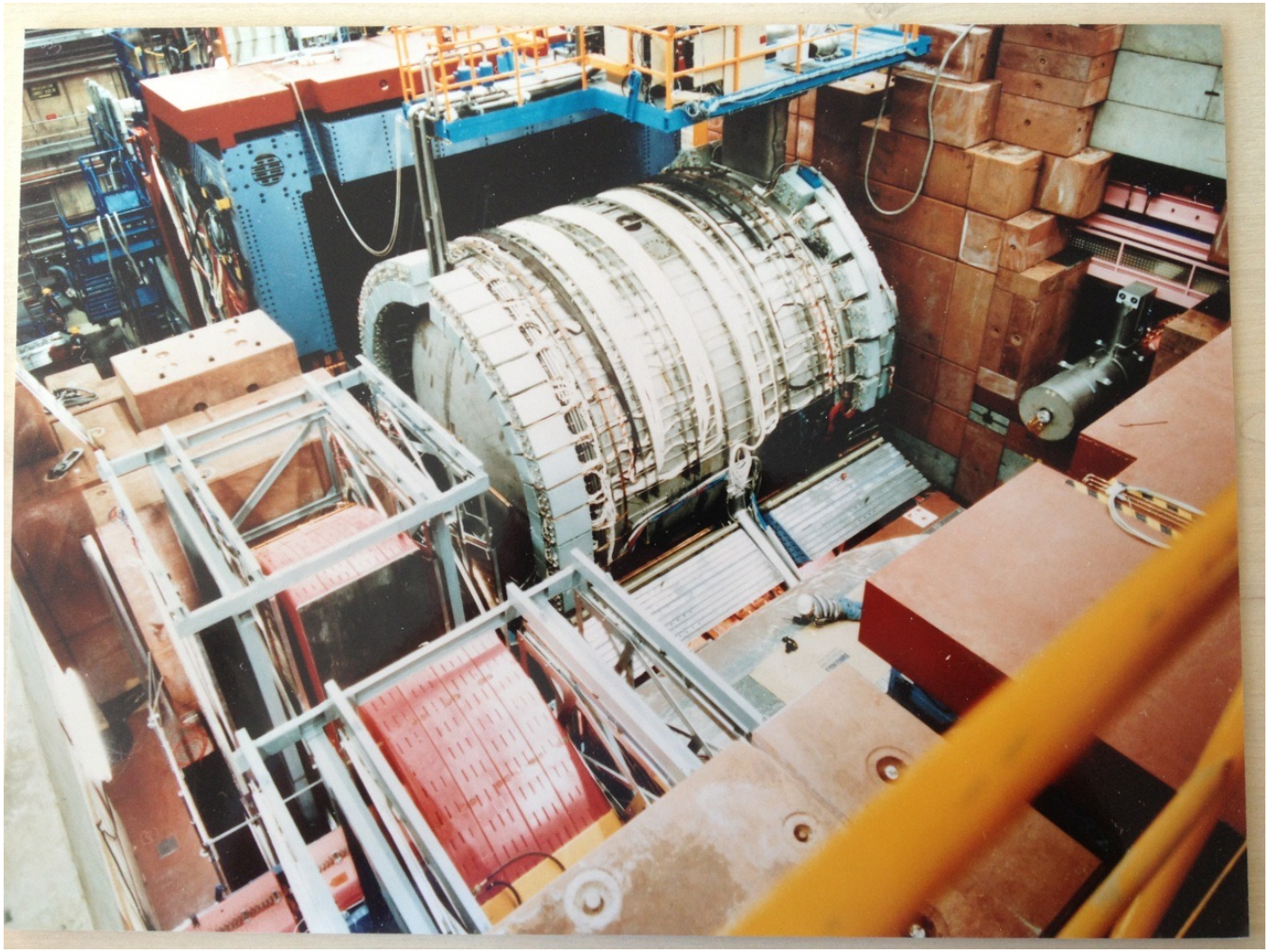


The Completed Forward Tracker

H1 on Paper

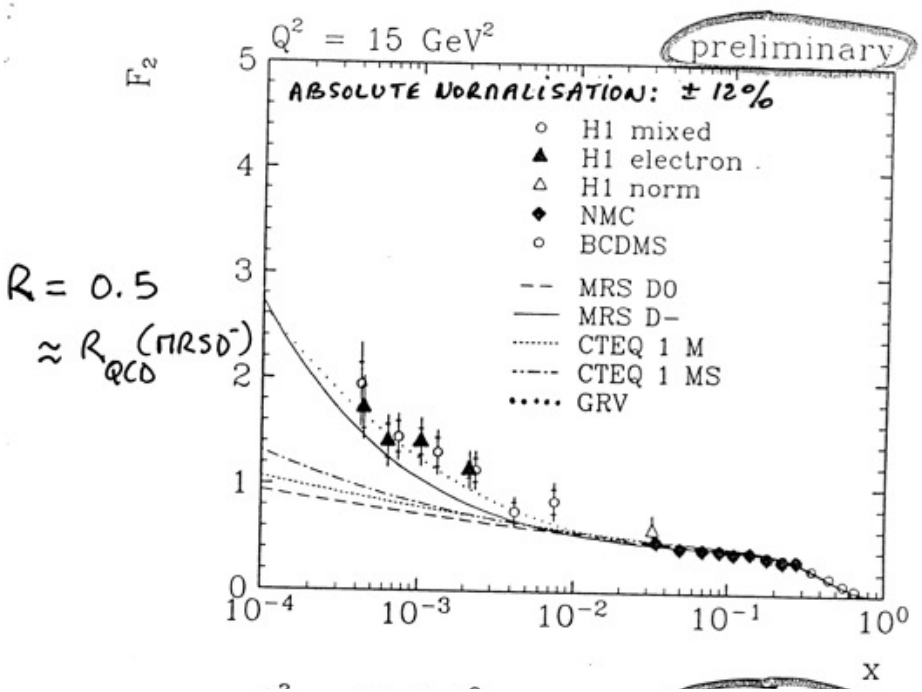


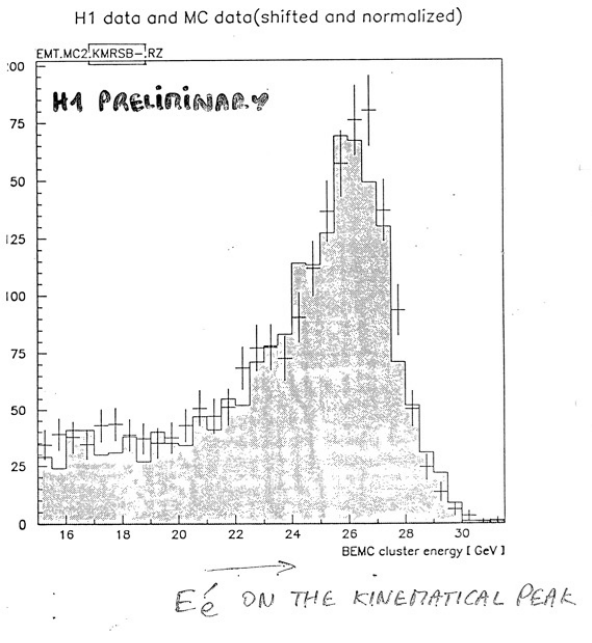
H1 in Reality



… data taking begins in 1992 …

First Results: Slides from C Vallee, Moriond '93





Notes:

- Wobbly plots!?
- `Questionable' control plots
- Remarkable rise of F_2 at low x
- Remarkable conclusions

- $F_2^p(x,Q^2)$ HAS BEEN MEASURED FOR THE FIRST TIME IN THE RANGE $10^{-4} < x < 10^{-2}$
- PRELIMINARY RESULTS FAVOUR A "LIPATOV BEHAVIOUR" OF THE GLUON IN $1/\sqrt{x}$ ALREADY IN THIS RANGE
- THIS SHOULD MAKE THE DETECTION OF SATURATION EFFECTS EASIER WHEN LARGER STATISTICS IS AVAILABLE

‘HERA – the new frontier for QCD’, Durham, March 1993
Progenitor of ‘DIS’ Conference series

‘HERA – the new frontier for QCD’, Durham, March 1993
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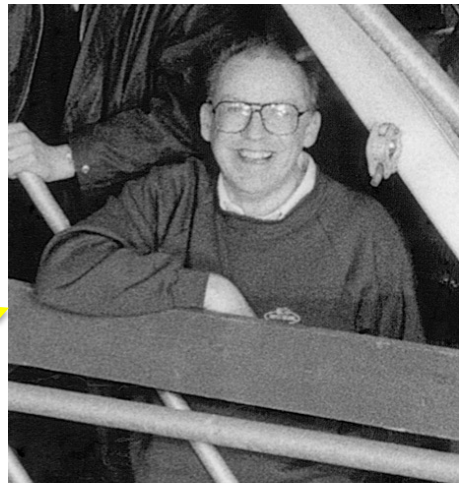
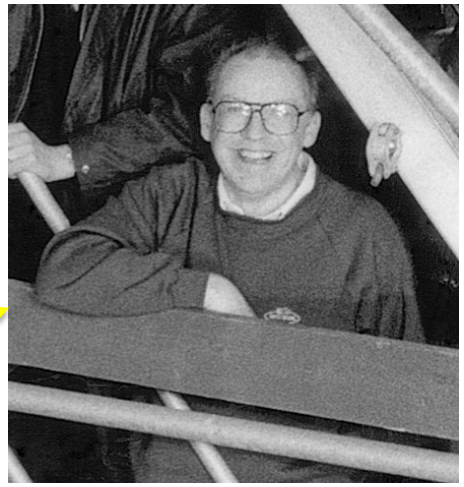
Another Famous Photograph (H1, March 1994)

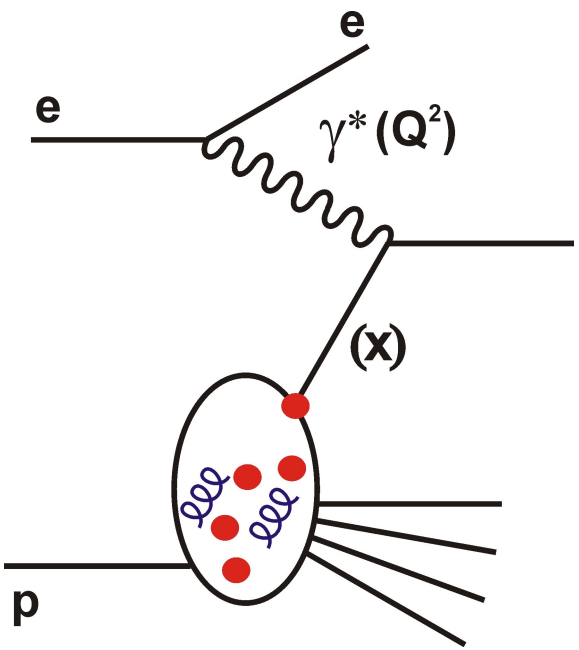


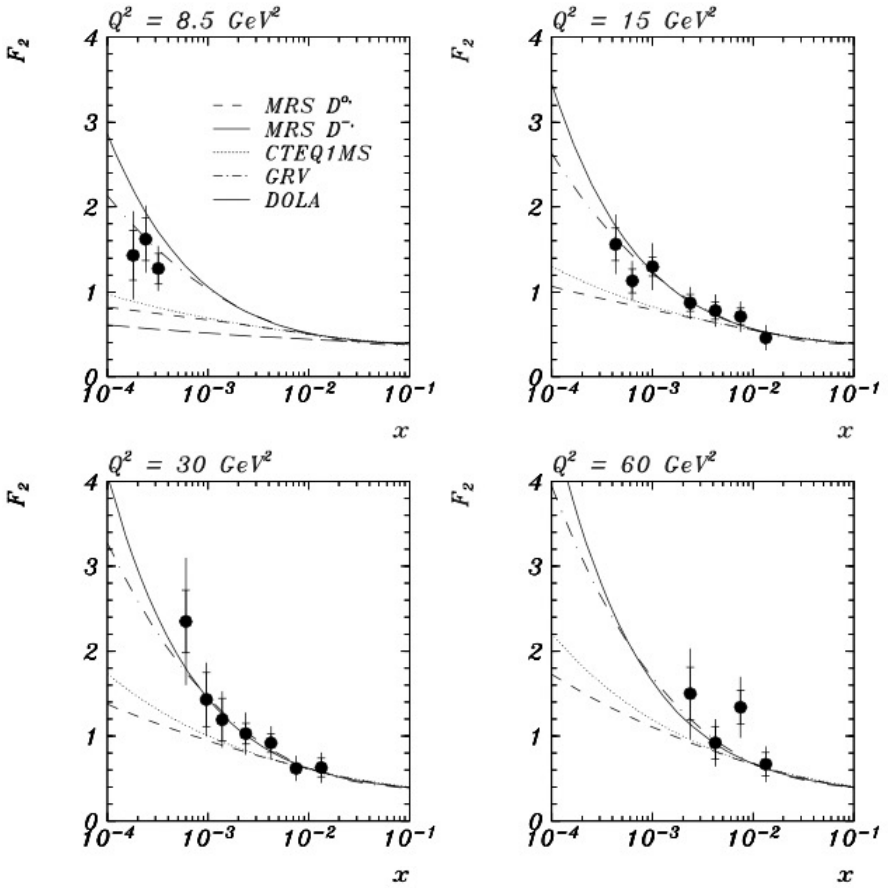
Another Famous Photograph (H1, March 1994)



PRN … still trying to understand why there were no forward muons

What had been discovered? … the birth of experimental low-x physics



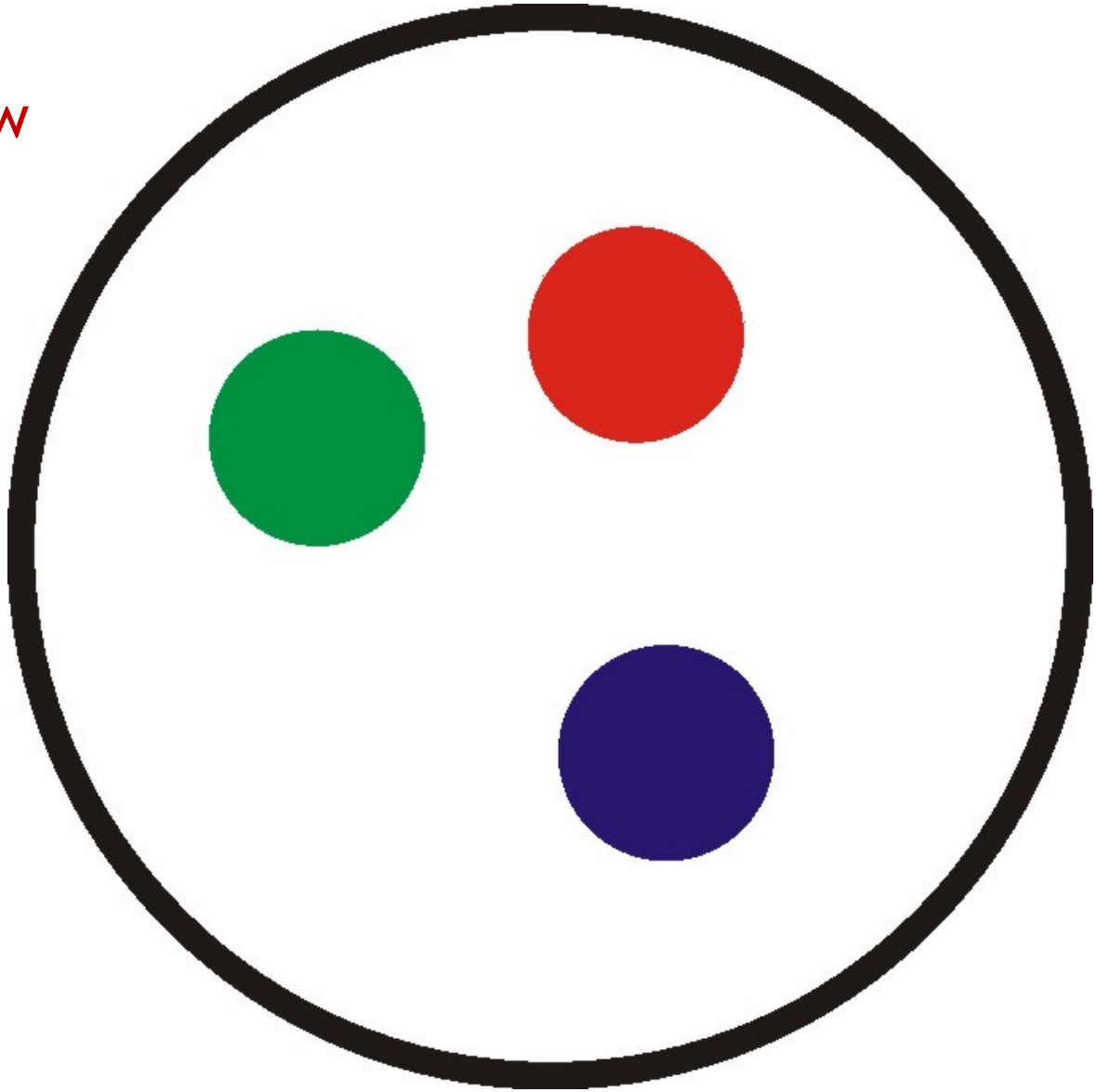


Q^2 = 4 momentum transfer squared

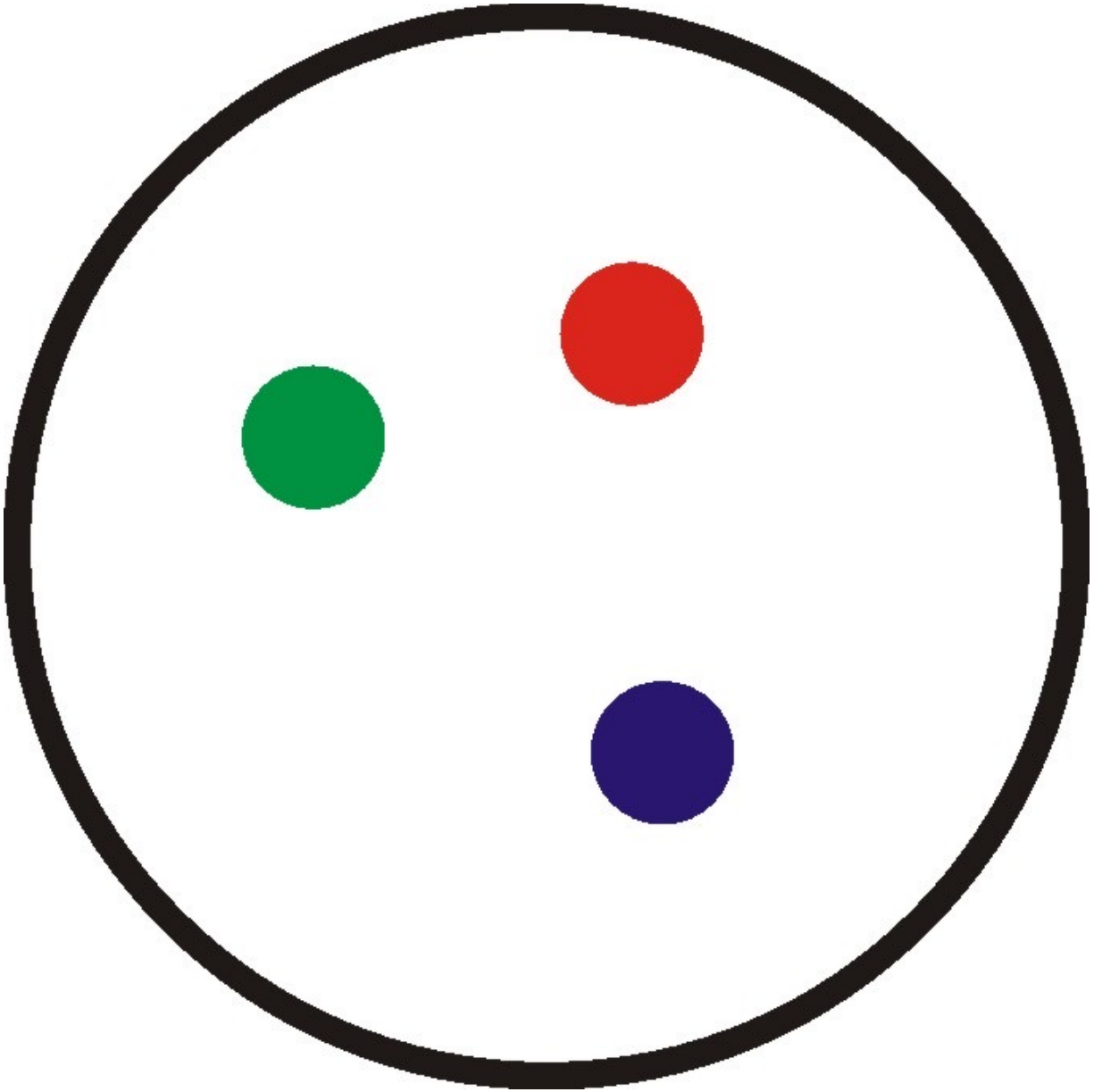
x = fraction of proton momentum carried by struck quark

Quarks at modest resolution (Q^2)

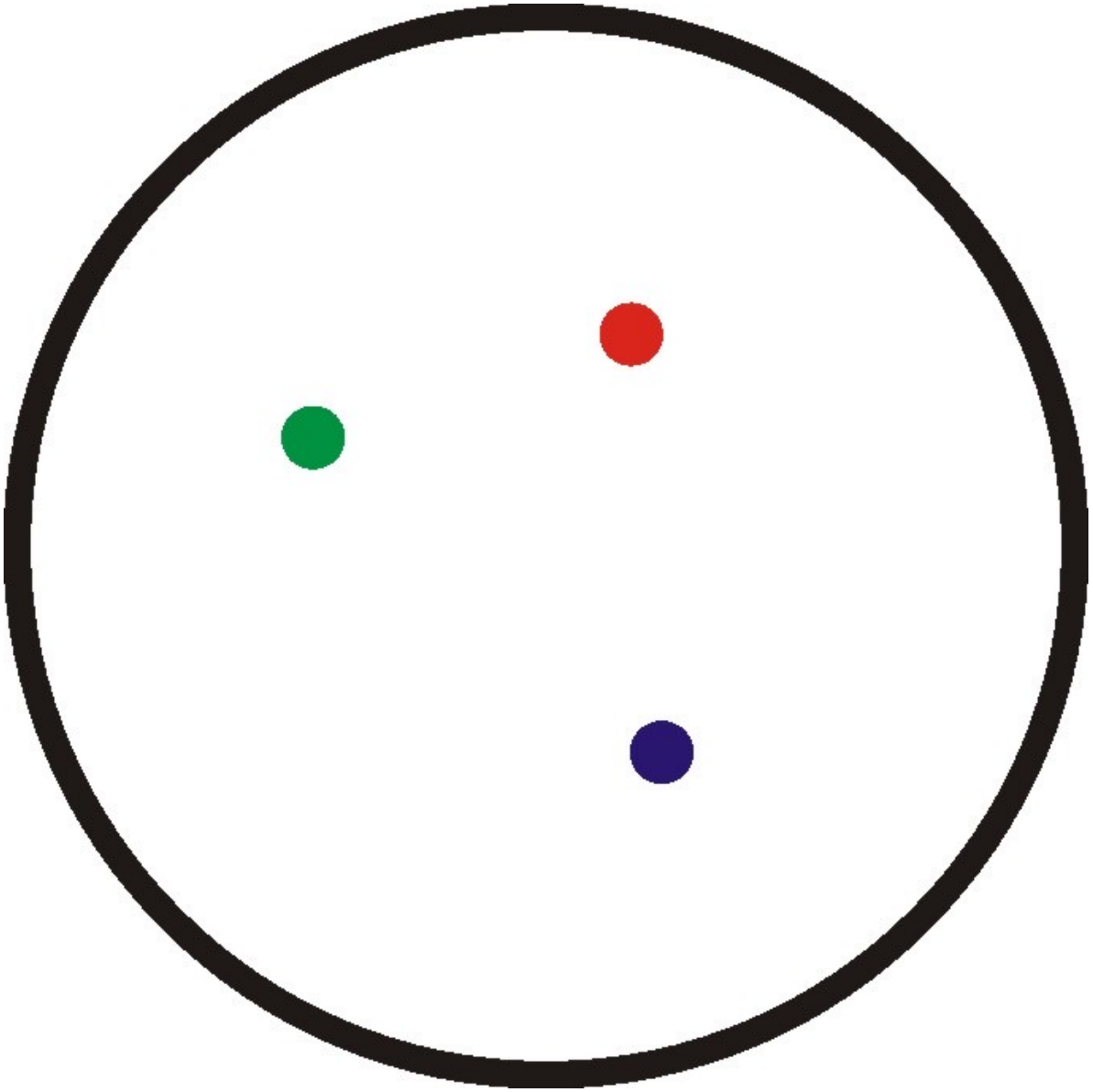
A ‘naiive QPM’ view



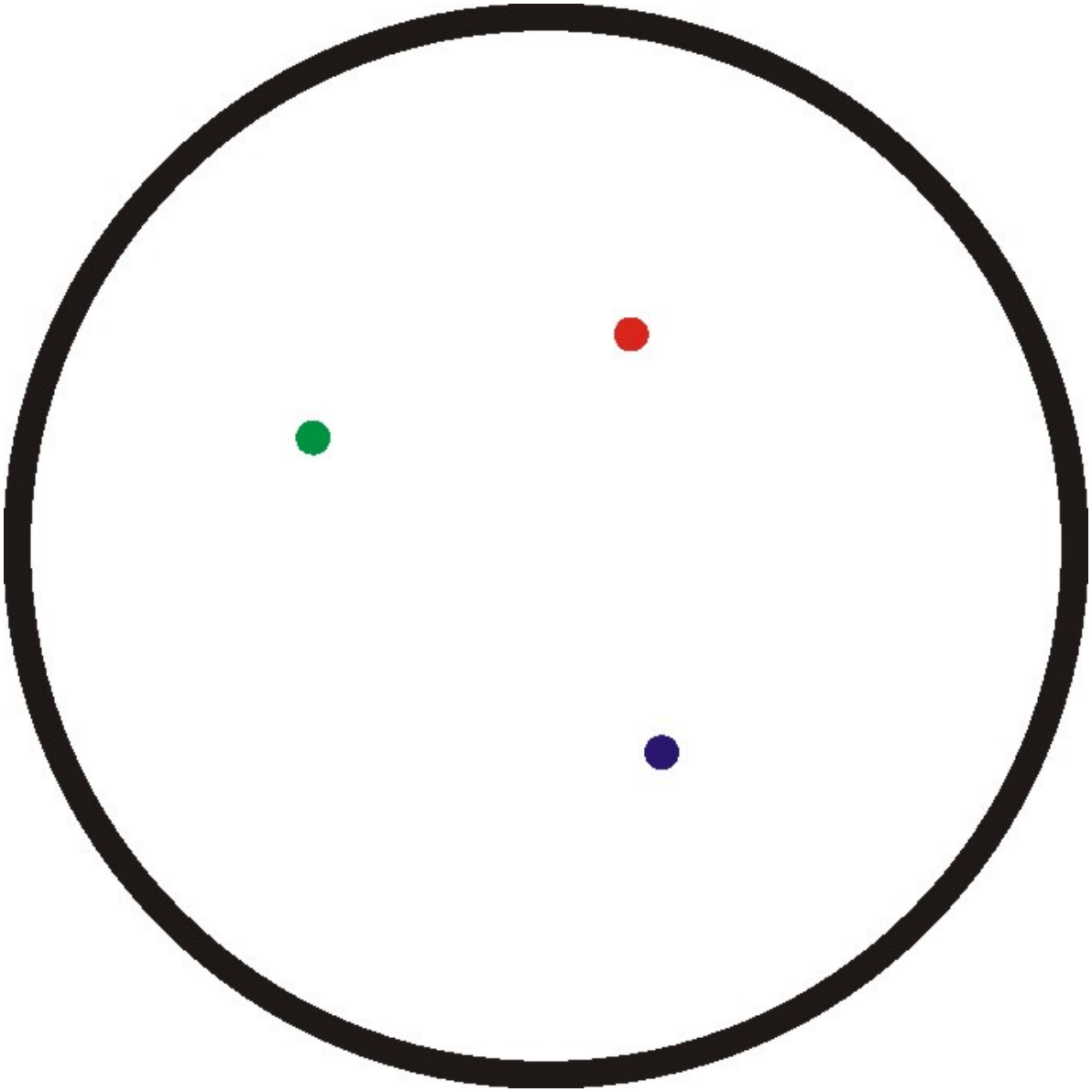
Quarks at higher resolution (Q^2)



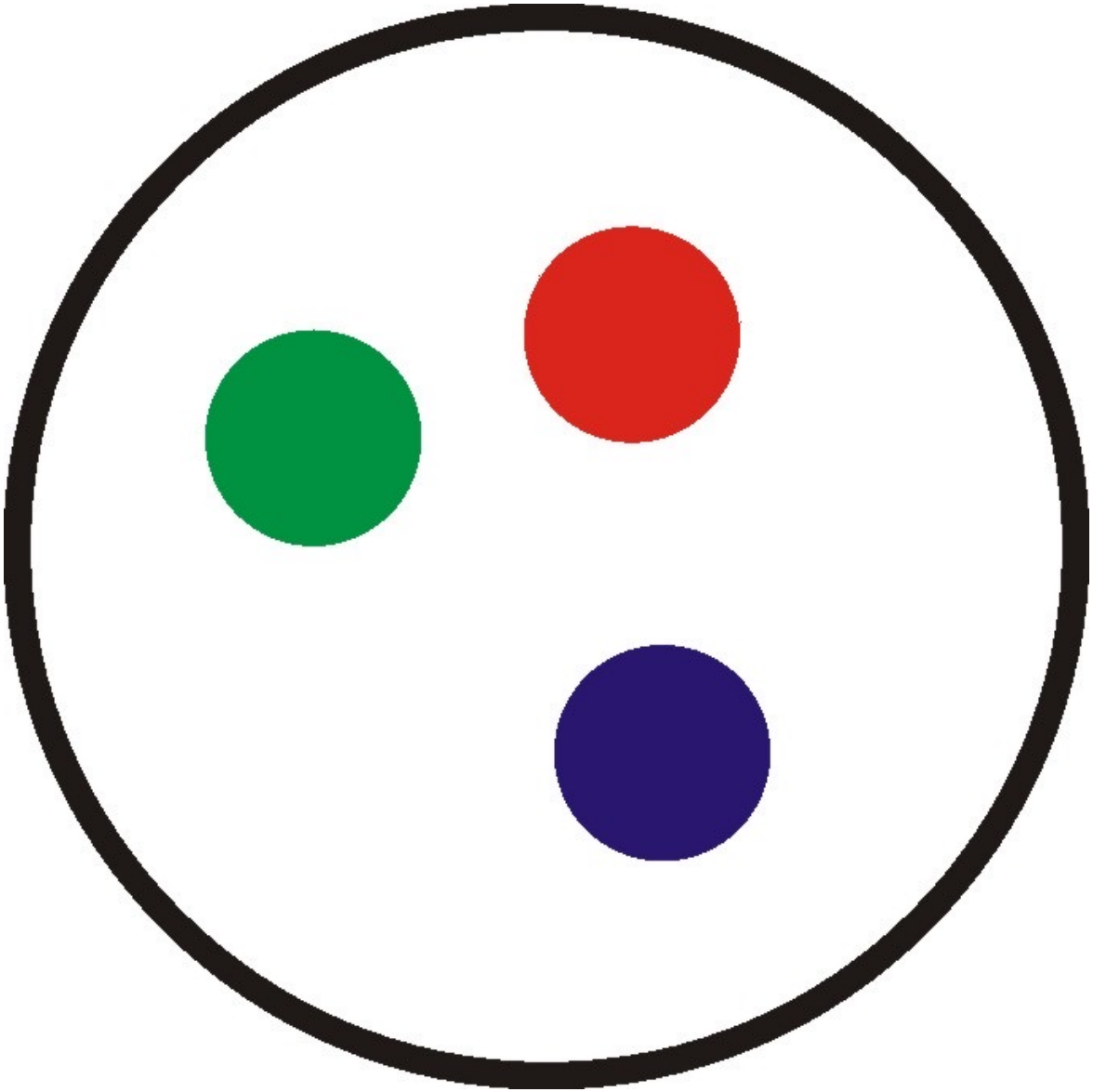
Quarks at high resolution (Q^2)



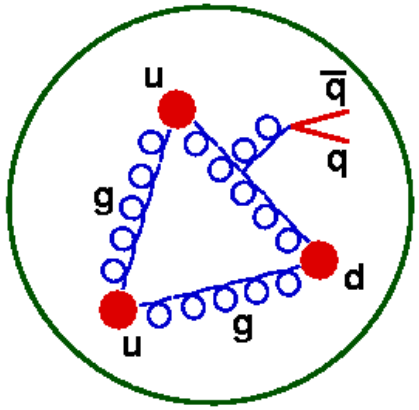
Quarks at very high resolution (Q^2)



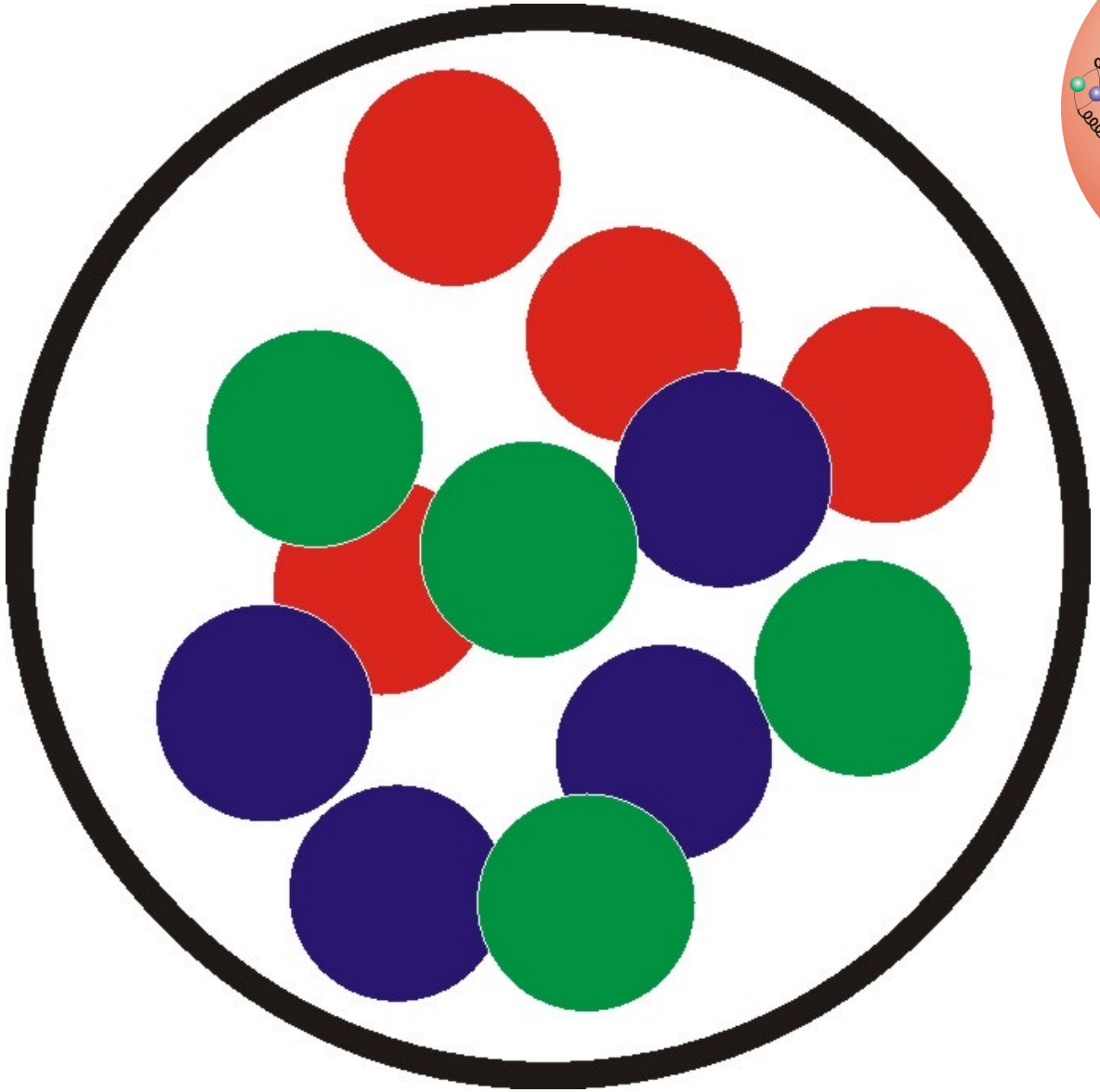
Quarks at large x

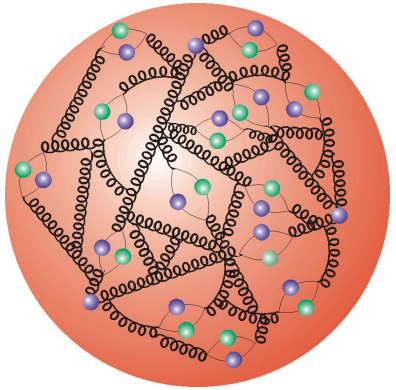


Decrease x: gluons → sea quarks & antiquarks

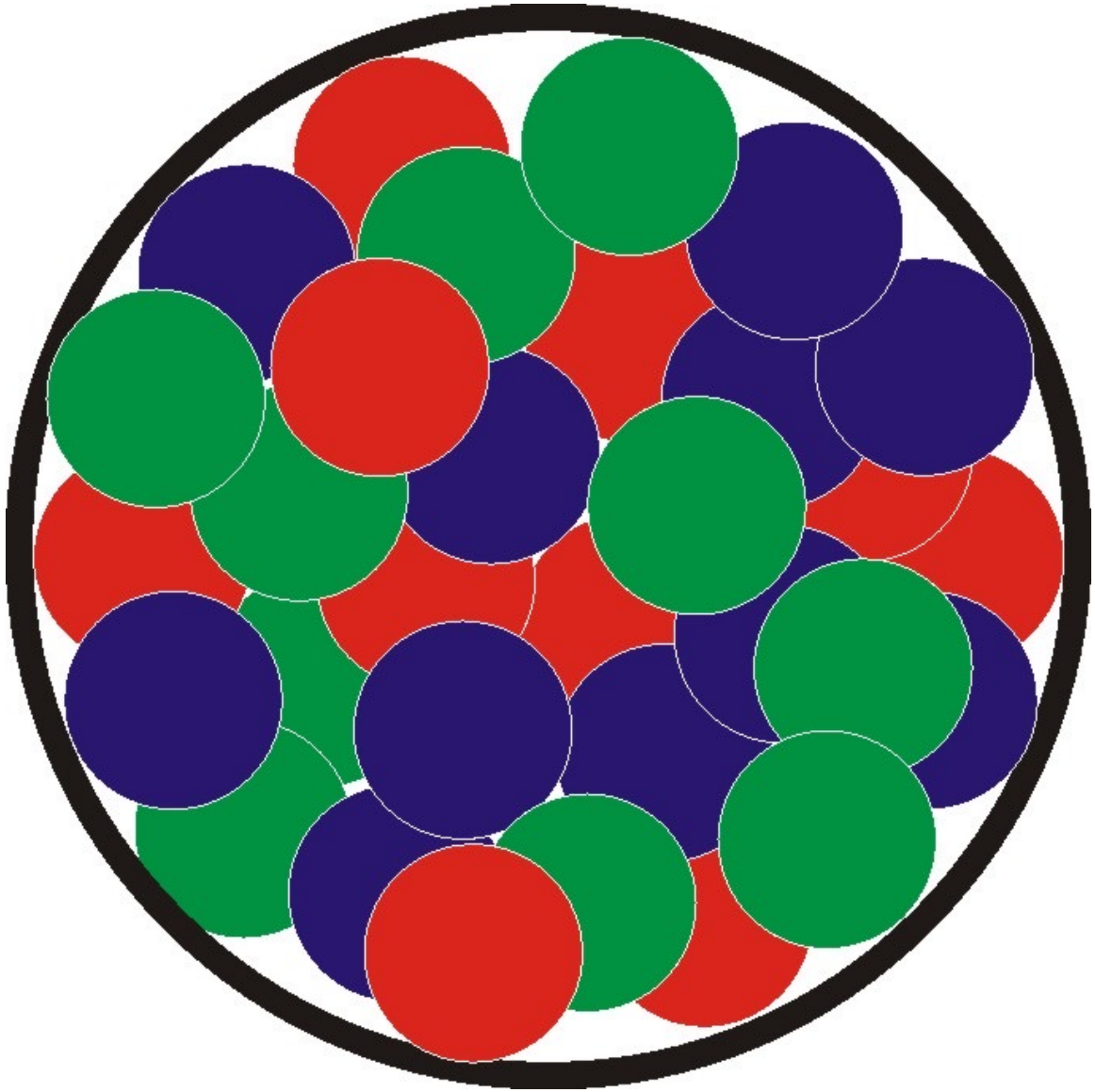


Decrease x Further



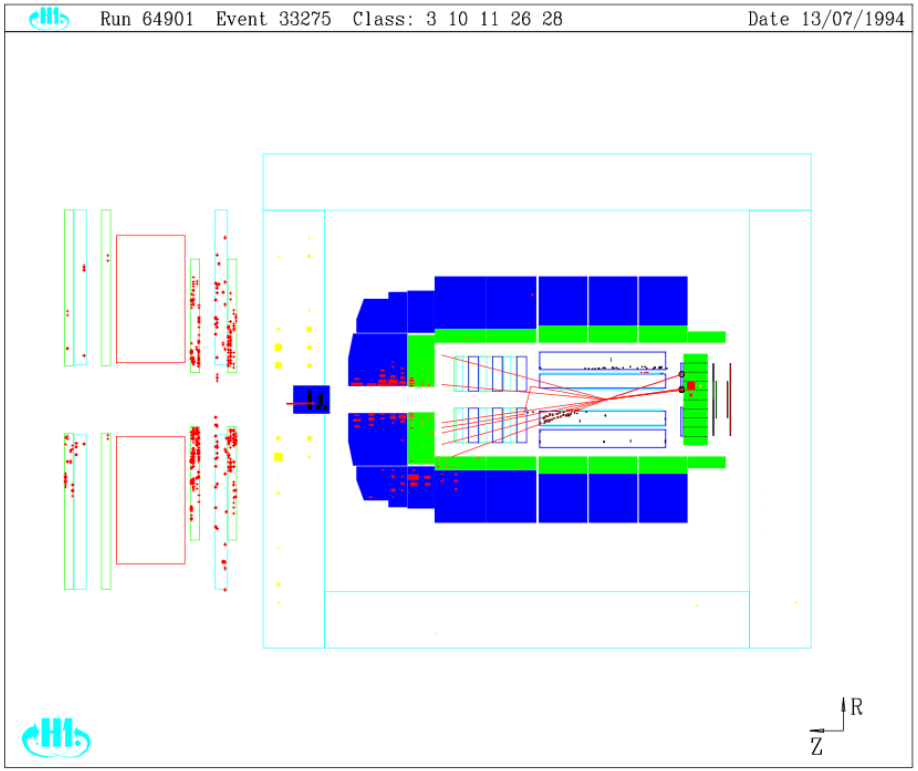


Consequences of such a dense parton system?

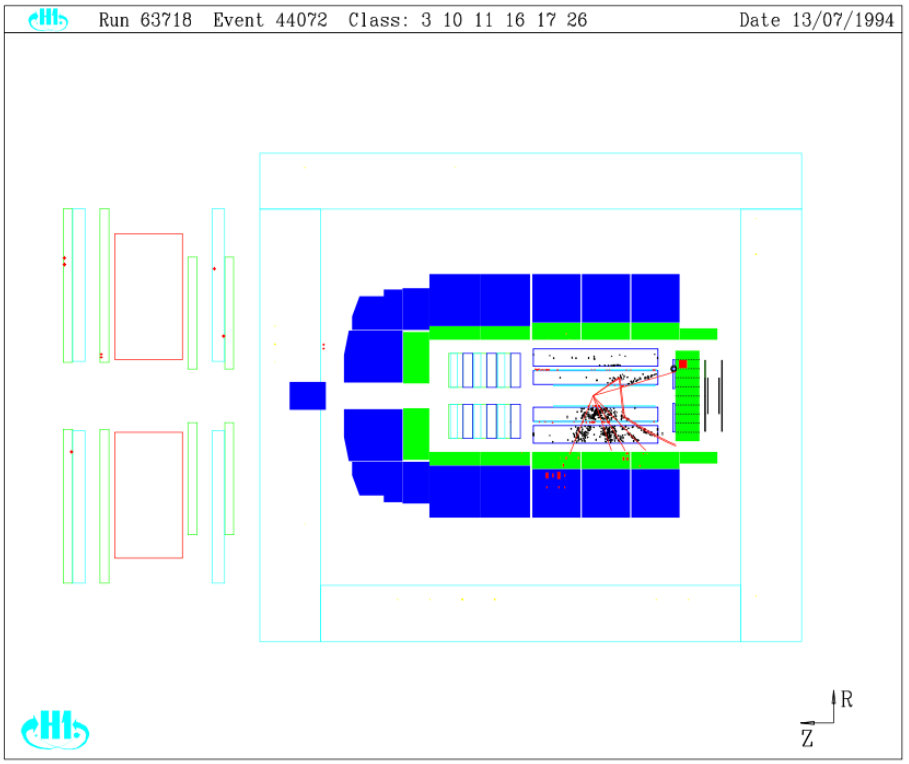


… does the proton even ‘saturate’ e.g. through gg→g?

… One of the Consequences …



‘Standard’ Event



‘Rapidity Gap’ Event

First discussion in H1 ‘HADES’ group

- **HADES Meeting 07.07.1993**

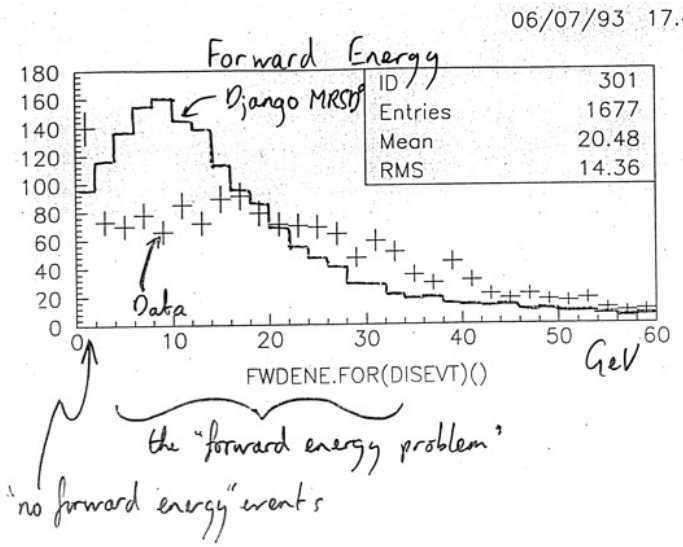
Agenda and Minutes	H.Kuester
Diffractive Events, Forward Energy and Other Mysteries	T.Greenshaw
No title (Corrected Energy Flows)	P.Laurus
Hadronic Covariance Calculations and Kinematic Fitting	J.Phillips
Updates to Hadronic Final State Studies	C.Hoeger

TOP SECRET

1) Diffractive Events, Forward Energy and Other Mysteries

The story so far:

1) Zeus and H1 observe forward energy in DIS events not described by "reasonable" Monte Carlos
2) Zeus identify a "new class of events" with no forward energy.....



(20)

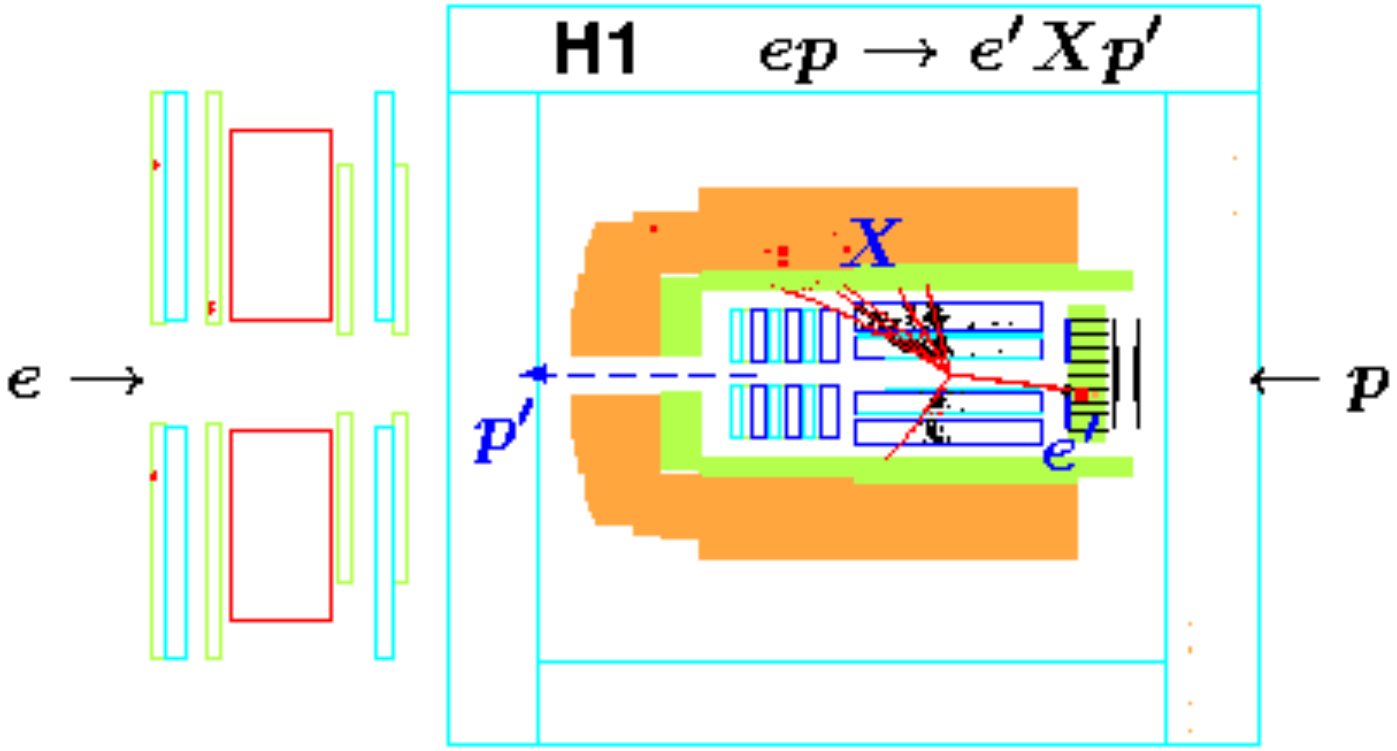
Tentative Conclusions

At least some of the rapidity gap events may be "boring old VDM", ie. ρ, ω and φ production. The rate may be higher than might be expected

Very Tentative Conclusions

There is some suggestion that discrepancies between "reasonable" DIS Monte Carlos and our measurements (F, x_{vis}) may be due to Deep Inelastic Pomeron Scattering.

… Interpreting Rapidity Gaps …

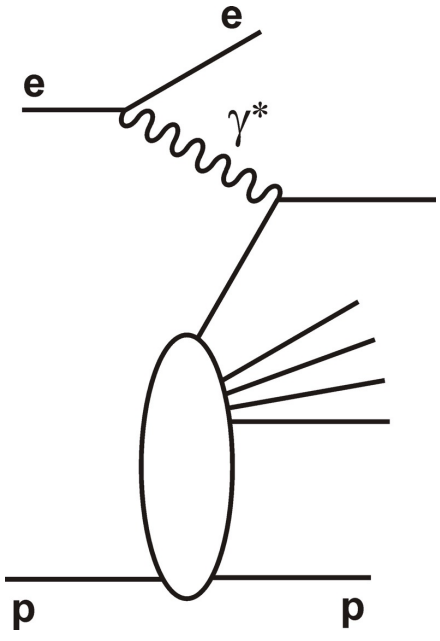


H1 quickly developed techniques to distinguish using an array of forward detectors

… Birth of H1 Diffractive Group

- **DI Diffractive Meeting 09.02.1994**

Minutes		J.Phillips
Forward Muon and p-Tag Analysis	(slides missing)	A.Mehta
FTOF	(slides missing)	P.Biddulph
Monte Carlo Production	(slides missing)	J.Phillips
High M_X Analysis	(slides missing)	J.Phillips
DIFFVM (+POMPYT and RAPGAP)	(slides missing)	B.List
RAPGAP, Charge Exchange, Proton Dissociation	(slides missing)	H.Jung
POMPYT and Comparisons with RAPGAP	(slides missing)	H.Mahlke
Plans for Tutorials on Diffractive Physics (discussion)		

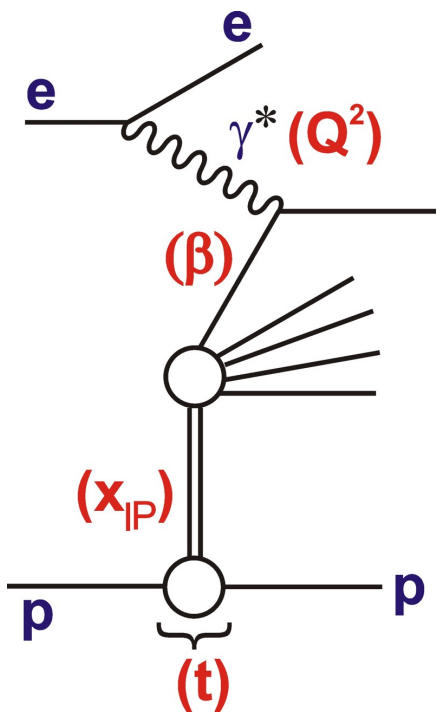


Conveners: John Dainton,Julian Phillips … 'special humour'!

'Wunderkinder': Andrew Mehta and Julian Phillips

… Pomerons
… Regge theory
… S matrix
… Old text books

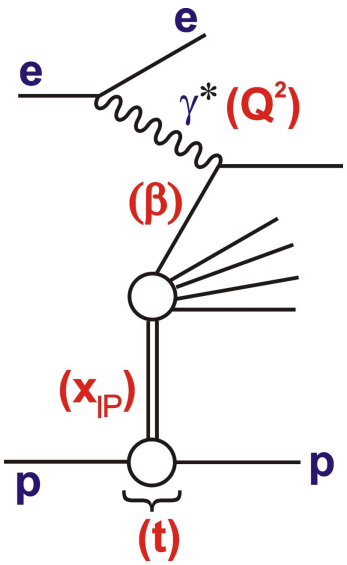
Nobody expected HERA physics to be like this!



John was now in his element!

- Many worked on this, but the basic picture was articulated by John, down to the naming of the x_{IP} and β variables

- Love of the (scientific) language and insistence on saying exactly what was warranted by the data (and no more) could occasionally cause complications with collaborators

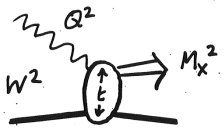


"∴ the interpretation of the rapidity gap events in DIS at low Bjorken-x as being due in the main either to diffractive scattering or to diffractive dissociation of the incident proton can be made without ambiguity."

John Dainton : H1 & HD Sept. 1995

Funny Games with Funny IP

- "minimal" interpretation $\gamma^* p \to M_X^2 p$



$W^2 \gg Q^2, M_X^2, t$ "asymptotic".

Lt $\frac{t}{W^2} \to 0$ $\frac{Q^2}{W^2} \to 0$ $\frac{M_X^2}{W^2} \to 0$ $\quad \frac{d\sigma}{dt\, dM_X^2} \propto f(M_X^2)(W^2)^{2\alpha(t)-2}$

α function of t Regge trajectory if take Regge theory

At fixed M_X^2: $\quad \frac{d\sigma}{dt\, dM_X^2} \sim (W^2)^{2\alpha(t)-2}$

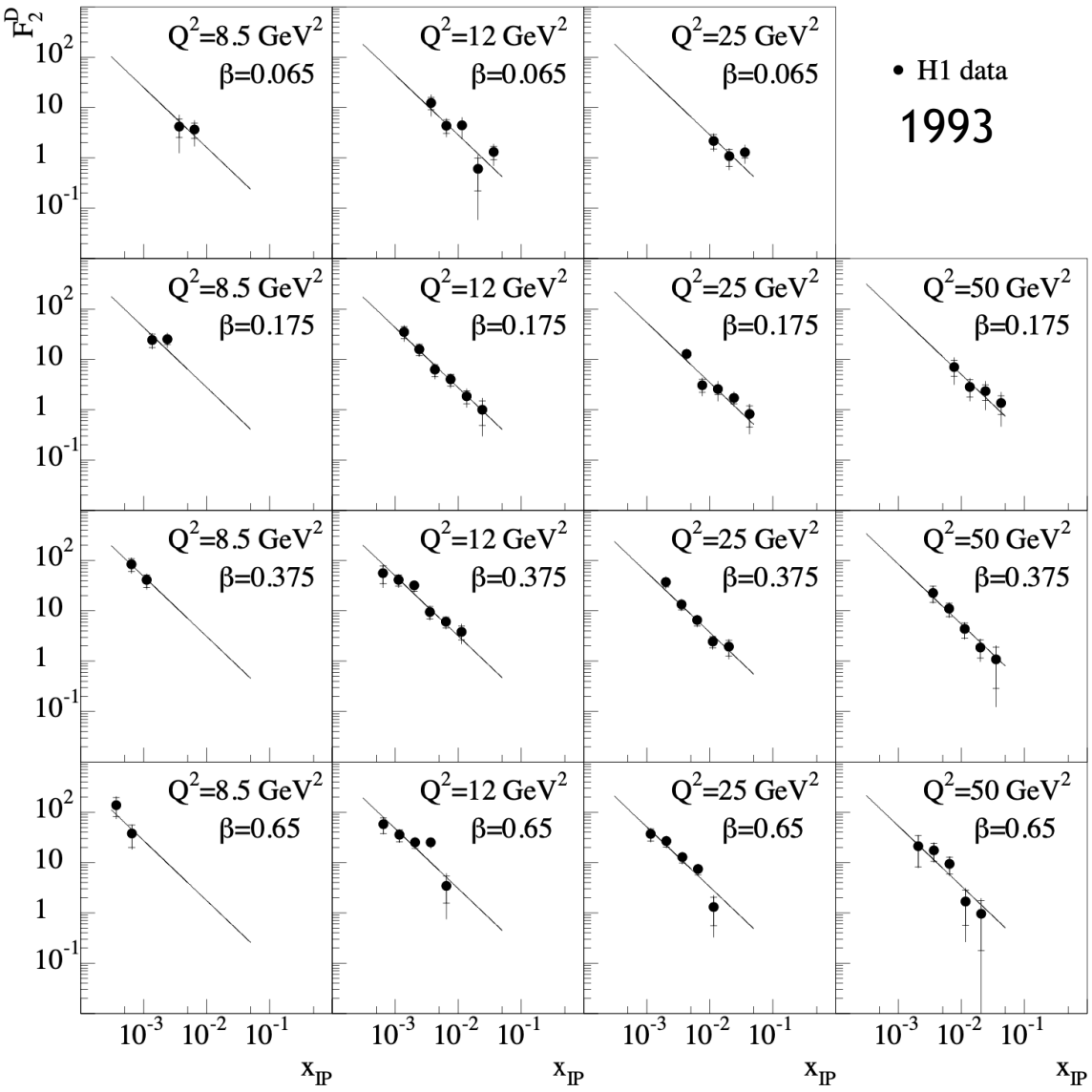
or $\quad \frac{d\sigma}{dt\, dx_{IP}} \sim \left(\frac{1}{x_{IP}}\right)^{2\alpha(t)-1}$ $\quad x_{IP} = \frac{Q^2+M_X^2}{Q^2+W^2}$

Or fixed Q^2, β $\quad \beta = \frac{Q^2}{Q^2+M_X^2}$

$$\int \frac{d\sigma}{dt\, dx_{IP}}\, dt \sim \frac{1}{x_{IP}^{2\alpha(0)-1}} \cdot \frac{e^{\left[1-2\frac{\alpha'}{b}\ln x_{IP}\right]t_{min}}}{1-2\frac{\alpha'}{b}\ln x_{IP}}$$

if $\frac{d\sigma}{dt} \sim e^{bt}$ and $\alpha(t) = \alpha(0) + \alpha' \cdot t$

Stamp Plots, Factorisation, Pomeron Structure

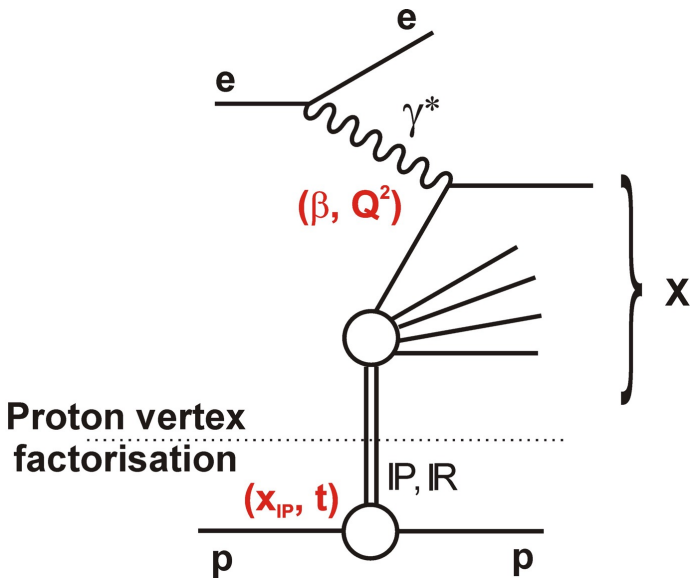


• H1 data

1993

… basic observation of a 'factorisation':

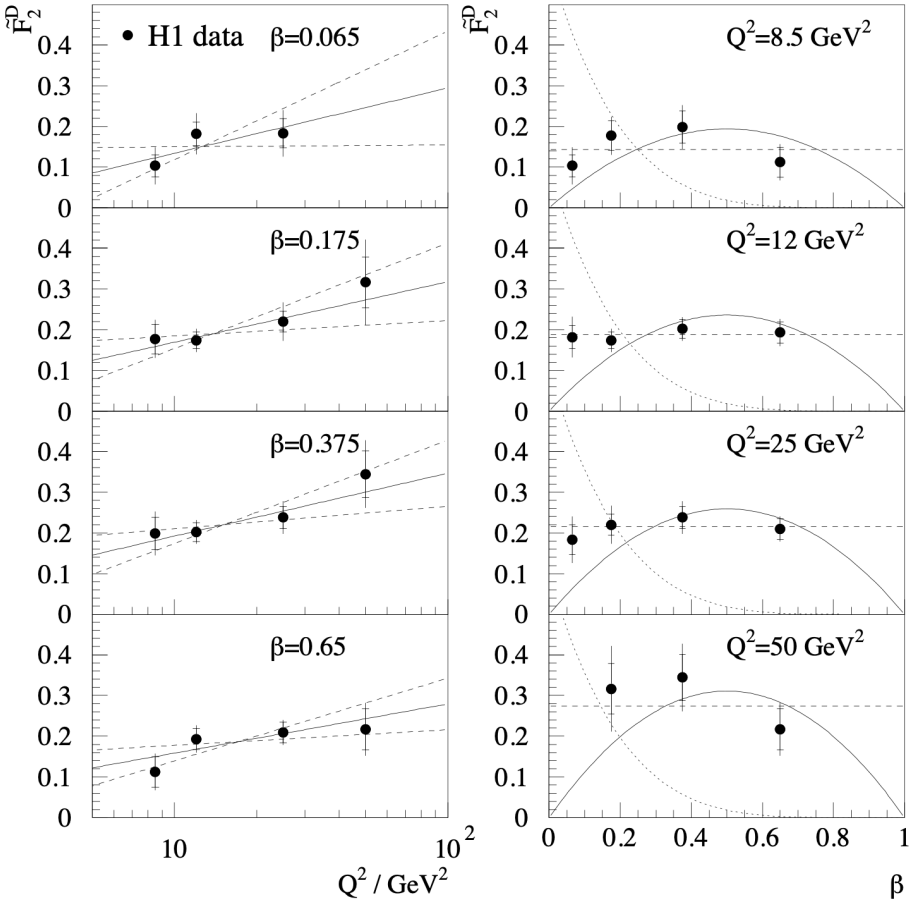
- IP flux (x_{IP}, t)
- DIS from IP (β, Q^2)



DESY 95-36
February 1995

Publication of 1993 Data

First Measurement of the Deep–Inelastic Structure of Proton Diffraction



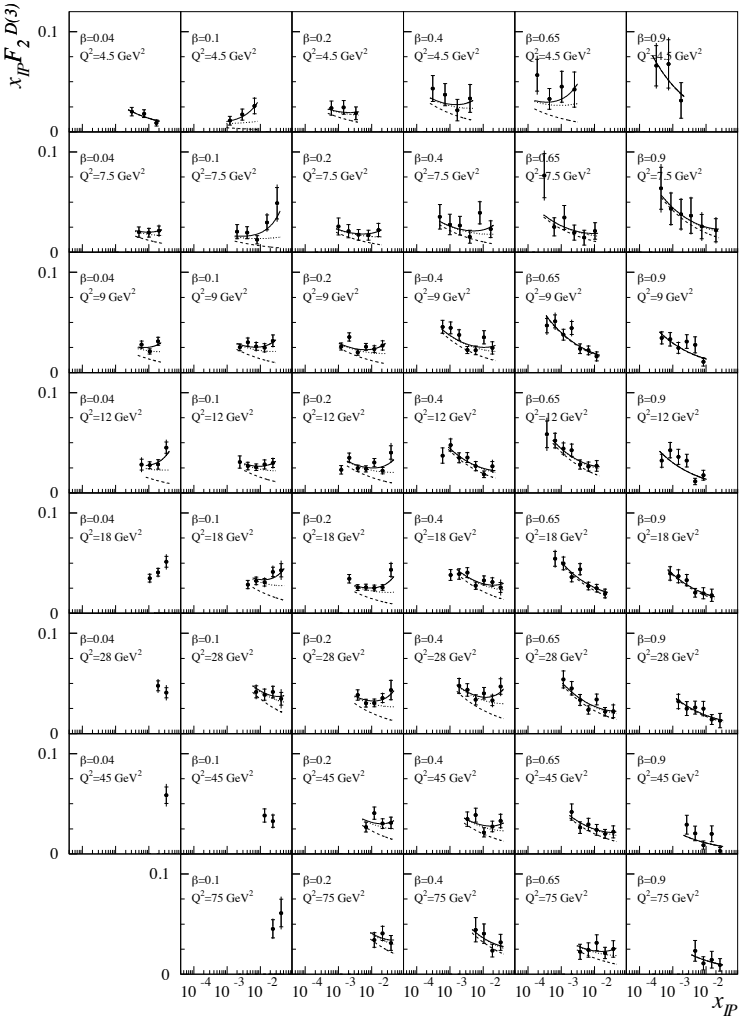
8. Summary and Conclusions

- events not described in present DIS simulations which have forward rapidity gap → contribution $F_2^D(\beta, Q^2, x_{IP})$ to F_2^P
- universal x_{IP} dependence of $F_2^D(\beta, Q^2, x_{IP})\ x_{IP}^{-n}$ = factorisable DIS process
- $n = 1.09 \pm 0.05(stat) \pm 0.12(sys)$ consistent with diffraction $\alpha(0) \gg 0.5$ rules out meson exchange(s) colourless target in/with p = IP
- IP structure broadly scale invariant room for scaling violations substantial inelasticity
- β dependence consistent with simplest 2 parton picture $\beta(1-\beta)$ and gluon corrections

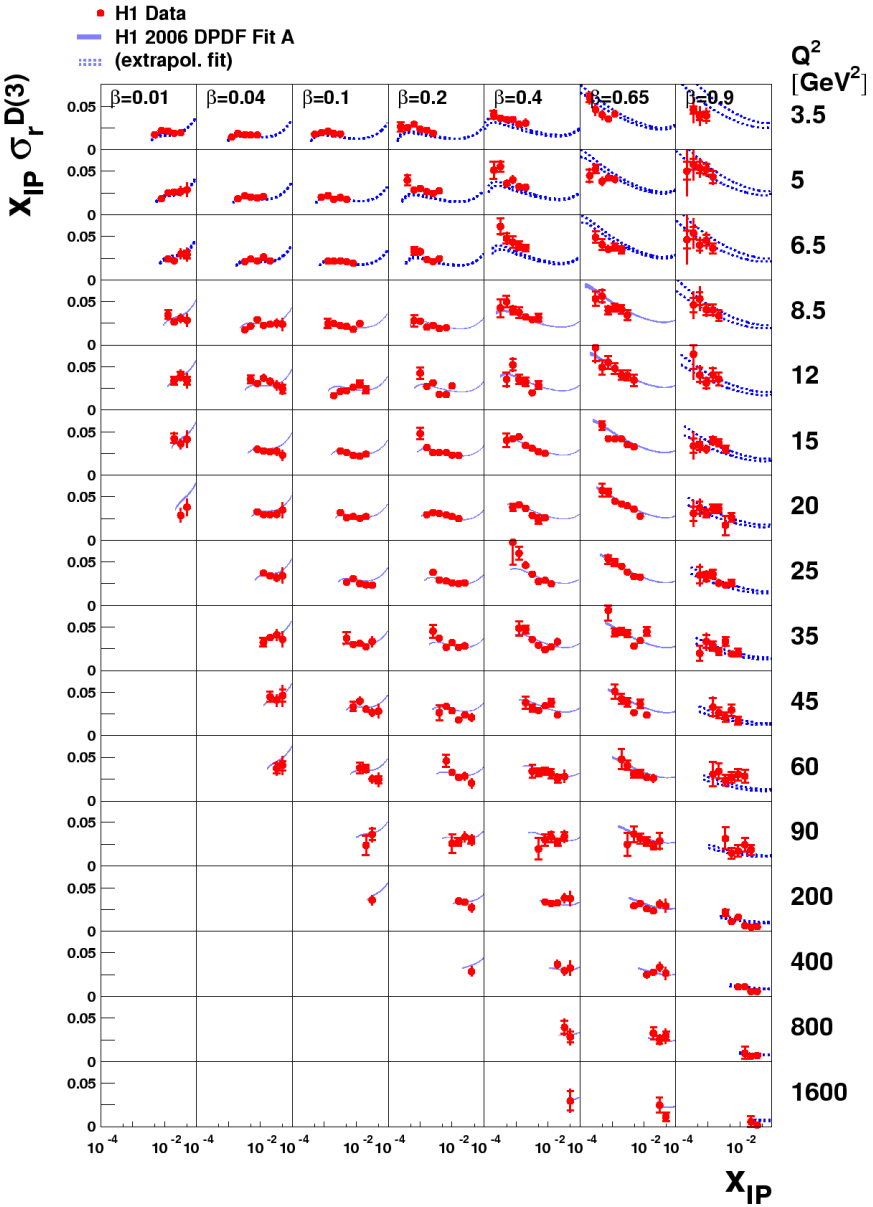
- From ‘T0’ talk (JBD)
- Most of what we know …

More Data - the stamp plot expands!

1994 data



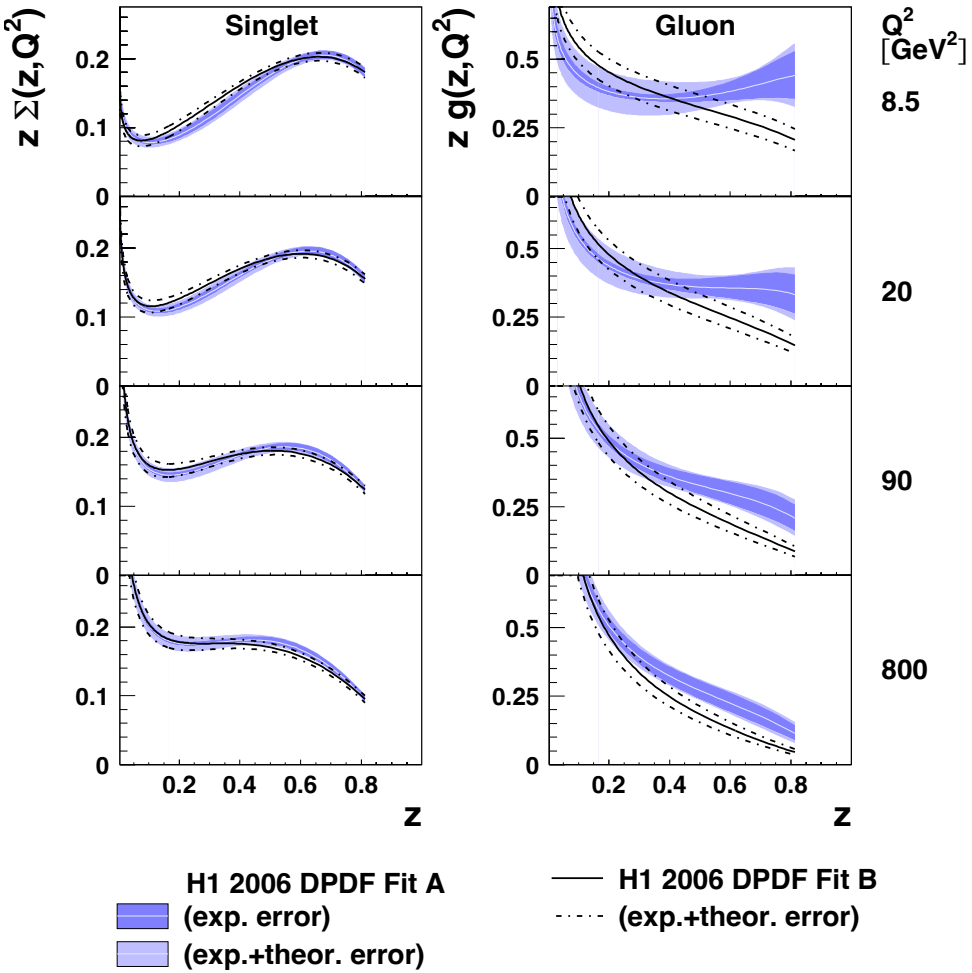
1997 data



Subtle ‘sub-leading’ effects when plotted on linear sclae

Ultimately: The deep-inelastic structure of strongly interacting colourless exchange

1997 data



- ‘Pomeron’ in DIS is basically a ‘soft’ object, with a Deep inelastic structure that is dominated by gluons carrying a large fraction of its momentum

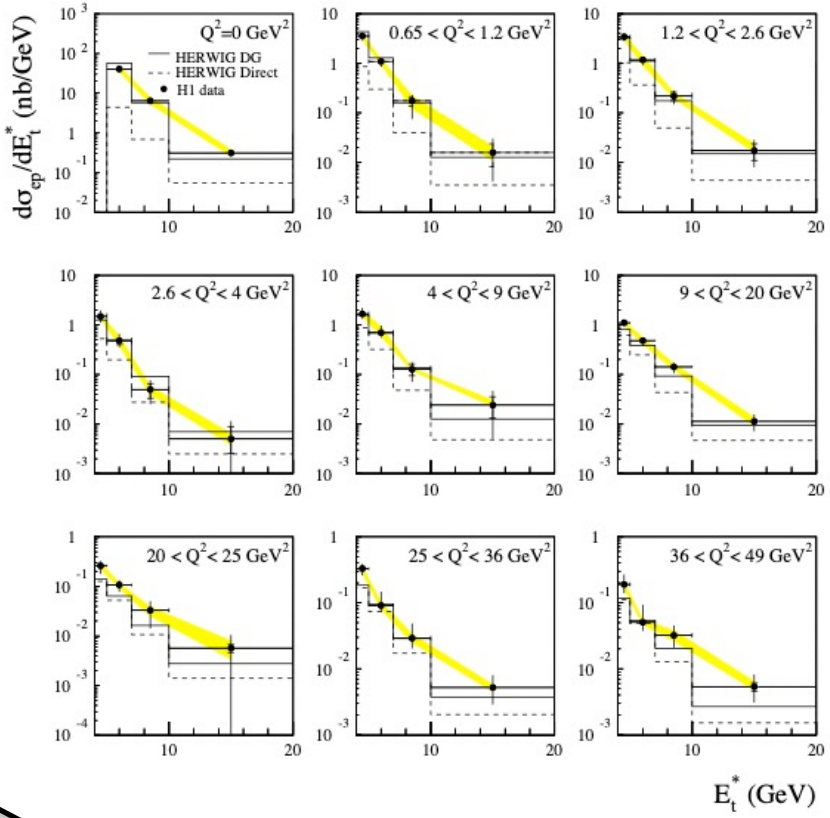
- That structure can be universally applied to describe diffractive final state data

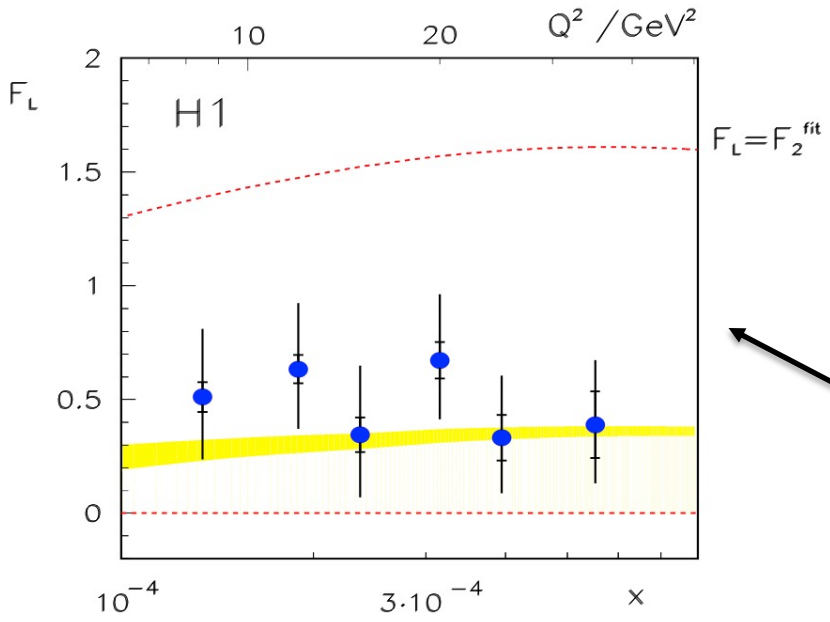
- ‘H1 Fit B’ became the standard diffractive PDFs used in models eg at LHC

John as H1 Physics Coordinator: Summer 1995 – Summer 1997

A pivotal time for H1: Many results emerging on the excellent 1994 data set (a 'massive' 2 pb^{-1})

e.g. Interplays between scales … Low Q^2 jets & virtual photon 'structure'





e.g. corroborating the gluon … a first glimpse of F_L

Feb 1997: Two seminal papers

DESY 97–009
January 1997

ISSN 0418-9833

Diffraction Dissociation in Photoproduction at HERA

H1 Collaboration

Abstract

A study is presented of the process $\gamma p \to XY$, where there is a large rapidity gap between the systems X and Y. Measurements are made of the differential cross section as a function of the invariant mass M_X of the system produced at the photon vertex. Results are presented at centre of mass energies of $\langle W \rangle = 187$ GeV and $\langle W \rangle = 231$ GeV, both where the proton dominantly remains intact and, for the first time, where it dissociates. Both the centre of mass energy and the M_X^2 dependence of HERA data and those from a fixed target experiment may simultaneously be described in a triple-Regge model. The low mass photon dissociation process is found to be dominated by diffraction, though a sizable subleading contribution is present at larger masses. The pomeron intercept is extracted and found to be $\alpha_{I\!P}(0) = 1.068 \pm 0.016$ (stat.) ± 0.022 (syst.) ± 0.041 (model), in good agreement with values obtained from total and elastic hadronic and photoproduction cross sections. The diffractive contribution to the process $\gamma p \to Xp$ with $M_X^2/W^2 < 0.05$ is measured to be 22.2 ± 0.6 (stat.) ± 2.6 (syst.) ± 1.7 (model) % of the total γp cross section at $\langle W \rangle = 187$ GeV.

DESY 97-24
February 13th 1997

ISSN 0418-9833

Observation of Events at Very High Q^2 in ep Collisions at HERA

H1 Collaboration

Abstract

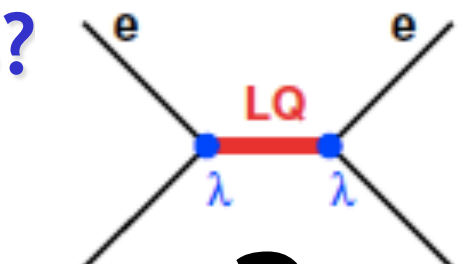
Measurements of ep scattering with squared 4–momentum transfer Q^2 up to 35000 GeV^2 are compared with the expectation of the standard deep-inelastic model of lepton–nucleon scattering (DIS). For $Q^2 > 15000$ GeV^2, $N_{obs} = 12$ neutral current candidate events are observed where the expectation is $N_{DIS} = 4.71 \pm 0.76$ events. In the same Q^2 range, $N_{obs} = 4$ charged current candidates are observed where the expectation is $N_{DIS} = 1.77 \pm 0.87$ events. The probability $\mathcal{P}(N \geq N_{obs})$ that the DIS model signal N fluctuates to $N \geq N_{obs}$ in a random set of experiments is 6×10^{-3} for neutral current and 0.14 for charged current. The difference in the observed and expected number of Neutral Current events is mostly due to events at large masses $M = \sqrt{x\,s}$ in which the positron is backscattered at large $y = Q^2/M^2$.

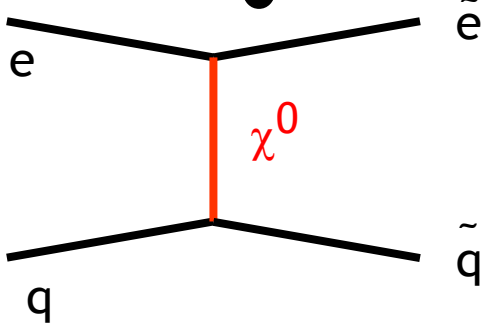
Submitted to Zeitschrift für Physik C

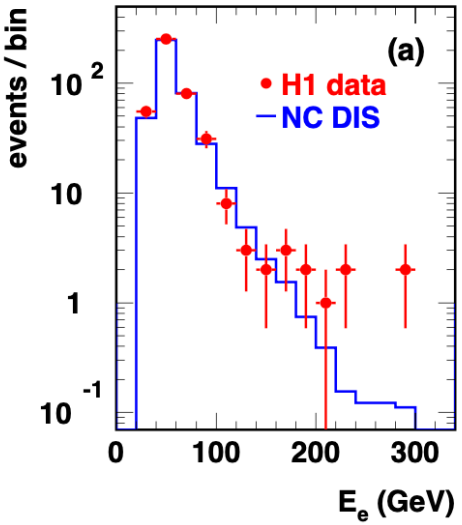
High Q^2 Strikes back: Leptoquarks?

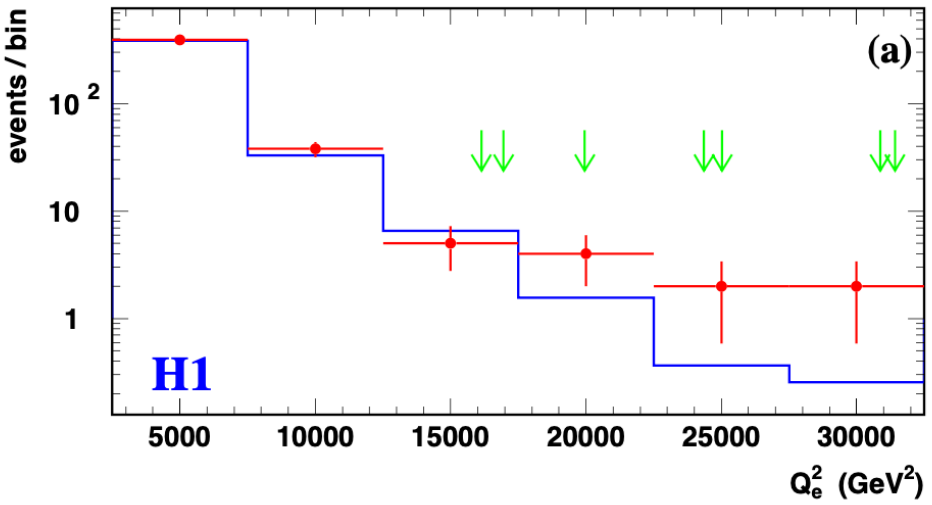
- One minute you're taking on the Physics Coordinator role, busy developing low x QCD
- The next you're wrapped up in potentially Nobel prize-winning fundamental discovery!

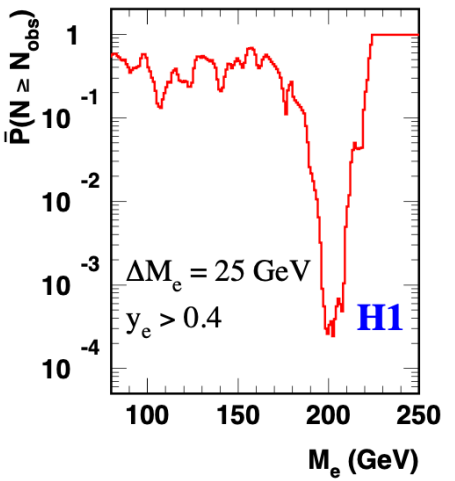
… High Q^2 'anomaly' in 1994-6 data
… Rumours that ZEUS had something too







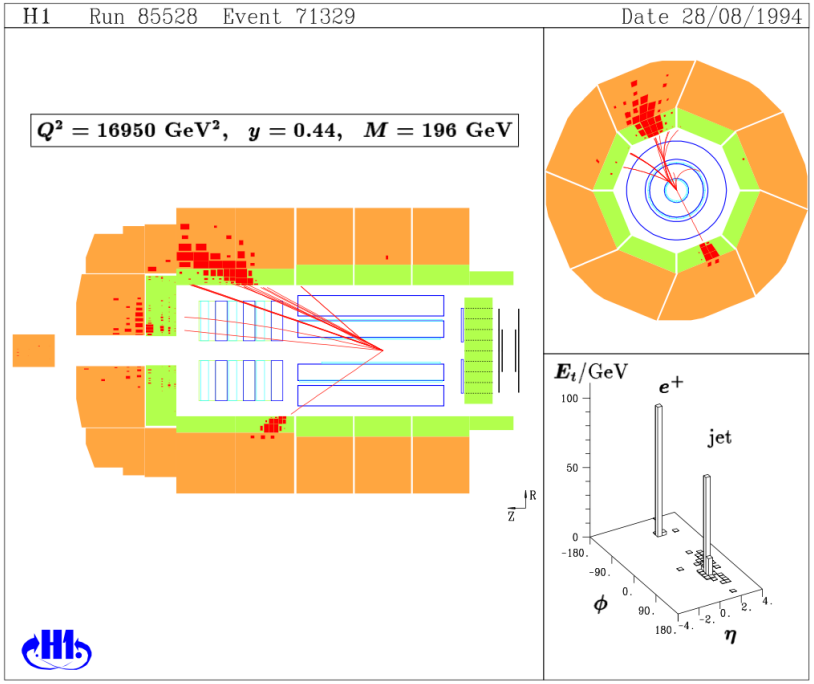




Ralf Eichler, H1 Collab Meet, Feb 1997

History of high Q^2 - events

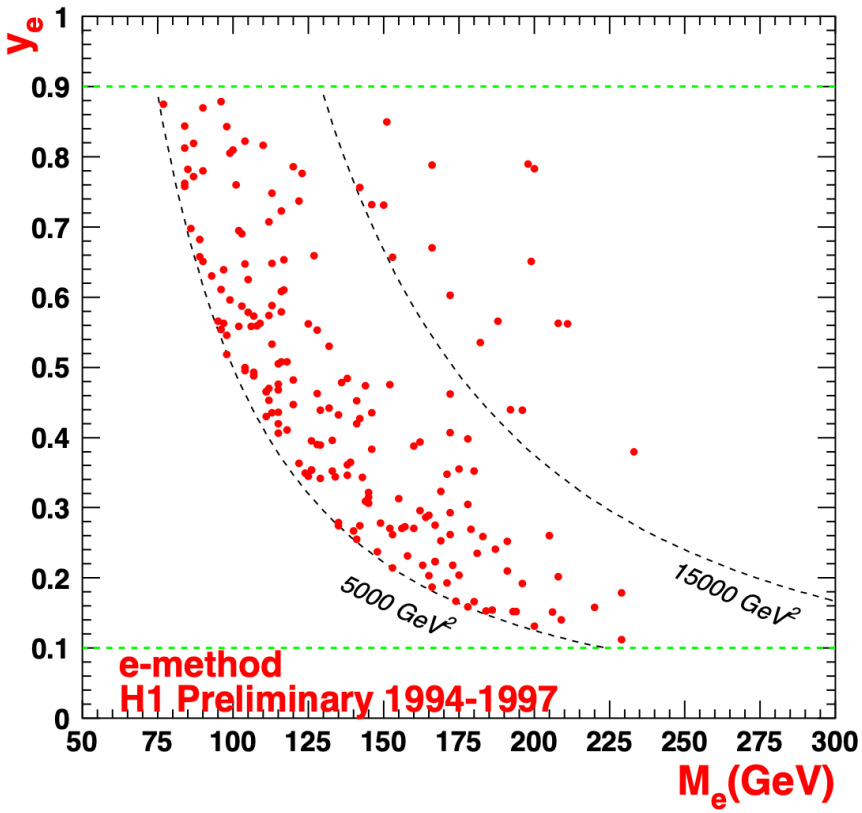
1994-95	first sign of high x, high Q^2 events
19.12.96	E. Perez shows scatterplot M vs y to H1
	Data shown to A. Wagner
	Setup of team to write paper
20.12.96	Agreement between H1+ZEUS to cross check expectation, publish together
17. 1.97	Draft 1 to H1
19. 1.97	Draft 1 to ZEUS
22. 1.97	Meeting with DESY directors
	ZEUS was asked to redo analysis
23. 1.97	Referee report
5. 2.97	Draft 2 to H1
7. 2.97	Wick/Wagner ask H1 to change text
13. 2.97	final paper to A. Wagner
17/18. 2.97	Comparison H1/ZEUS, papers exchanged
19. 2.97	DESY seminar
24. 2.97	H1+ZEUS papers signed by Wagner/Wick
	accepted by Z. Phys. C
28. 2.97	joint seminar H1+Zeus at Fermilab
4. 3.97	-"- CERN
6. 3.97	-"- SLAC

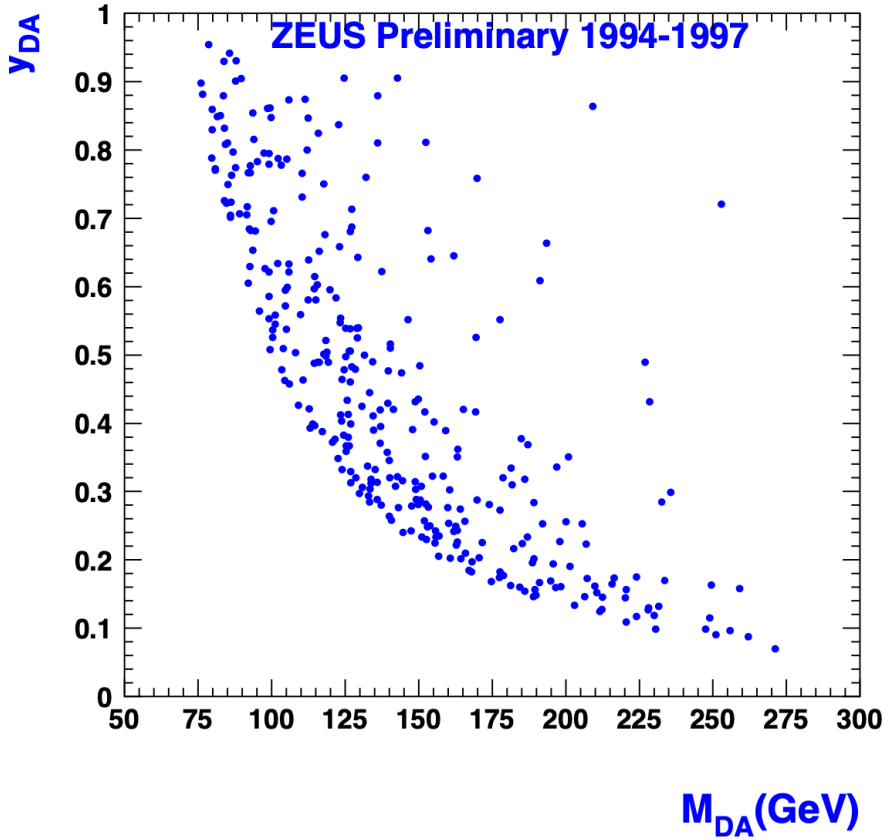


The ‘famous’ final reading

(… and an incident involving a seemingly innocent punctuation mark)

1997 Data Added … and ZEUS comparisons





- 1997 data didn't add to the excess, but it didn't go away
- Were H1 and ZEUS excesses compatible with one another?

- More data needed …
- What would e^-p data show us? … planned for 1998 …

John as H1 Spokesperson (Sept ’97-Sept ’99)

Presentation to H1
Dubna Collaboration Meeting
8/10/97

1. Physics
2. Data Taking 97
3. For 98 Data Taking
4. Computing Investment
5. H1 beyond 1999
6. CB
7. Summary

Report to the Collaboration

[Sept 1998 (Cracow)]

John Dainton

1. Data taking 98
2. Personpower
3. H1/2000
4. EC
5. Physics Output
6. Spokesman's challenge
7. Summary

H1 Collaboration meeting February 1999

Report to the Collaboration

John Dainton

1 Data Taking
2 Upgrade and Data 2000....
3 Physics Matters
4 Sundries

Report to the Collaboration

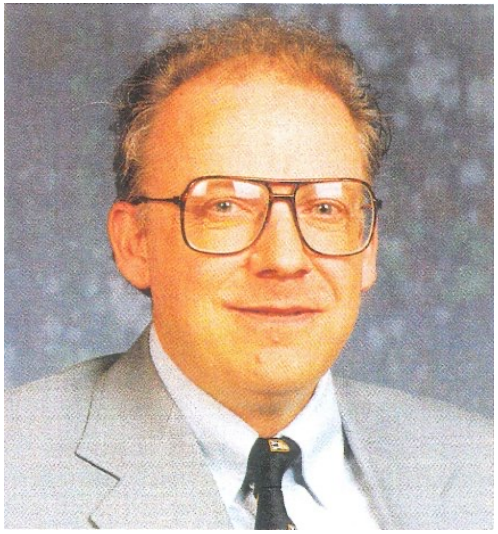
John Dainton

1. Data Taking
2. Physics
3. Upgrade
4. Conclusion

H1 Collaboration Meeting
June 15th 1999

[also Feb’98 and June’98]

Developing presentational techniques

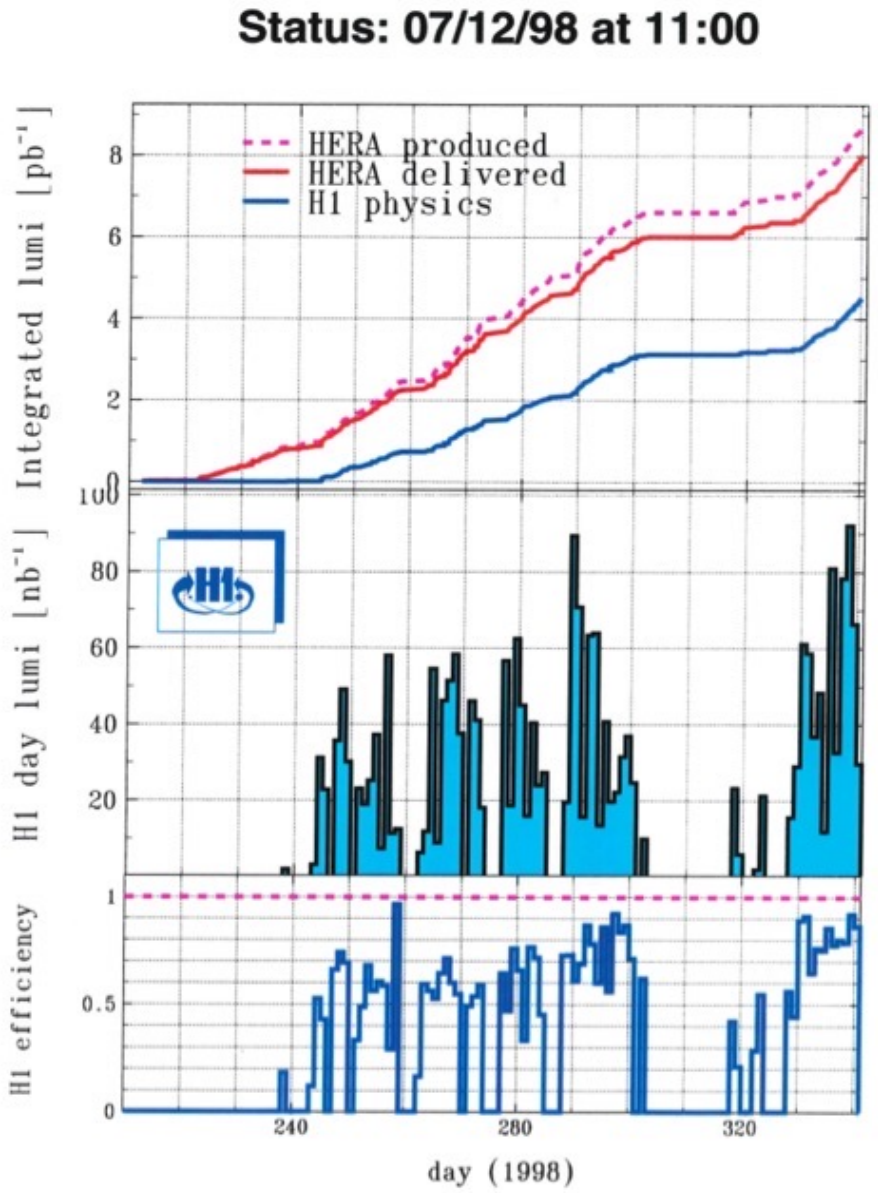


HERA / H1 Performance 1998

- While you're trying to confirm your potentially field-changing result …

- Poor (e^-p) luminosity delivery
- Large beam-backgrounds

… c.f. (97 was 32pb^{-1})



HERA / H1 Performance 1998

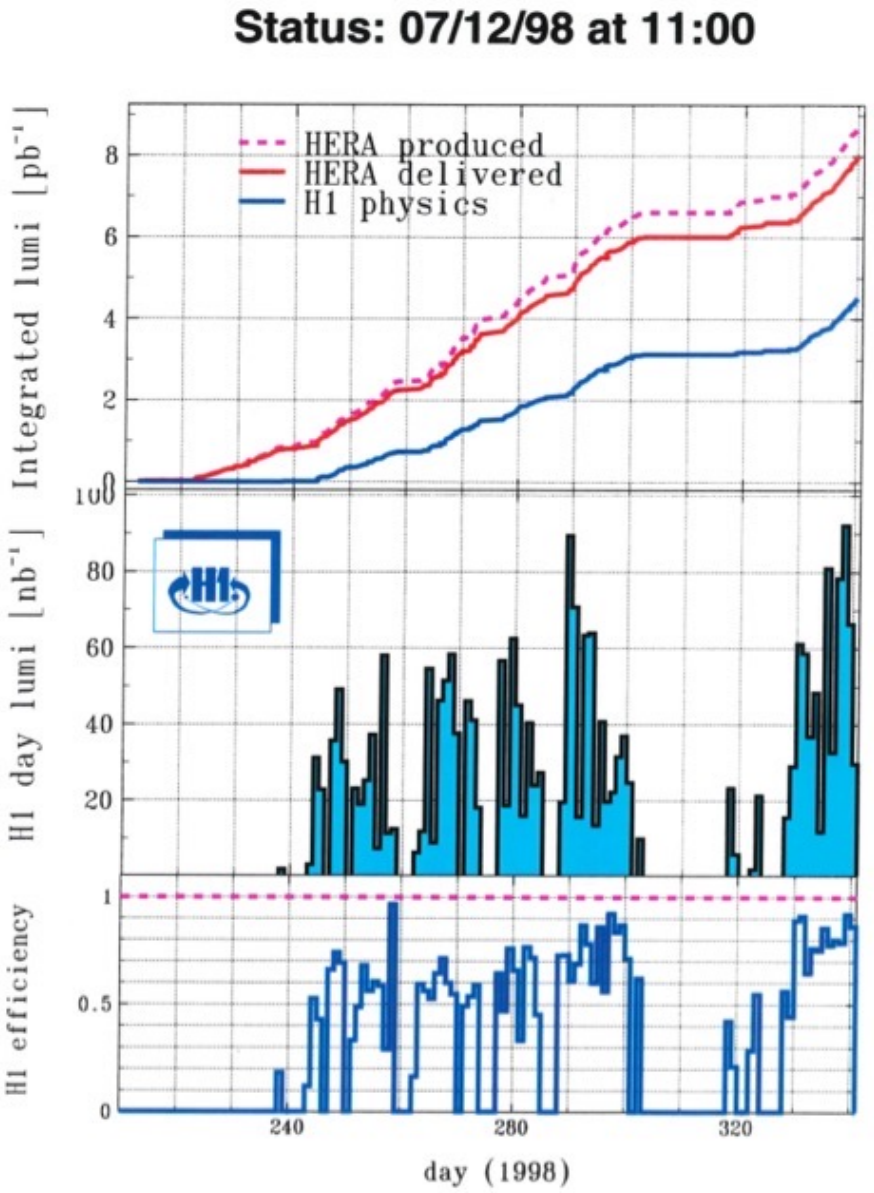
- While you're trying to confirm your potentially field-changing result …

- Poor (e^-p) luminosity delivery
- Large beam-backgrounds

… c.f. (97 was 32pb^{-1})

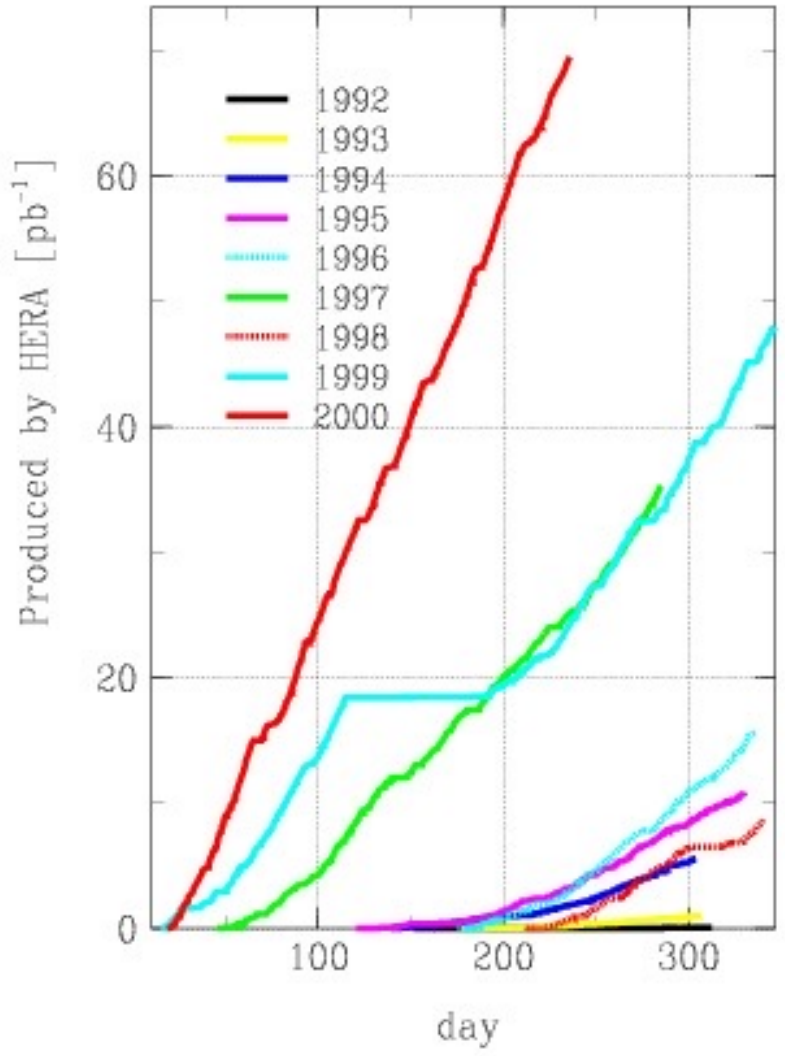
"Life is tough in H1 but it's worth it!"

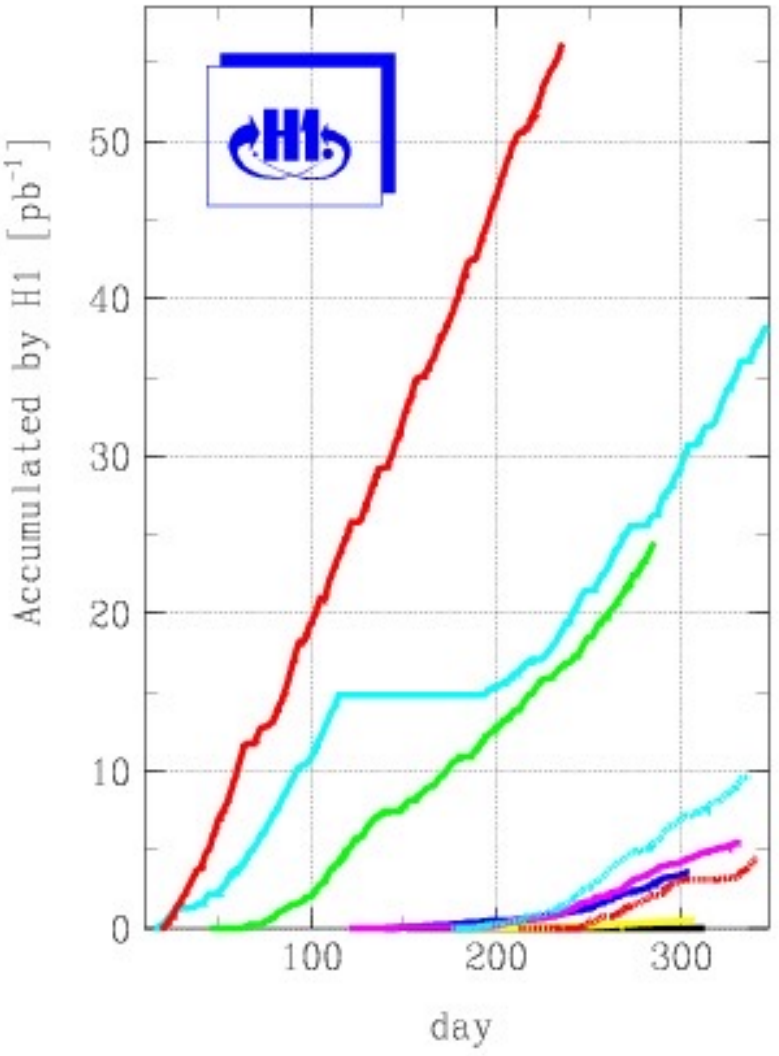
[Conclusion of Sept '98 Spokesperson report



1999-00 was much better

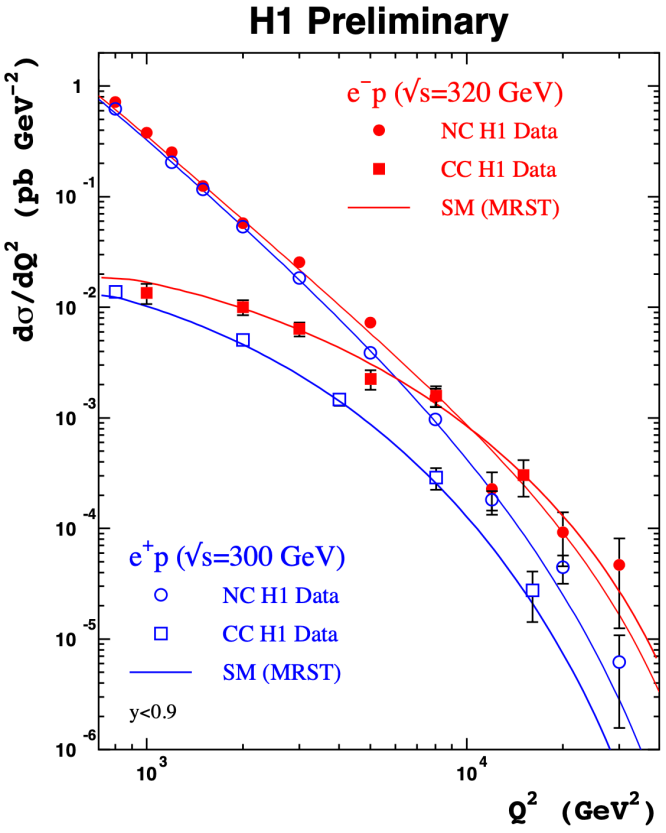
Hard work and task forces … and back to e^+p from mid 1999 …

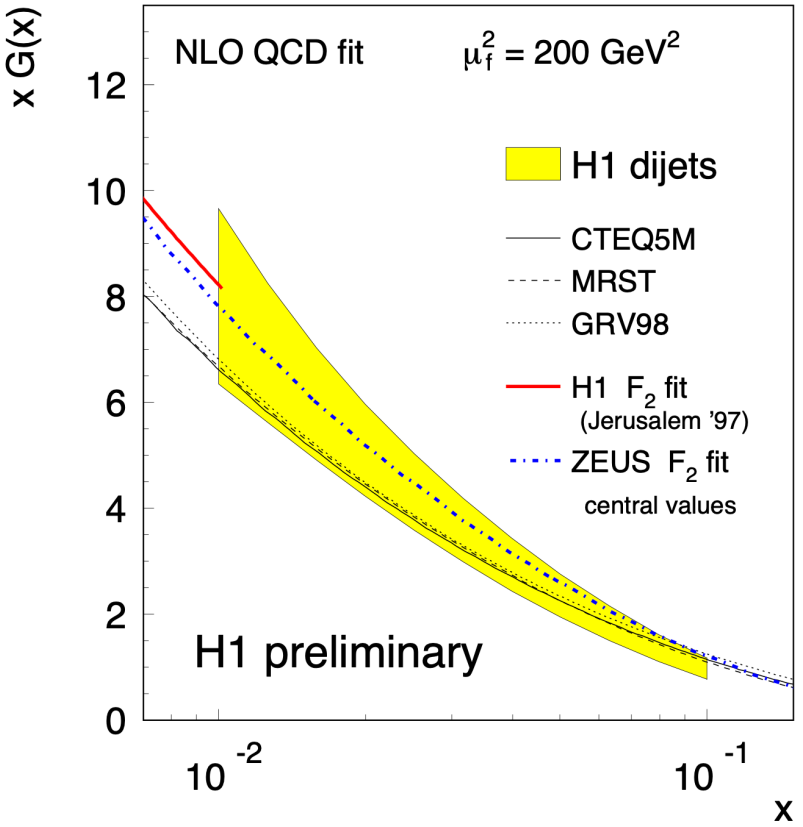




Physics outputs: Spring Conferences 1999

High Q^2 excitement starting to dissipate, but text-book plots …





First sight of high lumi e^+ v e^-:
Space-like EW unification

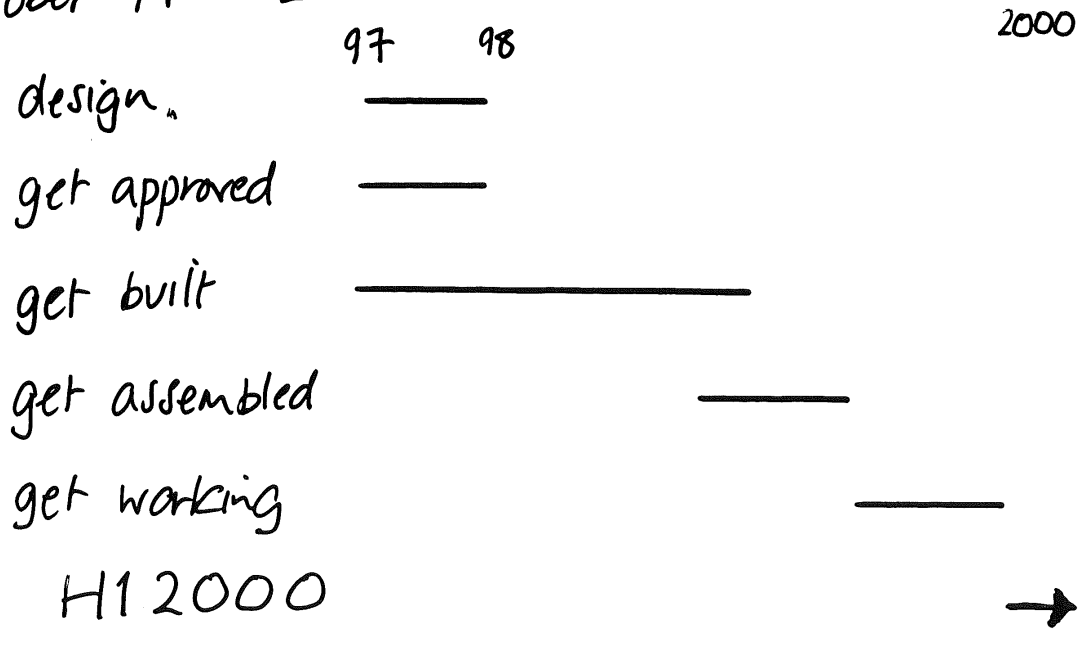
Gluon density from jets,
now routinely included
in DGLAP PDF fits

Motivating the 2000-1 Upgrade

HERA will be the only major particle physics facility in operation in Europe in the first half of the next decade. The program of physics which, with H1, it makes possible is both unique and exciting.

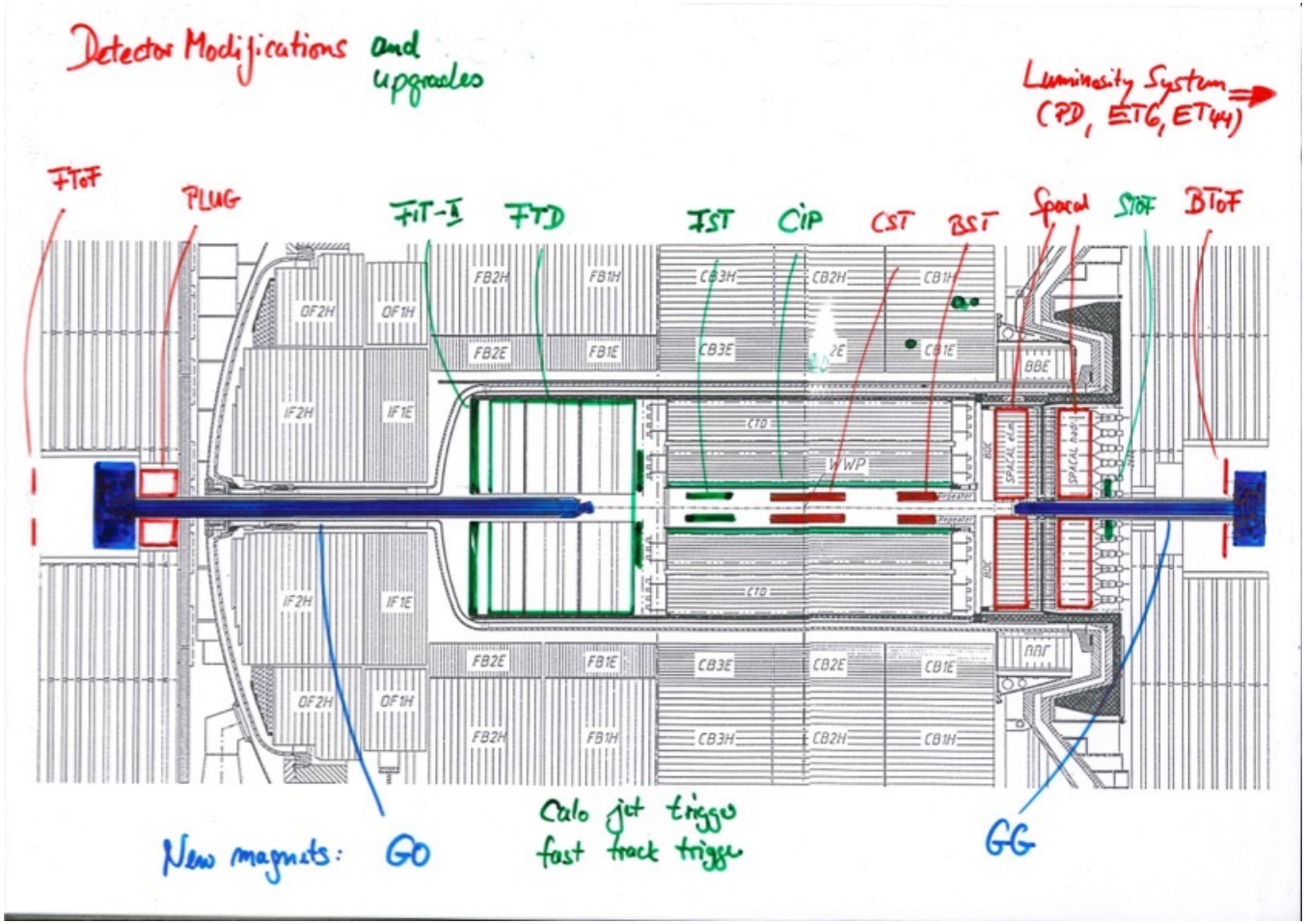
October 1997 Spokesperson report

- October 97 - 2000



Never forget the Gantt Chart …

Establishing the 2000-1 Upgrade



February 1999 Sokesperson report

… very ambitious!

… and it worked!

Getting the upgrade approved (many DESY PRC meetings) and on track (thereby keeping engineers close) was arguably John's most lasting contribution to H1 …

… ensuring we could run until the end of HERA

FTD Upgrade

New planar chambers built at Daresbury

Tim Greenshaw and Graham Houghton

Spokesmanship Handover

Invitation

You are cordially invited to a party on **Friday August 20th 1999 at 16:00hr** in the room immediately adjacent to the DESY Bistro. There you will be able to celebrate the passing of the symbols of office from the retiring spokesman to his successor.

Spokesmanship Handover

Invitation

You are cordially invited to a party on **Friday August 20th 1999 at 16:00hr** in the room immediately adjacent to the DESY Bistro. There you will be able to celebrate the passing of the symbols of office from the retiring spokesman to his successor.

Some Immediate Recognition

The Structure of Hadronic Physics

John Dainton

Oliver Lodge Laboratory, Department of Physics, The University of Liverpool, UK
and DESY, Hamburg, Germany

Max Born Lecture delivered at the
63. Physikertagung der Deutsche Physikalische Gesellschaft Heidelberg,
15. bis 19. März 1999.

Max Born Medal and Prize

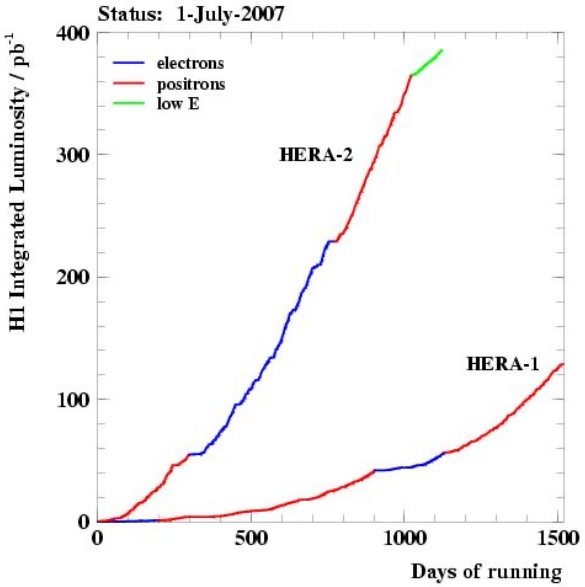
For outstanding contributions to physics by a physicist based in Germany or the UK/Ireland.

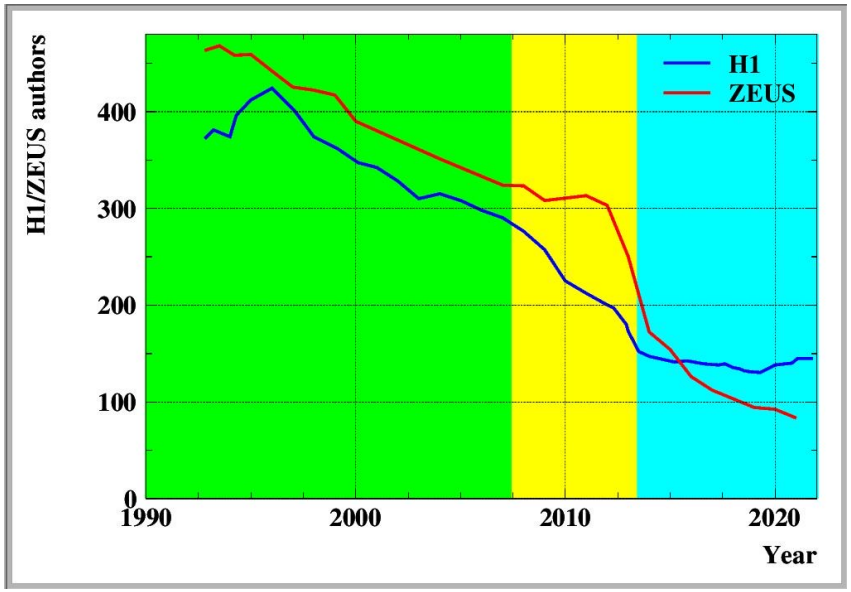
We present this award along with the German Physical Society. It was established in 1972 to commemorate German physicist Max Born who died in 1970.

1999

John Bourke Dainton

… active to the end of HERA data taking …





Available manpower inversely proportional to available data?

Elder Statesman

H1 Collaboration Meeting
Heidelberg Germany
September 2010

J.B.Dainton@cockcroft.ac.uk
The Cockcroft Institute of Accelerator Science and Technology
University of Liverpool

XXVth H1 Anniversary celebration

Tuesday, September 14th, 2010

- Talk by John Dainton at the Colloquium in Heidelberg University
- Welcome party (photos)

ep Physics: a Cornerstone

A somewhat personal, and therefore perhaps a somewhat eccentric and certainly idiosyncratic, view !

John Dainton
University of Liverpool and the Cockcroft Institute

1. Perspective
2. Introduction
3. The Fermi scale – H1 (1983 - ?)
4. Beyond the Fermi scale? (1986/2006 - ?)
5. Conclusion and Postscript

Legacy: H1 Top Cited Papers 1-5

Combined Measurement and QCD Analysis of the Inclusive e+- p Scattering Cross Sections at HERA #1

H1 and ZEUS Collaborations • F.D. Aaron (Bucharest, IFIN-HH and Bucharest U.) et al. (Oct, 2009)

Published in: *JHEP* 01 (2010) 109 • e-Print: 0911.0884 [hep-ex]

pdf DOI cite datasets claim reference search 1,232 citations

Combination of measurements of inclusive deep inelastic $e^{\pm}p$ scattering cross sections and QCD analysis of HERA data #2

H1 and ZEUS Collaborations • H. Abramowicz (Tel Aviv U.) et al. (Jun 19, 2015)

Published in: *Eur.Phys.J.C* 75 (2015) 12, 580 • e-Print: 1506.06042 [hep-ex]

pdf DOI cite datasets claim reference search 831 citations

Deep inelastic inclusive e p scattering at low x and a determination of alpha(s) #3

H1 Collaboration • C. Adloff et al. (Dec, 2000)

Published in: *Eur.Phys.J.C* 21 (2001) 33-61 • e-Print: hep-ex/0012053 [hep-ex]

pdf DOI cite datasets claim reference search 755 citations

A Measurement and QCD analysis of the proton structure function f2 (x, q2) at HERA** #4

H1 Collaboration • S. Aid et al. (Mar, 1996)

Published in: *Nucl.Phys.B* 470 (1996) 3-40 • e-Print: hep-ex/9603004 [hep-ex]

pdf DOI cite datasets claim reference search 574 citations

The H1 detector at HERA #5

H1 Collaboration • I. Abt et al. (Jul, 1996)

Published in: *Nucl.Instrum.Meth.A* 386 (1997) 310-347

DOI cite claim reference search 548 citations

1996-7 data

JBD PC

Legacy: H1 Top Cited Papers 6-10

Measurement of the proton structure function F2 (x, Q2) in the low x region at HERA** #6

H1 Collaboration • I. Abt et al. (Aug, 1993)

Published in: *Nucl.Phys.B* 407 (1993) 515-538

pdf links DOI cite datasets claim reference search 493 citations

Inclusive measurement of diffractive deep inelastic ep scattering #7

H1 Collaboration • C. Adloff et al. (Aug, 1997)

Published in: *Z.Phys.C* 76 (1997) 613-629 • e-Print: hep-ex/9708016 [hep-ex]

pdf DOI cite datasets claim reference search 461 citations

Measurement and QCD analysis of the diffractive deep-inelastic scattering cross-section at HERA #8

H1 Collaboration • A. Aktas (DESY) et al. (Jun, 2006)

Published in: *Eur.Phys.J.C* 48 (2006) 715-748 • e-Print: hep-ex/0606004 [hep-ex]

pdf DOI cite datasets claim reference search 421 citations

Observation of events at very high Q^2 in ep collisions at HERA #9

H1 Collaboration • C. Adloff et al. (Feb, 1997)

Published in: *Z.Phys.C* 74 (1997) 191-206 • e-Print: hep-ex/9702012 [hep-ex]

pdf DOI cite claim reference search 417 citations

Measurement and QCD analysis of neutral and charged current cross-sections at HERA #10

H1 Collaboration • C. Adloff et al. (Apr, 2003)

Published in: *Eur.Phys.J.C* 30 (2003) 1-32 • e-Print: hep-ex/0304003 [hep-ex]

pdf DOI cite datasets claim reference search 387 citations

F_2^D 94 data
JBD PC

F_2^D 97 data

Leptoquarks
JBD PC

99-00 data

Legacy: H1 Top Cited Papers 11-15

Deep inelastic scattering events with a large rapidity gap at HERA #11

H1 Collaboration • T. Ahmed et al. (Jul, 1994)

Published in: *Nucl.Phys.B* 429 (1994) 477-502

links DOI cite claim reference search 379 citations

A Measurement of the proton structure function f2 (x, Q2)** #12

H1 Collaboration • T. Ahmed et al. (Jan, 1995)

Published in: *Nucl.Phys.B* 439 (1995) 471-502 • e-Print: hep-ex/9503001 [hep-ex]

pdf links DOI cite datasets claim reference search 377 citations

First measurement of the deep inelastic structure of proton diffraction #13

H1 Collaboration • T. Ahmed et al. (Feb, 1995)

Published in: *Phys.Lett.B* 348 (1995) 681-696 • e-Print: hep-ex/9503005 [hep-ex]

pdf links DOI cite datasets claim reference search 369 citations

Elastic J/psi production at HERA #14

H1 Collaboration • A. Aktas et al. (Oct, 2005)

Published in: *Eur.Phys.J.C* 46 (2006) 585-603 • e-Print: hep-ex/0510016 [hep-ex]

pdf DOI cite datasets claim reference search 358 citations

The Tracking, calorimeter and muon detectors of the H1 experiment at HERA #15

H1 Collaboration • I. Abt et al. (Jul, 1996)

Published in: *Nucl.Instrum.Meth.A* 386 (1997) 348-396

DOI cite claim reference search 355 citations

Diffraction 92

F_2^D 93 data

More diff …
99-00 data

Legacy: H1 Top Cited Papers 16-20

A Measurement of the proton structure function f2 (x, q2) at low x and low q**2 at HERA** #16

H1 Collaboration • C. Adloff et al. (Mar, 1997)

Published in: *Nucl.Phys.B* 497 (1997) 3-30 • e-Print: hep-ex/9703012 [hep-ex]

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JBD PC

Measurement of neutral and charged current cross-sections in positron proton collisions at large momentum transfer #17

H1 Collaboration • C. Adloff et al. (Aug, 1999)

Published in: *Eur.Phys.J.C* 13 (2000) 609-639 • e-Print: hep-ex/9908059 [hep-ex]

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JBD Spokes

Elastic photoproduction of J / psi and Upsilon mesons at HERA #18

H1 Collaboration • C. Adloff et al. (Mar, 2000)

Published in: *Phys.Lett.B* 483 (2000) 23-35 • e-Print: hep-ex/0003020 [hep-ex]

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More diff …
97 data

Elastic and inelastic photoproduction of J/ψ mesons at HERA #19

H1 Collaboration • S. Aid et al. (Mar, 1996)

Published in: *Nucl.Phys.B* 472 (1996) 3-31 • e-Print: hep-ex/9603005 [hep-ex]

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JBD PC

Evidence for a narrow anti-charmed baryon state #20

H1 Collaboration • A. Aktas et al. (Mar, 2004)

Published in: *Phys.Lett.B* 588 (2004) 17 • e-Print: hep-ex/0403017 [hep-ex]

pdf DOI cite claim reference search 280 citations

My fault!

Future lepton-hadron scattering

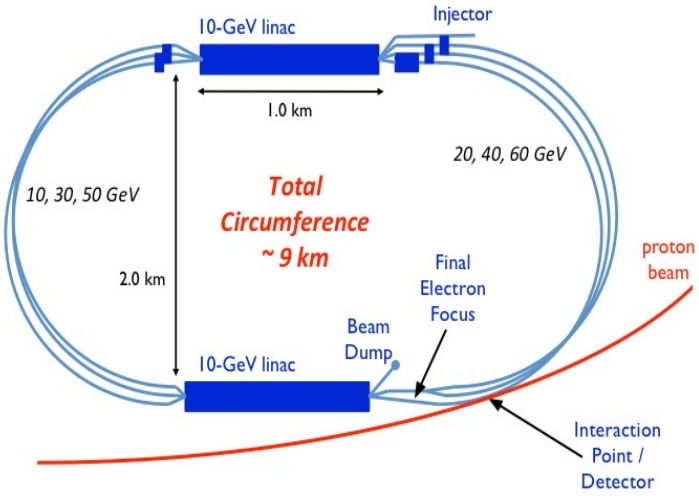
DESY 06-006
Cockcroft-06-05

LHeC – an idea that may yet have its day at CERN

Deep Inelastic Electron-Nucleon Scattering at the LHC*

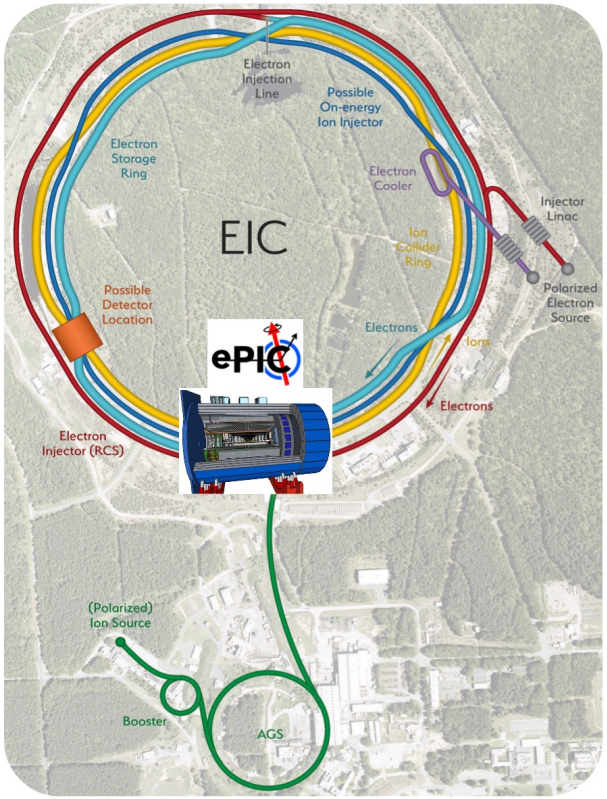
J. B. Dainton[1], M. Klein[2], P. Newman[3], E. Perez[4], F. Willeke[2]

[1] Cockcroft Institute of Accelerator Science and Technology, Daresbury International Science Park, UK
[2] DESY, Hamburg and Zeuthen, Germany
[3] School of Physics and Astronomy, University of Birmingham, UK
[4] CE Saclay, DSM/DAPNIA/Spp, Gif-sur-Yvette, France



Electron Ion Collider, BNL, 2030++ …

- 3D proton structure
- John remains an active member of the ePIC collaboration



DIS now and in the future

John remains a strong supporter of the ongoing DIS conference series, after 30 episodes

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Closing Thoughts

Life moved fast in those days! From the first HERA results to the end of John's tenure as H1 spokesperson was 6 years!

While e^+e^- and pp physics is about *collisions*, ep physics is more about *scattering*. It inherits ideas and techniques of probing matter, traceable through fixed target physics to Rutherford.

→ John understands that like nobody else I know. At HERA, he reinvigorated seemingly obsolete scattering theory ideas that have taught us a lot about vacuum-exchange at high energy, and the structure of matter.

- John Dainton fostered a uniquely 'H1' style of collaborating:

→ friendly, supportive and inclusive to all who honestly contribute, ultimately driven by a belief in the science and an unwavering excitement at its advancement.

→ Many of us owe a debt to your encouragement, motivation and knowledge .

Thank you John!