

# Remarks on the LHeC Project

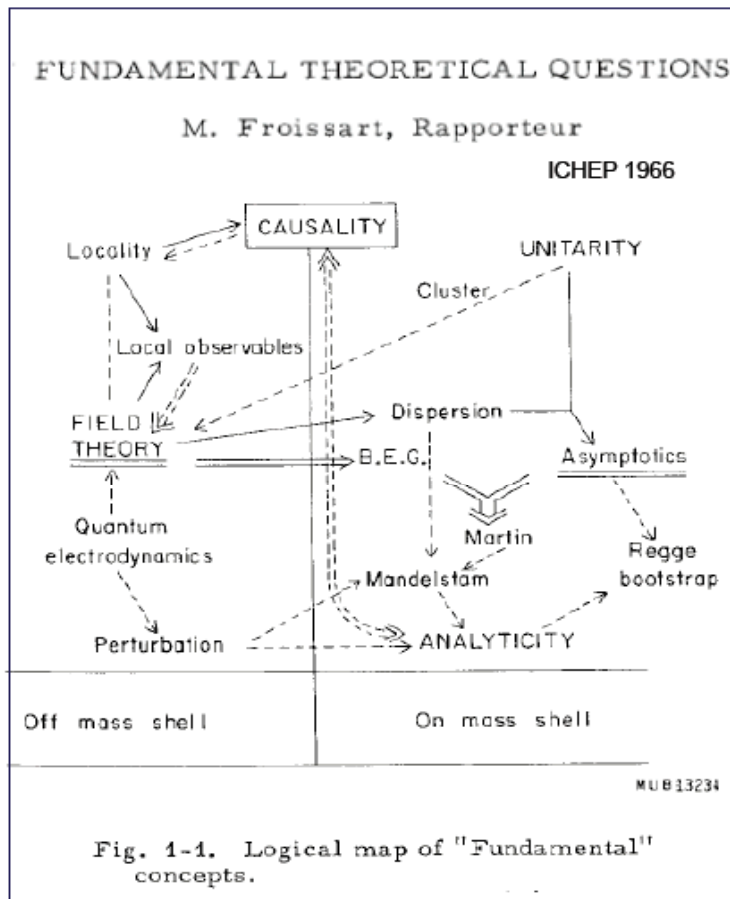
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1. Project Dimension
2. Status
3. Preliminary Answers
4. Open Questions
5. 2009 as 2008
6. New Horizon

Meeting of the LHeC Steering Group and Working Group Convenors, CERN, 15-16.12.2008

# 1. The Mind Setting



A few years before quarks and the November revolution

For the TeV scale:

**'The Higgs' to determine mass of W,Z,..**  
but all we really know is that  
the 4-IVB interaction diverges  $\sim E^2$   
and  $M_H > 114 \text{ GeV}$  (LEP)

**More Higgs particles, in SUSY**  
[avoids Higgs mass term divergence]

**No Higgs particles, in Technicolour**  
[avoid unitarity limit violation]

**Extra Dimensions and String Theory**  
[reminds on Heisenberg, Weyl, ..]

**Unparticles**  
[reminds on Ether]

**E8**  
[reminds on E6]

...

A few years before the LHC has explored the TeV scale

**The LHeC fits but also has to fit to such expectations. It needs highest energy, luminosity, and can become reality only as part of TeV scale particle physics with and "despite" its speciality, the strong interaction. It yet has a respectable ordinary programme too!**

## 2. Status

see slides on web

Lausanne84, Aachen90, Madison05, Tsukuba06, London08, Genua08, Divonne08...

HERA III, Thera, QCD Explorer, eRHIC/EIC

ECFA 07, NuPECC 08, ICFA 08, ECFA 08 -- we were never so high in expectation



**Renewed support for CDR. 11/2008**  
**The question we face is can this**  
**become reality and if so, how?**

ICHEP86 Berkeley

PHYSICS AT FUTURE HIGH ENERGY COLLIDERS

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To summarize: ep machines are sometimes regarded as poor sisters of  $e^+e^-$  and pp machines, but we should remember the story of Cinderella: poor sisters may strike rich and Hera or subsequent ep machines may be spectacularly successful if there are major surprises in the charged current or if lepto-quarks exist.

### 3. Tentative Answers

incomplete

Acc: RR: 50-70 GeV,  $\geq 10^{33}$ ,  $e^\pm$ , SPL or alternative inj., may fit, looks installable  
LR:  $\geq 100$  GeV,  $\geq 10^{32}$ ,  $e^-$ , high polarisation.

Infrastructure: ALICE IR by 2020, bypasses 30m away, SPL-TI2, racetrack site.

IR: RR design of JINST06 (FW) + Divonne; LR sketched

Detector: a first fascinating look

New Physics: added value to LHC, competitive in single production ( $lq$ ,  $e^*$ ), CI

QCD+elweak: all pdfs,  $\sigma(\text{CCTop}) \sim 5\text{pb}$ ,  $\sigma(\text{CCHiggs}) \sim 100\text{fb}$

High parton densities: Saturation with  $F_2$ ,  $F_L$  in ep, some simulations on diffr. DVCS

Distributed over recent conferences, seminars, Divonne, one paper (JINST06)  
Accepted as an expression of feasibility and interest by ECFA and CERN

## 4. Open Questions

Acc: RR: installation, radiation, polarisation, non SPL injector alternative  
LR: maximum energy, maximum (realistic) luminosity, ER, positron lumi

Infrastructure: from basic feasibility to real design considerations.

IR: 1° ir; LR ir; p,n,d fwd and e,  $\gamma$  bwd taggers; lumi measurement

Detector: reasons for and alternative choices. Two or one? Simulations

New Physics: added value to LHC, SUSY

QCD+elweak: top, Higgs physics, electroweak measurements

High parton densities: diffraction, DVCS, fwd physics; eA $\leftrightarrow$ AA,pA, eA alone.

To be clarified and worked out to some extent for a convincing CDR  
Everywhere should attract further interested colleagues.

## 5. 2009 as a linear extrapolation

February: New Colliders after the LHC: ILC/CLIC, b factories, muon collider, LHeC (18.2.)

March: Meeting/workshop on technical aspects - tentative

April: DIS09 premeeting (Sat) and session on future of DIS (AdR)

PAC: abstracts

Sept: Divonne 2

Nov: ECFA 3 --> basis for write up of the CDR

More may evolve and this is what we should be able to do the way we worked in 08.  
However..

## 6. A View on to and beyond the CDR

- SAC: the advisory committee is not used enough by us, has some great activists talked to A.Caldwell: steering group report due, seminars, ...
- Visit to laboratories in the US (spring 09) envisaged, other labs important too
- CERN: new directorate approached: confirmed support of CDR (ee,ep,pp)
- It is clear that the LHeC needs to develop to a project with person power and money, **IF** CERN and HEP want this to go beyond the CDR level. A first step will be an LHeC office at CERN. Further discussions planned for spring 09.
- The charm of the LHeC is its smallness, which is its weakness too. The CDR will in any case be based on the community's experience and LHC/ILC/HERA technology insight and boundary conditions, but the person basis needs to be widened, better deepened (too).
- R+D: magcal, crab cavities, 500kW power coupler (CW @ 1GHz) ...

If the LHeC is envisaged to lead beyond a CDR, then the organisation must change

# Time and Cost

It looks appropriate to not couple the CDR to the LHC physics.

A decision, however, is unlikely to be taken decoupled from the first indications on new/old physics at the TeV scale, and impossible to take without a cost estimate.

In near term, we have agreed the CDR timing with CERN/ECFA and will continue to do so.

In the long term: a TDR needs ~2 years and such an accelerator + detector ~8, thus it can hardly be faster than 10 years after the CDR, and if one goes too fast, reality usually sets you back.



# Summary

The reaction to the project has been encouraging: supportive by many accelerator and particle physicists, sceptical, mostly from those who follow different projects. The success is with the success of the LHC, and a local as global understanding that ep/A at high energies is a necessary part of HEP. The CDR is nothing but a contribution to this understanding with presently uncertain success, but increasing visibility. I look forward to the future and thank all for coming to this meeting, and for an environment in which it is so educative to work.

**We owe to express special thanks to the outgoing Chief Scientific Officer and the incoming Accelerator Director for their close collaboration with us and ECFA in 2008.**