

# Conceptual Design Report Large Hadron Electron Collider (LHeC) at CERN

DRAFT - February 2009

## 1. Introduction

## 2. Particle Physics and Deep Inelastic Lepton-Nucleon Scattering

1. DIS from 1 to 100 GeV
2. Status of the Exploration of Nucleon Structure
3. Tera Scale Physics

## 3. The Physics Programme of the LHeC

1. New Physics at Large Scales
2. Precision QCD and Electroweak Physics
3. Physics at High Parton Densities

## 4. Design Considerations

1. Acceptance and Kinematics
2. A Series of Measurements
3. Compatibility with the LHC (I assume this is the task of Karl-Hubert [at least for the machine part] and he can write this part of the CDR)
4. Proton, Deuteron and Ion Beams (does this part include the design and construction of the sources or mainly a discussion on the compatibility with the existing infrastructure [e.g. PS and SPS] at CERN? I think both points need to be addressed. The first one should be covered by Richard Scrivens and the second could be covered by John Jowett).

## 5. A Ring-Ring Collider Concept

**1. Injector** (This could be something for Helmut and his student and Alessandra and her student for the SPL option. The injection line could be covered by Brennan Goddard.)

**2. Lepton Ring** (again something for Helmut and John)

**3. Synchrotron Radiation** (I do not know why you want a dedicated chapter on this. For me this should be covered by the previous chapter together with damping partition and beam size calculations)

**4. Interaction Region** (Bernhard I guess)

**5. Installation** (Karl-Hubert again)

**6. Infrastructure and Cost** (Karl-Hubert and John. John told me already that he needs next year a budget of ca. 30kCHF for this in order to work with an external consulting company on this. I assume you also address the required general powering infrastructure here [50 MW to 100 MW!!!!]. This could be covered by David Nisbet.)

I think we are missing chapters on

- RF requirements and installation (e.g. space and ventilation requirements in the tunnel / by-passes -> Ed Chiapala)
- Beam-Beam effects (e-p and p-p in parallel) and the potential impact on the 'nominal' p-p operation. EPFL stated that they are interested in doing this as part of a collaboration.
- Chapters on vacuum and magnet systems (Davide Tommasini in collaboration with Novosibirsk and Miguel Jimenez)
- Were will we discuss performance reaches and limitations and more exotic means of performance enhancement like the use of CRAB cavities [so far assumed as 'baseline!!!']
- Where do we discuss the beam dump and machine protection system (-> Brennan Godard)?
- We also need a discussion on Impedance and beam stability analysis. So far, nobody has looked into this.

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## 6. A Linac-Ring Collider Concept

**1. Electron and Positron Sources, Polarisation** (Louis Rinolfi)

**2. Linac** (This could be a collaboration contribution from SLAC in collaboration with Frank and the CERN RF group.)

**3. Interaction Region** (Bernhard again I guess or Crocckroft?)

**4. Beam Dump** (Brennan Goddard)

**5. Infrastructure and Cost (I assume you include here general powering and ventilation infrastructure. In any case this implies again Karl-Hubert, David and John.)**

**I think we are missing chapters on:**

- **Beam-beam (EPFL again)**
- **General magnet and vacuum system. In the case of a recalculating linac design we also need a design for the return arcs (-> Davide Tommasini and Miguel Jimenez).**
- **Were will we discuss performance reaches and limitations and more exotic means of performance enhancement like the use of CRAB cavities ?]**
- **We also need a beam dump for the Ring-Linac version (-> Brennan Goddard).**

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## **7. A Detector for the LHeC**

- 1. Dimensions and General Requirements**
- 2. Coil**
- 3. Calorimeters**
- 4. Tracking**
- 5. Options for the Inner Detector Region**
- 6. Detector Simulation and Performance**

## **8. Summary**

- 1. Physics Highlights**
- 2. Parameters**
- 3. Concluding Remarks**

## **Appendix**

- 1. Tasks for a TDR**
- 2. Building and Operating the LHeC**