

ESPP document for WG4

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7 Nov 2024

LHeC WG4 SR+Det meeting

The Large Hadron electron Collider as a bridge project for CERN

***1, ... 2,
1 ***,
2 ...

(Dated: November 3, 2024)

[Main eds.: Nestor, Jorgen; readers: Daniel, Monica, Uta]

Unless you like otherwise,
all the people in this meeting should be
listed as authors, in my view

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← WG4 contribution: readiness of detector (Yuji)
+ and accelerator technology (Yannis)
i.e. our contribution in 2 pages

↑ (optional) joint detector and program for
ep/eA/pp/pA/AA physics (Yuji): do we like to say
something here?

Proposed contents of the 2p document for detector

1. Our detector is based on advanced and yet mature technologies (1 page)
 - HV CMOS for central tracker + elliptical beam pipe **(with a figure)**
(further advancement desirable around the scheme of the beam pipe)
 - Fine-segmented CALICE-type calorimeter for endcap (Si or plastic Sci) and LAr for barrel
 - Muon chambers from e.g. ATLAS
 - We may have some words on PID, DAQ + computing resources
2. Detector near beamline: some peculiarities, but manageable (1/3 page)
 - Backward detectors, forward detectors
3. Effect from SR in IP is being estimated (1/3 page)
 - SR optimized, simulation being developed
 - Hopefully with preliminary idea on power, with a collimator scheme **(best with a figure)**
4. Detector simulation is available in DD4Hep scheme **(best with a figure)** (1/3 page)
 - Interface to generators and connection to reconstruction packages

4. Detector simulation and offline software

- (meant to put hear for you to check if what I wrote is correct)
- DD4Hep-based simulation framework
 - Input from generators to Gaudi framework particles
 - G4 hits to Rec hits conversion suitable for reconstruction adopted to Gaudi
 - Reconstruction algorithm for e.g. FCC-ee/CEPC available (Key4hep)
 - Output to ROOT via podio framework (I need to understand what it means)
- Interfacing BDSIM for MDI development
- A figure of LHeC event display (like Laurent has shown in the workshop) with an event (best if it is Higgs to $c\bar{c}$ for example)
- May comment on ongoing efforts

2. Backward / forward detectors

- 1/3 pages
- Summarising Krakow meeting outcome
- Luminosity monitor: bremsstrahlung around zero degree with very high rate ($\gg 1\text{GHz}$)
 - Simple counting does not work
 - May need double-spectrometer to filter the photon by a thick + a thin converters
- Very forward detectors
 - Proton: most likely similar to that for the LHC
 - Neutron and γ, π^0 :
 - need place to put a large calorimeter
 - Radiation close to $10^{16} \text{ 1MeV eq. n/cm}^2$: technology exists (Si-based calorimeter)

Some Open Topics

... including both consolidation and
'from scratch' addition of new capabilities

Paul's slide from
the Feb 2024 Synergy WS

Design / simulation code base development

- Common framework to investigate (integrated) detector response

 possible extension

Detailed synchrotron radiation simulations

- Explore impact on inner regions more thoroughly

 our activity (first meeting tomorrow)

Optimising technology and layout of detectors near beamline

- Inner tracker technology / layout (Fluences? Sensor placement close to the beam)
- Forward / Backward instrumentation fully integrated with the IR design



Adding Particle ID capabilities (Cerenkov, TOF)

- (p_T / η) ranges / technologies to connect with EIC SIDIS and physics in AA
- Compromises with respect to other detector components?

Developing a Trigger / DAQ scheme

- Understanding the physics and background rates
- Obtaining a (triggered or streaming) concept for data acquisition

Review aspects of the detector 'inherited' from ATLAS?

- Are calorimeter and muon designs really ideal for use in ep / eA?

LHeC versus FCC-eh

- Implications of higher energies ... 'same again only bigger', or smarter?

A joint detector eh and hh detector?

- Technical challenges in simultaneously serving e-h and h-h studies
- Opportunities for cross-calibration and systematics reduction