Strategy update input from

the division of particle and nuclear physics in

Lund

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for the division

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What are we doing in Lund?

- Experiments:
  - ATLAS
  - ALICE
  - LDMX
  - HIBEAM/NNBAR
  - . . . and nuclear physics (FAIR, ISOLDE, SHE, . . .)
- Theory (Phenomenology)
  - Pythia
  - MadGraph5_aMC@NLO
  - QCD (+HI) phenomenology
  - BSM phenomenology
  - Low energy QCD

The Strategy update process in Lund

Only one dedicated group meeting.

+ corridor discussions and a shared box document for input

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Spoiler alert: We have no strong opinions on questions 3a-f.

3a) Preferred CERN flagship

The natural step(?): $\mathrm{Sp\bar{p}S} \rightarrow \mathrm{LEP} \rightarrow \mathrm{LHC} \rightarrow ?$

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The natural step(?): $\mathrm{Sp\bar{p}S} \rightarrow \mathrm{LEP} \rightarrow \mathrm{LHC} \rightarrow$ Muon collider?

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The natural step(?): $\mathrm{Sp\bar{p}S} \rightarrow \mathrm{LEP} \rightarrow \mathrm{LHC} \rightarrow \mathrm{LEP3?}$

3b) Important elements

i) We need to study the higgs in detail. No consensus beyond that.

ii) Yes. The proposed timeline for FCC is daunting.

iii) "*If you had 15 GCHF, is the FCC as proposed what you would build?*". We worry that we will not be able to afford anything except the FCC.

iv) Will the field still be alive when FCC-ee is ready?

v) How do you motivate a graduate student to work on FCC-hh studies that are 50 years away from realisation?

vi) What kind of sustainability are we talking about?

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3c) Alternatives?

i-iii) We want to keep CERN as the flagship of HEP.

iv) The FCC is probably the most flexible option for studying any new physics.

3d-f) Accelerator R&D in parallel?

Accelerators are not really our area of expertise, but squeezing more out of the LHC, and/or the LHC tunnel, does not sound unreasonable. Especially if it would lower the costs and shorten the timeline.

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- Physics (at all frontiers)
- Sustainability of our group

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Whatever strategy is decided upon, we will work with it.

The funding situation

It is difficult to think ahead on grand projects when it already today is hard to make ends meet.

Working with small incremental improvements in large collaborations for a long-term goal is not rewarded by VR/ERC. They want revolutionary breakthrough results from outstanding individual researchers withing 4-5 years.

Whatever the future of HEP will be, this must be addressed in the strategy.

Sustainability

How do we keep (and renew) the expertise we have in a 50-year perspective?

In Lund we have lately been engaging more in smaller projects (LDMX, HIBEAM, EIC, astro-particle, etc.) that give more “bang-for-the-buck” and “faster” results.

Whatever the future flagship of CERN will be, we will continue doing these.

And also continue squeezing as much physics as possible out of (HL-)LHC.

Theory, Phenomenology and Event Generators

Whatever the future holds, we will always need phenomenology and Event Generators.

- BSM pheno: what should we look for?
- QCD pheno: where are we looking?
- Event generators: how do we look for it?

We also have problems with the funding situation and career paths, maybe even worse problems than those of experiments.

(Draft statement from the MCnet collaboration)

Monte Carlo Event Generators (MCEGs) that simulate particle collisions, or “events”, to a level that allows direct comparison with experimental data, are indispensable for the planning and analysis of past, current, and future experiments in particle physics. MCEGs bridge the chasm between relatively abstract theoretical ideas or calculations and the often complex experimental reality. They provide inputs to detailed software models of detectors, are key components in the evaluation of systematic uncertainties on measurements, and frequently play an essential role in the interpretation of those measurements.

As such, the MCEGs buttress the continued success of the experimental programme through sustained improvements, responding to ever-increasing demands on their precision, reach, flexibility, and usability. The development, maintenance, validation and calibration of these central assets is in large part driven by researchers across European universities, constituting a relatively small but critically important ecosystem of authors of MCEGs and supporting tools for their deployment, validation and calibration. The ongoing physics exploitation at the (HL)LHC and other current experiments, and the preparation for future facilities, mandates the continuation of the strategic and vibrant research programme of this community at the interface of experiment, theory, and computation.

This intersectionality of MCEG developers poses serious challenges in terms of career paths and funding opportunities, and it is imperative that the particle physics community addresses such issues in order to ensure a sustainable development of MCEGs for existing and future facilities.