

Towards EU Strategy Update and Beyond

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For the Coordination Group and WG Convenors

EU Strategy
Choice of E_e
Organisation



LHeC and FCC-eh Workshop, 13th of September 2017, CERN

Goal for 'eh' in 2020: get a red mark

The 1st European Strategy for Particle Physics of July 2006

- 1.&2. Recognition of CERN's central role in the global effort
3. Commission and exploit the **LHC**
4. Do R&D for future energy and luminosity frontier: **CLIC**
5. Consider **ILC** as fundamental to complement LHC results
6. Coordinate Europe to prepare **neutrino physics** case for ~2012
- 7.&9.&13. Work with ApPEC, NuPECC and EU/EC
8. National & regional labs/collab's for flavour- and precision physics
10. Support theoretical particle physics
11. Establish European Strategy Secretariat with a Scientific Secretary
12. Create framework for Europe to engage in global PP projects
14. Involve non-Member States
- 15.&16.&17. Communicate, Innovate & Connect to industry
(bold emphasis added by the slides' author)

Next Update of European Strategy: Set in motion in December 2016

Council decisions in December 2016:

1) Aim at adopting an updated strategy in May 2020

Arguments for time frame:

- 2013-2020 is 7 years between updates
- End of LHC run 2 at end of 2018
- FCC Conceptual Design Report by end 2018
- CLIC update (staged implementation plan, cost, etc.) by end 2018
- Report of Physics Beyond Colliders Study Group by end 2018
- Japanese decision on ILC should be known by end 2018
- Advances in Neutrino physics

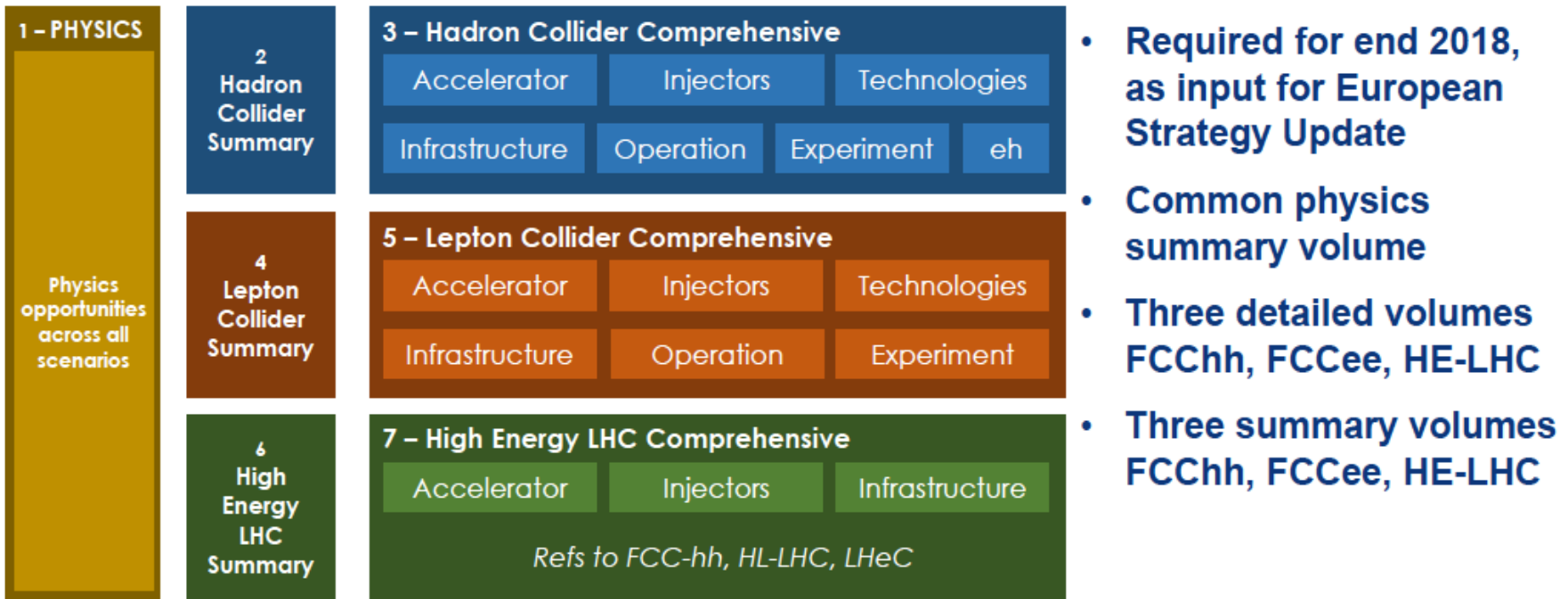
2) Appoint a Strategy Secretary early, i.e. September 2017

- Input/work needed to organise the strategy discussion

- Three bodies to be installed at opening of update process:
 - **European Strategy Group (ESG)**: establish a proposal
 - **Physics Preparatory Group (PPG)**: prepare Briefing Book
for the ESG
 - **Strategy Secretariat**: Organization & ancillary documents



- the **Strategy Secretary** (acting as Chairperson),
- the SPC Chairperson,
- the ECFA Chairperson,
- the Chairperson of the European Laboratory Directors' meeting.



'eh' is invited and expected to contribute to: 1, 2, 3, 6, 7

Drafts in Spring 18.



FCC Advisory Committee

- IAC composition to cover all study areas, 17 members
- Important role as expert review committee for study and CDR preparation

FCC International Advisory Committee				
Chair	Dissertori	Guenther	ETHZ	CH
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	Yamamoto	Akira	KEK	JP

Study reviews towards CDR

- FCC week for presentation of information, followed by executive review session to discuss key issues.
- FCC week Berlin & 29/30 June @ CERN.
- FCC week 2018 (9-13 April 2018, tbc.) + mid-May @CERN.



Electron-Hadron Scattering at the Energy Frontier – A Higgs Physics Facility Resolving the Substructure of Matter

Draft Table of Contents

1. Introduction: The LHC, Modern Particle Physics and the Rôle of ep/eA
2. Physics: QCD/PDFs, Higgs, top, BSM, small x, eA at the LHeC; key items at 1.9/3.4 TeV
3. ERL electron beam: Design, Components, Injector, Dump, Civil Engineering ..
4. LHeC Performance: Collider Parameters, Luminosity, Joint Operation, Infrastructure..
5. Detector: Machine Interface (IR), Design and Performance, Components, Software
6. Installation of the Machine and Detector
7. Summary

Appendix:

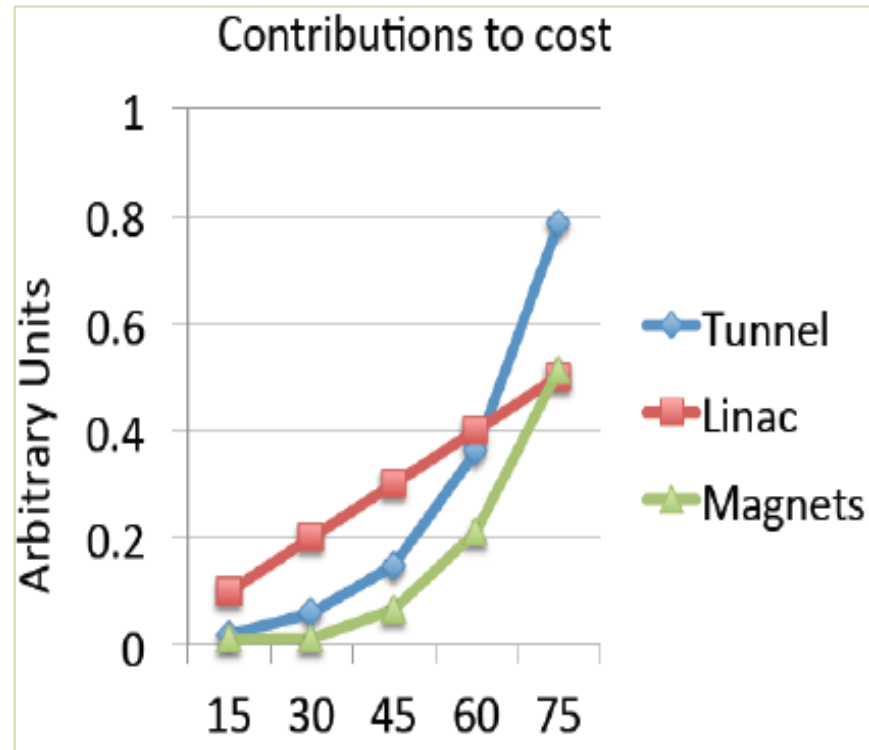
- Status of PERLE and ERL Developments
- Cost-Energy Relation and Cost Estimate for LHeC
- Detector Cost Estimate
- Extensions into the HE LHC Phase
- Electron-Hadron Scattering with the FCC (link to FCC CDR)

Update of the LHeC CDR^{*)} and input to EU strategy, reference document for FCC-eh + HE LHC

*) [arXiv:1206.2913](https://arxiv.org/abs/1206.2913)

Considerations on the Choice of E_e

Chosen 60 GeV and $U(\text{LHeC})=U(\text{LHC})/3$ as a supposedly realistic first choice.



MK, F Zimmermann

Initial, tentative, rough scaling estimate of basic cost (tunnel, linac (XFEL), magnets)

Tentative

Physics Considerations on the Choice of E_e

SM Higgs Couplings

$H \rightarrow bb$ (cc): 0.5 (4)% coupling uncertainty, for $1ab^{-1}$, 60 GeV, polarised
This becomes 2(15)% for $0.5ab^{-1}$ and 30 GeV: **Under these conditions one loses high H precision and the ep portal to new physics potential and the neutral current Higgs programme disappears**

New Higgs+top Physics

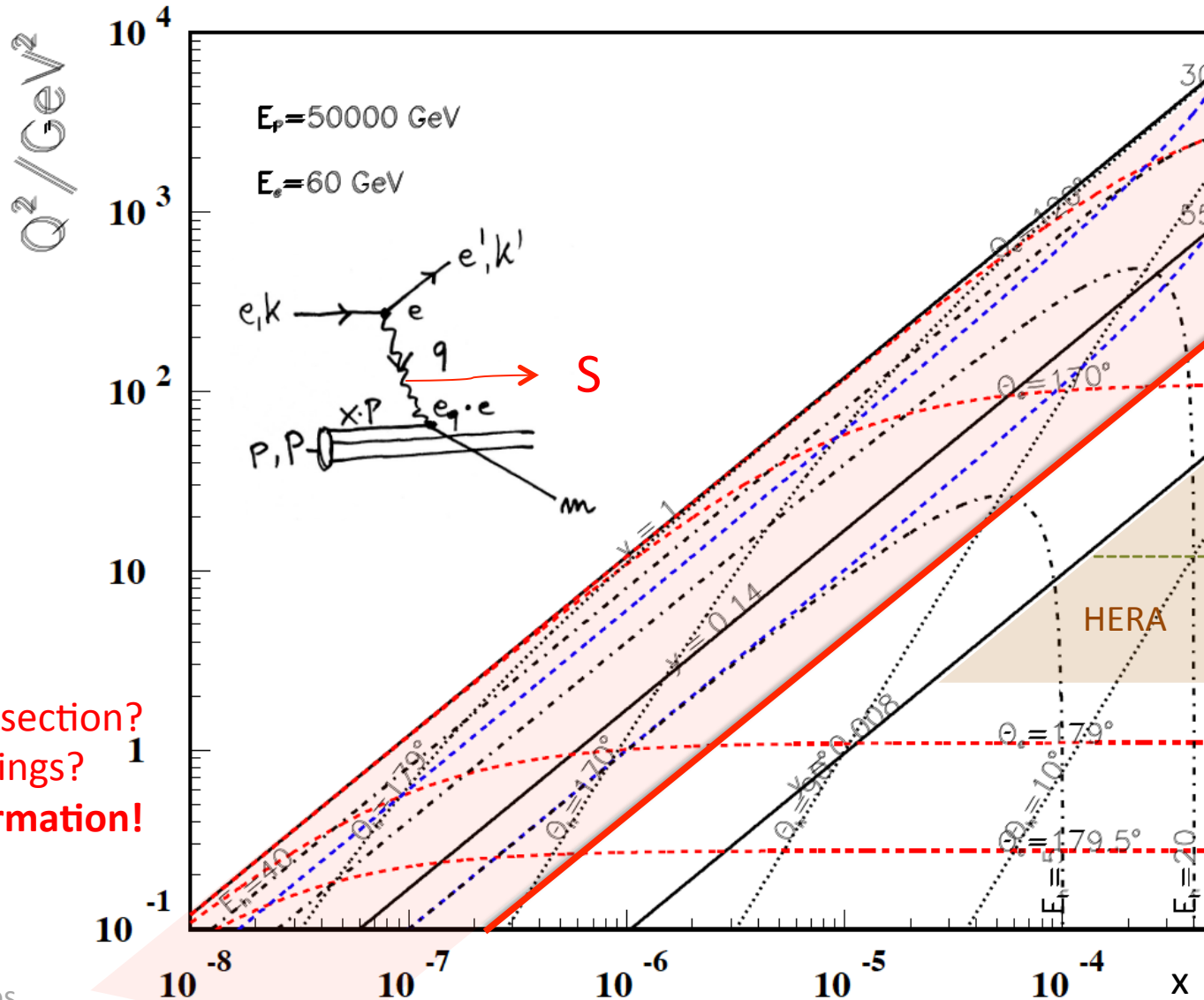
Heavy new objects: Htt coupling: 17 \rightarrow 31 % for 60 \rightarrow 40 GeV (M Kumar)
Discovery potential for anomalous tqH : 0.5 – 3.2 -22% precision for 60 \rightarrow 50 \rightarrow 40 GeV (H Sun). **At 40 GeV the discovery potential is gone.**

Longitudinal Structure Function – THE path to saturation

Low x physics: **Saturation** requires 1% measurement of F_L . That needs $y=0.9=1-E'/E_e$. HERA: big complication: E' at high y too small for precision (eID, background, charge symmetry): needs \sim twice E_e to be safe.

- \rightarrow 50 GeV the programme stands, 40 GeV it loses BSM, t , 30 GeV: precision gone
- \rightarrow Keep the electron energy as high as it can be afforded, and not lower than 50 GeV

Acceptance of a 750 GeV Ghost S



FCC-he
60 GeV

LHeC

← $\gamma > 0.047$
(=0.33 LHeC)

← 179°
@ 180 GeV
.. very low x
requires not
the maximum
of E_e

3 C's

Cross section?
Couplings?
Confirmation!

Considerations on the Choice of E_e

Next and ongoing Steps:

new CE costing with consultant

collection of complete cost information (early 18)

Cost the new detector (CDR was 106 MSF CORE cost)

Lattice study for 50 GeV

Physics: put energy dependent studies critically together

→ Chapter on cost vs energy

Organisation

International Coordination Group

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Anna Stasto (Pennsylvania)

Next is to agree on editor structure and table of contents, in intimate contact with IAC, its referees and the FCC coordination.

H, BSM, QCD, low x, HI groups
Regular meetings, strong links
See <https://indico.cern.ch/category/1874/>

International Advisory Committee

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O Bruening and M Klein ex officio



Referees:

Stefano Forte
Andrew Hutton
Aleandro Nisati
Leonid Rivkin

Careful advice and
collaboration with
CDR authors and as
input for the
deliberations of the
complete committee
chaired by Herwig
Schopper
eh with HL, HE LHC+FCC

Crucial Aspects in the Near Future

Focus required on most crucial questions and **new convincing physics cases** for

Microscope eh – Joint ep-pp Physics – Higgs – Beyond SM – Nuclear Physics

Visibility of the LHeC and the FCC-eh Option and its uniqueness for HEP and DIS (inside the particle and nuclear physics field AND for the global public)

Preparations of the future **transition from a study to a Collaboration**

Progress on most crucial technical items: **SCRF and ERL → PERLE and IR**

DIS energy frontier physics opens a new horizon for the development of our understanding of nature and new prospects for our institutions, CERN not the least. Together this can be made real and this workshop shows why that is worth it.

Special thanks to CERN for its attention to electron-hadron physics and to →

<http://lhec.web.cern.ch> collects 'all' we deliver to A Valloni (grazie)



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You never walk alone