Future Circular Colliders – Conceptual Design Study

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Sixth TLEP Workshop – 16th October 2013

The European Strategy for Particle Physics
Update 2013

c) *Europe's top priority should be the* ***exploitation of the full potential of the LHC****, including the high-luminosity upgrade of the machine and detectors with a view to collecting* ***ten times more data than in the initial design, by around 2030****. This upgrade programme will also provide further exciting opportunities for the study of flavour physics and the quark-gluon plasma.*

HL-LHC from a study to a PROJECT

300 fb^{-1} → 3000 fb^{-1}

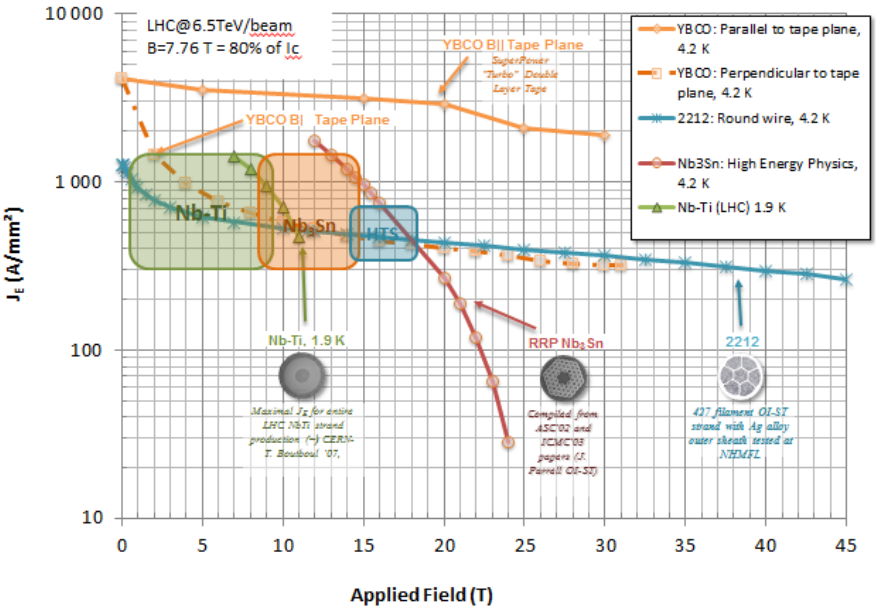
including LHC injectors upgrade **LIU**

(Linac 4, Booster 2GeV, PS and SPS upgrade)

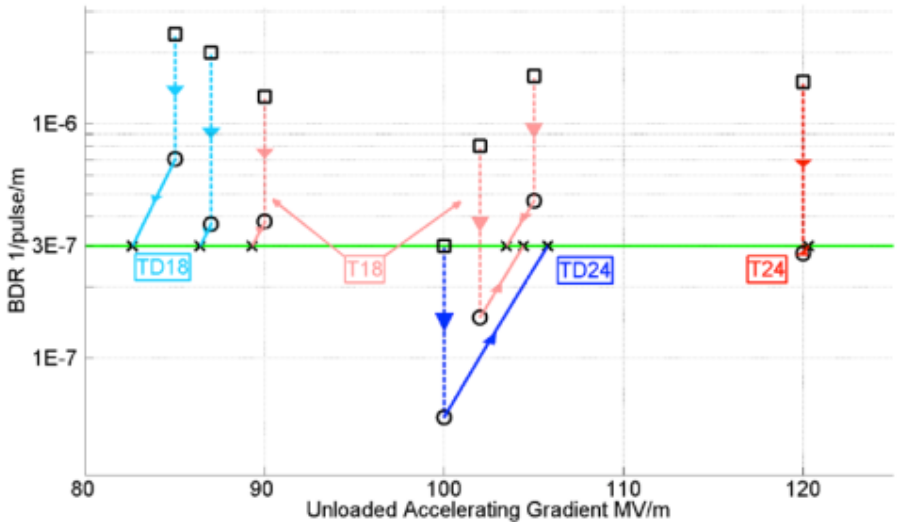
“to propose an ambitious **post-LHC accelerator project at CERN** by the time of the next Strategy update”

d) ***CERN should undertake design studies for accelerator projects in a global context,*** *with emphasis on* ***proton-proton and electron-positron high-energy frontier machines****. These design studies should be coupled to a vigorous accelerator* ***R&D programme****, including* ***high-field magnets*** ***and*** ***high-gradient accelerating structures****,* ***in collaboration with national institutes, laboratories and universities worldwide.***

HFM



HGA

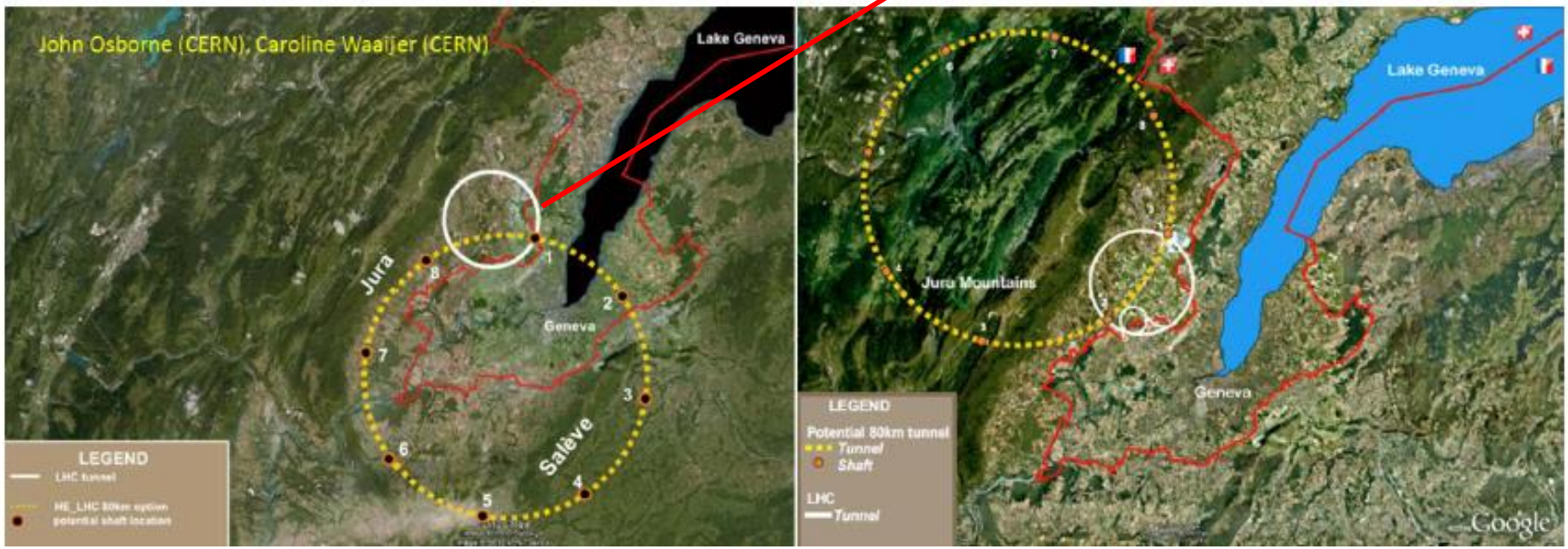


"Very High Energy LHC"

First studies on a new 80 km tunnel in the Geneva area

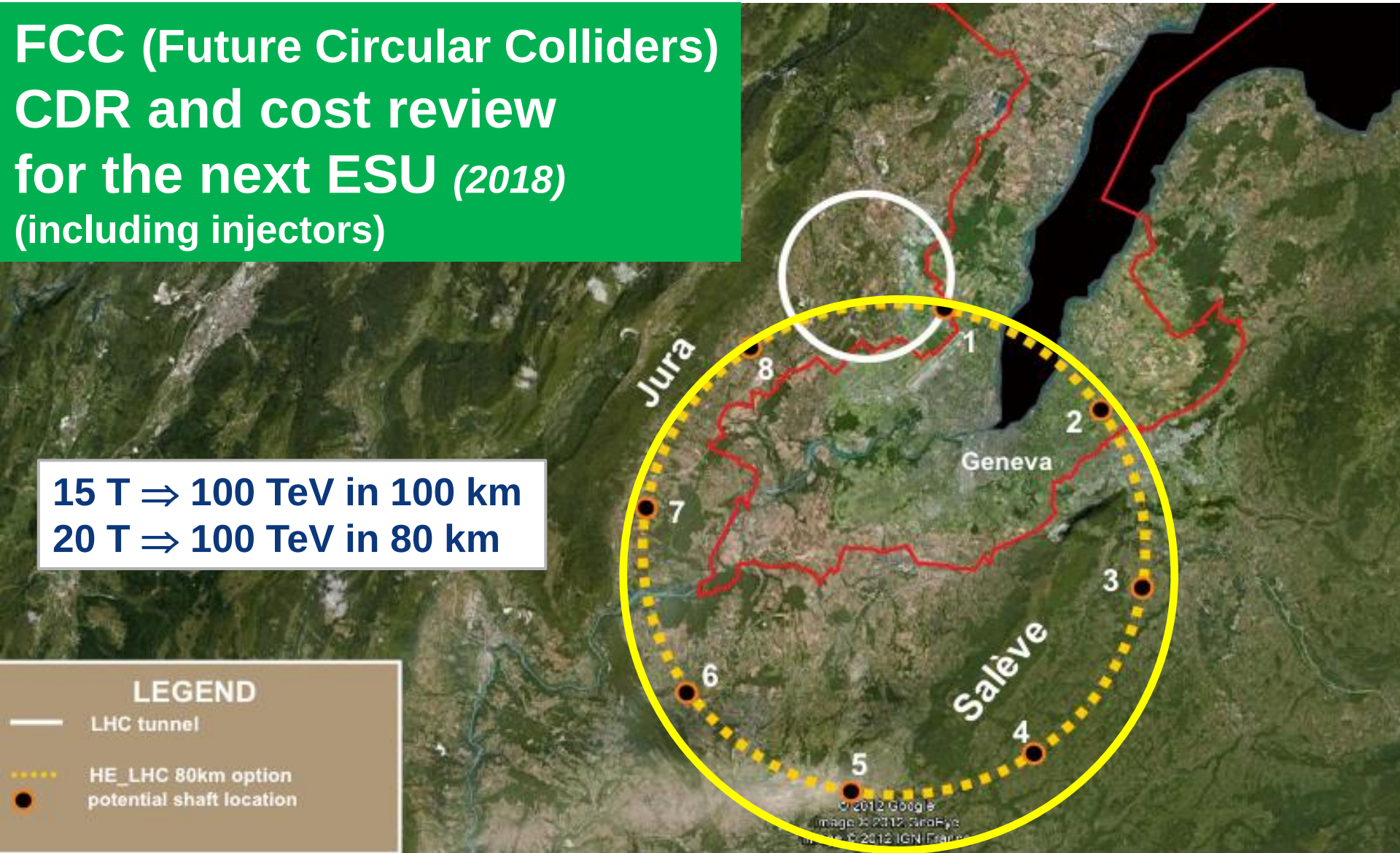
- **42 TeV with 8.3 T using present LHC dipoles**
- **80 TeV with 16 T based on Nb_3Sn dipoles**
- **100 TeV with 20 T based on HTS dipoles**

HE-LHC :33 TeV with 20T magnets



80-100 km tunnel infrastructure in Geneva area – design driven by pp-collider requirements with possibility of e+-e- (TLEP) and p-e (VLHeC)

FCC (Future Circular Colliders) CDR and cost review for the next ESU *(2018)* (including injectors)



FCC Study Scope and Structure

Future Circular Colliders - Conceptual Design Study for next European Strategy Update (2018)

Infrastructure

tunnels, surface buildings, transport (access roads), civil engineering, cooling ventilation, electricity, cryogenics, communication & IT, fabrication and installation processes, maintenance, environmental impact and monitoring,

Hadron injectors

Beam optics and dynamics
Functional specs
Performance specs
Critical technical systems
Operation concept

Hadron collider

Optics and beam dynamics
Functional specifications
Performance specs
Critical technical systems
Related R+D programs
HE-LHC comparison
Operation concept
Detector concept
Physics requirements

e+ e- collider

Optics and beam dynamics
Functional specifications
Performance specs
Critical technical systems
Related R+D programs
Injector (Booster)
Operation concept
Detector concept
Physics requirements

e- p option: Physics, Integration, additional requirements

Main areas for design study

Preparatory group for a kick-off meeting => Steering committee

Machines and infrastructure conceptual designs	Technologies R&D activities Planning	Physics experiments detectors
Infrastructure	High-field magnets	Hadron physics experiments interface, integration
Hadron collider conceptual design	Superconducting RF systems	e^+ e^- coll. physics experiments interface, integration
Hadron injectors	Cryogenics	e^- - p physics, experiments, integration aspects
Lepton collider conceptual design	Specific technologies	
Safety, operation, energy management environmental aspects	Planning	

Prel. parameters for FHC *(VHE-LHC)*

- **energy = 100 TeV c.m.**
- **dipole field = 15 T (baseline)**

  [20 T option] (design limit)
- **circumference ~100 km**
- **#IPs = 2**
- total beam-beam tune shift = 0.01
- bunch spacing = 50 ns [5 ns option]
- **peak luminosity = 5×10^{34} cm^{-2}s^{-1}**
- β^* = 1.1 m *[2 m conservative option]* linked to total beam current (~0.5-1 A)

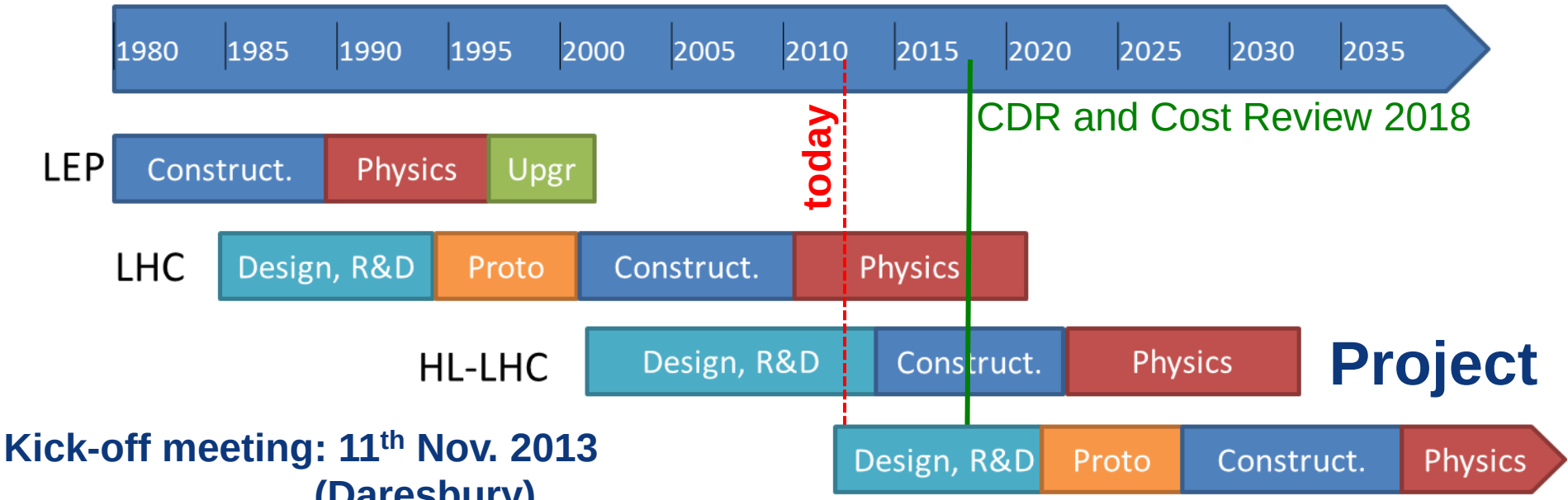
Prel. parameters for FEC *(TLEP)*

- **energy =** 91-Z, 160-W, **240-H,** 350-t **GeV c.m.** (energy upgrade 500-ZHH/ttH)
- **circumference ~100 km**
- **total SR power ≤ 100 MW** (design limit)
- **#IPs = 2 or 4**
- beam-beam tune shift / IP scaled from LEP
- **peak luminosity / IP = 5×10^{34} cm^{-2}s^{-1} at Higgs**
- top-up injection
- $\beta_y^* = 1$ mm ~ σ_z

Prel. parameters FHEC *(VHELHC-TLEP)*

- ***e*- energy = 60, 120, 250 GeV**
- ***p* energy = 50 TeV**
- spot size determined by p
- e^- current from FEC (SR power ≤ 50 MW)
- **#IPs = 1 or 2**

"CERN should undertake design studies for accelerator projects in a global context, with emphasis on ***proton-proton and electron- positron high-energy frontier machines.*** *"*



Kick-off meeting: 11th Nov. 2013 (Daresbury)

FCC Study : p-p towards 100 TeV

Kick-off meeting: 12th-14th Feb. 2014

FCC: Future Circular Colliders

Summary

- **CERN is undertaking an international study for the design of future circular colliders (FCC) in the 100 km range:**

  CDR and cost review for the next ESU (target 2018)

- **The study is driven by the hadron collider with a c.m. energy of ~100 TeV at the energy frontier, determining also the infrastructure.**

- **The common study will also contain an e^+e^- collider, as potential intermediate step, and look at an e-p option.**

- ***Preparation of FCC Design Study kick-off meeting:***

  12-14. February 2014 in Geneva area

  - ***Establishing international collaborations***
  - ***Set-up study groups and study committees***
  - ***International Advisory Committee (IAC)***

Thanks for your attention