High-gradient normal conducting rf – recent news

Walter Wuensch, CERN

Background

CERN scientific strategy: 3 main pillars

Full exploitation of the LHC:

- ❑ successful operation of the nominal LHC (Run 2, LS2, Run 3)
- ❑ construction and installation of LHC upgrades: LIU (LHC Injectors Upgrade) and HL-LHC

Scientific diversity programme serving a broad community:

- ❑ current experiments and facilities at Booster, PS, SPS and their upgrades (Antiproton Decelerator/ELENA, ISOLDE/HIE-ISOLDE, etc.)
- ❑ participation in accelerator-based neutrino projects outside Europe (presently mainly LBNF in the US) through CERN Neutrino Platform

Fabiola Gianotti
CERN Director General
11/1/2017

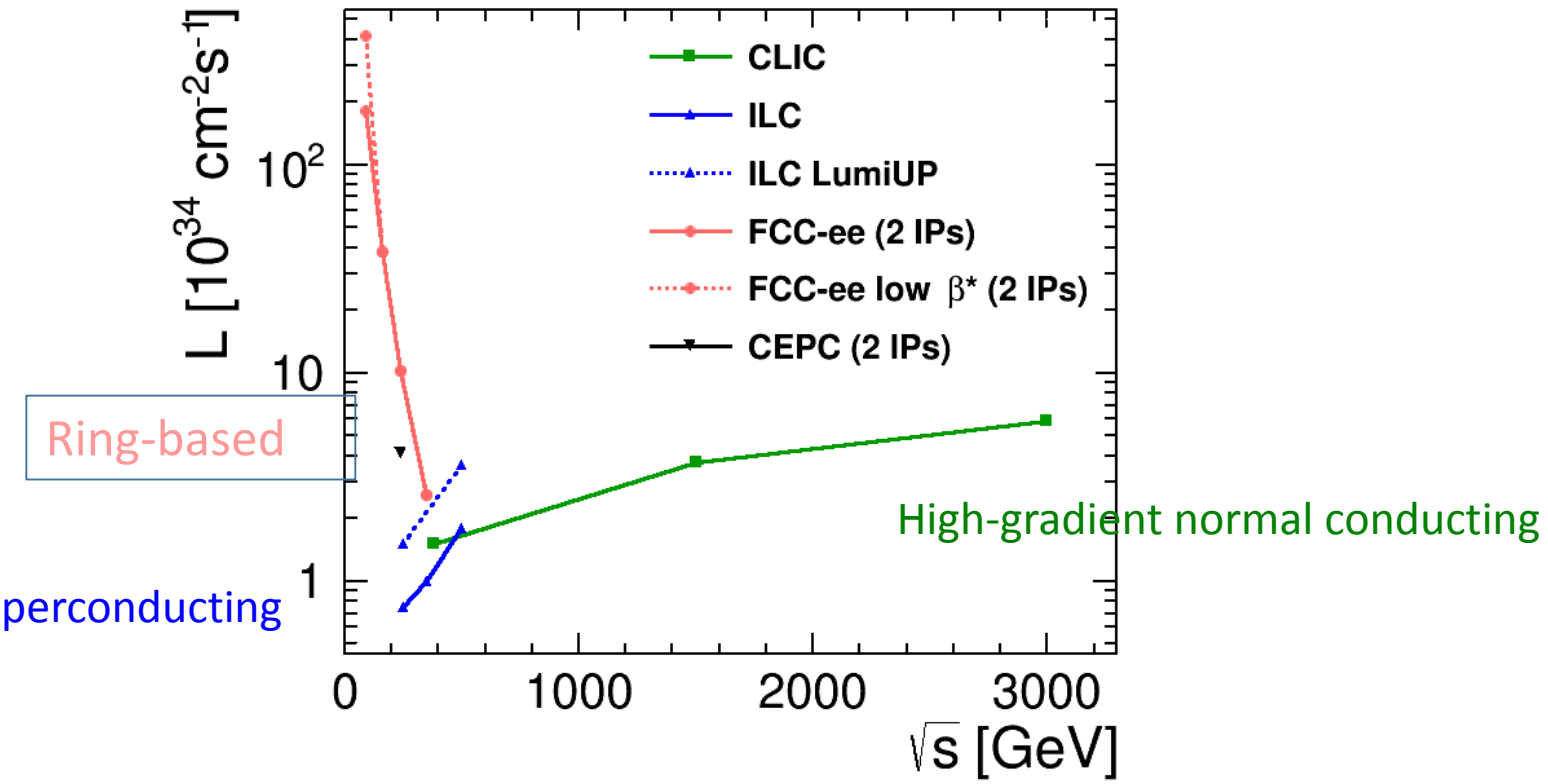
Preparation of CERN's future:

- ❑ vibrant accelerator R&D programme exploiting CERN's strengths and uniqueness (including superconducting high-field magnets, AWAKE, etc.)
- ❑ design studies for future accelerators: CLIC, FCC (includes HE-LHC)
- ❑ future opportunities of scientific diversity programme ("Physics Beyond Colliders" Study Group)

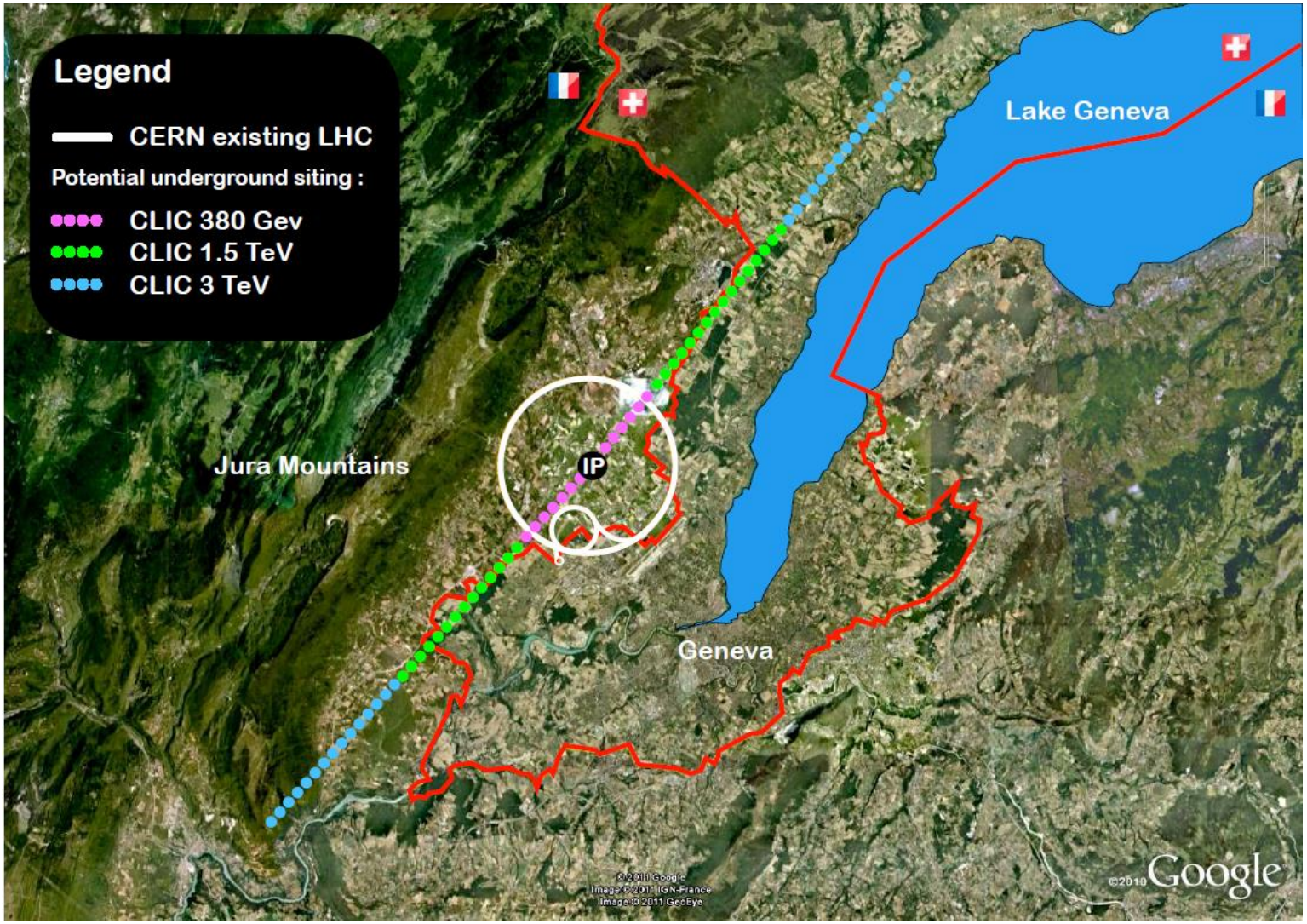
Important milestone: update of the European Strategy for Particle Physics (ESPP), to be concluded in May 2020

The accelerator landscape

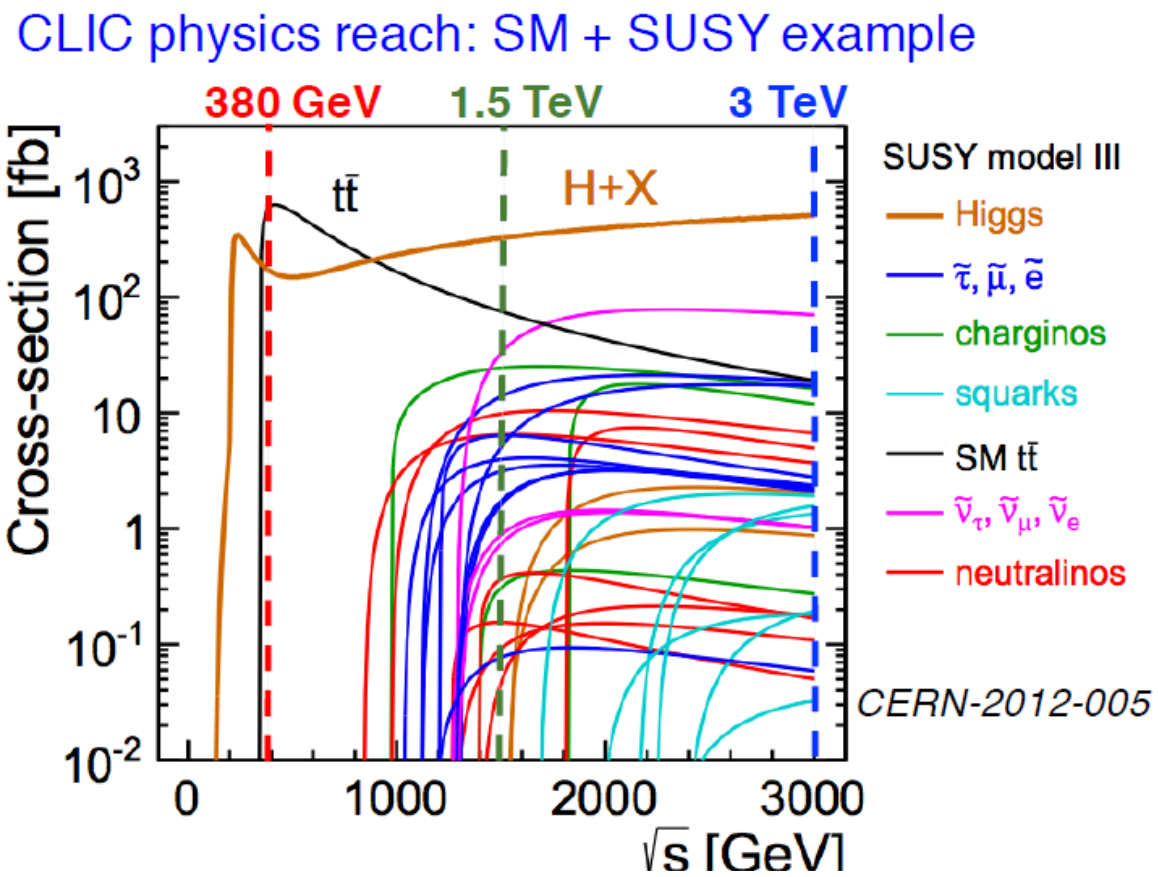
There are a number of accelerator options for next generation electron positron physics:



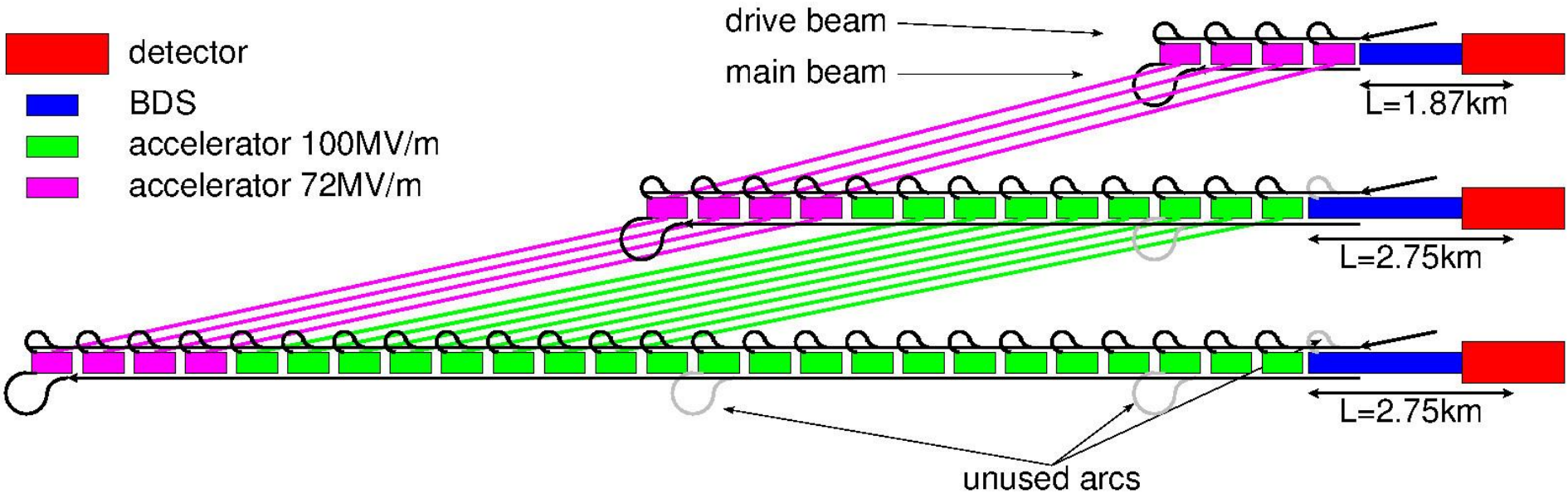
The Geneva landscape



Energy staging



Remember: CLIC Energy Stages



E_{cms}=380Gev, L=1.5x$10^{34}cm^{-2}s^{-1}$, $L_{0.01}/L>0.6$

- For higgs and top production, specified by CLIC physics group

E_{cms}=O(1.5TeV)

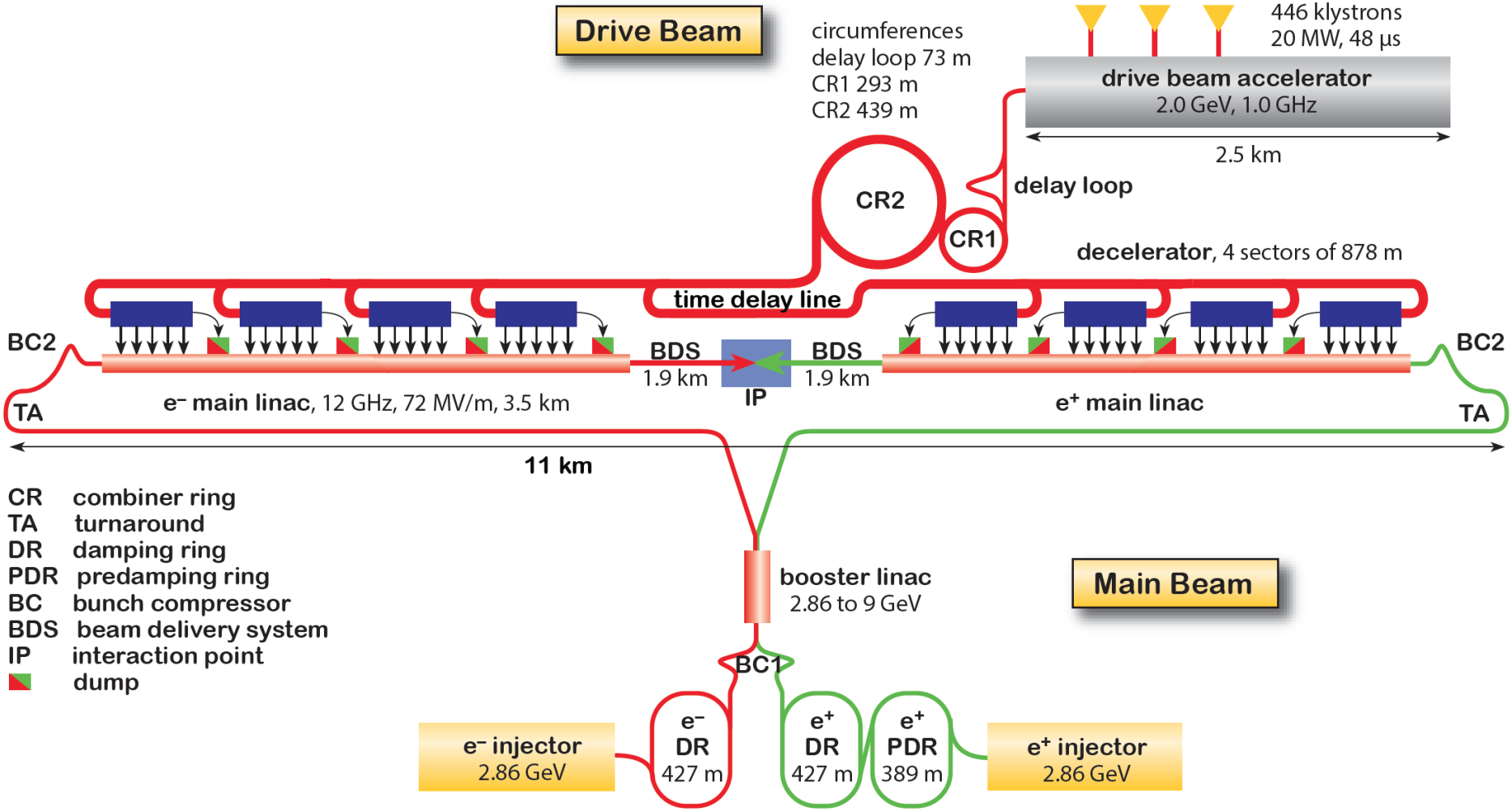
- Depends on LHC findings

E_{cms}=3TeV, $L_{0.01}$=2x$10^{34}cm^{-2}s^{-1}$, $L_{0.01}/L>0.3$

Klystron-based first energy stage has to be consistent with energy upgrade

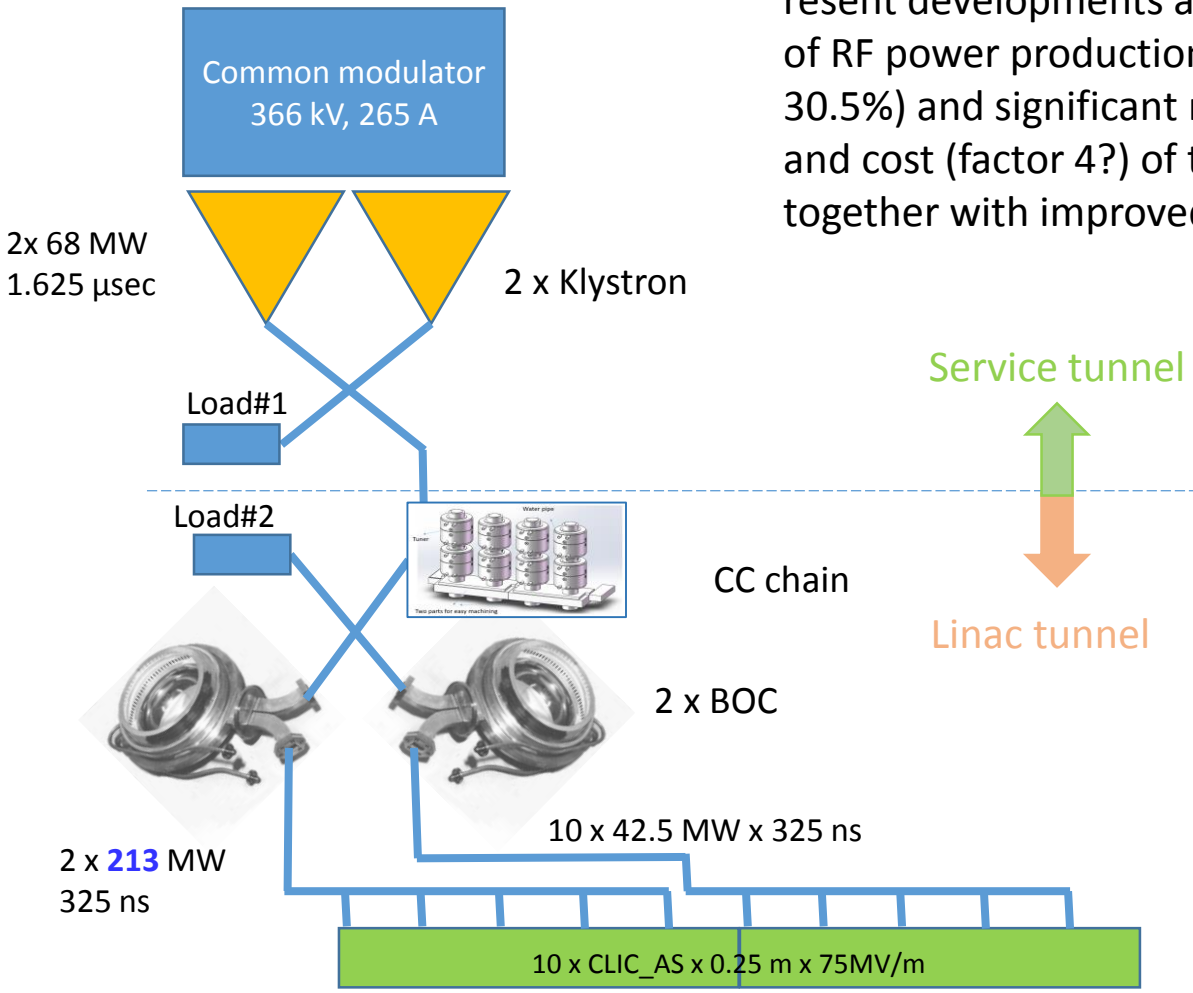
Bunch charge of > 4x10^{9}
> 312 bunches

CLIC layout at 380 GeV



New CLIC'k RF unit layout

In a given (not yet fully optimised) example, the resent developments allow for substantial increase of RF power production efficiency (from 21.8% to 30.5%) and significant reduction of the complexity and cost (factor 4?) of the RF distribution system together with improved reliability.

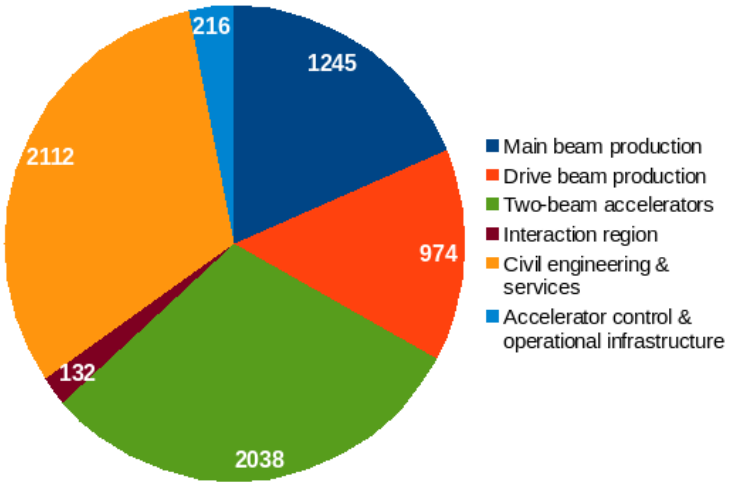


CLIC cost estimate

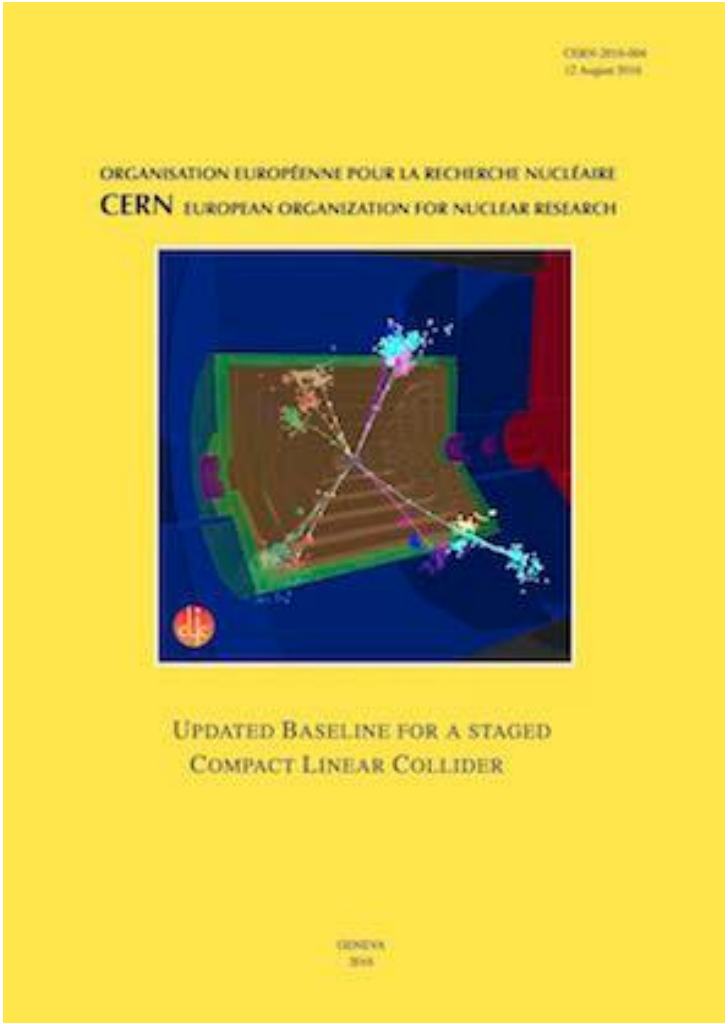
Preliminary estimate (scaled from CDR) with room for improvement.
New estimate will be provided for European Strategy Update.

System	**Value for 380 GeV** (MCHF of Dec 2010)
Main beam production	1245
Drive beam production	974
Two-beam accelerators	2038
Interaction region	132
Civil engineering & services	2112
Accelerator control & operation infrastructure	216
TOTAL	**6690**

Value for the CLIC accelerator at √s = 380 GeV (11.4 km site length)



Rebaselining document



The Compact Linear Collider (CLIC) is a multi-TeV high-luminosity linear e^+e^- collider under development. For an optimal exploitation of its physics potential, CLIC is foreseen to be built and operated in a staged approach with three centre-of-mass energy stages ranging from a few hundred GeV up to 3 TeV. The first stage will focus on precision Standard Model physics, in particular Higgs and top measurements. Subsequent stages will focus on measurements of rare Higgs processes, as wells as searches for new physics processes and precision measurements of new states, e.g. states previously discovered at LHC or at CLIC itself. In the 2012 CLIC Conceptual Design Report, a fully optimised 3 TeV collider was presented, while the proposed lower energy stages were not studied to the same level of detail. This report presents an updated baseline staging scenario for CLIC. The scenario is the result of a comprehensive study addressing the performance, cost and power of the CLIC accelerator complex as a function of centre-of-mass energy and it targets optimal physics output based on the current physics landscape. The optimised staging scenario foresees three main centre-of-mass energy stages at 380 GeV, 1.5 TeV and 3 TeV for a full CLIC programme spanning 22 years. For the first stage, an alternative to the CLIC drive beam scheme is presented in which the main linac power is produced using X-band klystrons.

CERN-2016-004

arXiv:1608.07537

New reference plots for physics, luminosity, power, costs …

2013 - 2019 Development Phase

Development of a Project Plan for a staged CLIC implementation in line with LHC results; technical developments with industry, performance studies for accelerator parts and systems, detector technology demonstrators

2020 - 2025 Preparation Phase

Finalisation of implementation parameters, preparation for industrial procurement, Drive Beam Facility and other system verifications, Technical Proposal of the experiment, site authorisation

2026 - 2034 Construction Phase

Construction of the first CLIC accelerator stage compatible with implementation of further stages; construction of the experiment; hardware commissioning

2019 - 2020 Decisions

Update of the European Strategy for Particle Physics; decision towards a next CERN project at the energy frontier (e.g. CLIC, FCC)

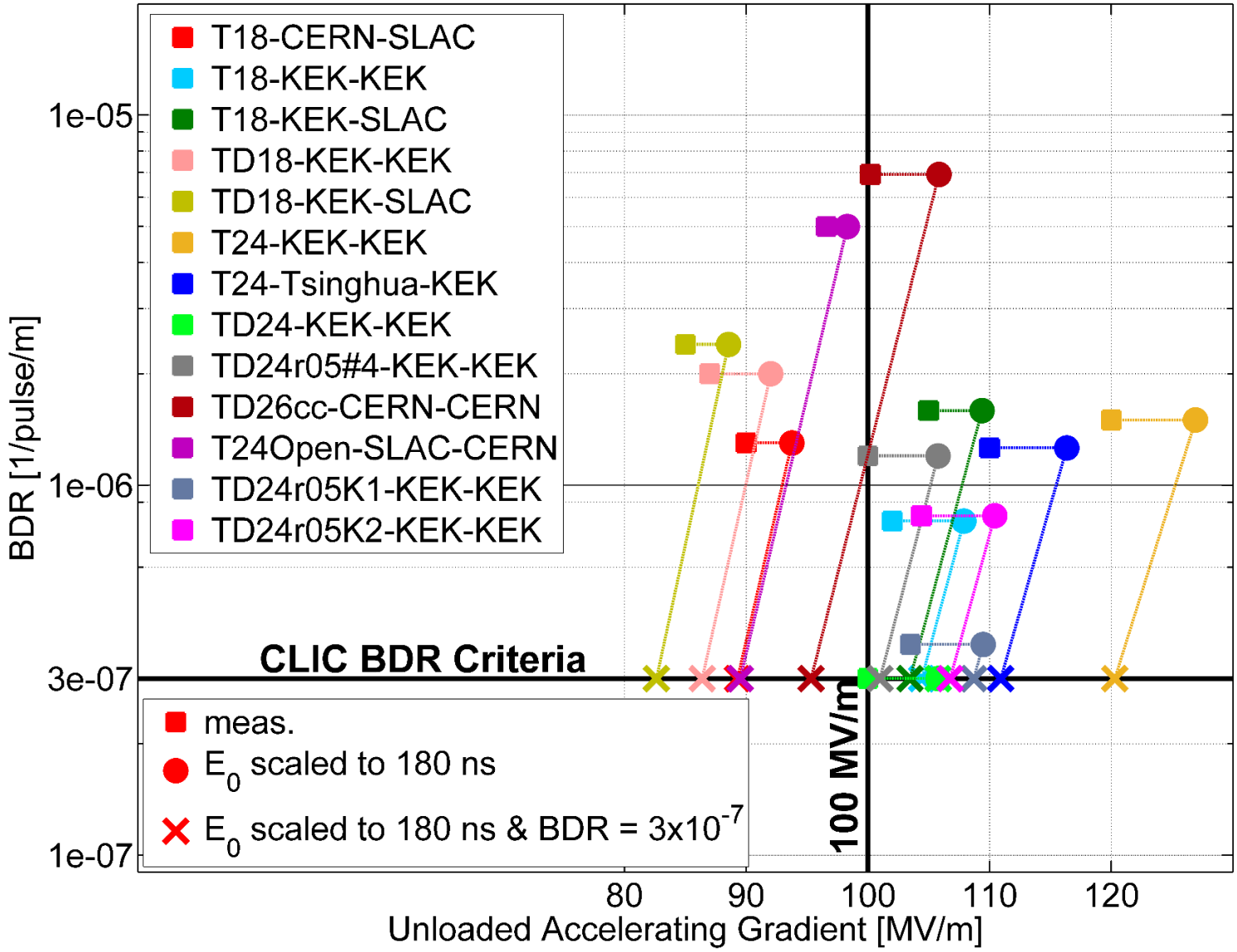
2025 Construction Start

Ready for construction; start of excavations

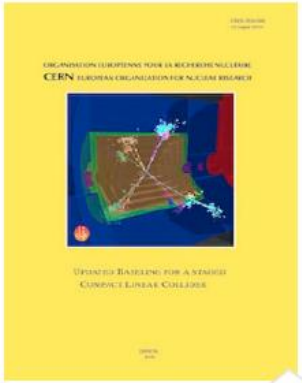
2035 First Beams

Getting ready for data taking by the time the LHC programme reaches completion

Prototype test results



Studies : CLIC and FCC => ESPP



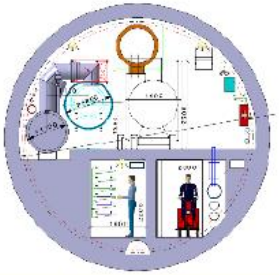
CLIC initial stage defined:

Complete re-baselining of a staged implementation starting at 380 GeV for Higgs and top physics, upgradeable to 3 TeV in two further stages, based on an overall power and cost optimisation for the initial stage. More than 500 authors.

CTF3 programme completed:

The CTF3 programme was brought to successful conclusion, proving the CLIC two beam concept and gradient performance, measuring the X-band structure breakdown rate with beam, benchmarking the drive-beam phase stability, verifying instrumentation prototypes and carrying out detailed module performance studies.

- Cost & schedule **estimates launched**
- **Inclined** access tunnels **assessment**
- Tunnel and shaft **cross-section designs**



FCC-hh
FCC-ee
FCC-he

CLEAR start up: CERN Linear Electron Accelerator for Research

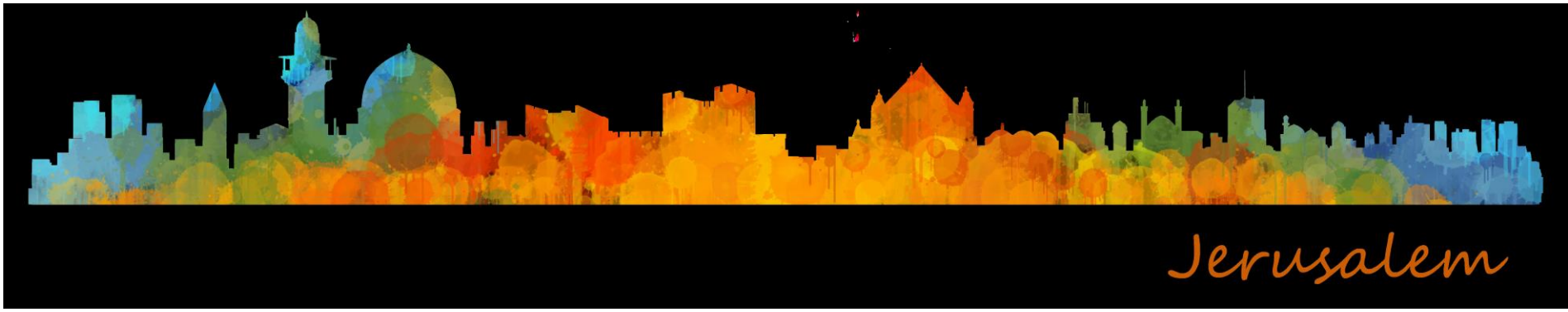
A new stand-alone user facility - CLEAR – will be available for users from 2017 onwards.

This new open electron beam facility is an adaptation of the CALIFES electron linac located in the experimental area of the CLIC Test Facility 3 (CTF3) at CERN.

Events

CLIC workshop 2017 http://indico.cern.ch/event/577810/

Mechanisms of Vacuum Arcs, MeVArc2017
https://indico.cern.ch/event/521667/overview



Events

https://indico.cern.ch/event/589548/