

# CERN-Status Report



ECFA meeting DESY, July 24, 2014

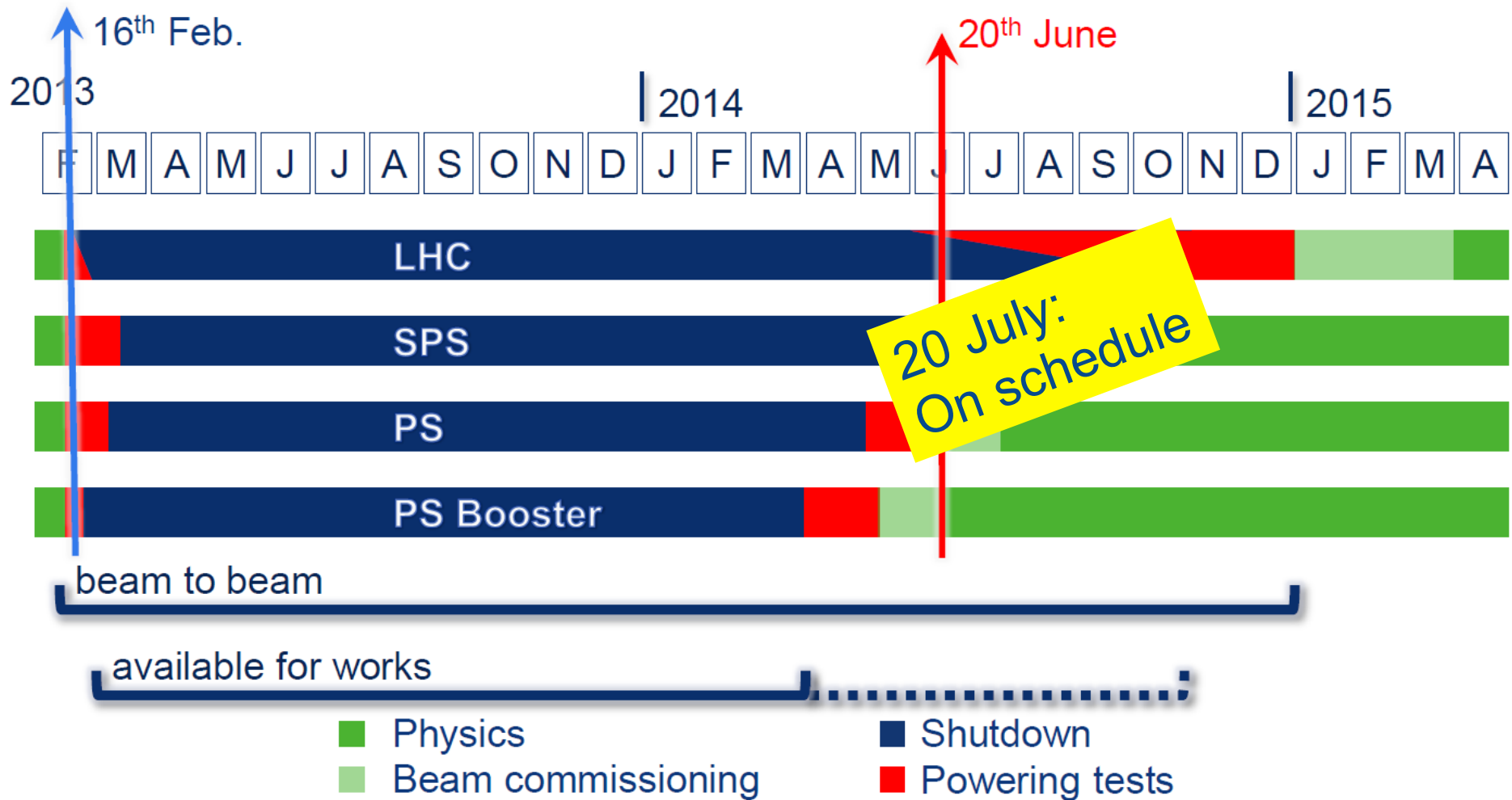


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LHC



# LS 1 from 16th Feb. 2013 to Dec. 2014



# CERN

## Medium Term Plan for the period 2015-2019

(scientific strategy approved by Council  
in June 2014)



# Main Aspects

- Implementation of all four European Strategy high priority items
- Implementation of a diverse fixed target program also along the European Strategy topics
- Presentation of a long-term plan
- Assumptions on additional revenues

# Main Aspects

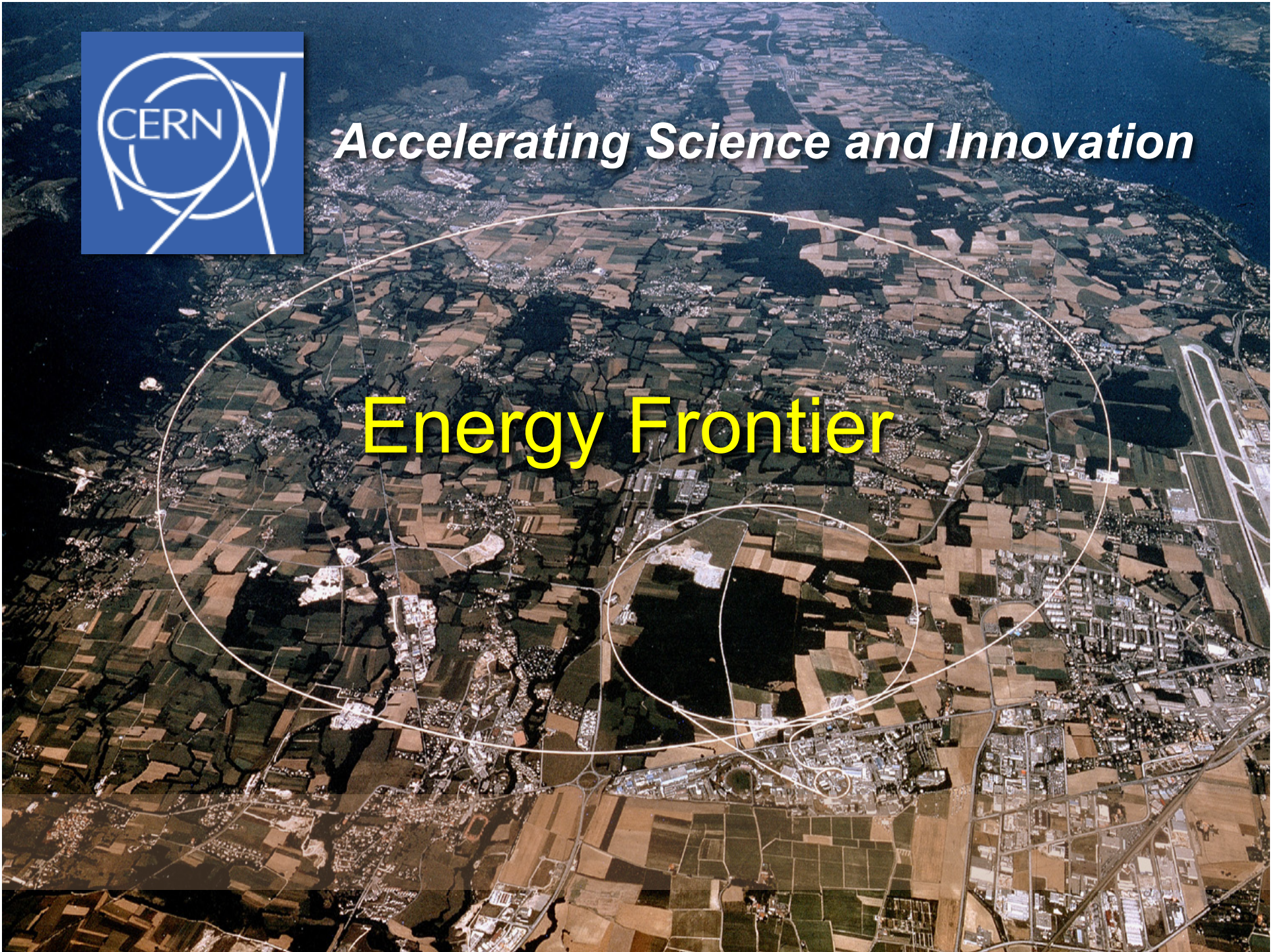
- Two main pillars of physics activities at CERN
  - High Energy Frontier, i.e. LHC, FCC, CLIC
  - Unique fixed target program, i.e. AD and ELENA, HIE-Isolde and TSR, n-ToF(EAR1,2)
- Two main pillars for physics activities outside CERN
  - Neutrino Platform (mainly towards activities in the US)
  - ILC





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**Energy Frontier**



# post- H(126)-discovery

- Good reasons to expect more
  - We have really just begun the searches
  - Much space has yet to be accessed
  - And there are important new physics models yet-to-be invented
- Precision and rare physics
  - Beyond our direct production reach
    - LHC is a superb intensity frontier machine
- Invest
  - Power, computing, triggers, computing
  - A sustained period of important results
  - And practical applications

**The LHC is the only H, (top, Z, W...) factory on the planet for many years to come!**





# Particle Physics Projects Prioritisation Panel (P5)



## Strategic Plan for U.S. Particle Physics

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- Charge: A strategic plan, executable over 10 years, in the context of a 20-year global vision
- US community has come together to make a plan

- Driven by the science

- Meets field

**Recommendations in line with the European Strategy**

- Considers the global context

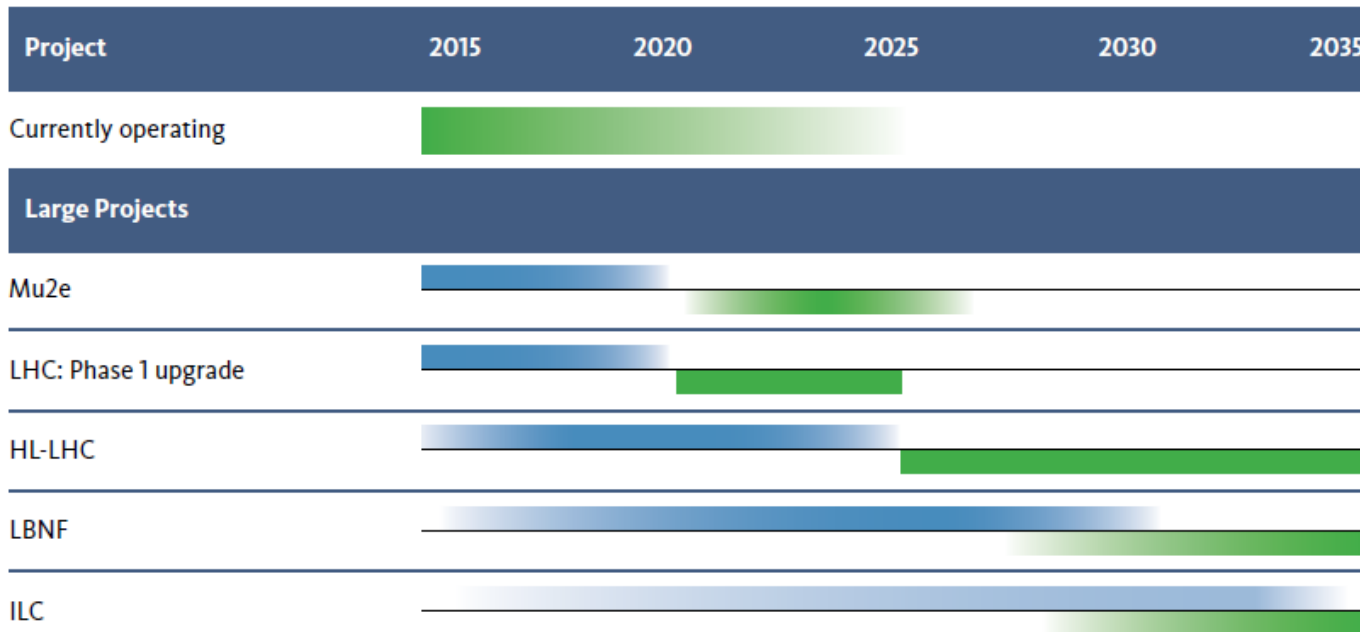
- Resolves key issues for the field

- Provides a continuous flow of results while making essential investments for the future



# From the P5 report

## Figure 1 Construction and Physics Timeline



# From the P5 report

## **Recommendation 10:**

Complete the LHC phase-1 upgrades and continue the strong collaboration in the LHC with the phase-2 (HL-LHC) upgrades of the accelerator and both general-purpose experiments (ATLAS and CMS). **The LHC upgrades constitute our highest-priority near-term large project.**

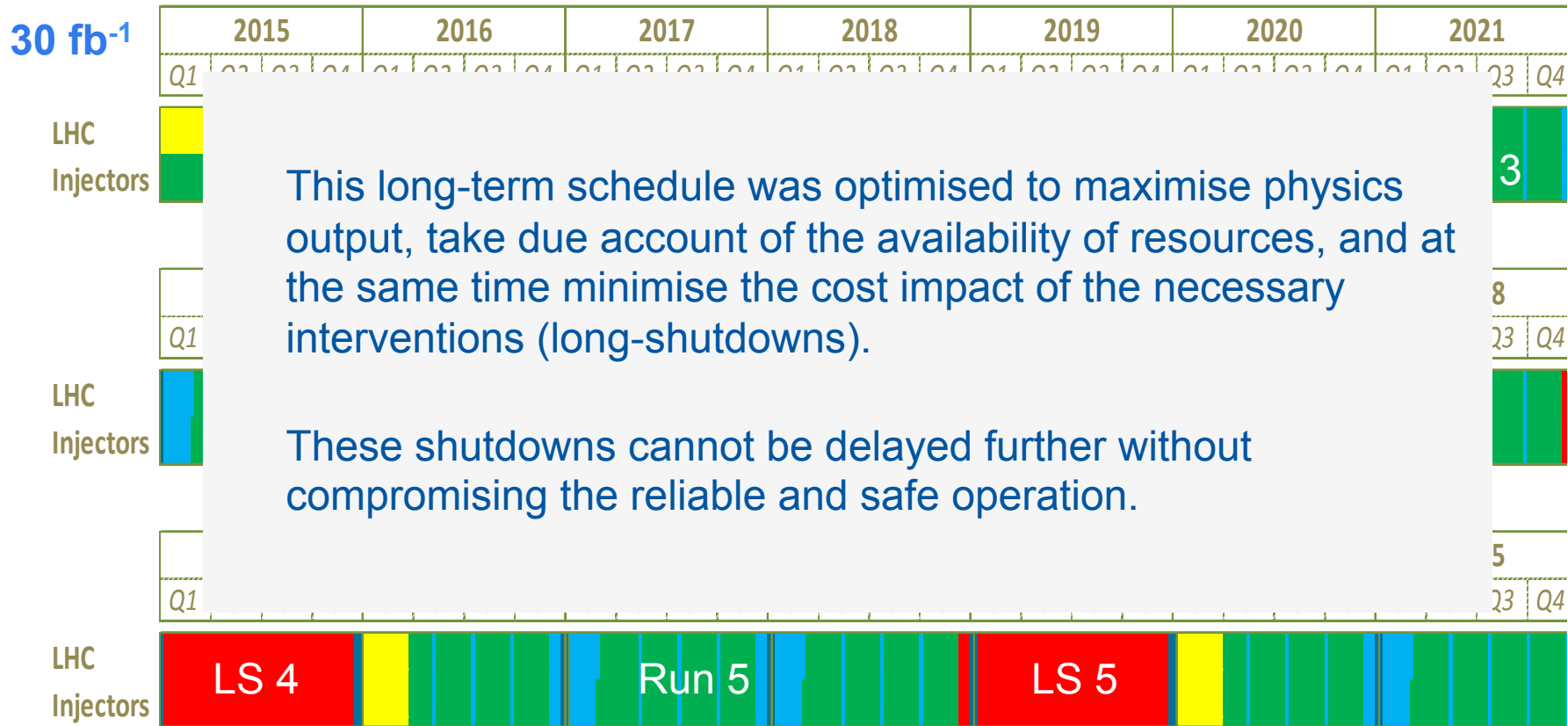
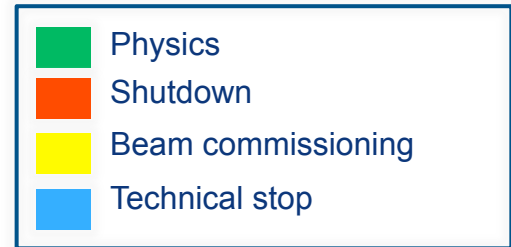
# European Strategy for Particle Physics

## High-priority large-scale scientific activities

***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.***

# LHC schedule beyond LS1

LS2 starting in 2018 (July) => 18 months + 3 months BC  
 LS3 LHC: starting in 2023 => 30 months + 3 months BC  
 Injectors: in 2024 => 13 months + 3 months BC



(Extended) Year End Technical Stop: (E)YETS

3'000 fb<sup>-1</sup>



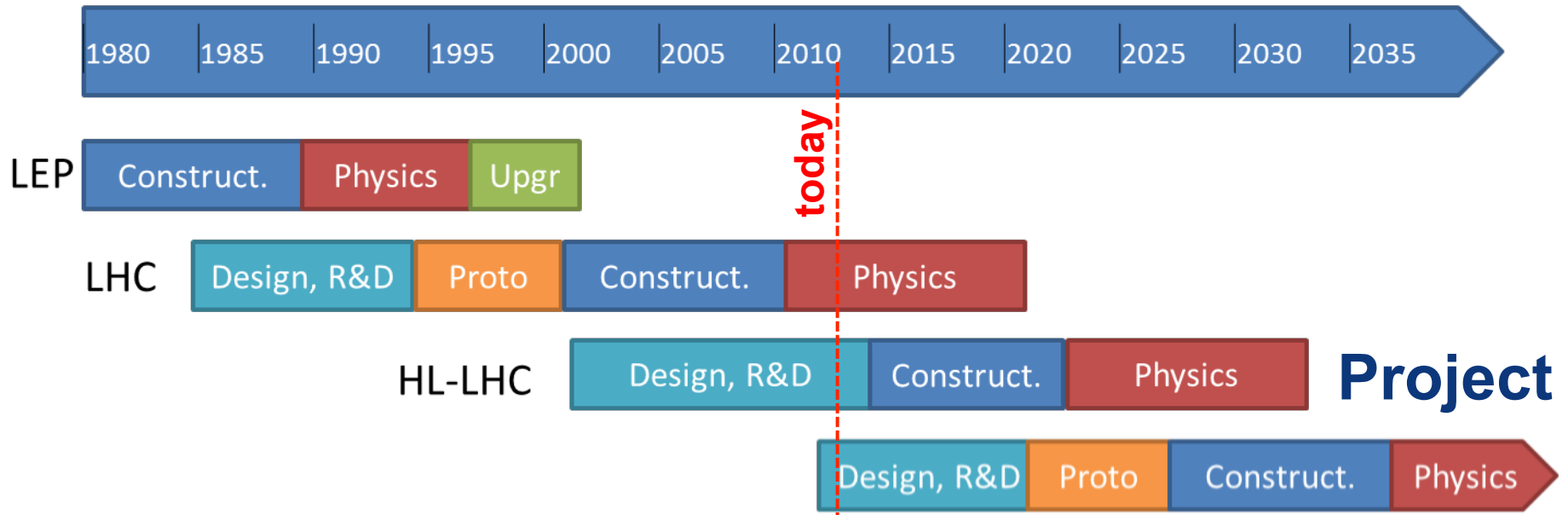
# High Energy Frontier (1) LHC

- Implementation of the schedule agreed end 2013
- In addition to PIC now also construction of HL-LHC included
- Careful adjustments concerning CtC for injectors, machine and CERN share to detectors upgrade to limit cumulative budgetary deficit
- Challenging personnel situation to allow for reliable exploitation AND construction of HL-LHC

# High Energy Frontier (2) FCC

- Study of Future Circular Colliders: FCC including all options: FCC-hh, ee, ep

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



**FCC Study : p-p towards 100 TeV**

**Kick-off meeting: February 2014  
(Univ. Geneva)**

**FCC: Future Circular Colliders**



# Future Circular Collider Study - SCOPE CDR and cost review for the next ESU (2018)

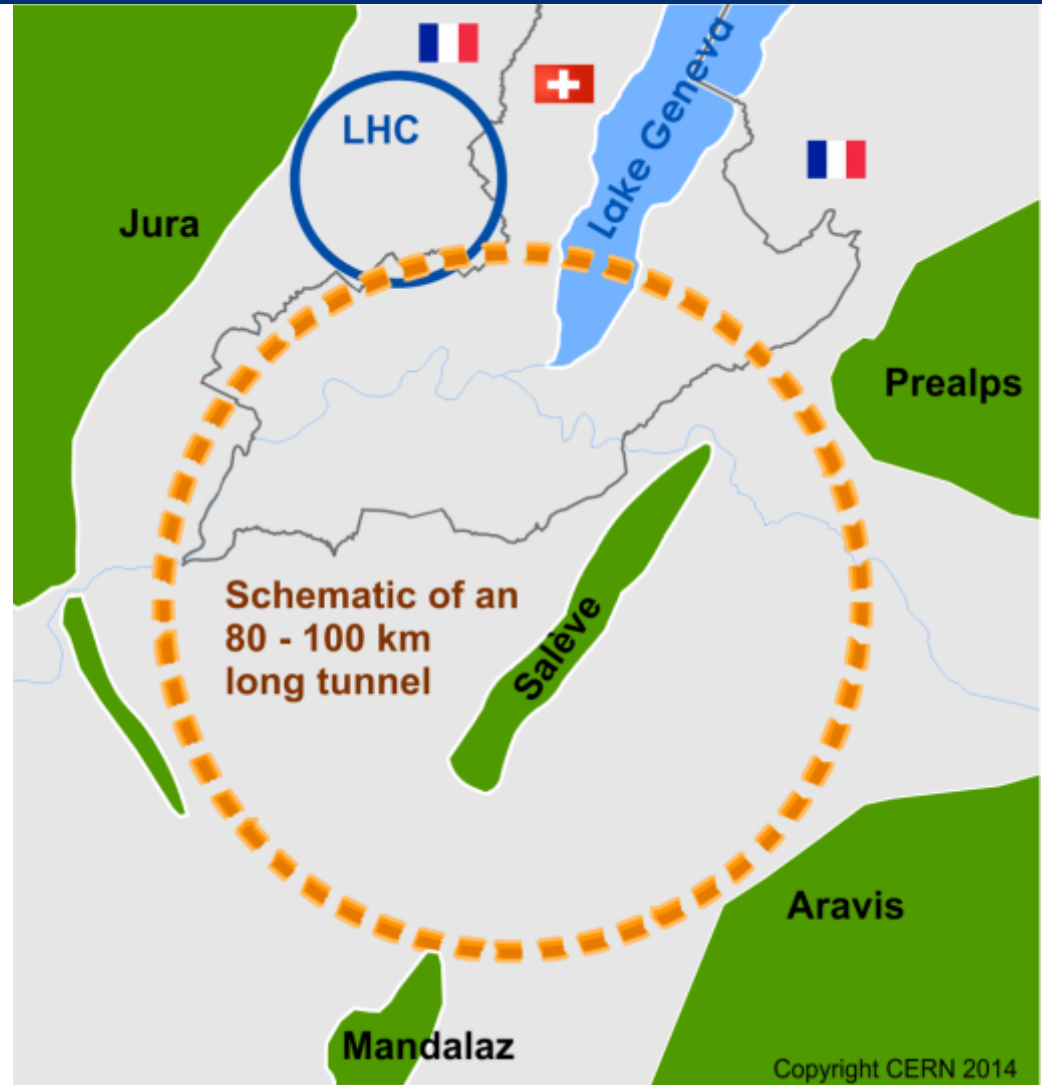
Forming an international collaboration to study:

- $pp$ -collider (*FCC-hh*)  
→ defining infrastructure requirements

~16 T ⇒ 100 TeV  $pp$  in 100 km

~20 T ⇒ 100 TeV  $pp$  in 80 km

- $e^+e^-$  collider (*FCC-ee*) as potential intermediate step
- $p-e$  (*FCC-he*) option
- 80-100 km infrastructure in Geneva area

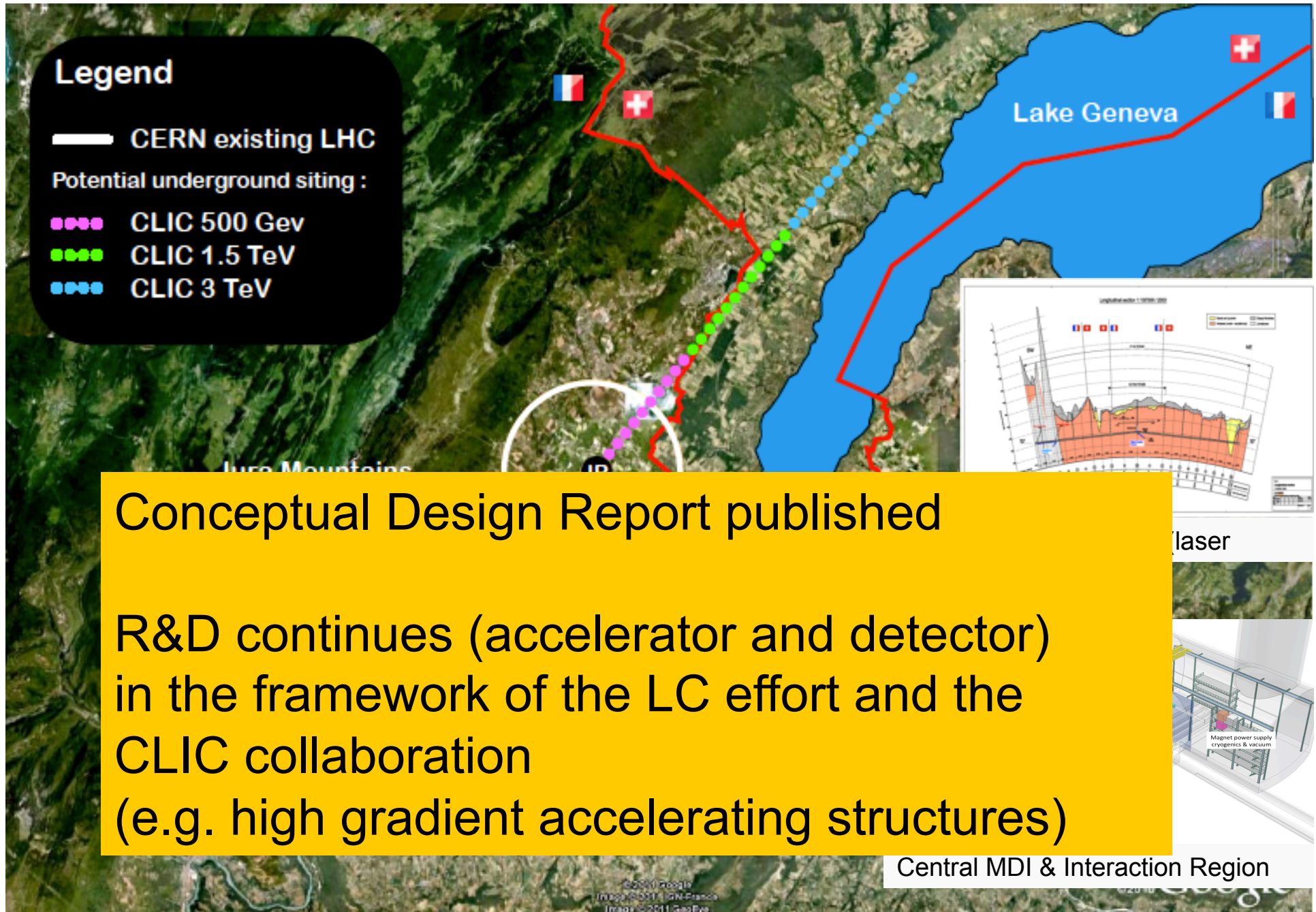




# High Energy Frontier (2) FCC

- Study of Future Circular Colliders: FCC including all options: FCC-hh, ee, ep
- Organisation of the collaboration in full swing, MoU in preparation, working groups' activities started
- H2020 proposal in preparation

# CLIC near CERN



Conceptual Design Report published

R&D continues (accelerator and detector)  
in the framework of the LC effort and the  
CLIC collaboration  
(e.g. high gradient accelerating structures)

Central MDI & Interaction Region

# European Strategy for Particle Physics

## High-priority large-scale scientific activities

After careful analysis of many possible large-scale scientific activities requiring significant resources, sizeable commitments, and long-term commitment, the following four activities have been identified as high-priority.

e) There is a strong scientific case for a new linear electron-positron collider, complementary to the LEP collider, to study the properties of the Higgs boson and other particles produced in the collision with unprecedented precision and whose energy can be upgraded to 500 GeV. The **Design Report of the International Linear Collider (ILC) has been completed**, with large European participation. The initiative from the Japanese particle physics community to host the ILC in Japan is most welcome, and European groups are eager to participate. ***Europe looks forward to a proposal from Japan to discuss a possible participation.***

# High Energy Frontier (3) CLIC ILC

- Continue R&D for CLIC (in particular high gradient acceleration) and common research on ILC (machine and detectors)

## High Energy Frontier Studies beyond ESU

- Ready for choosing one option at the time of the next European Strategy update
- One budget line for High Energy Frontier studies from 2020 onwards



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# Intensity Frontier



# Neutrino Platform

**CERN should develop a neutrino programme to pave the way for a substantial European role in future long-baseline experiments. Europe should explore the possibility of major participation in leading long-baseline neutrino projects in the US and Japan**

Create a platform to pave the way for a European contribution in a neutrino facility in the US or Asia

Financial scenario with an allocation to allow for

- Extension of the experimental area of the SPS complex (North Area)
- (liquid argon) detector R&D for neutrino experiments
- Preparing detectors at CERN for transport to US

**P 5 Recommendation 13:** Form a new international collaboration to design and execute a highly capable Long-Baseline Neutrino Facility (LBNF) hosted by the U.S. To proceed, a project plan and identified resources must exist to meet the minimum requirements in the text. **LBNF is the highest-priority large project in its timeframe.**



# Neutrino Platform

- Help in setting up an “umbrella collaboration” together with FNAL
  - Umbrella collaboration comprises several ‘sub’collaborations for different detector R&Ds and/or experiments
  - Build up a (small) team of physicists and engineers at CERN to participate in neutrino projects
- Engage with Japan in prototyping and testing of detector components

# OUTLOOK SPS-Committee

**Coherent program being set up by CERN (mainly with the US) to prepare EU participation to a future neutrino LBL program**

*NB1: this is still pending on stamping of the US HEP strategy*

*NB2: CERN goal is to set a solid framework to the EU participation, not to include the full future EU contribution to a LBL program.*

**The program makes best use of the expertise and motivation of EU communities and presents a good mix of short term physics and key R&D**

*NB1: the communities must be encouraged to make the necessary compromises to settle the remaining open points (Icarus T150, big MIND, etc...) within the MOUs in preparation.*

*NB2: The overall manpower situation is tight, making the focus of activities even more important. A better quantification of the external human resources associated to subprojects is required.*

**Overall the CERN MTP neutrino plan must be supported if one wishes EU to have a coherent and visible contribution to a future LBL neutrino program.**

SPC 287

SPSC review of neutrino projects

12





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**Diversity**



# The Particle Physics Landscape at CERN

## High Energy Frontier

*LHC*

### Hadronic Matter

*deconfinement*  
*non-perturbative QCD*  
*hadron structure*

### Low Energy

*heavy flavours / rare decays*  
*neutrino oscillations*  
*anti-matter*

### Non-accelerator

*dark matter*  
*astroparticles*

### Multidisciplinary

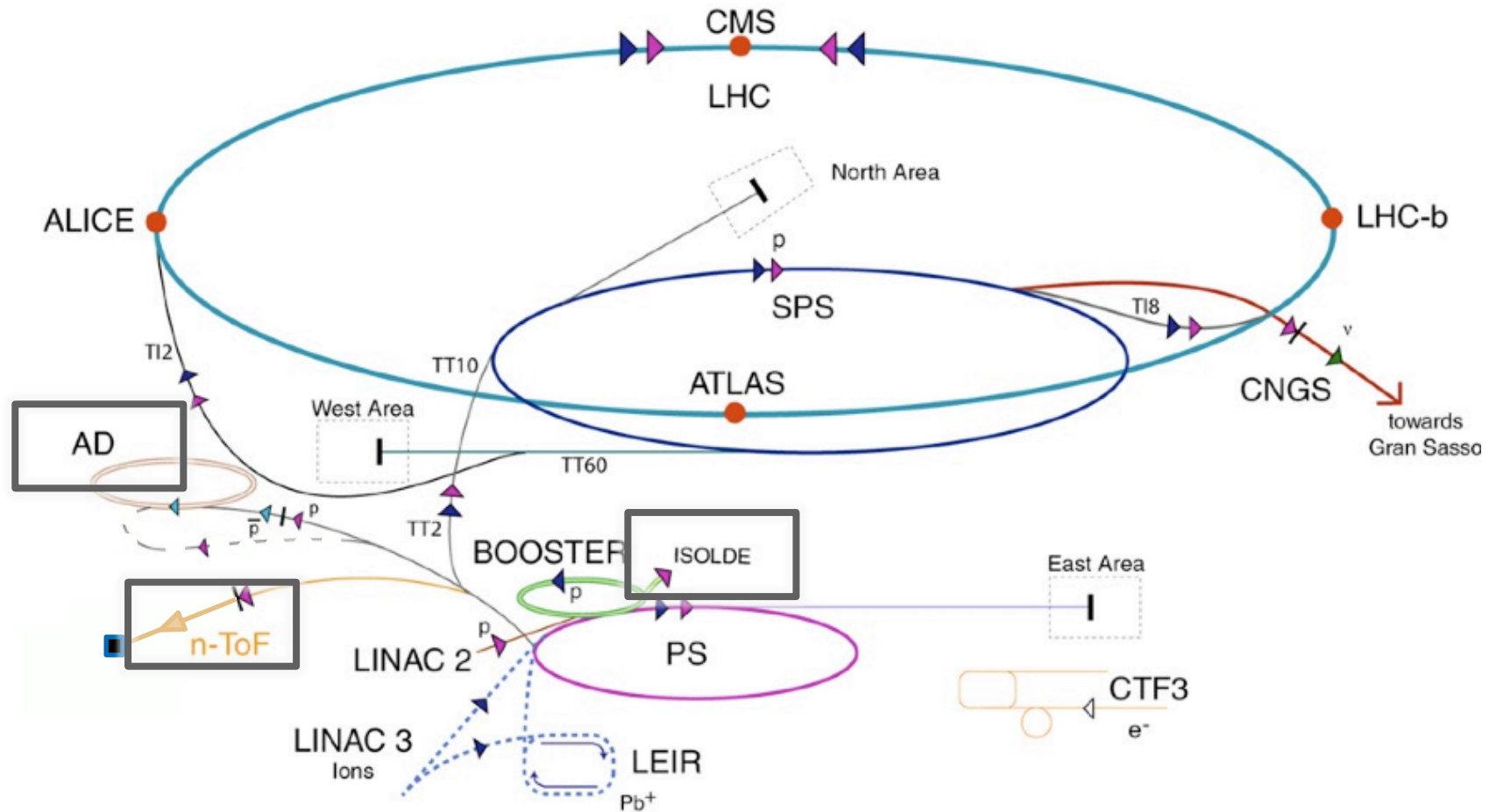
*climate, medicine*

*Non-LHC Particle Physics = o(1000) physicists / o(20) experiments*

Scientific Diversity at **unique facilities**

**CERN maintains and upgrades these facilities**

# CERN Accelerator Complex today



- |            |               |                              |                                |
|------------|---------------|------------------------------|--------------------------------|
| ▶ protons  | ▶ antiprotons | AD Antiproton Decelerator    | LHC Large Hadron Collider      |
| ▶ ions     | ▶ electrons   | PS Proton Synchrotron        | n-ToF Neutron Time of Flight   |
| ▶ neutrons | ▶ neutrinos   | SPS Super Proton Synchrotron | CNGS CERN Neutrinos Gran Sasso |
|            |               |                              | CTF3 CLIC Test Facility 3      |



# (4) Fixed-target program

- Continue support for HIE-ISOLDE, ELENA (upgrade of AD), n-ToF (2<sup>nd</sup> experimental area)
- Minimum consolidation funding for maintaining North Area, East Hall and AD facilities
- Materials allocation for TSR@ISOLDE integration needs external resources (manpower not allocated in present MTP)

# (5) R&D Projects, collaborations

- R&D Projects
  - cover **many different areas** like accelerator technologies, IT projects, scientific information, etc
  - are also of **strategic** nature
  - are also **service** to the community
- Collaborations
  - with National Laboratories/Institutes existing, will be further expanded
  - with EC will concentrate on projects of high priority within the European Strategy
  - Strong demand on CERN expertise at new infrastructures



# Final Remark

With the European Strategy, approved by Council May 2013,  
with the P5 recommendations, approved by HEPAP in the US,  
with the Japanese roadmap

we have (for the first time) a global vision for our field  
going beyond regional boundaries

CERN is playing a major role  
in this global endeavour



