A very warm welcome to the Accelerator and Technology Sector 2021

CERN Archives

Noble Prize in Physics, 1979

Abdus Salam, Sheldon Glashow, and Steven Weinberg all shared the Nobel Prize in physics for their verification of the weak neutral current as predicted by Salam and Weinberg's electroweak theories. The interaction was first viewed at CERNs Gargamelle experiment.

PS

Carlo Rubbia and Simon van der Meer in the UA1 cavern, celebrating the Nobel Prize, October 1984

SPS

François Englert, Peter Higgs celebrating the discovery of the Higgs boson, and the Nobel Prize 2012.

LHC

Preamble

- Freddy's talk in December
  - great overview of the sector's activities
- LS2 days (https://indico.cern.ch/event/980341/)
  - very good picture-reviews by facility coordinators showing the breath of involvement of teams across sector (and beyond)
    - PS – Fernando Pedrosa; SPS – David Mcfarlane; LHC – Marzia Bernardini
    - (And a picture-review of Exemplary Proactive Safety Attitudes! – Thomas Otto)
- Here will stay relatively high-level on the reorganization and our main goals over the next 5 years or so
- COVID – next Monday at New Year staff address

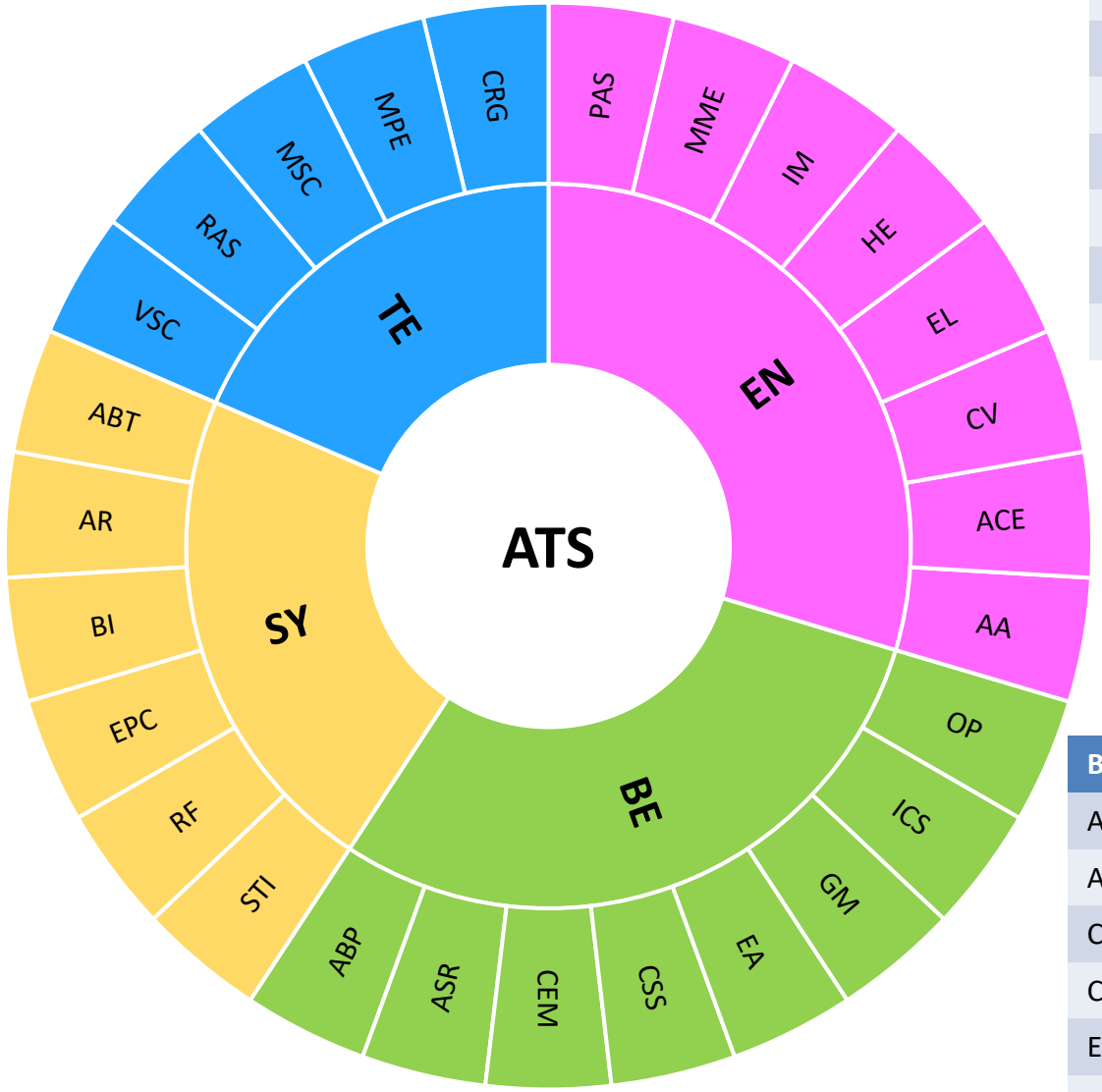
Big thanks to Julia Double and the Audio-visual team for the organisation of today's Webinar!

ATS

- The Accelerator and Technology Sector is responsible for the safe operation, maintenance, and consolidation of CERN's accelerator complex and its associated technical infrastructure.
- The sector hosts the requisite technical expertise to deploy, operate and develop the technologies that underpin present and future exploitation.
- In response to the strategic aims of the organization, the sector ensures the design, development and deployment of upgrades of existing facilities and novel accelerator projects along with the R&D for the necessary technology developments.

TE	Technology
CRG	Cryogenics
MPE	Machine Protection & Electrical Integrity
MSC	Magnets, Superconductors & Cryostats
RAS	Resources, Apprentices & Safety
VSC	Vacuum, Surfaces & Coatings

EN	Engineering
AA	Access & Alarms
ACE	Accelerator Coordination & Engineering
CV	Cooling & Ventilation
EL	Electrical Engineering
HE	Handling Engineering
IM	Information Management
MME	Mechanical & Materials Engineering
PAS	Planning, Administration & Safety

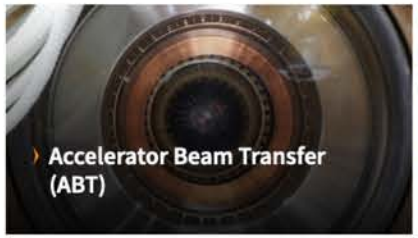


SY	Accelerator Systems
ABT	Accelerator Beam Transfer
AR	Administration & Resources
BI	Beam instrumentation
EPC	Electrical Power Converters
RF	Radio Frequency
STI	Sources, Targets & Interactions

BE	Beams
ABP	Accelerators & Beam Physics
ASR	Administration, Safety & Resources
CEM	Controls Electronics & Mechatronics
CSS	Controls Software & Services
EA	Experimental Areas
GM	Geodetic Metrology
ICS	Industrial Control Systems
OP	Operations


SY
Accelerator Systems Department
ABOUT SY
GROUPS
SAFETY SERVICE
SEARCH
Accelerator Systems Department
The SY department is responsible for the accelerator beam-related technical systems of:
Beam Instrumentation; Beam Transfer; Electrical Power Converters; Radio Frequency; Targets, Collimators and Absorbers. More...

GROUPS


Accelerator Beam Transfer (ABT)


Administration and Resources (AR)


Beam Instrumentation (BI)


Electrical Power Converters (EPC)


Radio Frequency (RF)


Sources, Targets and Interactions (STI)

Accelerator and Technology (ATS)

- Beams (BE)
- Technology (TE)
- Engineering (EN)
- Accelerator Systems (SY)

Mike Lamont

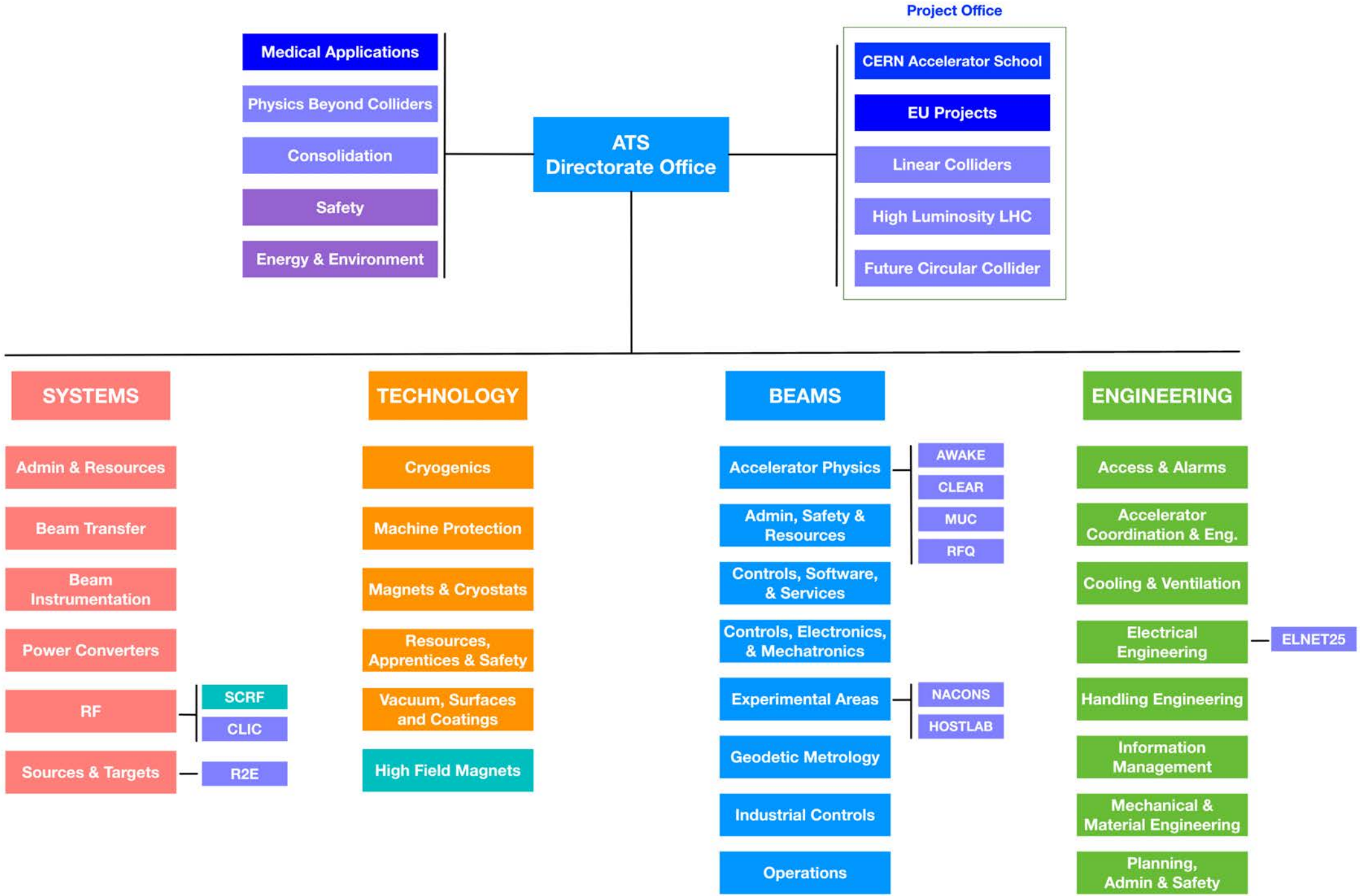
Malika Meddahi

Rhodri Jones

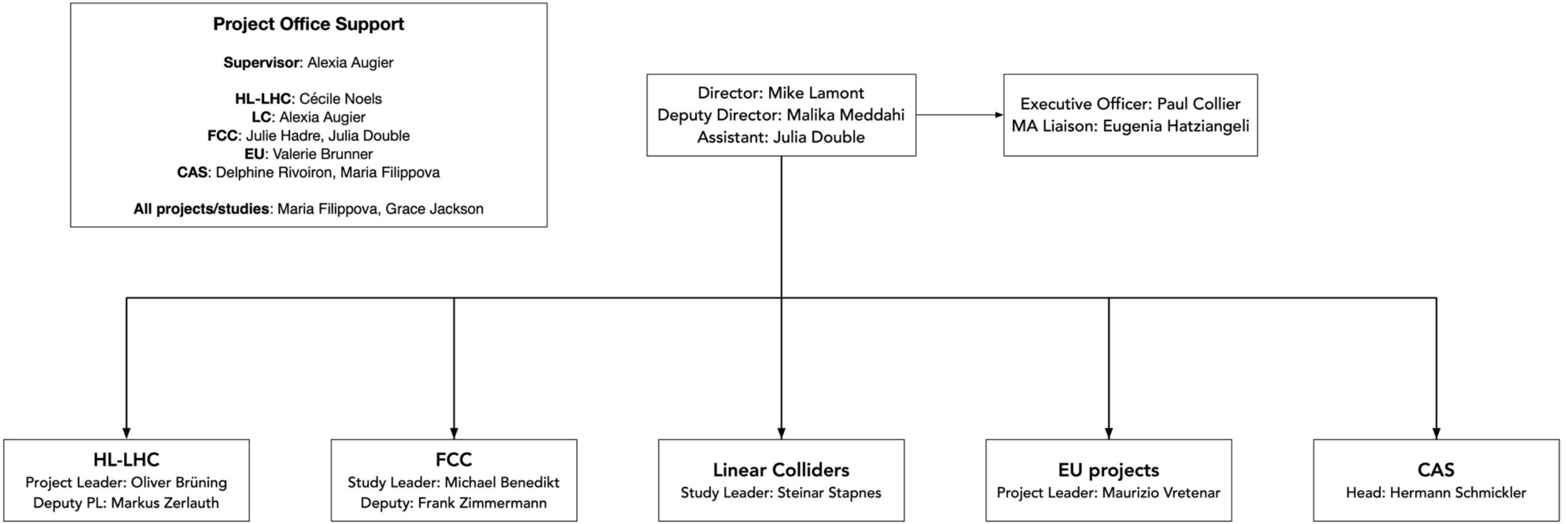
José Miguel Jimenez

Katy Foraz

Brennan Goddard


Project Office
Medical Applications
Physics Beyond Colliders
Consolidation
Safety
Energy & Environment
ATS
Directorate Office
CERN Accelerator School
EU Projects
Linear Colliders
High Luminosity LHC
Future Circular Collider
SYSTEMS
Admin & Resources
Beam Transfer
Beam Instrumentation
Power Converters
RF
SCRF
CLIC
Sources & Targets
R2E
TECHNOLOGY
Cryogenics
Machine Protection
Magnets & Cryostats
Resources, Apprentices & Safety
Vacuum, Surfaces and Coatings
High Field Magnets
BEAMS
Accelerator Physics
AWAKE
CLEAR
MUC
RFQ
Admin, Safety & Resources
Controls, Software, & Services
Controls, Electronics, & Mechatronics
Experimental Areas
NACONS
HOSTLAB
Geodetic Metrology
Industrial Controls
Operations
ENGINEERING
Access & Alarms
Accelerator Coordination & Eng.
Cooling & Ventilation
Electrical Engineering
ELNET25
Handling Engineering
Information Management
Mechanical & Material Engineering
Planning, Admin & Safety

Directorate Office (ATS-DO)



https://cas.web.cern.ch/

Motivation for reorganization 1/2

- The changes are meant to be a constructive evolution of a structure that has clearly delivered impressive results over the last 11 years and has a well established sector wide esprit de corps.
- Recognizing the
  - the commissioning and exploitation of post-LIU injector complex (NB Linac4 and the start of H- injection into the Booster)
  - the shift from the LHC commissioning period to more regular LHC exploitation
  - the critical construction period of HL-LHC
  - and the major new strategic initiatives (FCC, HFM in particular)
  - the need to already start planning for LS3

Motivation for reorganization 2/2

- Departmental **focus**
  - technical oversight of operations, projects, and R&D activities
  - continued good communication between departments and the projects and (new) R&D activities that matrix into the groups
- Exploit sector wide **synergies** via grouping of functions and expertise
- Exposure of functions and enhanced **communication** with the teams involved
- More manageable department size
  - Ease administrative burden at departmental level
  - Even more time for everybody to focus on the technical and operational aspects….

Reorganization - Summary

- 23 technical groups from the 20 last year
- The majority of groups stay as are, 9 change department

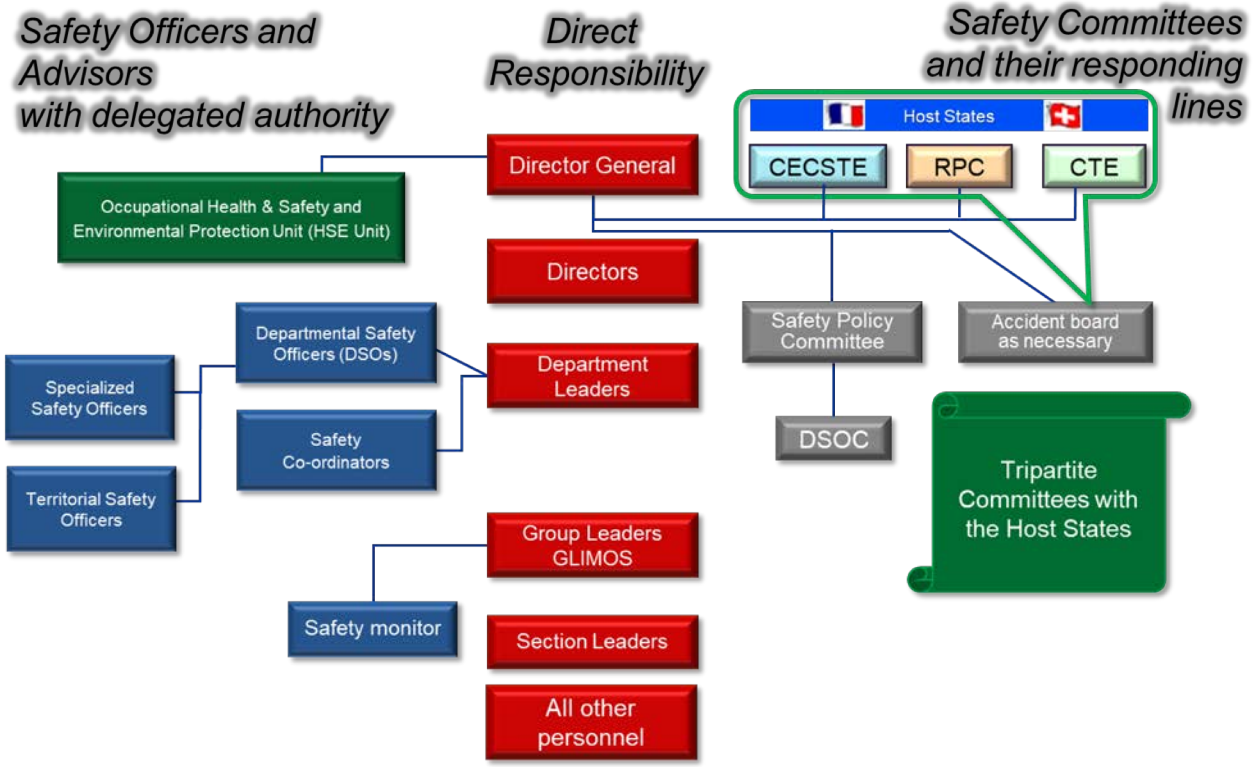
- Survey from SMM to **Geodetic Metrology** in BE
- **Access & Alarms** from ICS to EN
- **Information Management** (Asset & Maintenance Management, Product Lifecycle Management) from ACE in EN
- Mechatronics and Measurements ((S)MM) and Controls to
  - **Controls Software & Services** (CSS)
  - **Controls Electronics & Mechatronics** (CEM)
  - **MPE/Electronic Modules** to CEM
  - **ICS/Technical Infrastructure** to CSS

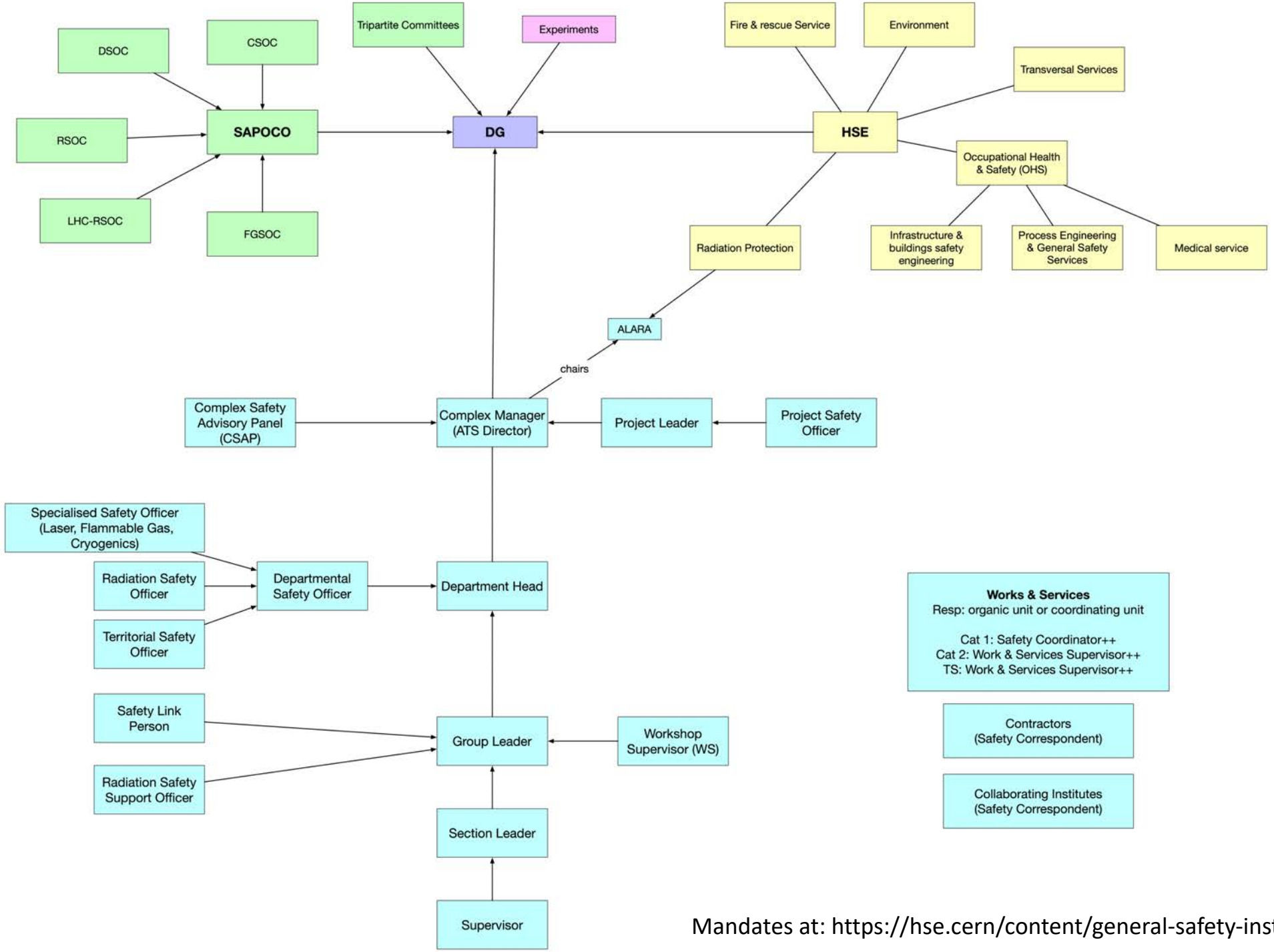
- **Of the 27 groups in the departments, 15 new group leaders, plus 2 changing groups plus healthy mobility at the DGL and SL level**

Huge thanks to everybody!

Safety responsibilities

- Individual responsibility
  - Each person participating in the activities of the Organization or present on its site shall actively contribute to the implementation of the CERN Safety Policy through exemplary conduct and, in particular, compliance with the CERN Safety Rules

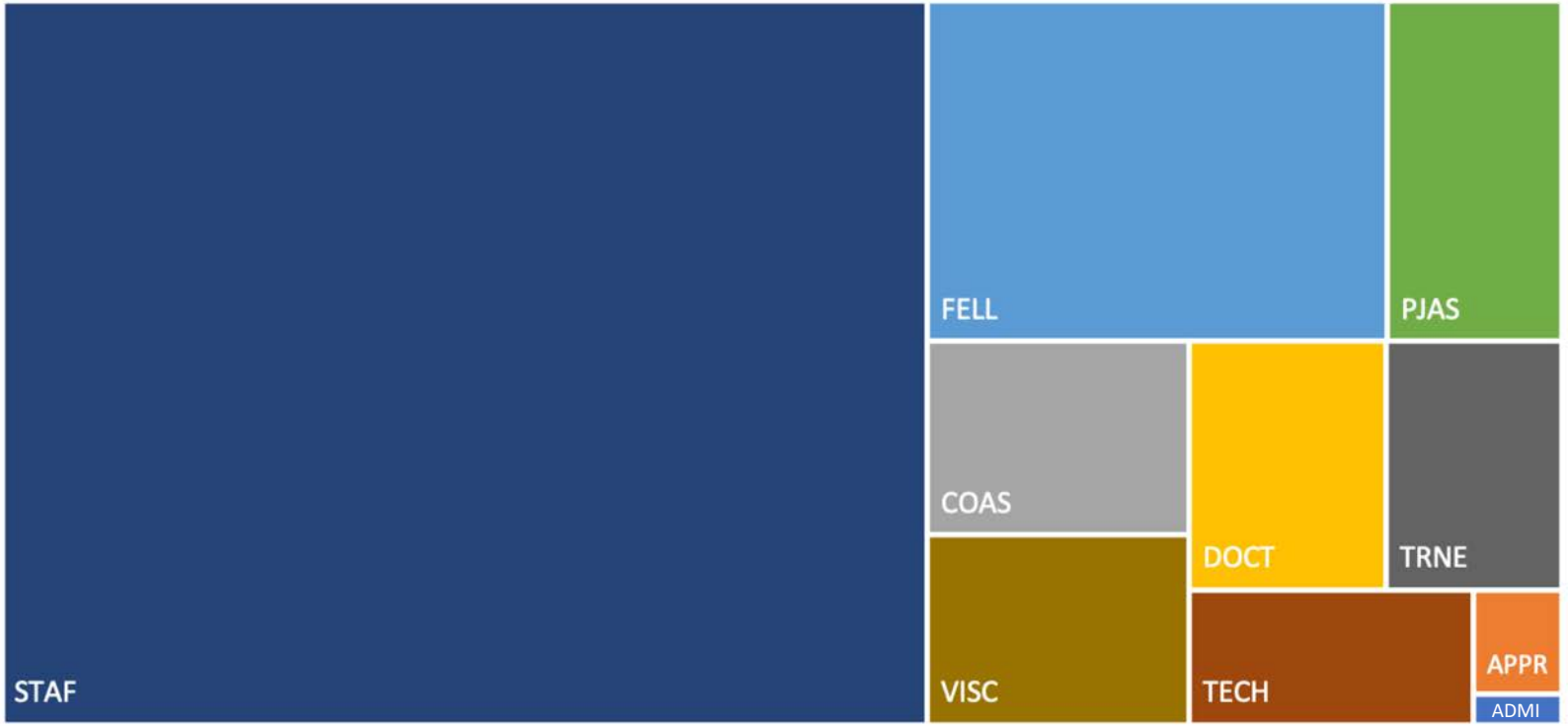




Mandates at: https://hse.cern/content/general-safety-instructions-gsi

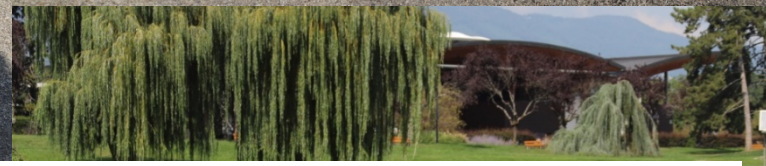
ATS – members of personnel

	ADMI	APPR	COAS	DOCT	FELL	PJAS	STAF	TECH	TRNE	VISC	Total
BE	2		22	42	69	35	300	29	20	49	**568**
EN	1		7	4	37	17	320	6	6		**398**
SY			12	29	99	16	320	20	24	37	**557**
TE	2	17	53	16	85	42	302	16	31	6	**570**
Total	**5**	**17**	**94**	**91**	**290**	**110**	**1242**	**71**	**81**	**92**	**2093**



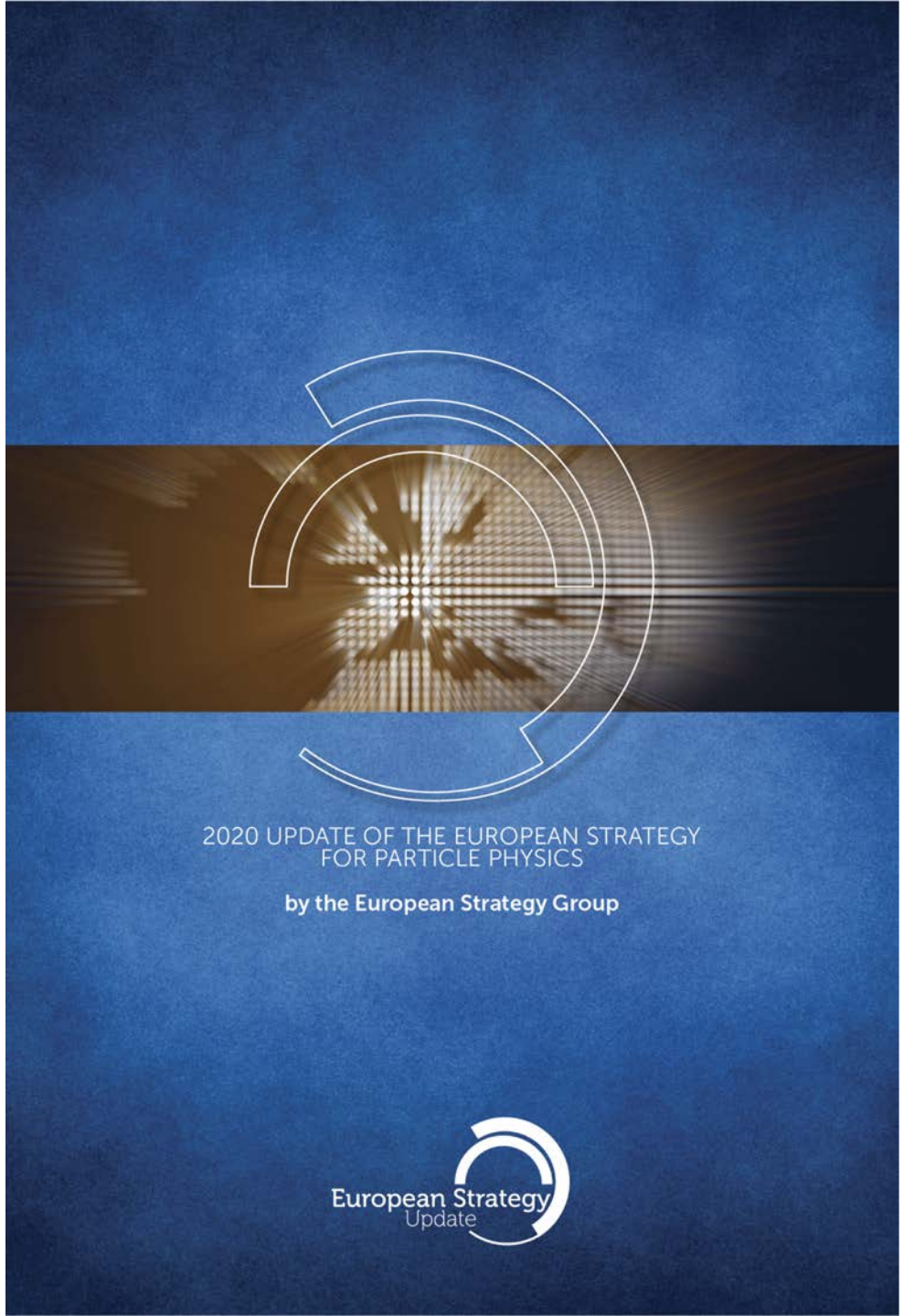
Plus the vital contribution of ~2000 employees of contractors

Working culture…



It is a fantastic place to work, and it is our duty to make sure it remains a great place, today, tomorrow and in the longer term.
We need to regularly revisit the way we work and ensure that we are all happy and developing professionally.

INCOMING

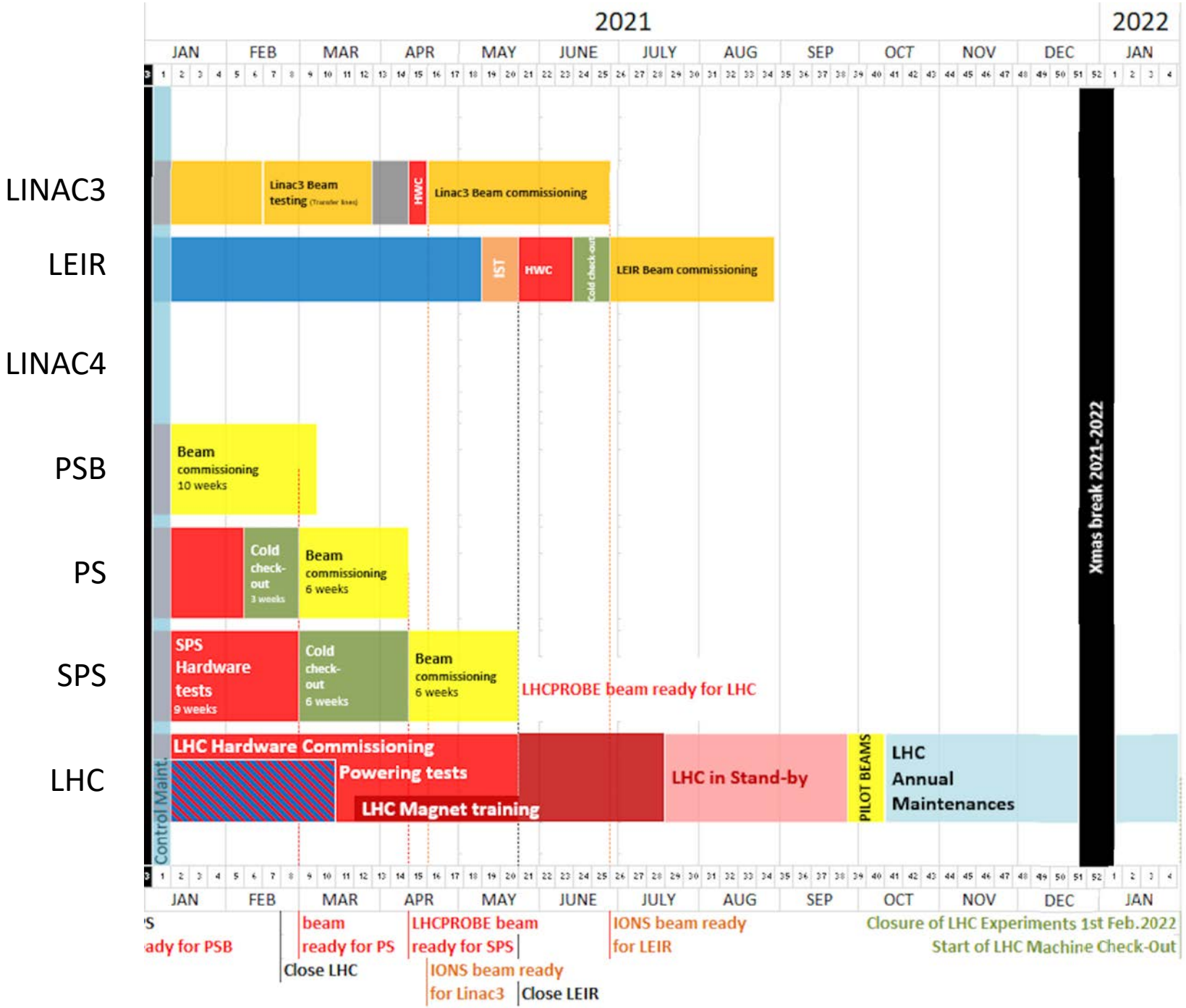

2020 UPDATE OF THE EUROPEAN STRATEGY
FOR PARTICLE PHYSICS
by the European Strategy Group
European Strategy
Update

ATS – key goals over the next 5 years

- **Exploitation – Run 3**
  - Safe, effective and full exploitation of the complex
- **Safety culture**
  - Maintain coherent sector wide safety practices in close collaboration with HSE
- **HL-LHC:**
  - Full realization of the HL-LHC goals, respecting the technical scope, budget and schedule.
- **Future options (FCC, R&D, Linear Colliders, Muon Collider…)**
  - Development of long term strategic accelerator options, respecting established roadmaps, unbiased evaluation of potential with realistic timelines
- **Consolidation:**
  - Maintain a comprehensive and well targeted long-term programme aimed at addressing the considerable challenges of a extensive and aging complex
- **Accelerator technology:**
  - Maintain world class expertise in accelerator technologies while maintaining focus on key objectives; share and engage with external partners
- **Sustainability and societal impact** as part of our culture

Where are we coming into Run 3?

- **LIU**
  - Essentially a very successful wrap – close books in June
  - 2021: operational deployment with beam, realization of target parameters to be met (pre-LS2 ones for protons and HL ones for ions)
  - LIU specs ramping up during Run 3
- **LS2**
  - Completed in injectors – keys back in the hands of Operations – remarkable effort in the circumstances
  - LHC being cooled-down, ELQA…, back in the hands of Operations in week 8…
- **2021**
  - Restart complex with beam under COVID compliant conditions
  - Re-establish physics for our non-LHC user community
  - In the LHC, hardware commissioning, training to 7 TeV, pilot run with beam…

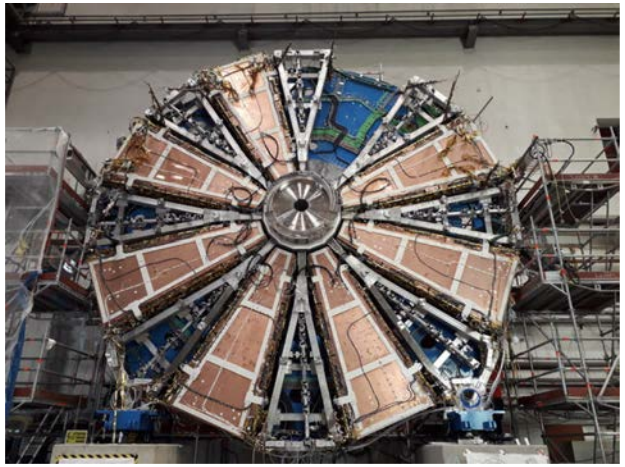

2021
2022
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEP
OCT
NOV
DEC
JAN
LINAC3
LEIR
LINAC4
PSB
PS
SPS
LHC
Linac3 Beam testing
HWC
Linac3 Beam commissioning
IST
HWC
Cold check-out
LEIR Beam commissioning
Beam commissioning 10 weeks
Cold check-out 3 weeks
Beam commissioning 6 weeks
SPS Hardware tests 9 weeks
Cold check-out 6 weeks
Beam commissioning 6 weeks
LHCPROBE beam ready for LHC
Control Maint.
LHC Hardware Commissioning
Powering tests
LHC Magnet training
LHC in Stand-by
PILOT BEAMS
LHC Annual Maintenances
Xmas break 2021-2022
ady for PSB
beam ready for PS
LHCPROBE beam ready for SPS
IONS beam ready for LEIR
Closure of LHC Experiments 1st Feb.2022
Start of LHC Machine Check-Out
Close LHC
IONS beam ready for Linac3
Close LEIR

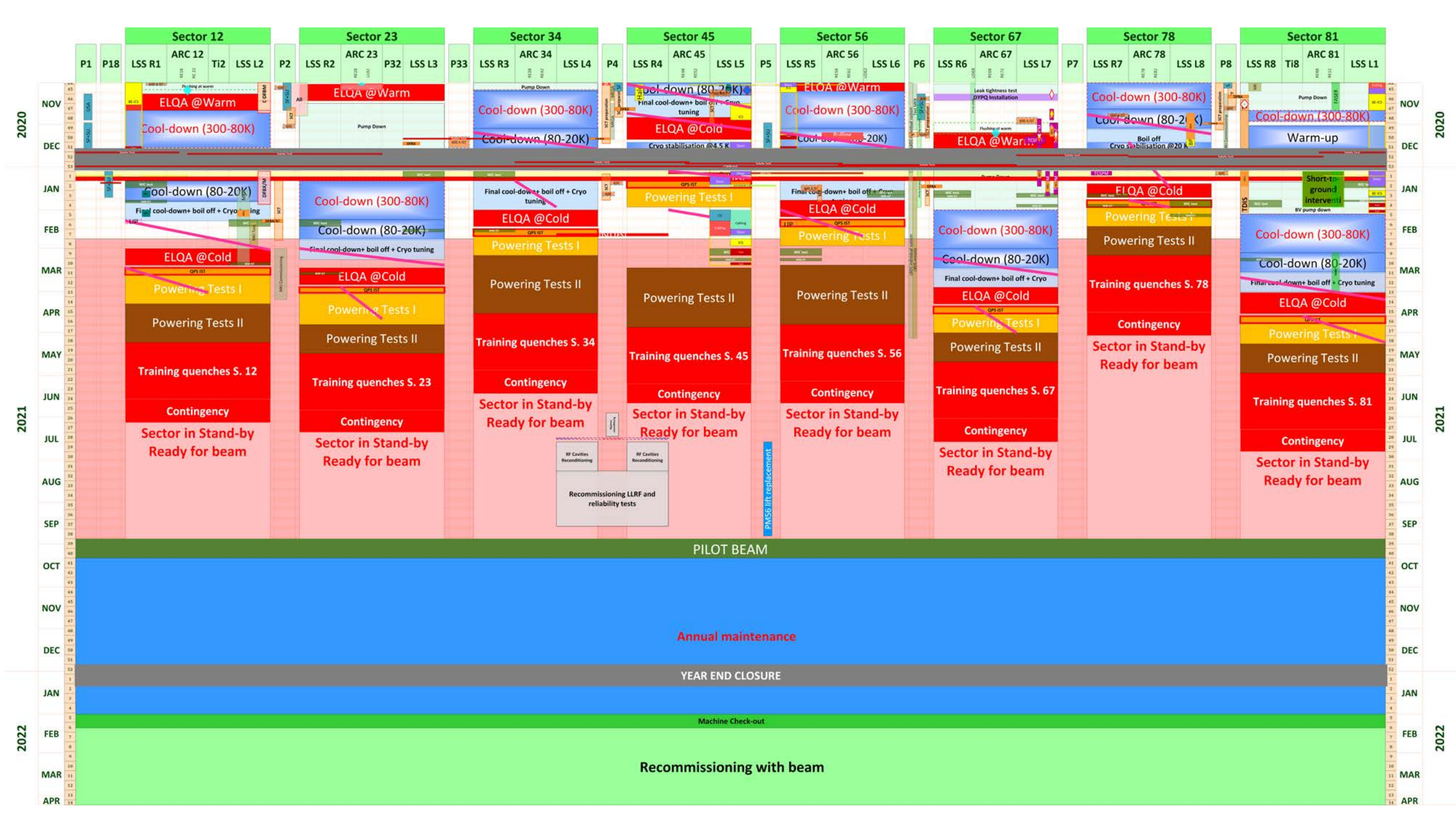
LHC experiments 2021 - 2022

- Major upgrades during LS2, still significant uncertainties from impact of COVID-19
- Situation as of Oct 20 shown below
- Revisit 15th March 2021

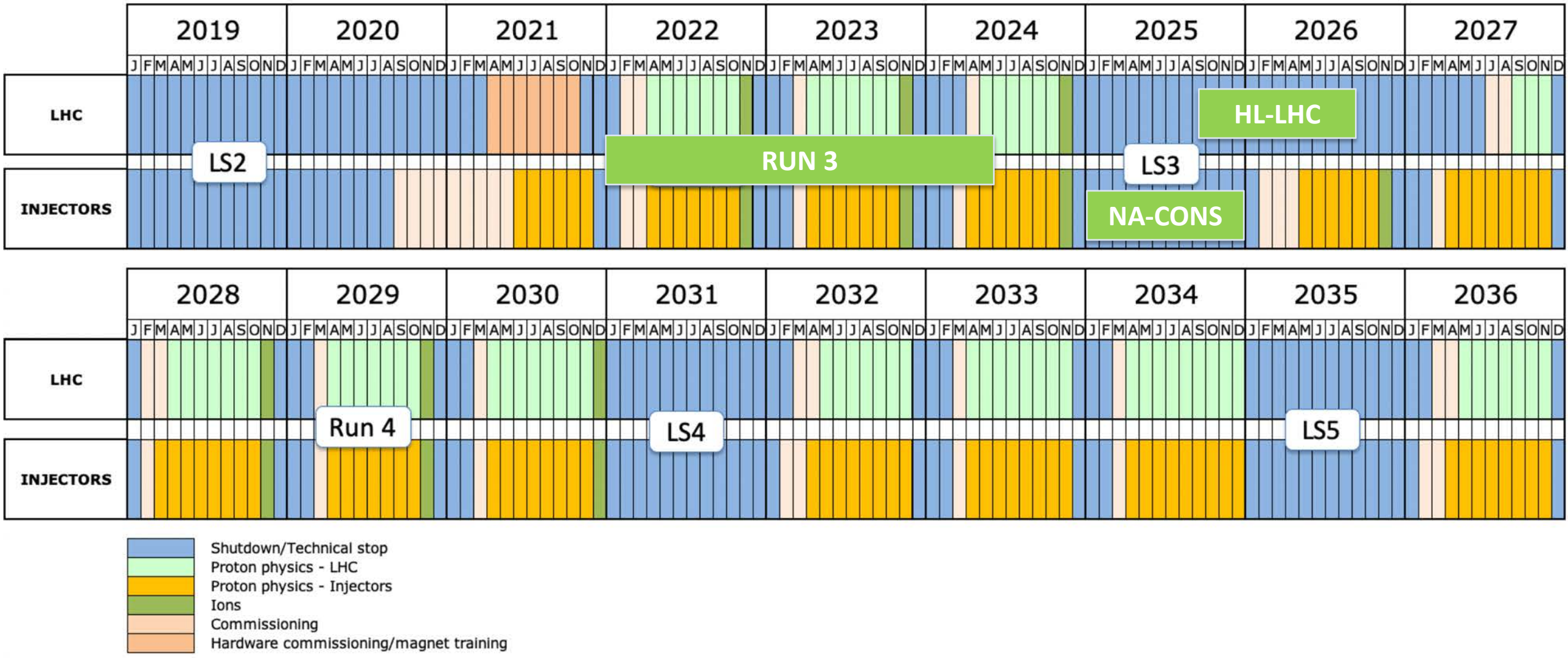
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
ALICE									
ATLAS				Needed for NSW-C					
CMS				Needed for shielding					
LHCb									

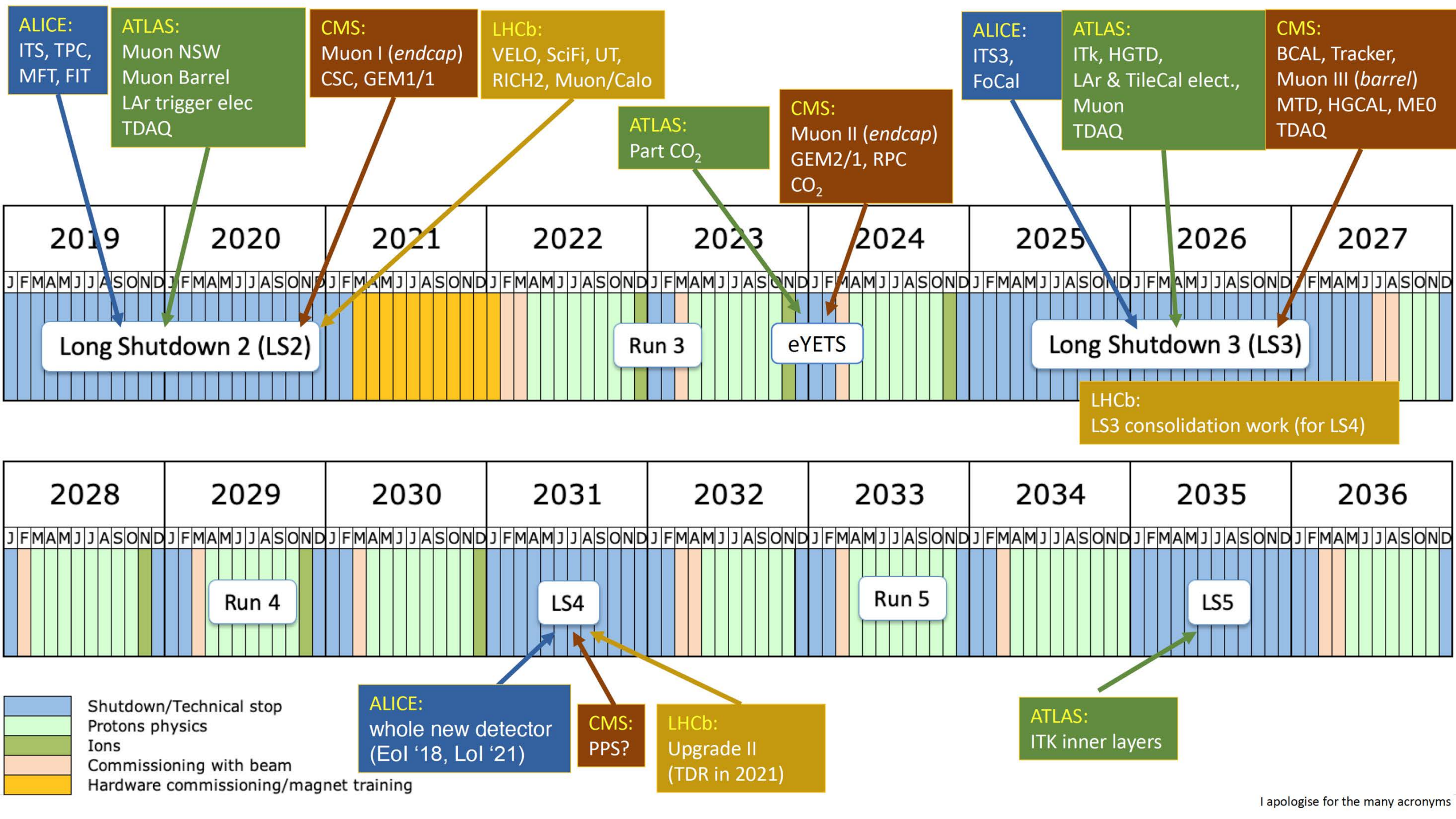
Preferred LHC beam test window from experiments,
i.e. minimal interruptions to their schedule



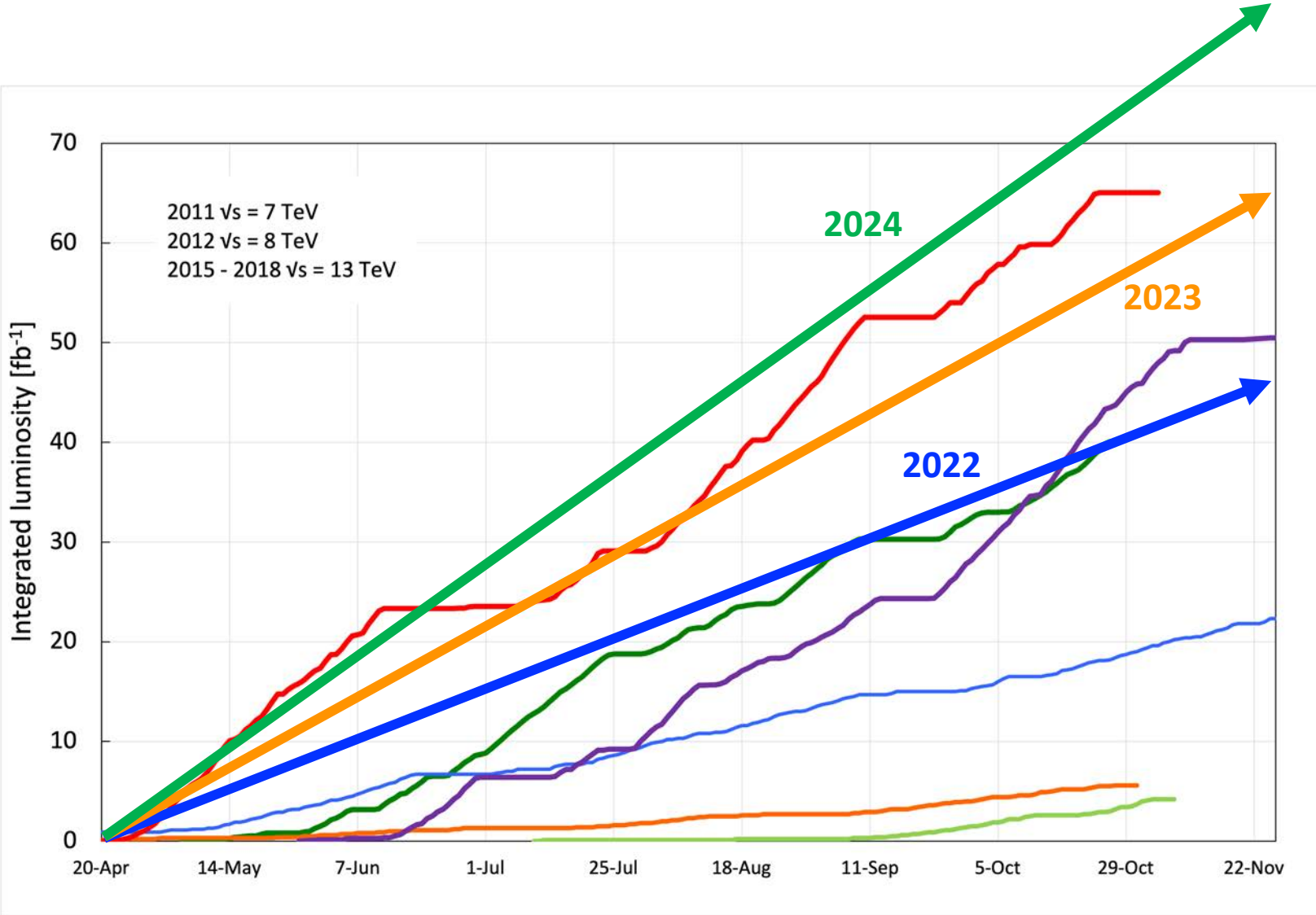

Sector 12
Sector 23
Sector 34
Sector 45
Sector 56
Sector 67
Sector 78
Sector 81
P1
P18
LSS R1
ARC 12
Ti2
LSS L2
P2
LSS R2
ARC 23
P32
LSS L3
P33
LSS R3
ARC 34
LSS L4
P4
LSS R4
ARC 45
LSS L5
P5
LSS R5
ARC 56
LSS L6
P6
LSS R6
ARC 67
LSS L7
P7
LSS R7
ARC 78
LSS L8
P8
LSS R8
Ti8
ARC 81
LSS L1
2020
2021
2022
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
ELQA @Warm
Cool-down (300-80K)
Pump Down
Cool-down (80-20K)
Final cool-down+ boil off + Cryo tuning
ELQA @Cold
Powering Tests I
Powering Tests II
Training quenches S. 12
Training quenches S. 23
Training quenches S. 34
Training quenches S. 45
Training quenches S. 56
Training quenches S. 67
Training quenches S. 78
Training quenches S. 81
Contingency
Sector in Stand-by
Ready for beam
Cryo stabilisation @4.5 K
Leak tightness test
DYPQ Installation
Boil off
Cryo stabilisation @20 K
Warm-up
Short-to-ground intervention
RF Cavities Reconditioning
Recommissioning LLRF and reliability tests
PM56 lift replacement
PILOT BEAM
Annual maintenance
YEAR END CLOSURE
Machine Check-out
Recommissioning with beam

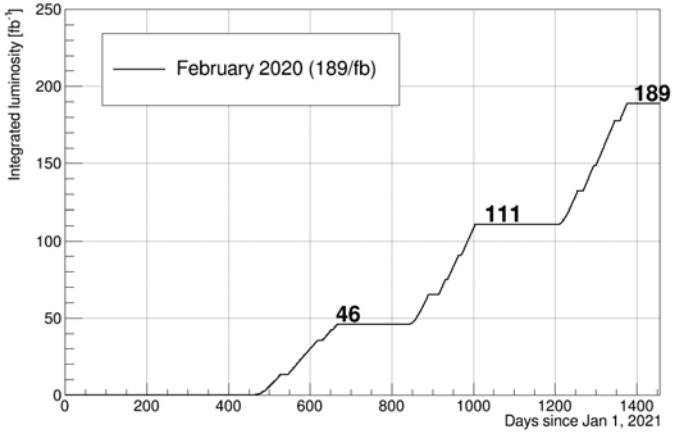
Longer term


2019
2020
2021
2022
2023
2024
2025
2026
2027
J F M A M J J A S O N D
LHC
INJECTORS
LS2
RUN 3
HL-LHC
LS3
NA-CONS
2028
2029
2030
2031
2032
2033
2034
2035
2036
LHC
INJECTORS
Run 4
LS4
LS5
Shutdown/Technical stop
Proton physics - LHC
Proton physics - Injectors
Ions
Commissioning
Hardware commissioning/magnet training


ALICE:
ITS, TPC,
MFT, FIT
ATLAS:
Muon NSW
Muon Barrel
LAr trigger elec
TDAQ
CMS:
Muon I (endcap)
CSC, GEM1/1
LHCb:
VELO, SciFi, UT,
RICH2, Muon/Calo
ATLAS:
Part CO_2
CMS:
Muon II (endcap)
GEM2/1, RPC
CO_2
ALICE:
ITS3,
FoCal
ATLAS:
ITk, HGTD,
LAr & TileCal elect.,
Muon
TDAQ
CMS:
BCAL, Tracker,
Muon III (barrel)
MTD, HGCAL, ME0
TDAQ
2019
2020
2021
2022
2023
2024
2025
2026
2027
Long Shutdown 2 (LS2)
Run 3
eYETS
Long Shutdown 3 (LS3)
LHCb:
LS3 consolidation work (for LS4)
2028
2029
2030
2031
2032
2033
2034
2035
2036
Run 4
LS4
Run 5
LS5
ALICE:
whole new detector
(EoI '18, LoI '21)
CMS:
PPS?
LHCb:
Upgrade II
(TDR in 2021)
ATLAS:
ITK inner layers
Shutdown/Technical stop
Protons physics
Ions
Commissioning with beam
Hardware commissioning/magnet training
I apologise for the many acronyms

LHC – Run 3

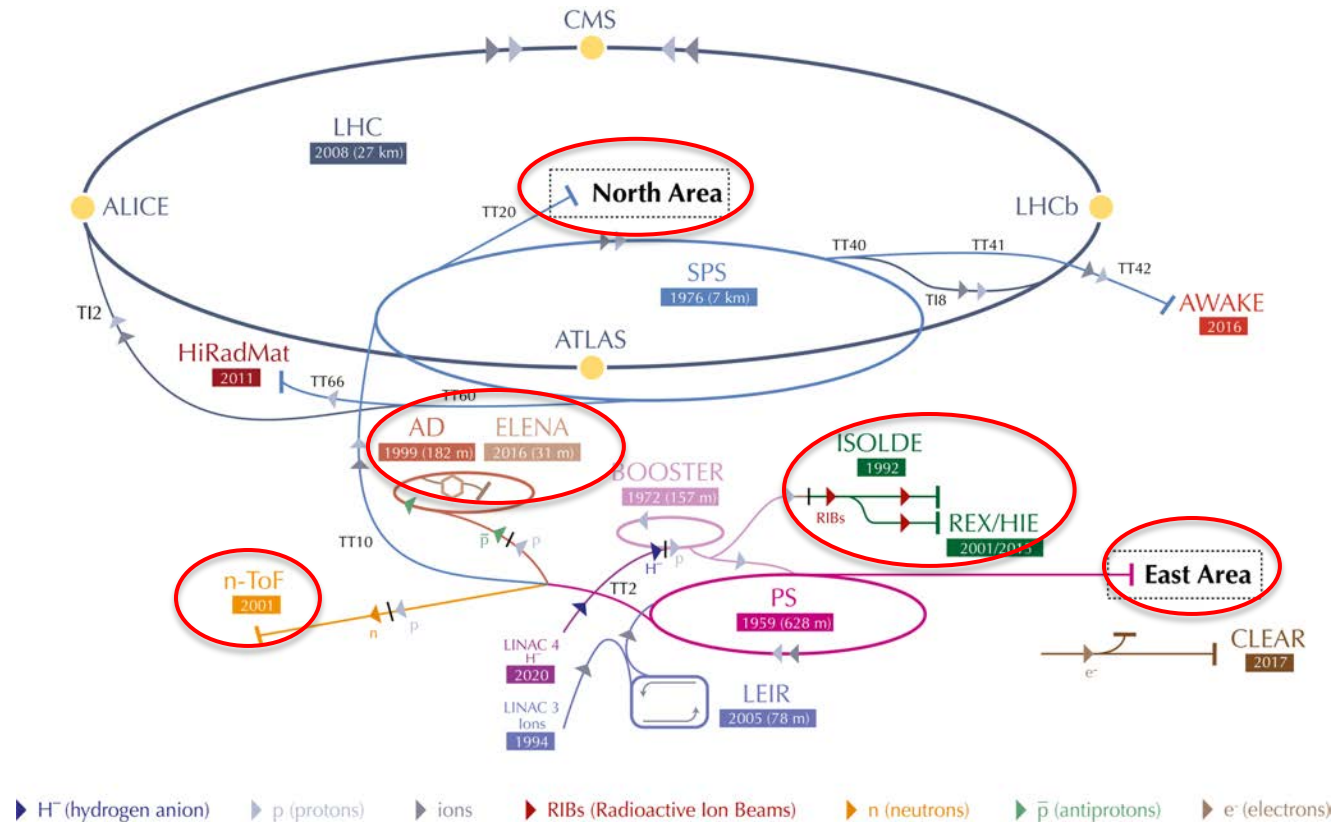


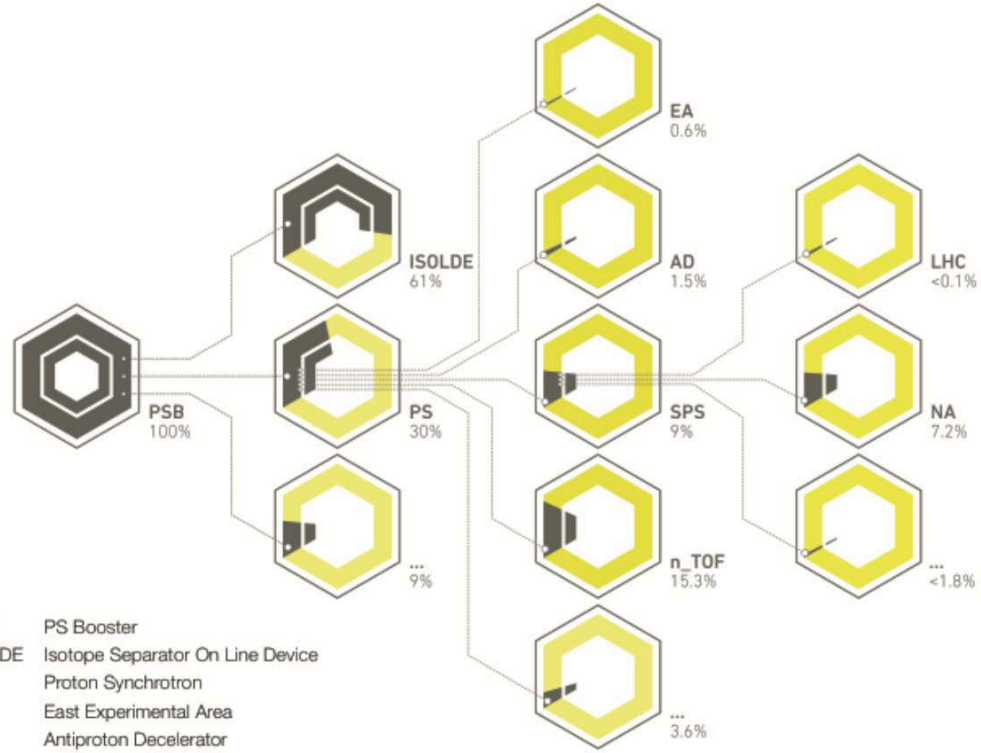


Plus:
LHCb & ALICE
Ions
Forward Physics
FASER.MoEDAL

"at least 160 fb^{-1} for ATLAS and CMS"

Protons from Booster: <0.1% to LHC





PSB	PS Booster
ISOLDE	Isotope Separator On Line Device
PS	Proton Synchrotron
EA	East Experimental Area
AD	Antiproton Decelerator
SPS	Super Proton Synchrotron
n_TOF	Neutron Time-of-Flight facility
LHC	Large Hadron Collider
NA	North Experimental Area
...	Other uses, including accelerator studies (machine development)

Quantity of protons used in 2016 by each accelerator and experimental facility, shown as a percentage of the number of protons sent by the PS Booster

Rich non-LHC programmes

APPROVED Experiments

- **LHC:** **ALICE**, **ATLAS**, **CMS**, **LHCb**, FASER, MoEDAL, **TOTEM**, LHCf
- **SPS:** COMPASS, NA61, **NA62**, NA63, NA64, NA65
- **PS:** CLOUD
- **AD:** **AEgIS**, ALPHA, ALPHA-g, ASACUSA, BASE, GBAR
- **Neutrino Platform:** **ProtoDUNE**, T2K/ND280, ENUBET
- **R&D:** RD42, **RD50**, **RD51**, **RD53**, Crystal Clear, UA9
- **Non-accelerator experiments:** CAST, OSQAR
- **ISOLDE** and nTOF facilities

Experiments and Projects under Study

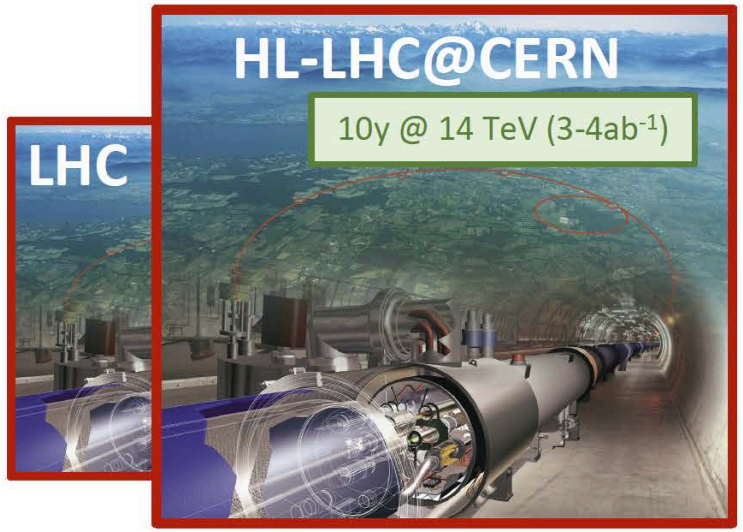
- **FCC**
- **BDF facility /** SHiP
- **LHC:** SND
- **SPS:** NA64μ, MUonE, AMBER, MadMax
- **AD:** PUMA

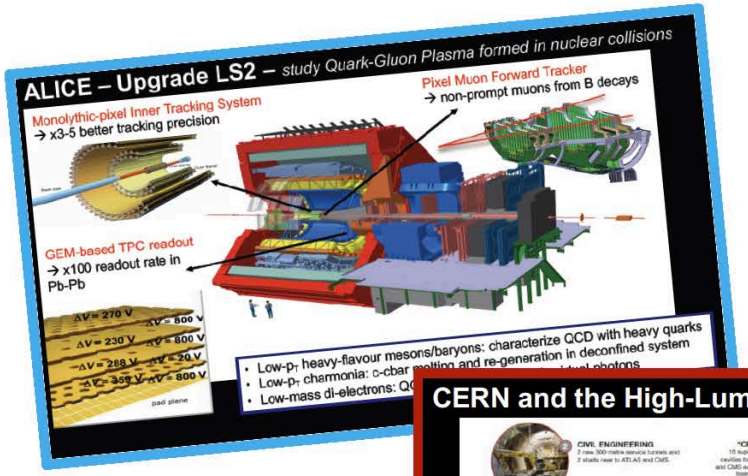
CERN-EP involvement
Substantial
Significant
Limited
None

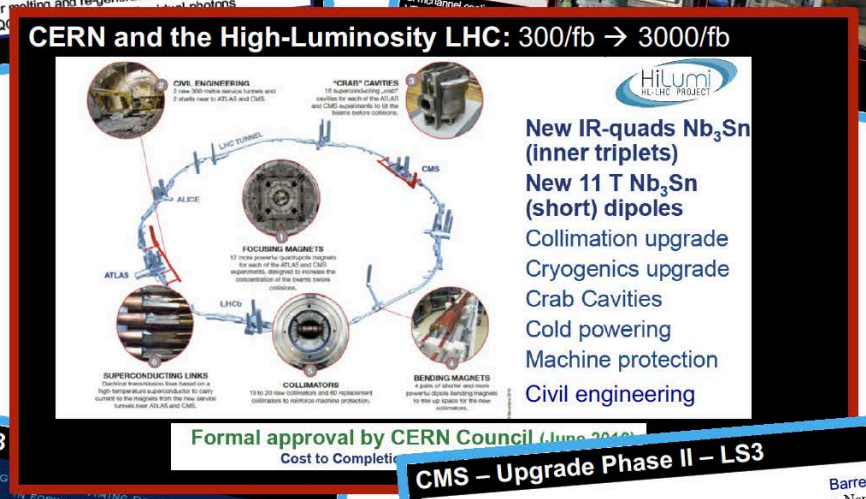
Besides the LHC, there are major, passionate user communities doing great physics

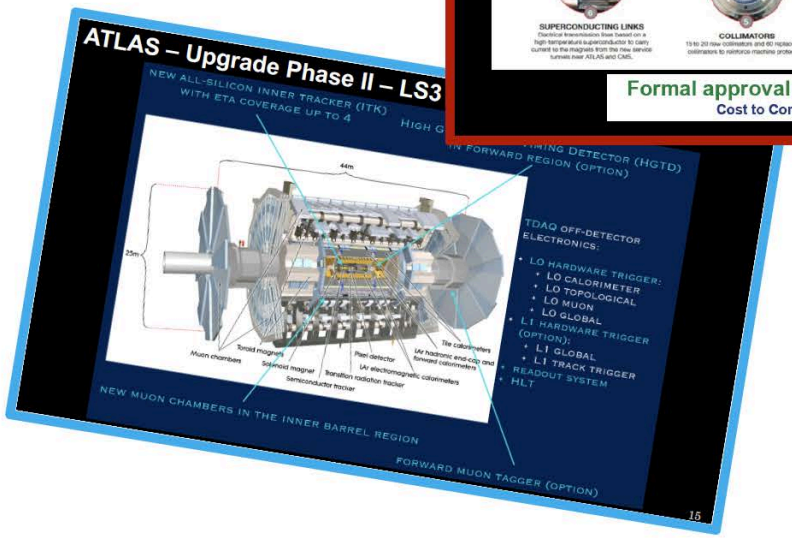
ESPP: "The successful completion of the high-luminosity upgrade of the machine and detectors should remain the focal point of European particle physics, together with continued innovation in experimental techniques. The full physics potential of the LHC and the HL-LHC, including the study of flavour physics and the quark-gluon plasma, should be exploited."

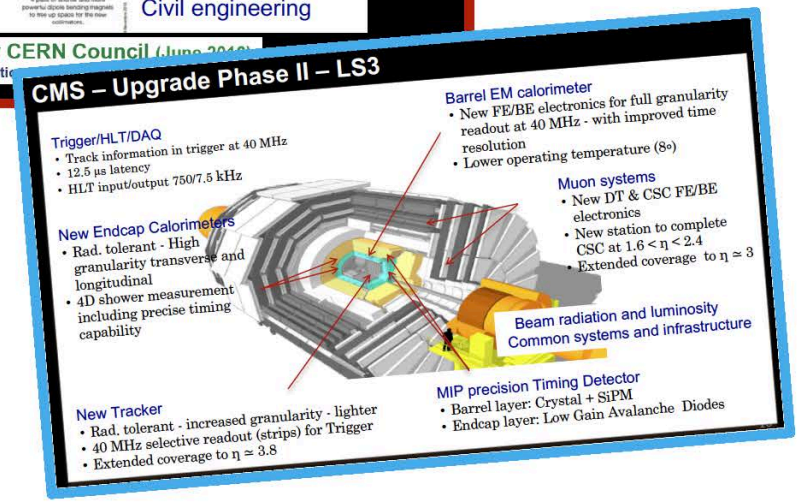
HL-LHC





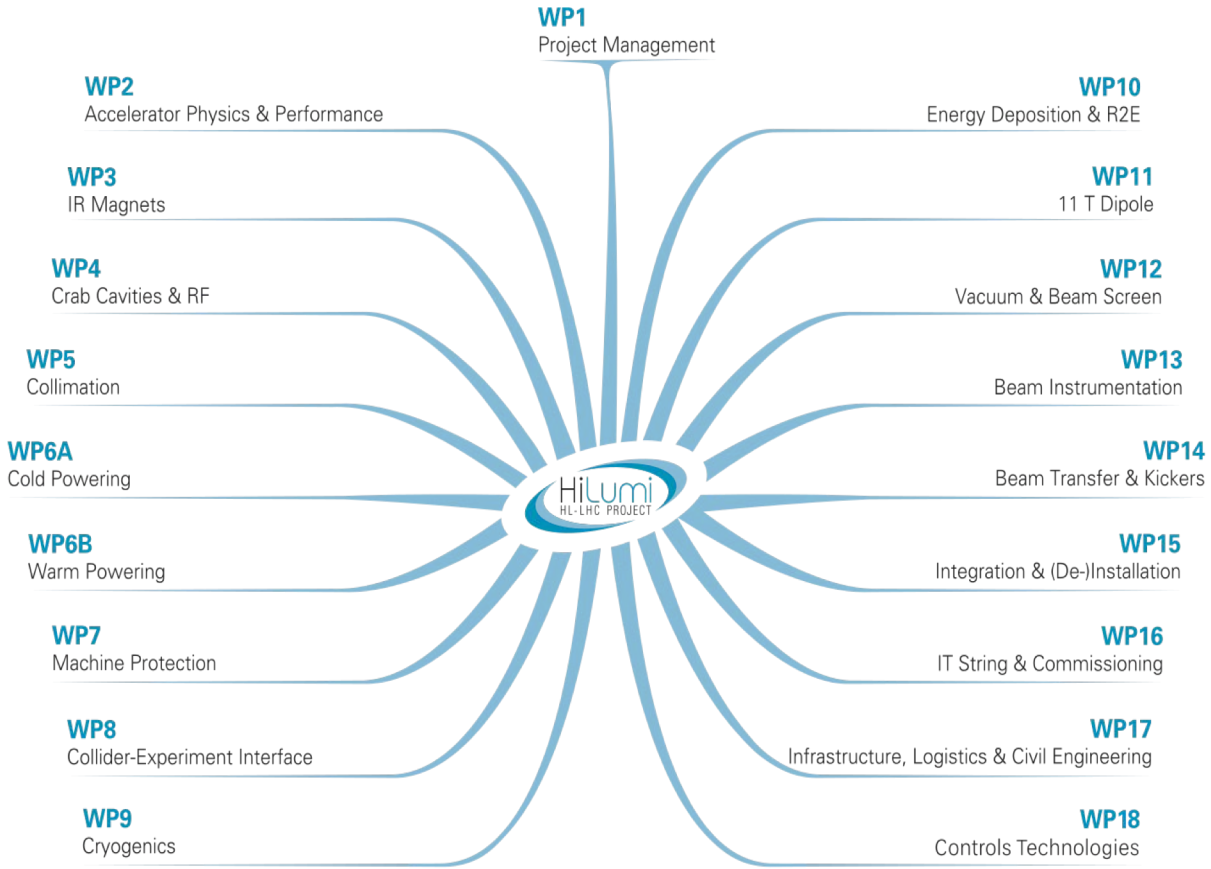




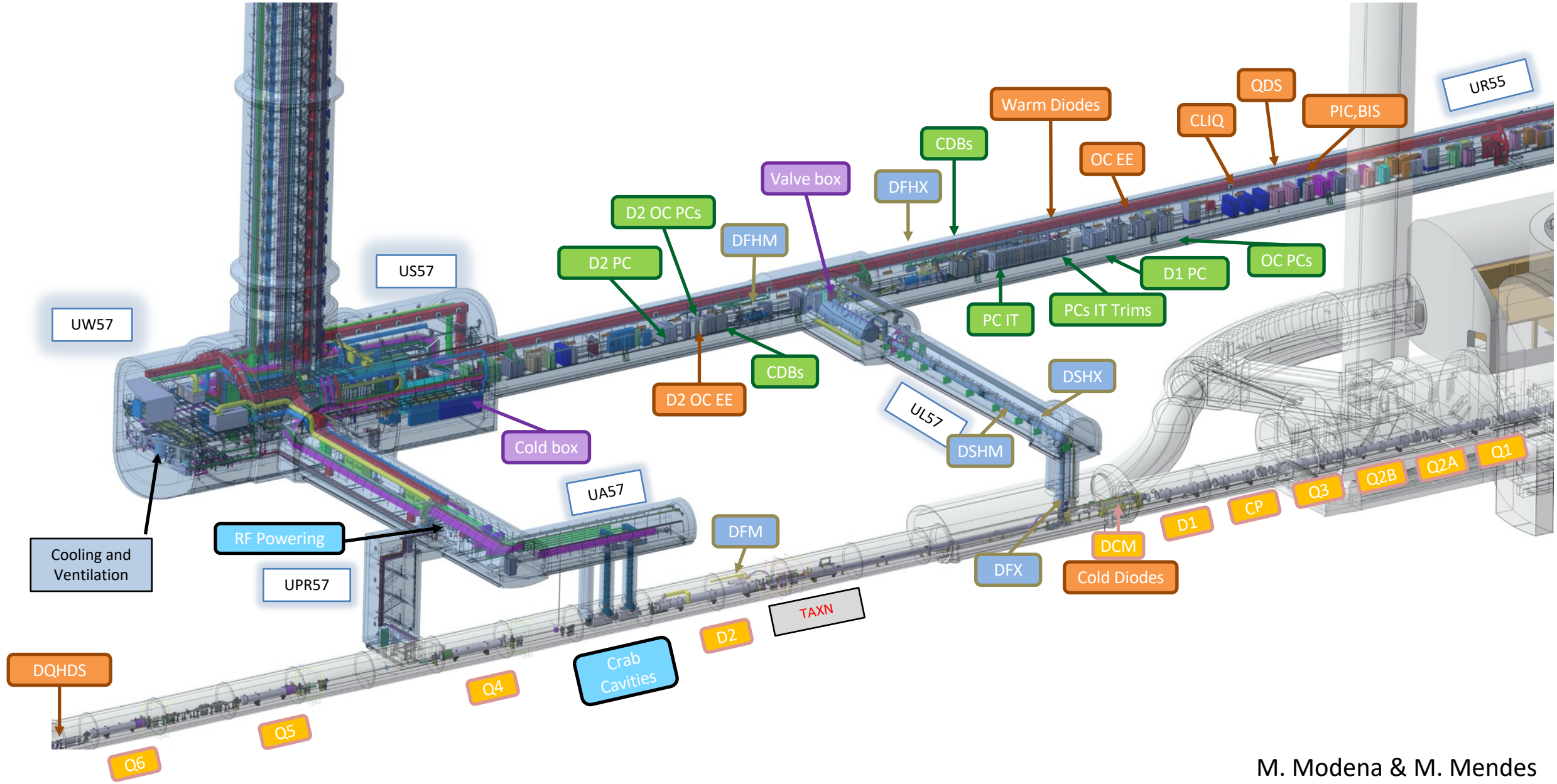


HL-LHC

- Moving into the production phase, Earned Value: ~40%
- Novel technologies moving into production after intense R&D - challenging schedule
- Preparation for LS3 (Integration, Planning) already well advanced
- Successful deployment in LS3 is absolutely critical for CERN



HL-LHC

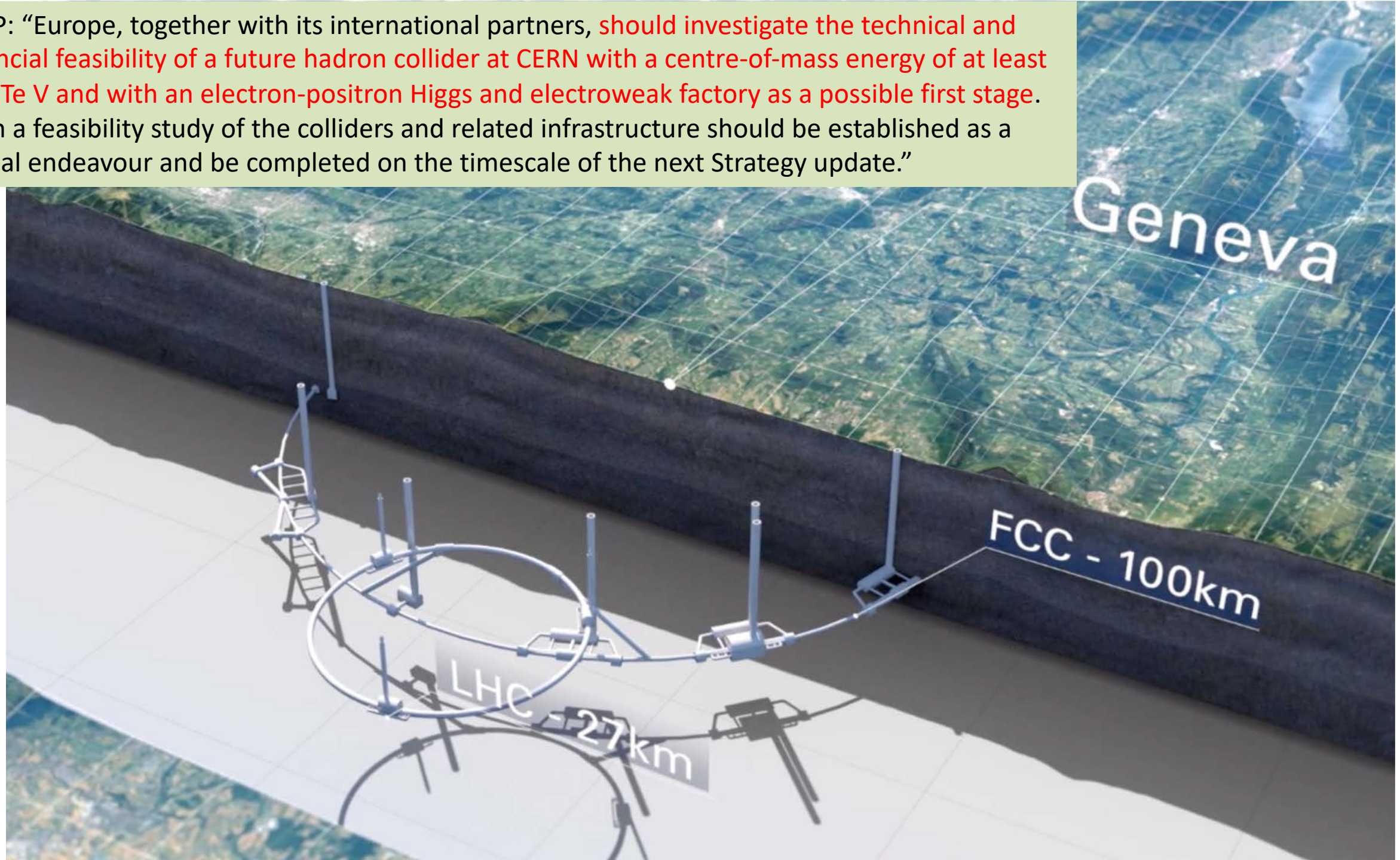


M. Modena & M. Mendes

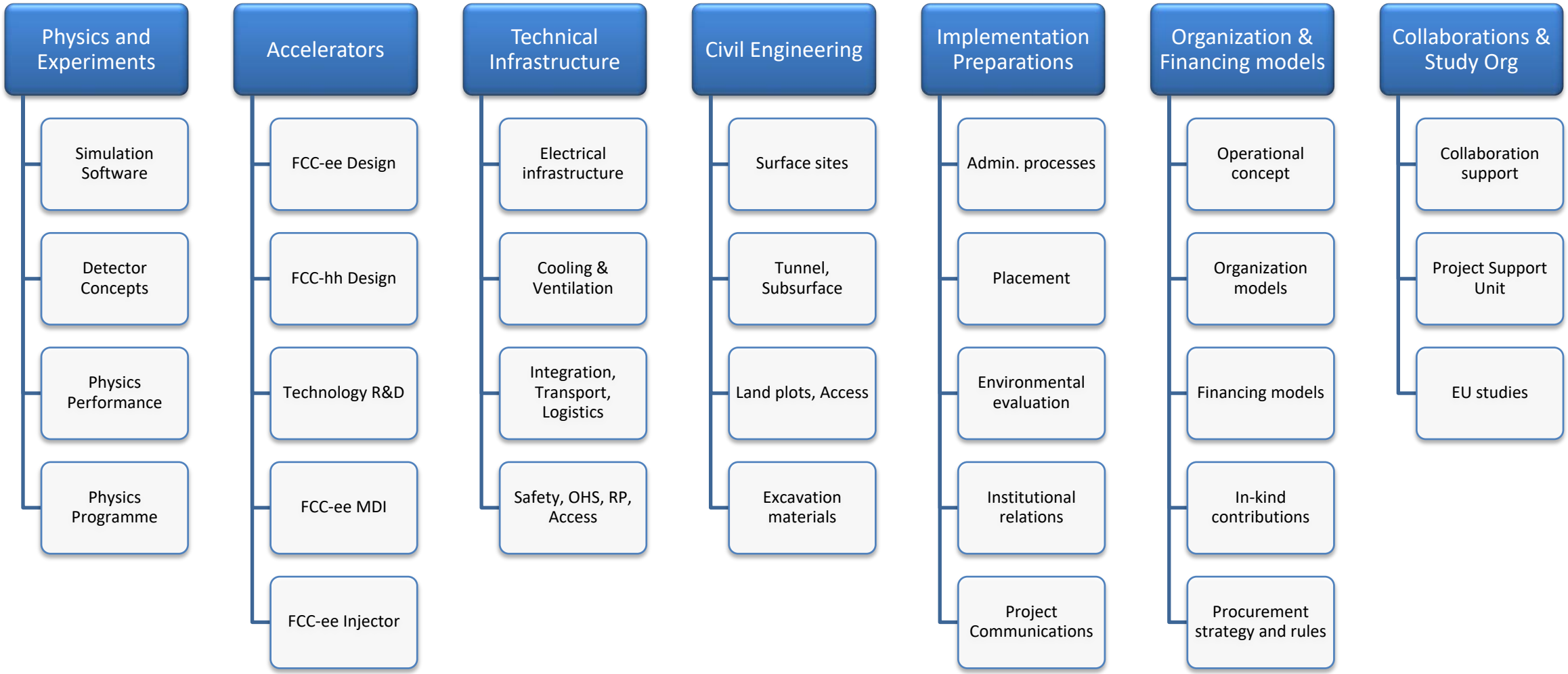
Future options

- FCC study
  - to deliver technical, administrative, financial feasibility of tunnel, with due regard to energy and environment, political, societal and scientific community impact and support
- Accelerator R&D
  - High Field Magnets, FCC, Muon Collider, CLIC, AWAKE…
- Physics Beyond Colliders
  - Will continue to explore and help develop novel possibilities

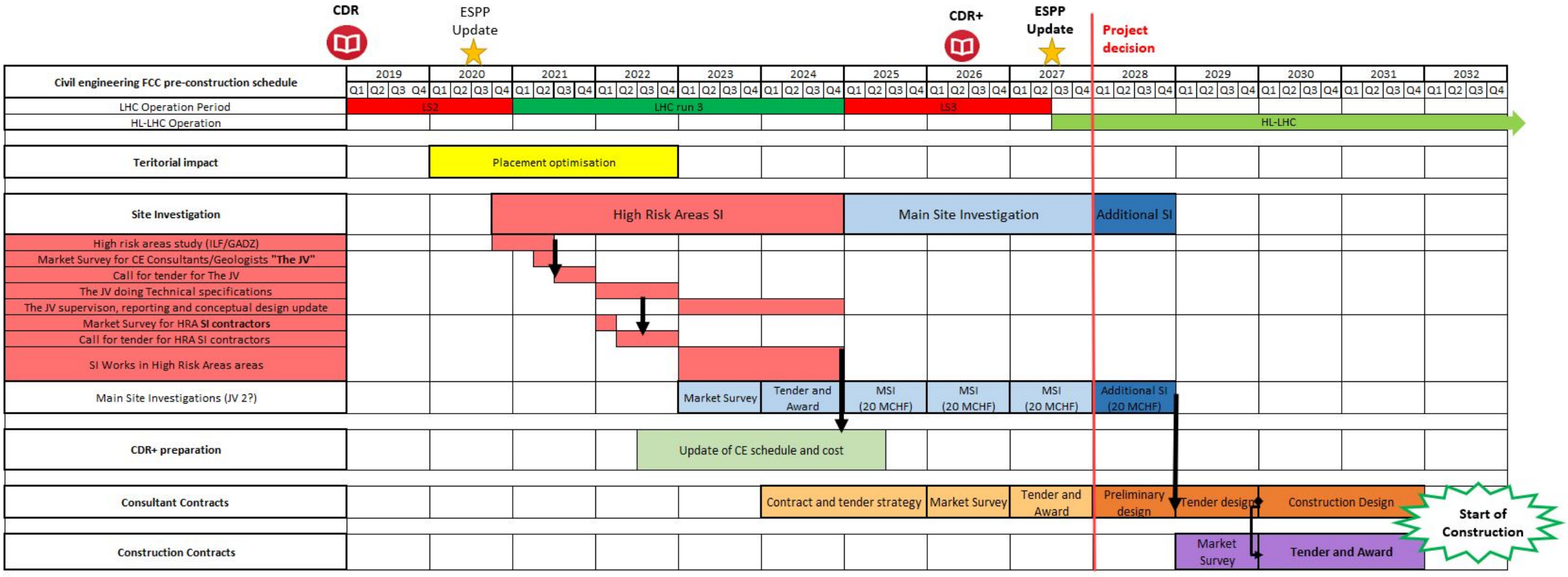
ESPP: “Europe, together with its international partners, should investigate the technical and financial feasibility of a future hadron collider at CERN with a centre-of-mass energy of at least 100 Te V and with an electron-positron Higgs and electroweak factory as a possible first stage. Such a feasibility study of the colliders and related infrastructure should be established as a global endeavour and be completed on the timescale of the next Strategy update.”



FCC study – Main Pillars



Underground Civil Engineering schedule



Underground WP1 with execution work for high-risk site investigations and overall feasibility. Contractual aspects, responsibilities, etc. important.

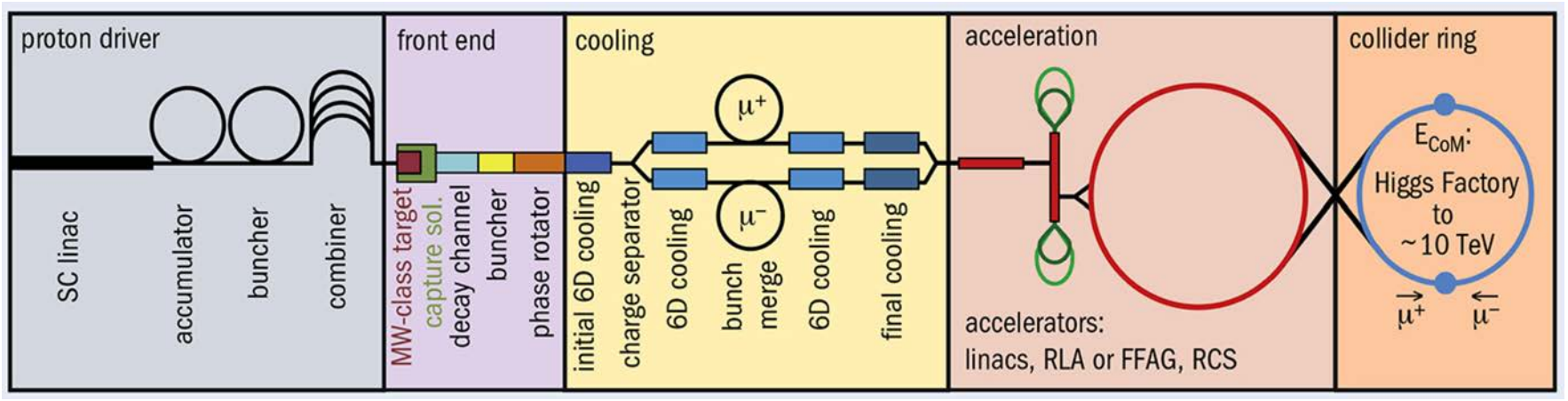
Surface buildings WP2 needed as input for Environmental Authorization process, conceptual designs for all surface buildings. (no executive action)

Site layout and access WP3 needed as input for Environmental Authorization process, construction activities for reference survey network

Muon Collider

A new international design study for a future muon collider began in July 2020, following the recommendations of the 2020 update of the European strategy for particle

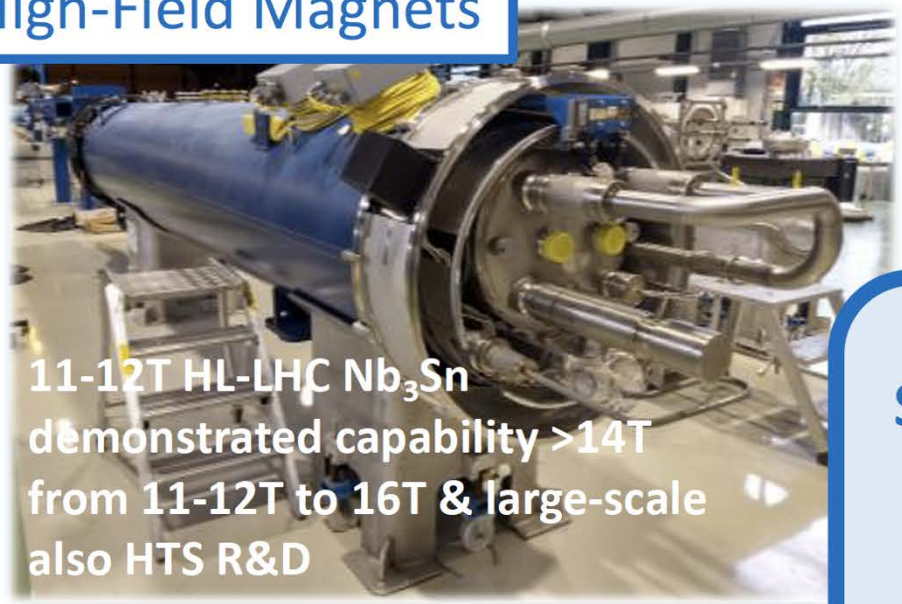
The study will initially be hosted at CERN, and carried out in collaboration with international partners. In time for the next European Strategy for Particle Physics Update, the study aims to **establish whether the investment into a full CDR and a demonstrator is scientifically justified.**



To say there are technical challenges would be to understate it! But a lot of work has already been done, there's a lot of interest, and the concept is certainly worth some serious attention.

Advancing Accelerator Technologies

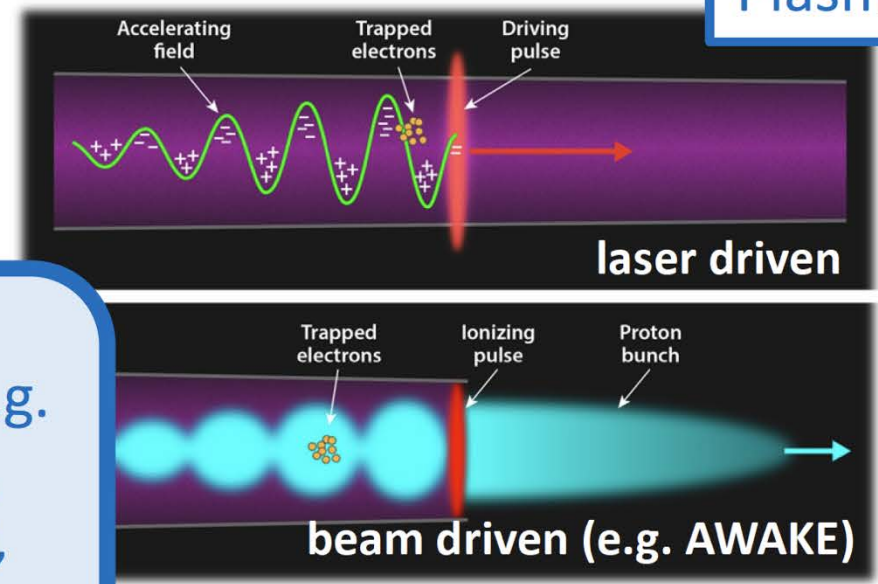
High-Field Magnets



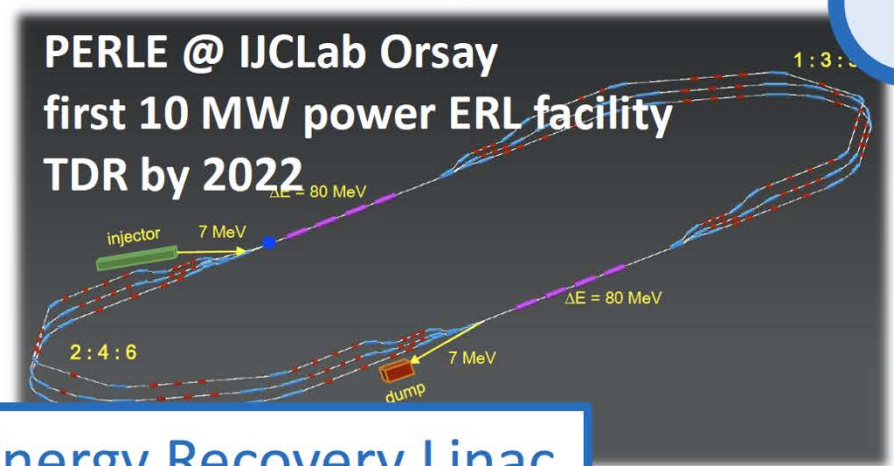
11-12T HL-LHC Nb_3Sn
demonstrated capability >14T
from 11-12T to 16T & large-scale
also HTS R&D

continue the development of CLIC accelerator technology and other high-gradient accelerating structures

Plasma

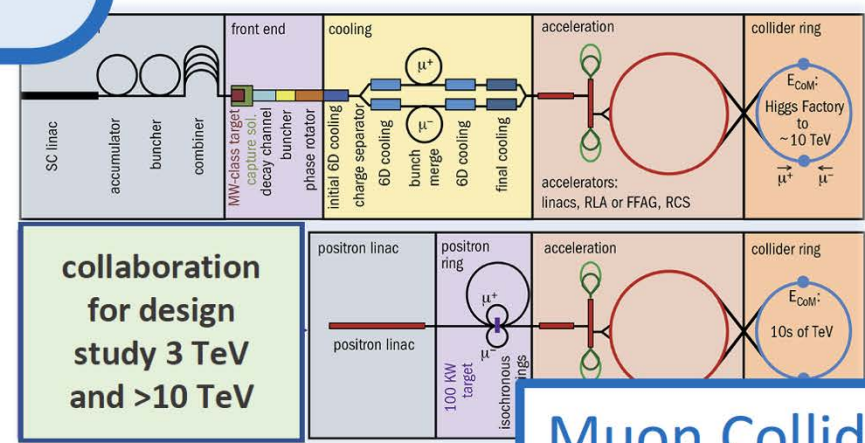


Strong EU support, e.g.
EuPRAXIA, EuroCircol,
FCC IS, ARIES, EuCARD,
EASITrain, E-JADE, …



Energy Recovery Linac

Accelerator and Detector R&D Roadmaps will be developed (2021)



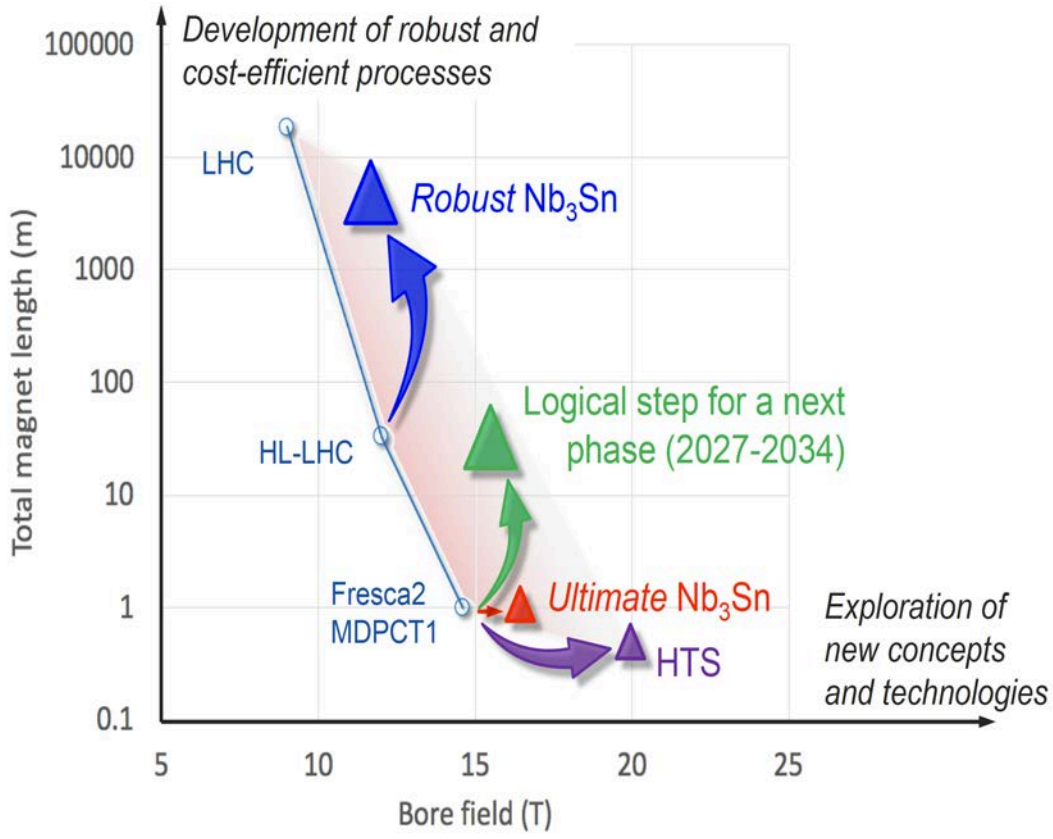
Muon Collider

High Field Magnet R&D Programme

2020 MTP implements a reinforced R&D programme for superconducting high-field magnets, as key technology for future accelerators (hadron colliders, muon colliders, neutrino beams, etc.) and detectors, with great potential for wider societal applications.

- Nb_3Sn **conductor** R&D
- Nb_3Sn **magnet technology** R&D
- Nb_3Sn **accelerator magnet** development
- HTS **material and conductor** R&D
- HTS **coil technology and accelerator magnet** R&D
- **Insulating materials**, polymers and composites
- **Infrastructure** for development, manufacture, test and measurement

Strong partnership with industry and with labs and universities in Europe, US and beyond



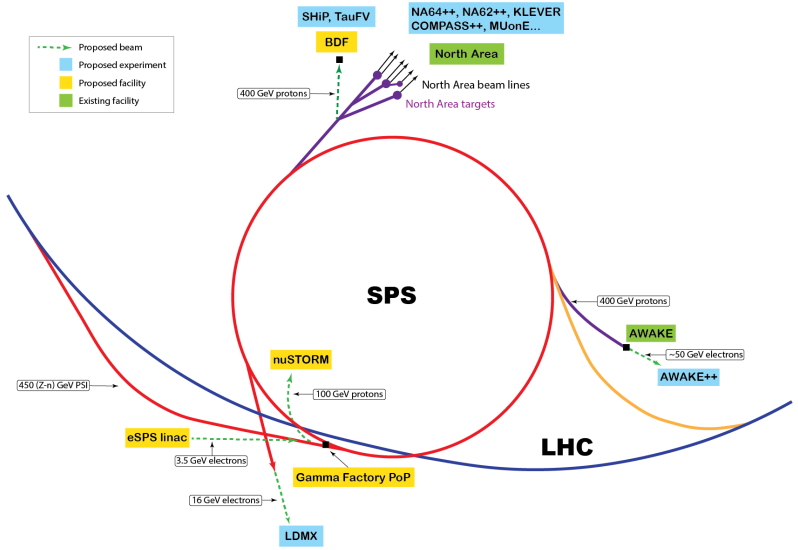
Some beautiful work already in progress…

Stefania Gori

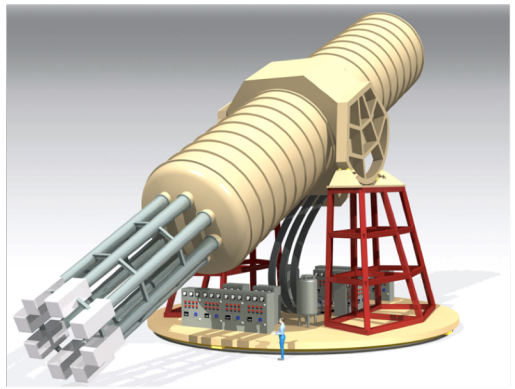
Physics Beyond Colliders

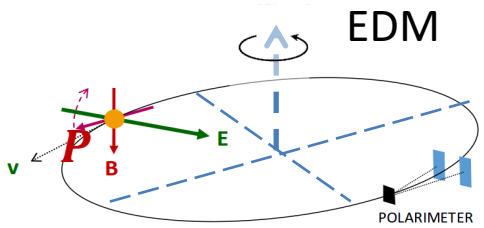
Since 2016: CERN has hosted the Physics Beyond Colliders Study group.
Interesting role in promoting and channelling new research initiatives at CERN and European labs.
Study continues… re-kick off meeting March 2021

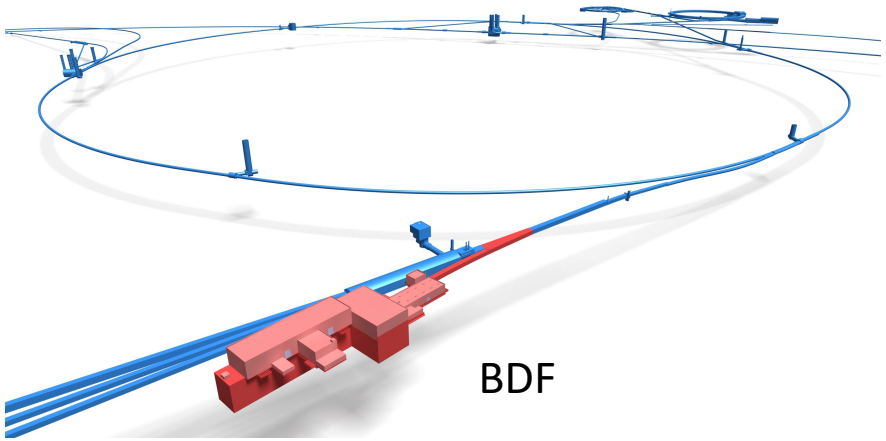
FASER



IAXO at DESY







BDF

Technology

- **Accelerator technology:** Maintain world class expertise in accelerator technologies while maintaining focus on key objectives. full technical and budgetary oversight
- **Technology support facilities**: Maintain and consolidate labs, workshops and on-site capabilities. Ensure well targeted investment.
- **R&D:** Develop and execute coherent R&D programmes to address the possibilities envisioned for the field in full collaboration with European partners and international collaborators.
- **European wide coherency** via adherence to ESPP established R&D roadmaps
- **Communicate** the results of these efforts to the public and external stakeholders.

Technology/R&D

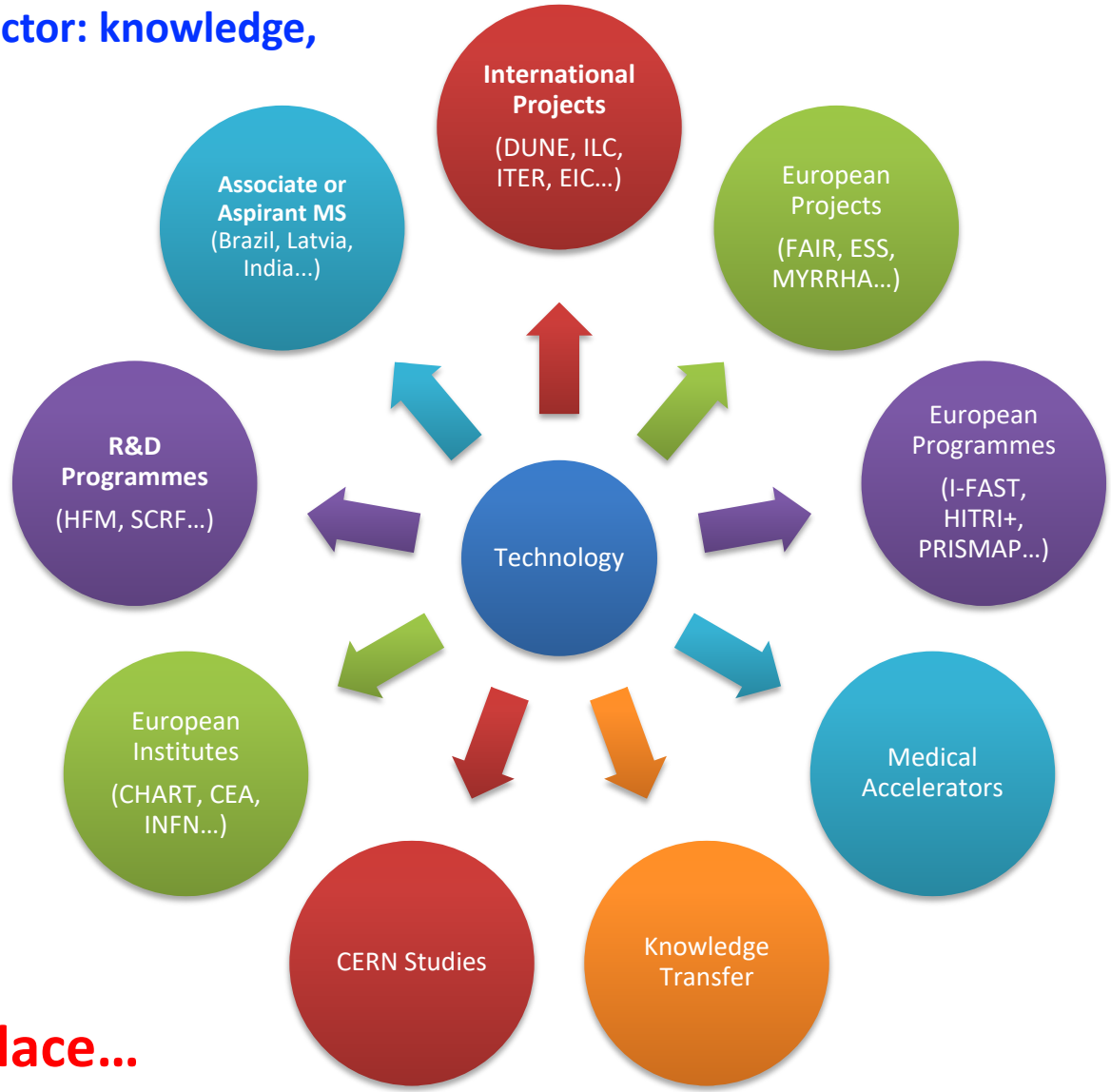
Hard to do justice to the diverse technical capabilities of the sector: knowledge, experience, expertise, facilities, manufacturing capability…

Developments for in-house applications

New requirements at existing complex (e.g LIU, L4)
New projects (e.g. HL-LHC, FCC)
R&D programmes (HFM, SCRF…)
Improving performance of existing systems
Obsolescence

AND… in other institutes:

- Use of CERN technology – leveraging CERN's knowledge base – with further R&D a possibility
- Development of novel applications with CERN's support
- R&D for CERN projects as means of establishing and maintaining in-country expertise



Truly impressive number of collaborations in place…

EU programmes

Last round of Horizon 2020 calls under the Large Research Infrastructures programme very successful

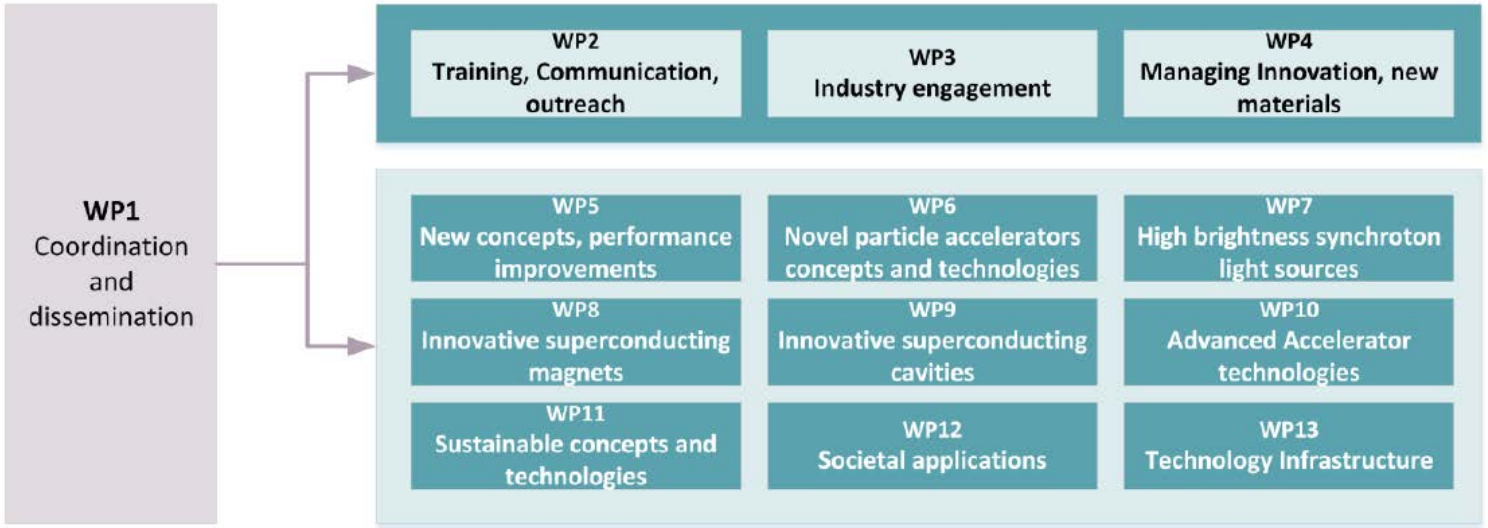
→ 5 projects led by CERN and 2 with CERN participation selected for funding (100% success!)

		Coordinator	Full cost M€	EC funds M€	For CERN M€
I.FAST	Fostering Innovation in Accelerator Science and Technology	CERN	18.7	10	2.9
RADNEXT	RADiation facility Network for the EXploration of effects for indusTry and research	CERN	9	5	0.8
PRISMAP	European Medical Isotope programme	CERN	5	5	1
HITRIplus	Heavy Ion Research Integration plus	CNAO	5	5	0.3
FCC-IS	FCC Innovation Study	CERN	7.4	3	0

Horizon Europe: “less curiosity driven science, more mission based (e.g. medical and environment)”

All projects with strong participation of CERN’s Member States

IFAST



IFAST (total budget 10 M€ for accelerator Research & Innovation)
2021-2025

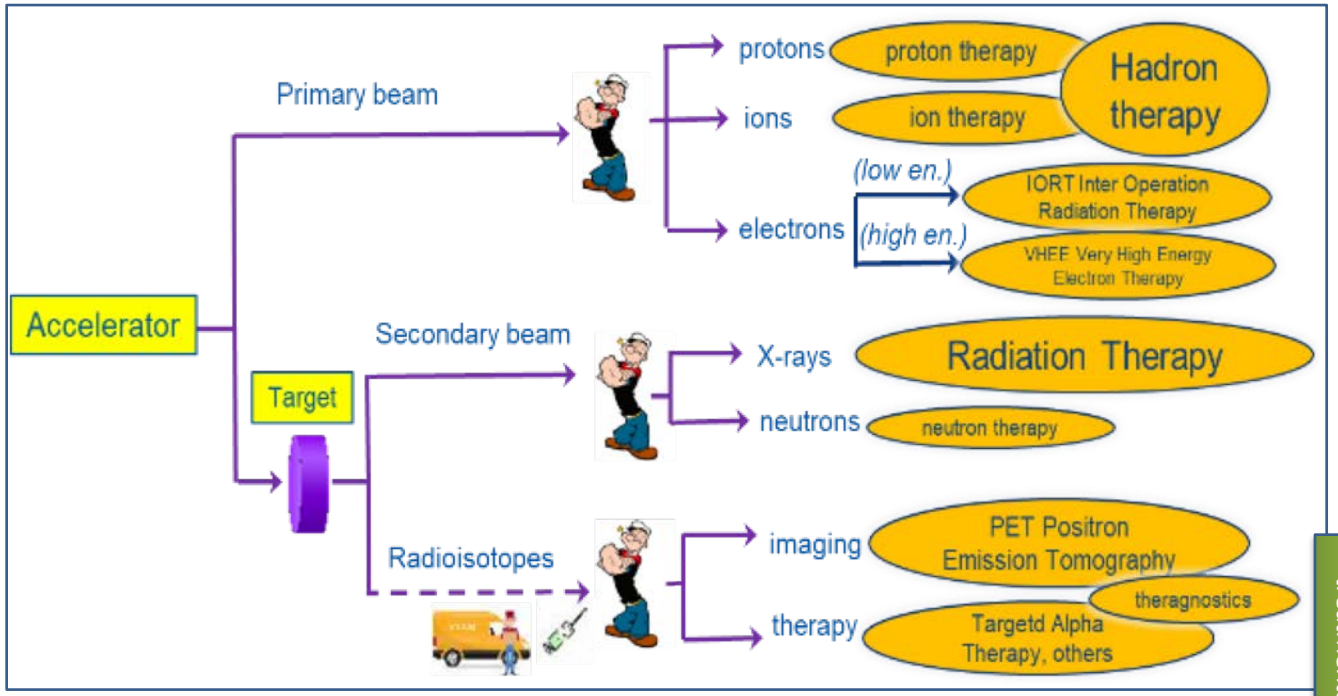
- Improvement of slow extraction spill quality (with FAIR)
- Engineering design of curved Canted-Cosine-Theta (CCT) magnet
- Engineering design of HTS CCT magnet
- Construction of curved CCT magnet demonstrator
- Construction of HTS magnet demonstrator
- Development of ReBCO HTS nuclotron cable (with FAIR)

GSI, BI, BT, CERN, HIT, CERN, CEA, INFN, CIEMAT, Wigner, UU, PSI, Scanditronix, Elytt, SigmaPhi

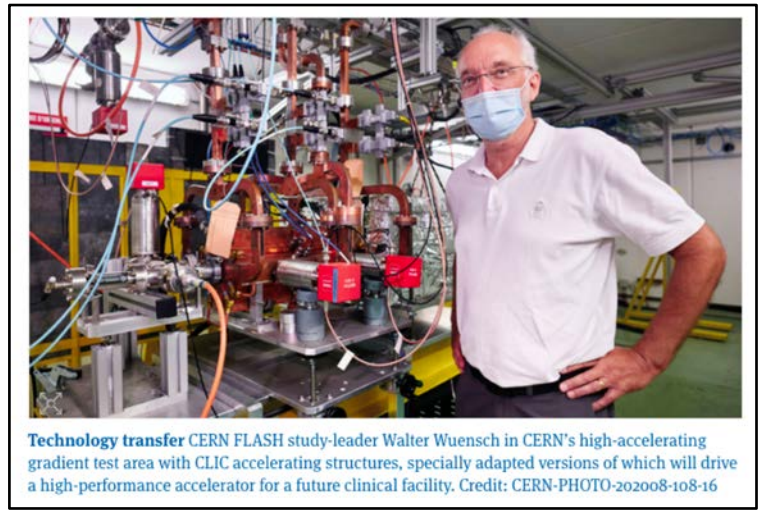
NIMMS

Medical Applications

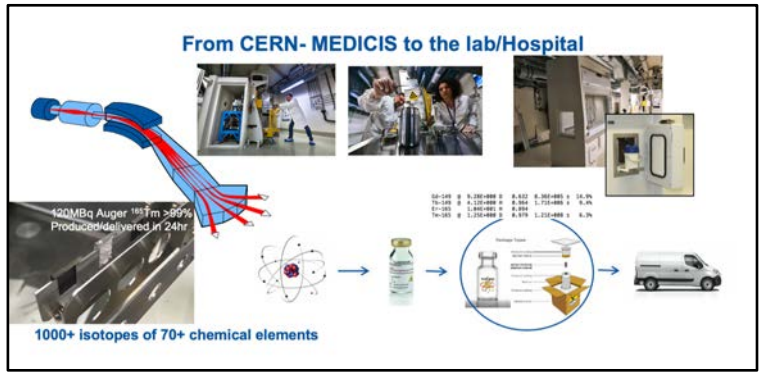
The **Next Ion Medical Machine Study (NIMMS)** is a CERN-based initiative, aimed at leveraging on CERN technologies developed for HEP for a new generation of accelerators for cancer therapy with ion beams



	Operating facilities
Cancer treatment	≈ 75
	12
	>300
	0
	≈ 14’000
	7
Imaging	≈ 1’500
New cancer treatments	0



Technology transfer CERN FLASH study-leader Walter Wuensch in CERN’s high-accelerating gradient test area with CLIC accelerating structures, specially adapted versions of which will drive a high-performance accelerator for a future clinical facility. Credit: CERN-PHOTO-202008-108-16

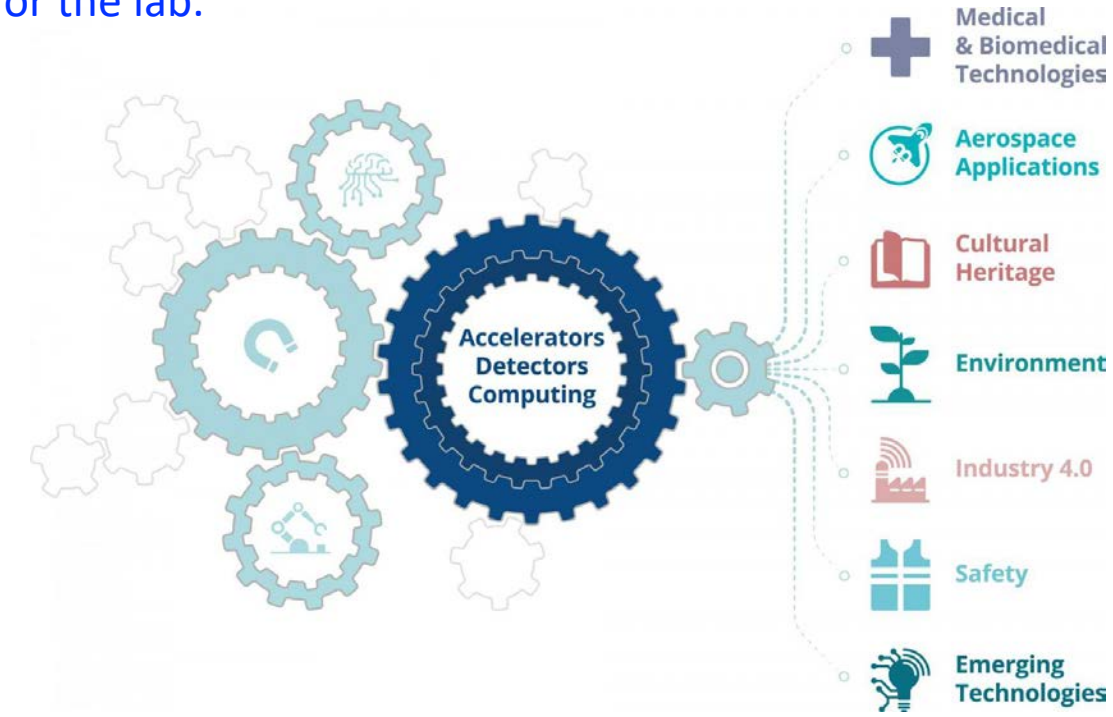


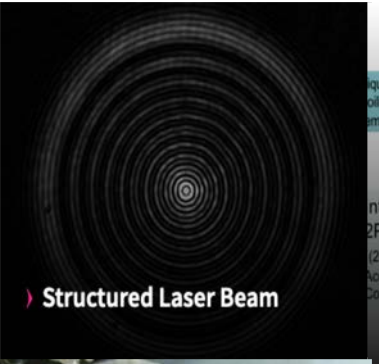
Knowledge Transfer

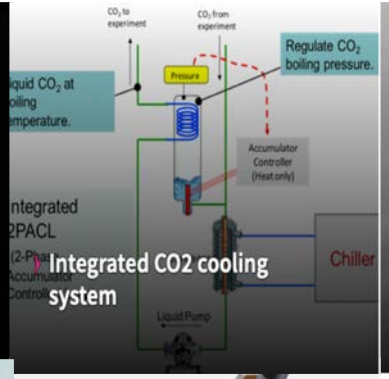
> Places like CERN contribute to the kind of knowledge that not only enriches humanity, but also provides the wellspring of ideas that become the technologies of the future.
>
> — Fabiola Gianotti, Director-General of CERN

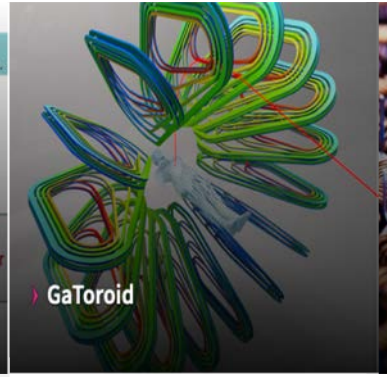
- "Leverage CERN's creativity and technology."
- "Transferring CERN's know-how and technology and maximising the societal impact of the laboratory's research is an integral part of CERN's mission"
- This is becoming more and more strategically important for the lab.

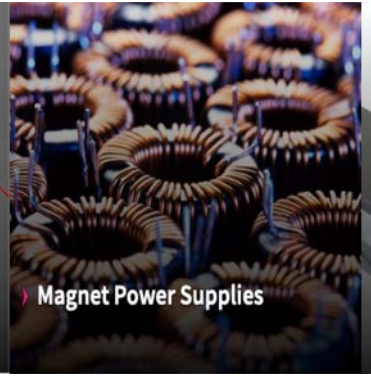
- Looking to encourage engagement within the sector
- Possible directed support to promising options

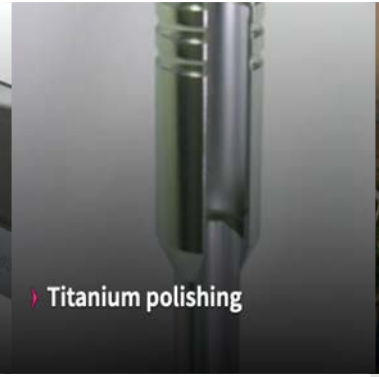


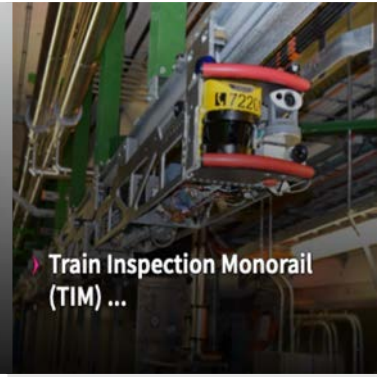












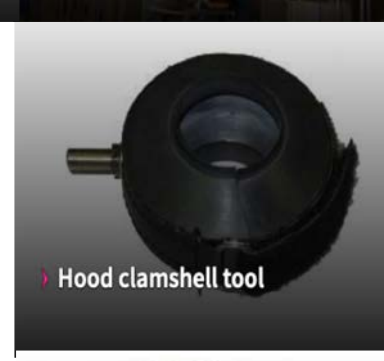
Knowledge Transfer

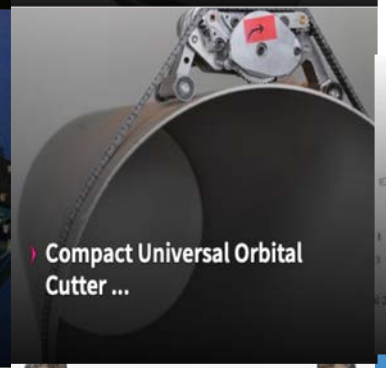
Application Domain

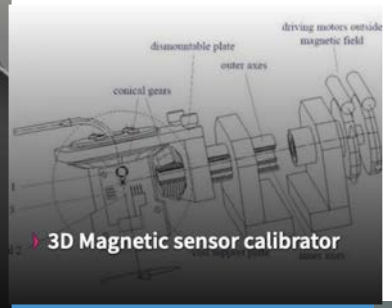
Aerospace | Better Planet | Cultural Heritage | Emerging Technologies | Industry 4.0 | Medtech | Other | Safety

Technical Domains

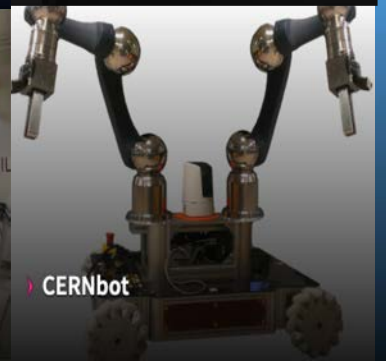
Accelerators | Beam Component & Systems | Cooling & Ventilation | Cryogenics | Detectors | Electronics | High & Ultra-High Vacuums | Industrial Controls & Simulations | Information & Communication Technology (ICT) | Magnets | Manufacturing & Mechanical Processes | Materials | Mechanics | Metrology | Microelectronics | Particle Tracking & Radiation Monitoring | Radiation Protection | Radio Frequency Technology | Superconductivity | Testing Facilities

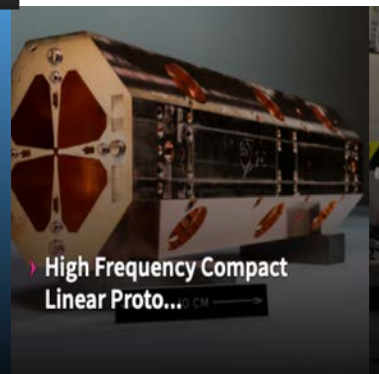


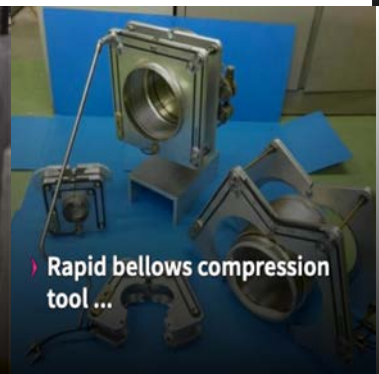


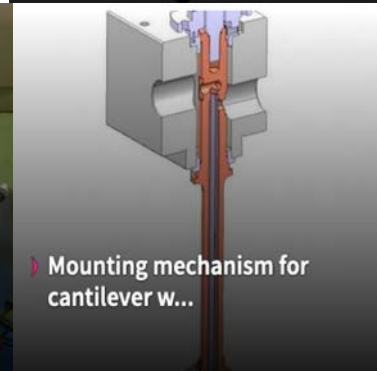


Giovanni Anelli









Energy & Environment

- A high level commitment to environment and energy management backed by a proactive identification and deployment of appropriate measures.
- Institutionalize consideration of energy and environment in technical choices and solutions.
- Energy & environment
  - Energy Management Panel now working CERN-wide with CERN Environmental Protection Steering Board (CEPS)
  - “Green accelerators” measures supported
    - SCRF, HEK, SC-links, heat recovery…
  - Environment Tripartite – liaison with Host States
- Accelerators for the environment
  - EU cross-over: Lot of interest, for example, activities in ARIES and IFAST (e.g. ship exhaust cleaning system with e- accelerator tested in ARIES).

A Duty and an Opportunity

European Strategy Update

- Obligations:
  - Be aware and make aware of efficient energy use and energy conversion
  - Make good design choices to minimize “waste”!
  - Design and use energy-efficient equipment
  - Monitor and plan energy use (Energy Management)
  - Recover otherwise “wasted” energy!

This is our duty to society, but also a necessity for acceptance!

The size of HEP projects, $\mathcal{O}(200\ \mathrm{MW})$ or $\mathcal{O}(\mathrm{TWh/y})$, allows dedicated R&D.

- Benefits:
  - Concepts and designs developed to improve energy efficiency in accelerators will be relevant for society at large.
  - Significant savings in operational cost.

Societal Impact

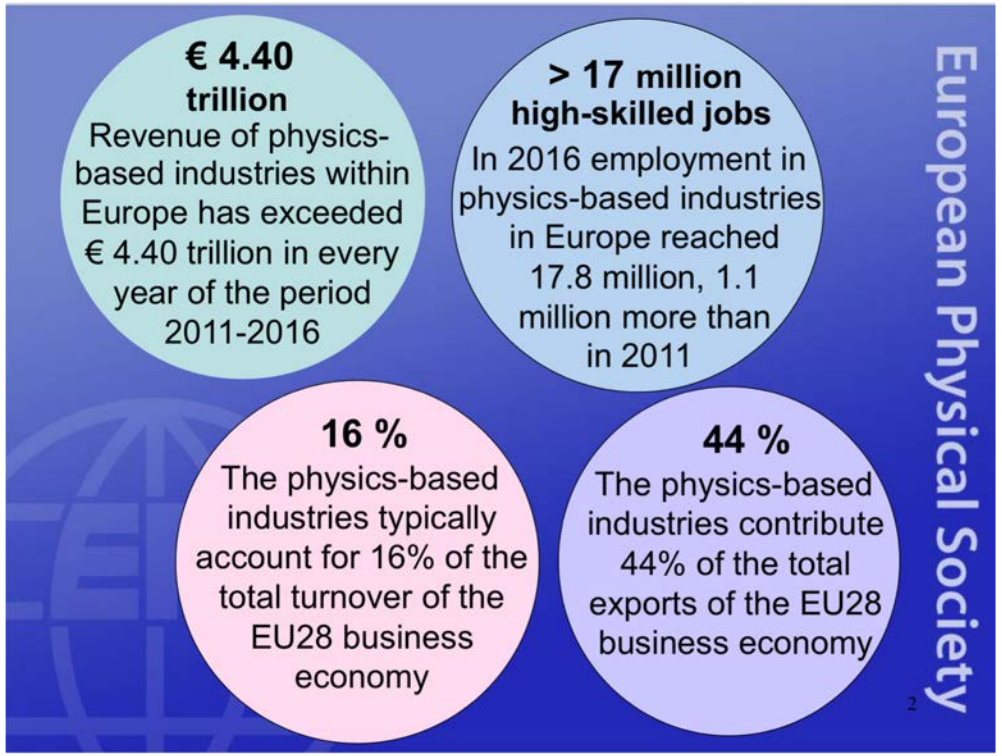
It's becoming increasingly important to highlight the societal impact of what we do (and indeed shaping what we do…)

- Particle physics has contributed to advances in many fields that have brought great benefits to society. Awareness of knowledge and technology transfer and the associated societal impact is important at all phases of particle physics projects.
- *Particle physics research centres should promote knowledge and technology transfer and support their researchers in enabling it. The particle physics community should engage with industry to facilitate knowledge transfer and technological development.*

Ursula Bassler

News from December 2020 Council Week

EPS study on “The Importance of Physics to the Economies of Europe”
Petra Rudolf (EPS President)



Social cost-benefit analysis of LHC and HL-LHC (1993-2038)
Massimo Florio et al.

Benefits baseline	**25.7**
Scientific publications	0.6
Human capital	8.5
Technological spillovers	10.2
Cultural benefits	3.3
Public good value	3.1
Costs baseline	**22.3**
Net Present Value	**3.4**

Source: Bastianin, Florio (2018)

Billion CHF 2016

In summary… we've got a lot do!

Interesting and challenging times ahead, but we are a remarkable team with some track record.

Exploitation	• Safe, effective and full exploitation of the complex in Run 3 • LHC, Injectors, Experimental facilities
Projects	• Full realization of HL-LHC goals, LIU in action, CLIC
Future Options	• FCC feasibility study, Muon Collider Study, Plasma Wakefield Acceleration, Physics Beyond Colliders
Technology	• Maintain world class expertise while keeping focus on key objectives • Support facilities: maintain, consolidate labs, workshops and on-site capabilities.
R&D	• Develop and execute designated R&D programmes: HFM, SCRF… • R&D in support of ATS technical domains…
Engagement	• EU programmes, Non-member state, International labs… • Continued (managed) engagement with our partners around the world
Societal	• Energy and Environment, Knowledge Transfer, Medical Accelerators • Outreach, education