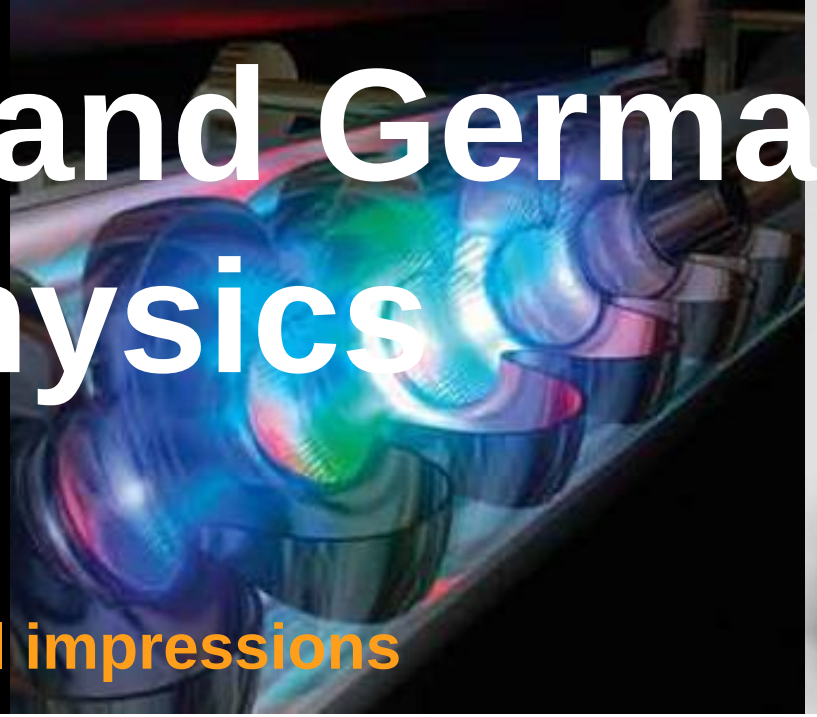
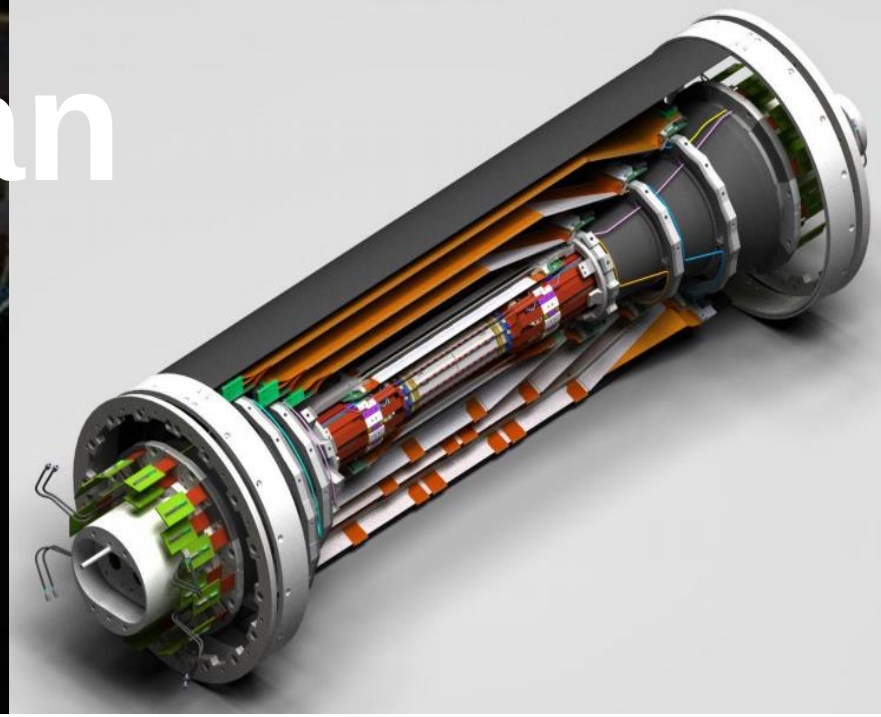
European and German Particle Physics Strategy





An overview with personal impressions

Thomas Schörner (DESY)

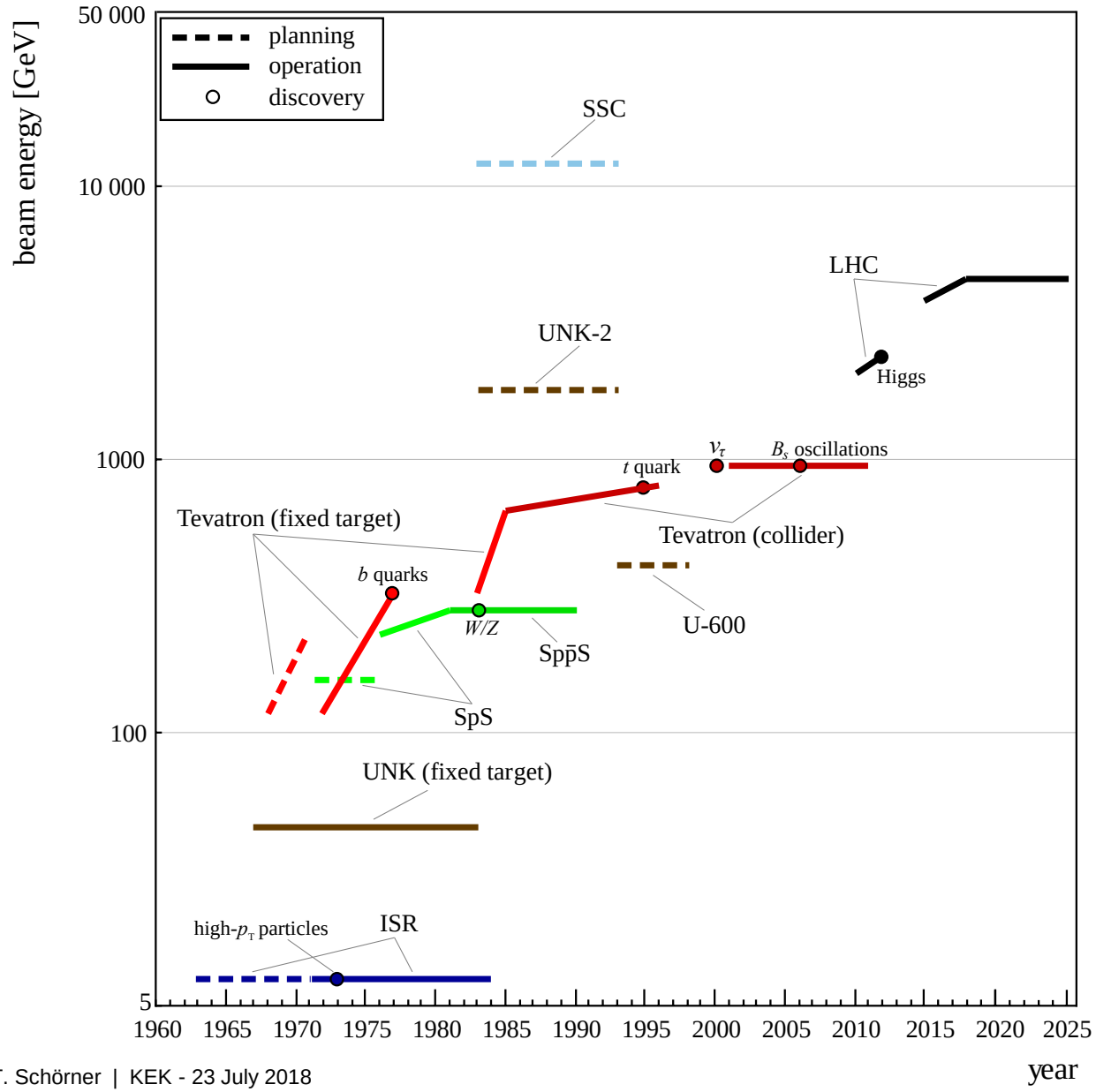
KEK, 23 July 2018

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

E-JADE

DESY.

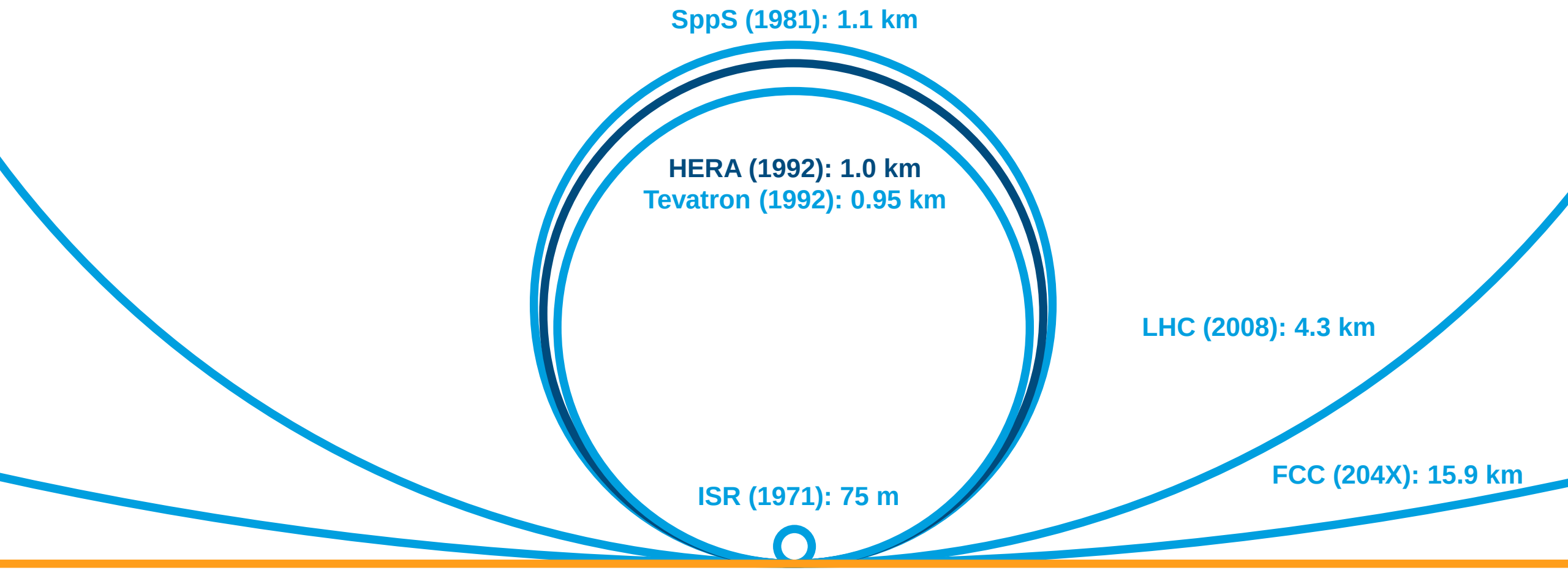
The Livingston Plot for Proton Machines



Development With Time: Size

1 km tunnel ≙ 100 M$

Size does matter: (anti)proton colliders only - radius



HEP as a Global Endeavour

New machines are multi-billion Euro enterprises

- There can only be one of a kind (?)
- Need international consensus

Co-ordinated strategy processes worldwide

- Last round concluded 2013.
- Different flavours in different regions of the world
- But looks like an emerging global, coherent strategy
- Next update of European strategy 2020 (see later slides); US to follow 2-3 years after.

Specific Topics for Europe

- HL-LHC is decided
- CLIC versus FCC?
- Or „only“ magnet development and HE-LHC?
- If Japan moves forward, European participation in ILC?
- Long-baseline neutrino programme?
- China?
- ...

Japan: Future HEP Projects
– „... Japan should take the leadership role in an early realisation of an e+e- linear collider.“

Update of European Strategy for by CERN Council (May 2013)
– LHC, incl. HL-LHC
– accelerator R&D
– strong support for ILC
– importance of theory

USA: Snowmass conclusions and recommendations to P5 in line with worldwide strategy statements

Outline

Europe – politically

Europe – scientifically

The European Strategy Update (ESU) Process

HEP Funding and Strategy in Germany

The DESY 2030 Strategy Process and the DESY HEP Strategy

HEP Strategies in other countries

Europe

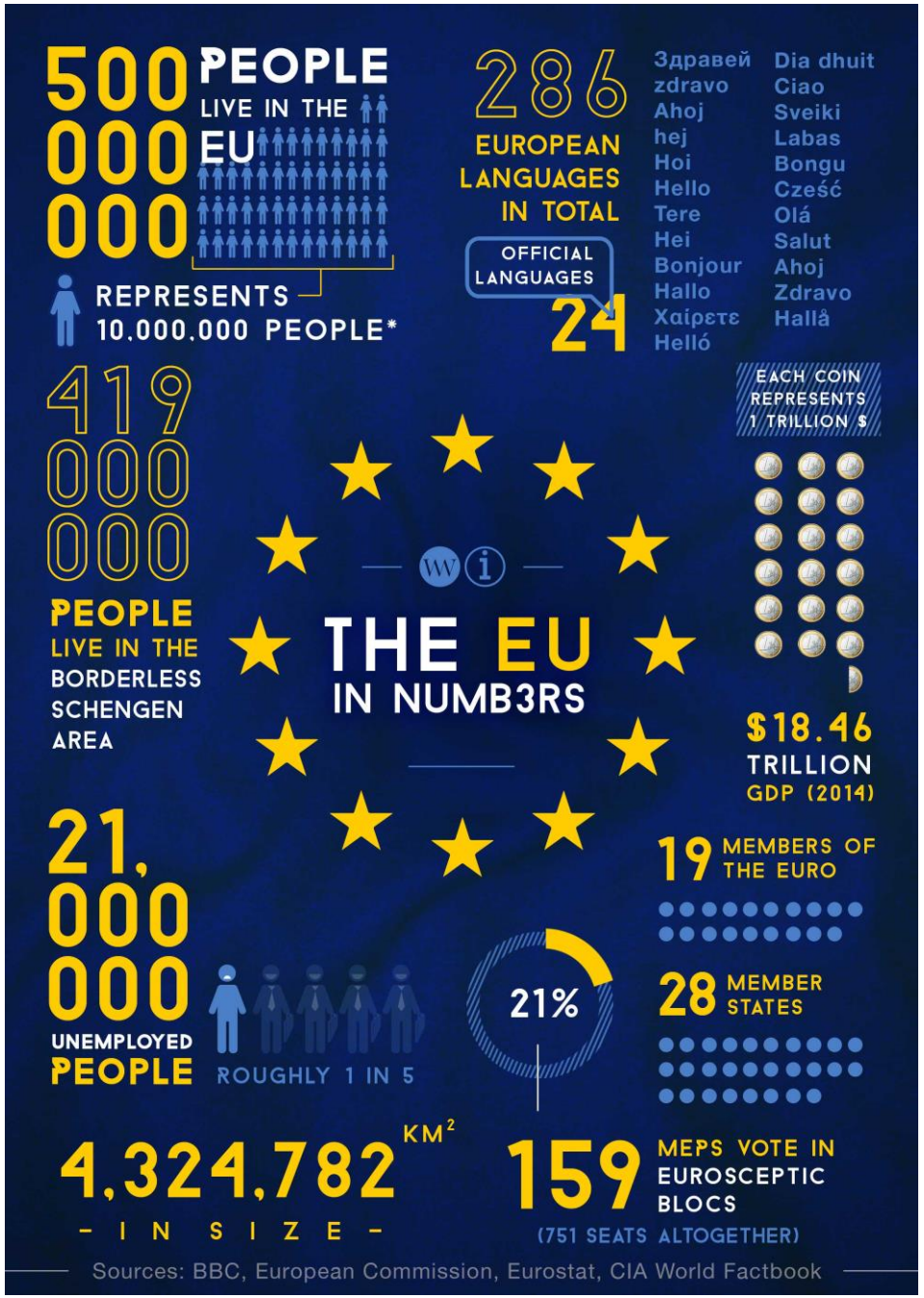

Boitroy
filius
1776

European Union

Some numbers, principles

A unique peace project

Since 1993: „European Free Market“:
free movement of goods
free movement of capital
free movement of persons
freedom to establish and provide services



History:

- 1945: End of World War II
- 1952: Foundation of ECSC
- 1955: Foundation of CERN

- 1992/3: European Community
- 2009: European Union
- 2019: Brexit?

Science in Europe

Science in Europe

Organising and funding research in the EU

European Research Area

Marie Skłodowska Curie Actions (MSCA)

European Research Area ERA

Integrating scientific ressources in the EU

The **European Research Area** (**ERA**) is a system of scientific research programs integrating the scientific resources of the European Union (EU). Since its inception in 2000, the structure has been concentrated on multinational cooperation in the fields of medical, environmental, industrial, and socioeconomic research. The ERA can be likened to a research and innovation equivalent of the European "common market" for goods and services. Its purpose is to increase the competitiveness of European research institutions by bringing them together and encouraging a more inclusive way of work, similar to what already exists among institutions in North America and Japan. Increased mobility of knowledge workers and deepened multilateral cooperation among research institutions among the member states of the European Union are central goals of the ERA.

Horizon 2020

EU framework programme

European Research Area

Note:

- EU framework programmes concentrate on European added value (optimum usage of facilities, creating synergies, strengthening technological developments, design studies like EuroTeV or ILCHiGrade, …)
- New facilities are mostly funded by national governments (with IK contributions, or as European Research Infrastructure Consortium (ERIC), or …
- Recent examples are FAIR, XFEL, ESS, …
- Sometimes EU takes coordinating role (e.g. in case of ITER).

Horizon 2020 [edit]

Horizon 2020 is the eighth framework programme funding research, technological development, and innovation. The programme's name has been modified to "Framework Programme for Research and Innovation". The framework programme is implemented by the European Commission, the executive body of the European Union, either by various internal directorate general (DGs), such as the directorate general for research and innovation (DG RTD) or the directorate general for communications networks, content and Technology, or by executive agencies such as the Research Executive Agency (REA), the Executive Agency for SMEs (EASME), or the ERC Executive Agency (ERCEA). The framework programme's objective is to complete the European Research Area (ERA) by coordinating national research policies and pooling research funding in some areas to avoid duplication. Horizon 2020 itself is seen as a policy instrument to implement other high-level policy initiatives of the European Union, such as Europe 2020 and Innovation Union. The programme runs from 2014–20 and provides an estimated €80 billion of funding,[18][19] an increase of 23 per cent on the previous phase.[20]

XFEL cryomodule production

From: N. Walker

HP coupler production

Thales-RI

CPI

Coupler Processing (LAL)

Module Assembly (CEA Saclay)

Aperam / MecaMagnetic

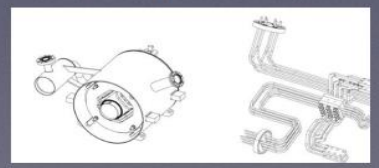
Magnetic shields

JEHIER

Multilayer insulation

CIEMAT

SC quad production



Niobium production

Tokyo Denkai

Ningxia

(Plansee)

Nb sheet QA/QC

Vertical test (AMTF, IFJ-PAN)

Cryostat QA/QC

SC magnet testing

Module test (AMTF, IFJ-PAN)

DESY

XFEL tunnel

INFN-Milan

ZANON

RI

Cavity production

IHEP

ZANON

Cryostat production

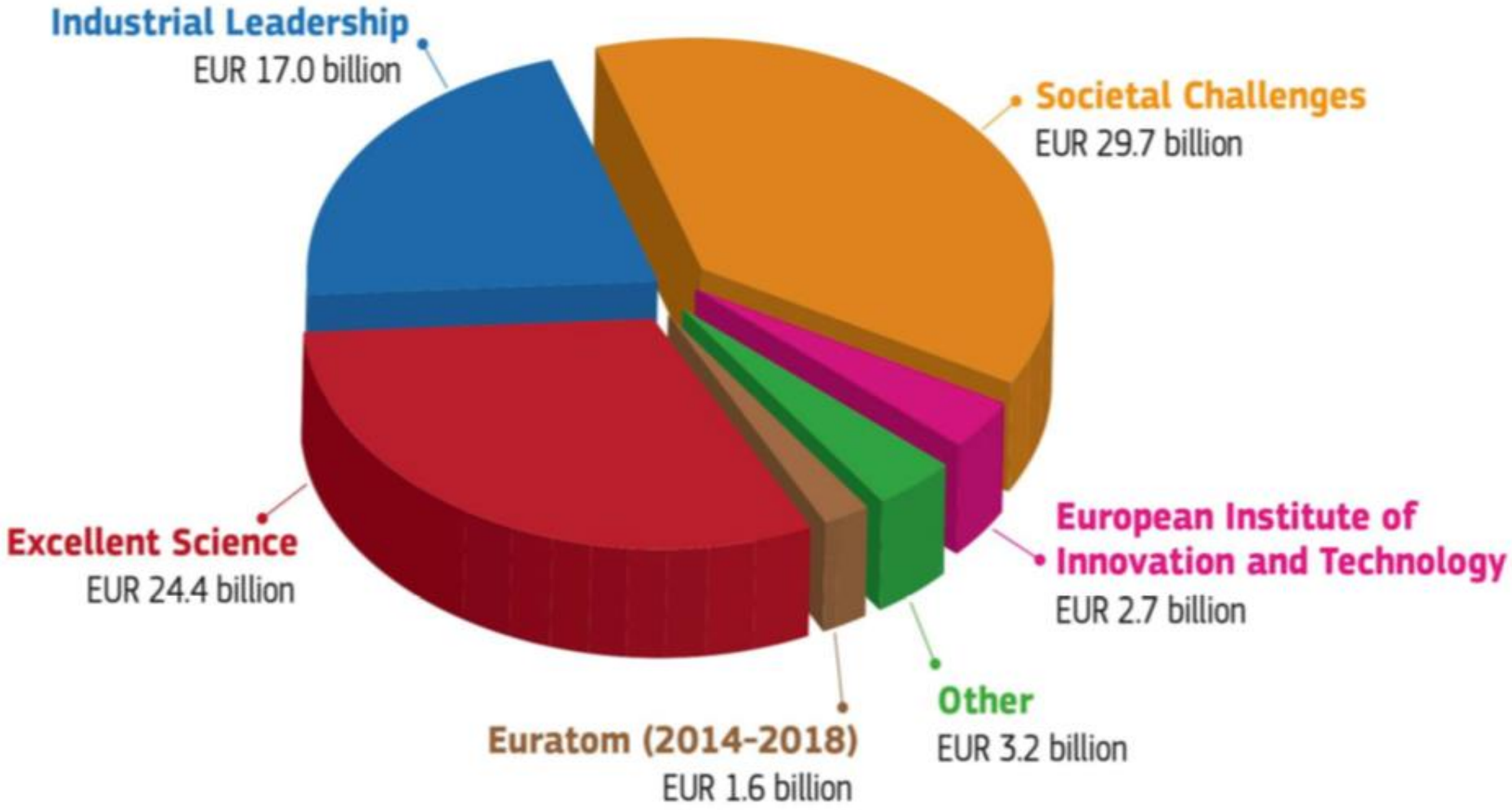
Not shown:

- cavity tuners
- BPMs
- Cavity bellows
- HOM absorberts

Production rate: 1 cryomodule / week

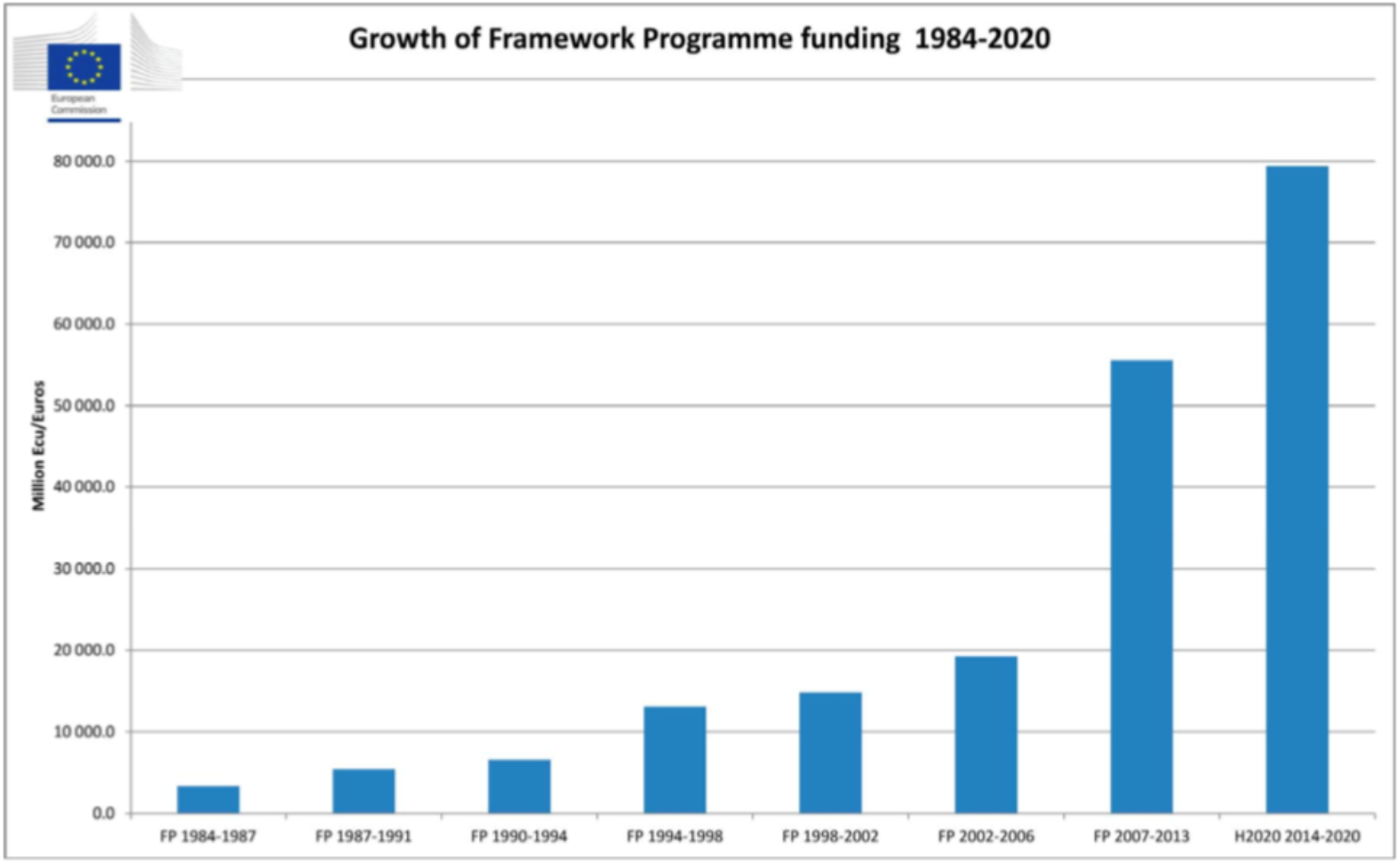
HORIZON 2020

Budget 2014-2020: ~80 billion EUR (current prizes)



EU Framework Programmes

Budget development



European Research Council ERC

Funding excellent research in the EU

The **European Research Council** (**ERC**) is a public body for funding of scientific and technological research conducted within the European Union (EU). Established by the European Commission in 2007, the ERC is composed of an independent Scientific Council, its governing body consisting of distinguished researchers, and an Executive Agency, in charge of the implementation. It forms part of the framework programme of the union dedicated to research and innovation, Horizon 2020, preceded by the Seventh Research Framework Programme (FP7). The ERC budget is over €13 billion from 2014 – 2020 and comes from the Horizon 2020 programme, a part of the European Union's budget. Under Horizon 2020 it is estimated that around 7,000 ERC grantees will be funded and 42,000 team members supported, including 11,000 doctoral students and almost 16,000 post-doctoral researchers.

Marie Curie Actions

E.g. E-JADE, Jennifer – and many others

European Research Area

E-JADE

Europe -Japan Accelerator Development Exchange Programme

Marie Skłodowska Curie Actions (MSCA)

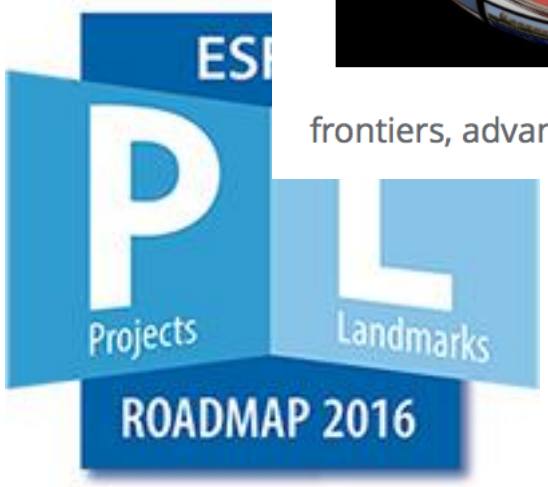
ESFRI Roadmap

European Strategy Forum on Research Infrastructures

Mission

The mission of ESFRI is to support a coherent and strategy-led approach to policy-making on research infrastructures in Europe, and to facilitate multilateral initiatives leading to the better use and development of research infrastructures, at EU and international level.

ESFRI's delegates are nominated by the Research Ministers of the Member and Associate Countries, and include a representative of the Commission, working together to develop a joint vision and a common strategy. This strategy aims at overcoming the limits due to fragmentation of individual policies and provides Europe with the most up-to-date Research Infrastructures, responding to the rapidly evolving Science frontiers, advancing also the knowledge-based technologies and their extended use.



ESFRI PROJECTS

	NAME	FULL NAME	ROADMAP ENTRY (YEAR)	OPERATION (YEAR)	LEGAL STATUS (AS OF 10 MARCH 2016)	CONSTRUCTION COSTS (M€)	OPERATIONAL ANNUAL BUDGET (M€/YEAR)
ENERGY	ECCSEL	European Carbon Dioxide Capture and Storage Laboratory Infrastructure	2008	2016	ERIC under preparation	80-120	1**
	EU-SOLARIS	European SOLAR Research Infrastructure for Concentrated Solar Power	2010	2020*	ERIC under preparation	120	3-4
	MYRRHA	Multi-purpose hYbrid Reactor for High-tech Applications	2010	2024*		NA	100
	WindScanner	European WindScanner Facility	2010	2018*		45-60	8
ENVIRONMENT	ACTRIS	Aerosols, Clouds and Trace gases Research Infrastructure	**2016**	2025*		190	50
	DANUBIUS-RI	International Centre for Advanced Studies on River-Sea Systems	**2016**	2022*		222	28
	EISCAT_3D	Next generation European incoherent scatter radar system	2008	2021*		74	6
	EPOS	European Plate Observing System	2008	2020*	ERIC under preparation	53	15
	SIOS	Svalbard Integrated Arctic Earth Observing System	2008	2020*		80	2-3
HEALTH & FOOD	AnaEE	Infrastructure for Analysis and Experimentation on Ecosystems					
	EMBRC	European Marine Biological Resource Centre					
	EMPHASIS	European Infrastructure for multi-scale Plant Phenomics and Simulation for food security in a changing climate					
	ERINHA	European research infrastructure on highly pathogenic agents					
	EU-OPENSCREEN	European Infrastructure of Open Screening Platfor for Chemical Biology					
	Euro-BioImaging	European Research Infrastructure for Imaging Technologies in Biological and Biomedical Science					
	ISBE	Infrastructure for Systems Biology Europe					
	MIRRI	Microbial Resource Research Infrastructure					
PHYSICAL SCIENCES & ENGINEERING	CTA	Cherenkov Telescope Array					
	EST	European Solar Telescope					
	KM3NeT 2.0	KM3 Neutrino Telescope 2.0: Astroparticle & Oscillations Research with Cosmics in the Abyss					
SOCIAL & CULTURAL INNOVATION	E-RIHS	European Research Infrastructure for Heritage Science	**2016**	2022*		4	5
e-RI							

*expected **for centralised services NA= Not Available

ESFRI LANDMARKS

	NAME	FULL NAME	ROADMAP ENTRY (YEAR)	OPERATION (YEAR)	LEGAL STATUS (AS OF 10 MARCH 2016)	CAPITAL VALUE (M€)	OPERATIONAL ANNUAL BUDGET (M€/YEAR)
ENERGY	JHR	Jules Horowitz Reactor	2006	2020*		1.000	NA
ENVIRONMENT	EMSO	European Multidisciplinary Seafloor and water-column Observatory	2006	2016	ERIC under preparation	108	36
	EURO-ARGO ERIC	European contribution to the international Argo Programme	2006	2014	ERIC, 2014	10	8
	IAGOS	In-service Aircraft for a Global Observing System	2006	2014	AISBL, 2014	25	6
	ICOS ERIC	Integrated Carbon Observation System	2006	2016	ERIC, 2015	48	24-35
	LifeWatch	e-infrastructure for Biodiversity and Ecosystem Research	2006	2016	ERIC under preparation	66	10
HEALTH & FOOD						170-220	3,5
						500	2,5
						1,5	2
					Agreement, 2013	125	95
					ation	180	80
					ortium	285	25
					ation		
PHYSICAL SCIENCES & ENGINEERING					O	1.000	40
					ation	850	90
						170	20
	ESRF UPGRADES	Phase I	2006	2015	Programme of ESRF	180	82
		Phase II: Extremely Brilliant Source	**2016**	2022*		150	
	European Spallation Source ERIC	European Spallation Source	2006	2025*	ERIC, 2015	1.843	140
	European XFEL	European X-Ray Free-Electron Laser Facility	2006	2017*	GmbH, 2009	1.490	115
	FAIR	Facility for Antiproton and Ion Research	2006	2022*	GmbH, 2010	1.262	234
	HL-LHC	High-Luminosity Large Hadron Collider	**2016**	2026*	Programme of CERN	1.370	100
	ILL 20/20	Institut Max von Laue-Paul Langevin	2006	2020*	Programme of ILL	171	92
	SKA	Square Kilometre Array	2006	2020*	SKAO, 2011	650	75
	SPIRAL2	Système de Production d'Ions Radioactifs en Ligne de 2e génération	2006	2016	Programme of GANIL	110	5-6
SOCIAL & CULTURAL INNOVATION	CESSDA	Consortium of European Social Science Data Archives	2006	2013	Norwegian limited company, 2013 ERIC under preparation	NA	1,9
	CLARIN ERIC	Common Language Resources and Technology Infrastructure	2006	2012	ERIC, 2012	NA	12
	DARIAH ERIC	Digital Research Infrastructure for the Arts and Humanities	2006	2019*	ERIC, 2014	4,3	0,6
	ESS ERIC	European Social Survey	2006	2013	ERIC, 2013	NA	6
	SHARE ERIC	Survey of Health, Ageing and Retirement in Europe	2006	2011	ERIC, 2011	110	12
e-RI	PRACE	Partnership for Advanced Computing in Europe	2006	2010	AISBL, 2010	500	120

*expected NA= Not Available

Note: No CERN / HEP projects in list of ESFRI projects!

- Relation EU-CERN regulated by treaty. EU delegates strategy development in the field of HEP infrastructures to CERN.
- CERN strategy and projects therein form part of ESFRI.
- CERN strategy is condition for access to EU framework programme funds → importance of ESU for ILC!

The European Strategy Update (ESU) Process

The Update of the European Strategy

Relevance and scope

https://council.web.cern.ch/en/content/european-strategy-particle-physics:

*The Convention bestows **two missions** upon the Organization, namely the **operation of laboratories** and the **organisation and sponsoring of international co-operation in the field of elementary particle physics**.*

*[…] In this context, the **Council has assumed full responsibility for defining the strategic orientations of European particle physics**, a bottom-up process that starts with the broad consultation of all stakeholders in Europe's particle physics community and culminates in a dedicated meeting of the European Strategy Group, which brings together representatives of the CERN's Member States and of the major European laboratories active in the field, particle physicists from outside Europe and specialists in related fields of physics. The Strategy updates are drafted at this special "drafting" session of the European Strategy Group and are then validated at a dedicated "European Strategy Session" of the Council.*
The last one of these was held on 28 May 2013 in Brussels.

➔ Strategy process defines long-term commitments of European community. CERN strategy as necessary condition for access to EU FP funds.

➔ ILC competing with large CERN projects (and others; note that CERN needs a future after LHC)

The Update of the European Strategy

European strategy update 2013 – outcome

a) *Europe should preserve this [European organisational] model in order to keep its leading role, sustaining the success of particle physics and the benefits it brings to the wider society.*

b) *The European Strategy takes into account the worldwide particle physics landscape and developments in related fields and should continue to do so.*

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.*

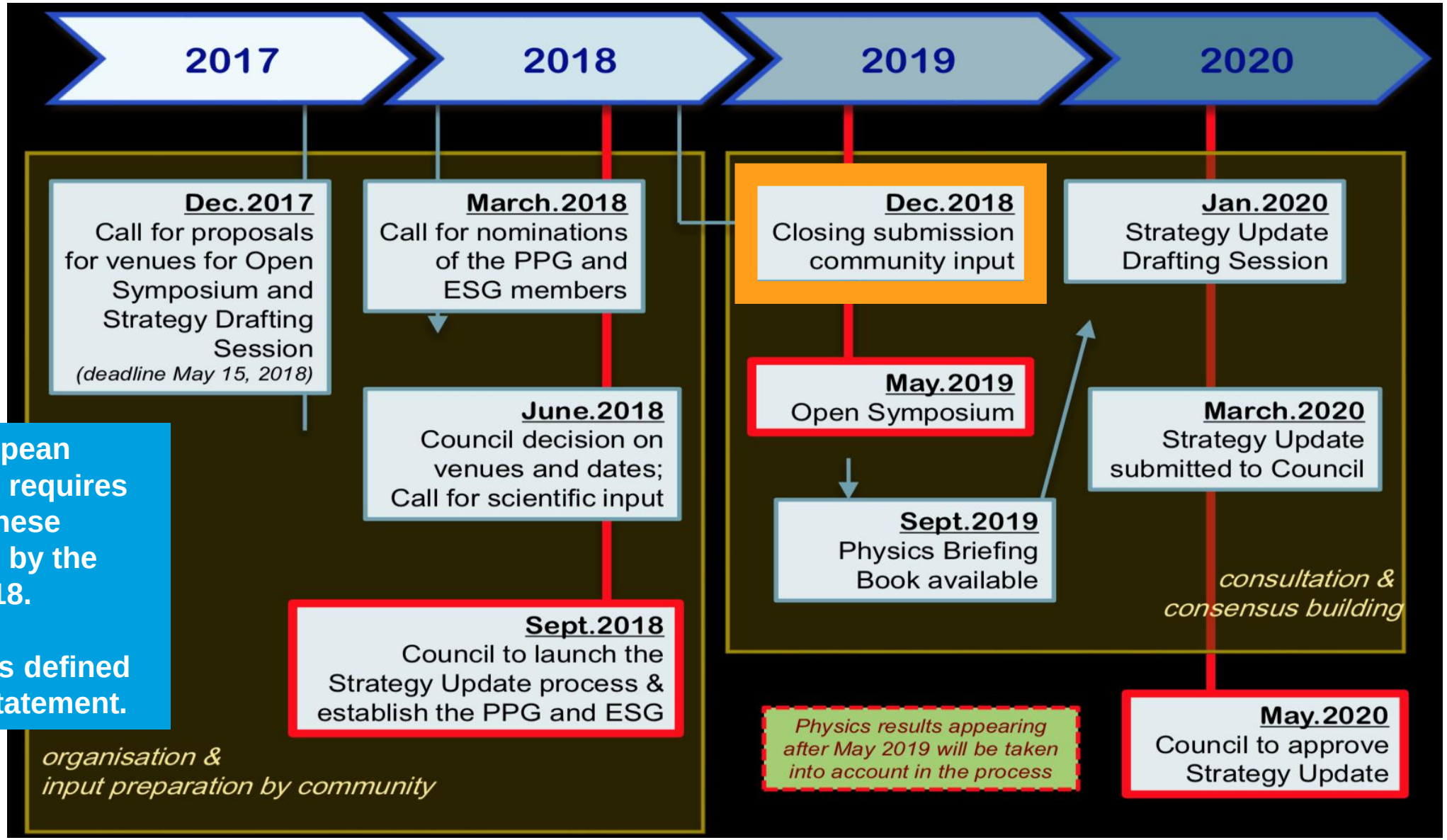
d) *CERN should undertake design studies for accelerator projects in a global context, with emphasis on proton-proton and electron-positron high-energy frontier machines. These design studies should be coupled to a vigorous accelerator R&D programme, including high-field magnets and high-gradient accelerating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

e) *There is a strong scientific case for an electron-positron collider, complementary to the LHC … 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.*

f) *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.*

The Update of the European Strategy

Timeline



Firm European statement requires firm Japanese statement by the end of 2018.

Conditions defined by ICFA statement.

The ICFA and LCB Statements on the ILC250

Ottawa, November 2017

ICFA Statement on the ILC Opera

The discovery of a Higgs boson in 2012 at
significant recent breakthroughs in scienc
Precision studies of the Higgs boson will f
laws of matter and its interactions.

The International Linear Collider (ILC) ope
excellent science from precision studies o
science project complementary to the LH

ICFA welcomes the efforts by the Linear C
indicate that up to 40% cost reduction rel
possible for a 250 GeV collider.

ICFA emphasizes the extendibility of the I
potential with important additional meas

ICFA thus supports the conclusions of the Linear Collider Board (LCB) in their report presented at this meeting and very strongly encourages Japan to realize the ILC in a timely fashion as a Higgs boson factory with a center-of-mass energy of 250 GeV as an international project[1], led by Japanese initiative.

Physics studies by the Linear Collider Collaboration Physics and Detector Group [1], and the Japanese Association of High Energy Physicists (JAHEP) [2] show a compelling physics case for constructing an ILC at 250 GeV centre of mass energy as a Higgs factory. The cost of such a machine is estimated to be lower by up to 40% compared to the originally proposed ILC at 500 GeV [3]. The acceleration technology of the ILC is now well established thanks to the experience gained from the successful construction of the European XFEL in Hamburg. One of the unique features of a linear collider is the capability to increase the operating energy by improving the acceleration technology and/or extending the tunnel length. For these reasons, the Linear Collider Board strongly supports the JAHEP proposal [4] to construct the ILC at 250 GeV in Japan and encourages the Japanese government to give the proposal serious consideration for a timely decision.

In recent examples of similar international projects[1], the host country made the majority contribution. A natural expectation would be that the cost for the civil construction and other infrastructure is the responsibility of the host country, while the accelerator construction should be shared appropriately. A clear expression of interest to host the machine under these principles would enable Japan to start negotiations with international partners. It would also allow members of the international community to initiate meaningful discussions with their own governments on possible contributions.

The Update of the European Strategy

Reminder (from H. Abramowicz – Strategy Secretary)

Strategy update approval by Council: May 2020 (fixed)

Strategy update is drafted by European Strategy Group (ESG), based on community input that is collected by the Physics Preparatory Group (PPG).

The PPG also organises the Open Symposium (13-16 May 2019, Granada, Spain) to discuss all proposals; the PPG summarises the input, the discussions and their conclusions in a Briefing Book.

The Briefing Book constitutes the input for the ESG for drafting their update.

The drafting takes place during a dedicated drafting session (the ESU conclave, 20-24 January 2020, Bad Honnef, Germany)

The organisation is handled by the Strategy Secretary who also chairs all groups.

Halina Abramowicz
Strategy Secretary

The Update of the European Strategy

Reminder (from H. Abramowicz – Strategy Secretary)

Strategy Secretariat:

H. Abramowicz (Strategy Secretary), K. Ellis (SPC chair), J. D'Hondt (ECFA chair), L. Rifkin (chair of European Laboratory Directors Group)

PPG (15-17 people):

H. Abromowicz, four members recommended by PSC, four members recommended by ECFA, SPC and ECFA chairs, chair of European Laboratory Directors Group, one CERN representative, 2 representatives from both Asia and the Americas

ESG (62-64 people):

H. Abramowicz, one representative from each of the 22 members states and the European labs, CERN DG, chairs of SPC and ECFA

Invitees: President of CERN Council, one representative from each AMS and OS (7+3), the EU representative, chairs of ApPEC, NuPECC, FALC, ESFRI, members of the PPG (17-secretariat)

HEP Funding and Strategy in Germany

- Helmholtz Association
- Funding Landscape
- HEP Strategy Development

Helmholtz Association

Association of 18 large research ("Helmholtz") centres (like DESY)

1. Berlin
Helmholtz-Zentrum Berlin für Materialien und Energie (HZB)

2. Berlin-Buch
Max Delbrück Center for Molecular Medicine in the Helmholtz Association (MDC)

3. Brunswick
Helmholtz Center for Infection Research (HZI)

4. Bremerhaven
Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung (AWI)

5. Bonn
German Center for Neurodegenerative Diseases (DZNE)

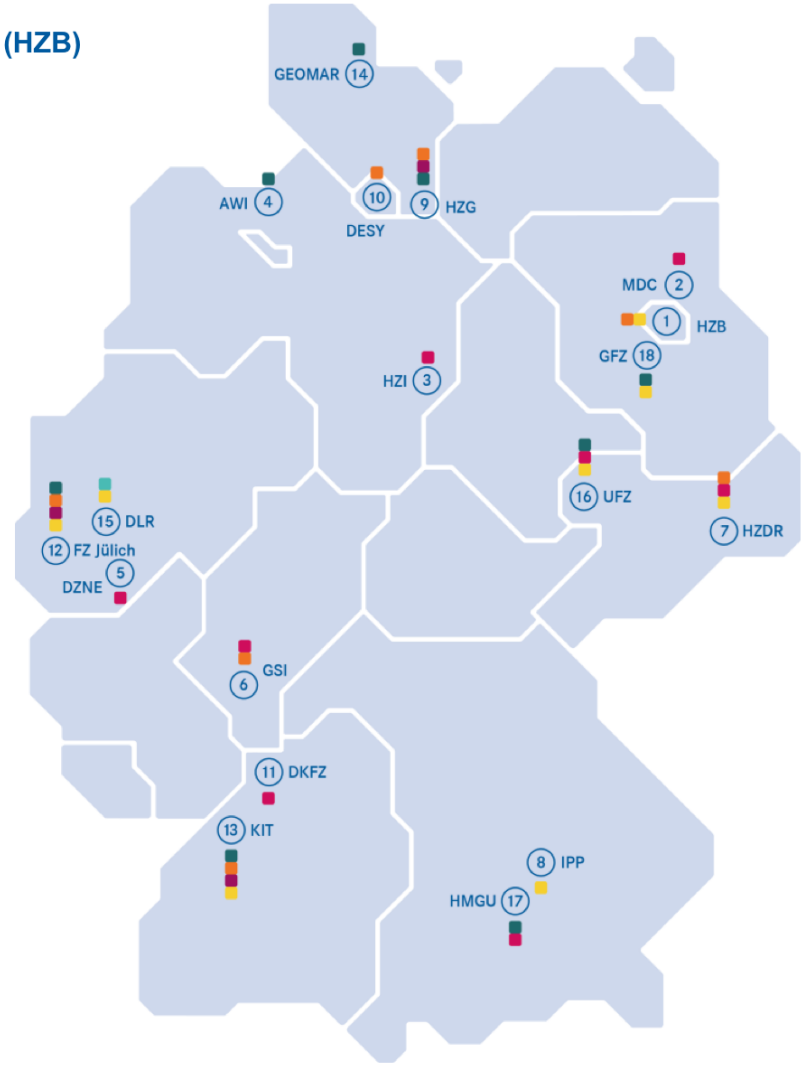
6. Darmstadt
GSI Helmholtz Center for Heavy Ion Research

7. Dresden
Helmholtz Center Dresden Rossendorf (HZDR)

8. Garching
Max Planck Institute for Plasma Physics (IPP) (Associate Member)

9. Geesthacht
Helmholtz Center Geesthacht Center for Material and Coastal Research (HZG)

10. Hamburg
Deutsches Elektronen-Synchrotron DESY



11. Heidelberg
German Cancer Research Center (DKFZ)

12. Jülich
Forschungszentrum Jülich

13. Karlsruhe
Karlsruhe Institute of Technology (KIT)

14. Kiel
GEOMAR Helmholtz Center for Ocean Research Kiel

15. Cologne
German Aerospace Center (DLR)

16. Leipzig
Helmholtz Center for Environmental Research (UFZ)

17. Munich
Helmholtz Center Munich – German Research Center for Health and the Environment

18. Potsdam
Helmholtz Center Potsdam German Research Center for Geosciences GFZ

Research Areas:
- Energy
- Earth and Environment
- Health
- Aeronautics, Space and Transport
- Matter
- Key Technologies

Helmholtz Association

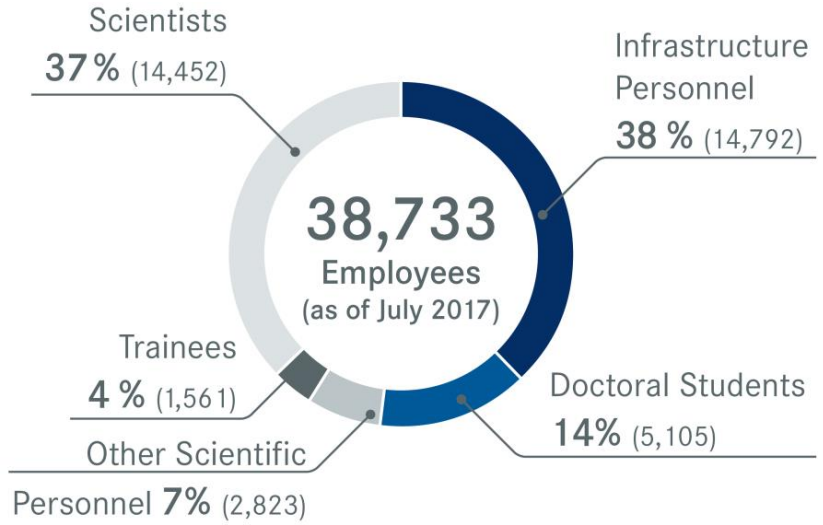
Mission, 6 research fields; personnel and budget 2017

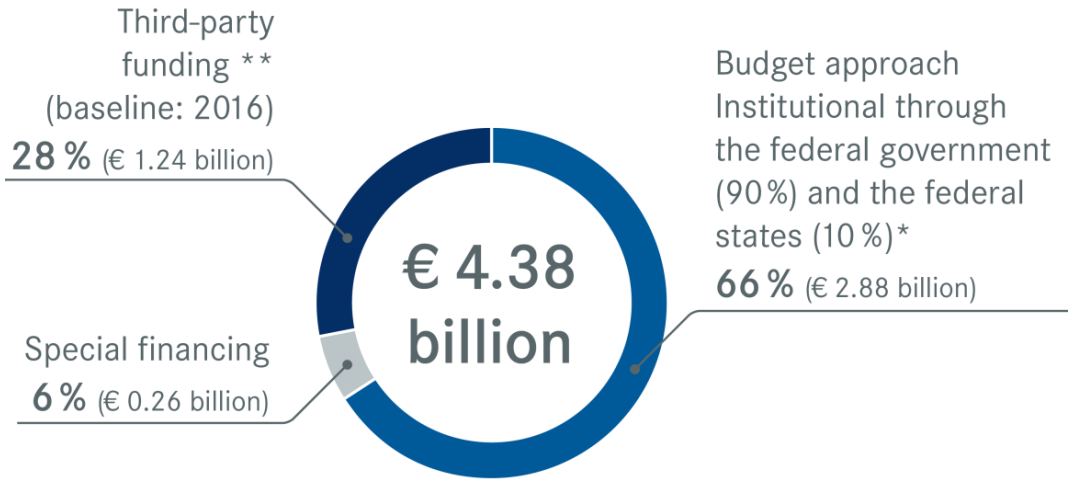
Systems solutions for grand challenges based on:

- Scientific excellence, interdisciplinarity and critical mass, long-term research programmes

Profound expertise in large scale research infrastructures

Helmholtz as a prime strategic partner at local, national and international level (5/7year funding cycles)





* As of 2016, the German federal government alone is financing the pact increase so that the federal government's share is over 90%.
** Including project sponsorships

Funding Landscape

In Germany: different players …
Funding lines

CERN

CERN budget

Collaborative research

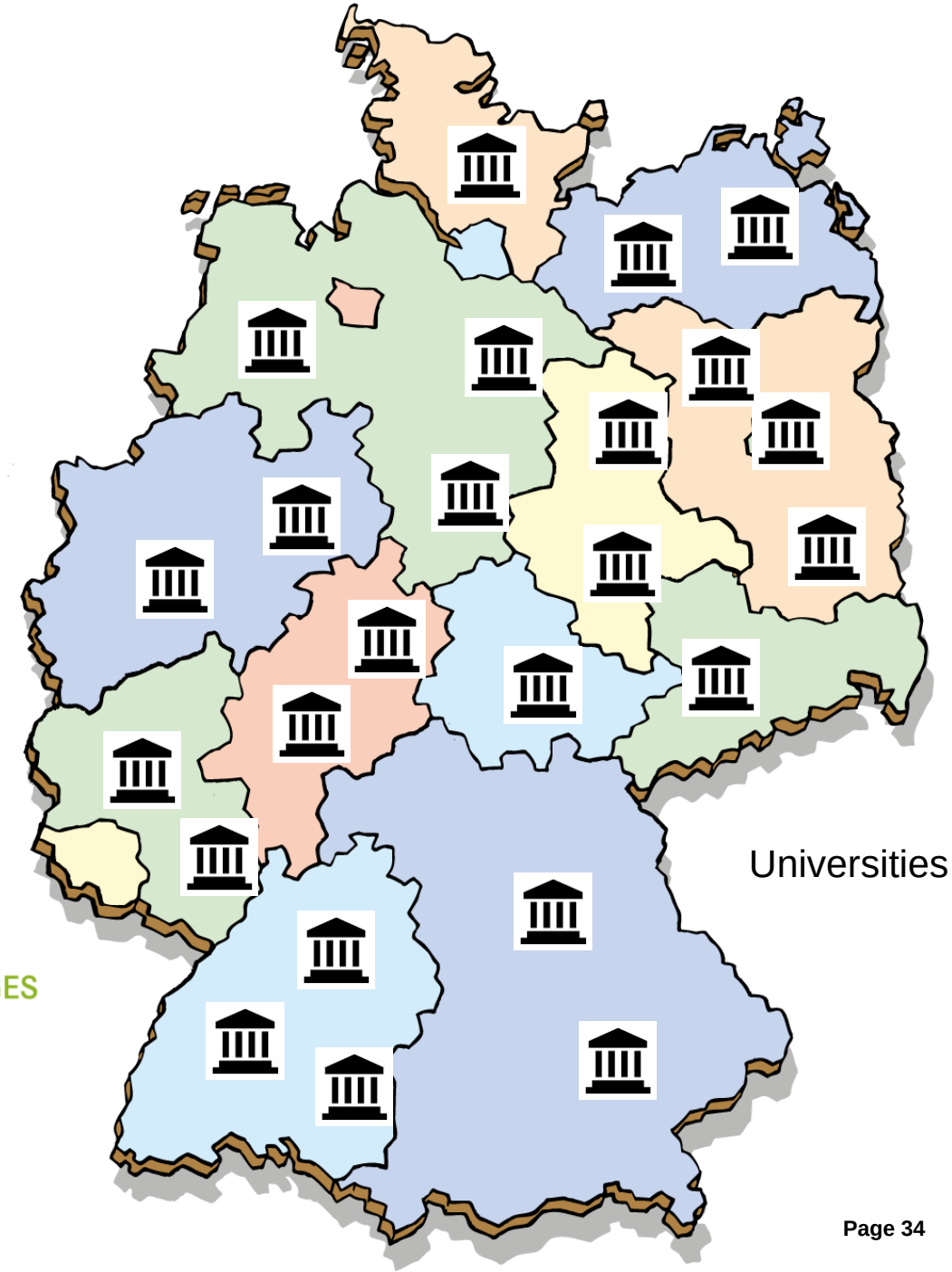
Project funding

Base+ project funding

HELMHOLTZ

RESEARCH FOR GRAND CHALLENGES

DESY.



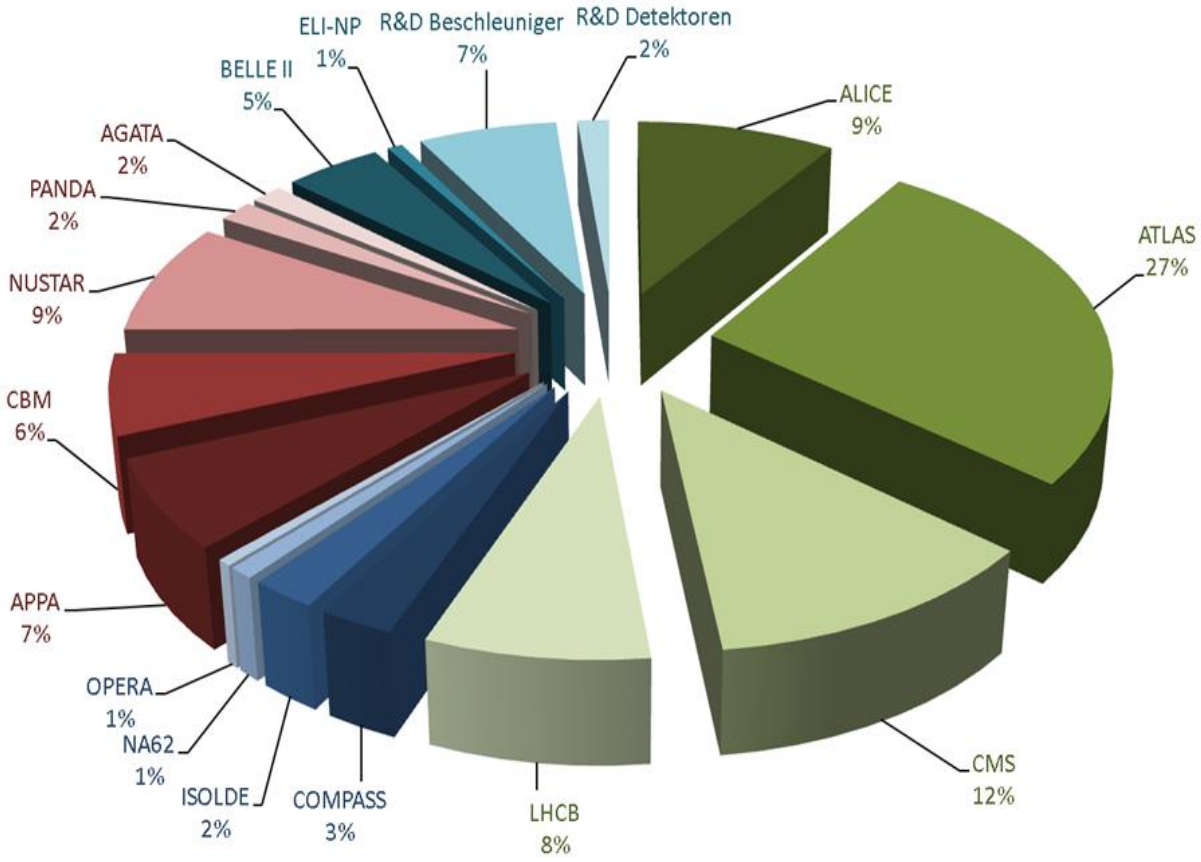
Universities

Plus EU and DFG project funds
Plus Max Planck Society

German Federal Funding for HEP

Interplay of different funding instruments

“Collaborative Research Funding”:
Physics of smallest particles 2015-2018
(102 MEUR for 3 years 2015-2018)



Example: German CERN contributions
Sum per year: 246 MEUR

Contribution CERN budget:	217 MEUR (2017)
Collaborative research (→ universities)	63.5 MEUR (3 years)
LHC detector upgrades (→ universities) (90 MEUR altogether)	16.8 MEUR (3 years)
Additional technical Ph.D. programme	2 MEUR / year

Plus Helmholtz and MPI contributions

BMBF and Strategy

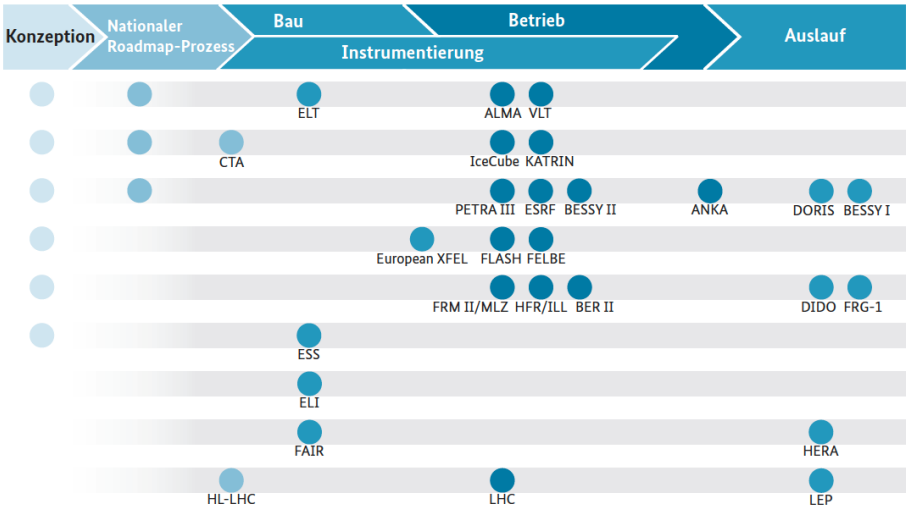
The principle

Federal Ministry of Education and Research

Investigation of the Universe and Matter
Framework Programme

DESY.

National RI roadmap



Research goals

Federal Ministry of Education and Research

Input, stakeholder

ESFRI Projects Landmarks ROADMAP 2016

Sends officials

Group of Senior Officials on Global Research Infrastructures

THE OECD GLOBAL SCIENCE FORUM

Influence via Council

CERN

European Strategy Update

Leading strategic (political) goals

- Enabling scientific excellence
- Strengthening future technologies, energy/material/life sciences
- Research as technology driver
- Educating experts and leaders for research and economy
- Ensuring societal participation in scientific insights and achievements

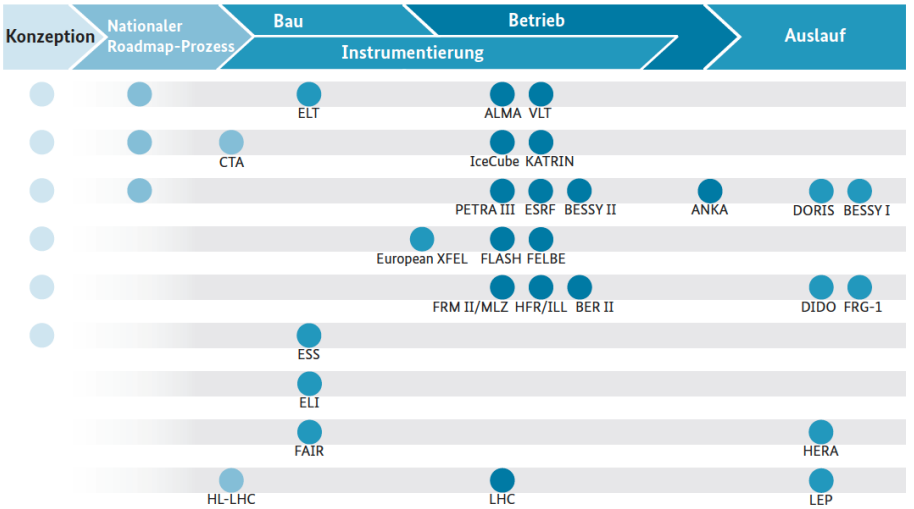
BMBF and Strategy

The principle

Federal Ministry of Education and Research

Investigation of the Universe and Matter
Framework Programme

National RI roadmap



DESY.

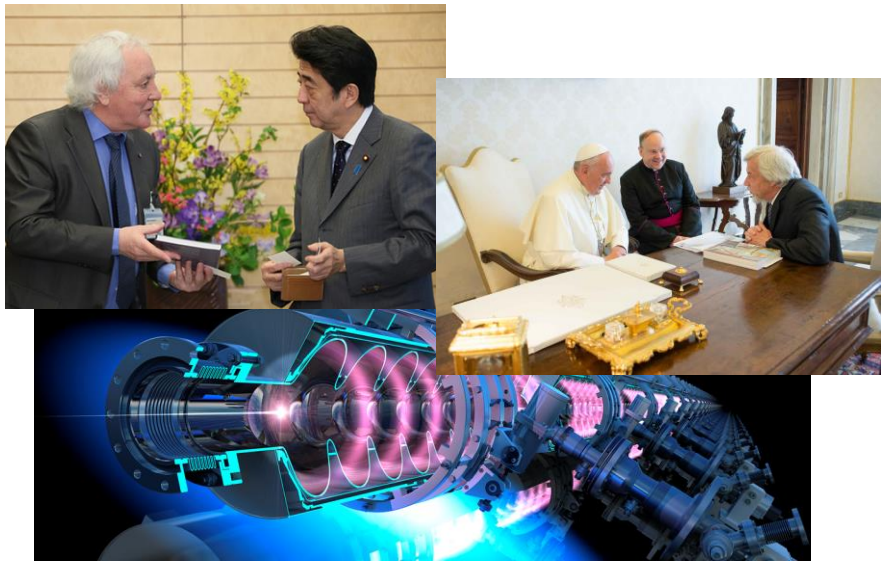
Research goals

Federal Ministry of Education and Research

Input, stakeholder

ESFRI Projects Landmarks ROADMAP 2016

High-level political processes



Influence via Council

Sends officials

CERN

European Strategy Update

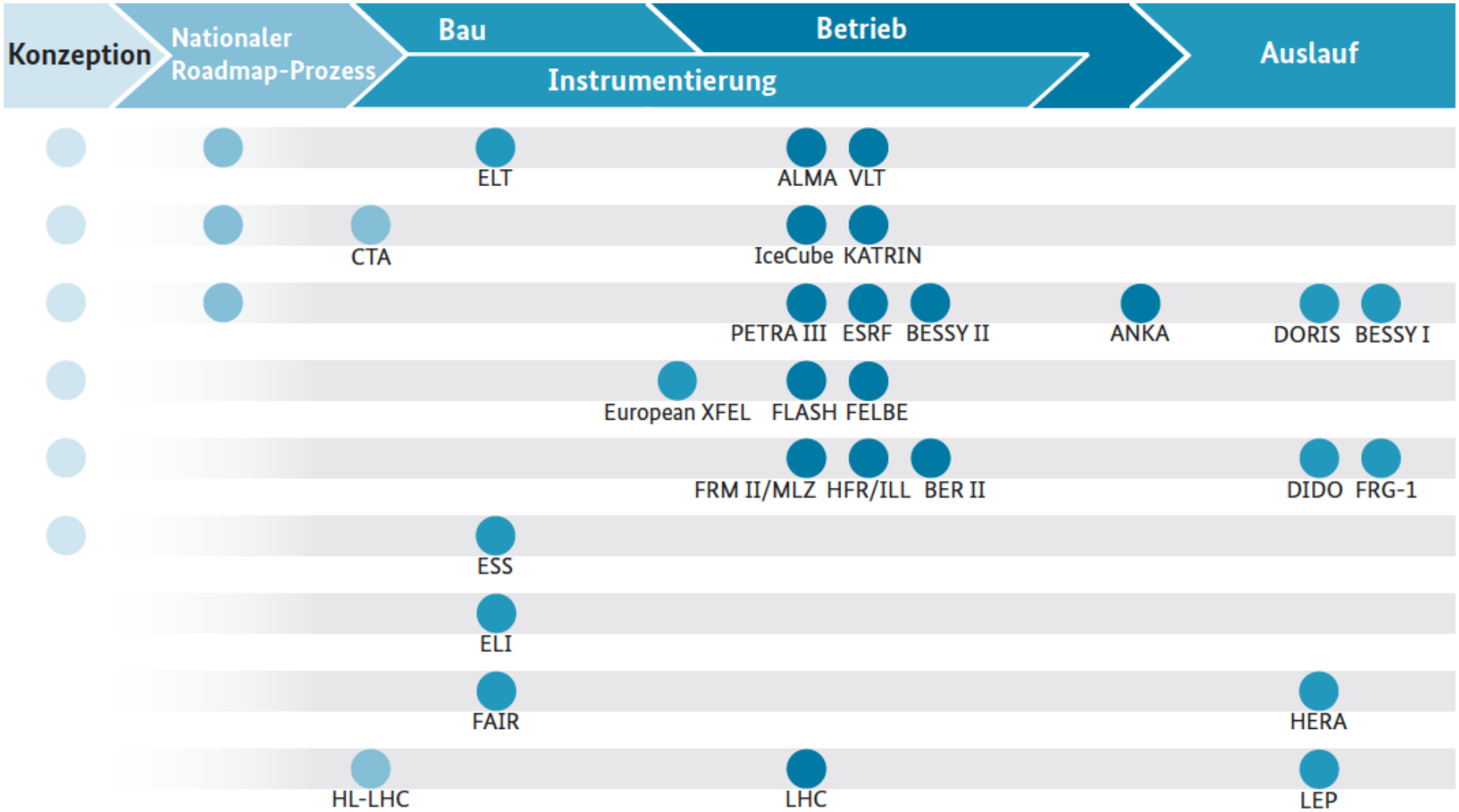
Group of Senior Officials on Global Research Infrastructures

THE OECD GLOBAL SCIENCE FORUM

BMBF Roadmap

For research infrastructures

Next update of German roadmap:
2020-2022 → suits ILC / ESU?

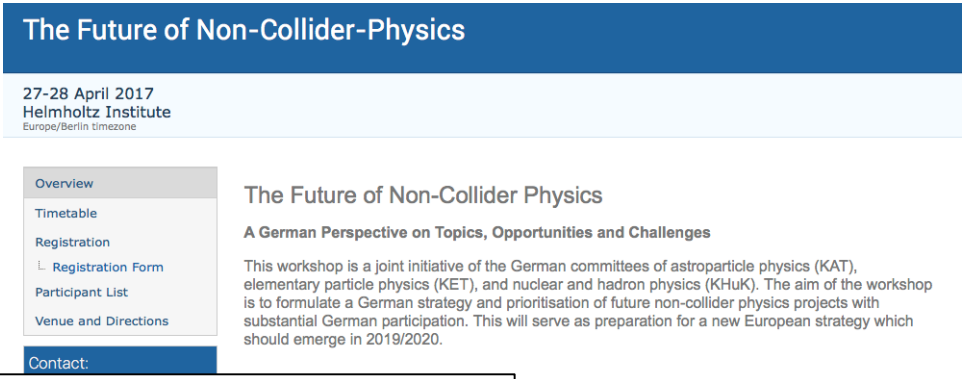


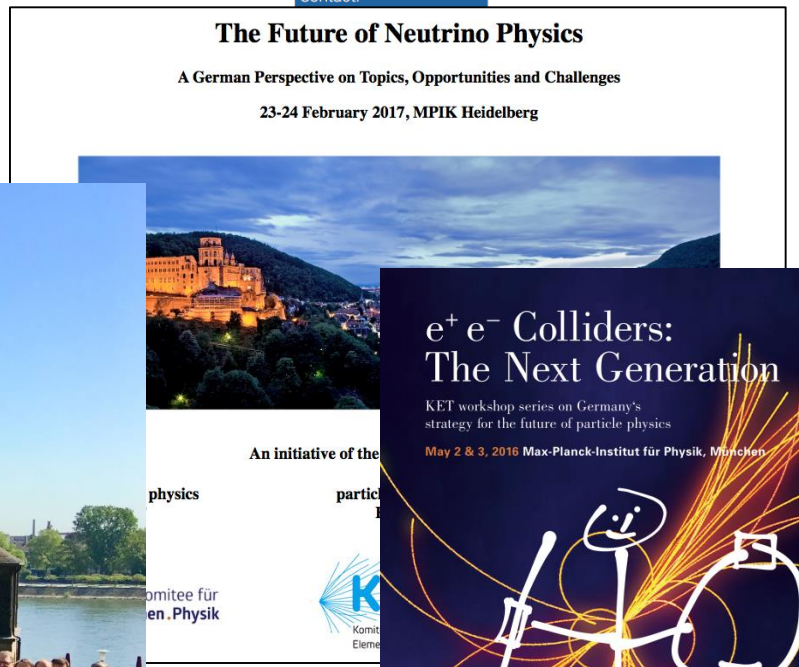
German Strategy Process

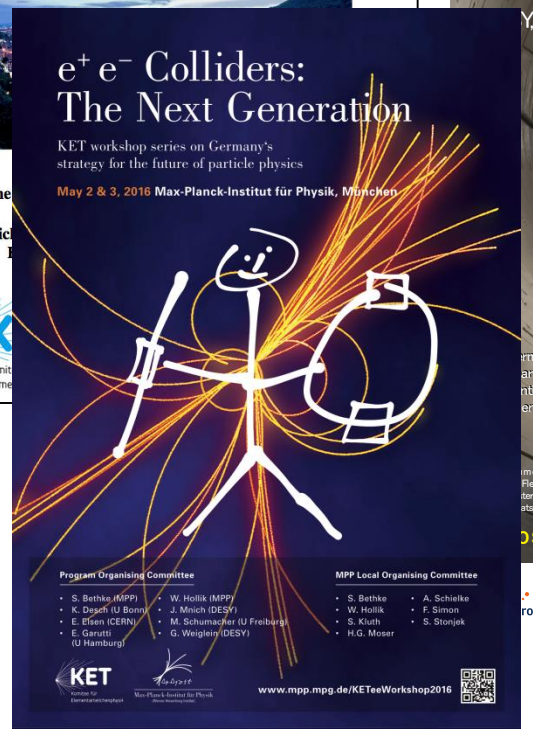
Organised by KET (similar to JAHEP?)

Since 2016: Strategy discussion in German Committee for Elementary Particle Physics (KET)

- Concluding statements as input to ESU
- German community has clear picture of future
- Input to BMBF / ESU







German Strategy

Draft conclusions (translation by TS); final document input to ESU (Nov. 2018)

"The strong German participation in the LHC and HL-LHC experiments shall be maintained at the same level."

"An e+e- collider shall be realized with the highest priority; upgradeable to at least 500 GeV."

- *"We emphasise our support for the Japanese initiative to realise, on a short timescale, the ILC as a "Higgs factory" with an initial energy of about 250 GeV as an international project ."*
- *"The option to upgrade the machine to higher energies (at least 500 GeV) shall be incorporated into the plans […]"*

"… significant development efforts in the areas of high-field magnets and of detectors are necessary."

Search for Axions or Axion-like particles

- Substantial interest in e.g. DARWIN, IAXO, MADMAX

" A visible participation of German groups in a long-baseline experiment, in particular in LBNF/DUNE, is strongly supported."

Importance of national and international labs, and of theory.

DESY 2030 Strategy Process and DESY HEP Strategy

- DESY
- DESY-2030 Strategy Process
- HEP Strategy

DESY in a Nutshell

The national laboratory for particle physics

DESY:

Foundation 1959

Research center within the Helmholtz Association

Two sites:
Hamburg and Zeuthen (1992)

250 Mio. € base budget (2017)
(90% federal, 10% state)

2450 staff (2017)

3000 visiting scientist per year from 45 nations

30 % research, 70 % facilities

Mission:

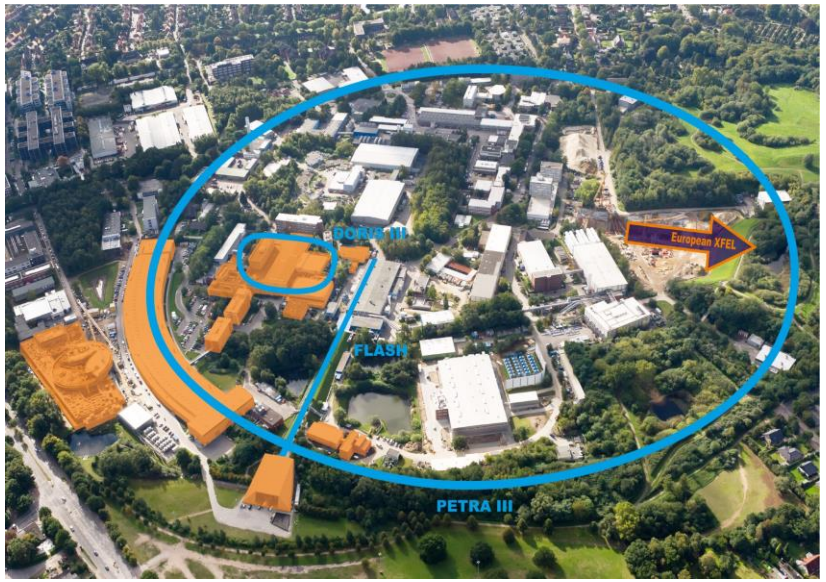
Development, construction, operation and scientific exploitation of accelerators

Provide access and services for national and international users

Exploration of matter (particle physics, photon science, …)

DESY in a Nutshell

Three research divisions, plus operation of the European XFEL

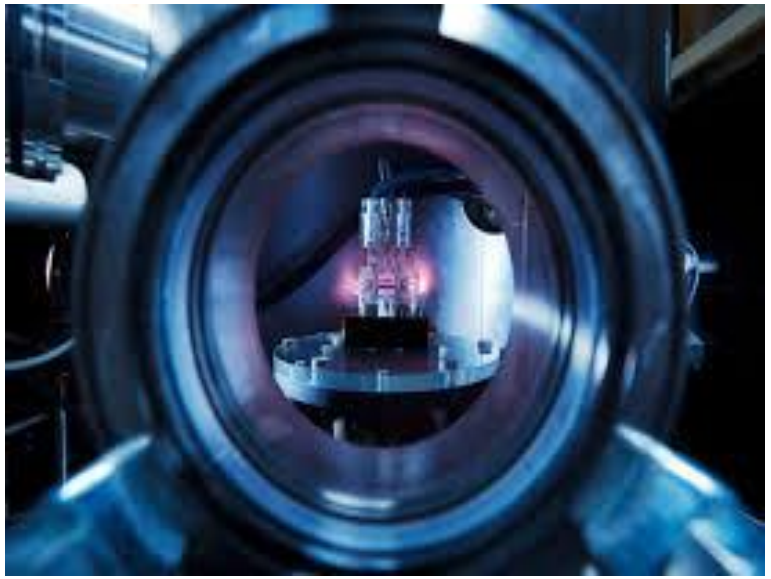


Photon Science:

Development of photon-science experiments and detectors

Research in “Matter – Dynamics, Mechanisms, Control”, “Biological and Soft Matter”, “Nano and Material Sciences”

Collaboration with universities, Max Planck etc. (CFEL, CSSB, …)



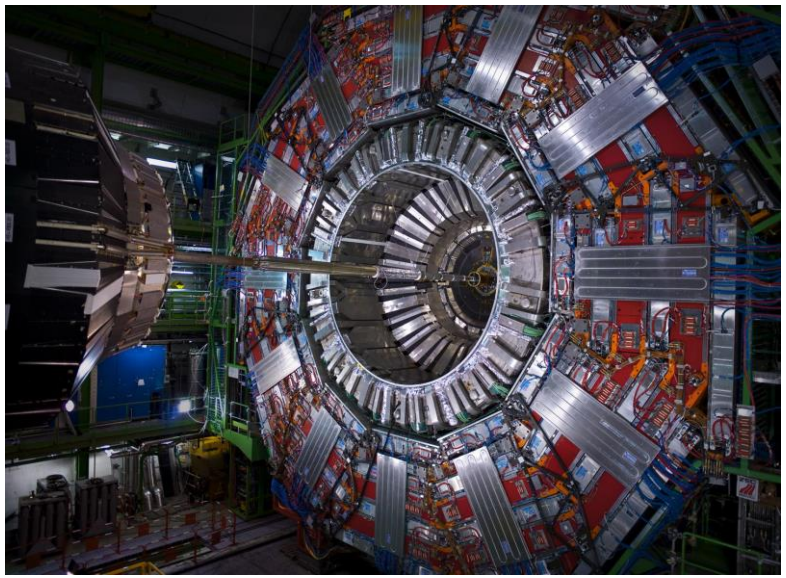
Accelerators:

Development of (electron) accelerators and FELs.

Construction of on-site accelerators.

Operation of FLASH I/II, PETRA 3 (4), European XFEL

Plasma-wakefield accelerator, THz acceleration, …



Particle Physics:

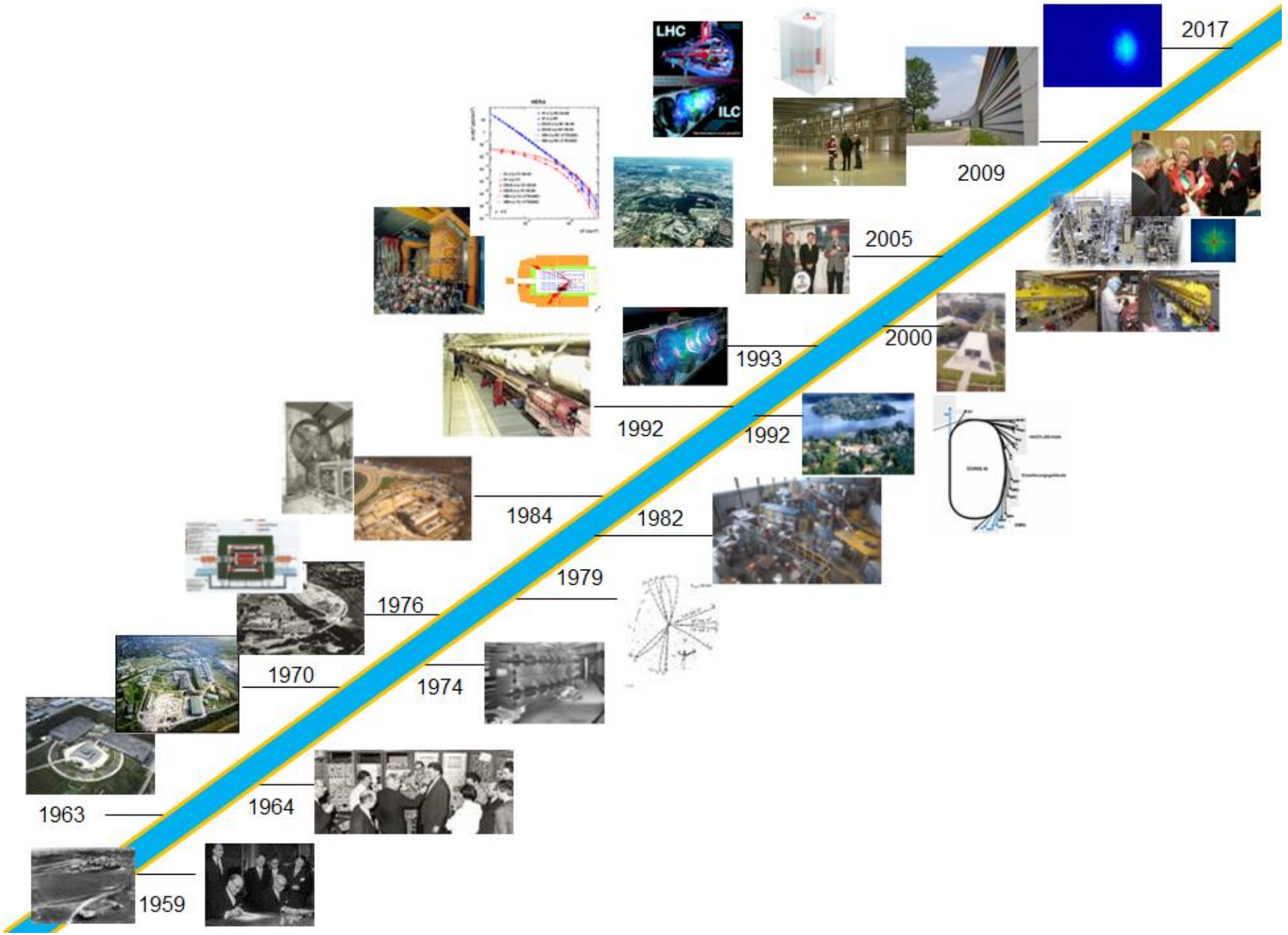
Design, development, construction, operation and analysis of particle physics experiments

ATLAS, CMS, Belle II, ALPS, ILC…

Astroparticle physics with e.g. IceCube, CTA, …

Computing

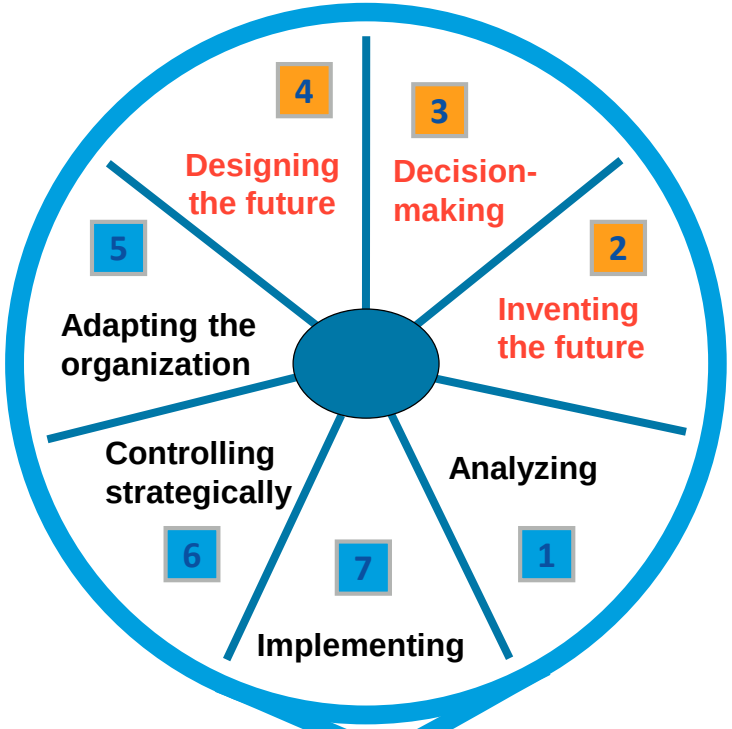
DESY


LHC
ILC
2017
2009
2005
2000
1993
1992
1992
1984
1982
1979
1976
1974
1970
1964
1963
1959

The Strategy Loop

3. Strategic Decisions
- Assess options
- Chances / Risk potential
- Strategic gap

4. Positioning
- Vision/mission statement
- Core strategy (formulated)
- Strategic initiatives & programs



2. Strategic Options
- Strategic goals
- Research portfolio
- Positioning

5. Check Organizational Design
- Leadership structures
- Organizational structure
- Process optimization
- In-/Outsourcing

1. Strategic Analysis
- Market/competition
- Strengths/weaknesses
- Existing core competencies
- Strategic challenges

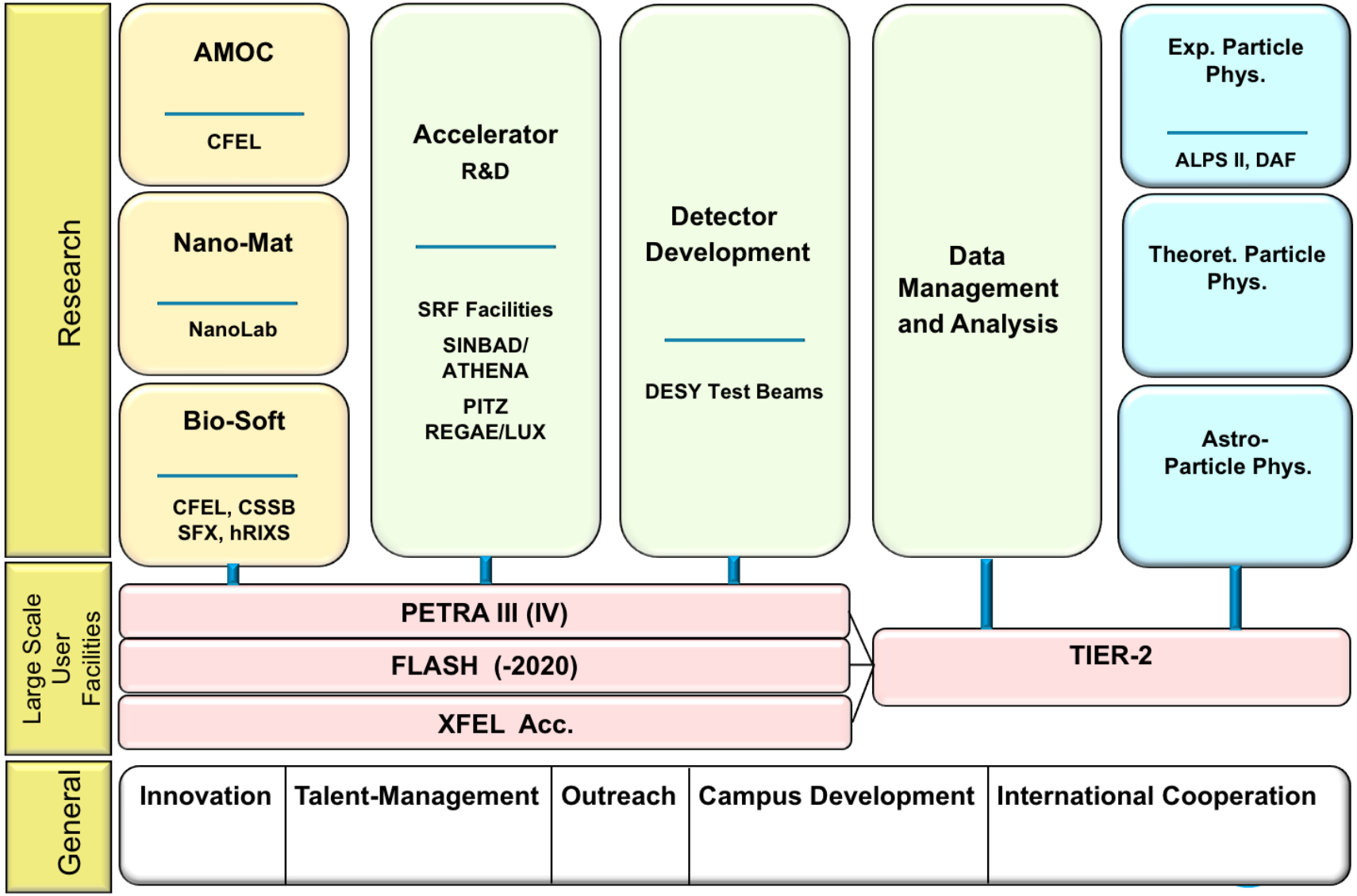
6. Governance & Controlling Systems
- Strategic controlling (results, impact)
- Controlling strategic initiatives
- Monitoring progresss

7. Implementation

- Change management - Communication, HR development - Leadership instruments
- Monitoring progress - Support - Review

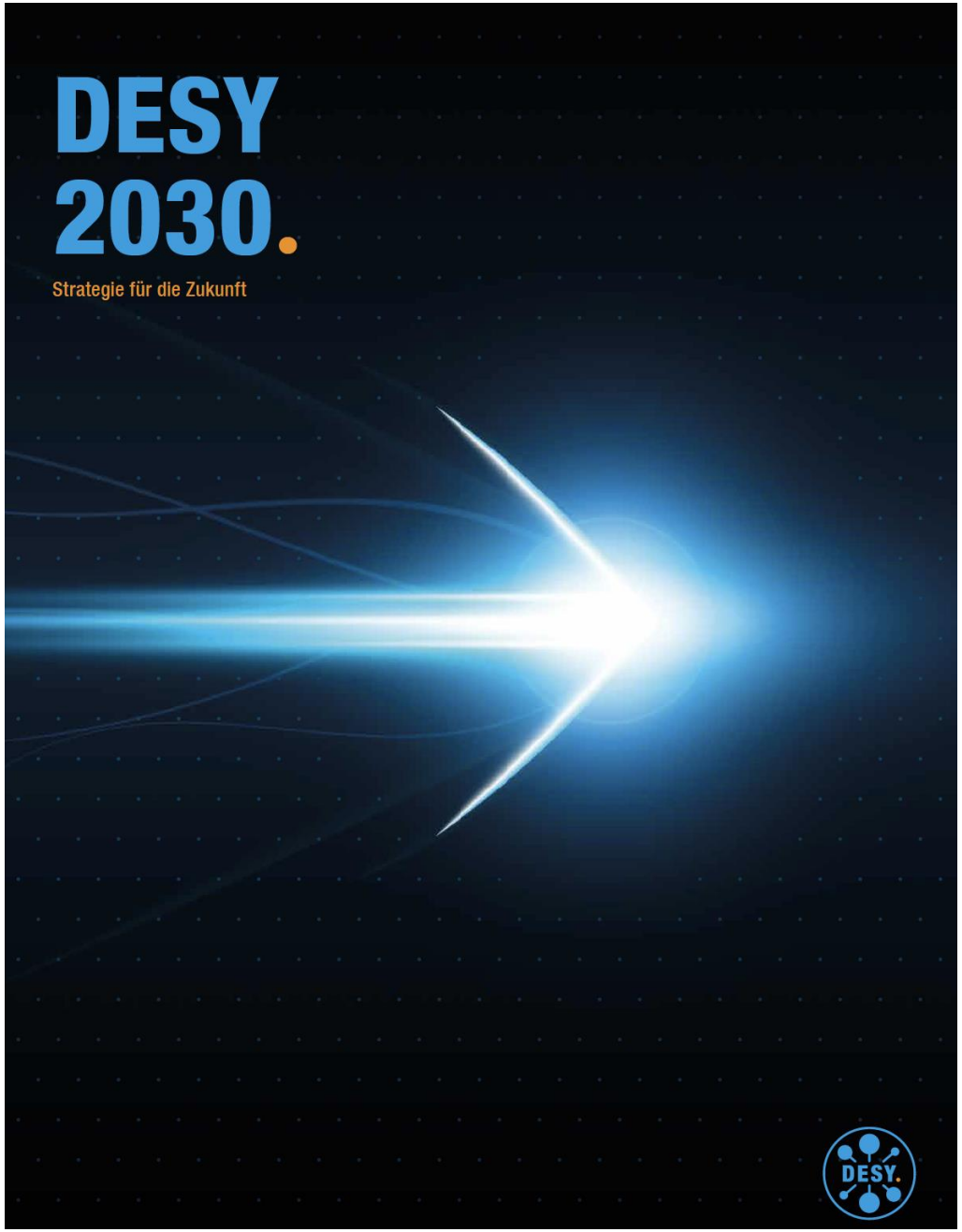
DESY “Competence Teams”

Providing input to the lab strategy



DESY-2030 – Output

A brochure …

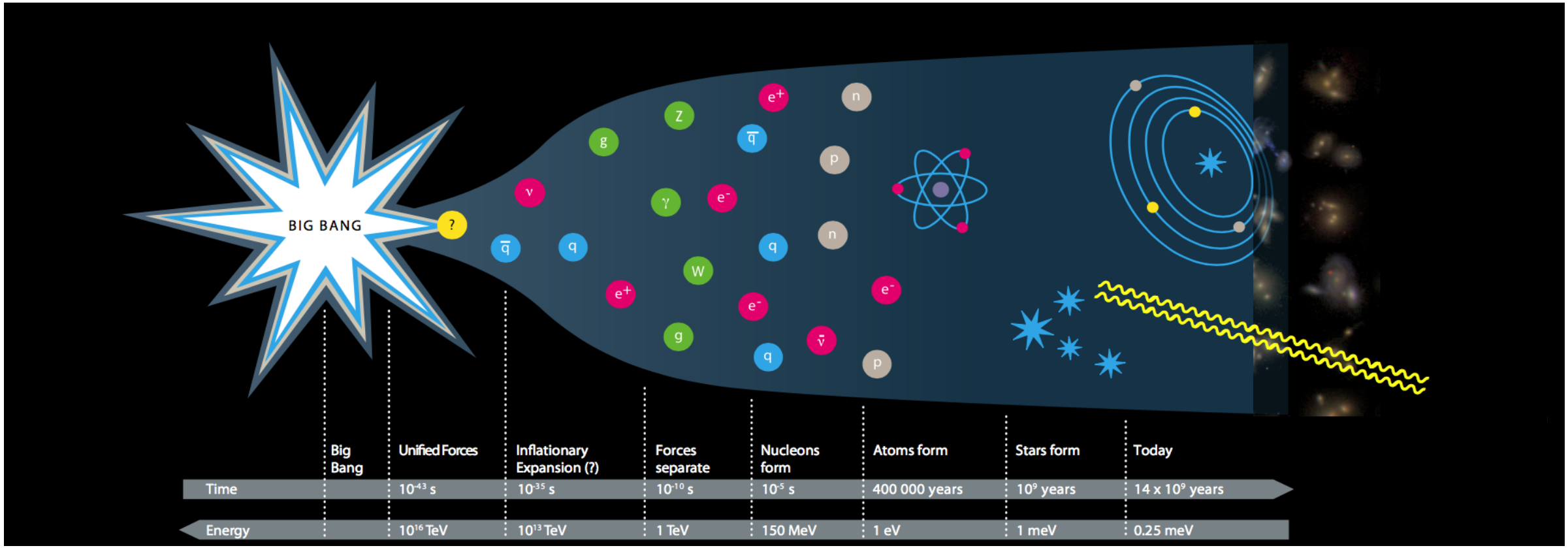


The Mission of Particle Physics

… and our “science drivers”

Understanding the most elementary building blocks of matter, their interactions, and their influence on the development of the universe.

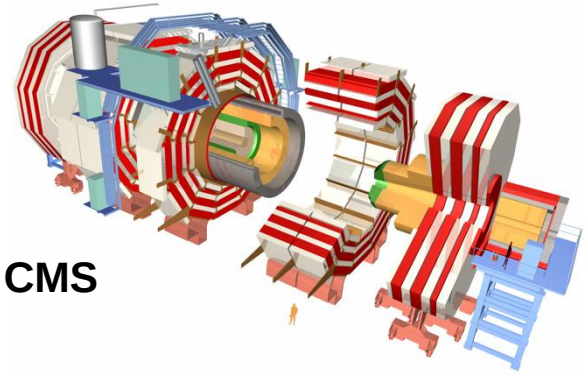
Our current picture is incomplete and partly inconsistent, and the entire effort in particle physics is dedicated to solving the related scientific challenges.



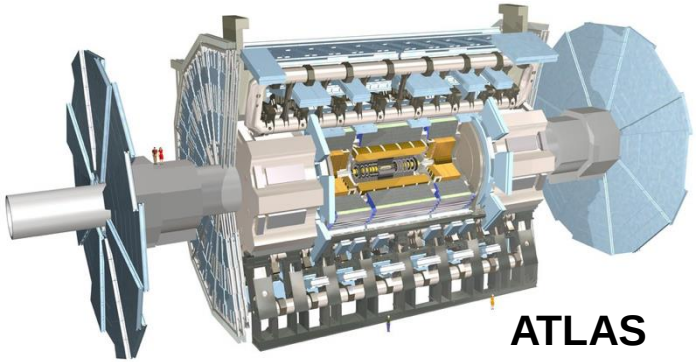
Science Drivers

Big open questions

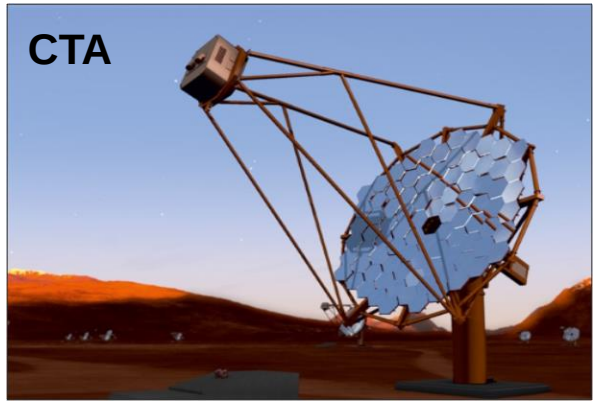
- Structure of the vacuum
- Nature of the Higgs boson
- Theory beyond SM
- Dark matter
- (Anti)Matter asymmetry
- Neutrino properties
- Cosmic accelerators



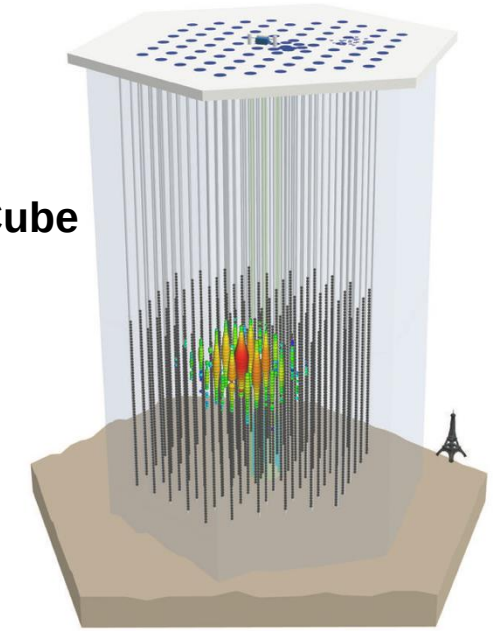
CMS



ATLAS

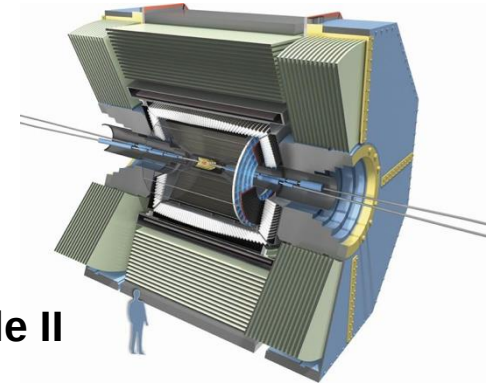


CTA



IceCube

Theory



Belle II

Particle Physics Strategy

From the DESY 2030 strategy process

Explore the LHC and beyond

- Upgrade ATLAS and CMS for HL-LHC
- Prepare leading participation in future global collider project

Harvest at Belle II

- Data taking and analysis until ~2027

On-site experiment

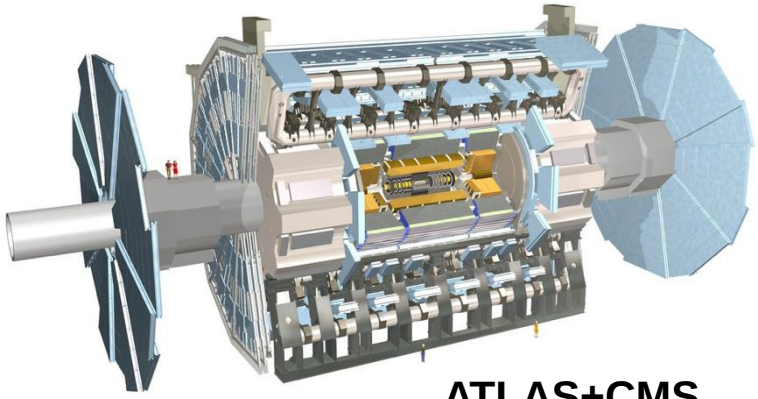
- Prepare a future on-site experiment after ALPS-II
- Detector R&D & testbeam operation

Theory:

- Maintain broad spectrum of research topics and world-leading expertise

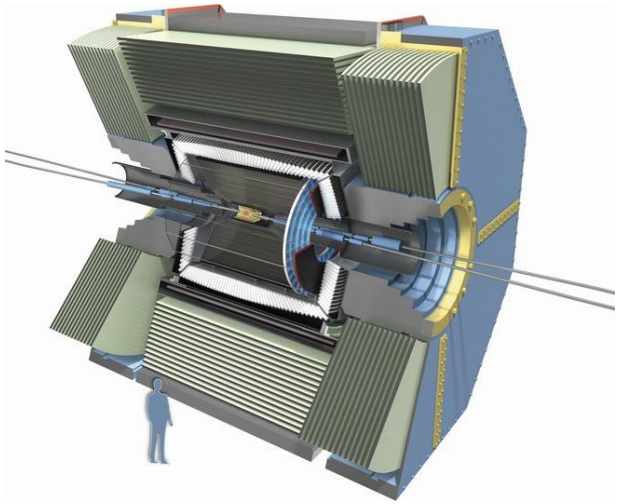
DESY as a "hub":

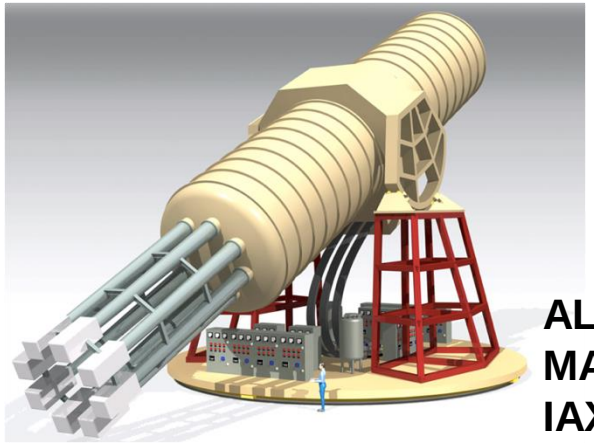
- Support projects with large German participation



ATLAS+CMS

Belle II

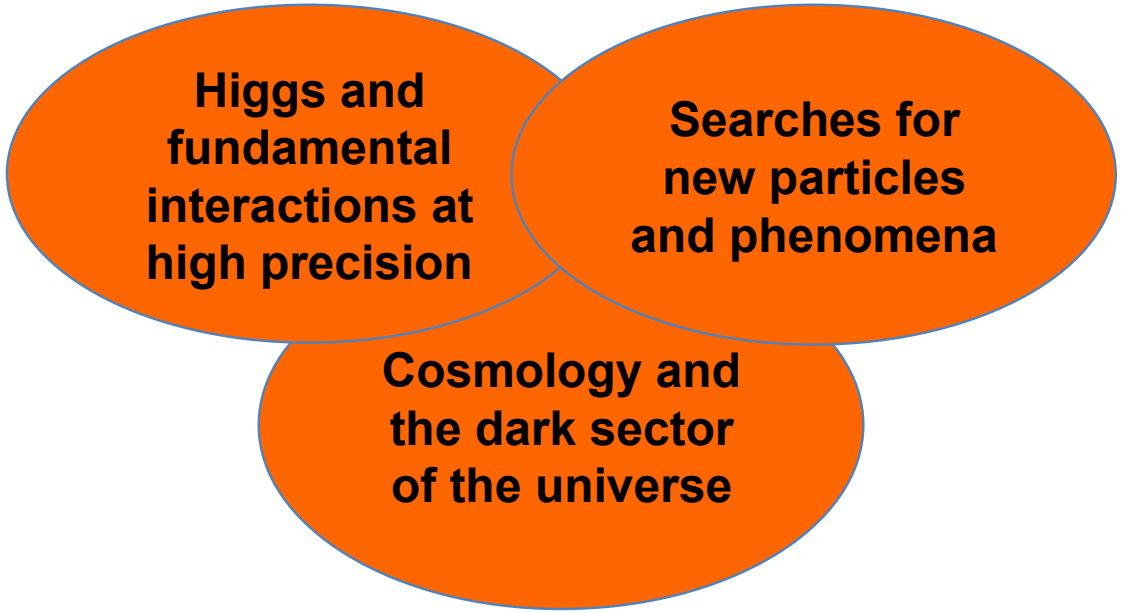




ALPS-II
MADMAX
IAXO

Future Strategic Orientation

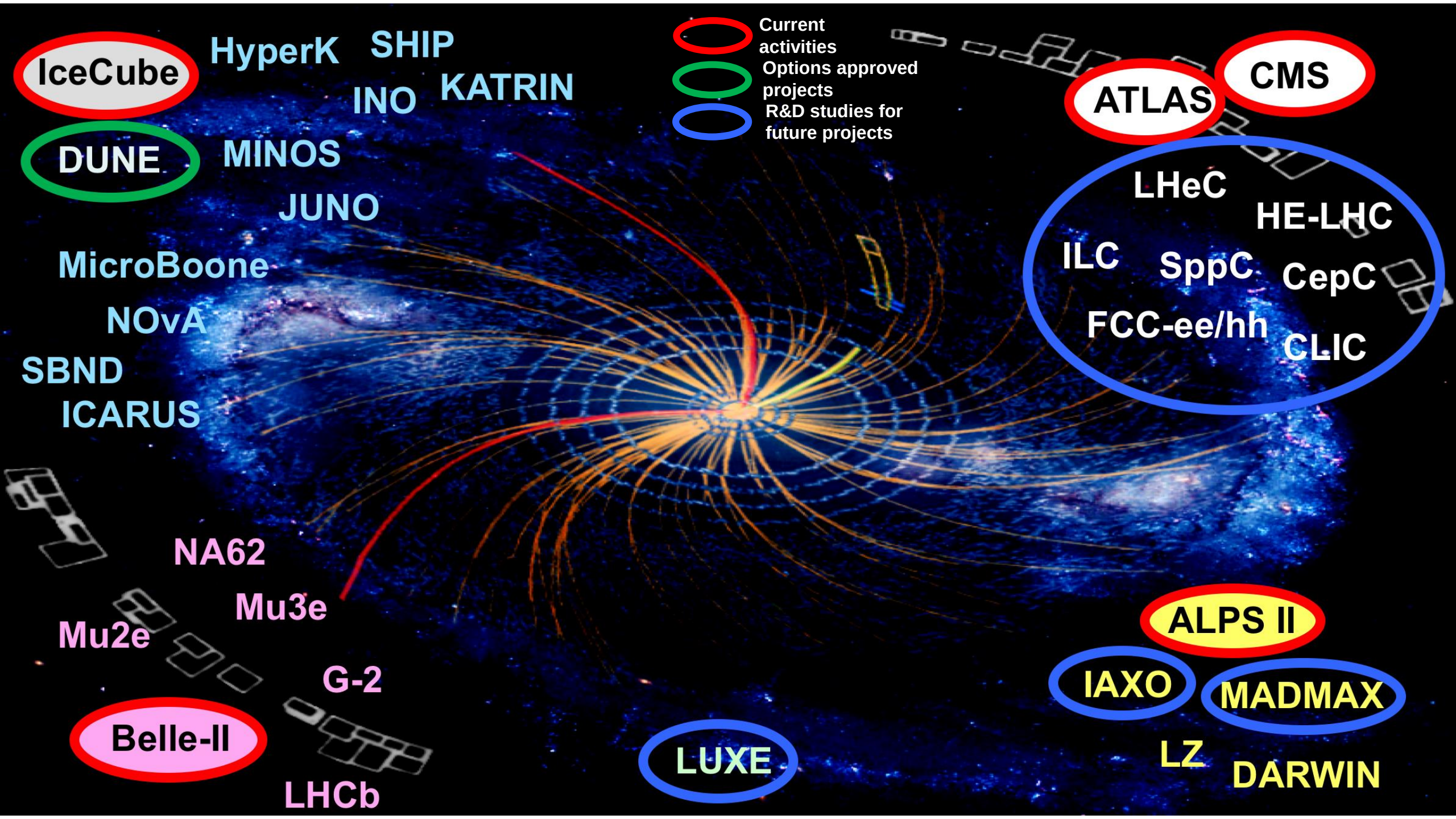
Focusing on science drivers



Theory

Detectors (ATLAS, CMS, Belle II, …) at large facilities (LHC, SuperKEKB, …)

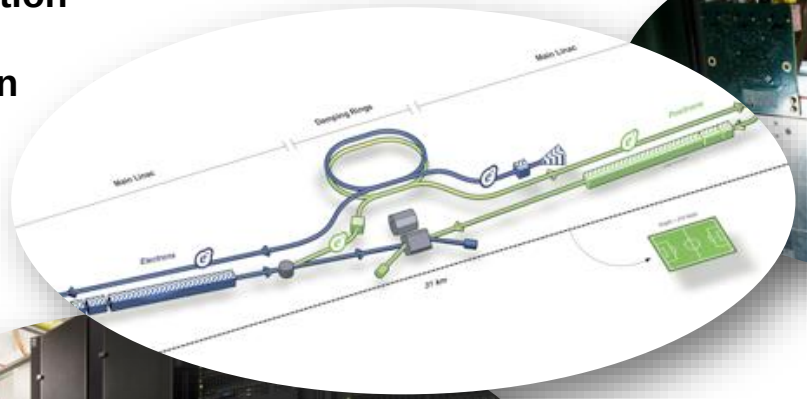
Big data, information and data analytics


Current activities
Options approved projects
R&D studies for future projects
IceCube
HyperK
SHIP
KATRIN
INO
DUNE
MINOS
JUNO
MicroBoone
NOvA
SBND
ICARUS
ATLAS
CMS
LHeC
HE-LHC
ILC
SppC
CepC
FCC-ee/hh
CLIC
NA62
Mu3e
Mu2e
G-2
Belle-II
LHCb
LUXE
ALPS II
IAXO
MADMAX
LZ
DARWIN

DESY Particle Physics – Lifecycle Competence

And long-term planning ability

Conception
Design
Decision

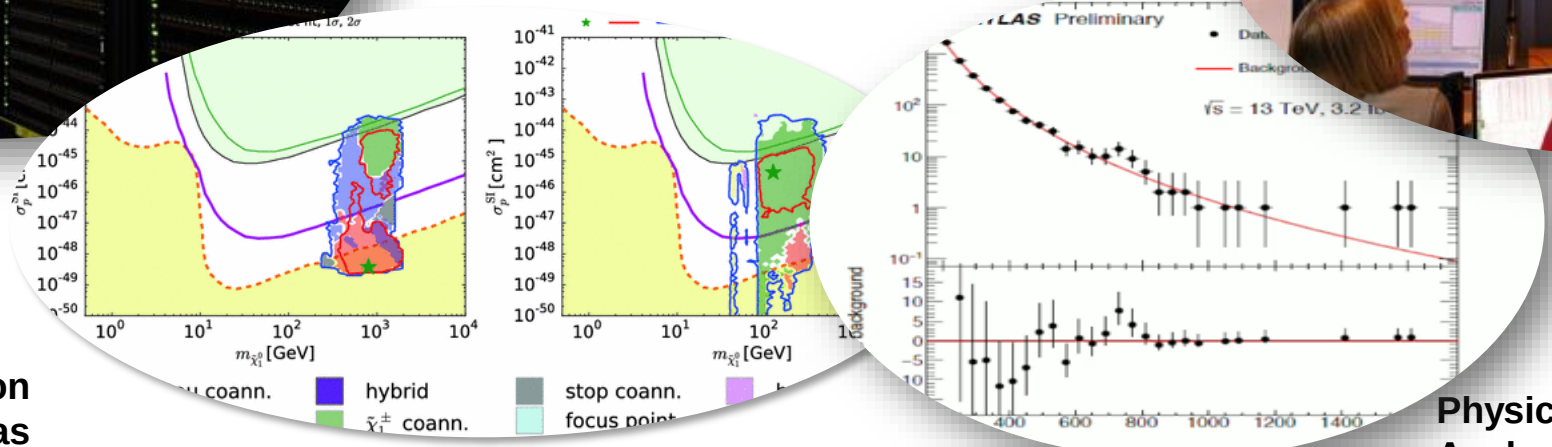


R&D

Construction
Commissioning

Data preservation
Outreach into society

Operation



Interpretation
New ideas

Physics analysis
Analysis strategy

HEP Strategy in Other (European) Countries

- USA
- France
- Italy
- UK

HEP Strategy in Other Countries

- USA
- France (Patrice Verdier / IN2P3)
- Italy
- UK

Institut national de physique nucléaire et de physique des particules

www.in2p3.fr

IN2P3

Patrice Verdier

Particle Physics Programme at IN2P3

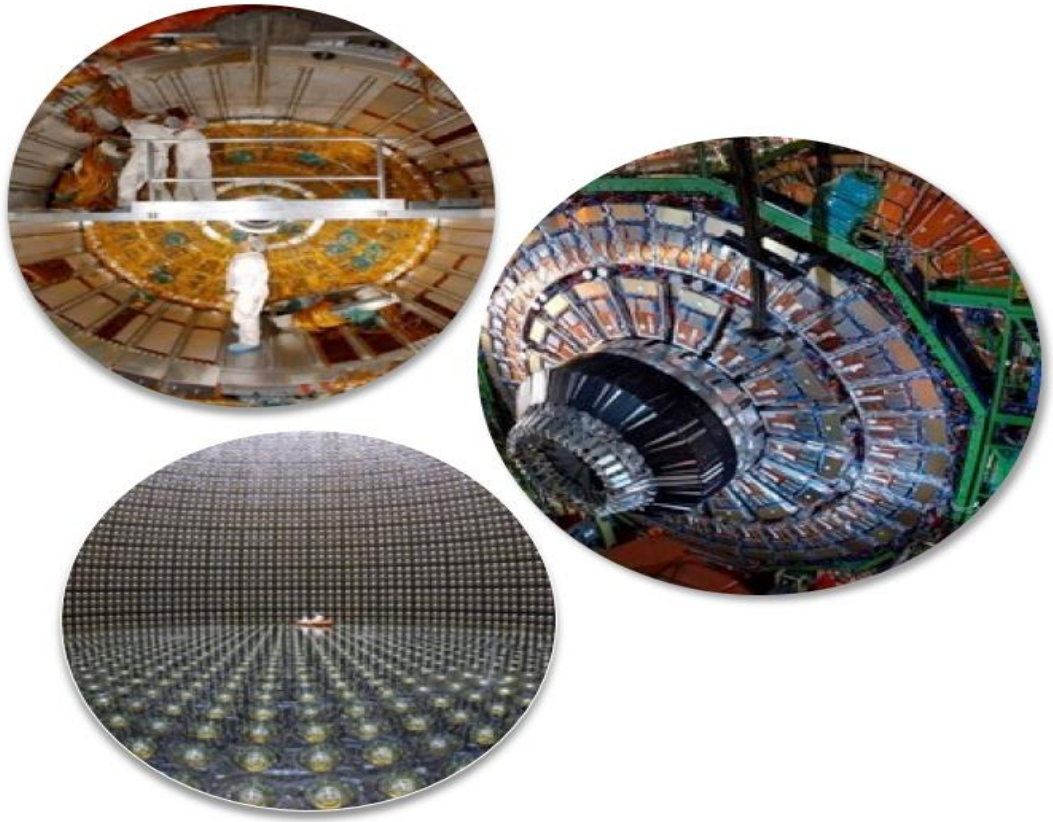
- Participation in all 4 major LHC experiments :
  ATLAS, CMS, LHCb, ALICE
  Physics of and beyond the standard model
  B-physics and fundamental symmetries
  Heavy-Ion physics

- B-physics at e^+e^- collider
  Belle-II (since 2017)

- Neutrino program:
  Accelerator based
  T2K, DUNE (Proto-DUNE-DP)
  Non-accelerator
  KM3NeT, SUPERNEMO, SuperKamiokande
  Reactor
  Double-Chooz, JUNO, STEREO, Solid

- Participation in precision physics experiments
  nEDM, GRANIT, Comet, AEgIS & Gbar

- Detector R&D for ILC:
  CALICE (SiW and SDHCAL)
  CMOS sensors (micro-vertex)



- Hadronic physics
  ALICE, CMS & LHCb HI
  J-Lab and Hades/GSI

- Direct dark matter detection
  Edelweiss, DAMIC
  XENON, Darkside

IN2P3 and ESU

- **IN2P3 input to ESPP is being prepared: it will be ready during Fall 2018**
  - Community driven inputs: scientific considerations from experimentalists and theorists
  - Associated technology into considerations: detector and accelerator R&D, computing
  - Related topics also discussed: Dark energy, gravitational waves, …

Some guidelines for this preparation:

- **Exploit CERN facilities and develop them for its long term future**
  - Physics programs at CERN represent ~2/3 of IN2P3 activities in HEP

- **Exploit European and French Research Infrastructures**

  Exploit and consolidate physics program at European infrastructures, in particular at:
  - Km3net, Laboratoire Souterrain de Modane, ILL, LNCA, Gran Sasso, FAIR, PSI, …

- **Strengthen IN2P3 participation in HEP programs in the US**
  - Neutrino program at Fermilab: Preparation of DUNE
  - Hadronic physics at J-Lab

- **Consolidate IN2P3 participation in HEP programs in Asia**
  - Neutrino program in Japan: T2K and its upgrade, SK, some interest for HK
  - Neutrino program in China (JUNO)
  - IN2P3 joined the Belle-II collaboration (2017)
  - Strong interest for ILC : accelerator based on XFEL developments, detector R&D

HEP Strategy in Other (European) Countries

- USA (J. Siegrist / DOE)
- France
- Italy
- UK

U.S. DEPARTMENT OF ENERGY | Office of Science

Status of the DOE High Energy Physics Program

High Energy Physics Advisory Panel
May 2018

Jim Siegrist
Associate Director for High Energy Physics
Office of Science, U.S. Department of Energy

P5 Long-Term Particle Strategy

2014 P5 report

Developed 2012-2014 (Snowmass, P5)

Supported by US HEP community

Supported by DOE, Congress

Recognized by international community through global partnership

LHC is „centerpiece of the U.S. energy frontier program“ (US ~19% of ATLAS, 29% of CMS);

US also contributing massively to LHC machine upgrade.

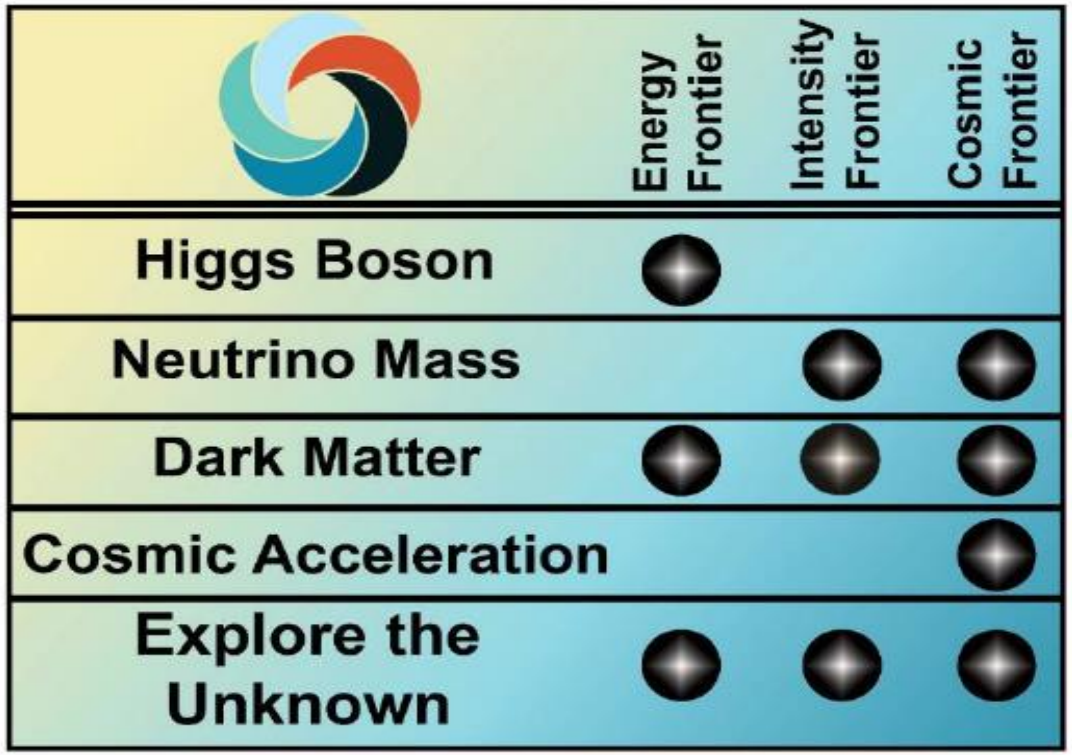
Science Drivers

And research frontiers

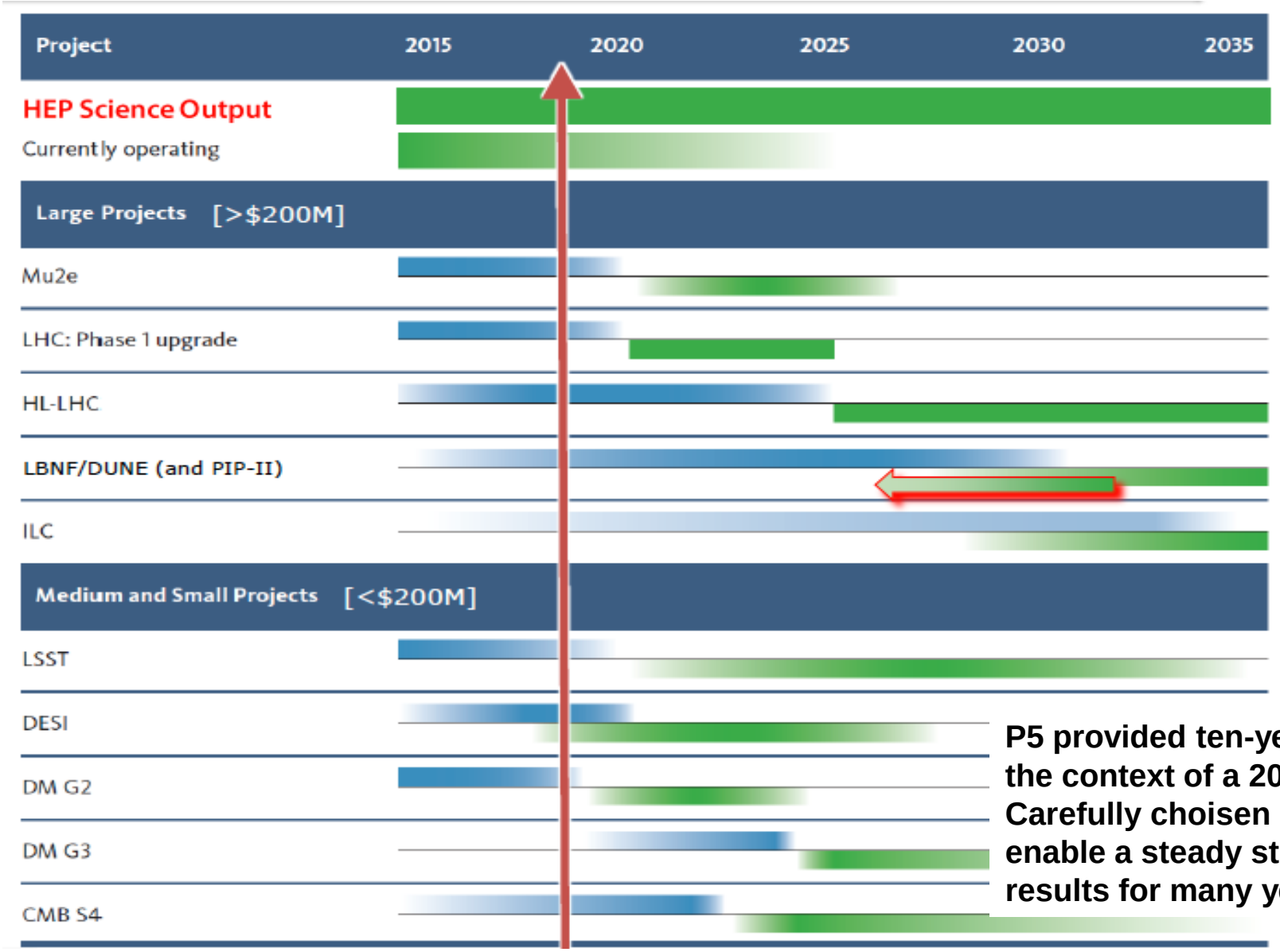
The U.S. long-term strategy report identified five **intertwined science drivers**, compelling lines of inquiry that show great promise for discovery:

- Use the **Higgs boson** as a new tool for discovery *2013
- Pursue the physics associated with **neutrino mass** *2015
- Identify the new physics of **dark matter**
- Understand **cosmic acceleration**: dark energy and inflation *2011
- **Explore the unknown**: new particles, interactions, and physical principles

* *Since 2011, three of the five science drivers have been lines of inquiry recognized with Nobel Prizes*



P5 Construction and Physics Timeline



P5 provided ten-year strategic plan in the context of a 20-year global vision
Carefully choisen investments will enable a steady stream of exciting new results for many years

Future Colliders

- DOE coordinating with international community towards development of the next collider program
  - U.S. looks forward to a decision this year by Japan to host the ILC as an international project
  - Global strategy for circular collider awaits 2020 European Strategy Update for Particle Physics
- Interest from HEP community to pursue R&D studies for future collider options
  - Circular collider: DOE efforts focused on high-field magnet technology to enable higher energy
  - ILC: DOE efforts focused on cost reduction R&D, *e.g.*, nitrogen treatment in SRF cavities has potential for up to 10% cost reductions in 3-5 years, up to 15% in 5-10 years
- Under any fiscal constraints in the Energy Frontier program, near-term priorities will aim to support the LHC program as well as R&D for the HL-LHC upgrades

HEP Strategy in Other (European) Countries

- USA
- France
- Italy (“What Next?” white paper, 2015)
- UK

Italy

2015 “What Next?” Brochure of CSN1 (in TS’ words)

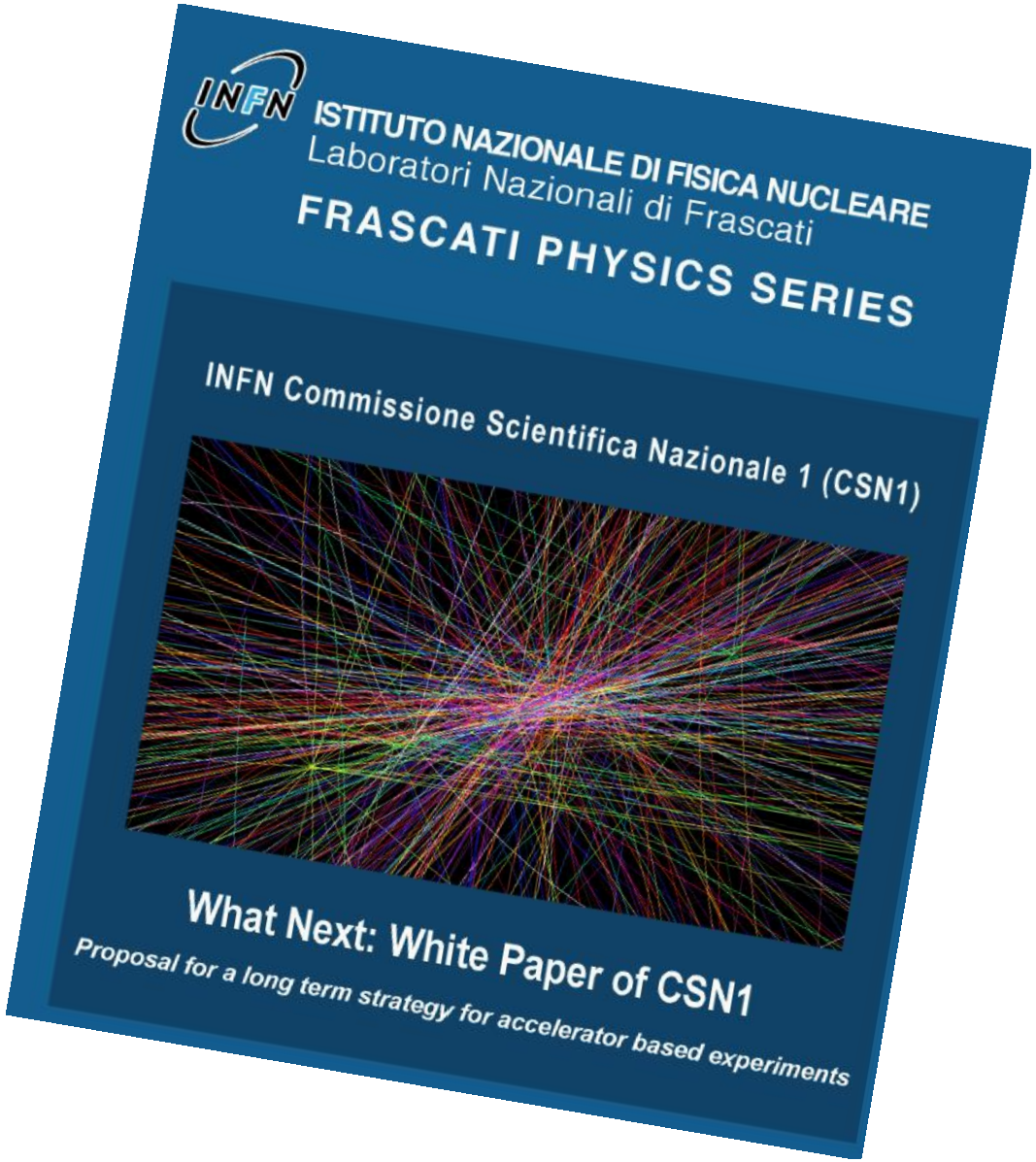
We live in a special period:
We have an important discovery (Higgs)
We have a precisely verified (!) model (SM)
We have unexplained phenomena (e.g. DM)

With the completion of the SM, we have somewhat lost guidance in the search for new fundamental particles / phenomena.

➔ **Two main science drivers for acc.-based HEP:**

- Understand the role of the newly discovered boson
- Clarify exp. observations and theoretical arguments for the existence of new physics.

Identification of relevant subjects more difficult!
➔ WGs on SM, BSM, flavour, non-pert. QCD



Italy

2015 "What Next?" Brochure of CSN1 (in TS' words)

Outcome: Drivers

Understand EW symmetry breaking

Direct searches for new physics, covering a broad range of theories

Precision measurements of and searches for highly suppressed processes testing the SM structure and delivering tight constraints on models of new phenomena

DM searches at colliders

Strategy to tackle these drivers determined by evolution of machines and detection techniques (plus resources)

#1: … continue and strengthen … support of R&D for the development of new high-field magnets and … acceleration structures.

#3: … urge experiments planned for HL-LHC to develop plans to deal with the computing issue.

#4: … continue funding of all approved experiments and … upgrades until their planned completion.

#6: The ATLAS and CMS detector upgrades for HL-LHC are the highest priority of CSN1.

#7: CSN1 supports INFN participation in studies and R&D related to future colliders. Our community must be part of the planning of the future.

#8: CSN1 supports the development of experimental proposals for new physics searches with fixed-target experiments …

This report will be updated by mid-2017. By then it will be clear if new physics is observed at LHC and most potential new experiments will have consolidated their proposals. This timing will also allow us to give our input to the update of the European strategy on particle physics planned for 2018.

HEP Strategy in Other (European) Countries

- USA
- France
- Italy
- UK → Follow-up of PPAP meeting (16/17 July): 20 September

A Word of Caution

A Word of Caution

A record of failed large projects

Superconducting Super Collider SSC (USA)

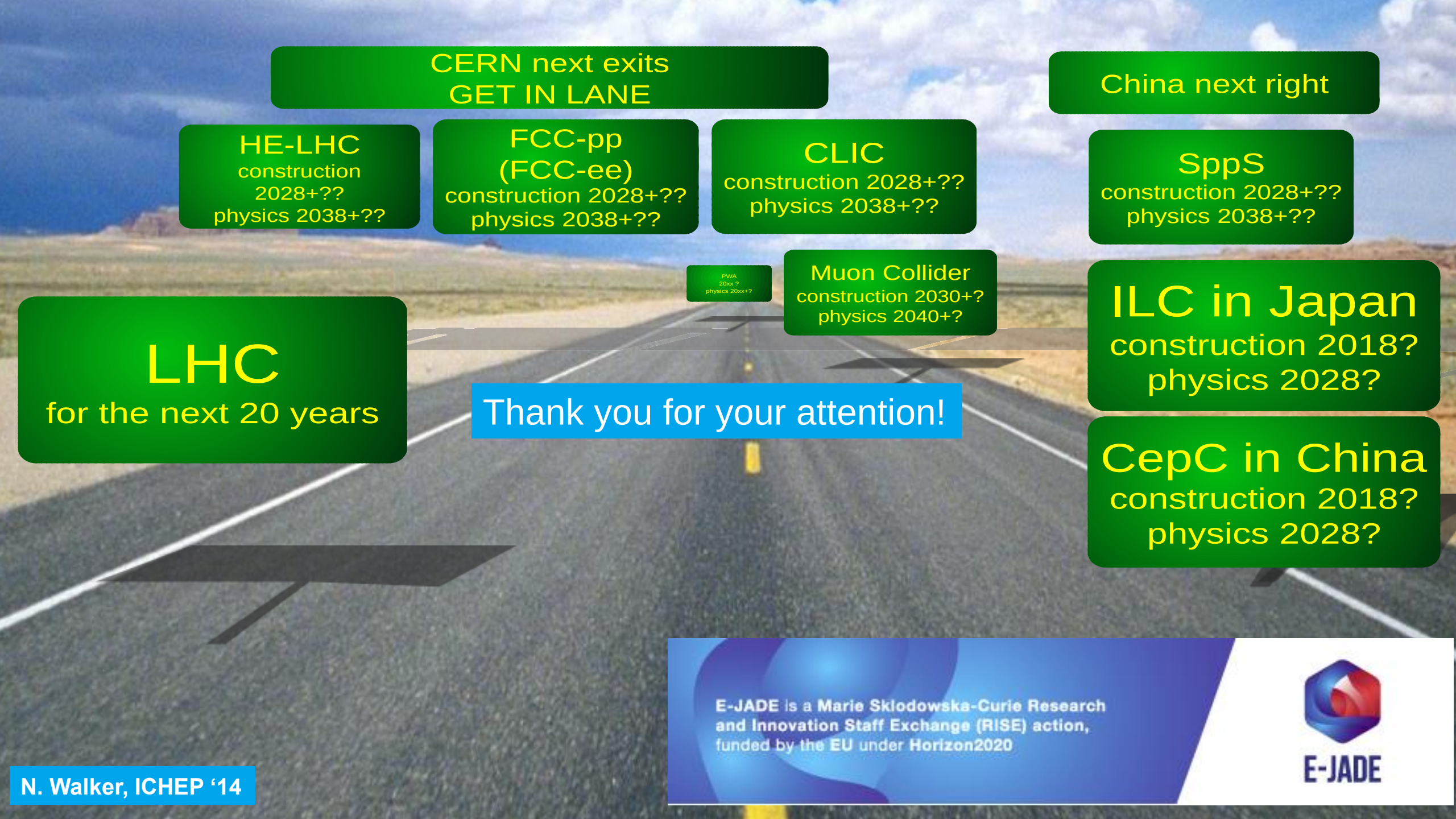
- Planned pp collider in 87 km tunnel
- First ideas in 1983, construction since 1987
- Stopped in 1993 by Congress, with half the tunnel ready.
- Reason: significant cost increase by almost factor of 10.

UNK in Serpukhov

- 21 km pp storage ring with up to 6 TeV CMS energy
- Later staged to a 2*600 GeV machine (U-600)
- In 1998, 75% of the U-600 dipoles available, most tested.
- A quarter of the ring ready for installation.
- Complete stop in 1998; since then tunnel and equipment kept unders safe coniditions.

Without international cooperation and a clear global strategy, we will not succeed in securing the next large project.

Thank you for your attention!



E-JADE is a Marie Sklodowska-Curie Research and Innovation Staff Exchange (RISE) action, funded by the EU under Horizon2020

E-JADE

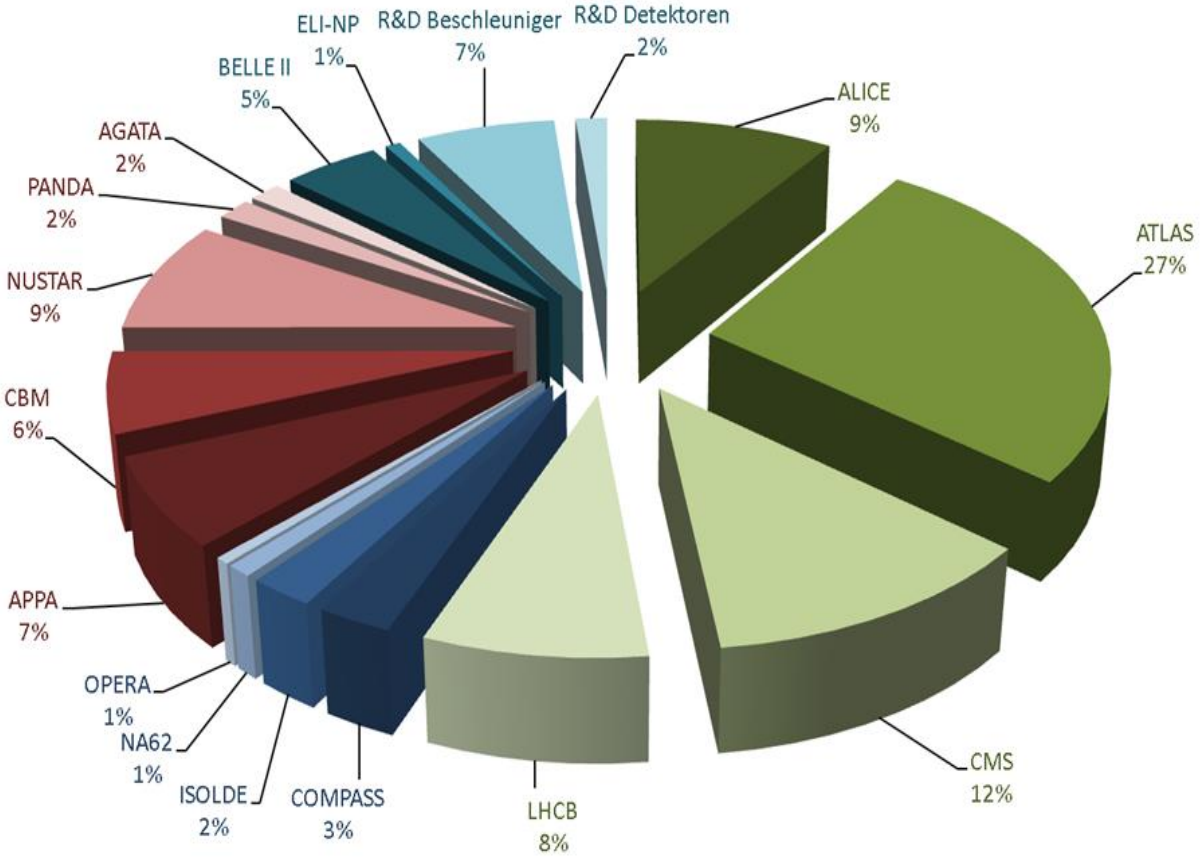
N. Walker, ICHEP '14

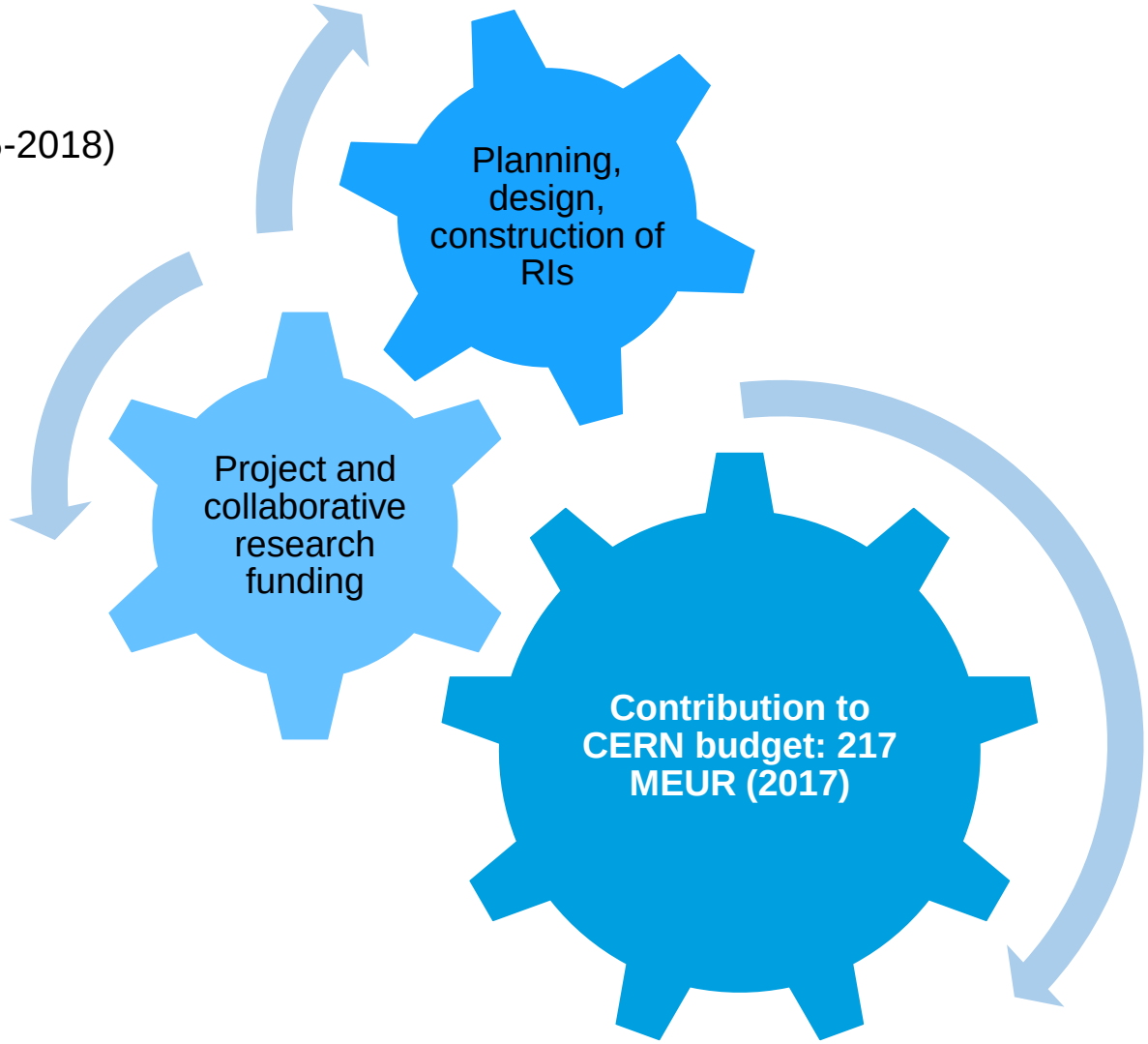
Backup

German Federal Funding for HEP

Interplay of different funding instruments

“Collaborative Research Funding”:
Physics of smallest particles 2015-2018 (102 MEUR for 3 years 2015-2018)





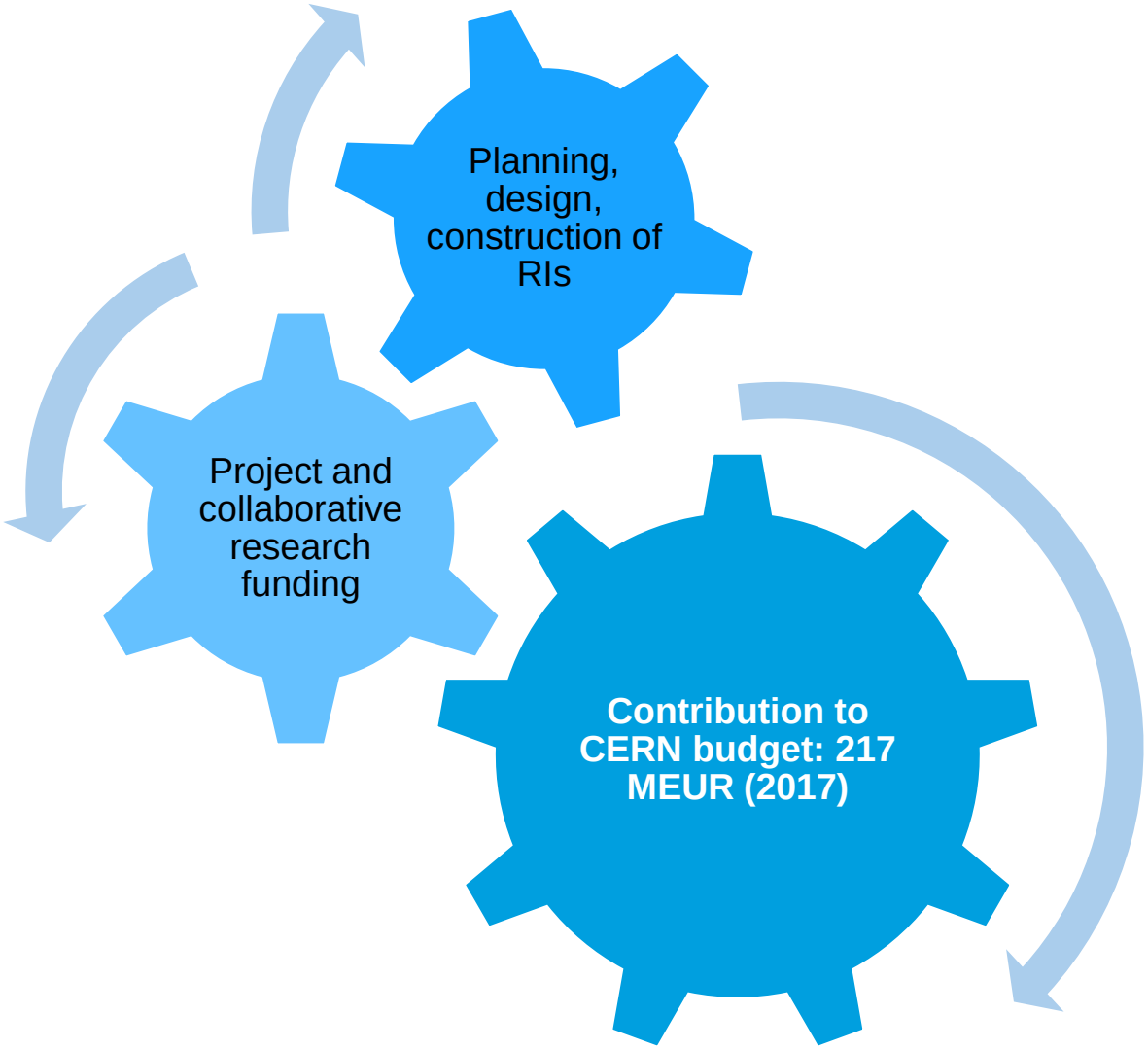
German Federal Funding for HEP

Interplay of different funding instruments – example CERN

Sum per year: 246 MEUR

Contribution CERN budget:	217 MEUR (2017)
Collaborative research (→ universities)	63.5 MEUR (3 years)
LHC detector upgrades (→ universities) (90 MEUR altogether)	16.8 MEUR (3 years)
Additional technical Ph.D. programme	2 MEUR / year

Plus Helmholtz and MPI contributions



AXION and WIMPs

Small-scale experiments for the low-mass regime

Axions – Goldstone boson of Peccei-Quinn symmetry that explains strong CP problem:

- Name „axion“ introduced by F. Wilzcek 1978.
- Hot candidates for cold dark matter.
- Not observed so far, but ...

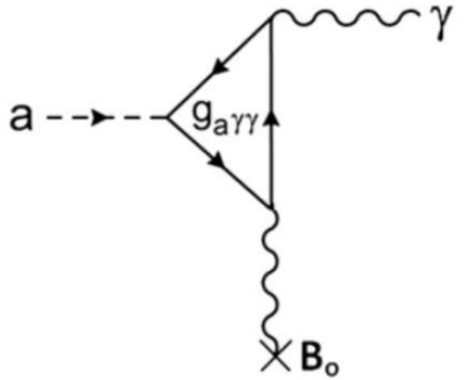
Numerous ways to search for them

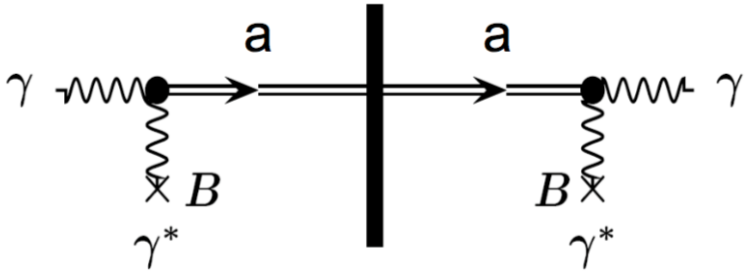
- Primakoff-like axion conversion in B field
- „Light-shining-through-a-wall“

➔ LSW, helioscopes, haloscopes

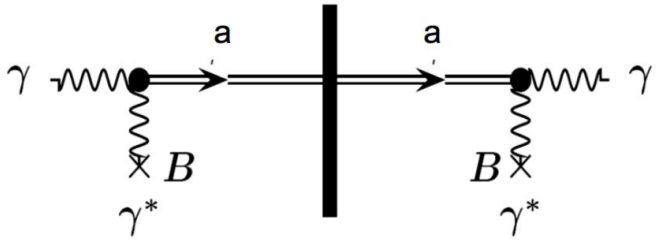
And many new experiments on the way ...

- See next slide!

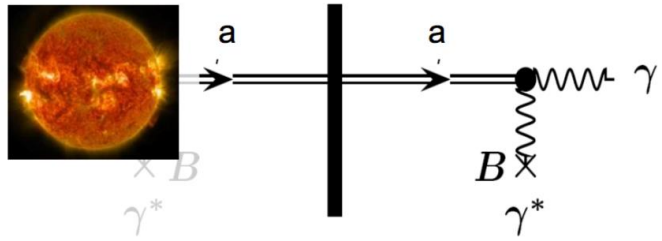




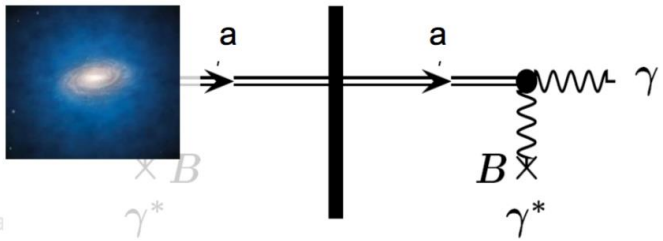
- Purely laboratory experiments
  “light-shining-through-walls”,
  optical photons



- Helioscopes
  ALPs emitted by the sun,
  X-rays,



- Haloscopes
  looking for dark matter constituents,
  microwaves.



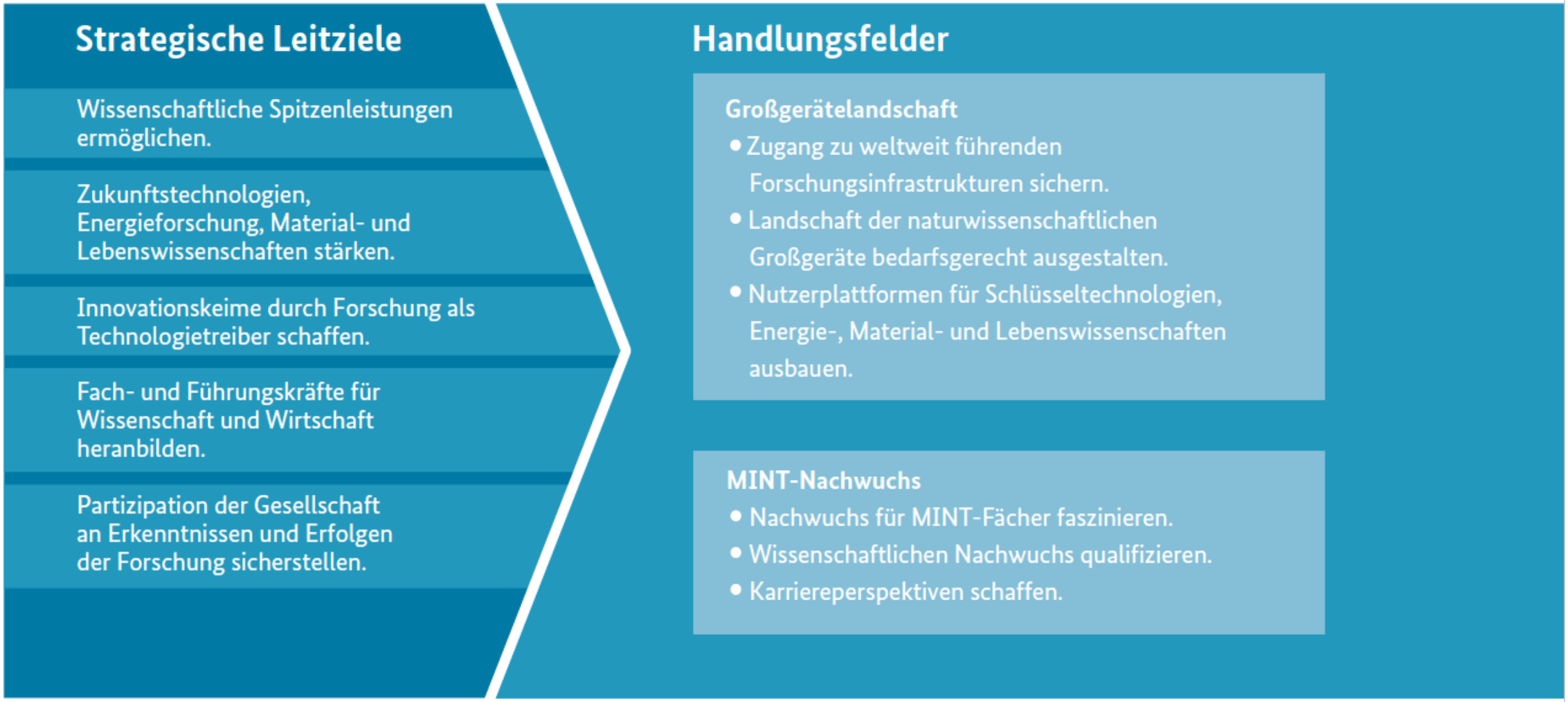
	Forschungsinfrastruktur	Beteiligte Zentren	beteiligte Programme	LK I / LK II	Investitionskosten insgesamt / Anteil Helmholtz in Mio. €	Betriebskosten p.a in Mio.€	Projektbeginn und -ende
Luftfahrt, Raumfahrt und Verkehr	Tandem-L	DLR	Raumfahrt; Programme Erde und Umwelt	LK I	Bau: 600 / 30 (dt. Anteil: 400)	8,3	Bau: 2016 – 2021 Betrieb: mind. 6 Jahre
	NGT FT	DLR	Verkehr	LK I	25/25	1	Bau: 2016 – 2017 Betrieb: 15 Jahre
	iSTAR	DLR	Luftfahrt	LK I	40/40	2.5	Bau: 2016 – 2018 Betrieb: 10 Jahre
	NGC-FID	DLR	Verkehr	LK I	18,5/18,5	1	Bau: 2016 – 2019 Betrieb: 10 Jahre
	C-Cube – Concurrent Certification Centre	DLR	Luftfahrt, Raumfahrt	LK I	17/17	4	Bau: 2016 – 2017 Betrieb: 10 Jahre
Materie	Large Hadron Collider (LHC) – Upgrades der LHC-Detektoren (LHC-Upgrades)	DESY (Koordination), KIT, GSI	Matter and the Universe	LK I	45 / 28	1,2	Bau: 2015 – 2023; Betrieb: bis mind. 2035
	Global Cosmic Ray Observatories	KIT	Matter and the Universe	LK I	390 / 45	15, davon Helmholtz 1	Bau: 2022 – 2030; Betrieb: 30 Jahre
	EDM @ COSY	FZJ	Matter and the Universe				
	BESSY-VSR (Variabler Pulslängen-Speicherring) Beschleuniger	HZB	From Matter to Materials and Life				
	FLASH Upgrade	DESY	From Matter to Materials and Life				
	PETRA IV	DESY	From Matter to Materials and Life				
	BESSY III	HZB	From Matter to Materials and Life				
	European XFEL Phase II	DESY	From Matter to Materials and Life				
	Hochbrillianz Spallationsquelle (HBS)	FZJ	From Matter to Materials and Life				
	Accelerator Technology HElmholtz iNfrAstructure (ATHENA)	DESY; GSI mit HI-Jena, FZJ, HZB, HZDR, KIT	Matter and Technology				
Schlüsseltechnologien	Jülich Short-pulsed Particle and Radiation Centre (JuSPARC)	FZJ	Future Information Technology				
	Large Scale European Facilities in Electron Microscopy	FZJ	Future Information Technology				
	Karlsruhe Center for Optics & Photonics (KCOP)	KIT	Science and Technology of Nanosystems	LK I	49 / 40	3	Bau: 2017 – 2021; Betrieb: mind. 15 Jahre
	Helmholtz Data Federation (HDF)	KIT (Koordination), AWI, DESY, DKFZ, FZJ, GSI	Supercomputing & Big Data	LK I / LK II	48 / 48	7	Bau: 2017 – 2021 (kontinuierlicher Ausbau) Betrieb: mind. 20 Jahre (bei regelmäßiger Erneuerung)
	Interdisciplinary Centre for Biomaterials and Biotechnologies Research (ICBBR)	KIT	BioInterfaces in Technology and Medicine	LK I	36 / 23	2,2	Bau: 2017 – 2020; Betrieb: mind. 50 Jahre
	Innovationsplattform für lasttragende und multifunktionale Materialsysteme (InnoMatSy)	HZG	Advanced Engineering Materials	LK I	25 / 25	2	Bau: 2018 – 2020; Betrieb: 20 Jahre

HELMHOLTZ-ROADMAP FÜR FORSCHUNGSINFRASTRUKTUREN II 2015

HELMHOLTZ GEMEINSCHAFT

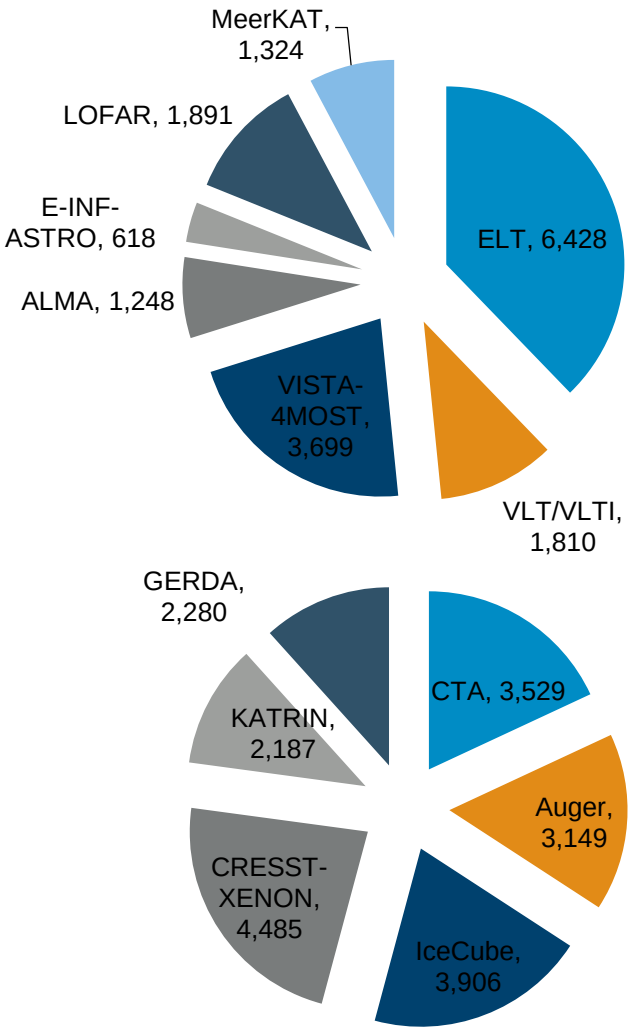
BMBF

ERUM – Strategic Goals



Further Examples from Germany

Astro and Astroparticle physics (2017-2020)



Earthbound astrophysics: 17,0M€

Astroparticle physics: 19,5M€