

HIP – coming years

Katri Huitu
20.5.2022

Action plans for the coming years: Strategy of HIP 2020

National tasks:

- HIP is responsible for the Finnish research collaboration with **CERN**.
- HIP coordinates the Finnish contribution to the **FAIR** laboratory currently under construction in Darmstadt, Germany

HIP:

- an extensive range of subjects in theoretical physics and experimental subatomic physics.
- carries out and facilitates research in basic and applied physics as well as technology development at international accelerator laboratories.

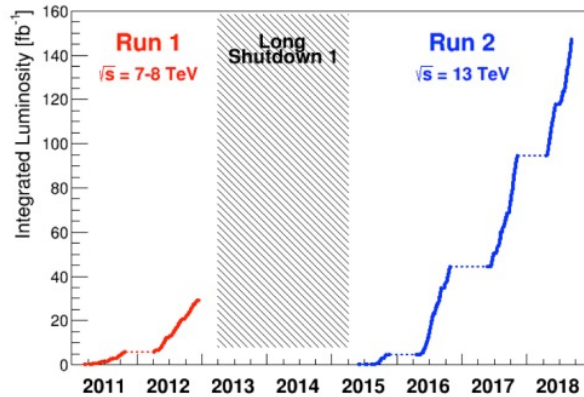
HIP as a hub nurturing collaboration between the member organizations.



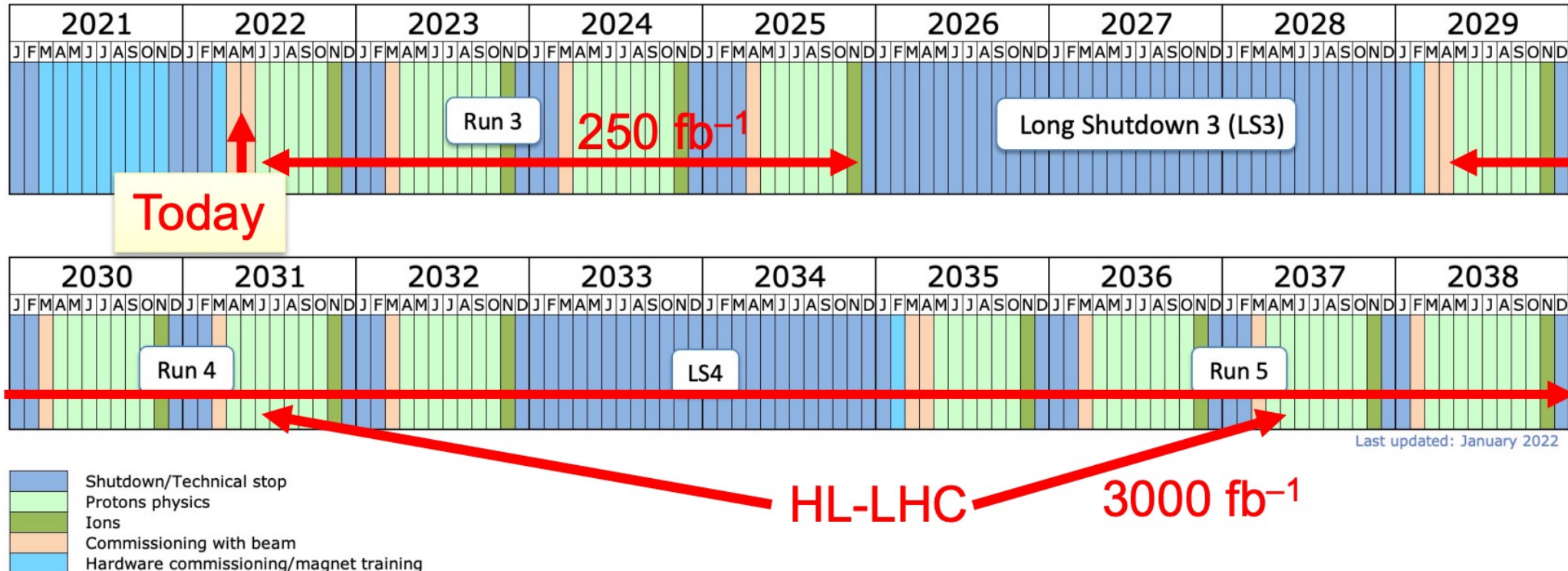
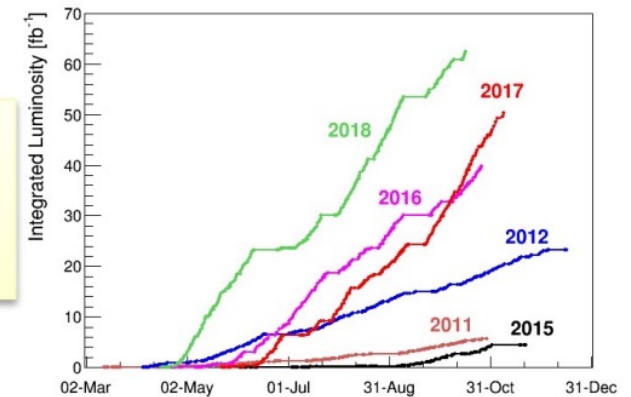
National tasks: CERN and FAIR



LHC & HL-LHC schedule



Run 1: 2010-2012; total $L \sim 30 \text{ fb}^{-1}$
 Run 2: 2015-2018 (150 fb^{-1})
 Peak lumi $\approx 2.1 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ (2018)

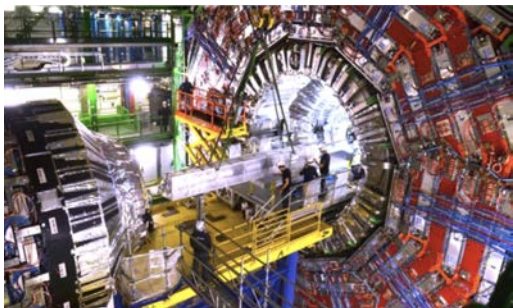


CERN: LHC

MoEDAL

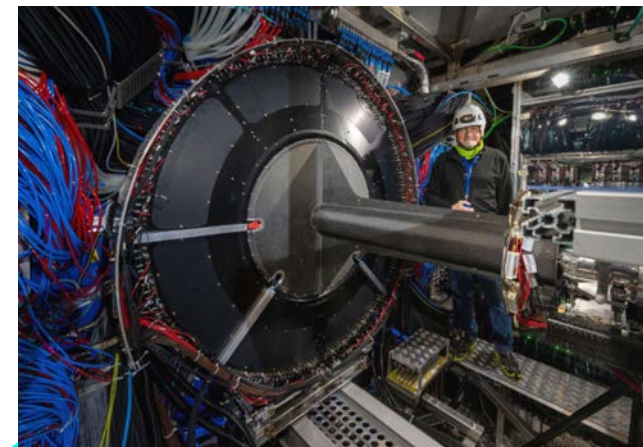
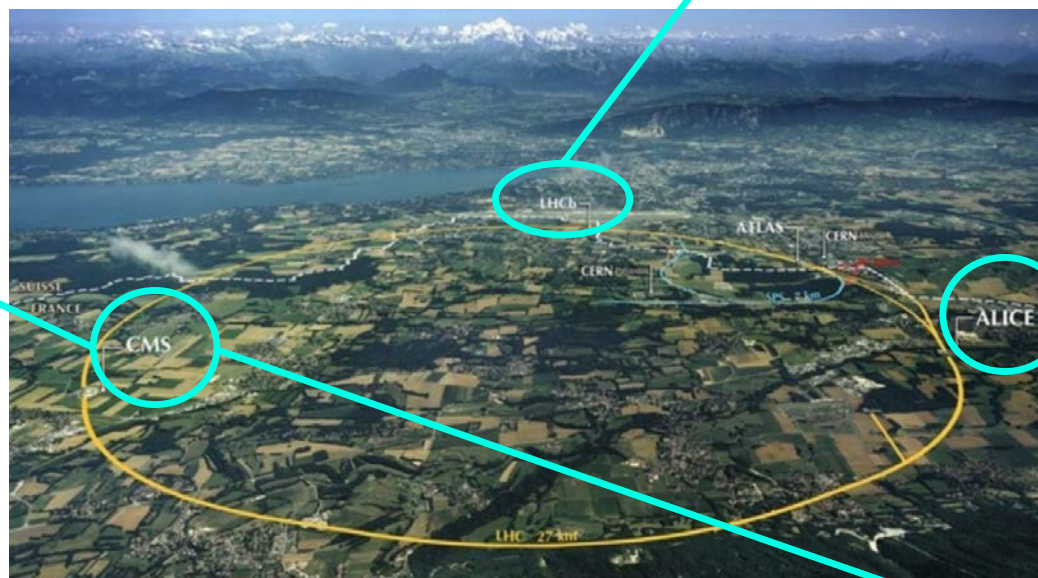
(HIP joined 2021)

Matti Kalliokoski, HIP blog 4.4.2022



CMS (MTD-ETL, PPS)

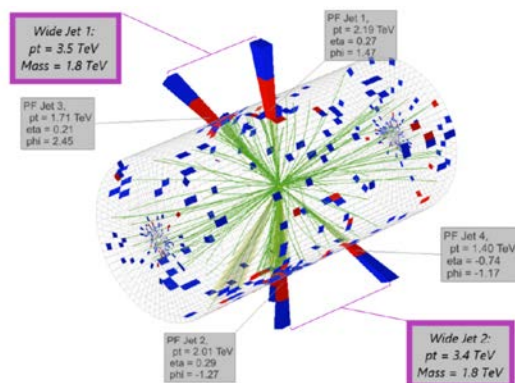
Panja Luukka, HIP blog, 2.11.2020



ALICE (FIT, FoCal)

Sami Räsänen, HIP blog 2.11.2020

Close collaboration with QCD theory project – center of excellence 2022-2029



Mikko Voutilainen, HIP blog, 7.12.2021;
ERC 2022-2027

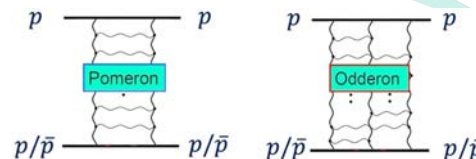


Kati Lassila-Perini, HIP blog 16.8.2021

Kati Lassila-Perini:

UH Open Science Award 2021

TOTEM

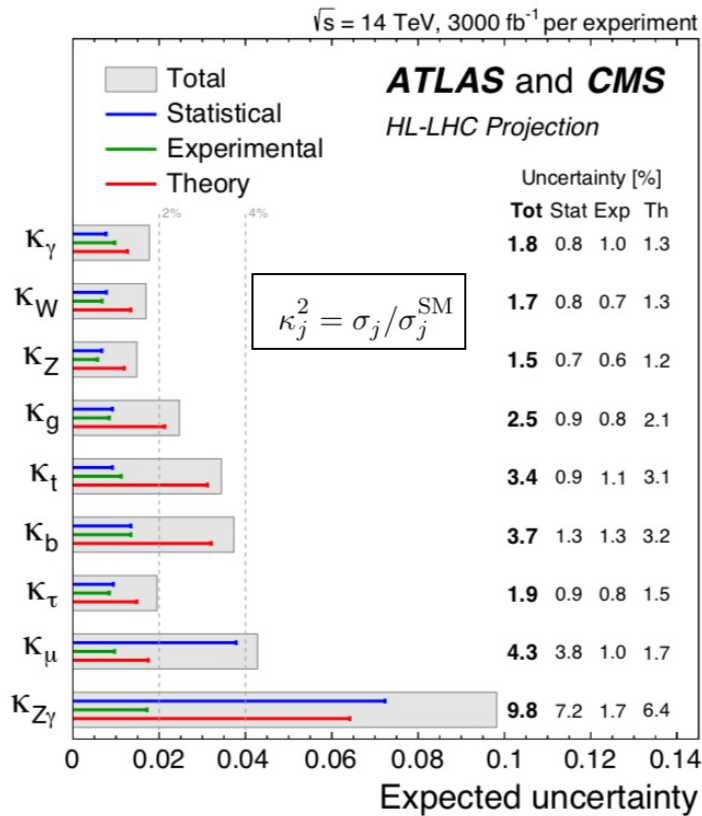


Kenneth Österberg, HIP blog, 6.9.2021

Laurent Forthomme, HIP blog 10.8.2020

Physics potential of HL-LHC

Higgs couplings measurements



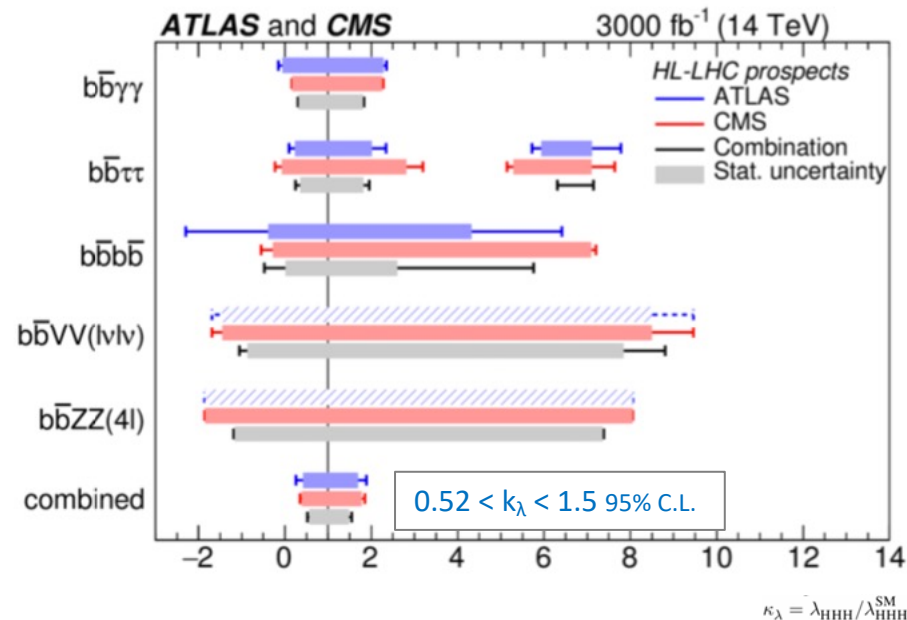
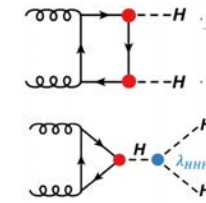
Global fit assuming no BSM contributions to Γ_H .

- 2-3 more precise than at end of LHC
- first 5 σ observation of $H \rightarrow Z\gamma$
- experimental precision challenges theory!

Factor ~ 10 in data sample and improved detectors $\rightarrow$ significant increase in sensitivity for new physics and precise measurements

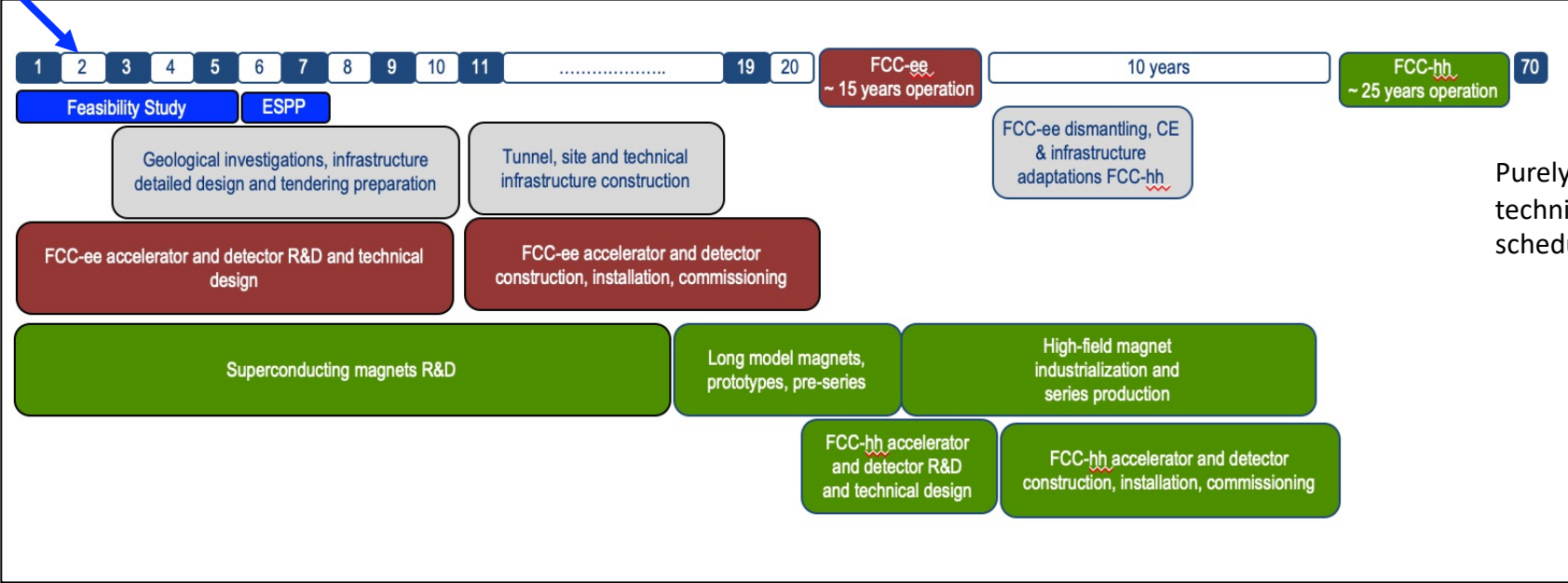
First observation of HH production ($\sim 4\sigma$ level)

$$\mathcal{L}_h = \frac{1}{2} m_H^2 H^2 + \lambda_3 H^3 + \lambda_4 H^4$$

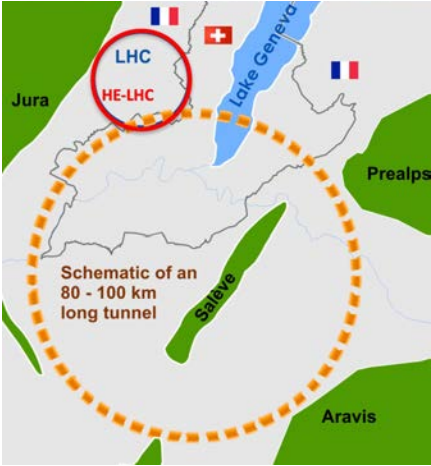


We are here

Timeline of the FCC integrated programme



Purely technical schedule



	$\sqrt{s}$	L / IP ($\text{cm}^{-2} \text{s}^{-1}$)	Int. L / IP (ab^{-1})	Comments
e^+e^- FCC-ee	$\sim 90 \text{ GeV}$ 160 240 ~ 365	230×10^{34} 28 8.5 1.5	75 5 2.5 0.8	2-4 experiments Total ~ 15 years of operation
pp FCC-hh	100 TeV	5×10^{34} 30	20-30	2+2 experiments Total ~ 25 years of operation
PbPb FCC-hh	$\sqrt{s_{\text{NN}}} = 39 \text{ TeV}$	3×10^{29}	100 nb $^{-1}$ /run	1 run = 1 month operation
ep Fcc-eh	3.5 TeV	1.5×10^{34}	2 ab $^{-1}$	60 GeV e- from ERL Concurrent operation with pp for ~ 20 years
e-Pb Fcc-eh	$\sqrt{s_{\text{eN}}} = 2.2 \text{ TeV}$	0.5×10^{34}	1 fb $^{-1}$	60 GeV e- from ERL Concurrent operation with PbPb

Tables from
Fabiola Gianotti,
CERN 2021

HIP joined FCC feasibility study 2021

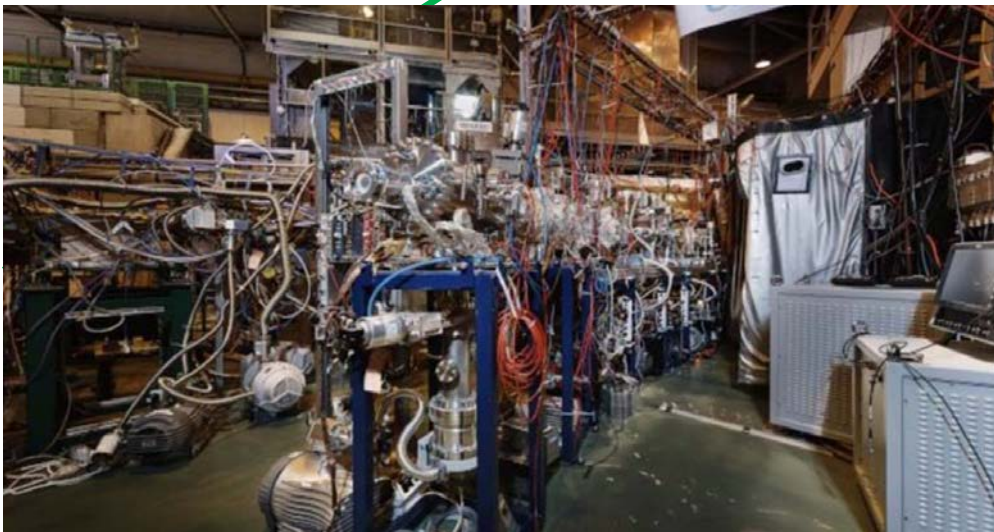
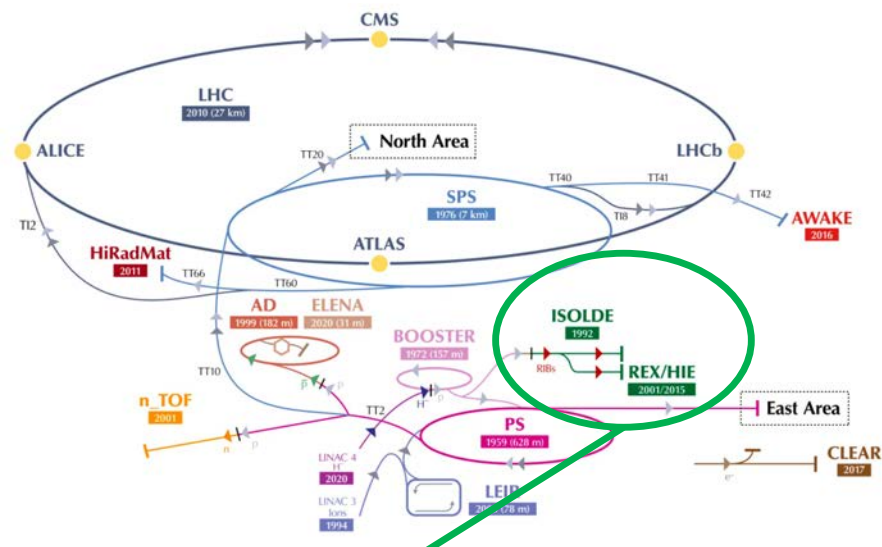
- ☐ Feasibility Study: 2021-2025
- ☐ If project approved before end of decade $\rightarrow$ construction can start beginning 2030s
- ☐ FCC-ee operation $\sim 2045-2060$
- ☐ FCC-hh operation 2070-2090++

CERN linear collider (CLIC)

Markus Aicheler,
HIP and CompactLight, HIP blog 10.2.2020

Other CERN activities

ISOLDE –radioactive beam facility



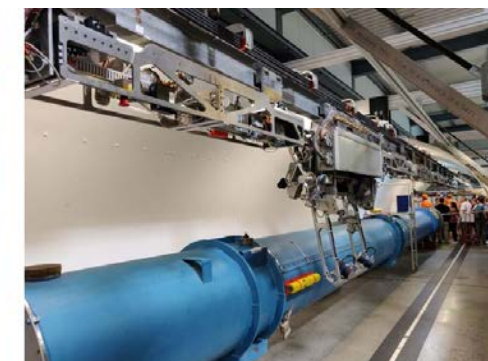
CLOUD – Cosmics leaving Outdoor Droplets



Katrianne Lehtipalo,
HIP blog 11.1.2021

27 m³

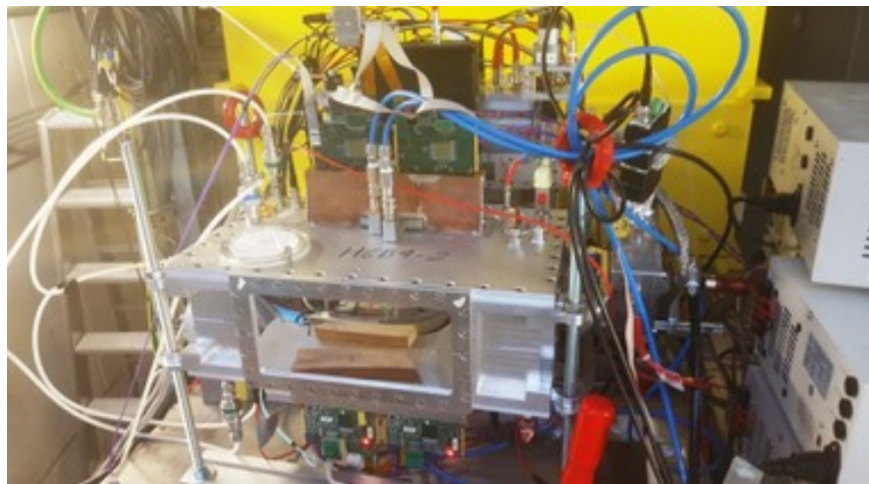
Robotics and AI for monitoring and intervention



Developments in detectors, accelerators and in materials physics



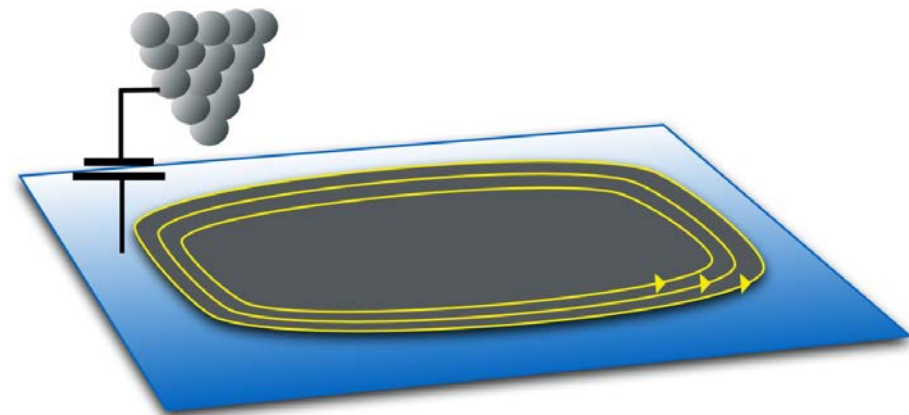
Erik Brücken, **Kaasutäytteisten säteilynlmaisinten kehitystyö HIPissä ja sen edeltäjissä**, HIP blog 9.5.2022



Filip Tuomisto, **Antimateriaalla materian kimppuun**, HIP blog 20.5.2019

Tuomas Lappi, **Maailman tehokkainta mikroskooppia suunnittelemassa**, HIP blog 12.8.2019

Teemu Ojanen, **Emergenssiä ja hiukkasia – tiiviin aineen fyysikon apologia**
HIP blog 7.12.2020



Teemu Ojanen et al, Nature 2020

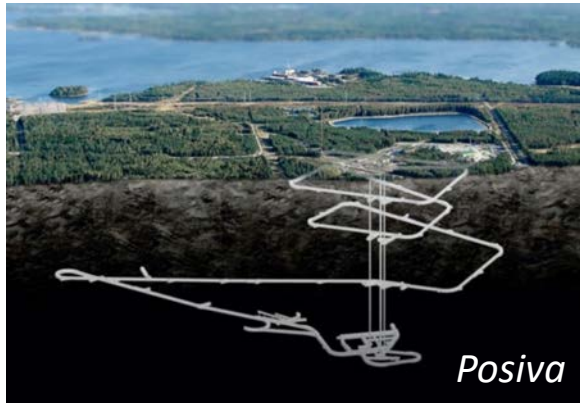
HIP group joined InstituteQ in 2021



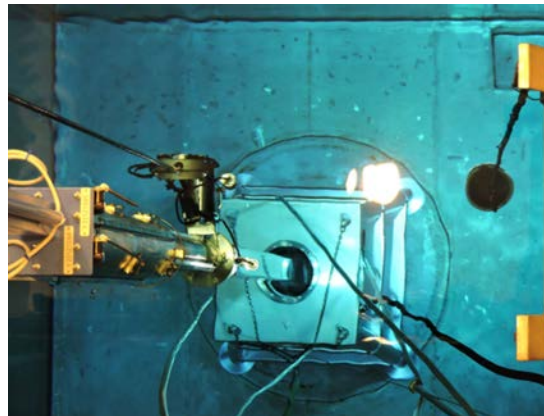
HELSINKI INSTITUTE OF PHYSICS

Applications of detectors for the society

Radiation safety, security and safeguards

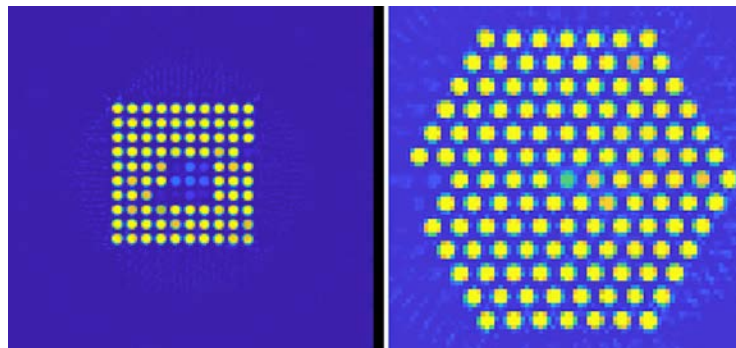


Posiva



Teemu Siiskonen,
HIP blog 4.10.2021

Peter Dendooven,
HIP blog 14.10.2019



DEFACTO radiation
early warning network



● BF R2B 2021-2022 HIP-LUT

Pietari Kauttu, **Physics research opens new collaboration opportunities for Finnish companies**, HIP blog 16.9.2019

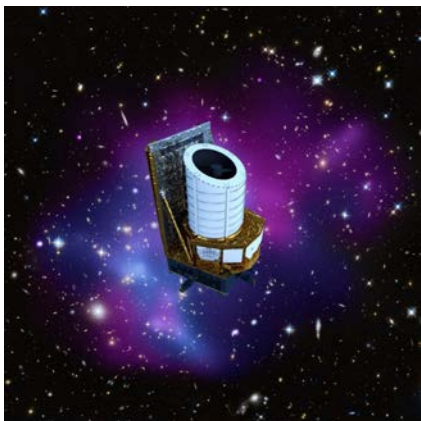


HELSINKI INSTITUTE OF PHYSICS

HIP represents Finland in APPEC since 2019: strengthening collaboration ECFA-NuPECC-APPEC



EUCLID, EUCLID will be launched in 2023



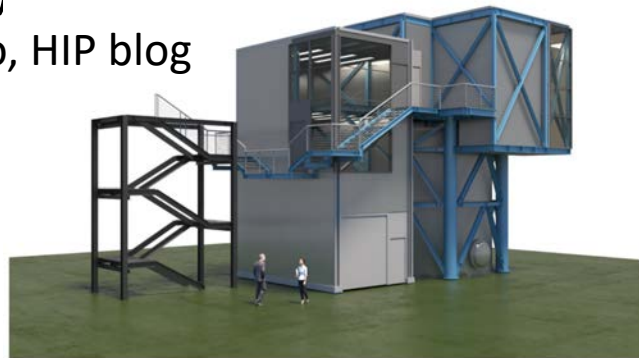
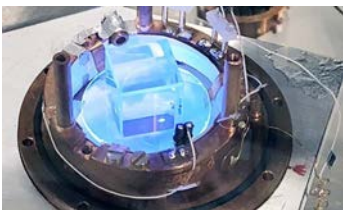
Airbus,
7/2020

Hannu Kurki-Suonio,
HIP blog 8.2.2021

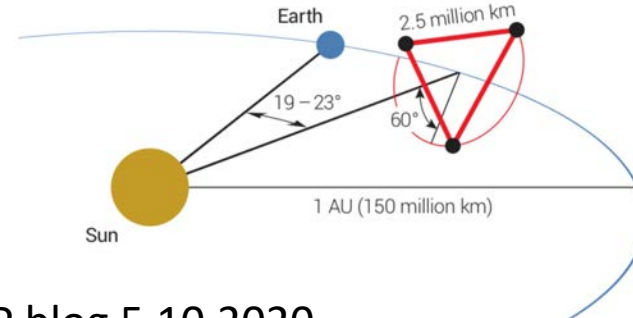
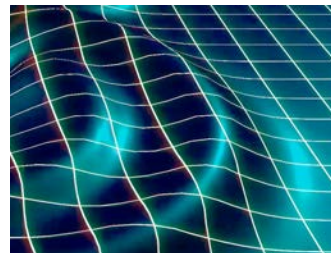
COSINUS

(HIP joined 2021)

Matti Heikinheimo, HIP blog
8.3.2021

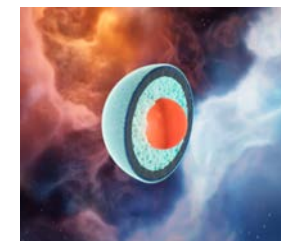


LISA



Mark Hindmarsh, HIP blog 5.10.2020
David Weir, HIP blog 16.1.2019

Alexi Vuorinen, **Kvarkkianetta
näköpiirissä!**, HIP blog 2.6.2020



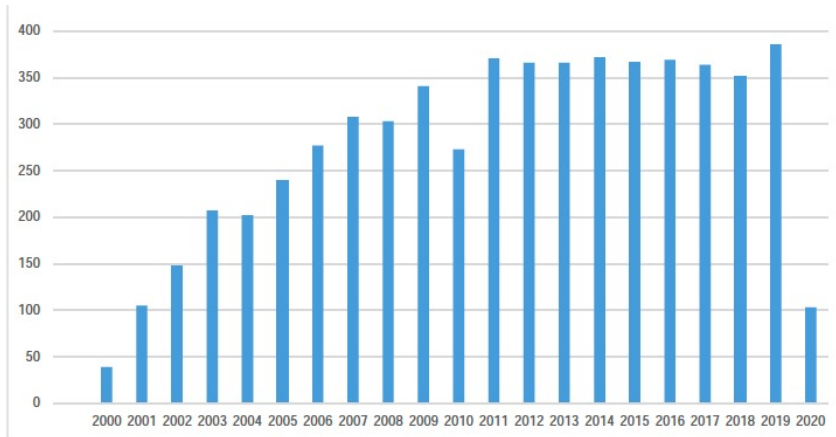
Niko Jokela, **Holografinen dualiteetti
hiukkasfysiikan työkalupakissa**, HIP blog 7.3.2022

Anu Kankainen, **Keskikokoisten tähtien kohtaloon uutta tietoa
beetahajoamiskokeesta Jyväskylässä**, HIP blog 9.3.2020

Sami Nurmi, **Näkemyksiä inflaatiotutkimuksesta**,
HIP blog 10.5.2021

Education at various levels

Science camps for high school students



Kati Lassila-Perini, HIP blog 18.3.2019

BootCamp with Universities of Applied Sciences



Tapio Lampén, HIP blog 25.6.2019

Tapio Lampén, **Summer jobs at CERN/ESRF and CERN Bootcamp**, HIP blog 24.1.2020



Teaching the open science tools for teachers

Janne Pakarinen, **How to engage the brightest talents in science**, HIP blog 13.1.2020

Detector Laboratory outreach activities



Researchers' Night



"Bring your Child to Work"
day @ Kumpula



"Smart as HEL" events,
@ UH Think Corner



Visits to schools



High School visits to Lab,
~200 students / year



Elementary
school
traineeships,
2-3 / year

Matti Kalliokoski, **Yleisöpalvelua ja ilmaisinteknologiaa Tutkijoiden yössä**, HIP blog 8.11.2021

Wellbeing groups important also in future

Eija Tuominen, **Hyvinvoivat työyhteisöt tekevät hyvää tulosta!**,
HIP blog 11.11.2019

Antti Väihkönen, **Corona considerations**, HIP blog 7.4.2020

Pirkkita Koponen, Eija Tuominen et al, **In summer 2020, HIP Detector Laboratory had first-ever remote-working summer trainees**, HIP blog 7.9.2020

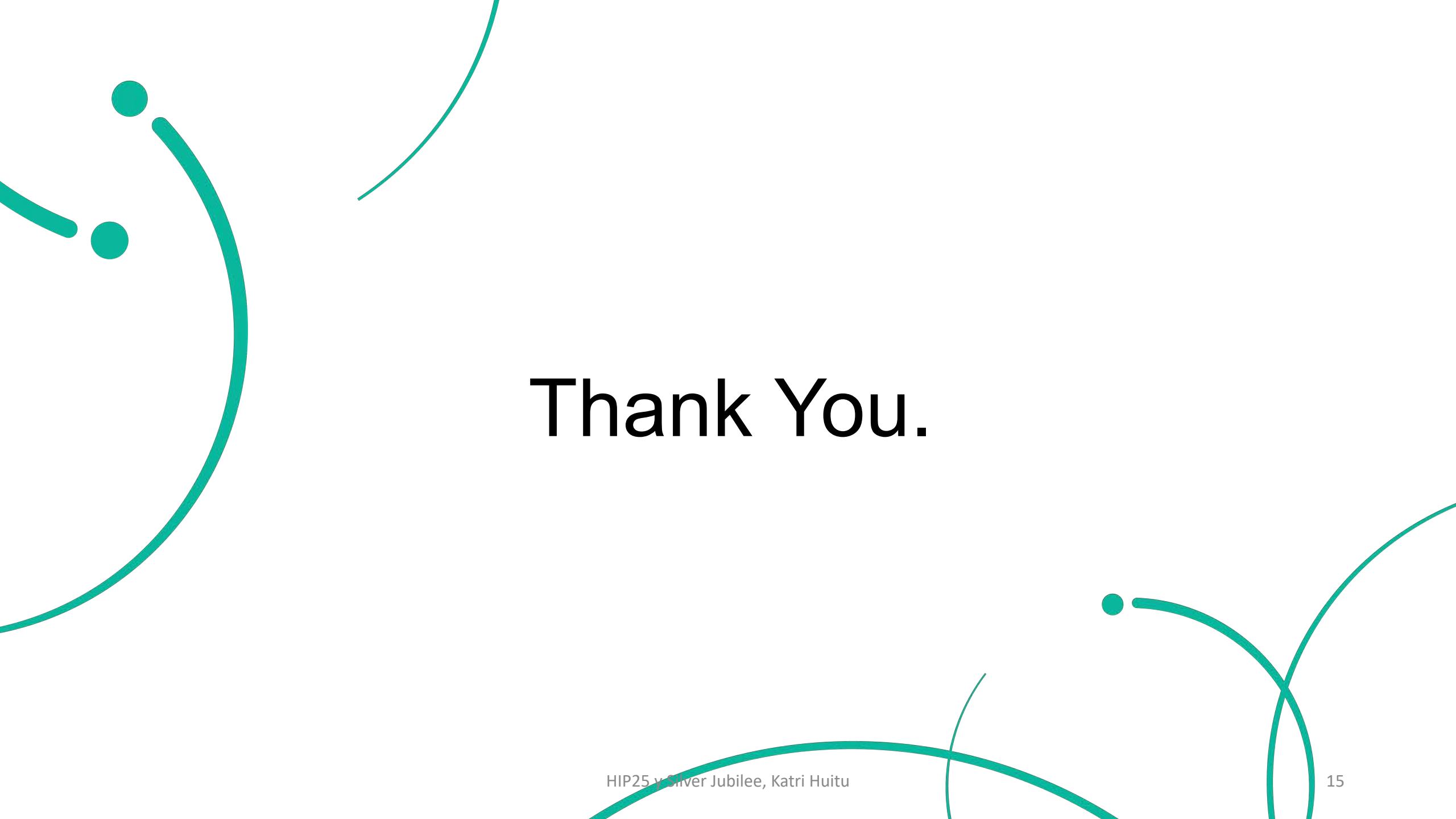
Finland joined CERN 1991 – 30 years ago

HIP was founded in 1996 – 25 years ago

A Higgs boson was announced 4.7.2012 – 10 years ago

Many other interesting and important results from the HIP projects in the past!

Looking forward to future developments and discoveries!



Thank You.