Welcome from INFN CSN1

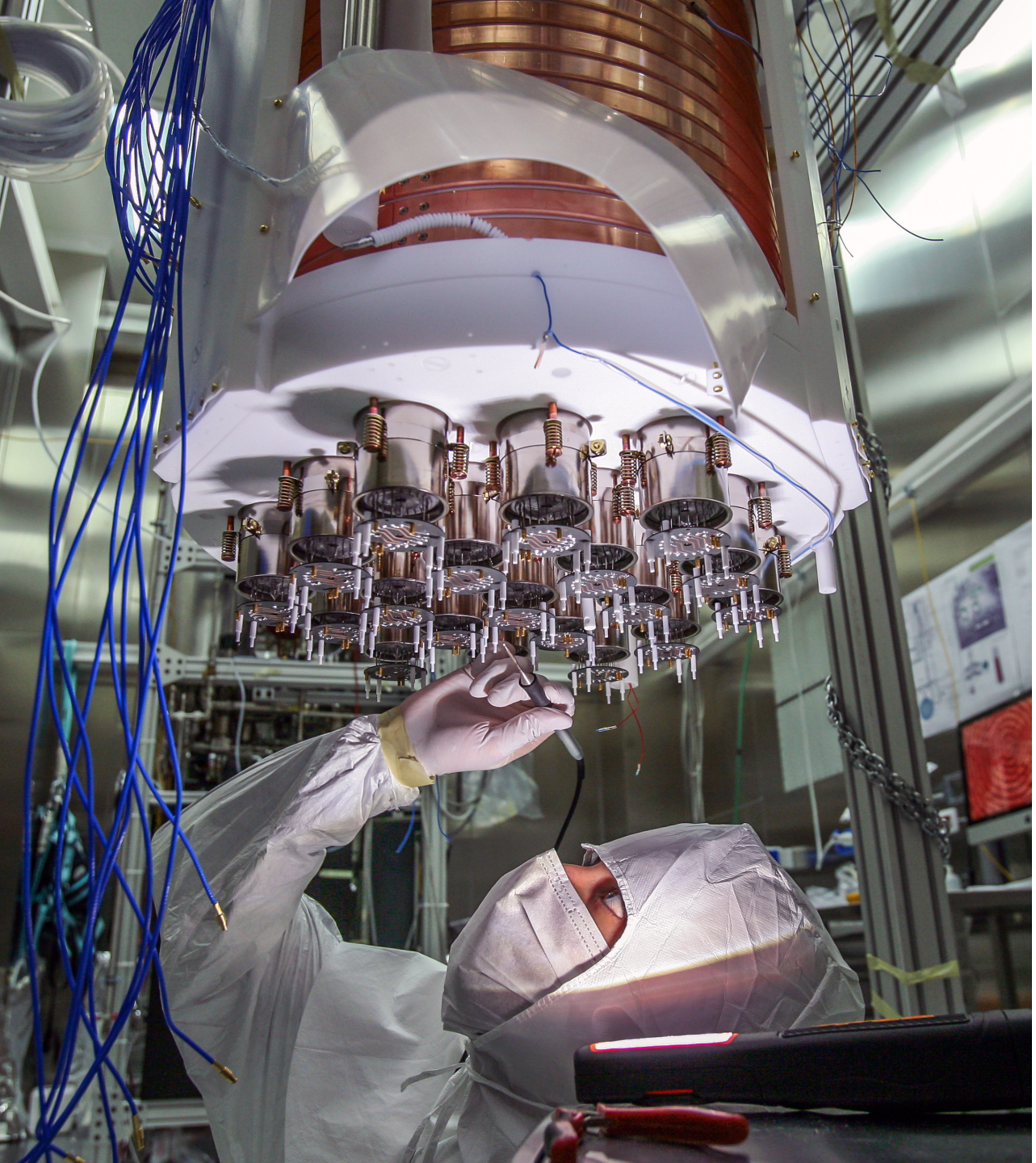
Roberto Tenchini

INFN Pisa

FCCIS 2023 WP2 Workshop
Rome 13 November 2023

INFN
Istituto Nazionale di Fisica Nucleare
SEZIONE DI PISA

A WARM WELCOME TO ROME



INFN is ...

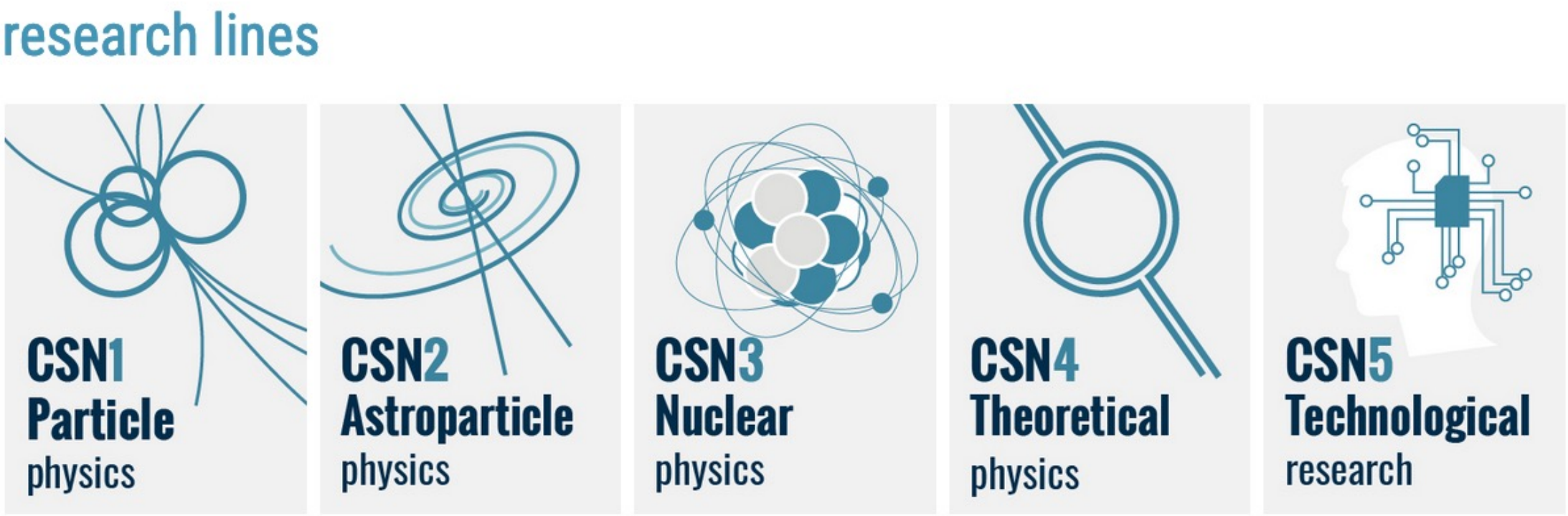
a community of over
6,700 people

~ 25% of them have PhD grants,
post-doc scholarships and research grants

Staff Researchers 699
Staff Technologists 447
Technicians, Administration 960
Associates 4503

INFN

INFN Reasearch lines
(“the five Scientific Committees”)



Future High Energy Physics projects at accelerators with INFN involvement

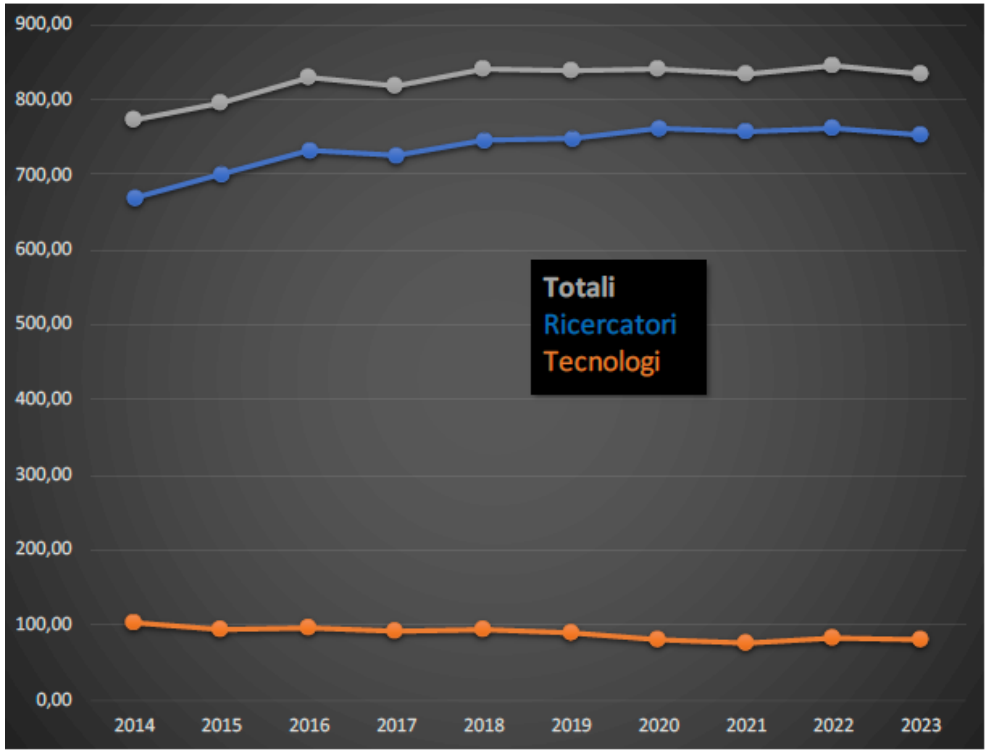
- **High Luminosity LHC**
  - **ATLAS, CMS phase 2 upgrades (CSN1)**
  - **LHCb phase 2 upgrade (CSN1)**
  - **ALICE phase 2 upgrade (CSN3)**
- **The Future Circular Collider (FCC)**
  - **FCC-ee (CSN1)**
  - **FCC-hh (CSN1)**

- **Electron Ion Collider (CSN3)**
- **Neutrinos at FNAL (CSN1)**
  - **Short Baseline neutrino (SBN)**
  - **Long Baseline neutrino (LBN)**
- **Hyper Kamiokande (HK) (CSN2)**
- **Muon Collider studies (CSN1)**

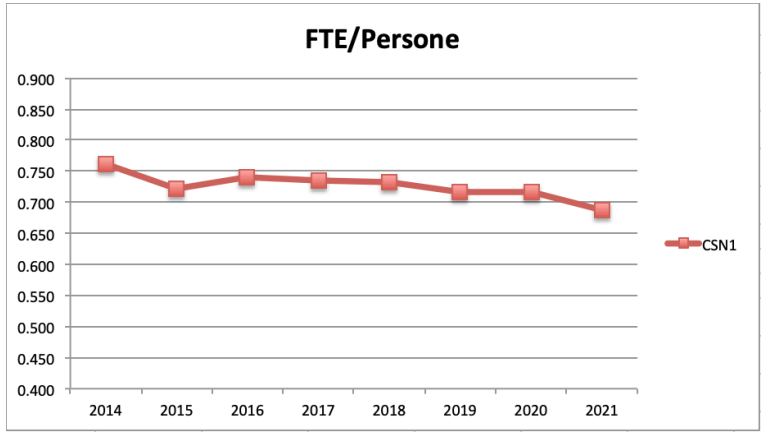
Smaller scale projects: **AMBER, BELLE 2 upgrade, HIKE, MEG2, MU2E,** etc.

(purple=already approved projects)

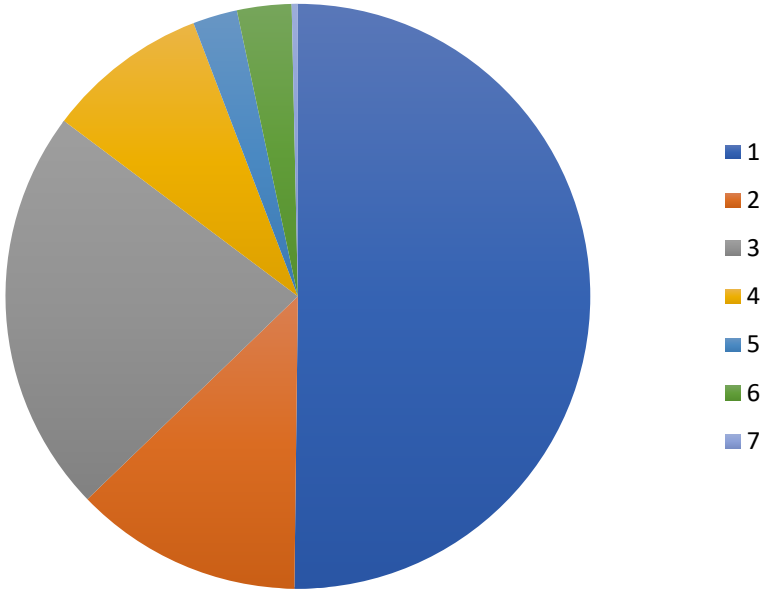
Number of FTEs, CSN1 (particle physics)



Ratio FTE/people around 70%



Research lines CSN1 2024	FTE (%)	Budget (%)
Physics at hadron colliders (LHC)	50,71	50,19
Neutrino Physics	9,10	12,6
Flavour Physics (with LHCb)	27,11	22,45
Charged Lepton Physics	5,73	8,95
Proton Structure	2,61	2,46
R&D for Future Accelerators	3,76	3,01
Dark Sector	0,99	0,34



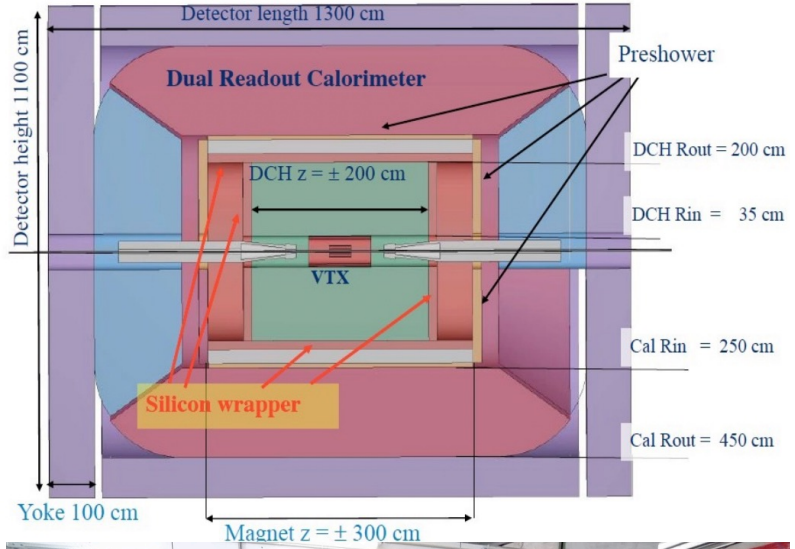
Specific INFN funds for future accelerators are also available, in addition to CSN1 budget

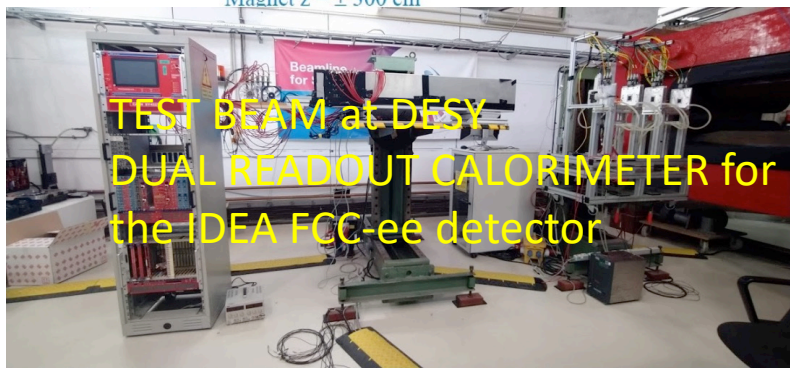
Preparing the future: FCC

CSN1: RD_FCC

170 scientists/25 FTE

~ 6-700 k€/yr (CSN1 & EU grants)





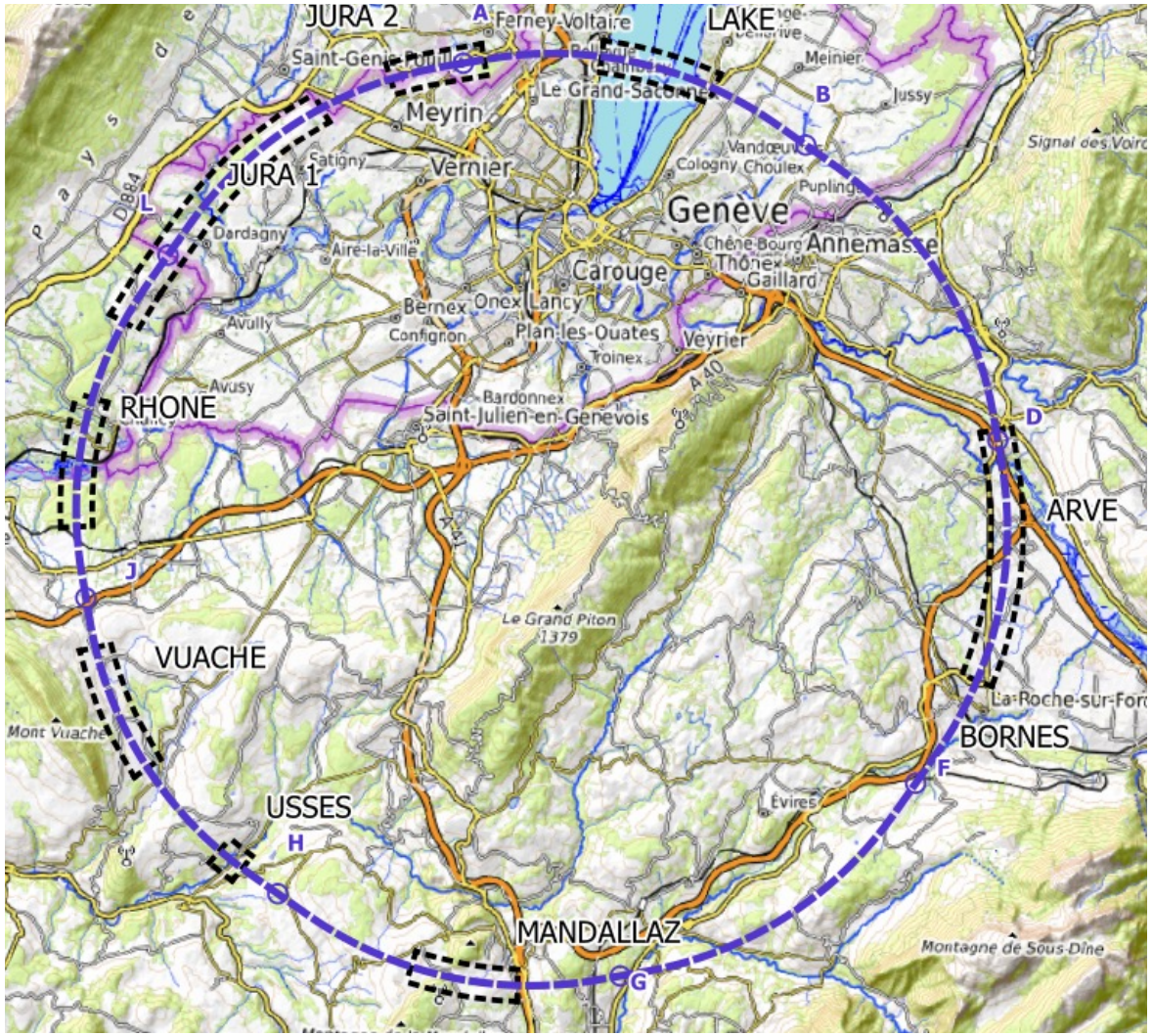
Specific INFN funds for future accelerators started in 2023: **2 million euros over 3 years**, with additional postdoc positions

In 2022 INFN started the efforts to boost participation and include the INFN accelerator community, in synergy with other projects

- SC magnets
- RF cavities
- etc

- FCC-ee IR and MDI
- High-Q/High-G SRF
- SRF R&D thin films
- Damping Ring and Transfer Lines

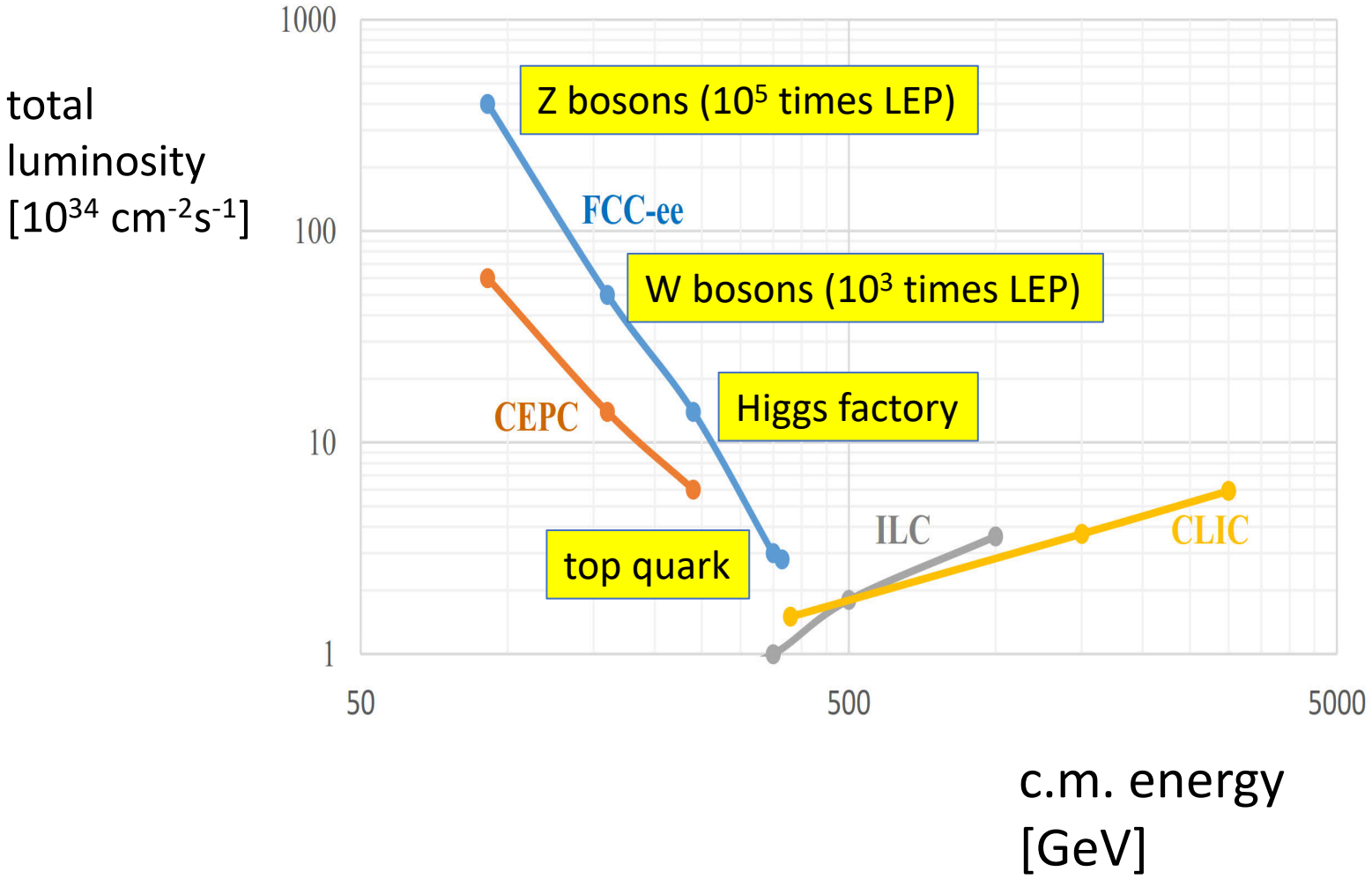
WHY FCC ? a particle physicist point of view

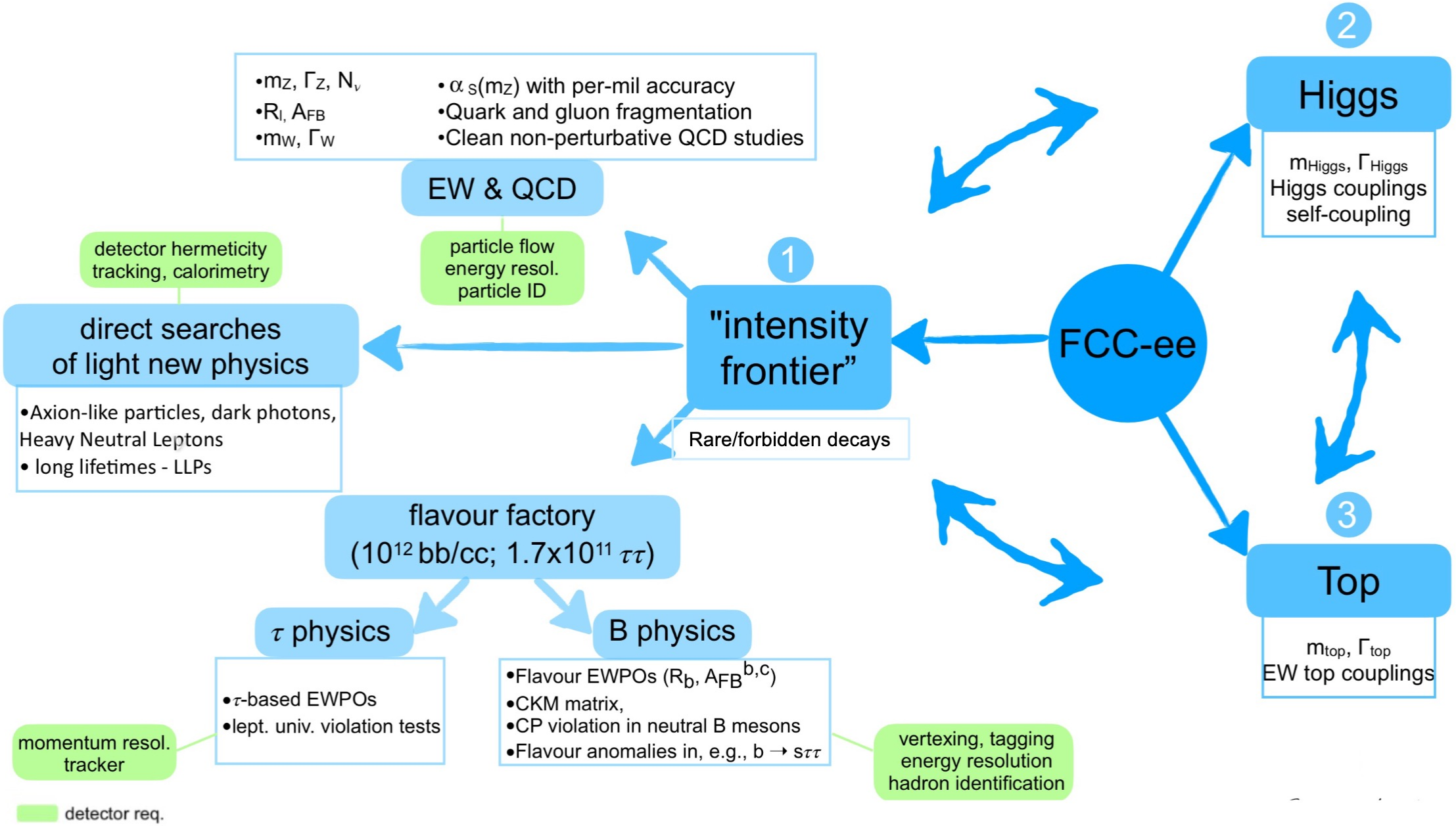


Precision Measurements ←→ Discoveries: a research programme adressing the next decades should must be wide-ranging, have a high-profile programme of measurements and considerably extend the search for new phenomena

→ Explore the landscape, do not leave stones unturned

Where nature decided to put stuff (the electroweak playground)

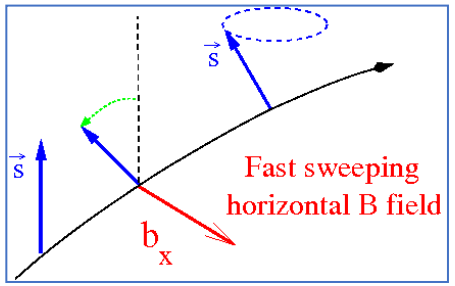


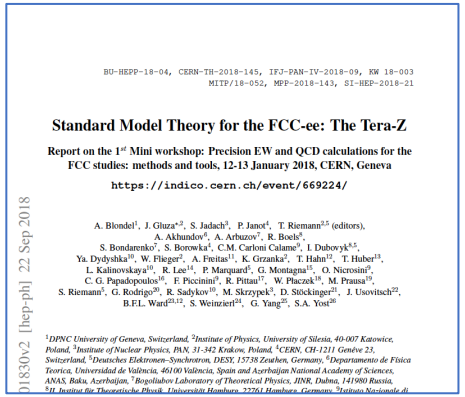


Slide from C. Grojean @ FCC Week'22

Some key points about FCC

- **FCC-ee is not just about brute-force luminosity**
  - Continuous calibration of centre-of-mass energy (e.g. 100 keV at the Z) with resonant depolarization
  - Direct measurement of parameters, which were computed until now (e.g. direct measurement of α_{QED} running)
- **There is a well-defined theory effort, to successfully use data in a meaningful way (e.g. 3-loop calculations)**
- **It has been shown in various ways (e.g. EFT analyses) that a jump in precision in Z, W, H, top measurements is required for a comprehensive interpretation of the electroweak sector**
  - A deviation of a single coupling or operator will not provide the full picture
- **FCC-hh is eventually required to precisely investigate the Higgs self-coupling, to close important chapters (e.g. WIMP interpretation of Dark Matter) and to significantly extend direct searches**




BU-HEPP-18-04, CERN-TH-2018-145, IFJ-PAN-IV-2018-09, KW 18-003
MITP/18-052, MPP-2018-143, SI-HEP-2018-21

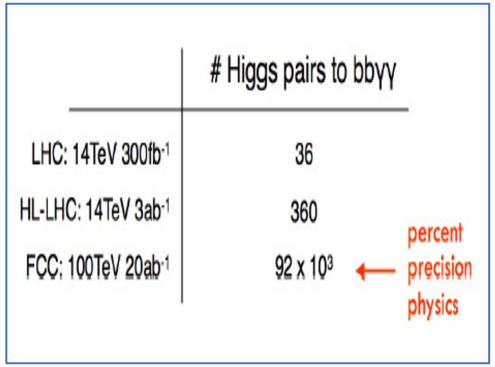
Standard Model Theory for the FCC-ee: The Tera-Z

Report on the 1st Mini workshop: Precision EW and QCD calculations for the FCC studies: methods and tools, 12-13 January 2018, CERN, Geneva

https://indico.cern.ch/event/669224/

A. Blondel[1], J. Gluza[*,2], S. Jadach[3], P. Janot[4], T. Riemann[2,5] (editors), A. Akhundov[6], A. Arbuzov[7], R. Boels[8], S. Bondarenko[7], S. Borowka[4], C.M. Carloni Calame[9], I. Dubovyk[4,5], Ya. Dydyshka[10], W. Flieger[2], A. Freitas[11], K. Grzanka[2], T. Hahn[12], T. Huber[13], L. Kalinovskaya[10], R. Lee[14], P. Marquard[8], G. Montagna[15], O. Nicrosini[9], C. G. Papadopoulos[16], F. Piccinini[9], R. Pittau[17], W. Płaczek[18], M. Prausa[19], S. Riemann[5], G. Rodrigo[20], R. Sadykov[10], M. Skrzypek[3], D. Stöckinger[21], J. Usovitsch[22], B.F.L. Ward[23,12], S. Weinzierl[24], G. Yang[25], S.A. Yost[26]

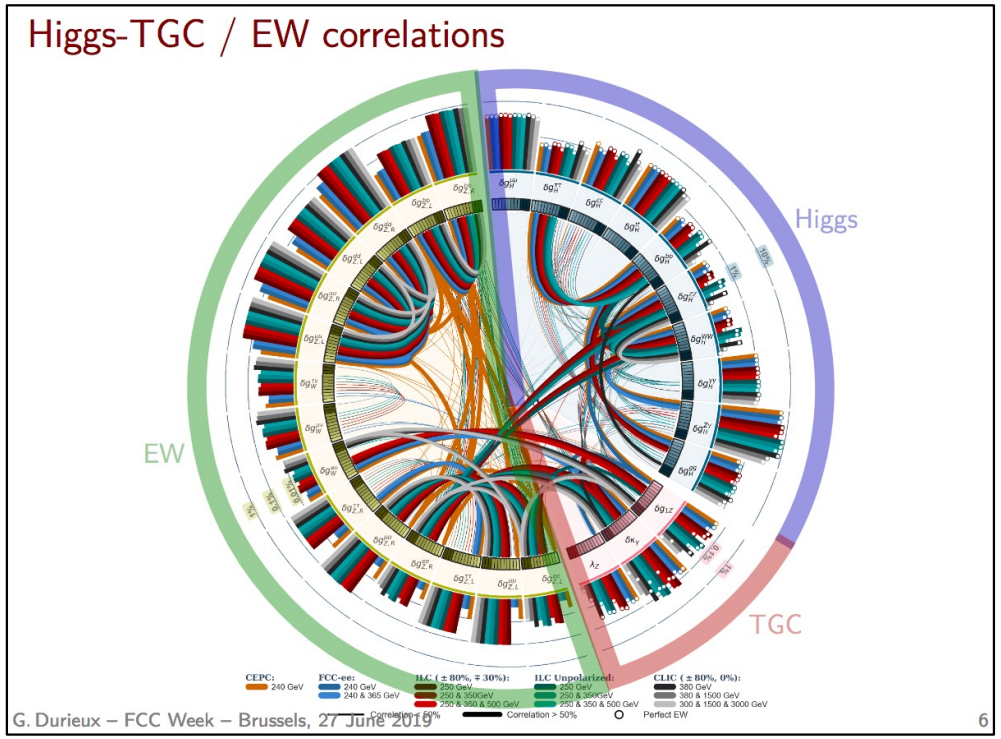
[1]DPNC University of Geneva, Switzerland, [2]Institute of Physics, University of Silesia, 40-007 Katowice, Poland, [3]Institute of Nuclear Physics, PAN, 31-342 Krakow, Poland, [4]CERN, CH-1211 Genève 23, Switzerland, [5]Deutsches Elektronen–Synchrotron, DESY, 15738 Zeuthen, Germany, [6]Departamento de Física Teorica, Universidad de Valência, 46100 Valência, Spain and Azerbaijan National Academy of Sciences, ANAS, Baku, Azerbaijan, [7]Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, 141980 Russia, [8]II. Institut für Theoretische Physik, Universität Hamburg, 22761 Hamburg, Germany, [9]Istituto Nazionale di

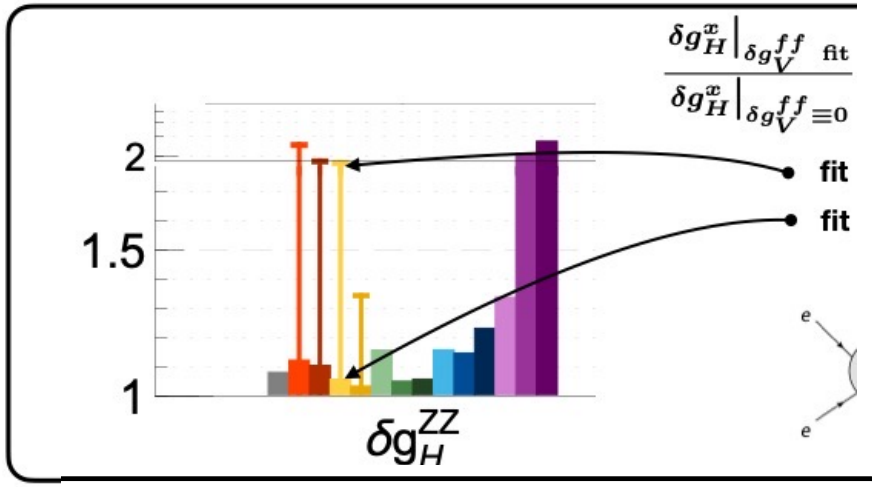


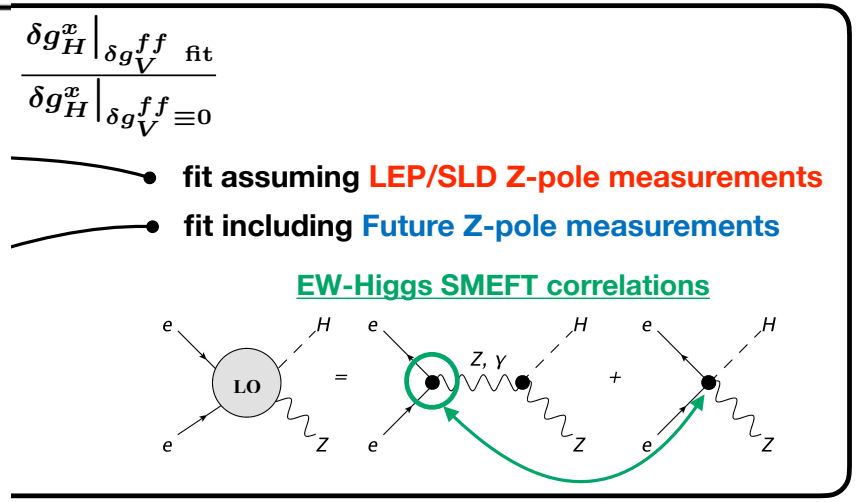
Beyond Standard Model, Precision Measurements, Discoveries: a robust medium- to long-term research programme must address most aspects of of precision measurements (and their correlations) in addition to direct searches.

Example: Higgs couplings uncertainties without and with new measurements at Z

Correlations between Higgs, Z and W observables at future accelerators







Summary

INFN is paying a special attention to the preparation for the future of our field

- Focusing on the **feasibility of FCC** (FCC-ee followed by FCC-hh):
- **«A first class infrastructure to maintain the leadership of European research in particle physics over the 21st century»**

We wish you a fruitful workshop !!