# Report from the countries

Mini reports
CERN
France
Switzerland
Germany
Italy
Spain
UK
Czechia
Poland
Romania
Finland/Denmark
Sweden
Turkey
USA
South Korea
India / expression of interest

# Mini-Reports

- Portugal (Jose Ricardo)

  There are now 2 MSc students working on theory (observables to increase accuracy in qcd) and analysis feasibility studiesc (Higgs). There is also activity in new rad-hard scintillator development plus some work on hadronic calorimeter simulation. All these are happening in parallel with other activities, so not much to report. I hope by summer there will be more to say.

- Norway (Alex Read)

  The situation in Norway has not changed during 2022. We are a small community and the large majority of our resources, human and otherwise, are focused on ongoing upgrades of the ALICE and ATLAS experiments, the ongoing physics exploitation of ALICE and ATLAS, and preparing for the HL-LHC era, including the considerable challenges in software and computing. There is ongoing generic detector and accelerator R&D, but so far no involvement in specific studies or preparations for FCC.

- Slovenia (Marko Mikuz)

  Slovenian HEP group is (overly) busy with the current engagement in ATLAS/Belle-II, so nothing really moved in the FCC direction so far. On the theory(phenomenology) front J. Kamenik contributed with G. Isidori as flavour convener.

- Serbia (Lidija Zivkovic)

  No feedback from the groups to report, although one group is starting.

- Canada (Michael Roney)

  The discussions on FCC-ee are continuing

- Brazil (Alberto Santoro),

  Discussions / kickoff meeting will take place early March during the LISHEP conference in Rio

- Chile (Francisca Garay) Discussions started

- No answers from member states: Austria, Belgium, Netherland, Bulgaria, Slovakia, Hungary, Greece, Israel

# CERN

P. Janot, M. Mangano

*What were the Physics-Expts and Detectors (PED) Activities in 2022 ?*

Pretty much all areas of PED are covered at CERN, including overall coordination

*Estimate of the resources (human and funds) that the lab plan to commit for FCC PED in 2023 and 2024*

About 11-13 FTEs, distributed over more than 25 members of staff, fellows and scientific associates (significant increase)

*What are the initiatives to recruit new people and to connect to other groups internationally*

We hired two fellows on FCC PED in 2022 (Juraj Smiesko and Alvaro Tolosa Delgado), and one LD staff (Brieuc François) for the PED software.

*Persons involved at 15% FTE or more in PED activities*

EP:
Patrick Janot
David D'Enterria
Emmanuel Perez
Martin Aleksa
Michele Selvaggi
Loukas Gouskos
Anna Zaborowska
Philip Roloff
Werner Riegler

TH:
Michelangelo Mangano
Matthew Mc Cullough
John Ellis
Pier Monni
Johann Usovitsch
Gauthier Durieux
Alex Huss
Samuel Abreu
Arnd Behring
Alexander Karlberg
Stefano Frixione
+ some who occasionally write papers
- typically BSM - of relevance to FCC

EP/Software:
Gerri Ganis
Brieuc François
Juraj Smiesko
Alvaro Tolosa Delgado
+ additional contributions from group members
connected with common software projects

# France (1)

G. Bernardi, R. Aleksan

*What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How dit it grow compared to 2021?*

- 11 IN2P3 Labs and 1 CEA Lab have an FCC Activity, with FCC-contact person:

  APC-Paris (AP), CPPM-Marseille (CM), IJC Lab-Orsay (IO), IPHC-Strasbourg (IS), IP2I-Lyon (IL), LAPP-Annecy (LA), LLR-X-Palaiseau (LX), LPC-Clermont (LC), LPNHE-Paris (LP), LPSC-Grenoble (LG), L2IT-Toulouse (LT) and IRFU/CEA-Saclay (IC)

- Activities can be grouped informally in PED topics: Higgs (AP,IO,LX), QCD (LP), Heavy Flavour (LC,IC), Electroweak (IS,LG), Top (LC), Software (IS) R&D Calice/FCC (LX,IL), L.Argon Calo (IO,AP), CMOS (IS,IL,CM), Tracking (IL,IS,IC), EPOL (LP), MDI (LA)

  and other projects are also being investigated (e.g. crystal calorimetry/GRAINITA)

- **PED activities: Personpower went from 37 active members equiv. to 7.5 FTE in 2021 to 52/15.4 FTE in 2022**
  **30/12.5 FTE when counting those at ~0.2 FTE or more**

*What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?*

→ Several MOU's for labs with accelerator work. One generic MOU for PED activities for the whole IN2P3

*Relations between PED and the Accelerator community working on FCC ?*

→ Joint FCC-France workshop but no direct collaboration.

*How is the FCC vs. other ee-colliders situation evolving in your country ?*

→ FCC is clear priority and will continue to receive good / increasing support. Other FC projects have steeply decreasing or stopped support.

# France (2)

*Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?*

- **Funding for FCC-PED is 66kE for 2023 (travel money), while R&D get separate funding (changing given the DRD reorganization)**
- **Accelerator activities receive separate funding, and several labs are very active (IO,LA) under Angeles Faus-Golfe responsibility**

→ In 2023 our goal to improve to more 20-25 FTE. 4 Postdocs LHC-FCC assigned by IN2P3 in 2022-2023 (1 Atlas, 2 CMS, 1 LHCb)

5 Ph.D LHC-FCC starting in 2022-2023

*What are the initiatives to recruit new people and to connect to other groups internationally ?*

→ Funding for mixed Postdocs and Ph.D Students, recruitment quite successful.

→ Workshops open to international partners: FCC- France, Bilateral meetings: FCC France – Italy

→ Participation in ECFA workshops for R&D

*Do you plan a National (or Regional ) FCC workshops in 2023? Are you building or planning to join a Regional FCC "cluster"*

→ 5$^{th}$ FCC-France workshop is foreseen for November 2023. Jamboree for Students/interns in July (every year)

→ Joint FCC-France-Italy could be repeated very two years (and maybe extended)

*Please list the persons involved at 10% FTE or more in PED activities in your country*

List available in backup slides

# PersonPower FCC-IN2P3 on 1/2023 (in red: newcomers)

| Labo | APC | CPPM | IJCLab | IP2I | IPHC | LAPP | LPC | LPNHE | LLR | LPSC L2IT |
|---|---|---|---|---|---|---|---|---|---|---|
| Perm. | G. Bernardi (D)<br>G. Marchiori(C) | **F. Djama(C)**<br>M. Barbero(C)<br>**E. Monnier(D)** | N. Morange(C)<br>Y. Ahmis (C)<br>S. Barsuk (D)<br>D. Fournier (E)<br>J.Lefrançois (E)<br>M-H Schune(D)<br>L. Serin (D) | S. Gascon (P)<br>G. Boudoul (C)<br>D. Contardo (D)<br>G. Grenier (MdC)<br>I. Laktineh (P)<br>L. Mirabito (C) | Z. El Bitar(C)<br>J. Andrea (D)<br>A. Besson (P) | **M. Delmastro(D)**<br>J. Lévèque (D)<br>L. DiCiaccio(P)<br>**C. Bourdarios(C)** | S. Monteil (P)<br>P. Gay (P)<br>R. Madar (C)<br>**H. Chanal mdc** | L. Poggioli (D)<br>A. Blondel (E)<br>B. Malaescu (C) | R. Salerno(C)<br>V. Boudry (D) | F. Malek<br>J. Stark |
| Postdoc | **T. Li (PD)** | | | | **M. Meena (PD)** | | | **L. Patwa (PD)** | **L. Portales (PD)** | |
| Doct. | A. Li (ED) | | | A. Lesauvage (ED) | **G. Sadowski** | | **L. Roerig (c-tut)**<br>T.Miralles<br>(MESRI) | **L.Delagrange (anr)** | | |
| IT | | | R. Chiche (IR)<br>G. Hull (IR) | **R. Barbie (IR)** | **E.Medernach** | | | **N.N (IR)** | | |
| Théorie | | | A. Abada (D)<br>D. Becirevic (D)<br>O. Sumensari | G.Cacciapaglia (D)<br>A. Deandrea (P)<br>**M. Nazilla (P)** | E. Conte (P) | | A. Texeira (D) | | | I.Schienbein<br>S. Kraml |

**52 physicists / 15.4 FTE** (not counting theory)

# Switzerland (1)

M. Weber

What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How dit it grow compared to 2021? Same questions for the Accelerator aspects.

The activities were more-or-less constant from a dedicated-FTE point of view. There is one postdoc dedicated specifically to PED activities and several senior scientists dedicate a significant fraction of their research time to FCC-PED activities. The values for PED are not collected systematically, therefore we have only estimates, compared for example to accelerator research which is organized through CHART.

There is a new initiative called CHEF that has started in 2022. CHEF provides the necessary national structure to organize PED activities in CH. As a platform, it will ramp up in 2023 and the plan is to build up to about 10-15 FTE in 2025-2028.

After a successful workshop in 2021, we organized a CHEF drafting and strategic workshop in Zürich in August 2022. https://indico.cern.ch/event/1041452/. The foundation of the FCC PED activities are summarized in a document (to be released soon) with >20 PhD student projects that PIs are ready to support. They include silicon tracking and timing, as well as theoretical developments and physics studies.

What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?

Several institutions have signed the MoU.

Relations between PED and the Accelerator community working on FCC ?

Very tight. The Swiss Institute of Particle Physics (CHIPP) facilitates the direct communication among these communities. More synergies are expected with the creation of CHEF, based on the CHART model.

# Switzerland (2)

How is the FCC vs. other ee-colliders situation evolving in your country ?

Switzerland, as host country, has a new collider at CERN, namely the FCC, as main priority.

https://api.swiss-academies.ch/site/assets/files/24379/chipp_roadmap_2021.pdf

Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?

Ramping up. Going from one PostDoc to a few PostDocs and students (depending on seed-funds) and aiming at a larger number in 2025-2028.

What are the initiatives to recruit new people and to connect to other groups internationally ?

Scientific personnel is funded through competitive grants and for those a scheme needs to be created that is compatible with PED activities. CHEF will create the basis for it and we hope that seed funds would allow to ramp up in 2023 and 2024.

Do you plan a National (or Regional ) FCC workshops in 2023? Are you building or planning to join a Regional FCC “cluster” ?

No concrete plans.

Please list the persons involved at 10% FTE or more in PED activities in your country

The University of Zurich has currently the only grant with dedicated PED personnel

# Germany (1)

F. Simon

*What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How did it grow compared to 2021?*

Some growth compared to 2021, with more involvement in PED coordination roles. Several seniors involved with small fraction of their time; significant contributions to overall PED coordination. ”Day-to-day” PED work seen modest growth, concrete experimental work still only at a small number of institutes. Overall FTEs hard to estimate, but relatively small (single digits). Interest present, but remains mostly passive. Analysis activities at DESY, KIT, MPP (with students / postdocs at larger FTE-fractions), expansion to additional University groups very slow. Several theory groups with interest and concrete pheno involvement.

Detector R&D remains the most significant activity – applicable to FCC PED, but not explicitly performed in this context.

*What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?*

No complete coherent overview. Typically no concrete commitments related to PED; best effort basis.

*How is the FCC vs. other ee-colliders situation evolving in your country ?*

Significant interest in other ee colliders, in particular ILC. Concrete activities (which are not single-person physics studies) typically pursued in a facility-independent context (simulation, software frameworks, ...)

# Germany (2)

*Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?*

*No concrete numbers (but small). Impact of leadership and personnel changes at MPI for Physics still to be seen. Currently preparing for next BMBF funding round (Funding beginning 07/2024). It remains to be seen if future collider physics & detector studies can be included within the R&D heading, which could enable some growth (currently no support through that line).*

*What are the initiatives to recruit new people and to connect to other groups internationally ?*

Active groups recruiting on the level of regular personnel turn-over. Ongoing efforts to increase engagement in Future Collider activities building on ECFA HF framework.

*Do you plan a National (or Regional ) FCC workshops in 2023?*

This remains in discussion. While the DESY ECFA HF workshop was overall well attended, representation by experimental groups at German Universities and research centers other than DESY was disappointing. Creates a very challenging environment for an ”FCC engagement meeting” or similar, with the risk of failure (e.g. small attendance, which would be a message also to Funding Agencies).

*Please list the persons involved at 10% FTE or more in PED activities in your country.*

No full overview. Among seniors: Christophe Grojean. [when considering explicit FCC PED activities only].

# Italy (1)

F. Bedeschi

*What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How dit it grow compared to 2021? Same questions for the Accelerator aspects.*

→ Activities are structured in work packages as follows:

- **WP1: Physics and software / WP2: Accelerator / WP3: Silicon Detectors /**
- **WP4: Drift Chamber / WP5: MPGD muon / WP6: DR calorimetry**

**Since 2021 great increase in accelerator activities. MDI keeps growing and new things are joining in the area of injectors and SRF.**

**Since 2021 Dual Readout calorimetry received substantial funding ~ 1 MEuro and vertex detector mechanics is being developed with MDI.**

**In addition full simulation of IDEA is nearly complete.**

*What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?*

→ MOU's present for accelerator work only at the moment

*Relations between PED and the Accelerator community working on FCC ?*

→ Good collaboration on vertex detector and luminometer mechanics with MDI group

# Italy (2)

*How is the FCC vs. other ee-colliders situation evolving in your country ?*

→ FCC will continue to receive good support. Also muon collider has good support.

*Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?*

→ In 2023 30.7 FTE/151 scientists and a total budget ~ 400 kEuro not including EU program support.

*What are the initiatives to recruit new people and to connect to other groups internationally ?*

→ Workshops open to international partners: FCC- Italy,  Bilateral meetings: FCC France – Italy

→ Participation in ECFA workshops for R&D

Do you plan a National (or Regional ) FCC workshops in 2023?

→ FCC Italy in spring 2023

*Are you building or planning to join a Regional FCC "cluster" with neighboring nations ?*

→ Working on it (Bilateral meeting with France was a good start)

*Please list the persons involved at 10% FTE or more in PED activities in your country*

→ Lit is too long

# Spain

J. Alcaraz

What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How dit it grow compared to 2021? Same questions for the Accelerator aspects.

**Compared to 2022, we have had specific contributions to the Snowmass process in 2022 in the context of Higgs factories: studies of top and bottom couplings, b-quark mass from Higgs decays, contributions to EFT studies, FCC white paper,**

What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?

Relations between PED and the Accelerator community working on FCC ?

**No new Spanish institutes have signed the MoU (to my knowledge), but a good representation of the Spanish community is there since years. FCC contributions are focused on accelerator/magnets for the original MoU signatures, with no new specific commitments for PED activities (again to my knowledge).**

How is the FCC vs. other ee-colliders situation evolving in your country ? **Slow activity in all fronts (but for other ee colliders too).**

Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?

What are the initiatives to recruit new people and to connect to other groups internationally ?

**New joint IFIC(Valencia)-CIEMAT(Madrid) project now approved by the National program.. IFIC also receives additional contributions from Valencian Community. We have healthy connections with other groups participating in FCC and other Higgs factories.**

Do you plan a National (or Regional ) FCC workshops in 2023?

Are you building or planning to join a Regional FCC “cluster” with neighboring nations (cf. Nordic countries) ?

**We are planning a workshop of the Spanish Network in Spring 2023.. Possibility to organize a regional FCC cluster with Portugal in the future.**

Please list the persons involved at 10% FTE or more in PED activities in your country

**Seniors: J. Alcaraz, M. Cepeda, M.C. Fouz, J. Fuster, J. Puerta, M. Vos, A. Irles, V. Mitsou, A. Ruiz, H. Yamamoto, D. Esperante, N. Fuster.**
**Contributions from the theory community too (J. De Blas and S. Heynemeyer contribute substantially, for instance). There are also some students contributing to the effort, who are not cited here.**

# UK (1)

A. Pilkington

*What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How did it grow compared to 2021? Same questions for the Accelerator aspects.*

- The FCC PED Workshop in February was hosted by Liverpool University, although circumstances dictated it ended up being a virtual event.
- FCC-ee: In July we held a successful half day meeting on joint FCC-ee / linear-ee topics, attended by around 60 people in total This explored the commonalities between the different e+e- initiatives, but with a significant focus on FCC-ee. A follow-up meeting later in the summer focused on UK activities in silicon vertexing and tracking.
- FCC-hh: In July, there was a half-day meeting on FCC-hh activities in Manchester, attended by about 30 people (in person and on zoom). A follow up meeting is planned for early July to provide tutorials for FCC physics analysis studies.
- FCC-eh: The community participated fully in the Orsay workshop (https://indico.ijclab.in2p3.fr/event/8623). In early 2023, the UK FCC-eh community plan to reevaluate its priorities following the renewal of the CERN mandate for the eh option.
- In September there was a separate meeting aimed at Early Career Physicists on the topic of 'future colliders'.

What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?

Relations between PED and the Accelerator community working on FCC ?

- The FCC webpage lists the UK institutes that are signed up, but it is hard to evaluate actual 'commitments'.
- There are contributions being made to the accelerator by the Cockcroft Institute and the John Adams Institute.

# UK (2)

How is the FCC vs. other ee-colliders situation evolving in your country ?

- There is a good relationship between the FCC and ILC/CLIC communities, which are working closely together to obtain funding for R&D suitable for experiments on any future e+e- collider. Although there is a historical core of UK physicists who have worked on ILC and CLIC this community is now small, and the attention is now more focused on FCC-ee.
- In addition to the FCC-ee option, we note that there is substantial interest in FCC-hh and FCC-eh in the UK community. The activities in these areas is largely independent of the FCC-ee activity. The detector R&D synergies between the collider options may however result in joint funding applications from interested institutes in the future, should new funding lines open.

Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?

- This is not possible to estimate. General R&D funding that is relevant for FCC would be funded via STFC. We hope that substantial new funding for such activities will become available in the near future.
- Most FCC physics and detector studies are currently done using fractions of academic and student time.

# UK (3)

What are the initiatives to recruit new people and to connect to other groups internationally ?

- See Q1: we have hosted a number of meetings to increase the interest of the community, especially amongst ECRs
- UK researchers hold various leadership roles in ECFA, FCC FS and other international initiatives related to FCC.

Do you plan a National (or Regional ) FCC workshops in 2023?

- Yes, many of these will focus on specific topics (i.e. joint FCC-ee/ILC, FCC-hh physics studies, detector R&D meetings, etc)
- We also plan to host another ‘global FCC’ workshop, to bring together the different interested parties.

Are you building or planning to join a Regional FCC “cluster” with neighboring nations (cf. Nordic countries) ?

- No

Please list the persons involved at 10% FTE or more in PED activities in your country

- It is not possible to estimate the FTE that people are spending on FCC. Every institute in the UK has expressed an interest in FCC and has a designated contact person.
- A sizeable number of people are active in relevant detector R&D at a considerable level (some is generic, some is FCC-ee focused).
- Around 7 - 8 groups are involved in FCC physics studies.

# Czechia

J. Faltova

**What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How dit it grow compared to 2021?**

– Noble liquid calorimeter for FCC-ee; 0.6 FTE

– No work related to accelerators

**What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?**

– Charles University (CUNI) signed the MOU and Addendum (2018), promised work on calorimetry for FCC.

Relations between PED and the Accelerator community working on FCC ?

**How is the FCC vs. other ee-colliders situation evolving in your country ?** – Czechia is involved in FCC, but not in other ee-colliders

**Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?**

– There is currently no plan to increase the person-power. If no other institute join the effort, we cannot expect more than 1-2 FTE in 2023/2024.

What are the initiatives to recruit new people and to connect to other groups internationally ? – There is no such initiative planned.

**Do you plan a National (or Regional ) FCC workshops in 2023?** – No

**Are you building or planning to join a Regional FCC "cluster" with neighboring nations (cf. Nordic countries) ?** – No

**Please list the persons involved at 10% FTE or more in PED activities in your countr**y – Jana Faltova

# Poland

T. Lesiak, M. Chrzasz

What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How dit it grow compared to 2021?

MC generators, Physics Analysis, Software development. Thinking about expanding detector R&D (Calo).

What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?

Yes. 3 MOU signed. 4th one with LEGEL departments.

Relations between PED and the Accelerator community working on FCC ? Building a relationship with

How is the FCC vs. other ee-colliders situation evolving in your country ? Stable. Strong group involved in FCC

Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024? 0.5M USD

What are the initiatives to recruit new people and to connect to other groups internationally ? This is done as shared PhD with LHC experiments.

Do you plan a National (or Regional ) FCC workshops in 2023? Are you building or planning to join a Regional FCC “cluster” with neighboring nations ?

Not in 2023, 2024 is more likely, Yes in the future we look forward to a regional cluster

Please list the persons involved at 10% FTE or more in PED activities in your country:

Tadeusz Lesiak, Marcin Chrzaszcz, Staszek Jadach, Janusz Gluza, Maciej Skrzypek, Zbigniew Was, Jihyun Bhom, Andrzej Siodmok, Jacek Holeczek, Bartosz Dziewi

# Romania

G. Stoicea

What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? No activities yet.

Same questions for the Accelerator aspects. No activities yet. We are not aware of the existence of an accelerator group in Romania.

What is the situation with the MOU and Addendum for your country ? We would like to sign the MoU for PE&D as soon as possible.

Are there commitments related to PED ? No commitments yet, we will assume contributions once the MoU is signed.

How is the FCC vs. other ee-colliders situation evolving in your country ? No activities yet. We intend to contribute to FCC ee as soon as possible, MoU is needed for obtaining the funding.

Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?
2.6 FTE, apply for funding after MoU is signed.

What are the initiatives to recruit new people and to connect to other groups internationally ?

Several colleagues form the ATLAS group will dedicate a certain FTE fraction to FCC. The contributing institutions: IFIN-HH Bucharest, ITIM Cluj Napoca, University of Bucharest (UB), University Politehnica of Bucharest (UPB), Transylvania University of Brasov (UTB).

Do you plan a National (or Regional ) FCC workshops in 2023? Yes, meeting with people from several universities and national R&D institutes.

Are you building or planning to join a Regional FCC “cluster” with neighboring nations (cf. Nordic countries) ? Not yet, but could be envisaged.

Please list the persons involved at 10% FTE or more in PED activities in your country:

PE (IFIN, UB): Calin Alexa 0.5FTE, Gabriel Stoicea 0.5FTE, Valentina Tudorache 0.1FTE, Adam Jinaru 0.1FTE, Ioana Duminica (PhD student) 0.3FTE, Marina Rotaru 0.1FTE, Alexandra Tudorache 0.1

Detectors (IFIN, ITIM, UB, UPB, UTB; will overlap with Detector R&D projects; at least 0.1FTE for each): Sorin Martoiu, Dorel Pietreanu, Matei Vasile, Ioan Dinu, Calin Bira, Radu Hobincu, Adrian Chitan, Stefan Popa, Radu Coliban, Gabriel Popeneciu, Alecsandru Chirosca

- students will join the project after the funding is secured

# Denmark, Finland

M. Dam, K. Österberg

What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How dit it grow compared to 2021?

Denmark: Convenership of PED Detector Concepts group. Supervision of few master student projects. ~0.4 FTE, steady.

No PED activities in Finland in 2022.

What were the Accelerator Activities in 2022 in your country (type and FTE) ? How dit it grow compared to 2021?

Finland: about 1.2 FTE of FCC accelerator activities, molecular dynamics simulations of different superconducting RF cavity coatings. No change with respect to 2021.

No accelerator activities in Denmark

What is the situation with the MOU and Addendum for your country ?

Denmark: MOU signed 2021, no Addendum existing.Are there commitments related to PED ? No commitments to PED

How is the FCC vs. other ee-colliders situation evolving in your country ?

Finland: Activity on accelerator part of CLIC ramping down, some FCC accelerator activity on-going, no ILC activity currently.

Denmark: only FCC-ee

What are the initiatives to recruit new people and to connect to other groups internationally ? No initiatives currently. Currently focus is on LHC activities.

Do you plan a National (or Regional ) FCC workshops in 2023? Yes

Are you building or planning to join a Regional FCC “cluster” with neighboring nations? Already part of Nordic FCC cluster.

Please list the persons involved at 10% FTE or more in PED activities in your country: Denmark; M. Dam, J.B. Hansen.

# Sweden

R. Gonzalez Suarez

- Physics-Experiments and Detectors (PED)  Activities in 2022:
  - Continued work in BSM: long-lived signatures
  - One postdoc (Giulia Ripellino) joined in with a portion of her time (position: ATLAS + FCC)
- The accelerator community showed a moderate interest in the past years
  - Not materialized in any concrete plans in 2022
  - Move towards a muon collider from the accelerator side in Uppsala
- **Physics group in Uppsala will continue activities in 2023**
- Interest in Nordic cluster still very much alive, no plans for a new workshop, but we could think about it
- Summary of 2022:
  - Master thesis of Lovisa Rygaard (with Juliette Alimena and Suchita Kulkarni) LLPs HNLs
    - http://uu.diva-portal.org/smash/record.jsf?pid=diva2%3A1679659&dswid=3692
  - Snowmass papers:
    - **arXiv:2209.13128, arXiv:2203.08039, arXiv:2203.06520, Front. Phys. 10:967881 (2022)**
- Commitment for 2023:
  - **PI + postdoc + master students (one finishing soon –Magdalena Vande Voorde-, more to come)**

# Turkey (1)

I. Turk Cakir, O. Etiksen

**1-What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ?**

**2- How dit it grow compared to 2021? Same questions for the Accelerator aspects.**

- FCC National Collaboration and Information Exchange Workshop, 2-3 April 2022, Ankara. (https://indico.cern.ch/event/1135770/)
- 8th Internationally Participated Congress on Particle Accelerators and Applications, Bodrum, Turkey, 05-07 September, 2022.(https://indico.cern.ch/event/1149205/)
- Istanbul High Energy Physics Workshop, Istanbul, Turkiye, 24-25 Sept 2022 (https://indico.cern.ch/e/yefist2022)
- Particle Accelerators and Detectors Local Infrastructure and R&D Workshop, Istanbul, Turkey, 3-4 December 2022. (https://indico.cern.ch/event/1201951/)

These activities have increased in 2021. All activities are organized jointly for PED and accelerator studies.

**3- What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?**

- MoU were signed by 14 Univ. during CDR years (BAIB Uni. (Bolu), Akdeniz Uni., Ankara Uni., Ege Uni., Giresun Uni., Isik Uni., Istanbul Aydin Uni., Istanbul Uni., Izmir Universty of Economics, IYTE, Okan Uni., Piri Reis Univ., TOBB ETU and Uludag Uni.). There were also addendums signed by 4 universities (BAIB Uni, Ankara Uni, Giresun Uni, IUE Uni.).

- MoU (Feasibility Study) were signed/resigned by 12 universities after 2020 (Istanbul Univ., Giresun Univ., Istanbul Aydin Univ., Ege Univ., Izmir University of Economics, IYTE, BAIB Uni., Isik Uni., İstinye Uni., Piri Reis Uni., Ankara Uni., Uludag Uni).

- In addition, processes for three universities are still going on to sign the MoU (Kırıkkale Uni., Akdeniz Uni., TOBB).

# Turkey (2)

**4- Relations between PED and the Accelerator community working on FCC ?**

Scientists from Physics, Detector and Accelerator Community meet periodically in the FCC national collaboration workshops. National projects related to FCC Feasibility Study are planed upon the acceptance of the project. There will be some commitments about to PED.

**5- How is the FCC vs. other ee-colliders situation evolving in your country ?**

There have been serious contributions to the CLIC and FCC Projects; however, it seems that we are more focused on FCC Project currently.

**6-Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?** It is not easy to give an estimation about resources.

**7-What are the initiatives to recruit new people and to connect to other groups internationally?**

Discussions are ongoing between Kırıkkale University, Ege University, Izmir University of Economics and FCC management about new/further collaboration opportunities for the FCC-ee accelerator design/prototype study.

**8-Do you plan a National (or Regional ) FCC workshops in 2023? Are you building or planning to join a Regional FCC “cluster” ?**

We are planning another FCC national collaboration workshop in 2023.

There is no concrete plan for a cluster, yet.

# Turkey (3)

**10-Please list the persons involved at 10% FTE or more in PED activities in your country.**

For FCC related studies (only for PED):


İlkay Türk Çakır : ilkay.turkcakir@cern.ch

Orhan Çakır : Orhan.Cakir@cern.ch

Sinan Kuday :Sinan.Kuday@cern.ch

Alican Canbay :alican.can.canbay@cern.ch

İlhan Tapan : ilhantapan@gmail.com

Fatma Koçak :fkocak@uludag.edu.tr

Adnan Kılıç :adnank@uludag.edu.tr

Umit Kaya : Umit.Kaya@cern.ch

Haluk Denizli : haluk.denizli@cern.ch

Ali Yılmaz : ali.yilmaz@ibu.edu.tr

Abdulkadir Şenol :abdülkadir.senol@cern.ch

Furkan Tokaç :furkantokac@gmail.com

Özkan Şahin: osahin@ukudag.edu.tr

Nülgün Demir :dnilgun@uludag.edu.tr

Işınsu Kahraman :isinsukahraman91@gmail.com

Saleh Sultansoy :salekh.sultanov@cern.ch

Aysuhan Ozansoy: aysuhan.ozansoy@gmail.com

Volkan Arı: volkan.ari@science.ankara.edu.tr

Burak Dağlı : burak.dagli@cern.ch

# USA (1)

S. Eno, D. Denisov, T. Raubenheimer

What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How did it grow compared to 2021?

The US was involved in the Snowmass process during 2022, which feeds into the P5 process that sets US long term priorities. We produced an FCC whitepaper that was submitted to the energy frontier and coordinated submission of multiple related white papers. US now has leadership roles (Paus, Graham) in the FCC electroweak precision physics group and activities are progressing in accelerator areas based on MoUs. Estimates of a few FTEs were involved in FCC activities in the US in 2022 which is substantial growth vs previous years.

Same questions for the Accelerator aspects.

The direct contributions to the FCC-ee accelerator are still small in the US and there is very little funding to support such work. There are strong synergies between the FCC-ee and the US Electron-Ion Collider and collaborative meetings have been started, initially focused on the Superconducting RF (SRF) cavities and Interaction Region magnets but planned to grow to include other common technologies as well as critical beam physics. In addition, the SRF R&D programs at both Fermilab and Jlab are very applicable to FCC-ee. Both laboratories are providing guidance on SRF and stronger collaborations are being discussed. It is expected that the combined effort in the US should grow from 0.5 FTE in 2022 to 3 to 4 FTE's in 2023 due to these collaborative activities. Finally, it is hoped that the National Collider R&D Initiative, proposed at Snowmass, will provide direct funding in 2024 and beyond to grow US the FCC accelerator effort.

# USA (2)

What is the situation with the MOU and Addendum for your country ?

We have a list of universities which signed MoUs and more to come as soon as future colliders dedicated funding to become available. US labs can only sign Attendums to DOE-FCC MoU and by now many have them and more are in the discussion stage.

Are there commitments related to PED ?

Eno and Denisov are members of the PED coordination group. Paus and Graham are PED precision electroweak coordinators.

In addition, Pleier at BNL is covering, for now, physics, detectors and interaction region magnets. More specifically, his physics interests comprise Higgs to charm couplings, Higgs self couplings and BSM searches (e.g. H->invisible) at the FCC-ee, paired with our interests and expertise in tracking and timing detectors, noble-liquid based calorimetry and DAQ architecture

Relations between PED and the Accelerator community working on FCC ?

There are some preliminary interactions about interaction region magnets and dependence of the FCC physics reach vs collision energy (increases due to possibility to use energy recovery methods). The Machine-Detector Interface (MDI) effort which has contributions from both PED and the Accelerator groups is growing in Europe. If desired, the US could make a significant impact here.

# USA (3)

How is the FCC vs. other ee-colliders situation evolving in your country ?

The P5 process will clarify this. There are certainly many various Higgs factory options under discussion.

Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?

Only BNL has a commitment currently, although small work on calorimetry goes on at FNAL and Argonne. P5 recommendations are important to establish financial support for FCC related activities.

What are the initiatives to recruit new people and to connect to other groups internationally ?

We are working with various international partners and plan to increase interactions.

Do you plan a National (or Regional ) FCC workshops in 2023?

Yes, at BNL in April 2023. Potentially more in the future.

Are you building or planning to join a Regional FCC “cluster” with neighboring nations?

Not at this moment, although we are open to such collaborations.

Please list the persons involved at 10% FTE or more in PED activities in your country

Paus, Graham, Pleier, Eno, Denisov, Pleier, Raubenheimer, and potentially others.

# South Korea (1)

P. Ko, H.Yoo

What were the Physics-Experiments and Detectors (PED) Activities in 2022 in your country (type and FTE) ? How dit it grow compared to 2021? Same questions for the Accelerator aspects.

=> 1. perform the test-beam experiment at CERN (Aug. 17 – 24) for the prototype modules of the dual-readout calorimeter built newly by Korean group: 11 institutes 32 participants in Korea (23 graduate students)

2. Pheno activity at KIAS (Korea Institute for Advanced Study): one dedicated workshop and six seminars were held between May and December in 2022

What is the situation with the MOU and Addendum for your country ? Are there commitments related to PED ?

Relations between PED and the Accelerator community working on FCC ?

⇒ No further MOU beyond previous ones. PED activities are on-going with regardless of the MOUs. National-wide clustering and new MOU participants are under discussion. We will extend our networking with accelerator community in 2023

How is the FCC vs. other ee-colliders situation evolving in your country ?

=> Focus on the FCC program mostly. Same detector R&D program (the dual-readout calorimeter R&D) is connected to the CEPC project. Korea-ILC community has worked intensively in 2000s and 2010s, but no further activities in last 5 years

# South Korea (2)

Estimate of the resources (human/funds) that the labs in your country or your national institute plan to commit for FCC PED in 2023 and 2024?

=> Korea dual-readout calorimeter R&D team will continue to work and two new institutes join newly the R&D program (below table). Theorists will continue to work the various physics studies.

What are the initiatives to recruit new people and to connect to other groups internationally ?

=> Korea dual-readout calorimeter R&D team connect to EU consortium (INFN mostly) and US consortium (Calvision team).

| | Faculty | Researchers | Students | funds | comment |
|---|---|---|---|---|---|
| Yonsei University | 1 | 1 | 7 | $350k in 2023 (same in 2024) | |
| Kyungpook National University | 1 | 1 | 3 | Soft fund | |
| University of Seoul | 1 | 1 | 2 | Soft fund | |
| Seoul National University | | | 1 | - | |
| Gangneung Wonju National University | 1 | | 2 | $20k in 2023 | Newly join |
| Severance Hospital | 1 | | 2 | $70k in 2023 | Newly join |

# South Korea (3)

Do you plan a National (or Regional ) FCC workshops in 2023?

⇒Yes, we consider it and it's under discussion in our local community

Are you building or planning to join a Regional FCC "cluster" with neighboring nations (cf. Nordic countries) ?

⇒Yes, we consider the regional cluster in Asia. For example, University of Tokyo team (Japan) participated in the test-beam experiment performed in 2022.

Please list the persons involved at 10% FTE or more in PED activities in your country

=> 1. Yonsei University: Prof. Hwidong Yoo, Dr. Seungkyu Ha, Kyuyeong Hwang, Guk Cho, Sungwon Kim, Dongwoon Kim, Yun Eo, Haeun Jang, Seoyun Jang

2. Kyungpook National University: Prof. Sehwook Lee, Dr. Minsang Ryu, Bobae Kim, Changgi Huh

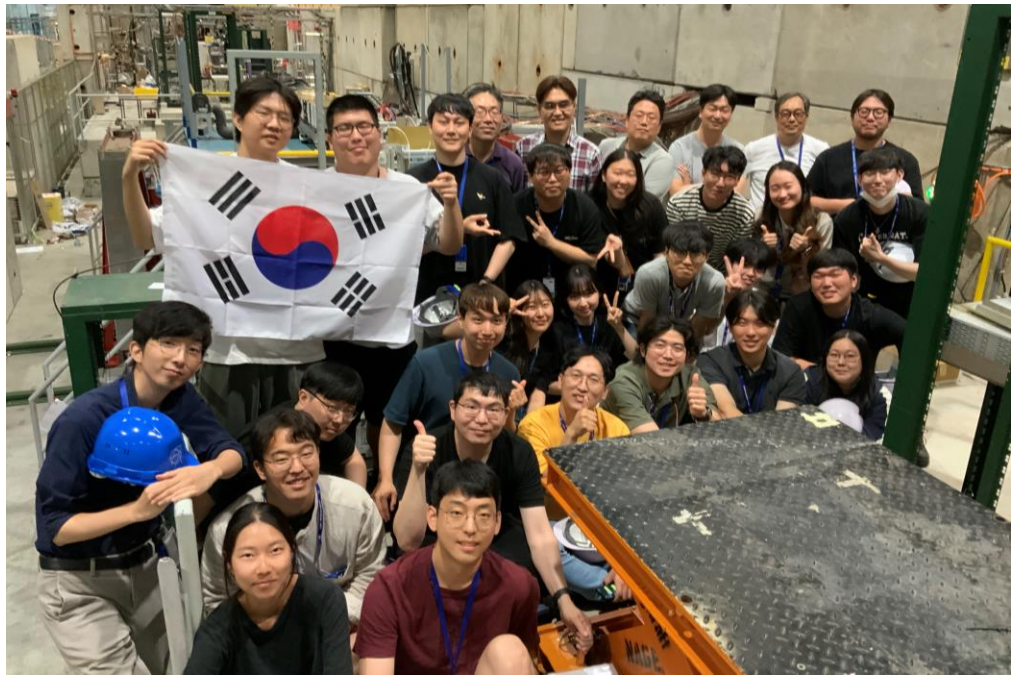
3. University of Seoul: Prof. Jason Lee, Hyupwoo Lee, Yunjae Lee, Youngwan Son

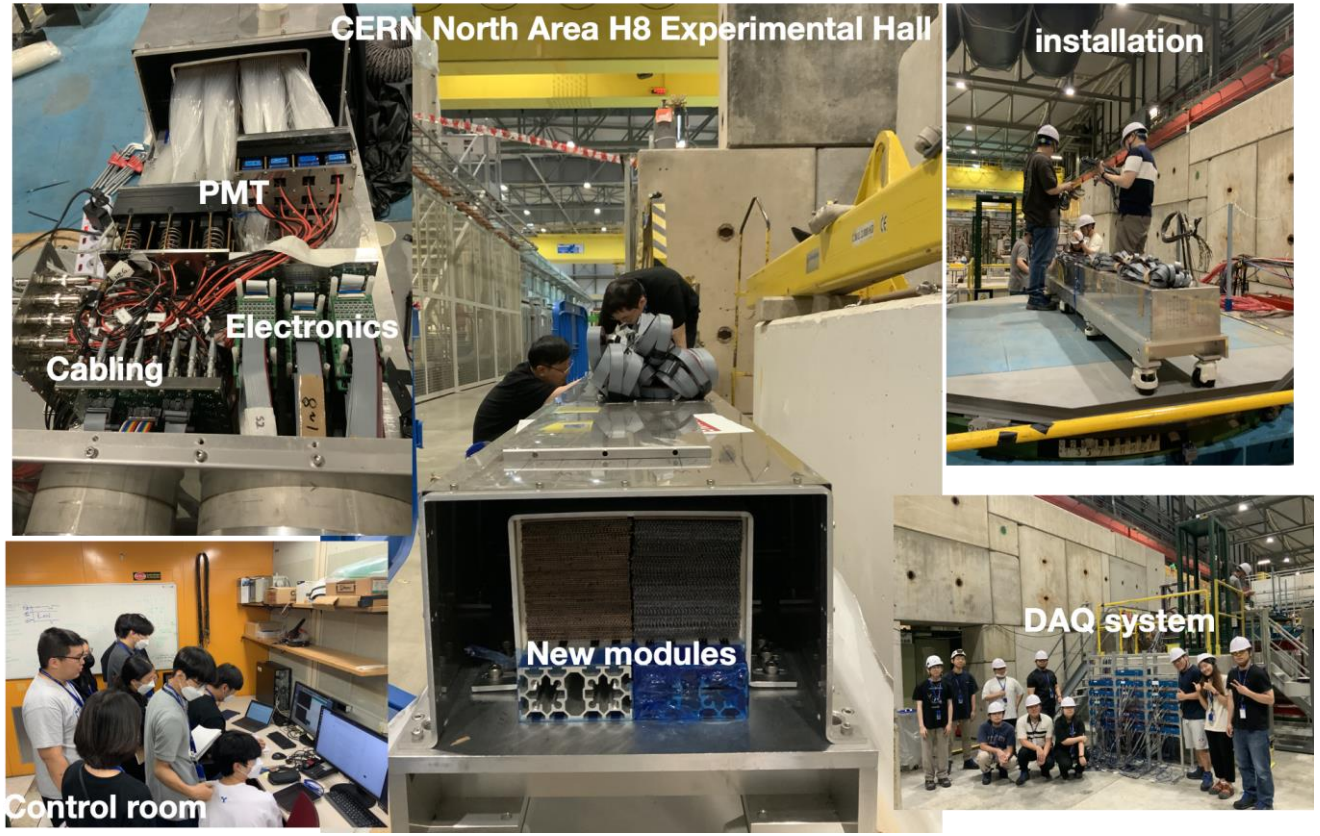
4. Seoul National University: Sanghyun Ko

5. Gangneung Wonju National University: Prof. Minsuk Kim, Jieun Hwang

# Test-beam of the Dual-Readout Calorimeter at CERN

- Two full-size (2.5 m length) modules are newly built by Korean group
  - R&D applications: various optical fibers / PMT types, high granularity by SiPM, fast time resolution DAQ system, etc.
- Test-beam experiment at CERN (August) with 13 institutions, 34 participants (including 23 students)
  - 84 hours data-taking, about 28M events taken

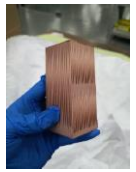
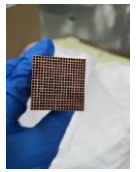




# Other R&D Studies of the Dual-Readout Calorimeter

## Copper forming and engineering R&D

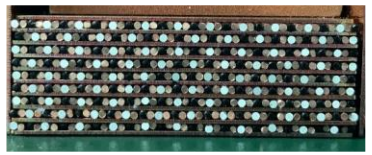
- 3D printing

It has very perfect accuracy, but the cost is very high

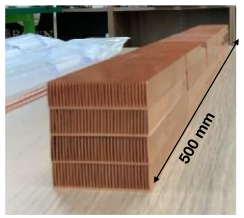
- LEGO-like ( Copper pipe )

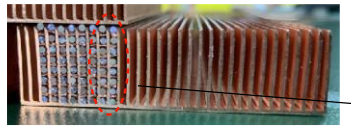




It has very good accuracy, and pretty low cost

- SF Heatsink

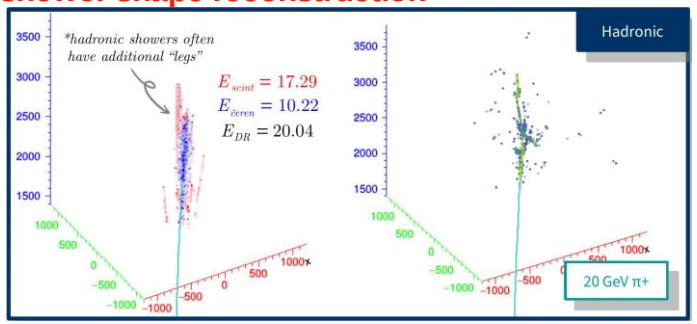


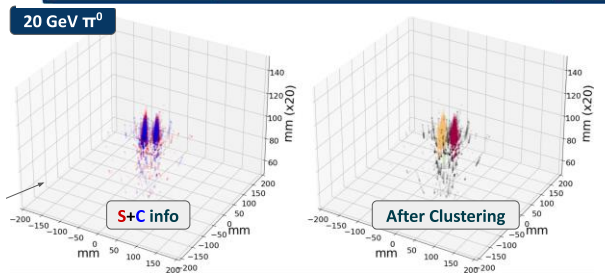



It has very excellent accuracy, and cost is low

**Possibility for mass production!**

## 3D shower shape reconstruction

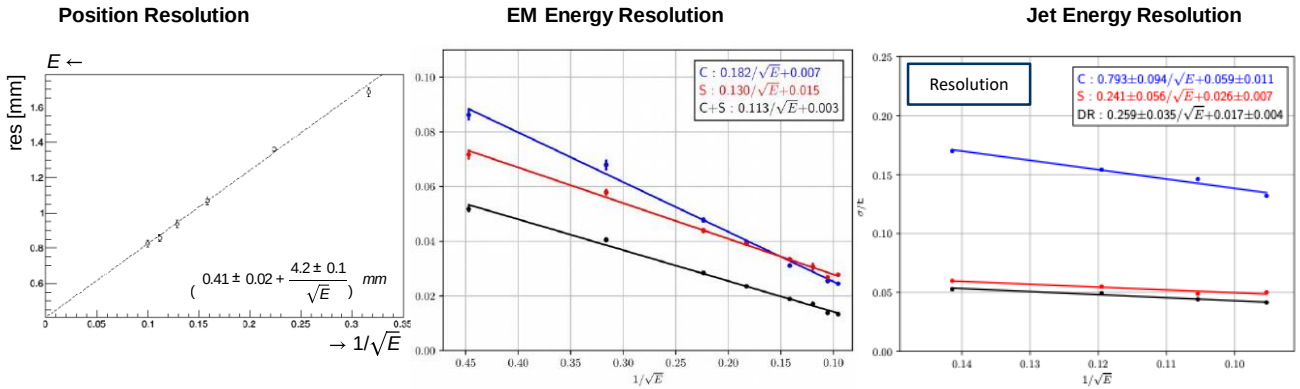


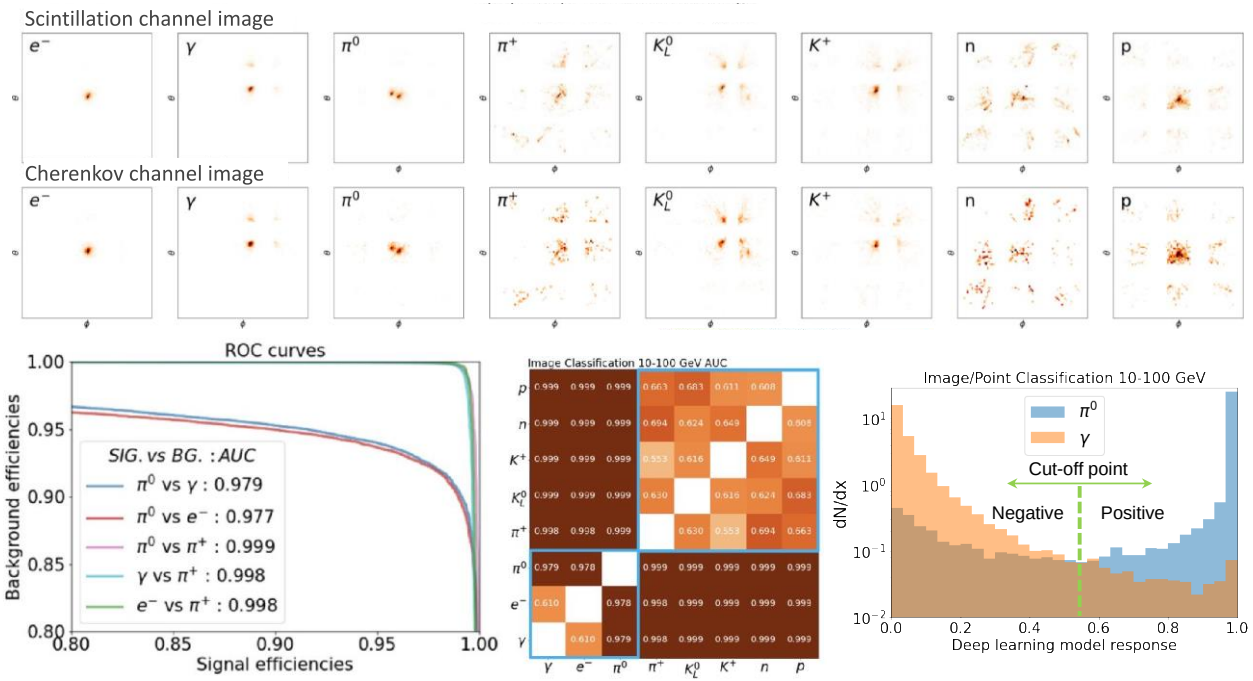

- Combining lateral granularity and longitudinal information allows **3D reconstruction** of shower shape
- Unlocks potential as **particle flow calorimeter**

**$\pi^0$ needs tighter ε with respect to other particle showers**

## Energy & position resolution




## Particle ID with Machine Learning



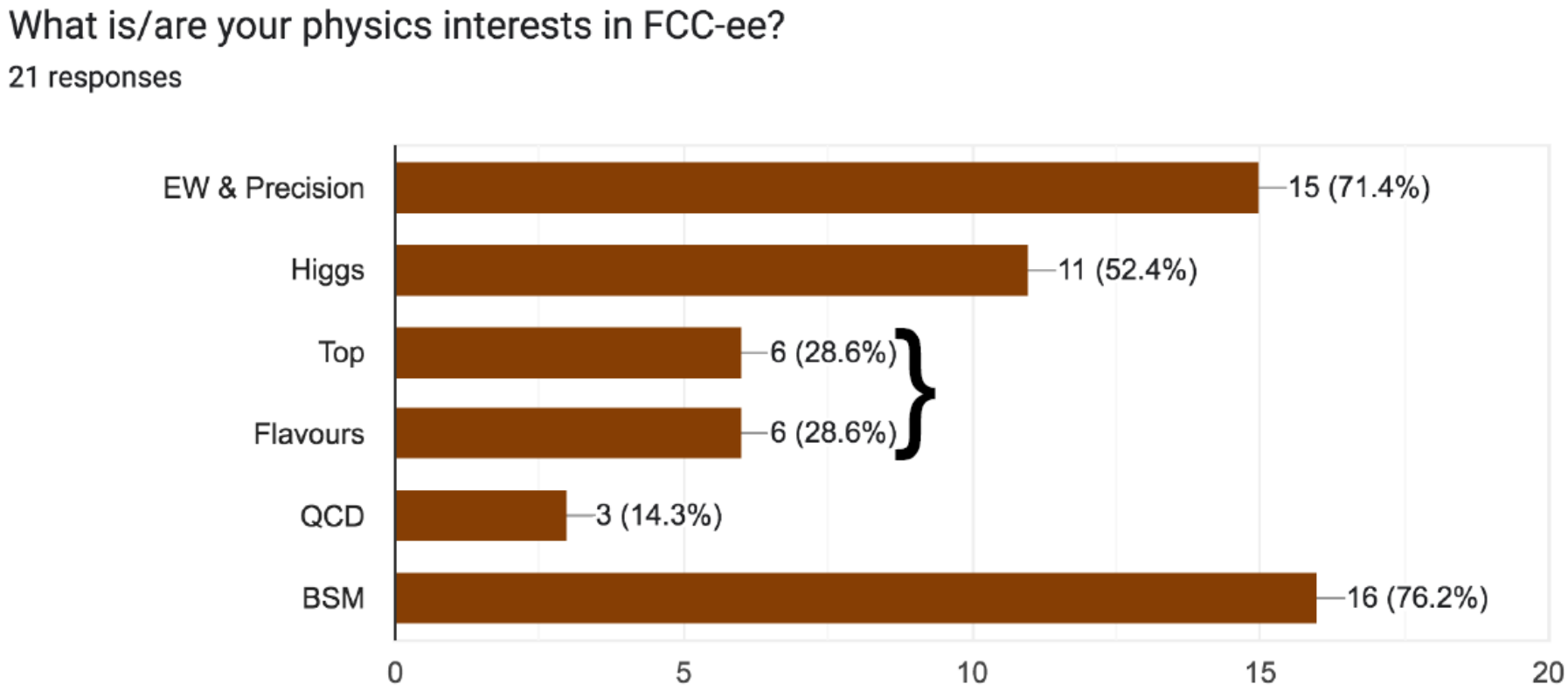
# Expression of Interests for FCC-ee

G. Mohanty
P. Mal
J. Libby

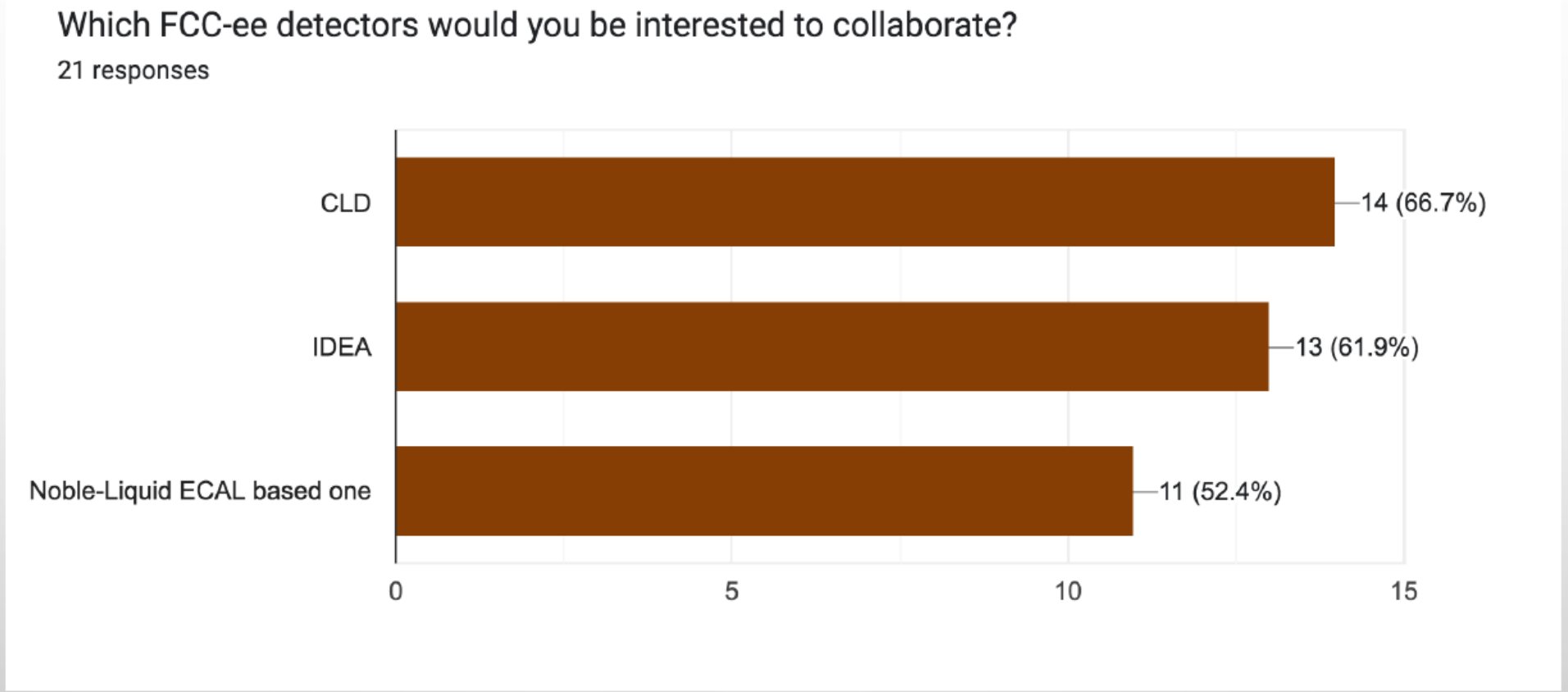
## India

- FCC-ee presentations by Emmanuel Perez and Moggens Dam on Jan 17, 2023 on physics and detectors, respectively – thanks to G. Bernardi
  - https://indico.cern.ch/event/1239356/
  - Announced/open to all Indian experimentalists working on CMS, Belle II and partly to hep phenomenologists/theorists having immediate interest on e+e- physics
  - Zoom recordings are made available afterwards
- Expression of interests on FCC-ee with questionnaire surveyed online (till Jan 22, 2023)
  - **21 physicists** from **16 Indian institutions** participated in this survey
  - Interests on a broad variety of physics and detector topics were evident

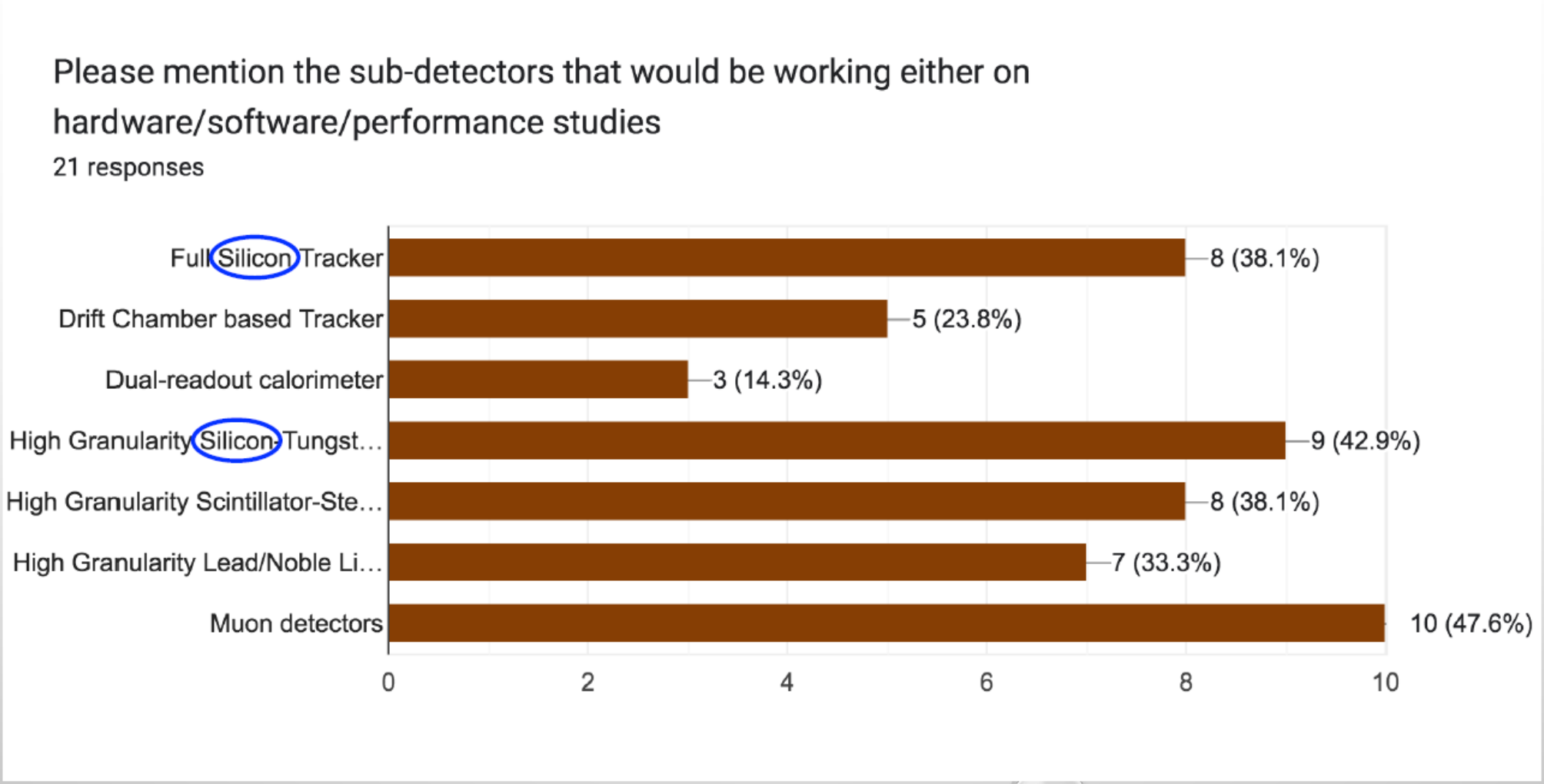
# PHYSICS INTERESTS



# CLD/IDEA/NOBLE-LIQUID ECAL



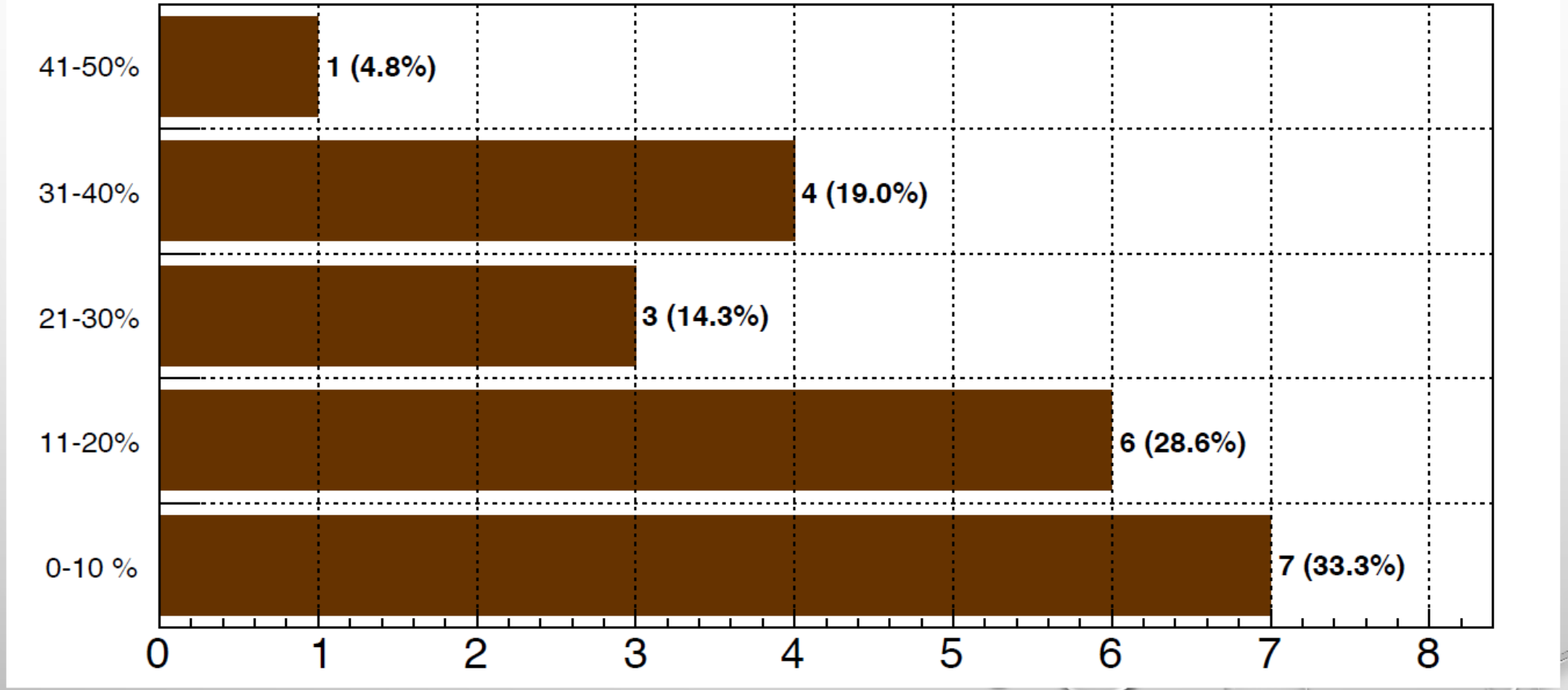
# INTERESTS ON SUBDETECTORS



# PROJECTED TIME FRACTION (PHYSICISTS)

What is your projected fraction (in percentage) of your research time (only yourself) for next few years on FCC-ee?

21 responses



# QUESTIONS TO THE NATIONAL CONTACT(S)

**WHAT WERE THE PHYSICS-EXPERIMENTS AND DETECTORS (PED) ACTIVITIES IN 2022 IN YOUR COUNTRY (TYPE AND FTE) ? HOW DIT IT GROW COMPARED TO 2021? SAME QUESTIONS FOR THE ACCELERATOR ASPECTS.**

**-- CMS AND BELLE II**

**WHAT IS THE SITUATION WITH THE MOU AND ADDENDUM FOR YOUR COUNTRY ? ARE THERE COMMITMENTS RELATED TO PED ?**

**RELATIONS BETWEEN PED AND THE ACCELERATOR COMMUNITY WORKING ON FCC ?**

**-- CMS PHASE 2 UPGRADE MOU IS YET TO BE SIGNED, HARDWARE DELIVERABLES/COMMITMENTS IN PLACE FOR TRACKER, HGCAL, GEM, AND TRIGGER**

**HOW IS THE FCC VS. OTHER EE-COLLIDERS SITUATION EVOLVING IN YOUR COUNTRY ?**

**-- NOTHING VERY FOCUSED AT THIS POINT OF TIME; PREVIOUSLY SOME THEORETICAL WORKS AND MODEST DETECTOR R&D DONE FOR ILC**

**ESTIMATE OF THE RESOURCES (HUMAN/FUNDS) THAT THE LABS IN YOUR COUNTRY OR YOUR NATIONAL INSTITUTE PLAN TO COMMIT FOR FCC PED IN 2023 AND 2024?**

**-- SEE SLIDE# 6 FOR PERSON POWER ESTIMATES; NO FUNDING PROPOSAL IN PLACE YET**

**WHAT ARE THE INITIATIVES TO RECRUIT NEW PEOPLE AND TO CONNECT TO OTHER GROUPS INTERNATIONALLY ?**

**-- EXPERIMENTAL HEP COMMUNITY IS SLOWLY GROWING (PHENO SIDE IS PRETTY LARGE); NOT DECIDED/THOUGHT ABOUT THE 2$^{ND}$ POINT**

**DO YOU PLAN A NATIONAL (OR REGIONAL ) FCC WORKSHOPS IN 2023?**

**-- PLAUSIBLE, AND CAN BE PLANNED**

**ARE YOU BUILDING OR PLANNING TO JOIN A REGIONAL FCC "CLUSTER" WITH NEIGHBORING NATIONS (CF. NORDIC COUNTRIES) ?**

**-- NEED DISCUSSION, AND COORDINATION WITH PHYSICISTS IN NEIGHBORING COUNTRIES**

**PLEASE LIST THE PERSONS INVOLVED AT 10% FTE OR MORE IN PED ACTIVITIES IN YOUR COUNTRY**

**-- 21 INDIAN PHYSICISTS WORKING ON CMS AND/OR BELLE II, ALONG WITH FEW PHENOMENOLOGISTS/THEORISTS**

**(INDIVIDUAL PHYSICIST NAMES AND INSTITUTIONAL DETAILS CAN BE SHARED LATER)**

# General Remarks

- FCC collaboration keeps growing:

  → Inside participating countries

  →New countries joining explicitely the PED effort, often on top of already existing Accelerator effort

  Most recently, outside Europe — Korea

  Pakistan

  Turkey

  USA

Goals for 2023: - India, Brazil, Canada, Mexico, Chile, and more

and progress on collaborations with China and Japan

- all European countries manage to have significant effort on FCC

# Challenges

- To succeed, FCC will need a strong and complete consensus of the community

- Need to work on the motivations of some projects in order to prioritize properly ➔ ECFA policy should be clearer

- Need to work on the resistance inside some large countries:

➔US has expressed interest for several Future Colliders → can FCC appear in the first position at the end of P5 ?

➔Some large European countries have hesitations about FCC (cost), or on ee vs hh

→ we need to continue explaining why FCC is by far the best option for the community