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**ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE**  
**CERN** EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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PLENARY ECFA

109th meeting

Geneva – 18 and 19 November 2021

Participation by videoconference or in person

Draft Minutes



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## **LIST OF PARTICIPANTS**

<b>Chair:</b>	K. Jakobs	Germany
<b>Secretar</b>	P. Conde Muíño	Portugal
<b>Member</b>	E. Adli	Norway
	P. Adžić	Serbia
	U. Bassler	C E R N C o u n c i l
	T. Behnke	DESY
	S. Bentvelsen	Netherlands / Nikhef
	G. Bernardi	France
	N. Besson	France
	D. Bettoni	Italy
	J. Bielčiková	Czech Republic
	F. Bossi	LN Frascati
	A.-M. Bragadireanu	Romania
	L. Brenner	ECR Panel
	P. Burrows	United Kingdom
	A. Çakır	Turkey
	P. Campana	Italy
	C. Collard	France
	D. Contardo	France
	M. Dam	Denmark
	T. Davidek	Czech Republic

M. Delmastro	France
S. De Curtis	Italy
N. De Groot	Netherlands
D. Della Volpe	Switzerland
J. D'Hondt	Ex officio
S. Farrington	United Kingdom
R. Forty	CERN
B. Foster	Ex officio
J. Fuster	Spain
H. Fynbo	Denmark
E. Gallo	Germany
J. Gluza	Poland
F. Gianotti	CERN ex officio
C. González García	Spain
U. Husemann	Germany
P. Iaydjiev	Bulgaria
M. Jeitler	Austria
A. Kaczmarska	Poland
Y.-K. Kim	USA
H. Kirschenmann	ECR Panel
M. Klein	United Kingdom
M. Krammer	Ex officio
H. Lacker	Germany
E. Laenen	Netherlands
J. Łagoda	Poland
S. Lai	Germany
K. Lassila-Perini	Finland
M. Lewitowicz	NuPECC Chair
V. Manzari	Italy
L. Masetti	Germany

I. Melzer Pellmann	Germany
C. Meroni	Italy
M. Mezzetto	EPS-HEPP Chair
M. Mikuž	Slovenia
J. Mnich	CERN ex officio
T. Nakada	Ex officio
D. Newbold	LDG Chair / STFC
R. Pasechnik	Sweden
A. Read	Norway
L. Rivkin	SPC Chair / PSI
C. Salgado Lopez	Spain
A. Schmidt	Germany
C. Schwanda	Austria
M. Seidel	Switzerland
F. Siklér	Hungary
B. Spaan	Germany
P. Sphicas	Greece
A. Stocchi	IJCLab
P. Sznajder	ECR Panel
M. Taševský	Czech Republic
L. Vacavant	France
C. Vallée	France
N. Van Remortel	Belgium
G. Veres	Hungary
M. Voutilainen	Finland
M. Wing	United Kingdom
M. Zeyrek	Turkey

**Invited:**

J. Alcaraz	Spain
P. Allport	United Kingdom
S. Asai	Japan
P. Azzi	Italy
M. Benedikt	CERN

S. Campana	CERN
P. Janot	CERN
S. Kühn	CERN
S. Stapnes	CERN
J. Wang	China

**Other attendees:** C. Amsler, D. Arutinov, A. Barr, R. Bartek, T. Berjauer, A. Besson, S. Bethke, G.M. Bilei, C. Bini, K. Borras, D. Boumediene, F. Briec, D. Britzger, F. Brizioli, E. Brondoli, E. Carquin Lopez, G. Chachamis, M. Chamizo Llatas, A. Cheplakov, P. Colas, S. Dalla Torre, C. D'Ambrosio, C. Damerell, N. De Filippis, C. De La Taille, N. Delerue, M. Donega, F. Dordei, G. Dujany, S. Easo, G. Eigen, K. Einsweiler, M. Elsing, S. Eso, D. Fiorina, M. Fouady, E. Fullana Torregrosa, G. Ganis, Y. Gao, F. García Fuentes, L. Gonella, R. Gonzalez Suarez, O. Grachov, E. Grancher, S. Giagu, B. Giebels, E. Grancher, G. Hallewell, P. Hansen, N. Harnew, P. Hazell, C. Helsens, Z. Hubacek, A. Ilg, V. Innocente, M. Kasemann, T. Kawamoto, M. Klute, K. Koeneke, T. Koffas, P. Kontaxakis, I. Kopsalis, V. Kostyukhin, C. Lacasta Llacer, M. Lamont, C. Lee, R. Lemmon, P. Leroux, T. Lesiak, J. Leveque, S. Levorato, R. Lindner, J. List, E. Lyons, L. Lyons, F. Malek, C. Martínez Rivero, W. Mitaroff, T. Mori, B. Murray, T. Naumann, A. Nisati, J. Nowak, A. Oblakowska-Mucha, J. Oleniacz, E. Olivero, D. Orestano, K. Özdemir, N. Pastrone, M. Petris, M. Petrovici, L. Pezzotti, A. Price, J. Qian, E. Rabinovici, E. Radicioni, F. Richard, M. Rivero, T. Robens, A. Robson, S. Roiser, L. Ropelewski, M. Ruan, H. Rzehak, G. Santin, E. Santos, T. Schörner, I. Shipsey, O. Smirnova, A. Sofron, H. Soltveit, G. Stewart, P. Striženec, F. Tartarelli, M. Titov, M. Toliman Lucchini, H. Torres, S. Trigazis, Y. Tsipolitis, N. Tyurin, C. Valderanis, F. Vasey, B. Ward, S. Wesch, M. Winter, C.E. Wulz, Y. Yamazaki, D. Zhang

The meeting, held in hybrid mode, was called to order at 2.00 p.m. on Thursday, 18 November 2021.

1. OPENING AND ADOPTION OF THE AGENDA  
(Item 1 of the Agenda)

The CHAIR welcomed the members, expressed his pleasure to be meeting partly in person and presented<sup>1</sup> his opening remarks. PECFA's 109th meeting would be divided into two parts, with the present closed session covering internal matters, endorsements of EFCA, RECFA and ECR Panel members and the approval of the Detector R&D Roadmap, which would then be presented publicly alongside the Accelerator R&D Roadmap during the open session the following day.

The Agenda<sup>2</sup> was adopted.

2. DRAFT MINUTES OF THE 108TH MEETING  
(Item 2 of the Agenda) (ECFA/RC/21/509/Draft)

The Minutes of the 108th meeting of Plenary ECFA (ECFA/RC/21/509/Draft) were approved.

3. REPORT FROM THE CHAIR  
(Item 3 of the Agenda)

The CHAIR presented<sup>3</sup> his report, covering the final version of the Detector R&D Roadmap, which PECFA would be called on to approve before its submission to the CERN Scientific Policy Committee and Council in December; the status of and plans for ECFA activities in relation to a future Higgs, electroweak and top factory; recent and forthcoming RECFA country visits; the Joint ECFA–NuPECC–APPEC (JENA) Seminar in Madrid in May 2022 and other JENA Activities; updates on the work of the diversity and recognition working groups; and the schedule for ECFA meetings and RECFA country visits in 2022.

In reply to a question from VAN REMORTEL (University of Antwerp) about the decision to invite representatives of funding agencies to the JENA Seminar, the CHAIR said

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<sup>1</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562879/attachments/2332199/3974699/ECFA-21-509-Draft-PECFA\\_23%20July%202021-Draft1.pdf](https://indico.cern.ch/event/1085137/contributions/4562879/attachments/2332199/3974699/ECFA-21-509-Draft-PECFA_23%20July%202021-Draft1.pdf)

<sup>2</sup> See Indico: <https://indico.cern.ch/event/1085137>

<sup>3</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562880/attachments/2348176/4004679/Chair\\_Report\\_PECFA\\_2021.11.18.pdf](https://indico.cern.ch/event/1085137/contributions/4562880/attachments/2348176/4004679/Chair_Report_PECFA_2021.11.18.pdf)

that the expected level of representation was delegates to CERN Council and that the matter would be discussed further at RECFA.

In reply to questions from VALLÉE (CPPM) about the JENA Seminar, the CHAIR said that it was not planned for the working groups to meet in parallel to the plenary session owing to time constraints, and that the possibility of opening up the attendance beyond PECFA would depend on the COVID-19-related restrictions on meeting size in May 2022.

The Committee took note of the Chair's report and of the additional information provided during the discussion.

#### 4. ENDORSEMENT OF NEW ECFA, RECFA AND ECR PANEL MEMBERS (Item 4 of the Agenda)

The CHAIR presented<sup>4</sup> the proposed list of re-appointed and new members of ECFA. In the light of the recent change in the composition of ECFA, whereby major laboratories except for CERN were represented through the Large Particle Physics Laboratory Directors Group (LDG), the CHAIR also presented a proposal – which was supported by the Early-Career Researchers (ECR) Panel, the LDG and Restricted ECFA – to phase out the current ECR Panel members from DESY and LN Frascati at the end of their mandates and to allow countries with laboratories in the LDG to add a fourth member. He then presented the proposed list of new ECR Panel members.

The Committee unanimously endorsed the following PECFA appointments and reappointments:

- S. Caron of the Netherlands, replacing M. Merk;
- N. Tuning of the Netherlands, replacing N. De Groot;
- A.-M. Bragadireanu of Poland (re-appointment);
- A. Kaczmarek of Poland (re-appointment);
- W. Wiślicki of Poland (re-appointment);
- P. Milenovic of Serbia, replacing D. Šijacki;
- L. Zivkovic of Serbia, replacing P. Adžic;

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<sup>4</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4580913/attachments/2348178/4005554/Endorsements\\_PECFA\\_2021.11.18.pdf](https://indico.cern.ch/event/1085137/contributions/4580913/attachments/2348178/4005554/Endorsements_PECFA_2021.11.18.pdf)

- M. Mikuž of Serbia (re-appointment);
- L. García Tabares of Spain (re-appointment);
- M. Vos of Spain, replacing J. Fuster;
- C. González García of Spain (re-appointment);
- F. Blanc of Switzerland (re-appointment);
- M. Seidel of Switzerland (re-appointment);
- P. Schmidt-Wellenburg of Switzerland, replacing A. Knecht;
- A. Robson of the United Kingdom, replacing S. Boogert;
- M. Shul'ga of Ukraine (re-appointment);
- C. Joram from CERN, replacing R. Forty;
- P. Monni from CERN, replacing M. McCullough.

The Committee further unanimously endorsed the proposal concerning the ECR Panel composition and the appointment of the following new members of the ECR Panel:

- G. Benato (Italy), replacing S. Biondi;
- P. Major (Hungary);
- L. Dufour (CERN), replacing A. Pearce.

The CHAIR thanked the outgoing members and representatives for their excellent work and commitment to ECFA's activities and welcomed the newcomers, whose terms of office would begin on 1 January 2022.

## 5. DETECTOR R&D ROADMAP (Item 5 of the Agenda)

ALLPORT (University of Birmingham), Chair of the Detector R&D Roadmap Panel, presented<sup>5</sup> a brief overview of the now completed process and summarised the conclusions and recommendations set out in the final Detector R&D Roadmap document, which was accompanied by a shorter synopsis publication for less specialist audiences, both of which

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<sup>5</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562899/attachments/2348626/4005674/Short\\_Summary%20PECFA%20Detector%20R%26D%20Roadmap.pptx](https://indico.cern.ch/event/1085137/contributions/4562899/attachments/2348626/4005674/Short_Summary%20PECFA%20Detector%20R%26D%20Roadmap.pptx)

would be presented to the CERN Council in December. The next step – after endorsement by the Council – would be to propose mechanisms for implementing the recommendations.

In reply to a question from NAKADA (EPFL) about the progress of discussions in the astroparticle physics community about R&D for its field and how it intersected with the Detector R&D Roadmap, the CHAIR said that representatives of NuPECC, APPEC and the wider community had been involved in the Roadmap task forces and been encouraged to give their input, meaning that the Roadmap provided a good basis for common R&D. The Roadmap's main focus was, naturally, particle physics instrumentation, but synergies between the particle and astroparticle physics fields should certainly be exploited.

The Committee took note of the presentation by Allport and of the additional information provided during the discussion and unanimously approved the Detector R&D Roadmap.

On behalf of ECFA, the CHAIR thanked all those involved in the Detector R&D Roadmap process for their hard work and congratulated them on the successful completion of the drafting stage. In conclusion, he made a presentation<sup>6</sup> underlining the importance of following through to implementation and the key roles that could be played by ECFA, the ECFA Detector Panel, the LDG, the CERN Scientific Policy Committee (SPC) and other bodies in the implementation and follow-up/review process.

6. REPORT FROM THE EARLY-CAREER RESEARCHERS PANEL  
(Item 6 of the Agenda)

SZNAJDER (National Centre for Nuclear Research, Poland) presented<sup>7</sup> a report on the activities of the ECR Panel, highlighting its mandate, composition and structure, the annual schedule of meetings, and the four working groups that had been set up and would report to ECFA. In conclusion, he urged the ECFA members to approach the ECR Panel for its perspective on any subject.

ALLPORT and the CHAIR thanked the ECR Panel for its valuable input to the Detector R&D Roadmap process, particularly to the work of Task Force 9 on training.

In reply to a question from D'HONDT (Vrije Universiteit Brussel), SZNAJDER said that the ECR Panel had not yet reached out to early-career researchers in adjacent fields, such

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<sup>6</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562902/attachments/2348179/4005565/DRD\\_Implementation\\_PECFA\\_2021.11.18.pdf](https://indico.cern.ch/event/1085137/contributions/4562902/attachments/2348179/4005565/DRD_Implementation_PECFA_2021.11.18.pdf)

<sup>7</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4577559/attachments/2348728/4005735/ECR\\_report\\_1121.pdf](https://indico.cern.ch/event/1085137/contributions/4577559/attachments/2348728/4005735/ECR_report_1121.pdf)

as astroparticle physics, but recognised the importance of doing so now that the Panel was better established.

The CHAIR said that he and the ECFA Secretary would continue to stay in close contact with the ECR Panel.

The Committee took note of the report by Sznajder and of the additional information provided during the discussion.

7. MID-TERM REPORT AUSTRIA  
(Item 7 of the Agenda)

JEITLER (Austrian Academy of Sciences) presented<sup>8</sup> the mid-term report on the status of particle physics in Austria since the last visit of RECFA, in 2018, focusing on the research groups, the international collaborations in which Austria was most active, Austrian involvement in the Future Circular Collider (FCC) Feasibility Study and high-performance computing, the status of astroparticle and theoretical physics in the country, new research positions and national outreach efforts.

In reply to a question from NAKADA about how the various groups and institutes worked together, JEITLER said that collaboration between the groups in Vienna and Graz was well established, while the Institute for Astro- and Particle Physics in Innsbruck was less well integrated. Initiatives had been carried out to promote national cooperation, such as meetings of the whole community to discuss and prepare the national response to the update of the European Strategy for Particle Physics.

The Committee took note of the report by Jeitler and of the additional information provided during the discussion.

8. MID-TERM REPORT ROMANIA  
(Item 8 of the Agenda)

BRAGADIREANU presented<sup>9</sup> the mid-term report on the status of particle physics in Romania since the last visit of RECFA, in 2018, providing details of funding from the public budget for research and for projects at CERN, Romanian involvement in experiments at CERN and in the Worldwide LHC Computing Grid, the status of astroparticle and theoretical

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<sup>8</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562903/attachments/2348789/4005869/2021\\_midtermAustria\\_MJeitler.pdf](https://indico.cern.ch/event/1085137/contributions/4562903/attachments/2348789/4005869/2021_midtermAustria_MJeitler.pdf)

<sup>9</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562904/attachments/2348707/4005697/Mid-term%20report%20Romania\\_2021.pdf](https://indico.cern.ch/event/1085137/contributions/4562904/attachments/2348707/4005697/Mid-term%20report%20Romania_2021.pdf)

physics in the country, the Extreme Light Infrastructure–Nuclear Physics project being co-financed by the European Regional Development Fund, national education and outreach efforts, and Romania’s well-balanced industrial return. He further outlined the progress made with RECFA’s recommendations following the country visit, highlighting some successes and stumbling blocks.

In reply to a question from CONDE MUIÑO about the low numbers of students entering particle physics in Romania, BRAGADIREANU said that the issue affected all the fundamental sciences, which were failing to attract enough students and were therefore suffering from a lack of high-quality students.

The Committee took note of the report by Bragadireanu and of the additional information provided during the discussion.

## 9. MID-TERM REPORT SLOVAK REPUBLIC (Item 9 of the Agenda)

STRIZENEC presented<sup>10</sup> the mid-term report on the status of particle physics in the Slovak Republic since the last visit of RECFA, in 2018, covering the characteristics and locations of the research facilities, relevant human resources statistics, funding for high-energy physics (HEP), Slovak involvement in international projects and collaborations, national communication and outreach efforts, and persistent problems facing the field.

In reply to a comment from MILSTEAD about the unfortunate way in which publications produced by large collaborations were registered and counted by universities in Slovakia, making HEP unattractive for PhD students, STRIZENEC said that the national research community was trying to rally together and make its case to the authorities, but progress was slow.

The CHAIR observed that similar problems were seen repeatedly in other countries around the world and encouraged Strizenec to request a letter of support for the Slovak community’s efforts from the ALICE and ATLAS spokespersons. ECFA, through forums such as the working group on recognition, must continue to explore the wider issue of how to measure an individual’s contribution to the field.

MEZZETTO (EPS-HEPP Chair) added that the European Physical Society’s High-Energy Particle Physics Board had, in the past, discussed ways to improve the system for weighting individual authors’ contributions to publications produced by large collaborations,

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<sup>10</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4574425/attachments/2348602/4006468/SK\\_midterm\\_report.pdf](https://indico.cern.ch/event/1085137/contributions/4574425/attachments/2348602/4006468/SK_midterm_report.pdf)

but it had proven difficult to get national institutes on board and no consensus had been reached.

In reply to a question from CONDE MUÍÑO about the nature of the difficulties with finding postdoctoral positions outside the Slovak Republic, STRIZENEC said that the people who were successful in securing a postdoctoral position abroad did not generally return to the country and it was a struggle for Slovak research groups to forge better international links. It was hoped that ministry-level support and involvement would facilitate the search for positions abroad, but little progress had been made so far.

The Committee took note of the report by Strizenec and of the additional information provided during the discussion.

The meeting was adjourned at 6.00 p.m. on Thursday, 18 November 2021 and resumed in open session at 9.00 a.m. on Friday, 19 November 2021.

10. ACCELERATOR R&D ROADMAP  
(Item 10 of the Agenda)

NEWBOLD (LDG Chair) presented<sup>11</sup> the almost-finalised Accelerator R&D Roadmap, which would be presented to the CERN Council in December, briefly explaining the organisational structure and the consultation and drafting process, setting out the questions answered through the work of the expert panels, drawing parallels with the Detector R&D Roadmap process and focusing on the Accelerator R&D Roadmap's recommendations. In conclusion, he underlined the need to carry forward the momentum into the implementation phase, with the accelerator, detector and physics communities working together towards the new machines and experiments that would underwrite the future of the field.

On behalf of ECFA, the CHAIR congratulated all those involved in the Accelerator R&D Roadmap drafting process for their impressive achievement.

In reply to a question from D'HONDT about the plan and timeline for magnet R&D, which had not been shown in the slides, NEWBOLD said that the expert panel had been asked to consider how to accelerate magnet R&D by working with greater flexibility and on various aspects in parallel. The conclusions reached boded well for technical progress, but the challenge would be to convince the whole field to work in that different way.

In reply to a question from BENTVELSEN as to whether action had been taken to involve industry in the process, NEWBOLD said that nothing specific had been done so far to

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<sup>11</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562905/attachments/2349309/4006917/LDG\\_Update\\_211118.pdf](https://indico.cern.ch/event/1085137/contributions/4562905/attachments/2349309/4006917/LDG_Update_211118.pdf)

identify key industrial partners but steps would need to be taken, as in certain fields only industry was in a position to reduce costs and would need to be convinced through continuous feedback from the field of the future benefits of investing in R&D.

The Committee took note of the report by Newbold and of the additional information provided during the discussion.

## 11. DETECTOR R&D ROADMAP (Item 11 of the Agenda)

The CHAIR announced that the Detector R&D Roadmap had been approved by PECFA the previous day in closed session and would be submitted to the CERN Council in December.

ALLPORT presented<sup>12</sup> the Detector R&D Roadmap, summarising the organisational structure, process and timeline by way of introduction, before setting out the organisational recommendations, the Detector R&D Development Themes and Detector Community Themes, and the General Strategic Recommendations that had emerged from the Roadmap process. Alongside the full Roadmap document, an eight-page synopsis brochure had been produced for non-specialist audiences. In conclusion, he thanked all those who had been involved in the development of the Roadmap.

In reply to a question from KLEIN (University of Liverpool) about the key detector technologies that had been identified for a future  $e^+e^-$  Higgs factory, ALLPORT said that the R&D needs were distributed across the full range of task force areas, which would have to be pursued in parallel to make such a facility possible.

The Committee took note of the report by Allport and of the additional information provided during the discussion.

## 12. COMPUTING – CHALLENGES AND FUTURE DIRECTIONS (Item 12 of the Agenda)

S. CAMPANA (CERN) presented<sup>13</sup> the challenges and future directions of HEP software and computing for the next 10–15 years, describing the challenges posed by the HL-LHC's requirements in terms of central processing units, event generation, simulation,

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<sup>12</sup> See Indico: <https://indico.cern.ch/event/1085137/contributions/4562906/attachments/2349055/4006852/Plenary%20ECFA%20Detector%20R%26D%20Roadmap.pptx>

<sup>13</sup> See Indico: <https://indico.cern.ch/event/1085137/contributions/4562907/attachments/2348585/4006849/ECFA-2021.pdf>

reconstruction, storage, analysis, data carousels and network; outlining hardware costs and market trends; laying out the potential of opportunistic resources and heterogeneous architectures; and emphasising the importance of infrastructure sustainability and collaboration. In conclusion, he underlined that the HL-LHC computing challenges were not yet resolved, that more needed to be done to bridge the gap between needs and resources, and that risks could materialise for which it was important to have mitigation strategies.

In reply to a comment from ELSING (CERN) on slide 8, in relation to ATLAS reconstruction, pointing out that the fast reconstruction prototype was not the same as ATLAS's fast simulation technique, which did not take shortcuts in the reconstruction, CAMPANA agreed and said that his slide referred to the extent to which fast techniques in general could be used. The best scenario was indeed fast reconstruction with no shortcuts, which could be used everywhere.

In reply to a question from MNICH (CERN), CAMPANA said that the difference between conservative and aggressive R&D for the HL-LHC was determined by risk analysis. The experiments believed that they could achieve the conservative R&D with the current set-up in the areas of lower risk, but full integration of computing accelerators, for instance, would come under the more aggressive model.

In reply to a question from BETHKE (Max Planck Institute for Physics) about the prospects for quantum and other emerging technologies, CAMPANA said that quantum computing was not part of the HL-LHC strategy but, given the impressive developments in quantum technologies, the application opportunities and possible use cases must be explored in the coming years. Various quantum computing initiatives were already under way at CERN and its partner laboratories.

In reply to a question from MNICH about how to move from opportunistic to a more strategic and predictable use of high-performance computing (HPC) centres, CAMPANA said that CERN did not currently drive the evolution of those centres, and that the Organization should focus on better integrating heterogeneous HPC architectures. It was also advisable to develop partnerships with the centres and engage them in CERN's computing activities (operations and development) in the medium to long term, rather than simply making use of their hardware. In discussions with funding agencies, it was important to set out a process for creating stronger and more strategic ties with their HPC centres in order to leverage their expertise.

In reply to a question from LAENEN (Nikhef / University of Amsterdam), CAMPANA said that the only supplier of tape drives for the data carousels was now IBM, which presented a risk that had been included in the risk catalogue and was being monitored closely and

mitigated by market survey and R&D efforts. Industry shared CERN's need for archive media so if tape disappeared from the market, a data-archiving alternative would undoubtedly be found.

In reply to a question from LAENEN about the career opportunities available in event generation, which had been identified as another risk, particularly for NNLO event generation, CAMPANA said that it was encouraging to see that, following the HEP Software Foundation workshop, the small number of experts in the field were engaged in dialogue and working in synergy to address the issue.

The Committee took note of the presentation by Campana and of the additional information provided during the discussion.

### 13. REPORT ON ECFA STUDIES TOWARDS A HIGGS/EW/TOP FACTORY (Item 13 of the Agenda)

Introducing the agenda item, the CHAIR said that, following the update of the European Strategy for Particle Physics in June 2020, ECFA had set up an International Advisory Committee (IAC) to bring together the experimental and theoretical communities involved in physics studies, experiment designs and detector technologies at future Higgs factories, and to define a path towards a series of workshops with a view to sharing challenges and expertise, exploring synergies and responding coherently. To that end, the IAC had proposed setting up three working groups, two of which were already operational.

#### a) Working Group 1 report

ALCARAZ (CIEMAT) presented<sup>14</sup> a report from Working Group 1, “Physics Potential”, covering the group's mandate, focus, activities so far on the five different fronts of activity identified (precision calculations and theoretical, parametric and experimental systematic uncertainties; global interpretation in (SM)EFT and UV complete models; Higgs, top and electroweak physics; flavour physics; and direct discovery potential), some initial findings and future plans.

#### b) Working Group 2 report

AZZI (INFN Padova) presented<sup>15</sup> a report from Working Group 2, “Physics Analysis Methods”, focusing on its mandate, scope (covering generators, simulation, reconstructions,

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<sup>14</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562924/attachments/2349302/4006882/Alcaraz\\_ECFA\\_HTE\\_WG1\\_19Nov2021.pdf](https://indico.cern.ch/event/1085137/contributions/4562924/attachments/2349302/4006882/Alcaraz_ECFA_HTE_WG1_19Nov2021.pdf)

<sup>15</sup> See Indico: <https://indico.cern.ch/event/1085137/contributions/4562925/attachments/2349343/4007095/WG2Report-ECFANov2021%20%282%29.pdf>

algorithms and tools, and the software ecosystem), work so far, next steps, resource people identified and the work plan of topical meetings and seminar-style follow-up meetings.

c) Discussion

Commenting on the reference to systematics in the report from Working Group 1, LYONS (University of Oxford) said that a PHYSTAT workshop on how systematic uncertainties were incorporated in data analyses in particle physics had taken place earlier in November. The event website<sup>16</sup> contained videos of all the talks and a wide range of useful background information.

In reply to a question from CONTARDO (Université Claude Bernard–Lyon I) about how much of the emerging Key4HEP software ecosystem already existed and could be used, AZZI said that some pieces – such as the EDM4hep event data model, the Acts common tracking software tool for track reconstruction and some limited workflows with fast simulation and generators – were already useable, but the full Key4HEP framework was still a work in progress.

GANIS (CERN) added that the current FCC physics and detector studies in Key4HEP used GAUDI, LHCb’s software architecture and framework for building data processing applications, which was openly available as a full workflow for event generation.

In reply to a question from LAENEN about similarities and synergies with the Snowmass process, ALCARAZ said that the Working Groups were following the Snowmass process from afar and wished to keep in step with it.

AZZI added that Snowmass was more focused on the work of specific communities, while the Working Groups’ efforts went beyond that, aiming to bring all the communities together to achieve a more wide-reaching outcome. Nevertheless, the Working Groups were open to collaboration with Snowmass and other ongoing activities and to any interested physicists.

The CHAIR encouraged any attendees interested in getting involved in the Working Groups to contact the conveners. The Working Groups would continue to report to ECFA on a regular basis.

The Committee took note of the Working Group reports and of the additional information provided during the discussion.

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<sup>16</sup> See Indico: <https://indico.cern.ch/event/1051224>

14. REPORT FROM CERN  
(Item 14 of the Agenda)

GIANOTTI (CERN) presented<sup>17</sup> a status report on CERN, covering the COVID-19-related health situation, the status of the injectors, the status of AD-ELENA, the LHC beam test with collisions at injection energy in October, beam-test collision data in the experiments, LHC magnet training and experiment upgrades in preparation for Run 3, recent physics results, major underground civil engineering work for the HL-LHC completed during the second long shutdown, the performance of the 11–12 T niobium-3–tin magnets, the publication of CERN’s second Environment Report, the progress of Science Gateway construction, and the adoption in September of a Council resolution admitting Brazil as an Associate Member State.

In reply to a question from BENTVELSEN, GIANOTTI confirmed that the goal was to reduce CERN’s emissions by 28% by 2024 compared to the 2018 baseline. Having seen the possibilities of remote work and meetings during the pandemic, the Organization had set a target to reduce business travel for employed members of the personnel by some 30% in the coming years. CERN would also pursue its already well-advanced mobility initiatives in order to reduce emissions from commuting. A dedicated “sustainable procurement” project was getting under way, which would analyse emissions related to CERN’s procurement activities.

In reply to a question from NAKADA about the LHC luminosity target of 14 TeV, GIANOTTI said that it had been determined that the risks involved in reaching 7 TeV were too large at the current time and that it was no longer a realistic target for Run 3.

In reply to a further question from NAKADA about the potential repercussions of rising construction costs worldwide for Science Gateway, GIANOTTI said that the construction company had already warned CERN that the price of raw materials was increasing and that some cost overruns were anticipated.

The Committee took note of the report by Gianotti and of the additional information provided during the discussion.

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<sup>17</sup> See Indico: <https://indico.cern.ch/event/1085137/contributions/4577530/attachments/2349437/4008306/ECFA-Nov-2021.pdf>

15. FCC – FEASIBILITY STUDY  
(Item 15 of the Agenda)

BENEDIKT (CERN) presented<sup>18</sup> an update on the FCC Feasibility Study, recalling its origins in the 2020 update of the European Strategy for Particle Physics and subsequent Council decisions, setting out its organisational structure and objectives and the timeline of both the study and the FCC programme as a whole, outlining the work performed to date and the next steps, and focusing on some technical aspects such as the high-field magnet (HFM) development and the placement of the ring.

In reply to a request from NAKADA for more information about the HFM R&D development programme, and in particular the high-temperature superconductors (HTS), BENEDIKT said that 16 T had been confirmed as the requirement for the FCC dipoles. Given the remarkable results from HTS activities in recent months and years, particularly in the fusion community, it would certainly be interesting to pursue HTS options. The HFM programme came under the remit of the Accelerator R&D Roadmap that would be presented to the CERN Council in December.

In reply to a question from BENTVELSEN about the 2023–2025 drilling campaign as part of the placement studies, BENEDIKT said that the required depth was generally between 50 and 350 metres and did not present any particular technical difficulties, even in areas of high water pressure. The purpose of the initial drilling campaign was to reduce uncertainty in areas where the geology is either not well known or may represent risks for tunnel construction. At a later stage, more extensive, systematic drilling would be carried out at denser intervals in preparation for the design and construction phases.

In reply to a question from STAPNES (CERN) about the constraints identified for the placement of the FCC (shown on slide 10), BENEDIKT said that for the time being the mapping had covered the full range of presently known environmental, societal, urbanistic and infrastructure factors, mainly above ground.

In reply to a question from EASO (STFC) about the impact of a decision by China to build its own 100-km circular collider with international involvement, which might be operational some 10–15 years before the FCC, BENEDIKT said that the schedule and plans for the FCC were realistic and necessary for the success of the project. After the initial five-year feasibility study, the appropriate discussions would take place in order to decide how to proceed.

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<sup>18</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562910/attachments/2349576/4007372/211119\\_FCC-FeasibilityStudyStatus.pptx](https://indico.cern.ch/event/1085137/contributions/4562910/attachments/2349576/4007372/211119_FCC-FeasibilityStudyStatus.pptx)

The Committee took note of the presentation by Benedikt and of the additional information provided during the discussion.

## 16. REPORTS FROM EUROPEAN LABORATORIES

(Item 16 of the Agenda)

### a) IJCLab

STOCCHI (IJCLab) presented<sup>19</sup> the *Irène Joliot-Curie Laboratoire de Physique des 2 Infinis* (ICJLab), which had been formed in 2020 through the merger of five laboratories in Orsay, France, explaining the motivations for the merger and providing details of the new laboratory's location, finances, personnel, organisational structure, areas of expertise and involvement in major HEP and accelerator physics projects in France and worldwide.

The Committee took note of the report by Stocchi.

### b) Nikhef

BENTVELSEN (Nikhef) presented<sup>20</sup> a report on activities at Nikhef in 2020 and 2021, covering Nikhef's mission, people and work, its challenges and successes during the pandemic, the national science programme in the Netherlands, Nikhef's involvement in the LHC upgrades and experiments and the Worldwide LHC Computing Grid as well as astroparticle physics, neutrino physics and astronomy projects, and the pillars of its 2017–2022 strategy.

In reply to a question from NAKADA about Nikhef's involvement in the Laser Interferometer Space Antenna (LISA), BENTVELSEN said that the Dutch astronomy community had the ambition to contribute specifically to the instrumentation, given that the same techniques could be re-used at ETpathfinder for the Einstein Telescope.

The Committee took note of the report by Bentvelsen and of the additional information provided during the discussion.

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<sup>19</sup> See Indico: <https://indico.cern.ch/event/1085137/contributions/4562918/attachments/2349572/4007361/IJCLab-Presentation-RECFA2021.pdf>

<sup>20</sup> See Indico: <https://indico.cern.ch/event/1085137/contributions/4562919/attachments/2349594/4007407/ECFA-Nikhef-2021.pdf>

c) PSI

SEIDEL (PSI) presented<sup>21</sup> the Paul Scherrer Institute, showing its geographical location, giving an overview of its accelerator facilities, particle physics activities, experiments, contribution to CMS and involvement in the Swiss Accelerator Research and Technology (CHART) collaboration, and focusing on its sustainability efforts and strategic long-term planning.

The Committee took note of the report by Seidel.

d) RAL-STFC

NEWBOLD (STFC) presented<sup>22</sup> a report on the status of particle physics in the United Kingdom, describing the multidisciplinary environment composed of three particle physics laboratories and their close research partners at some 15 universities, giving an overview of the research activities and facilities, the technical support available for the field and accelerator R&D and construction under way, applauding some positive developments despite the challenging COVID-19 situation, and setting out the future prospects and priorities.

In reply to a question from BENTVELSEN, NEWBOLD said that the Muon Ionisation Cooling Experiment (MICE) had been completed and disassembled, with its components distributed around the world for other experiments, and its papers had been published. Discussions about the future of muon colliders were ongoing in the context of the accelerator R&D roadmap.

The Committee took note of the report by Newbold and of the additional information provided during the discussion.

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<sup>21</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562920/attachments/2349563/4007344/PSI\\_Seidel.pptx](https://indico.cern.ch/event/1085137/contributions/4562920/attachments/2349563/4007344/PSI_Seidel.pptx)

<sup>22</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562921/attachments/2349631/4007657/UK\\_labs\\_overview\\_v2.pdf](https://indico.cern.ch/event/1085137/contributions/4562921/attachments/2349631/4007657/UK_labs_overview_v2.pdf)

## 17. STATUS OF POSSIBLE FUTURE E+E- FACILITIES

(Item 17 of the Agenda)

### a) CLIC status

STAPNES presented<sup>23</sup> a status report on the Compact Linear Collider (CLIC), summarising its proposed timeline, cost, power and parameters, providing details of the international collaborations already in place and the resources produced so far, and underlining the maturity of the design and of the studies on the core technologies.

In reply to a question from GLUZA (University of Silesia in Katowice), STAPNES said that the Z-pole performance would range from  $2.3 \times 10^{32}$  to  $0.4 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ , the latter being when CLIC was specifically configured for optimal Z running.

ROBSON (University of Glasgow) added that CLIC would produce some 4.5 billion Z bosons when optimised for Z running, which was similar to the performance of the International Linear Collider (ILC).

In reply to a question from BENTVELSEN about the geology of the planned placement of CLIC, STAPNES said that the 380 GeV collider would be located under the site of the LHC, where the geology was already known, and the extended CLIC could be built in very similar terrain that reached as far as Bellegarde-sur-Valserine. In addition, CLIC would require fewer surface infrastructures than a circular collider owing to its single collision point.

In reply to a question from COLAS (CEA / Irfu Université Paris Saclay) about the claim made by a group of US physicists that gradient and stability could be improved by running with copper at 77 K, STAPNES pointed out that that would require a cryogenic system. The CLIC team was working with the Stanford Linear Accelerator Center (SLAC) to investigate the possibility of combining high gradients in cryo-copper and high-temperature superconductors for high efficiency and reduced peak radiofrequency power requirements.

The Committee took note of the report by Stapnes and of the additional information provided during the discussion.

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<sup>23</sup> See Indico: <https://indico.cern.ch/event/1085137/contributions/4563172/attachments/2349573/4007437/CLIC-Stapnes-PECFA-2021.pdf>

b) ILC status

ASAI (University of Tokyo) presented<sup>24</sup> a status report on the ILC, outlining the design, the technical developments in superconducting radiofrequency (SRF) technology and the damping ring, the technical preparation plan, the findings of the site study, the status of the proposed detectors and the ILC's physics potential as a Higgs factory. **The International Development Team (IDT) has been created to prepare for the Pre-Lab phase,** and the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) had set up an expert panel to address issues related to technology development, international collaboration and cost sharing. In conclusion, he underlined the importance of securing the international community's support and involvement.

In reply to a question from BERNARDI (APC Paris CNRS / IN2P3) about the timescale and cost of the subsequent stages of operation after ILC250, ASAI said that it was expected that the ILC would run at 250 GeV for some 15 years and then undergo a tunnel extension and energy upgrade programme, whose nature would be determined by future energy scales.

LIST (DESY) added that the boring of the tunnel extension could for the most part be conducted in parallel with data taking, thereby reducing the gap between the 250 GeV running and the higher-energy next stage to roughly one or two years. The initial ILC budget contained a lot of baseline costs, which would not be necessary for the extension of the collider.

In reply to a question from BENTVELSEN about Japan's economic situation following the Olympic Games, which had been cited in the past as an obstacle to the ILC, ASAI said that the economic situation, which had been exacerbated by the COVID-19 pandemic, was still not conducive to discussions with the authorities on major projects. It was hoped that an international project like the ILC would be a boost for Japan's economic recovery, which was an argument that proponents of the ILC should foreground in discussions with MEXT.

The Committee took note of the report by Asai and of the additional information provided during the discussion.

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<sup>24</sup> See Indico: <https://indico.cern.ch/event/1085137/contributions/4562937/attachments/2349710/4007649/ECFA-ILC.pdf>

c) FCC-ee status

JANOT (CERN) presented<sup>25</sup> a status report on the FCC-ee, focusing on the key developments since the November 2018 presentation to ECFA, on the physics, experiments and detector planning, on the physics potential of the FCC as a Higgs factory and beyond, and on the case for four interaction points.

In reply to a question from BENTVELSEN about the status of the US proposal made in 2019 for an energy recovery linac version of the FCC-ee, JANOT said that the cost of the proposal needed to be studied and it was not yet included in the Feasibility Study, which focused on the baseline design.

KLEIN added that the US proposal was being studied in detail as part of the Accelerator R&D Roadmap; it was a very interesting concept but was not yet ready to replace the FCC-ee baseline design.

JANOT added that it was not an option for the Higgs factory because all the resonant depolarisation and monochromatisation aspects would be lost.

In reply to a question from NAKADA about the factories mode, specifically concerning the trigger and online analysis with multiple channels, JANOT said that those aspects were included in the computing infrastructure plan.

The Committee took note of the report by Janot and of the additional information provided during the discussion.

d) CEPC status

WANG (Chinese Academy of Sciences) presented<sup>26</sup> a status report on the Circular Electron–Positron Collider (CEPC), covering its physics potential, possible sites, the milestones reached to date, the ideal roadmap and schedule, international efforts, financing, collaboration with industry, and accelerator and detector R&D efforts.

In reply to questions from VALLÉE about the scope of the current five-year pre-construction phase and the level of domestic resources allocated to those studies, WANG said that the total domestic contribution amounted to some 60 million Chinese yen. A similar amount should be secured from other sources. The pre-proposal had been submitted to the

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<sup>25</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562938/attachments/2349640/4007499/FCCee\\_PECFA\\_Nov2021.pdf](https://indico.cern.ch/event/1085137/contributions/4562938/attachments/2349640/4007499/FCCee_PECFA_Nov2021.pdf)

<sup>26</sup> See Indico: [https://indico.cern.ch/event/1085137/contributions/4562939/attachments/2349662/4007916/CEPC\\_Wang.pdf](https://indico.cern.ch/event/1085137/contributions/4562939/attachments/2349662/4007916/CEPC_Wang.pdf)

government and should be endorsed by 2023. International collaboration would be essential in moving from the CDR to the TDR phase (ending in 2025).

In reply to a question from ROBENS (Ruđer Bošković Institute), WANG explained that the “international-friendly” criterion for site selection listed on slide 6 referred to the proximity with an international travel hub.

In reply to a question from MITAROFF (Institute for High-Energy Physics, Austrian Academy of Sciences) about the reason for building separate rings for electrons and positrons, WANG said that, following discussions of the various options since the CDR, that configuration had been chosen in order to achieve higher luminosity and address a range of physics questions.

MITAROFF added that at the ILCX2021 workshop from 26 to 29 October 2021, electron–electron collisions had been discussed as a way to search for heavy Majorana neutrinos and investigate other interesting physics questions.

The Committee took note of the report by Wang and of the additional information provided during the discussion.

The meeting rose at 5.40 p.m.