Early-Career Researchers White Paper input to European Particle Physics Strategy Update

ECR Workshop on the European Particle Physics Strategy
CERN, 14.11.2024

The CERN event organisers:
Jan-Hendrik Arling, Alexander Burgman, Axel Gallen, Abdelhamid Haddad, Laura Huhta,
Armin Ilg, Krzysztof Mekala, Emanuela Musumeci, Leonhard Reichenbach, Daniel Reichelt, Francesco Pio Ucci

ECFA ECR Panel

[…] *to discuss* ***all aspects*** *that contribute in a broad sense to the* ***future of the research field of particle physics*** […] ..

Aiming to represent the European early-career particle physics community

- From PhD students to young assistant professors
- Theoreticians, phenomenologists, experimentalists, …
- 3 members per country (+1 if LDG lab in country)
- Organization Committee (Marko Pesut, Jan-Hendrik Arling, Arnau Morancho Tarda)
- 5 delegates in Plenary ECFA, 1 delegate in Restricted ECFA
    - Andrea Garcia Alonso, Lydia Brenner (RECFA), Patrick Dougan, A.I, Holly Pacey

Our panel actually was created as a follow-up to the ECFA Early-Career Researchers response to the 2020 Update of the European Strategy for Particle Physics (rather ad-hoc, not a panel)

→ The ECFA ECR panel is tightly linked with the Update of the European Strategy

→ Make sure that this time ECRs are in the loop from the beginning!

European Particle Physics Strategy Update: Remit

The Strategy update should include the preferred option for the next collider at CERN and prioritised alternative options to be pursued if the chosen preferred plan turns out not to be feasible or competitive. The Strategy update should also indicate areas of priority for exploration complementary to colliders and for other experiments to be considered at CERN and at other laboratories in Europe, as well as for participation in projects outside Europe.

The ESG should review and update the Strategy and add other items identified as relevant to the field, including accelerator, detector and computing R&D, the theory frontier, actions to minimise the environmental impact and to improve the sustainability of accelerator-based particle physics, the **strategy and initiatives to attract, train and retain the young generations**, public engagement and outreach.

EPPSU timeline and structure

- Anyone can submit input to the strategy (31st of March)
  - Future collider communities
  - E.g. ECFA countries, collaborations, … → use this chance!
  - And us! → ECR White Paper
    - Focus on topics relevant to ECRs, not covered in topical WGs

9 topical WGs:

- EW/Higgs Physics
- Strong Interaction
- Flavor Physics
- BSM
- Neutrino Physics and Cosmic Messengers
- DM and Dark Sector
- Accelerator Science and Technology
- Instrumentation
- Computing

1 ECR scientific secretary for each WG

Process towards *ECR White Paper input to EPPSU*

Initiated by ECFA ECR panel, but open to all European* ECRs†

- Preparatory meetings within ECFA ECR panel and with other ECR representatives
  - Discuss process, first ideas on possible topics to address
- 3rd ECFA Workshop:
  - Bring ECR community together, rally people to contribute to ECR White Paper
  - Define topics to address in ECR White Paper → Form WGs to address most important topics

*: Focus on ECRs employed/hired in European institutes, but input beyond Europe appreciated

†: Non-permanent position or <10 years after PhD

Highlights of Paris event

Number of participants:
~ 55 in lunch and evening sessions

Some relevant statements:

- ECRs need...
  - stable funding and career certainty to support their professional development.
  - a decision on future colliders to be made as soon as possible.
  - sustainability to be taken into consideration.

Live survey findings:

- "ECR opinions and concerns taken into account" vs. "ECRs adequately represented in FC decision-making"

➢ Importance of an ECR White Paper

Some relevant questions:

- (How to) untangle next collider (i.e Higgs factory) decision from further downstream decisions?
- (How to) participate in potential CEPC?
- Role of sustainability?

Working groups established*

- Future colliders (incl. choice, priorities, timeline, sustainability, etc.)
  - Conveners: Jason Aebischer, Uli Einhaus, Axel Gallen, Armin Ilg, Krzysztof Mekala, Emanuela Musumeci, Leonhard Reichenbach
- Future particle physics experiments beyond colliders (added after Paris)
  - Conveners: Alexander Burgman, Elizabeth Sarah Long, Marvin Pfaff, Erik Wallin
- Communicating the importance of particle physics (present and future)
  - Conveners: Abdelhamid Haddad, Jan-Hendrik Arling
- Career prospects and ECR leadership (not only on future colliders)
  - Conveners: Christina Dimitriadi, Laura Huhta, Jan Klamka, Emanuela Musumeci
- Interplay of particle physics with neighbouring fields
  - Conveners: Alexander Burgman, Abdelhamid Haddad

Join eppsu-ecr@cern.ch and *ECRs for EPPSU 2024* Mattermost channel

Join the WG channels

Some WGs definitely would benefit from more conveners!

Had 2-3 meetings per WG since Paris event

*: More WGs can be added if there is interest!

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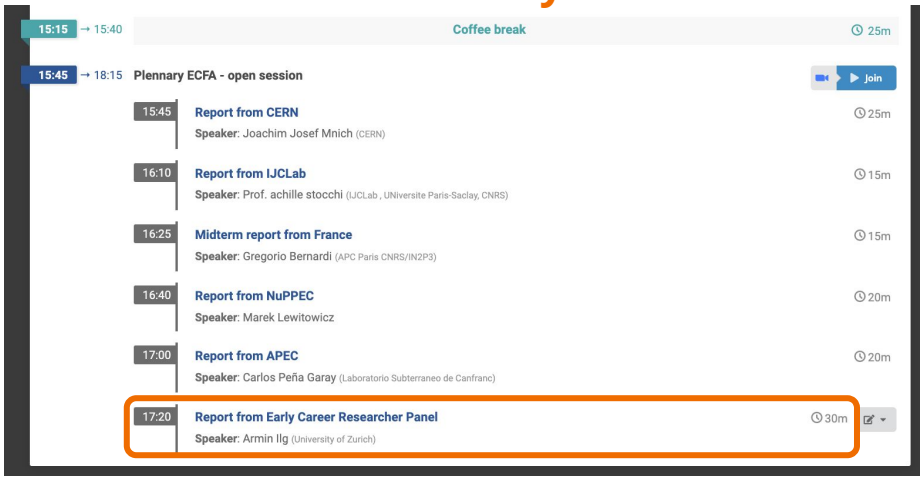
  - Define topics to address in ECR White Paper → Form WGs to address most important topics ✅
- Online WG meetings ✅
- **ECR Workshop on the European Particle Physics Strategy** **←You are here**
  - First plenary after start of WGs
  - Adjacent to (Open) Plenary ECFA meeting at CERN

Open Plenary ECFA

- The ECFA member country, CERN, and the ECFA ECR panel have representatives in Plenary ECFA (PECFA)
- The November meetings are at CERN, with most of the meeting *open to anyone*!

Today



Open Plenary ECFA

Tomorrow

Friday 15 November

09:00 → 10:55 **HETF**

Zoom

- 09:00 **ESPP preparation** — 15m
  Speaker: Karl Jakobs (University of Freiburg (DE))
- 09:20 **ECFA HET Factory study: Overall status and report planning** — 10m
  Speaker: Christos Leonidopoulos (The University of Edinburgh (GB))
- 09:35 **ECFA HET Factory study: WG1 Higgs, top & electroweak physics and global fits** — 15m
  Speaker: Marcel Vos (IFIC Valencia (ES))
- 09:55 **ECFA HET Factory study: WG1 Searches and flavour** — 15m
  Speaker: Roberto Franceschini (Rome 3 U.)
- 10:15 **ECFA HET Factory study: WG2 Physics Analysis Tools** — 15m
  Speaker: Patrizia Azzi (INFN Padova (IT))
- 10:35 **ECFA HET Factory study: WG3 Detector Technologies** — 15m
  Speaker: Mary-Cruz Fouz Iglesias (CIEMAT - Centro de Investigaciones Energéticas Medioambientales y Tec. (ES))

11:15 → 12:35 **LHC experiments upgrades and plans**

Zoom

- 11:15 **ALICE upgrades and plans** — 15m
  Speaker: Felix Reidt (CERN)
- 11:35 **ATLAS upgades and plans** — 15m
  Speaker: Craig Sawyer (Science and Technology Facilities Council STFC (GB))
- 11:55 **CMS upgrades and plans** — 15m
  Speaker: Katja Klein (Rheinisch Westfaelische Tech. Hoch. (DE))
- 12:15 **LHCb upgrades and plans** — 15m
  Speaker: Vava Gligorov (Centre National de la Recherche Scientifique (FR))

14:00 → 16:00 **Accelerator R&D areas**

Zoom

- 14:00 **Update on LDG** — 10m
  Speaker: Prof. Dave Newbold (STFC Rutherford Appleton Laboratory (GB))
- 14:15 **High Field Magnets** — 15m
  Speaker: Dr Ezio Todesco (CERN)
- 14:35 **Radiofrequency Structures** — 15m
  Speaker: Igor Syratchev (CERN)
- 14:55 **Energy Recovery Linacs** — 15m
  Speaker: Jorgen D'Hondt (Vrije Universiteit Brussel (BE))
- 15:15 **Muon colliders** — 15m
  Speaker: Daniel Schulte (CERN)
- 15:35 **Plasma Accelerators and the HALHF concept** — 15m
  Speaker: Erik Adli (University of Oslo)

16:20 → 17:20 **JENA and others**

Zoom

- 16:20 **Report from the LDG Sustainability WG** — 15m
  Speakers: Caterina Bloise (INFN e Laboratori Nazionali di Frascati (IT)), Caterina Bloise (Laboratori Nazionali di Frascati (LNF)), Dr Maksym Titov (IRFU, CEA Saclay, Université Paris-Saclay (FR))
- 16:40 **Nuclear Physics at the LHC** — 15m
  Speaker: Alexander Philipp Kalweit (CERN)
- 17:00 **AI/ML for Particle Physics: Building an Infrastructure with EuCAIF and Beyond** — 15m
  Speaker: Sascha Caron (Nikhef National institute for subatomic physics (NL))

Goals of this workshop

Questions that the WGs will address:

- Motivation for the WG and what is it addressing?
- What is not addressed in the WG or could be addressed in another WG
- What should the EPPSU ECR White Paper yield, demand or change?
- Potential statements or contents for the White Paper
- Next steps of the WG and how to contribute

What should the discussions bring?

- Feedback from everyone!
- Are there additional questions, ideas, or concerns that the WG should take into account?
- Collaboration with other WGs, to avoid or benefit from overlaps

Agenda of today

09:00
- **Introduction** — *Armin Ilg* — *40/S2-D01 - Salle Dirac, CERN* — 09:00 - 09:20
- **WG: Communicating the importance of particle physics** — *Abdelhamid Haddad et al.* — *40/S2-D01 - Salle Dirac, CERN* — 09:20 - 09:50
- **WG: Future Colliders** — *Leonhard Reichenbach* — *40/S2-D01 - Salle Dirac, CERN* — 09:50 - 10:20

10:00
- **Coffee break** — *40/S2-D01 - Salle Dirac, CERN* — 10:20 - 10:50
- **WG: Future particle physics experiments beyond colliders** — *Dr Alexander Burgman et al.* — *40/S2-D01 - Salle Dirac, CERN* — 10:50 - 11:20

11:00
- **WG: Interplay with neighboring fields** — *Abdelhamid Haddad et al.* — *40/S2-D01 - Salle Dirac, CERN* — 11:20 - 11:50
- **WG: Career prospects and ECR leadership** — *Christina Dimitriadi et al.* — *40/S2-D01 - Salle Dirac, CERN* — 11:50 - 12:20

12:00
- **Discussion about scope of WGs** — *Emanuela Musumeci et al.* — *40/S2-D01 - Salle Dirac, CERN* — 12:20 - 12:40
- **Summary and next steps** — *Krzysztof Mekala* — *40/S2-D01 - Salle Dirac, CERN* — 12:40 - 13:00

10 min of talk + 20 min of discussions per WG

13:00
- **Lunch break** — *R1, CERN* — 13:00 - 14:00

14:00
- **WG meeting: Future particle physics experiments beyond colliders** — *Dr Alexander Burgman et al.* — *4/R-050, CERN* — 14:00 - 15:00
- **WG meeting: Future Colliders** — *Armin Ilg et al.* — *40/S2-D01 - Salle Dirac, CERN* — 14:00 - 15:00

15:00
- **WG meeting: Career prospects and ECR leadership** — *Christina Dimitriadi et al.* — *40/S2-D01 - Salle Dirac, CERN* — 15:00 - 16:00
- **WG meeting: Communicating the importance of particle physics** — *Abdelhamid Haddad et al.* — *Zoom only* — 15:00 - 16:00
- **WG meeting: Interplay with neighboring fields** — *Abdelhamid Haddad et al.* — *4/R-050, CERN* — 15:00 - 16:00

16:00
- **Informal ECR discussion** — *Krzysztof Mekala et al.* — *40/S2-D01 - Salle Dirac, CERN* — 16:00 - 17:30

17:00

18:00
- **Open Networking in R1** — *R1, CERN* — 17:30 - 19:00

Process towards ECR White Paper input to EPPSU

- Preparatory meetings within ECFA ECR panel and other ECR representatives ✅
- 3rd ECFA Workshop ✅
- Online WG meetings ✅
- **ECR Workshop on the European Particle Physics Strategy** ←**You are here**
  - Adjacent to (Open) Plenary ECFA meeting at CERN
- Continue online WG meetings throughout process
- White paper drafting
  - Mid-December: Draft of White Paper sections by WGs, lead by WG conveners
  - End of January: First overall White Paper draft by WG conveners
  - Mid-February: Consolidation of first overall White Paper draft by all WGs
- White paper feedback and consolidation
  - Mid-February: One-day **symposium/workshop** similar to today, open again to all ECRs!
  - From external advisors: Snowmass ECRs, ECRs from last strategy, some selected seniors
- Mid-March: Endorsement of White Paper by ECFA ECR panel, submission to EPPSU
- Follow the EPPSU and continue to voice interests of ECRs
  - e.g. at Open Symposium in Venice, 23-27. June 2025
  - Benefit from ECR scientific secretaries in Strategy group

Backup

Future colliders

- Future colliders for Early-Career Researchers event in September 2023
    - Early-Career Researchers' Perspective on Future Colliders (arXiv:2407.01852)

- Follow up with national, in-person events on future colliders, directing discussions into the ECFA countries focusing on country dependent issues
    - Blueprint for national Future Colliders for Early-Career Researchers events
    - Belgium+Netherlands, Nordic countries, CERN, Austria, Czech Republic, Czech Republic+Slovakia, France, Germany, Italy so far
    - CERN (22.11), and more planned!

ECFA ECR panel

Keep in touch with us

- Our webpage to find your country ECR representative
- ecfa-ecr-organisers@cern.ch
- Subscribe to ecfa-ecr-announcements e-group to get notified about our activities!

ECFA Early-Career Researchers response to the 2020 Update of the European Strategy for Particle Physics (report)

General

- [...] must therefore include sociological and sustainability aspects [...]
- [...] funding for non-permanent positions is converted to funding for permanent positions [...]
- [...] different states of maturity of the projects were not taken into account sufficiently.
- [...] impact of collider projects outside Europe [...] has not been laid out sufficiently.

Future of the Field

- While being open for future international projects, the ECRs emphasise the importance of a European collider project soon after HL-LHC. Postponing the choice of the next collider project at CERN to the 2030s has the potential to negatively impact the future of the field.

Human and Sociological Factors

- [...] holistically include social and human factors when planning the future of the field.
- [...] equal recognition and career paths for the various domains of our field have to be established to maintain expertise in the field.
- The possibility for a healthy work-life balance and the reconciliation of family and a scientific career is a must.

Environment and Sustainability

- A strong statement from CERN putting the environment and sustainability at the forefront of decision-making, aiming at becoming a carbon-neutral laboratory in the short term future, would have a significant impact.
- [...] higher renewable energy fraction.
- Travel and conference schedules [...] to reduce the amount of travel and the associated CO2 footprint.

Computing and Software

- [...] recognised not only as means to do physics analyses, but as research that requires a high level of skill.
- [...] minimise the time to produce physics results allowing more person-power to be allocated to areas where innovation and development is truly needed.
- [to reduce CO2 footprint] our community can drive the development of new software for remote meetings
- [...] open data and [...] the need for sharing knowledge and resources with other computing communities.

EW and Strong Interaction Physics

- Priority should be put on precision measurements and global fits rather than model-driven searches.
- Tighter collaboration between theory and experiment would enhance the precision of measurements.

Beyond Standard Model, Dark Matter and Dark Sector Physics

- [...] diversification of experiments, building on projects such as Physics Beyond Colliders, [...] vital for the future of the field [...]

Flavour, Neutrino and Cosmic Messenger Physics

- [...] specialised smaller experiments in the light sector are needed [...]
- Real-time observations between connected observatories [...] will be crucial in the future

Future Colliders for ECRs, Sep. 2023 @ CERN (indico, report)

- There **are** guaranteed discoveries out there (e.g. Higgs self coupling and many more)
- Learn how to communicate importance of precision
- Future colliders are worth it
  - ➢ For science and society
- See sustainability not as a concern but as a challenge
  - ➢ To develop technologies relevant for society (e.g. high-temperature superconductors)
- Future collider R&D highly transferable between collider proposals (and beyond)
  - ➢ Good ideas will survive a collider proposal or two…
- It's a long time until any future collider is operational
  - ➢ Take future collider decision as early as possible, give ECRs a goal and timeline, ease grant application
  - ➢ Long-term R&D projects and support for careers in instrumentation/engineering/accelerator physics/…
  - ➢ Mind the gap!
- Huge enthusiasm for future colliders! (>100 participants in person and >100 on Zoom)
- Many aspects relevant for ECRs are country-dependent!
  - ➢ Created national ECR event blueprint and organised/organising national follow-up events
  - ➢ Nordic countries, Austria, Czech Republic, Czech Republic+Slovakia, France (Tuesday), Germany, Italy, Belgium+Netherlands, United Kingdom, and more planned!

ECFA ECR letter to March 2024 CERN Council (see report)

Dear CERN Council,

In the 70 years since its founding, CERN has not only established itself as the global centre of particle physics research but as a powerful symbol of international collaboration and scientific excellence. This would never have been possible without the unfaltering support offered by the CERN member states.

As a community, we feel immense pride and gratitude that we are part of this journey of scientific exploration and opportunity which CERN has pioneered. While the High-Luminosity LHC constitutes a much-anticipated and necessary advance in the LHC program, a clear path beyond it for our future in the field must be cemented with as little delay as possible. For the field to sustain the population, expertise, and enthusiasm required to overcome the challenges of what CERN's next major project/accelerator will present, the ECR community needs certainty without delay that High Energy Physics has an immediate future beyond HL-LHC, and that funding and positions required to realise our future will grow rapidly.

We, the ECFA Early-Career Researchers Panel, on behalf of the ECR community, would like to strongly urge the Council to make every effort to ensure that the process of evaluating, selecting and implementing potential future projects, which will define this century of High Energy Physics for Europe and the World, proceed with as quick a pace as possible, accelerating its time frame to start the European strategy process as early as possible and conclude by early 2026. This will go some way in helping further secure CERN's unique position in science, technology and international cooperation for the next 70 years and beyond.

Kind regards,

The ECFA Early-Career Researchers panel

EPPSU started earlier than originally anticipated! ECR input has impact

ECR Session at LCWS24 (indico)

Conditions for Future Project Excitement

Physics:

- Must fully explore Higgs and electroweak physics
- Should probe beyond the Standard Model scenarios

Technology:

- Must be feasible in funding and technology, allowing for innovative upgrades
- Should include interesting and challenging hardware

Feasibility/Sustainability:

- Should ensure environmental sustainability and minimize ecological impact
- Must demonstrate stable funding support and construction timelines to attract early-career participation

Time Scale:

- The project should be launched in a timely manner to ensure sustainable career opportunities for ECRs

Other Considerations

- Scientific work should be free from political influence and support a diverse, tolerant environment

ECR Aspirations for Collaboration:

Leadership and Participation:

- Desire for empathic leadership with well-trained management skills
- Call for transparent decision-making and impactful participation from ECRs

Sustainability and Inclusivity:

- Emphasis on integrating environmental sustainability from the beginning
- Advocacy for inclusivity and adoption of work ethics that promote a supportive environment

Communication and Quality:

- Focus on good communication and documentation, valuing quality of work over quantity

Career Concerns of ECRs:

Long-Term Viability:

- Uncertainty about career stability due to a lack of permanent positions and funding challenges

Transitioning Projects:

- Difficulty in moving from large-scale projects to future initiatives while maintaining career prospects

Funding Feasibility:

- Concerns about funding large colliders due to current economic challenges create uncertainty for ECRs

FCC Week 2024 ECR session (session, summary)

By the time a future collider is built, today's ECRs will be the ones leading it

- Are future collider organisational structures designed to give influence and decision making power to ECRs?
  - ➢ Open nominations for convenor positions!
- Appoint ECRs to convenorship roles within future collider related efforts (e.g. DRDs)

Uncertainties...

- How to maintain current ECRs (and their expertise) working in engineering/auxiliary fields for the LHC over long timescales?
  - ➢ Prevent gap after HL-LHC upgrades are finished!

Need better communication of how precision measurements translate to mass reach for new physics

Early Career Researchers & Muon Colliders event (indico)

Significant interest of community in muon colliders

- Sustainable approach
  - Including people!
- Importance of synergies to other (sub)-fields
  - High-field magnets, nuclear fusion, …
  - New technologies
- “No showstoppers identified” for muon colliders, “time is now”
- Recent wave of excitement about muon colliders due to access of 10 TeV partonic centre of mass regime
  - Precision Higgs program complimentary to Higgs factory
  - Highly motivated physics targets that might be too heavy for the LHC, but only one order of magnitude above in energy