



Promoting ECR engagement in Future Colliders

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Introduction

Please feel free to ask questions/ make comments as I go through the slides

- This session aims to promote discussion amongst the (FCC) ECR community on avenues to further engage ECRs in the roadmap towards future colliders.
- Will share some experiences from a recent event organized at the University of Birmingham involving 40 ECRs affiliated with institutes around the UK.
- This is also an opportunity to share ideas/experiences amongst those present and discuss the roadmap ahead.

Disclaimer: I have tried to pick out discussion points most relevant to the FCC (ECR) community- hopefully this will promote some interesting discussions!

ECR forum in Birmingham

Thanks to the Institute of Advanced Study (IAS) for hosting the meeting

- In-person meeting organized following the initiative of Prof. Eliezer Rabinovici who was visiting the UK and wanted to understand further the views of the ECR community on future colliders beyond the LHC.
- Organising committee: Andy Chisholm (Birmingham), Matt Kenzie (Warwick), Michaela Queitsch-Maitland (Manchester), Cristiano Sebastiani (Liverpool), Sarah Williams (Cambridge)



Guiding principles for the meeting

- Most ECRs are not currently engaged in work on future colliders- this was an opportunity to further inform the community and promote further discussion.
- Tried to avoid emphasis on technical details and instead focus on ‘bigger picture’ discussions.
- Where possible, invited speakers were within the ECR community, with the exception of Prof. Andy Parker who was invited to give perspectives on building collaborations and the funding landscape associated with the LHC.
- Tried to leave as much time as possible for Q+A/discussion.

Overview of the meeting

4 sessions of 1 hour each, with all talks ~ 15 minutes and remaining time for discussion

11:00 → 11:05 **Welcome and Introduction**
Convener: Andrew Stephen Chisholm (University of Birmingham (GB))



11:05 → 12:00 **Physics Opportunities and Existing Anomalies**
Convener: Matthew William Kenzie (University of Warwick (GB))



11:05 **Review of Physics Landscape**
Speaker: Mika Anton Vesterinen (University of Warwick (GB))

🕒 15m



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11:20 **Discussion Session**

🕒 40m




- We do not want to discuss the details of current physics results.
- Given a blank cheque and assuming appropriate technology, what would we build first?
- Do we agree with the priorities of the current / nominal road map (Euro Strategy Doc)?
- What future physics scenarios could we find ourselves in, in the next 5, 10, 20 years and what does this mean for the best approach to future colliders?
- What do we build if we see nothing BSM anywhere?

Discussion points raised:


- Avoid physics case for future colliders relying on current anomalies.
- Can we come up with a new “no-lose” theorem for the FCC?
- Several comments in favour of staged option for FCC, but the importance of smaller, lower budget experiments was also highlighted.

Overview of the meeting

12:00 → 13:00 **Accelerator and Detector Technologies**
Convener: Michaela Queitsch-Maitland (University of Manchester (GB))

12:00 **Accelerators Talk**
Speaker: Laurie Nevay (Royal Holloway University of London)
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12:15 **Accelerators Urgent Questions**

12:20 **Detectors Talk**
Speaker: Jens Dopke (Science and Technology Facilities Council STFC (GB))
 Slides

12:35 **Detectors Urgent Questions**

12:40 **Technologies Discussion**

- We do not want to discuss details of current technology issues.
- What collider options are there and what weighting do people give them in terms of importance - FCC (ee+eh+hh?), linear collider, muon collider - are there others?
- What technology advances are critical to achieve the scenarios agreed above? ECFA R&D Roadmap (<https://cds.cern.ch/record/2784893>).
- What particular R&D areas is the UK community best placed to make progress on (we cannot do everything)?
- What is the likelihood of technology advances being realised on an appropriate time scale?
- How much R&D - both in terms of FTE and funding is required to achieve this?
- Are there other prohibiting factors aside from financial?

Discussion points:

- Relative readiness of FCC-ee technology provides argument to proceed with tunnel (relative to HE-LHC)
- ECRs wanted to understand more the challenges associated with the magnets for FCC-hh, and the potential logistics of a staged approach (as was first proposed for the LHC)

- Muon colliders also discussed extensively though the technology is further away.
- Concerns about energy budget and implications for climate change were raised- important to factor these considerations into decision making and planning.

Overview of the meeting

14:00 → 15:00 **Facilitating a Future Collider**
Convener: Sarah Louise Williams (University of Cambridge (GB))

14:00 **Lessons from the LHC and the Funding Landscape**
Speaker: Andy Parker (University of Cambridge (GB))

 LHC-FCC history.pdf

14:15 **Funding landscape discussion**

🕒 45m 

- How do we build a competitive funding model that does not directly take resources from other essential STFC activities?
- What are the differences in the field / funding landscape / CERN budget between the LHC development and now?
- How do we secure funding and ensure sufficient variety / diversity / importance that it is hard to cut in the future?
- What can be learnt from previous successes (e.g. LHC) and challenges (e.g. ILC)?
- How are collaborations built and is this model still suitable in the future?

This discussion was very well-received by the participants- we are eager to arrange further discussions to share experiences from those involved in planning the LHC

- Emphasised the significance of re-using the LEP tunnel as a key selling point for the LHC (very relevant for the integrated FCC plan).
- Sticking to a realistic budget envelope is important. Recruiting associate members to CERN was an effective way to manage this for the LHC.
- Lots of discussion on the possible 'staged' approaches to the LHC and whether they could be used for the FCC.
- The importance of convincing the scientific community (outside HEP) of the importance of our programme.

Overview of the meeting

15:00 → 16:00 **Opportunities and Challenges for ECRs**

Convener: Cristiano Sebastiani (University of Liverpool (GB))




15:00 **Perspective from ECR working on R&D**

Speaker: Craig Sawyer (Science and Technology Facilities Council STFC (GB))

🕒 15m



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15:15 **Career Prospects Discussion**

🕒 45m



- How sustainable is it to do small fractions of time on future R&D?
- How risky is it to commit to a career in future R&D?
- What is the best strategy as a community (many people giving small fractions of time - fewer people giving larger fractions) and as an individual (how do I get a permanent position)?
- How straightforward is it to start performing R&D / transition from data analysis?

Session focused on challenges/opportunities for ECRs to work in detector R+D for future colliders...

- Concerning lack of ECRs involved in R+D was noted- not entirely surprising based on the lack of funding for R+D. Are there also barriers for career progression?
- Open questions of how to balance current project delivery with future R+D, the sustainability of spending small amounts of time on R+D, and potential risks

Next steps

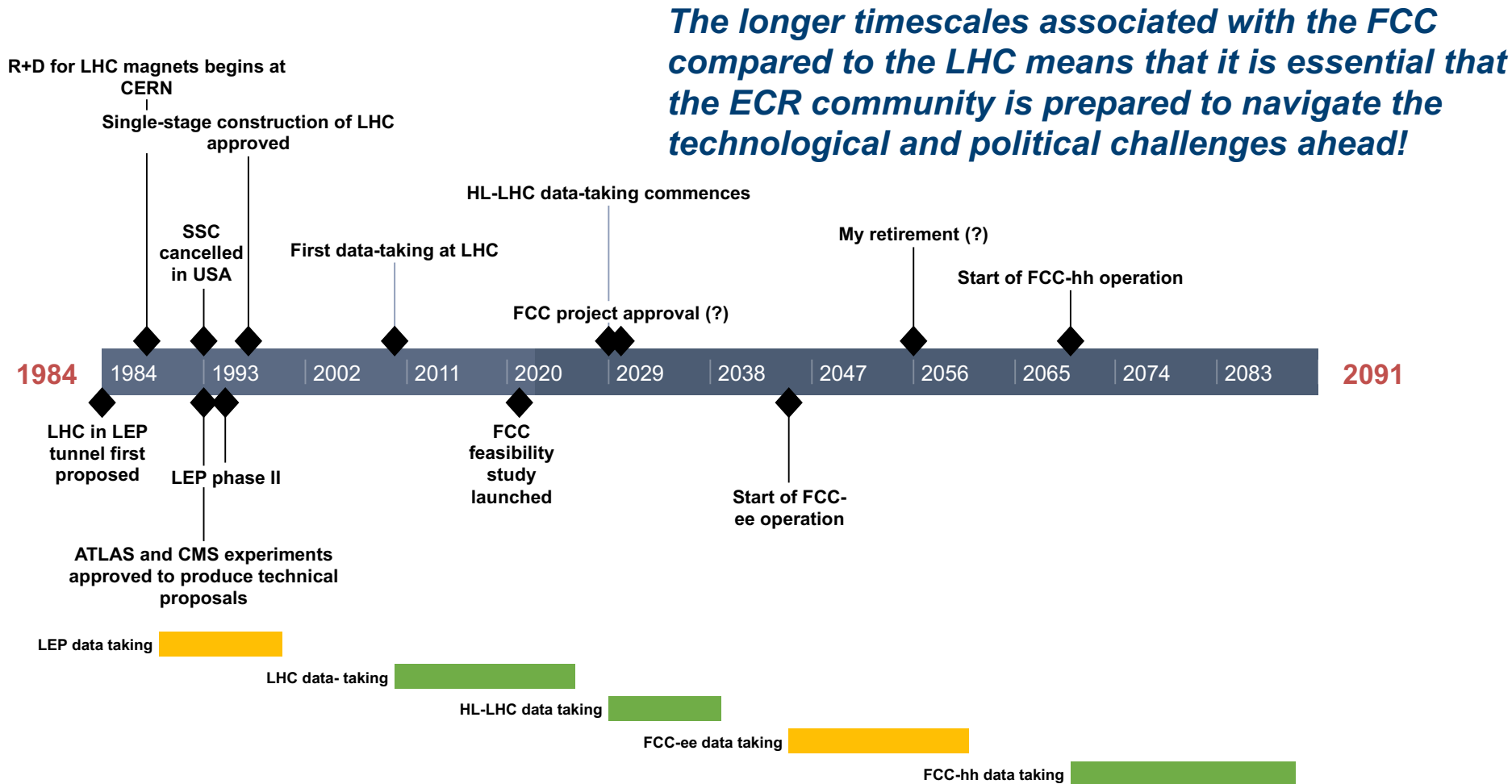
- In the closeout discussion, many appreciated the format of the meeting, which allocated most of the available time to discussions.
- It was suggestion that further representation from the theory and accelerator communities would be beneficial for future meetings.
- Participants unanimously shared the sentiment that they were excited by the physics and technology opportunities offered by future colliders.

Due to constraints on the timing and venue of the meeting, this event was a small invite-only meeting. It was well-received by the participants and the organisers are in the process of planning a follow-on event that would be open to the UK ECR community more broadly.

- We are also happy to discuss/share experiences with others interested in planning such initiatives.

Reflections on the meeting

Note that these are my own opinions...



Reflections on the meeting

There are key similarities to the position we are in now compared to ~ 40 years ago when the LHC was first proposed, but also some very big differences...

- Facing the challenge of planning for future experiments alongside ongoing upgrades.
- For FCC-hh we do not yet have the magnet technology needed to reach 100 TeV (similar to when the LHC was proposed).

BUT

- The funding landscape is vastly different- unlikely to get significant input from non-member states to boost the available budget.
- Physics case is arguably more challenging- can we recreate the no-lose argument?

Points for further discussion

Thanks to the organisers for enabling us to have this session!

1. Have there been any similar events elsewhere in the FCC community? Can we share best practices/ learn more from each-other?
2. Funding landscapes will vary in different countries/regions- how can we adequately prepare ourselves for this?
3. How to encourage/engage more ECRs in future collider discussions (and ongoing studies?)
4. Can we do more to educate ourselves/the ECR community about the political/sociological/technical challenges ahead?

... and other points/questions you may want to raise for discussion 😊