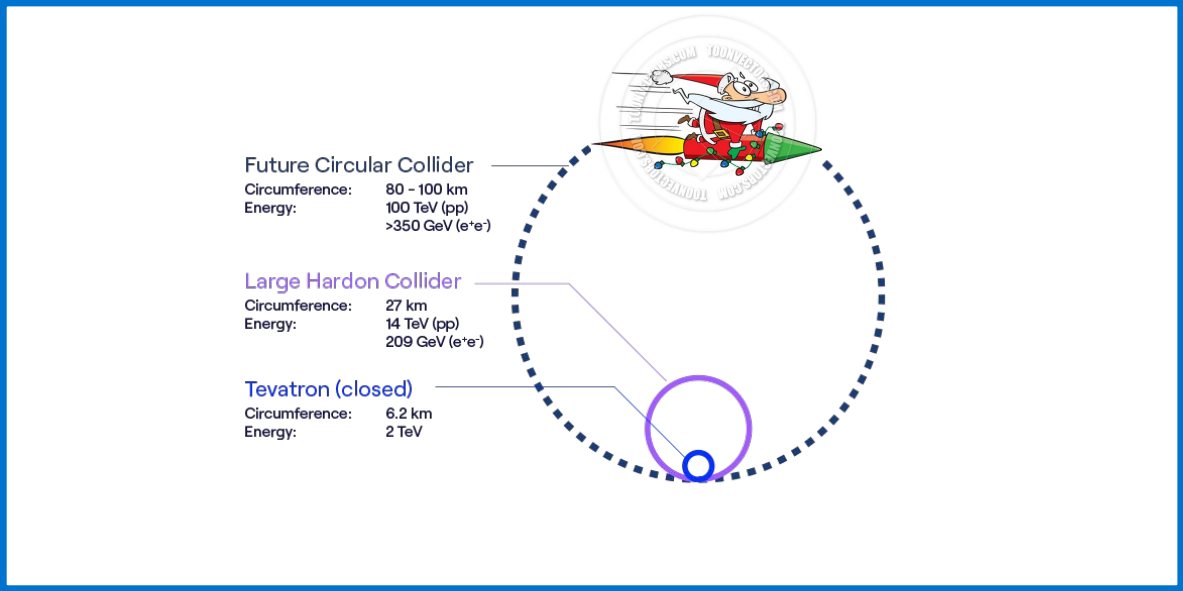
UNIVERSITY OF CAMBRIDGE

FUTURE CIRCULAR COLLIDER

Future colliders



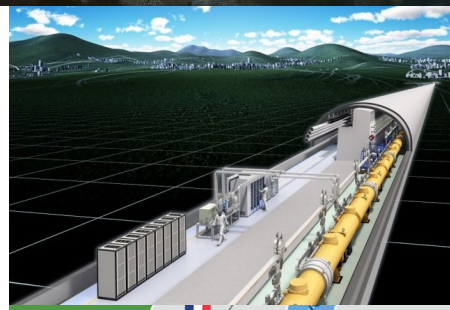
Dr Sarah Williams, Dr Matthew Kenzie

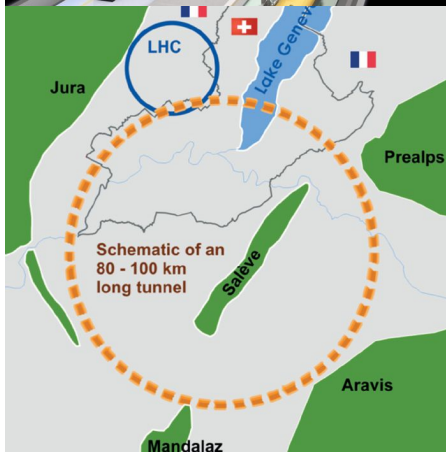
Future colliders beyond the LHC?

In the aftermath of the Higgs discovery, lots of discussion on what machine should follow the LHC…

What should come after the LHC?

- e^+e^- machine?
  - Linear collider?
    - **CLIC** (CERN?)
    - **ILC** (Japan?)
  - Circular collider?
    - **CepC** (China)
    - **FCC-ee/eh/hh** (CERN)
- Hadron collider?
- Muon collider?





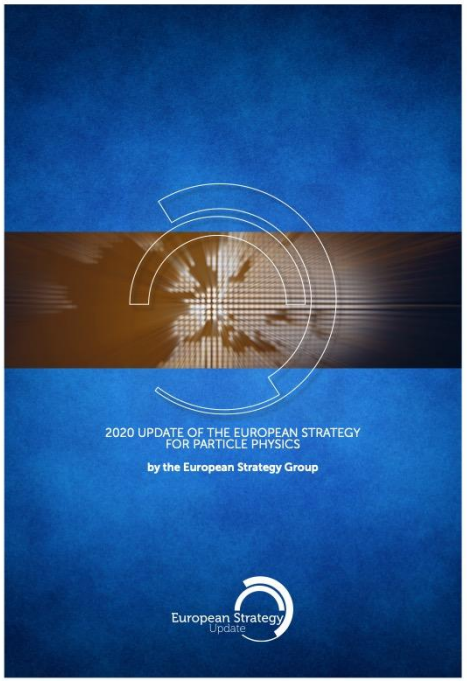
How might Europe fit into the global context?

The 2020 European Strategy Update

Following ~ 2 years of concensus gathering within the community, the ESU made several key recommendations to the community:

1. An electron-positron Higgs factory is the highest-priority next collider. For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy

2. Europe, together with its international partners, should investigate the technical and financial feasibility of a future hadron collider at CERN with a centre-of-mass energy of at least 100 TeV and with an electron-positron Higgs and electroweak factory as a possible first stage



Following these recommendations, several initiatives were started within the international HEP community….

2020 ESU- next steps

1. ECFA detector R+D roadmap => CERN DRDs (and corresponding UK structure) now being formed.
2. FCC feasibility study
3. ECFA Higgs/top/EW factory study

Both (2) and (3) are aiming to provide input to the next ESU…

Local organizing committee

- Guy Wilkinson (University of Oxford) Chair
- Gavin Davies (Imperial College London)
- Jon Butterworth (University College London)
- Harry Cliff (University of Cambridge)
- John Ellis (King's College London)
- Seth Zenz (Queen Mary University of London)
- William Panduro Vazquez (Royal Holloway London)
- Stewart Boogert (Royal Holloway, incoming director of Cockcroft Institute)
- Philip Burrows (University of Oxford, John Adams Institute)
- Andy Pilkington (University of Manchester)
- Nicholas Wardle (Imperial College London)
- Sarah Williams (University of Cambridge)
- Dave Newbold (STFC)

Cambridge future collider activities

Harry at the ECFA workshop in Paestum

1. FCC-ee physics studies:
   - BSM (S. Williams)
   - Flavour (M. Kenzie)

   (see contributions here: https://indico.ph.qmul.ac.uk/indico/conferenceDisplay.py?confId=1763

   Plus FCC-hh (S. Williams)…
2. Participation in DRD collaborations (M. Kenzie, O. Brandt, B. Hommels, C. Jones, S. Wotton, S. Williams)
3. Science communication towards future colliders (H. Cliff, S. Williams)
4. ECR initiatives to discuss future colliders (M. Kenzie, S. Williams + others)

ECRs and future colliders

- Group members on the forefront of efforts to engage more ECRs in conversations about future colliders.

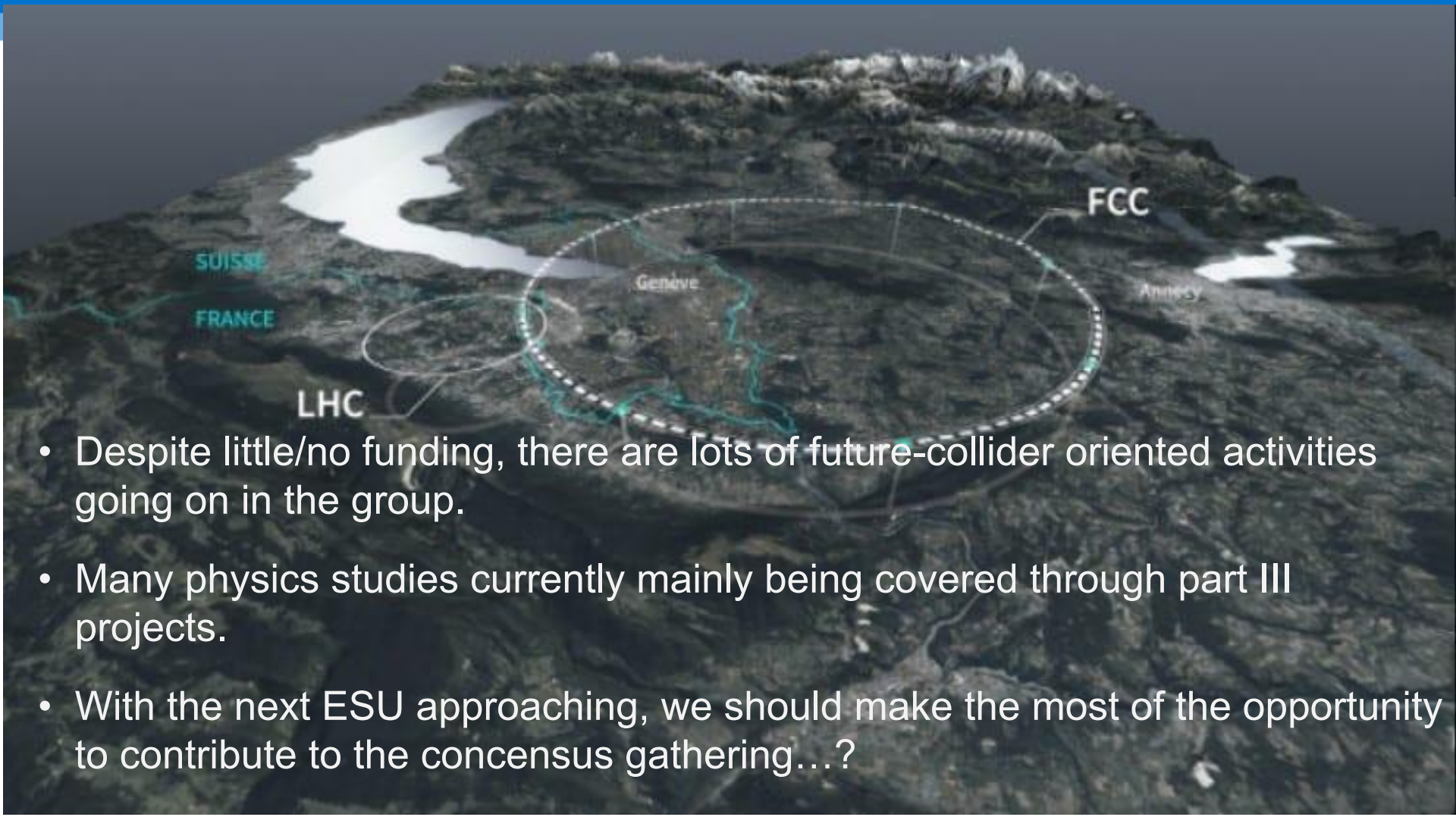
- Involved in organizing events in 2022 (including one hosted in Cambridge)

- These events culiminated in a town hall in July 2023, with community recommendations now sent to STFC, UK ECFA, PPD and IPPP, which include…

> Establish a sustainable plan to enable more regular discussions between the ECR and non-ECR community about the future road-map of HEP (this includes identifying who will coordinate/fund these efforts). This includes ensuring plans to involve UK ECRs in the national consensus gathering process for the next European strategy are discussed early and circulated to the community prior to the process beginning.

- For more perspectives see: https://www.nature.com/articles/s42254-023-00667-z

Looking ahead…



- Despite little/no funding, there are lots of future-collider oriented activities going on in the group.
- Many physics studies currently mainly being covered through part III projects.
- With the next ESU approaching, we should make the most of the opportunity to contribute to the concensus gathering…?