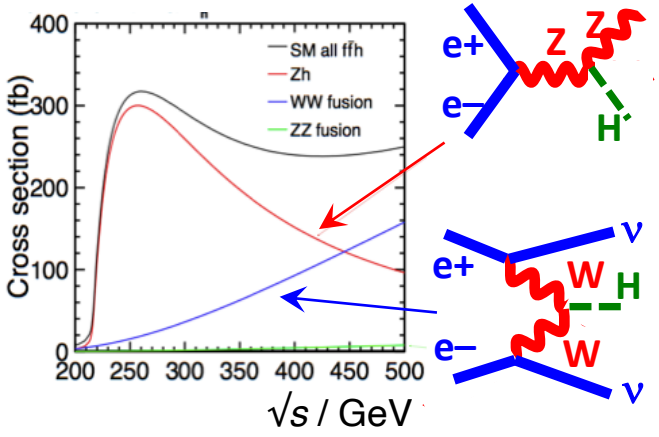
Unified efforts towards a future e^+e^- facility

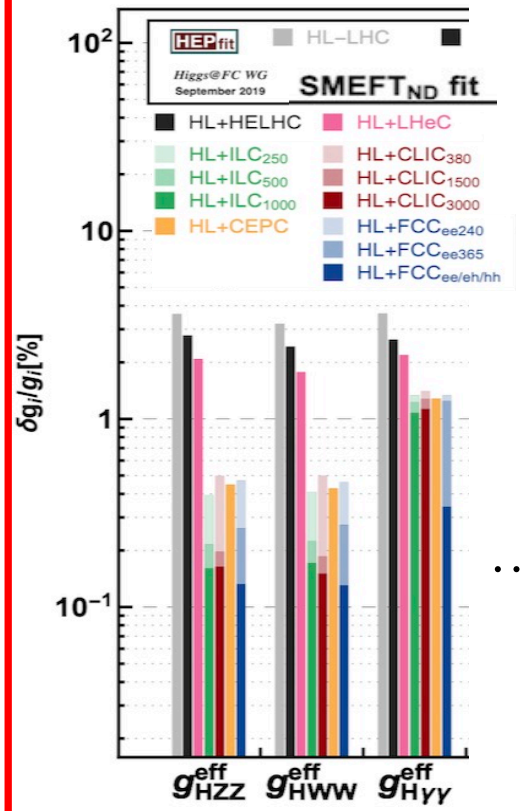
UK meeting on a future e^+e^- Higgs/EWK/top factory, 5 July 2022, Oxford

Aidan Robson, University of Glasgow

Physics programme



- **Common to all projects: ZH threshold at 250 or 380 GeV**



Higgs@Future Colliders 1905.03764

…etc

–> core Higgs programme

–> sets requirements on detector performance: momentum resolution, jet energy resolution, impact parameter resolution etc

–> project run-plans are optimised differently, but result in largely similar sensitivities for core Higgs coupling measurements

- **TeraZ / WW @ circular**

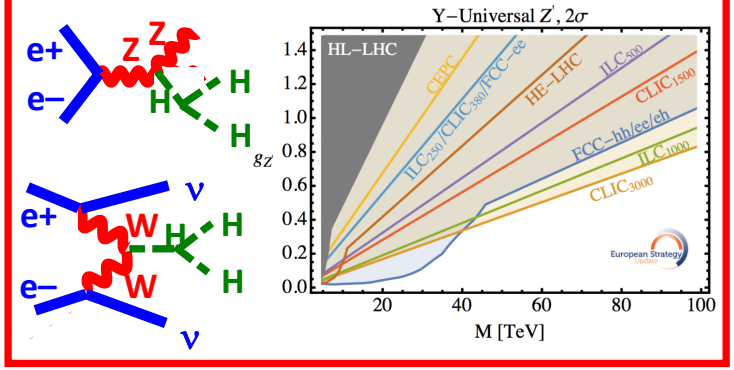
  –> ultra-precise EWK and QCD programme at Z pole

  –> potentially more stringent requirements on detector momentum & angular resolutions, beam energy and luminosity measurements etc

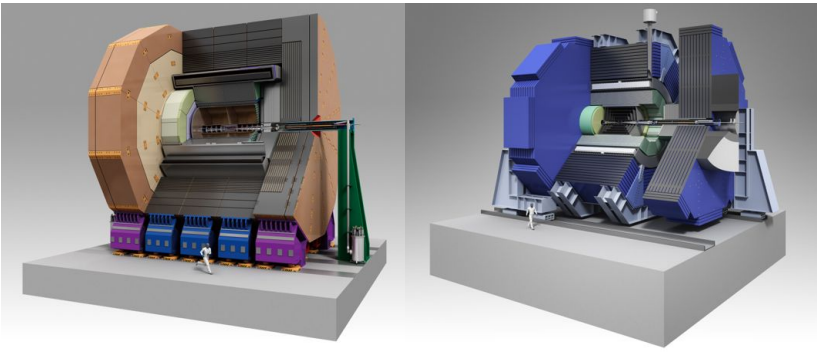
- **TeV / multi-TeV @ linear**

  –> direct HH production, extra BSM reach etc

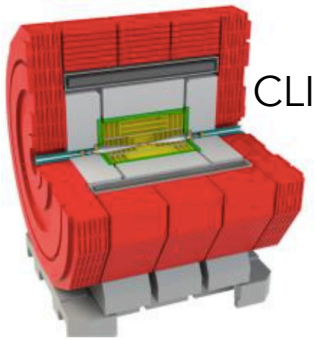
  –> detectors require deeper calorimeters etc



Detector & Physics: exploiting synergies

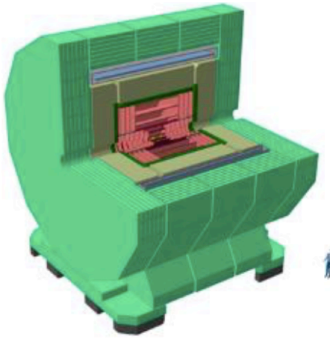


ILD SiD

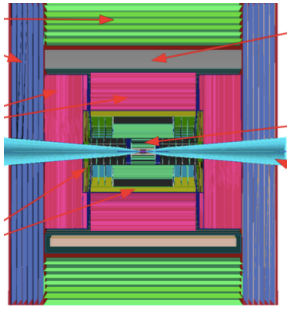


CLICdet

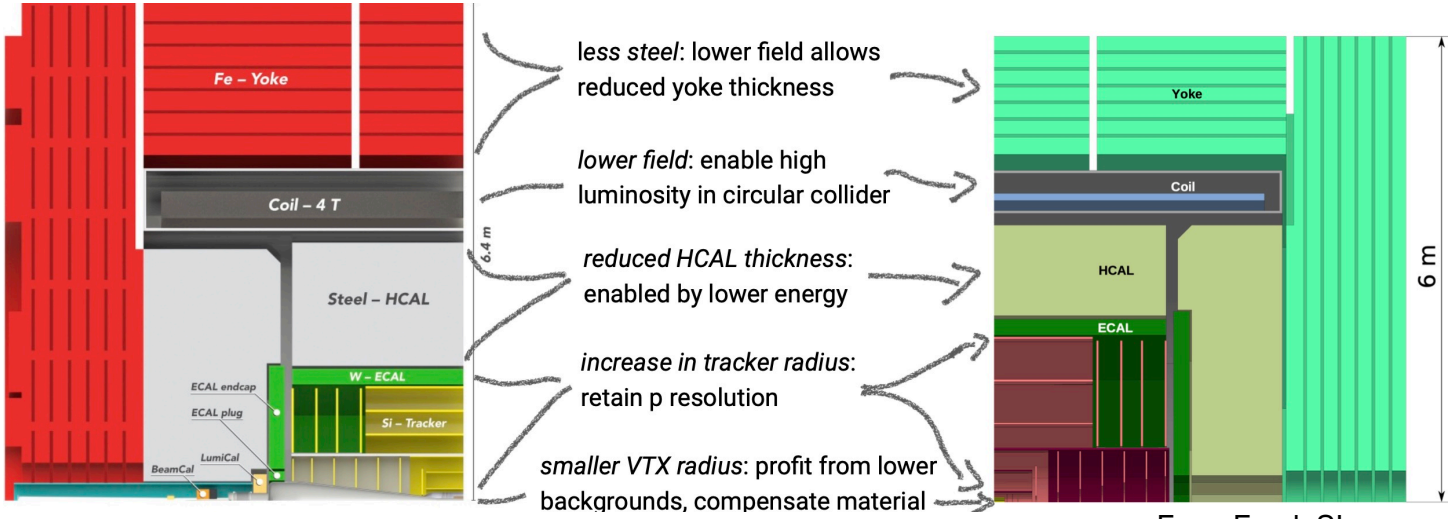
example



CLICdet adapted for FCC-ee



CLICdet adapted for muon collider



From Frank Simon

Bunch trains vs continuous beams –> different cooling requirements

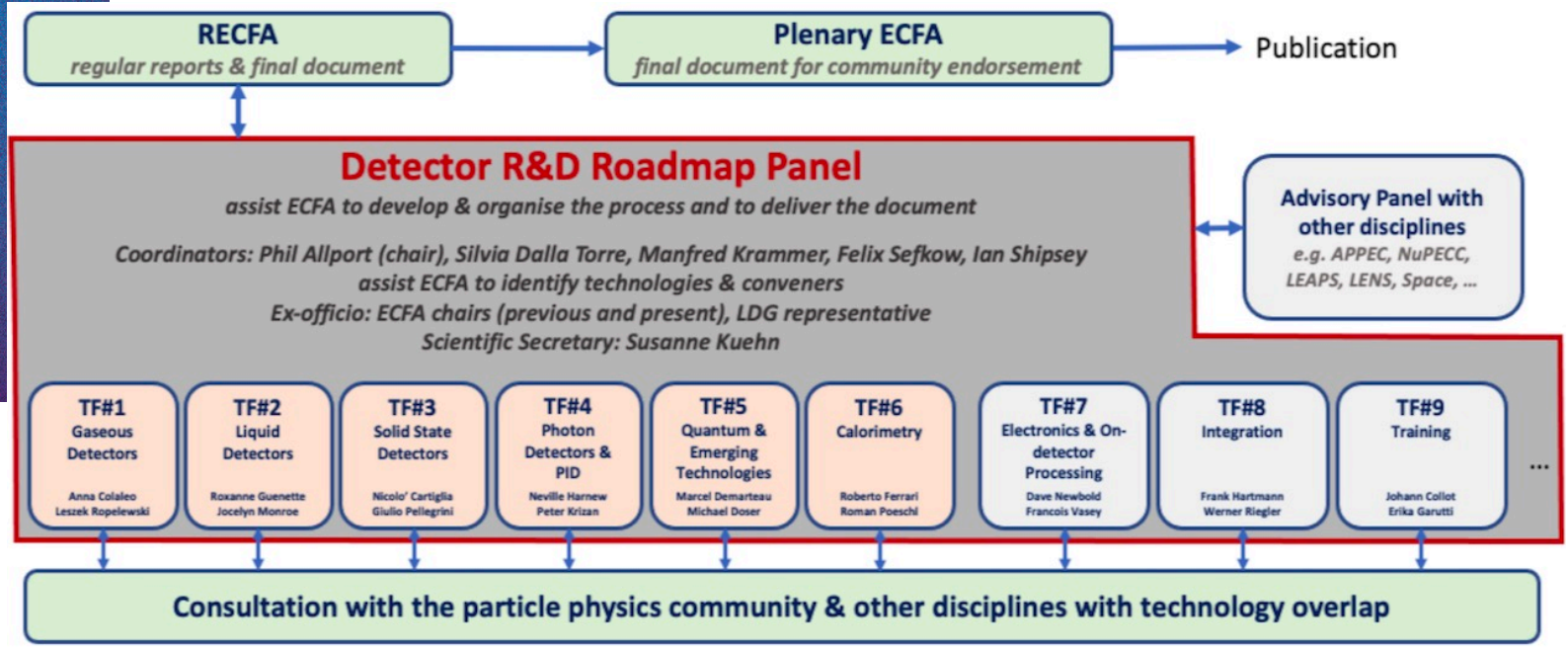
Projects have individual specific requirements but also many common aspects
- detector concepts
- detector technologies
- software tools
- physics studies

Linked efforts via ECFA to identify commonalities and complementarities, and to share expertise:

- 2021 ECFA Detector R&D Roadmap
- ECFA Higgs/EWK/top factories initiative
- (ECFA Accelerator Roadmap)

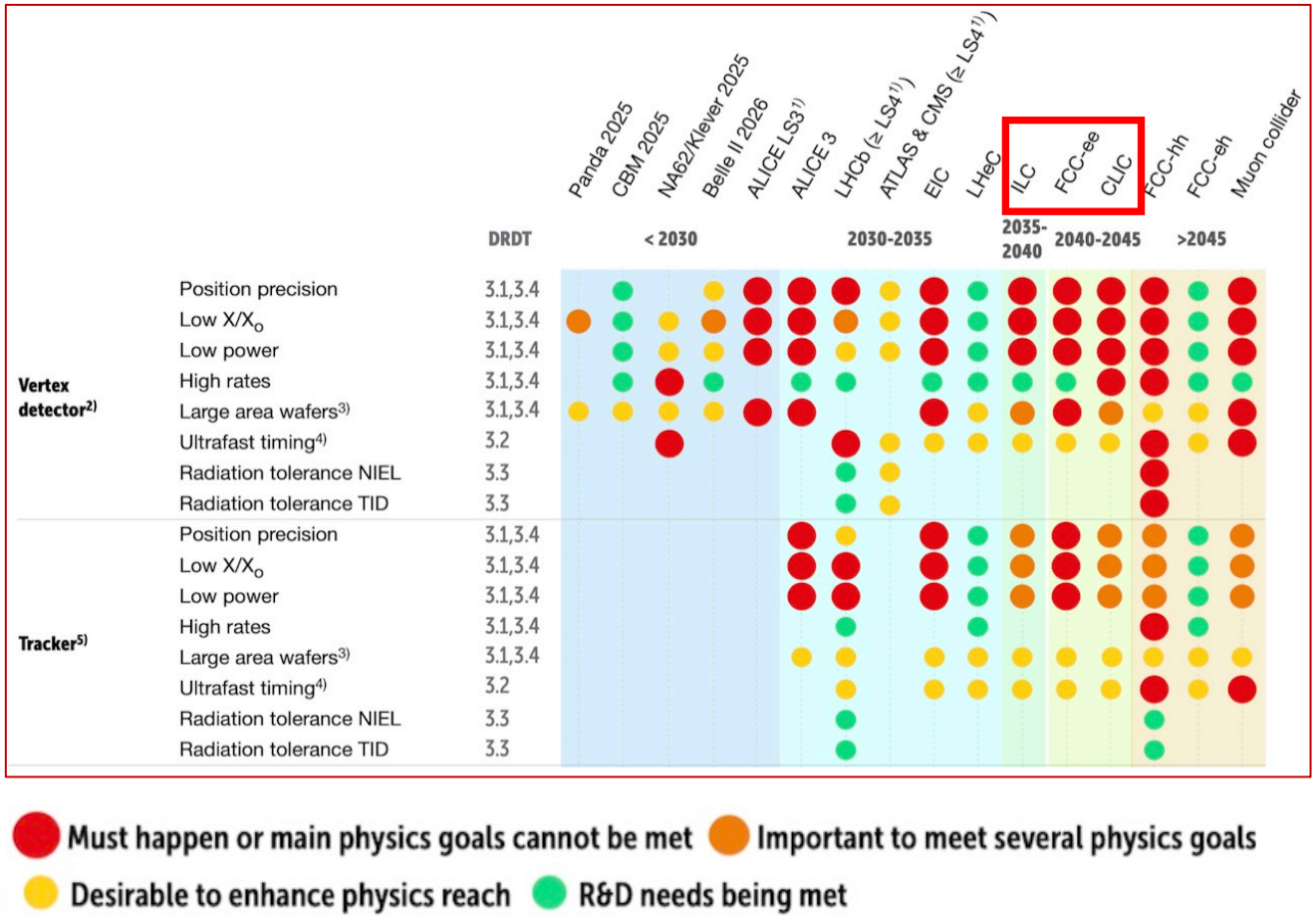
2021 ECFA Detector R&D Roadmap

- https://cds.cern.ch/record/2784893?ln=en
- Charge: to identify and describe a diversified detector R&D portfolio that has the largest potential to enhance the performance of the particle physics programme in the near and long term
- –> projects are the European Particle Physics Strategy Update (EPPSU) "High-priority future initiatives" or "Other essential scientific activities for particle physics"
- Broad input from national communities and projects



2021 ECFA Detector R&D Roadmap

- Roadmap identifies requirements and readiness of technologies for each project, highlighting similarities / commonalities
- Recommends priority activities



DRDT 3.1 - CMOS sensors.

- Develop MAPS sensors with very high spatial resolution and low mass;
- Design and produce MAPS sensors for high fluence environments;
- Develop MAPS with very large areas and reduced granularity for tracking and calorimetry applications;
- Develop CMOS passive designs for pixel and strip sensors, as a complement to present standard silicon sensors;
- Explore the use of state-of-the-art CMOS imaging sensors technology for tracking and vertex detectors.

DRDT 3.2 - Sensors for 4D-tracking.

- Understand the ultimate limit of precision timing in sensors with and without internal multiplication;
- Develop sensors with internal multiplication with 100% fill factors and pixel-like pitch;
- Investigate production of sensors with internal multiplication in a monolithic design;
- Increase radiation resistance, push the limit of 3D sensors and explore LGAD and MAPS capabilities;
- Investigate the use of BiCMOS MAPS, exploiting the properties of SiGe.

DRDT 3.3 - Sensors for extreme fluences.

- Measure the properties of silicon sensors in the fluence range 1×10^{16} n... cm^{-2} to

2021 ECFA Detector R&D Roadmap

- Roadmap **implementation** under discussion

  - Recognition that national communities need continuity *between* large detector construction projects and their associated funding
  - CERN RD collaborations seen as a good model
  - Proposal to 'relaunch' RD collaborations as Detector RD "DRD" collaborations
  - –> Use RD50 and RD51 as starting points:
    RD50 – Radiation hard semiconductor devices for very high luminosity colliders
    RD51 – Development of Micro-Pattern Gas Detectors Technologies
  - –> Potentially use CERN magnet and mechanics groups as nucleation for other DRD activities

  - Points under discussion include…:
    – number of proposed DRDs (one per topic would be many…)
    – collaboration management model, including funding within CERN (many/few committees…) and administrative overhead
    – length of transition for existing RD collabs

  - As with RD collabs, national communities will need their own funding for participation

–> expect to hear more soon

ECFA Higgs/EWK/top factories initiative

- ECFA Higgs/EWK/top factories initiative set up to respond coherently to European Strategy highest-priority next collider –> share challenges and expertise and explore synergies across efforts

- Intention: to bring the entire e+e- Higgs factory effort together and foster cooperation across various projects. Collaborative research programmes are to emerge.

- WG1: Physics programme — WG1 conveners Fabio Maltoni, Jenny List, Jorge de Blas, Juan Alcaraz
  – 5 physics themes with coordinators; mini-workshops and seminars underway
  Following on from European Strategy joint activities and Snowmass studies

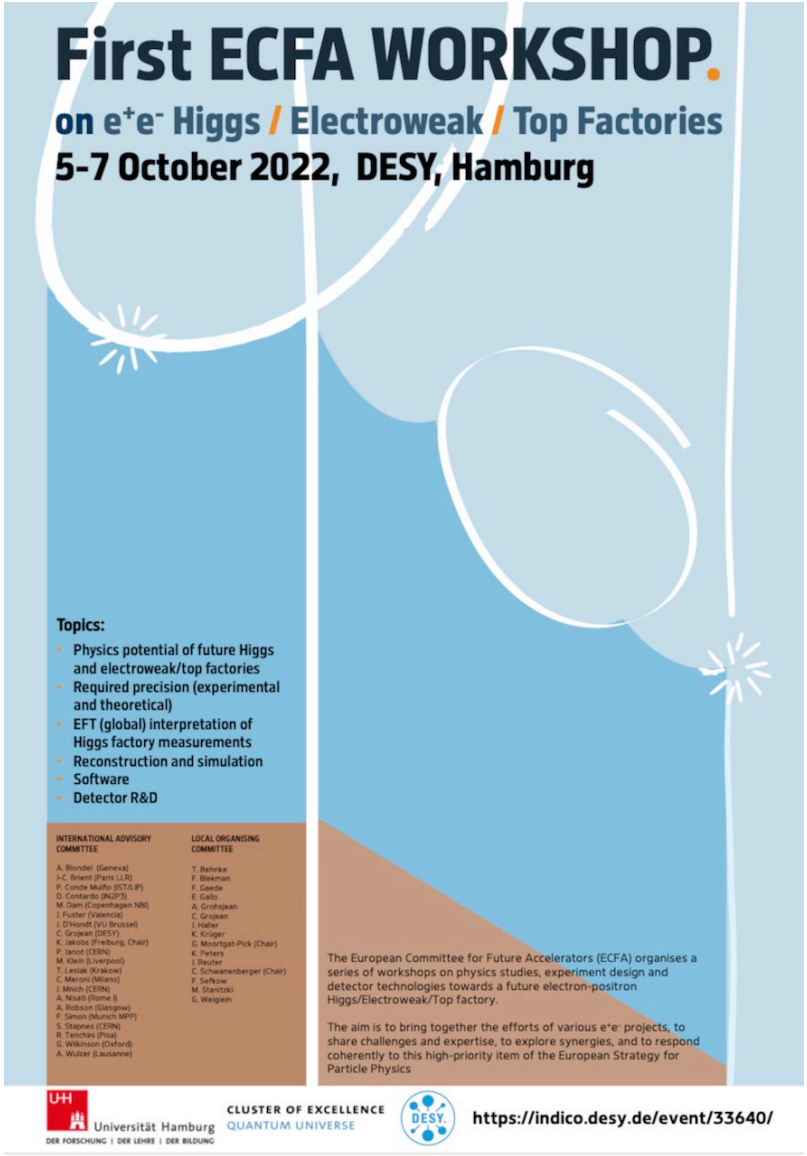
  WG1-GLOB: global interpretations
  WG1-PREC: theoretical and experimental precision
  WG1-HTE: specific Higgs/Top/EW studies (+ connection with LHC)
  WG1-HF: Heavy Flavour
  WG1-SRCH: Direct searches (weakly-interacting, directly accessible particles)

- WG2: Physics analysis methods — WG2 conveners Patrizia Azzi, Fulvio Piccinini, Dirk Zerwas
  – workshops already held on each of generators, simulation, reconstruction

- WG3: Detector technologies — WG3 conveners Felix Sefkow, Mary-Cruz Fous, Giovanni Marchiori
  – launching imminently in light of ECFA Detector R&D roadmap
  – bridge between detector technology activities and detector concepts

–> everyone invited to participate; see all activities here: https://indico.cern.ch/category/14055/

ECFA Higgs/EWK/top factories initiative



Working group activities feed in to annual 'overall' workshops in 2022 and 2023, leading to Yellow-Report style input to next European Strategy Update

Registration now open for First Workshop 5–7 Oct 2022 at DESY; abstract deadline extended to 22 July
https://indico.desy.de/event/33640/

–> please register!
– support available for early career scientist attendance

All of these ECFA activities strengthen the European PP community toward a Higgs factory, and participation can be beneficial to the UK