

PPD R&D Showcase

25th May 2022

PPD seminar

Fergus Wilson

Why have PPD R&D Showcase Talks

- In the last two years about 15 new people have joined PPD.
 - Do you know what they look like ?!
 - Our roving photographer will capture you soon for the photo board.
- A lot of what PPD does is not written down.
 - We have the PPD advisory board status report 2021.
 - We have the 2019 strategy report.
 - We have an internal abysmal web site (despite everyone's best effort).
 - We have sharepoint (write once, find never).
- There are a lot of particle physics reviews going on at the moment.
 - UK, STFC, ECFA, ICFA, National Labs, CERN, Uncle Tom Cobbley et al...
 - They are going to report between summer and end of 2022.
 - R&D for future projects is on everyone's mind.
 - We (PPD) need to position ourselves to respond to the recommendations.

How is R&D in PPD funded

- STFC Project funded:
 - R&D that targets a specific aspect of a project e.g. ATLAS upgrade, LHCb upgrade 2.
 - Awarded through STFC's Projects Peer Review Panel (PPRP).
 - Project R&D grants (PRD) will reappear this autumn (£250k over 2 years).
- BEIS/Government direct funded e.g. Infrastructure fund
 - £100M/year for UKRI. Not sure about the future.
 - STFC curates requests and applications are made in a similar way as PPRP projects (but not as detailed).
 - We have secured two grants so far.
- Technology Department's Centre for Instrumentation:
 - R&D of generic use to STFC facilities using TD effort. £1.5M/year.
 - 5 Managed programs (3-year, £150k/yr).
 - ~12 Responsive mode programs (1-year, up to £50/yr).
 - 3 out of our 4 proposals were accepted this year.
- PPD Director's generous nature:
 - £25k/year to kick start new projects. £30k/year for laboratory infrastructure. Requests to me.
 - £125k/year for capital items (>£10k including VAT). Need to buy before summer.
- CERN RD programs e.g. RD50, RD53, RD90-93:
 - Sometimes can get some matching funds or access to restricted IP (Intellectual Property).
 - Mostly a good networking exercise.
- And lots of opportunities that wax and wane e.g. Facility Infrastructure, Newton, Horizon 2020, Marie Curie,

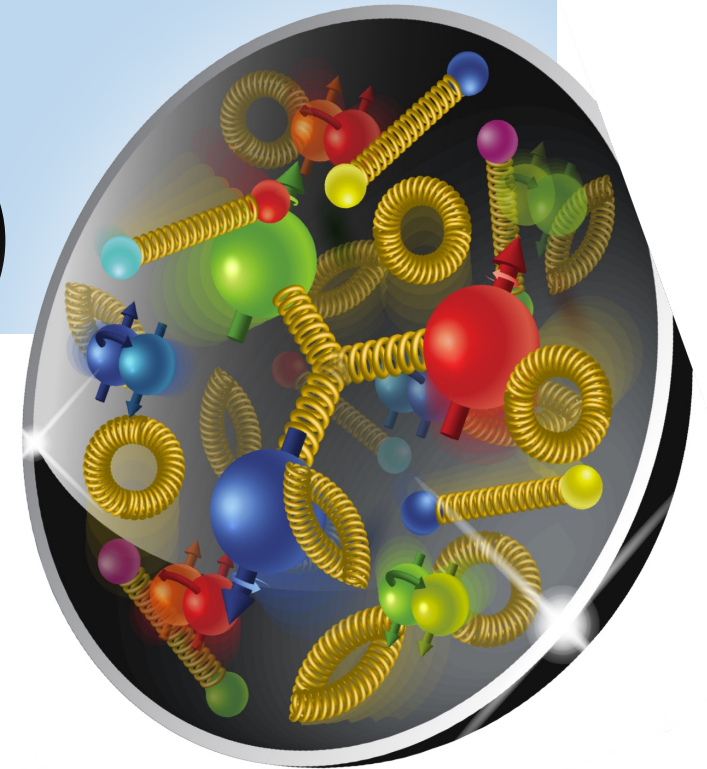
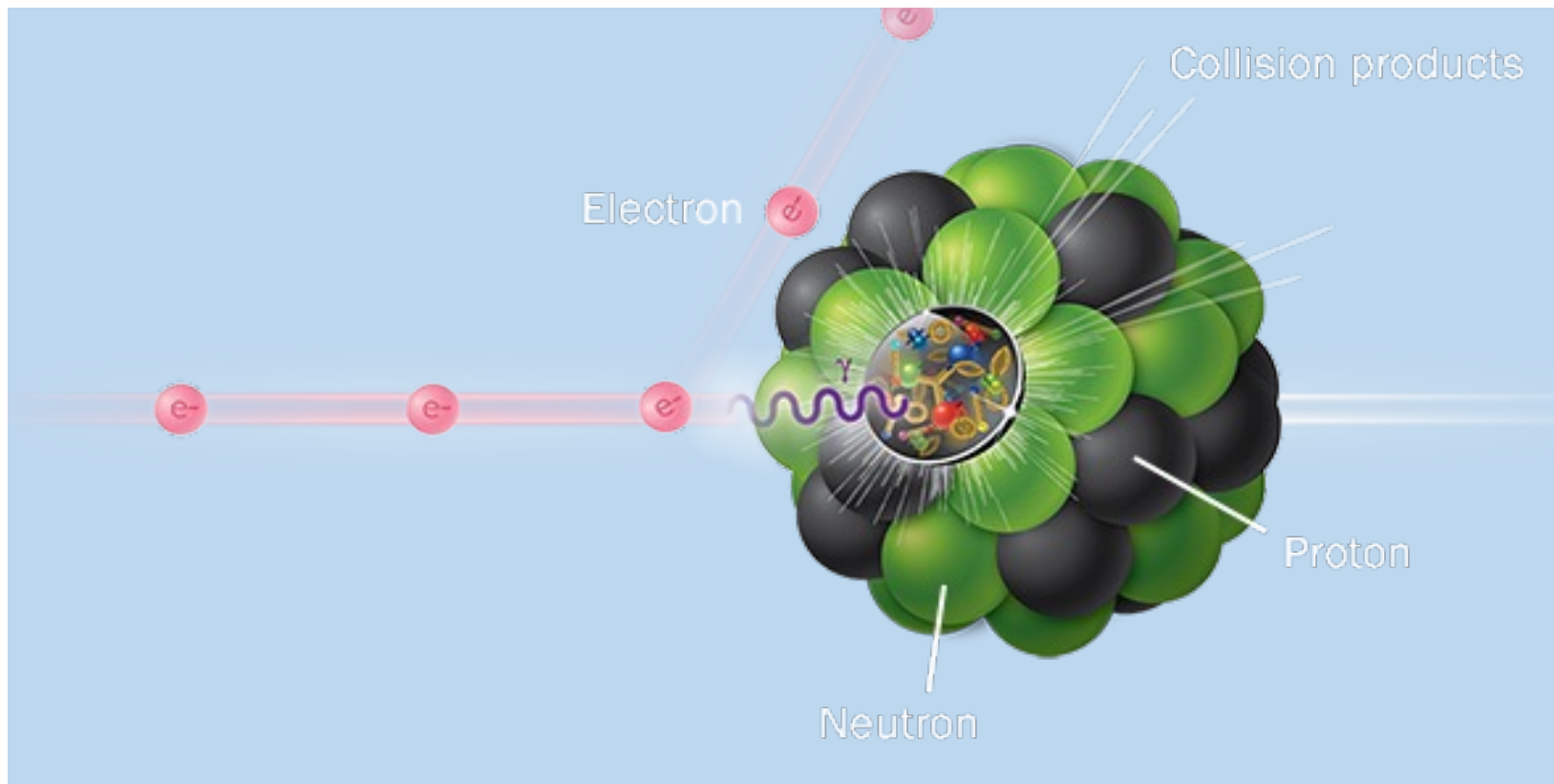
- In March I asked everyone to tell me about their R&D work.
- Discovered there are ~40 projects.

Subject	Contact	Subject	Contact
EiC vertexing/tracking	FFW	Hexitec radioisotopes	John Matheson
ATLAS (HLT)	John Baines	ATLAS (tracker)	Craig
CMS (trigger/DAQ)	Claire	Cryogenic electronics	Dave N
LHCb upgrade 2 SiPM	Antonis	3D imaging of burnt scrolls	Jens
Accelerated Computing	Chris Brew	Centre for Instrumentation	FFW
CEPC+ATLASPix	FFW	Future Colliders	Jens
RD50 Schottly	Giulio	Hyper-K	Anna/Federico
AION/Quantum	Mark Bason	CERN MALTA chip	Iain Sedgwick
LGADs	Giulio	Computing group	Chris Brew
Hyper-K photodetectors	Anna	DUNE DAQ/trigger	Claire
Boulby (Infrastructure)	Paul	MIGDAL	Pawel
ATLAS HVMUX	Giulio	Strontium Laboratory	Mark Bason
Cryogenic Radon Emanation Facility	Maurits	LUX-Zeplin/Future LXe G3	Pawel
RD51 MPGD	Pawel	LhAra	John Matheson
ALICE ITS3 MLR1 (65nm)	FFW	65 nm technology	TD
28 nm technology ASICs	TD	Swift-HEP/Optiks?	Claire
LHCb upgrade 2 SiPM	Antonis	RD50 GaN	Giulio
Unfolding	Tim	TD CMOS Design Group	Iain Sedgwick
TD ASICS	Mark Prydderch	EiC Dc-Dc/serial power (65nm)	Peter
PPD Support Office / Finance	Chris Lowe	ATLAS (L1 calo)	Robin
Programmes Office	Sarah Verth		

Contents of showcase talks

- We will have two or three talks every month.
 - Even at 3/month will take ~18 months to cycle through.
- These are **not** science review talks.
- 10-minute talks (no more than 10 slides per talk) to cover:
 - Who in PPD is involved, contacts.
 - UK institutes involved.
 - What you are doing, and why, with pictures.
 - Schedules (real and imaginary).
 - Funding (real and hoped for).
 - Deliverables/milestones/outcomes.
 - Up to 10-year outlook.
 - What resources you would hope for.
- Have invited TD (sensors and ASICS) and programmes office to give talks as well.

Electron-Ion Collider (EIC)

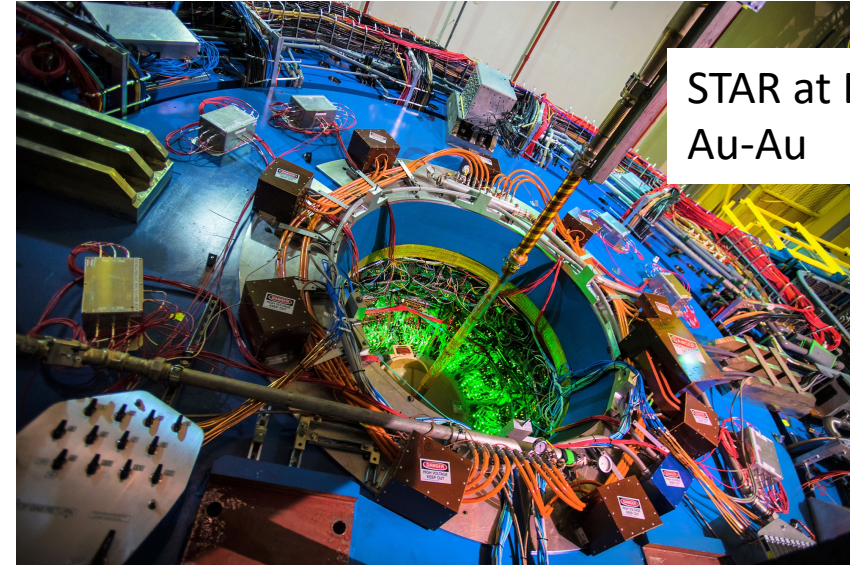
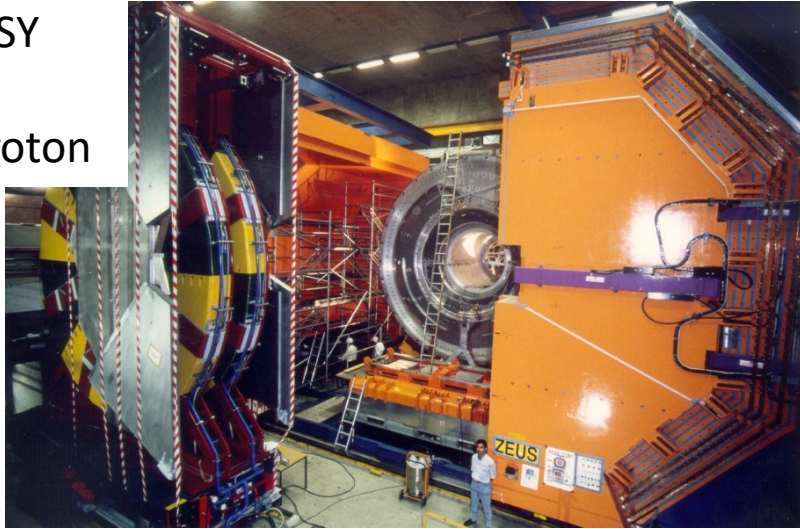


What is it?

- Next generation Nuclear Physics experiment.
- Will collide electrons with ions:
 - High luminosity 10^{33} - 10^{34} $\text{cm}^{-2} \text{sec}^{-1}$
 - Large centre of mass 20-140 GeV
 - Both beams will be polarized to 70%.
 - Large range of ions: protons to Uranium.
- Goal:
 - Precision 3D imaging of protons and nuclei (parton density functions).
 - Understand spin of the proton (where does it come from).
 - Generation of nucleon mass from massless gluons.
 - Search for saturation “color glass condensates”.
- CD-1 approved by DOE July 2021:
 - Conceptual design, cost and schedule estimate, etc... approved
 - Now need to firm up design for CD-2 in next two years

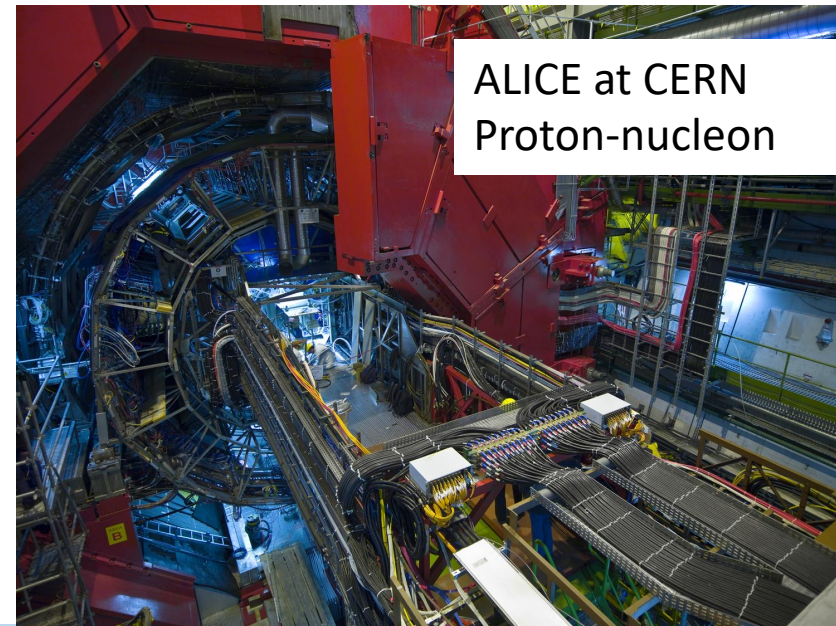
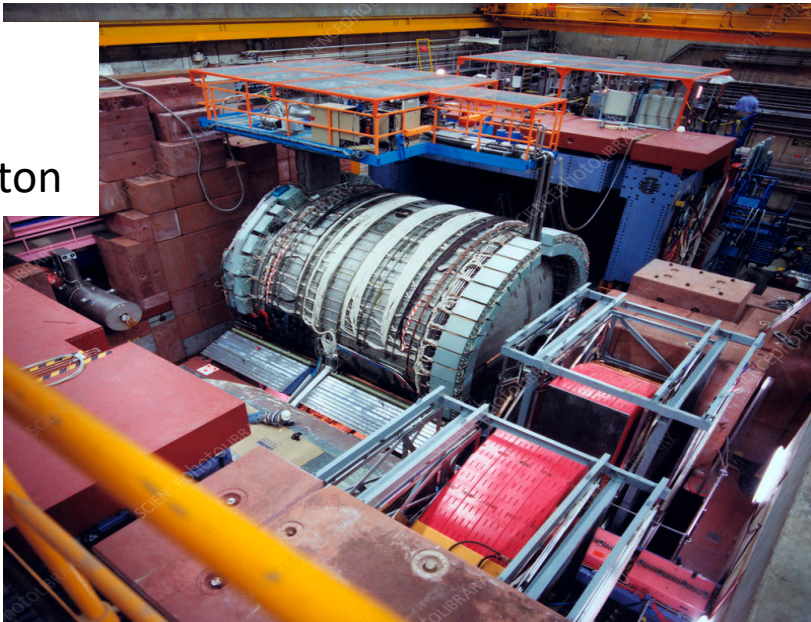
Similar experiments

ZEUS at DESY
1992-2007
Electron-proton



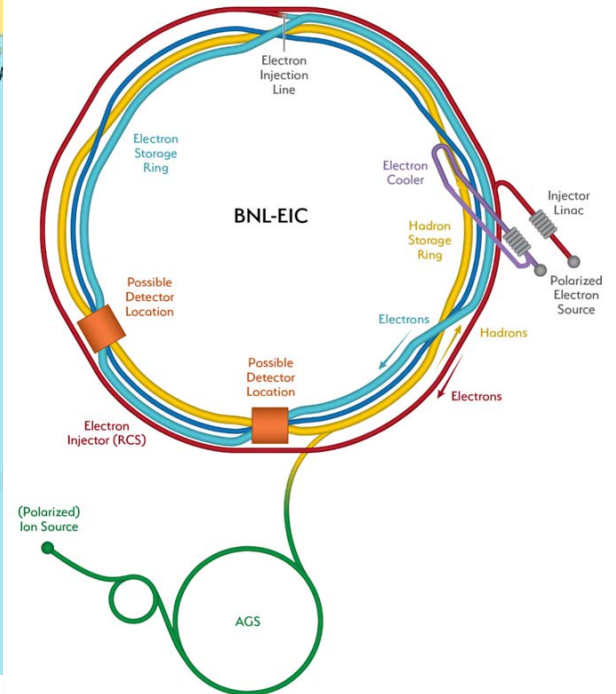
STAR at BNL
Au-Au

H1 at DESY
1992-2007
Electron-proton



ALICE at CERN
Proton-nucleon

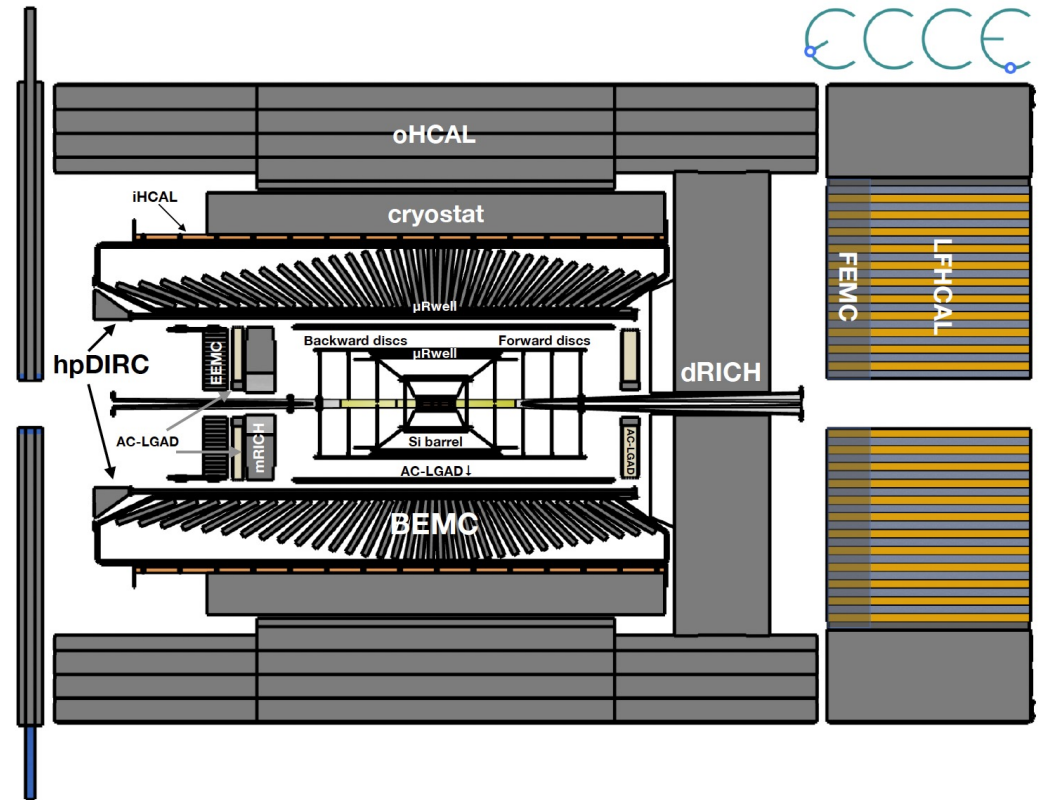
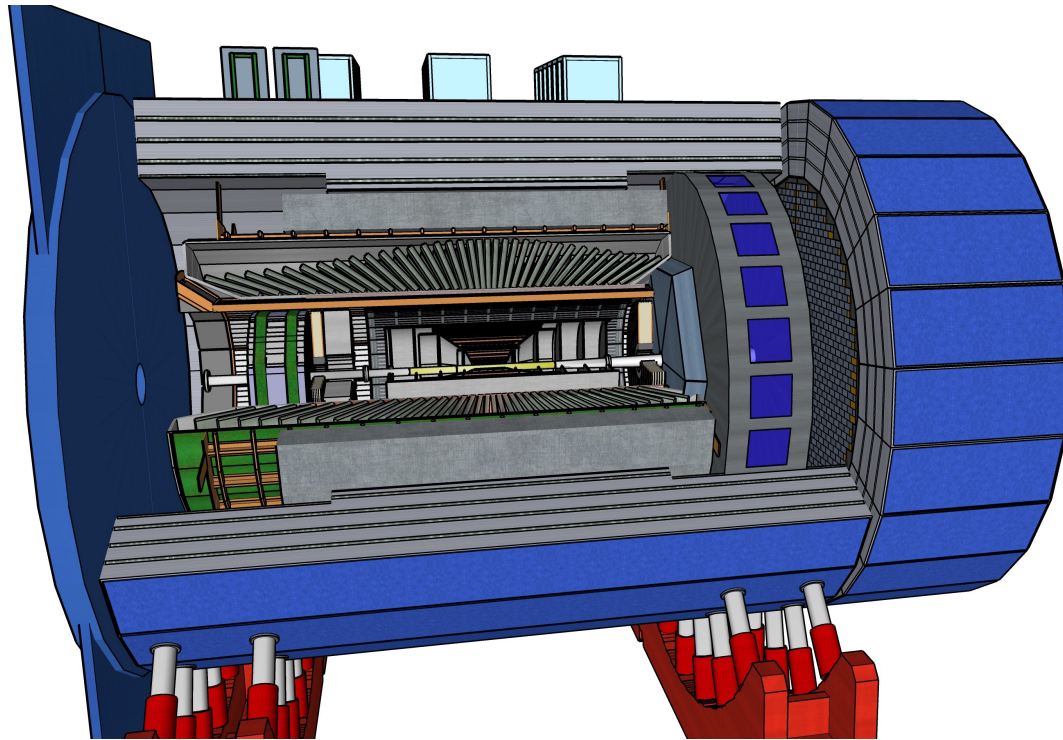
Brookhaven National Laboratory, Long Island, USA



Who's involved?

- Large international proto-“collaborations”
 - Mainly based around capabilities e.g. calorimetry, tracking,...
 - Recently ECCE was chosen as the base detector design by BNL review committee.
 - However tracking/vertexing is basically the same for all detector designs.
- UK: Glasgow, Birmingham, Lancaster, York, Liverpool, Brunel, STFC TD and PPD.
- UK has a £2.7M Infrastructure grant (Oct-21 – Mar-24)
 - **WP1: 65nm MAPS for tracking and vertexing, based on ALICE ITS3 sensor design**
 - WP 1.1: Sensor design (TD-RAL, Brunel)
 - WP 1.2: Sensor characterization (Birmingham, PPD)
 - WP 1.3: Modules and test systems (Liverpool, Lancaster, TD-DL)
 - WP 1.4: Detector Layout simulation (all)
 - **WP2: Timepix (Glasgow)**
 - **WP3: Polarimetry (York)**
- At RAL/Birmingham, we are also helping out with DC-DC and serial powering options using ATLAS expertise.
- RAL group: FFW + EiC PDRA (still hiring) + secret ATLAS person (DC-DC/serial power)

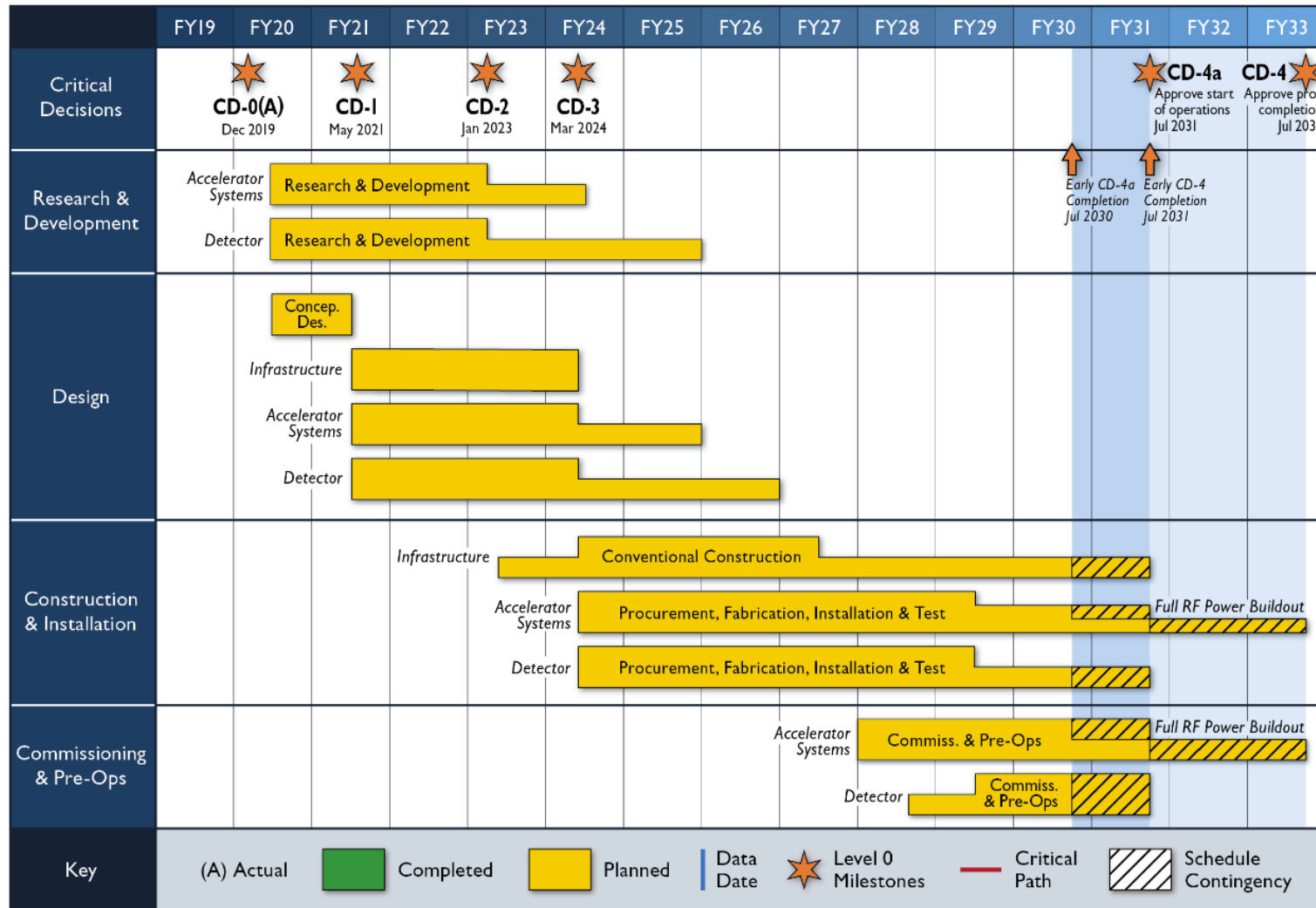
ECCE Detector



What's happening now

- Collaborations are forming.
- UK contributing (and co-leading) to tracking/vertexing design.
- UK contributing to DC-DC and serial powering options.
- Hope to convert this R&D phase into a construction project:
 - Potential to construct part of the tracking/vertexing at RAL.
 - ~\$7M project (1/3rd of a vertex detector)
- Construction due to start ~2024 (with a large pinch of salt).
- Operations due to start “early next decade”.

Plans for the future



March 2021 projection

Cost: ~\$2B

Only one detector in baseline but option for a second.