EIC Overview and UK Involvement

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University of York

UK Nuclear Physics Forum
07/07/26

- Overview of the Electron-Ion Collider and the ePIC Detector

Opening Cover Image - Brookhaven National Lab

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- Overview of the Electron-Ion Collider and the ePIC Detector
- UK EIC/ePIC Contributions

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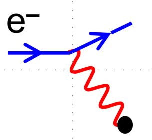
Borrowing heavily from many UK and ePIC colleagues throughout!

- From an uncertainty principle argument, resolving scale:

$$\Delta x \sim \frac{200\mathrm{MeV}}{E}\mathrm{fm}$$



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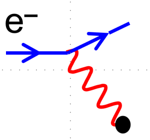

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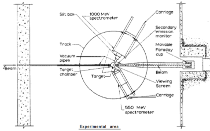

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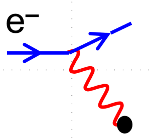

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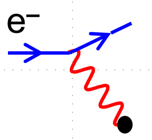

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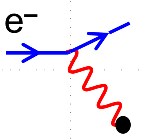

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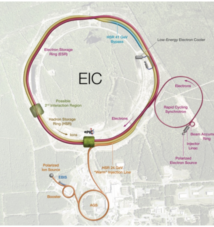
- 2030s: Electron-Ion Collider (EIC)...



Past, Present and Future *ep* (*eA*) Colliders

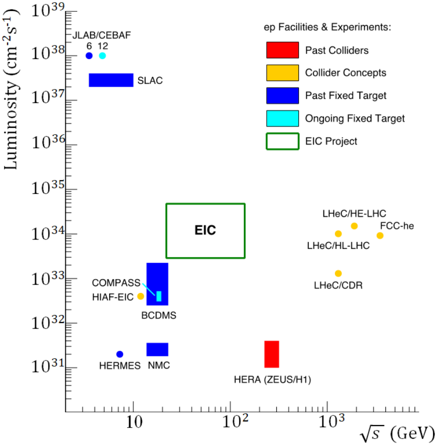


Image - A. Desphpande, modified

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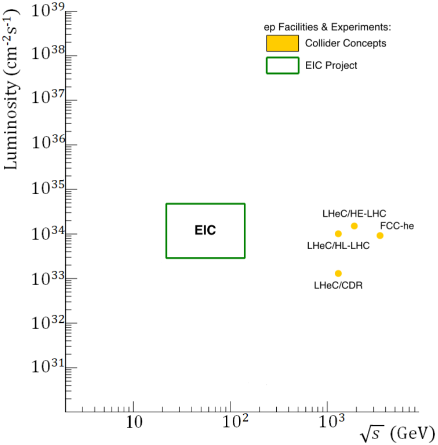

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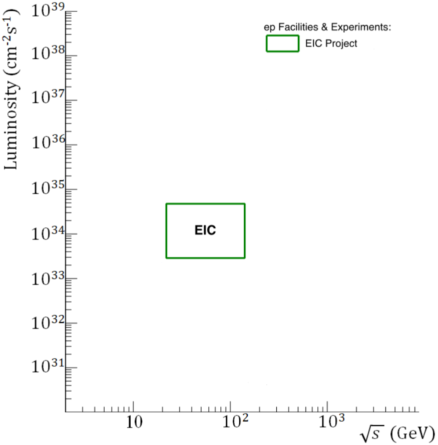

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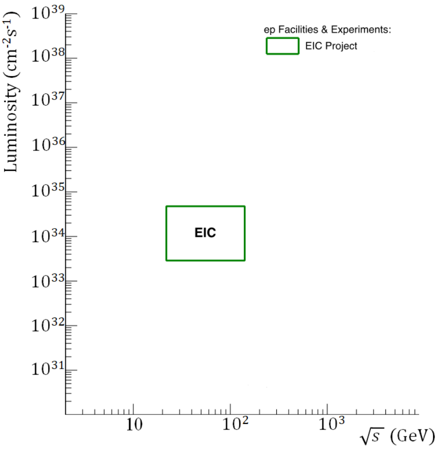

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- Only the EIC ticks all the boxes
- EIC is unique

Mapping Between Physics and Facilities

- Very crudely, can map between facilities and physics insights into the nucleon

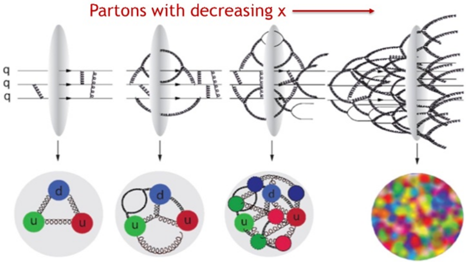

Image - Kong Tu, BNL, modified

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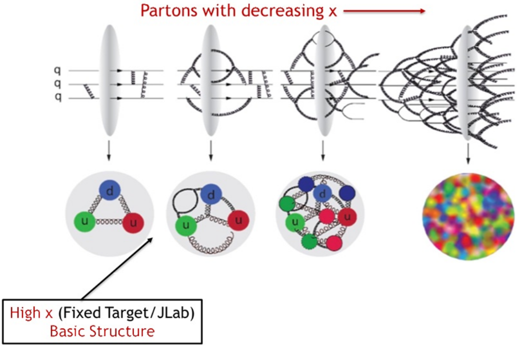

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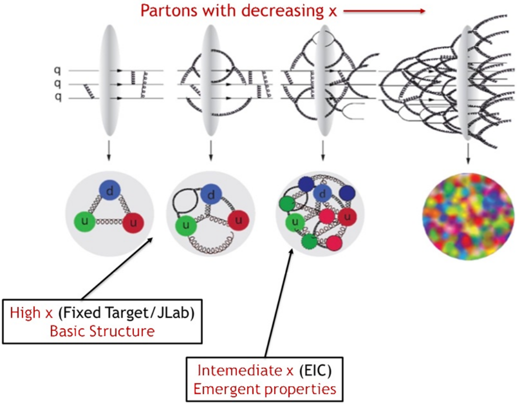

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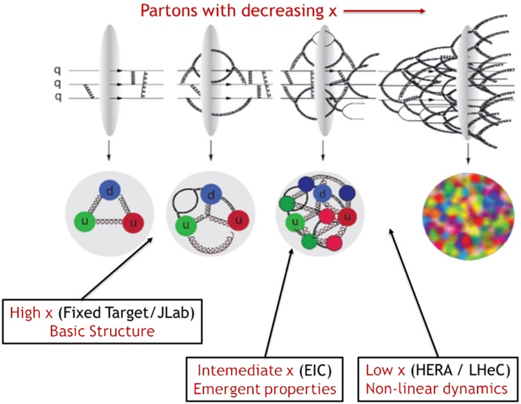

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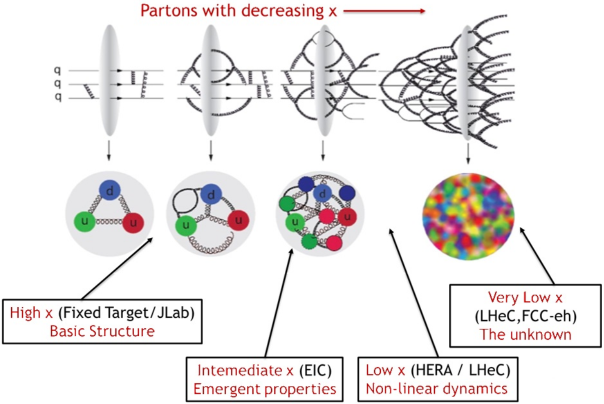

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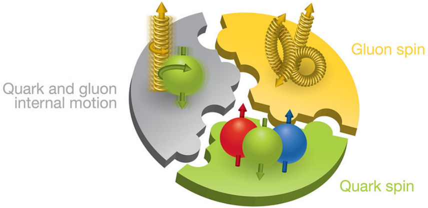

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- *How does the mass of the nucleon arise?*
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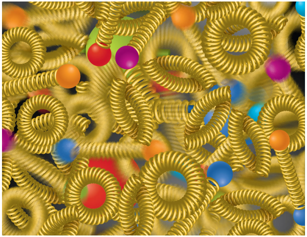
- *What are the emergent properties of dense systems of gluons?*



The Electron-Ion Collider (EIC)

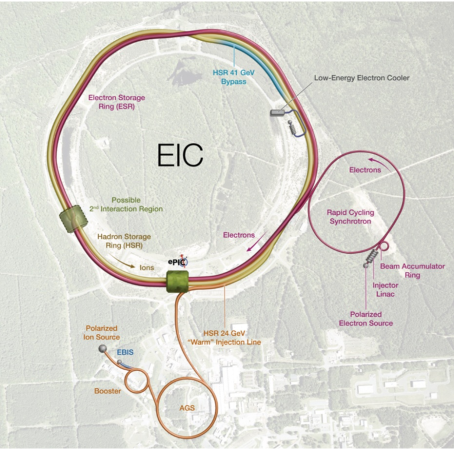


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Image - Brookhaven National Lab, modified

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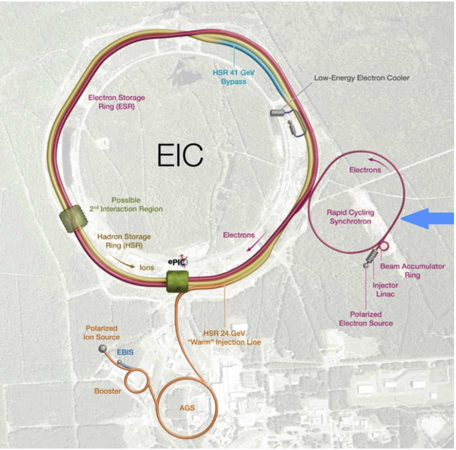

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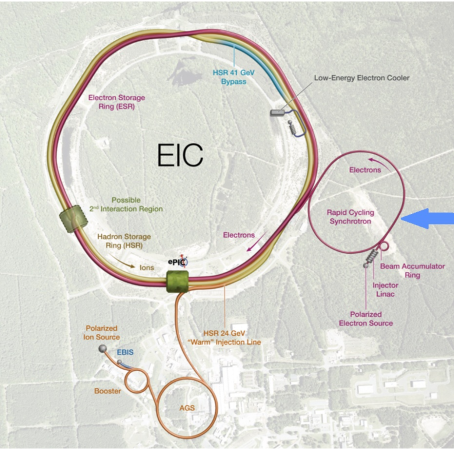

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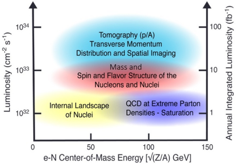
  - $28 < \sqrt{s} < 140 GeV$

Collider Specifications from Science



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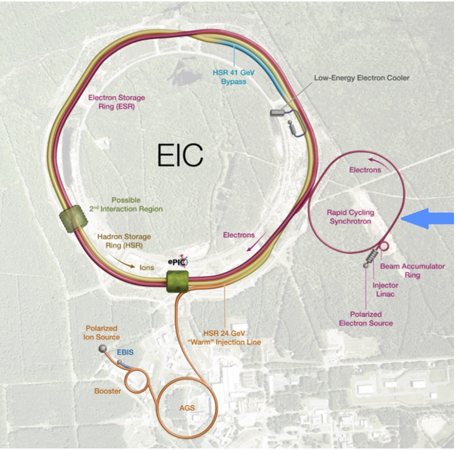

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  - Doubly-polarised, e^{-} and light A
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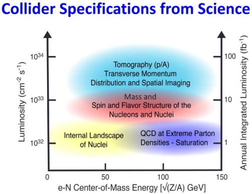

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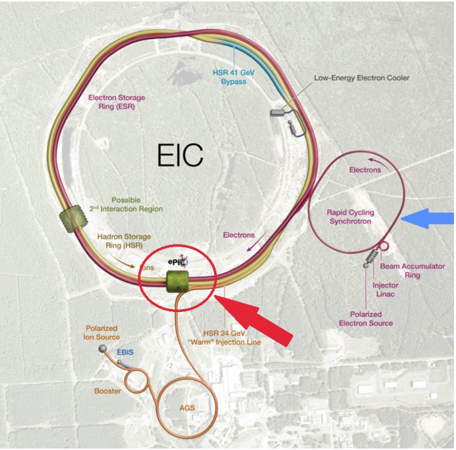

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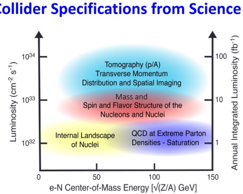
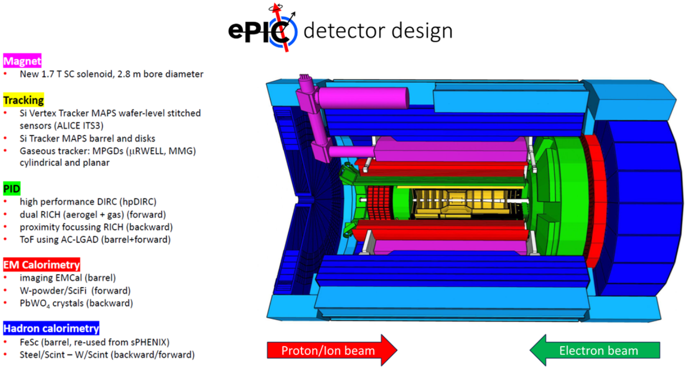
- Detector to cover broad science programme - ePIC



The ePIC Detector

- Electron-Proton/Ion Collider Experiment - **ePIC**
- General purpose hermetic detector with a central solenoid, asymmetric beams



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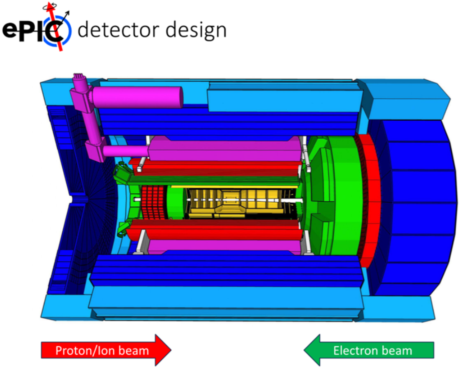
- Extensive far-forward (p/A direction) and far-backward (e direction) instrumentation too



Magnet
- New 1.7 T SC solenoid, 2.8 m bore diameter

Tracking
- Si Vertex Tracker MAPS wafer-level stitched sensors (ALICE ITS3)
- Si Tracker MAPS barrel and disks
- Gaseous tracker: MPGDs (μRWELL, MMG) cylindrical and planar

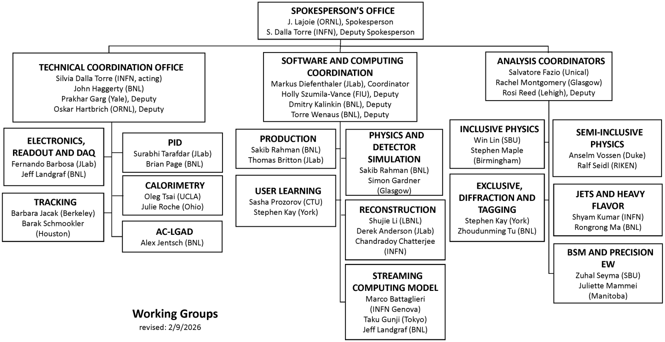
PID
- high performance DIRC (hpDIRC)
- dual RICH (aerogel + gas) (forward)
- proximity focussing RICH (backward)
- ToF using AC-LGAD (barrel+forward)

EM Calorimetry
- imaging EMCal (barrel)
- W-powder/SciFi (forward)
- $PbWO_4$ crystals (backward)

Hadron calorimetry
- FeSc (barrel, re-used from sPHENIX)
- Steel/Scint – W/Scint (backward/forward)

ePIC Structure and UK Leadership: Physics/Software

- UK leadership and expertise across the collaboration



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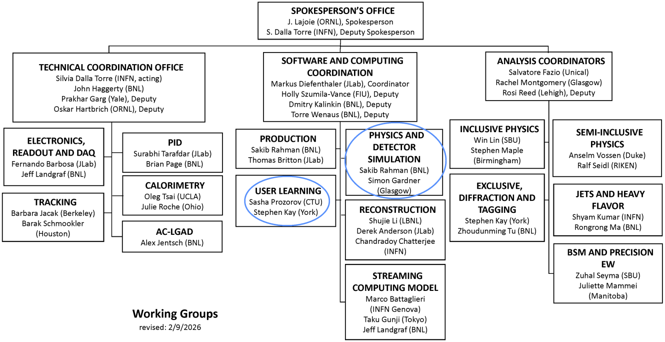

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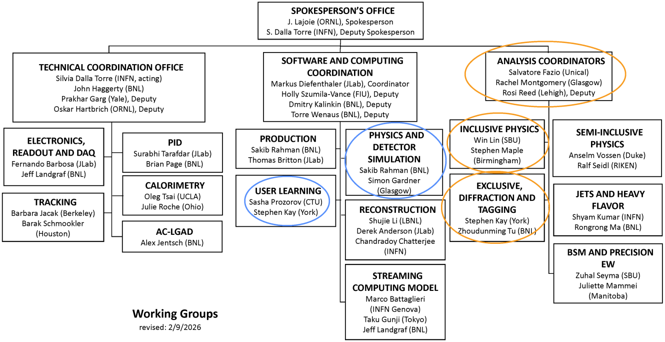

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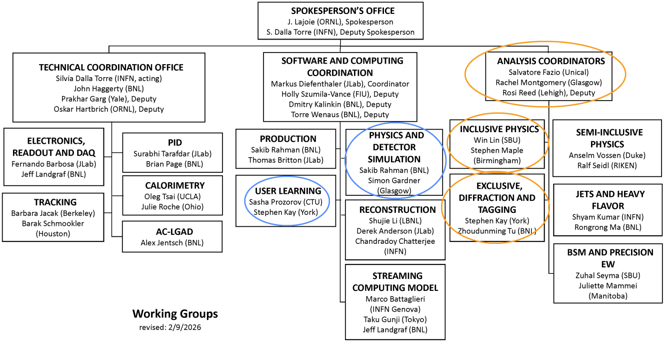
- Paul Newman and Rachel Montgomery on the ePIC collaboration Executive Board



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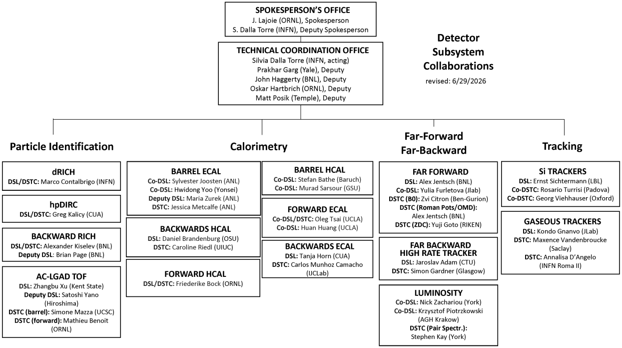

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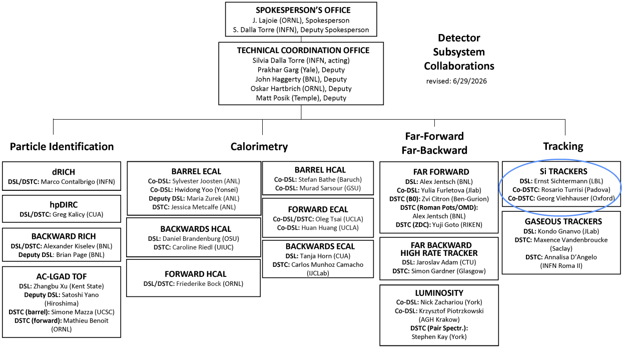

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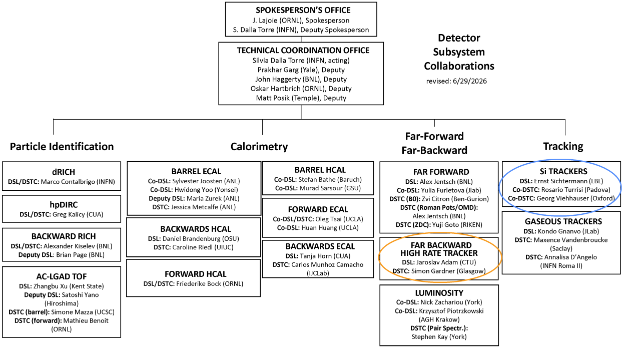

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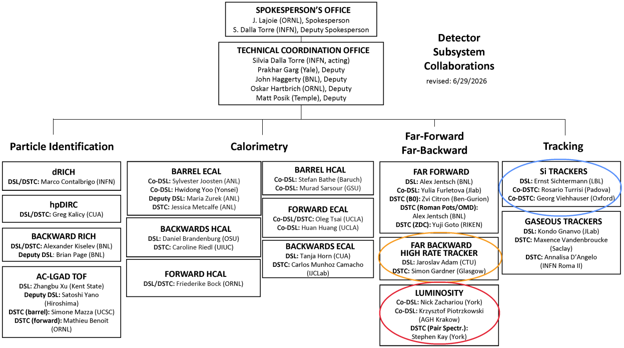

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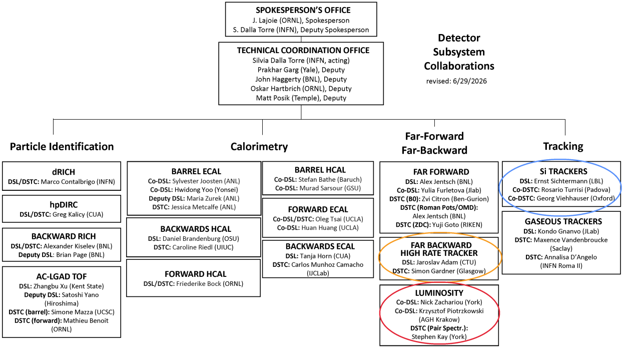

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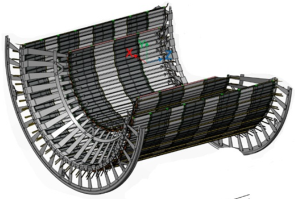

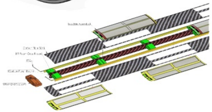

Images - J. Glover, University of Birmingham

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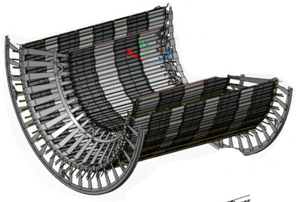
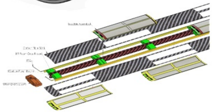
- Design, Construction, QA/QC, testing of:
    - Sensors and modules
    - Electrical interconnections, AKA flexible printed circuit
    - Stave (mechanical support structure)
    - Interfaces to the greater SVT and ePIC detector
    - Assembly procedures





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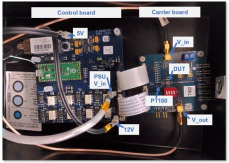

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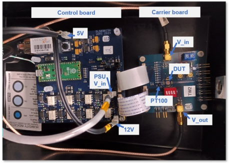

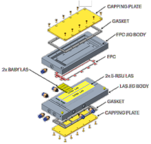

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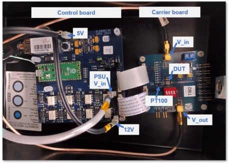
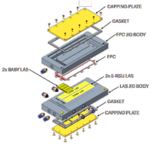
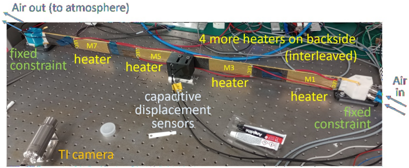
- Stave assembly and cooling tests







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Work Package 2: Electron Tagger (Glasgow)

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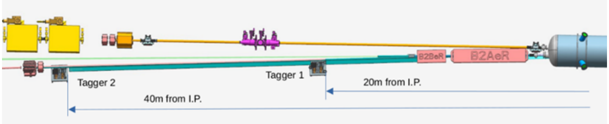
- Acceptance to $Q^2 \approx 0$, photoproduction physics



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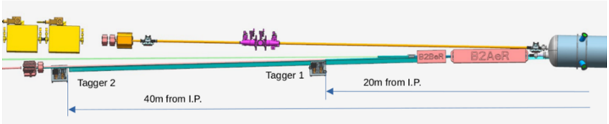
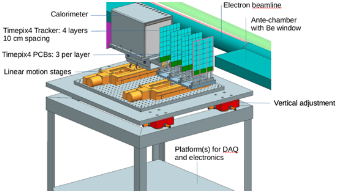
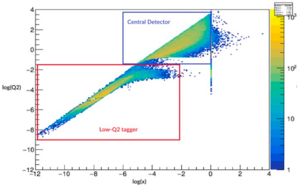


- Two tagger stations placed very close to e^- beamline





Images - K. Livingston, S. Gardner, University of Glasgow

Work Package 3: Luminosity Detectors (York)

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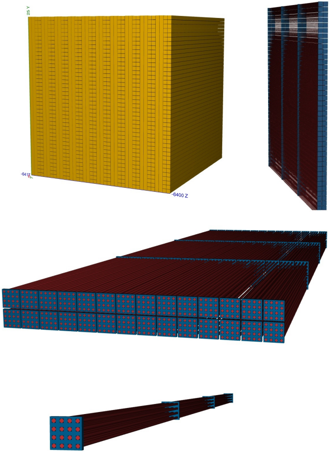

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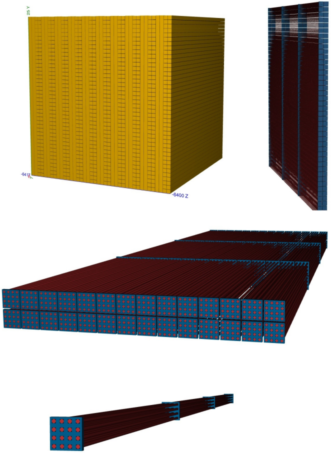

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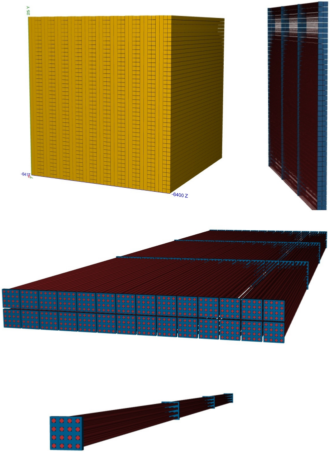

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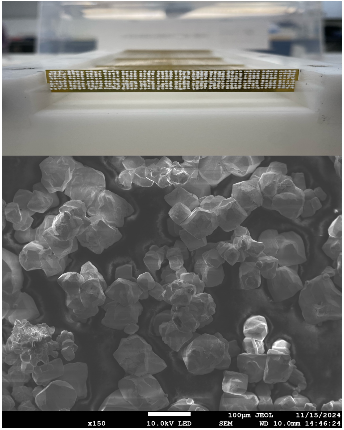

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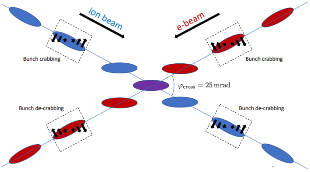
- Crabbing critical for high $\mathcal{L}$



Images - Borrowed from a presentation by D. Sokhan

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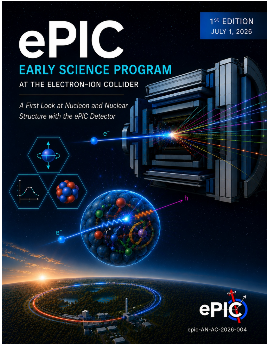

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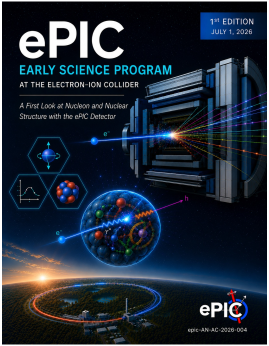
- Multiple workshops to drive this effort, including one at the IOP in Sept 25
- Many key studies which impact the 3 science pillars
- Public release imminent
- Further details and studies to follow in a NIM-A Special Issue later in the year



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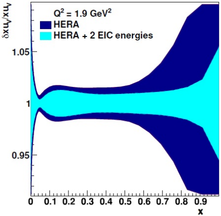

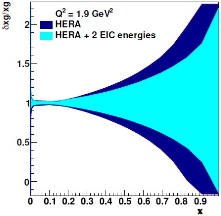

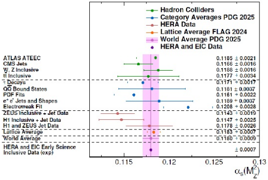

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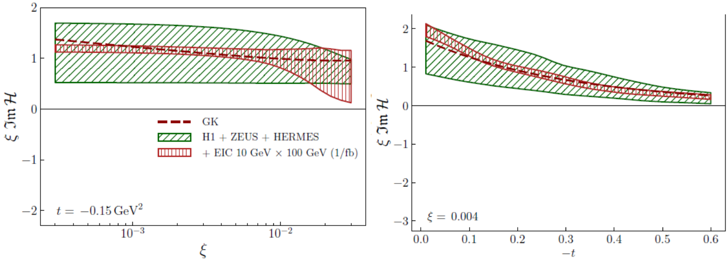

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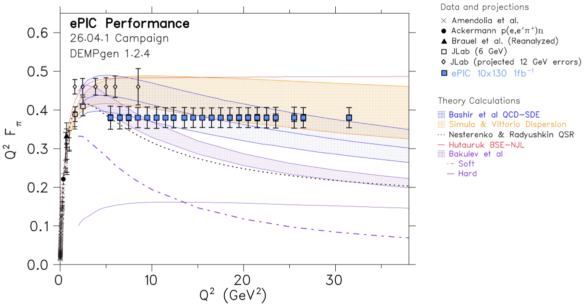
- DEMP, meson structure - S. Kay, York



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- Colleagues within the collaboration have emphasised that they see UK expertise and skills as <u>essential</u> to the delivery of hardware projects within the 4 work packages
- Many are integral to the operation of ePIC and the EIC

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- Exciting and revolutionary era of EIC physics on the horizon

Thanks for listening, any questions?

Daresbury Laboratory
Rutherford Appleton Laboratory

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