ADRIAN BEVAN

PPAP COMMUNITY MEETING, 20TH NOV 2020

COVERING COMMUNITY SUBMISSIONS FROM THESE 4 AREAS:

- NA62/KLEVER
- CMOS
- SHIP
- EDM

Queen Mary
University of London

NA62/KLEVER

- Rare decay sensitivities provide a window to BSM physics (indirectly up to ~100TeV mass scales).
  - K_L and K^+ measurements are complimentary; combining them can help elucidate the nature of any BSM physics discovered.
  - NA62 - focus on K^+ measurements continues (both SM and BSM)
  - KLEVER: Physics Beyond Collider proposal to study $K_L \to \pi^0 \nu\bar{\nu}$: measure BR to 20% precision and open the experimental window on ultra rare K_L decays.

- Builds on decades of UK leadership in the CERN Kaon programme for modest STFC investments.
  - UK involved from the outset of these programmes.

- A number of interesting technical challenges to be solved to realise the kaon facility upgrade; synergy with UK investment in other projects including the LHC and DUNE on DAQ.

NA62/KLEVER

- UK currently holds spokesperson, vice spokesperson, trigger coordinator and two analysis coordinator roles.

- UK group on NA62 is **Birmigham, Bristol, Glasgow, Lancaster**.

- Discussions underway with other groups about possibility to expand programme.

CMOS

- Historically CMOS MAPS technology has been a strength of UK R&D.
  - Some opportunities historically missed & others leveraged to great success.

- In 2016 had UK community support from 11 Universities, PPD and TD:

Birmingham, Bristol, Brunel, Glasgow, Lancaster, Liverpool, Manchester, Oxford, Sheffield, Queen Mary University London, The Open University, STFC PPD and TD

- Since 2016:
  - ALICE ITS upgrade has been completed; Phase 3 upgrade under consideration;
  - Mu3e HVMAPS tracker is underway, outer layer modules to be constructed in the UK;
  - LHCb Upgrade II proposal under consideration by PPRP, with a significant HR-CMOS detector component;
  - HV MAPS work being considered for the BNL e-ion collider;
  - Smaller R&D efforts funded by various means round the UK evidencing continued interest.

CMOS

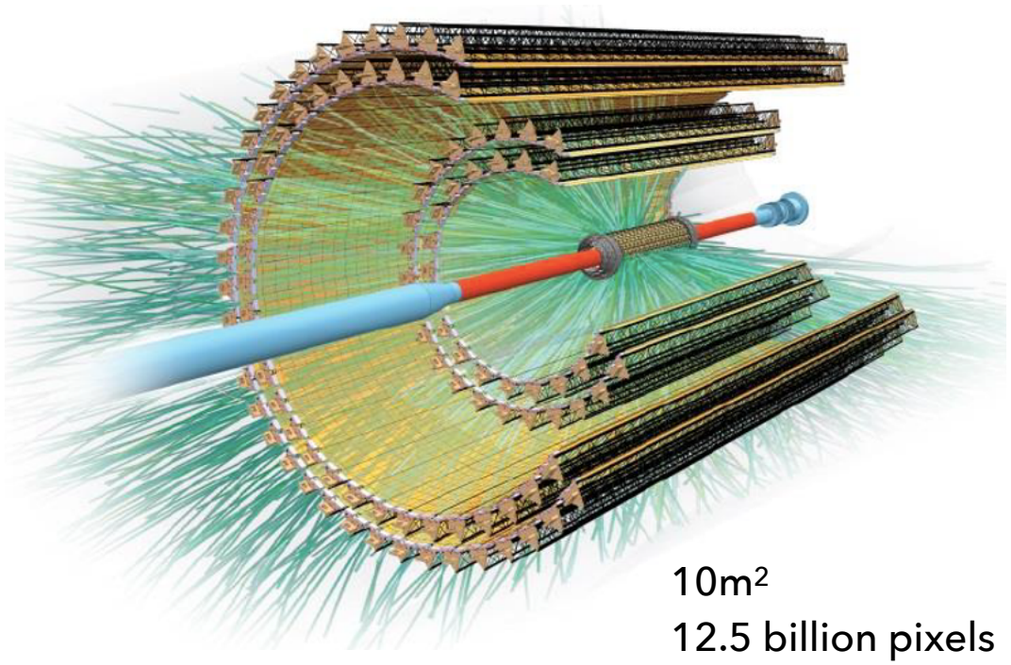
- Consensus remains that CMOS is the technology for the future for trackers and vertexing detectors.

- Significant potential for MAPS technology for future colliders:
  - Cheaper, scalable technology than other options (e.g. hybrid pixels, strips etc.);
  - UK has extensive instrument design expertise aligned with future collider opportunities;
  - Interest in moving to 65nm technology;
  - Huge potential to leverage innovations in this area.

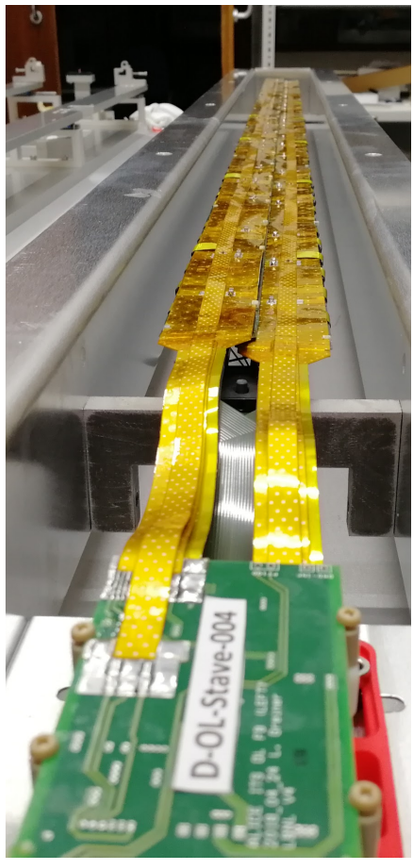
CMOS: ALICE INNER TRACKING SYSTEM (ITS)

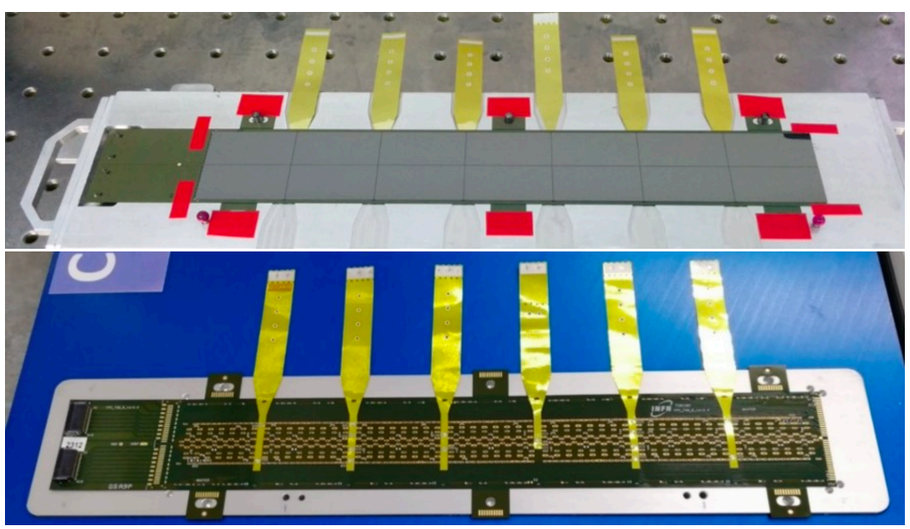
ALICE UK: **Birmingham, Liverpool, Lancaster, Daresbury**

- UK plays an important role in the ITS: Liverpool, Daresbury (TD)



$10m^2$
12.5 billion pixels
$<40mW / cm^2$





- Modules assembled at Liverpool, staves assembled at Daresbury, final assembly at CERN.
- UK contribution very highly regarded within the ALICE Collaboration.
- Current status - ITS fully assembled and taking cosmics on the surface at CERN through December 2020.

CMOS

- Technology targeting both next generation intensity and energy frontier projects.

- R&D required to improve radiation hardness toward 10^{18} n/cm^2.

- Timing requirements targeting ~100ps scale.

- Granularity requirements for the future ~1-5μm.

- Ultimately targeting epi-layer thicknesses ~20μm for detectors.

Note that there is a separate technology roadmapping exercise about to start via the Particle Physics Technology Advisory Panel (PPTAP). The first meeting of the PPTAP will be soon.

SHIP

- Physics goals: BSM searches (Hidden Sector), as well as high intensity source for other particle measurements.

- 5 UK groups interested in this project: **Bristol, Imperial, RAL, UCL, Warwick**.

- UK holds leadership positions even with modest support: spokesperson (Golutvin) and convenor of the muon shield project, critical for the beam dump facility for this experiment.

- UK community focusing on understanding backgrounds and detector layout studies.

- The magnets and muon shield offer opportunities for UK industry.

EDM

- Sensitive BSM probe related to possible new sources of CP violation:
  - Indirect probe of energy scales to ~30TeV;
  - New generation of experiments expected to push limits by x100;
  - Win-win scenario: find an EDM at this level of sensitivity, or major re-think of theory to accommodate a null result.

- UK leadership in this area has been maintained for a long time.

- Currently 9 academics at 5 institutes named on a letter of support for EDM measurements: **Imperial, Liverpool, RAL-PPD, Sussex, UCL**.

EDM

- UK expertise in:
  - Ultracold molecules for eEDM measurements; Only running expt. outside of US, with an upgrade planned targeting 10^5 times colder than prev. expts.;
  - Ultracold neutrons for nEDM measurements;
  - Deep understanding of systematic effects related to these measurements.
- UK interest in next generation of experiments, and storage rings for measuring the EDMs of charged particles such as the proton and muon.
- Strong links to quantum technology.
- Opportunity for the UK to punch above its weight given this expertise.
- Low cost, high gain/risk experiment.