

### **Cockcroft Collaboration**

Will Butcher, Narender Kumar, Milaan Patel, Ondrej Sedlacek, Oliver Stringer, Alex Webber-Date, Hao Zhang and Carsten P Welsch



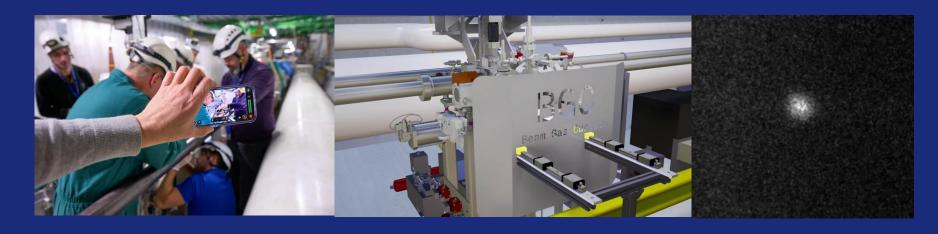
### Status of the collaboration

We need a group photo!

- What a year!! Integration in LHC, animation, measurements with protons and lead ions, invited talk at IBIC. WOW!!
- Annual feedback from CI Scientific Advisory Committee (11/2023):
  - SAC congratulates CI on the very successful HL-LHC phase 2 such as the delivery (...) of the gas jet monitor.
  - SAC encourages CI to request funding to continue the CI achievements of HL-LHC phase 2 into the commissioning/operational phase.



# Major milestone reached



- Gas jet monitor successfully installed in the Large Hadron Collider.
- Fantastic work by all involved very emotional moment ☺
- Successful measurements with both, proton and lead ion beams (above)...paper/s in preparation.



## Quantum Helium Atom Microscope





- Quantum technologies showcase
- Great work by Sandy,
  Constantinos and Narender
- Maybe opportunity also in CERN's quantum initiative?



### IPAC23





- 'Optical transition radiation measurements of a high intensity low energy hollow electron beam on electron beam test facility', O. Sedlacek, et al.
- 'Optimization of a gas jet-based beam profile monitor for high intensity electron beams', O. Stringer, et al.
- 'Imaging a high-power hollow electron beam non-invasively with a gas-jet-based beam profile monitor', H. Zhang, et al.
- 'Development and testing of quantum gas jet beam profile scanner', N. Kumar, et al.
- 'Characterization and analysis of supersonic gas jets using interferometric measurement methods', A. Webber-Date, et al.



## Planned journal articles

### From 2022 plans:

- "A gas curtain beam profile monitor using beam induced fluorescence for high intensity charged particle beams", Appl. Phys. Lett. 120, 174101 (2022)
- "Characterization of a supersonic molecular beam for charged particle beam profile monitoring", Vacuum 208 (2023) 111701

#### **Submitted:**

• "Beam Gas Curtain monitor Phase II: vacuum studies for LHC integration and operation", Phys Rev AB (2023)

#### **Planned:**

- Simulation and experimental studies into a supersonic gas jet curtain for beam profile monitoring, in preparation for Vacuum or Nucl Instr Meth A (delayed,...needs more data @ CI)
- EBTS results @ COOL23 now expand to full article in Nucl Instr Meth A or Rev Sci Instr?
- Measurements at 7 TeV with protons and lead ions PRL or PRX
- V3 with full technical details Phys Rev AB (Ondrej's thesis!)
- Cross section measurements Phys Rev C?
- Gas jet applications: Microscopy, medical accelerators (DCF), plasma targets, nozzle-skimmer optimization, simulations,...



## Planned conference papers

- IPAC24 (will have an industry booth!)
  - Gas Jet Based Beam Profile Monitor for the Electron-Beam Test Stand at CERN
  - First measurement of the LHC proton and lead ion beam profiles using the beam gas curtain monitor
- IBIC24
  - Systematic study into LHC proton and lead ion beam profile measurements using the beam gas curtain monitor
- HLLHC Meeting presentations across full range of studies to date
- IBIC25 (Liverpool)
  - We hope you can all come and join us! ☺





## Funding successes

- HLLHC-UK phase I, STFC PPRP, £185k + CI + CERN
- HLLHC-UK phase II, STFC PPRP, £766k + CI matching funding
- Quantumjet STFC IPS project, £110k
- qHAM Helium atom microscope, Innovate UK, £50k
- JetDose in-vivo dosimetry, STFC CLASP, £330k



## **Funding plans**

- Gas jet R&D should be part of Cockcroft Institute Core Grant proposal
- In discussion with STFC on HLLHC phase III (exploitation)
- FCC/EIC/ESS/etc
- Medical applications: Online dosimetry and LhARA
- Quantum scanner and microscope
- Simulations HPC



### Recruitment

- Postdoc will start on 1 January 2024 with focus on simulations, ML/AI: Dr Qi Ding
- EuPRAXIA-DN Fellow will start 1 January 2024: Farhana Thesi MP
- Additional 2-year Postdoc is being recruited, advert out with deadline on 7 January 2024 (https://bit.ly/3sEPRjR)
- Additional PhD student to start in 2024 between ULIV and CERN within LIV.INNO framework (2+2) (https://shorturl.at/knqYZ)



### **Summary & outlook**

- What an amazing and eventful year!! Many thanks to everyone for the fantastic collaboration.
- Team keeps growing please give a warm welcome to our new starters!
- Publications now in focus:
  Journals and conferences
- Plans in place for additional funding to secure continuation
- Need to discuss and agree future use and program



