



HL-LHC-UK Gas Jet Collaboration Meeting

Carsten P Welsch

STFC Award

- Almost 1 M£ for delivery of two gas jets to CERN, supported by project grant and (upcoming) CI core grant
- Additional funding being applied for to support work on FZP, medical applications, etc – diversifying the program and making best use of hardware

HLLHC UK - II

- Collaboration agreement
 - Phase I being finalized, issues around some other contributions, delaying project end (and payments)
 - Phase II delayed because of COVID and phase I – should not be any issue for us
- Currently on hold, target is March 2021
 - *“contracts and legal team resource focussed on Phase 1 amendments”*
 - *“Need acceptance criteria for all Work Packages approved, and we are still working on WP1, 2, 4 and 5.”*

HLLHC UK - II

WP3.2 Acceptance Criteria ([EDMS 2369616](#)) is approved **which is great progress.**

The UK Deliverable dates below are also agreed and there were no delays due to Covid-19 (so far).

T Jones, STFC

Deliverable Number	Deliverable Description	Complete by	Type
D3.2.1	Get-jet monitor engineering design: report that shows proposed design fits specification and can be built	31/12/21	Document
D3.2.2	Final design: report with final drawing, integration, costs production and commissioning plan	30/09/22	Document
D3.2.3	Delivery of interaction chambers for integration in Hollow Electron Lens build-up	31/03/23	Hardware
D3.2.4	Delivery of gas-curtain monitor unit 1, pre-tested at the Cockcroft Institute, for integration in Hollow Electron Lens and testing, participation in commissioning tests	31/03/24	Hardware
D3.2.5	Delivery of gas-curtain monitor unit 2 for integration at CERN, pre-tested at the Cockcroft Institute	31/12/24	Hardware

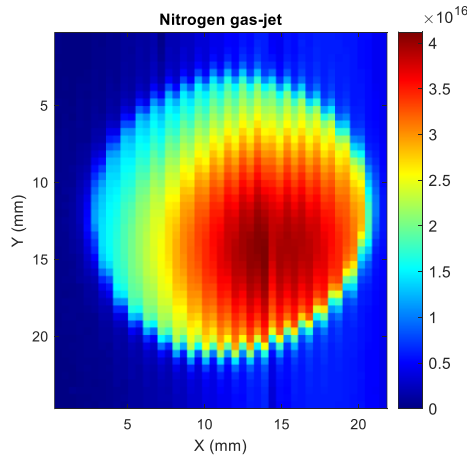
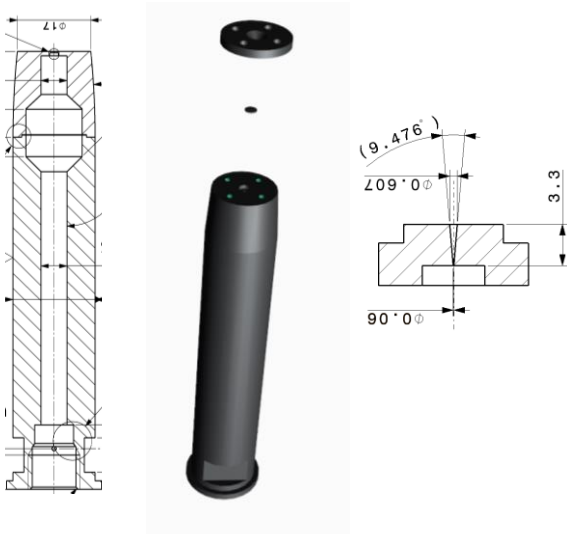
HL-UK Task 3.2 - Gas Curtain Monitor

- Milestones
 - Milestone M3.4 (2017)
 - Installation of a gas-jet monitor on the Cockcroft e-beam test stand
 - Comparative Beam Induced Fluorescence and Ionisation Profile Monitor measurements
 - Milestone M3.5 (2018)
 - Mechanical design of HL-LHC prototype for Cockcroft
 - Milestone M3.6 (2019)
 - HL-LHC prototype gas-jet monitor available for testing at Cockcroft
- Deliverables
 - Deliverable D3.6 (2017)
 - Gas jet available for testing at Cockcroft
 - Deliverable D3.7 (2018)
 - Design report for HL-LHC gas-jet monitor
 - Deliverable D3.8 (March 2020)
 - Full prototype adapted for testing in the LHC – ON TRACK
 - Collaboration meeting organized for March to complete formal HL-UK1 collaboration
- CERN Contribution
 - Preparation of LHC infrastructure
 - Vacuum sectorisation & cabling complete
 - Interaction chamber being prepared for installation during LS2
 - Full gas-jet prototype foreseen for installation in YETS 21/22
 - Preparation of CERN e-beam Test Bench
 - Integration studies for gas-jet assembly ongoing
 - Will be used to qualify gas-jet performance & vacuum controls in 2020/21

Highlight - experiment

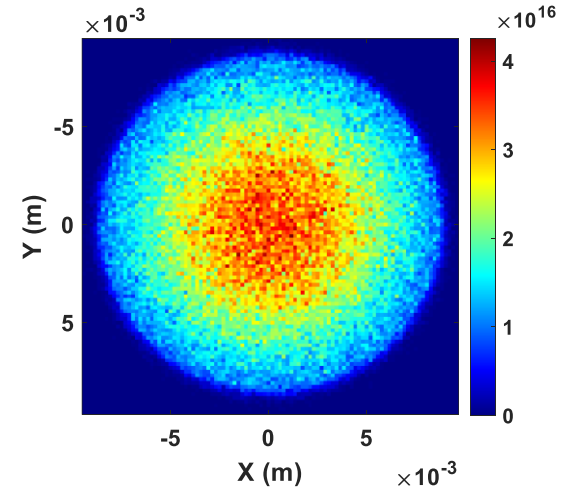
Validation of larger jet with higher density is possible through different skimmer design

Different nozzle tests to confirm the current design of $30\ \mu\text{m}$



Measured gas jet distribution at 286 mm from nozzle

Developed a fast Monte Carlo simulation code to validate the jet density



Simulated gas jet distribution at 286 mm from nozzle

Highlight - procurement

- Most parts already delivered 😊



Gas injection chamber

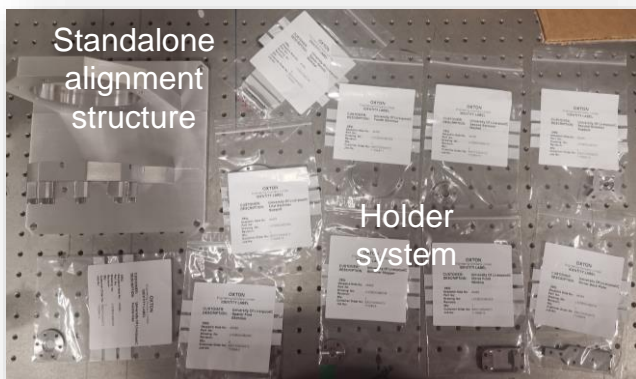


interaction chamber



Gauges and valves

Imaging system



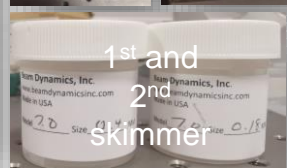
Standalone alignment structure

Holder system



Laser alignment camera holder

Two Basler CMOS cameras



1st and 2nd skimmer



Pumping system



Pumping system

Plan and milestones

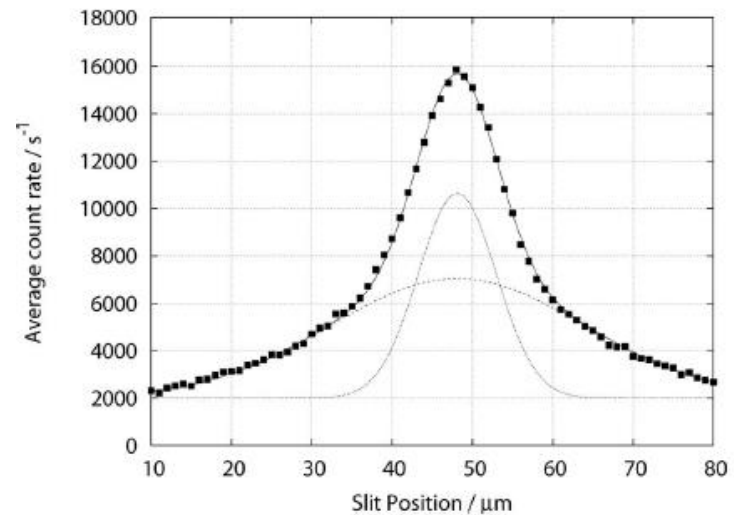
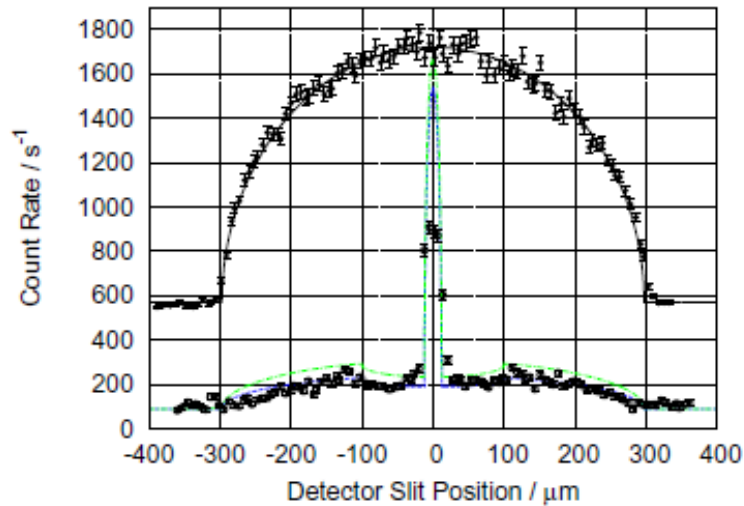
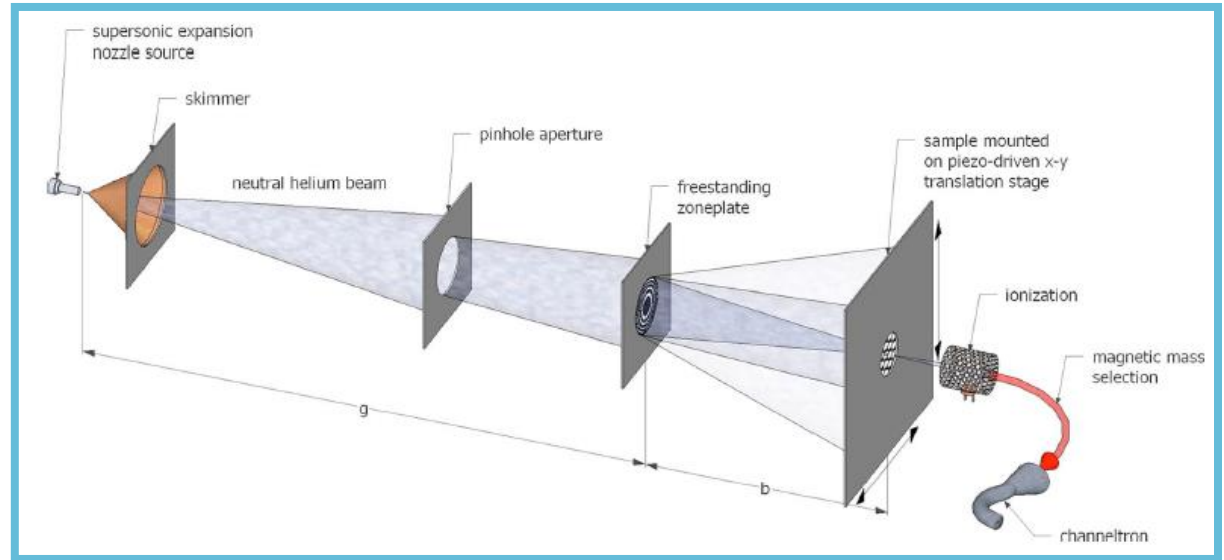
1. Chamber inspection. Dec 2020 – Jan 2021
2. Assemble the system and vacuum test without baking. Jan 2021.
3. Gas jet quantification. Feb 2021.
4. Measurement with lab electron beam. March 2021.
5. Report on performance and ship preparation. April 2021.
6. Devices at CERN and will be installed in HEL test stand. May 2021

LITERATURE ON FZP BASED QUANTUM GAS JET

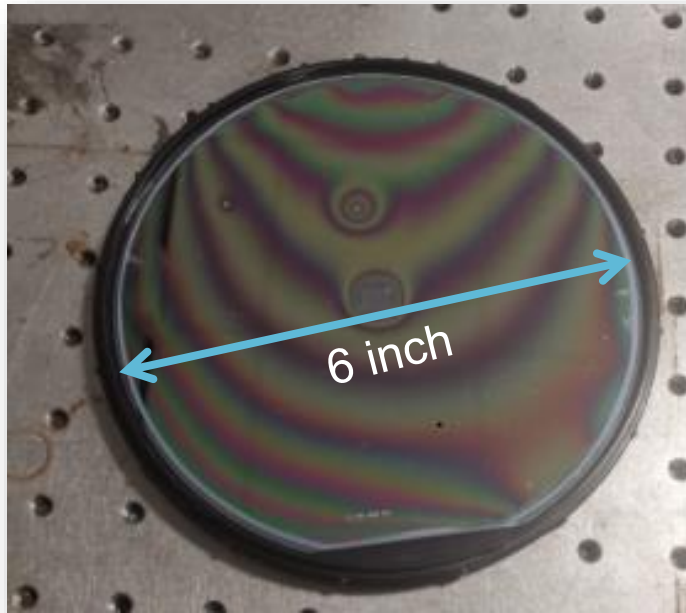
Bergen University

Supersonic D_2 beam focused down to $15.2 \pm 0.5 \mu\text{m}$.

Helium beam focused to diameter less than $1 \mu\text{m}$



Current status



Fresnel Zone Plate on Si wafer of ~150 mm diameter



2 Fresnel Zone Plates of size
~23 mm x 23 mm

Shall be tested in version2 setup at Cl.

Cockcroft Team

- Carsten Welsch
- Oznur Apsimon
- Hao Zhang (*)
- Narender Kumar

- Amir Salehilashkajani
- Ondrej Sedlacek (*HEL*)
- Luana Parsons Franca (*SEM*)
- Bethany Spear
- New PhD, starting 10/2021 (*)

Publication plans

- No IPAC conference proceedings in 2021 – target journals to get results into community
- PRL in preparation, APL as alternative option
 - BGC experiment with nitrogen, neon and argon
 - LHC residual gas test
- PRAB and NIM papers already in preparation and needed for thesis completion (Amir)
 - Gas jet density quantification method and measurement
 - Gas jet geometry simulation and validation
 - v3 device and HEL test

Outlook for HL-LHC-UK2

- Continue our close and excellent collaboration;
- Build working devices and push the limits of the technology further, considering other applications and improving understanding
- Work on both, LHC and HEL prototypes – going well beyond original plans

We look forward to it!