Potential improvements for the Gas Jet 2D mapping using the Moving Gauge

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Overview

- Actual situation
- Precision of the multi-axis actuator positioning
- Speed and acceleration of the stepper motor
- Precision of the moving gauge and digitization
- Reaching higher pressure in the jet.

Data presented on the BGC workshop by Amir

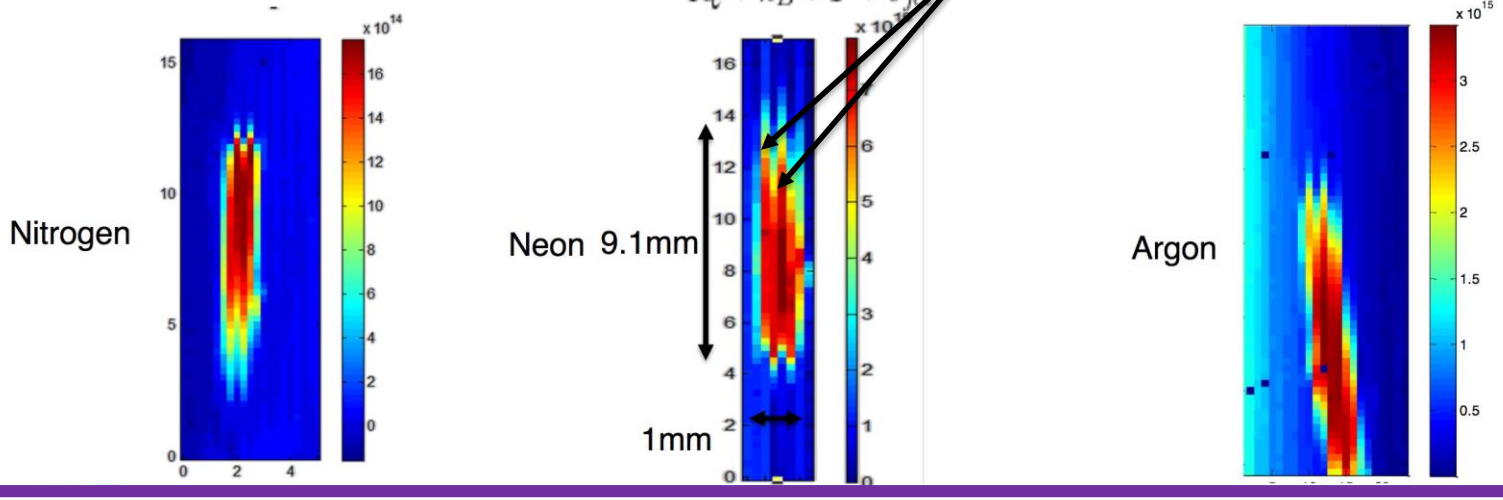
Density measurements with the pin-hole gauge

- A scan was taken using the pin-hole opening for nitrogen, neon and argon under similar experimental conditions. (30 micron nozzle at the optimum nozzle-skimmer distance and the third skimmer set vertically).

Backlash or Gauge inertia effect ?

- Density measured by :

$$\rho = \frac{\frac{I_{ion}}{I_e} * S * < v >}{4Q * k_B * T * v_{jet}}$$



How to improve on this measurement technique?

Spatial position of the gauge / Resolution of Gauge

Multi-Axis Actuator bottleneck

I have been **extensively using the exact same actuator** to move a 50um ODR slit target with respect to a 1um electron beam in ATF2-KEK.

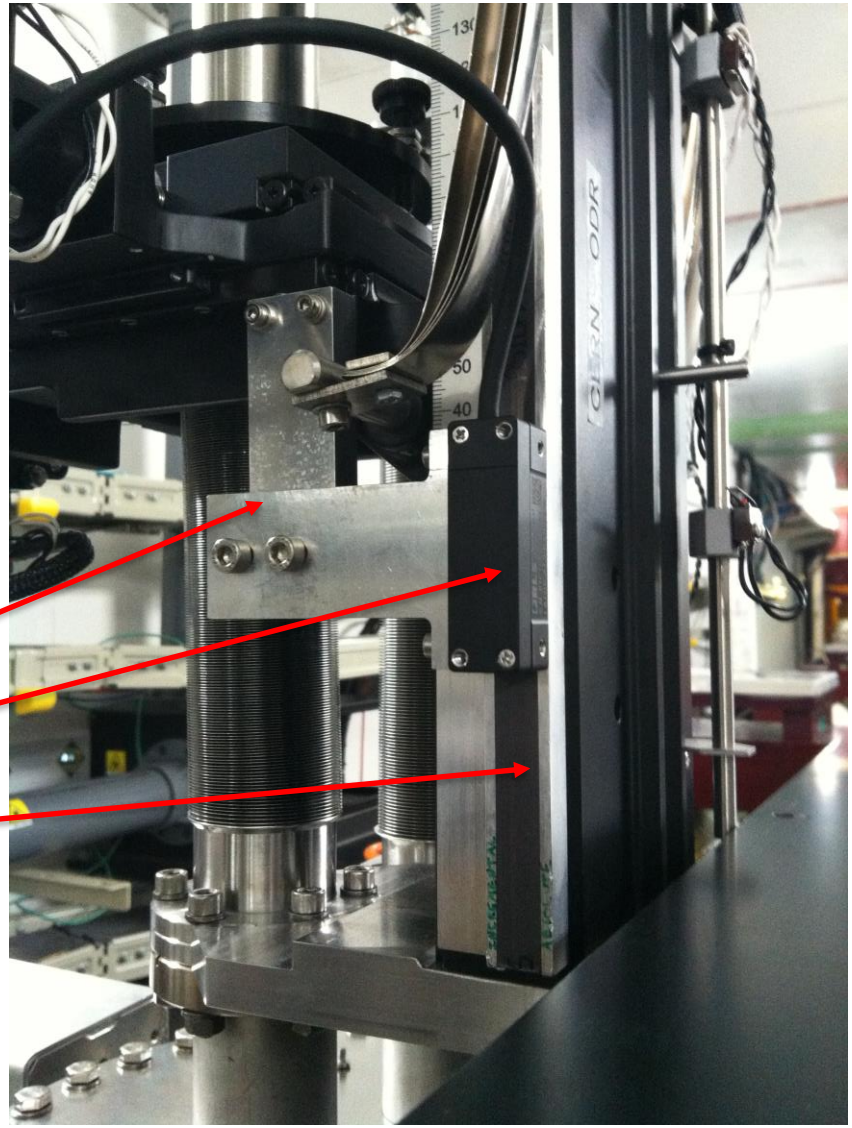
We quickly found a **mechanical backlash** on this actuator and decided to install **magnetic encoders(1um precision)** on it to overcome the problem.

Only with this add we where able to move the target repeatedly within micron accuracy.

System as installed in ATF on the same mover

Encoder LA11 from Renishaw RLS

Full 1 axis kit with USB encoder costs 650 CHF



Mechanical Support

Magnetic encoder

Magnetic pole strip

For gas jet a 2D axis kit with USB encoder and mechanics : 2000 CHF

Manipulator movement

During the visit in the Cockcroft lab, the actuator have been moved quick to show us the gauge.

Looking by the view port I have noticed a **pendulum** behavior of the gauge over few millimeter **that was few minutes after the move** !

Amir told me that he only performs small steps moves to reduce pendulum oscillation during a 2D scan.

That's helping but I think that a careful control of the **stepper acceleration/deceleration** would also help to reduce further this oscillation. (High speed small steps can be bad)

A better **stiffness** of the **manipulator mechanics** would also help to reduce this great source of uncertainty.

Gauge and digitization of the signal

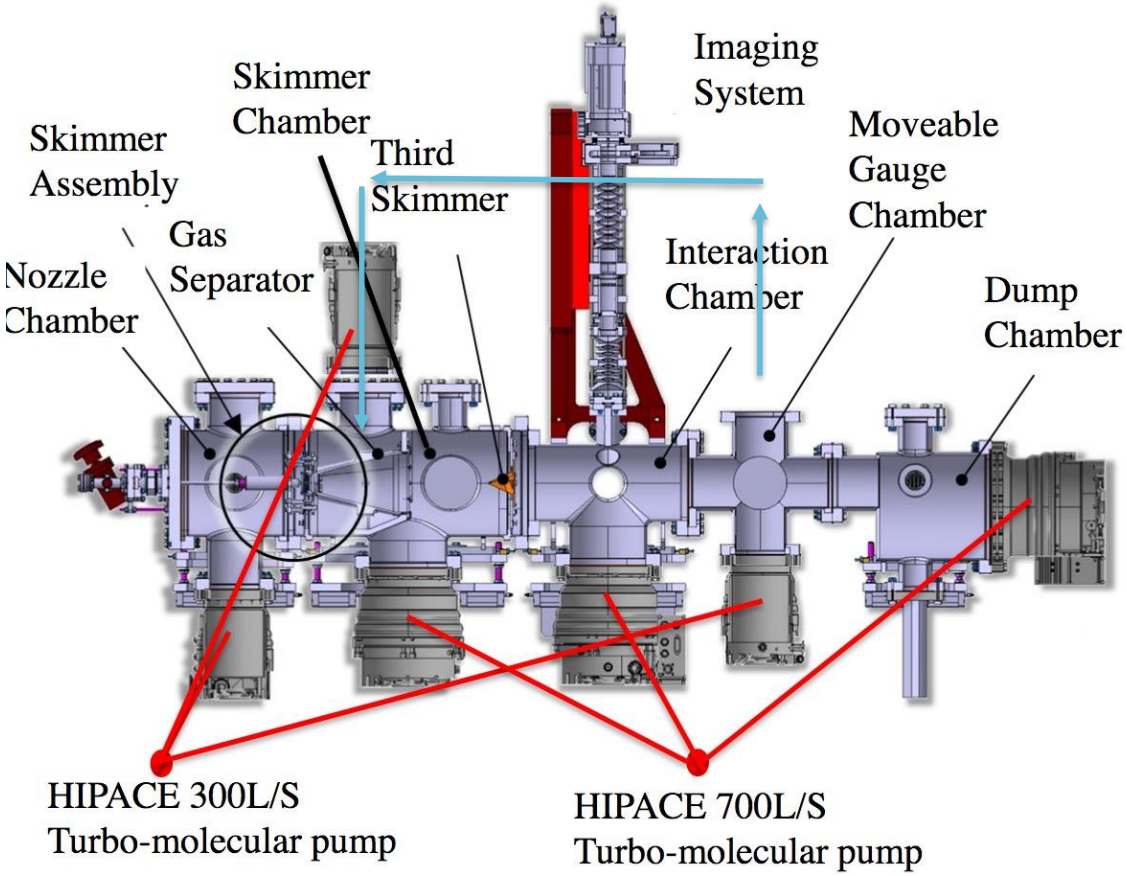
Few questions from my side

- What is the exact gauge model ?
- Could the moving gauge volume be smaller?
- Does it lead to more fluctuations at the expense of a faster scan capability?
- Can we improve on the sensor itself and the system used for signal processing? (I have noticed old equipment with partially broken cable shielding)
- If yes: can we gain in map precision if we use a more accurate digitizer for the gauge signal?

Can we reach higher pressure for the BGV gas jet

First check just after the second skimmer

The idea would be to move the *Moveable Gauge Manipulator* on the *Skimmer Chamber* as shown with the blue arrows.



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Next actions for the BGV gas jet

The possibility of getting to higher pressure within the jet just after the second skimmer is something essential which could be tested on the actual setup (to be seen when).

A robust and precise measurement of the gas jet pressure profile is a key aspect for the BGV.

As a first step, I could help upgrading the scanning gauge system by purchasing adapted encoders, and using existing software that I developed to read these sensors.