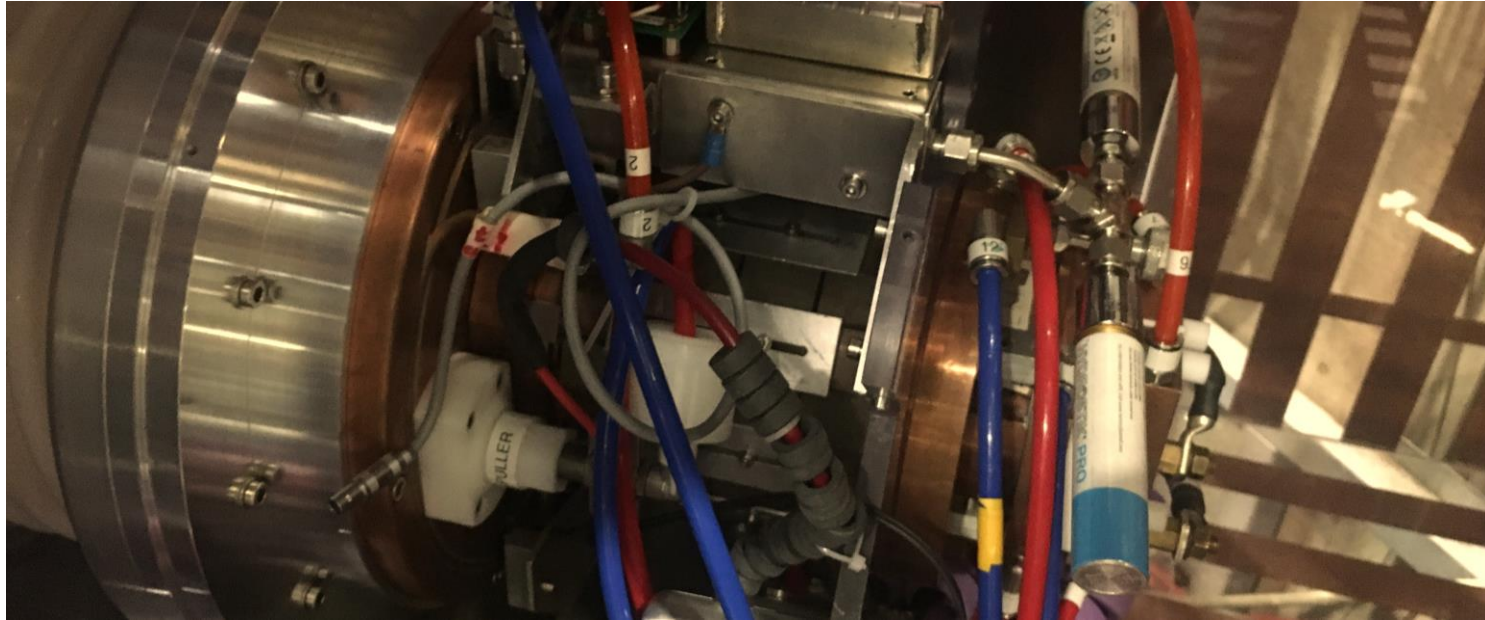


ELENA Source Charging Up status and plans



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- Just a few slides with pictures and previous observations

Summary of source investigation



From logbook of 14 Jan 2021

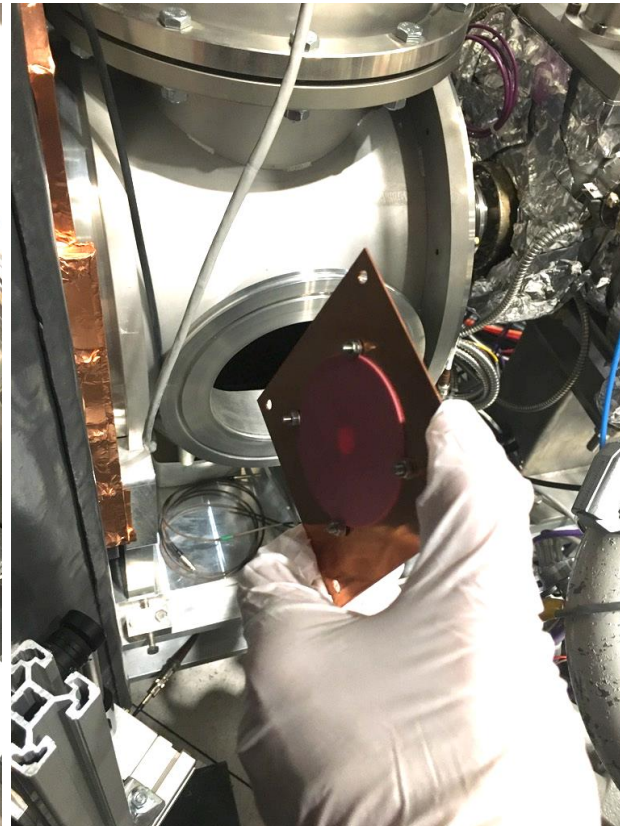
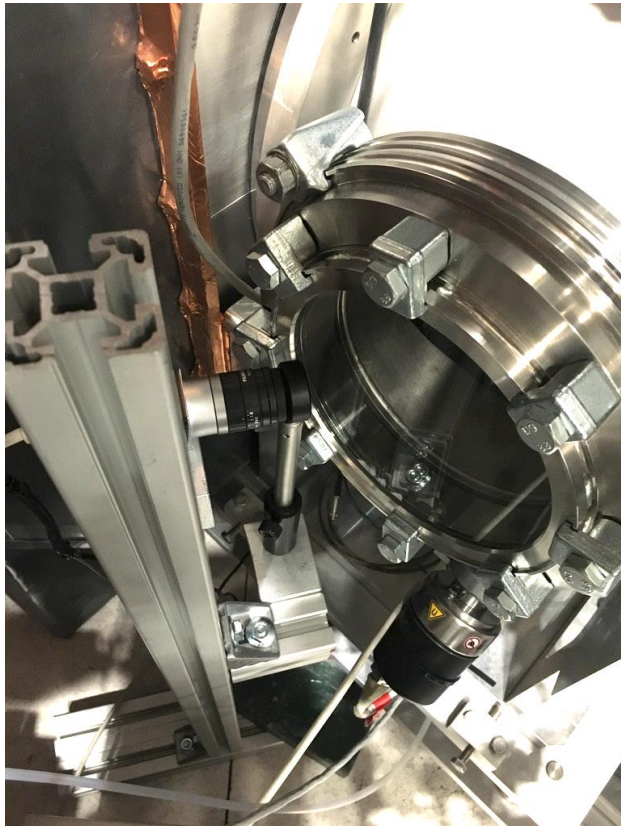
- 0) setup CERN Windows virtual machine to fully control the ion source + standard CO tools
- 1) setup camera system with 700 nm filter (to be exchanged for a ~690 nm filter already ordered)
- 3a) checked the **focusing effect of the puller**
- 3b) checked and documented in the logbook effect of **steerers plate and quadrupoles**
 - > Q1 focusing in V, Q2 focusing in H
 - > + voltage steers to LEFT and BOTTOM on both quads.
- 4) "grounded" the quads electrodes to exclude they are somehow charging up.
- 5) For negative puller $\ll 250V$ one does not see much "charge" arriving to the screen, nor a short-time scale charging up effect.
- 6) For negative puller $>250V$ (already from 260V) one immediately see some more "DC beam" arriving to the screen. This seems to go "exponentially". Probably interesting to quantify this current in the future using the copper plate as a Faraday Cup.
- 7) **Beam can move *vertically*** in a charge-up like movement by setting the negative puller settings $>250V$
- 8) to let the beam "come back", one has **to keep the beam on at ~250V, otherwise the "discharge" seems to be much slower.**
- 9) the beam **movement can be of the order of 1 cm or so.** In order to "reproduce" such a movement with steerers, one needs about **$>1000V$ on the first quad or $>3000V$ on the second quad.**
 - > This seems to exclude any charging up in the quad region (e.g. cables) as it would require unreasonably(?) high voltages (e.g. cables are far away from beam, shielded by metallic structure of quads assembly etc. etc..)
- 10) the deflection is inversely proportional to the energy of the beam. (see 14:39 entry of wednesday): we setup a ~6 mm movement of the beam at 80 keV which was probably enhanced to ~8 mm going quickly back to 60 keV beam)
- 11) there is not really a way to make sure that all the charges that leave the quad is indeed transported to the screen. Very likely the quad assembly is indeed shielding most of this charge, and all positive charge must be going somewhere else...
- 12) in principle, one could setup the negative puller at 0 V. In this mode, at 60 keV the H- beam seems to arrive to the screen seems to barely fit the quad assembly. Nothing can be said about protons and electrons maybe generated on the puller region.

Action plan:

- 1) install the screen with the hole (when it arrives), and see if it is confirmed that the beam moves vertically "down" when it disappears from the ring.
- 2) see if one could clean the hole of the puller (injecting compressed nitrogen?!)
- 3) during next winter shutdown, when source operation is maybe not so critical anymore, foresee a major intervention to disassemble the source and verify all components (e.g. the plasma chamber seems to have some damages seen today from visual inspection...)

New camera setup

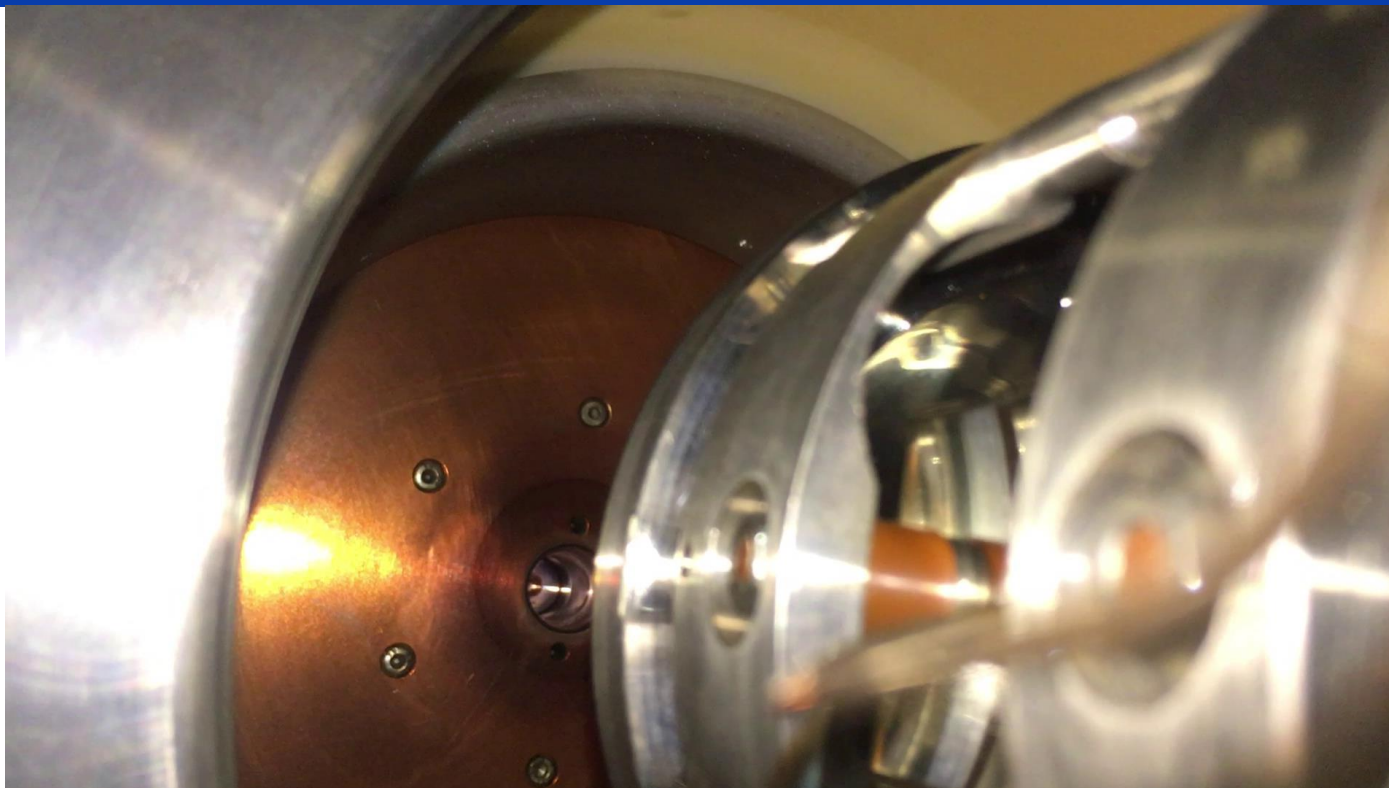
- New digital camera that can be triggered
- 700 nm (10 nm FWHM) filter (**694 nm filter ordered**)
- New screen with hole (10 mm diam) **still to come**





- Surfaces need to be cleaned (carefully!)
 - And see what happens after some time...
- Measurement of magnetic field in the puller can be done with a probe inserted from the plasma chamber side.
 - **TODO:** Ralf to look up about nominal values and provide pictures of the assembly here.





- Marks probably due to ionization of residual charge -> all positive charges go back to puller.
 - Need to make simulations to see where charges go if generated on the ground electrode or in the vacuum in front of the puller.
- **Simulations** (**Ralf** might be able to do some, but not in the short term) also needed to:
 - improve ground electrode shape (i.e. maybe bringing quad assembly closer to puller. This is possible to do even now.)
 - Implement some shielding of isolator
 - **Warning: dark current increases** quickly if one goes too close with ground electrode.

■ Still pending **gas quality control**

- Should we repeat a **proper leak detection**?
 - **Cooling water circuits not tested last time!**
 - Too much **H₂O** or **O₂** is typically resulting in bad source performance in other sources.
- No other source is using our cartridges. They should have appropriate quality at least for ~50 refills...

■ **Spare situation:**

- flow controller electronics found, but no mechanics... it should be there! If not, Ralf can provide one easily.
- 100 kV FUG spare available in Julich (at least until 2025 ☺). (otherwise, 6 months to get a new one from Fug)
- “solid” insulation transformer ordered from Hungarian company. Bertrand to check with Christian if possible to pay one (9kEUR)

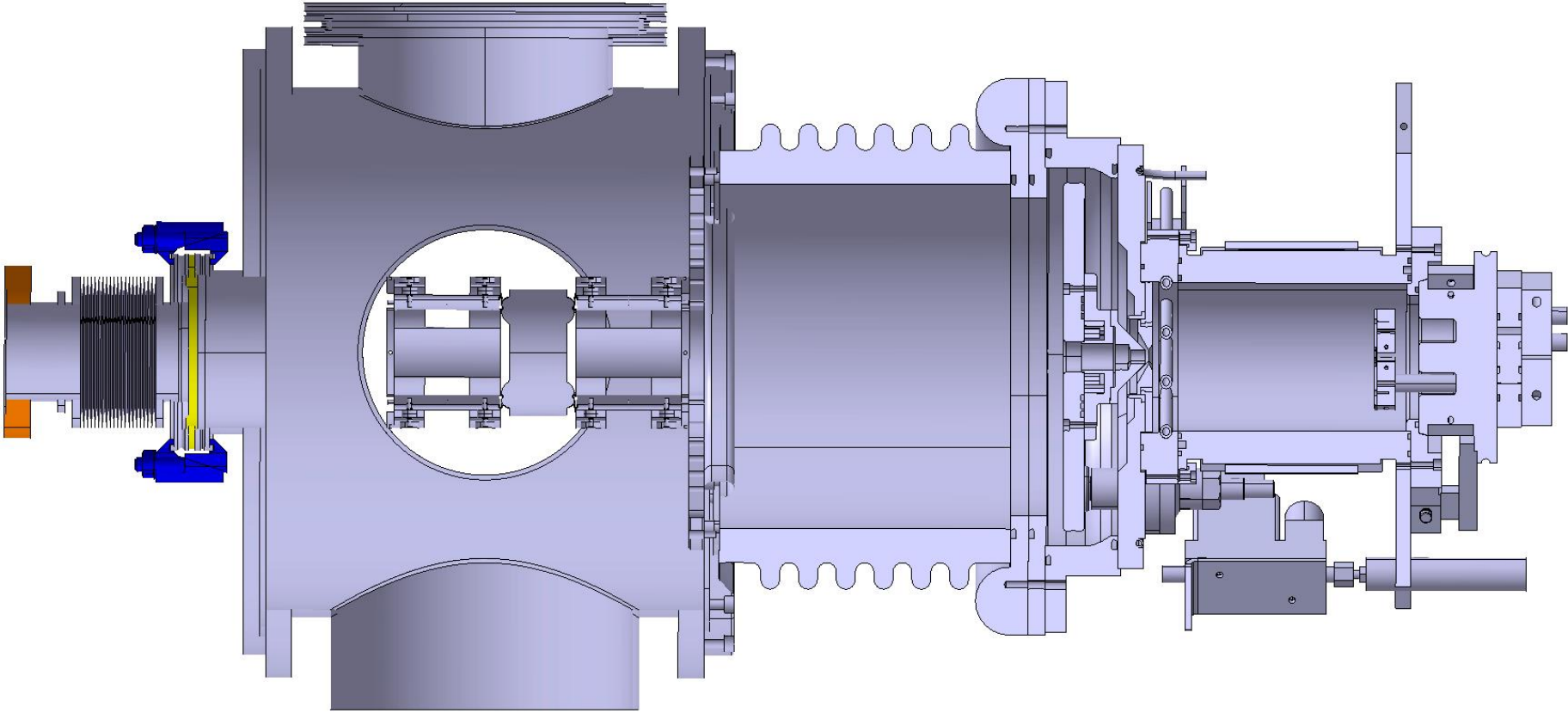
■ Still pending (second order):

- Adding aperture restriction in the Pearson to allow for better vacuum downstream

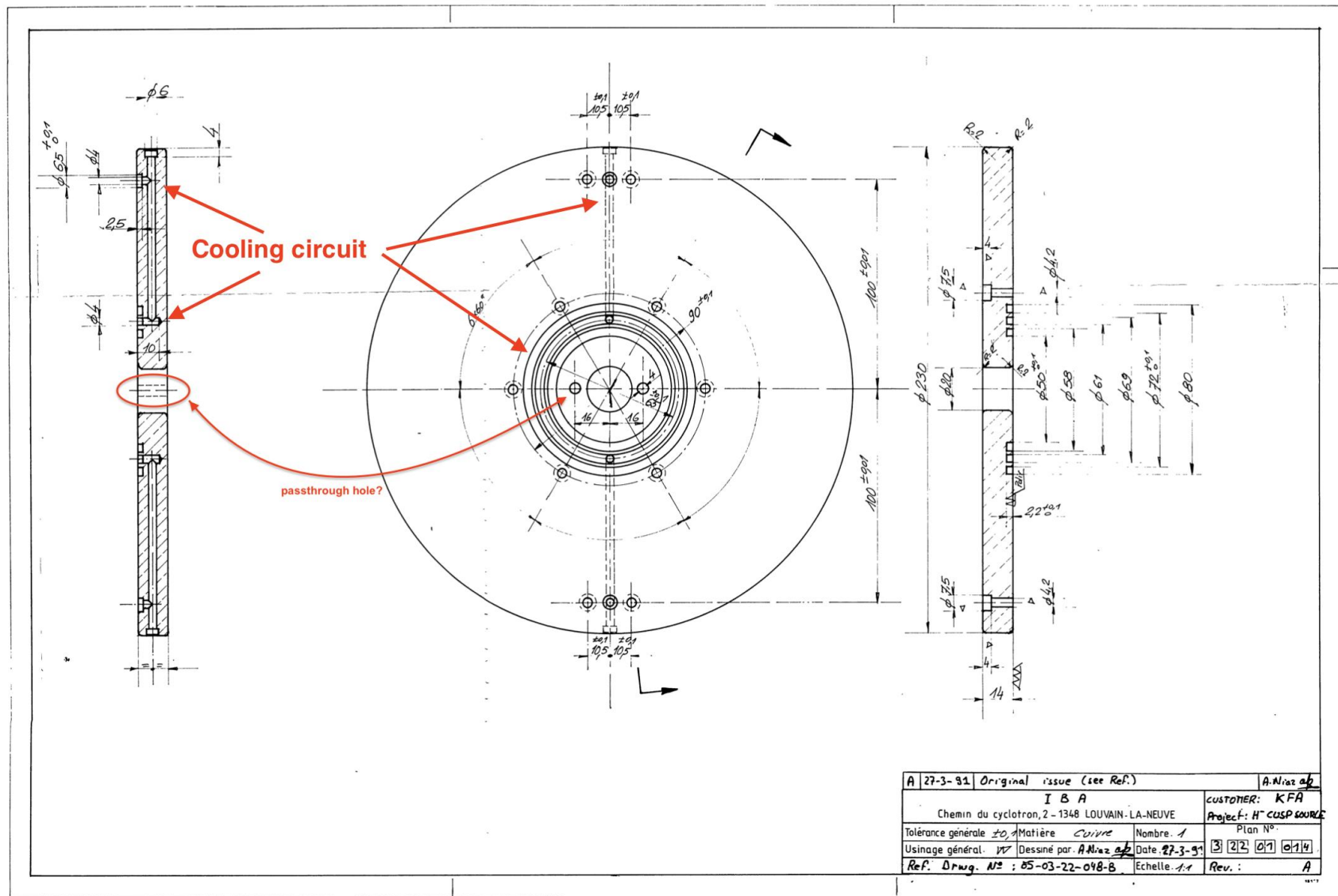
Quadrupoles chamber



Source view



Puller drawing



Source assembly drawing

