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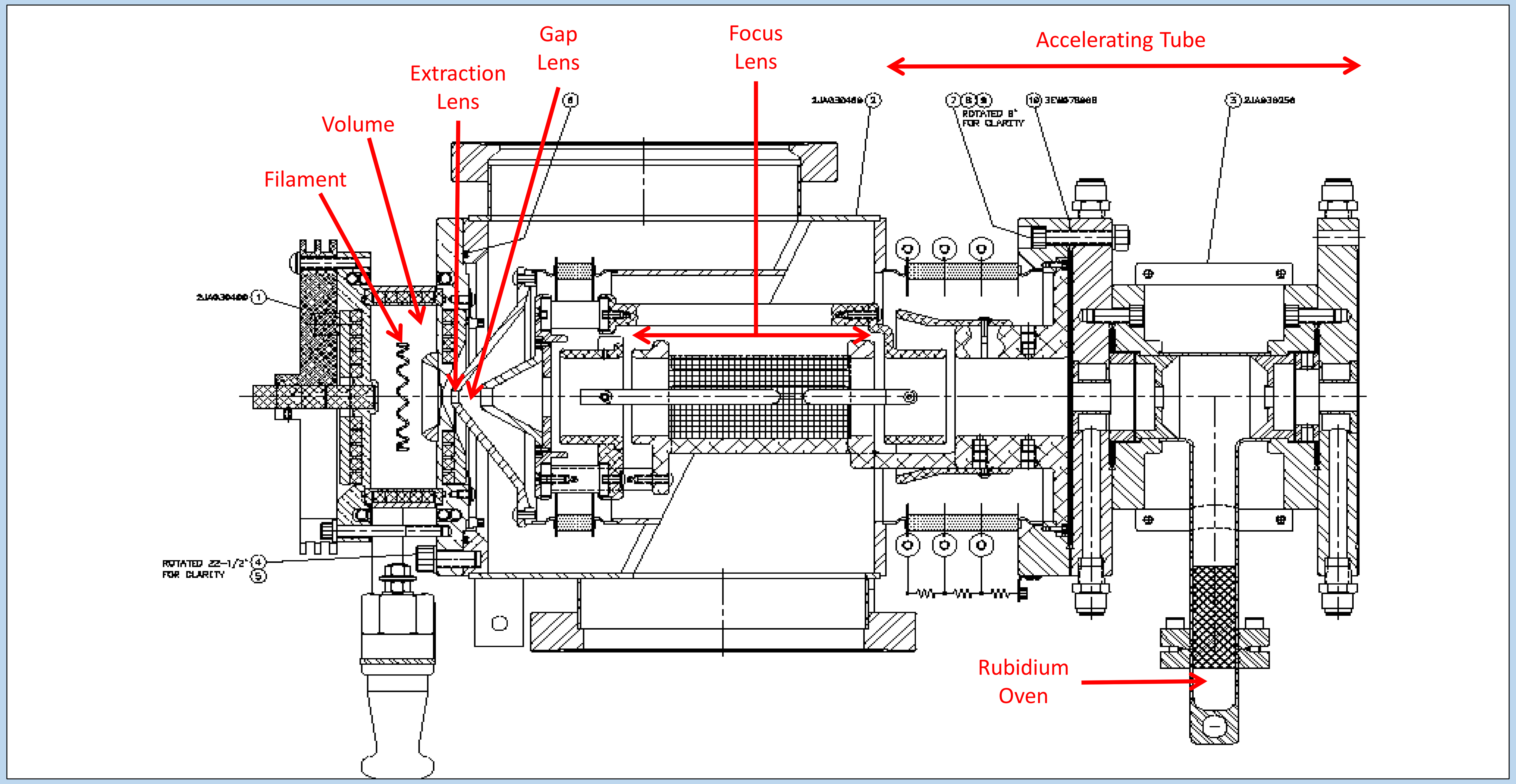
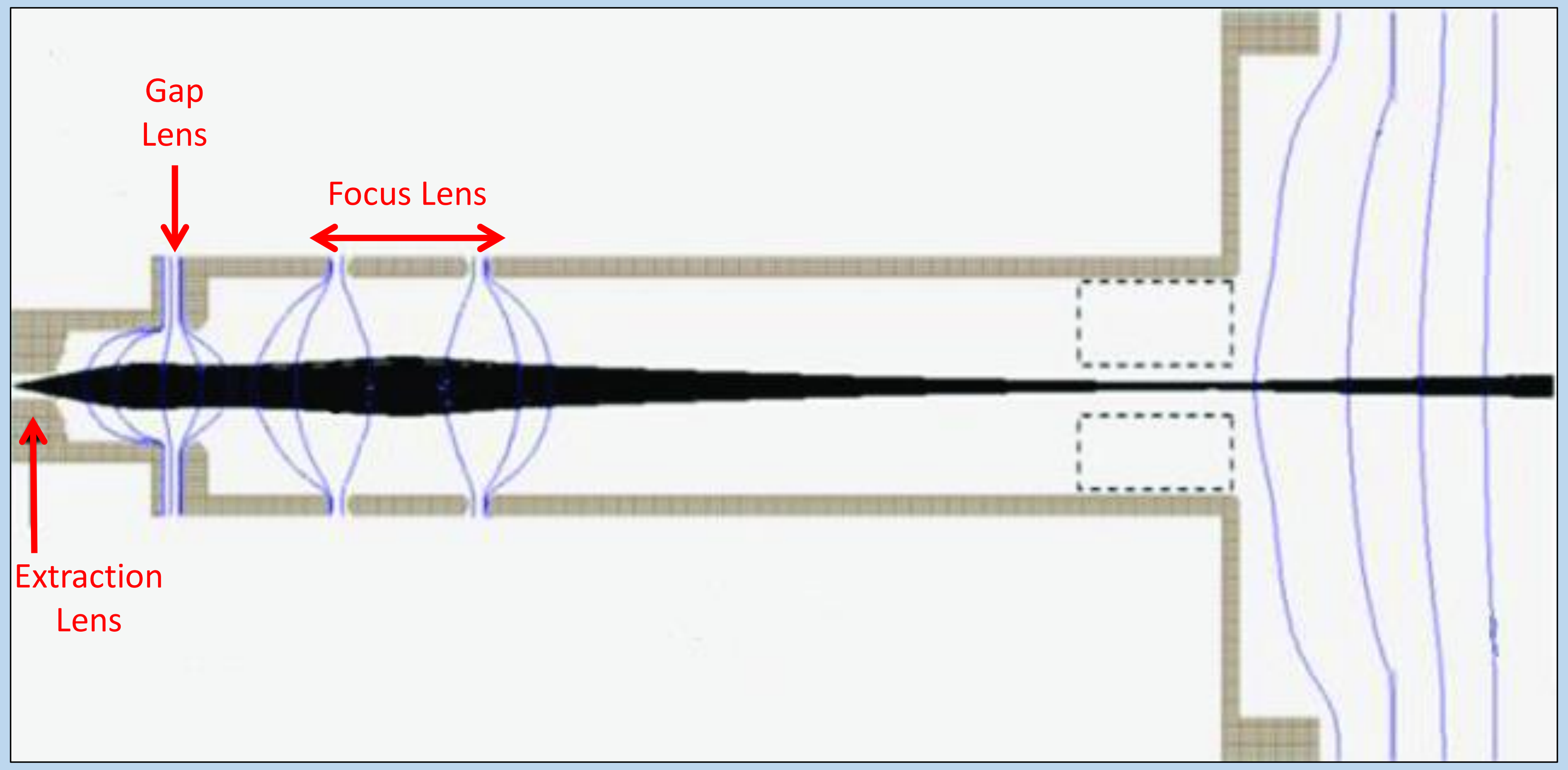
TORVIS

(**TOR**oidal **V**olume **I**on **S**ource)



How Does This Focus an Ion Beam?



Once we have made an ion beam from the TORVIS, **we use a series of electromagnetic lenses** (Extraction, Gap, Focus) to position and focus the beam as desired, ready for accelerating. These lenses do much the same thing as optical lenses, though with electric and magnetic fields.

Operation

Step 1: Bleed the gas you want to make an ion beam of, into the volume (usually H or He).
Step 2: Put a large current through the filament.
Step 3: This **makes a plasma** next to the filament.
Step 4: This **plasma ionises the gas** in the volume.
Step 5: Use electromagnetic fields (extraction, gap, focus) to pull a focused beam to the accelerating tube.

Performance

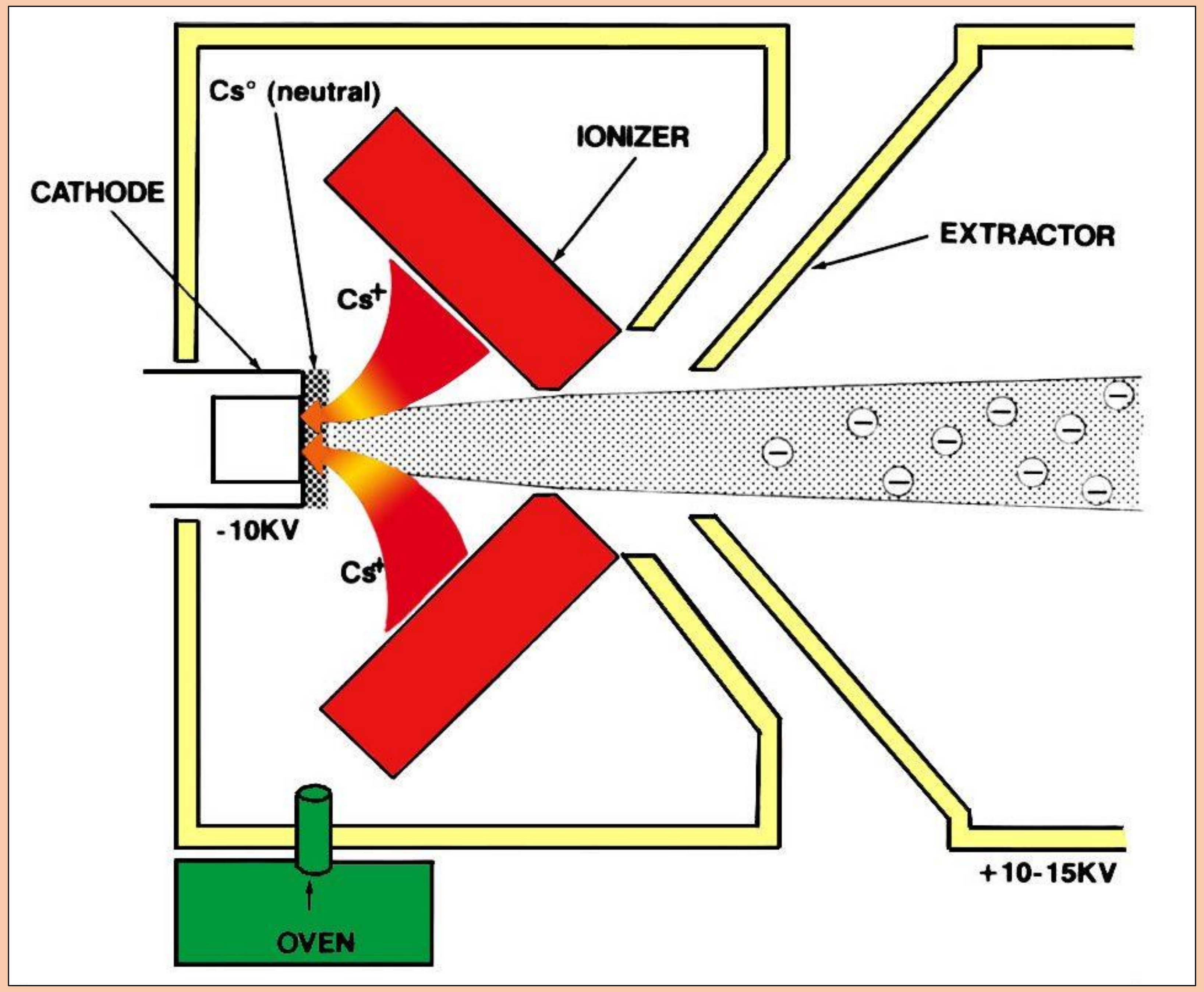
At DCF, we only use Hydrogen or Helium in the TORVIS, which after removing electrons become a proton or alpha particle beam respectively.

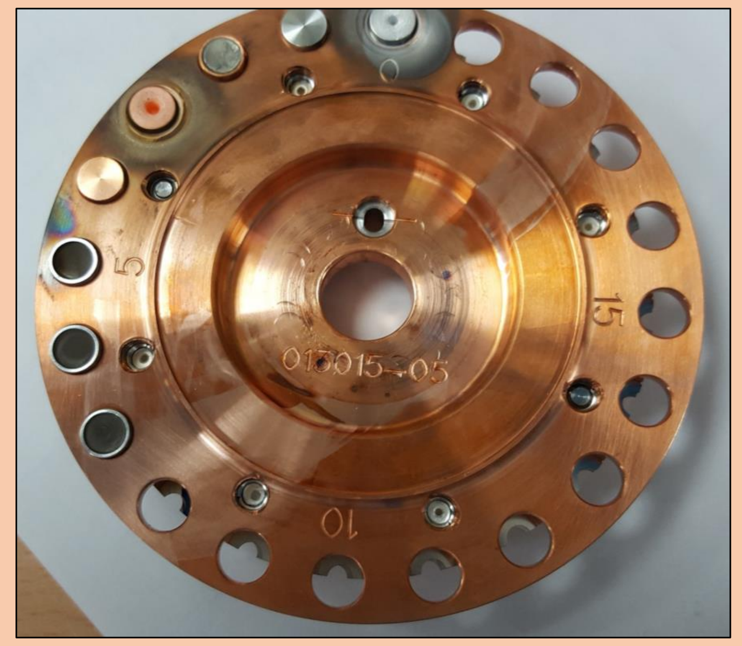
It will output up to:

- **50 µA of protons (in a 10 MeV beam)**
- **2 µA of alphas (in a 15 MeV beam)**

MC-SNICS

(**M**ulti **C**athode **S**ource of **N**egative **I**ons by **C**aesium **S**puttering)





Operation

Step 1: The oven is heated to about 105 ^{o}C, **vapourising the Caesium** inside.
Step 2: Caesium gas fills the main volume of the source. Some condenses on the cold surface of the cathode and forms a neutral Caesium film. Some hits the surface of the hot ioniser – producing Caesium positive ions.
Step 3: A negative voltage is applied to the cathode, causing the positively charged Caesium ions to accelerate towards it.
Step 4: The Caesium ions strike the cathode surface with sufficient energy to liberate small amounts of material from the surface **(sputtering)**.
Step 5: The sputtered material can be positive, negative or neutrally charged. However, it must pass through the Caesium film formed in step 3. This Caesium film, freely donates electrons, reliably producing a negative ion beam of the sputtered material.
Step 6: A positive voltage is applied to the extractor, causing the negative ion beam to accelerate towards it and through an aperture in the centre

What Ion Beams can the MC-SNICS Produce?

One of the great strengths of the SNICS is it's flexibility. Negative ion beams are essential for use in tandem accelerators, such as DAFNE – the SNICS grants us the ability to provide this for **almost any material**.

At DCF, we use **powders pressed into a 6mm cathode shell**. This cathode is sputtered to produce the negative ion beam we accelerate. The cathode is consumed in the process. Cathodes are loaded into a disc containing up to 20 cathodes, which is rotated to provide the cathode required to produce any desired beam from among those available.

Performance

The **current produced varies** depending on the material.

Some typical outputs include:

- **40 µA of Gold ions**
- **22 µA of Nickel ions**
- **18 µA of Iron ions**
- **10 µA of Carbon ions**