Ultra compact / Ultra low power ECRIS for RIB production

COMIC : a microwave FEBIAD ?

1 - A new approach for ECR device :

- The quarter wave geometry

2 – COMIC (COmpact MIcrowave and Coaxial) :

- Main characteristics for stable ions

3 – COMIC-Isolde :

- The quartz bulb as plasma chamber / sticking control et gas efficiency tests

4 – Reception tests and schedule

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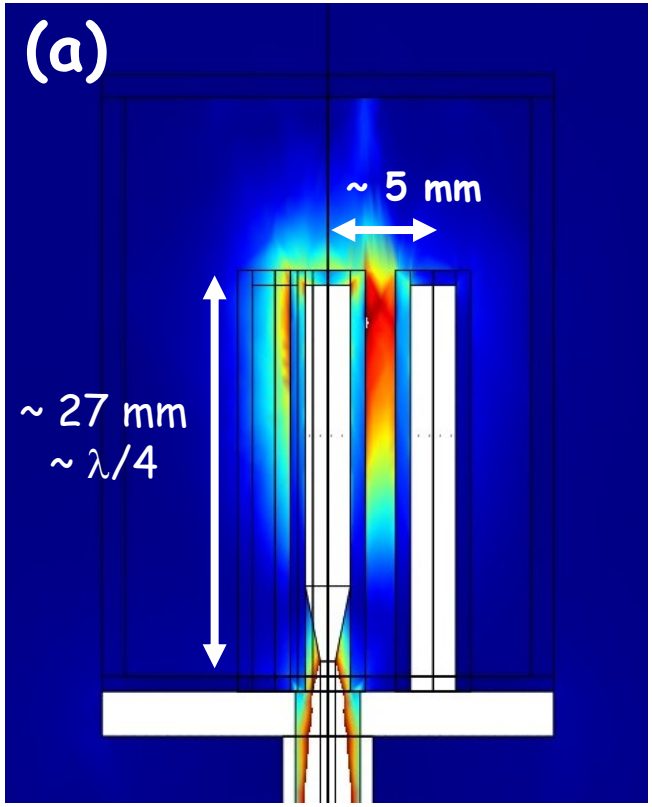
Microwave field distribution inside a quasi coaxial geometry



Electric field amplitude distribution between the central antenna and couplers with quasi-coaxial geometry (COMSOL Calculation)

f_{hf} = 2.45 GHZ

Red > 10^4 V/m

Distribution of light in a **Xenon** discharge (2 W) between the central antenna and the coupler with quasi-coaxial geometry

$p \sim 10^{-2}$ mbar

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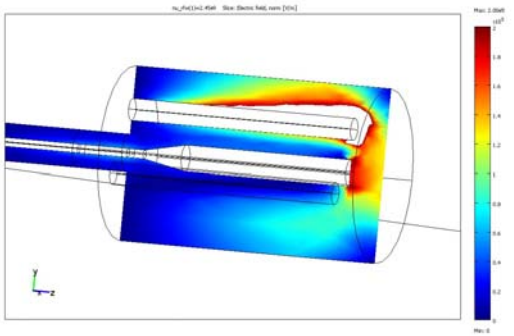
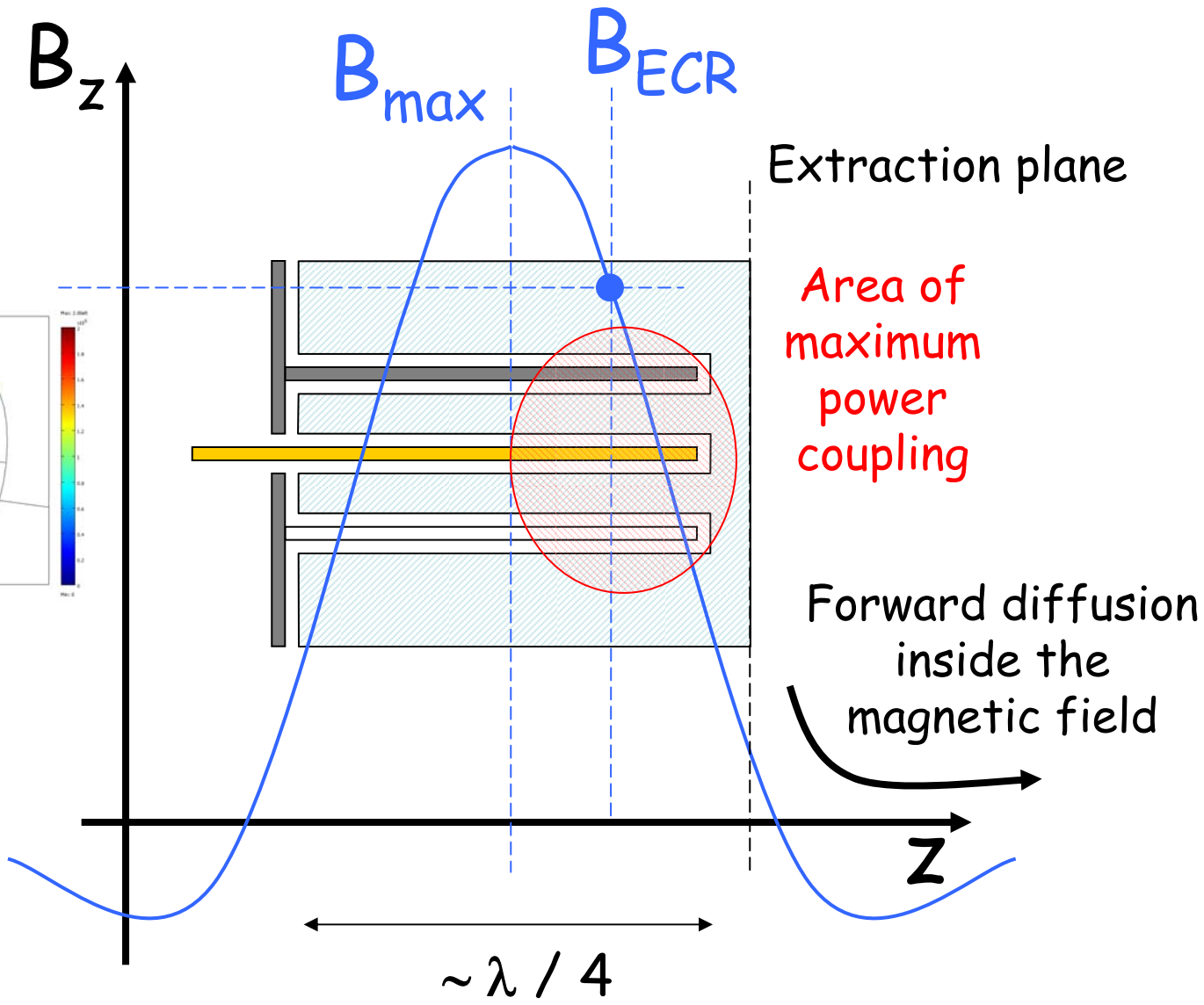
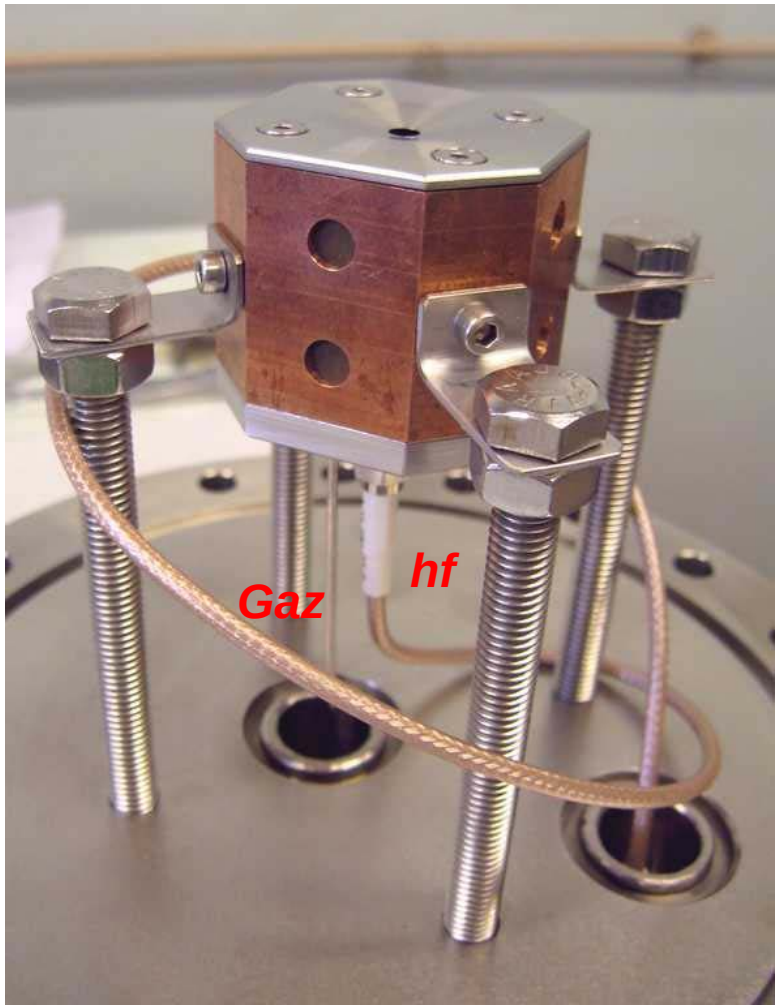
COMIC cavity : conductive resonant cavity

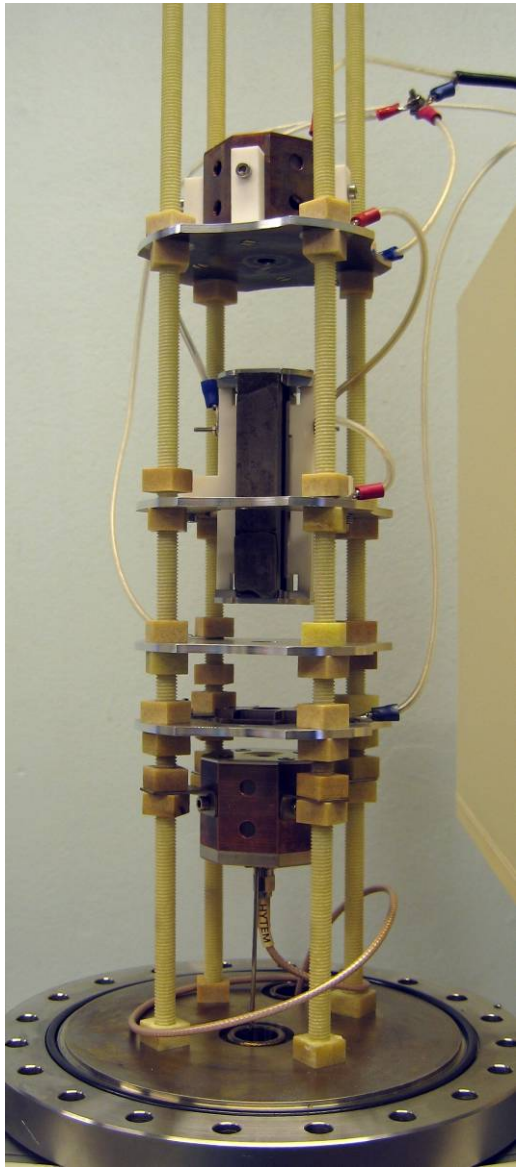




COMIC *operation* under vacuum with/without beam line



Plasma source mode
gaz *and* HF (coax. SMA)



Ion source mode with Wien filter

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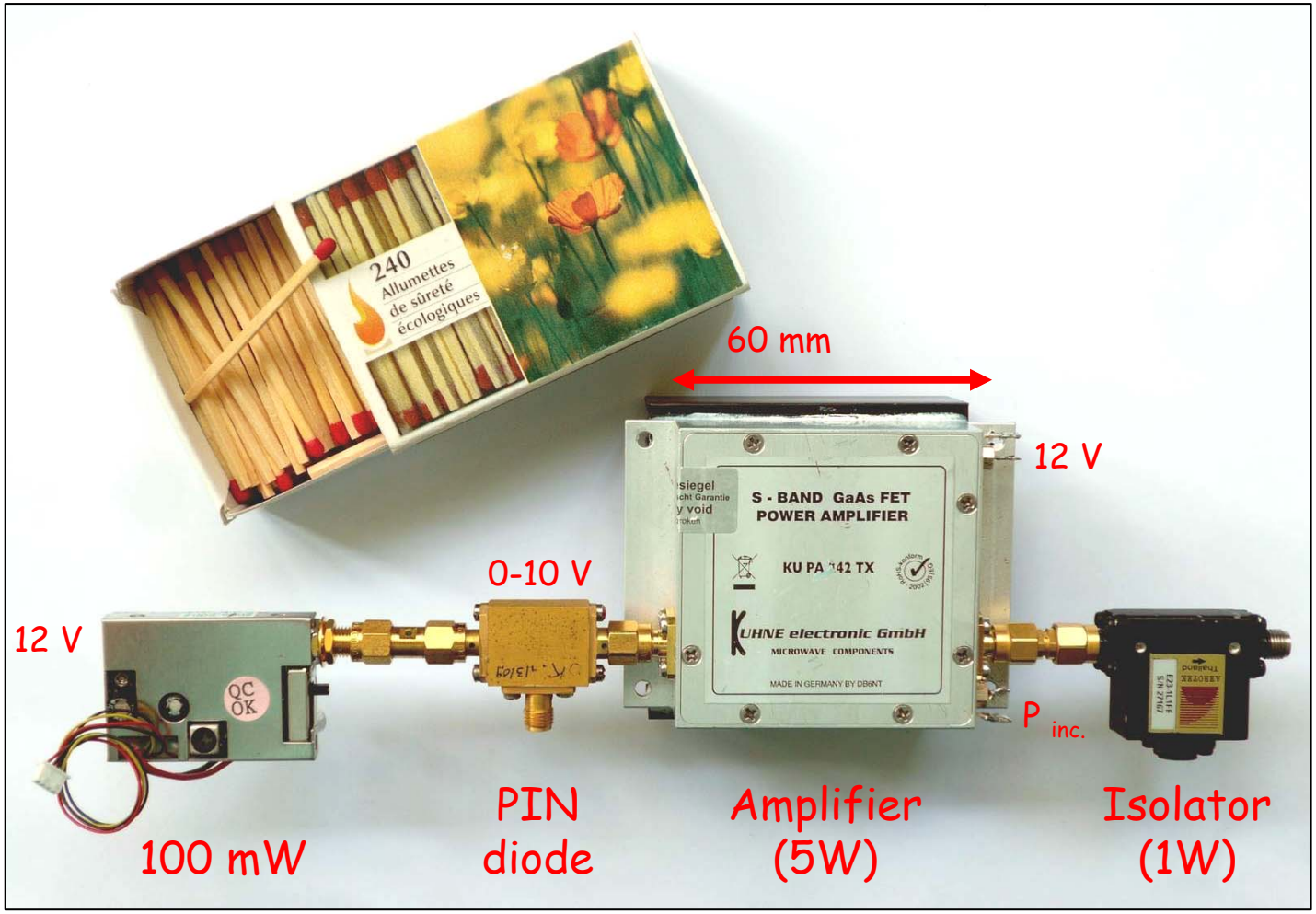
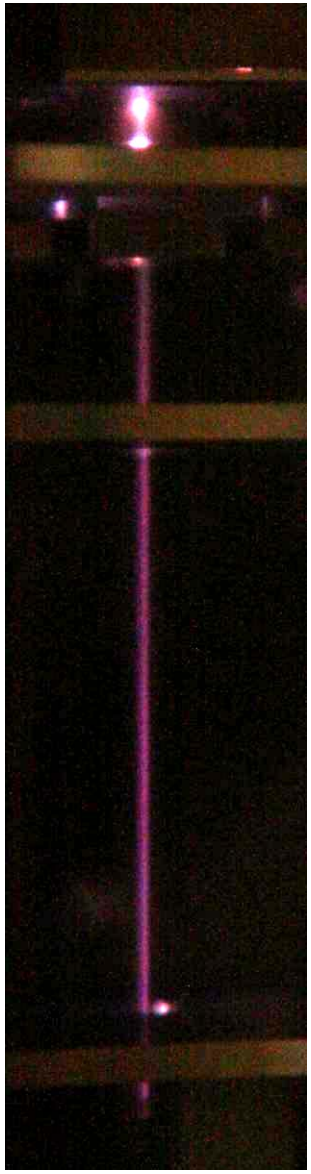
5 W solid state transmitter (Kuhne Electronics Amplifier, Germany)



possibly
20W same size

COMIC *operation* under vacuum : plasma & ion source

Argon 10^{-2} mbar / 5 W



hole 3/10 mm

Source
18 KV

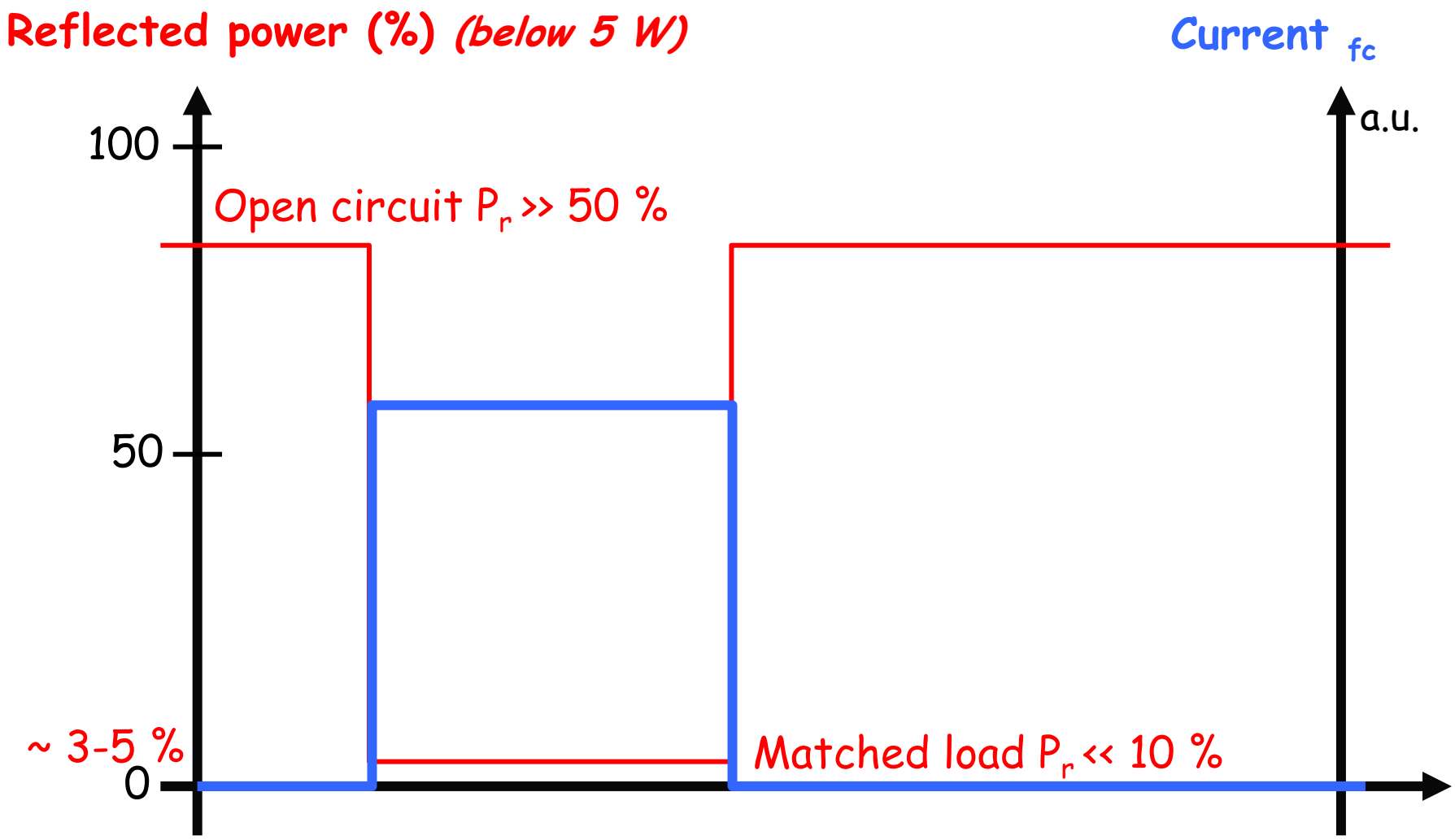
Extraction electrode
14 KV

Grounded electrode
0 KV

4 W Hélium
4 µAe
Φ ~ 0.5 mm
à 10 cm

FC entrance (Φ 7 mm)

COMIC *operating* points and reflected power



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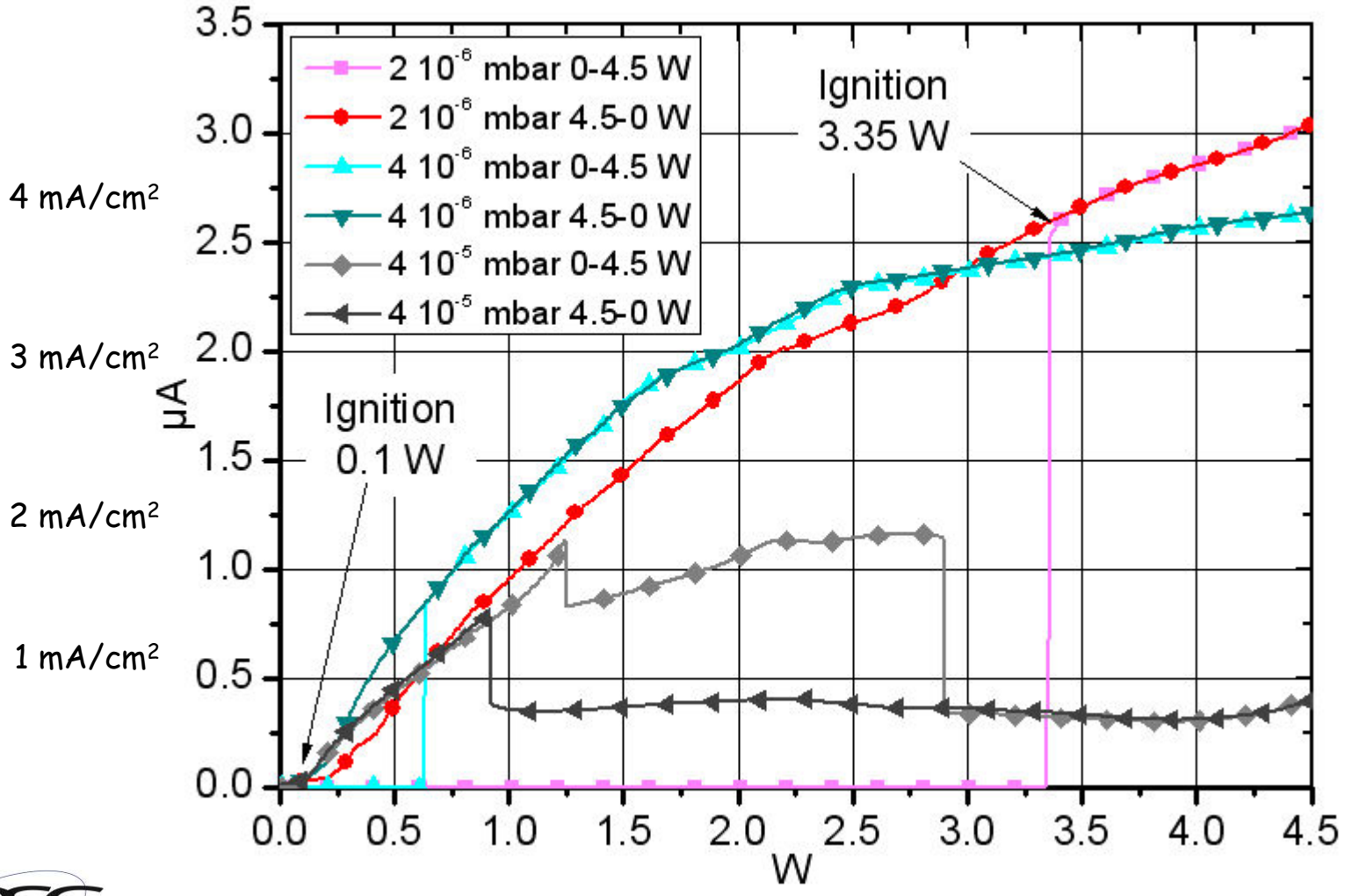
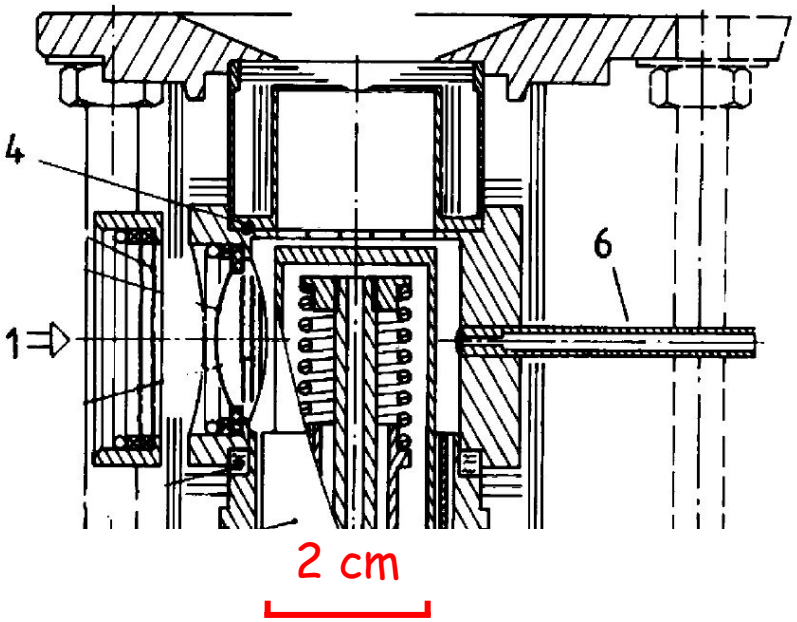
Ar - 20 KV - extraction 3/10 mm - **Power ignition and plasma stability**



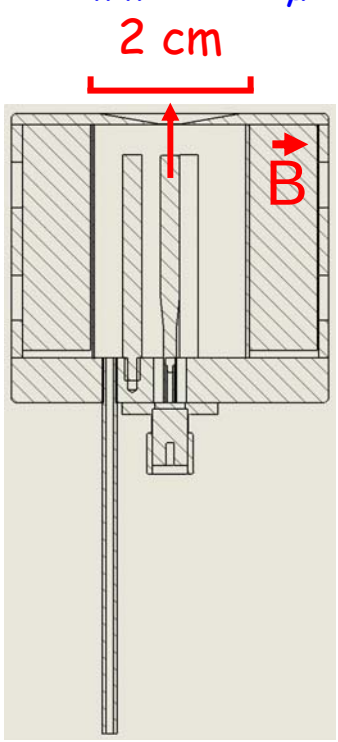
COMIC versus FEBIAD : a microwave FEBIAD ?

Φ 1 mm 2-20 μA*

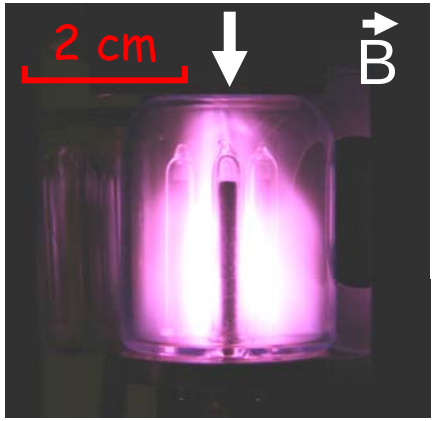


FEBIAD

Φ 1 mm 10-60 μA



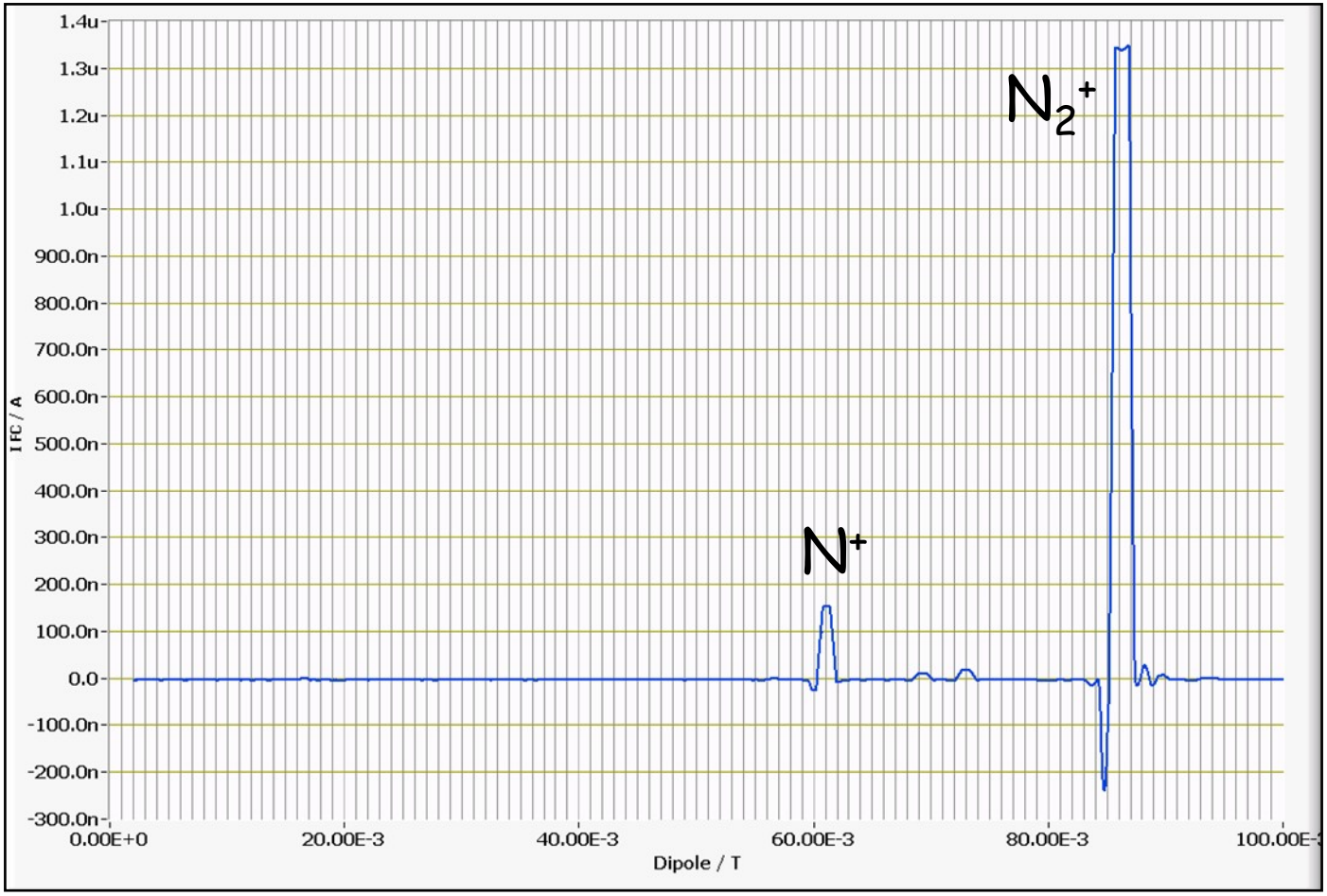
COMIC source



COMIC bulb

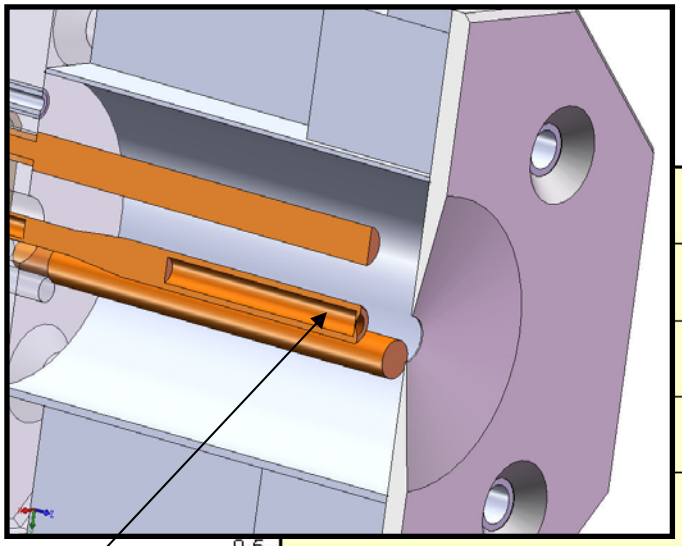
R. KIRCHNER et al., "ION SOURCE DEVELOPMENT FOR THE GSI ON-LINE ISOTOPE SEPARATOR", NIM B26 (1987) 235-239

COMIC 1+ injection line : Nitrogen spectrum (4.7 W – 15 KV- 3/10 mm)



If noble gas ➔ « monopeak » spectrum

COMIC as a « micro » induction oven : Rubidium Spectrum

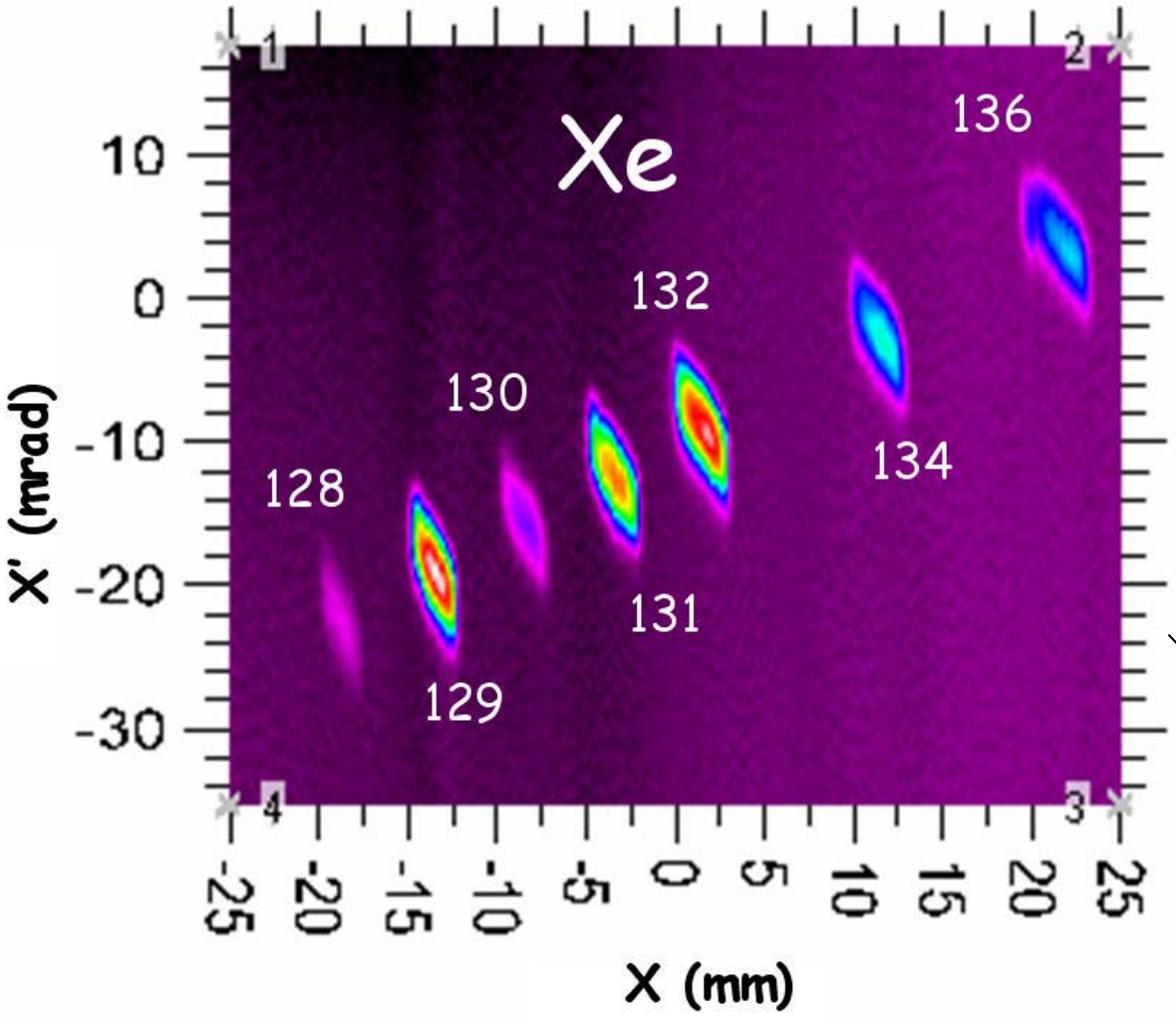


Antenna / Rb crucible

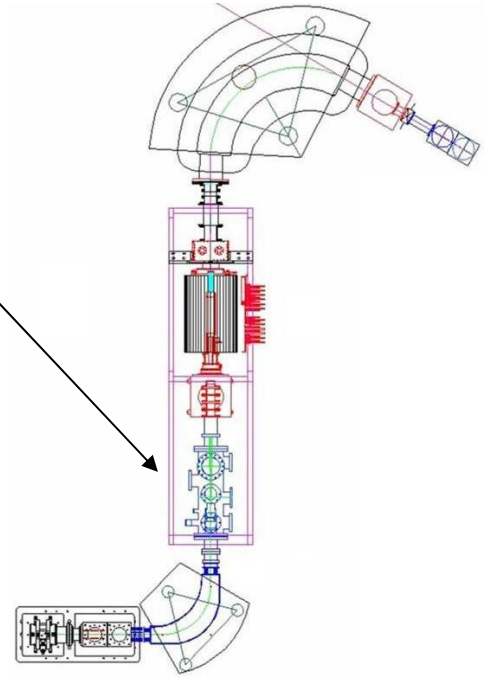
Ar^+ (8 µA) (3 W & 1 mm extract.)

Noble gaz AND « metallic » ion production

Xe – emittance on the 1⁺ charge breeder beam line



1 σ
1.2 π.mm.mrad
15 KV
3/10 mm ext.



1.8 *µA*e total / 3 W / ext. *0.3* mm / 15 KV
(12.5 *kV* élect. intermédiaire)

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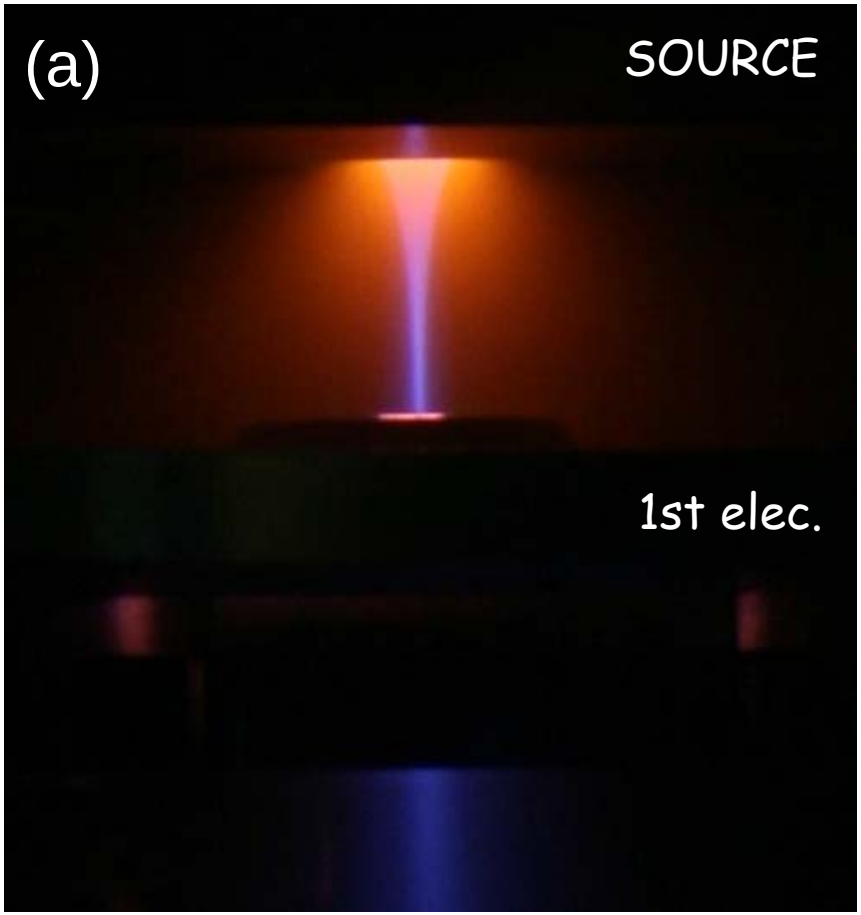
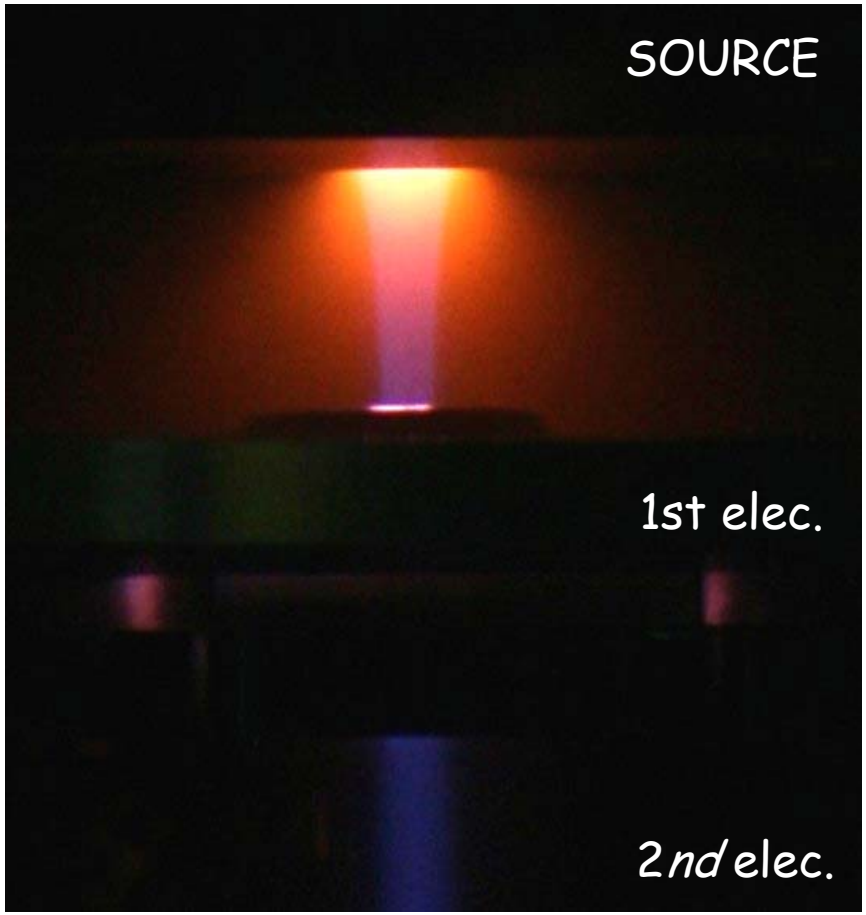
COMIC : 2 mm extracted beams focus control





1 W HF 2 mm 15 KV ~ 100 µA

Extraction 15 KV + 0 KV *Extraction 3 KV + 12 KV*

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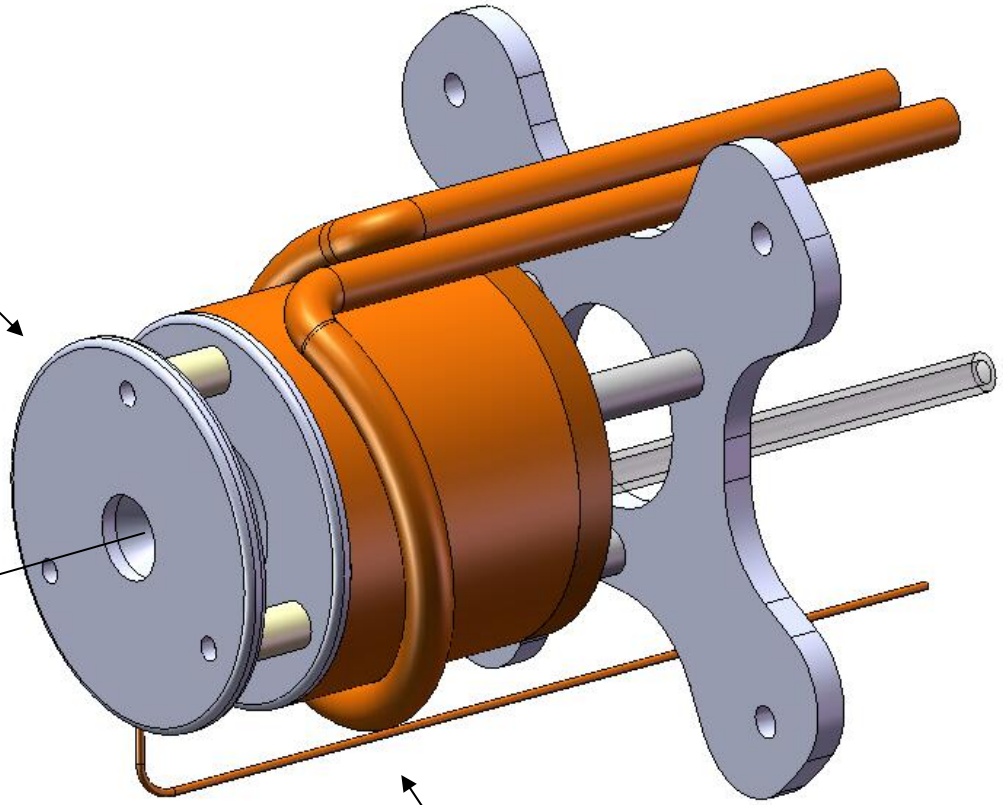
Prototype for retrofit « plug and play » / source CERN-I*SOLDE*
Fully quartz plasma chamber and transfer tube for CO_2/CO tests *(Thierry Stora, ISOLDE CERN)*

Focus control

Mechanical support

Plasma
Extraction
3/10 mm
or less ?



Gas

Beam

B field & cooling

Microwave
(0-20 W transmitter)

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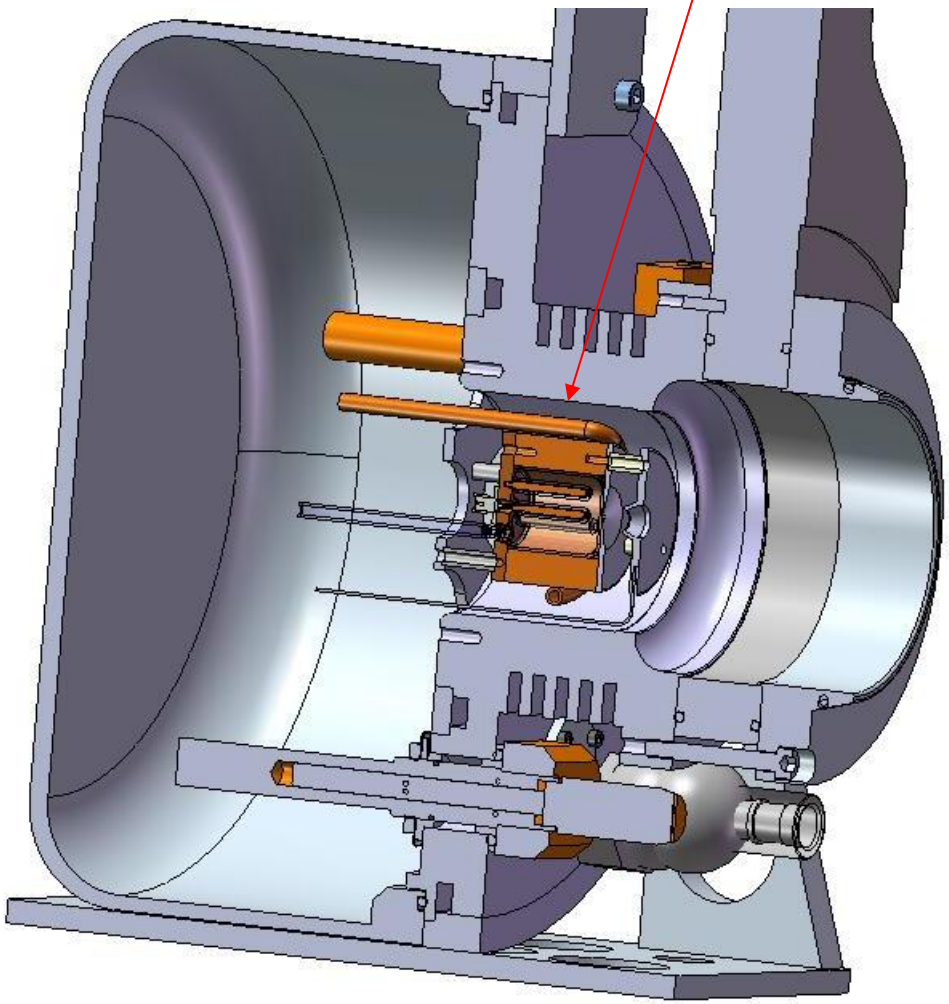
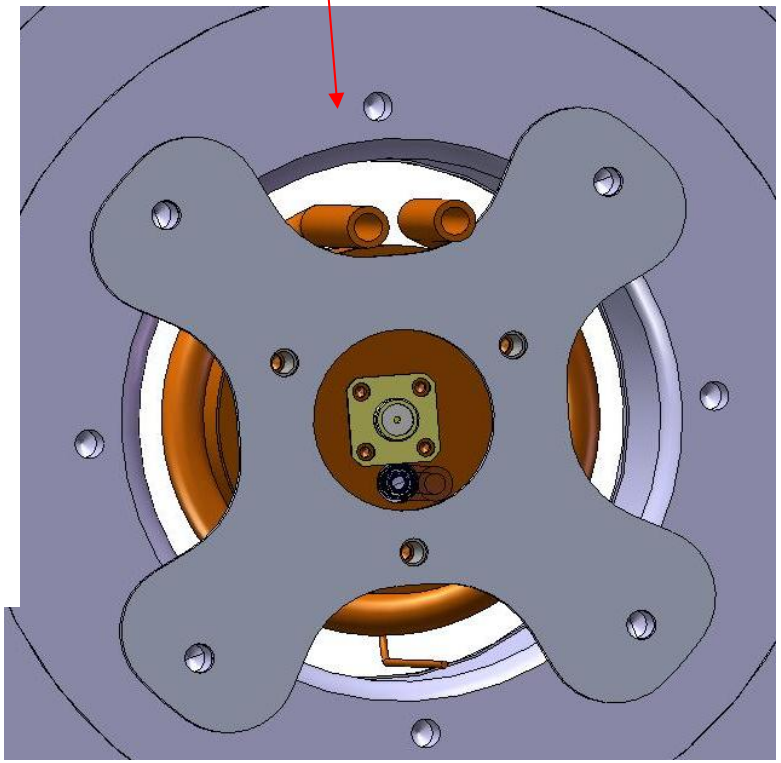
ISOLDE CERN

Prototype for retrofit « plug and play » / source CERN-I*SOLDE*
Fully quartz plasma chamber and cold transfer tube for CO_2/CO tests

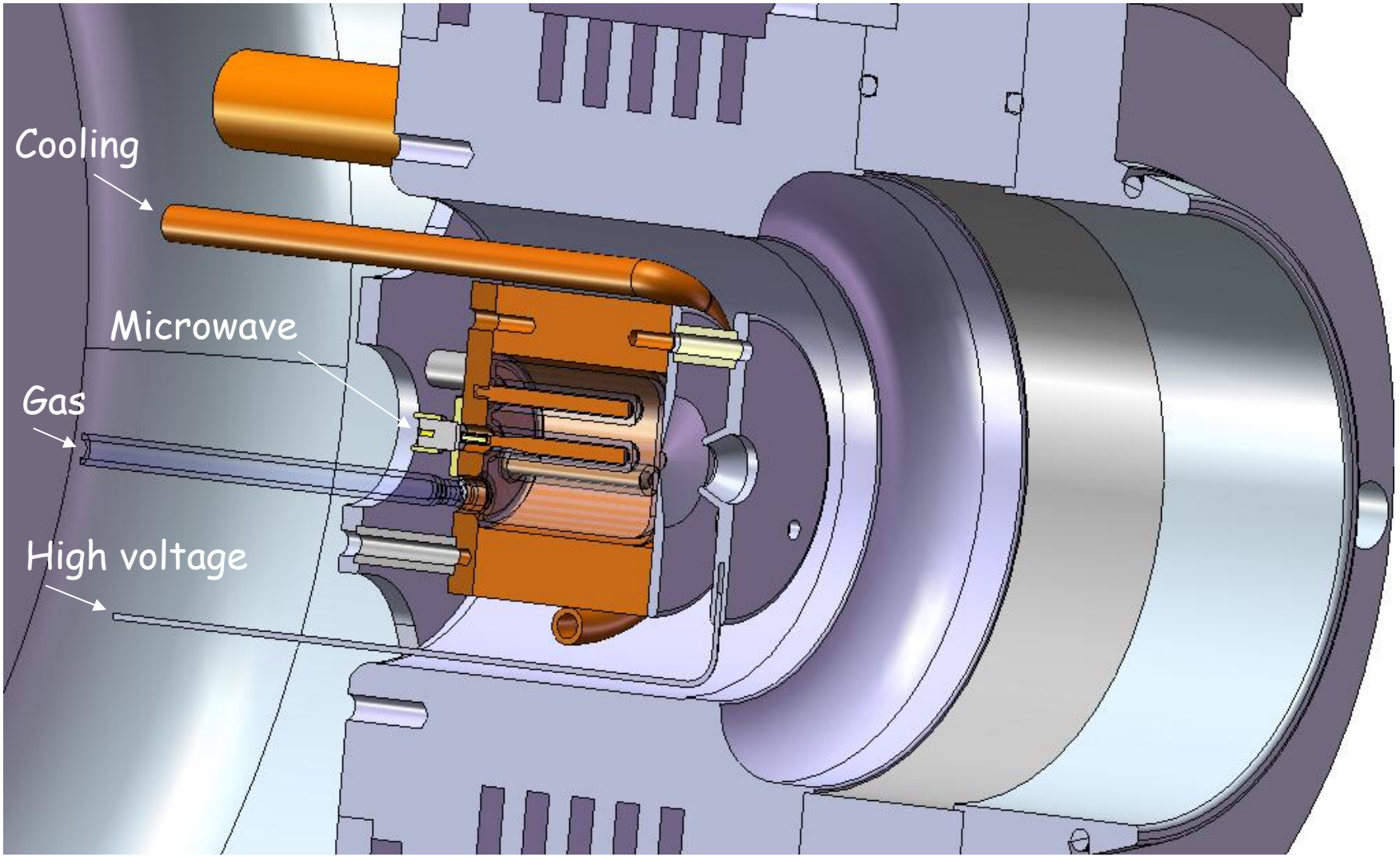




ISOLDE
CERN

LPSC Grenoble

Prototype for retrofit « plug and play » / source CERN-I*SOLDE*
Fully quartz plasma chamber and cold transfer tube for CO_2/CO tests



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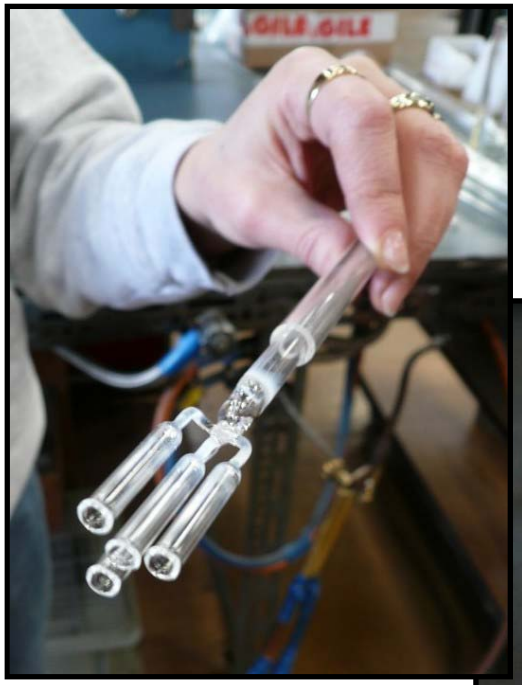
ISOLDE CERN

The quartz chamber making

(Initial lampe version / Pignat S.A. Lyon)



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Ultra compact / Ultra low power ECRIS for RIB production

Performance tests end schedule

1 – 20 KV(16KV), parallel beam, 3/10 mm extractor,
> 10 % gas efficiency CO_2^+

2 – Quartz plasma chamber (under fabrication)

3 – Juanary 2010 tests on the COMIC test bench
- Microwave operating point
- Noble gas functionning (Ar)

4 – March 2010 transfert on the ISOLDE test bench
- efficiency measurements
- emmitance measurements (60 KV)

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