Recent results of PHOENIX V2 and new prospects with PHOENIX V3

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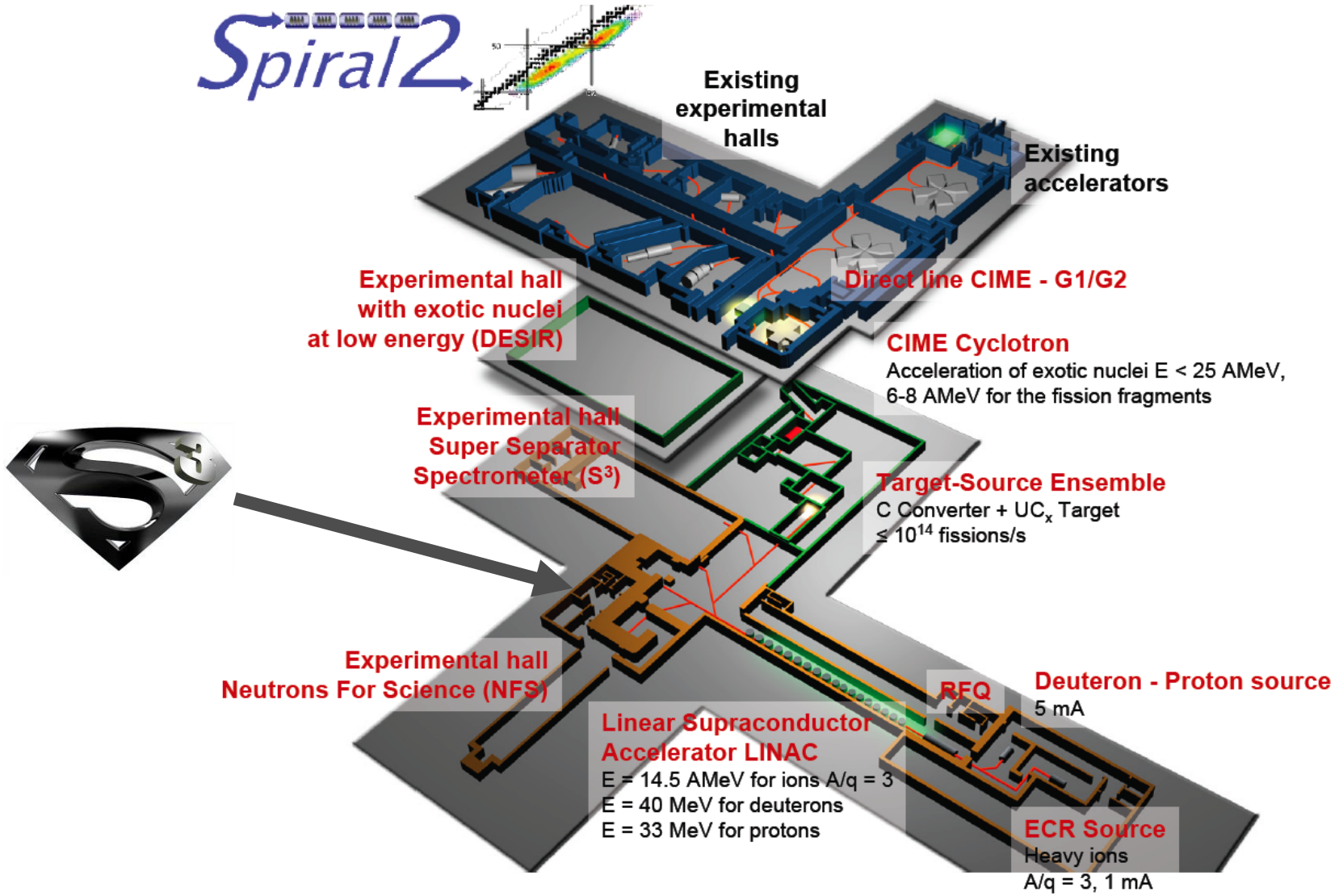
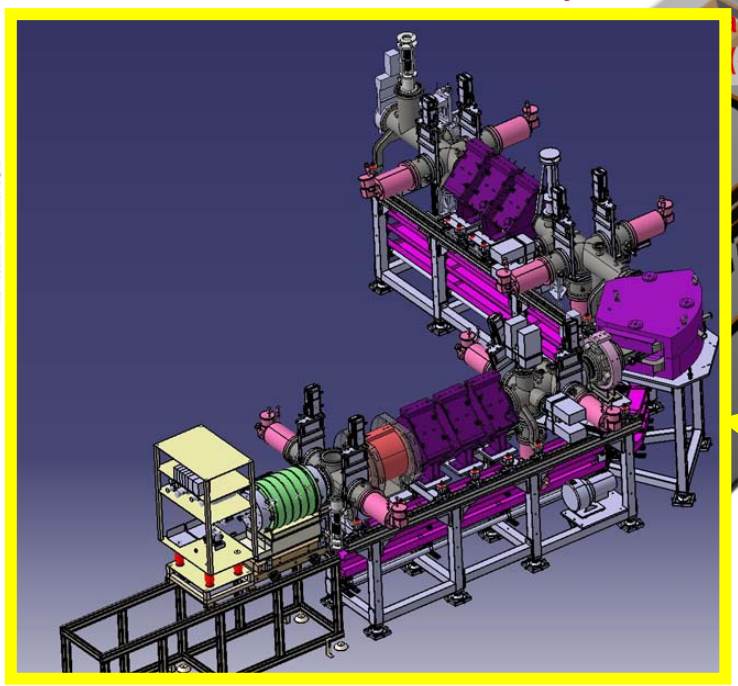
Outline

- Spiral 2 and Heavy ions Low energy beam transport line installed at Grenoble
- PHOENIX concept and extraction of PHOENIX V2
- Recent results obtained with Phoenix V2 on the LEBT
- Plasma chamber volume effect on A/Q= 3 beams
- Planned upgrade : PHOENIX V2 to V3

Spiral 2 project



Spiral 2 project and LEBT installed at LPSC Grenoble



Existing experimental halls

Existing accelerators

Experimental hall with exotic nuclei at low energy (DESIR)

Direct line CIME - G1/G2

CIME Cyclotron
Acceleration of exotic nuclei E < 25 AMeV,
6-8 AMeV for the fission fragments

Experimental hall
tor
(S^3)

Target-Source Ensemble
C Converter + UC_x Target
$\leq 10^{14}$ fissions/s

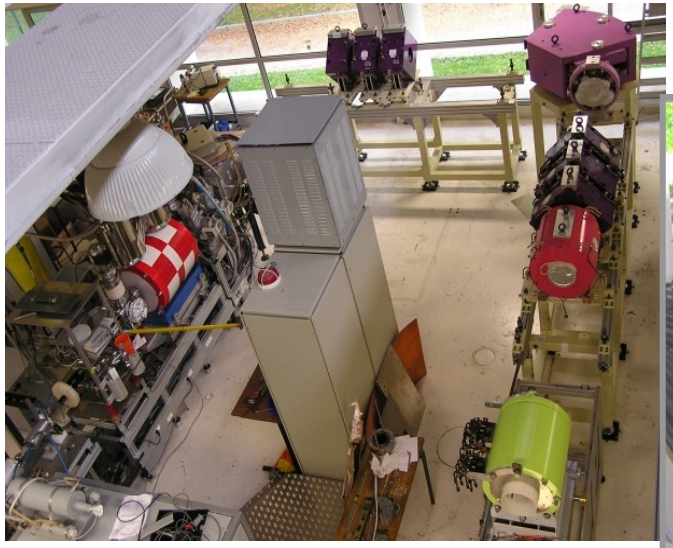
RFQ

Deuteron - Proton source
5 mA

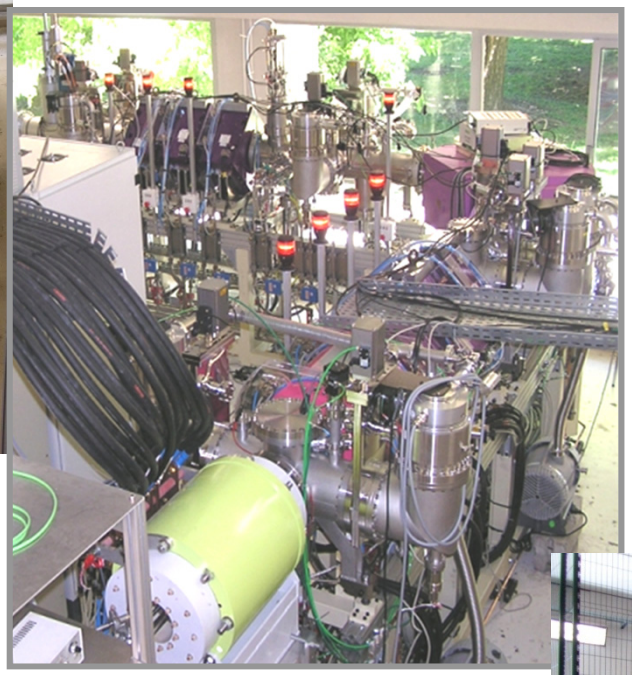
Linear Supraconductor Accelerator LINAC
E = 14.5 AMeV for ions A/q = 3
E = 40 MeV for deuterons
E = 33 MeV for protons

ECR Source
Heavy ions
A/q = 3, 1 mA

Low Beam Energy Transport Line A/Q=3 at Grenoble



October 2008

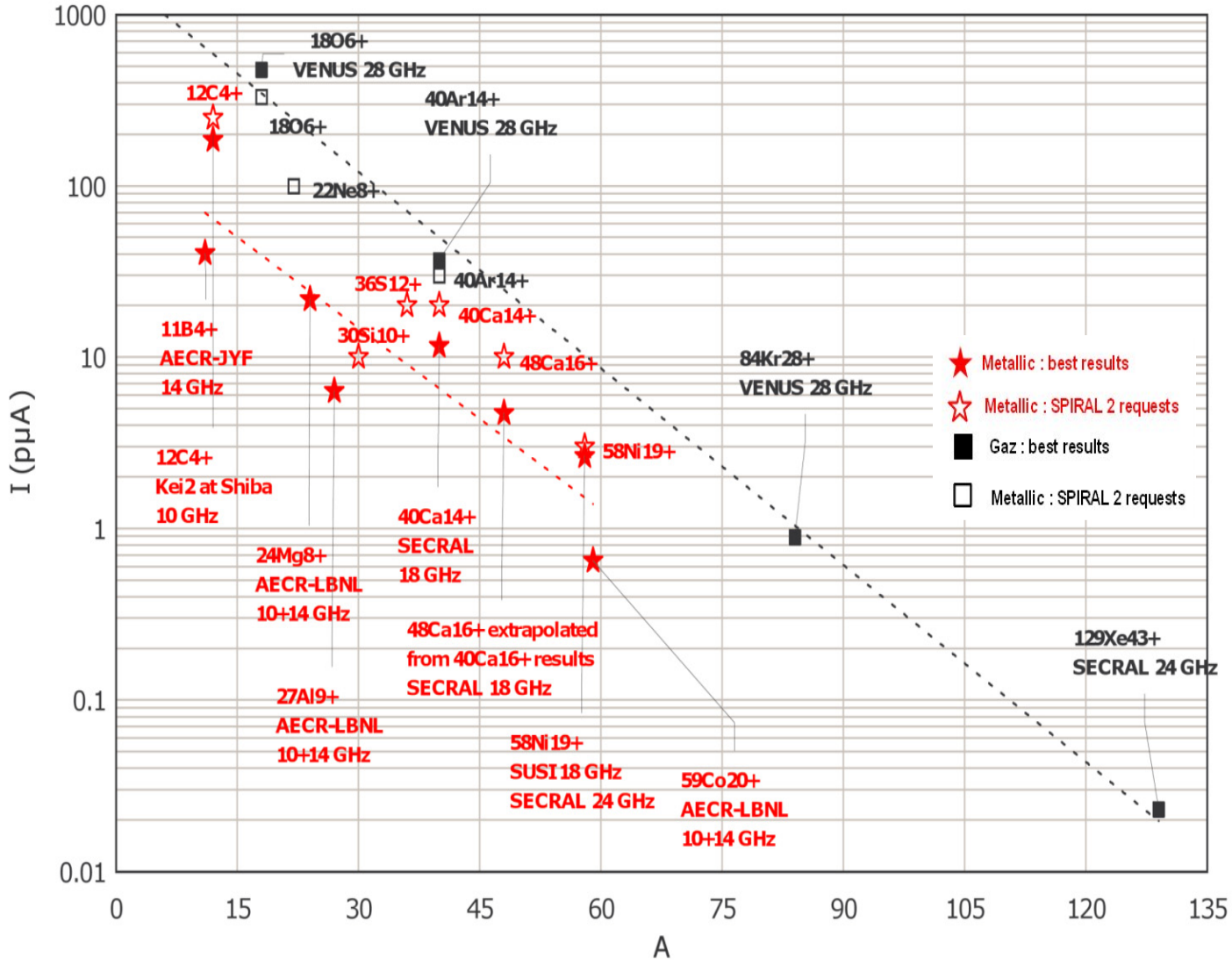


From april 2009 to june 2012

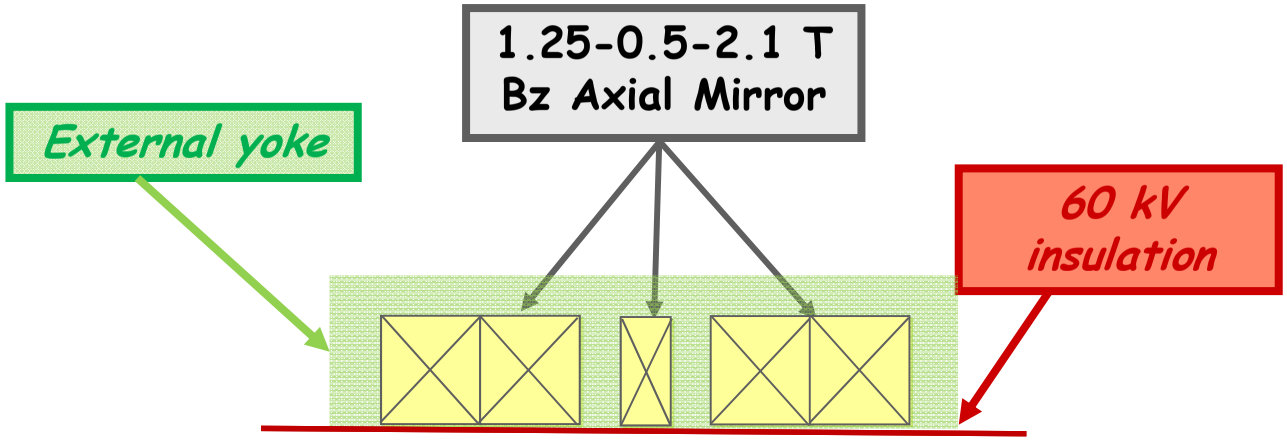
September 2012

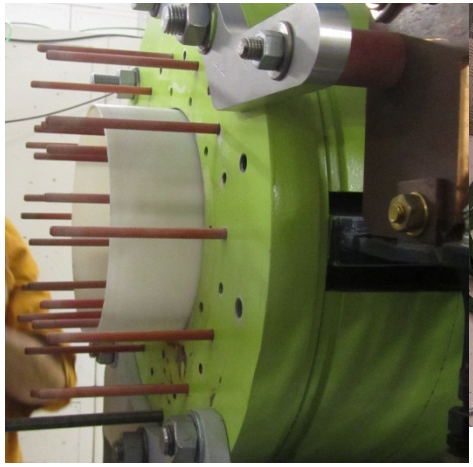
- Move to Spiral2 in end of September 2012
- Rebuild from beginning of 2013 at GANIL

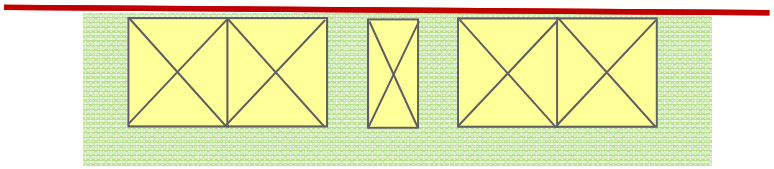
Best intensities obtained for A/Q=3 ions



PHOENIX concept and V2 configuration







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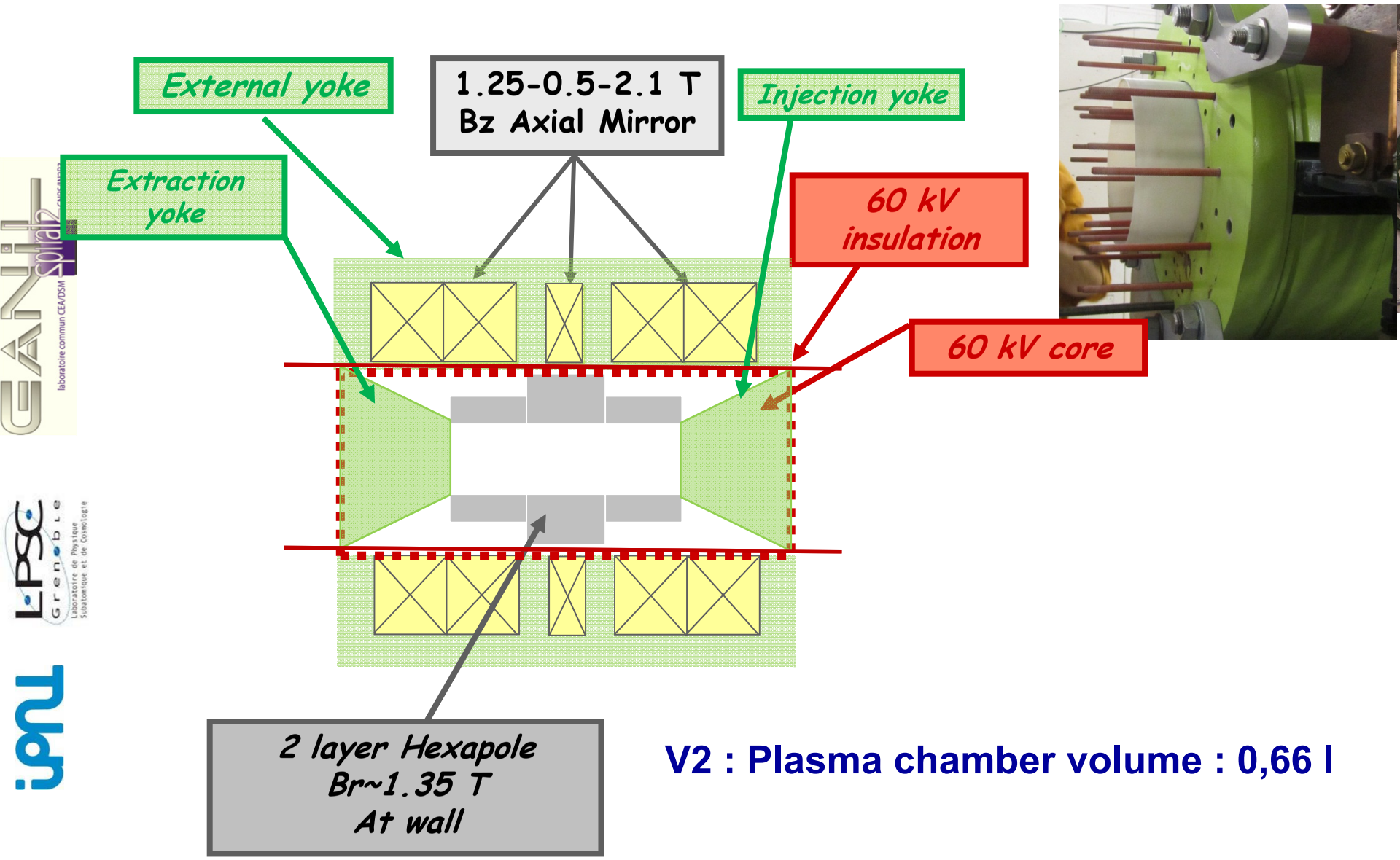
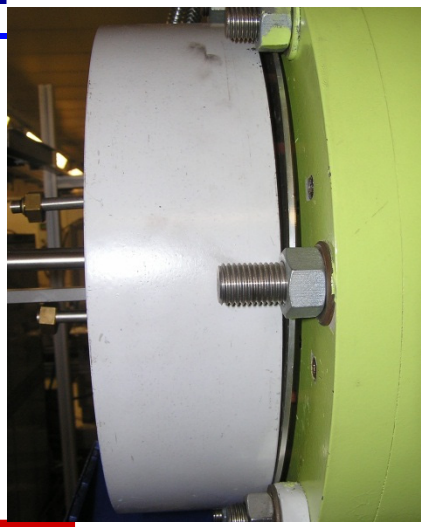
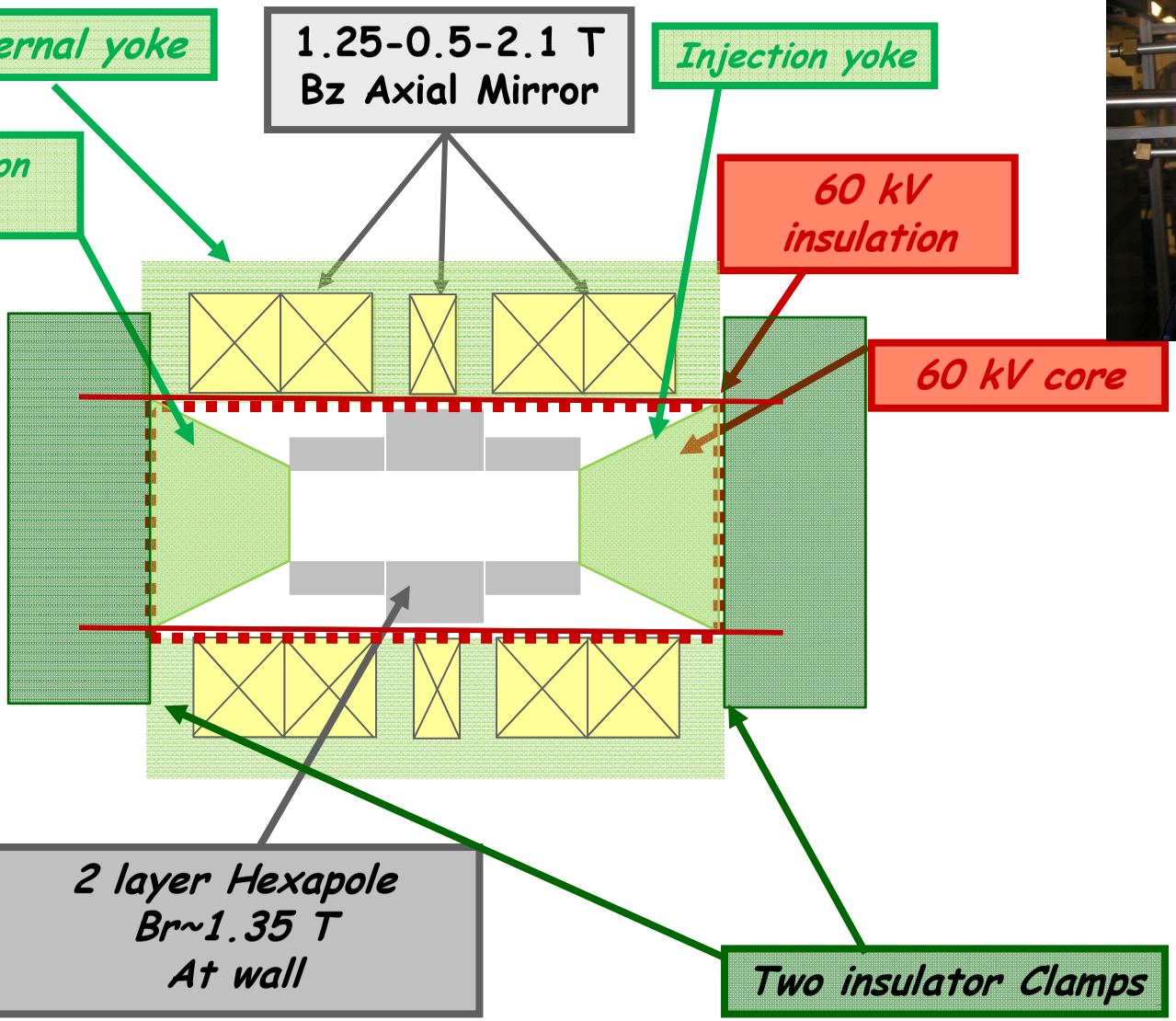


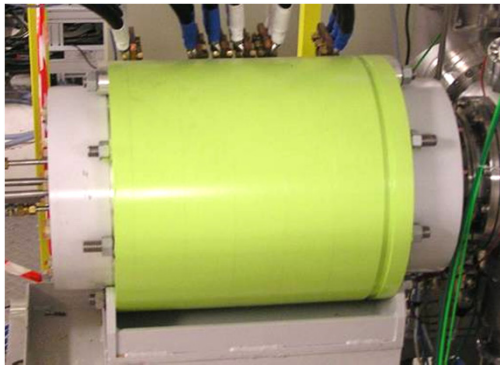
V2 : Plasma chamber volume : 0,66 l

PHOENIX concept and V2 configuration



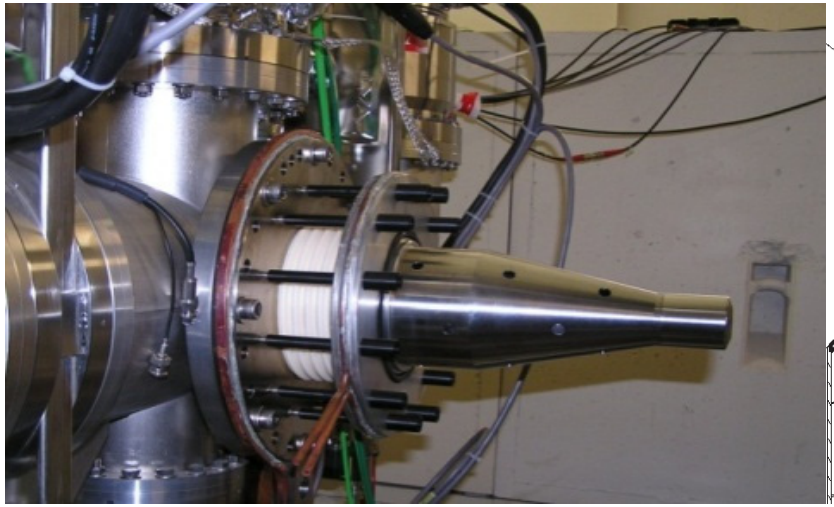


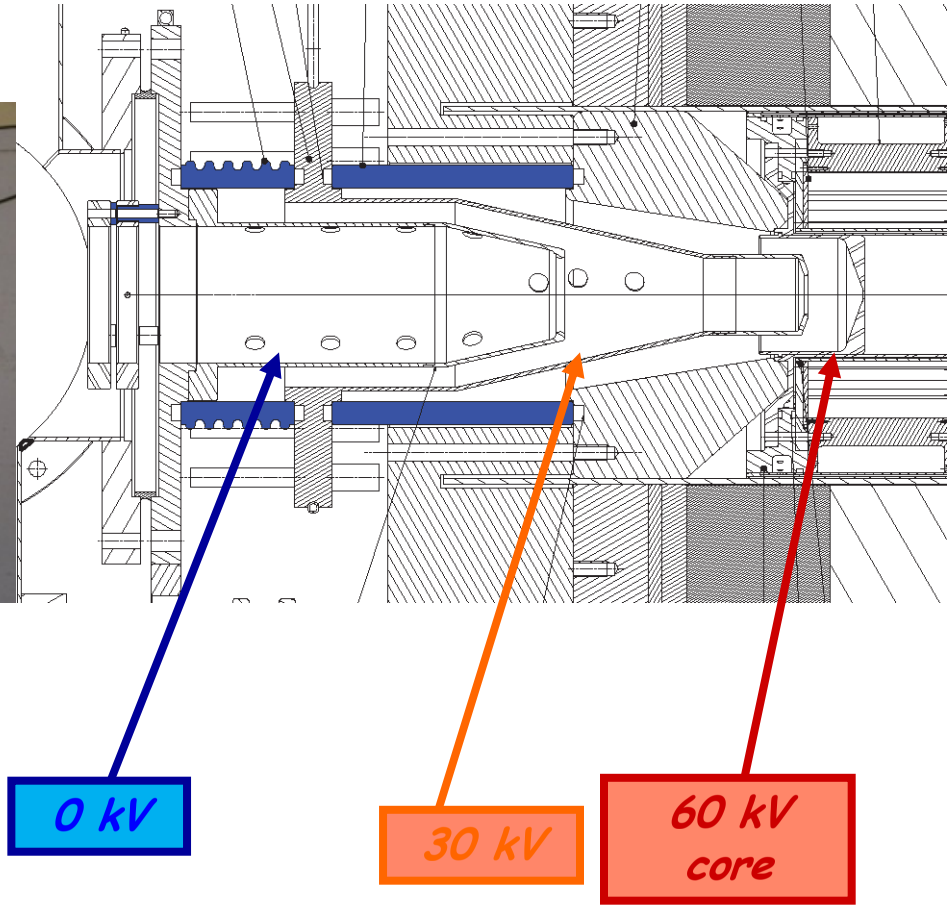
PHOENIX concept and V2 configuration



PHOENIX V2 : new extraction at 60 kV

- New 60 kV ion extraction system with double electrode
- Gap : 44 mm
- Ø plasma electrode : 10 mm
- Ø extraction electrode : 18 mm



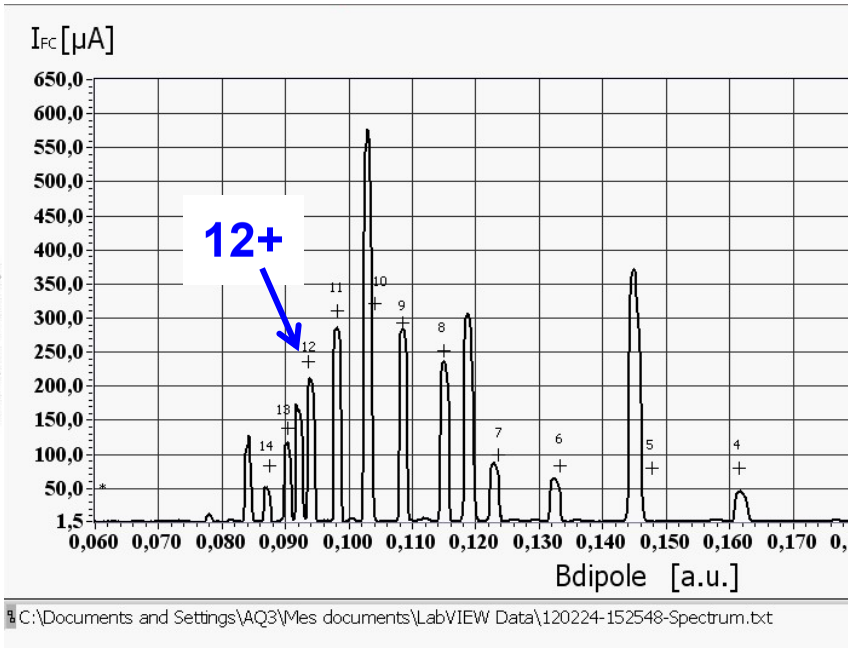


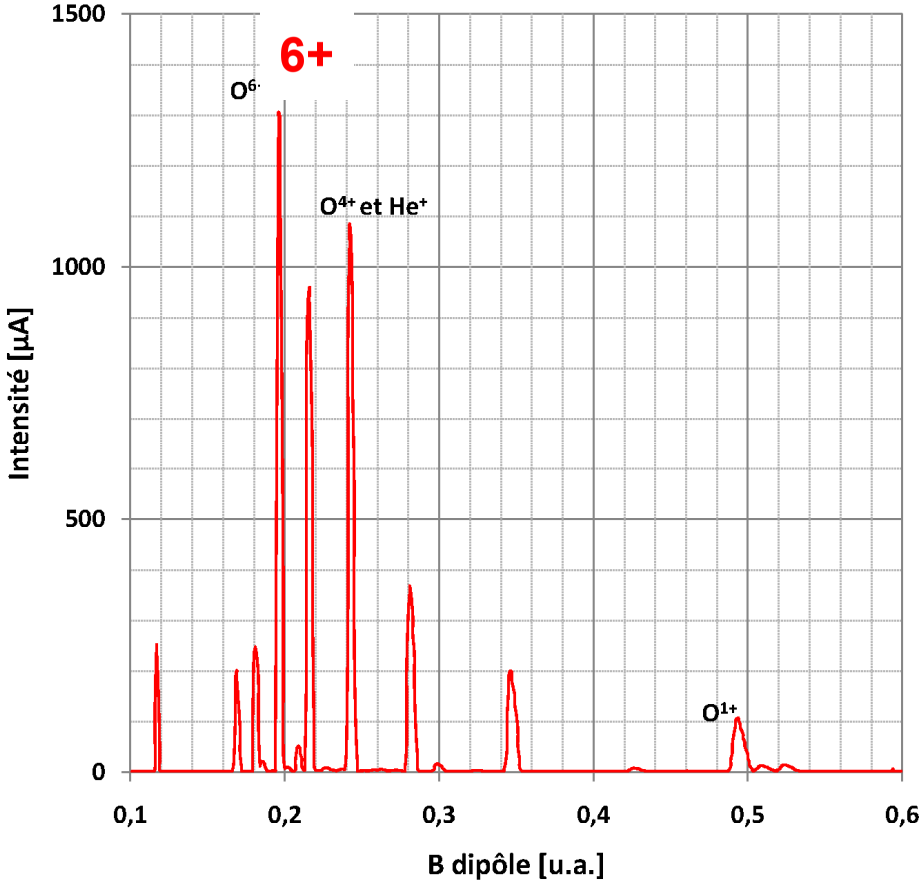
Recent results with Oxygen and Argon beams at 60 kV

1.3 mA , Oxygen 6+ at 60 kV Beam Produced with PHOENIX V2

RF power at emitter : 1.6 kW

Reliable and stable beam

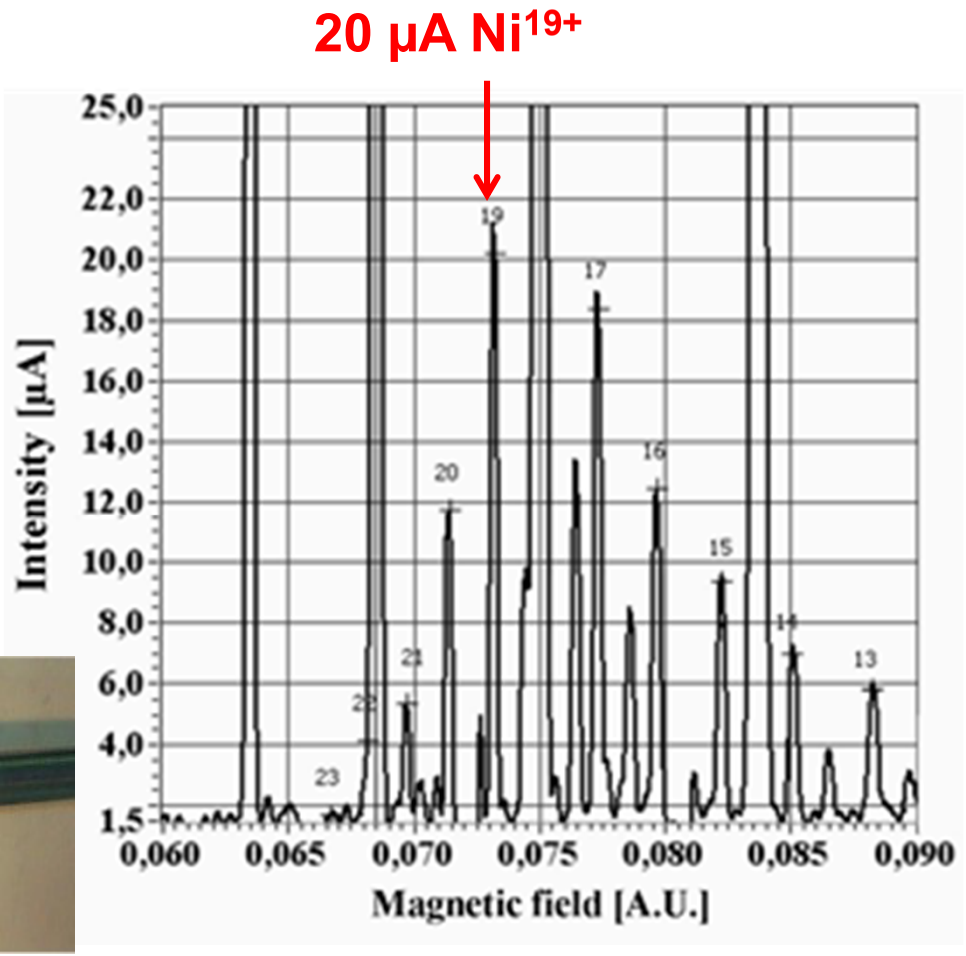




200 µA Argon 12+ at 60 kV Beam Produced with PHOENIX V2

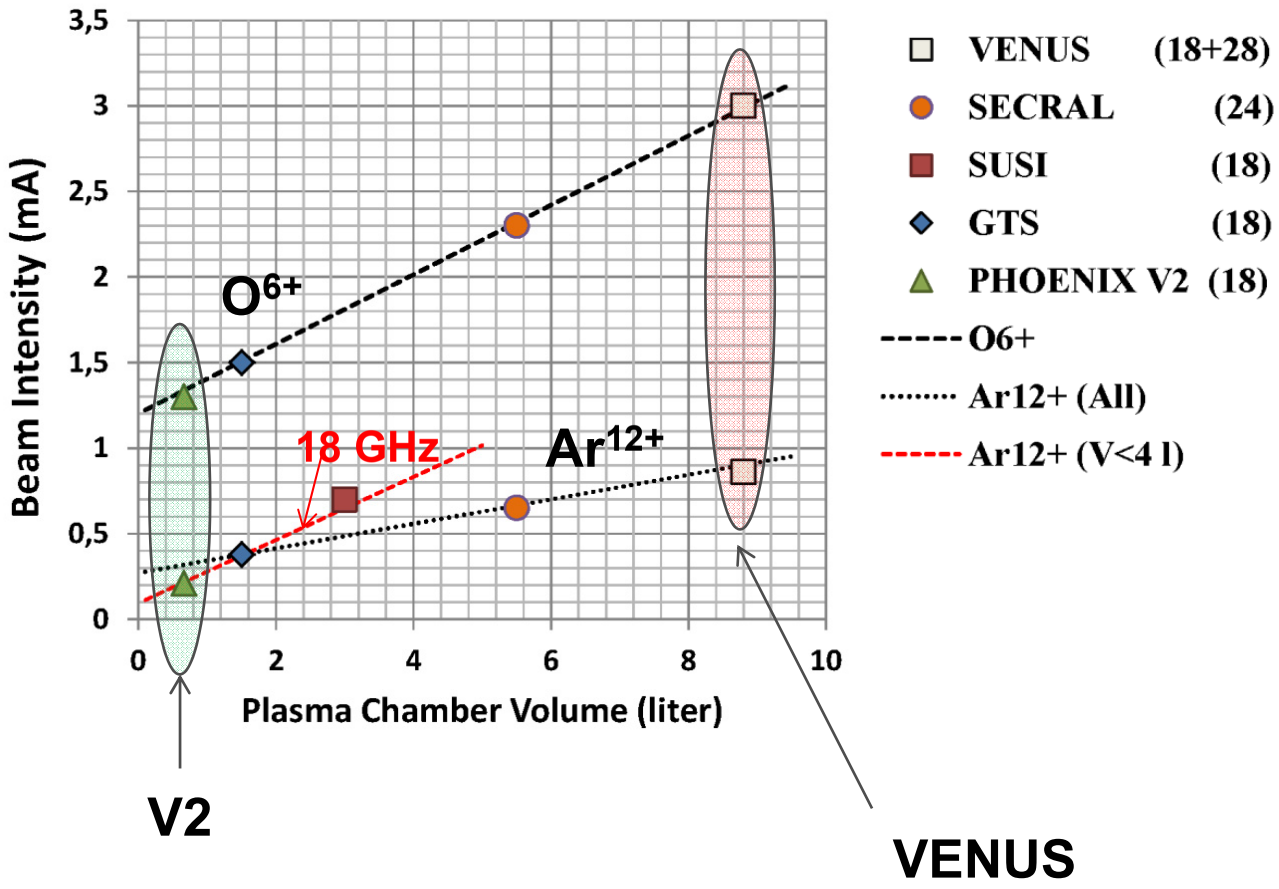
First Results with metallic ion beam : Nickel

- With Large capacity Oven developed by GANIL
- Ni consumption : 0.2 mg/h
- Intensity limited by max. temperature of oven
- Very stable beam



- High charge state thanks to :
  - Very low pressure in LEBT : 2 10^{-8} mbar
  - Pressure lowered by Getter effect (dominant effect in compact source)
  - Buffer gas flux should be carefully adapted to compensate Getter effect

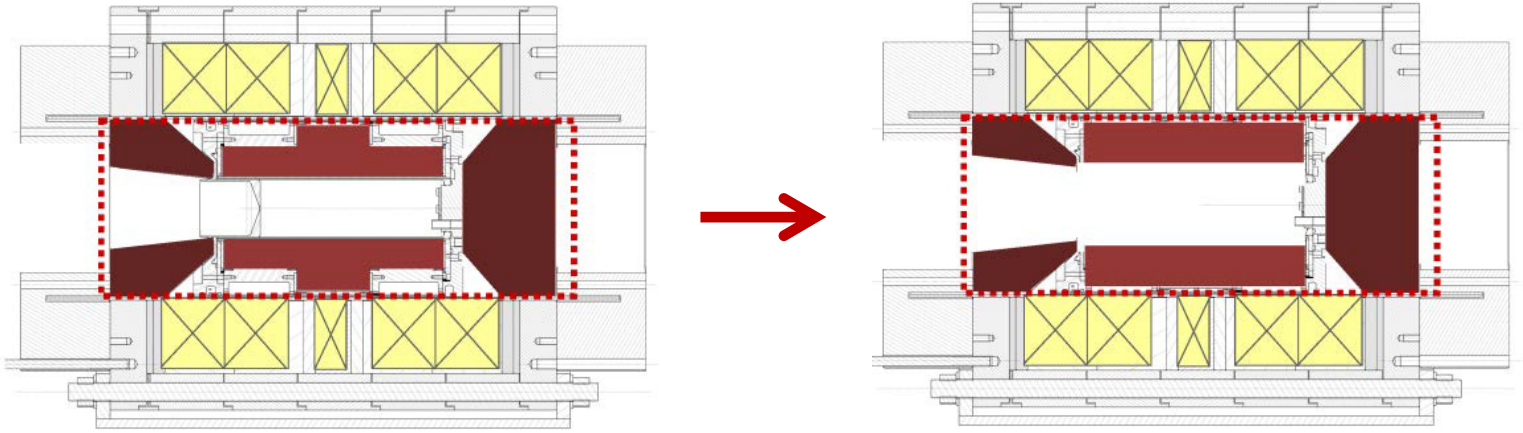
Plasma chamber volume effect on A/Q= 3 beams



- **Need to build a large volume to increase beams of multicharged ions**
  - **Larger ECR surface enhances ion production rate**
  - **Higher confinement time**

Planned upgrade : Phoenix V2→V3

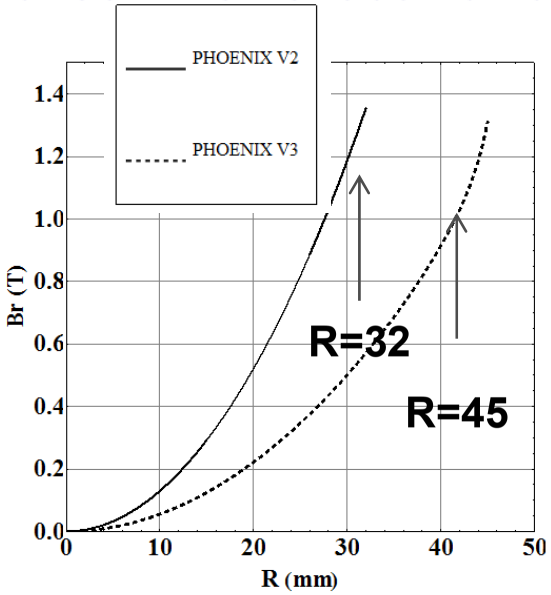
- **Goal : Increase beam intensity by increasing plasma chamber volume from 0.6 to 1.3 liter**
- **expected M/Q=3 beam intensity increased by 50 to 100 %**
- **Magnetic confinement kept**
  - **Axial magnetic structure identical to PHOENIX V2**
  - **Radial magnetic intensity at wall almost unchanged**
- **Reversible design, easy to implement thanks to PHOENIX concept :**
  - **Only the central High Voltage core is changed**
  - **Allows short switching between V2 and V3 configuration during operation**

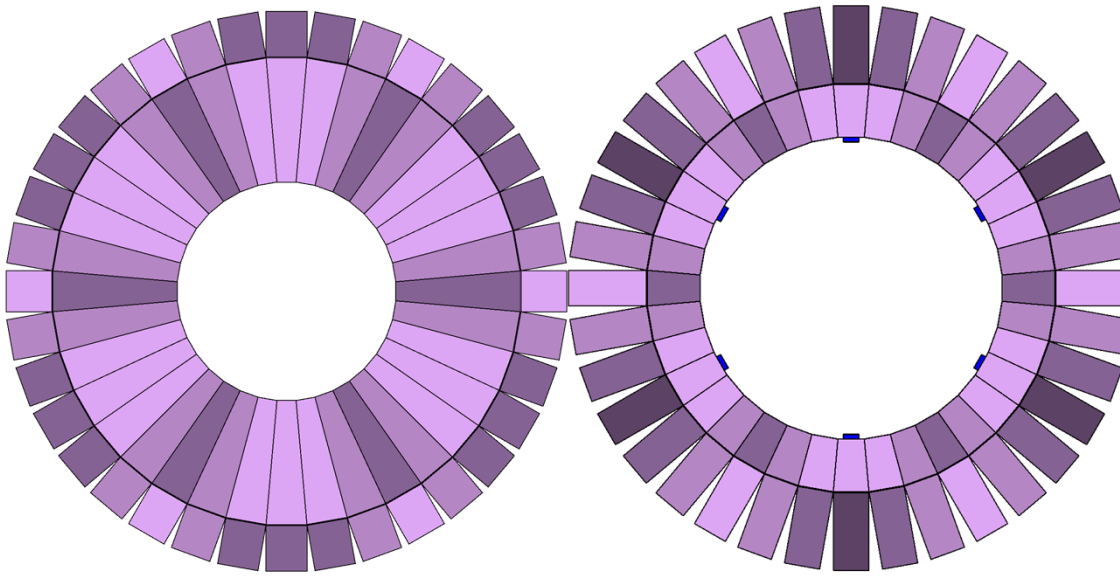


V2 **V3**

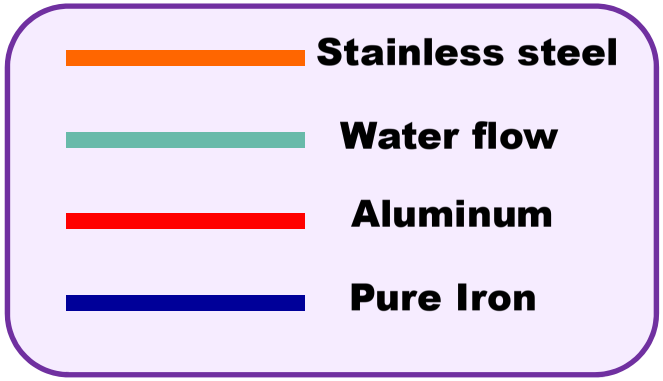
PHOENIX V2 and V3 Hexapole

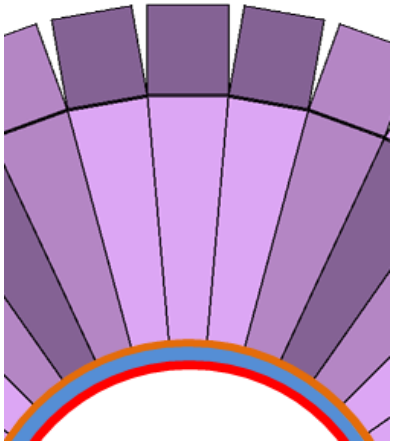
Radial confinement at wall almost unchanged

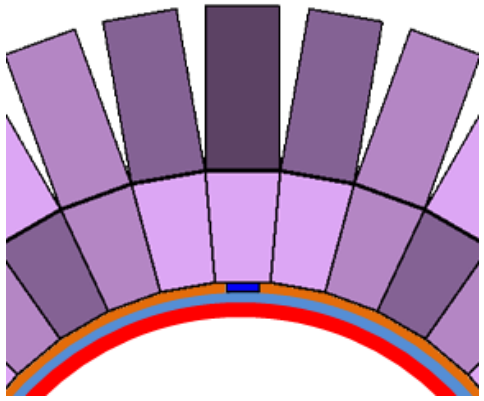




V2 V3

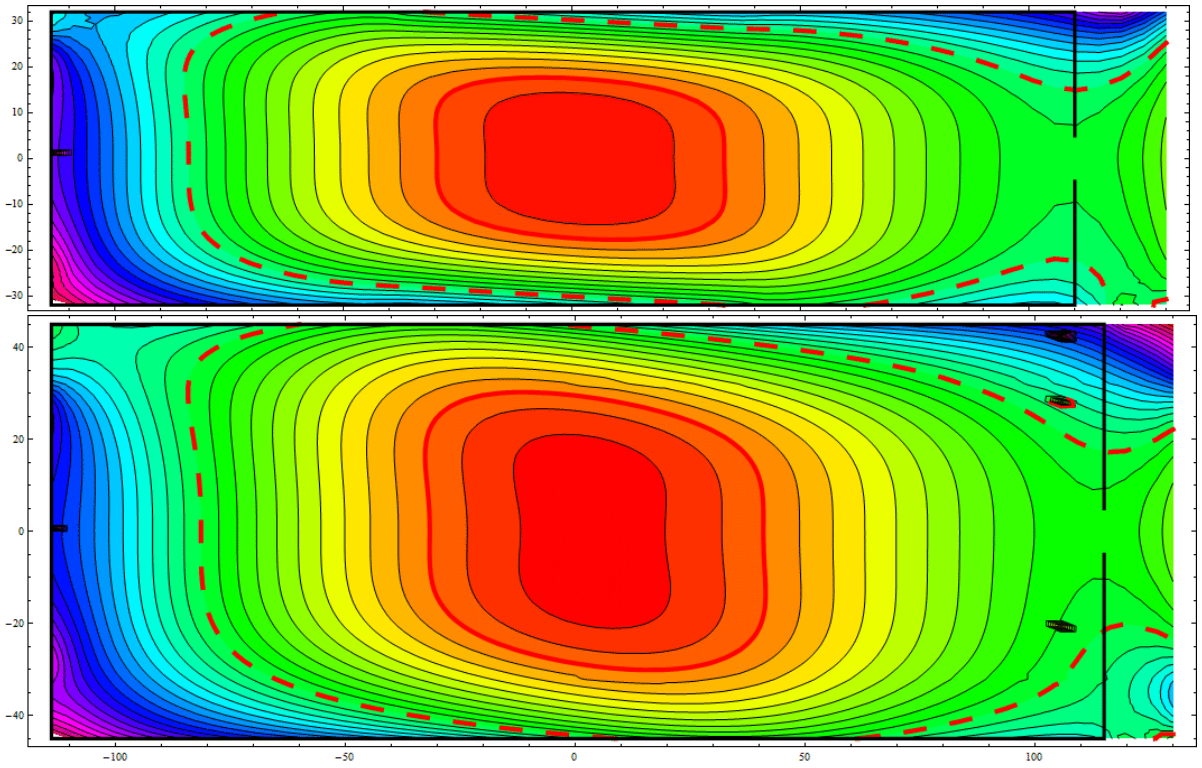


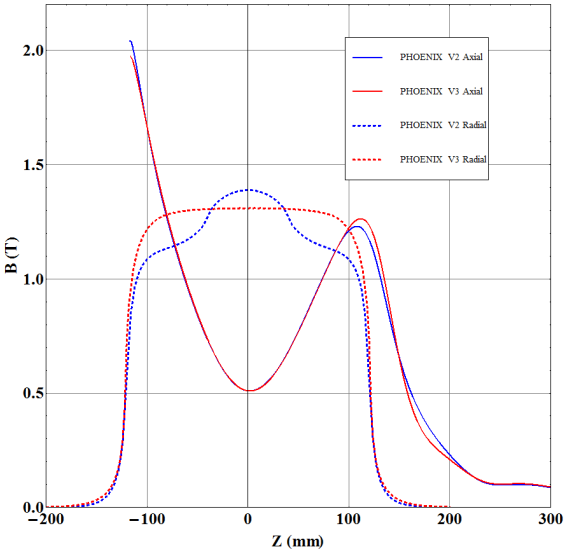




PHOENIX V2 et V3 min-B structure

- Volume doubled (0.66->1.3 l.)
- Same axial magnetic mirror
- Same distance of ECR zone to the wall
- ECR Zone doubled



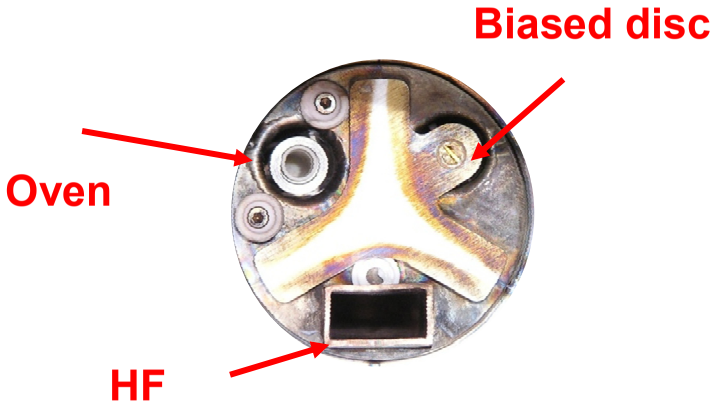


Bz(Z) solid

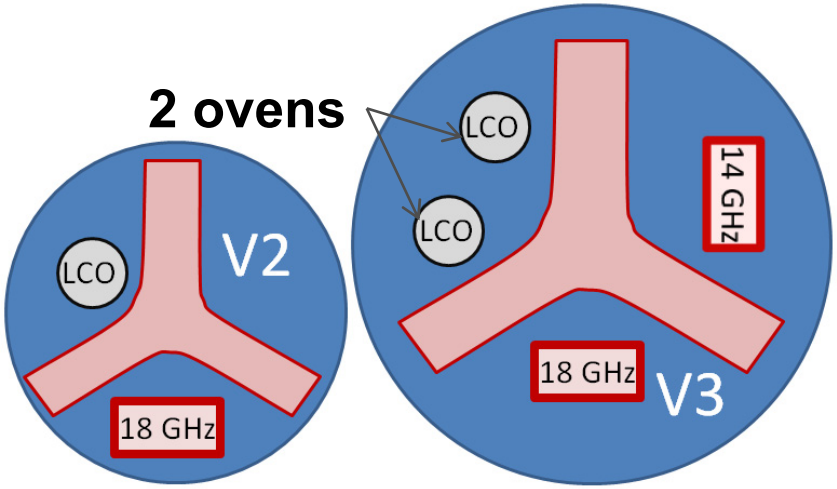
Br(Z) at wall dash

PHOENIX V3

- Ion extraction study collaboration with GSI
  - experimental/simulation comparison between V2 and V3
- Double RF frequency to be considered (14+ 18 GHz)
- Two oven can be used simultaneously to enhance A/Q=3 current



injection flanges for V2



injection flanges for V2 and V3

- Preliminary Magnetic structure of hexapole done
- Detailed design to be started soon
- Commissioning scheduled for mid 2013
- First beam with PHOENIX V3 expected in September 2013