Status of the $\text{H}^-/\text{p}$ source for ELENA

Preparations at Jülich

17. 06. 2013 | Ralf Gebel
Outline / Current main activities

• Preparation of test bench and source cage
  • Power, water, Hydrogen and pressurized air distribution
  • Computer control and interlock
  • Diagnostics

• Simulation and verification
Preparation of test bench
... ion source and 19“ racks (depth 800 mm)
FZJ power distribution (current state)

Main switch

Power box

Line out:
Circuit breaker
4 x FAZ B16
6 x FAZ B32

Main switch: Circuit breaker
3 x Neozed 16a
Rack connection

Connection

Line in

Water
Power distributor for vacuum pumps (3 Ph + N + PE)

delivered with the source

16 x Neozed 16a

4 x DIL M9-10
24 V 4 kW
Power supplies, transformer

120 kV – 400 Hz
(and spares)
Water cooling

Deionized (< 0.2 µS/cm)

~ 6 bar

4 x > 360 l/hour for the source

+ rack supply
+ vacuum pump supply

We might cut here:
(PCL needs interlock signals)
PCL realization

Simatic S7-300
with FO-link to peripheral devices on the high voltage platform

Interface for operator:
WinCC on a network connected PC
PCL interface
as seen by the source operator
Hydrogen generation

Hydrogen consumption: max. 9 l/day

- Current test of a H$_2$ generator and HydroStik-pro (metal-hydride) instead of bottles (based on fuel cell technology)
The negative ion source

IBA negative ion source (product information 1991)
Simulation – electron filter system

Permanent magnets for generation of a filter field

Electrons should be suppressed

H minus deflection needs correction
Simulation: electron filter

Path of a few electrons inside the plasma chamber

Check of several magnet configurations at the source

Next: add electrostatic part
Magnetic field contour plot: 0 .. 0.5 mT
Diagnostic beam line

A fixed, biased plate, used as cup and viewer.

~200 µ H⁻
dot distance: 10 mm
Beam spots (0.6 m beam line, 20 keV)

H- (~200 μA, 20 keV)
4 mm aperture
focused by e-quad-doublet
to minimum spot size
(by eye)
Horizontal beam profile

\[ y = y_0 + \frac{A}{\sqrt{\pi} w} \frac{e^{-\frac{(y-y_c)^2}{w^2}}}{w} \]  
(Gaussian)
Vertical beam profile

\[ y = y_0 + \frac{A}{w \sqrt{\pi / 2}} e^{-\frac{(x-x_c)^2}{w^2}} \]

\( (\text{Gaussian}) \)

\(-1y_0 = 3843,22554, \quad x_c = 0,29605 \)
\( w = 1,41021, \quad A = 48778,08487 \)
\( \sigma = 0,70511, \quad \text{FWHM} = 1,660 \)
\( \text{Height} = 27598,17318 \)
Outlook

- Continuation of tests at 20 kV
  - Pulse schemes with semiconductor switches
  - Proton operation with tuneable extractor
  - Optimize extraction and filter arrangement

- Enable operation up to 100 kV
  - Installation of 120 kV transformer
  - Operation up to +/- 65 keV and +100 keV
  - COSY RP has started the approval process in 2013
  - ...
Questions

- Pulse parameters
  - Effort for simulation and diagnostics
  - Criteria for semiconductor switches
- Vacuum requirements
  - Two stages required (from FZJ)?
- Interfaces to
  - Safety
  - Power
  - Water
- ...