

jba

Facts and figures on S2C2 ion source: experimental characterization and extrapolated results for application in protontherapy

> Sébastien Henrotin 11th of May 2012

We protect, enhance and save lives

Outline

- A cold cathode PIG source for S2C2
- The test bench
- Results and statistical analysis
- Simulation of a pencil beam scanning treatment



A cold cathode PIG source for S2C2

Typical PIG behaviour



The test bench



Statistical analysis and results

Example of a pulse. Simulation of the capture.





Statistical analysis and results

Analysis of the charge/pulse distribution



- Slow drift
- Gaussian fit



Statistical analysis and results



- Analysis performed for different arc currents
- Major improvement of the dynamic: (from ~30 to ~500)
- Optimizations includes:
 - Chimney geometries
 - Gaz flow
 - Cathodes position



Pencil beam scanning simulation

Simulation of the treatment of a prostate tumor, 1 Gy, 2353 spots. Assumptions:

- □ Time to switch the layer: 1 s
- Time for a pulse: 1 ms
- Beam line efficiency taken into account
- Smallest pulse at the exit of the accelerator: 0.14 pC
- Largest pulse at the exit of the accelerator: 20 pC
- Measurement errors neglected
- Capture window: 7 µs
- Random number generator with a similar statistical behaviour.
- Efficiencies:
 - □ 30% of injection
 - 30% of extraction
 - □ 45/360 for the RF phase



A PBS simulation: results

Required charge/spot distribution



Mean: 2.1 pC, min: 0.39 pC, max: 20.8 pC



A PBS simulation: results

Irradiation error : smaller than +/-1%



2.5 cycles/spot in average

- Total treatment time : 35.5 s
- □ The irradiation of a cube (1 dm³, 2 Gy) gives 39 s
- Lifetime of the cathodes is huge (> 1 year)



Thx!

Many thanks to:

- Yves Claereboudt IBA
- Olivier De Wilde IBA
- Yves Jongen IBA
- Gabriel Krier IBA
- Pierre Mandrillon AIMA
- Jérôme Mandrillon AIMA
- Sébastien Quets IBA
- Fabrice Salicis AIMA
- Bruno Torremans IBA
- Patrick Verbruggen IBA



Chimney geometries





Beam line efficiency



iba

