Results from the drive beam electron source

Kévin Pepitone, Steffen Doebert, Bruno Cassany

Outline

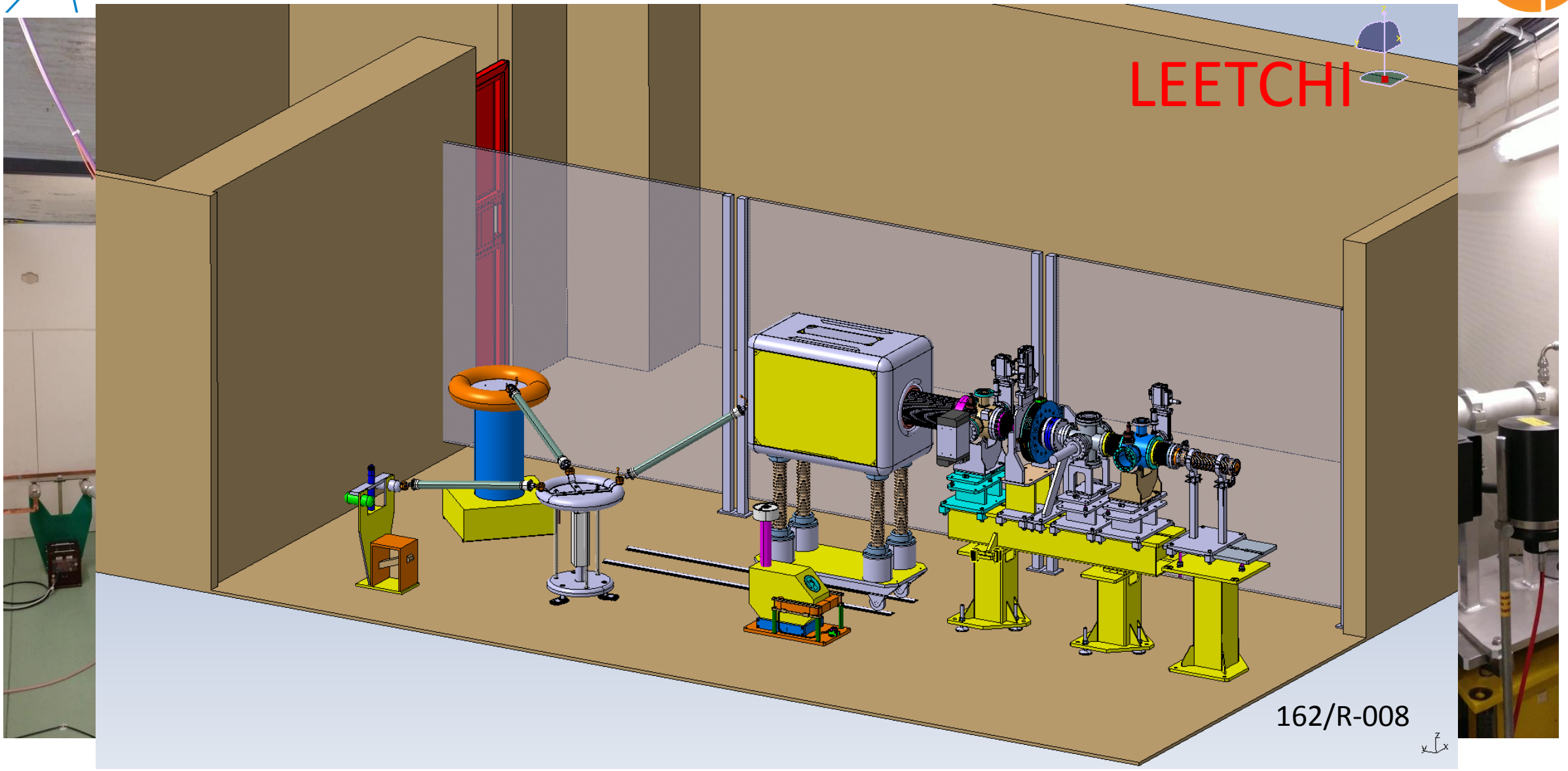
- CLIC drive beam electron source requirements
- Experimental prototype
- Cathode and connector
- HV and cathode conditioning
- Simulations
- Experimental results
- Conclusions

Electron beam parameters

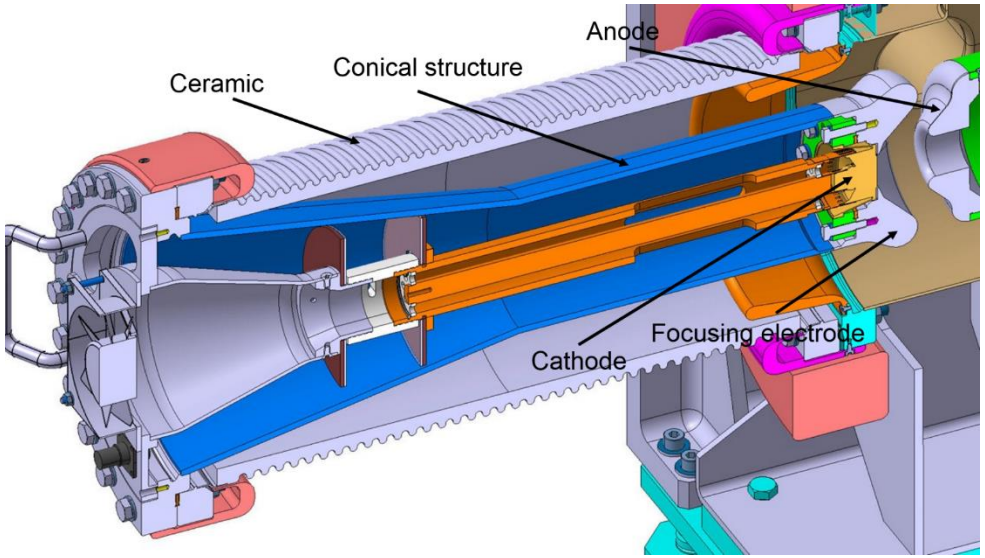
Parameters	Baseline
Beam energy	140 keV
Beam current	5 to 7 A
Pulse length	140 µs
Emittance (RMS)	< 20 mm mrad
Repetition rate	50 Hz
Beam power	4,9 to 6,9 kW
Shot to shot charge variation	0.1 %
Flat top charge variation	0.1 % after correction

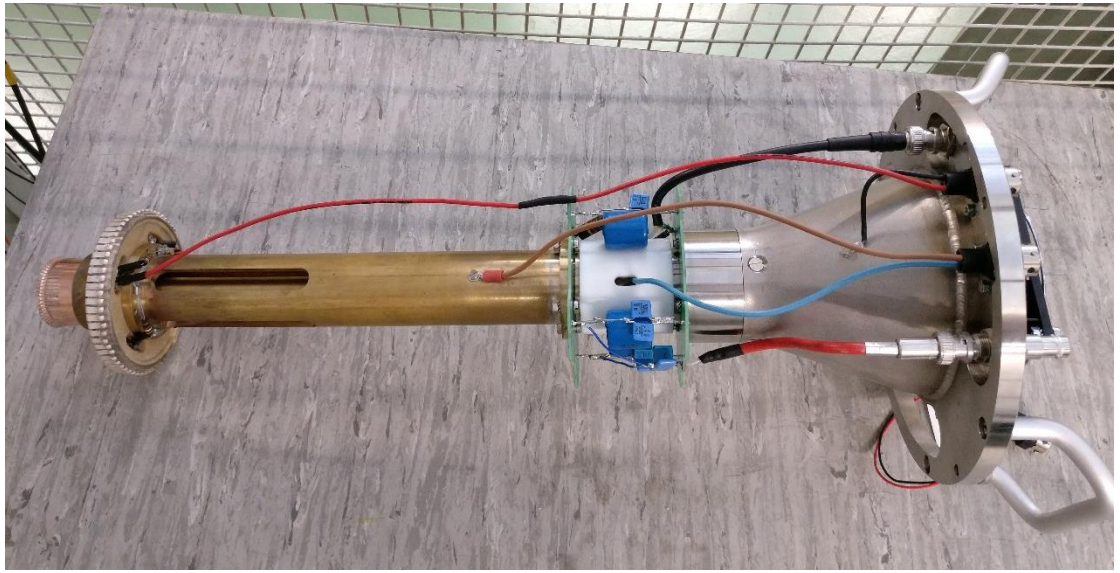
From a thermionic cathode

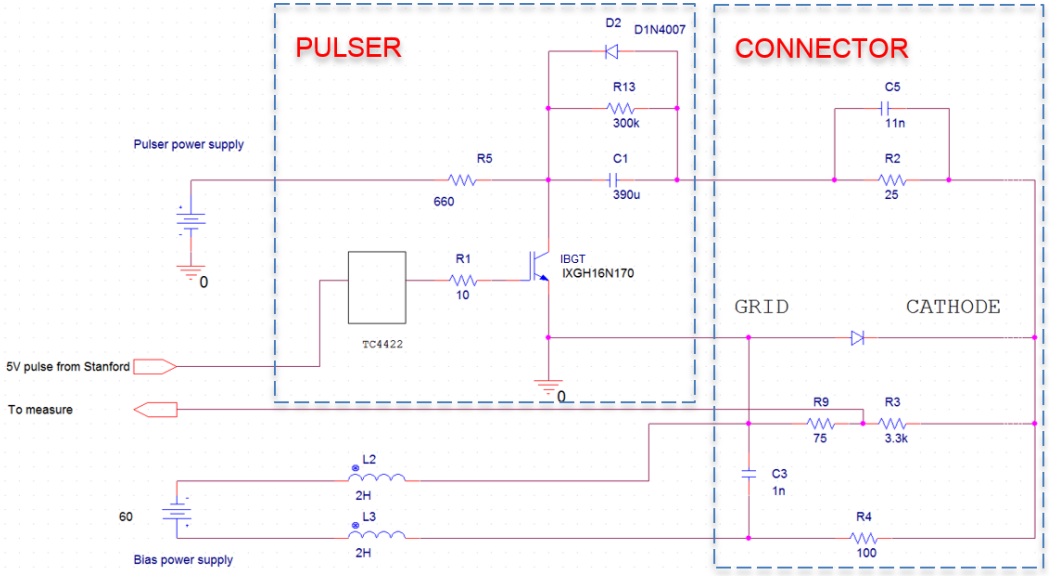
LEETCHI



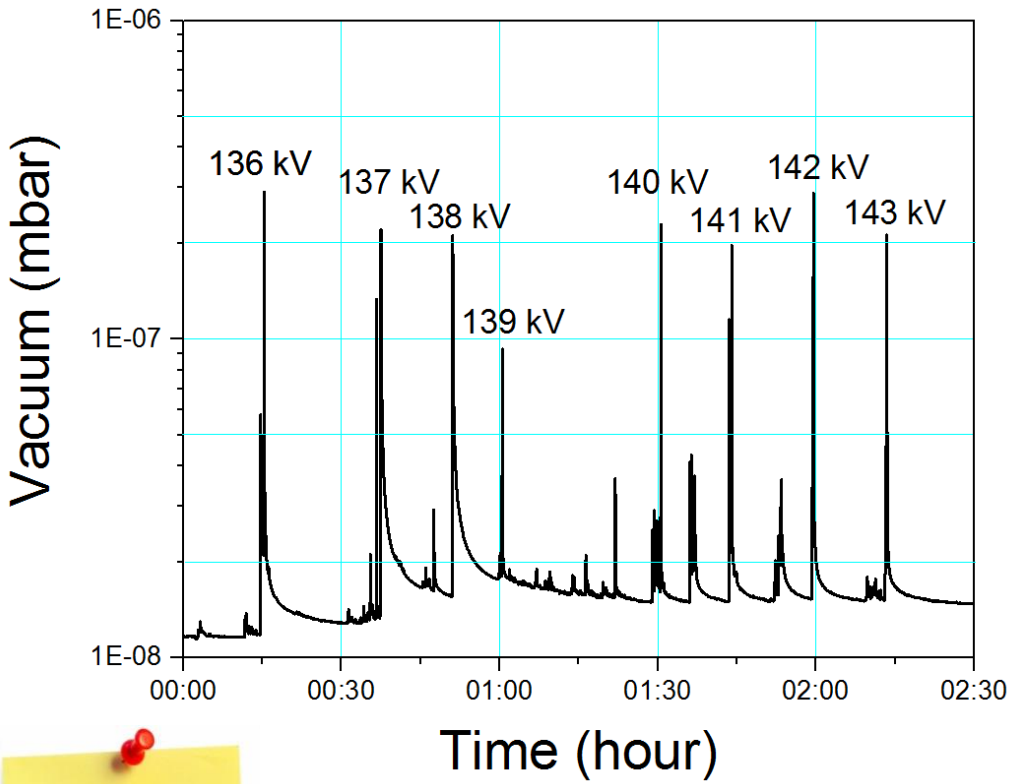
Cathode and connector



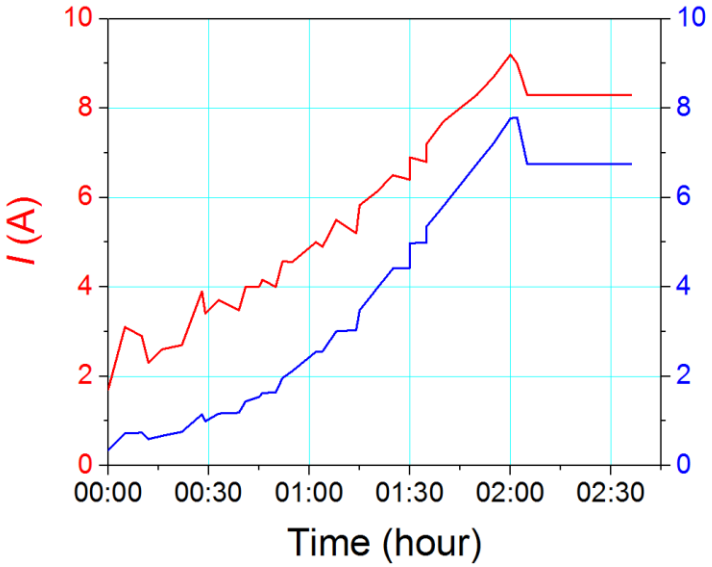


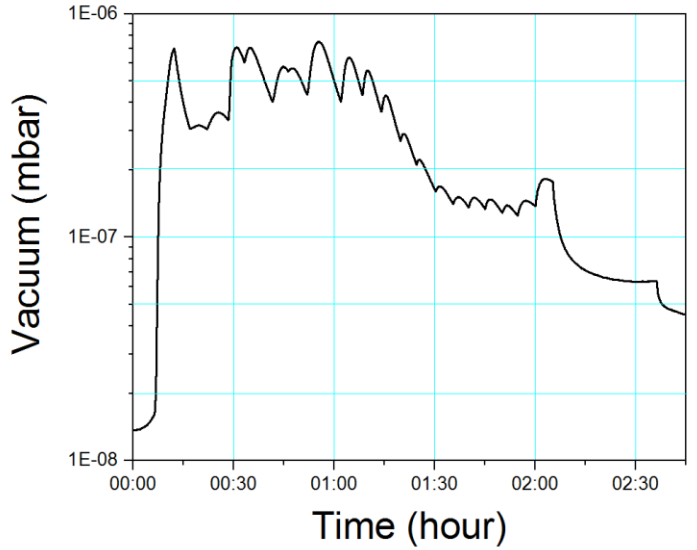


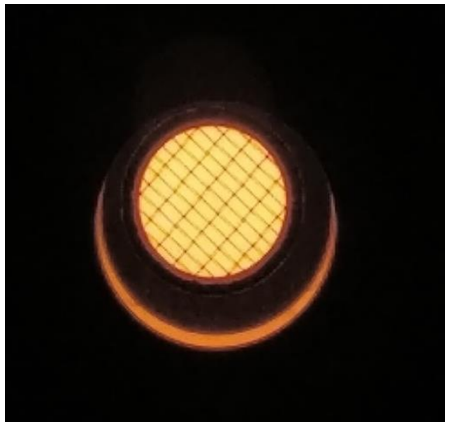
HV and Cathode conditioning



Spring 2016







Summer 2016

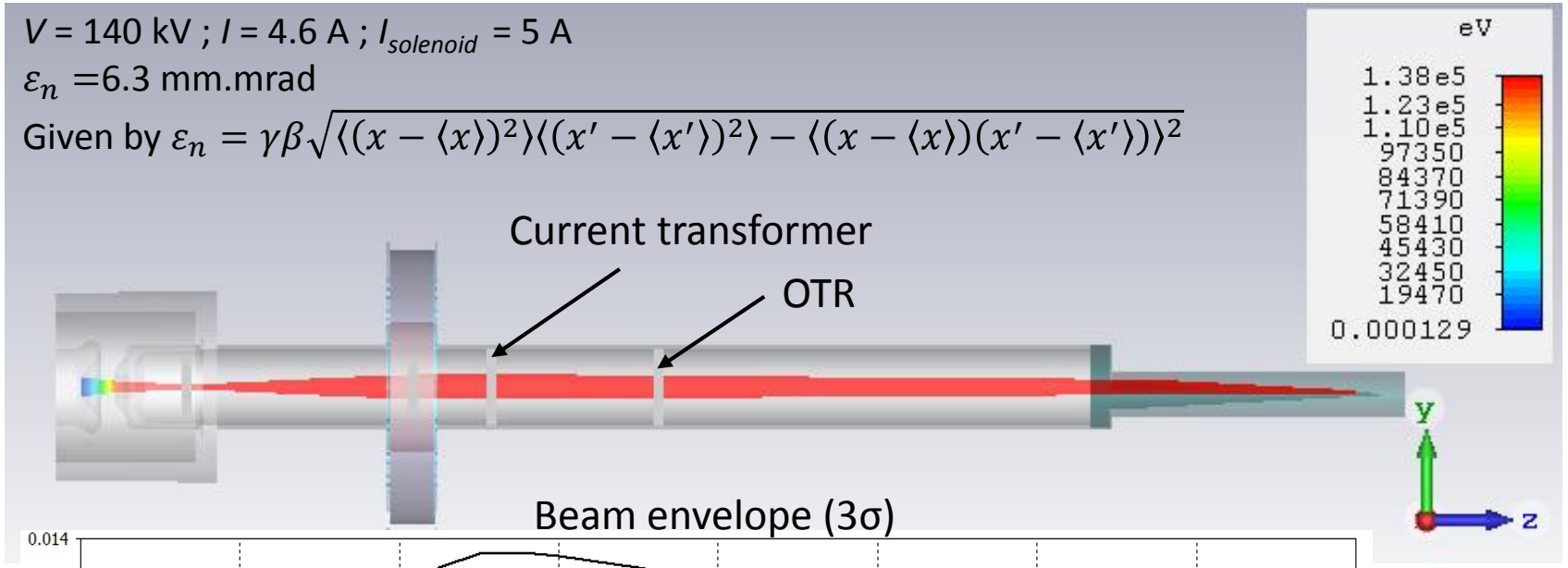
Simulations

CST studio Tracking solver

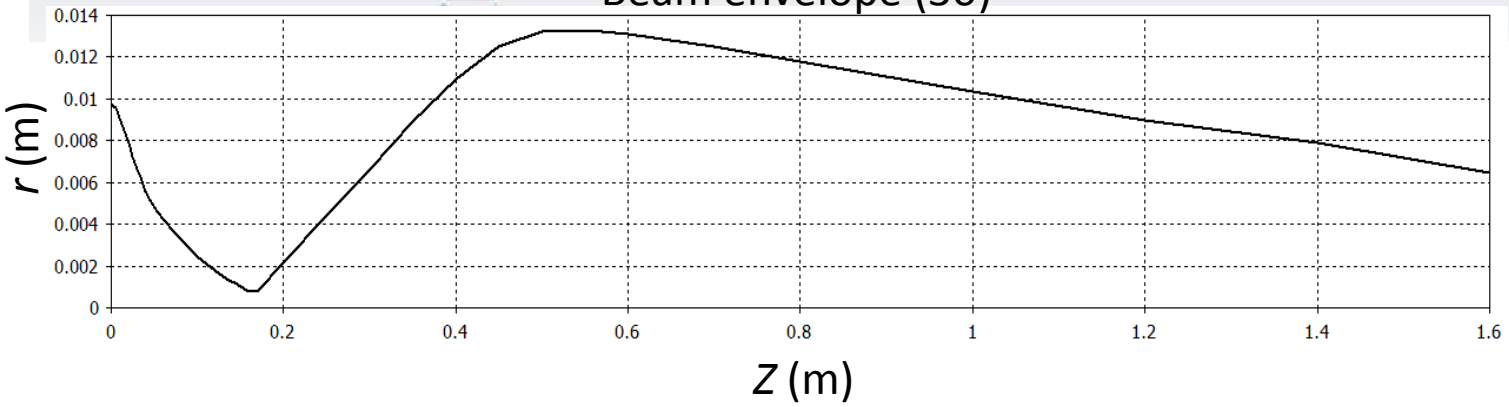
V = 140 kV ; I = 4.6 A ; $I_{solenoid}$ = 5 A

ε_n =6.3 mm.mrad

Given by $\varepsilon_n = \gamma\beta\sqrt{\langle(x-\langle x\rangle)^2\rangle\langle(x'-\langle x'\rangle)^2\rangle - \langle(x-\langle x\rangle)(x'-\langle x'\rangle)\rangle^2}$

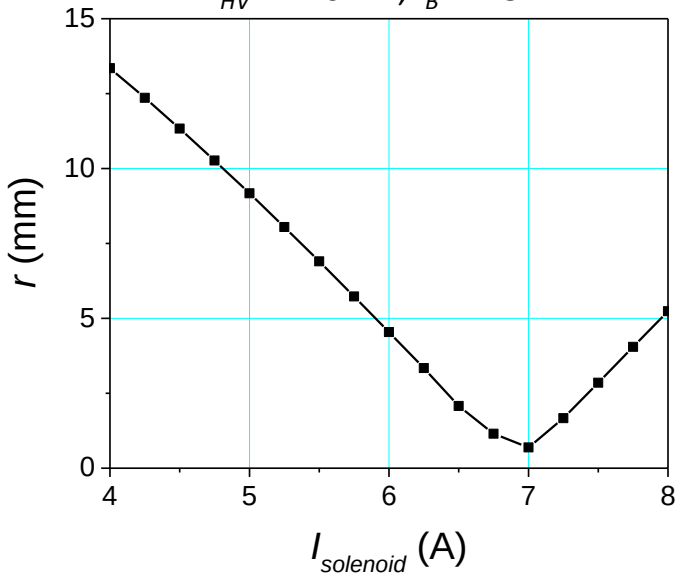


Beam envelope (3σ)



Radius as a function of the current in the solenoid (1σ)

V_{HV} = 140 kV ; I_B = 4.5 A

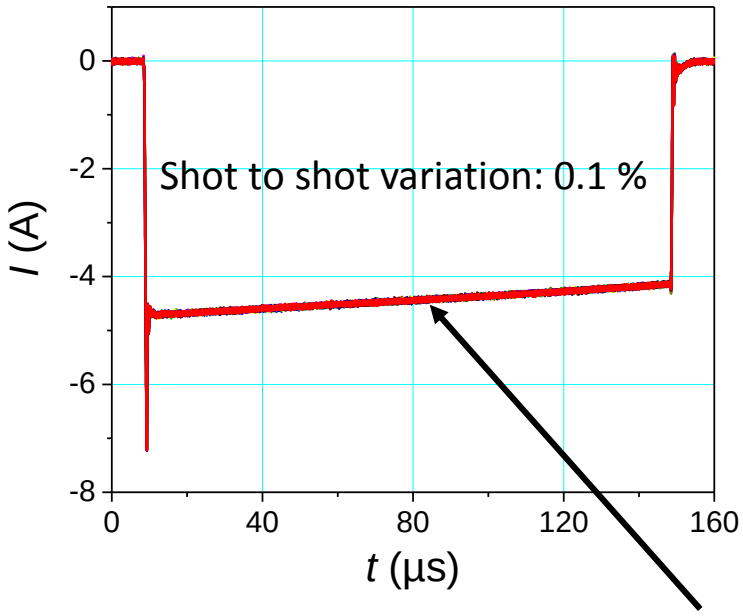


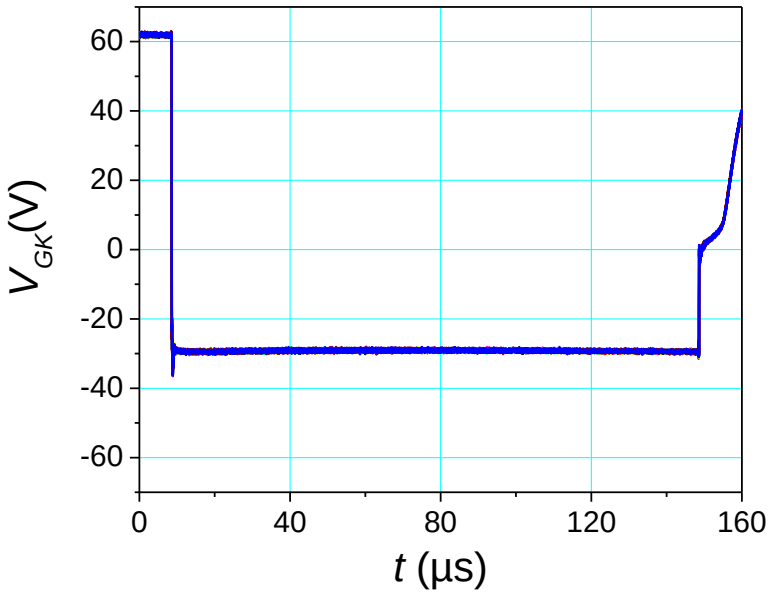
Experimental results

November 2016

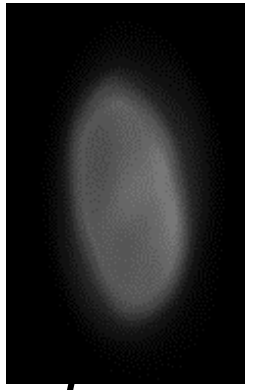
12 shots @ 0.05 Hz

V_{HV} = 140 kV ; t = 140 µs ; I_B = 5 A



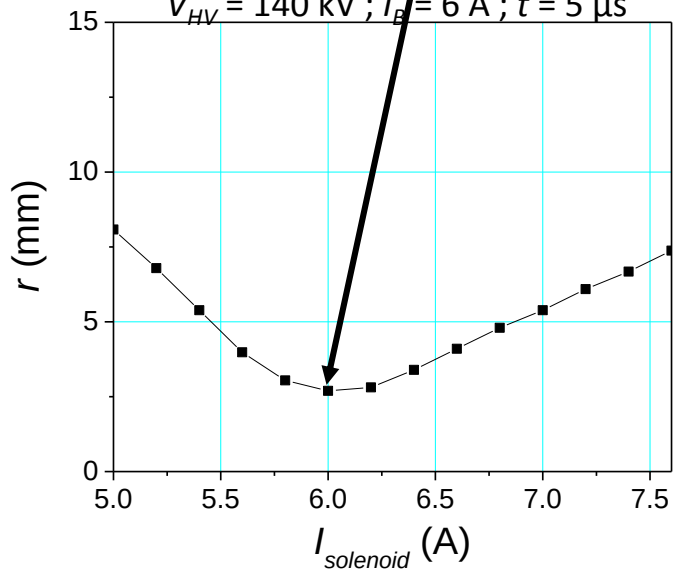


Capacitor discharge during the pulse, see Bruno's talk



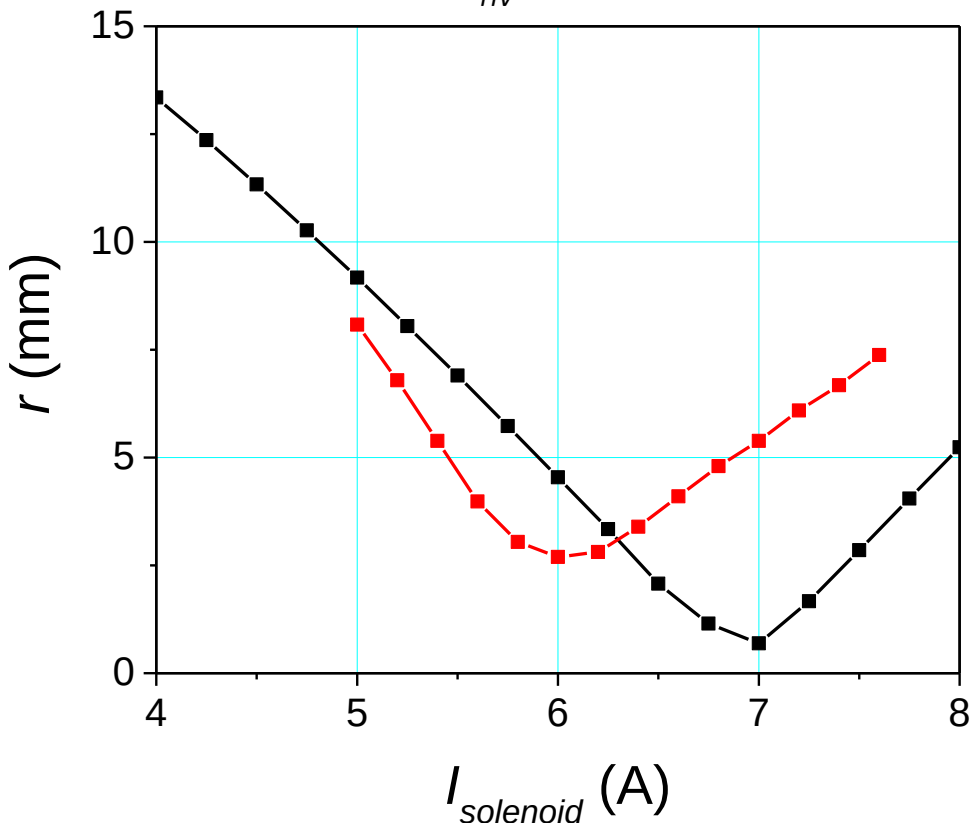
Radius as a function of the current in the solenoid (1σ)

V_{HV} = 140 kV ; I_B = 6 A ; t = 5 µs



Comparison between experimental results and simulations

Radius as a function of the current in the solenoid (1σ)
V_{HV} = 140 kV



CST (I_B = 4.5 A)
LEETCHI (I_B = 6 A, t = 5 µs)

A better analysis of these results is ongoing

Conclusions

- Encouraging results in single shot operation
  - LEETCHI is perfectly working at 140 keV
  - The mean current is 4.5 A @ 140 µs
  - Shot to short variation of the order of 0.1 %

- Next steps
  - Improvement on the beam stability over 140 µs
  - Emittance measurement
  - Increase the repetition rate

Thank you for your attention