



Additional ancillaries for the operation of the Hollow Electron Lens

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Hollow Electron Lens

Electron gun 5Ax15kV

Modulator

Instrumentation

Current transformers

BPM

Overlap/transvers profile monitor

Collector

Main SC solenoid 4-6 T

Gun solenoid 0.2-3T

Bending SC solenoids ~3T

6.4 – 6.5 m

The diagram illustrates the geometry of a hollow cathode assembly. It features a central vertical section labeled "ANODE" and two side sections labeled "CATHODE". The top section is labeled "C. ELECTRODE" and the bottom section is labeled "F. ELECTRODE". Dimensions are provided in millimeters (mm). Key dimensions include:

- Anode Section:** A semi-circular profile with a radius of R0.5. The total height from the base to the top of the anode is 16.2 mm.
- Cathode Section:** A rectangular profile with a width of 9.48 mm at the base and a height of 17.5 mm. The top edge has a radius of R0.5.
- Electrode Sections:** The C. ELECTRODE and F. ELECTRODE sections have a width of 9.48 mm at the base and a height of 17.5 mm. The top edge has a radius of R0.5.
- Other Dimensions:** The distance between the centerlines of the C. ELECTRODE and F. ELECTRODE is 17.5 mm. The distance between the centerlines of the C. ELECTRODE and the ANODE is 17.5 mm. The distance between the centerlines of the F. ELECTRODE and the ANODE is 17.5 mm.

node
water
x40V

V_{CA}

Control
electrode
4kVx40mA

Anode
modulator

16kV, I_{anode}
33kHz,
200ns rise time

Anode
modulator
MHz %current

Cathode -
Collector
PC

V_{CO}

Cathode
PC

High voltage (up to 15kV)
High current
 $V_{CA}-V_{CO} \sim 5kV$, $I_{beam}=5A$

High voltage (15kV)
low current (losses)
 V_{CA} , I_{tube}

mi
JECT

CERN

Preliminary Budget (uncertainty : $\pm 20\%$)

- **Magnets** powering: [989,1059] kCHF
 - Operational converters: 780 kCHF
 - Converter spares: 89 kCHF
 - Manpower (Assembly/Test/Installation) 100 kCHF
 - Control rack (GWs+Eth.Cabling) 20 kCHF
 - Coupled control (if needed: 1 fellow x 1 year) 70 kCHF (*)
- **HV** powering: 200 kCHF
 - Operational converters: 100 kCHF
 - Converter spares: 20 kCHF
 - Manpower (Assembly/Test/Installation) 10 kCHF
 - Control equipment: (PLC, FEC...) 30 kCHF
 - HV cables (computed for 70m length) 40 kCHF
- **“Baseline”** project (2 x HELs): ≈ 1.3 MCHF
- **Scenario 2** (3 circuits x main solenoid): + 140 kCHF

Key Points

- Preliminary proposal based on “baseline” configuration
- Budget: uncertainty accepted (HV to be redefined)
- Two main powering systems: Magnets and HV
- HV: DC powering only
 - Modulator beyond EPC expertise
- Magnets: “HL-LHC” converters 600A-10V and 60A-10V
 - based on upcoming redundant converters (full redundancy below 400A)
 - if new design needed overcost of 1MCHF per design (strongly not advised)
- Main solenoids: Energy Extraction allowed up to 1kV c.m.
 - 1.2 MJ (at 450A) to be managed (slow discharge, E.E. activation etc.)
 - no need of E.E. for 3 4 Henry-circuits currently foreseen (Scenario 2)
- Coupled control of circuits might require special solution
 - new control (hw&) sw might be needed: overcost already considered
- Estimates do not include DC cabling, AC, cooling and ventilation, ...