CEBAF Load-Lock Polarized Electron Photogun

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Outline

- Relevant EIC R&D
- CEBAF e- source
  - gun evolution
  - high current & longer lifetime
  - high current & high polarization
- Exciting directions
Relevant EIC R&D

200 kV gun for CEBAF NP
  • Qweak, PREX & other higher current experiments
  • Pursue enabling technologies
    • Inverted gun, ceramic insulators
    • FE elimination via HPR/EP/BCP

Polarized e- beam for e+ source
  • CEBAF at >1 mA for polarized positron source
  • Surface charge limit

Unpolarized e- beam for FEL/light sources
  • DC gun at >10 mA
  • Lifetime vs. laser handling (spot size, incident/ reflected power)
CEBAF e-source: gun evolution
Installed July 2007
Operated since September 2007

Key Features:
• Smaller surface area
• Electropolished and vacuum fired to limit outgassing
• NEG-coated
• Never vented
• Multiple pucks (8 hours to heat/activate any photocathode)
• Suitcase for installing new photocathodes (one day to replace all pucks)
• Mask to limit active area, no more anodizing
CEBAF e-source: current & lifetime

**Bulk GaAs w/ 532nm DC light**

- Improve vacuum
  - Reduce surface area
  - 400 C bake
  - Ion pump = Gas Source?

- Limit “bad” electrons
  - Eliminate FE
  - Laser handling

- Increase QE
  - Longer heat clean
  - Better vacuum

**High-P Photocathode**

March 2007

- Superlattice high-P material (85%)
- QE ~1% @ 780 nm
- Fiber laser (499 MHz @ 780nm)

**CEBAF-like Operation**
I=0.25 mA (~20 C/day)
Measured Lifetime ~0.25-1 kC
(translates > 1 week running/spot)

**EIC-like Operation**
I=1 mA (~85 C/day)
Measured Lifetime ~0.2 kC
(translates ~few days running/spot)

J. Grames et al., in Proc. of the 2007 Particle Accelerator Conference, THPMS064, p. 3130.
Exciting direction: inverted gun geometry

- Medical x-ray technology
- Ceramic not exposed to FE
- Compact, no SF6

Present design

New design?
Investigate SRF-cavity technique “high pressure rinsing”

Exciting direction: eliminate field emission

New electrodes, including single crystal Niobium...
Exciting direction: investing in design effort

- To date => more QE, polarization or laser power
- Now, opportunity to focus on cathode/anode design & first few meters of machine
- Want to “get it right” the first time
- Growing design/modeling expertise with PhD students:
  - Ken Surles-Law: 200kV gun
  - Ashwini Jayaprakash: ILC gun
  - Jonathan Dumas: polarized positron source
  - Alicia Hofler: RF gun and genetic algorithm