
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

- Ø Qweak, PREX & other higher current experiments
- Ø Pursue enabling technologies
 - Inverted gun, ceramic insulators
 - FE elimination via HPR/EP/BCP

Polarized e- beam for e+ source

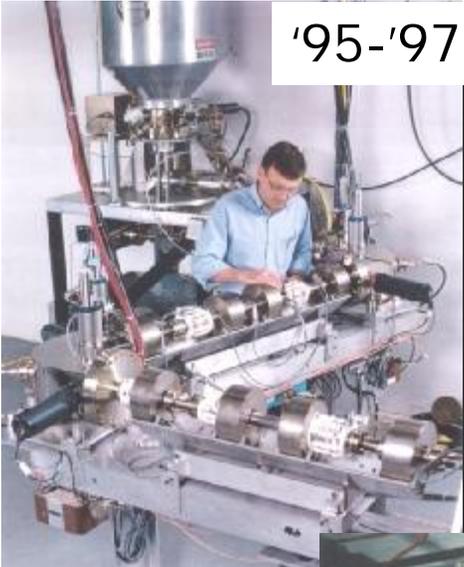
- Ø CEBAF at >1 mA for polarized positron source
- Ø Surface charge limit

Unpolarized e- beam for FEL/lightsources

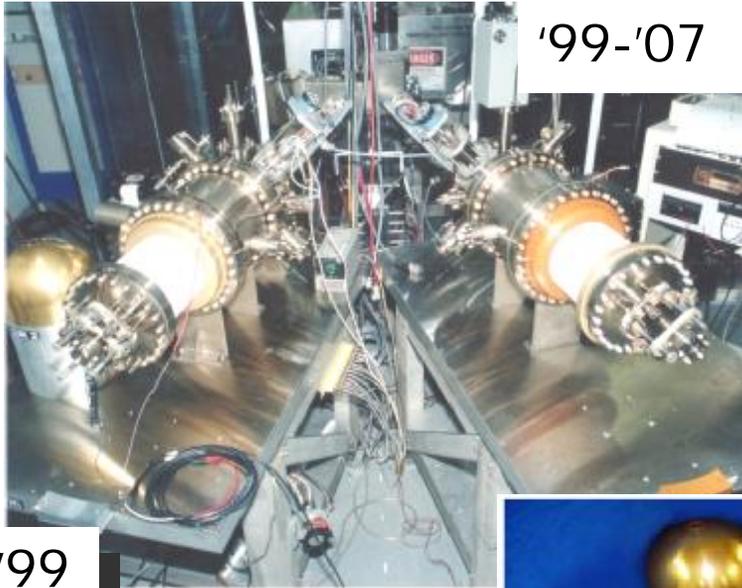
- Ø DC gun at >10 mA
- Ø Lifetime vs. laser handling (spot size, incident/reflected power)

CEBAF e- source: gun evolution

'95-'97



'99-'07



'98-'99



'01-'05



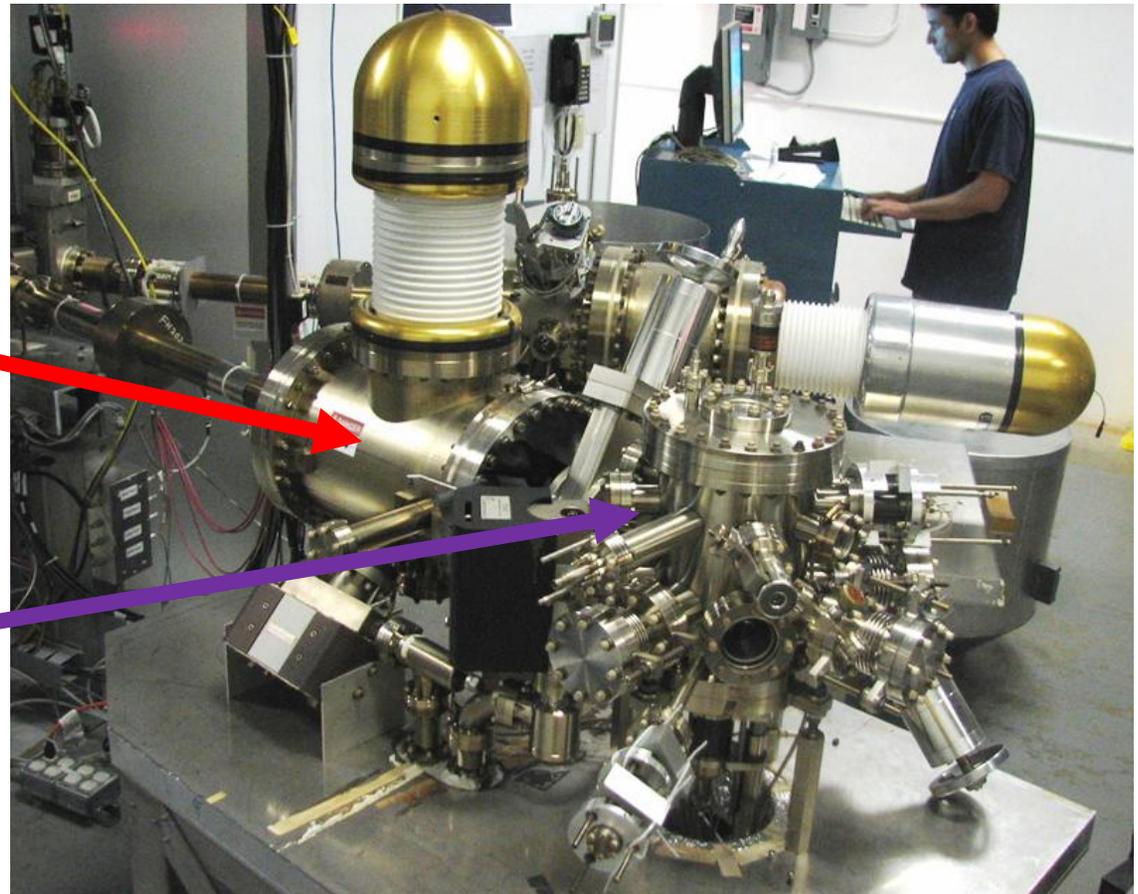
CEBAF e- source: today

Installed July 2007

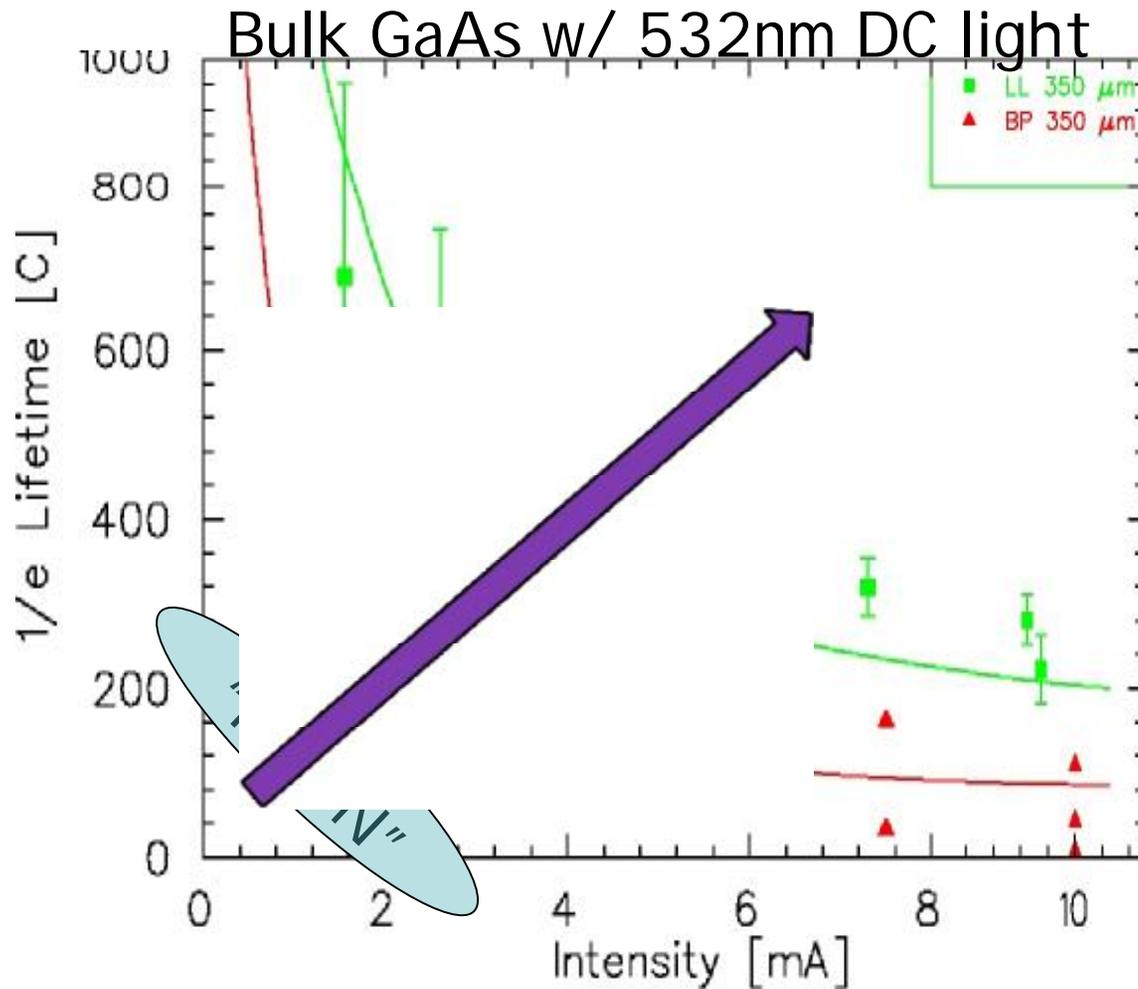
Operated since September 2007

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



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

J. Grames et al., in AIP Conference Proceedings 915, p. 1037-1044 (2006).

CEBAF e- source: high current & polarization

March 2007

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

CEBAF-like Operation

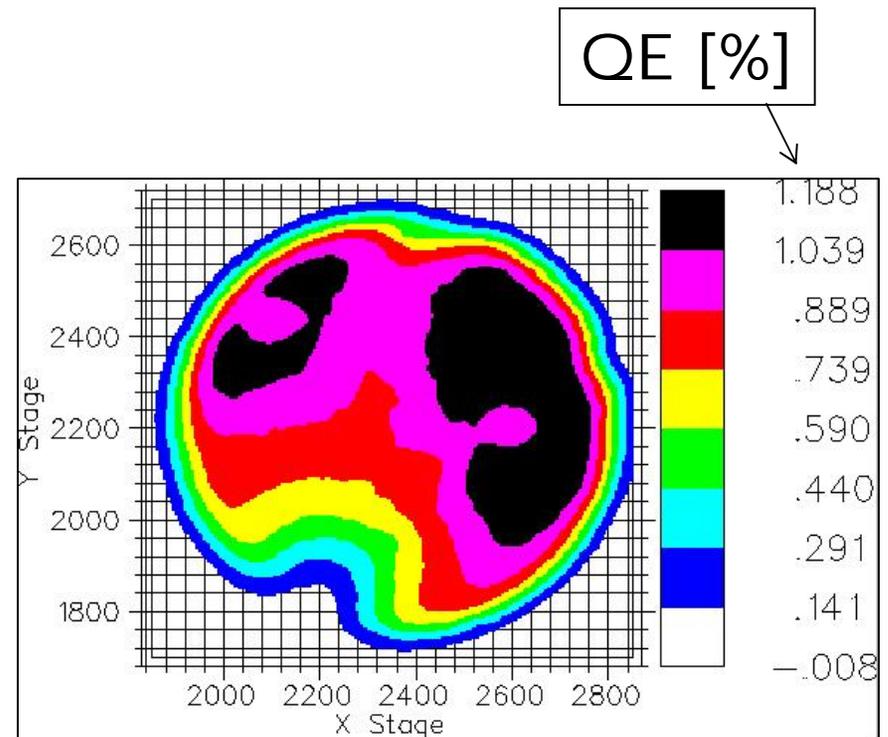
$I = 0.25$ mA (~20 C/day)

Measured Lifetime ~0.25-1 kC
(translates > 1 week running/spot)

EIC-like Operation

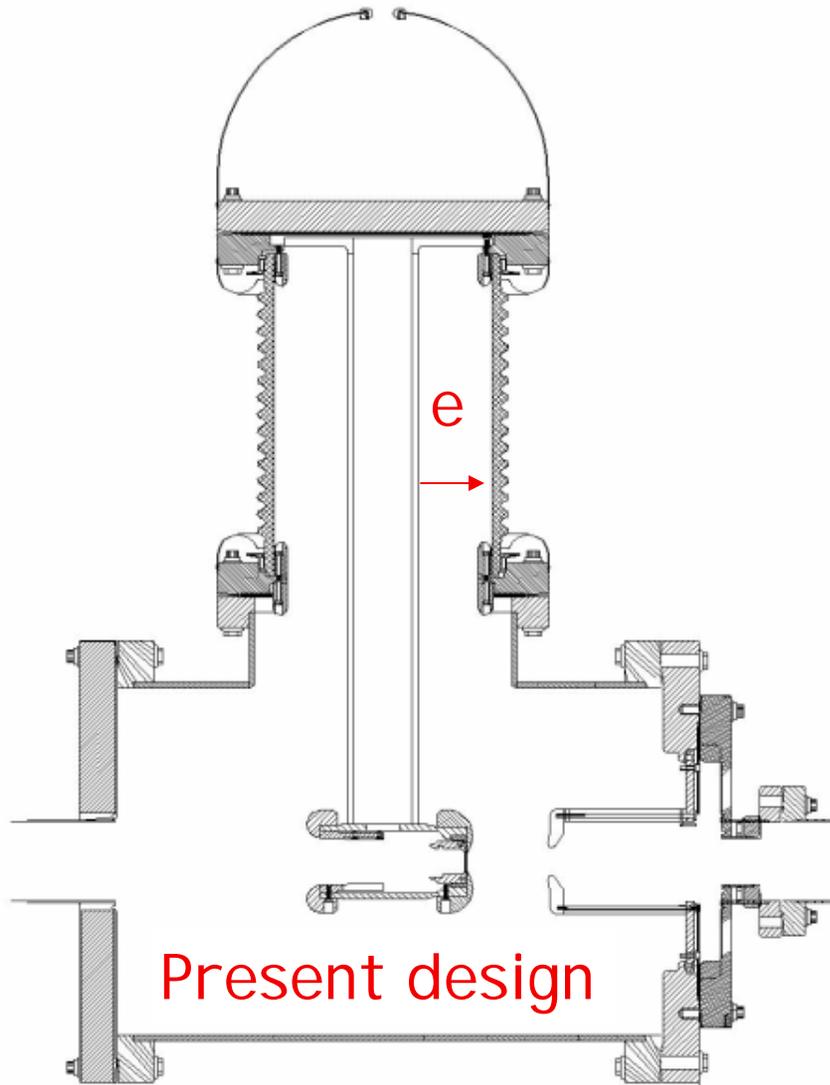
$I = 1$ mA (~85 C/day)

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.

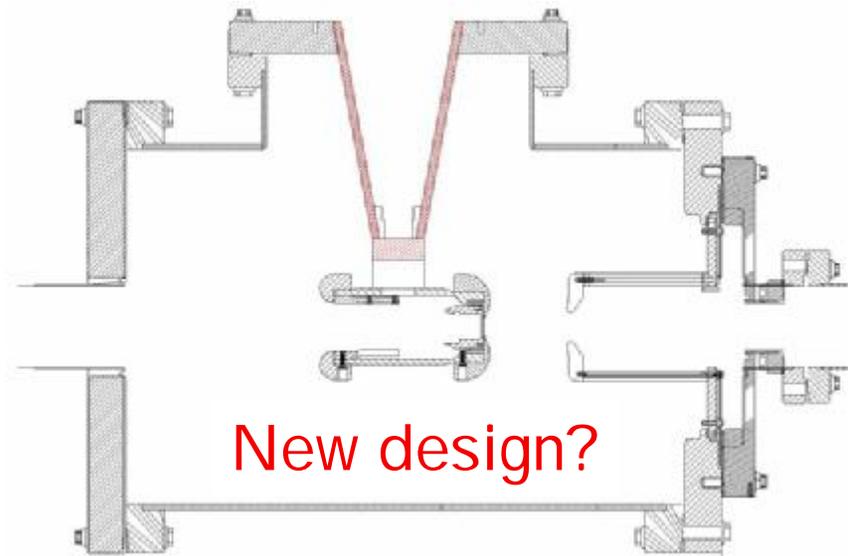
Exciting direction: inverted gun geometry



SCT

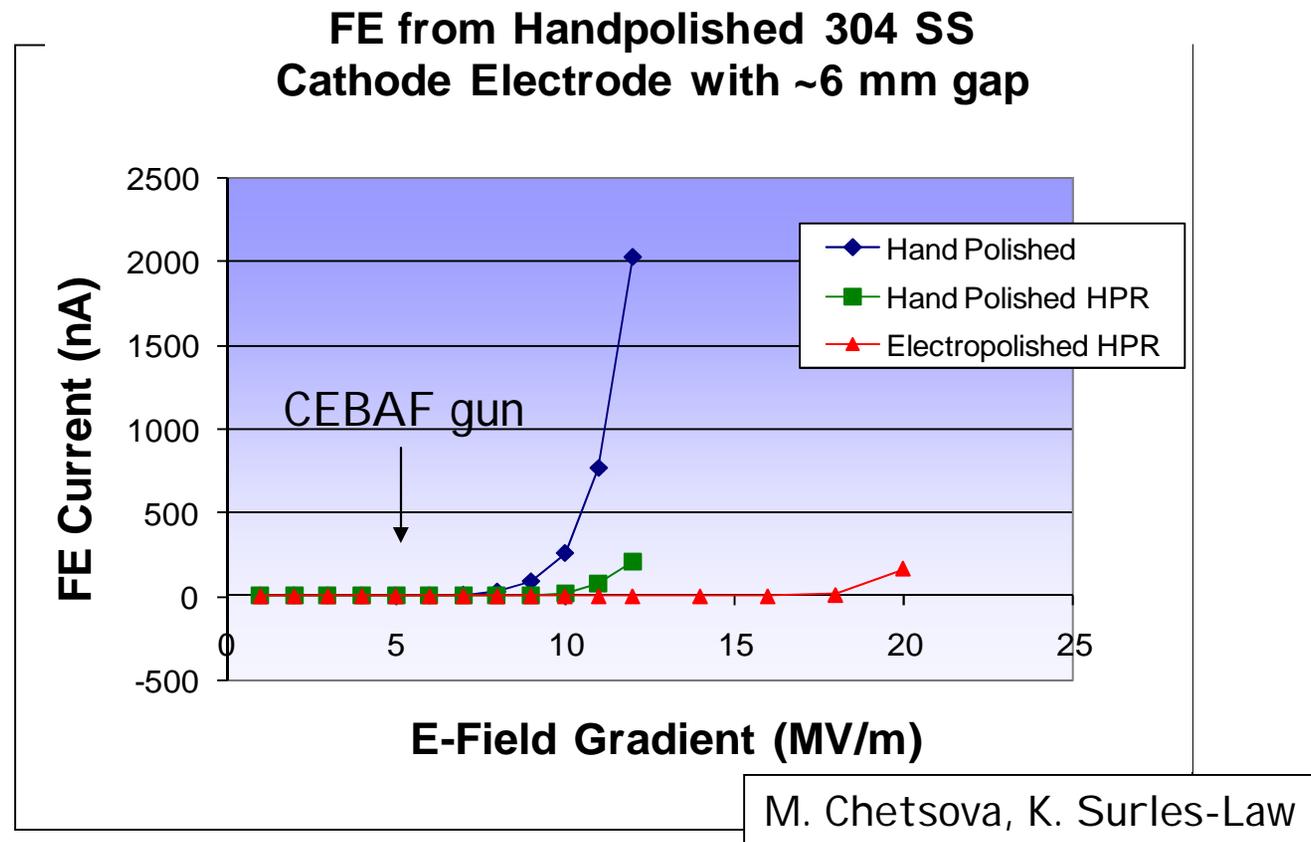


- Medical x-ray technology
- Ceramic not exposed to FE
- Compact, no SF6



Exciting direction: eliminate field emission

Investigate SRF-cavity technique "high pressure rinsing"



New electrodes, including single crystal Niobium...

Exciting direction: investing in design effort

- Ø To date => more QE, polarization or laser power
- Ø Now, opportunity to focus on cathode/anode design & first few meters of machine
- Ø Want to “get it right” the first time
- Ø 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