Electron Source Status update

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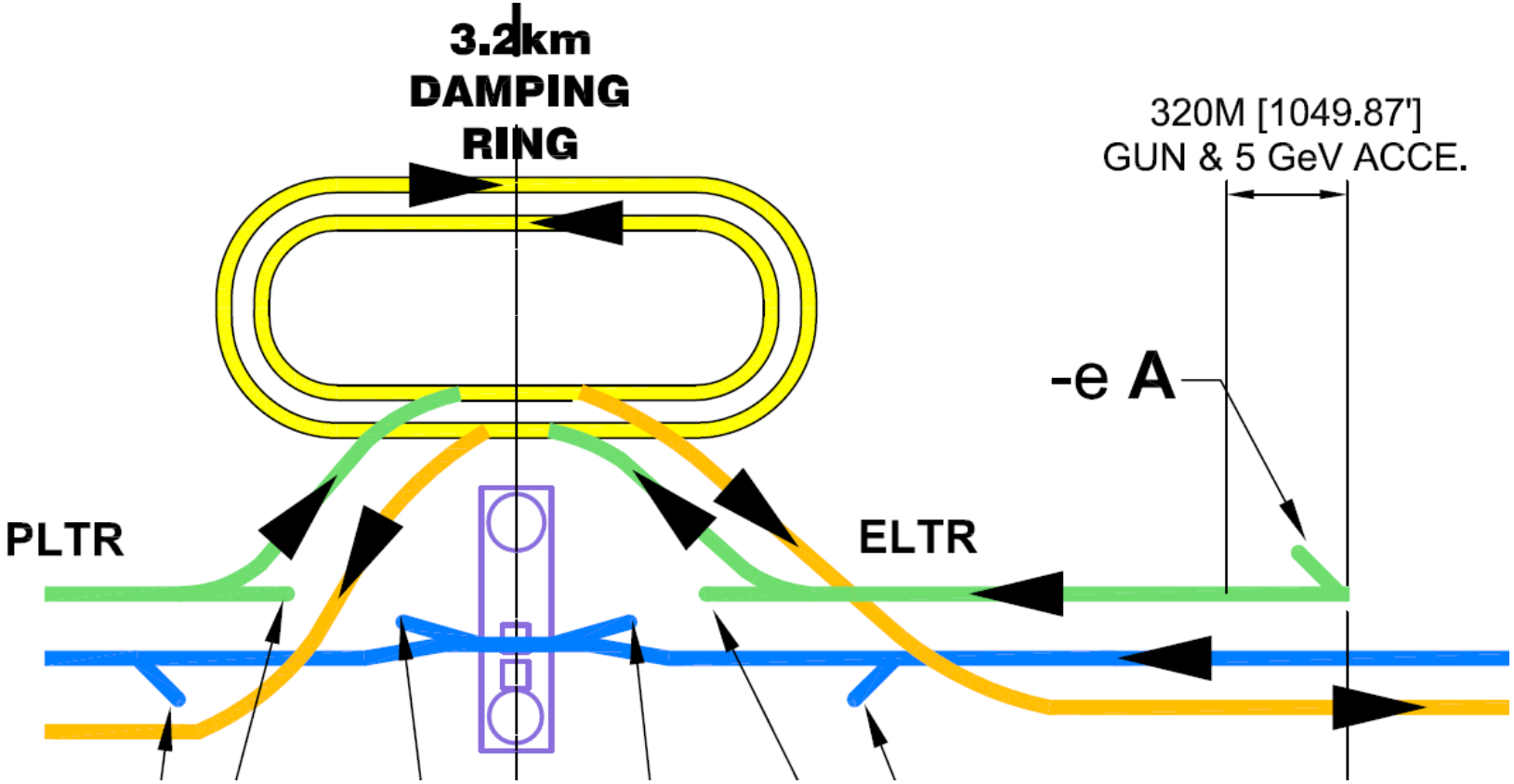
SLAC / Jlab

Albuquerque, Sept. 29 – Oct.3, 2009

Current e- source location



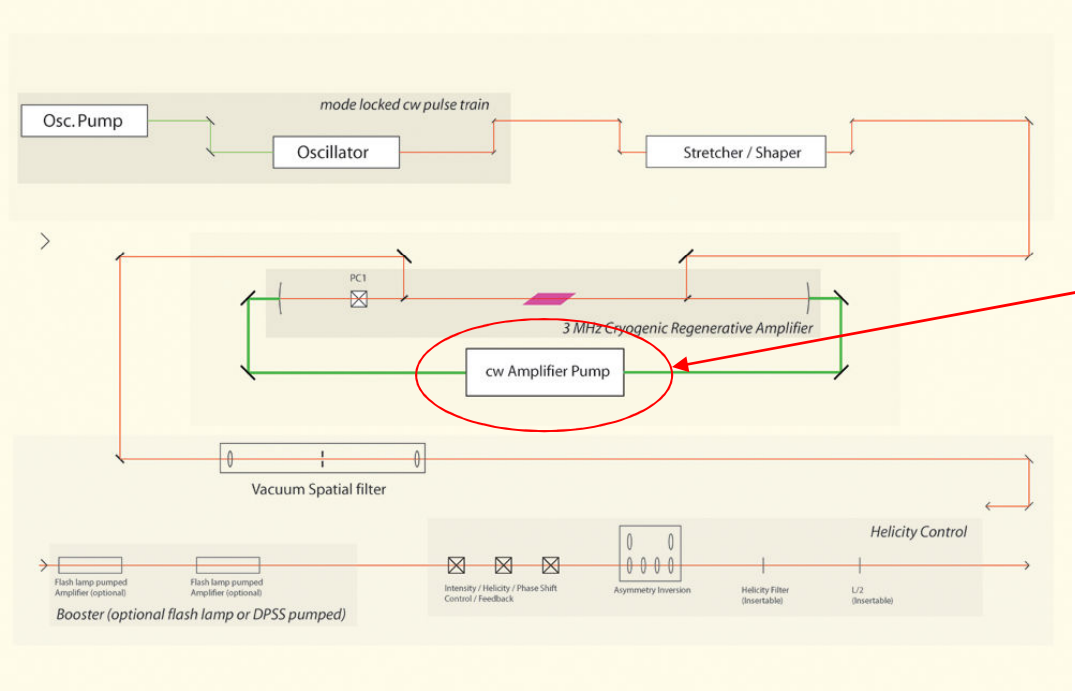
Drawing provided by Vic Kuchler of FNAL (8/21/09)

Activities

- Design
  - **Integration into overall layout (CFS group)**
  - **Spin rotation options at lower energy**

    → K. Moffeit
- R&D
  - **Source Laser System**
  - **Polarized Photocathodes** **→ F. Zhou**
  - **Polarized Gun**
  - **CLIC Collaboration** **→ J. Sheppard**
- Cost
  - **Largely unchanged**
  - **Main cost drivers are CFS and technical systems (e.g. RF configuartion, cryogenic systems)**
  - **No modification of beam line components**

Laser System Development



- Most components in place
- Problem with pump laser for Ti:Sapphire amplifier
- Consider replacement
- Evaluating options (commercial systems)

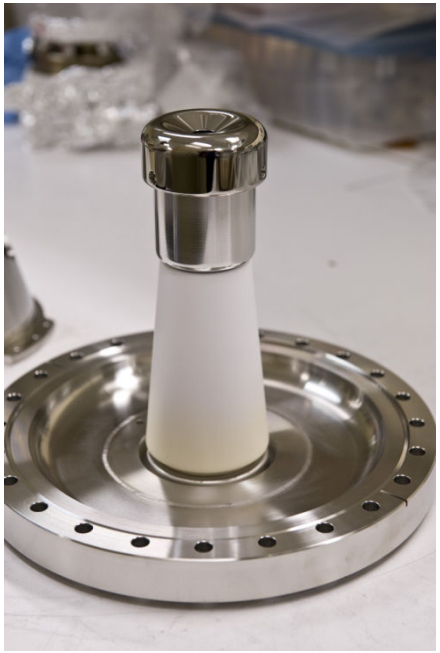
Polarized Photocathode Work

- Continue work at SLAC's CTS and GTF
- GaAs/GaAsP, AlInGaAs/AlGaAs
- Promising results for Alkalide Co-deposition techniques
- Collaboration with our main cathode supplier SVT through SBIR projects
- Address issues of polarization measurements (GTF Mott polarimeter)

DC Gun development at Jlab

- Inverted Gun installed at CEBAF
- Currently 100 – 125 kV

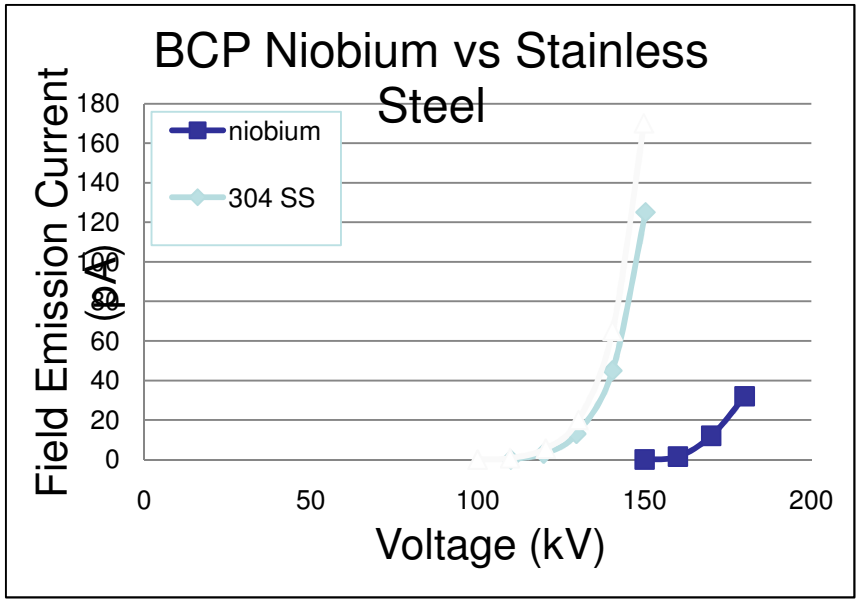
Conventional geometry: cathode electrode mounted on metal support structure



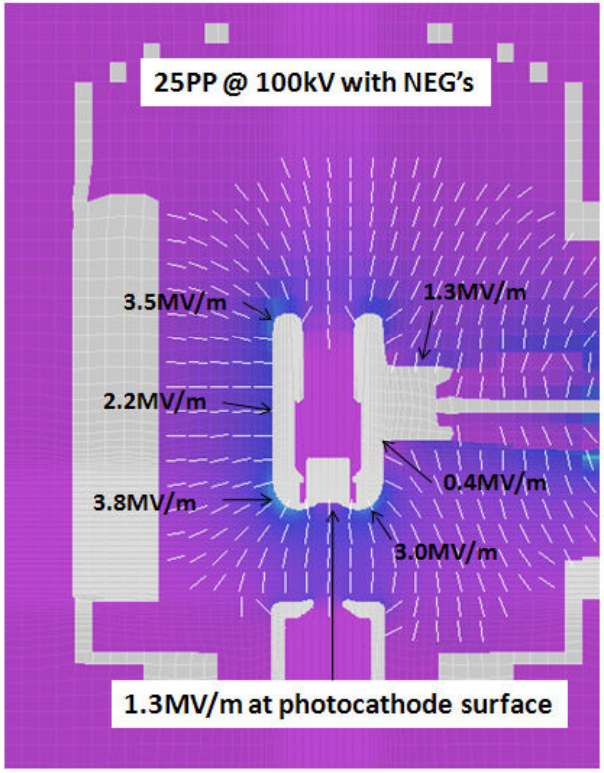
Replace conventional ceramic insulator with "Inverted" insulator: no SF6 and no HV breakdown outside chamber

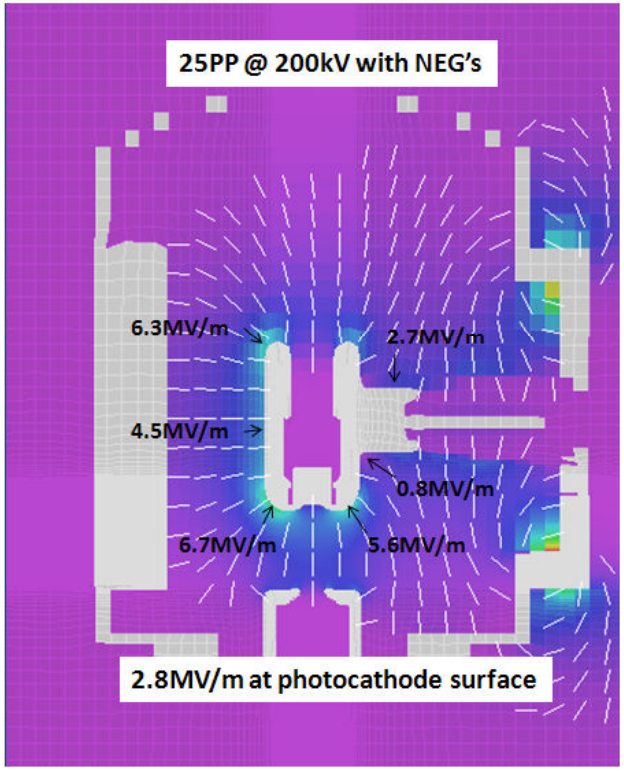
Nb electrodes

- Comissioning of second inverted gun with Nb electrodes – in progress
- Single Crystal Niobium:
  - **Capable of operation at higher voltage and gradient**
- Buffer chemical polish (BCP) much easier than diamond-paste-polish



Inverted Gun at voltage > 100kV?

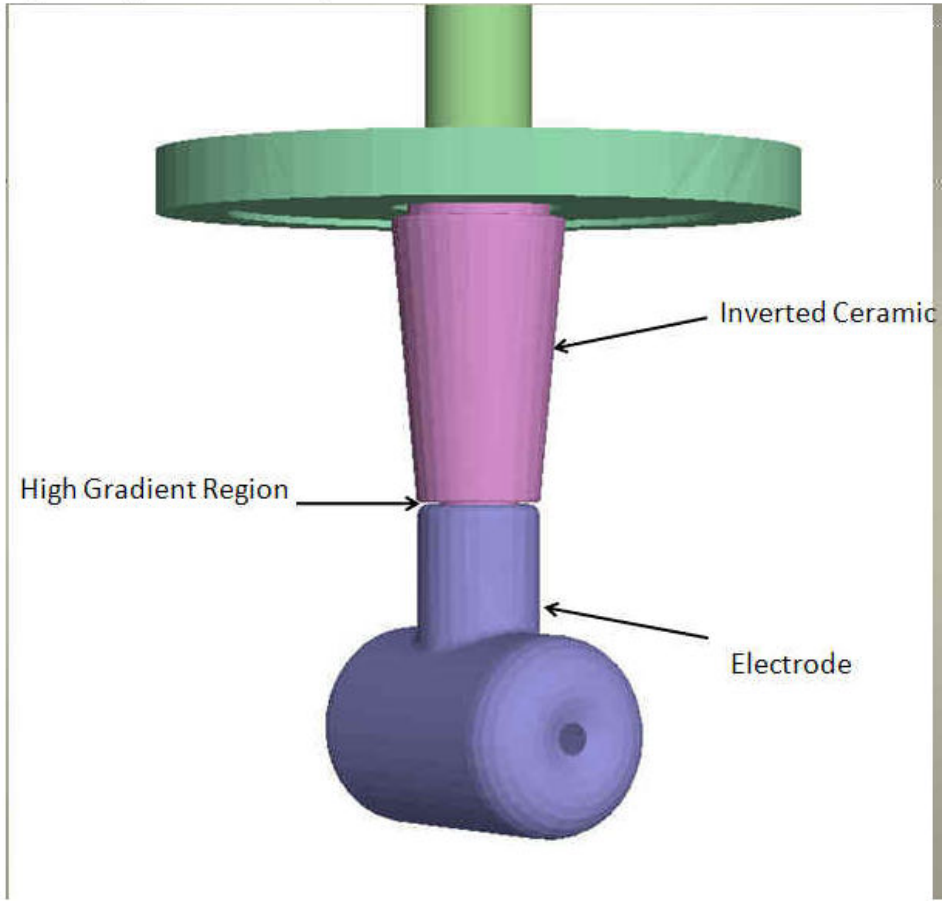




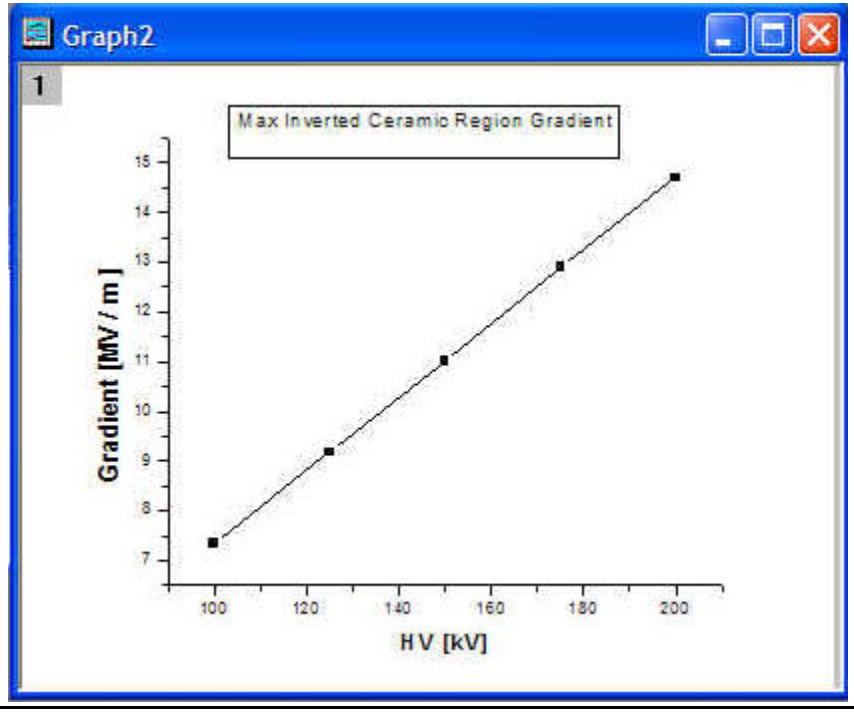
- Presently limited to 150kV at CEBAF
- 150 kV would provide "safe" gradient and likely markedly better transmission,

Gun design optimization

Figure 1: Highest Gradient Region



Design has one region of "unintended" high gradient – could be problematic…..exploring new designs via electrostatic modeling



Gun Work Summary

- New Inverted Gun works, a viable design for ILC…a good way to go…FEL pursuing similar approach for 500kV gun….
- Spare Inverted Gun nearly complete, to provide beam at Test Cave by November. Will push operating voltage > 100kV
- Field emission tests continue, but slowly.
- During FY2010…
  - Model the ILC electrode
  - Identify quiet electrodes to 10MV/m
  - Demonstrate reliable 140kV operation
  - Push voltage to ~ 200kV
- Future: Mate Jlab gun and SLAC laser system to demonstrate ILC beam

CLIC collaboration (electron source)

- Successful Demonstration of CLIC polarized source parameters using (evolved) SLC source
  - **Beam Charge**
  - **Surface Charge Limit**
  - **Electron Polarization**
  - **Cathode Lifetime**
- Details by John Sheppard

Recent and upcoming Milestones (I)

Source Laser

1)	ILC formatted laser bunch pattern.	Dec. 08 Done
2)	Installation of KM Labs SBIR laser system.	Dec. 09
3)	Full laser system operational.	Mar. 10

Photocathode R&D

1)	Investigate the effects of doping profile on QE, polarization, and charge limit in GaAs cathodes.	Ongoing
2)	Study effects of ion back bombardment on QE lifetime.	Ongoing

Gun R&D

1)	Reliable 200kV load locked gun	2009
2)	Progress towards ~ 350kV design	2010 (2011)

Recent and upcoming Milestones (II)

Integrated source system development

1) Generate electron beam with ILC bunch train parameters in SLC gun. — Mar. 10
2) Build ILC polarized electron source in conjunction with Jefferson Laboratory. — Dec. 10
3) Demonstrate ILC specification polarized electron source. — Dec. 11

CLIC Source Collaboration

1) Demonstration of CLIC electron source beam with existing equipment: — Sep. 09, Done
2) Modeling of CLIC source rf capture: — Sep. 09, Done

Summary

- Main Activities are of R&D nature.
- All of our ‘focus’ areas are progressing towards the ILC beam demonstration
- Most severe problem currently is ‘stall’ of laser development due to pump laser failure.
- Very successful use of SLAC’s facilities for CLIC source development.