

# Short summary of PESP2008

F. Zhou (SLAC)

**PESP 2008**  
Workshop on Sources of Polarized Electrons and High Brightness Electron Beams

**October 1 - 3, 2008**  
Jefferson Lab, Newport News VA

SPIN 2008  
UVA

**Workshop topics:**

- Status of polarized electron beam programs
- New accelerator initiatives
- Unpolarized high current GaAs photoguns
- Polarized RF gun
- Photocathodes
- Extreme high vacuum
- Drive Lasers
- High Voltage
- Gun and Injector modeling
- Gun designs
- Spin polarized electron applications
- Polarimetry

**Local Organizing Committee:**

- M. Fatenbaker (conference secretary)
- J. Grames
- C. Hernandez-Garcia
- M. Poelker (chair)
- M. Stutzman
- R. Suleiman

**Scientific Advisory Committee:**

- K. Aulenbacher (NAMI/Univ. Mainz)
- Axel Brachmann (SLAC)
- J. Clendenin (SLAC)
- B. Dunham (Cornell)
- W. Hillert (ELSA/Bonn)
- Y. Mamaev (St. Petersburg)
- T. Maruyama (SLAC)
- T. Nakanishi (Nagoya Univ)
- C. Sinclair (Cornell)
- E. Tsentolovich (MIT-Bates)
- A. Terekhov (Novosibirsk)
- S. Wolfe (Univ. Virginia)

**Jefferson Lab**  
Hosted by Jefferson Lab and Sponsored by the International Spin Symposium

**for more information:**  
<http://conferences.jlab.org/PESP2008>

The bottom of the poster features a collage of seven images: a close-up of a metallic particle gun component, a person in a lab coat working with a green laser beam, a large cylindrical particle accelerator component, an aerial view of the Jefferson Lab campus, a close-up of a metallic component, a circular inset showing a grid pattern, and a complex assembly of particle accelerator components.

Note: I 'borrowed' most slides from Matt Poelker, who prepared them for SPIN08

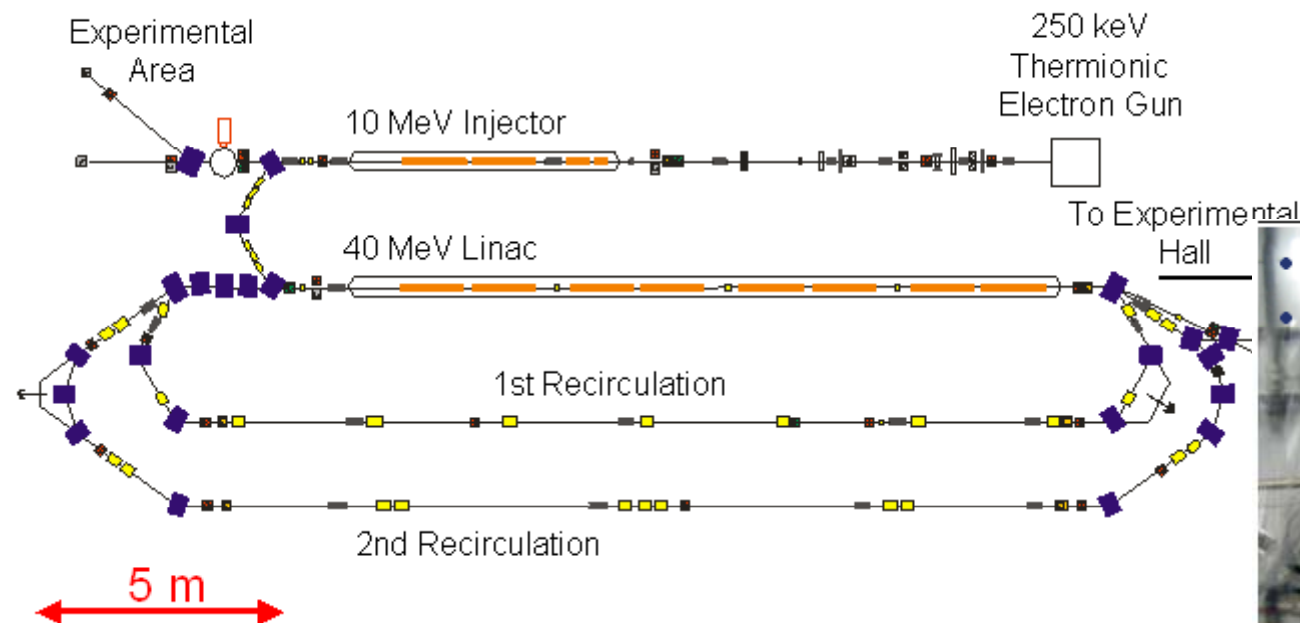
# Programs of PESP2008

- Polarized e-Beam Programs – with focus on NEW and proposed machines
- Photocathodes: High Polarization, novel structure, obtaining longer lifetime
- Very High Voltage DC Guns (voltage  $\gg 100\text{kV}$ )
- RF and SRF guns – with focus on polarized and CW
- Drive lasers
- Vacuum
- Polarimetry

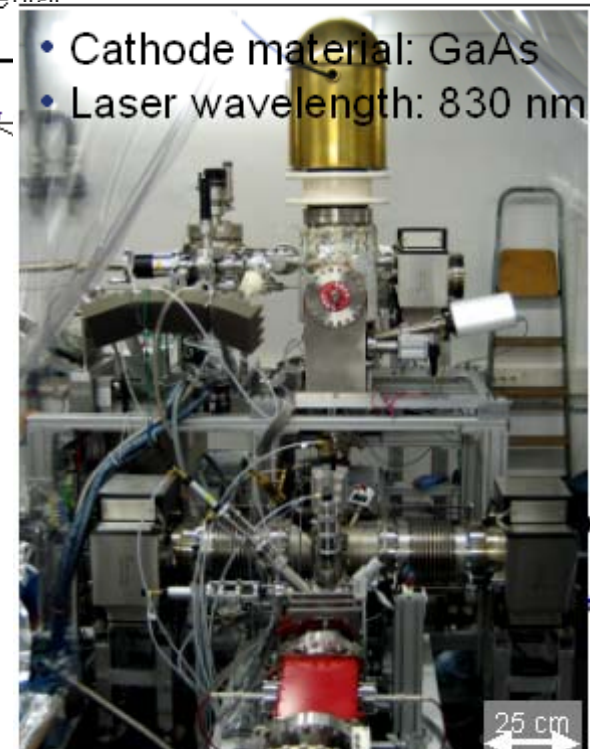
~80 registered attendees, 37 talks.

# NEW Polarized e-Beam Facility

S-DALINAC Polarized Injector („SPIN“)  TECHNISCHE UNIVERSITÄT DARMSTADT



- Cathode material: GaAs
- Laser wavelength: 830 nm

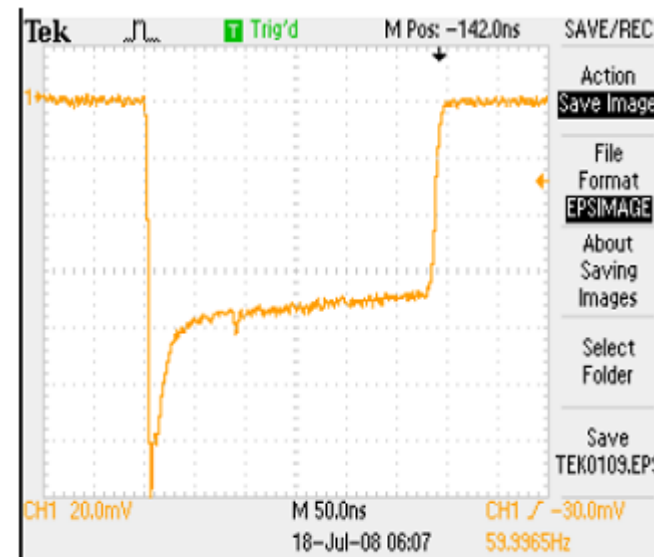
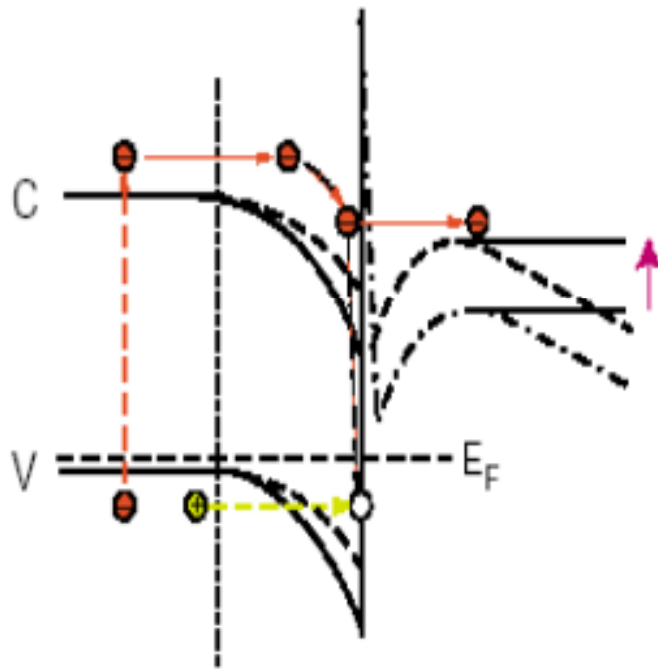


With help from Mainz....

From Y. Poltoratska, Darmstadt Univ.

# Proposed polarized facilities: ILC and CLIC

ILC and CLIC: High Bunch Charge, High Peak Current and “new” time structure compared to SLC. R&D Issues: Space Charge and Surface Charge Limit.



$2.5 \times 10^{10}$  e- @ 8x laser energy  
10 mm full size

From F. Zhou, SLAC

# Proposed polarized facilities: Electron Ion Collider

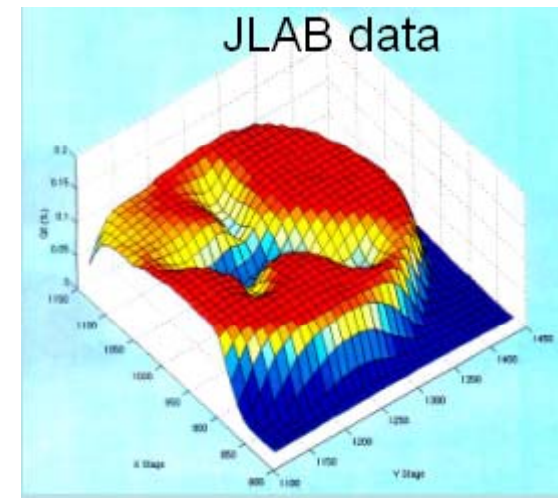
## eRHIC (Linac-ring version)

Requires a polarized electron source with an extremely high current

$$\text{Luminosity} \sim 2.6 \cdot 10^{33} \text{ cm}^{-2} \text{ s}^{-1} \Rightarrow I(\text{average}) \sim 250 \text{ mA}$$

Residual Gas leads to Ion Back-Bombardment and QE decay and short lifetime:

- Improve Vacuum
- Large laser spot
- Higher gun voltage
- More rugged photocathodes
- Better beam management



Slide from E. Tsentalovich, MIT-Bates



# Polarized photocathodes

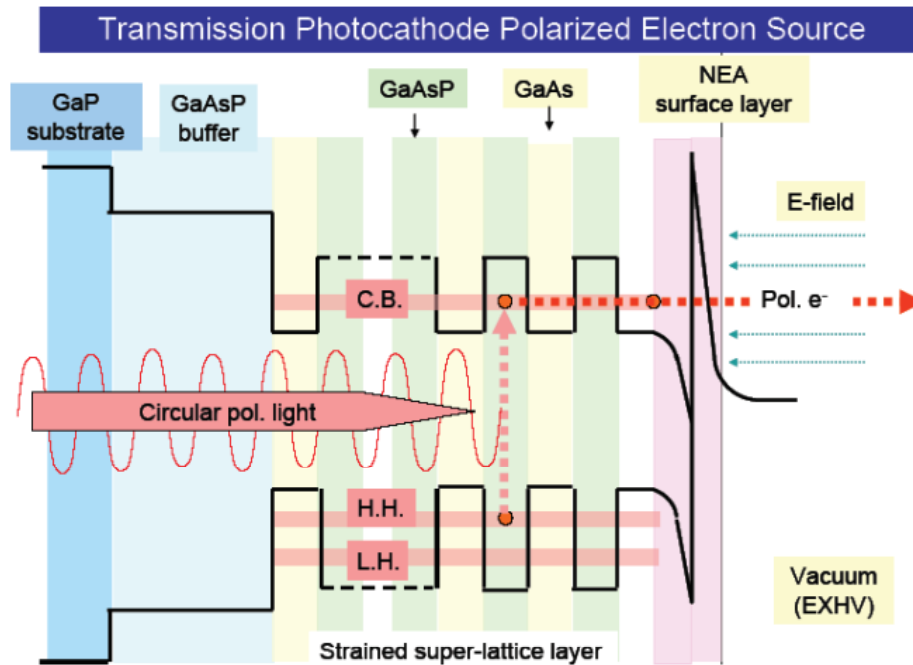
## Best photocathodes

Sample	Composition	$P_{\max}$	$QE(\omega_{\max})$	Team
SLSP16	GaAs(3.2nm)/ GaAs <sub>0.68</sub> P <sub>0.34</sub> (3.2nm)	92%	0.5%	Nagoya University, 2005
SL5-777	GaAs(1.5nm)/ In <sub>0.2</sub> Al <sub>0.23</sub> Ga <sub>0.57</sub> As(3.6nm)	91%	0.14%	SPbSPU, 2005
SL7-307	Al <sub>0.4</sub> Ga <sub>0.6</sub> As(2.1nm)/ In <sub>0.19</sub> Al <sub>0.2</sub> Ga <sub>0.57</sub> As(5.4nm)	92%	0.85%	SPbSPU, 2007

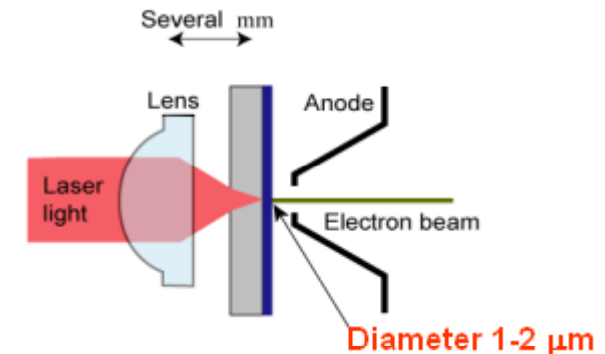
- Exceptional modeling helps identify depolarization mechanisms
- Working on reflective back surface to boost QE

From L. Gerchikov. State Polytechnic Univ. St. Petersburg  
Samples grown at Ioffe Technical Institute, St.Petersburg

# Polarized photocathodes



## Novel Back-side illumination

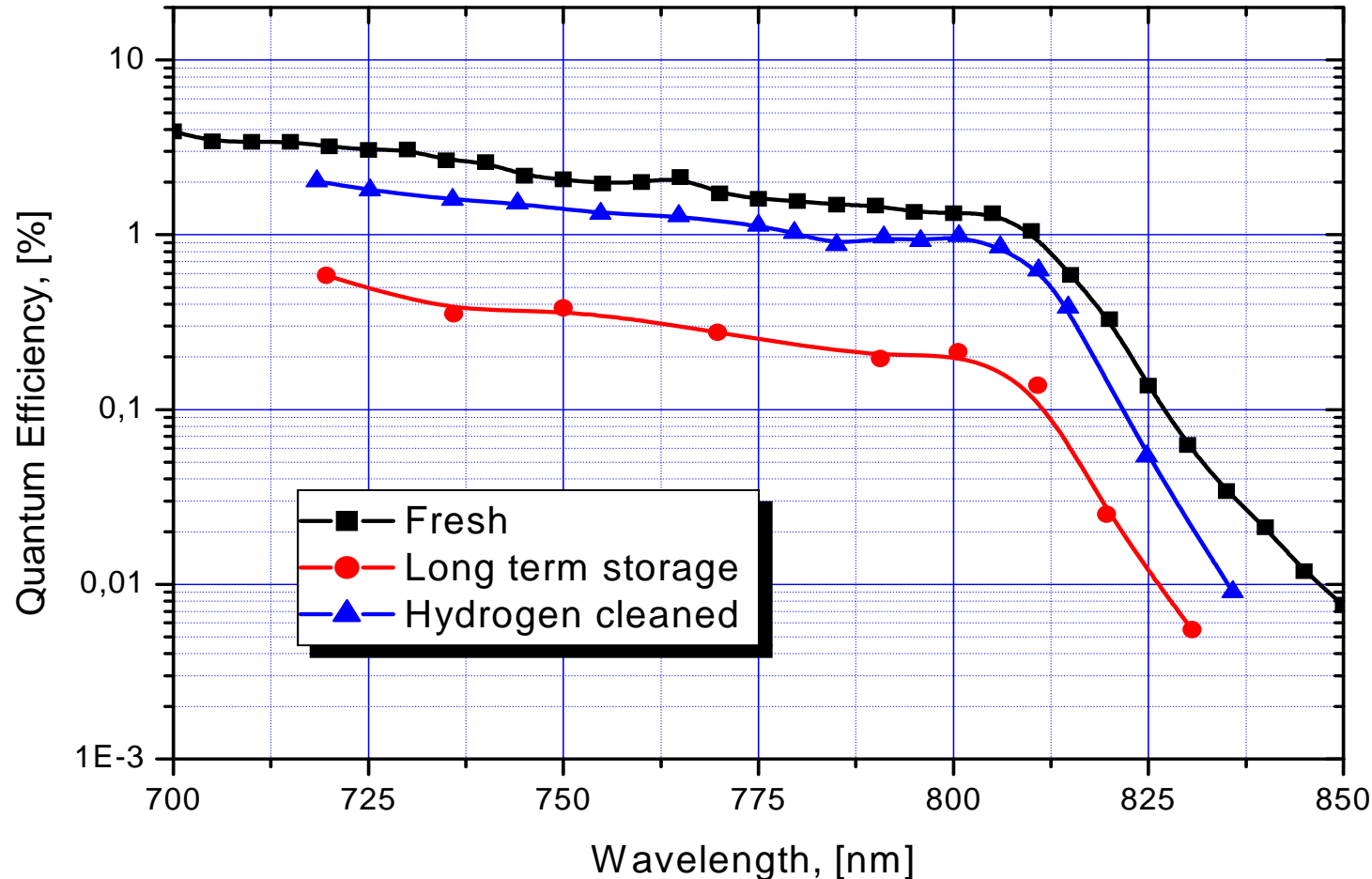


Highly focusing lens can be used.

Back-illuminated High Polarization ( $\sim 90\%$ ) and High Brightness Photocathode, built for materials science, but could be used for accelerator applications with extremely low emittance requirement

Excellent work reported by T. Ujihara, X. Jin, N. Yamamoto, T. Nakanishi, Nagoya University

# Polarized photocathode: Atomic hydrogen cleaning



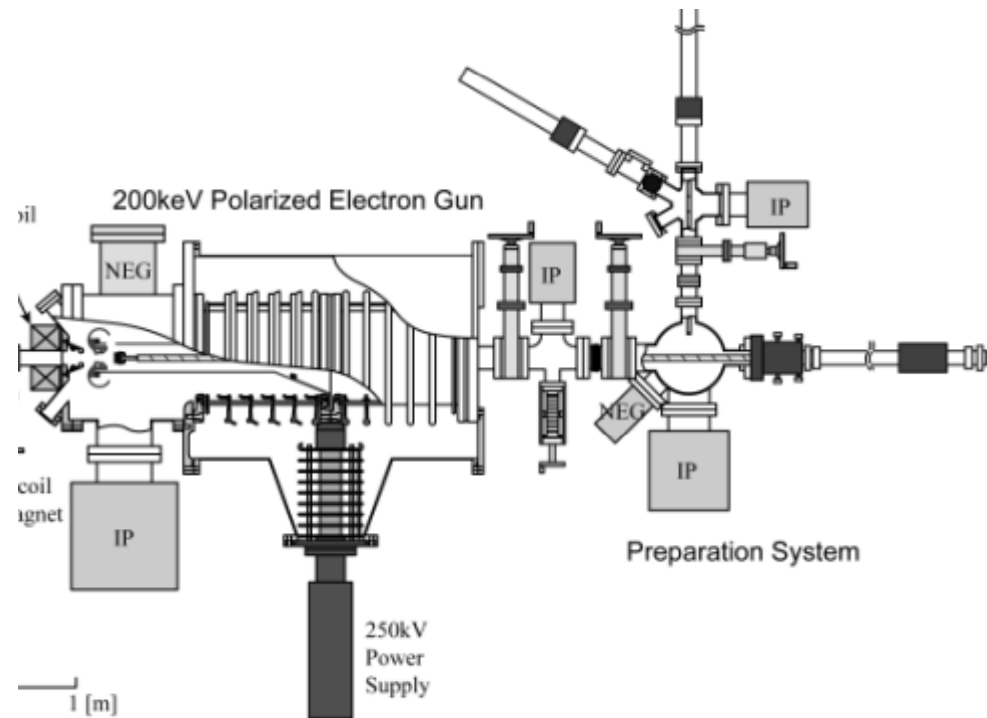
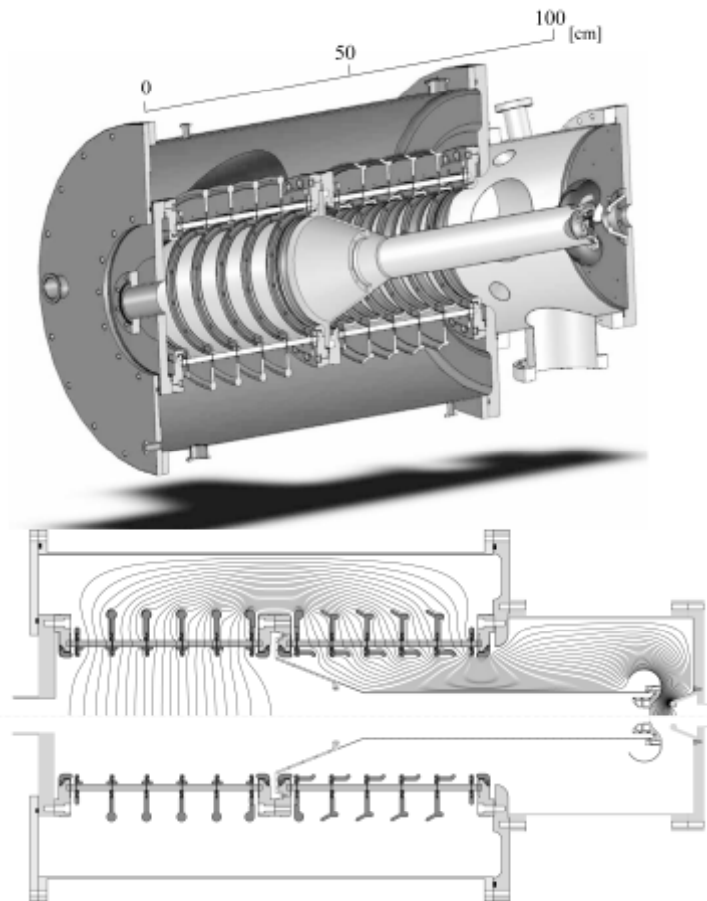
Improves \*5 at low intensities+absence of saturation!  
(\*50 improvement for high intensities at MAMI)

V. Tioukine, MAMI, Germany



# Very High Voltage DC Guns (polarized)

200kV Gun, load lock gun with segmented insulator and high polarization GaAs photocathode



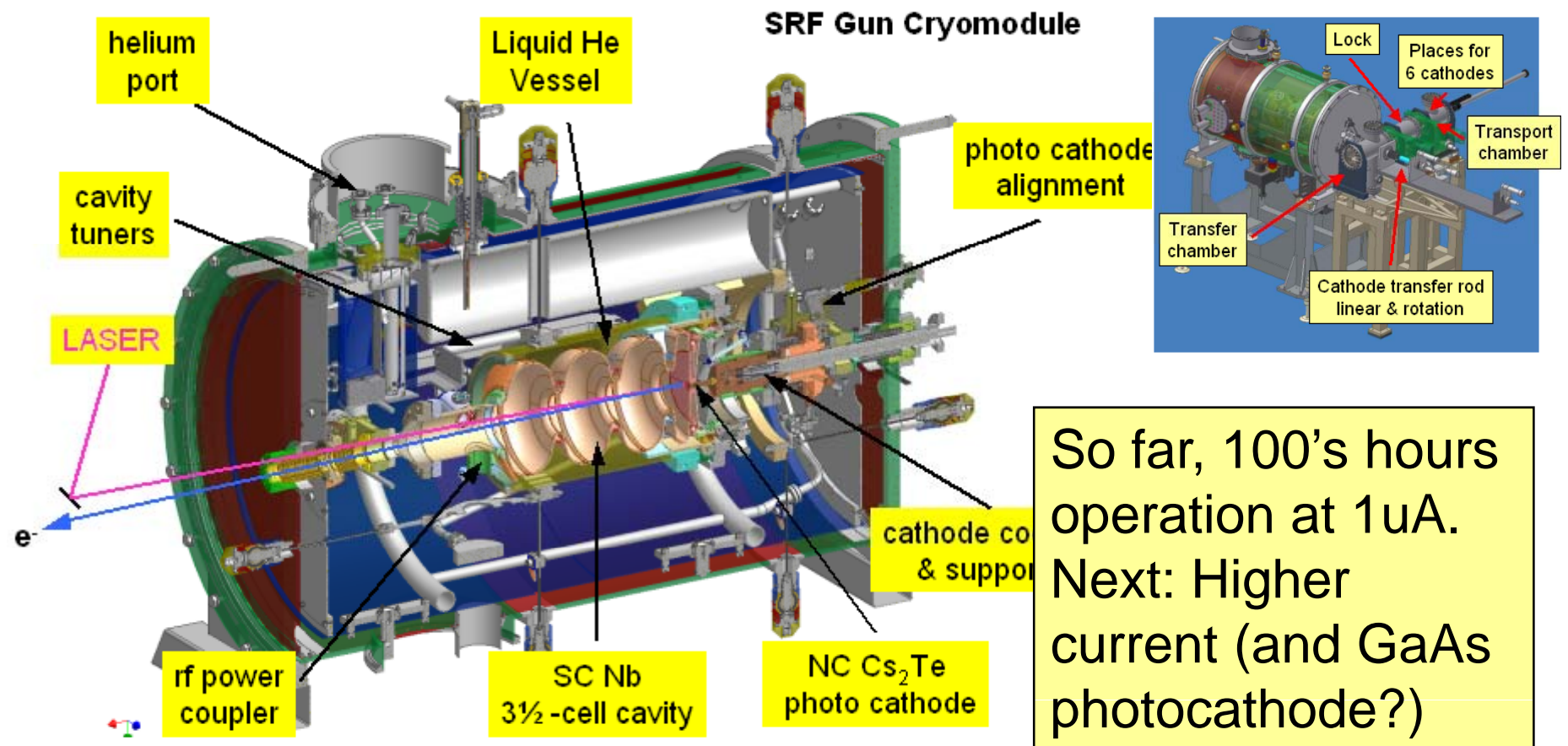
From M. Yamamoto, Nagoya Univ.

# Very high voltage DC gun (unpolarized)

- JLAB-FEL project: design 500kV but typical operation at 330kV; field emission can lead to catastrophic insulator “punch-through (C. Hernandez-Garcia).
- ASTeC-Daresbury: 350 kV; field emission not problematic but repeated mechanical failures at ceramic-to-flange joint...(L. Jones)
- Cornell: design 750 kV but Field emission and “punch through” limits voltage to ~ 300kV (K. Slomenski).
- JAEA: 250 kV; working on 500kV version with segmented insulator (N. Nishimori).

# SRF Gun (unpolarized)

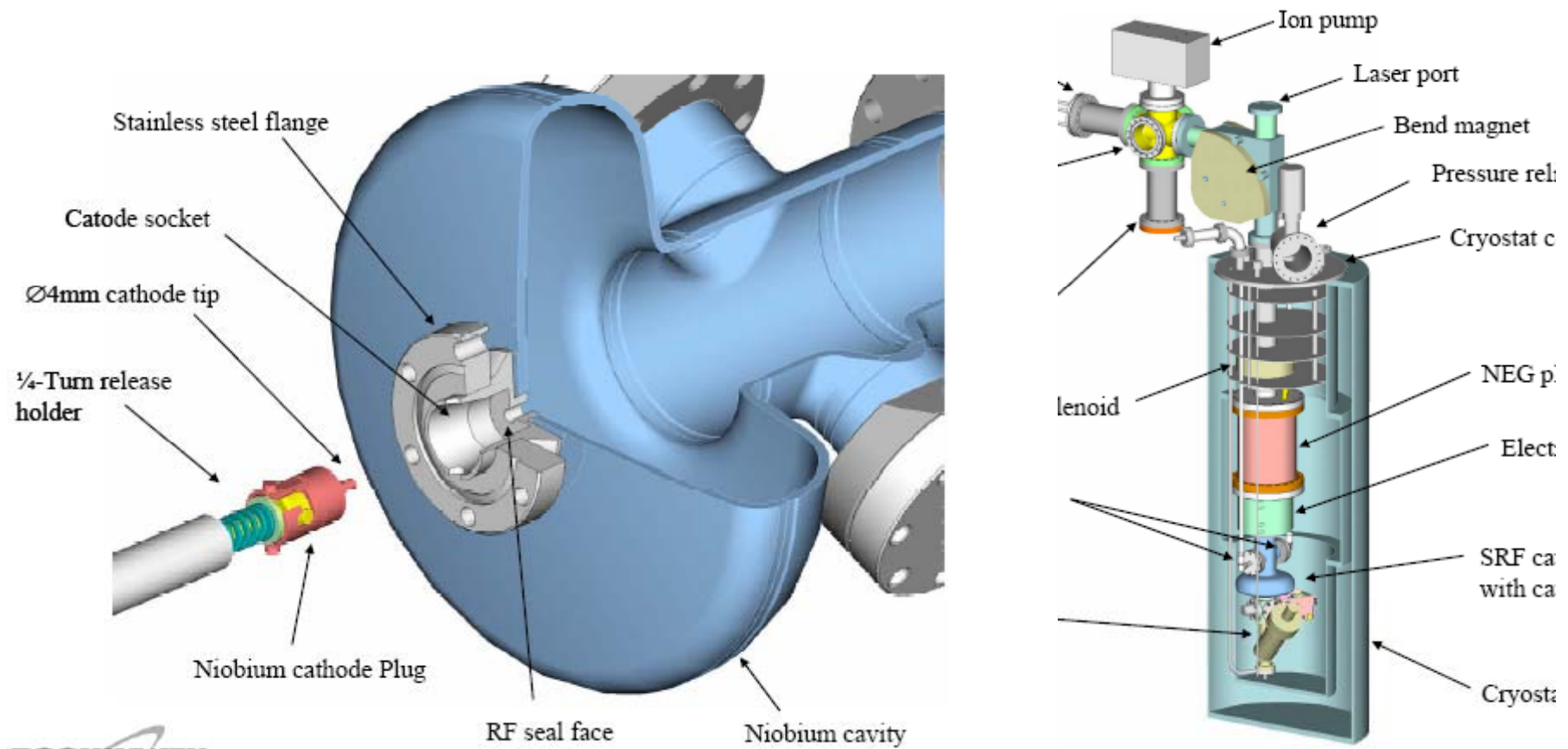
Holy Grail of e-guns: Perfect vacuum, High Average Current, High Brightness, Low RF Power



From J. Teichert, A. Arnold, FZD Dresden-Rossendorf

# SRF Gun under development (polarized)

Polarized SRF Gun at BNL: for ILC, eRHIC and ERLs

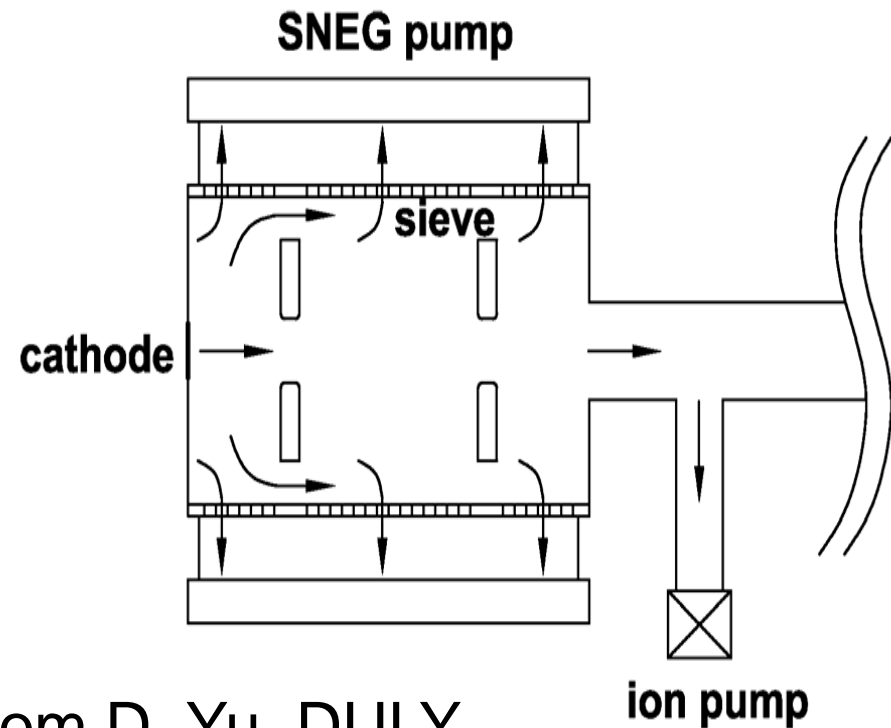
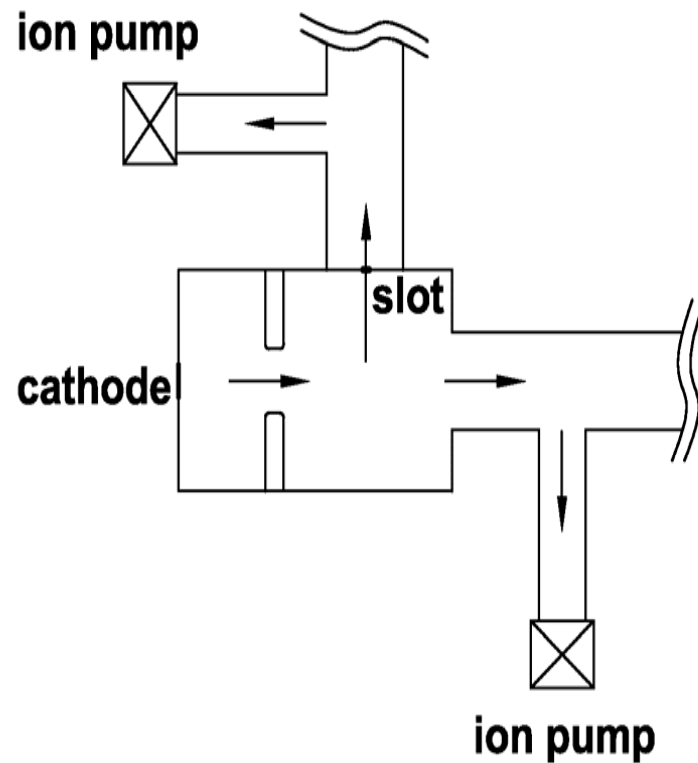


From D. Holmes, AES and J. Kewisch, BNL

# PWT N.C. RF gun under development (polarized)

## Vacuum Pumping Paths

### 1.6-cell Gun (left) and PWT Gun (right)



From D. Yu, DULY

# Summary of R&D Projects

- Reliable trouble-free DC high voltage gun operation beyond 300kV (eliminate field emission, improved insulator design)
- Understanding (and eliminating) Surface Charge Limit (the phenomenon of reduced QE at high laser power)
- Develop rugged photocathodes with improved lifetime
- Back-illuminated, transmission-style photocathodes
- Achieve better vacuum,  $10^{-12}$  Torr and below
- SRF gun technology – BNL (and Rossendorf?) to demonstrate operation with GaAs...