

POLARIZED e⁺/e⁻ SOURCES

Jym Clendenin, SLAC

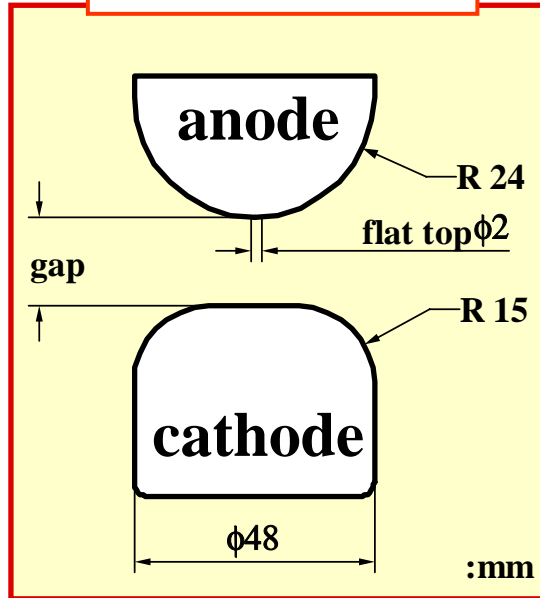
12 talks related to polarized e⁻ (10) and e⁺ (2)
sources, all but 4 in plenary sessions

1. Developments for low DF pulsed sources

- Higher polarization and QE photocathodes
 - **Mamaev**: InAlGaAs/AlGaAs highly-strained SL results
 - $P_e=91-92\%$, $QE=0.5\%$
 - **Gerchikov**: Increase QE by up to factor of 10 by using DBR to form Fabry-Perot resonant cavity
- Laser development: ILC requires quasi-cw laser system
 - **Brachmann**
- Higher voltage to reduce longitudinal bunching requirements - **M. Yamamoto**

Material dependence of dark current

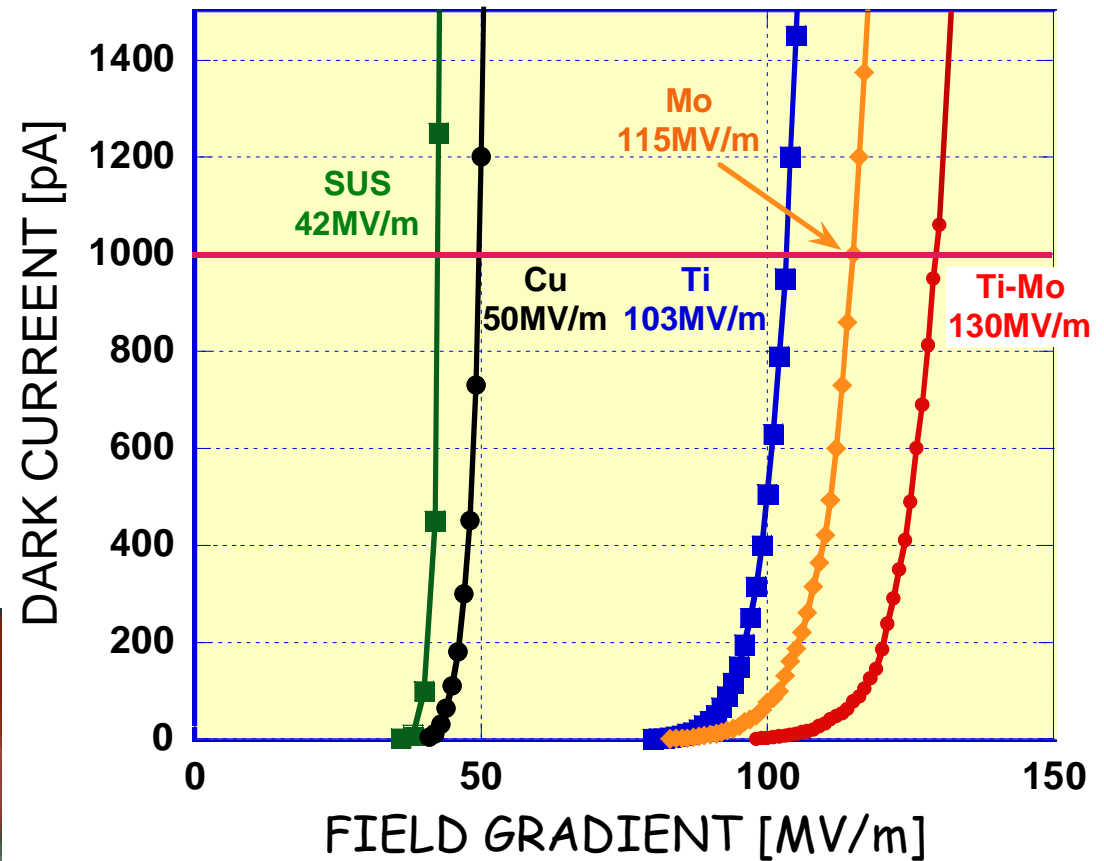
Electrode shape



Test sample

Nagoya & KEK

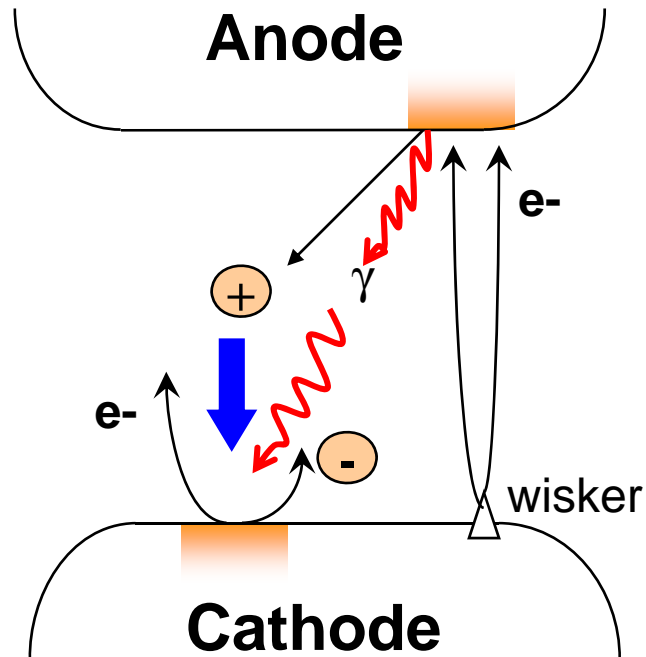
Gap 0.5mm results



F.Furuta et al., NIM-A 538 (2005) 33-44

Material dependence of dark current

M. Yamamoto (Nagoya)



Dark current = F-N theory
Primary field emission
+ Enhanced emission

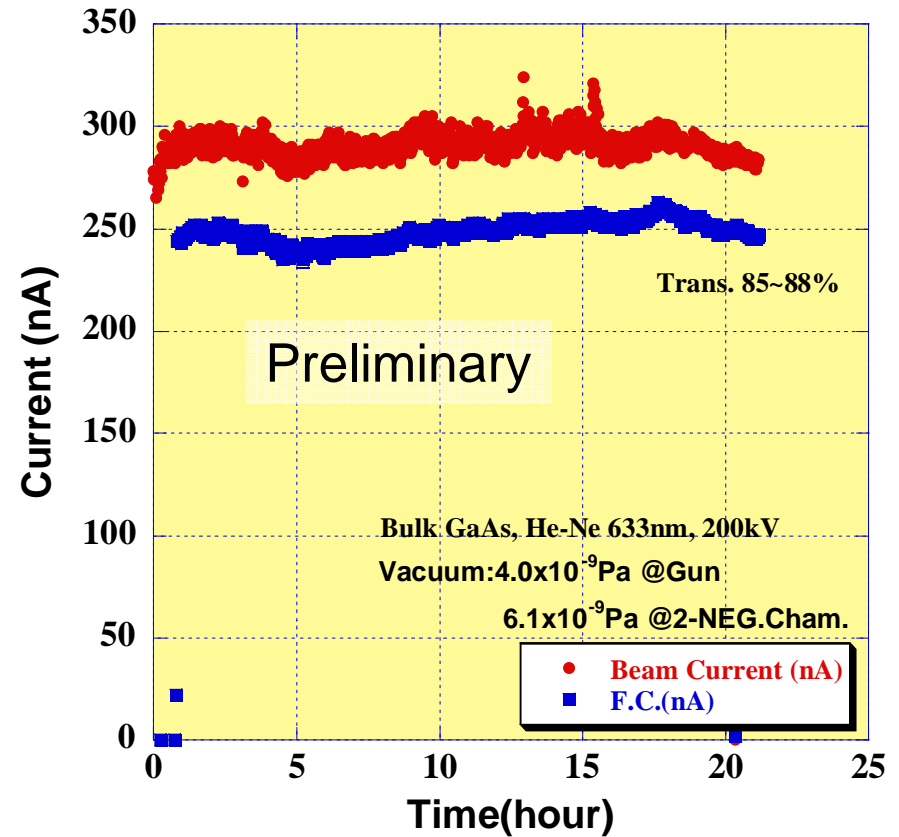
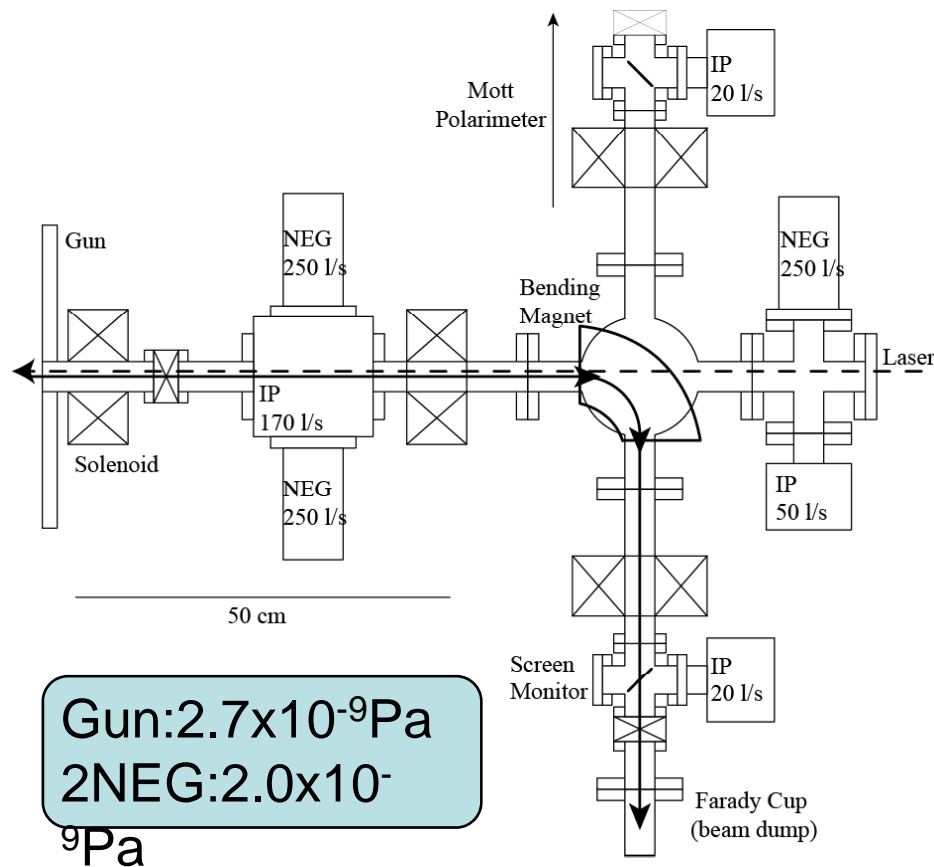
Enhanced emission current

Ions emission from the anode,
secondary electrons and negative
ions emission from the cathode.

Reduction of primary field emissions → Mo

Reduction of secondary enhanced emissions → Ti

Photocathode Lifetime



The photocathode lifetime seems no problem under the condition of a few micro amps beam emission. **Dark current only ~1 nA @200 kV!**

M. Yamamoto (Nagoya)

2. Developments for CW sources

- **Higher average currents**
- **Cathode cooling**
- **Ion back bombardment**
- **Higher voltage**

1mA from High Polarization Photocathode*

Parameter	Value
Laser Rep Rate	499 MHz
Pulselength	30 ps
Wavelength	780 nm
Laser Spot Size	450 mm
Current	1 mA
Duration	8.25 hr
Charge	30.3 C
Lifetime	210 C
Charge Lifetime	160 kC/cm ²

* Note: did not actually measure polarization

Estimate 48 days with 10 W laser

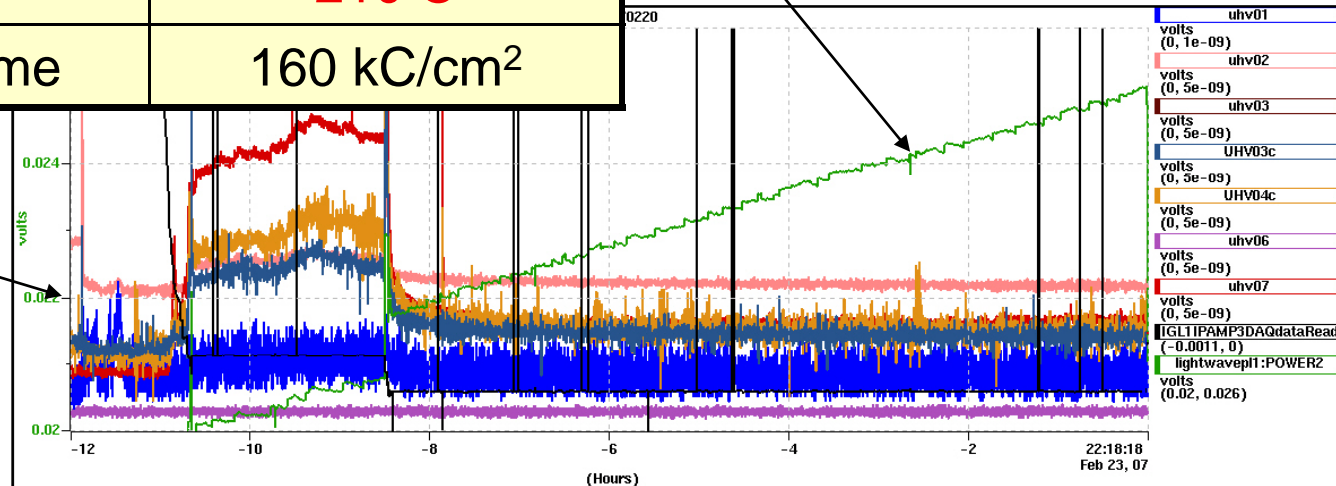
Above 0.5 W need active cooling of cathode

Worry about surface charge limit

Laser energy

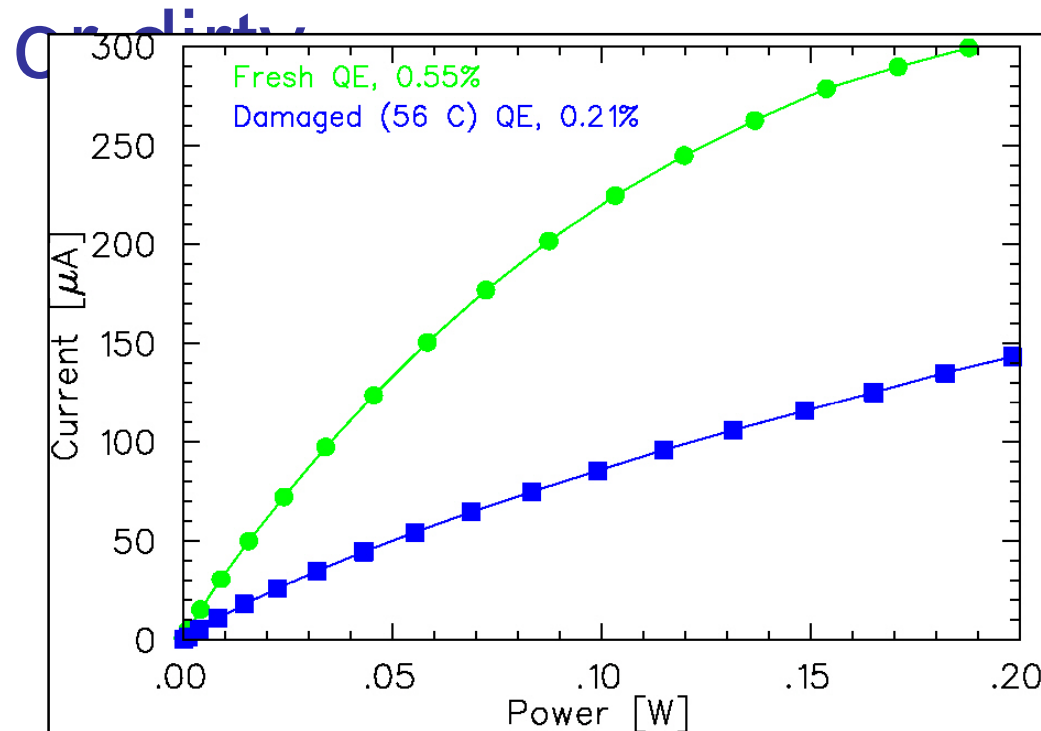
Current & vacuum

Poelker (JLab)



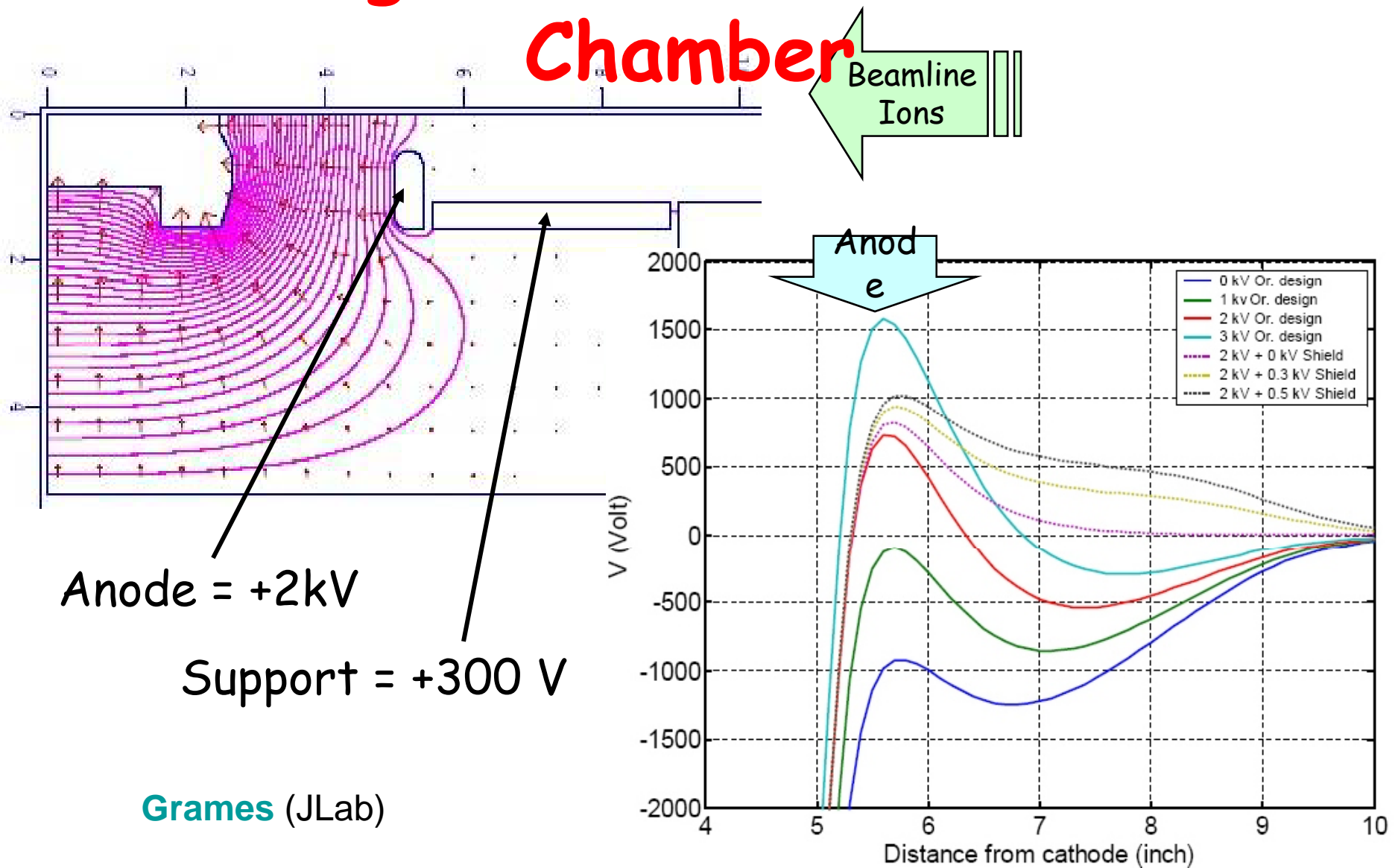
But QE not constant...

...when surface is damaged



Surface charge limit, not just a problem for pulsed machines

Limiting Ionized Gas from HV Chamber

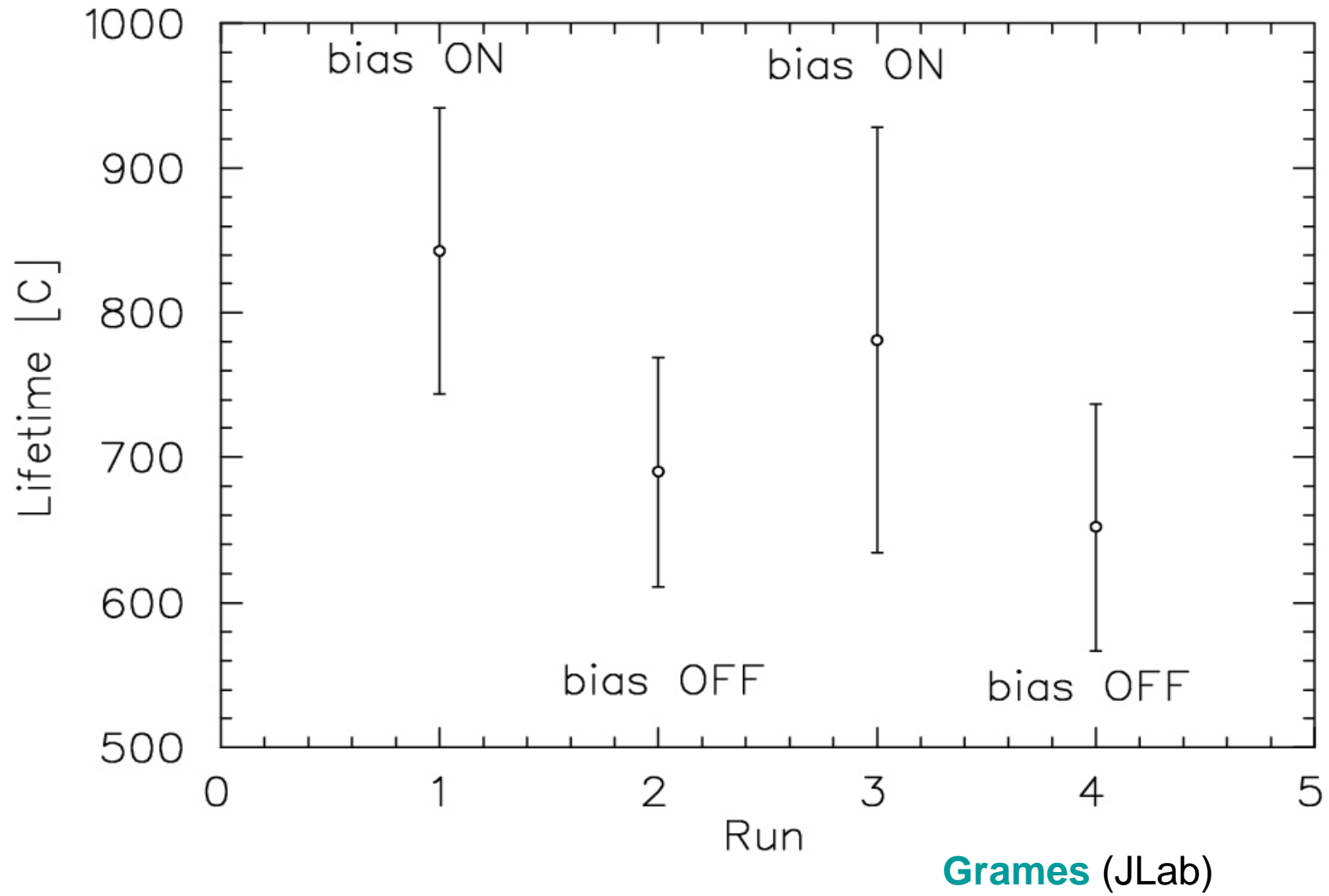


Anode = +2kV

Support = +300 V

Grames (JLab)

Lifetime at "EC" at 2mA (~150 C runs)

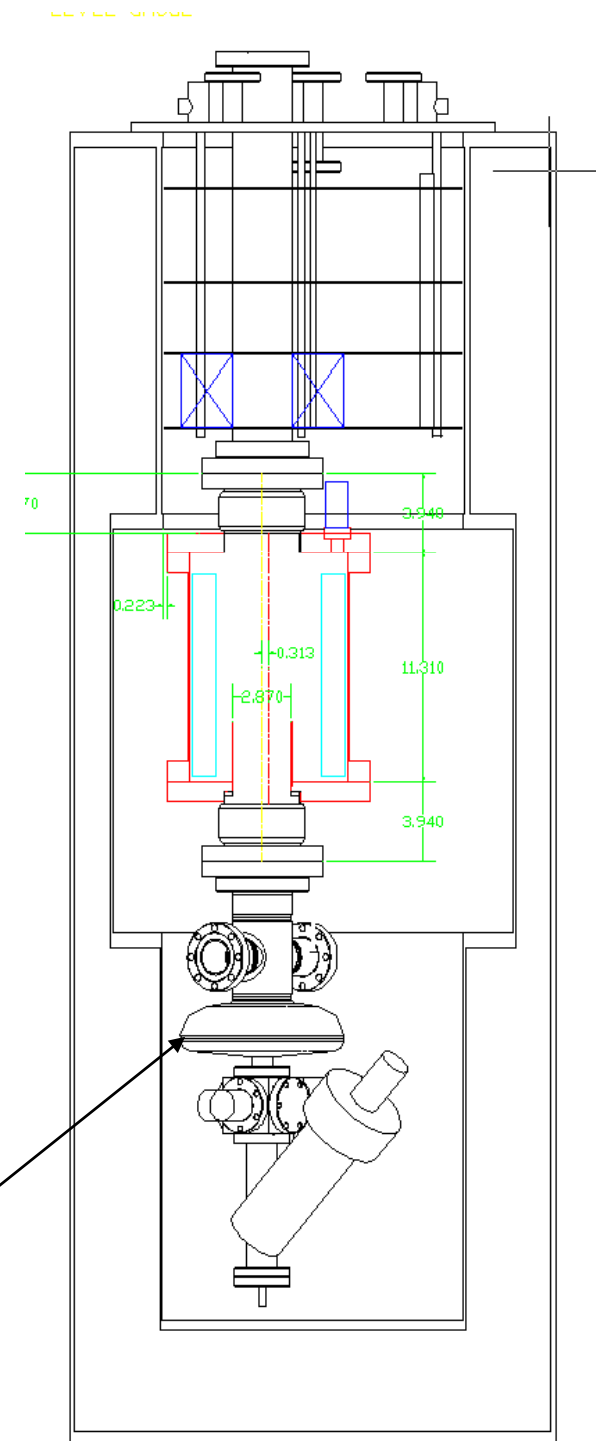


3. Sources for other applications

Initial test up to 10 mA, up to 100x more with higher power rf modulator and appropriate laser

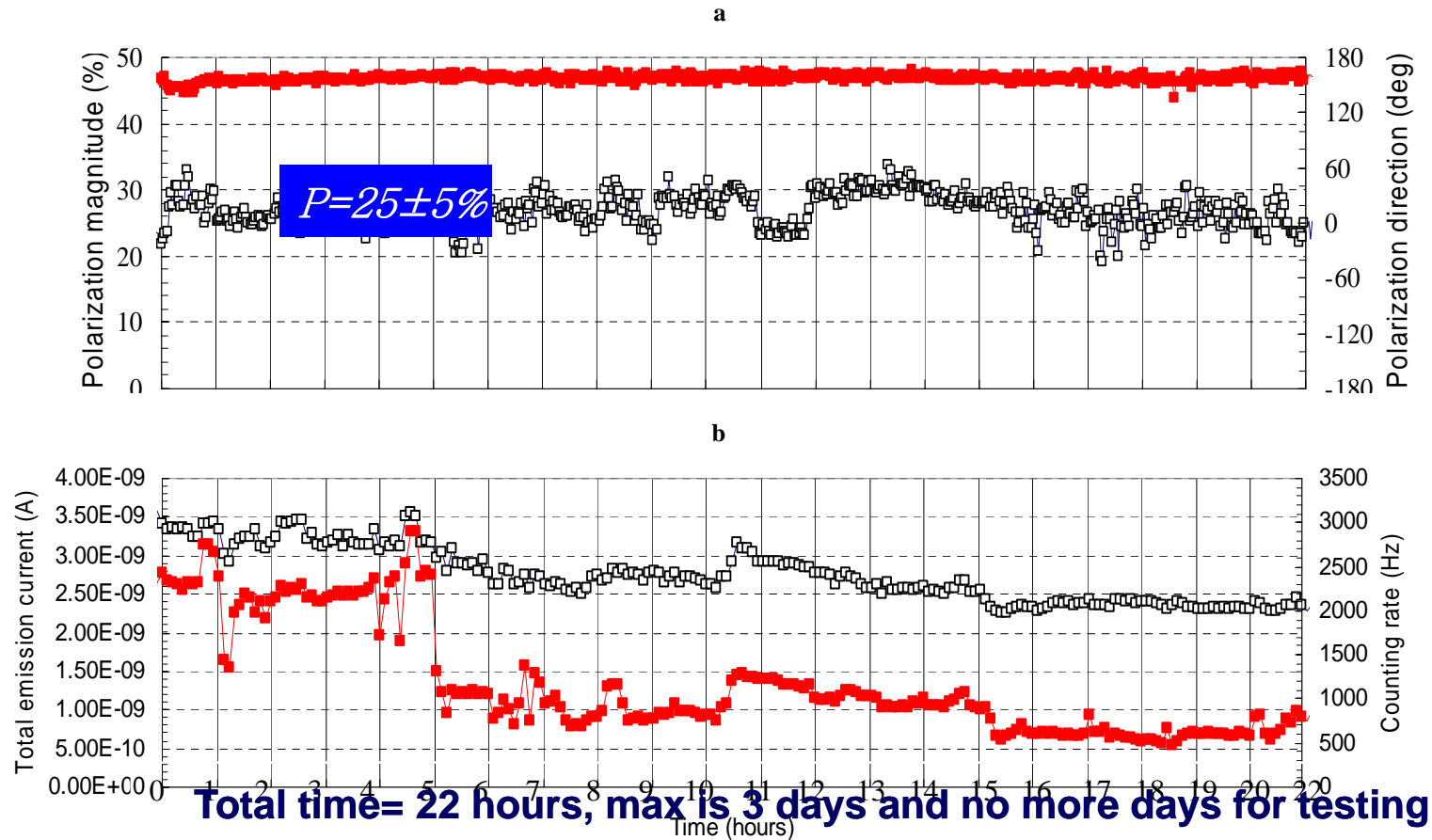
Kewisch (BNL)

- Beam energy 0.8 MeV, current 10 μ A, limited by available RF power
- Removable NEA bulk GaAs cathode, 1 mm diameter.
- 100 liter cryostat, helium lasts about 24 hours
- Beam exits to on top, is bend 90 degrees into a Faraday cup
- Focusing with permanent magnet solenoids
- NEG pumps inside the cryostat, close to the gun, expected vacuum close to 10^{-12} torr.
- Superconducting $\frac{1}{2}$ cell 1.3 GHz gun



FE from ultra-thin Fe films on W(100) tip.

Time stability of polarization and emission current



Niu (Hong Kong Univ)

4. e+ sources

Schuler: Helical undulator (E166)

Kiriki: Compton