Photocathode R&D

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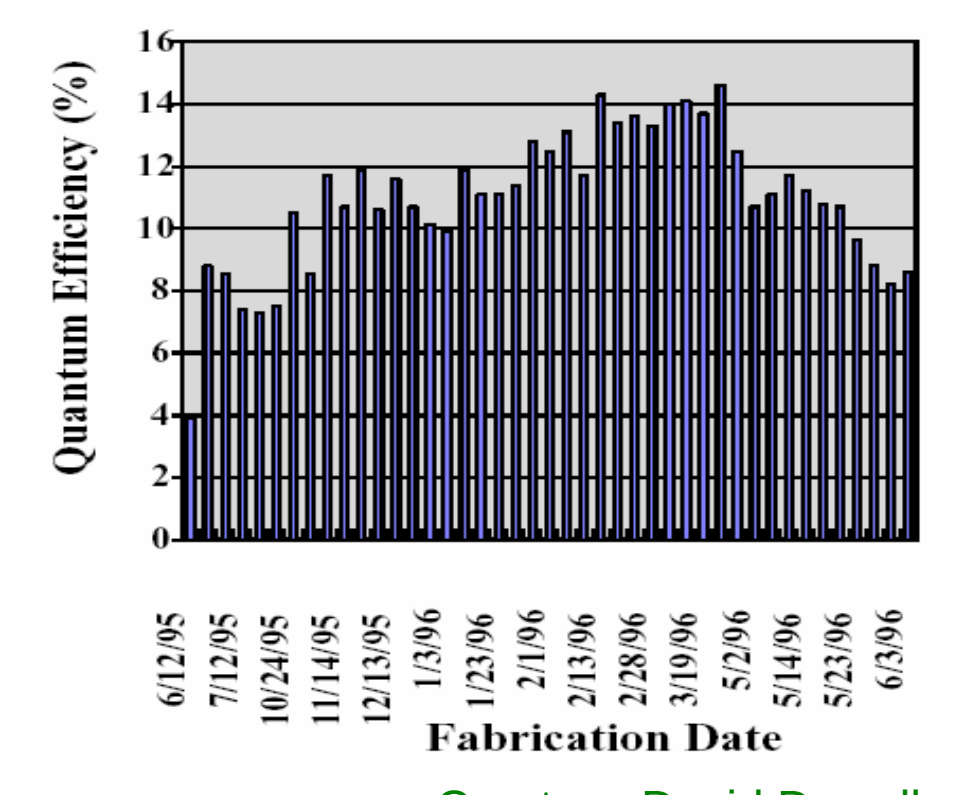
RHIC

Outline of the Talk

- Cathode Research
- Laser System
- Cathode-Gun Interface

Cathode Research

Application Oriented: Low risk choice for cathode material CsK_2Sb



Courtesy David Dowell

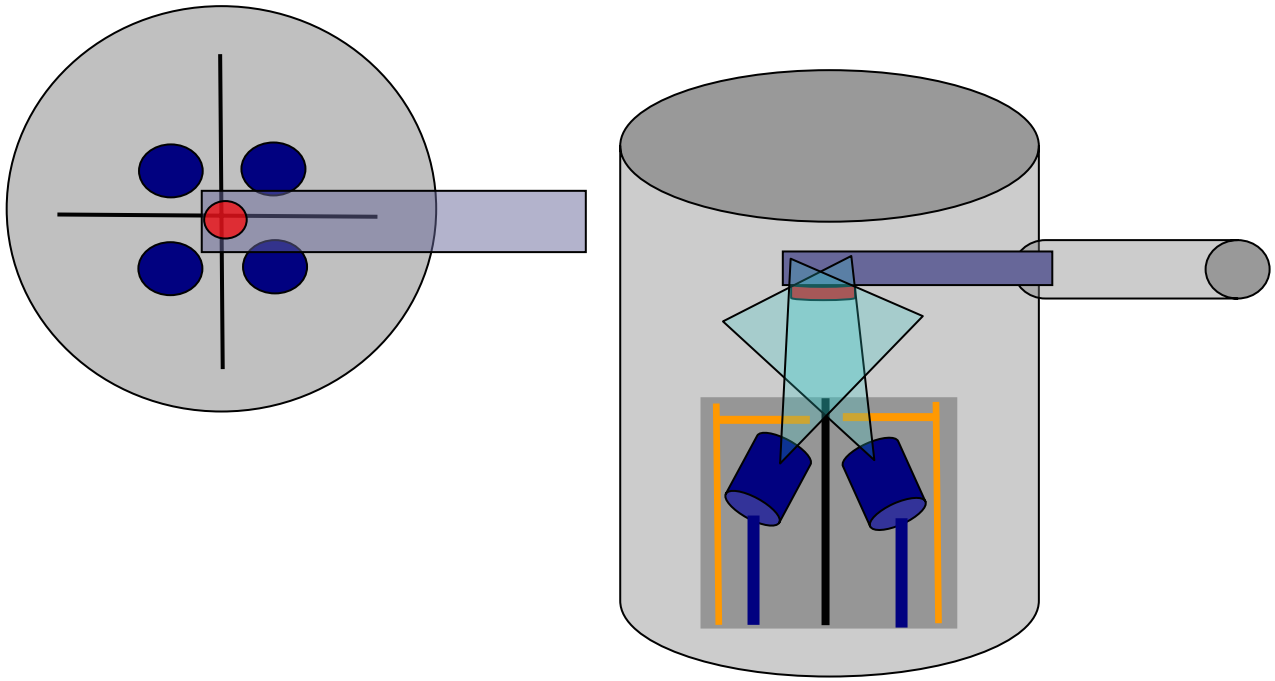
- **Proven high QE**
- **Proven High Peak Current**
- **Proven High Average current**
- Lifetime
- Average current > 100 mA

Research Goals

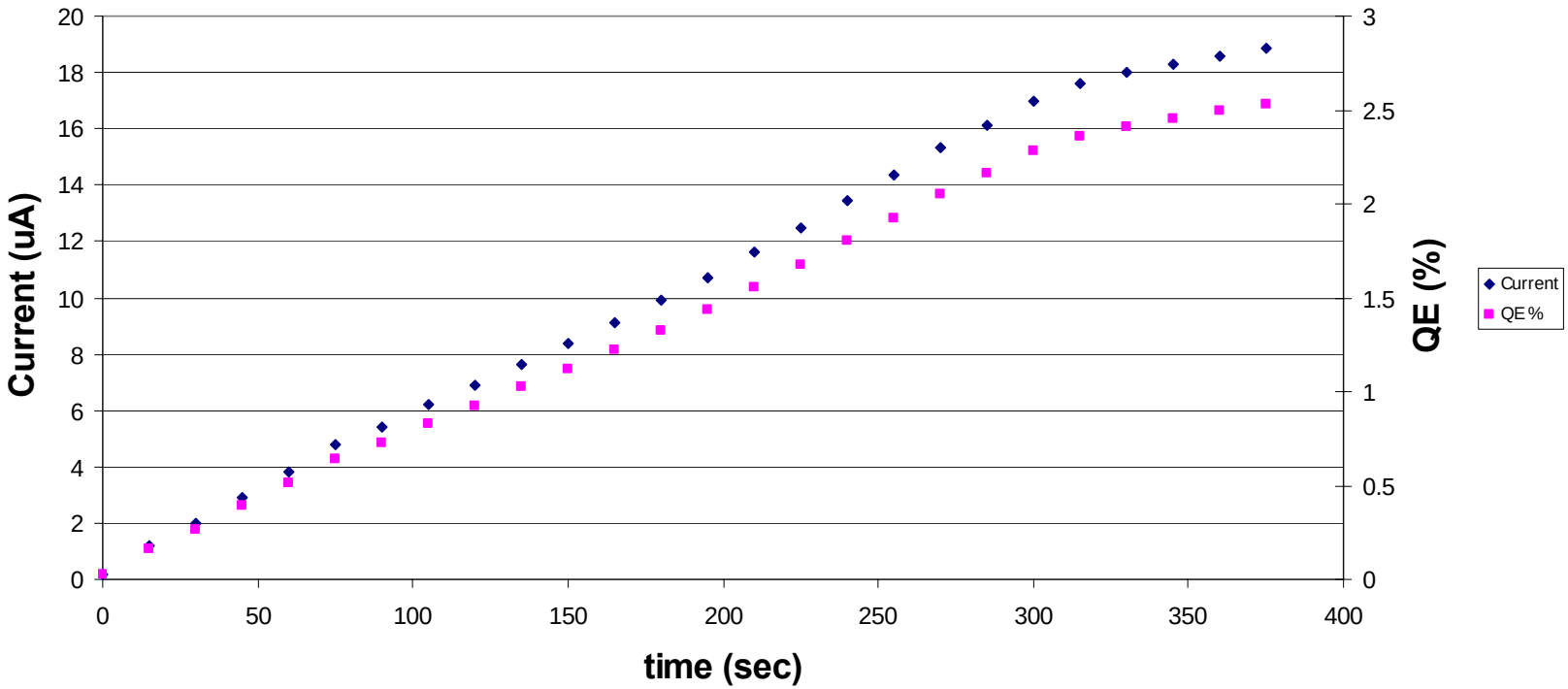
- Establish deposition system
- Uniformity of emission
- Study Lifetime related issues: Dependence on
  - laser intensity
  - current density
  - contaminants
  - Possible rejuvenation methods
- Reproducible cathodes

Photocathode Deposition System

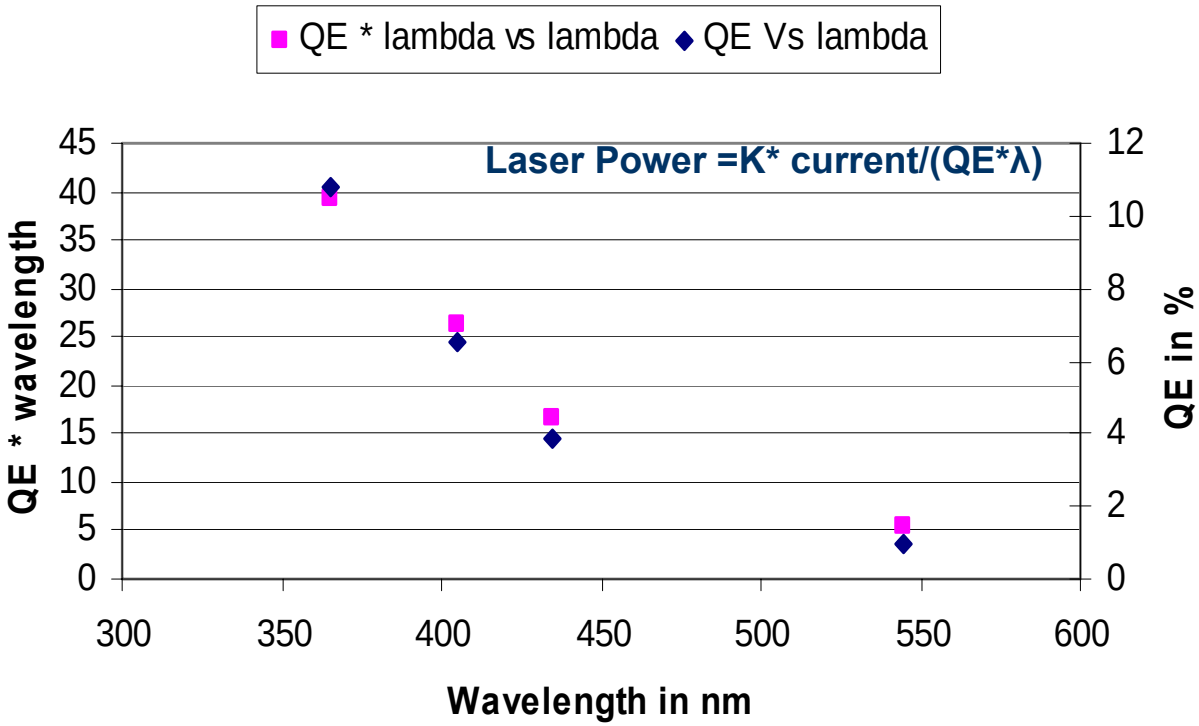
Deposition System



Current vs. Cs Deposition time



Wavelength Dependence



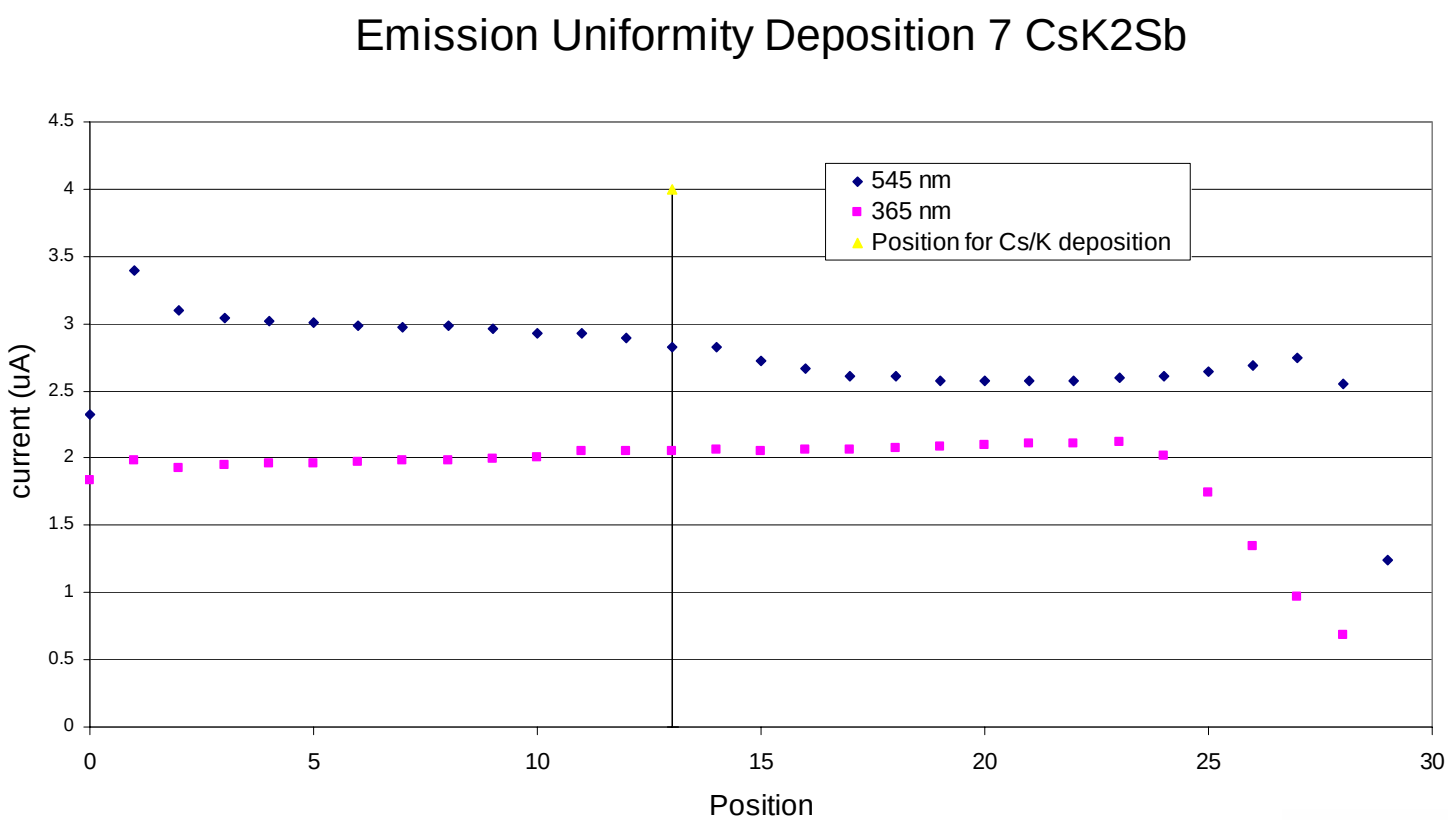
Input Power normalized based on specs

Emission @ 545 near threshold, sensitive to preperation

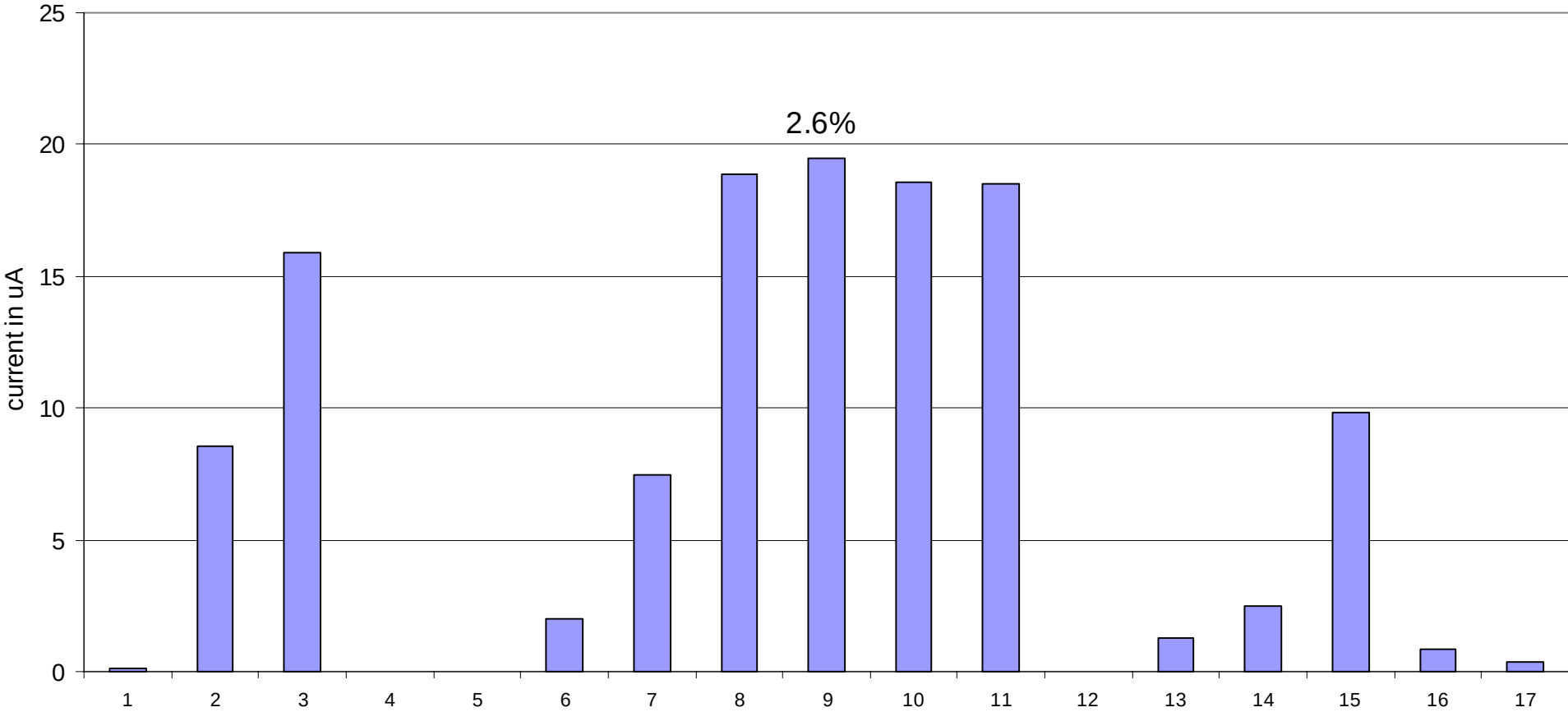
QE @ 365 11x QE @ 545

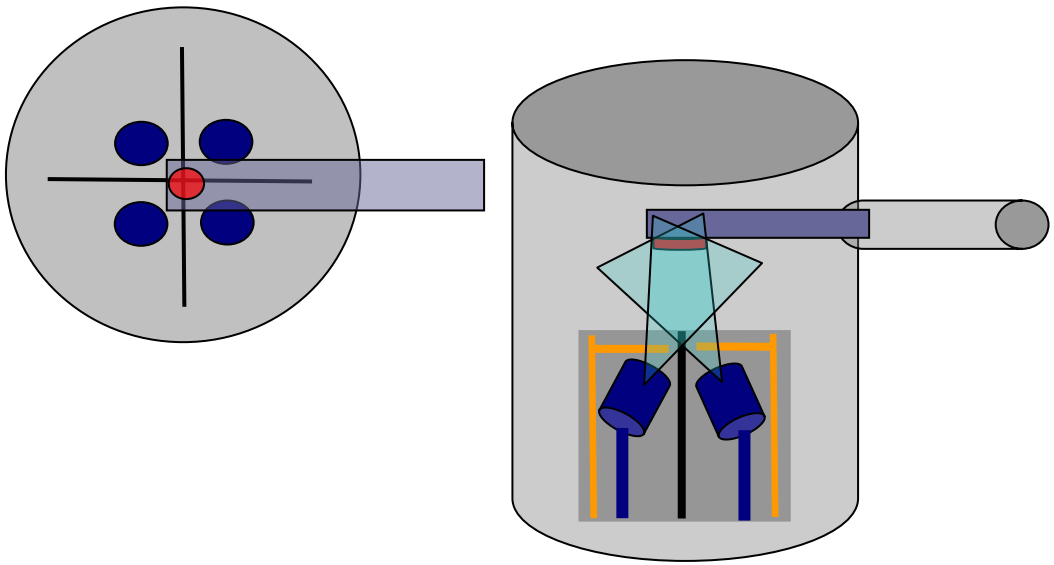
Laser power μ 1/ QE*λ

Surface Uniformity



Reproducibility





- QE of 1-2% reproducible
- Reasonably uniform emission
- Performance under high laser power density encouraging
- Wavelength dependence encouraging
- Still riding the learning curve
- Confirm wavelength dependence, high laser power density performance
- Address Lifetime, uniformity, reproducibility, efficiency, & # of cathodes/feed issues

Laser System

- ~ 500 nm/365 nm
- 9.4, 28.2 MHz
- 10-20 ps
- ~ 20 W adjustable during tuning
- ~2 µJ @ 100 Hz for high peak current studies

Possible Layout

Oscillator àPulse selector à Amplifier stages àHarmonic conversion

Oscillator

- **9.4, 28.2 or 94 MHz**
- **Few Watt**
- **~10 ps**

Pulse selector

100 Hz/9.4 MHz

Not needed if oscillator is 9.4 MHz

Amplifier

Multipass, multistage Adjustable output power

Harmonic Crystal

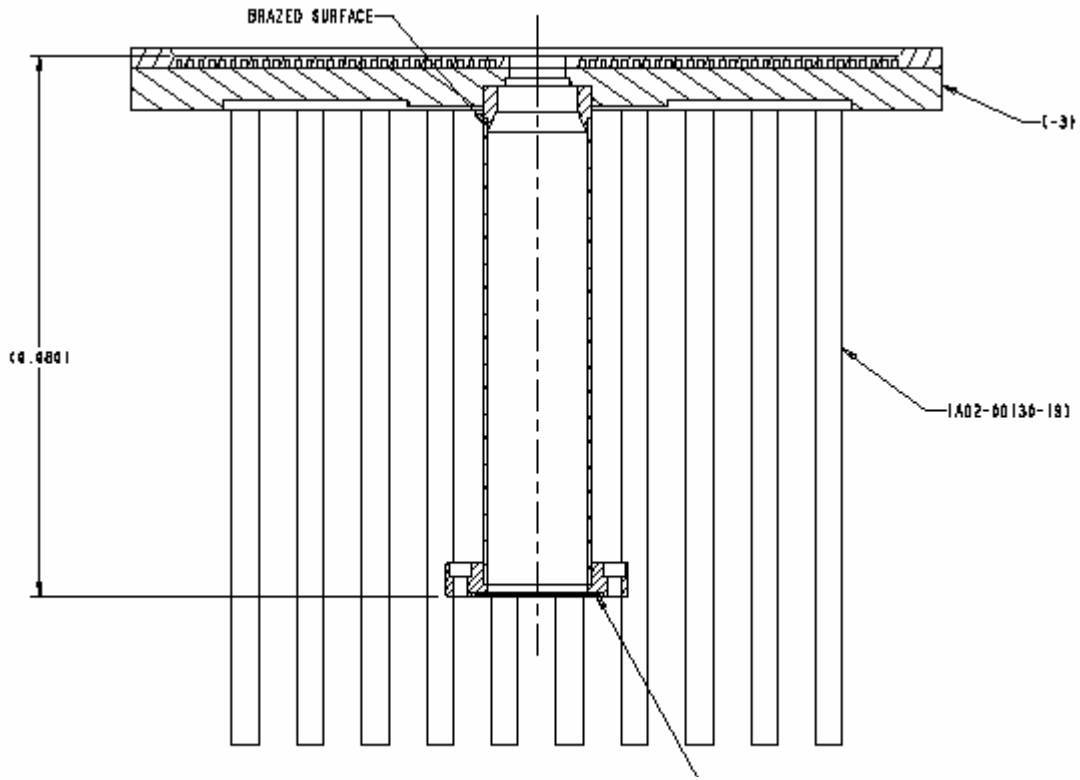
LBO

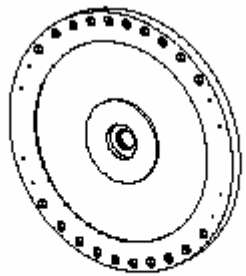
~2 µJ at 100 Hz

~20 W @ 9.4 MHz

Courtesy TBP

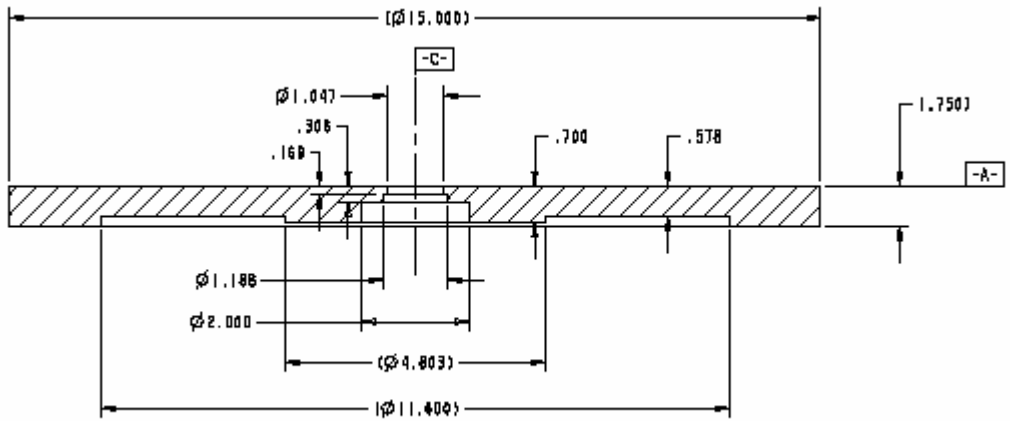
Cathode-Gun interface: Copper Injector Courtesy: AES





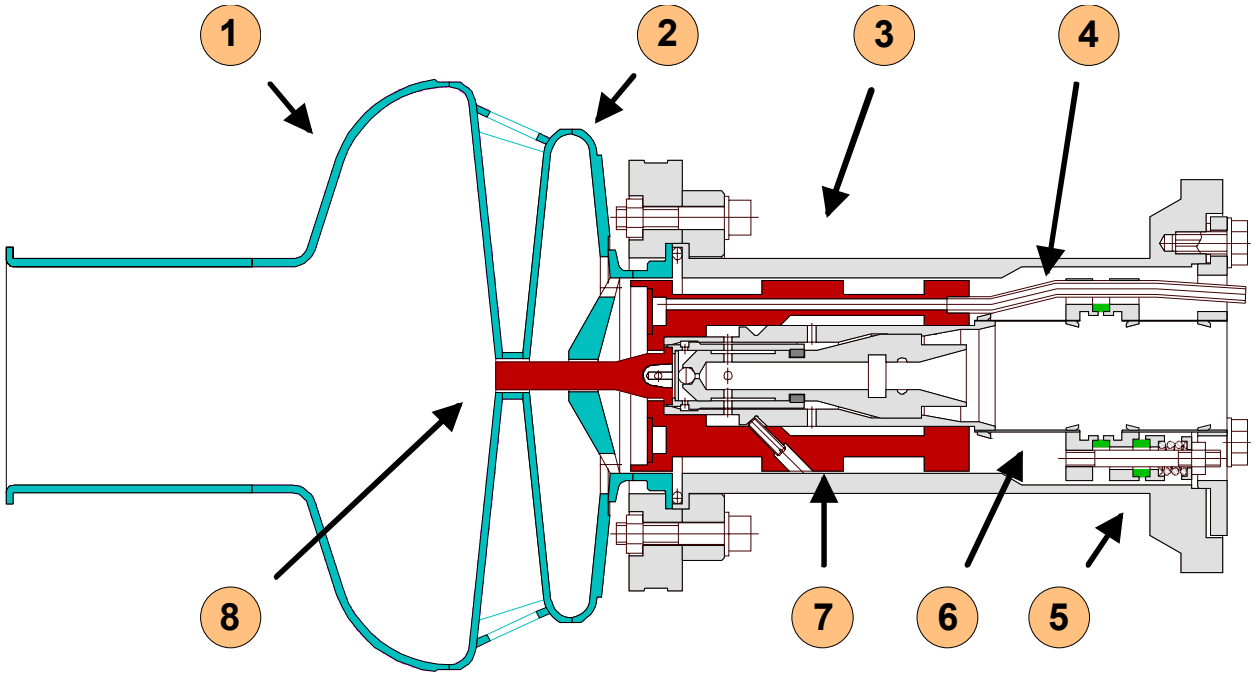
SCALE 0.250

Cathode Lifetime!!



SECTION A-A

FZR 1.5 cell 1.3 GHz Fully SRF Gun Design



(1) Niobium Cavity
(2) Choke Flange Filter
(3) Cooling Insert
(4) Liquid Nitrogen Tube
(5) Ceramic Insulation
(6) Thermal Insulation
(7) 3 Stage Coaxial Filter
(8) Cathode Stem

Cavity Breakdown

Complicated Choke Joint

Conclusions

Cathode:

- Reasonable QE
- Good Uniformity

Need to

- Improve reproducibility,
- Number of Depositions per feed
- Study Lifetime

Laser System:

Not Commercially available, but achievable

Cathode-Gun Interface

Initial stage – Collaborating with other interested Groups