

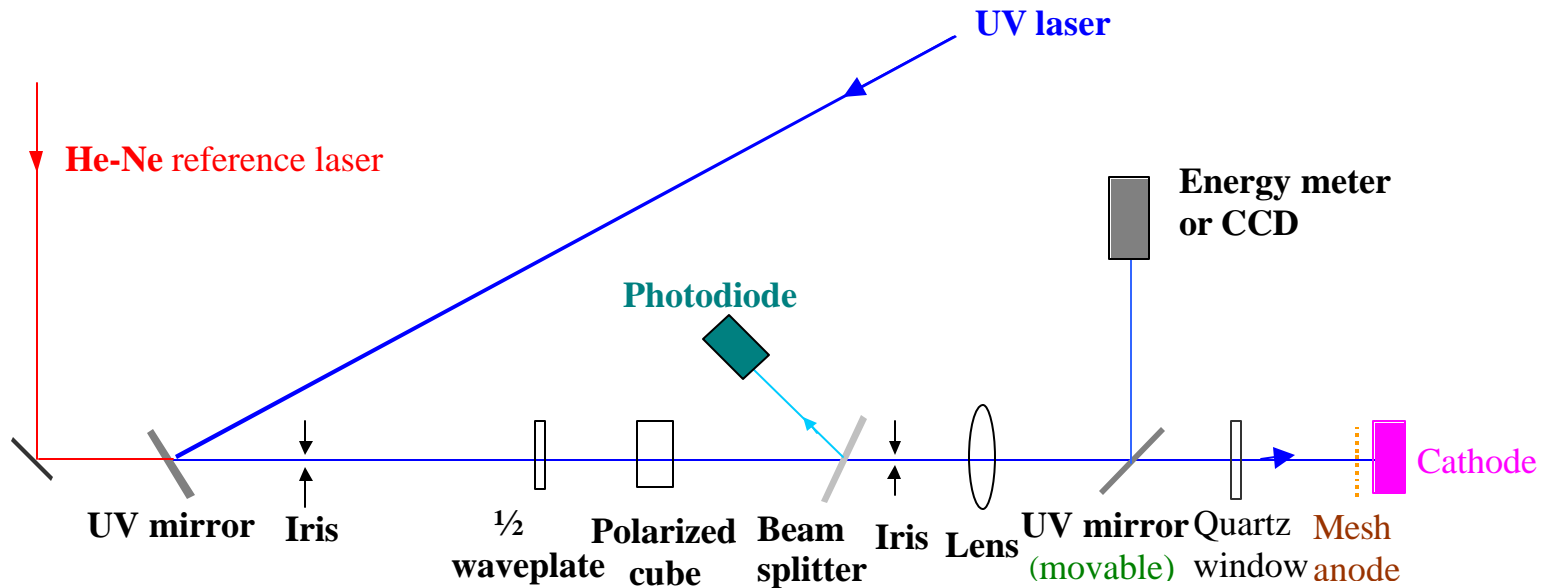
Photocathode Studies & Pulsed Power Gun

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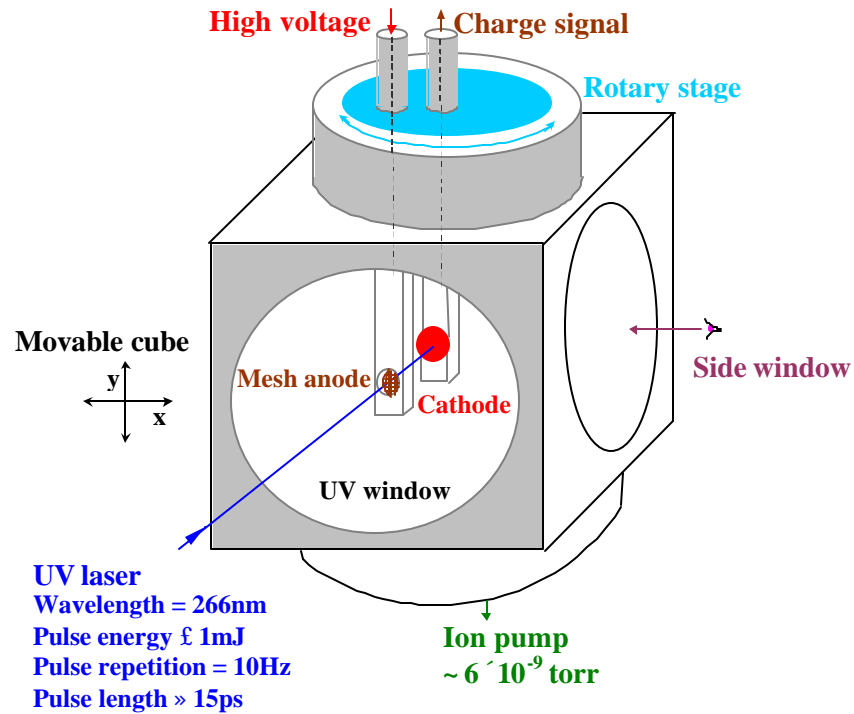
- Photocathode studies
 - Photoemission from niobium
 - 3 step \Rightarrow 4 step model
 - Effect of laser cleaning

- Pulsed Power Gun
 - Principle
 - Pulser Design
 - Data from 1 MV pulser
 - Data from 5 MV pulser

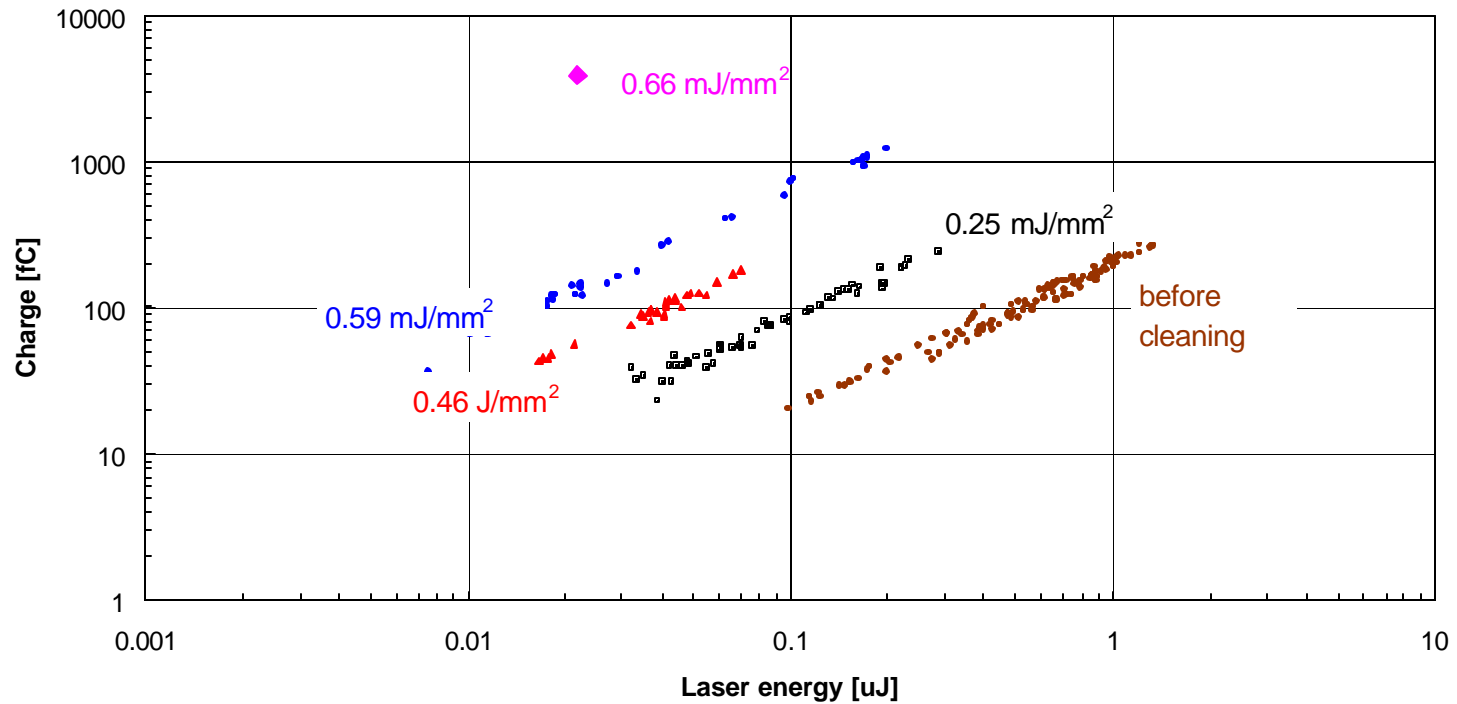
Schematic of the optical lay out for DC photoemission studies



Block Diagram of the vacuum cell



Photoelectric charge vs. laser energy at different laser cleaning



Theory of Photoemission - Three Step Model

- Excitation of Electrons within the metal
 - Absorption of light
 - Energy distribution of excited electrons
- Transit to the Surface:
 - e⁻-e⁻ scattering
- Overcome workfunction to escape surface
 - Must have sufficient momentum perpendicular to the surface

Integrate over all electron energies capable of escape

$$QE(\mathbf{n}) = A(\mathbf{n}) \int_{\mathbf{f}+E_f}^{\mathbf{h}\mathbf{n}+E_f} P(E)T(E,\mathbf{n})D(E)dE$$

For small values of $(h\nu-\phi)$: $QE(\mathbf{n}) \propto (h\mathbf{n} - \mathbf{f})^2$

Calculation of β & ϕ from Photoemission Data

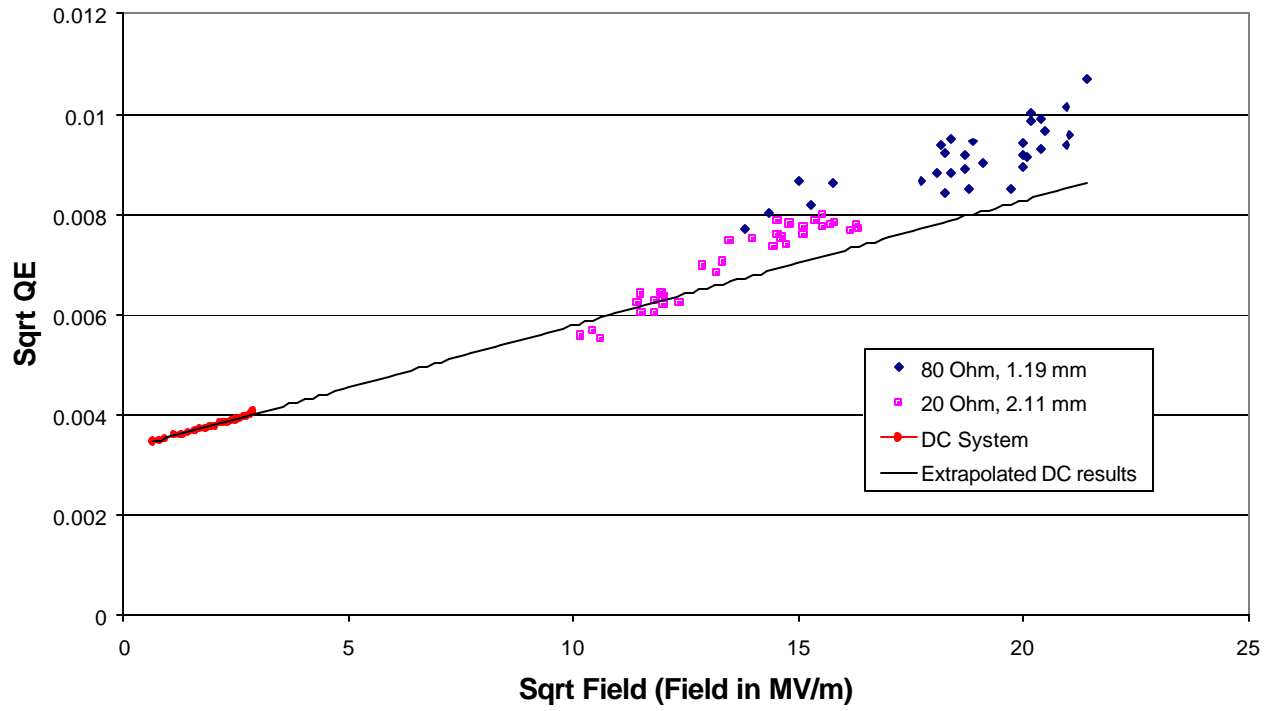
- Reduction of ϕ due to applied field: $f = f_0 - \sqrt{\frac{eE}{4pe_0}}$
- Including Schottky Effect: $QE \propto (h\nu - f + \sqrt{\frac{e b_{PE} E}{4pe_0}})^2$
- Plot $QE^{1/2}$ vs $E^{1/2}$, Expect linear dependence with

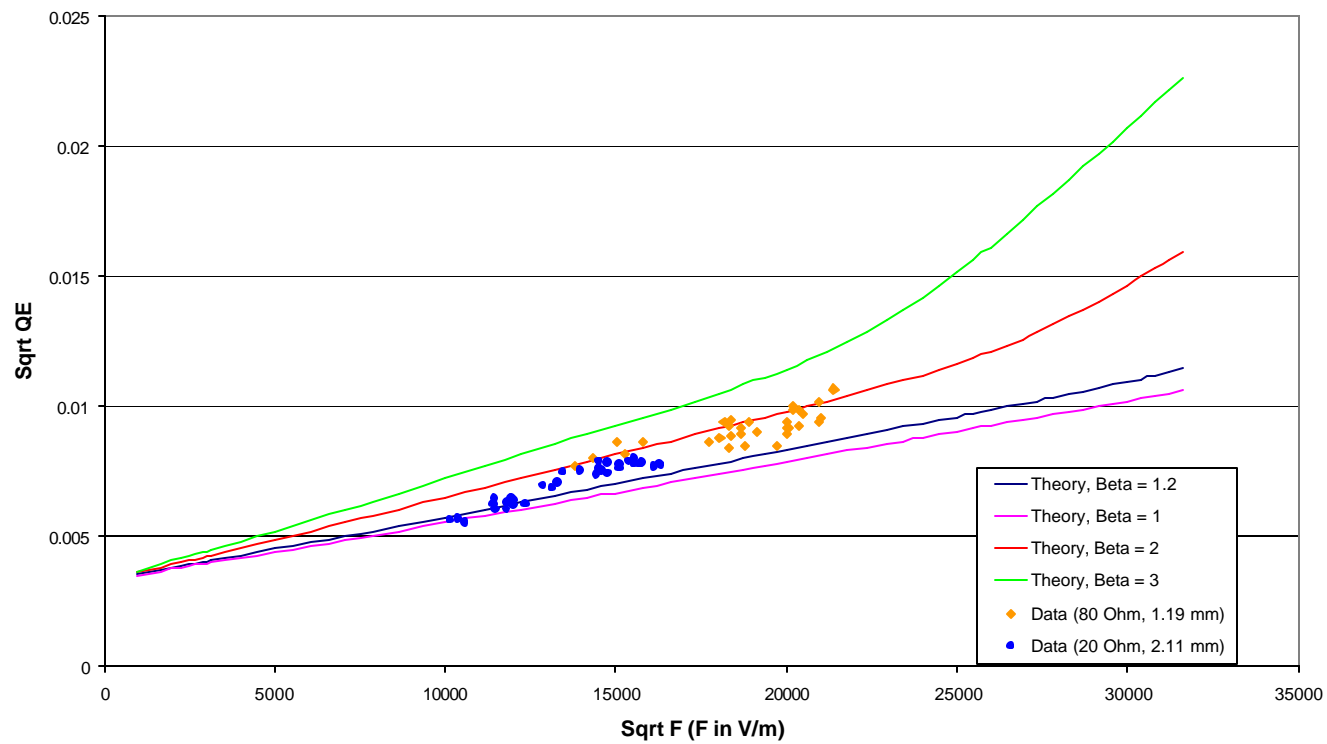
$$\frac{\text{slope}}{\text{intercept}} = (h\nu - f)^{-1} \sqrt{\frac{e b_{PE}}{4pe_0}}$$
- Assuming ϕ and β_{PE} are independent of $h\nu$, values from two λ can be used to determine ϕ and β

$$\left(\frac{m_1}{b_1}\right)(h\nu_1 - f) = \left(\frac{m_2}{b_2}\right)(h\nu_2 - f)$$

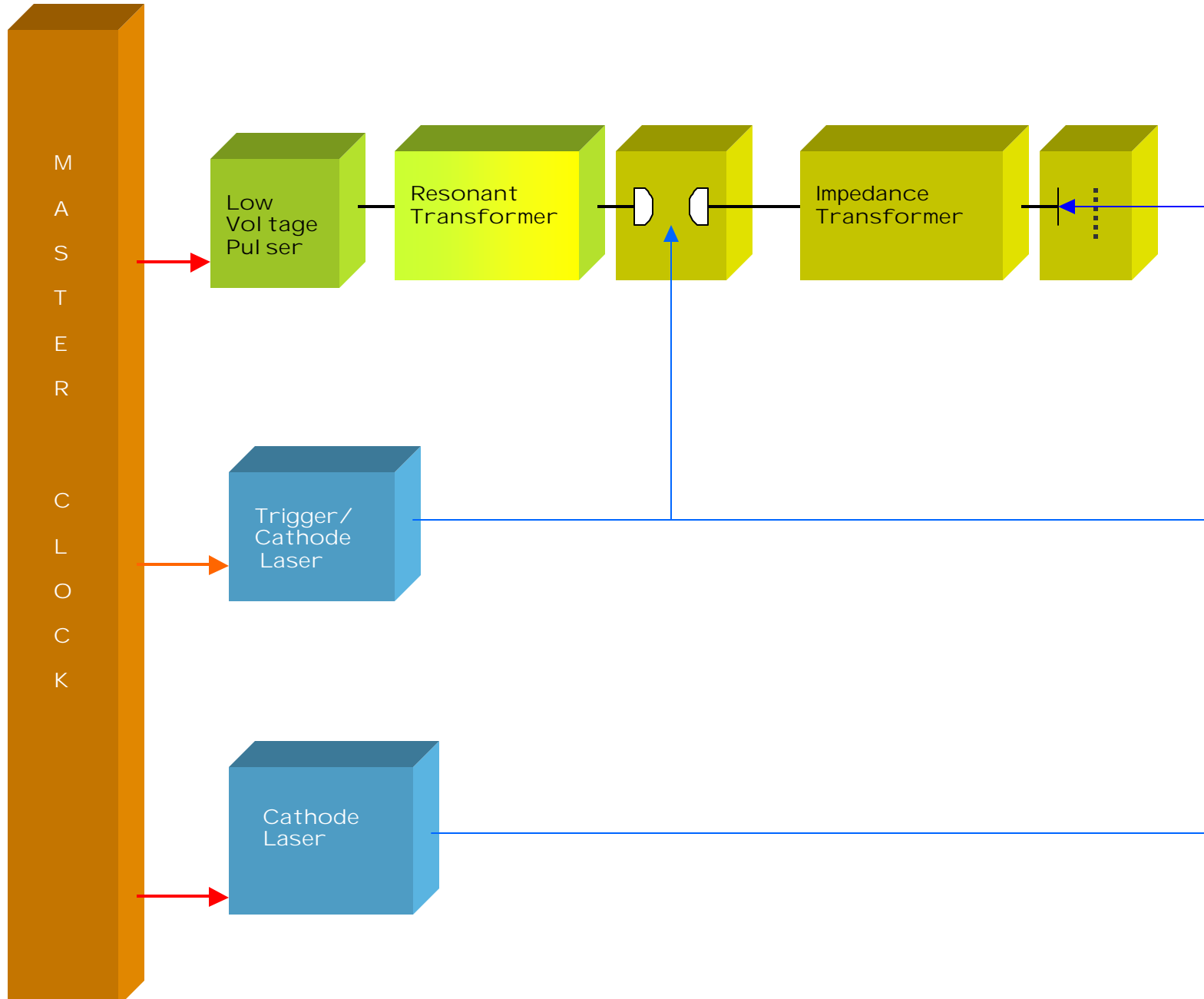
DC data & Laser Cleaning: Cu

Cleaning Energy	ϕ	β	Filters	
			YAG	KrF
Before Cleaning	4.37	1.45	0.13	0.16
.35 mJ/ mm ²	4.37	1.51	0.12	0.15
.65 mJ/ mm ²	4.37	1.47	0.12	0.13
1.18 mJ/ mm ²	4.37	1.66	0.83	0.51
3.02 mJ/ mm ²	4.37	2.79	0.59	0.62
2.34 mJ/ mm ²	4.37	1.35	0.95	0.96

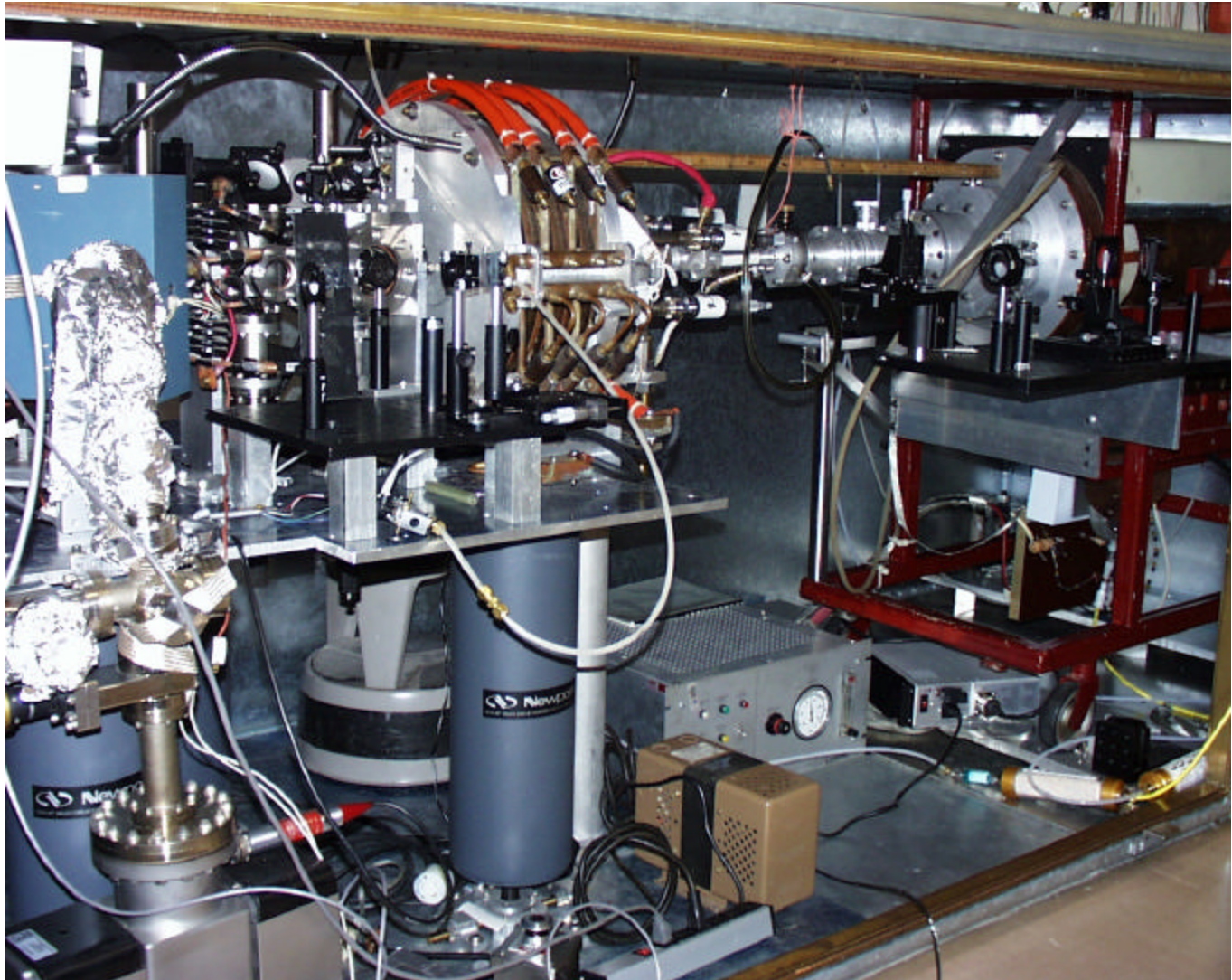




Block Diagram of Pulse generator

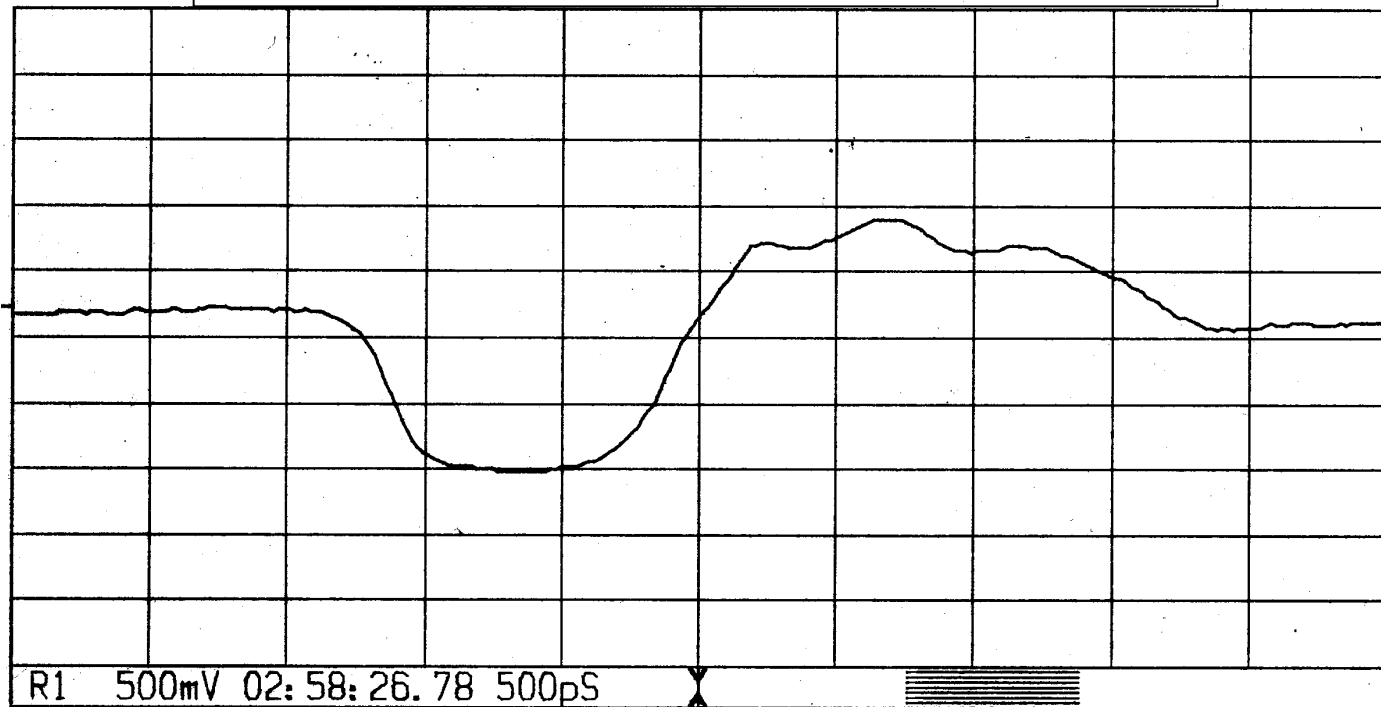


Photograph of 1 MV pulser



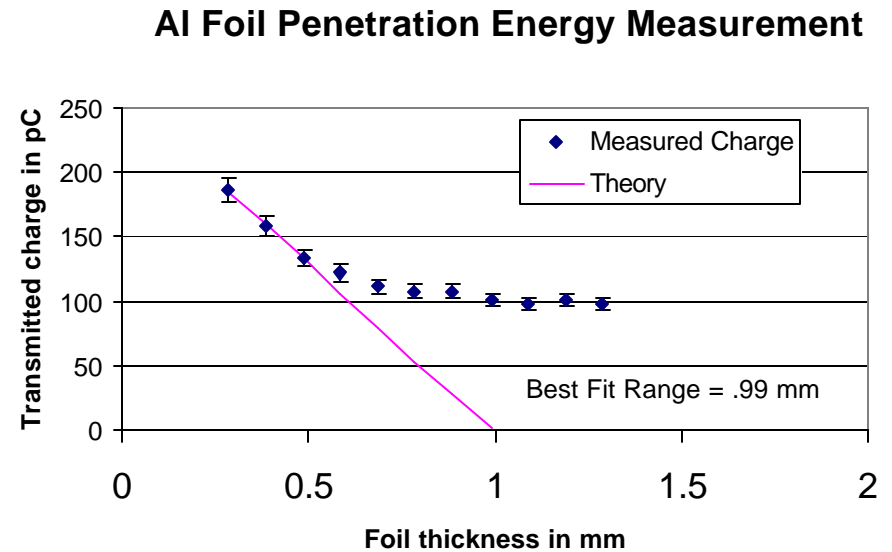
Voltage Trace from MV pulser

1 ns duration, with 100 ps rise and fall
Amplitude is 900 kV

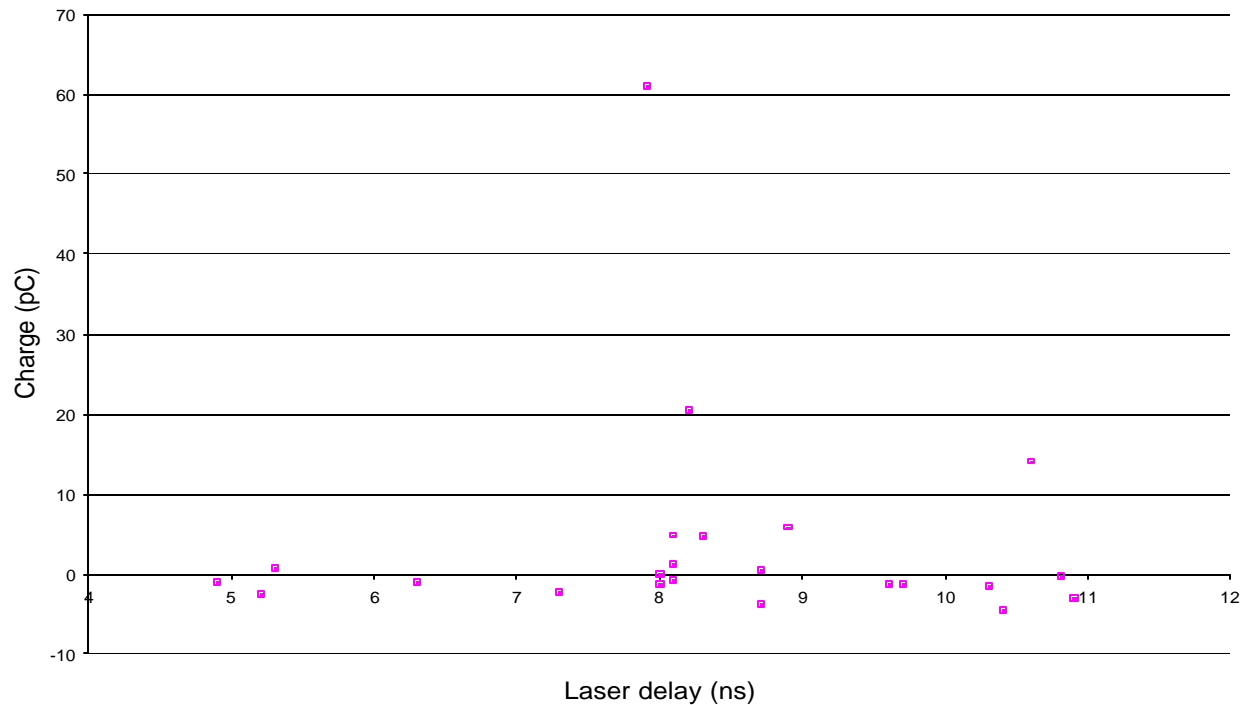


Electron Energy Measurement

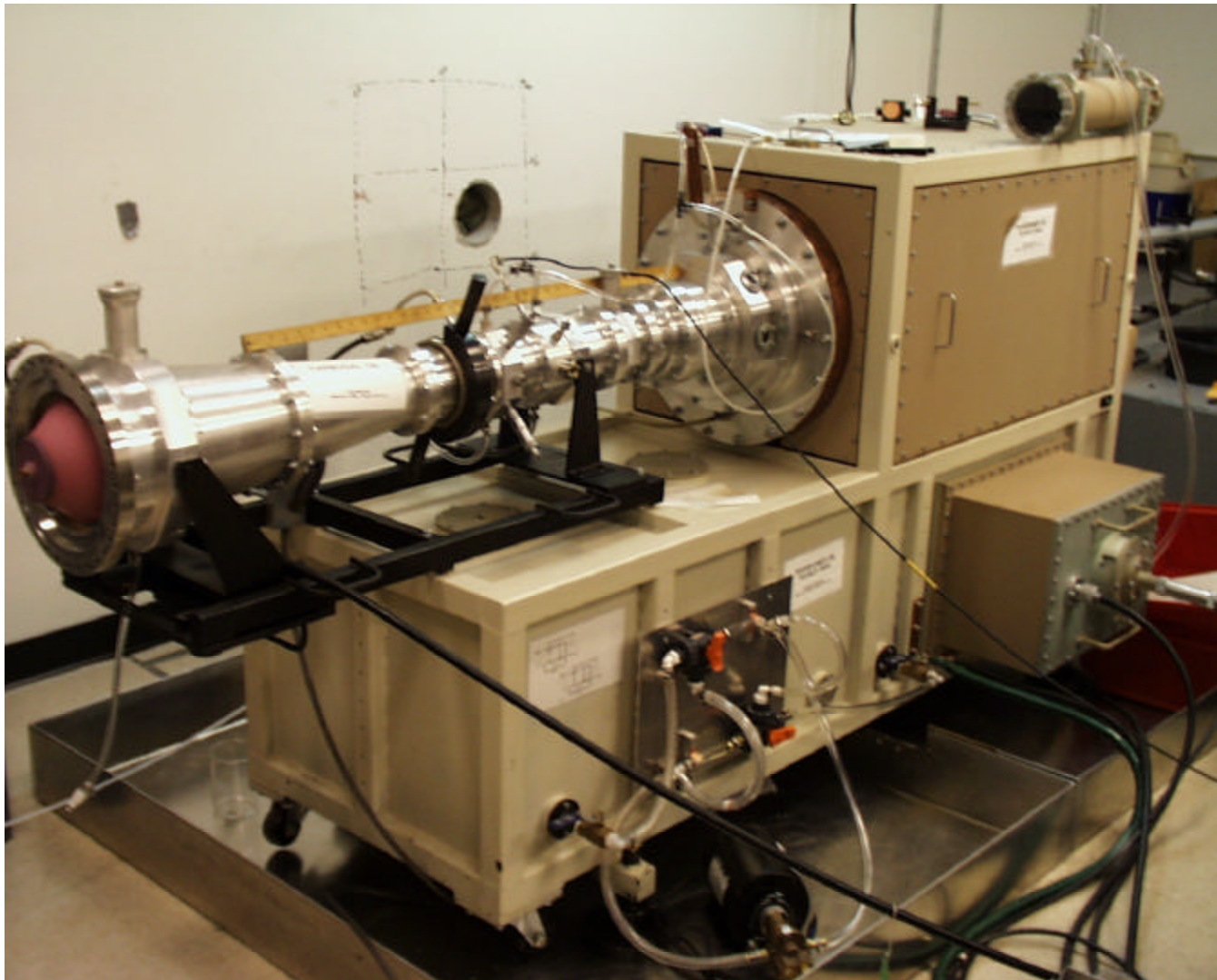
- Transmission through Al foils measured
- Best fit range is ~1 mm
- Corresponds to 715 keV



Photoemission from Cu using 250 fs, 266 nm laser



Photograph of 5 MV pulser



Temporal Profile of Voltage Trace at the End of the Impedance Matched Transmission Line

