# LASER BASED PROFILE AND ENERGY MONITOR DEVELOPMENT FOR $H^-$ BEAMS

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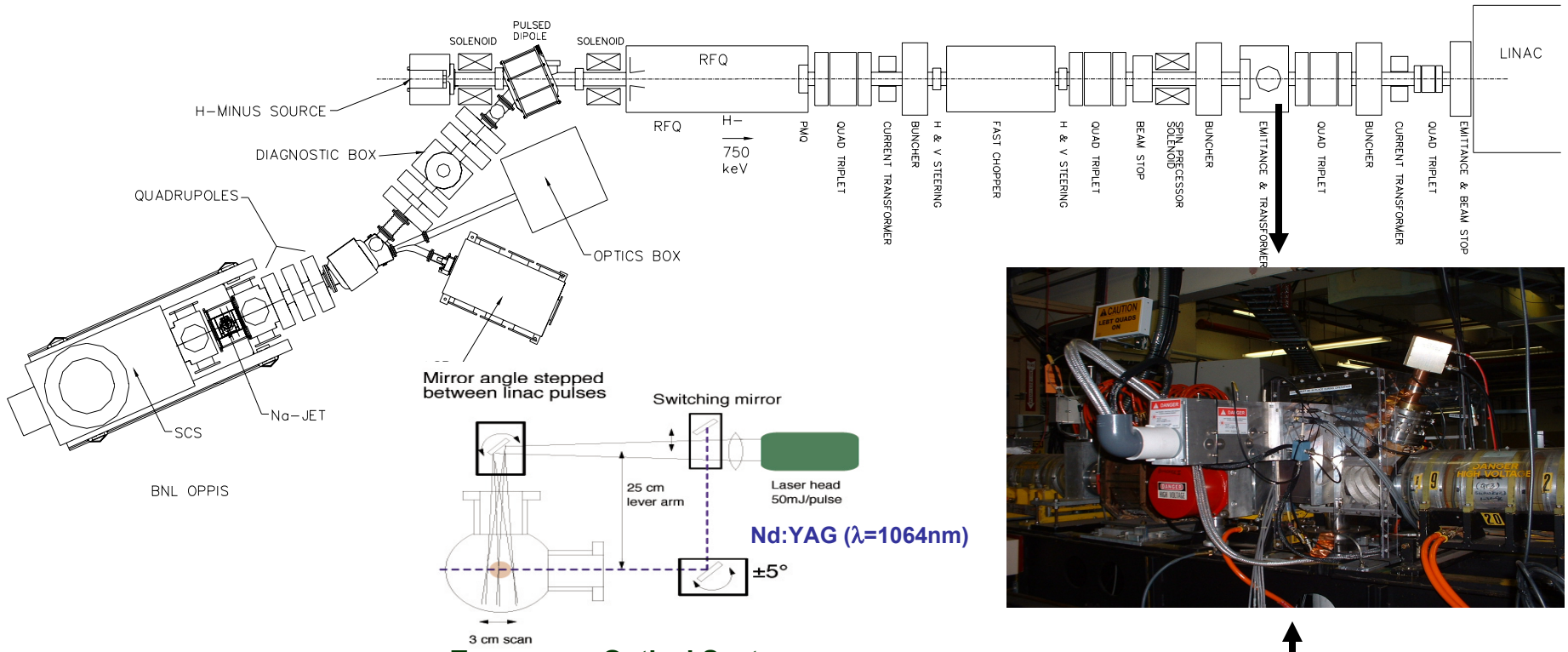
# Profile Measurement

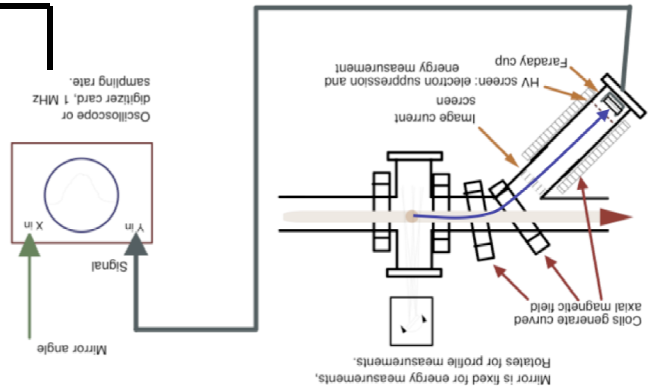



**Transverse Optical System**

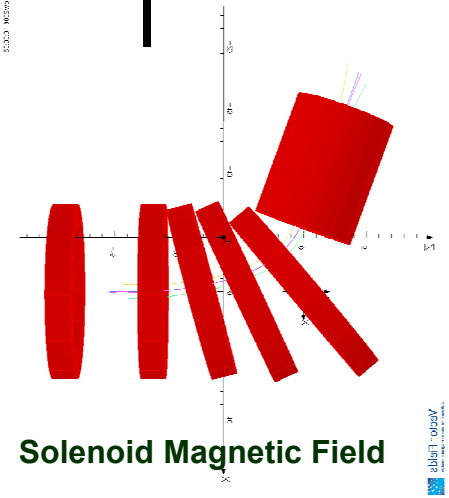



Labview


**H- Beam profile**




**e from H- are guided by magnetic field**



**Solenoid Magnetic Field**

# SC Potential Measurement

## DC beam

$V(r) = V_s(1 + 2\ln(b/a) - r^2/a^2)$; $r \le a$

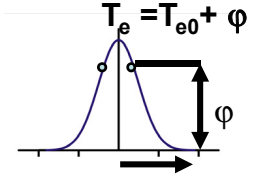
$V(r) = 2 V_s \ln(b/r)$; $a \le r \le b$

$V_0 = V_s(1 + 2\ln(b/a))$

$V_s = 30 * I / \beta$

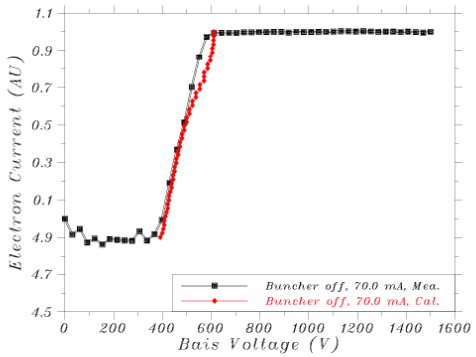

**I Cur. in Amp**

**β Rel. Parameter**




**Electron Energies**

**$T_{e0} = T_{H^-}/1838 = 408$ eV**
**$a_x = 13.5$, $a_y = 7.0$ mm,**
**$b_x = b_y = 38$ mm**
**$r = (x+y)/2 = 10.25$ mm**
**$V_0$(70mA) ~ 200 V**
**$E_e = 408 + 200$ ~608 eV**




**Electron Current VS Bias Voltage**

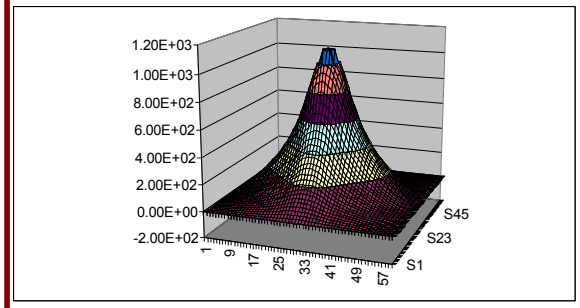
**$E_{H^-}$ = 750,000 eV**
**$\Delta E_{H^-} = \pm 20{,}000$ eV**
**$E_e$ = 408 eV**
**$\Delta E_e = \pm 10.9$ eV**

$$E_x = \frac{1}{4\pi\varepsilon_0}\frac{3I\lambda}{c\gamma^2}\frac{(1-f)}{a_x(a_x+a_y)a_z}x$$

$$E_y = \frac{1}{4\pi\varepsilon_0}\frac{3I\lambda}{c\gamma^2}\frac{(1-f)}{a_y(a_x+a_y)a_z}y$$

$$E_z = \frac{1}{4\pi\varepsilon_0}\frac{3I\lambda}{c}\frac{(1-f)}{a_x a_y a_z}z$$

**Electric Field due to Uniformly Charge Ellipsoid**



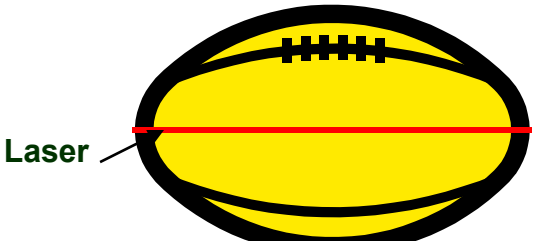

**Potential Distribution in x-z Plane**

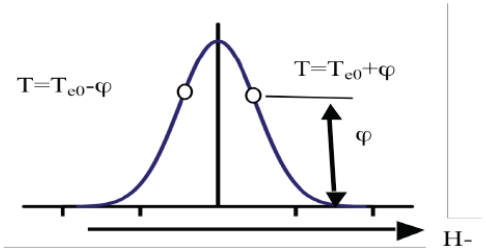
Table I: Beam parameters used in the calculations

| Current mA | Buncher On/off | % of DC component | Bunched Length degrees |
|---|---|---|---|
| 70 | OFF | 100 | 360 |
| 70 | ON | 50 | 90 |
| 35 | ON | 30 | 70 |

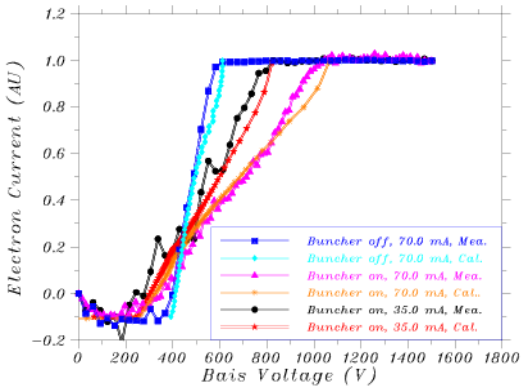
**Beam Parameters Used in Simulations**

## Bunched Beam




**Electron Energies**




**Electron Current VS Bias Voltage**

# Summary

- Transverse Profile
- At low energies ($\Delta E(m_e/m_p) << $ SCP)
  - Space Charge Potential (SCP)
  - Bunch Length and Bunching Factor
- At high ($\Delta E(m_e/m_p) >>$ SCP)
  - Energy Spread ($\Delta E$)