

# Plan of CCD Radiation Damage Test at Tohoku Univ.

**KEK  
Niigata U.  
Tohoku Gakuin U.  
T.N.C.M.T.**

**Y. Sugimoto, A. Miyamoto  
N. Tamura, G. Iwai, K. Fujiwara, H. Takayama  
K. Abe  
T. Aso**

## Charged Particle Detector using CCDs

**Excellent Spatial Resolution:**  $< 3 \mu\text{m}$

**2-Dim. Information (Pixel):** **Good 2-track Separation**

**Thin Active Layer:** **Less Multiple Scattering**

**=> The Best Candidate for Vertex Detector**

**Signal Charge is transferred by O(cm)  $\Leftrightarrow$   $\sim 300 \mu\text{m}$  for SSD**

**=> More Radiation Damage Sensitive (Trap)**

## **Beam Background at JLC**

**$e^+e^-$  pair background by beam-beam interaction**

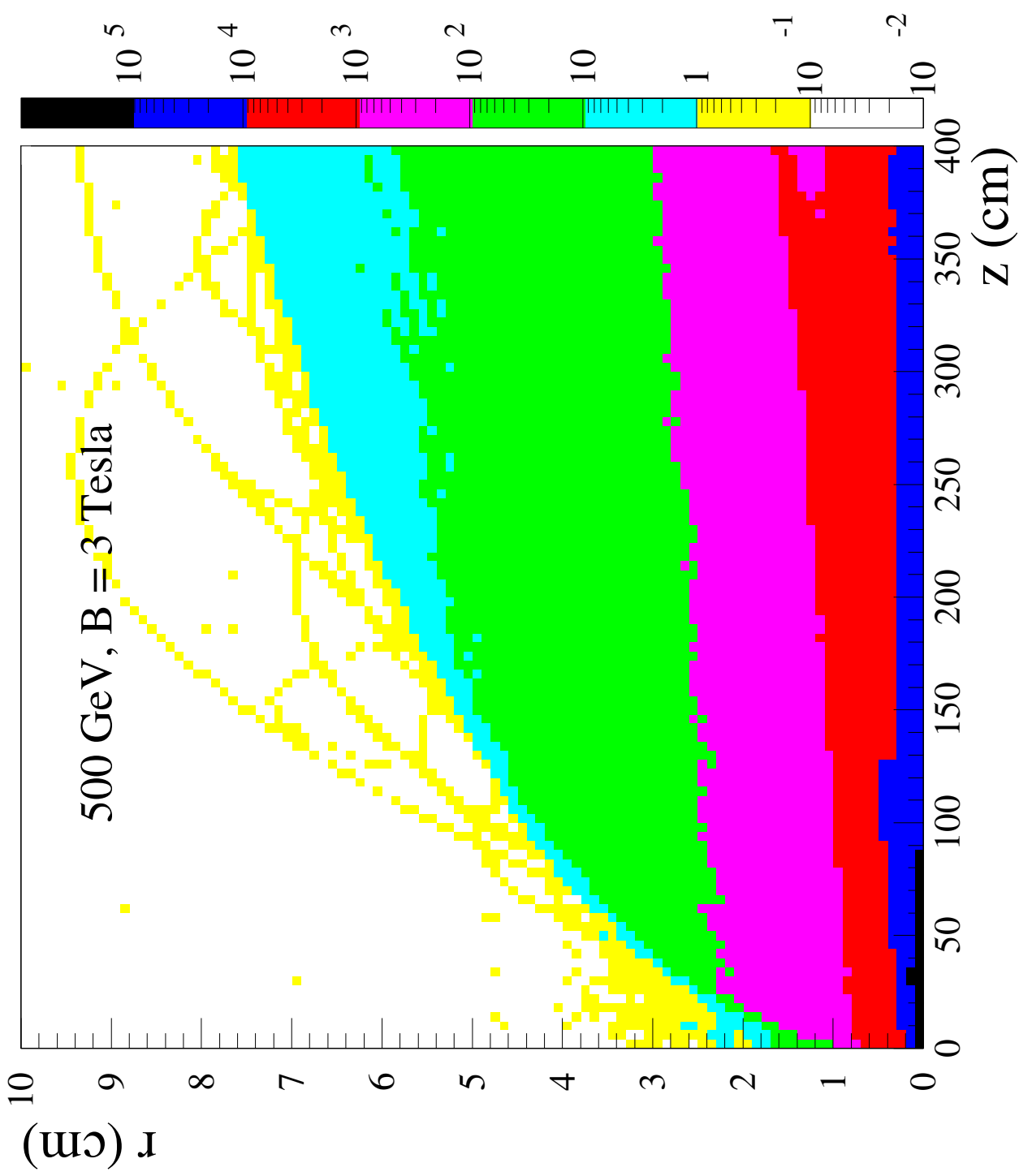
**Low energy components: Trapped by B field**

**High energy component: Go through forward region**

**=> ~10 to ~few 100 MeV  $e^+/e^-$  hit CCD vertex det.**

**~ $5 \times 10^{11}/\text{cm}^2/\text{y}$  @  $B=2\text{T}$ ,  $R=2.4\text{cm}$**

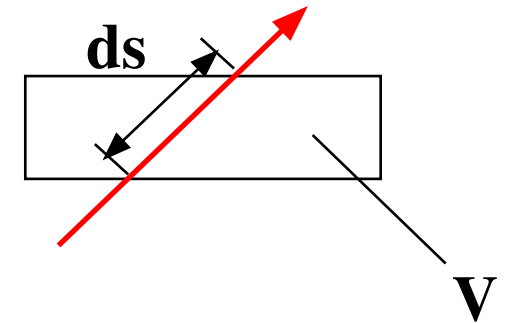
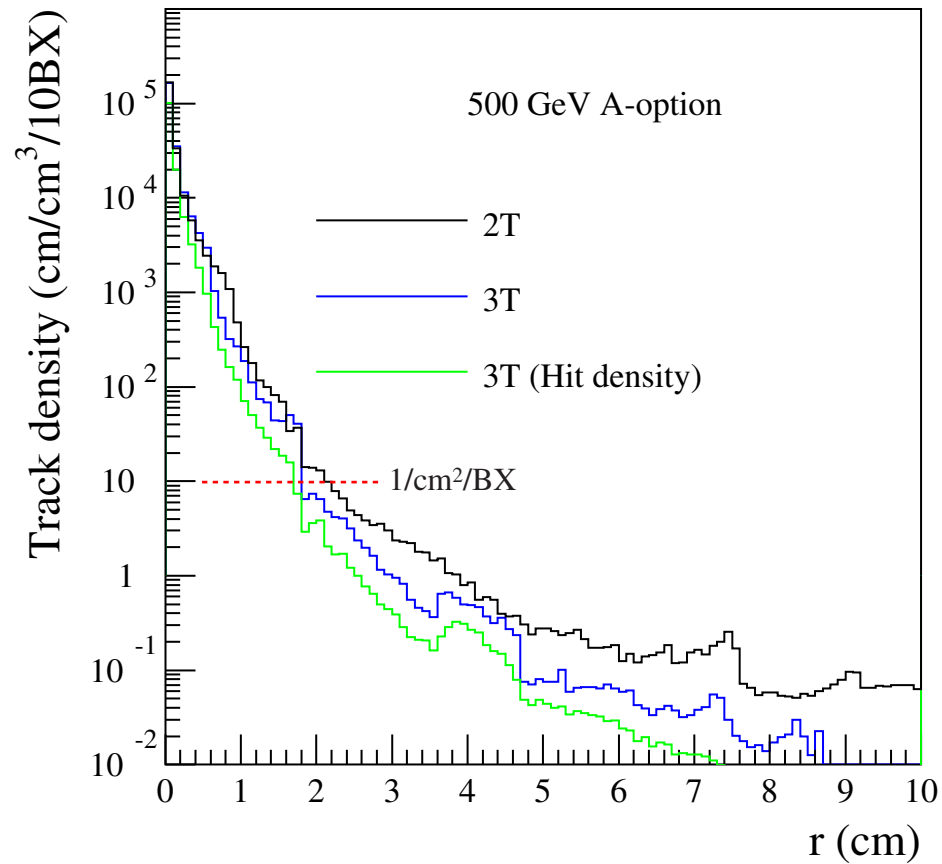
# Pair background track density



# Pair background track density

$|\cos \theta| < 0.9$

$$\text{track density} = \frac{ds}{V}$$



## Study of Radiation Damage of CCD

Irradiation test by 10 mCi Sr-90 source

=> OK up to  $5 \times 10^{12} / \text{cm}^2$

What about for high energy electrons?

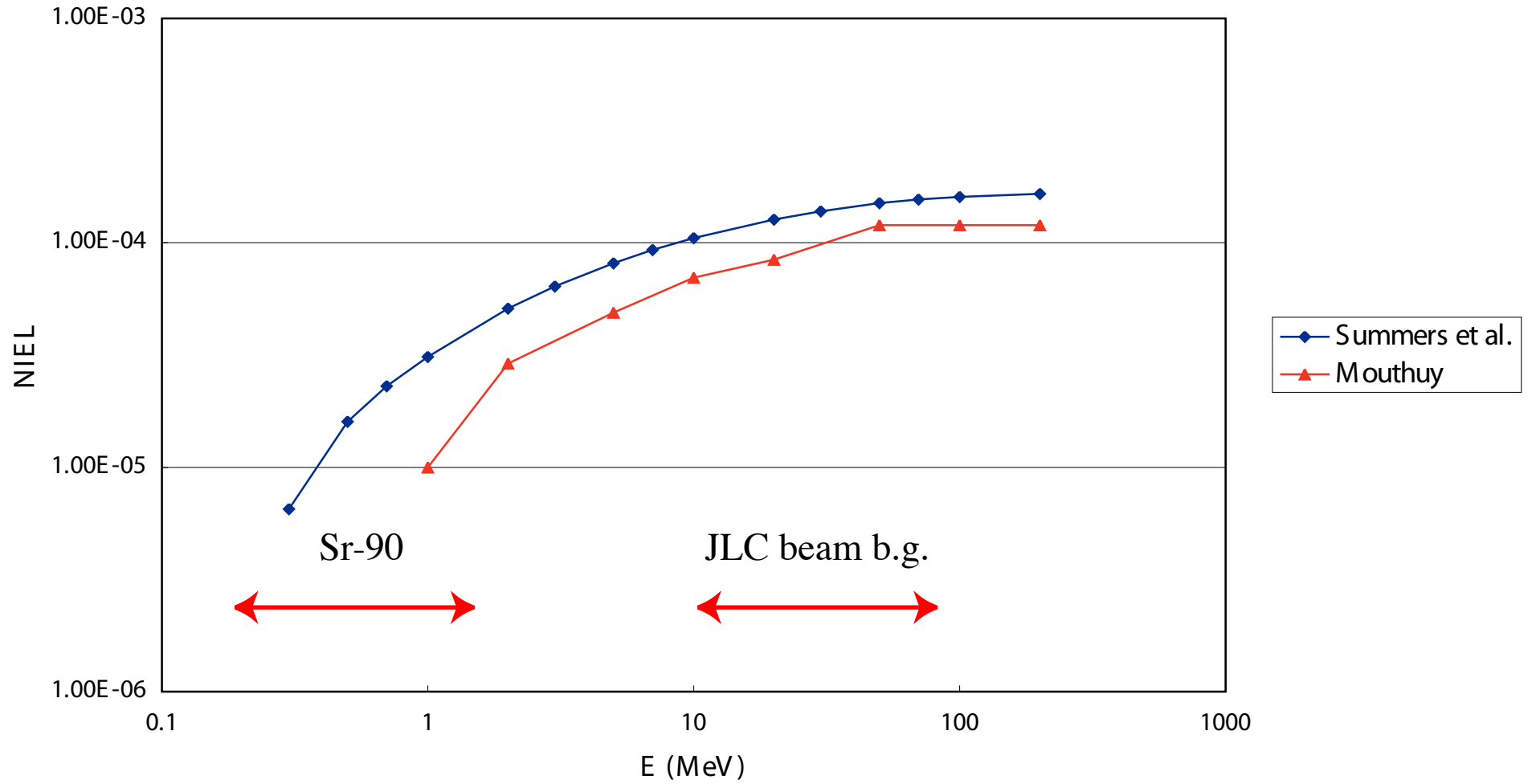
- Assuming NIEL(Non Ionizing Energy Loss) hypothesis;
- Assuming  $\langle E \rangle$  of is 1 MeV;

=> 10 times worse than : OK up to  $5 \times 10^{11} / \text{cm}^2$

But, it is a very **ROUGH** estimation

=> We proposed irradiation test by high energy electrons.

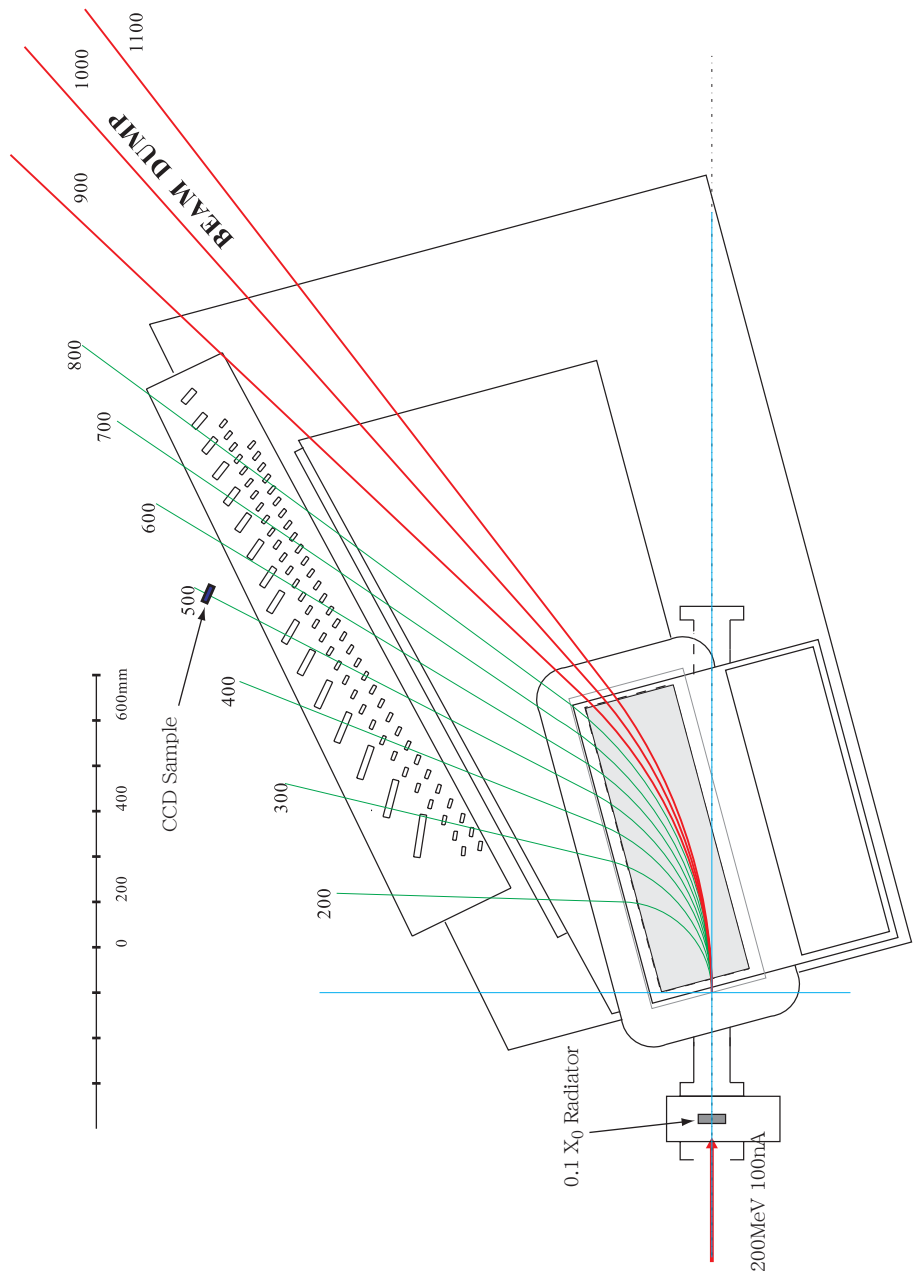
# NIEL (MeV cm<sup>2</sup>/g)



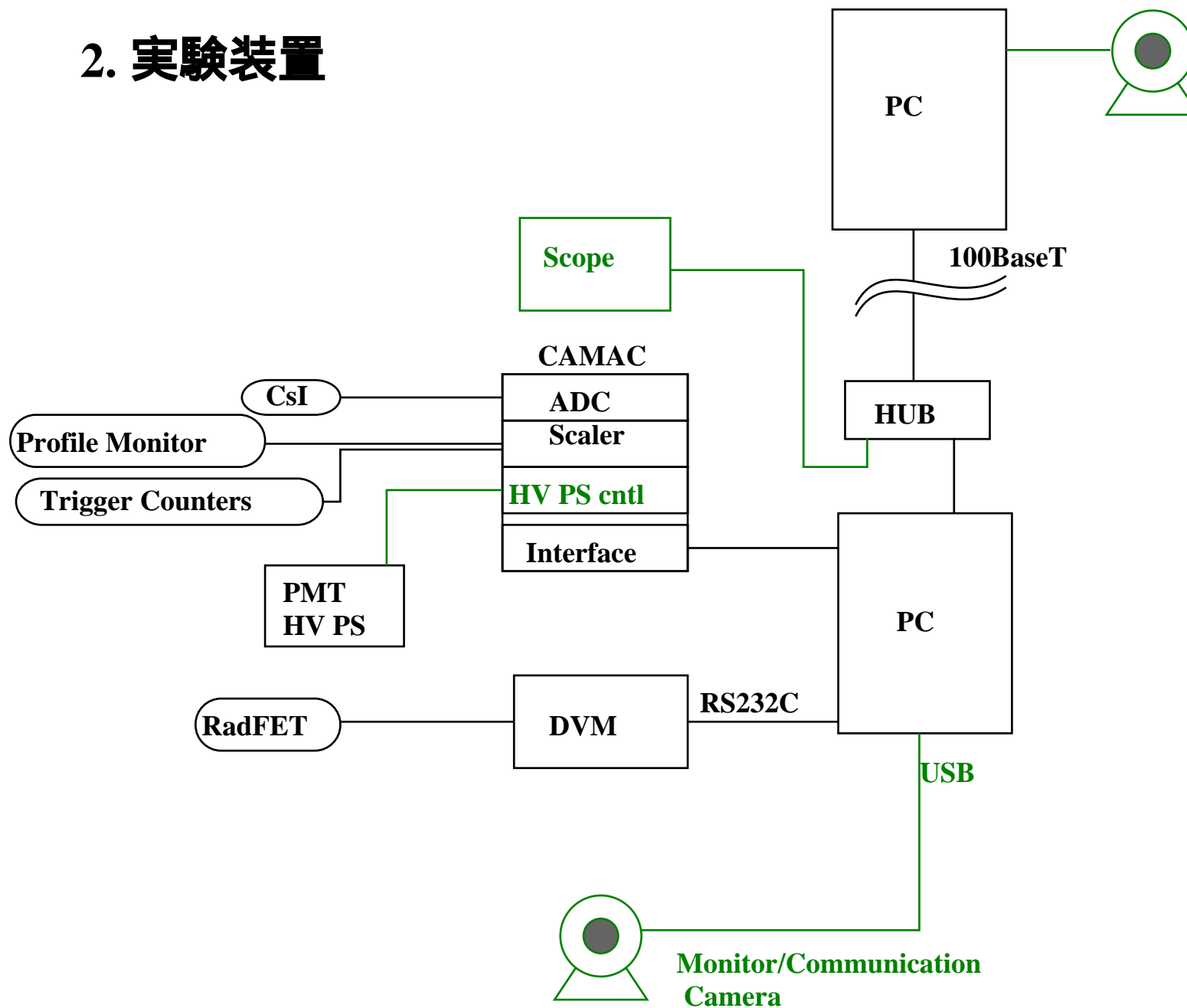
**Plan of Experiment at LNS (KAKURIKEN)  
(Laboratory of Nuclear Science, Tohoku Univ.)**

- **Primary Beam: 200MeV (Linac - Stretcher - BL-V - Tagged g line)**
- **Use tagging electrons (100MeV) of the tagged line for irradiation**
- **Estimate low energy background by measuring E-spectrum by CsI**
- **This time, irradiate up to  $5 \times 10^{10}/\text{cm}^2$** 
  - **--eventually irradiate up to  $1 \times 10^{12}/\text{cm}^2$  (in FY 2003)**
- **Dose monitor: RadFET ---- measure leak current**
- **Measurement of damage at Niigata Univ.**





## 2. 実験装置



## **Machine Time**

**2002/12/7 --- setup**

**2002/12/8 --- cosmic test of CsI**

**2002/12/9 --- Machine time**

**8 hours for E spectrum measurement**

**2 hours for changing setup**

**2 hours for irradiation**

**total - 1 shift**

**2002/12/10 --- Withdraw**