R&D Plan in FY2003

Vertex Detector Subgroup

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Activity in FY2002

- Development of CPCI ADC
  - Design has been completed
  - Modules will delivered in this summer
- Radiation Damage Study
  - High energy (150MeV) electron irradiation at Tohoku Univ.
  - Sr-90 irradiation at KEK
  - 6×10^{10} /cm^2 electrons irradiated in both cases
  - 150MeV electrons have x3 (not x10) larger effect

Activity Plan in FY2003

- CCD Radiation Damage Study
- Development of CPCI ADC
- Study of Thin CCD Wafer
- Study of Diffusion in Epitaxial Layer
- Simulation

CCD Radiation Damage Study

- Irradiation of HE electrons
  - 1 shift x 4 machine times (up to $10^{12}/cm^2$)
  - More accurate and reliable dose monitor
- Irradiation of Sr-90 β
  - Same dose as HE electron irradiation
  - Reliable comparison with HE irradiation

CCD Radiation Damage Study (Cont.)

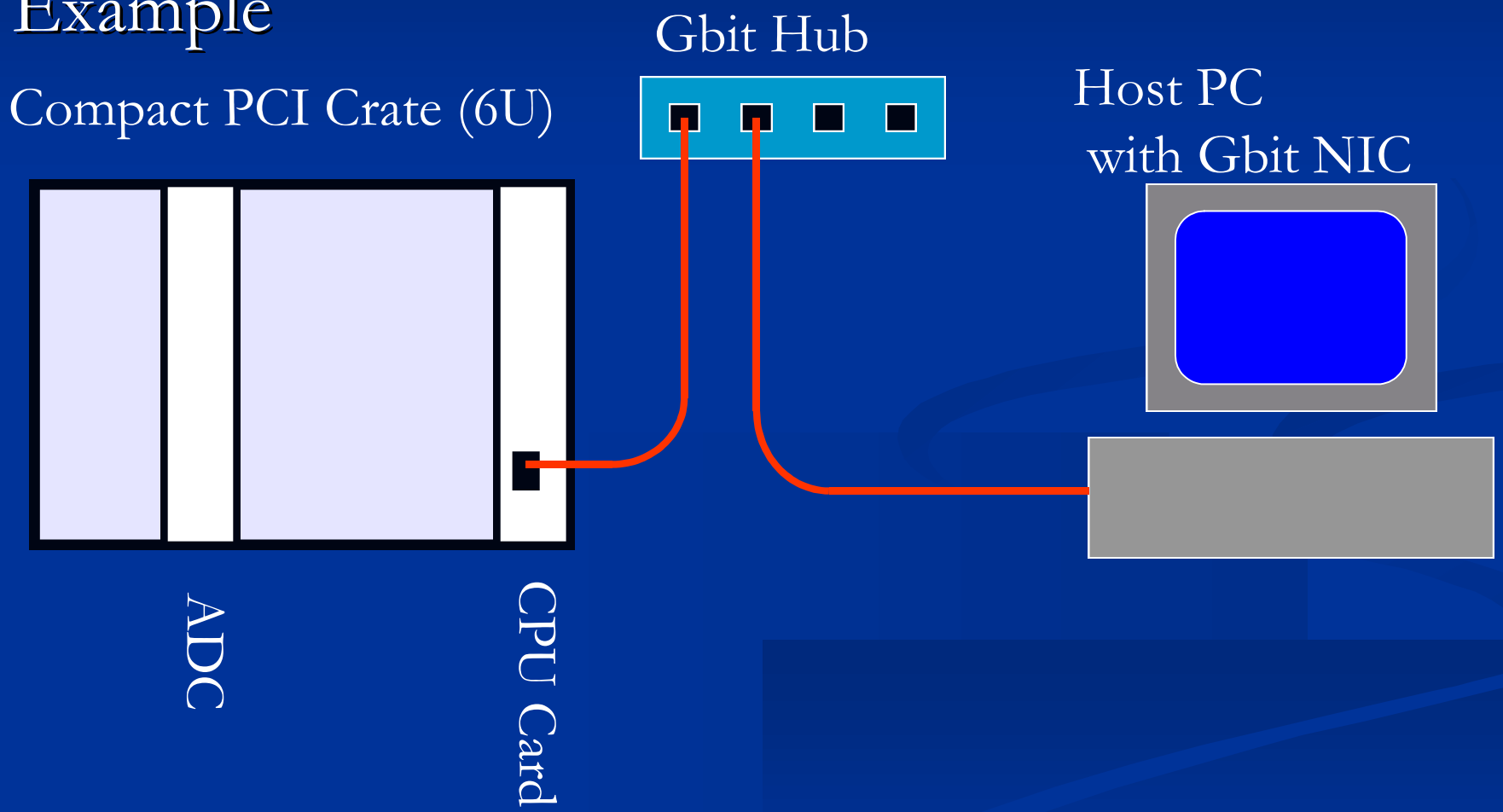
- Study of characteristics of irradiated CCDs
  - I_d vs. Temp
  - Flat-band Voltage Shift
  - CTI vs. Temp
  - CTI vs. Readout frequency
  - CTI vs. Fat-zero charge
  - CTI vs. clock pulse width/height
  - σ_x vs. dose
  - E-dependence of items listed above
  - Annealing/anti-annealing

Development of CPCI ADC

- Get CPCI ADC Modules from company
  - Planned in August
- CCD Timing Circuit
  - Use FPGA
  - Generate drive pulses for CCD (TTL) and clock pulses for CPCI ADC (LVDS)
- Construction of CPCI DAQ system

CPCI DAQ System

- Example

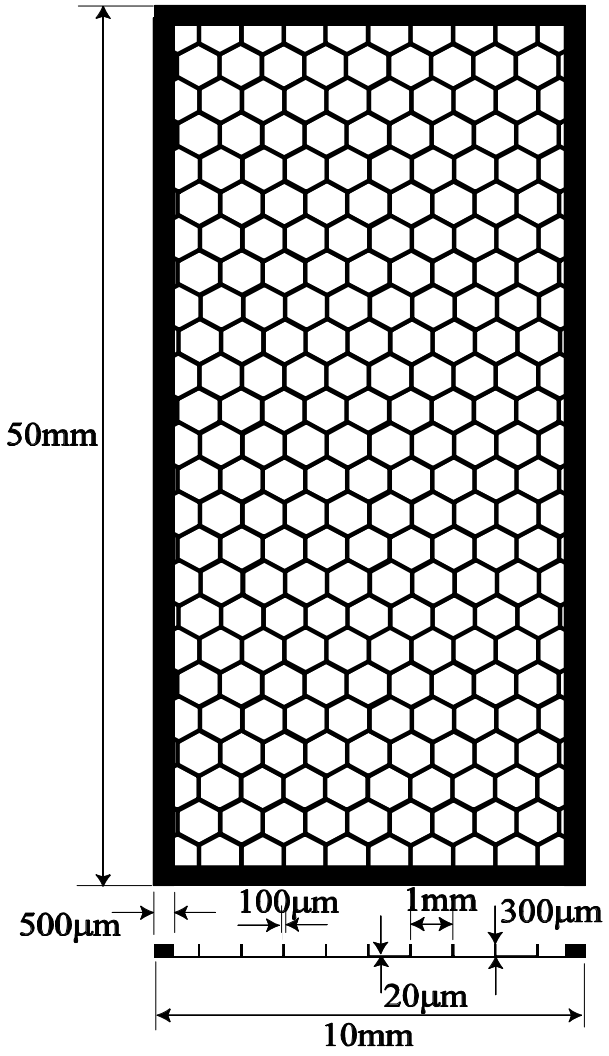


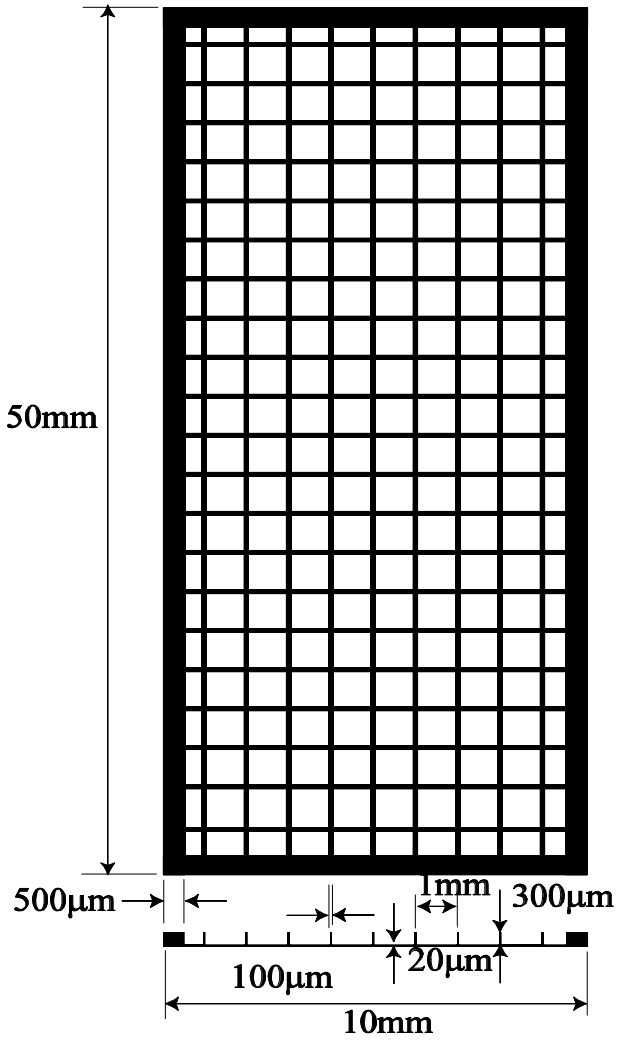
Study of Thin CCD Wafer

- Motivation
  - CCDs have ~20μm thick sensitive region
  - Should be thinned to ~20μm if mechanical strength is ensured
- Sample Wafers
  - Picture frame type ---- No good
  - Honeycomb/SHOJI type will be studied
    - Strength calculation with ANSIS
    - If OK, make sample wafers

Sample Wafer

- Honeycomb Type
- Shouji Type





Average thickness

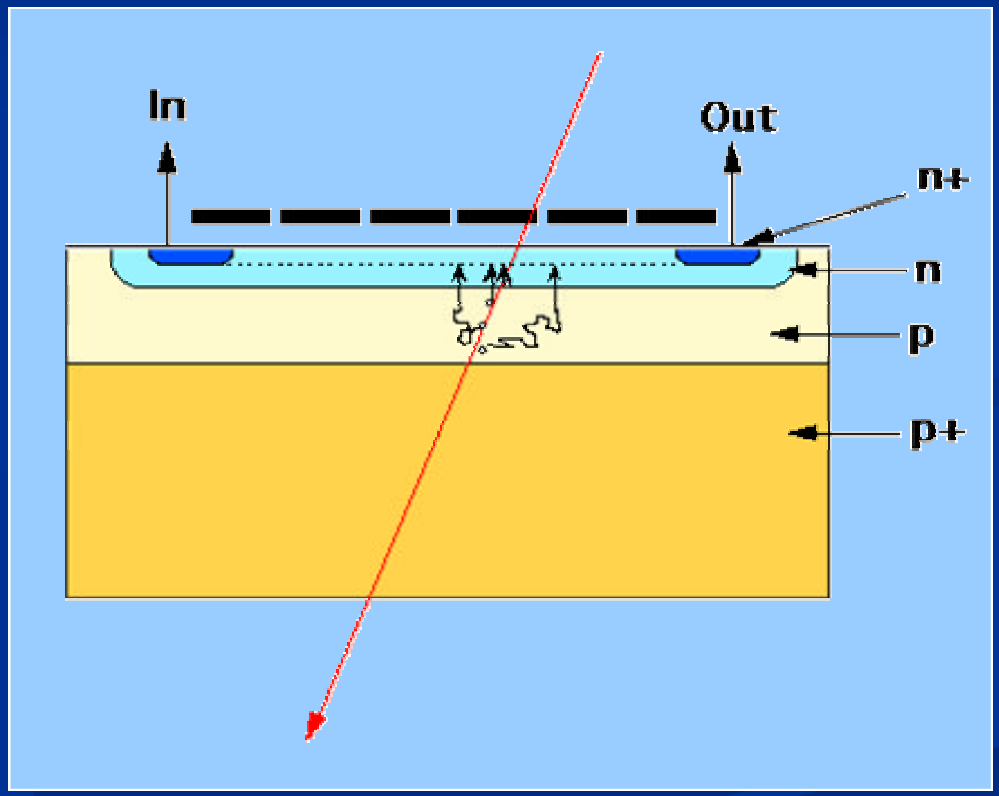
= 76μm

= 100μm (includeing edge)

Study of Diffusion in Epi-Layer

- Diffusion of electrons in Epi. Layer
  - Key of excellent spatial resolution for CCD & CMOS pixel sensors
  - Takes time to diffuse
    - d = sqrt(Dt)
    - d ~ 6μm @ t=10ns

    ⇒ May not work at TESLA
- Measure charge spread as a function of time



Simulation

- Simulation studies concerning Vertex det.
  - Background study using Full Simulator (JIM, JUPITER) -- Sugimoto, Aso
  - Physics study using Quick Simulator -- G.B. Yu
  - Physics and Detector study using Full Simulator

Future dream in FY2004~

- Custom made CCDs with
  - > 20MHz readout speed
  - Multiple readout nodes
  - Notch structure
  - Charge injection capability
  - Readout by ASIC with multi-channel CDSs, Amplifiers, ADCs, and a Multiplexer
- Things to do in 2003
  - Technical design of the prototype CCD (with HPK)
  - Try to get ¥ -- Japan-US, KAKENHI, etc.