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## Characterization of Heavy Ion Beams used for the ICCHIBAN Experiments

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# Contents

- NIRS-HIMAC Facility
- Instruments for Beam Monitoring
- Beam conditions of ICCHIBANs

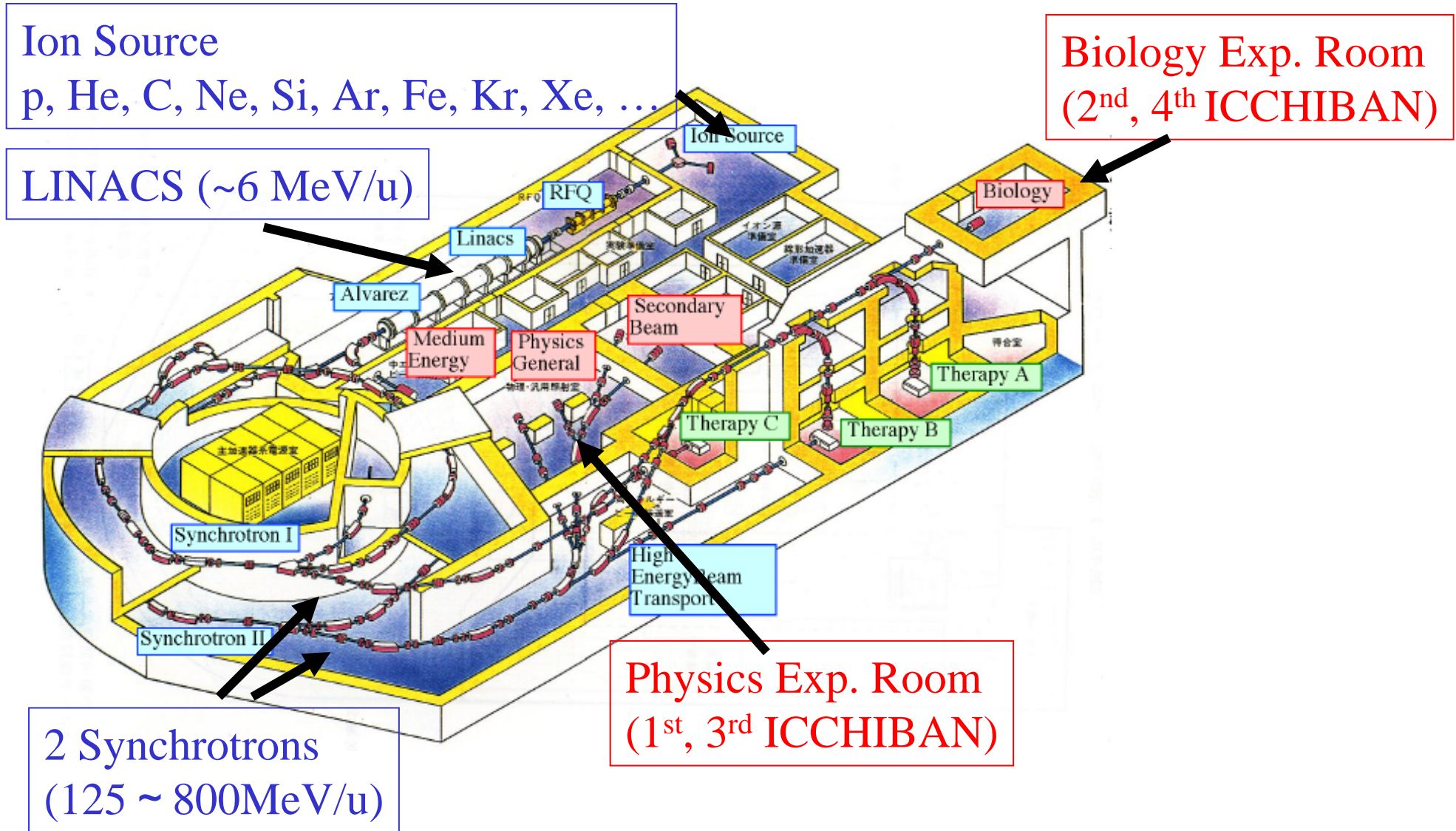
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# ICCHIBAN Experiments

Feb. 2002 (HIMAC)	1 <sup>st</sup> ICCHIBAN (for active detectors)
May. 2002 (HIMAC)	2 <sup>nd</sup> ICCHIBAN (for passive detectors)
Feb. 2003 (HIMAC)	3 <sup>rd</sup> ICCHIBAN (for active detectors)
May. 2003 (HIMAC)	4 <sup>th</sup> ICCHIBAN (for passive detectors)
Sep. 2003 (Loma Linda Univ.)	Proton-ICCHIBAN

# HIMAC

## (Heavy Ion Medical Accelerator in Chiba)



# Biology Experimental Room (BIO)



- 2<sup>nd</sup> and 4<sup>th</sup> ICHHIBAN
- Binary filters to decrease beam energy, measure Bragg curve
- Wide, uniform beam spot (~10cm diameter)
- Spread-Out Bragg Peak
- Sample changer
- Ion chamber and SEM (secondary electron emission monitor)

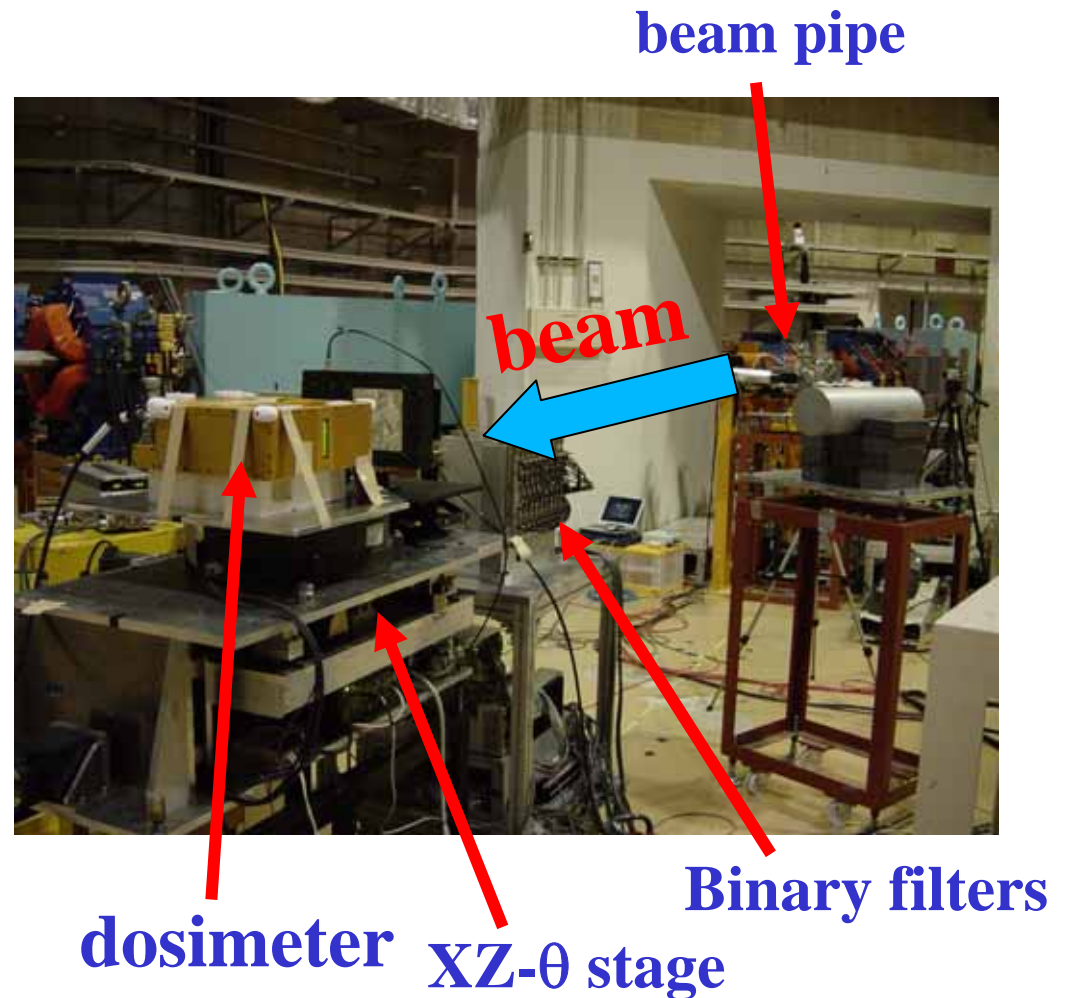
**Sample changer**

**dosimeter**

**Binary filters**

# Physics Experimental Room (PH)

- 1<sup>st</sup> and 3<sup>rd</sup> ICHHIBAN
- XZ and  $\theta$  stage
- Binary filters
- Beam spot : 0.3~3cm diameter
- Intensity : from 10 to  $10^7$  particles/spill



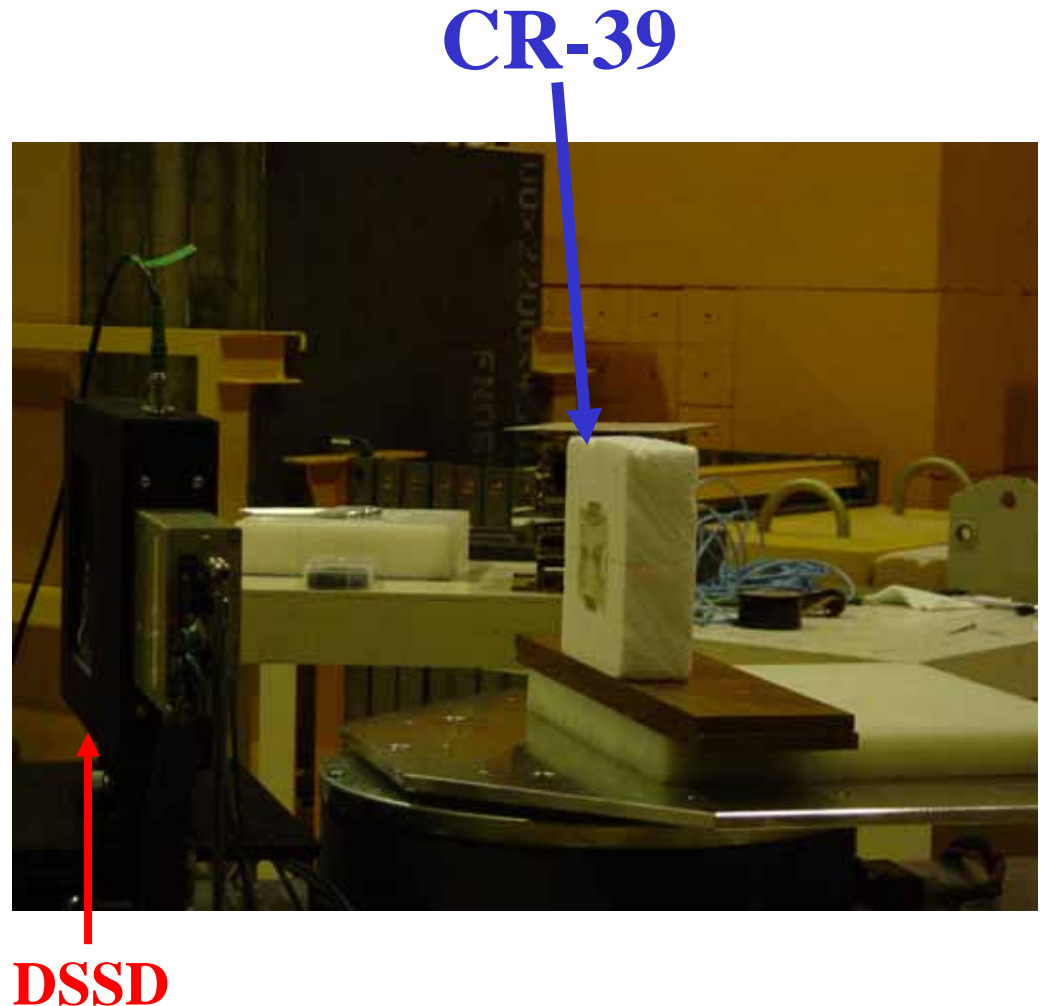
# Instruments for beam monitoring (1)

- DSSD (NIRS)  
(Double-Sided Strip Detector)
  - Real Time Beam Profile
  - Si detector, thickness :  $311\mu\text{m}$
  - Efficient detection area  
 $9.73 \times 9.73 \text{ cm}^2$   
128 strips for each sides
  - Position sensitive



# Instruments for beam monitoring (2)

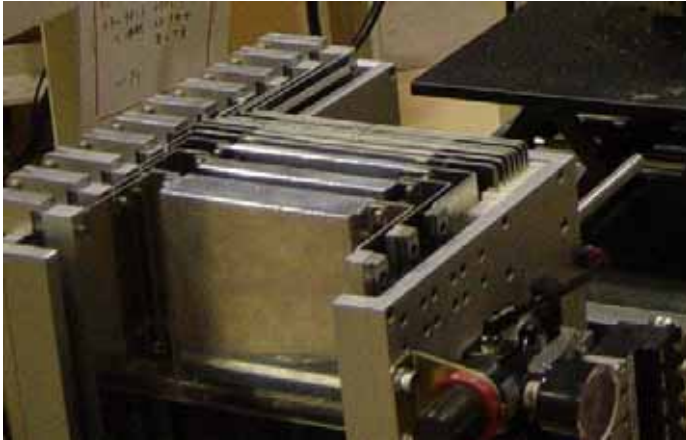
- CR-39 (EriI Res.)
  - Average Beam Profile
  - LET Spectrum





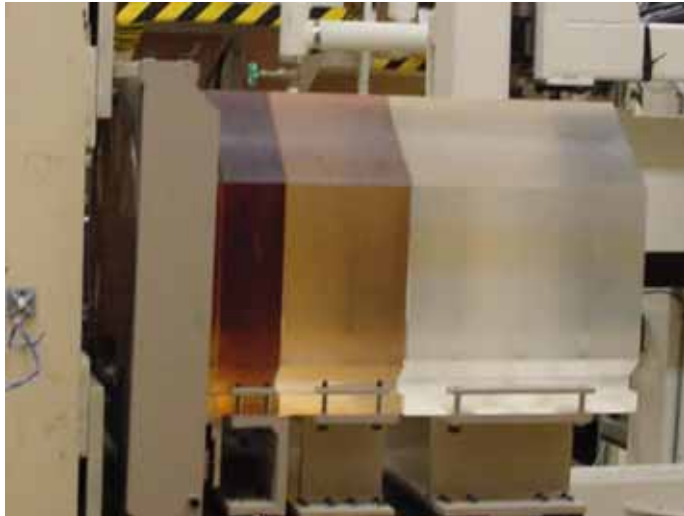
# Instruments for beam monitoring (3)

Physics  
(3<sup>rd</sup> IC)



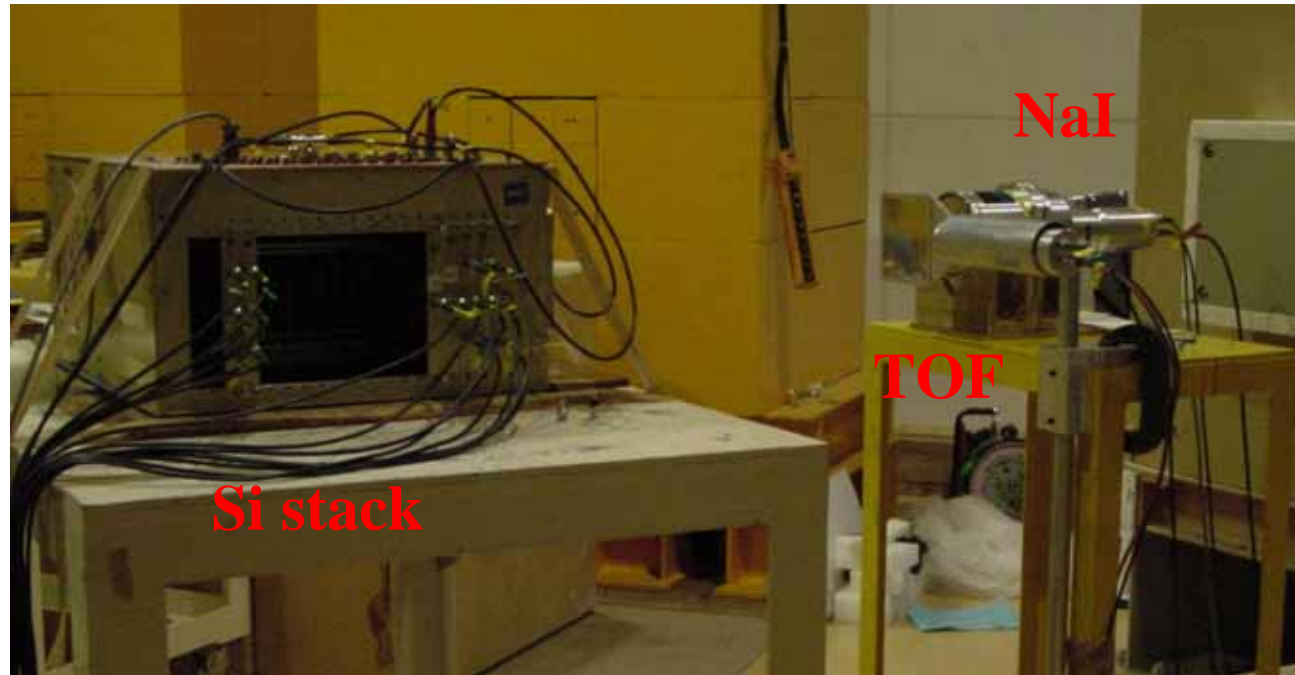
- Binary filters (NIRS)
  - For Range Measurements
  - Aluminum plates for 3<sup>rd</sup> ICCHIBAN
  - PMMA plates for 4<sup>th</sup> ICCHIBAN (in Biology Room)

BIO  
(4<sup>th</sup> IC)



# Instruments for beam monitoring (4)

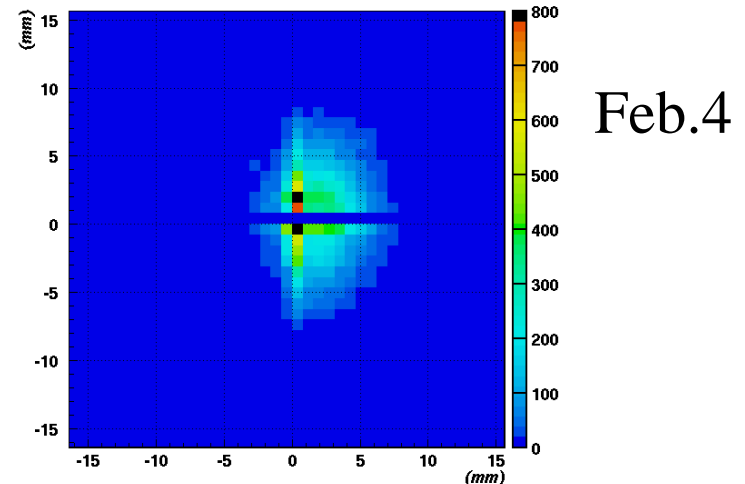
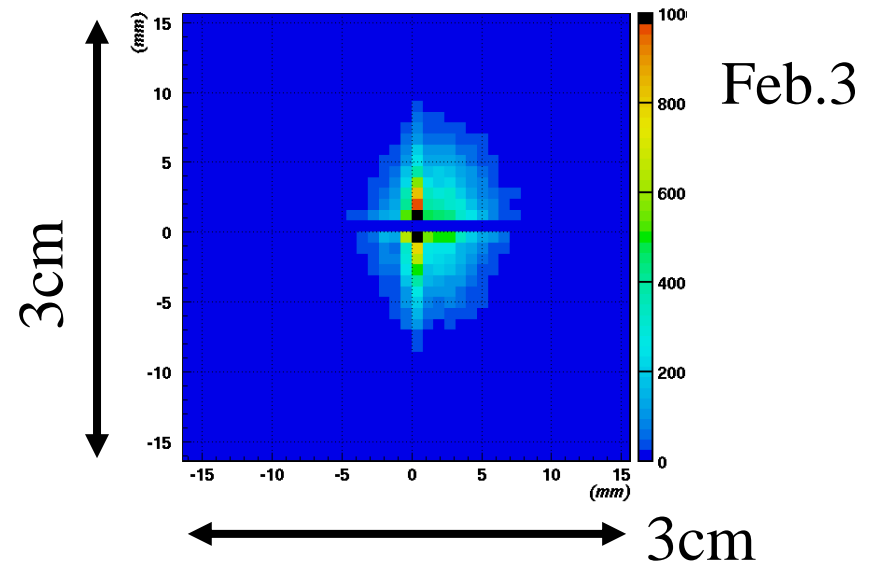
- LBNL Baseline Detector
  - Si stack, TOF (Time Of Flight), and NaI
  - For 1<sup>st</sup> and 3<sup>rd</sup> ICCHIBAN



# Si 800MeV/u @ 3<sup>rd</sup> ICCHIBAN

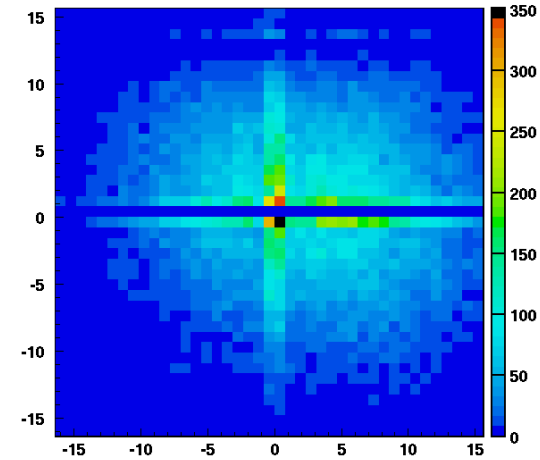
- Range :15.52 cm for Al
  - Spot size
    - 0.5 x 0.8 cm<sup>2</sup>
  - beam center
    - (0.13 cm, 0.05 cm)
- from upstream of the beam

Position distributions  
measured by DSSD  
(3cmx3cm)

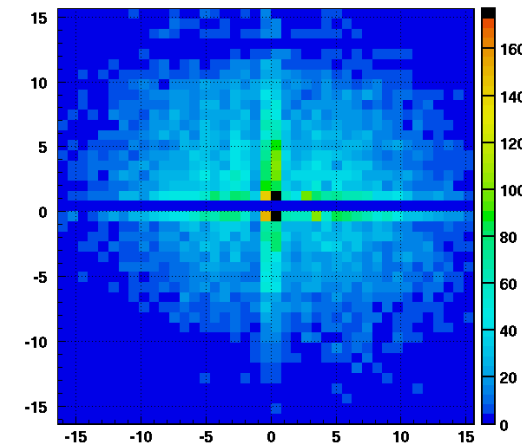


# Fe 500 MeV/u @ 3<sup>rd</sup> ICCHIBAN

- Range :4.17cm for Al
- Spot size
  - 1.7 x 1.4 cm<sup>2</sup>
- beam center
  - (2.5, 0.7) at Feb.5
  - (0.6, 1.4) at Feb.6



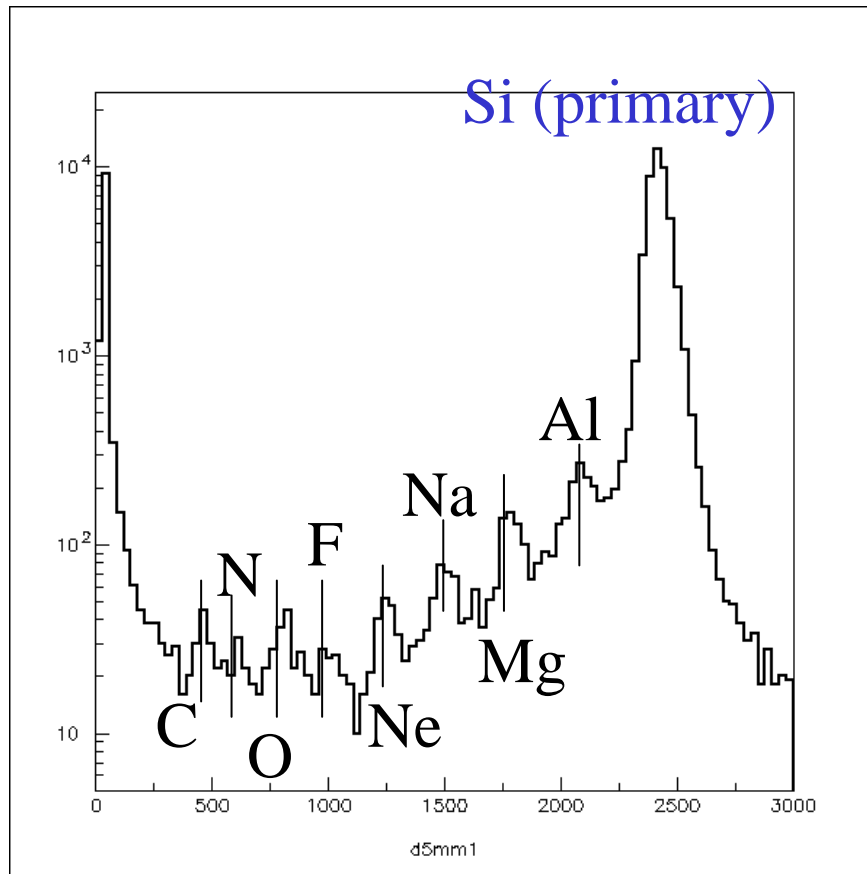
Feb.5



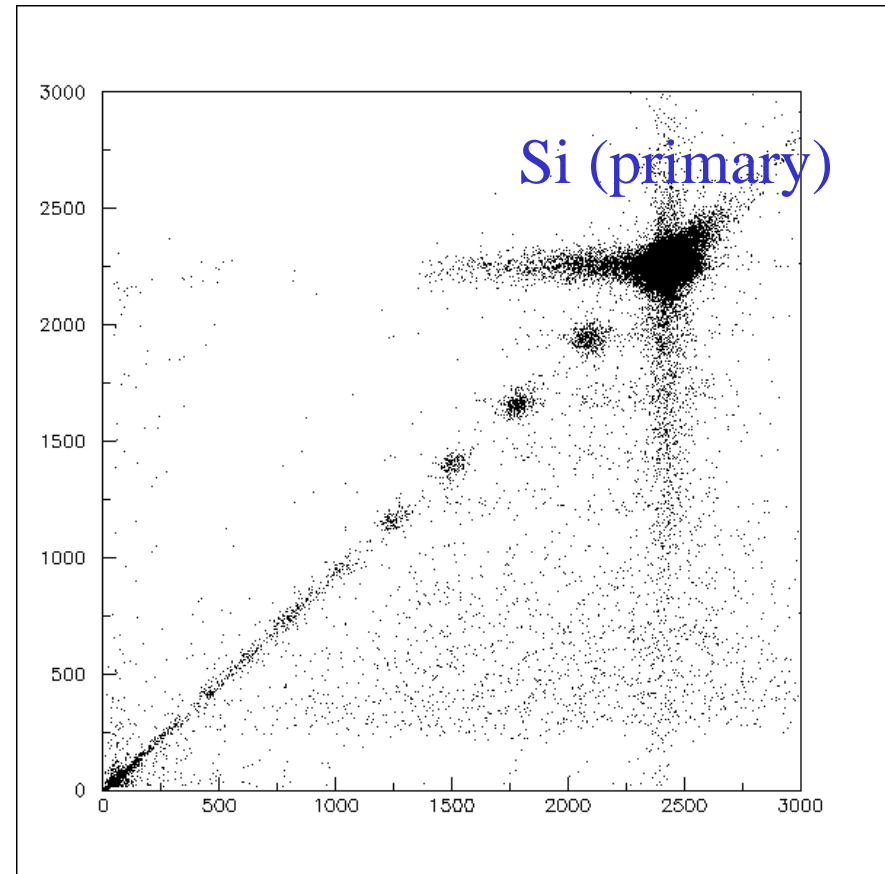
Feb.6

# Si 800MeV/u @ 3<sup>rd</sup> ICCHIBAN Fragment Run with 1cm Acryl plate

**LBNL baseline detector, preliminary analysis by Kitamura**

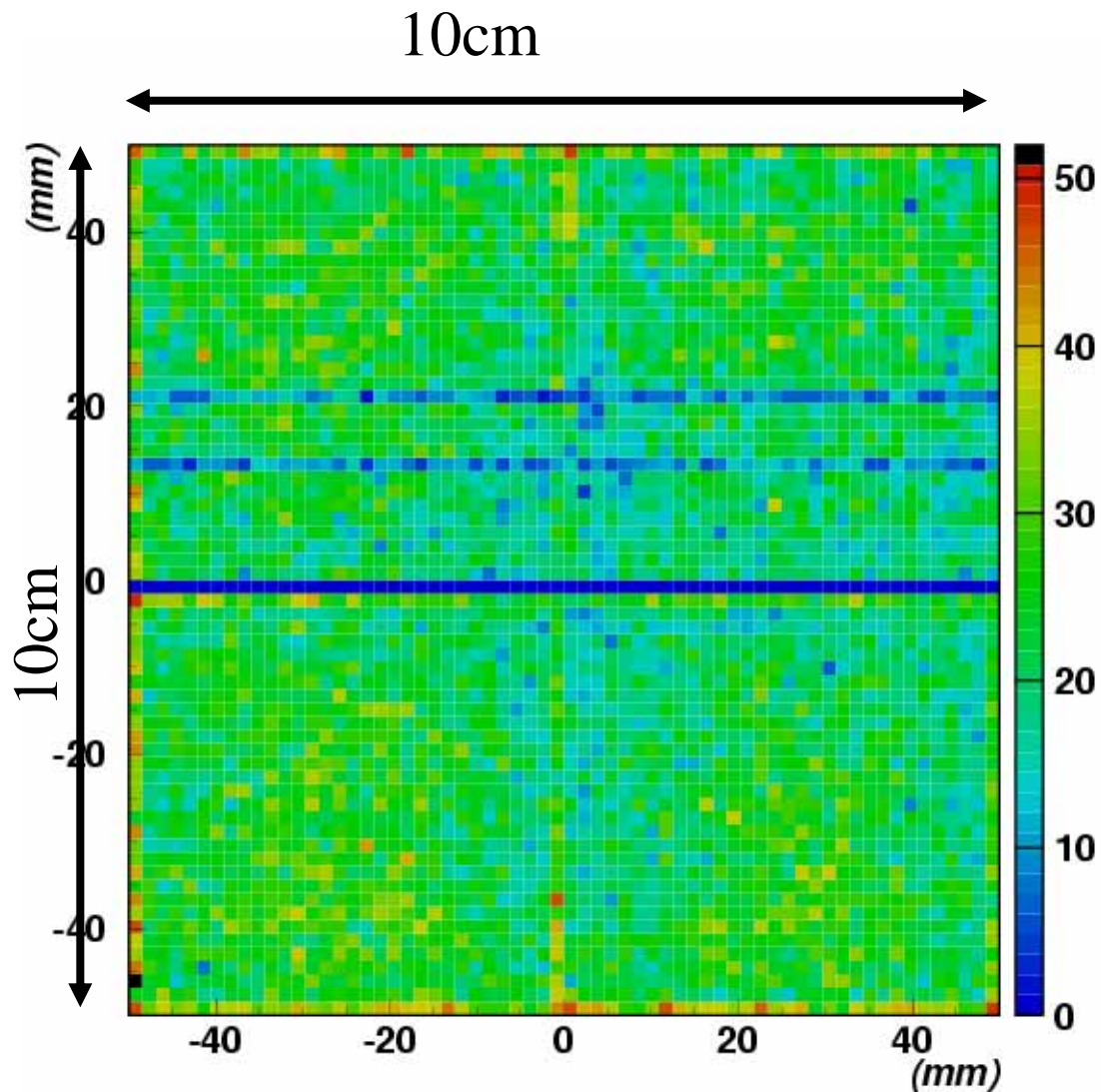


dE distribution



Scatter plot of d5mm\_1 vs d5mm\_2

# Fe 500 MeV/u @ 4<sup>th</sup> ICCHIBAN in BIO room



- Position distributions measured by DSSD
- 10 cm x 10 cm area is uniform.
- 3 blue lines are dead strips

# Summary

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- 4 ICCHIBAN experiments were carried out at NIRS-HIMAC, BIO room for passive dosimeters and Physics room for active detectors.
- Current status of the ICCHIBAN analysis will be presented by Eric Benton and Yukio Uchihori later in this session.