

# **Comparison of Results from the ICCHIBAN-3 Experiment and Current Status of the ICCHIBAN-5 Experiment**

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and E. Benton (Eril Research Inc.)  
on behalf of ICCHIBAN Working Group and Participants

<http://www.nirs.go.jp/ENG/rd/1ban/index.html>

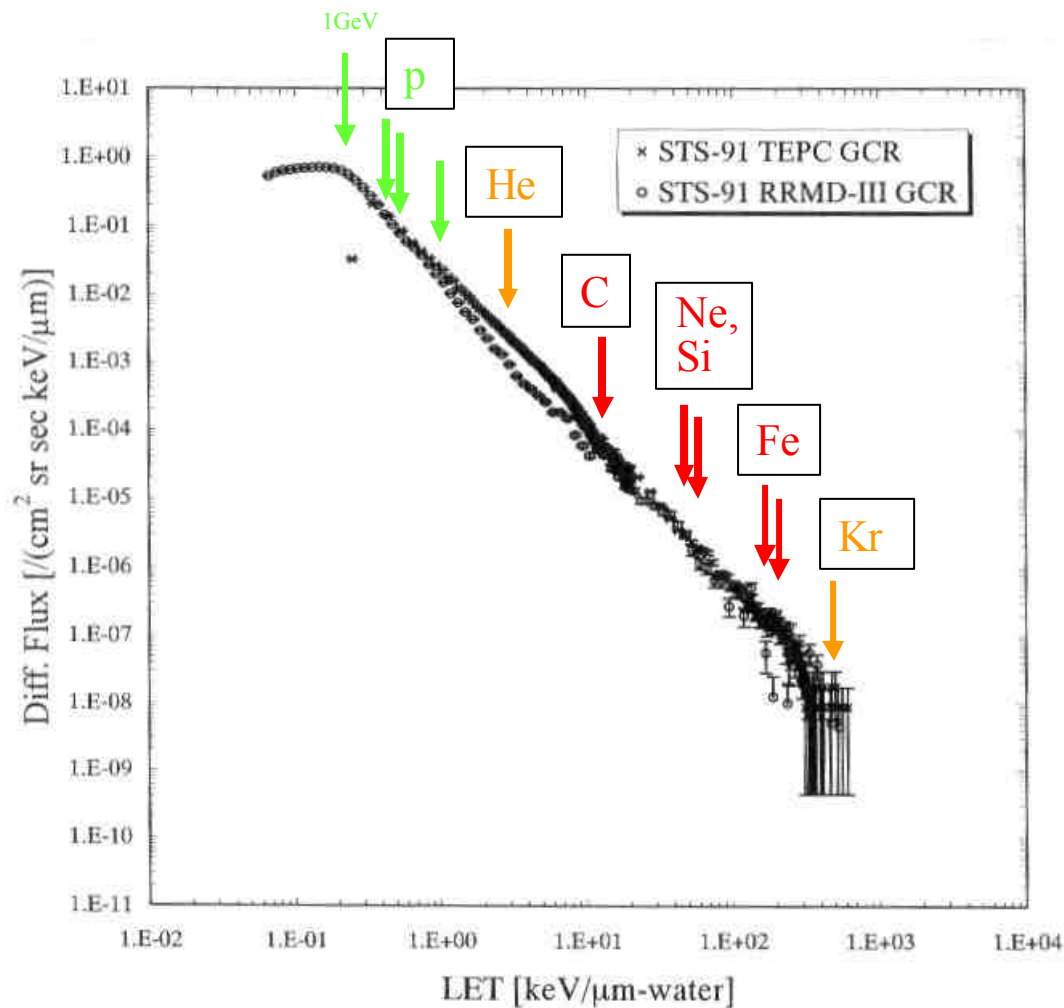
# Working Group

- Yukio Uchihori (Project Coordinator), NIRS, Japan
- Kazunobu Fujitaka (Chair), NIRS, Japan
- Eric Benton (Deputy Project Coordinator), Eril Research, USA
- Nakahiro Yasuda (Deputy Project Coordinator), NIRS, Japan
- Hisashi Kitamura, NIRS, Japan
- Masashi Takada, NIRS, Japan
- Tadayoshi Doke, Waseda University, Japan
- Cary Zeitlin, LBNL, USA
- Jack Miller, LBNL, USA
- Takeshi Takashima, JAXA/ISAS, Japan
- Thomas Berger, DLR, Germany
- Michael Hajek, ATI, Austria

# History of ICCHIBAN runs

Feb. 11-13, 2002	1 <sup>st</sup> ICCHIBAN Experiment (For Active Detectors)	C400, Fe400
May 23-28, 2002	2 <sup>nd</sup> ICCHIBAN Experiment (For Passive Detectors)	He150, C400, Si490, Fe500
Feb. 3-6, 2003	3 <sup>rd</sup> ICCHIBAN Experiment (For Active Detectors)	Si800, Fe500
May 19-30, 2003	4 <sup>th</sup> ICCHIBAN Experiment (For Passive Detectors)	He150, C400, Ne400, Fe500, ...
Sep. 6-7, 2003	1 <sup>st</sup> Proton ICCHIBAN Experiment (For All Detectors)	p70-250
Feb. 14-17, 2004	5 <sup>th</sup> ICCHIBAN Experiment (For Active Detectors)	He150
June 4-15, 2004	6 <sup>th</sup> ICCHIBAN Experiment (For Passive Detectors)	C135, Ar500, Kr400, ...
Sep. 24-26, 2004	1 <sup>st</sup> NSRL ICCHIBAN Experiment (For All Detectors)	p1000, O1000, Fe1000

# Covered LET Region in ICCHIBAN Exp.



T.Doke et al.,  
Rad. Meas. 33  
(2001) 373

# 3<sup>rd</sup> ICCHIBAN Run

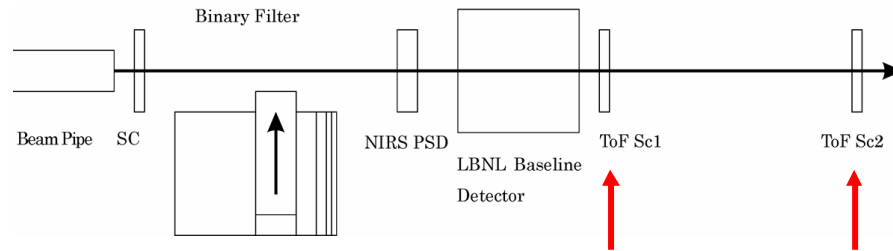
## 3<sup>rd</sup> ICCHIBAN Participants

Monitor Name	Institution	Nation	Detection Principle	Type
RRMD-III	Waseda Univ.	Japan	Silicon Telescope	Active
DOSTEL-1	Kiel Univ.	German	Silicon Telescope	Active
DOSTEL-2			Silicon Telescope	Active
DOSTEL-D			Silicon Telescope	Active
Shuttle-TEPC	NASA-JSC	USA	Proportional Counter	Active
ISS-TEPC			Proportional Counter	Active
IV-CPDS			Silicon Telescope + C	Active
Liulin-4J	NIRS	Japan	Silicon	Active
Dosimeter Package	Eril Research	USA	TLD+CR-39	Passive
Ground Base Detector	LBNL	USA	Silicon Stack + SC	Active

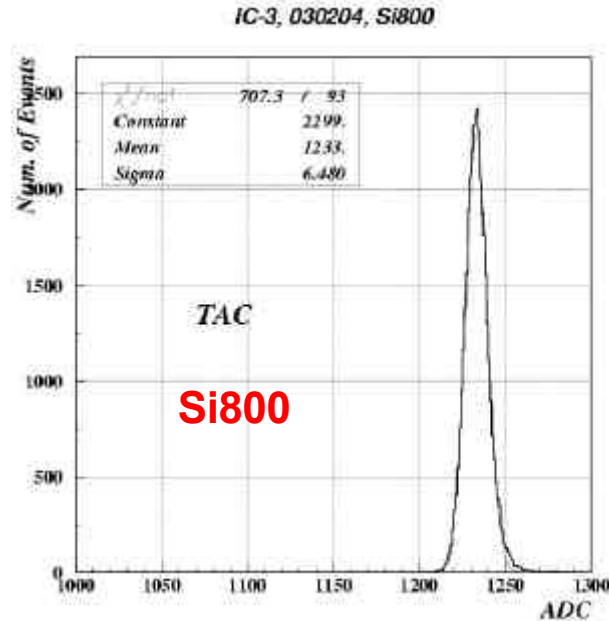
# 3<sup>rd</sup> ICCHIBAN Run (2003)

Date	Time		Ion & Energy	LET in H <sub>2</sub> O
Feb. 3 & Feb. 4	21:00~7:00 21:00~7:00	20 hrs	Si(800MeV/u)	46 keV/um
Feb. 5 & Feb. 6	21:00~7:00 21:00~7:00	20 hrs	Fe(500MeV/u)	185 keV/um
Feb. 11	16:00~7:00	15 hrs	Ne(400MeV/u) in BIO	31 keV/um

# Reference Measurements using LBNL Detectors

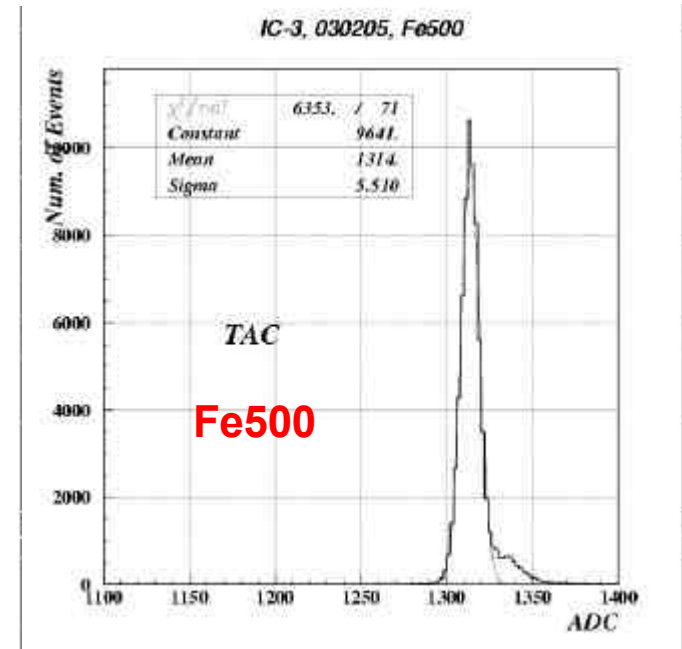


## Time of Flight Measurements



$dv/v = 0.012$  (fwhm)

@Beta=0.843



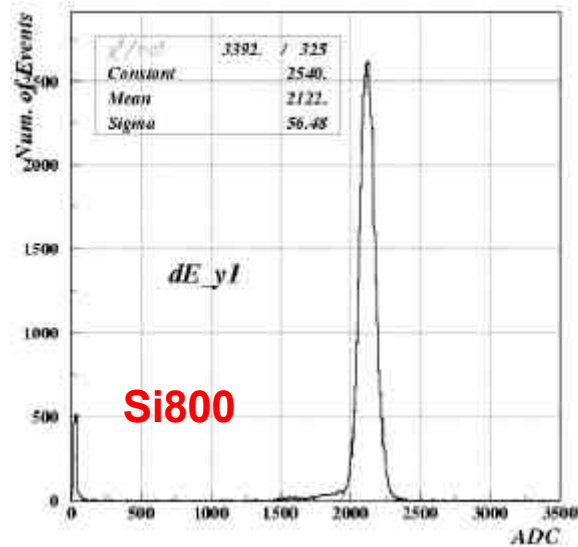
$dv/v = 0.010$

@Beta=0.759

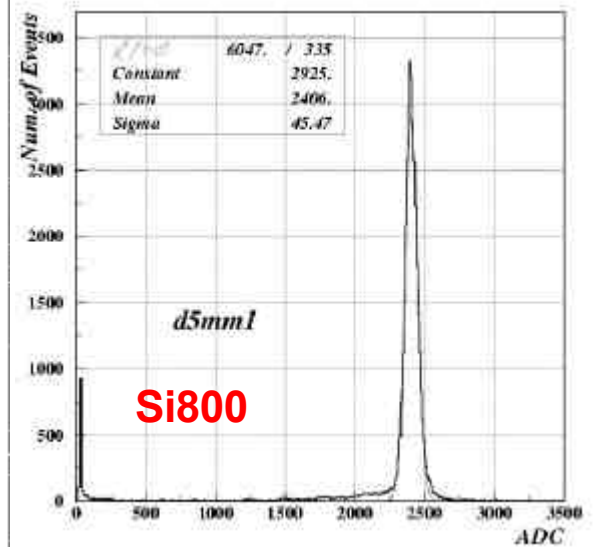


# Reference Measurements using LBNL Detectors (II)

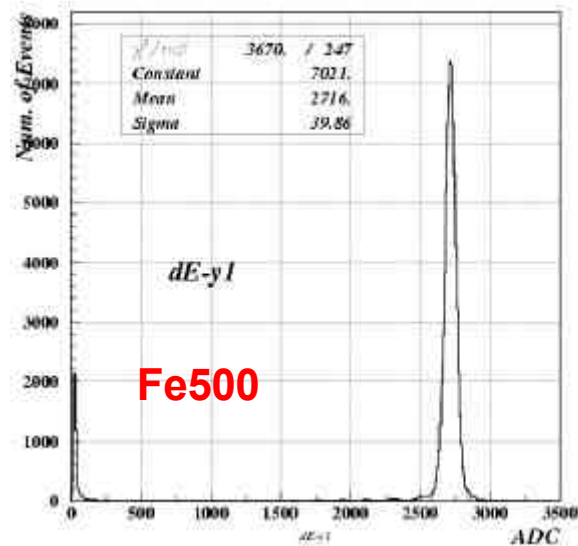
IC-3, 030204, Si800



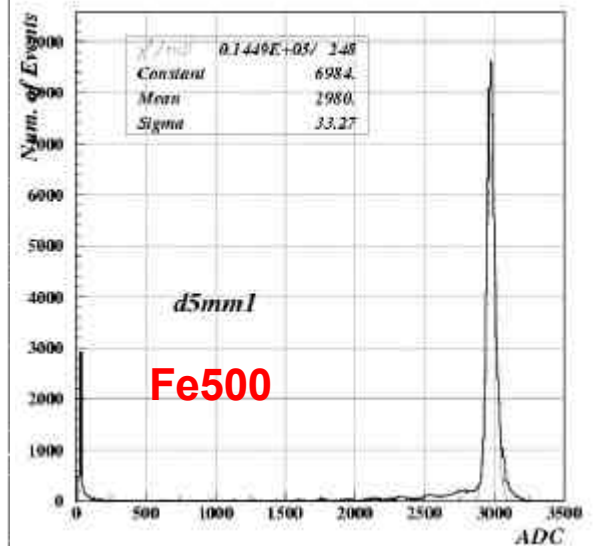
IC-3, 030204, Si800



IC-3, 030205, Fe500

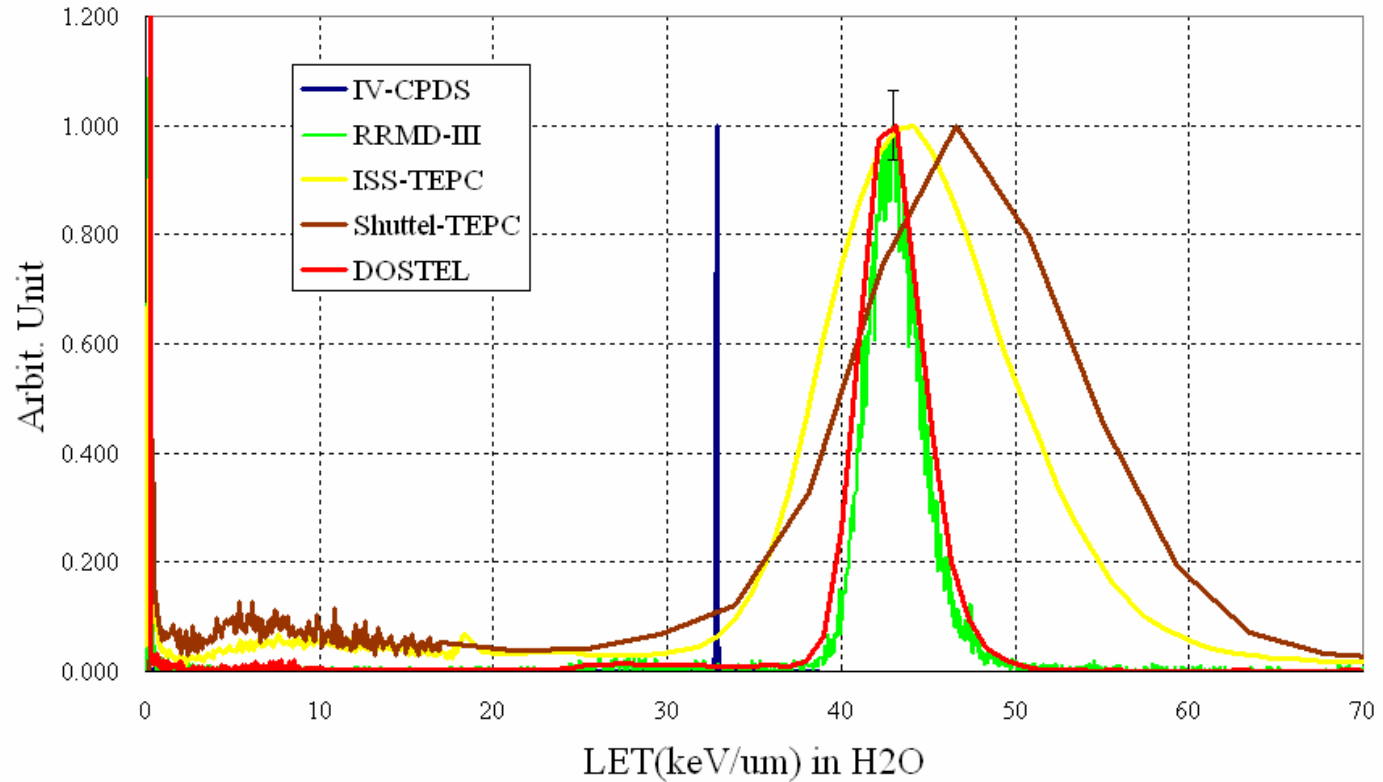


IC-3, 030205, Fe500



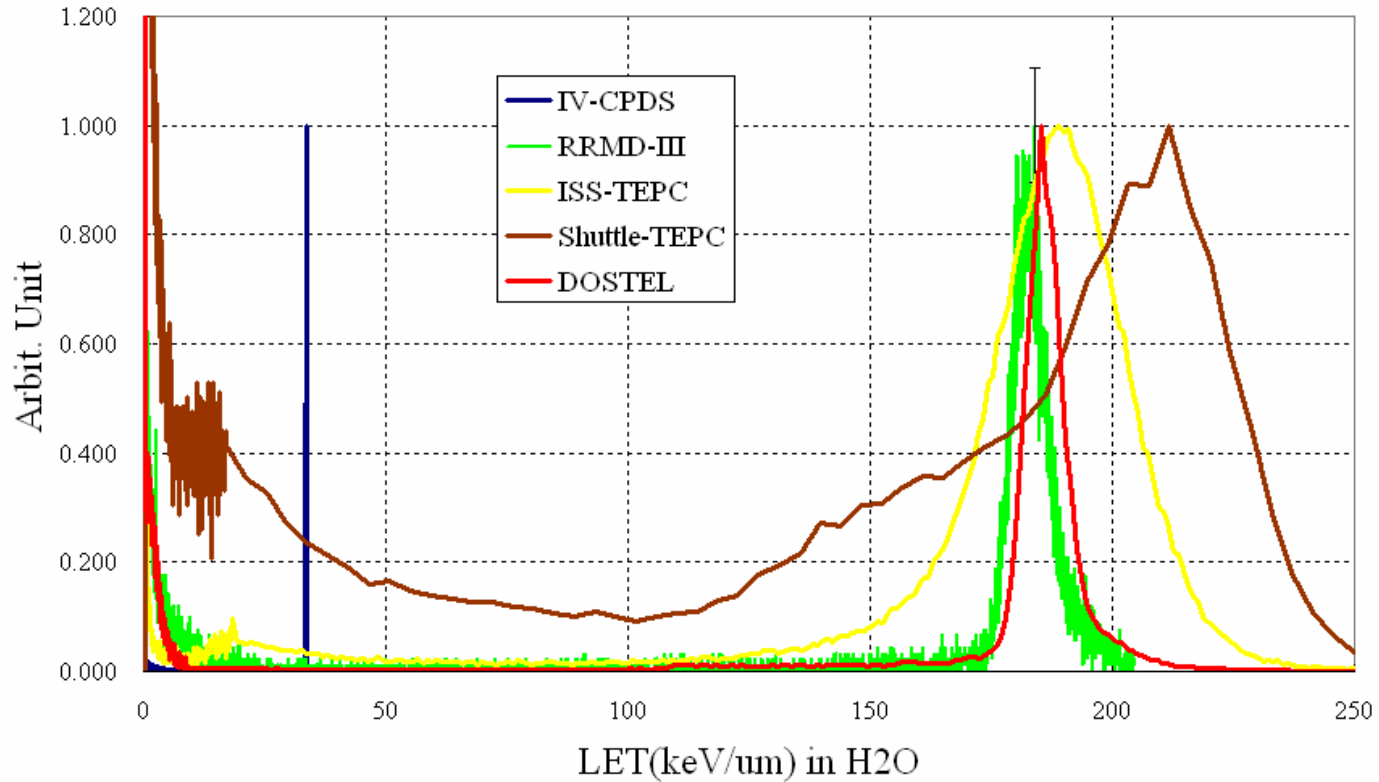
# Comparison for Si800

Bare Beams and 0 degree



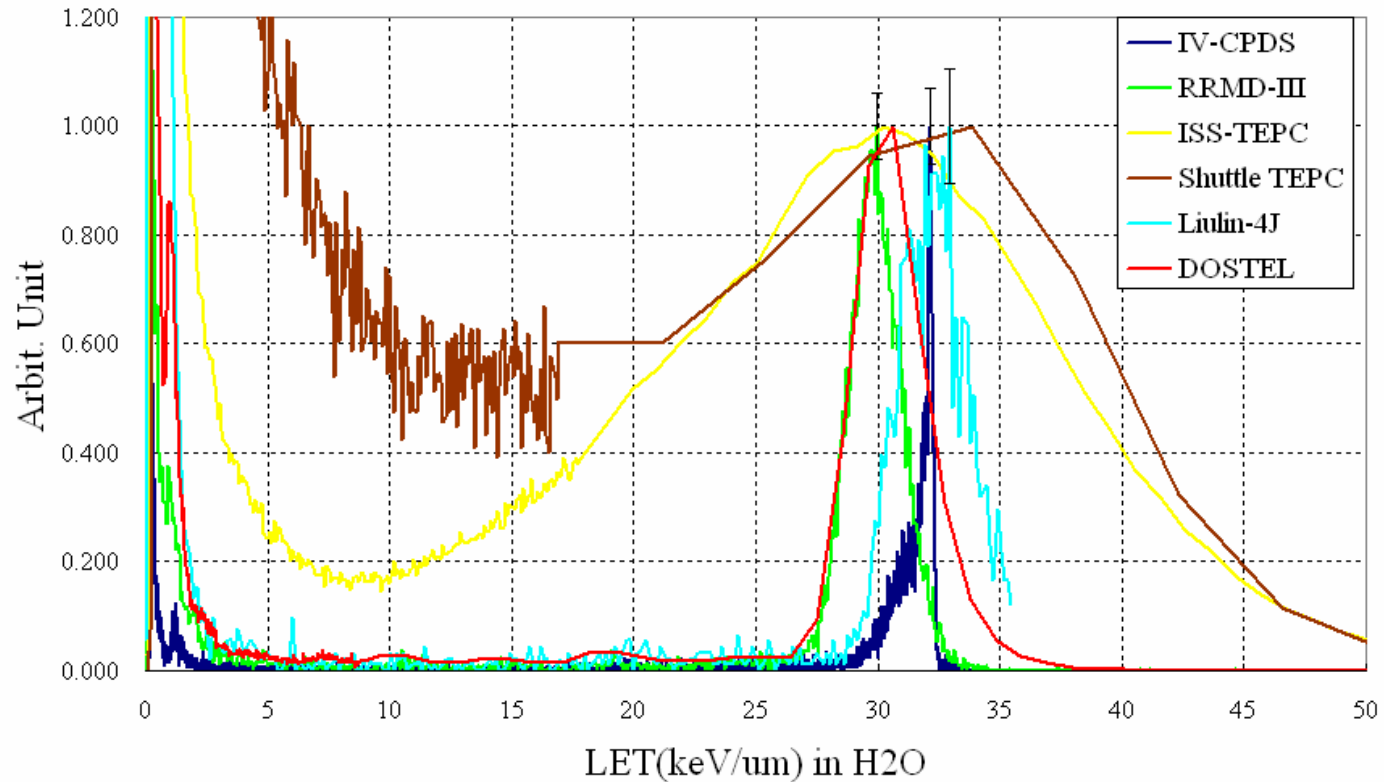
# Comparison for Fe500

Bare Beams and 0 degree



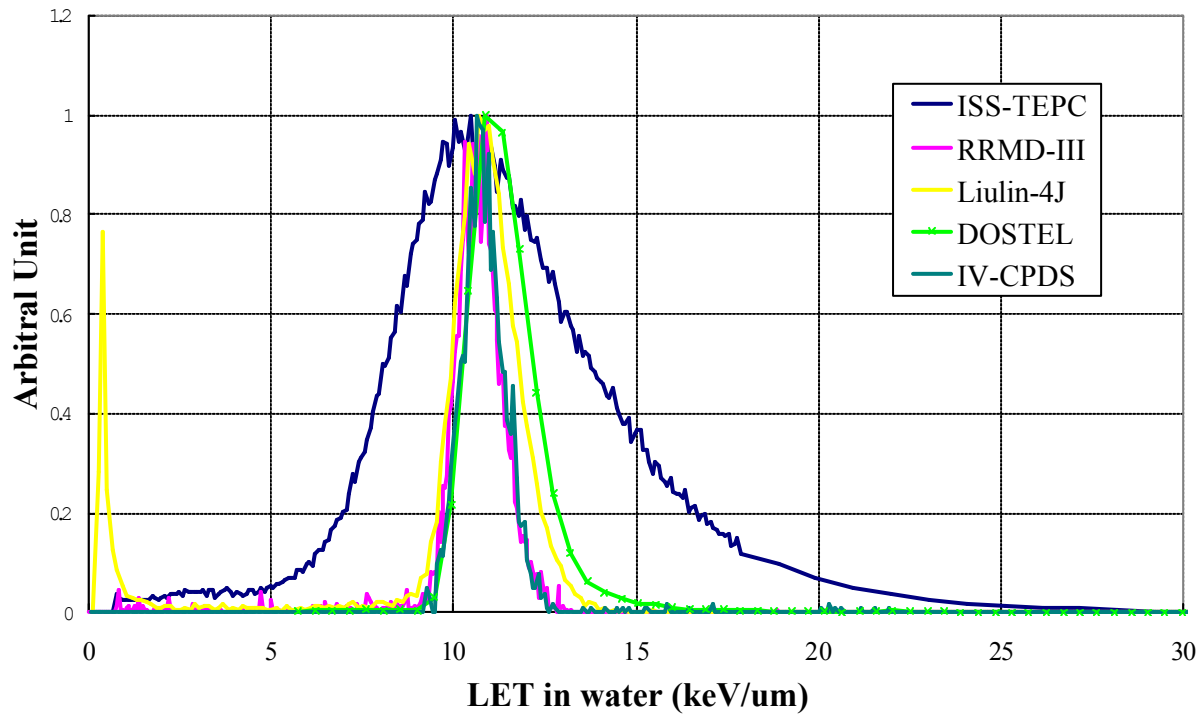
# Comparison for Ne400 in BIO

Bare Beams and 0 degree

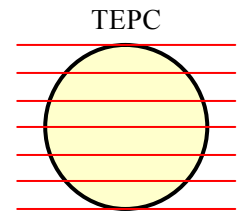


# Comparison for Carbon Run

ICCHIBAN-1, Carbon 400MeV/u

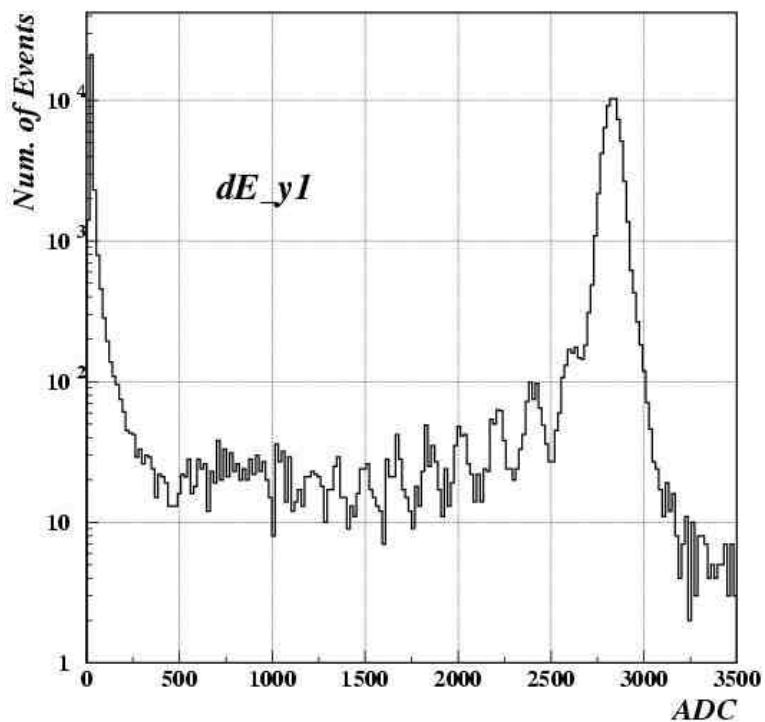


0 degree  
Center  
No Absorber

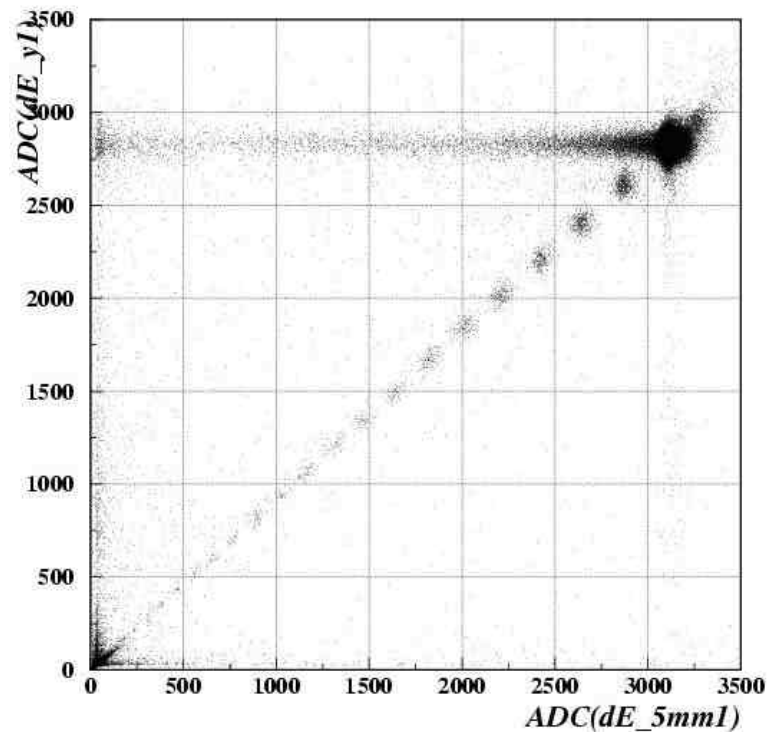


# Fragments Measurements by LBNL Detectors for Fe500

IC-3, 030205, Fe500

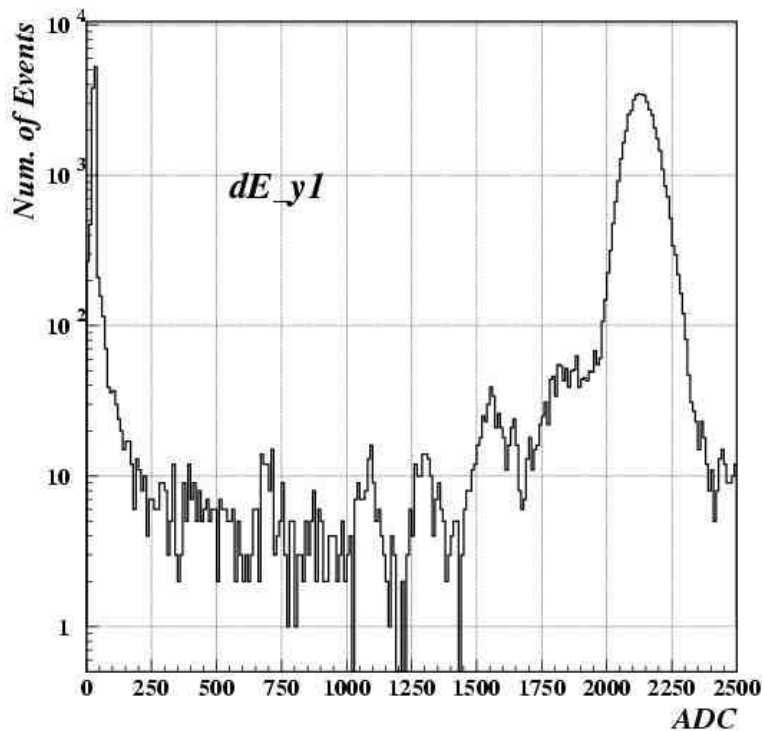


IC-3, 030205, Fe500

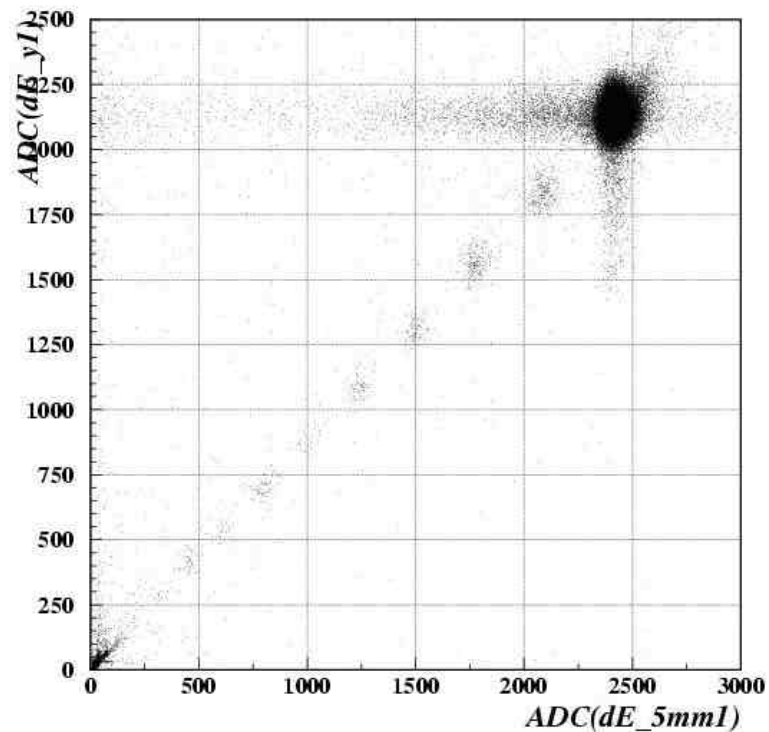


# Fragments Measurements by LBNL Detectors for Si800

*IC-3, 030204, Si800, Fragment*



*IC-3, 030204, Si800, Fragment*



# 5<sup>th</sup> ICCHIBAN Run



## 5<sup>th</sup> ICCHIBAN Participants

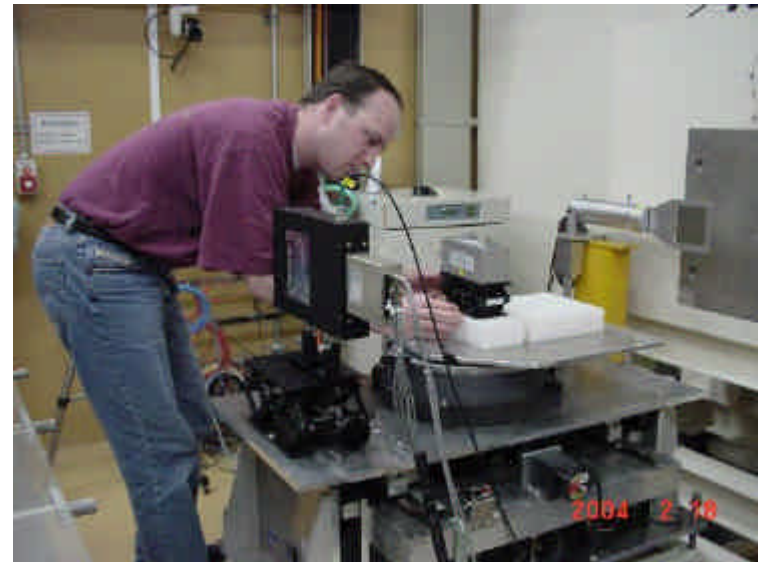
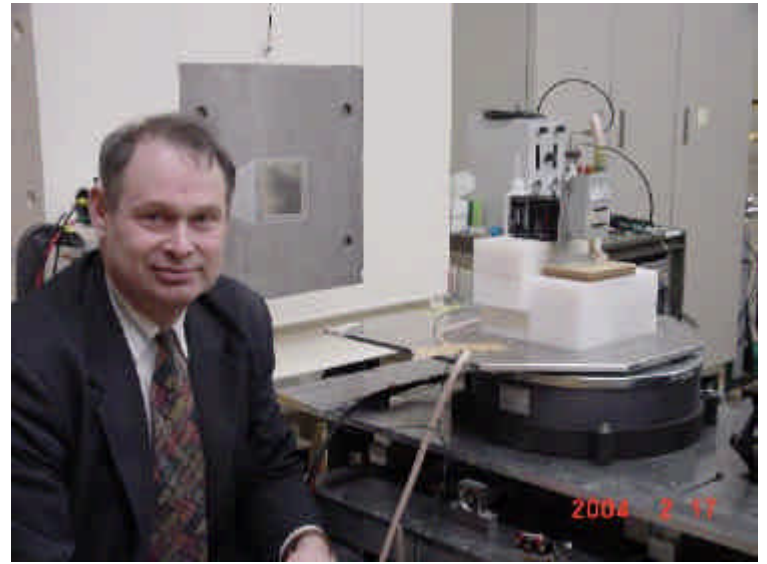
Instrument Name	Institution	Nation	Detection Principle	Type
RRMD-III	Waseda Univ.	Japan	Silicon Telescope	Active
DOSTEL-2	Kiel Univ.	German	Silicon Telescope	Active
DB-8	IMBP	Russia	Silicon	Active
Liulin-ISS			Silicon	Active
Shuttle type TEPC	Prairie View A&M Univ.	USA	Proportional Counter	Active
Liulin-4J	NIRS	Japan	Silicon	Active
Dosimeter Package	Eril Research	USA	TLD+CR-39	Passive
Ground Base Detector	LBNL	USA	Silicon Stack + SC	Active

# 5<sup>th</sup> ICCHIBAN Run (2004)

Date	Time		Ion & Energy	LET in H <sub>2</sub> O
Feb. 14, 16 & 17	10:00~20:00 20:00~7:00 22:00~7:00	30 hrs	He(150MeV/u)	~2.3 keV/um

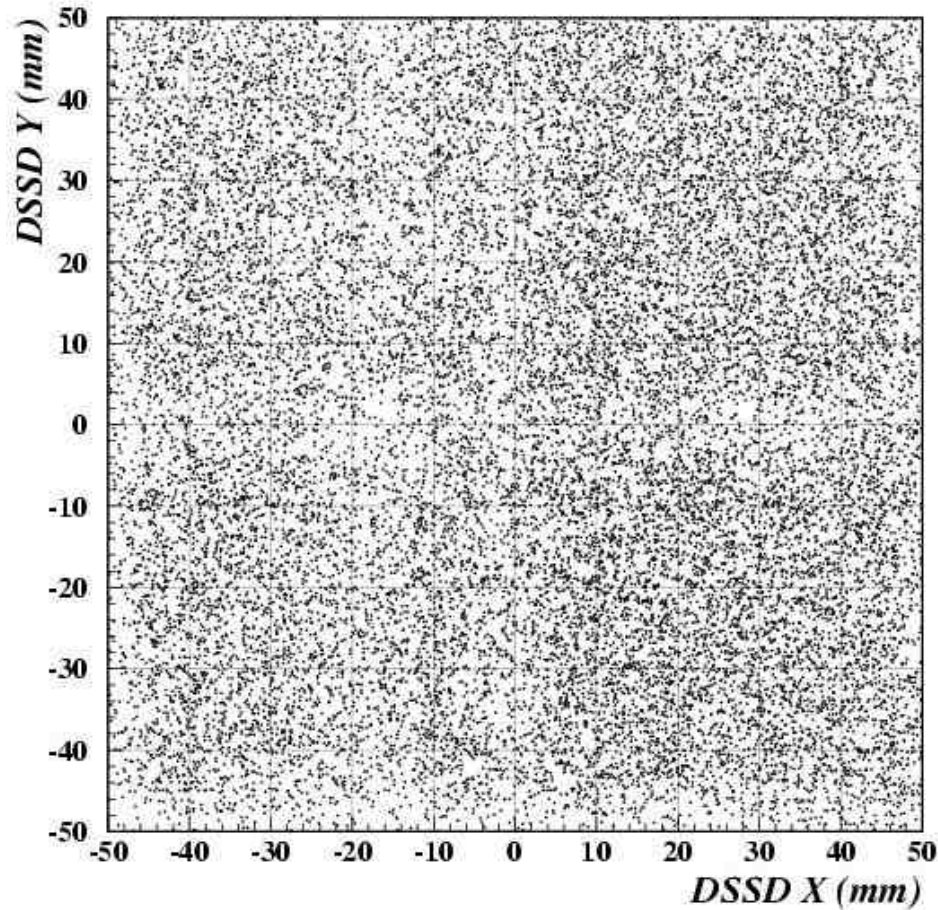
## Differences with IC-1&3

- Wide, Uniform Beam at Biology Room in HIMAC
- Light Ion Beams



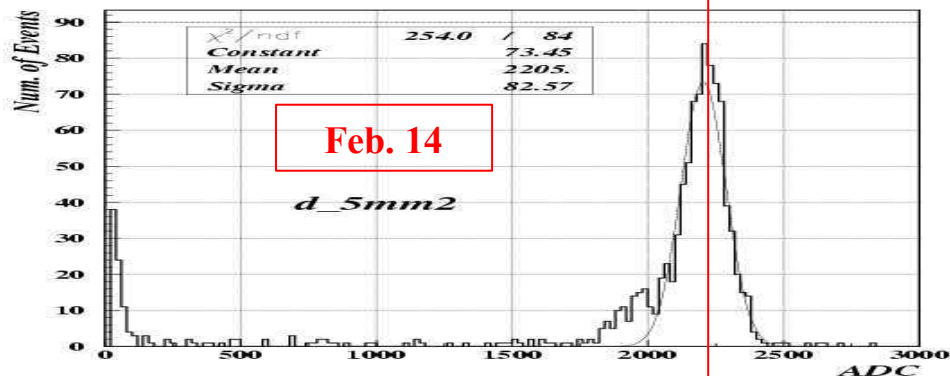
# Beam Profile

*IC-5, 040217, He150*

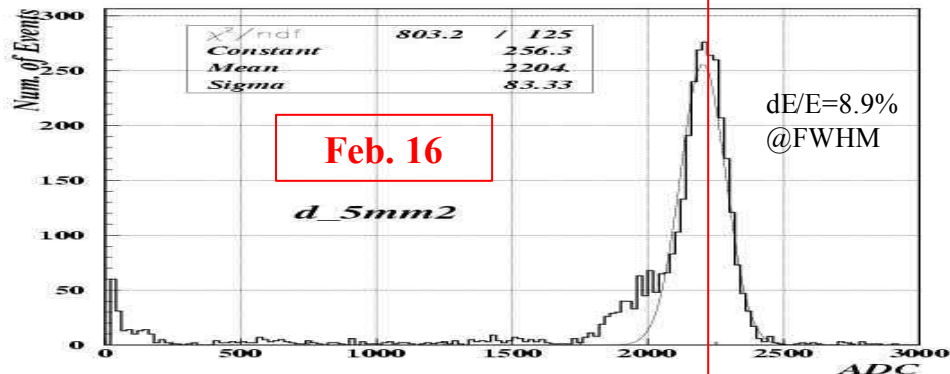


# Reference Measurements by LBNL Detectors

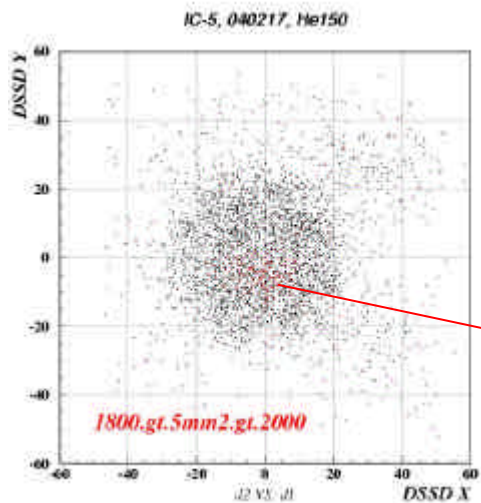
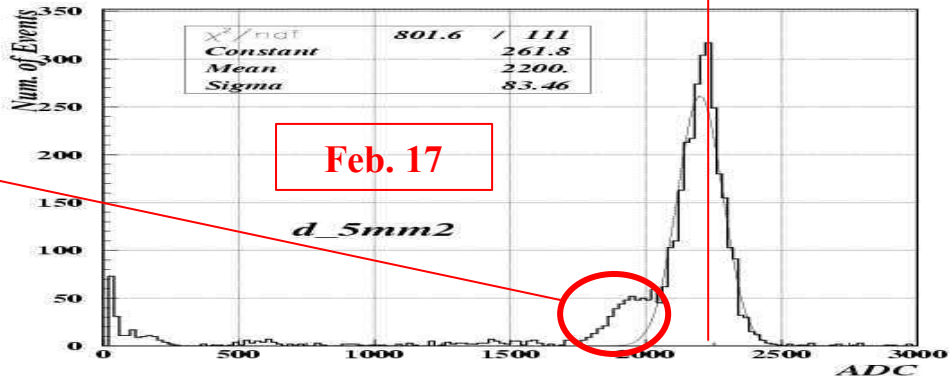
IC-5, 040214, He150



IC-5, 040216, He150

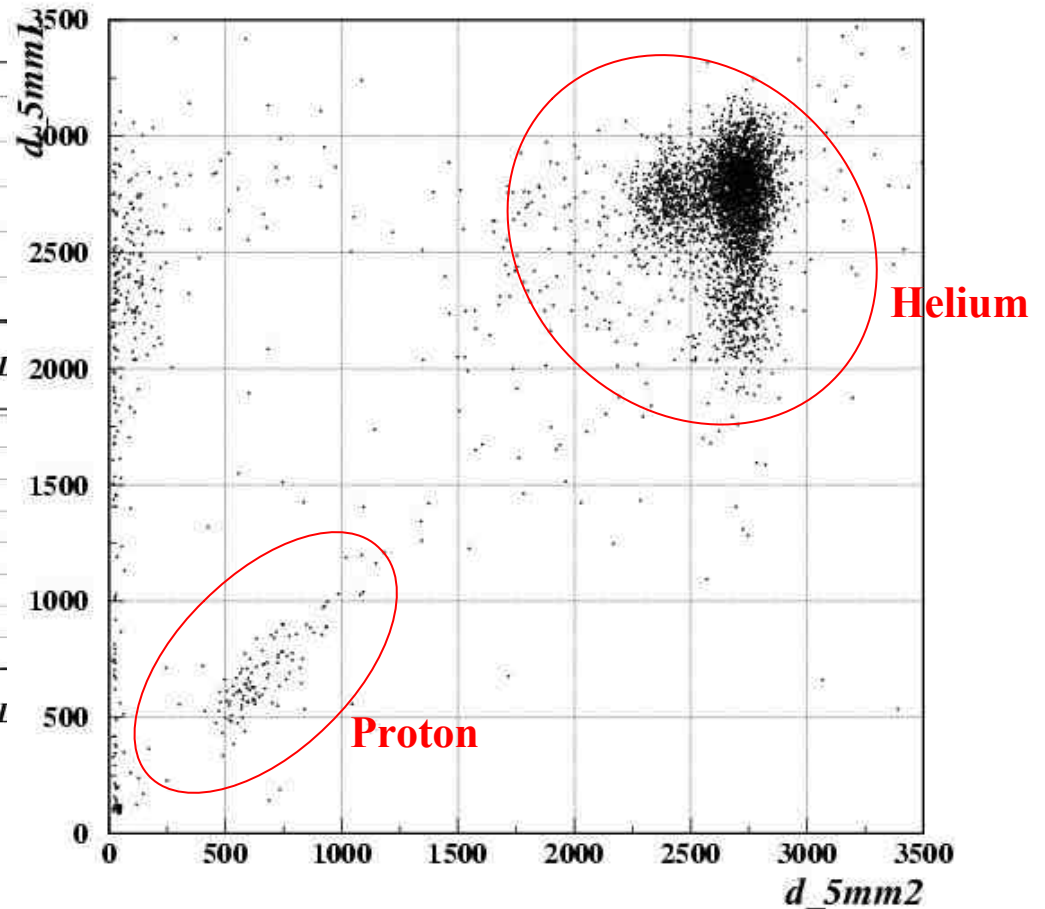
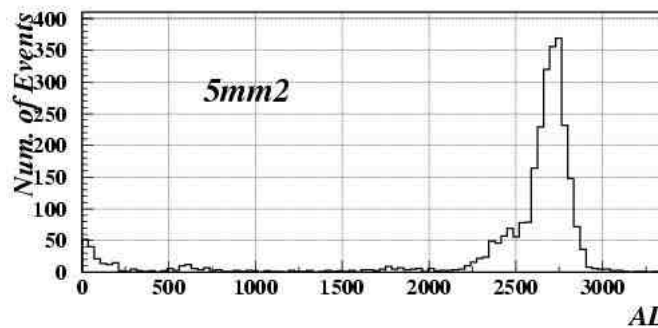
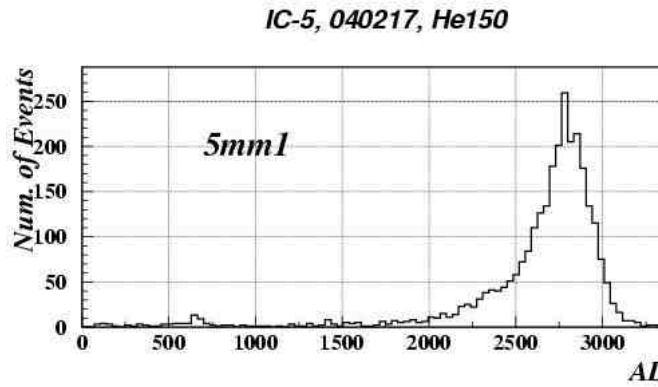


IC-5, 040217, He150



# Reference Measurements by LBNL Detectors for Fragments

IC-5, 040217, He150







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# Future Schedule of ICCHIBAN runs

Sep. 8-10, 2004	9 <sup>th</sup> WRMISS Workshop on Vienna
Sep. 25-28, 2004	1 <sup>st</sup> NSRL-ICCHIBAN Experiment (For Active and Passive Detectors)
Autumn, 2005	7 <sup>th</sup> and 8 <sup>th</sup> ICCHIBAN Experiment (For Active and Passive Detectors)



# 1<sup>st</sup> NSRL-ICCHIBAN Run (2004)

Date	Time		Ion & Energy	Range in H <sub>2</sub> O	LET in H <sub>2</sub> O
Sep. 25	2:00~2:00	24 hrs	p(1GeV/u)	329.0 cm	0.22 keV/um
Sep.26	2:00~2:00	24 hrs	Fe(1GeV/u)	82.2 cm	13.8 keV/um
Sep. 27	10:00~10:00	24 hrs	O(1GeV/u)	27.2 cm	146.2 keV/um

ICCHIBAN Working Group and Participants would like to thank all efforts by people who are working in the NSRL and supports by Dr. Schimmerling, Dr. Cucinotta and other researchers in NASA.

We want to thank Dr. Miller and other researchers in the LBNL for their help.

# Future Possibility

- The **GSI-SIS** can be candidate of a facility to perform future ICCHIBAN experiments.
- Members of “Bio-Physics” group in the GSI have interest in the ICCHIBAN project. We can expect their support to perform experiments.
- Although several procedure will be required to obtain beam time of GSI-SIS, we may be better to consider the possibility.

# Facilities

Facility	Institution	Ions	Energy MeV/n
HIMAC	NIRS, Japan	p, He, C, O, Ne, Si, Ar, Fe, Kr, Xe	150~800
LLUMC	Loma Linda Univ., USA	p	30~250
NSRL	BNL, USA	p, C, O, Ti, Fe	200~2000
CERF	CERN, Switzerland	Neutron	~1000(?)
SIS	GSI, Germany	C, O,..., Fe, Au, U	~2000(?)

# Conclusion

- 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> ICCHIBAN experiments were carried out successfully at HIMAC in 2002, 2003 and 2004.
- We published the results from 1<sup>st</sup> and 2<sup>nd</sup> ICCHIBAN experiments as HIMAC report-078 in NIRS.
- We would like to summarize the results from 3<sup>rd</sup> and 4<sup>th</sup> ICCHIBAN experiments in this year. If you have not sent your report, would you please send us your report by **Dec. 15, 2004**.
- 1<sup>st</sup> NSRL-ICCHIBAN run will be performed on **Sep. 25-28** at NASA Space Radiation Laboratory in Brookhaven National Laboratory, USA. We welcome your participation to these experiments.



# Reference Measurements by LBNL Detectors

