Comparison of Results from the 1st ICCHIBAN Experiment and Current Status of the 3rd ICCHIBAN Experiment

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on behalf of ICCHIBAN Working Group and Participants

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History of ICCHIBAN runs

Feb. 11-13, 2002	1st ICCHIBAN Experiment (For Active Detectors)
May 23-28, 2002	2nd ICCHIBAN Experiment (For Passive Detectors)
Sep. 2-4, 2002	7th WRMISS Workshop on Paris
Feb. 3-6, 2003	3rd ICCHIBAN Experiment (For Active Detectors)
May 19-30, 2003	4th ICCHIBAN Experiment (For Passive Detectors)
Sep. 3-5, 2003	8th WRMISS Workshop on Berkeley

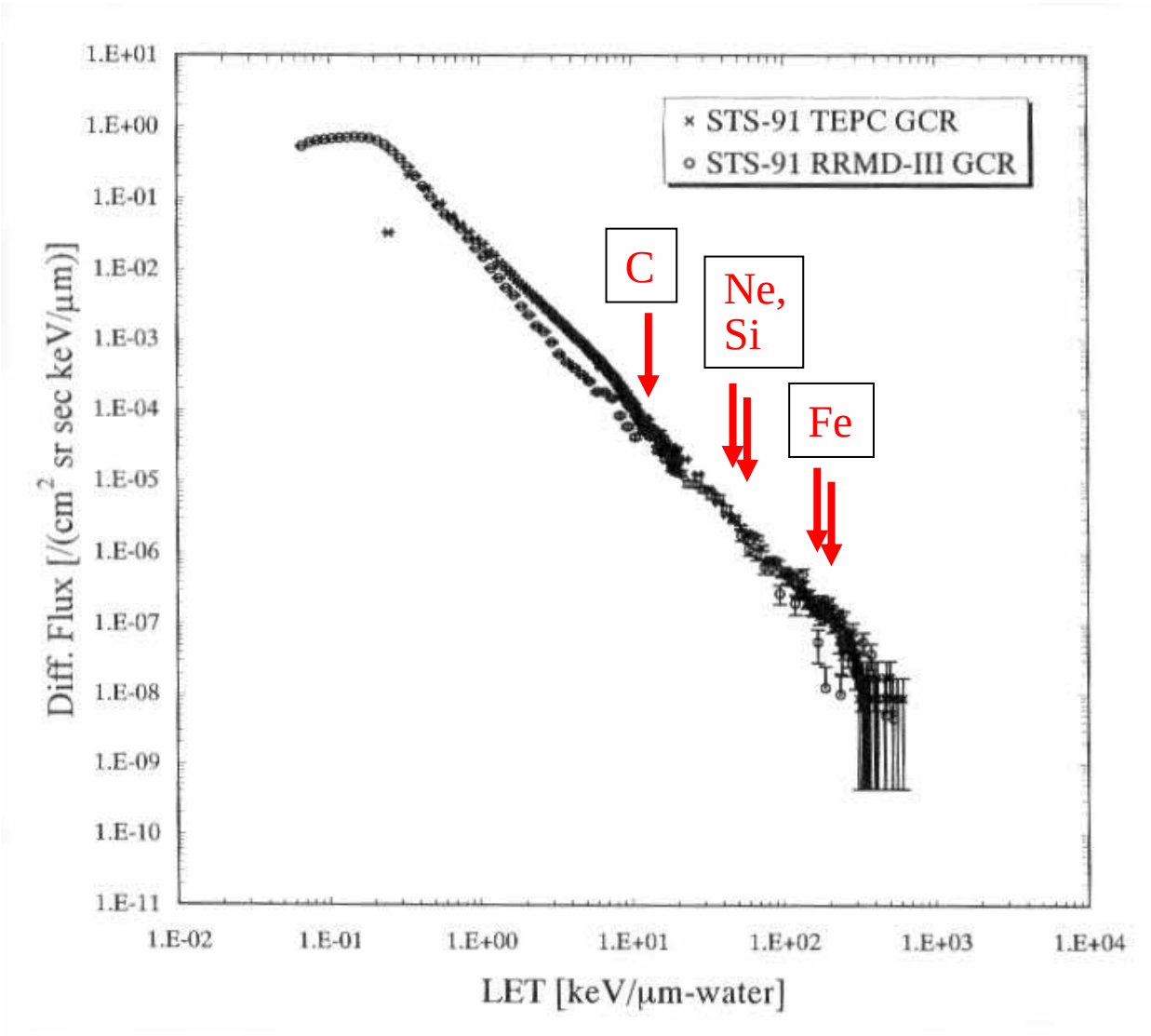
1st ICCHIBAN Run (2002)

Date	Time		Ion & Energy	LET in H_2O
Feb. 11	11:00~7:00	20 hrs	C(400MeV/u)	11 keV/um
Feb. 12 & Feb. 13	21:00~7:00 21:00~7:00	20 hrs	Fe(400MeV/u)	204 keV/um

3rd ICCHIBAN Run (2003)

Date	Time		Ion & Energy	LET in H_2O
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

Covered LET Region in IC-1 & 3



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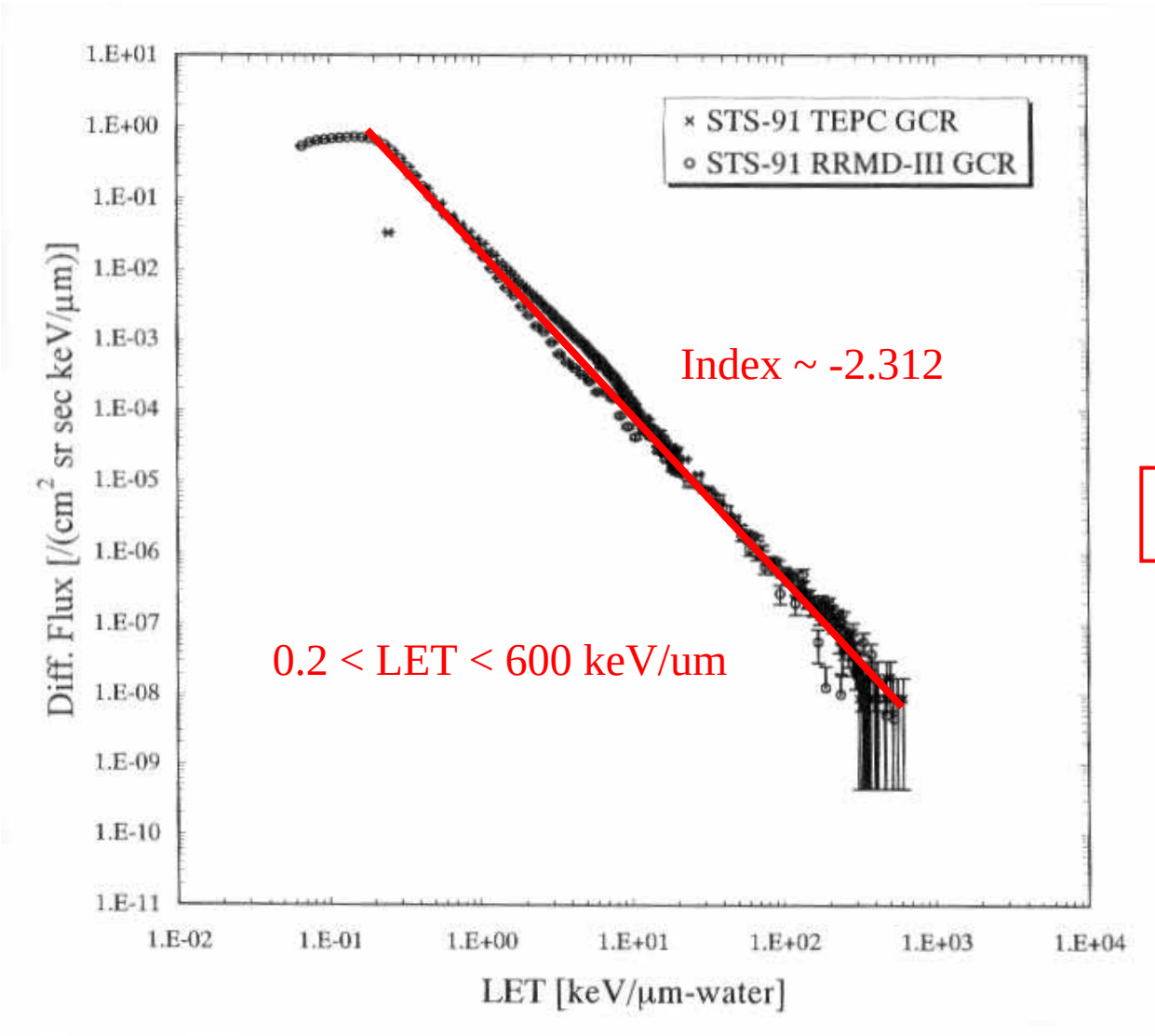
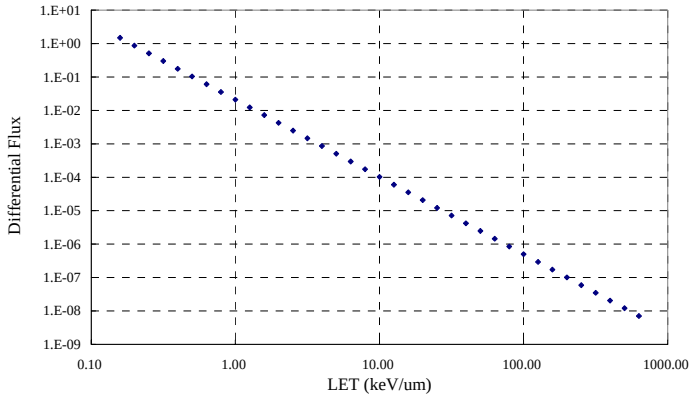
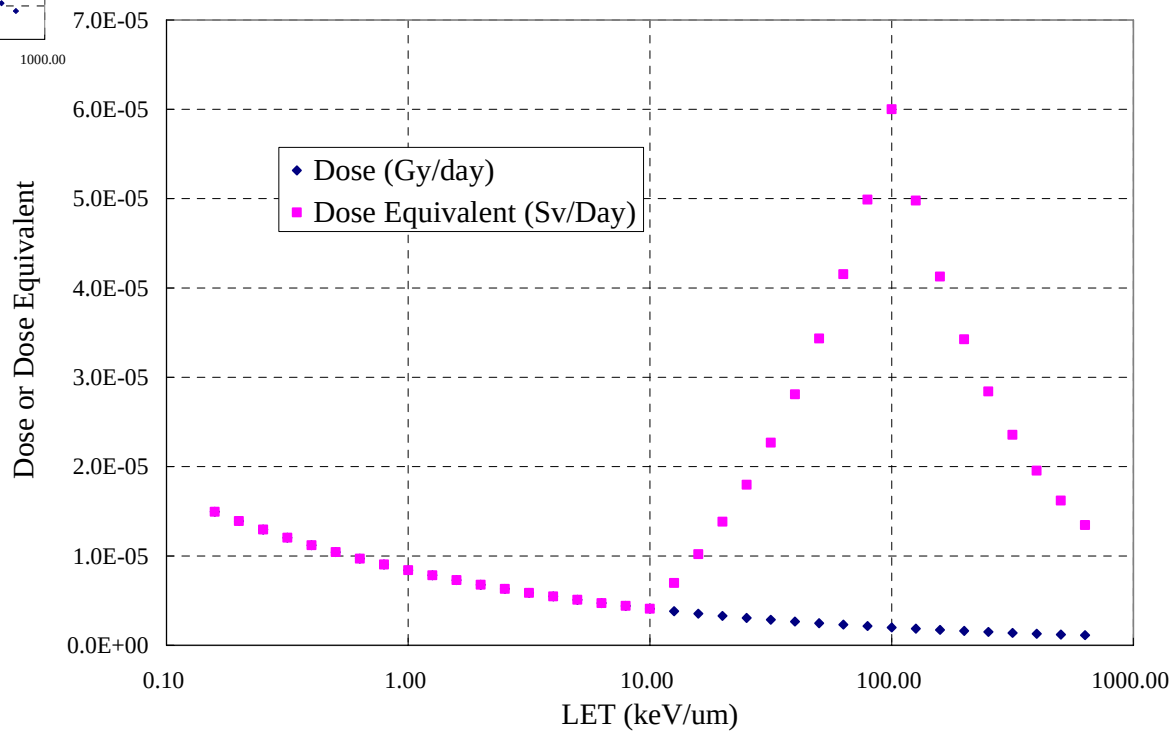
Index of LET spectrum



GCR

Simulation of LET spectrum

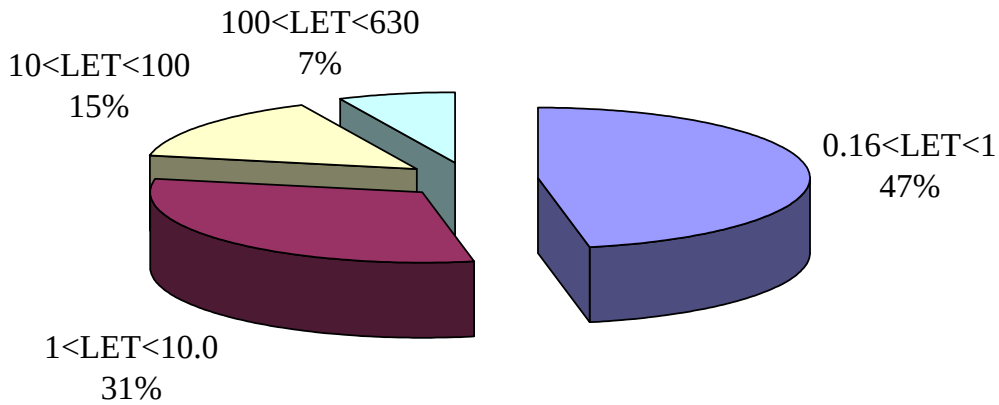




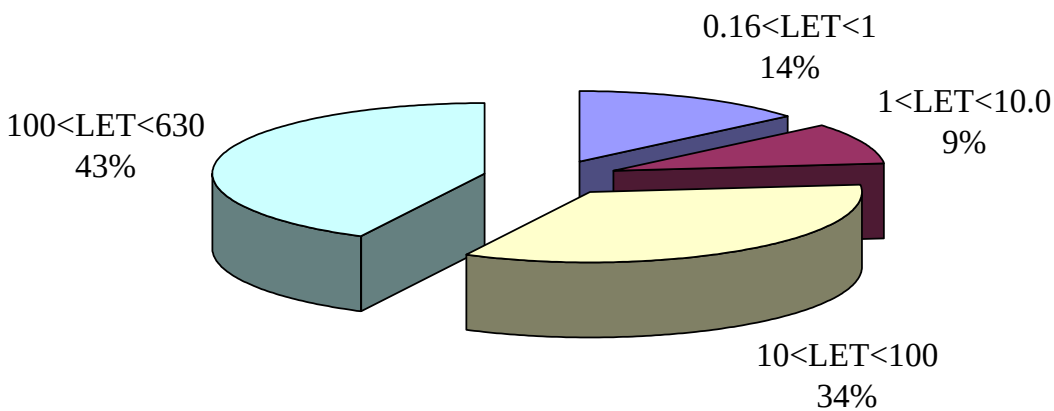
If we mistake calibration about 20 % above 10 keV/um, Total Dose Equivalent also increase about 16 %.

Heavy Ion Contribution for Dose and DE

GCR



Dose



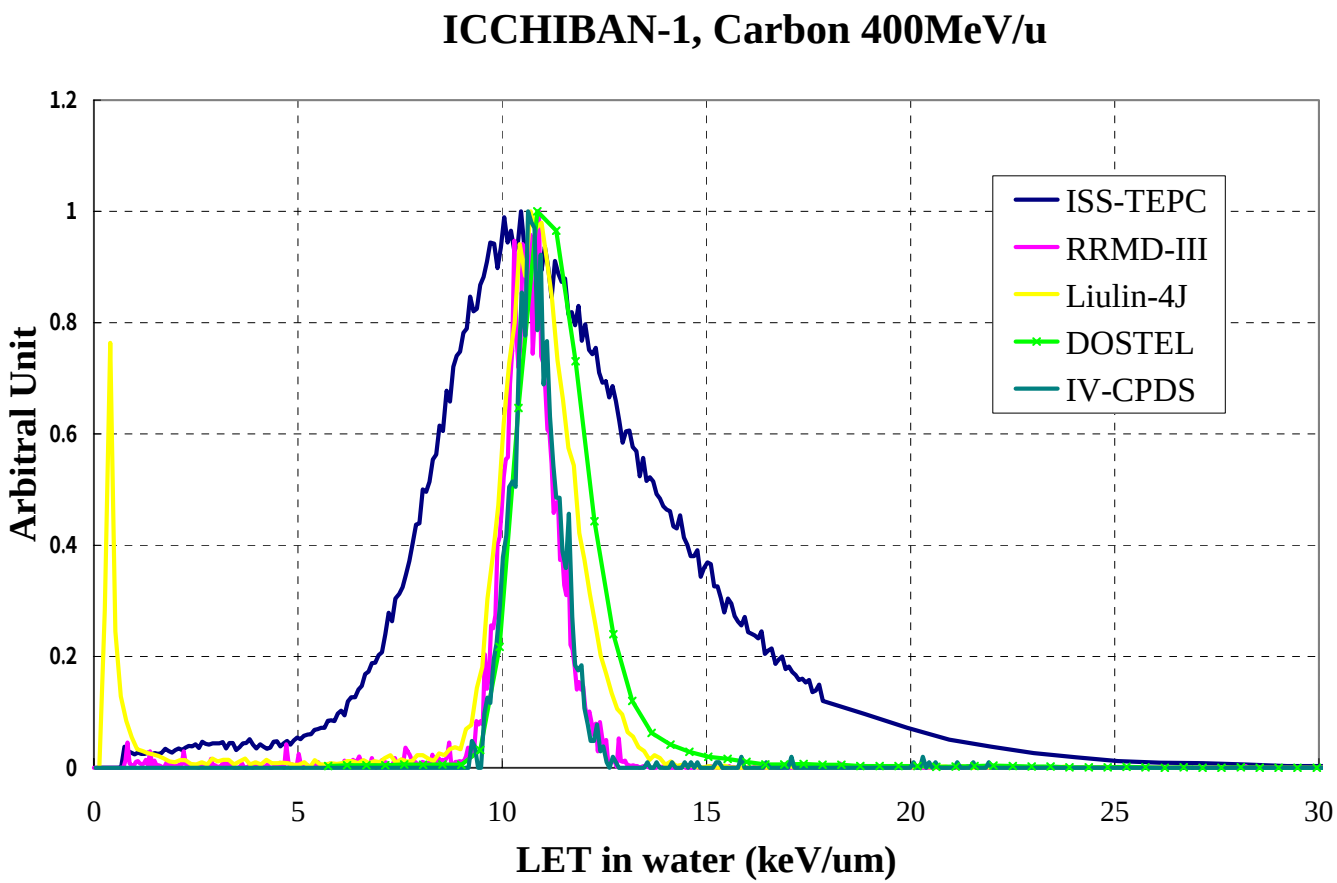
Dose Eq.

1st ICCHIBAN Run

1st 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 + Č	Active
Liulin-4J	NIRS	Japan	Silicon	Active
Liulin E087	STIL-BAS	Bulgaria	Silicon	Active
Dosimeter Package	Eril Research	USA	TLD+CR-39	Passive
Dosimeter Package	NASDA	Japan	TLD+CR-39	Passive
Ground Base Detector	LBNL	USA	Silicon Stack + SC	Active

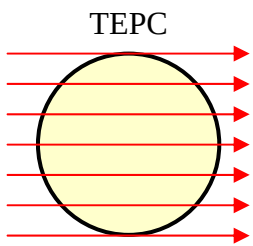
Comparison for Carbon Run



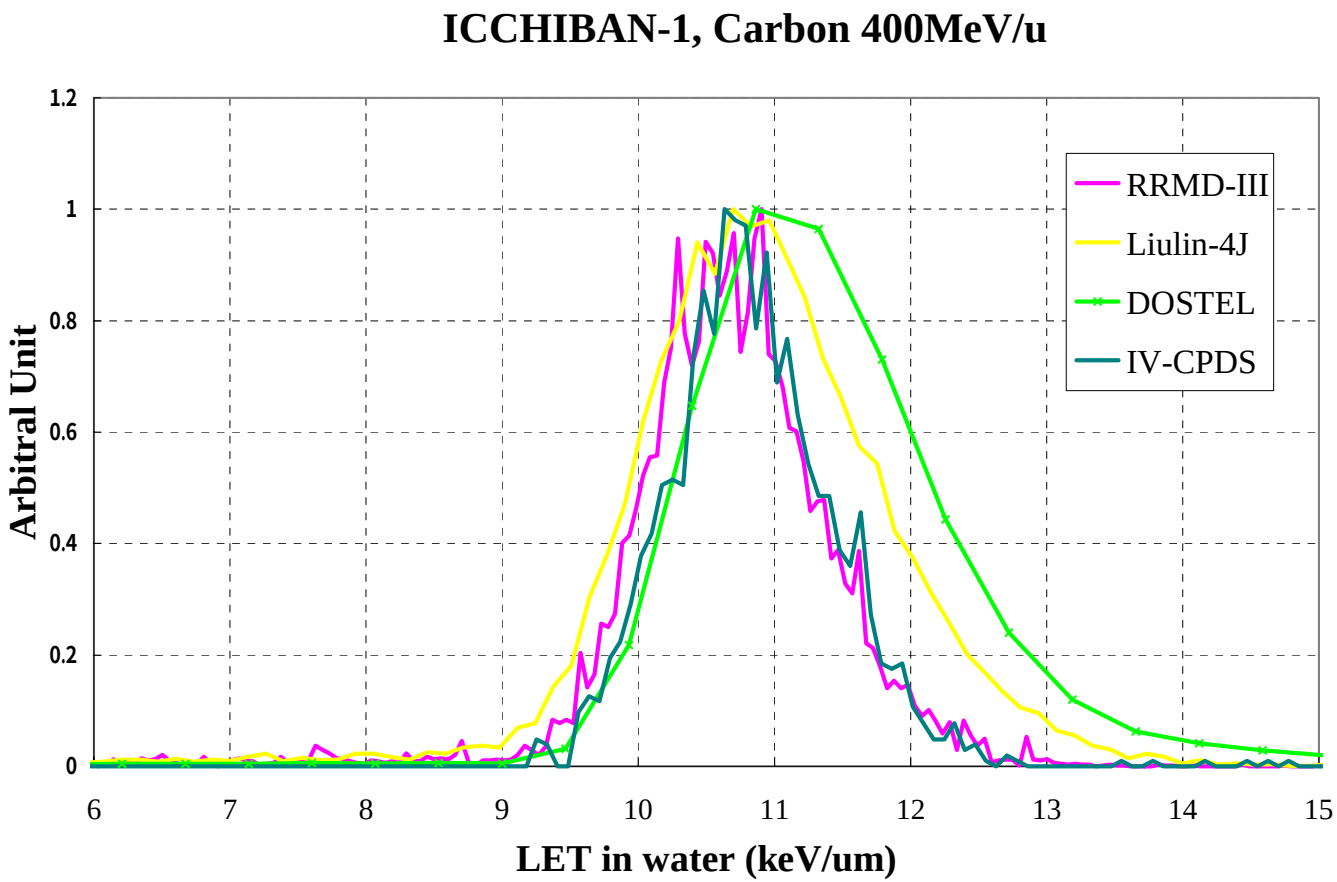
0 degree

Center

No Absorber



Comparison for Carbon Run (Only Si Detectors)



0 degree

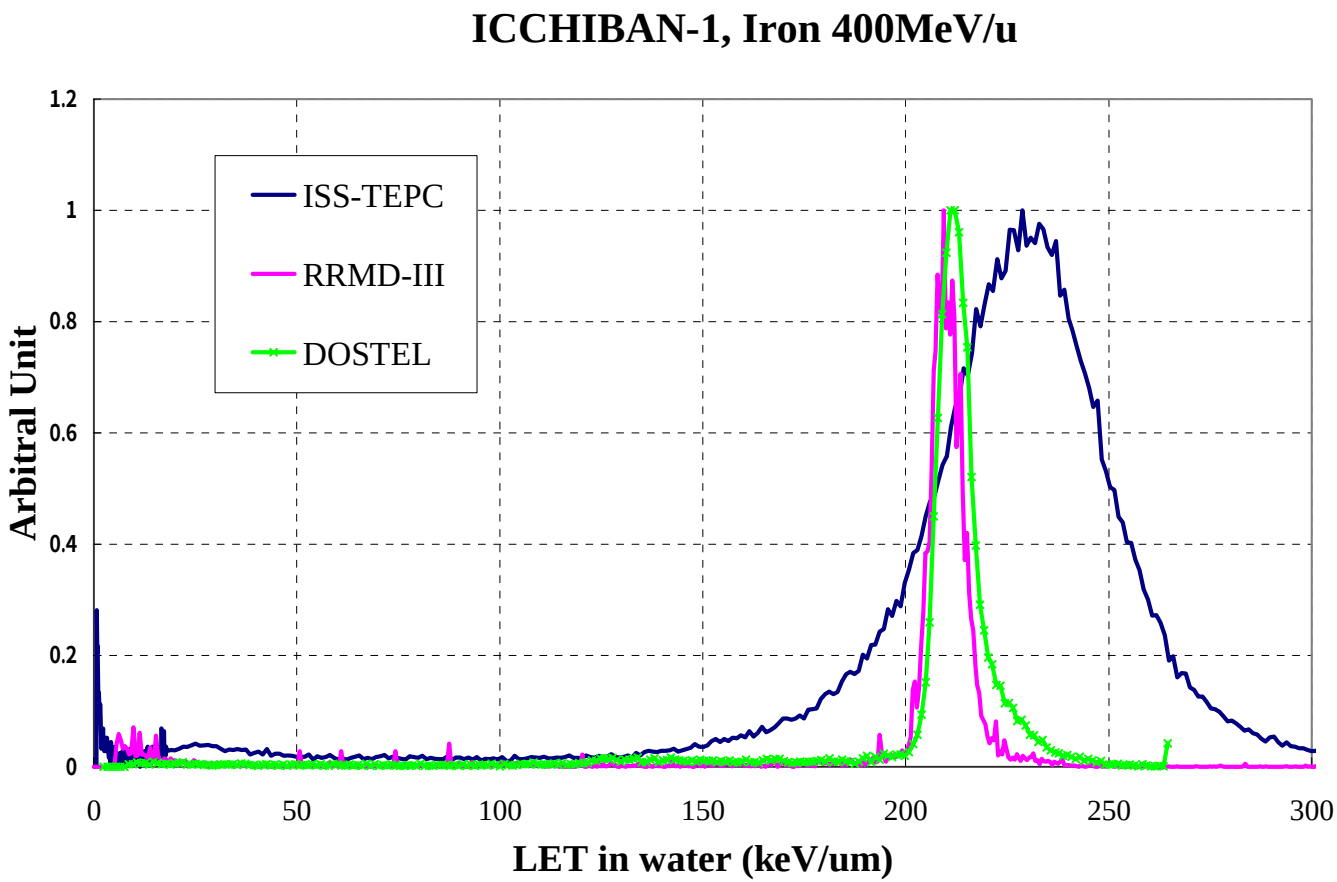
Center

No Absorber

Comparison Table (C400, 0deg., Center)

	Avg. LET (keV/um- H_2O)	Avg. y_f (keV/um- H_2O)	Avg. y_d (keV/um- H_2O)	Quality Factor (ICRP-60)
RRMD-III	10.6	-----	-----	1.26
DOSTEL-2	10.7	-----	-----	1.6
DOSTEL-D	(10.7)	-----	-----	1.7
IV-CPDS	N.R.	-----	-----	N.R.
ISS-TEPC	-----	11.76	13.49	2.39
Liulin-4J	(9.8) 10.8	-----	-----	(1.29) 1.32
Calculation	10.9	-----	-----	(1.29)

Comparison for Iron Run



0 degree

Center

No Absorber

CPDS and Liulin-4J have no data.

Comparison Table (Fe400, 0deg., Center)

	Avg. LET (keV/um- H_2O)	Avg. y_f (keV/um- H_2O)	Avg. y_d (keV/um- H_2O)	Quality Factor (ICRP-60)
RRMD-III	198.24	-----	-----	21.23
DOSTEL-1	227.6	-----	-----	20.0
DOSTEL-2	(227.6)	-----	-----	20.3
ISS-TEPC	-----	222.53	235.63	15.54
Calculation	207.2	-----	-----	(20.8)

3rd ICCHIBAN Run

3rd 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 + Č	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

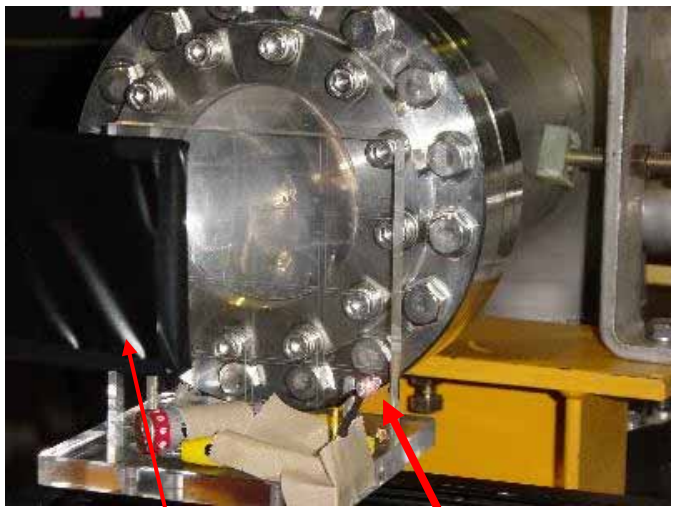
3rd ICCHIBAN Run (2003)

Date	Time		Ion & Energy	LET in H_2O
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

Differences with IC-1

- Different Ions and Energy (Highest in HIMAC)
- Fragment Beam
- Wide, Uniform Beam at Biology Room in HIMAC

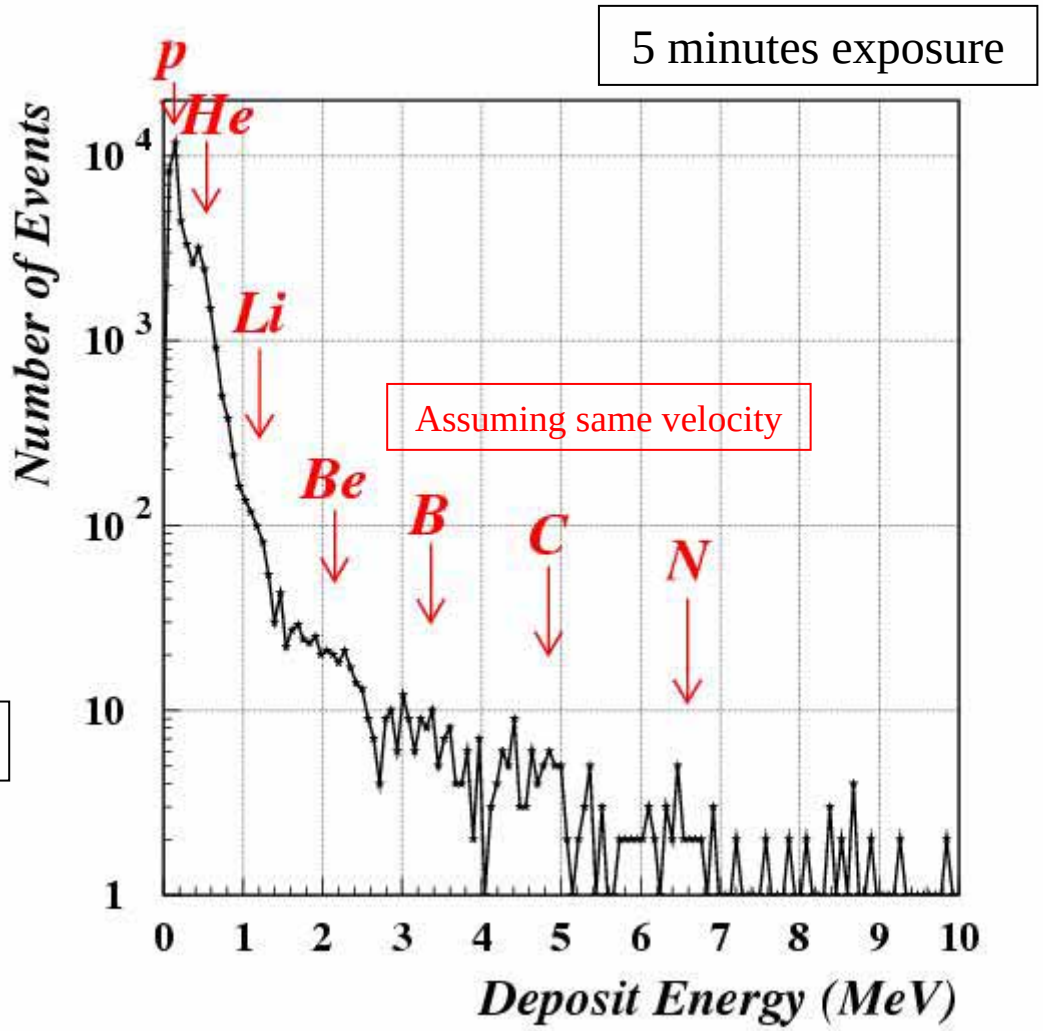
Fragments from Si(800) Beam (Liulin-4J data)



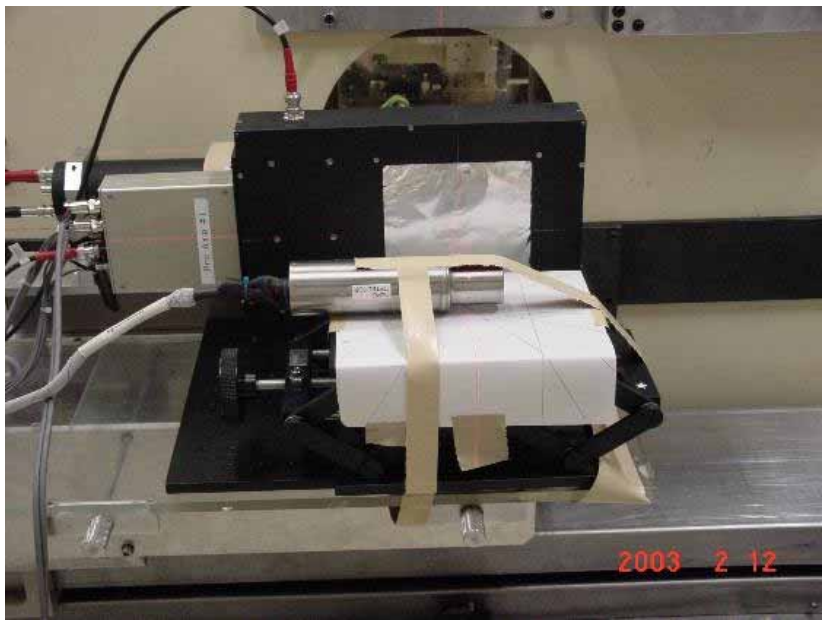
Plastic Scintillator (50umt)

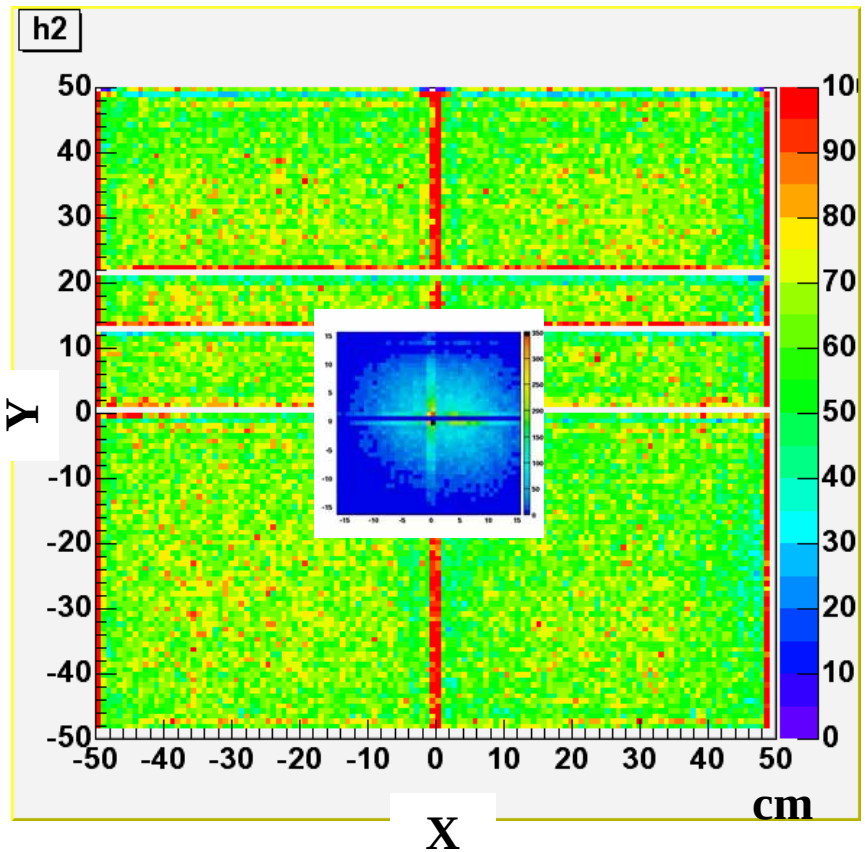
Acryl Target (1cmt)

5 minutes exposure

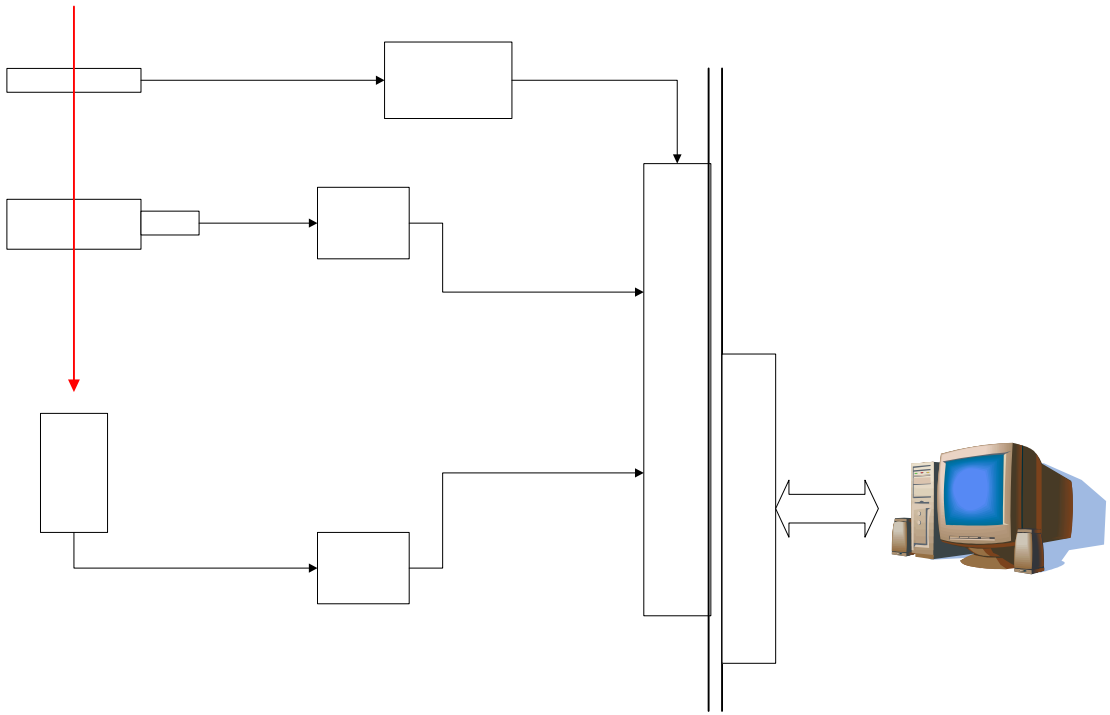


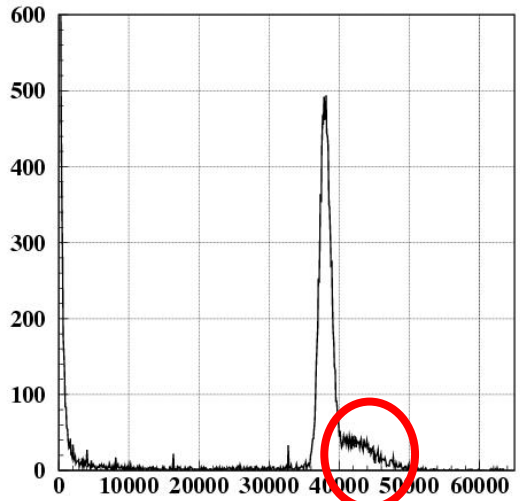
Wide and Uniform Beam in BIO





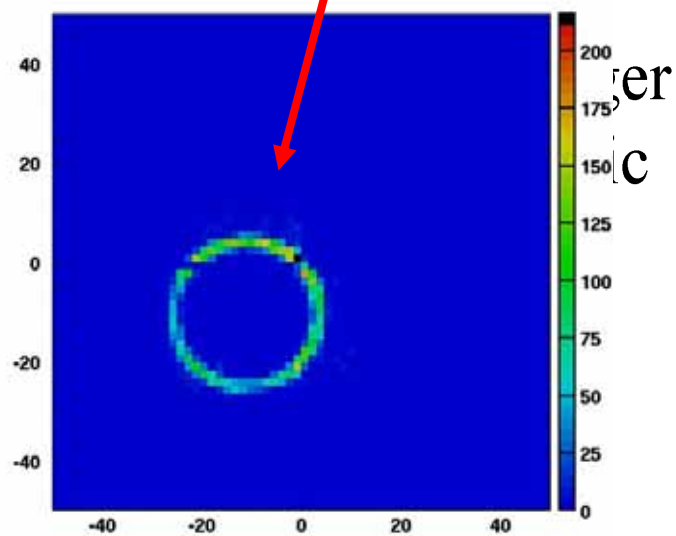
Position Sensitive Detector + Monitor





DOSTEL ADC

Trig. SC



What have we gotten from ICCHIBAN-1 & 3?

- Very Good Calibration for high LET region.
- Comparison of LET distribution and calculation method between detectors.
- Understanding of other detectors.
- Confirmation of hardware problems.
- Confirmation of software problems.

More…

- Most of silicon detector show good agreement of LET spectrum.
- TEPC shows wide distribution but it comes from its structure (chord length).
- Several monitors could not measure high LET ions like Fe because they were concentrated to measure protons and light ions.
- A Peak and average values of Fe LET distribution of ISS-TEPC were not consistent with Fe LET.
- LET distribution of DOSTEL was good agreement for calculation. But, because the monitor could not measure path length in silicon, it must assume average path length for isotropic exposure.
- RRMD-III has good LET distribution. But we can see small portion of digitalization problem.

Limitations of Intercomparison

- We understand that the ICCHIBAN comparison with heavy ion beams is not characterize all ability of monitors.
- Space radiation includes not only heavy ion but also protons and neutrons.
- In addition, we should consider the cost benefit, power consumption, available space, easy maintenance and so on when we evaluate all monitors.
- Because of these limitations, we cannot summarize the results from ICCHIBAN runs yet.
- We have to perform intercomparison experiments not only at HIMAC but also at proton and neutron facilities.

What is the target of future ICCHIBAN runs?

- Wide, uniform beam in BIO to compare total dose in all monitors.
- Isotropic exposures to confirm angle dependency.

- Proton runs in Loma Linda Univ. Medical Center Synchrotron Facility.
- Neutron runs…

- If possible, intercomparison in space environment.

Future of ICCHIBAN runs

Sep. 3-5, 2003	8th WRMISS Workshop on Berkeley
Sep. 6-8, 2003	1st Proton-ICCHIBAN Experiment (For Active and Passive Detectors)
Feb. 14-18, 2004	5th ICCHIBAN Experiment (For Active Detectors)

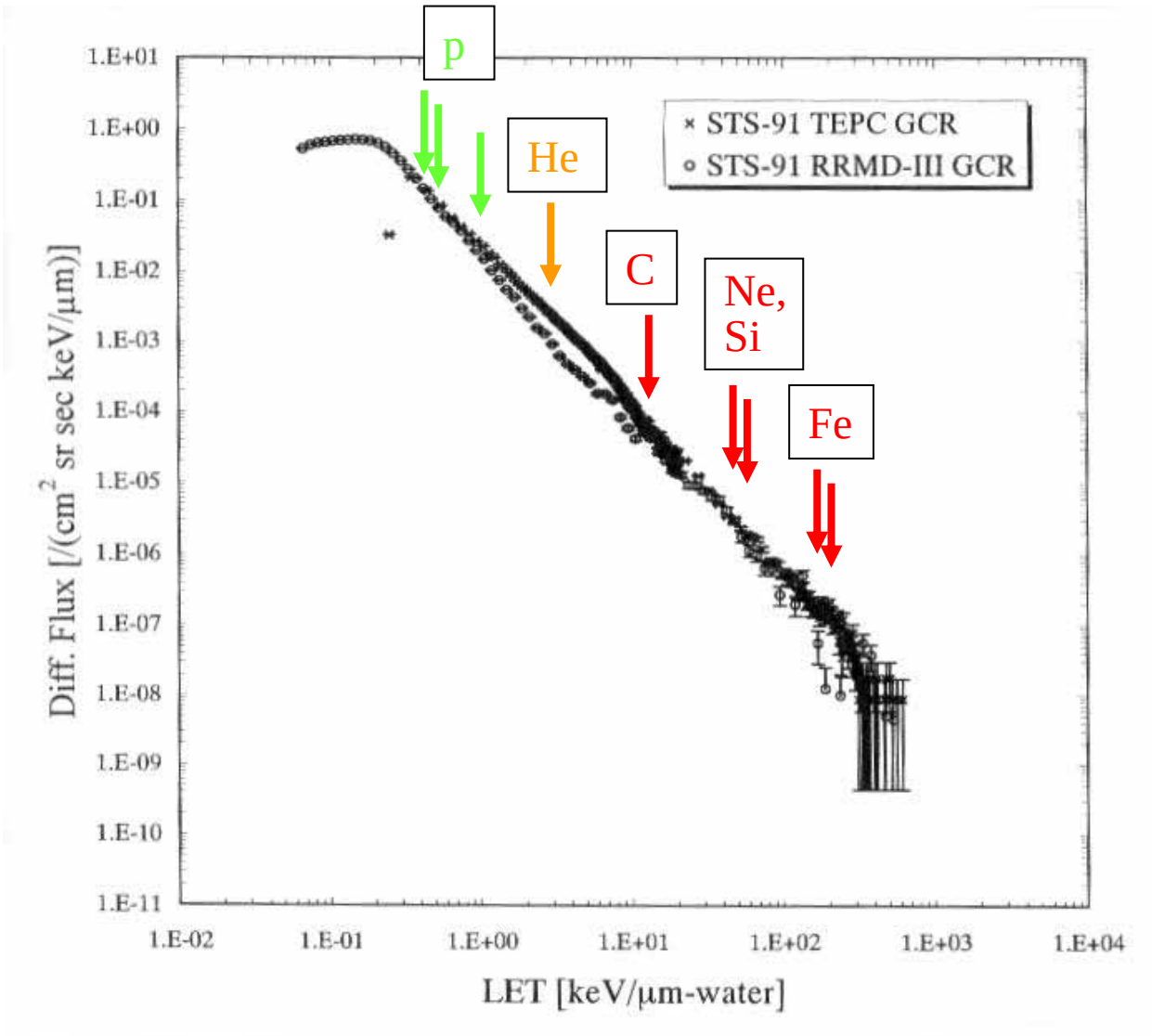
Winter, 2003	BRADOS Intercomparison (Space-ICCHIBAN #0) (For Passive Detectors)

IMBP, NIRS, ERI&OSU, ATI

5th ICCHIBAN Run (2004)

Date	Time		Ion & Energy	LET in H_2O
Feb. 14	10:00~20:00	10 hrs	C(290MeV/u) in **BIO**	15 keV/um
Feb. 16	20:00~7:00	11 hrs	He(150MeV/u) in **BIO**	2.2 keV/um
Feb. 17	22:00~7:00	9 hrs	He(150MeV/u) in **BIO**	2.2 keV/um

Covered LET Region in P-IC-1 & IC-5



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Conclusion

- 1st, 2nd, 3rd and 4th ICCHIBAN runs were carried out successfully at HIMAC in 2002 and 2003.
- We have compared the results and it will be published as HIMAC report in NIRS soon.
- 1st Proton-ICCHIBAN run will be performed on Sep. 6-8 at Loma Linda Synchrotron Facility and 5th ICCHIBAN run for active detectors will be performed on Feb. 14-18 2004. We welcome your participation to these runs.

Thank you very much for your participation and your support for ICCHIBAN project!