

Heavy Ion Beam Characteristics of ICCHIBAN 7 and 8 Experiments and Brief Summary of the ICCHIBAN Experiments

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Subjects of ICCHIBAN Project

- Determine the response of space radiation dosimeters to heavy ions of charge and energy similar to that found in the galactic cosmic radiation (GCR) spectrum.
- Compare response and sensitivity of various space radiation monitoring instruments. Aid in reconciling differences in measurements made by various radiation instruments during space flight.
- Establish and characterize a heavy ion “reference standard” against which space radiation instruments can be calibrated.

History of ICCHIBAN

Feb. 11-13, 2002	1 st ICCHIBAN Experiment (For Active Detectors)	C400, Fe400
May 23-28, 2002	2 nd ICCHIBAN Experiment (For Passive Detectors)	He150, C400, Si490, Fe500
Feb. 3-6, 2003	3 rd ICCHIBAN Experiment (For Active Detectors)	Si800, Fe500
May 19-30, 2003	4 th ICCHIBAN Experiment (For Passive Detectors)	He150, C400, Ne400, Fe500, ...
Sep. 6-7, 2003	1 st Proton ICCHIBAN Experiment (For All Detectors)	p70-250
Feb. 14-17, 2004	5 th ICCHIBAN Experiment (For Active Detectors)	He150
June 4-15, 2004	6 th ICCHIBAN Experiment (For Passive Detectors)	C135, Ar500, Kr400, ...
Sep. 24-26, 2004	1 st NSRL ICCHIBAN Experiment (For All Detectors)	p1000, O1000, Fe1000
Sep. 13-17, 2005	7 th ICCHIBAN Experiment (For Active Detectors)	O400, Fe300
Sep. 13-17, Oct. 22, 2005	8 th ICCHIBAN Experiment (For Passive Detectors)	He150, O400, Ar500, Fe200,...

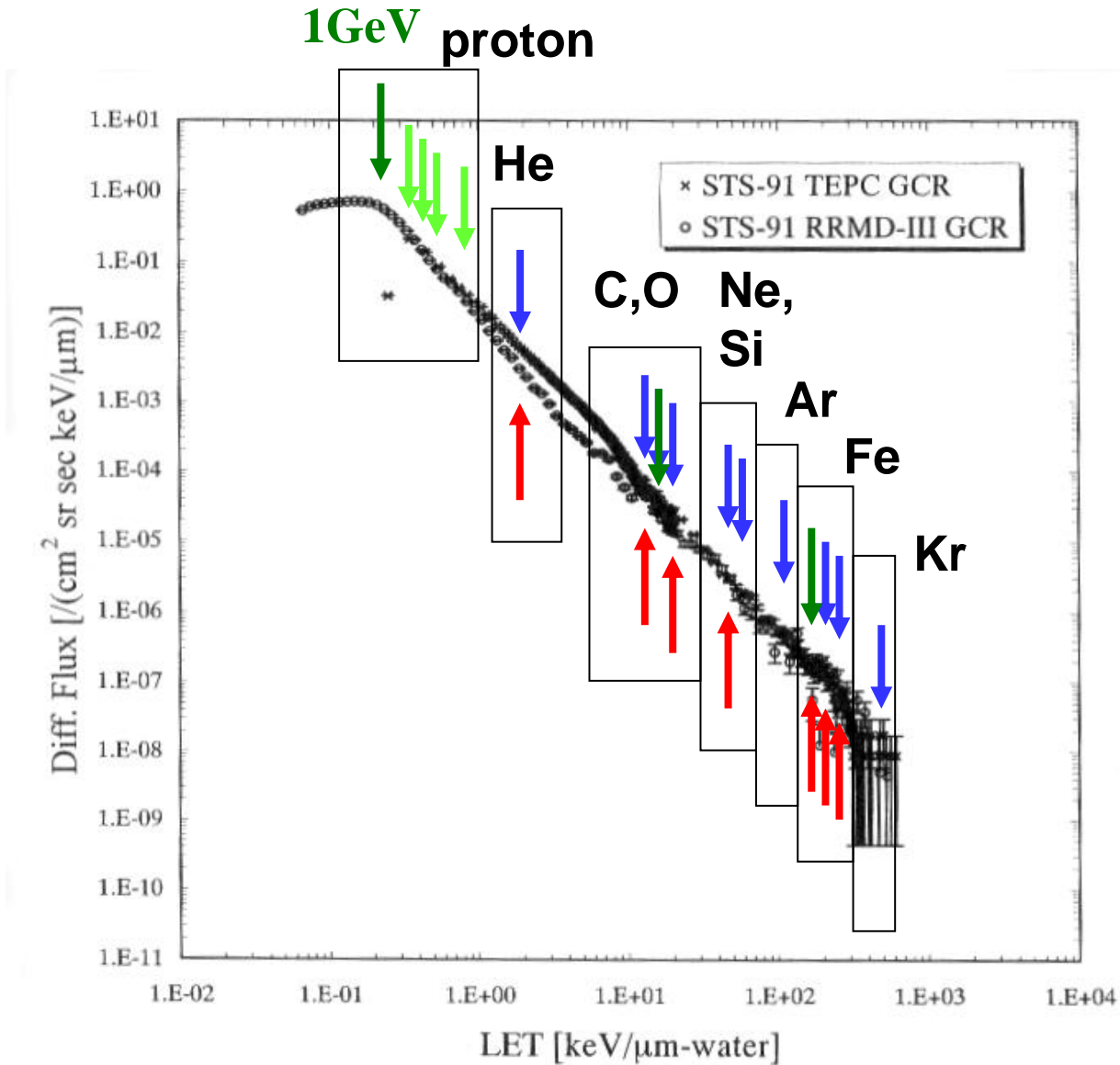
ICCHIBANs for active detectors

Ion	Nominal Energy (MeV/u)	Nominal LET in water (keV/ μ m)	Beam Shape	Run Name of ICCHIBAN
proton	70-250	0.393-0.961	Wide	Proton
	1000	0.221	Wide	NSRL
He	150	2.19	Wide	5
C	400	10.7	2cm ϕ	1
O	400	19.4	2cm ϕ ,Wide	7
	1000	14.1	Wide	NSRL
Si	800	45.8	2cm ϕ	3
Fe	300	235	2cm ϕ (?)	7
	400	202	2cm ϕ	1
	500	182	2cm ϕ	3
	1000	147	Wide	NSRL

ICCHIBANs for Passive Detectors

Ion	Nominal Energy (MeV/u)	Nominal LET in water (keV/ μm)	Run Name of ICCHIBAN
Proton	70-250	0.393-0.961	Proton
	1000	0.221	NSRL
He	150	2.19	2,4,8
C	135	20.8	6
	400	10.7	2,4
O	400	19.4	8
	1000	14.1	NSRL
Ne	400	30.1	4
Si	490	54.4	2
Ar	500	92.3	6,8
Fe	200	299	8
	500	183	2,4
	1000	147	NSRL
Kr	400	396	6

Covered LET Region in ICCHIBAN Exp.



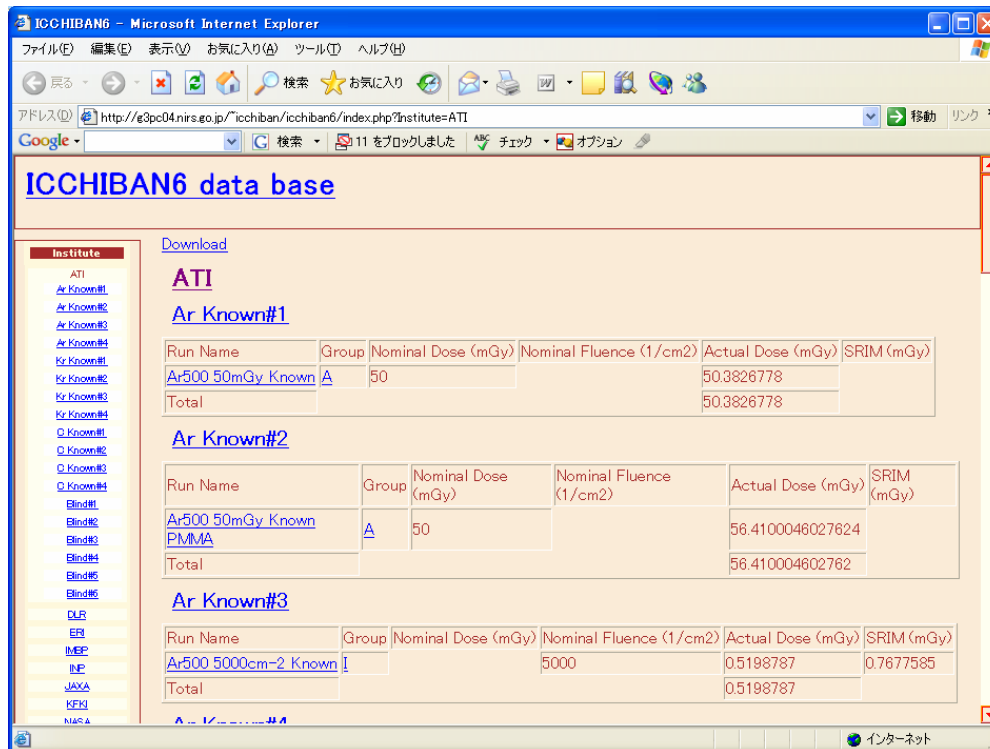
- ↑ 1,3,5,7 (active)
- ↓ 2,4,6,8 (passive)
- ↓ Proton (both)
- ↓ NSRL (both)

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

Call for Results

We would like to summarize the results from 5th and 6th HIMAC-ICCHIBAN and 1st NSRL-ICCHIBAN experiments.

Would you please send us your reports by Dec. 31, 2006.



ICCHIBAN6 data base

Institute

- ATI
- Ar Known#1
- Ar Known#2
- Ar Known#3
- Ar Known#4
- Kr Known#1
- Kr Known#2
- Kr Known#3
- Kr Known#4
- Q Known#1
- Q Known#2
- Q Known#3
- Q Known#4
- Blind#1
- Blind#2
- Blind#3
- Blind#4
- Blind#5
- Blind#6
- DJR
- ERI
- IMEP
- INP
- JAXA
- KFKI
- NASA

Download

ATI

[Ar Known#1](#)

Run Name	Group	Nominal Dose (mGy)	Nominal Fluence (1/cm2)	Actual Dose (mGy)	SRIM (mGy)
Ar500 50mGy Known	A	50		50.3826778	
Total				50.3826778	

[Ar Known#2](#)

Run Name	Group	Nominal Dose (mGy)	Nominal Fluence (1/cm2)	Actual Dose (mGy)	SRIM (mGy)
Ar500 50mGy Known	A	50		56.4100046027624	
PMVA					
Total				56.410004602762	

[Ar Known#3](#)

Run Name	Group	Nominal Dose (mGy)	Nominal Fluence (1/cm2)	Actual Dose (mGy)	SRIM (mGy)
Ar500 5000cm-2 Known	I		5000	0.5198787	0.7677585
Total				0.5198787	

We will open the exposure records.

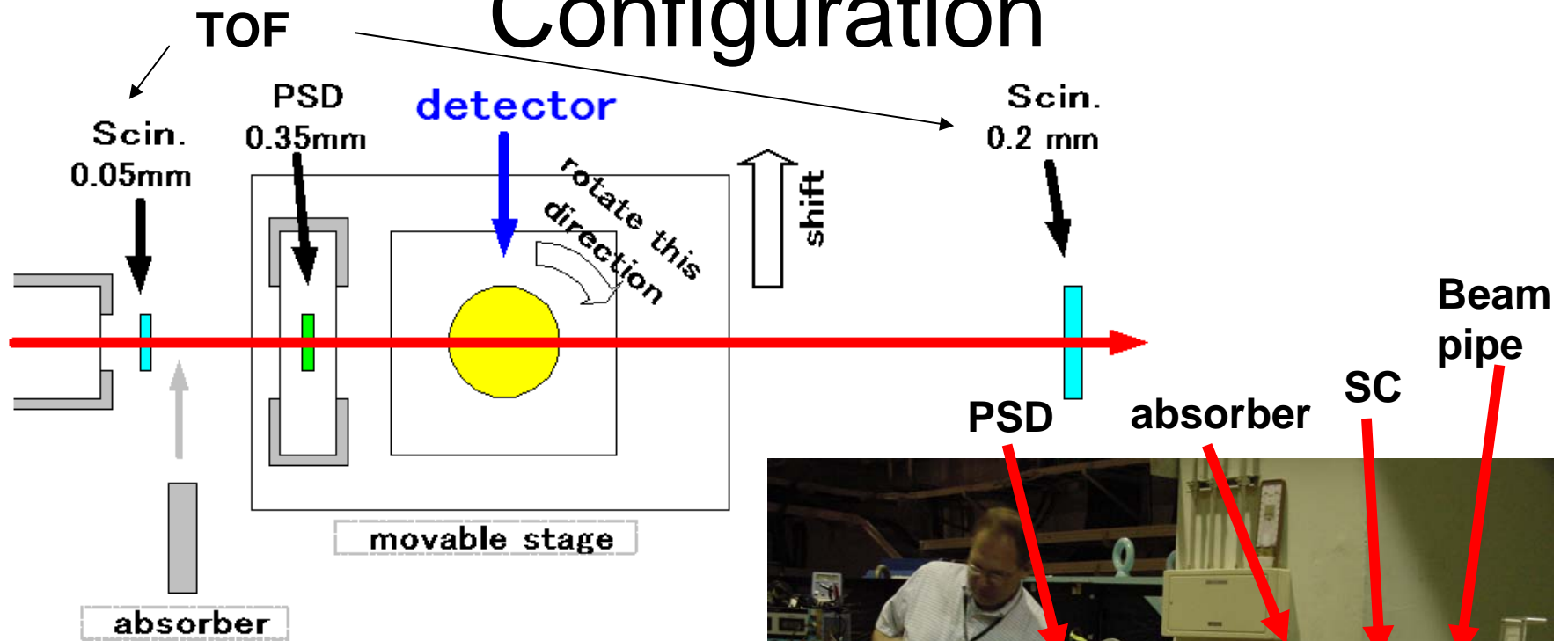
ICCHIBAN Experiments in September 2005

- ICCHIBAN-7 for Active Dosimeters
 - Sep.13-15, O 400 MeV/u pencil beam
 - Sep. 16-17, Fe 300 MeV/u pencil beam
 - Sep.15, O 400 MeV/u, 10 cm diameter wide beam
- ICCHIBAN-8 for Passive Dosimeters
 - Sep. 13 (Ar),15(O),17(He) and Oct.22(Fe)
 - 10 cm diameter wide beam

ICCHIBAN-7 Participants

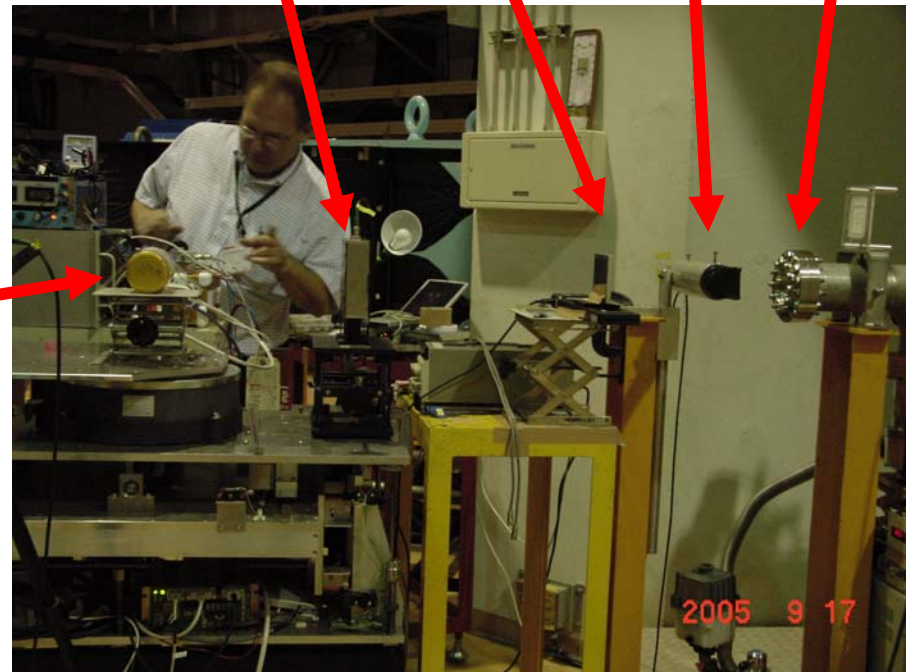
Name	Institute	Nation	Detector
R-16	IBMP	Russia	ion chamber
DB-8			semiconductor detector
DOSTEL	Kiel Univ.	Germany	semiconductor detector
ISS-TEPC	NASA JSC	USA	proportional counter
IV-CPDS			semiconductor detector
Liulin-4J	NIRS	Japan	semiconductor detector
Liulin-5	STL-BAS	Bulgaria	semiconductor detector
RRMD-III	Waseda Univ.	Japan	semiconductor detector
HAWK-TEPC	ARCS	Austria	proportional counter
HAWK-SiPC			proportional counter
Baseline measurement	LBNL	USA	semiconductor detectors, TOF

ICCHIBAN-7 Configuration



Aluminum 20mm

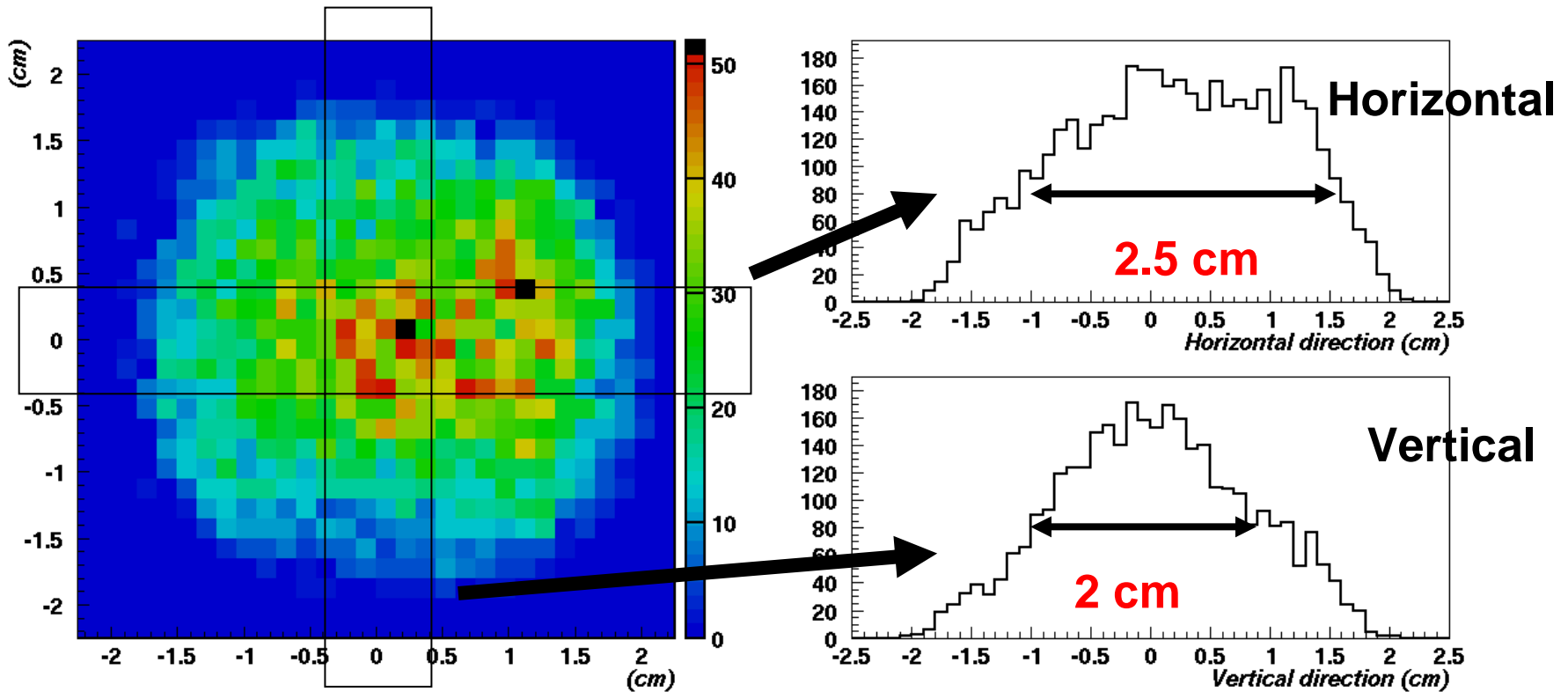
detector



ICCHIBAN-7

Oxygen 400 MeV/u

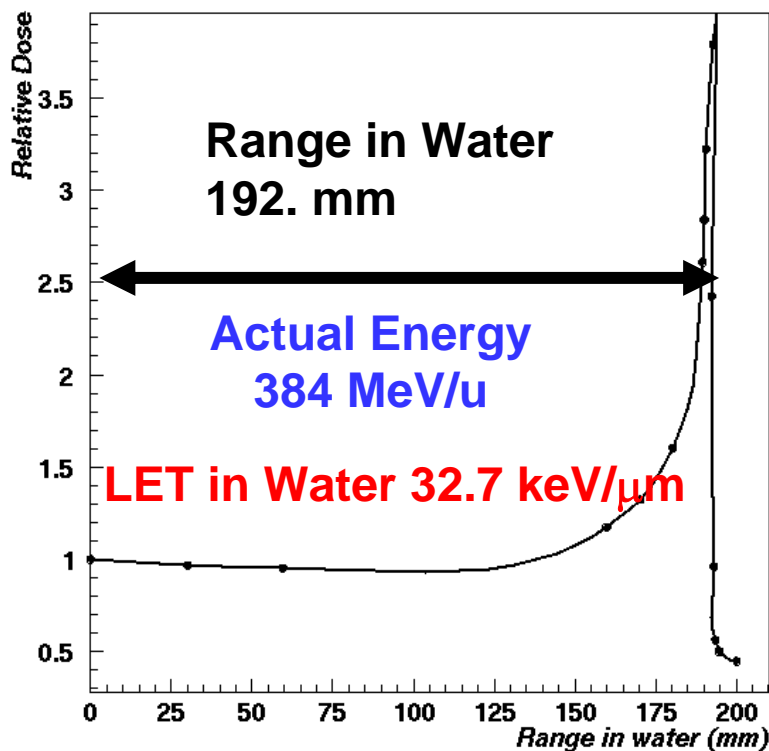
Sep.13, 2005 (No absorber)



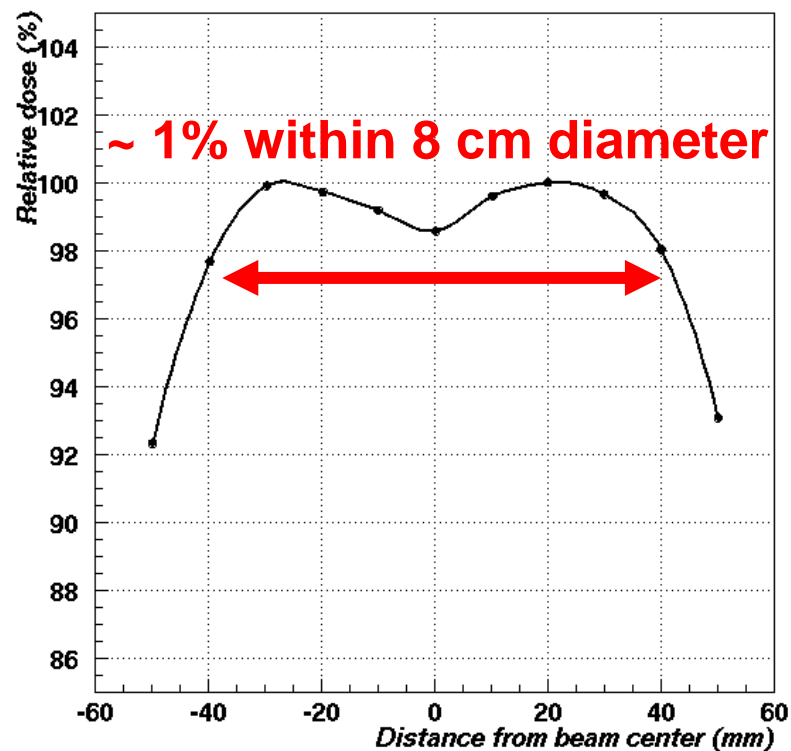
The Beam Profile measured
with PSD
(Viewed from downstream)

ICCHIBAN-7

Oxygen 400 MeV/u Wide Beam



Bragg curve measured using
a binary filer system

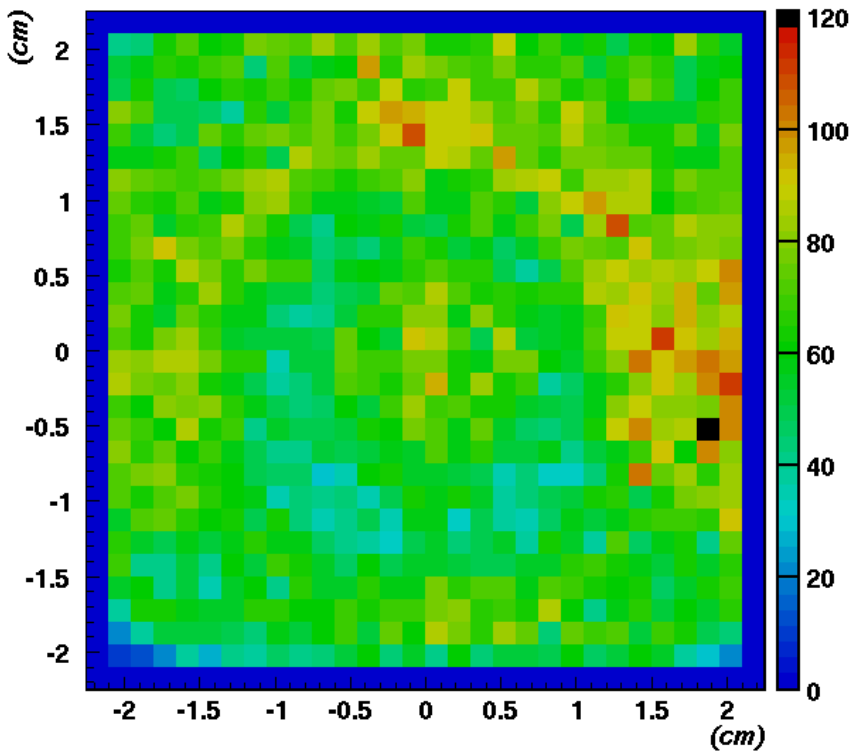


Uniformity of dose measured
with a ion chamber

ICCHIBAN-7

Fe 300 MeV/u

Wide beam ... because of a unexpected placement of a monitor.



**The Beam Profile measured
with PSD
(Viewed from downstream)**

- The monitor is a parallel plate ion chamber with 0.6 mm thickness of Aluminum.
- It was placed at about 15m upstream from the exposure port.
- The center of beam was shifted by Q magnets because of the energy loss at the monitor.
- The beam size was wider than the scintillator (5cm x 5cm).

ICCHIBAN-8

- Ion
 - Ar 500 MeV/u (Sep.13,2005)
 - O 400 MeV/u (Sep.15)
 - He 150 MeV/u (Sep.17)
 - Fe 200 MeV/u (Oct.22)
- Beam intensities
 - 50mGy in H₂O
 - 5000 particles/cm²
- Absorber
 - No absorber
 - PMMA (Binary Filter System)

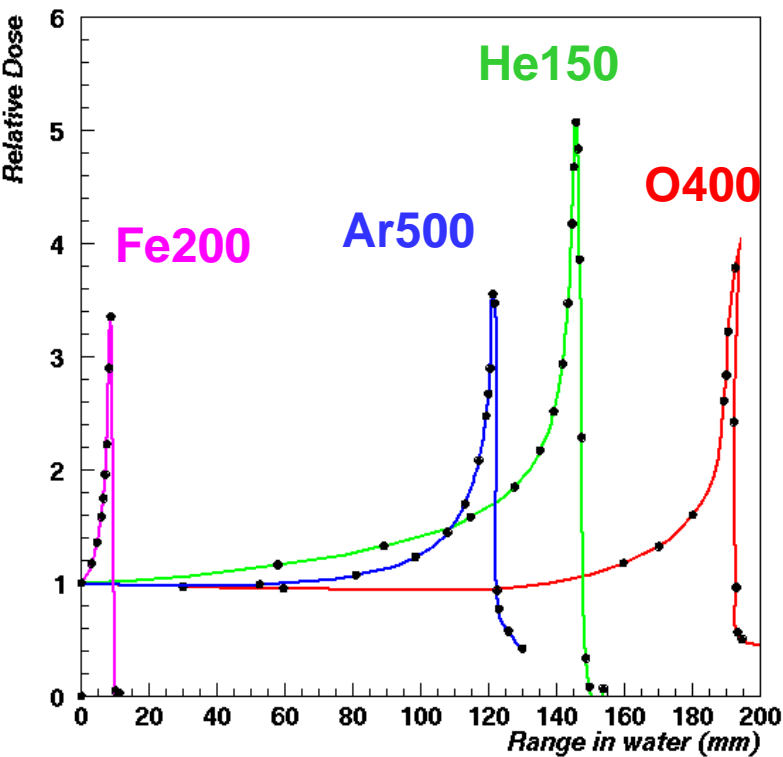
Total 8 or 16 packages for “Known Exposure” and 6 packages for “Blind Exposure”

ICCHIBAN-8 Participants



ICCHIBAN-8

Estimated LET

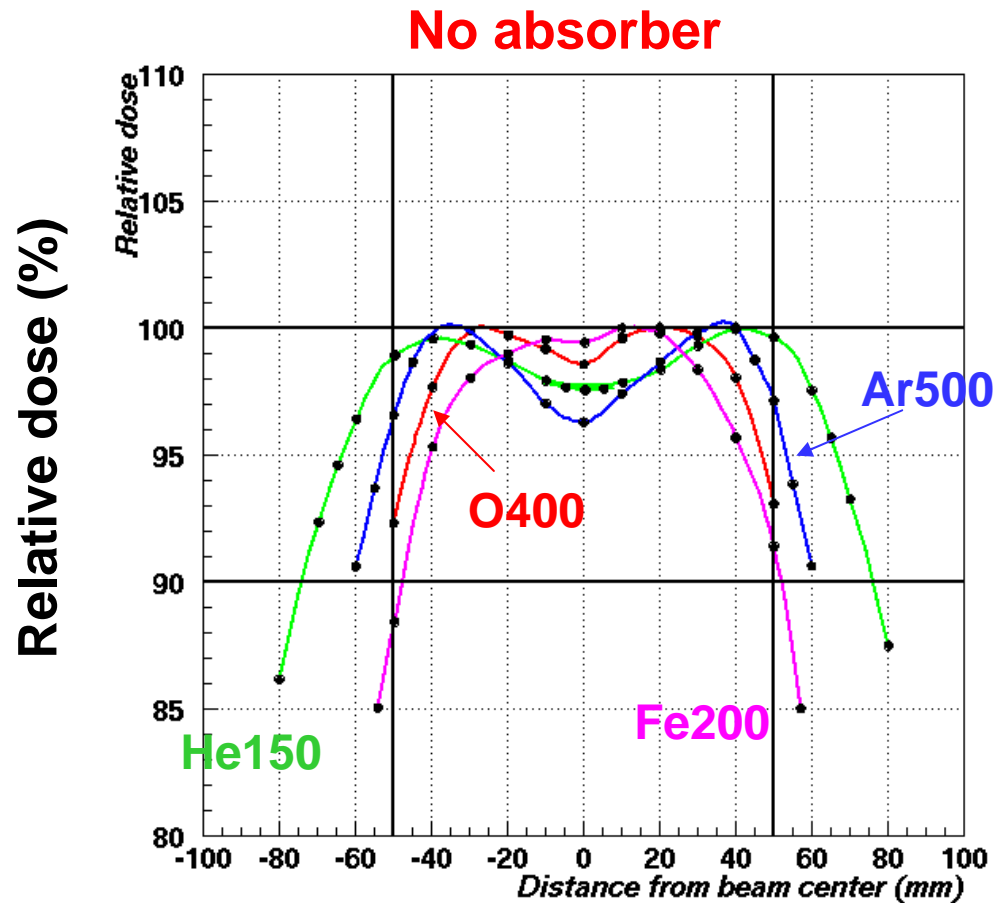


Beam	Helium 150	Oxygen 400	Argon 500	Iron 200
Actual energy (MeV/u)	145	384	461	121
Range in H ₂ O (mm)	147	192	122	9.3
LET in H ₂ O (keV/μm)	2.25	19.7	95.6	422
With PMMA				
Absorber thickness (mm H ₂ O)	114.74	100.14	52.5	3.45
LET in H ₂ O with absorber (keV/μm)	4.22	32.7	114	513

Bragg curves measured with Ion Chamber using a binary filter system

Calculated by SRIM 2003

ICCHIBAN-8 Beam Profiles



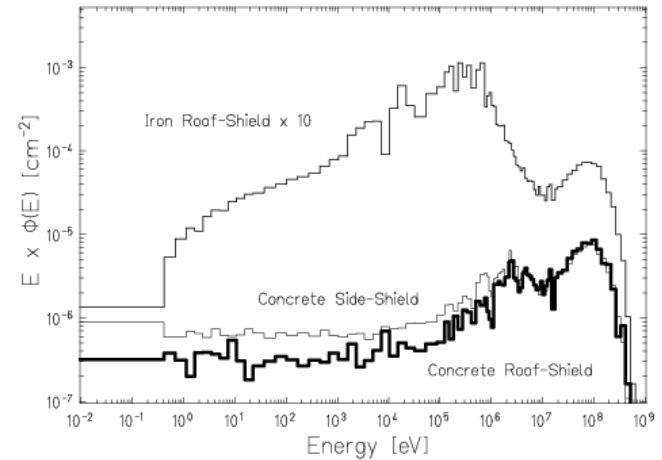
ICCHIBAN experiments soon

- BRADOS / 2nd Space Intercomparison (SI-2)
 - December 2006
- CERF-ICCHIBAN
 - October 2006

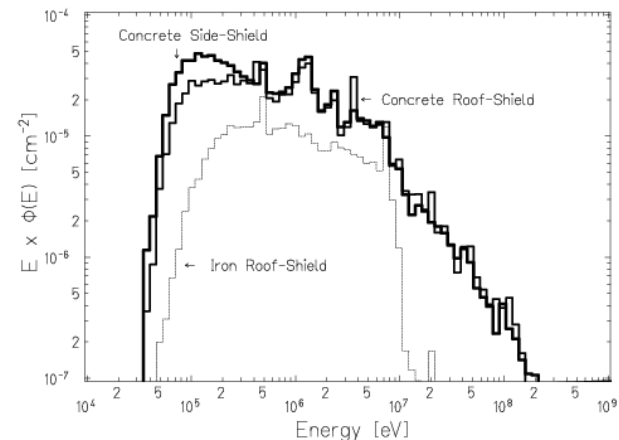
CERF-ICCHIBAN

- Plan of CERF ICCHIBAN

- Local Organizer
 - M. Hajek & T. Berger
- For passive dosimeters
- Exposure time:
 - ~24 hours
- Total dose: ~10mSv
- Schedule:
 - Oct. '06



Neutron spectral fluencies (lethargy)



Photon spectral fluencies (lethargy)

Summary

- Since 2003, we performed 10 ICCHIBAN runs. (8 in NIRS, 1 in Loma Linda Univ., 1 in BNL)
- 7th and 8th ICCHIBAN were performed on September 2005.
- We will publish the results from 3rd and 4th ICCHIBAN experiments as a HIMAC Report very soon.
- Please send us your reports of 5th and 6th HIMAC-ICCHIBAN and 1st NSRL-ICCHIBAN experiments.
- In this year, we will perform 1st CERF-ICCHIBAN and 2nd Space Intercomparison.