

Preliminary results of SI3 and ICCH-CR-39 experiments obtained by PADC track etch detectors

B. Dudás, J. K. Pálfalvi, J. Szabó

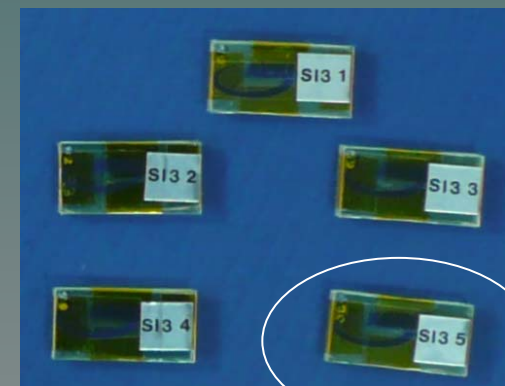
*Hungarian Academy of Sciences
KFKI Atomic Energy Research Institute
P.O.B. 49, H-1525 Budapest, Hungary*



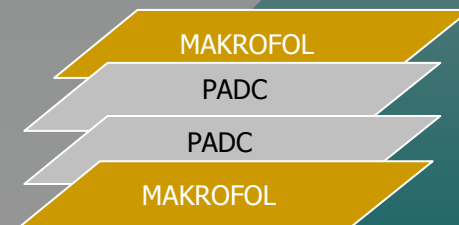
**14th Workshop on Radiation Monitoring for the International Space Station
8th-10th September 2009, DUBLIN**

INTRODUCTION - Position of the AERI detectors 1.(SI3)

Stack #I	Stack #II	Stack #III	Stack #IV	Stack #V	
NPI Top + Page No1	NIRS Top + SI3-T-001	ATI Top + SI3-T-005	OSU Top + SI3-OSU-4-1	IBMP SI3-T-015	Top ↑ ↓ Bottom
INP Top + SI3 IFJ 1	JAXA Top + JAXA-301	DLR Top + DLR I	NASA-JSC Top + SI3-JSC-4-1	Armenia SI3-T-016	
SCK-CEN Top + SI3-T-008	SI3 BL 2	SI3 BL 3	SI3 BL 4	SI3 BL 5	
SI3 BL 1	SI3-T-011	SI3-T-012	SI3-T-013	SI3-T-014	
SCK-CEN Bottom + SI3-T-009	SI3-B-001	SI3-B-002	SI3-B-003	SI3-B-004	
INP Bottom + SI3 IFJ 2	SI3 1	SI3 2	SI3 3	SI3 4	
NPI Bottom + Page No2	TD-1 No1	TD-1 No2	TD-1 No4	TD-1 No3	
	Page No4	Page No5	DLR IV	DLR V	
	JAXA Bottom + JAXA-302	DLR Bottom + DLR II	NASA-JSC Bottom + SI3-JSC-4-2	Armenia SI3-T-017	
	NIRS Bottom + SI3-T-002	ATI Bottom + SI3-T-006	OSU Bottom + SI3-OSU-4-2	IBMP SI3-T-018	



- Travelling background detectors
- Thickness of stacks: 3 mm



Position of the AERI detectors 1.(SI3)- in Russian Service Module

Wall #1 SI 1	Wall #2 SI 2	Wall #3 SI 3	Wall #4 SI 4	Wall #5 SI 5	Wall #6 SI 6	
SI3-W-T-001	SI3-W-T-002	SI3-W-T-003	SI3-W-T-004	SI3-W-T-005	SI3-W-T-006	Wall ↑ ↓ Inside
SI3-W-B-001	SI3-W-B-002	SI3-W-B-003	SI3-W-B-004	SI3-W-B-005	SI3-W-B-006	
SI3-OSU-1-1	SI3-OSU-1-2	SI3-OSU-2-2	SI3-OSU-2-1	SI3-OSU-3-2	SI3-OSU-3-1	
SI3-JSC-1-1	SI3-JSC-1-2	SI3-JSC-2-2	SI3-JSC-2-1	SI3-JSC-3-1	SI3-JSC-3-2	
Box 2 1	Box 2 2	Box 2 3	Box 2 4	Box 2 5	Box 2 6	
Page No3 K46	Page No4 K47	Page No3 K51	Page No4 K52	Page No3 K56	Page No4 K57	
Tastrak No3 T129	Tastrak No4 T130	Tastrak No3 T134	Tastrak No4 T135	Tastrak No3 T139	Tastrak No4 T140	
TD-1 No3 Z48	TD-1 No4 Z49	TD-1 No3 Z53	TD-1 No4 Z54	TD-1 No3 Z58	TD-1 No4 Z59	
WALL-JAXA- 303	WALL-JAXA- 304	WALL-JAXA- 308	WALL-JAXA- 309	WALL-JAXA- 313	WALL-JAXA- 314	
DLR BIII	DLR BII	DLR BIII	DLR BII	DLR BIII	DLR BIV	
Spc-ICC SPD Big IFJ 1	Spc-ICC SPD Big IFJ 2	Spc-ICC IFJ 1 SPD Med	Spc-ICC IFJ 2 SPD Med	Spc-ICC SPD IFJ 1 small	Spc-ICC SPD IFJ 2 small	

- Wall detectors

- Thickness of AERI stacks: 1.4 mm



14th May 2008 – 24th October 2008

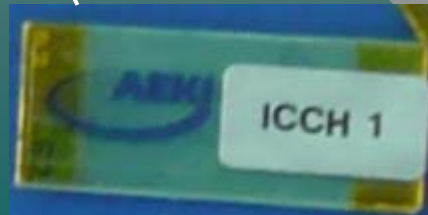
Position of the AERI detectors 2. (ICCH-CR-39) – in PIRS Docking Module

Main stack
(1):

IC3-T001
IC3-B001
TTS-1
OSU-5-1
JSC-5-1
ICCH1, ICCH2 ICCH3 ICCH4
Page No1 K33
Tastrak No1 116T
TD-1 No1 Z35
ATP No1 A116
CR39ICCHI-JAXA-301
DLR ICC I
SpC-ICC IFJ1

Wall detectors:

Wall #1 IC 1	Wall #2 IC 2	Wall #3 IC 3	Wall #4 IC 4	Wall #5 IC 5	Wall #6 IC 6	
IC3-W-T-001	Page No1 K44	IC3-W-T-003	Page No1 K49	IC3-W-T-005	Page No1 K54	Wall ↑ ↓ Inside
IC3-W-B-001	Tastrak No1 T127	IC3-W-B-003	Tastrak No1 T132	IC3-W-B-005	Tastrak No1 T137	
CRSI-OSU-1-2	TD-1 No1 Z46	CRSI-OSU-2-2	TD-1 No1 Z51	CRSI-OSU-3-2	TD-1 No1 Z56	
CRSI-JSC-1-2	WALL-JAXA-301	CRSI-JSC-2-2	WALL-JAXA-306	CRSI-JSC-3-2	WALL-JAXA-311	
Box 1 1	DLR BV	Box 1 3	DLR BV	Box 1 5	DLR BI	
	SI3 SPD Big IFJ 1		SI3 SPD Med IFJ 1		SI3 SPD IFJ 1 small	



Thickness of AERI stacks: 3 mm

Thickness of AERI stacks: 1.4 mm

ETCHING METHOD

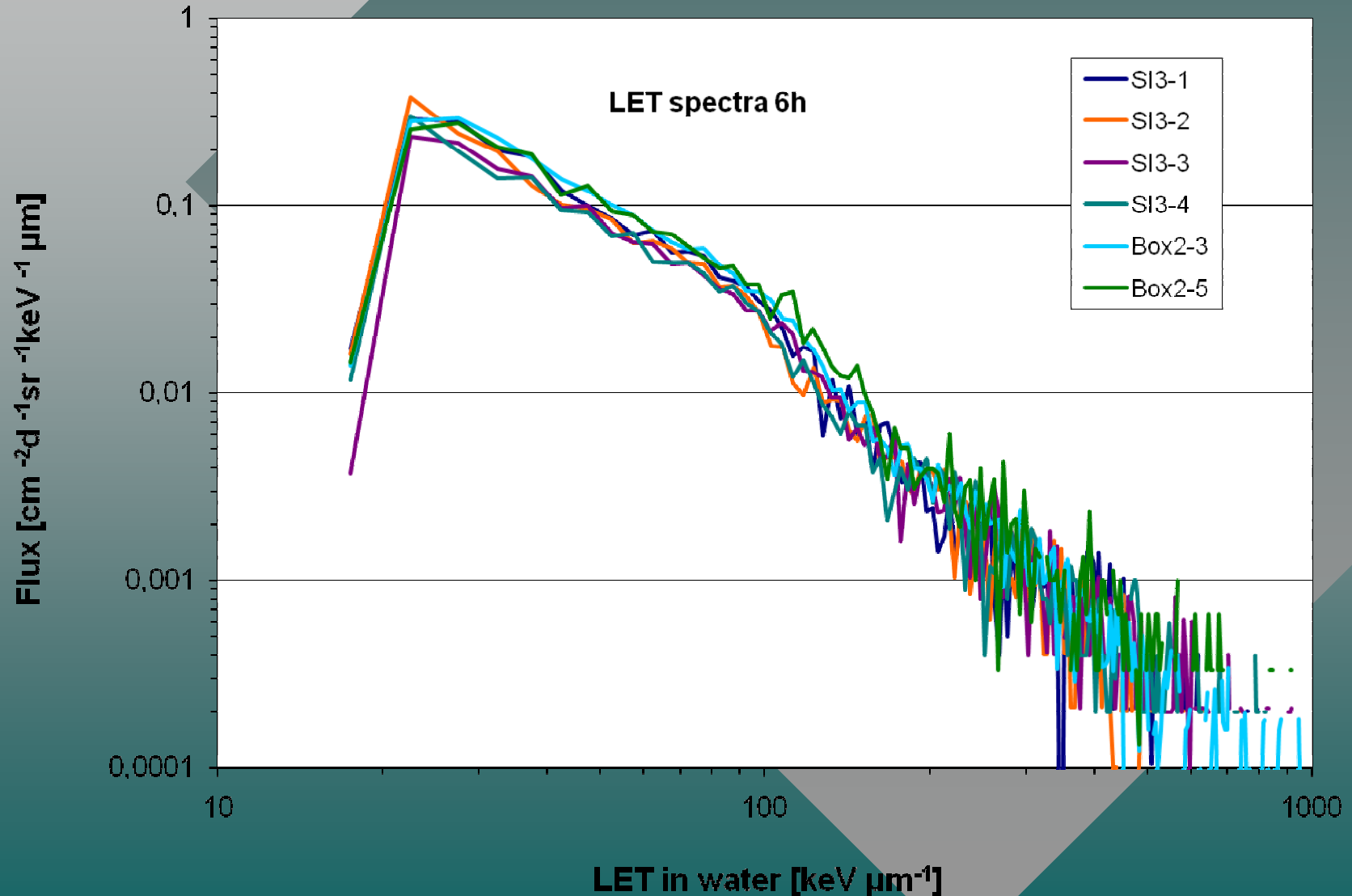
- In 6 N NaOH, 70 °C
- Detector material: polyallyl-diglycol-carbonate (PADC, Tastrak)
- Thickness of detectors: 1 mm
- 6h: to measure the short range and high LET particles, 8 μm removal
- +9h=15h: to measure lower LET particles, 20.1 μm removal

INVESTIGATIONS AND CALCULATIONS

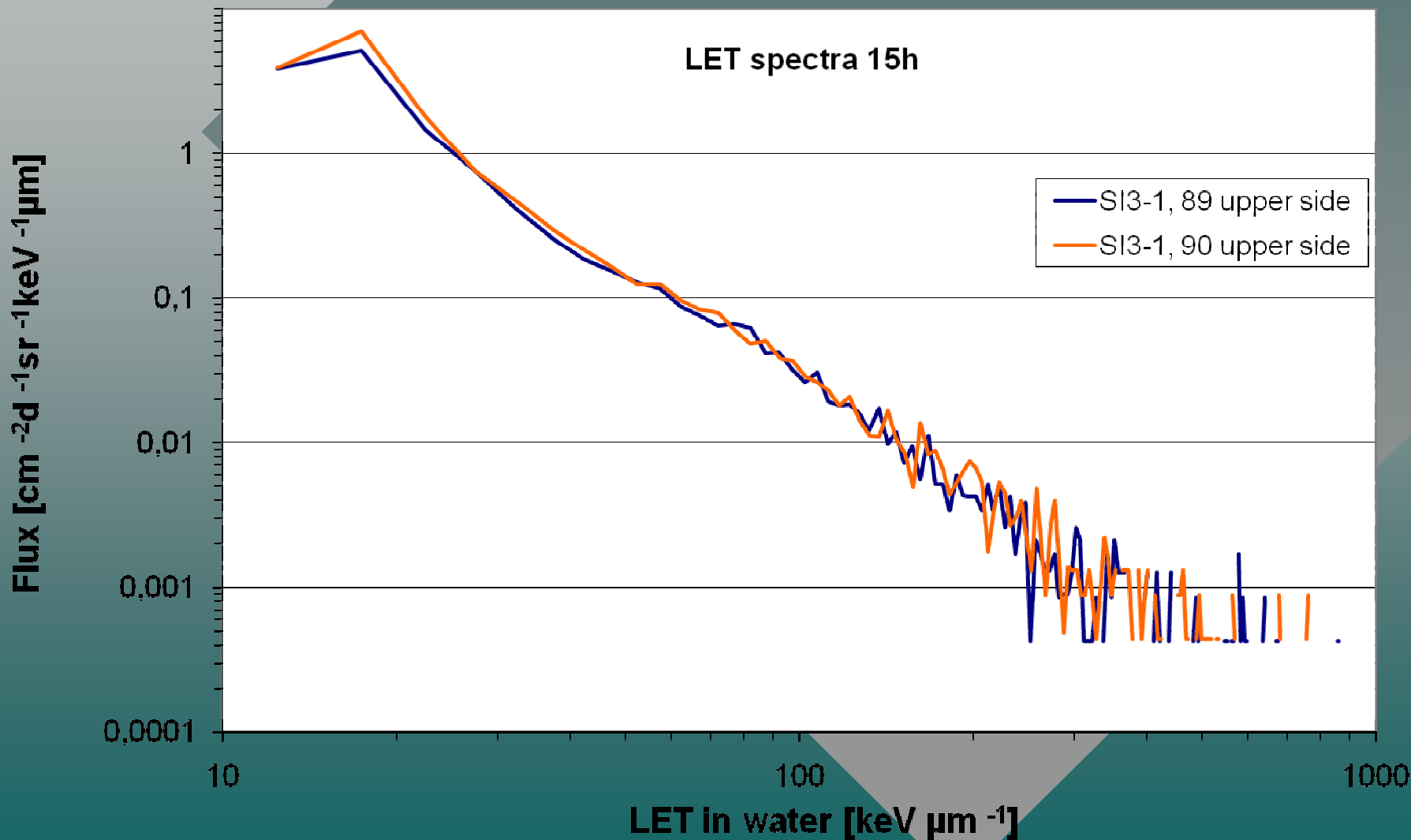
- Semi-automatic measurements using the VIRGINIA image analyzer and optical microscope → geometrical and optical parameters → V
- Calibration curves (6h, 15h) – converting the track etch rate ratio (V) obtained from the track parameters into LET
- Using standard calculation method → Φ (L), D , H , $Q=H/D$
- Manual measurements → HZE



LET SPECTRA (SI3)- 6h etching time



LET SPECTRA (SI3) - 15h etching time



DOSE VALUES (SI3): results obtained after 6h etching (≥ 17.5 keV/ μm)

stack	D $\pm 1\sigma$ [mGy]	H $\pm 1\sigma$ [mSv]	D rate $\pm 1\sigma$ [$\mu\text{Gy/d}$]	H rate $\pm 1\sigma$ [$\mu\text{Sv/d}$]	Q $\pm 1\sigma$
SI3-1	2.05 \pm 0.06	35.12 \pm 0.89	12.67 \pm 0.38	216.8 \pm 5.5	17.12 \pm 0.37
SI3-2	1.83 \pm 0.13	31.09 \pm 2.38	11.27 \pm 0.79	191.9 \pm 14.7	17.02 \pm 0.23
SI3-3	1.88 \pm 0.14	32.89 \pm 2.22	11.60 \pm 0.89	203.0 \pm 13.7	17.51 \pm 0.35
SI3-4	1.84 \pm 0.16	32.06 \pm 3.08	11.38 \pm 0.99	197.9 \pm 19.0	17.39 \pm 0.21
Box2-3	2.12 \pm 0.20	37.51 \pm 2.82	13.11 \pm 1.26	231.6 \pm 17.4	17.74 \pm 0.30
Box2-5	2.27 \pm 0.20	40.87 \pm 3.29	13.99 \pm 1.25	252.3 \pm 20.3	18.04 \pm 0.16

DOSE VALUES (SI3): combined results of 6 and 15h etching (≥ 10 keV/ μm)

stack	D $\pm 1\sigma$ [mGy]	H $\pm 1\sigma$ [mSv]	D rate $\pm 1\sigma$ [$\mu\text{Gy}/\text{d}$]	H rate $\pm 1\sigma$ [$\mu\text{Sv}/\text{d}$]	Q $\pm 1\sigma$
SI3-1	6.21 \pm 0.52	61.60 \pm 2.36	38.32 \pm 3.19	380.2 \pm 14.5	9.94 \pm 0.45

Only the evaluation of the first stack has been completed.

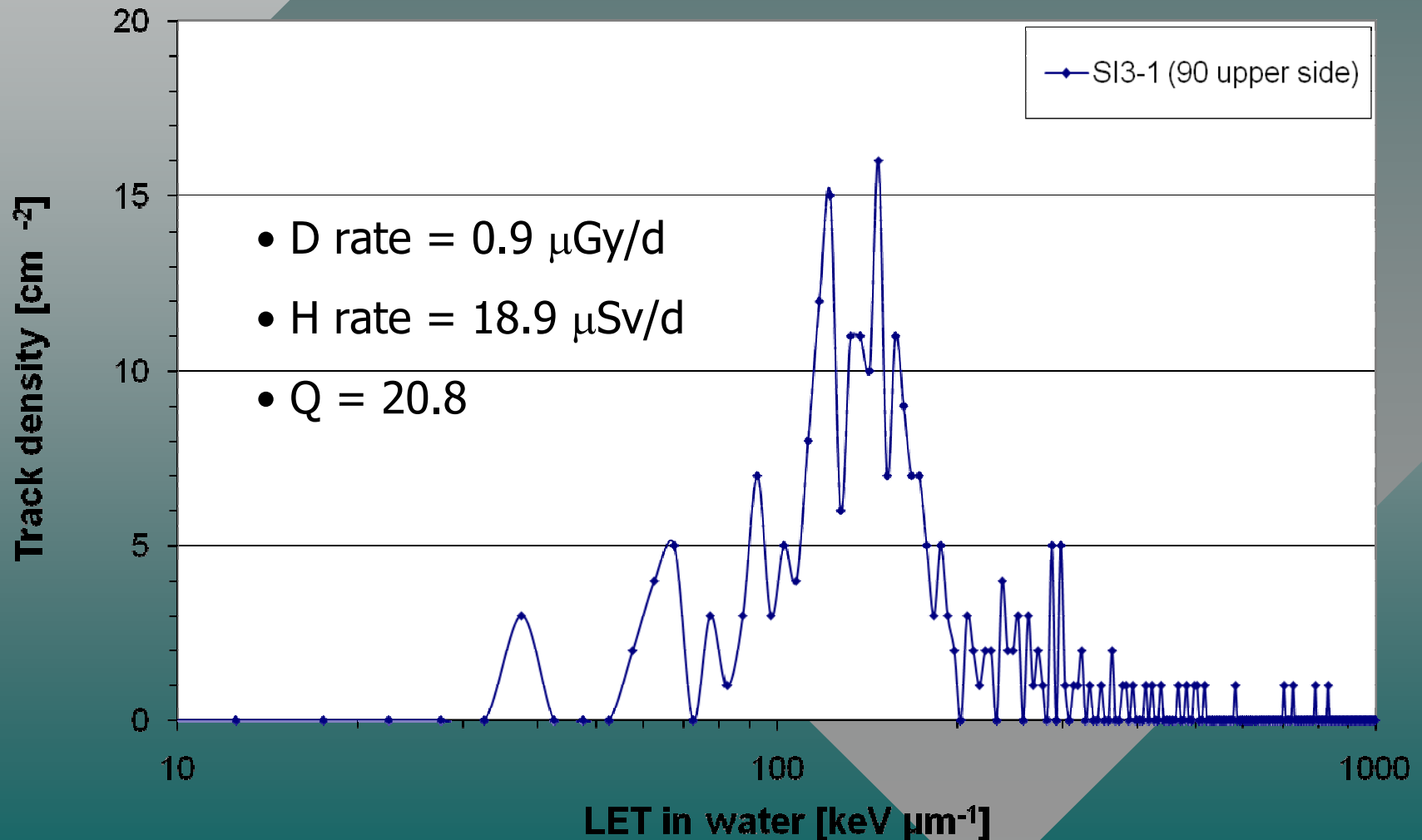
DOSE VALUES (ICCH-CR-39): results obtained after 6h etching (≥ 17.5 keV/ μm)

- Only the evaluation of the first stack has been completed.
- The detectors were placed in PIRS Docking Module.

stack	$D \pm 1\sigma$ [mGy]	$H \pm 1\sigma$ [mSv]	$D \text{ rate} \pm 1\sigma$ [$\mu\text{Gy/d}$]	$H \text{ rate} \pm 1\sigma$ [$\mu\text{Sv/d}$]	$Q \pm 1\sigma$
ICCH-1	3.06 ± 0.06	53.26 ± 1.08	18.88 ± 0.39	328.78 ± 6.68	17.41 ± 0.30

stack	$D \pm 1\sigma$ [mGy]	$H \pm 1\sigma$ [mSv]	$D \text{ rate} \pm 1\sigma$ [$\mu\text{Gy/d}$]	$H \text{ rate} \pm 1\sigma$ [$\mu\text{Sv/d}$]	$Q \pm 1\sigma$
SI3	1.90 ± 0.10	32.79 ± 1.72	11.73 ± 0.64	202.4 ± 10.6	17.26 ± 0.23

Distribution of the manually measured HZE tracks



Acknowledgement

- The authors would like to thank the opportunities to take part in the Space Intercomparison-2 and ICCHIBAN-CR-39 missions. Thanks for the work of the ICCHIBAN working group.
- The work has been performed in the frame of FP-7 project.

Thank you for your attention!

