



Status Report of Active Space Radiation Detector, A-DREAMS-2 at NIRS

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A-DREAMS Project

- A-DREAMS (Active Dosimeter for Radiation Environment and Astronautic Monitoring in Space), it is name of <u>active</u> <u>dosimeters</u> for space environment at NIRS.
- The first version, A-DREAMS-1 (AD-1), was designed by NIRS and produced by an private electronics company, Techno AP, Co. LTD., in Japan.
- To participate to the Matroshka-III experiment, we are developing the real time dosimeter called as "A-DREAMS-MTR" for measuring depth dose in the human phantom.
- The 2nd version, A-DREAMS-2 (AD-2) has been developed as the prototype of the AD-MTR with the AD-1 technology.





A-DREAMS-1 (AD-1)

- AD-1 was developed for a real time personal dosimeter.
- The detector is one silicon detector with 20mm diameter and 300µm thickness.
- The OEL display is on-board to know current dose rate or deposited energy spectrum to know exposed dose in real time.
- See Y.Uchihori et. al, 20th WRMISS.





A-DREAMS-MTR (AD-MTR)

- For MATROSHKA-III experiment, we are planning to prepare A-DREAMS-MTR in near future.
- A-DREAMS-MTR are planning to be installed in a phantom torso to be measured depth dose distribution. For this purpose, it has <u>multiple silicon detectors to obtain coincident events</u>.
- Two couples of detectors will be installed. One is placed on the surface of the phantom, and the other is placed inside of Phantom.







A-DREAMS Project (Roadmap)







A-DREAMS-2 (AD-2)

- In order to confirm the design and specification, we are developing prototype active detector, A-DREAMS-2 (AD-2).
- AD-2 has the same types of detectors and electronics of the AD-1. The module to get of the coincidence event between two detectors is installed.
- For each detector, two spectra are recorded. One is triggered by discriminator. The other is triggered by coincidence of two detectors. Total 4 spectra are recorded.





A-DREAMS-2 (cont.)

	AD-1	AD-2	
Detector	Si detector, (20mm dia., 300µm thickness)	Si detector (20mm dia., 300µm thickness)	
Number of detectors	1	2 (1 telescope)	
ADC	12 bit	12 bit	
Display	OEL display	No	
Buttons to control	3 buttons	No	
Interface	USB(serial)	USB(serial)	
Power	Li-ion battery	via USB	





AD-2(Left) and AD-1(Right)







Detectors and circuits







Schematic view







Diagram of Logic







Beam experiments for AD-2

- 70 MeV proton beam at the NIRS-Cyclotron (Feb. 2016)
 - Test of the trigger / the coincidence logic.
 - Check of gains of amplifiers.
- 400 MeV/u <u>carbon ion</u> beam at the BIO room in HIMAC (June 2016)
 - Calibration of ADC with the heavy ion beam
- 70 MeV/u proton beam at the NIRS-Cyclotron (July 2016)
 - Calibration with the proton beam as lower LET particle.





HIMAC-BIO exposure room

• <u>Spread beams</u> (10cm diameter) of heavy ions



O. Ploc et al., 16th WRMISS





Coincidence gate width







400 MeV/u Carbon beam







ADC distributions

Detector 1 Detector 2 Coinc.1 Coinc.2







ADC distributions of Detector 1







ADC calibration

Deposited energies of carbo ions are calculated by SRIM.







Projectile fragments (126mm in water eq. of PMMA)





JOST Z² vs Peak (ADC) (126mm in water)



21st WRMISS





Summary

- As the prototype detector of AD-MTR, AD-2 has been developed.
- The trigger logic with the coincidence circuit works well.
- The amplifiers and AD converters have good linearity.
- There are some bugs to find out the reasons.
- The AD-MTR has been developed based on the AD-1/2 technology.





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- The calibration experiments were performed as a collaboration research of HIMAC and Cyclotron facilities in NIRS.





Thank you for your attention.





Coincidence gate width







0 mm (no absorber)







63.3mm in water eq. of PMMA







126mm in water eq. of PMMA







189mm in water eq. of PMMA







250mm in water eq. of PMMA





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BF入れた時

- レンジ 259.07 mm
- 382 MeV/u (SRIMより)

BF	Energy	LET in water	Energy after 1mm Al (MeV/u)	ΔE 300um in Si (MeV/u)
0	382	10.9	380	0.507
63.26	322	12.0	320	0.556
126	255	13.7	253	0.638
189.04	175	17.3	172	0.804
249.94	55	41.4	48	1.916









A-DREAMS-2

