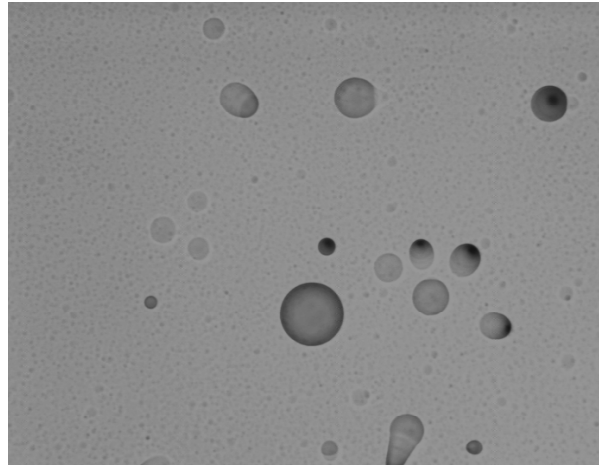


Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

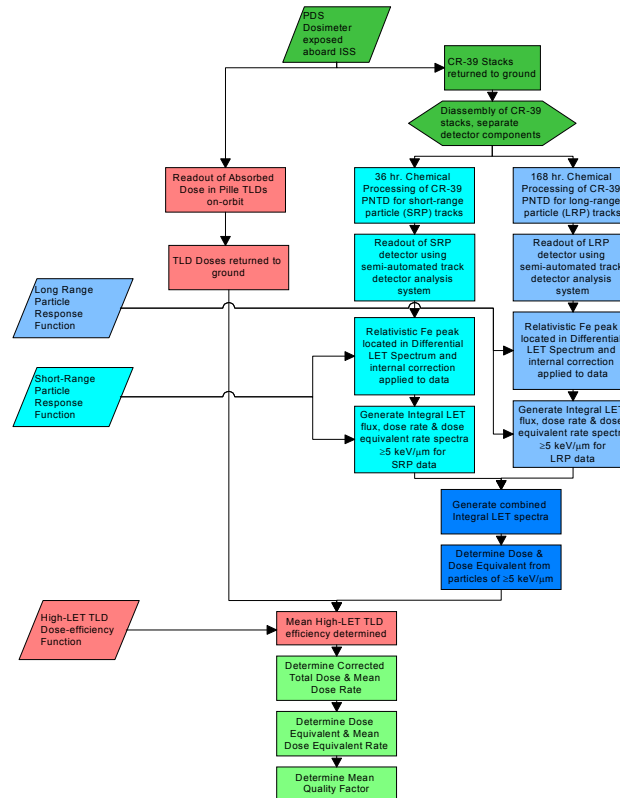


E. R. Benton, Eril Research, Inc.
presented by Sandor Deme, KFKI AEKI
2nd DOSMAP Results Workshop
Krakow, Poland



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Review of Method



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Correction for “Combined” Exposure

- During ~20% of the on-orbit time, the ISS PDS CR-39 plastic nuclear track detectors (PNTDs) were stored together and were thus exposed under identical shielding conditions.
- Details obtained from NASA Ames Research Center regarding the times and locations of the PNTD exposures:
 - ~7 days (19-26 April) PNTDs were stored together in the MPLM;
 - ~3 days (26-29 April) PNTDs were stored together in an unspecified location in the USLab.
 - ~4 days (29 April-3 May) all PNTDs were stored together in the HRF rack, USLab.
 - ~100 days (3 May-9 August) PNTDs deployed and exposed in correct locations throughout the USLab and Node 1.
 - ~13 days (9-22 August) PNTDs stored together in CTB 1153, Airlock Deck, Node 1.
- A correction has been made based on above information and assuming that particle flux, dose rate and dose equivalent rate remained more or less constant during the experiment.



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Correction for “Combined” Exposure

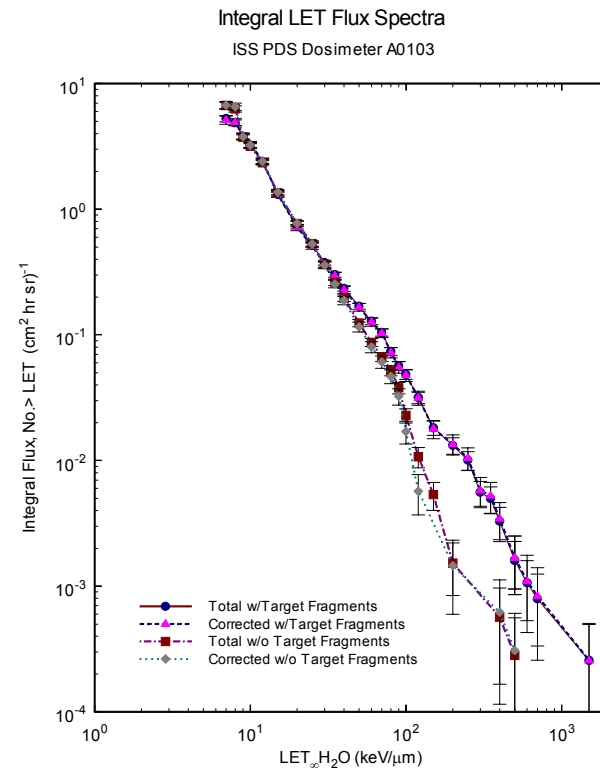
- Subtractions made from differential LET spectra:
 - 7 days total combined LET spectra (for MPLM exposure);
 - 7 days, A0101 HRF Rack (for USLab exposure);
 - 13 days, A0105 Node 1 (for Airlock Deck exposure).
- Recalculated LET spectra both:
 - with Target Fragments
(<30 keV/ μm - long etch, ≥ 30 keV/ μm - short etch);
 - without Target Fragments (long etch only);
- All results have been recalculated. However, A0103 (colocated with DOSTEL) is shown as a representative example.



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Correction for “Combined” Exposure

- Little effect on LET Spectra $\geq 5 \text{ keV}/\mu\text{m}$;
- Similar results seen in other eleven LET spectra measurements.



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Correction for “Combined” Exposure

- Only modest effect on total mean Dose Rate, mean Dose Equivalent Rate (ICRP-60) and average quality factor.
- Similar results for other eleven PDS Dosimeters.

PDS Dosimeter/TLD Bulb No. A0103 CR-39 PNTD No. 005	Target Fragmentation not included			Target Fragmentation included		
	Total no correction	Deployed w/correction	percent difference	Total no correction	Deployed w/correction	percent difference
Pille TLD Dose Rate ($\mu\text{Gy/hr}$)	6.27 \pm 0.05			6.27 \pm 0.05		
Dose Rate ≥ 10 keV/ μm ($\mu\text{Gy/hr}$)	1.10 \pm 0.04	1.11 \pm 0.05	-0.9%	1.23 \pm 0.04	1.24 \pm 0.05	-0.8%
Dose Rate < 10 keV/ μm ($\mu\text{Gy/hr}$)	5.35 \pm 0.20	5.34 \pm 0.24	0.2%	5.28 \pm 0.18	5.27 \pm 0.23	0.2%
Mean TLD efficiency ϵ	0.84 \pm 0.04	0.84 \pm 0.05		0.80 \pm 0.04	0.81 \pm 0.05	
Total Dose Rate ($\mu\text{Gy/hr}$)	6.44 \pm 0.32	6.44 \pm 0.40	0.0%	6.51 \pm 0.31	6.51 \pm 0.39	0.0%
Total Dose (mGy)	19.15 \pm 0.95	15.28 \pm 0.94	20.2%	19.35 \pm 0.92	15.44 \pm 0.92	20.2%
Dose Contribution ≥ 10 keV/ μm	17.1%	17.2%		18.9%	19.1%	
Dose Equivalent Rate ≥ 10 keV/ μm ($\mu\text{Sv/hr}$)	7.20 \pm 0.31	7.01 \pm 0.38	2.6%	9.80 \pm 0.40	9.70 \pm 0.50	1.0%
Total Dose Equivalent Rate ($\mu\text{Sv/hr}$)	12.54 \pm 0.70	12.35 \pm 0.88	1.5%	15.08 \pm 0.81	14.97 \pm 1.01	0.7%
Total Dose Equivalent (mSv)	37.28 \pm 2.09	29.29 \pm 2.08	21.4%	44.82 \pm 2.41	35.50 \pm 2.39	20.8%
Dose Equivalent Contribution ≥ 10 keV/ μm	57.4%	56.8%		65.0%	64.8%	
Average Quality Factor	1.95 \pm 0.13	1.92 \pm 0.16	1.5%	2.32 \pm 0.15	2.30 \pm 0.18	0.9%



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Contributions from Target Fragmentation (short etch)

- Do “I” really have to analyze two detectors for each LET Spectrum?
- Substantial Contribution (>15 %) from Target Fragments to mean total Dose Equivalent Rate.

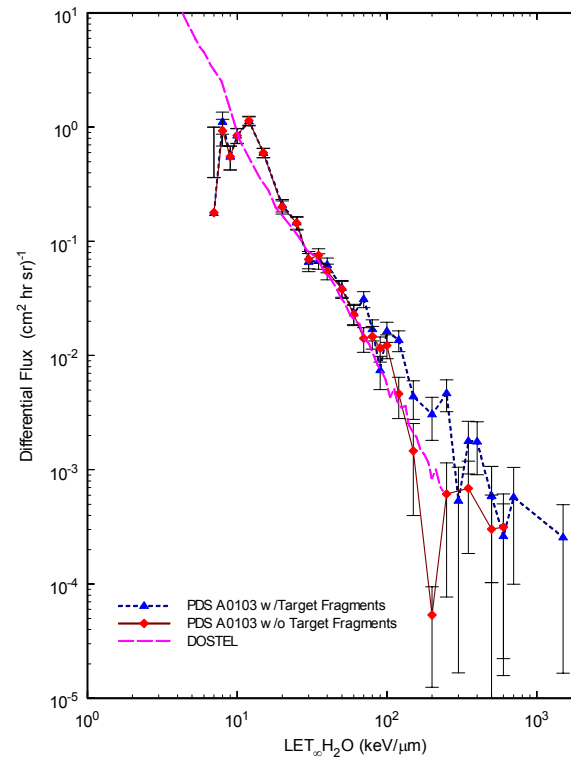
PDS Dosimeter/TLD Bulb No. A0103 CR-39 PNTD No. 005	Total (no correction)			Deployed Only (includes correction)		
	not including target fragments	including target fragments	percent difference	not including target fragments	including target fragments	percent difference
Pille TLD Dose Rate ($\mu\text{Gy/hr}$)	6.27 \pm 0.05			6.27 \pm 0.05		
Dose Rate ≥ 10 keV/ μm ($\mu\text{Gy/hr}$)	1.10 \pm 0.04	1.23 \pm 0.04	10.9%	1.11 \pm 0.05	1.24 \pm 0.05	10.8%
Dose Rate < 10 keV/ μm ($\mu\text{Gy/hr}$)	5.35 \pm 0.20	5.28 \pm 0.18	-1.3%	5.34 \pm 0.24	5.27 \pm 0.23	-1.2%
Mean TLD efficiency ϵ	0.84 \pm 0.04	0.80 \pm 0.04	-4.6%	0.84 \pm 0.05	0.81 \pm 0.05	-4.8%
Total Dose Rate ($\mu\text{Gy/hr}$)	6.44 \pm 0.32	6.51 \pm 0.31	1.0%	6.44 \pm 0.40	6.51 \pm 0.39	1.1%
Total Dose (mGy)	19.15 \pm 0.95	19.35 \pm 0.92	1.0%	15.28 \pm 0.94	15.44 \pm 0.92	1.1%
Dose Contribution ≥ 10 keV/ μm	17.1%	18.9%		17.2%	19.1%	
Dose Equivalent Rate ≥ 10 keV/ μm ($\mu\text{Sv/hr}$)	7.20 \pm 0.31	9.80 \pm 0.40	26.6%	7.01 \pm 0.38	9.70 \pm 0.50	27.7%
Total Dose Equivalent Rate ($\mu\text{Sv/hr}$)	12.54 \pm 0.70	15.08 \pm 0.81	16.8%	12.35 \pm 0.88	14.97 \pm 1.01	17.5%
Total Dose Equivalent (mSv)	37.28 \pm 2.09	44.82 \pm 2.41	16.8%	29.29 \pm 2.08	35.50 \pm 2.39	17.5%
Dose Equivalent Contribution ≥ 10 keV/ μm	57.4%	65.0%		56.8%	64.8%	
Average Quality Factor	1.95 \pm 0.13	2.32 \pm 0.15	16.0%	1.92 \pm 0.16	2.30 \pm 0.18	16.6%



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Comparison with DOSTEL

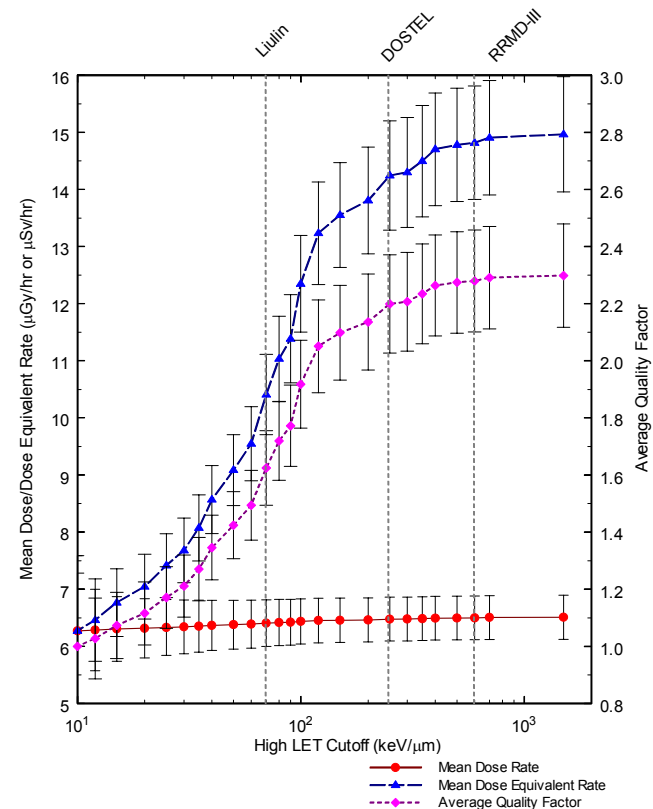
- Good Agreement in range where both detectors are sensitive.
- Closer agreement between DOSTEL and results without Target Fragmentation than with Target Fragmentation.



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Effect of lowering High LET Cutoff

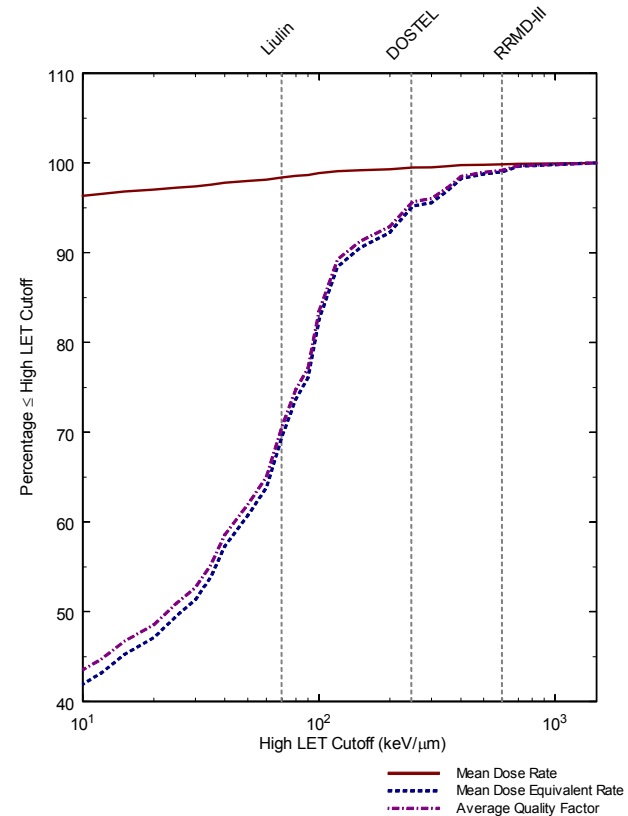
- What do “I” lose by using a Si telescope which excludes high-LET events?
- Results of A0103 determined while iteratively reducing the high-LET cutoff from 1500 to 10 keV/ μm .
- Negligible loss in dose rate.
- Dose equivalent and average quality factor start to drop rapidly below ~ 300 keV/ μm



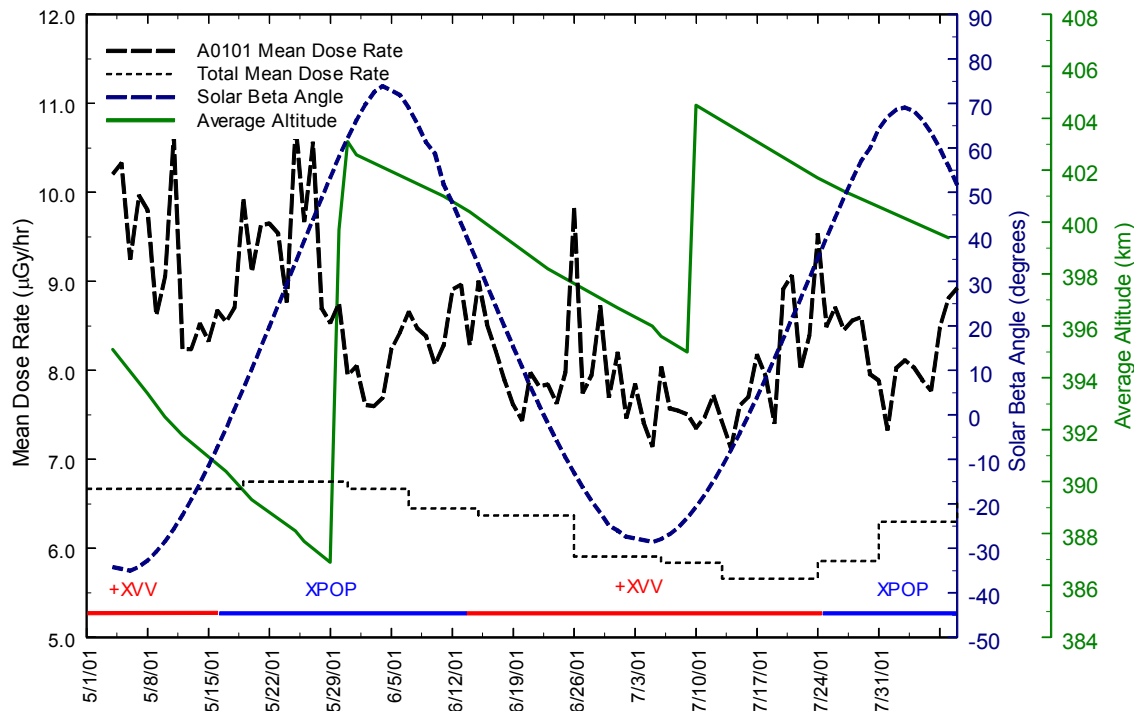
Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Effect of lowering High LET Cutoff

- Percentage of mean dose rate, mean dose equivalent rate and average quality factor retained while iteratively reducing the high-LET cutoff from 1500 to 10 keV/ μm .
- 90% of mean dose equivalent and average quality factor lies below 150 keV/ μm



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment: Correlation of Pille TLD Dose Rates with solar β angle, ISS altitude, and ISS attitude



4-5 July 2002

ERIL RESEARCH, INC.



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Conclusions - 1

- Correction for Deployed Time has negligible effect on LET Spectra and only minimal effect on mean total dose rate, mean dose equivalent rate and average quality factor.
- >15% of mean dose equivalent rate is from short range neutron and proton-induced Target Fragments. Important to include this component.
- Good agreement between CR-39 PNTDs and DOSTEL.
- Dose equivalent and average quality factor start falling off when high LET cutoff drops below ~ 300 keV/ μm .
- However, $\sim 90\%$ of total dose equivalent is below 150 keV/ μm , making Si telescopes a viable dosimetric option.



Progress in Analyzing Results from the ISS Passive Dosimetry System during the DOSMAP Experiment

Conclusions - 2

- No correlation is obvious between either the 90 minute A0101 dose rates or the mean Pille dose rates with altitude, solar β angle or station attitude.

