COMPONENT TEST H4IRRAD

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Outline

- Component description
- Goal of the test
- Radiation conditions and dosimetry
- Results
- Conclusions

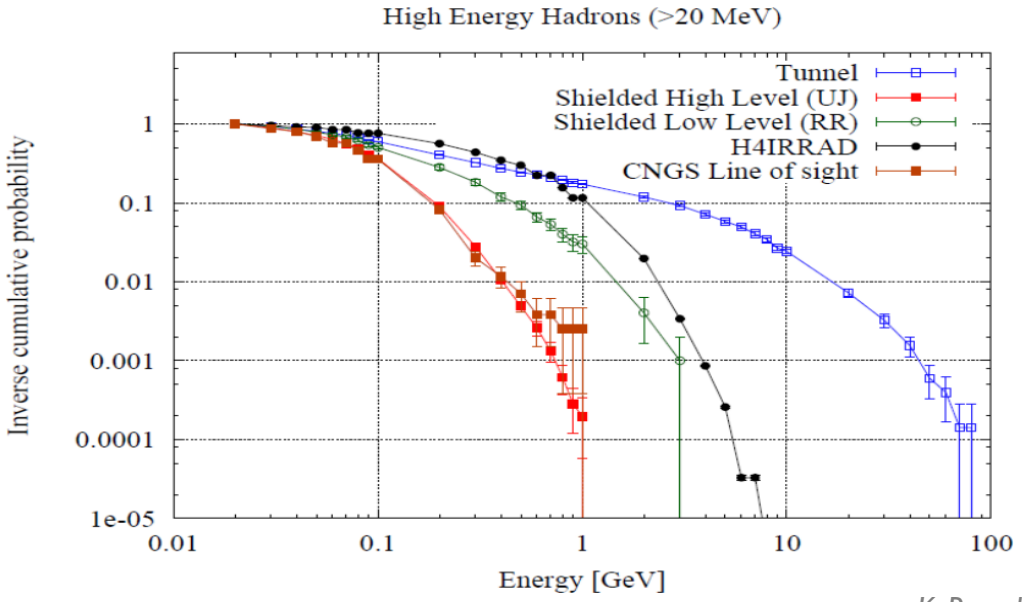
Components under test

DUT	Type-Tec	Voltage	Input	Gain
MAX410	OpAmp-Bip	+/-5 V	+/-1,GND	2
OPA2227	OpAmp	+/-5 V	+/-1,GND	2
TL072	OpAmp	+/-5 V	+/-1,GND	2
TL431	Voltage Ref	+5 V	-	
TL432	Voltage Ref	+5 V	-	
INA141	DiffAmp	+/-5 V	120 mV	10
LM4041	Voltage Ref	+5 V	-	
MAX6341	Voltage Ref (ADC)	+10 V	-	

- 3 parts for each DUT

Motivation

- Devices already tested at PSI
  - p+ beam, 230 MeV, Dose rate 250-300 Gy/h
- Test in a mixed field (LHC-like environment) at low dose rate to compare the results
- Verify destructive events in this environment



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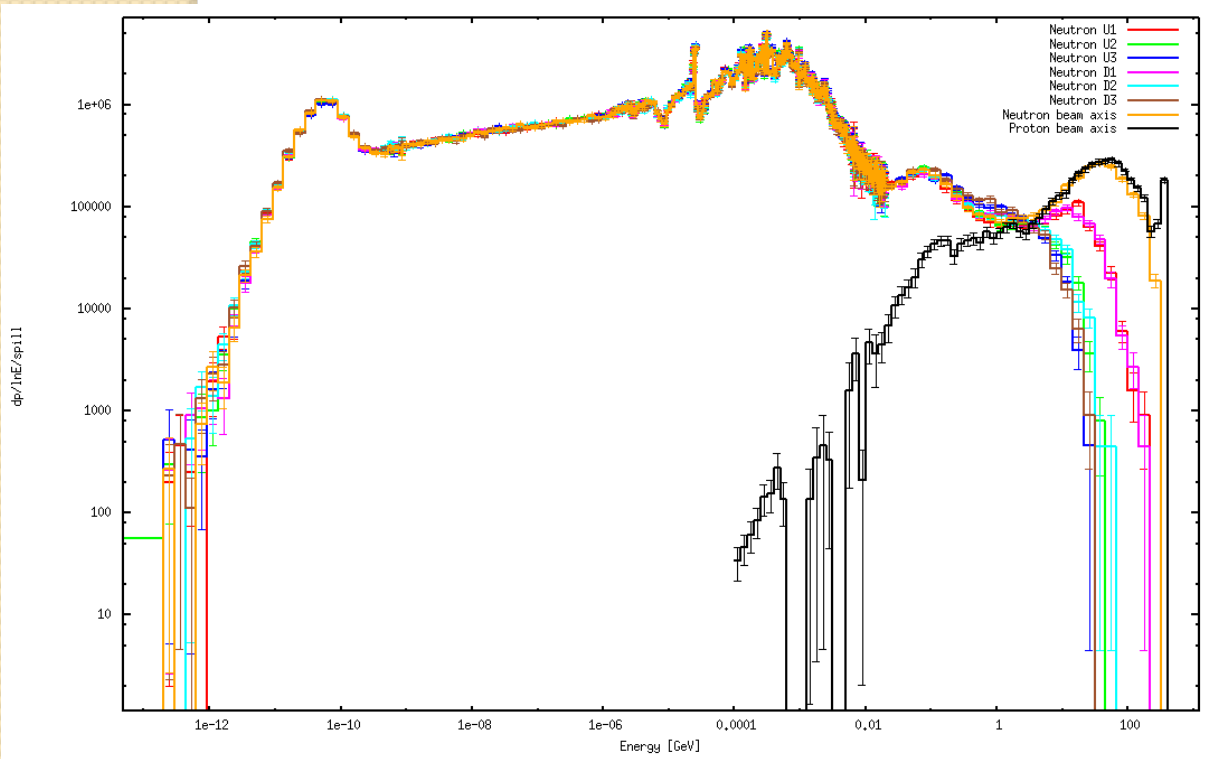
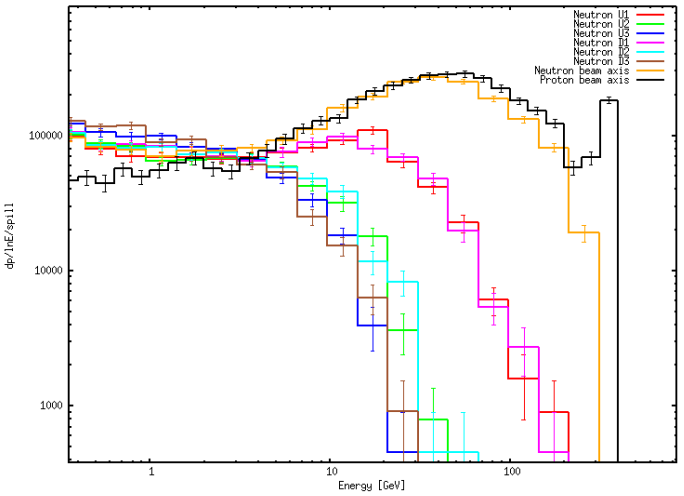
H4IRRAD – Beam conditions

- H4IRRAD Internal location
- Mixed field and high energy hadrons

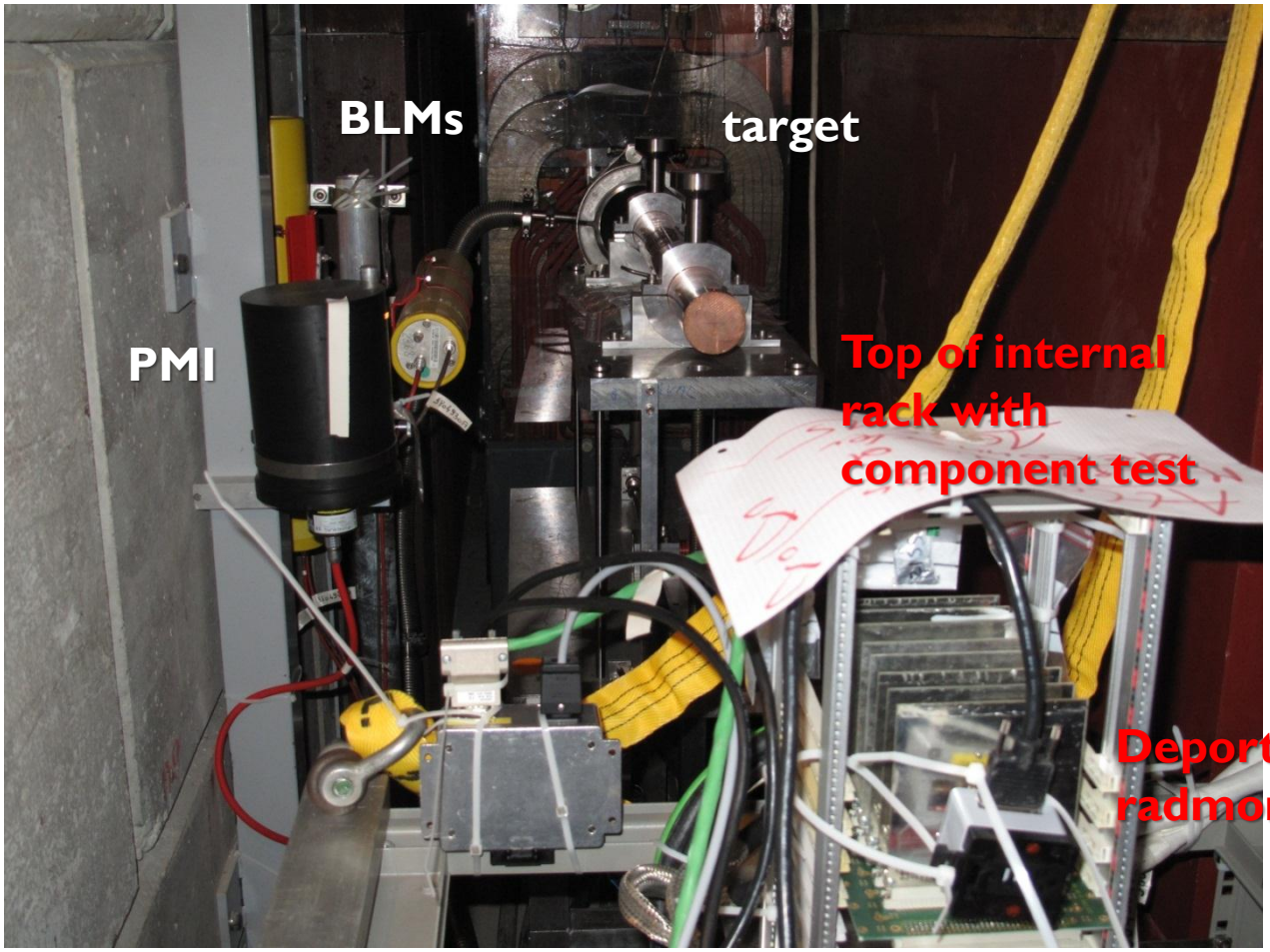




@ M. Calviani

H4IRRAD – Beam conditions

- H4IRRAD Internal location

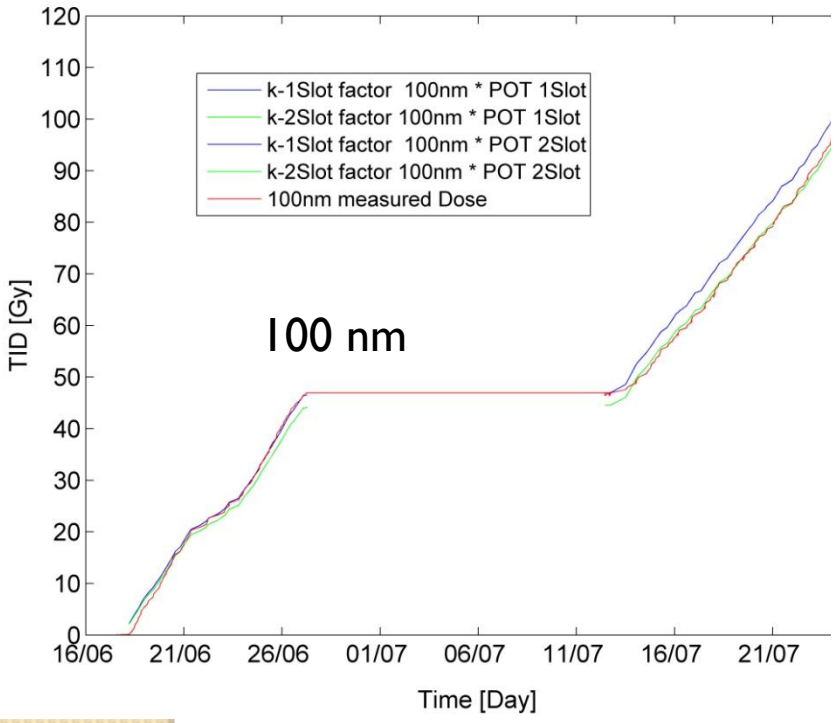


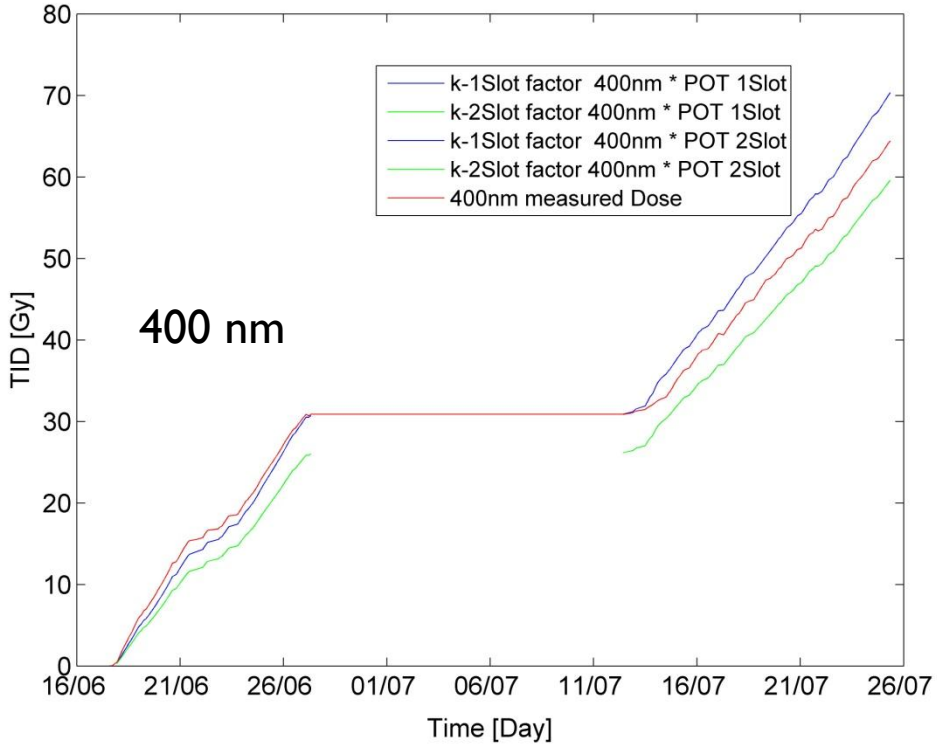
H4IRRAD – Beam conditions

- H4IRRAD Internal location
  - 1.2e9 pot per cycle
  - Cycle ~ 45 s
  - Bunch length 5 s
  - TID/Pot ~ 3e-12 [Gy/pot]
  - TID per cycle ~ 3.6 mGy
  - TID during extraction (5s)=2.6Gy/h
  - Average Dose rate (3.6 mGy over 45 sec) = 0.3 Gy/h
  - Recommended dose rate to evaluate ELDR

H4IRRAD – Dosimetry for TID

- FLUKA calculation (TID in air)
  - High gradient on the target line
- Radfets on the RADMON (2 oxide Thickness)





H4IRRAD – Dosimetry for TID

- FLUKA calculation (TID in air)
  - High gradient on the target line
  - Score position to be reviewed
- Radfets on the RADMON (2 oxide Thickness)

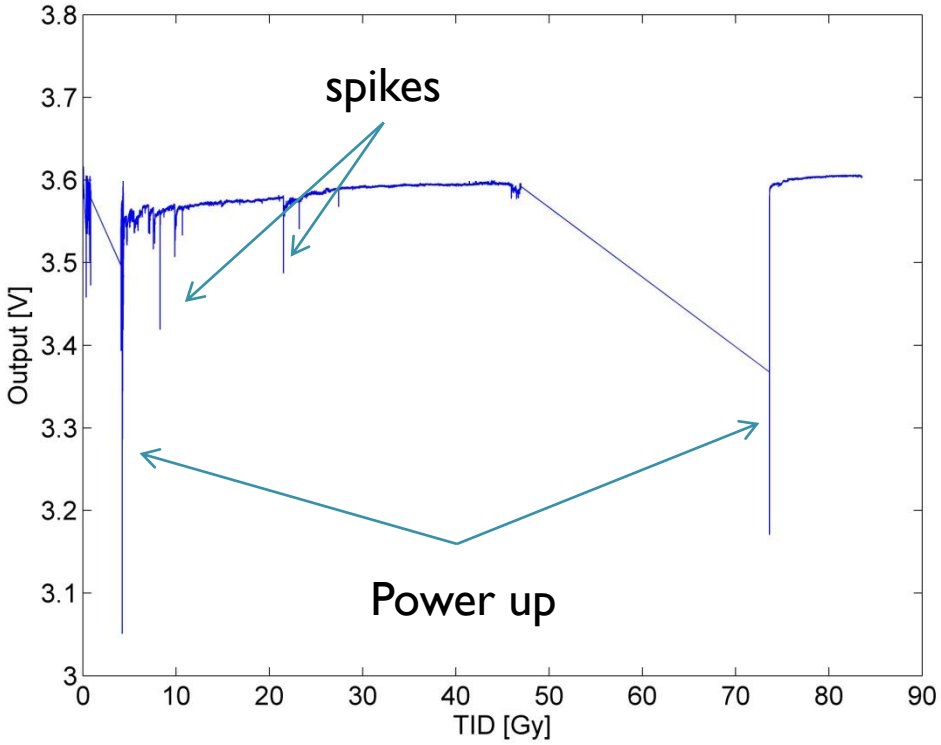
	FLUKA [Gy Air]±50%	400nm	100nm	TID ±50%
19/06-27/06	70	30	46	
19/06-25/07	160	70	100	100±50
19/06-21/07	130	60	85	85±40

Acquisition not running after 21st July.

Uncertainty could improve if
•400nm (low) response is understood; it seems to be systematic
•Target score is improved and TID in SI is considered (20% difference)
→In this condition: 100nm and FLUKA calculation are in agreement within 20 %

Results

- Same acquisition system as PSI but
  - Some signals were noisy.
  - Power Supply interruption due to spikes on the current consumption (not related to radiation)



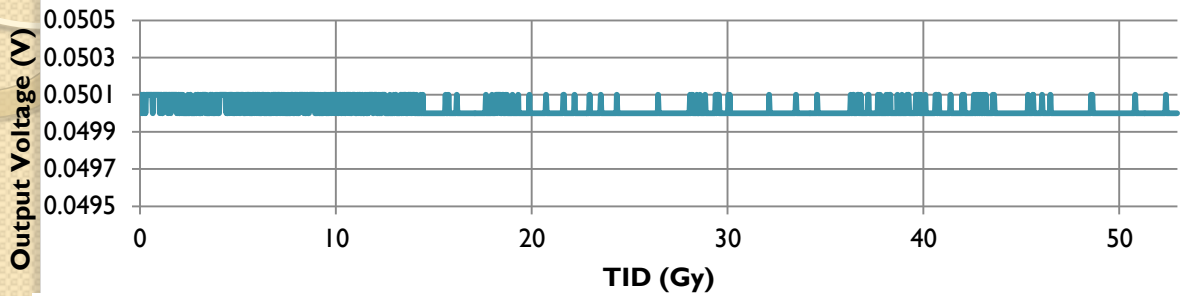
TL431 (typical signal)

Results

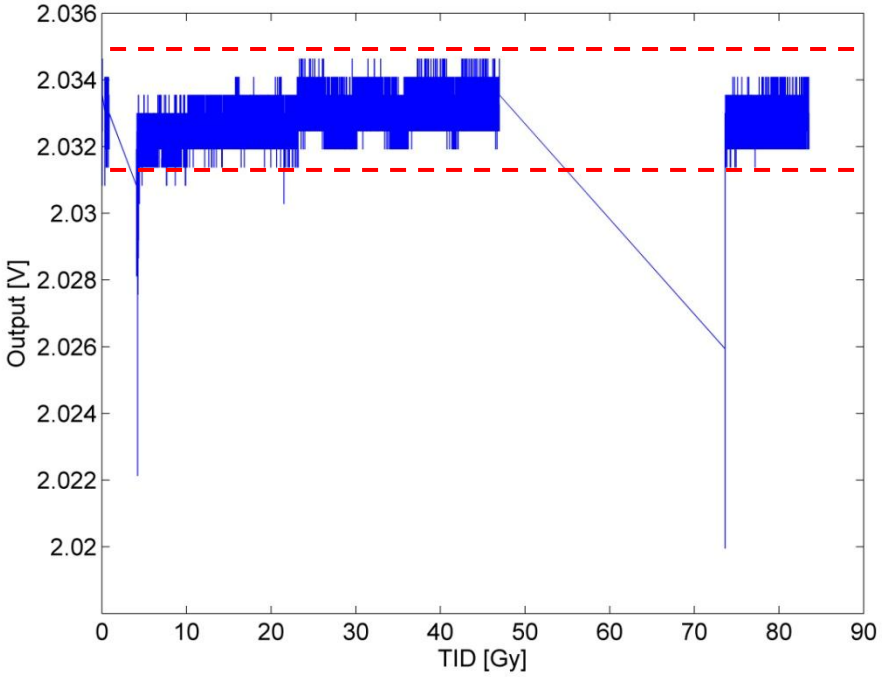
DUT	Type-Technology	PSI, p+, >250Gy/h *	H4IRRAD 0.3 Gy/h *	Comment
MAX410	OpAmp-Bip	100 Gy-ok	85-ok	
OPA2227	OpAmp	200 Gy -ok	85-ok	
TL072	OpAmp	200 Gy-ok	-	
TL431	Voltage Ref	200 Gy-ok	85 – ok	
TL432	Voltage Ref	200 Gy-ok	85 - ok	
LM4041	Voltage Ref	200 Gy-Ok	85 – ok	
INA141	DiffAmp	130Gy-Out of spec	85 - ok	Limit of spec
MAX6341	Voltage Ref (ADC)	25 Gy-Out of spec	25 Gy-Out of spec.	3 mV drift over 100 Gy

* Max TID without failure or TID at which measurements are out of spec

Results – Max410

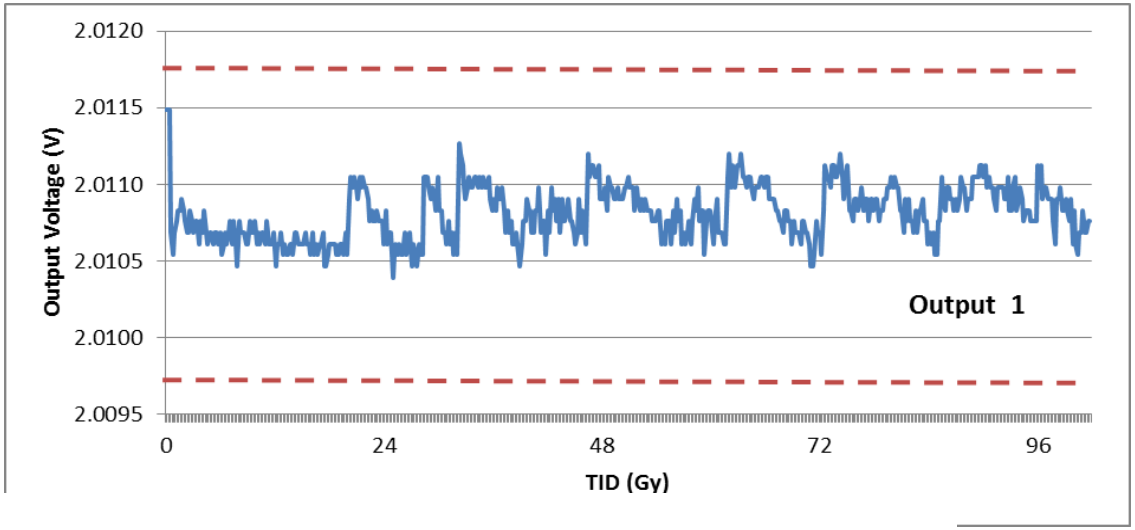


- PSI
  - 250 Gy/h
  - 230 MeV p+
  - 100 Gy (2 runs of 50 Gy)

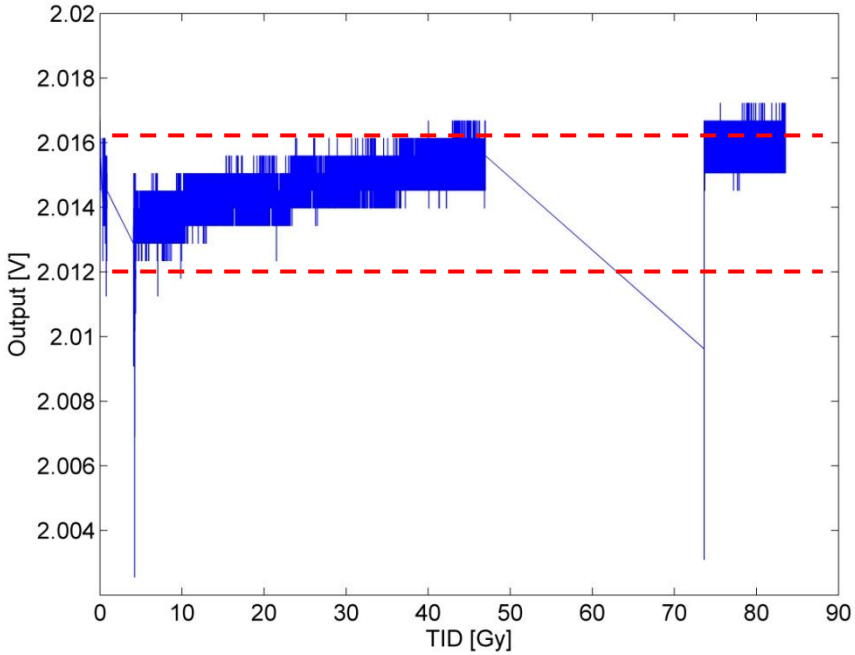


- H4IRRAD
  - 3 Gy/h(per extraction)
  - 0.3Gy/h (average)
- Within specification

Results – OPA2227

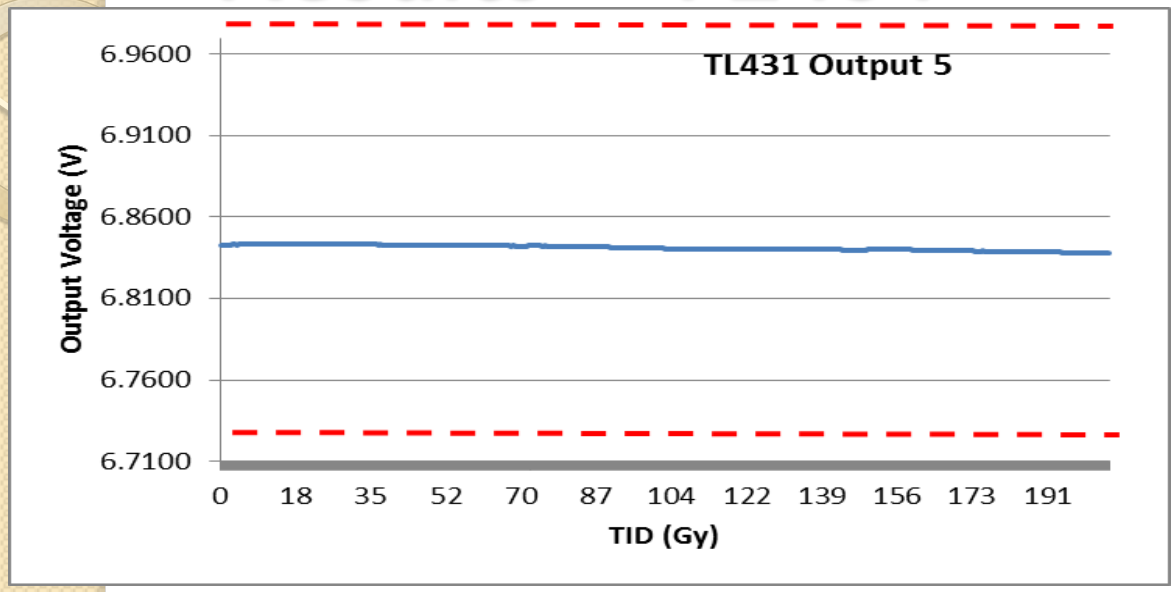


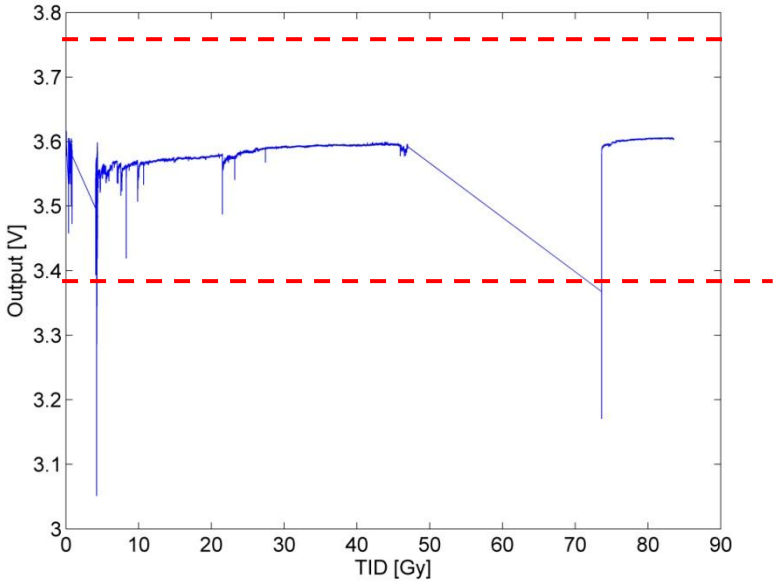
- PSI
  - 290 Gy/h
  - 230 MeV p+
  - 200 Gy (2 runs of 100 Gy)



- H4IRRAD
  - 3 Gy/h(per extraction)
  - 0.3Gy/h (average)
- Within specification

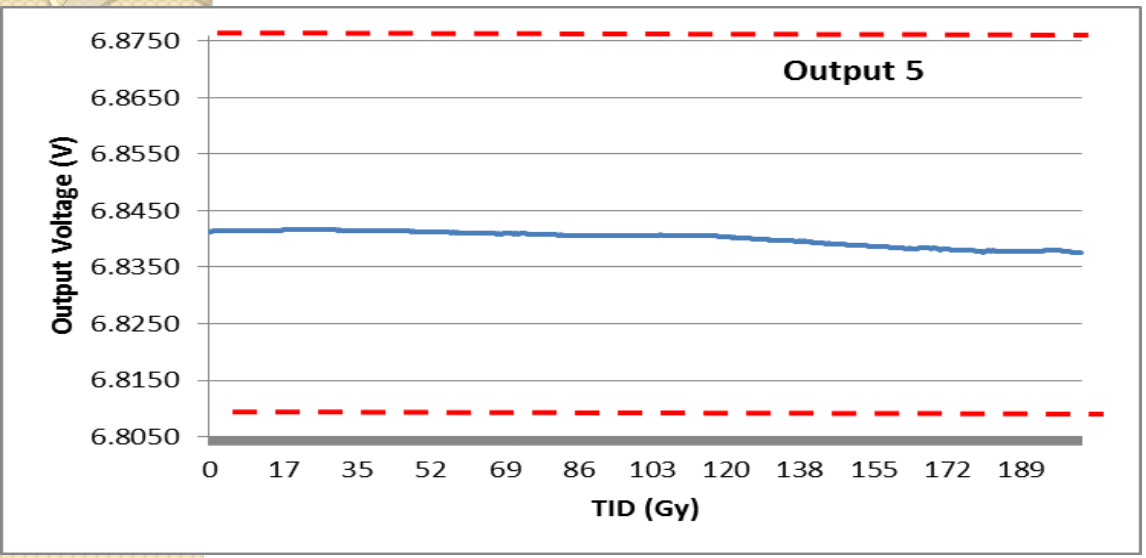
Results – TL431

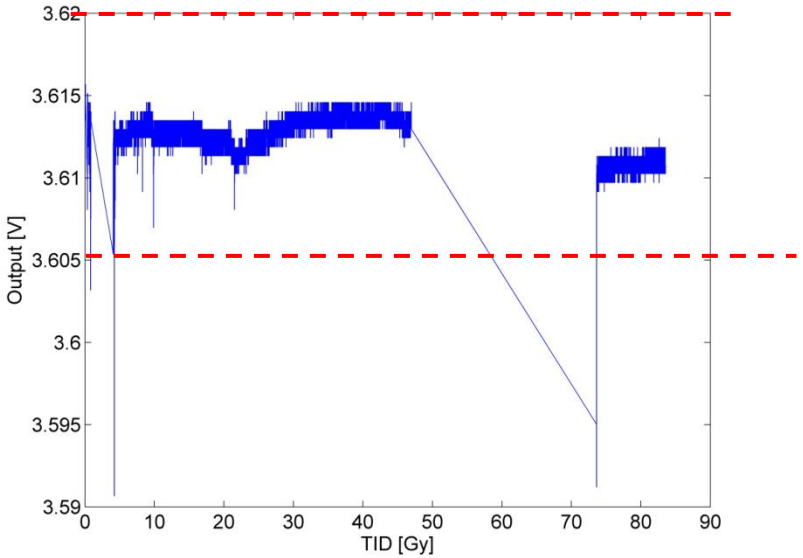




- PSI
  - 290 Gy/h
  - 230 MeV p+
- H4IRRAD
  - 3 Gy/h(per extraction)
  - 0.3Gy/h (average)
- Within specification

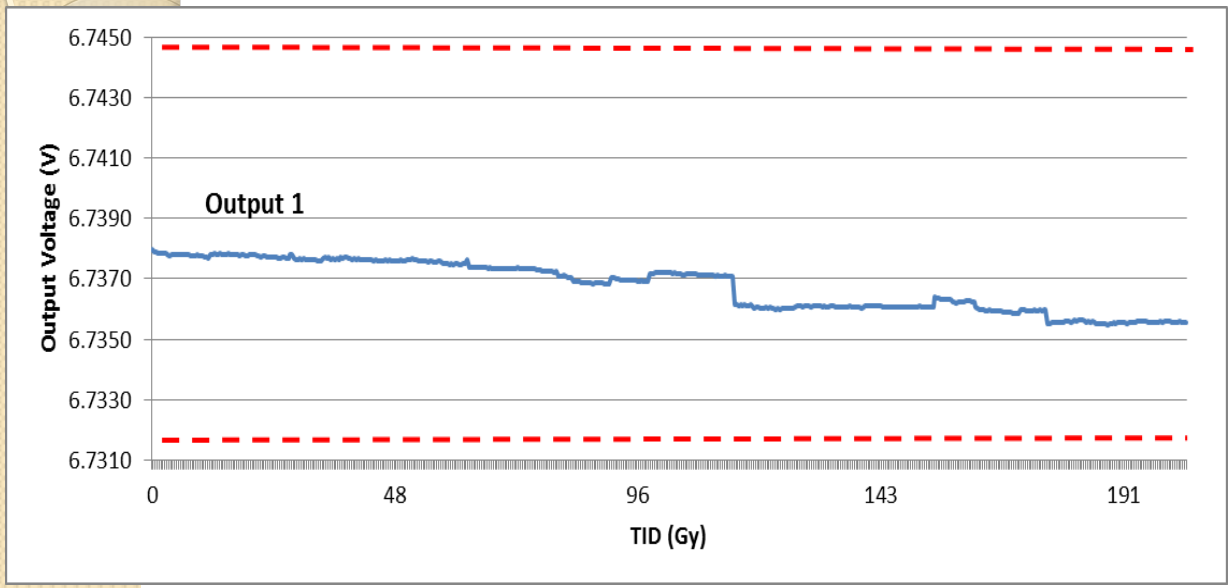
Results – TL432

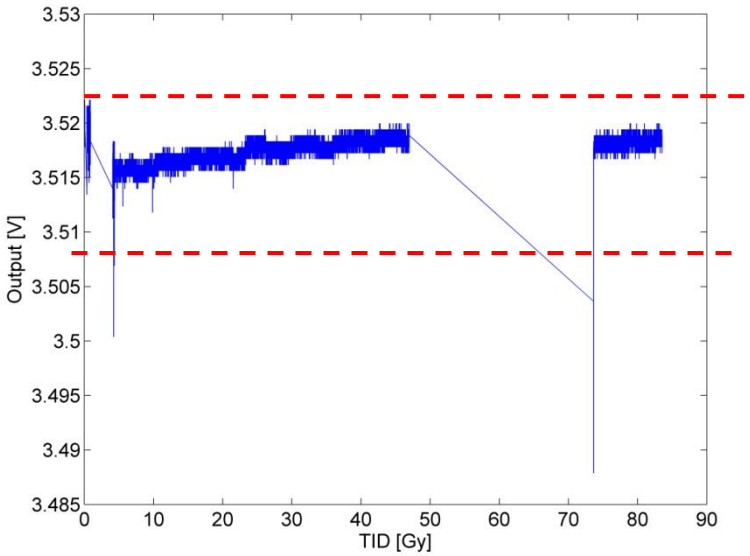




- PSI
  - 290 Gy/h
  - 230 MeV p+
- H4IRRAD
  - 3 Gy/h(per extraction)
  - 0.3Gy/h (average)
- Within specification

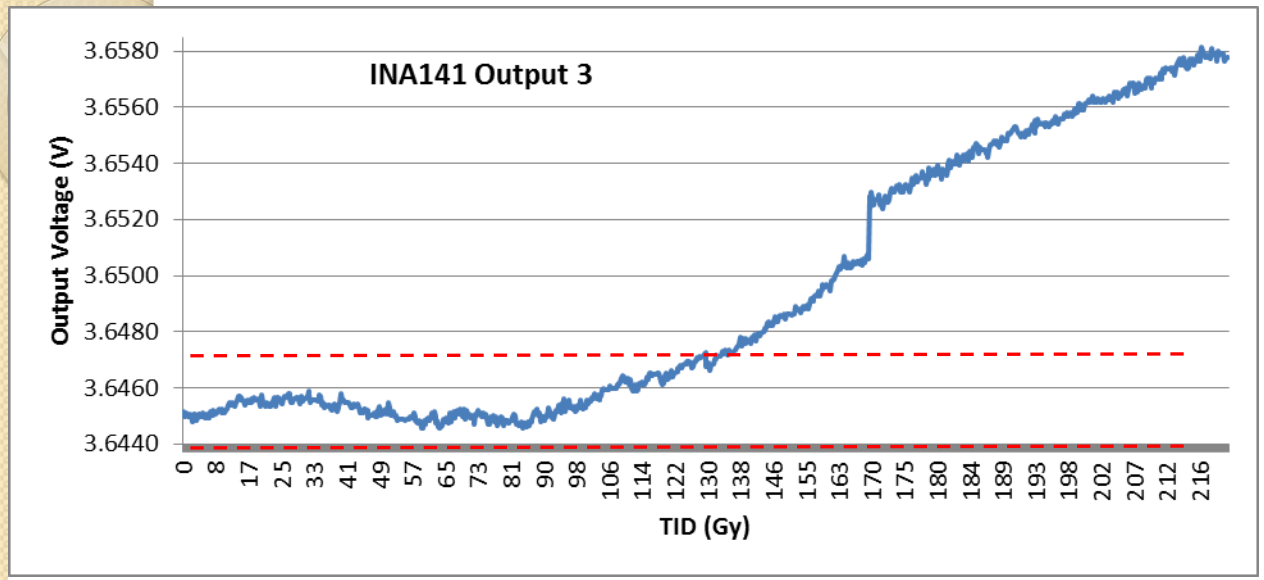
Results – LM4041

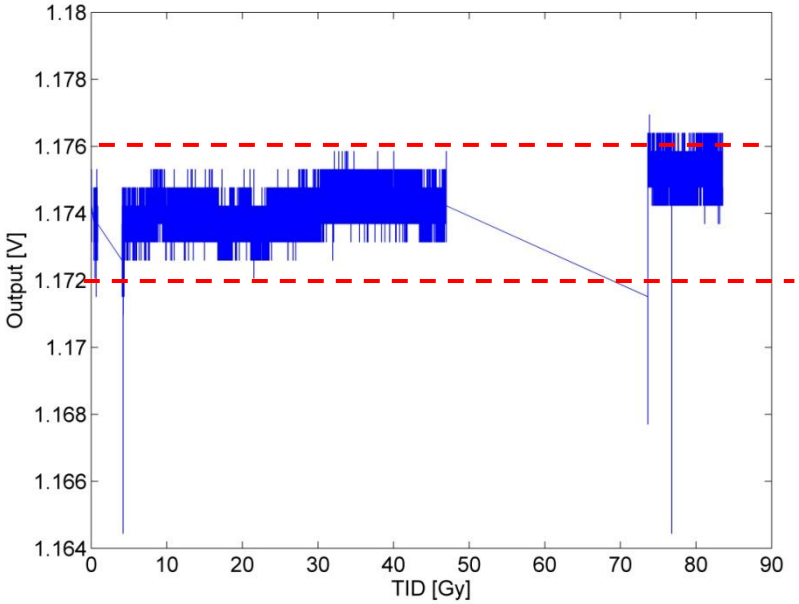




- PSI
  - 290 Gy/h
  - 230 MeV p+
- H4IRRAD
  - 3 Gy/h(per extraction)
  - 0.3Gy/h (average)
- Within specification

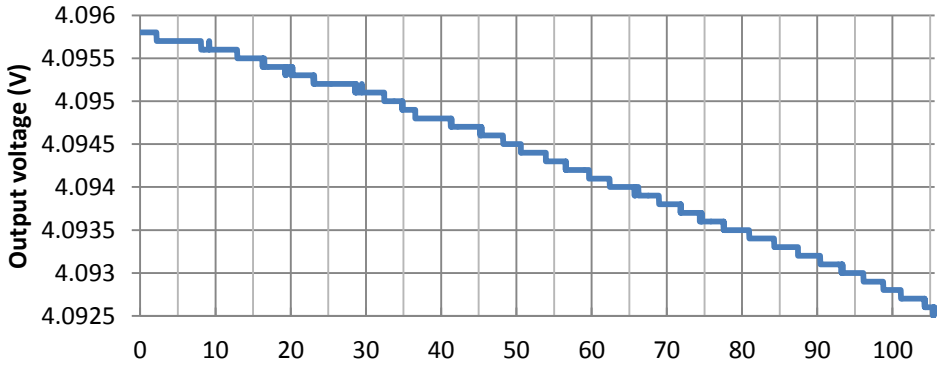
Results – INA141

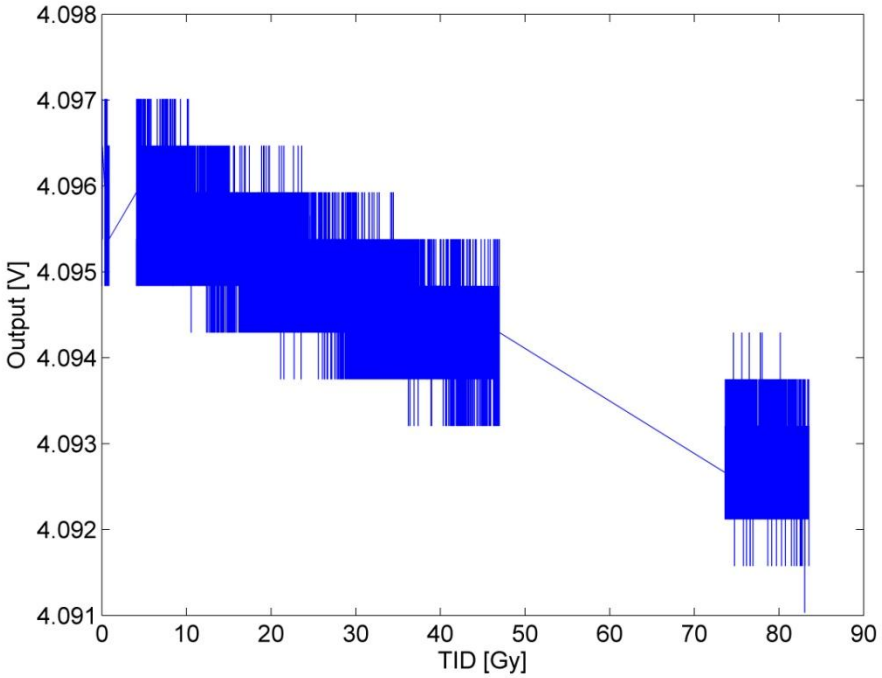




- PSI
  - 290 Gy/h
  - 230 MeV p+
  - 130 Gy out of specification
- H4IRRAD
  - 3 Gy/h(per extraction)
  - 0.3Gy/h (average)
- 1 case within specification; 2 cases at the boarder of spec.

Results – Max6341





- PSI
  - 250 Gy/h
  - 230 MeV p+
- H4IRRAD
  - 3 Gy/h(per extraction)
  - 0.3Gy/h (average)
- 0.02% Accuracy
- 3mV drift in both cases

Results

DUT	Type-Technology	PSI, p+, >250Gy/h *	H4IRRAD 0.3 Gy/h *	Comment
MAX410	OpAmp-Bip	100 Gy-ok	85-ok	
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* Max TID without failure or TID at which measurements are out of spec

Conclusions

- No destructive events were observed
- Comparison PSI-H4IRRAD has to take into account the uncertainty on the TID
- H4IRRAD test (low dose rate and mixed field) tends to confirm the PSI results (high dose rate)
  - No significant increase of DUT degradation up to 80 Gy for most of the devices
  - MAX6341 and INA141 are out of spec at 25 and 85 Gy respectively