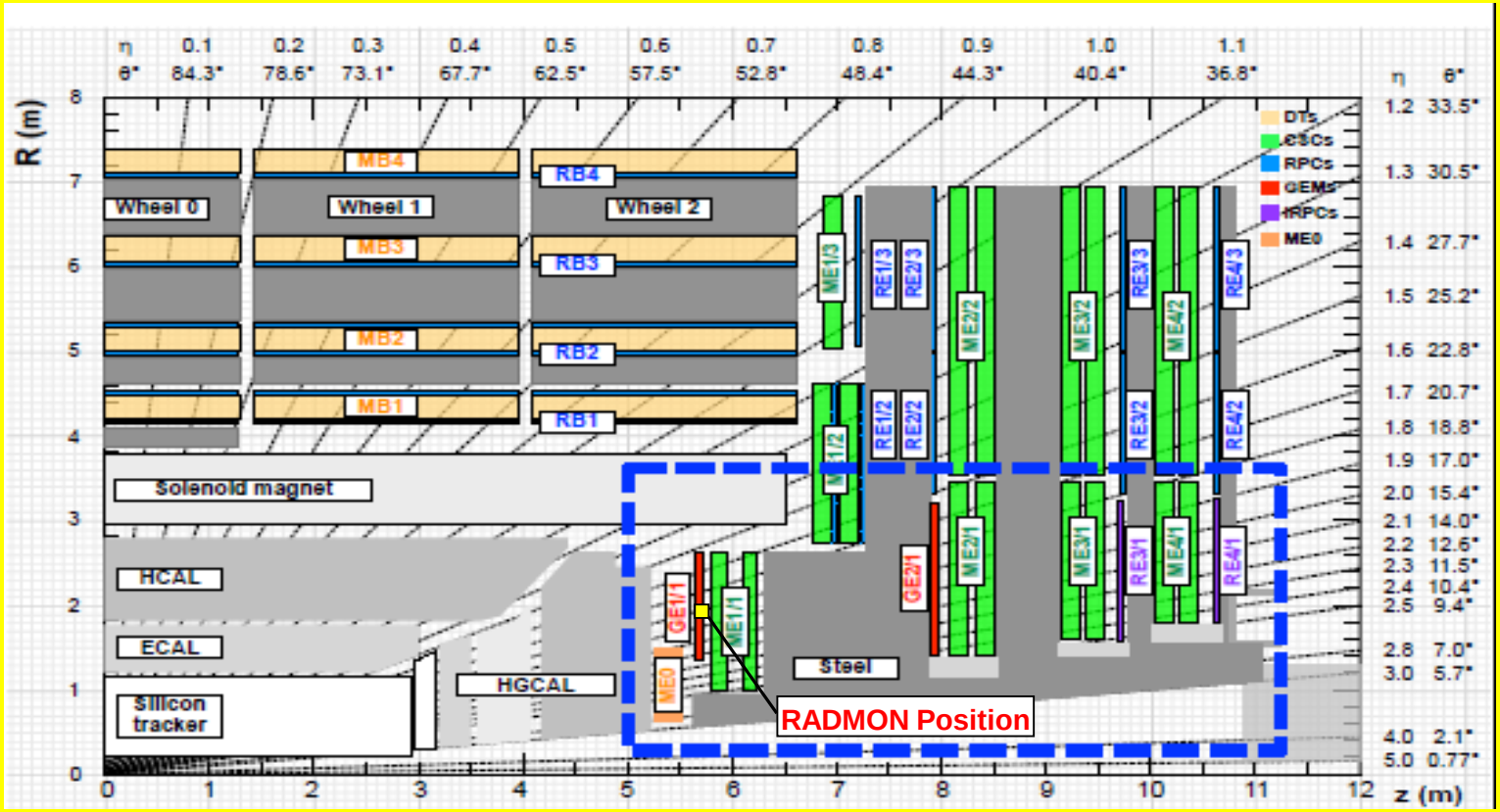
Results of the Radiation Study at slice Test and Progress in Radmon system Installation

P. Iaydjiev, INRNE, BAS, Sofia,

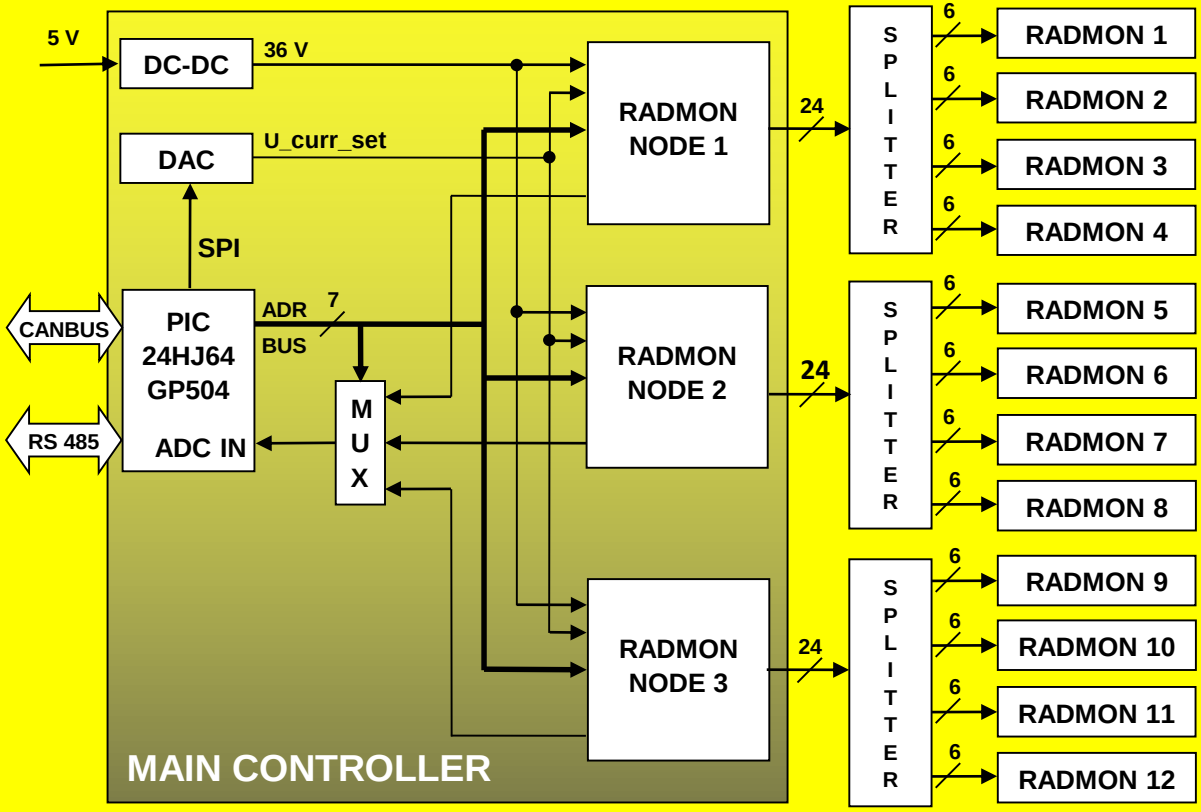
One important task was to study the radiation level distribution around the GEM working places.



WORKPLACES OF THE GEMs in CMS and RADMON positions

RADIATION MONITORING SYSTEM - STRUCTURE

A monitoring system is designed to control the radiation absorbed by the GEM detectors during their operation.



The system consists of a Main Controller and a basic radiation sensor unit, called RADMON. Up-to 12 RADMONs can be connected to the main controller.

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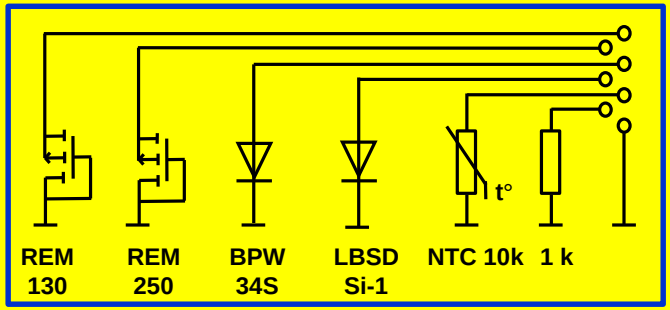
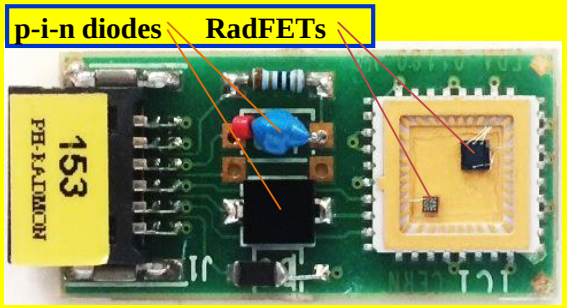
RADIATION MONITORING SYSTEM - RADMON

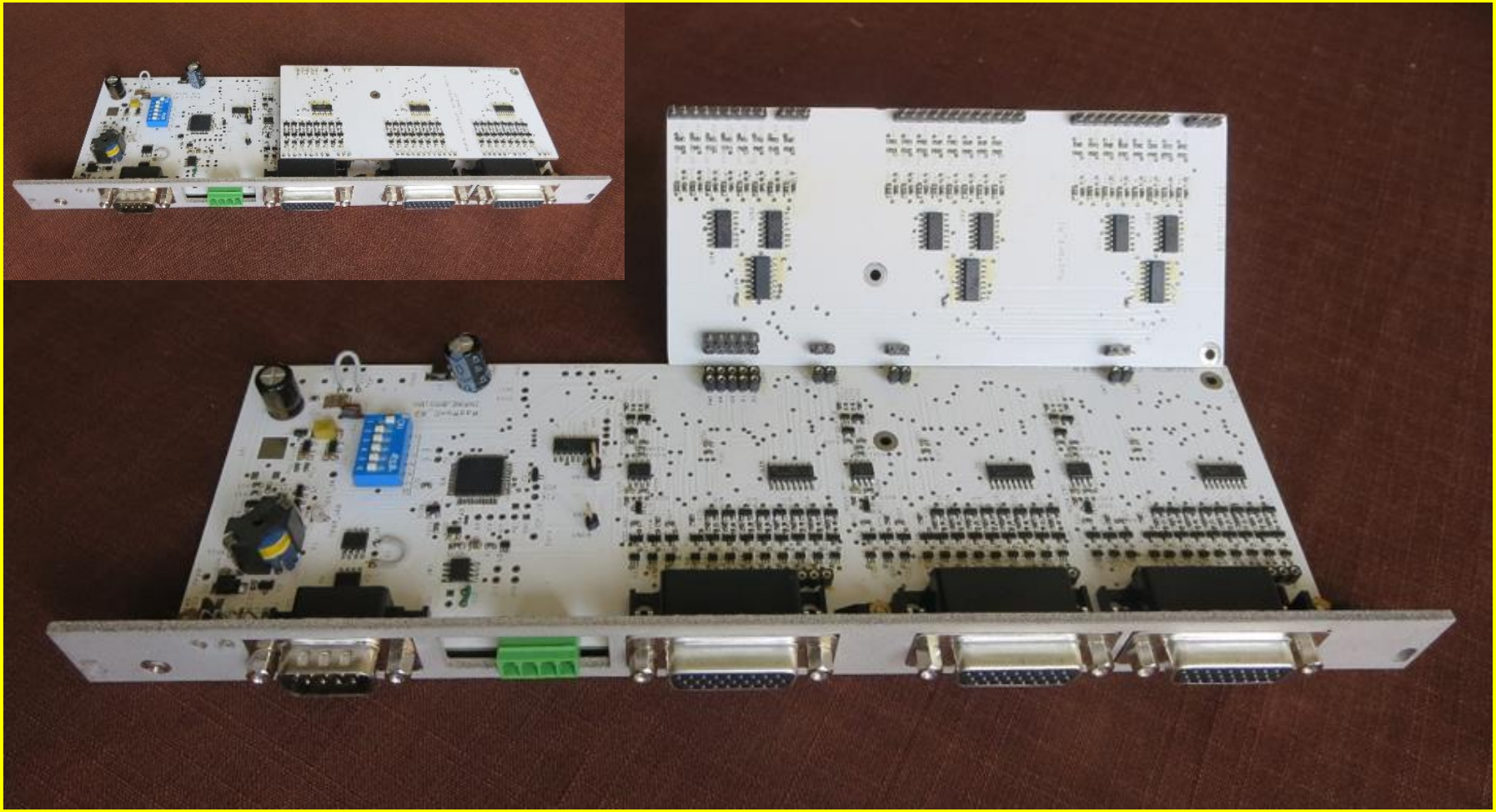




4 SENSORS:
2 RadFETs – absorbed dose
2 p-i-n diodes – 1 MeV neutron equivalent fluence

Function	Type	Device	Operating range	Sensitivity / Resolution	I_{read}
Total Dose Sensor (high doses)	RadFET	REM 250	A few 10^{-1} Gy to > $2x10^{4}$ Gy	~ 20 mV/Gy (initial)	160 µA
Total Dose Sensor (very high doses)	RadFET	REM 130	A few Gy to > $2x10^{5}$ Gy	~ 3 mV/Gy (initial)	160 µA
1 MeV n eq. Fluence Sensor (high sensitivity)	p-i-n diode	LBSD Si-1	10^{10} cm^{-2} to ~ $2x10^{12}$ cm^{-2} (almost linear)	~ $2.1x10^{8}$ cm^{-2}/mV	10 mA
1 MeV n eq. Fluence Sensor (low sensitivity)	p-i-n diode	BPW34S	~2.10^{12} cm^{-2} to ~ $4x10^{14}$ cm^{-2} (linear)	~ $1x10^{10}$ cm^{-2}/mV	1 mA
Temperature sensor	Thermistor	NTC 10 k	-55 ^{0}C to 125 ^{0}C	0.1 ^{0}C	10 µA
Line checking	Resistor	1 k		1%	1 mA

RADIATION MONITORING SYSTEM – MAIN CONTROLLER



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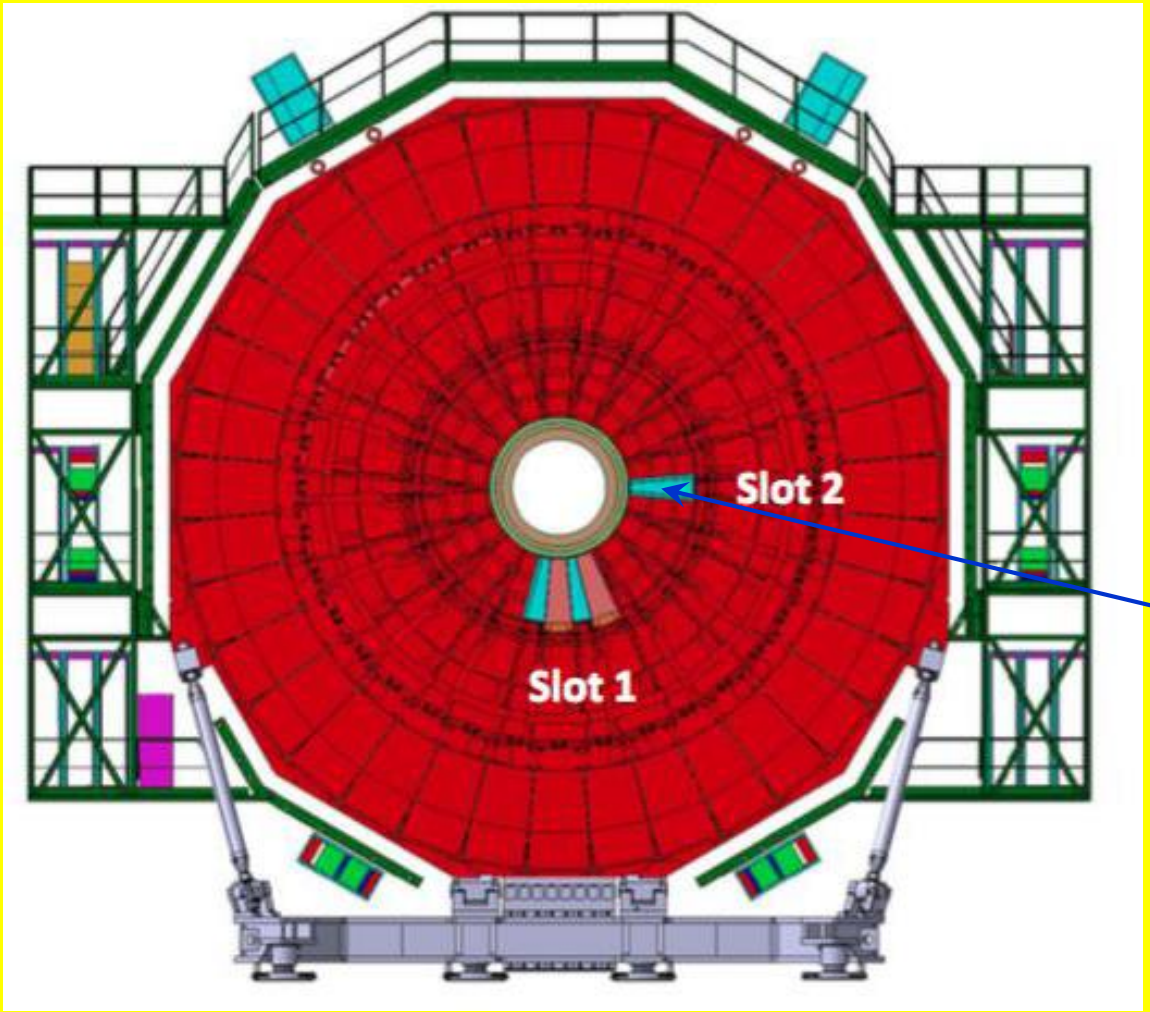
GEM SLICE TEST: 2017-2018

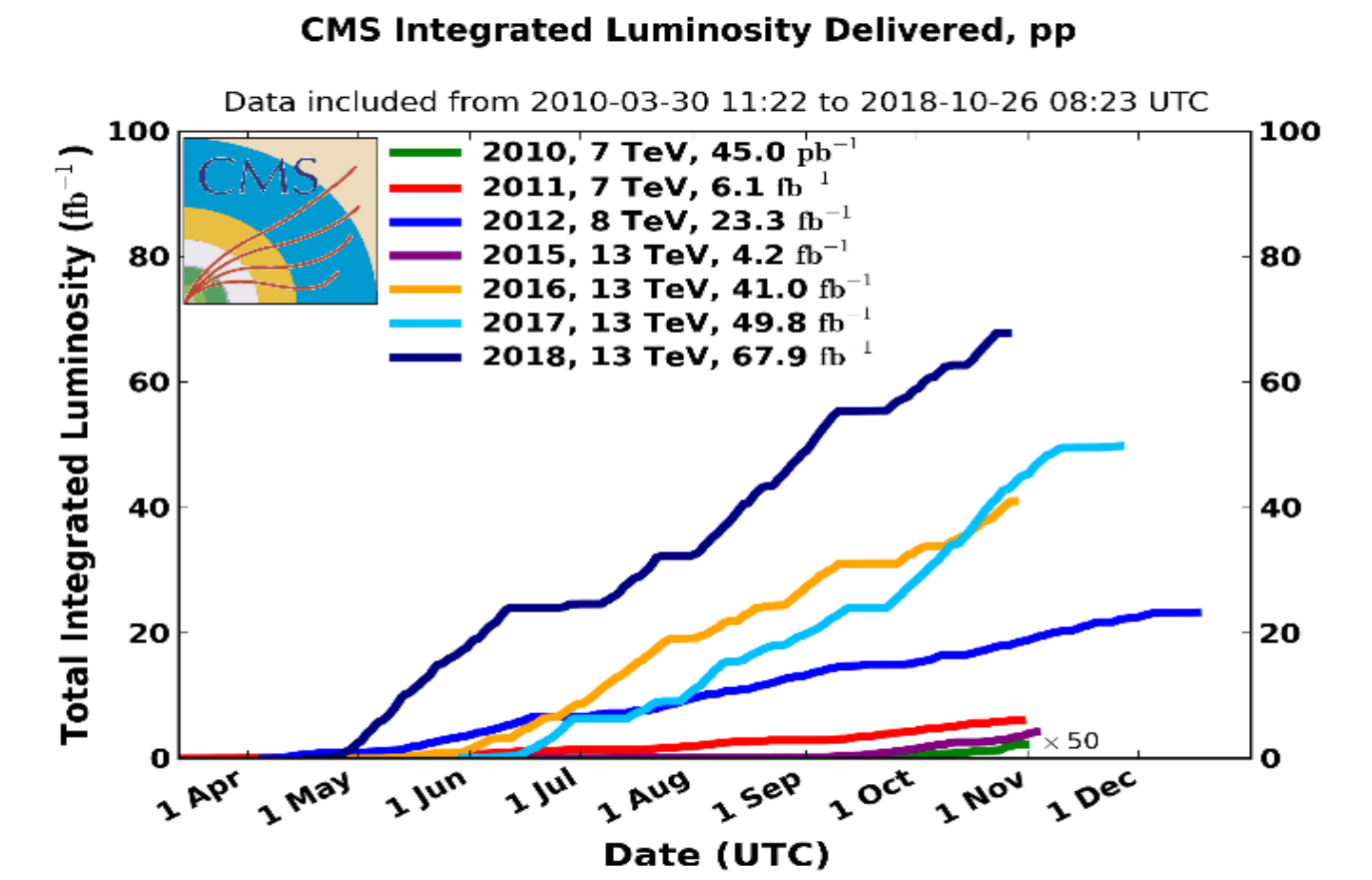


Three GEM detector prototypes were installed in March 2017 insight two slots of the GE1/1 station in inner endcap of CMS for a slice test

One RADMON sensor was placed at the center of the GEM chamber in Slot 2

Results of the Radiation Study at slice Test and Progress in Radmon system Installation

CMS INTEGRATED LUMINOSITY 2017-2018



Full luminosity during the slide test –
49,8 + 67,9 = 117,7 fb^{-1}

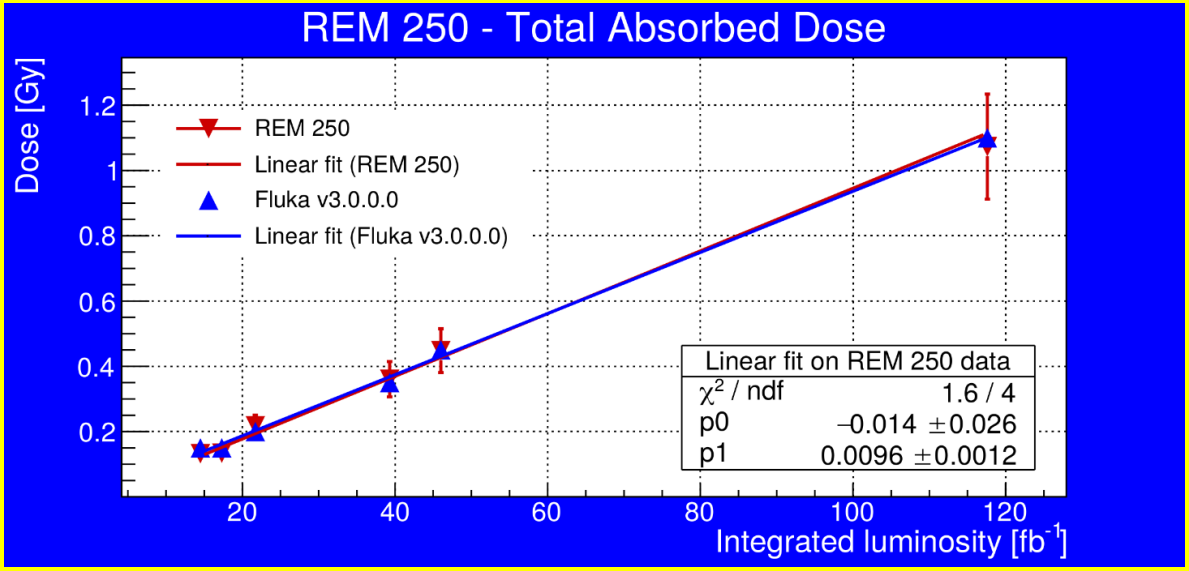
Results of the Radiation Study at slice Test and Progress in Radmon system Installation

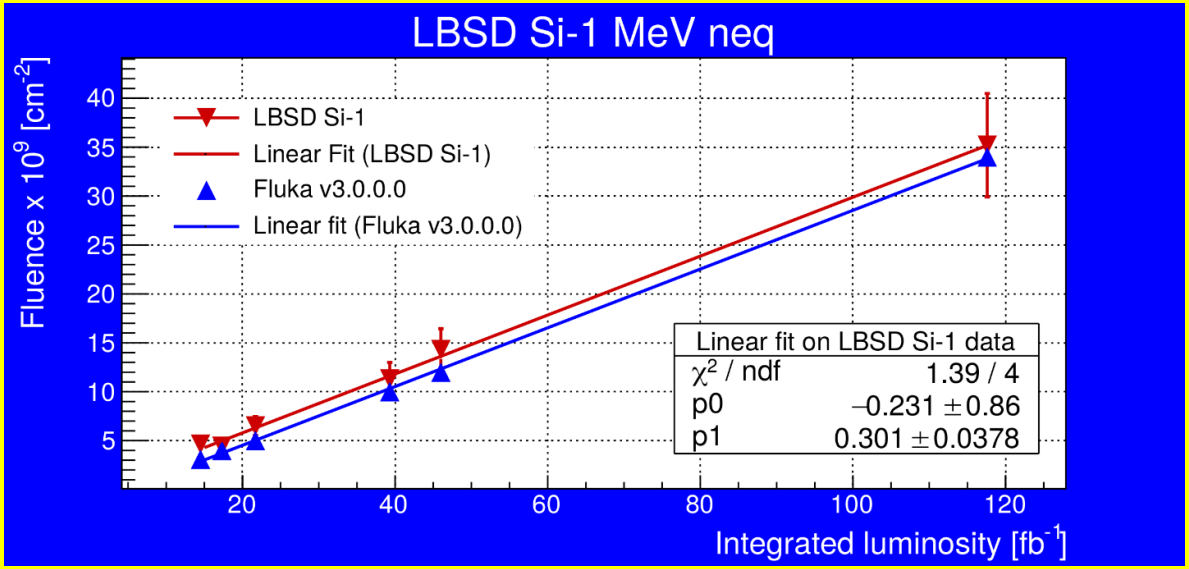
ALL EXPERIMENTAL AND SIMULATED DATA

Date of measurement	Integrated luminosity	Dose		Fluence	
		REM 250	FLUKA v.3.0.0.0	LBSD Si-1	FLUKA v.3.0.0.0
	fb^{-1}	Gy	Gy	cm^{-2}	cm^{-2}
07.08.2017	14,5	0,132	0,15	4,42E+09	3,10E+09
15.08.2017	17,3	0,134	0,15	4,63E+09	4,00E+09
05.09.2017	21,7	0,218	0,20	6,50E+09	5,00E+09
18.10.2017	39,3	0,361	0,35	1,13E+10	1,00E+10
01.11.2017	46,0	0,448	0,45	1,43E+10	1,20E+10
31.07.2019	117,6	1,073	1,1	3,52E+10	3,40E+10

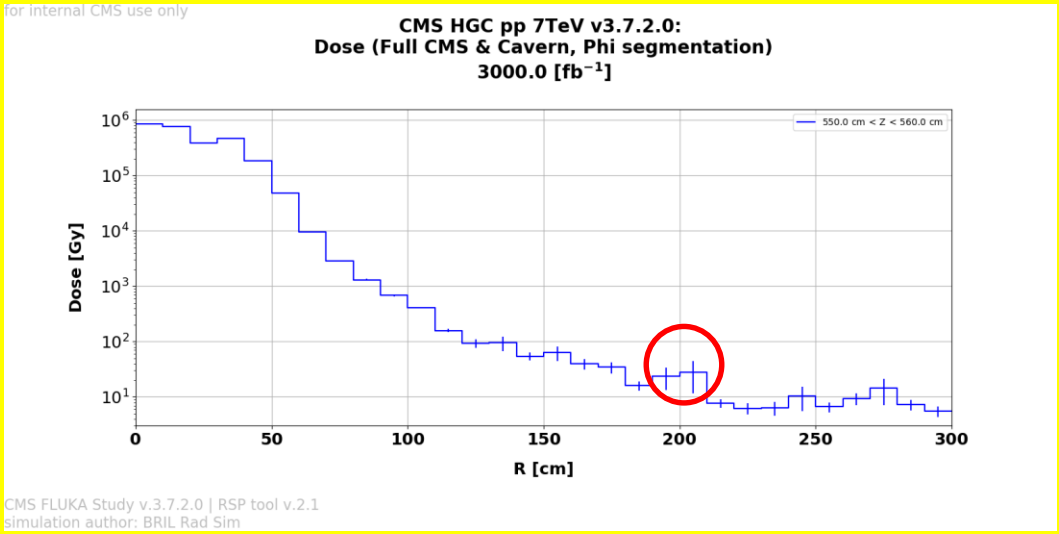
No data from REM 130 and BPW34S – low sensitivity

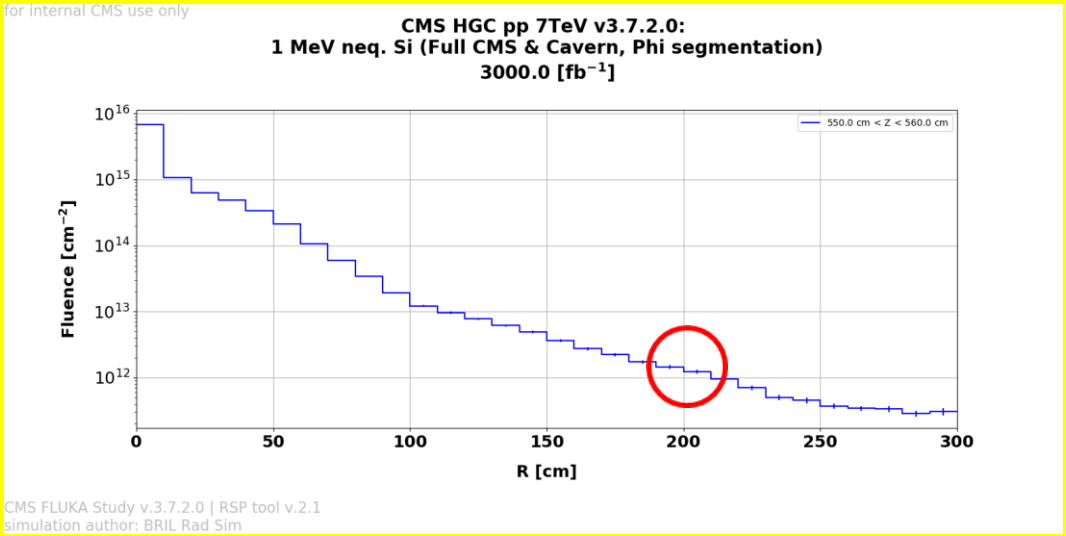
Results of the Radiation Study at slice Test and Progress in Radmon system Installation





Results of the Radiation Study at slice Test and Progress in Radmon system Installation



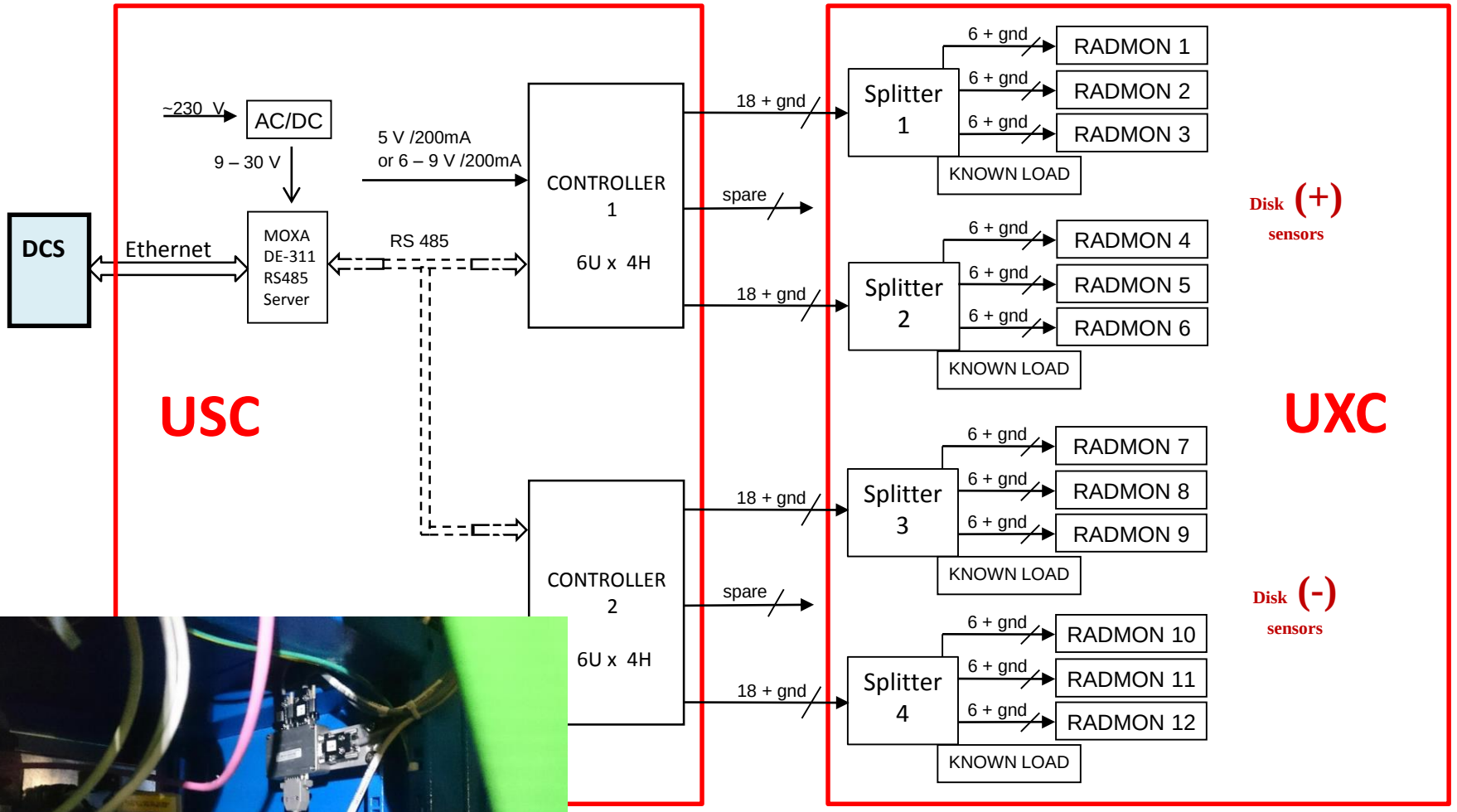


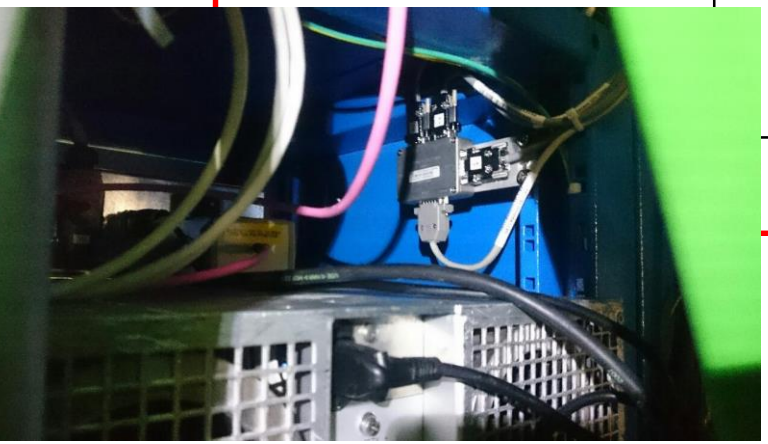
FLUKA SIMULATION SHOW AN AVERAGE ABSORBED DOSE OF 20 Gy FOR THE PHASE 2 (AT 3000 fb^{-1})

REPLACING REM 130 BY A SECOND REM 250?

LBDS Si-1 sensor sensitivity corresponds to the Run 3 simulation for the 1 MeV neq. Si fluence

FLUKA v3.7.7.0 PHASE 2 - Dose and 1 MeV neq. Si Simulation at 3000 fb^{-1}





GEM RADMON Cabling

Radmon cables routing completed, to be connectorized UXC side

Results of the Radiation Study at slice Test and Progress in Radmon system Installation

CONCLUSIONS

- The experimental results obtained confirm the good qualities of the selected radiation sensors for the control of the total absorbed dose and the 1 MeV neutron equivalent fluence.
- Our results show also that for this region of CMS (around the slot GE1/1) the BRILL simulations by FLUKA v. 3.0.0.0 estimates well the dose and fluence distribution.
- Control of the cable resistance from the controller to the RADMON is needed
- First test of the full chain -> controller – RADMON should be made when the first superchamber with sensor is installed (ongoing)

ACKNOWLEDGEMENTS

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