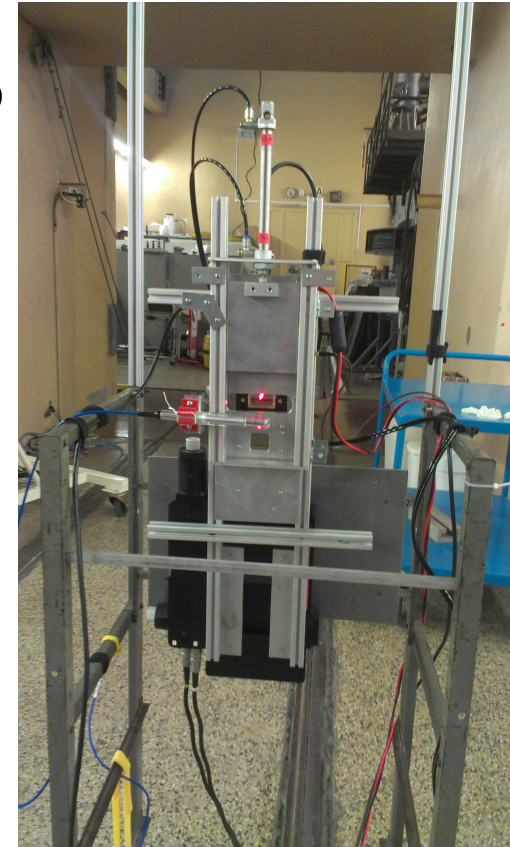
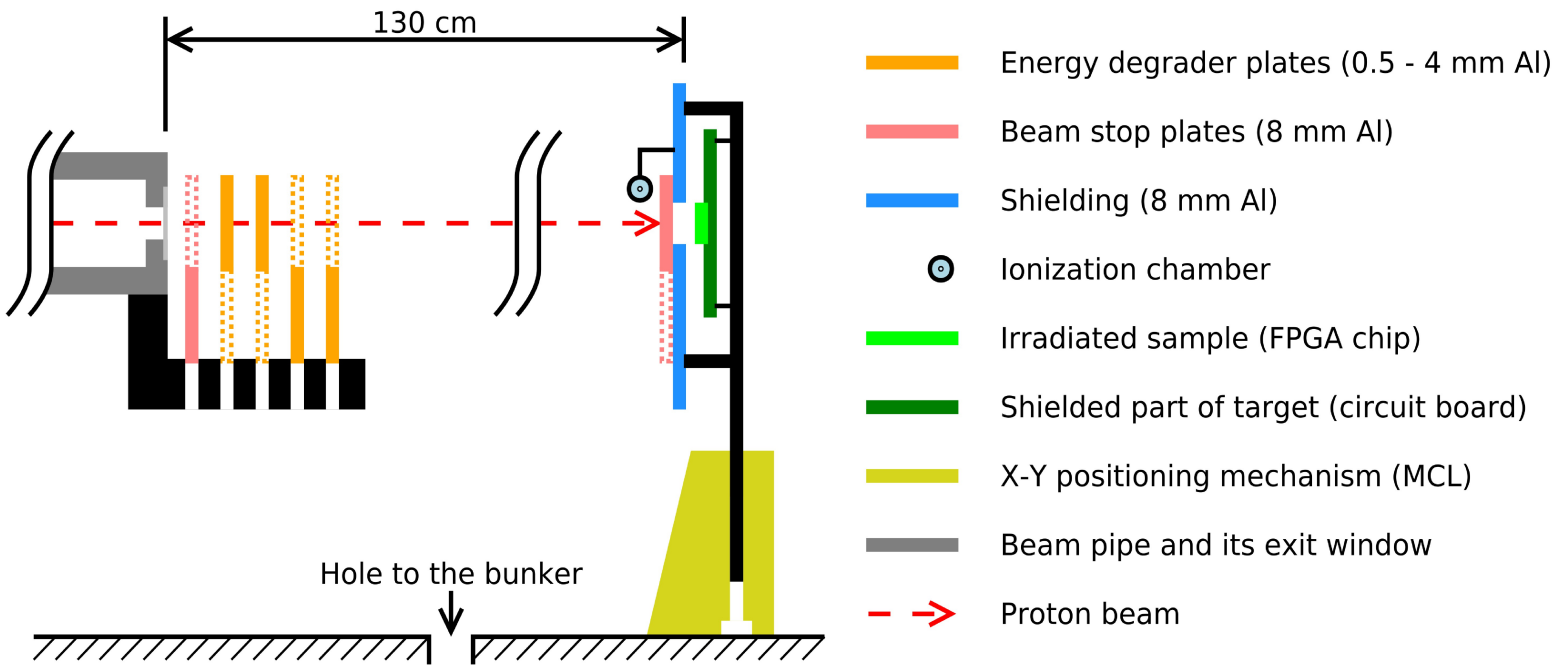


Study of radiation hardness of ALPIDE chips using 30 MeV proton beam

F. Krizek, NPI Rez

H. Hillemanns, CERN

Irradiation in Rez



Chips: **A4W7G7R38**, **A4W7G7R41**

Beam: 30 MeV protons; $\sigma = 21$ mm

Flux : $\sim 10^8$ protons $\text{cm}^{-2} \text{s}^{-1}$

Dose rates: 17 - 60 rad/s

Tests : DAC scan
 threshold scan
 analogue current
 + study of annealing

Settings:

VBB	-3V
VCASN	105
VCASN2	117
VRESETP	117
VRESETD	147
VCLIP	60
ITHR	51
IDB	64
IRESET	100

Beam test overview

CHIP A4W7G7R38

Date	Dose[krad]	Total Dose	Fluence[cm ⁻²]	Total Fluence	Dose rate[rad/s]
Sep/2016	340	340.	1.45e+12	1.45e+12	60.5
Oct/2016	122	463.	5.20e+11	1.97e+12	65.0
Dec/2016	122	585	5.19e+11	2.49e+12	38.2
Jan/2017	89	674	3.80e+11	2.87e+12	49.5
Mar/2017	77	752	3.31e+11	3.20e+12	38.3
Apr/2017	89	842	3.82e+11	3.58e+12	18.9
May/2017	86	928	3.66e+11	3.95e+12	17.7
Jun/2017	95	1024	4.06e+11	4.35e+12	41.2
Jul/2017	87	1111	3.69e+11	4.72e+12	34.3
Aug/2017	94	1204	3.98e+11	5.12e+12	35.8
Sep/2017	86	1290	3.64e+11	5.48e+12	33.0

Dose rate is calculated using net time of chip is irradiation (without breaks)

NIEL ~ 1.37e+13 1MeV n_{eq} cm⁻²

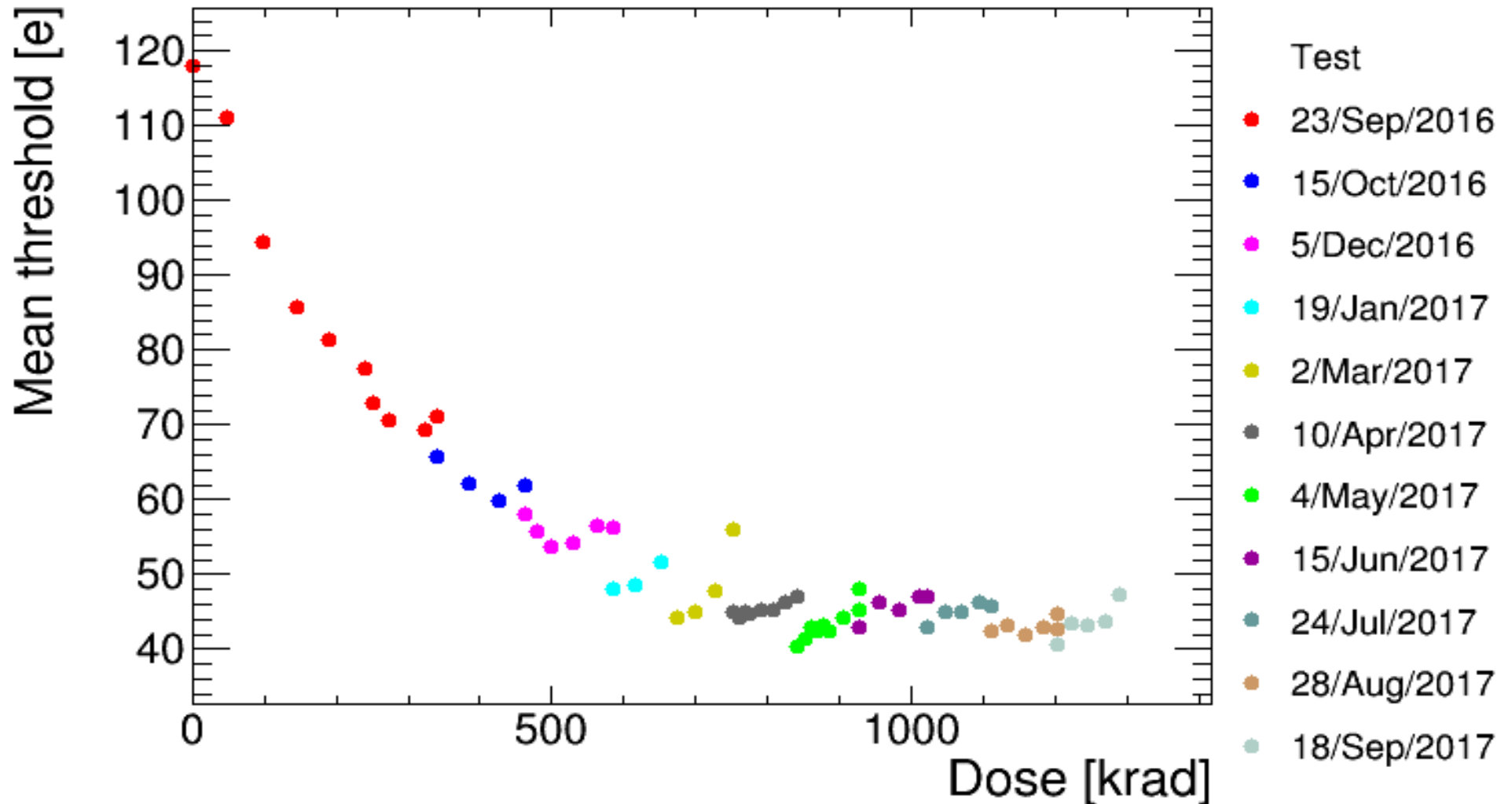
CHIP A4W7G7R41

Date	Dose[krad]	Total Dose	Fluence[cm ⁻²]	Total Fluence	Dose rate[rad/s]
Sep/2016	338	338	1.44e+12	1.44e+12	18.0
Oct/2016	171	509	7.27e+11	2.16e+12	65.6
Dec/2016	140	649	5.94e+11	2.76e+12	55.1
Jan/2017	125	774	5.30e+11	3.29e+12	34.0
Mar/2017	113	886	4.79e+11	3.77e+12	37.7
Apr/2017	94	980	3.98e+11	4.16e+12	27.6
May/2017	100	1080	4.26e+11	4.59e+12	26.0
Jun/2017	115	1195	4.89e+11	5.08e+12	36.7
Jul/2017	116	1311	4.92e+11	5.57e+12	24.4
Aug/2017	118	1429	5.01e+11	6.07e+12	36.5
Sep/2017	122	1551	5.18e+11	6.594e+12	37.2

NIEL ~ 1.65e+13 1MeV n_{eq} cm⁻²

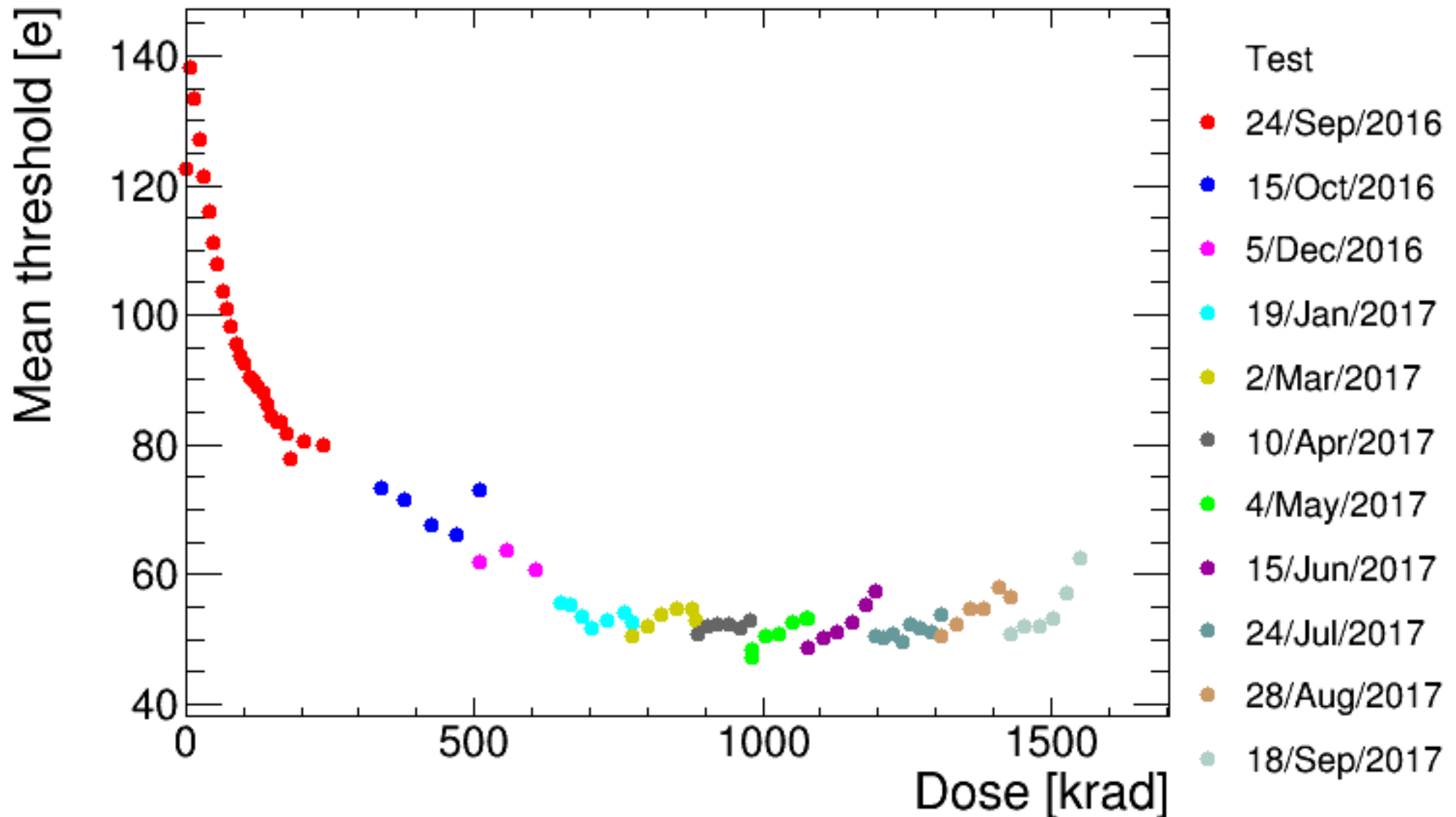
Mean threshold versus total accumulated dose

A4W7G7R38

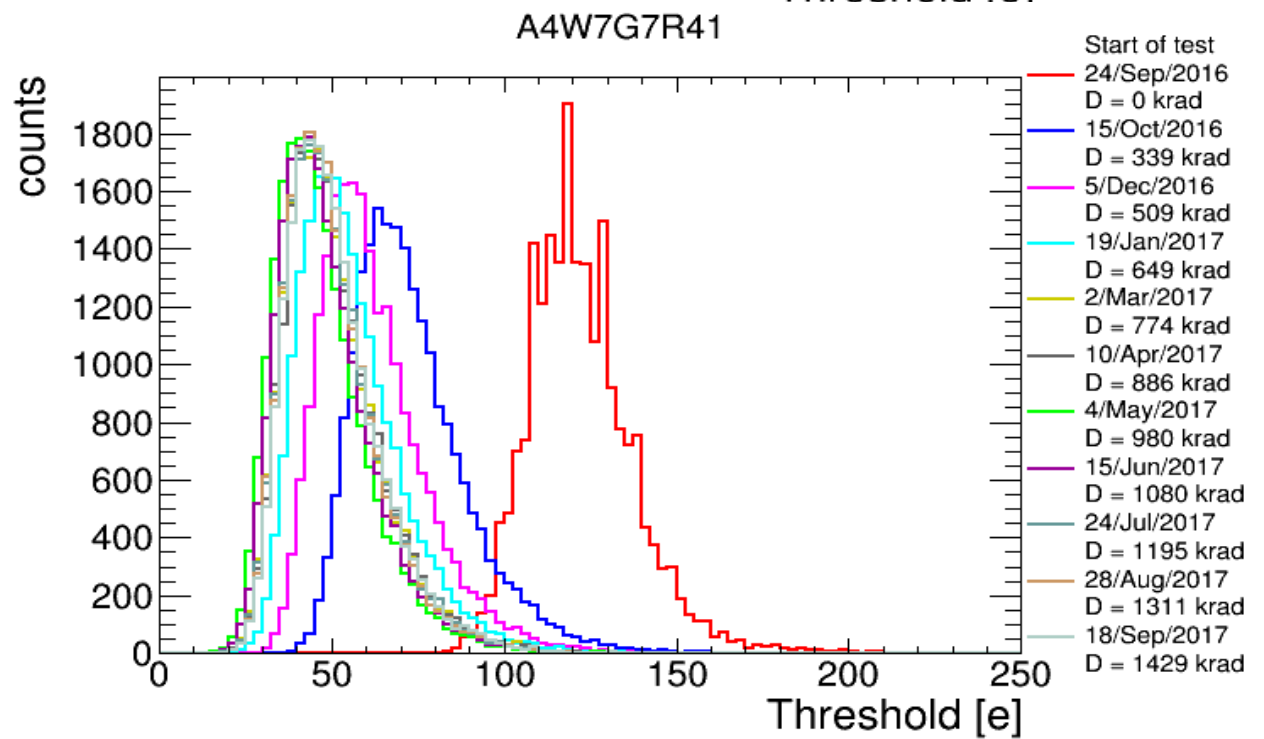
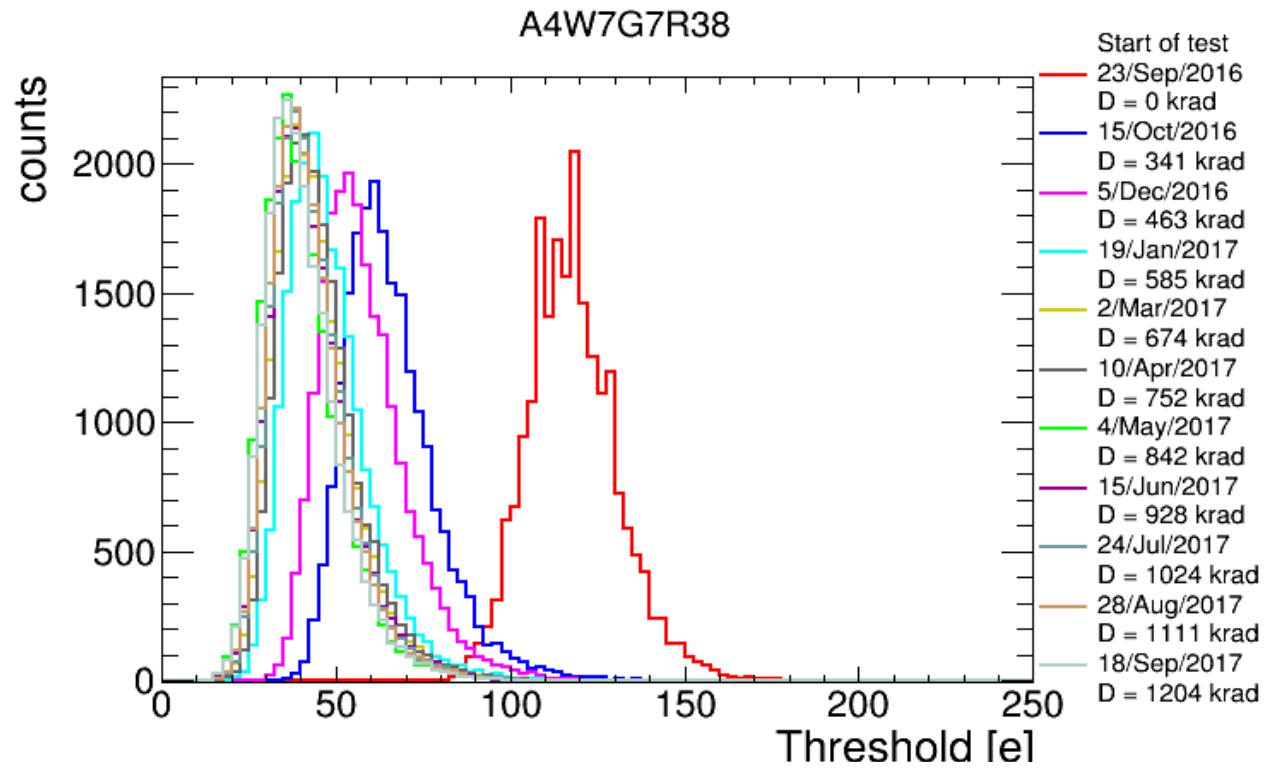


Mean threshold versus total accumulated dose

A4W7G7R41

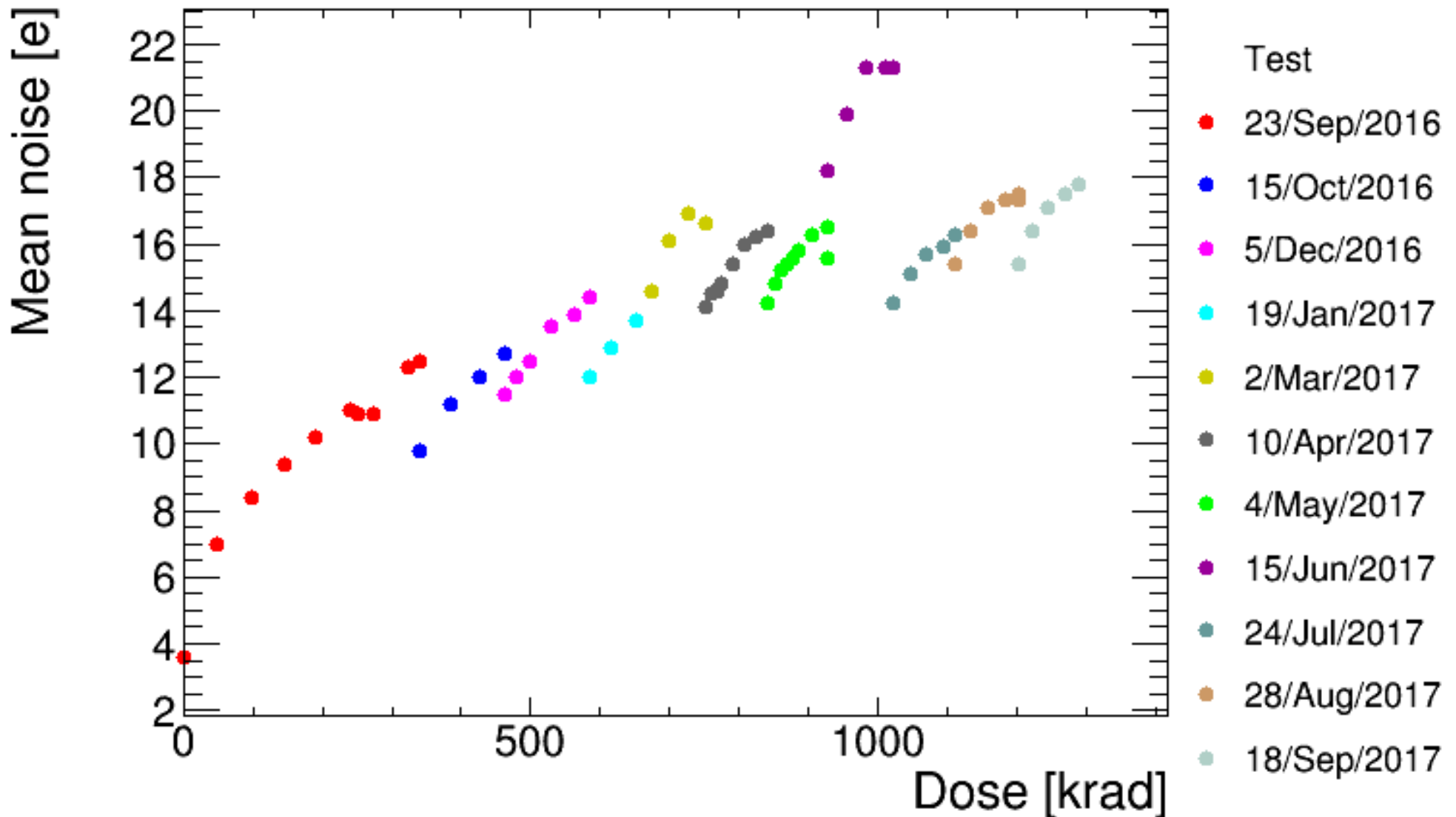


Distrib of thresholds at the beginning of irradiation



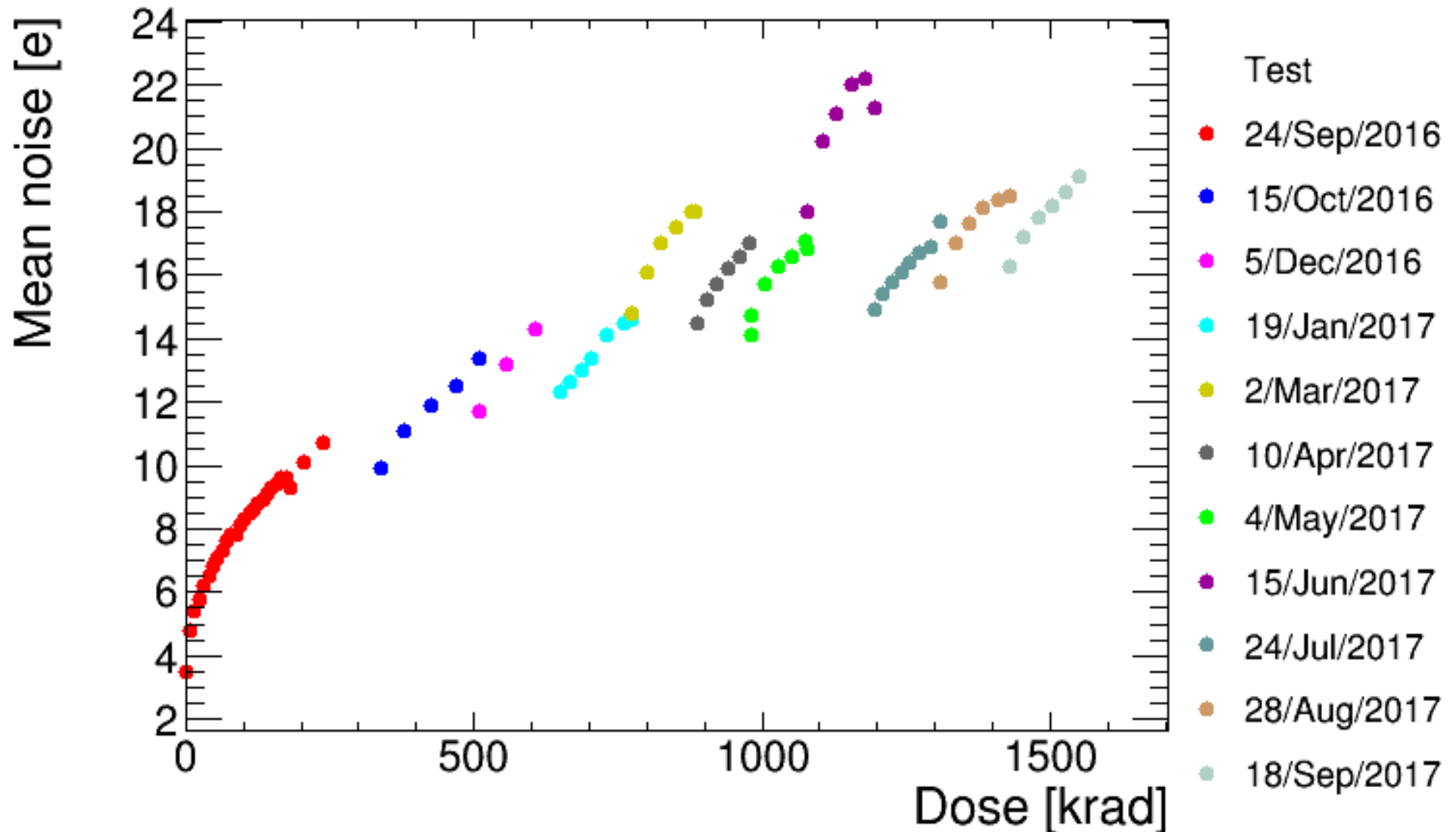
Mean noise versus total accumulated dose

A4W7G7R38

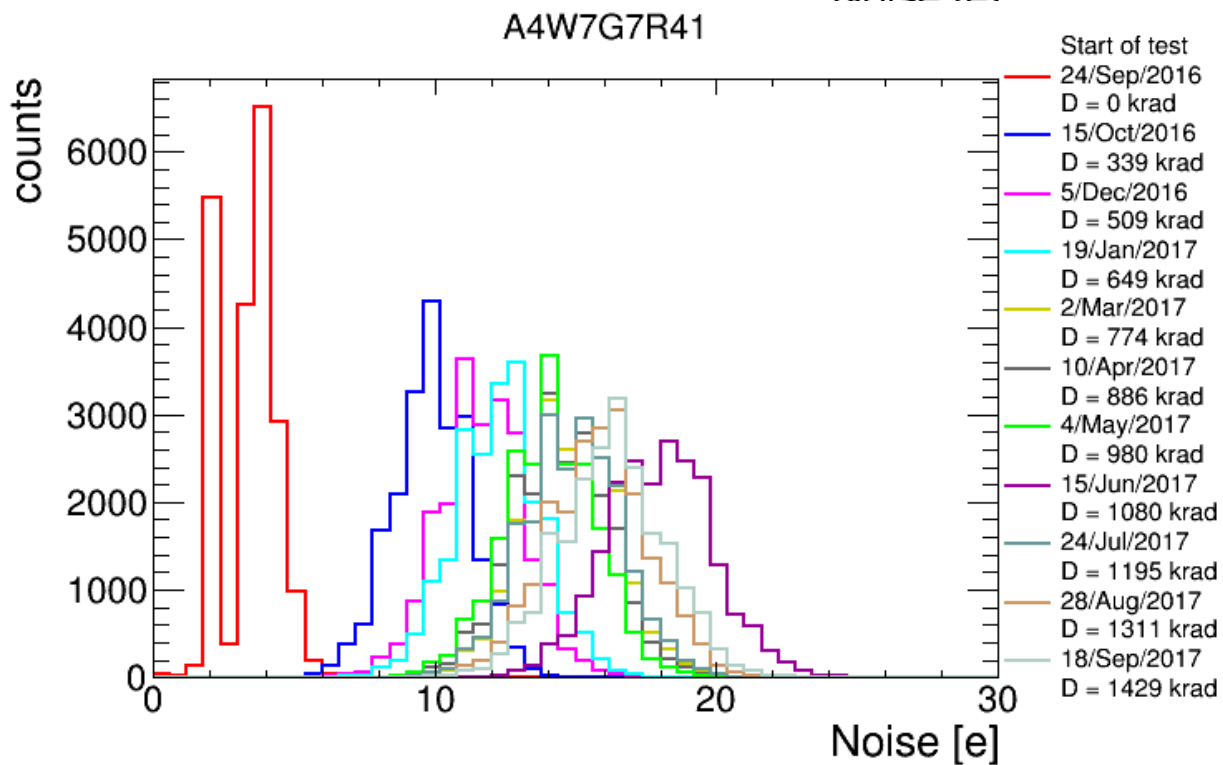
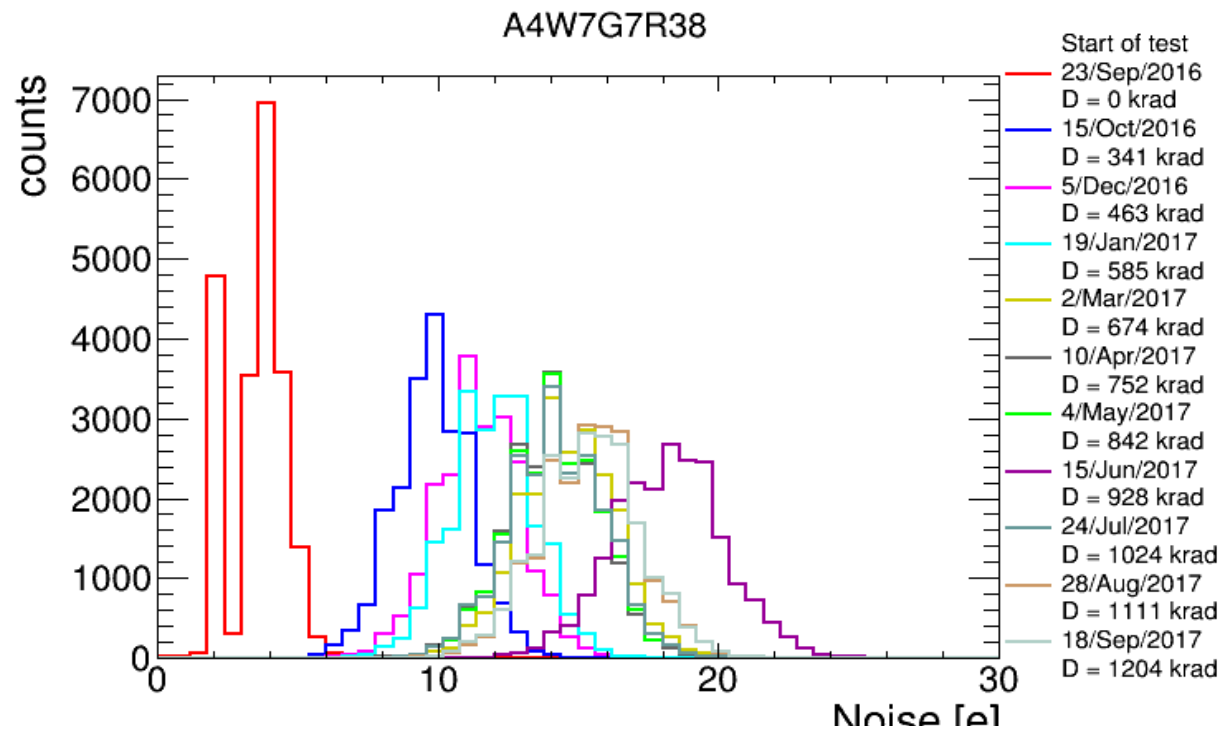


Mean noise versus total accumulated dose

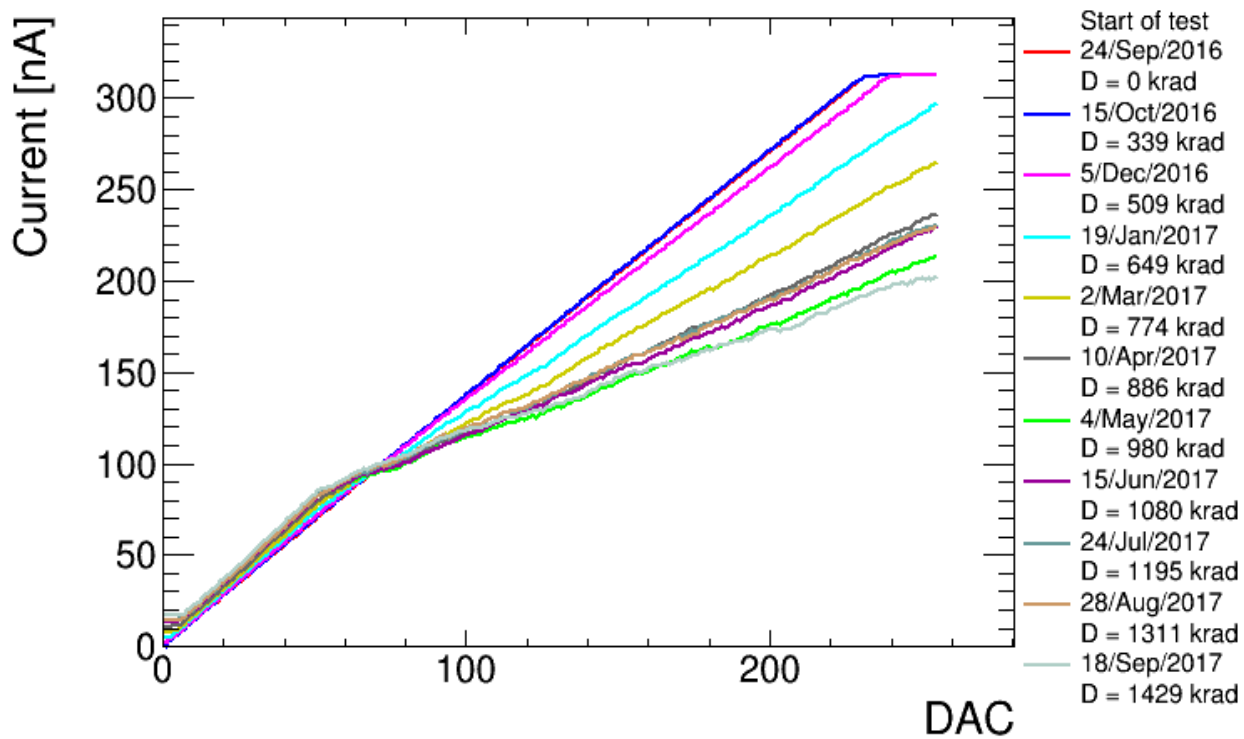
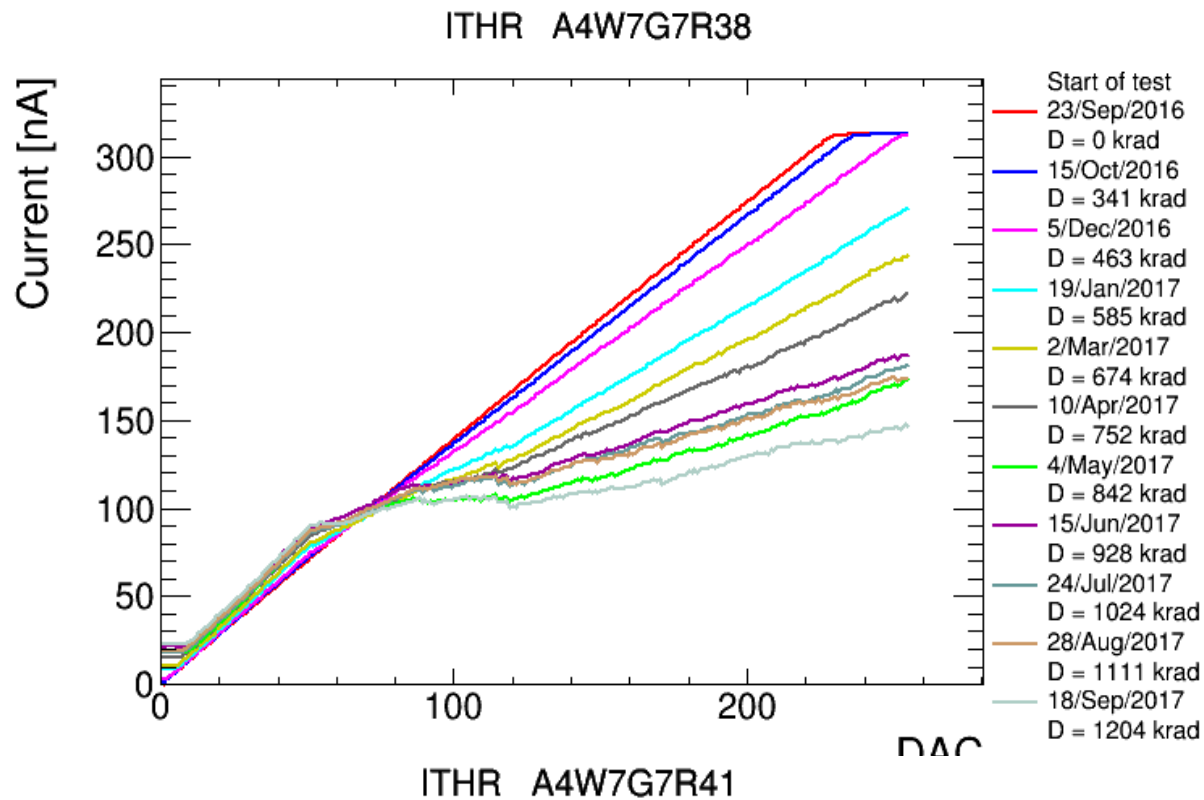
A4W7G7R41



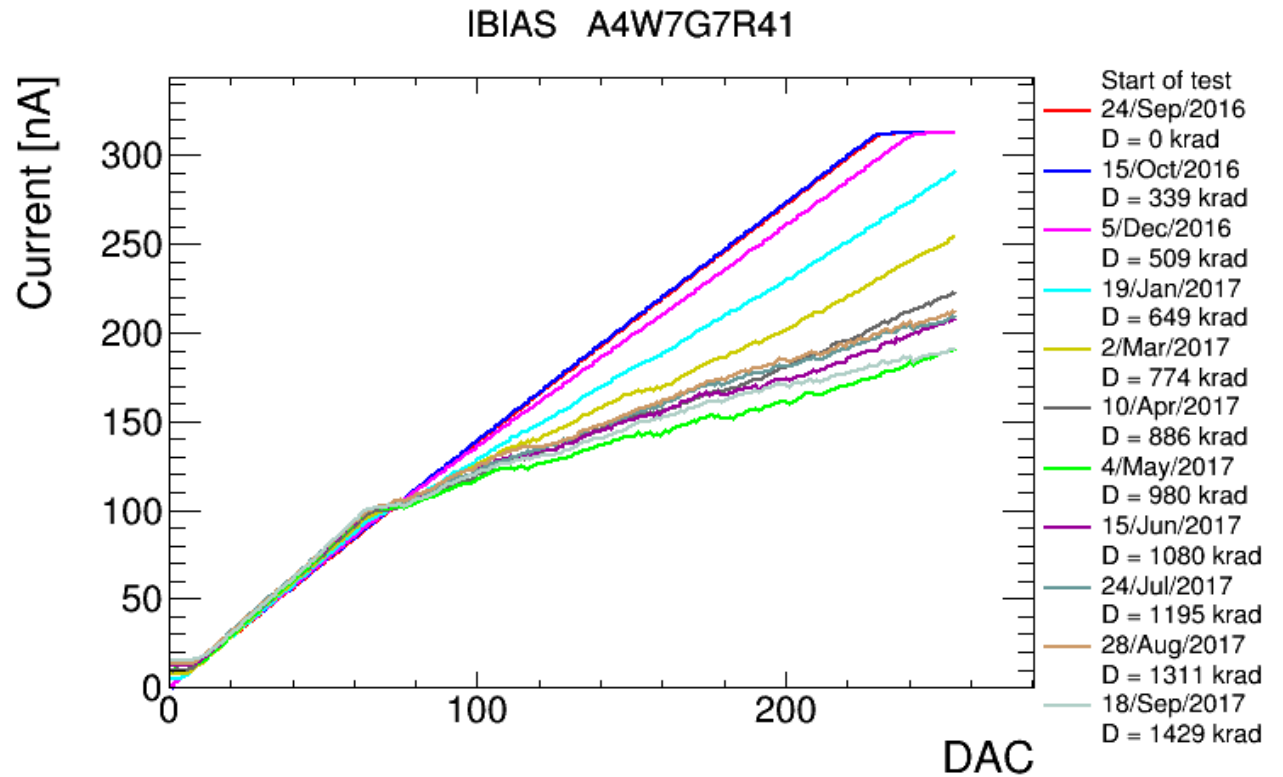
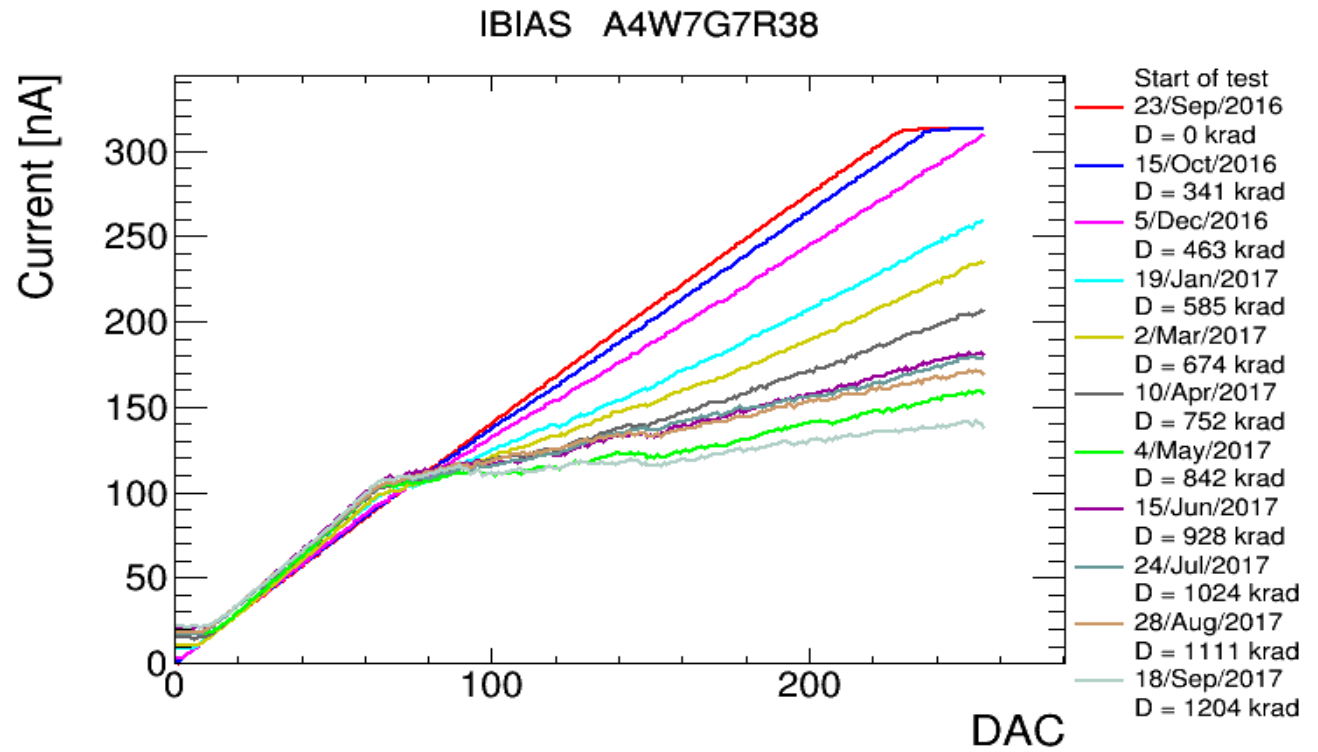
Distrib of noise at the beginning of irradiation



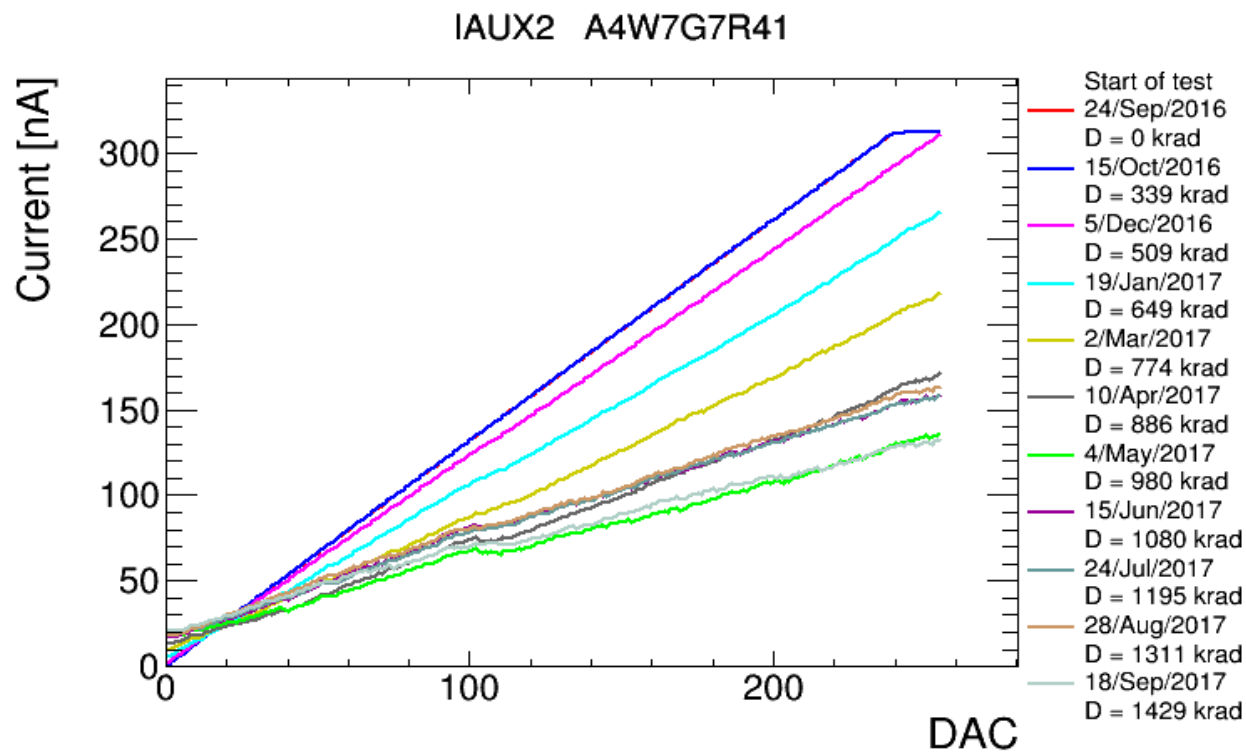
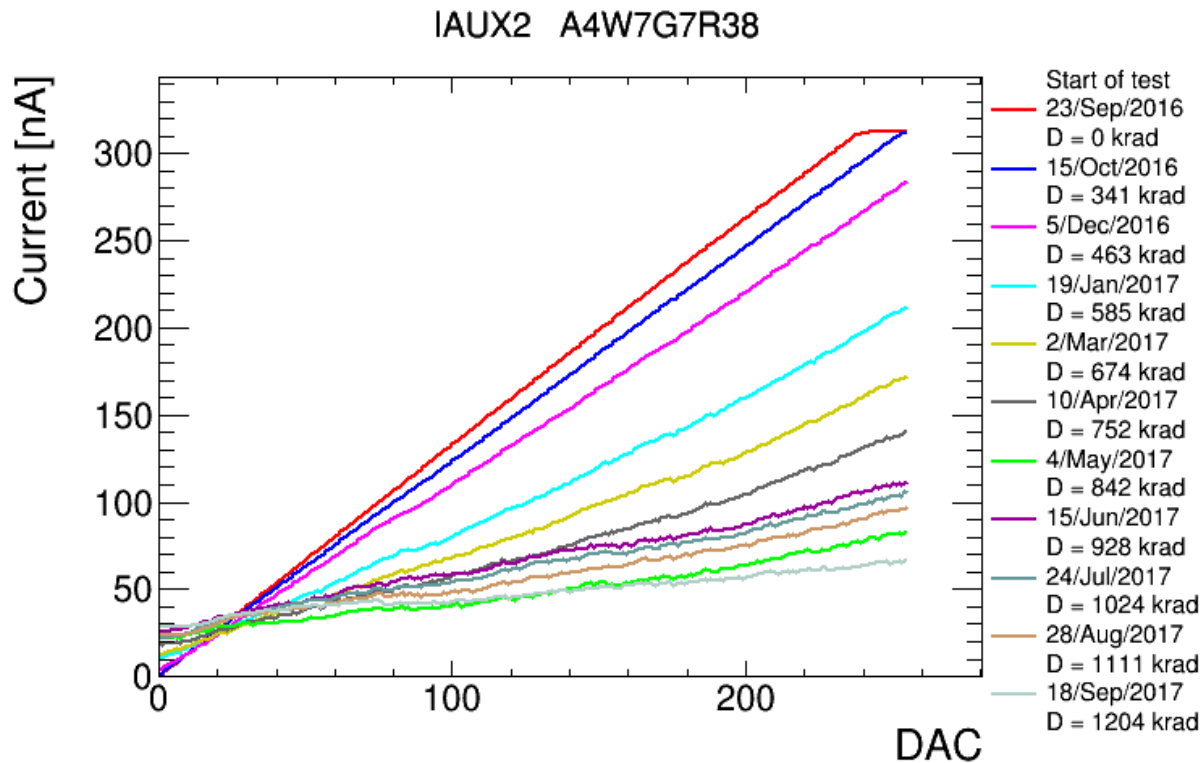
I_{THR} at the beginning of irradiation



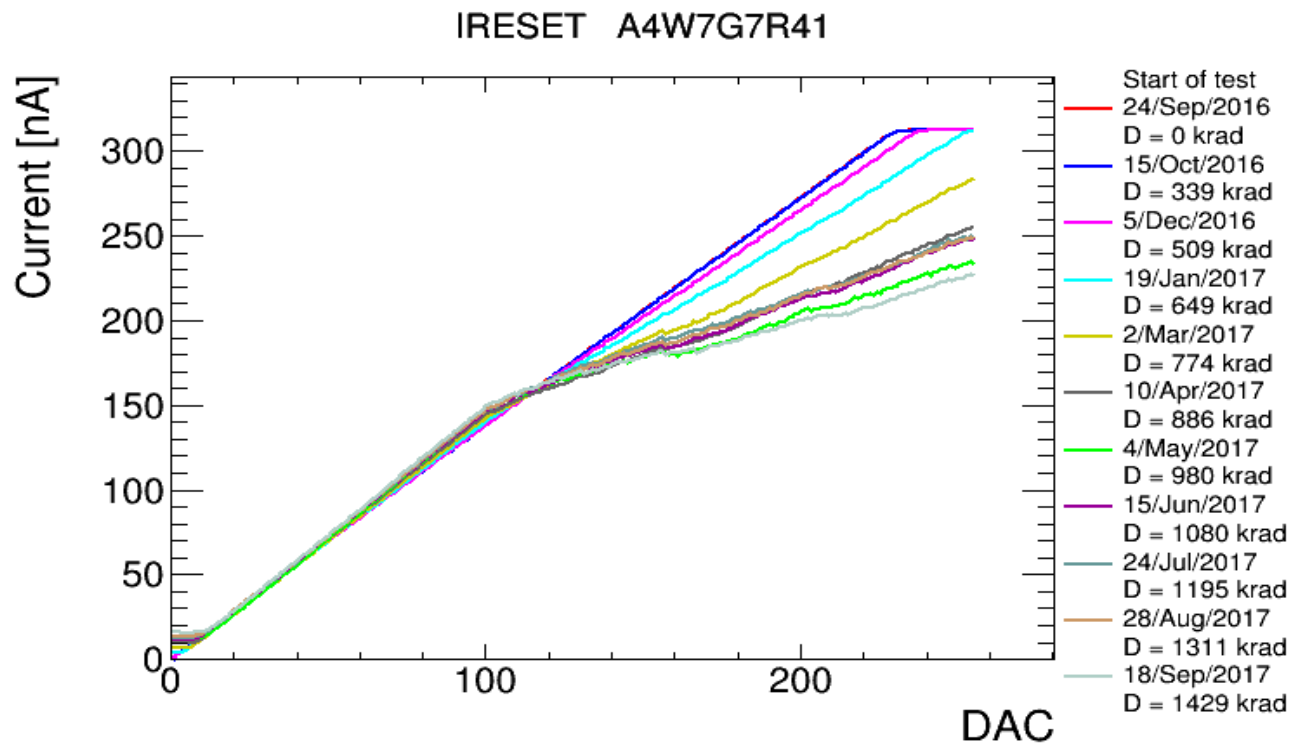
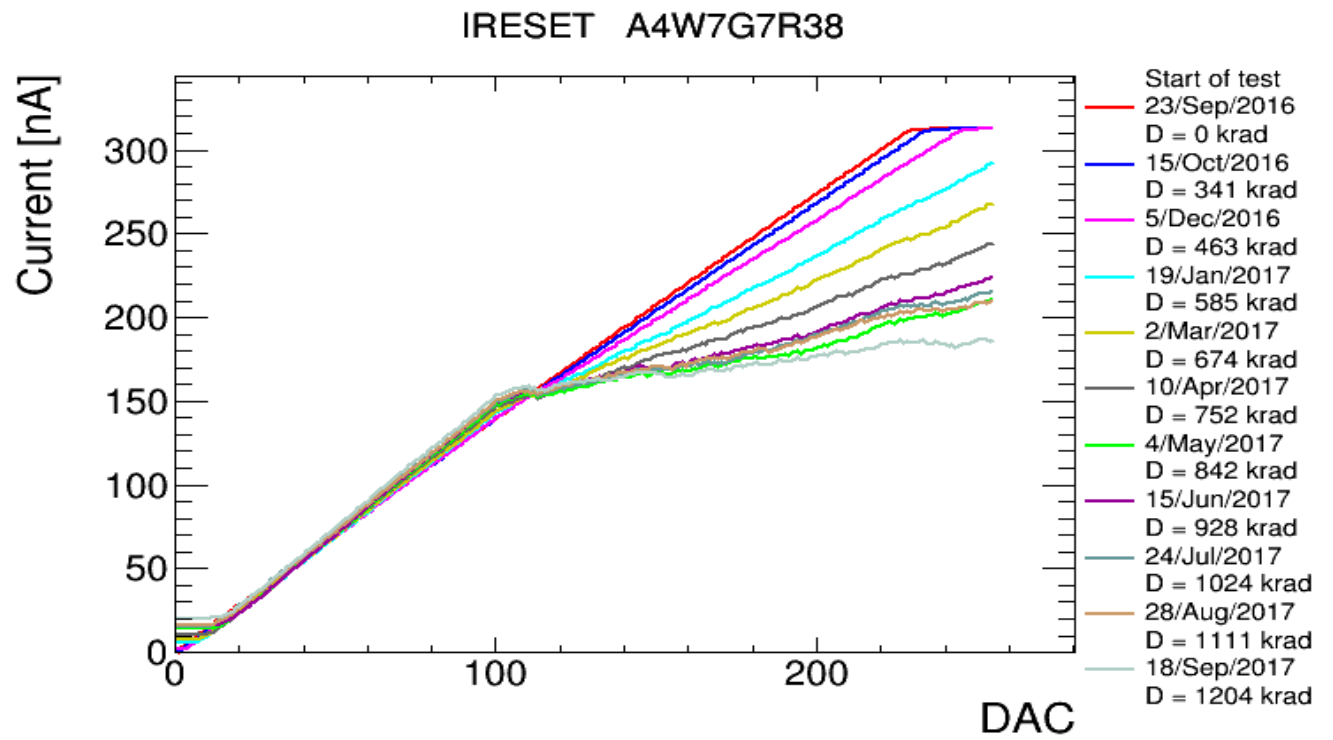
IBIAS at the beginning of irradiation



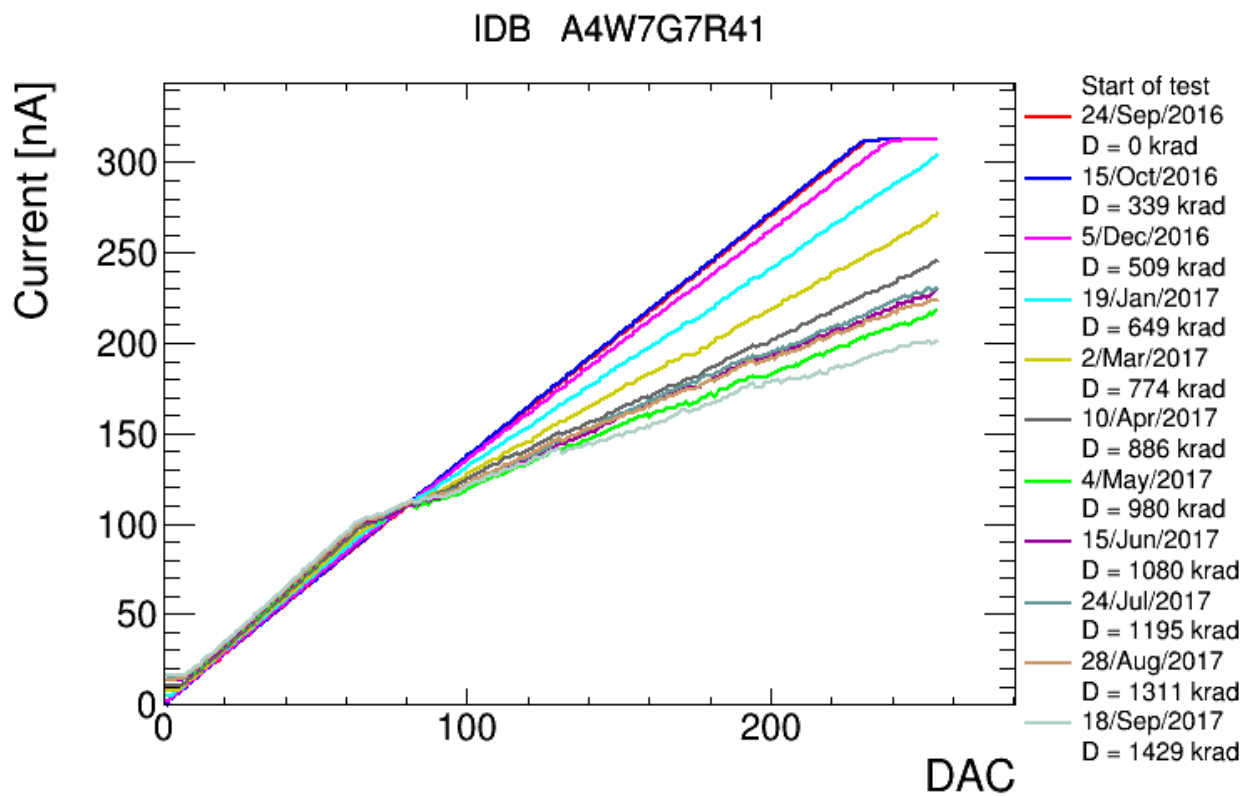
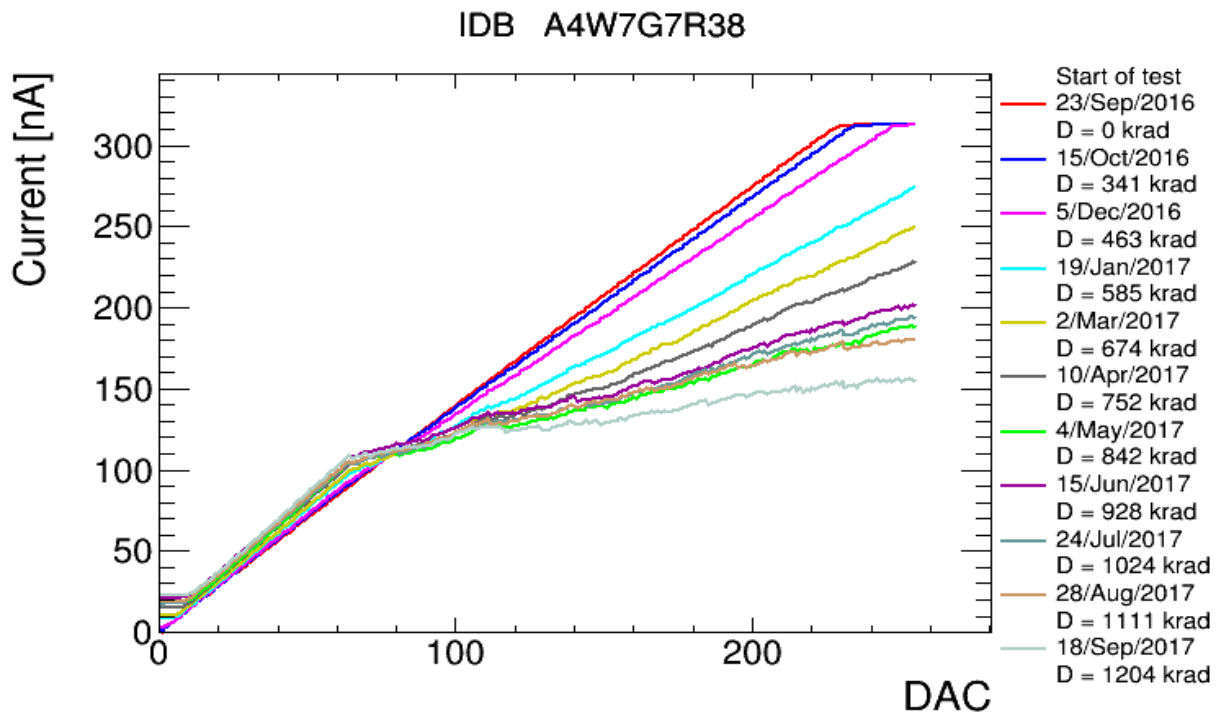
IAUX2 at the beginning of irradiation



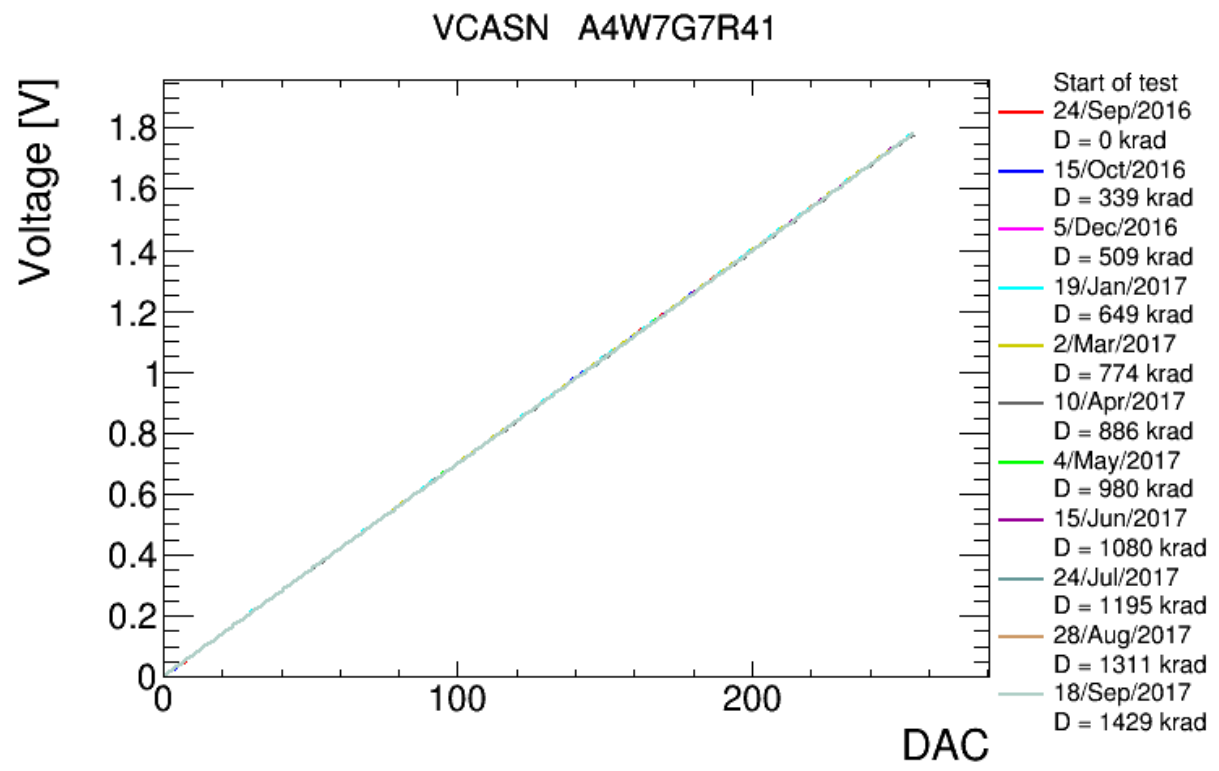
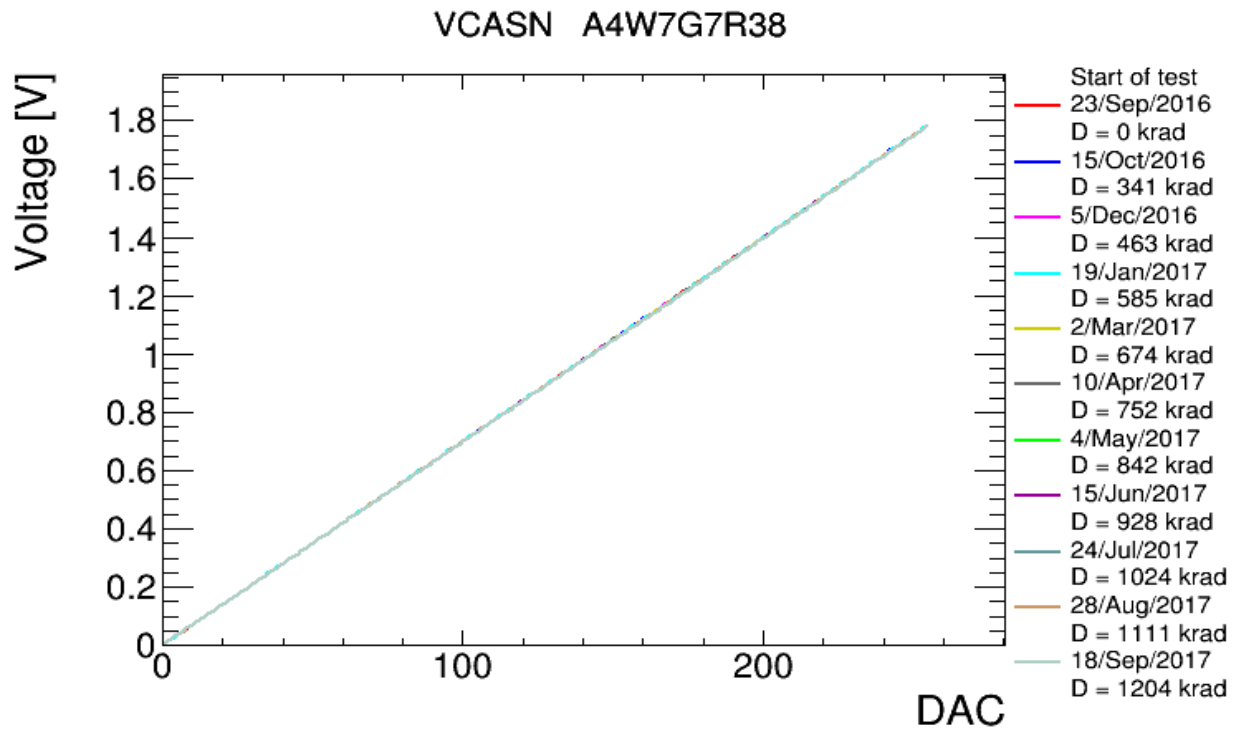
IRESET at the beginning of irradiation



IDB at the beginning of irradiation

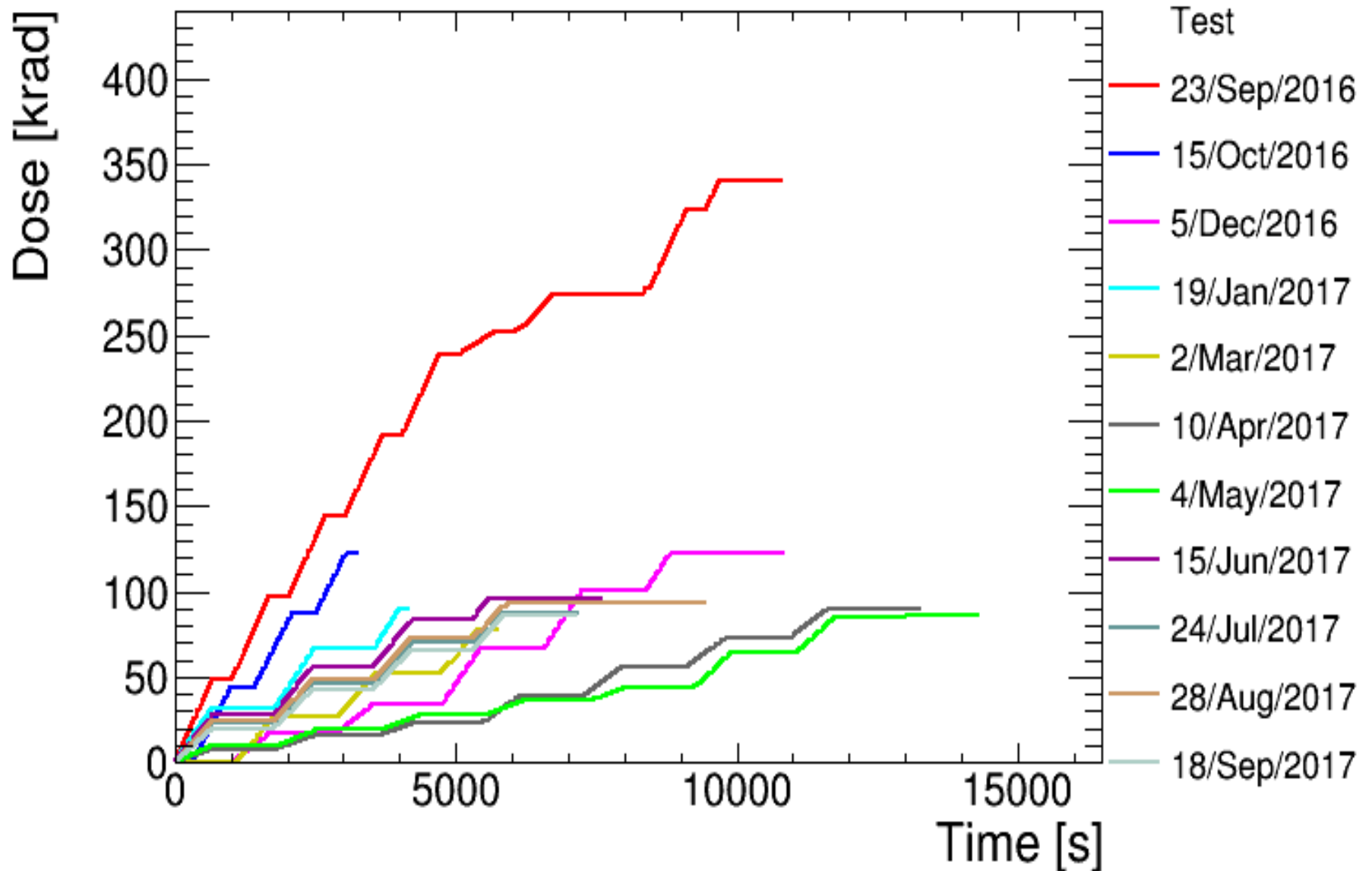


VCASN at the beginning of irradiation



Dose delivered to the chip vs time

A4W7G7R38



Dose delivered to the chip vs time

A4W7G7R41

