

ACTIVITIES & MILESTONES FOR 2021

LIME

- **Test overground (LNF and LNGS) and underground (LNGS):** Setup of Labs at LNGS, LIME installation, development and realisation of GAS and DAQ systems, study and realisation of shieldings (Copper and water);
- **Analysis:** analysis of data taken with LIME;

1 m³ DEMONSTRATOR

- **Design studies** and start material procurement and realisation of detector and shieldings
- **Background reduction:** Development and test of low radioactive GEM, optics, sensors and materials;
- **Simulation:** simulation of signals and background in the 1 m³ demonstrator and LIME

underground tests of LIME at the LNGS	30-06-2021
realisation of a purification and recirculation gas prototype	31-12-2021
realisation of a DAQ system prototype	31-12-2021

TOTALE PREVENTIVI 2021

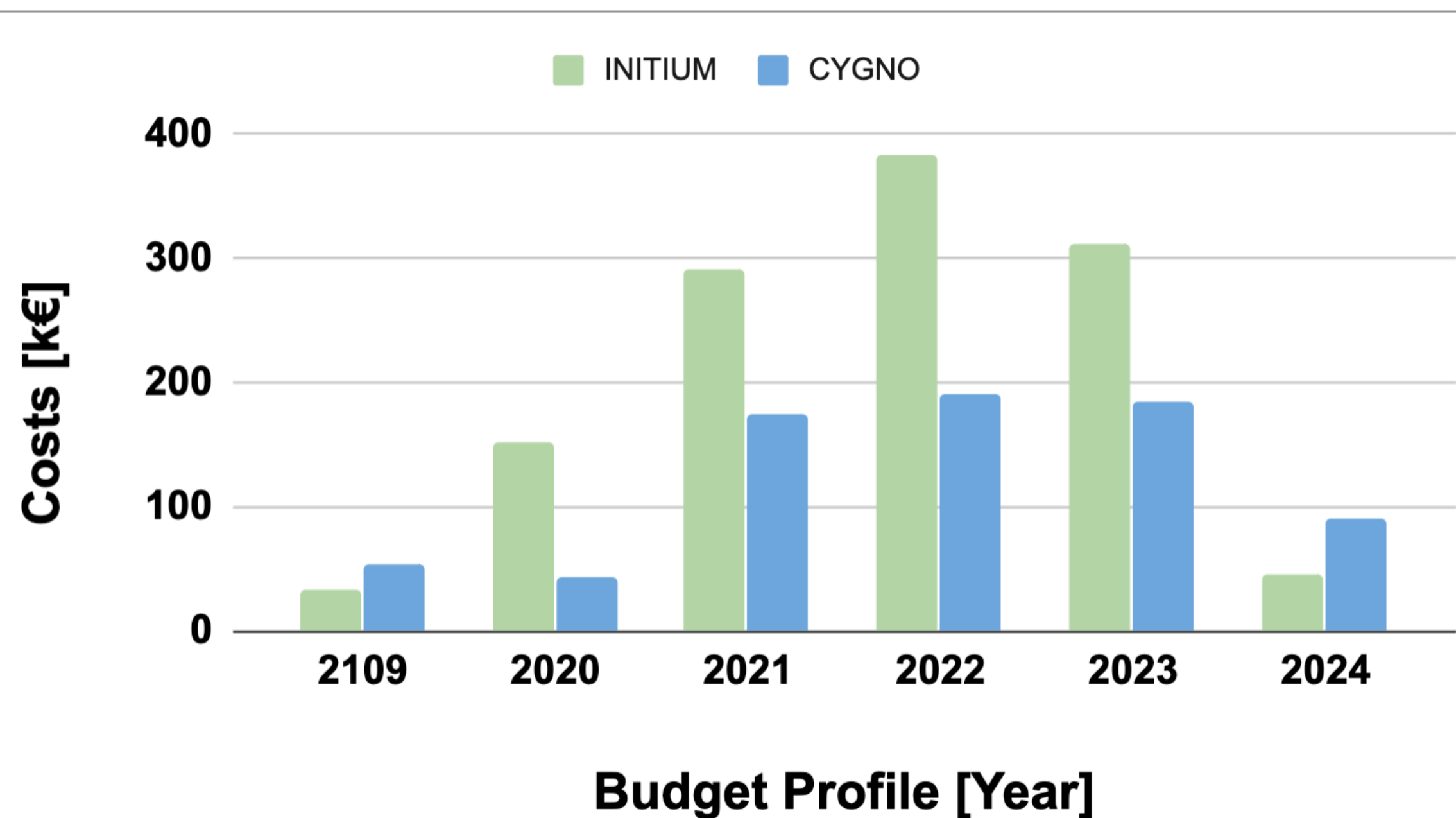
	FTE	Missioni (k€)	Consumo (k€)	Inventariabile (k€)	Transportations (k€)	Totale
LNF	2.8	18	30	8	3	59
LNGS	5.4	5	20	20	0	45
RM1	2.8	12.5	9	38	0	59.5
RM3	0.4	2	5	0	0	7
Totale	11.4	37.5	64	66	3	170.5

For **2020** we are asking a “**Sblocco SJ**” of **6 k€** for starting the development of a “detector monitoring system” based on Fibre Bragg Grating at LNF;

So far, we are **not asking** other “**Sblocchi SJ**” for **travels** and **transportations**;

BUDGET PROFILE

WBS ID	TASK	APPROVAL (2019)			DESIGN and PROCUREMENT (2020)			PROCUREMENT and CONSTRUCTION (2021)			CONSTRUCTION and INSTALLATION (2022)			COMMISSIONING – OPERATION (2023-2024)						Gran Total		
		CYGNO	INITIUM	Tot19	CYGNO	INITIUM	Tot20	CYGNO	INITIUM	Tot21	CYGNO	INITIUM	Tot22	CYGNO	INITIUM	Tot23	CYGNO	INITIUM	Tot24	CYGNO	INITIUM	Total
1.3.1	Safety & Health	5		5		0		0		0	5		5	5		5		0	15	0	15	
2.2.1	Vessel			0		0		20	20			0			0			0	0	20	20	
2.2.2	GEM			0		0			0		20	20			0			0	0	20	20	
2.2.3	FC & Cathode			0		0		12	12		0	0			0			0	0	12	12	
2.2.4	Lens			0		5	5		0		36	36			0			0	0	41	41	
2.2.5	Camera			0		16	16		0			0			160	160		0	0	176	176	
2.2.6	PMT/SiPM	5.5		5.5		0			0		21	21			0			5.5	21	26.5	26.5	
2.2.7	Shielding			0		0		150	150		200	200			77	77		0	427	427	427	
2.2.8	CRT			0		0			0			0			0		20	0	20	20	20	
2.2.9	DAQ & Storage			0		0			0		50	50		50	50		5	5	0	105	105	
2.2.10	Calibration			0		0			0		12	12			0			0	12	12	12	
2.2.11	High Voltage System		16	16		16	16		70	70		0			0			0	102	102	102	
2.2.12	Gas System	7		7		60	60	20	20			0			0			27	60	87	87	
2.2.13	Axiliary Services (Sensors)			0	6	6	6	8	20	28	0	25	25		5	5		14	50	64	64	
2.2.14	Gas Bottles	5.5		5.5	4	5	9	30	30	20	20	20	20	20	20	20	20	99.5	5	104.5	104.5	
2.2.15	Consumables	5		5	6	6	6	25	25	20	20	20	20	20	20	20	20	96	0	96	96	
2.6.1	R&D LIME/MANGO	16.5	5	21.5		0	0	20	20			0			0			36.5	5	41.5	41.5	
2.7.1	R&D GEM			0		0		5	5	5	5	5	5	5	5	5	5	10	0	10	10	
2.8.1	R&D Camera			0	4	4	8		0	80	80	80	80	80	80	80	80	164	4	168	168	
2.9.1	R&D Lens			0		10	10	5	5		0	0	0	0	0	0	0	5	10	15	15	
2.10.1	R&D DAQ		3	3	5	26	31	18	18		0	0	0	0	0	0	0	23	29	52	52	
3.2.1	Transportation			0	3	3	3	3	3	10	10	10	10	10	10	10	10	26	0	26	26	
	Total (detector)	44.5	24	68.5	28	142	170	134	272	406	140	364	504	135	292	427	40	25	65	521.5	1119	1614.5
	Travels	9.5	10	19.5	16	10	26	37	20	57	50	20	70	50	20	70	50	20	70	175.5	80	255.5
	Total	54	34	88	44	152	196	171	292	463	190	384	574	185	312	497	90	45	135	697	1199	1870



Total costs in 6 years:

CYGNO = 522 + 175 (travels) = 697 k€

INITIUM = 1119 + 80 (travels) = 1199 k€

OUTCOME FROM CSN2

General comments were positive;

President (Cremonesi) and Referees noticed that total amount of requests is not negligible, so we have to prepared to defend it;

Referees asked to meet before next CSN2 to discuss following items:

- INTERNAL BACKGROUND: maximum acceptable values and how to get there;
- LIME PERFORMANCE: response homogeneity, electrostatic stability, efficiency, discrimination, reco 3D...
- NON-LINEARITY: grid, software correction, hardware correction;
- CHINOTTO: performance and background in case we go with a smaller demonstrator;
- MILESTONES

INTERNAL BACKGROUND

Summarise results of simulations (RM1);

Collect information about low radioactivity copper, acrylic and other materials (LNF?);

Measure radioactivity of Kentaru foil (GSSI);

Measure radioactivity and “broken” camera, as soon as it arrives (GSSI);

Get in contact with T-Rex people to start studying low radioactive GEM (LNF);

LIME PERFORMANCE

We already took a lot of data (1e5 images). Analysis needed:

- stability for weeks;
- ^{55}Fe ;
- AmBe;
- ^{137}Cs ;
- Cosmics;
- Pedestals;
- Giovanni+Emanuele+Igor are looking at the data. We should have some results in few weeks;

NON LINEARITY

Software

Francesco+Emanuele provided a recipe to correct the gain. We'll test it on new LIME data;

Hardware

We should add a grid to LEMON and try to work with lower gain. Is it feasible at LNF?

CHINOTTO

Simulation of performance (GSSI) and background (RM1) of a smaller (0.4 m³) with a thinner shielding (110 cm water and 10 cm copper)

MILESTONES

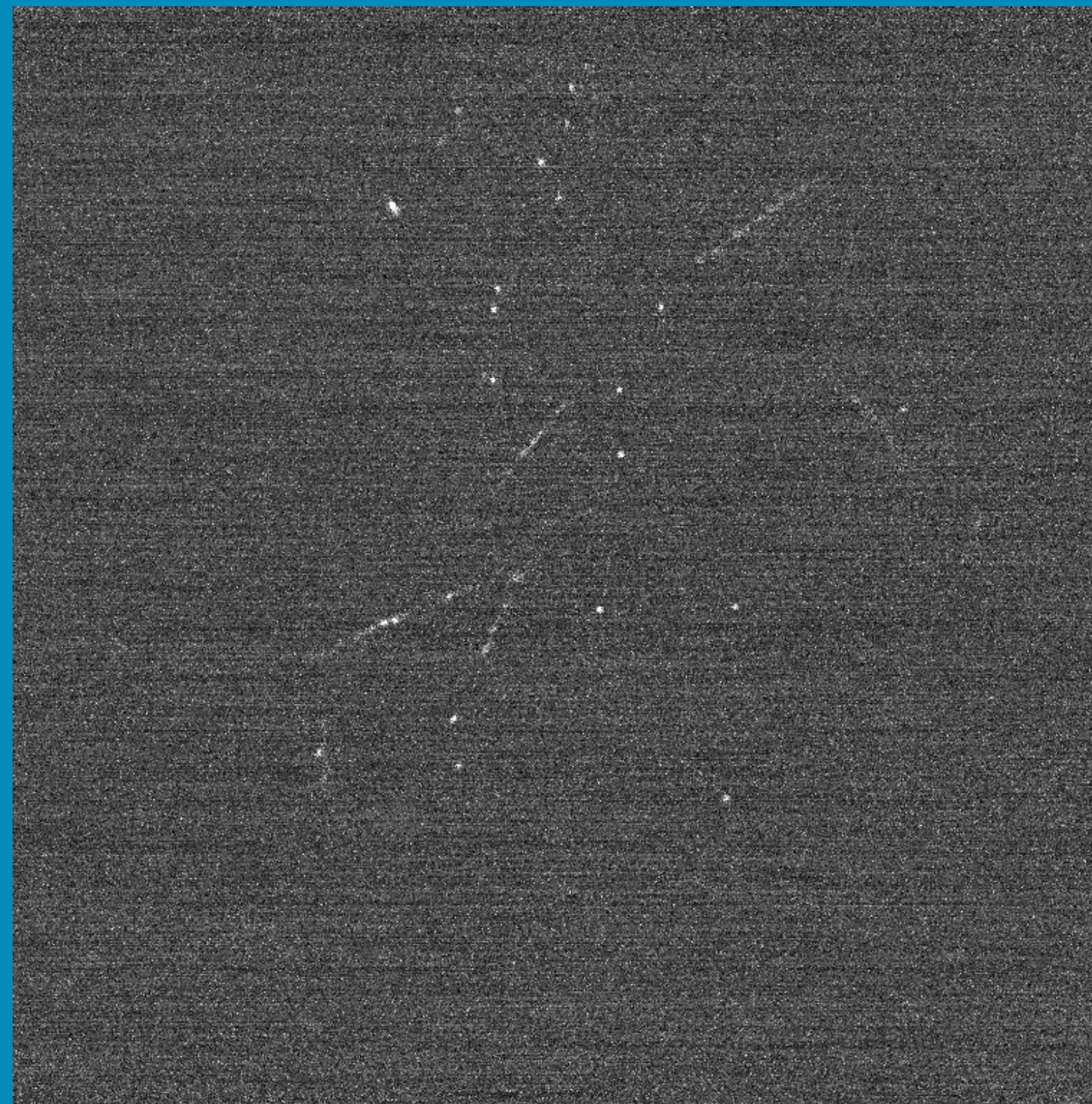
31-07-2020	Valutazione dei fondi di radioattività
30-09-2020	Studio performance Reiezione e Direzionalità
31-12-2020	Test prototipo LIME in ambiente a bassa radioattività.

OK
OK

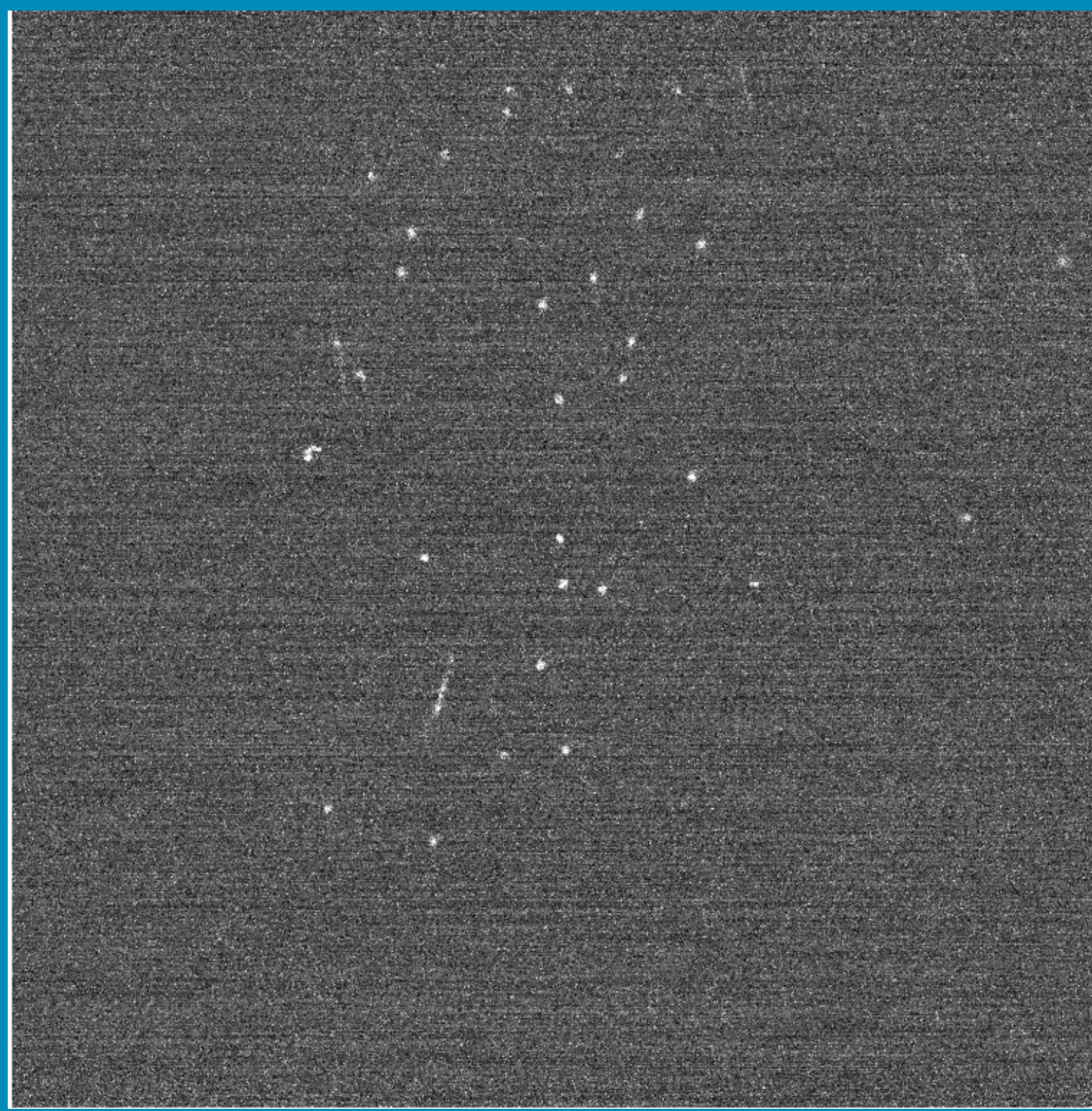
Any possibility to go in a low radioactive environment?

LIME - ^{55}Fe SPOTS

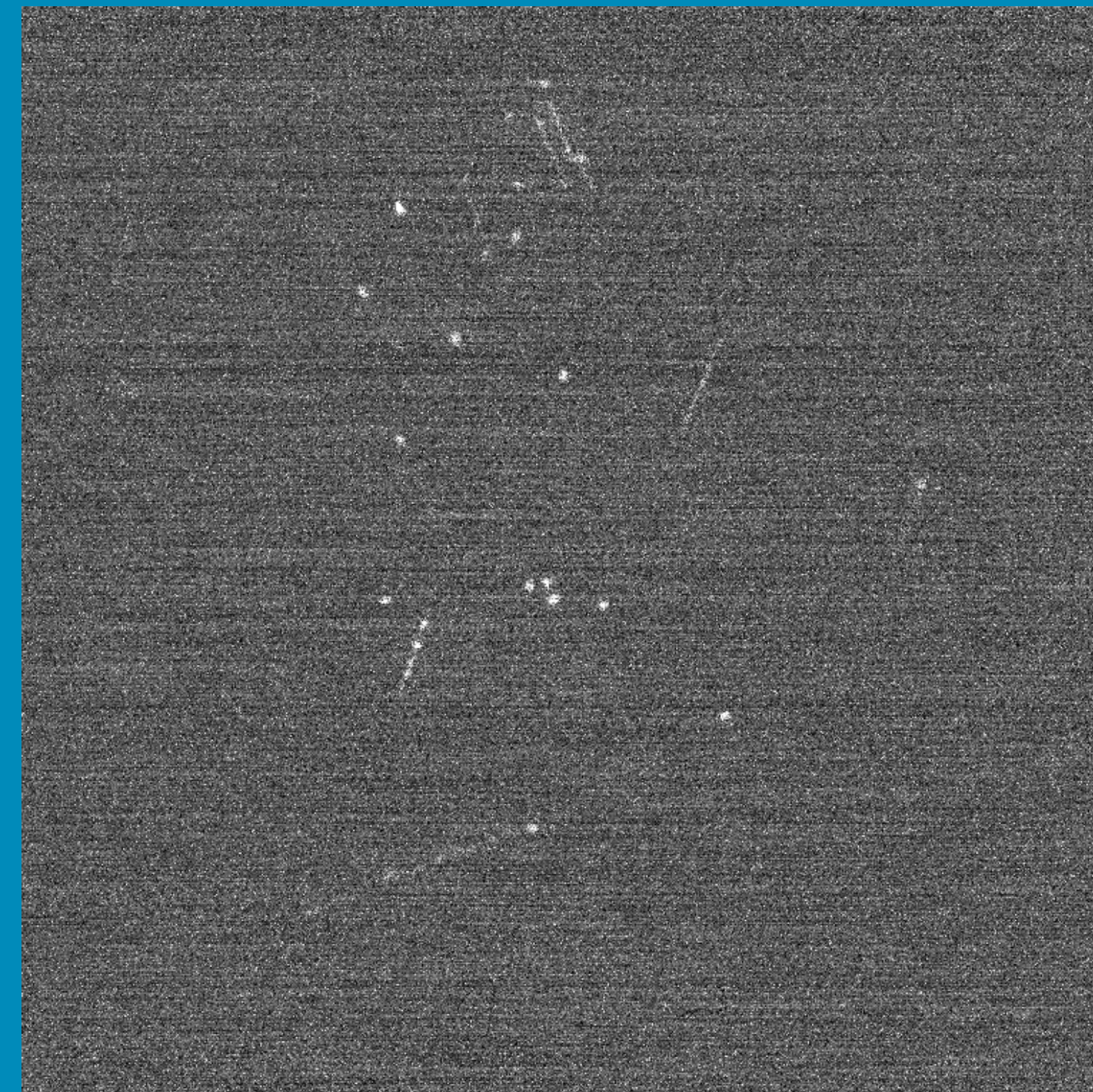
- 5 cm from GEMs



- 20 cm from GEMs

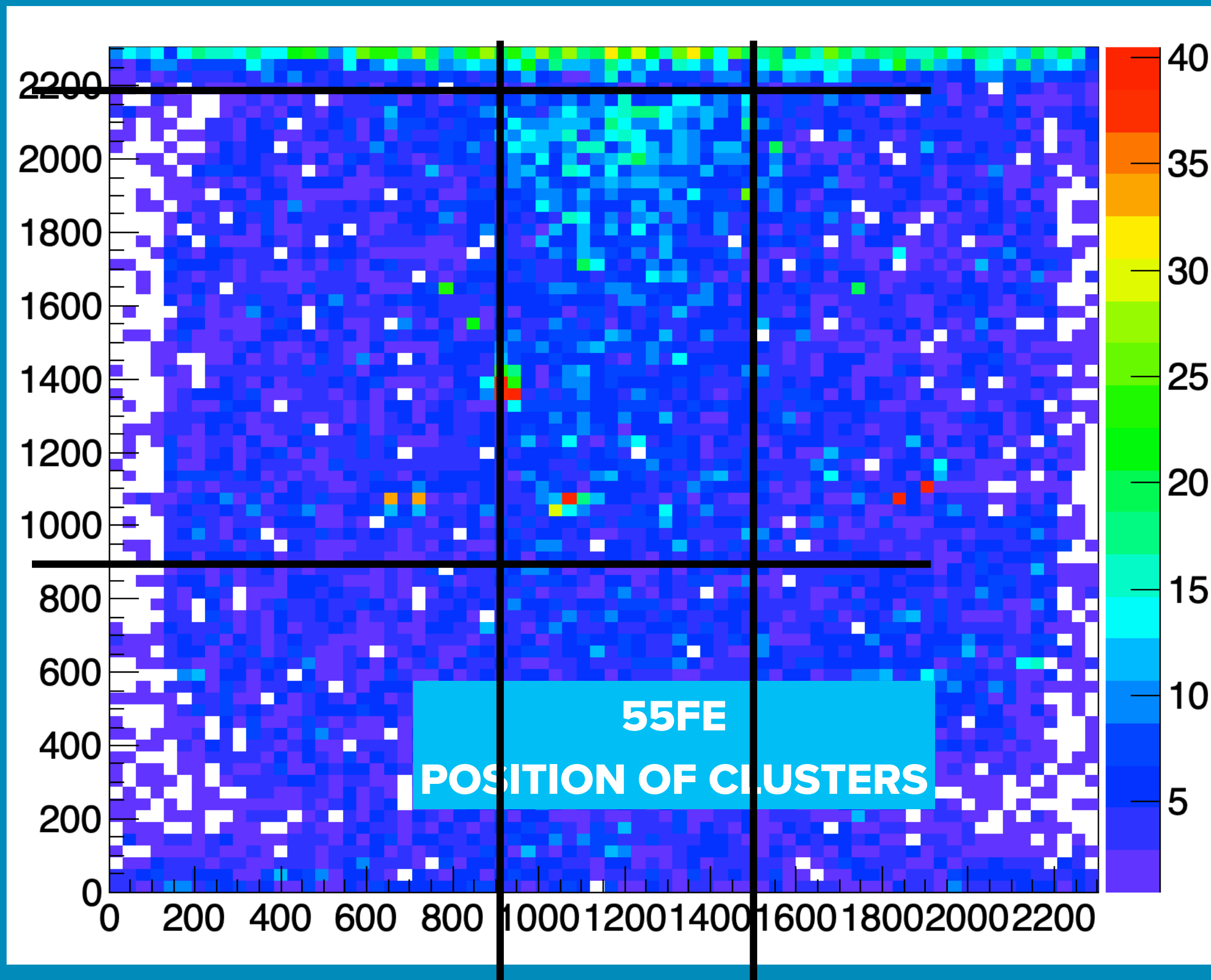


- 45 cm from GEMs

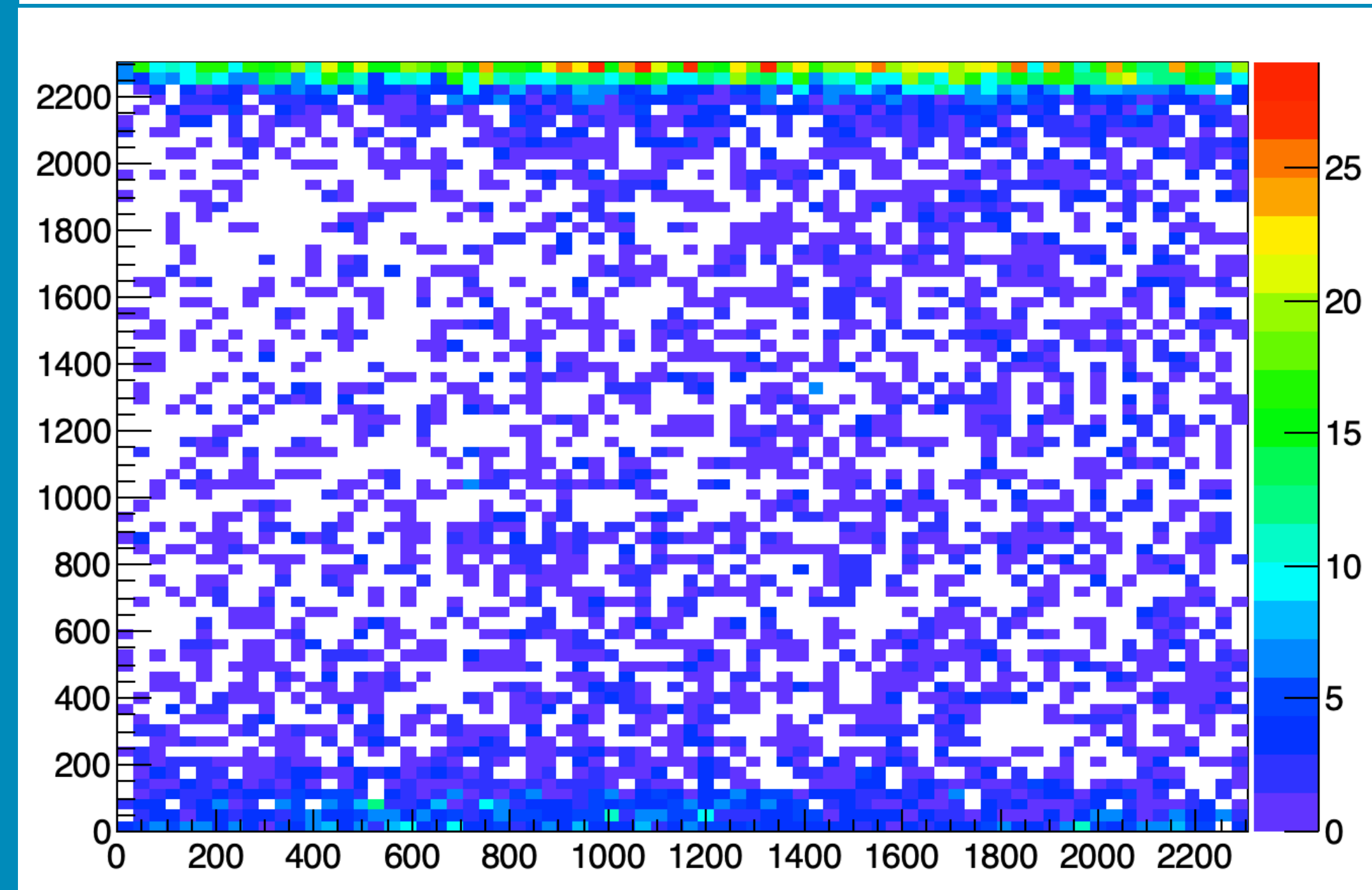
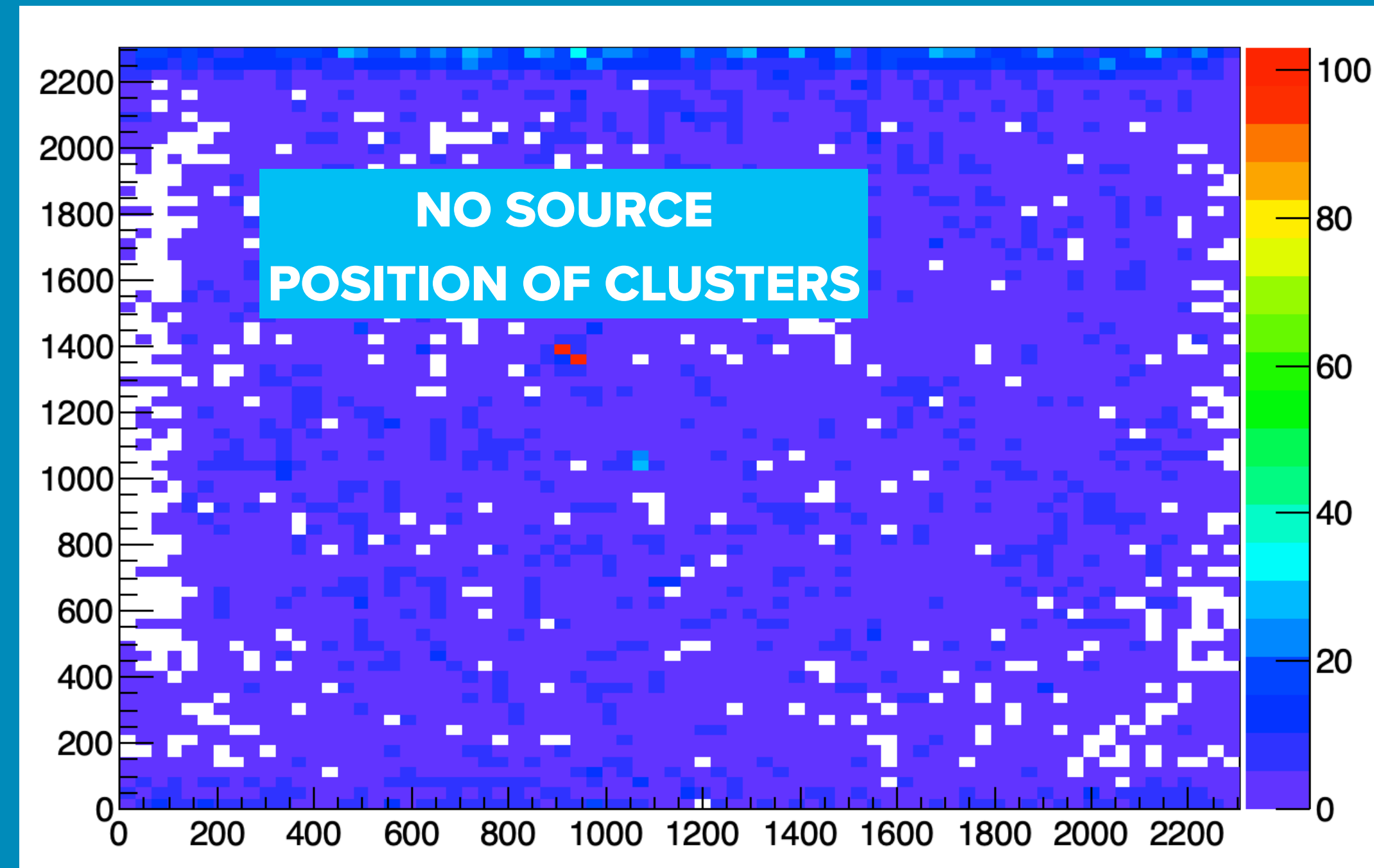


$V_{\text{GEM}} = 440$, $E_{\text{D}} = 0.8$ kV/cm

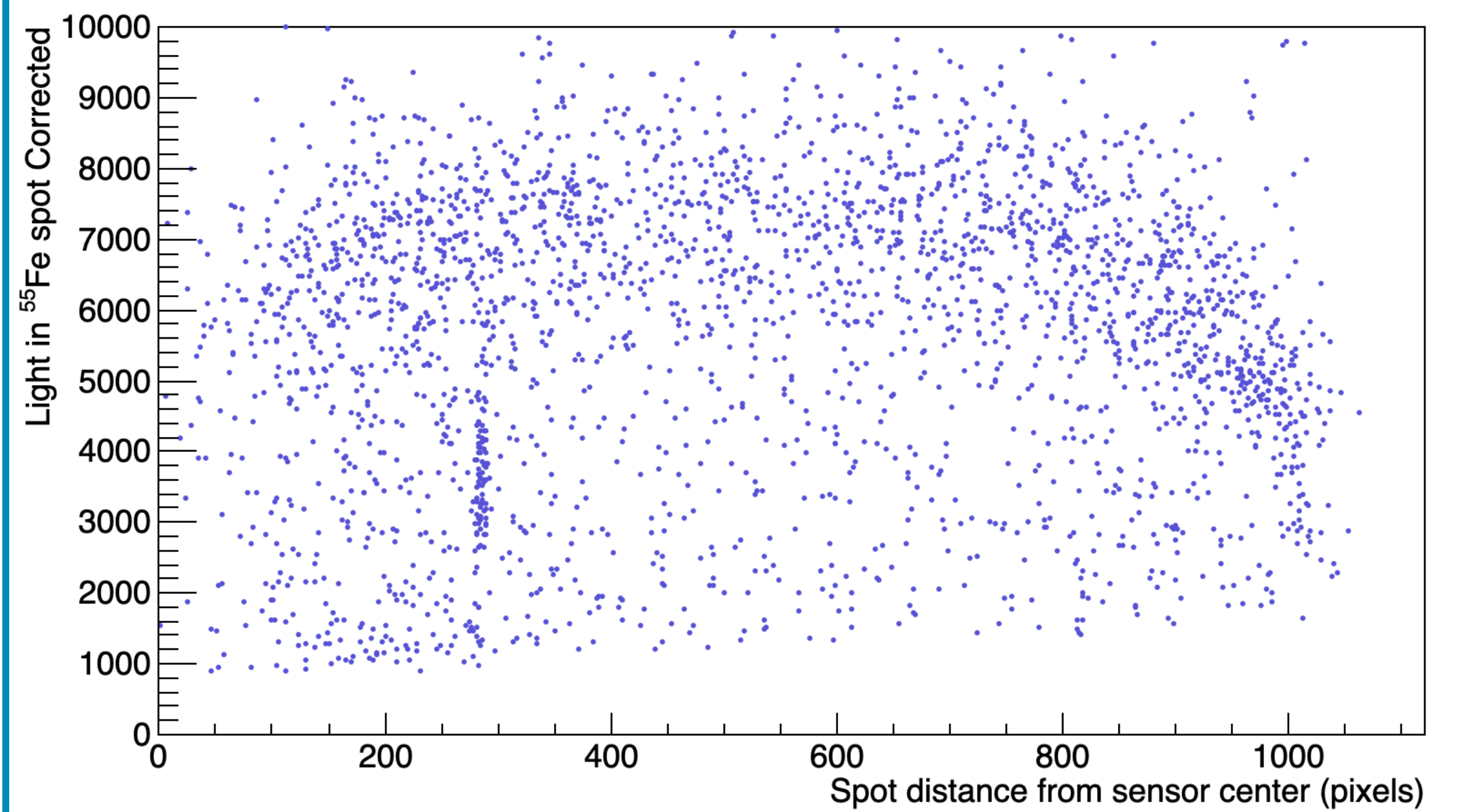
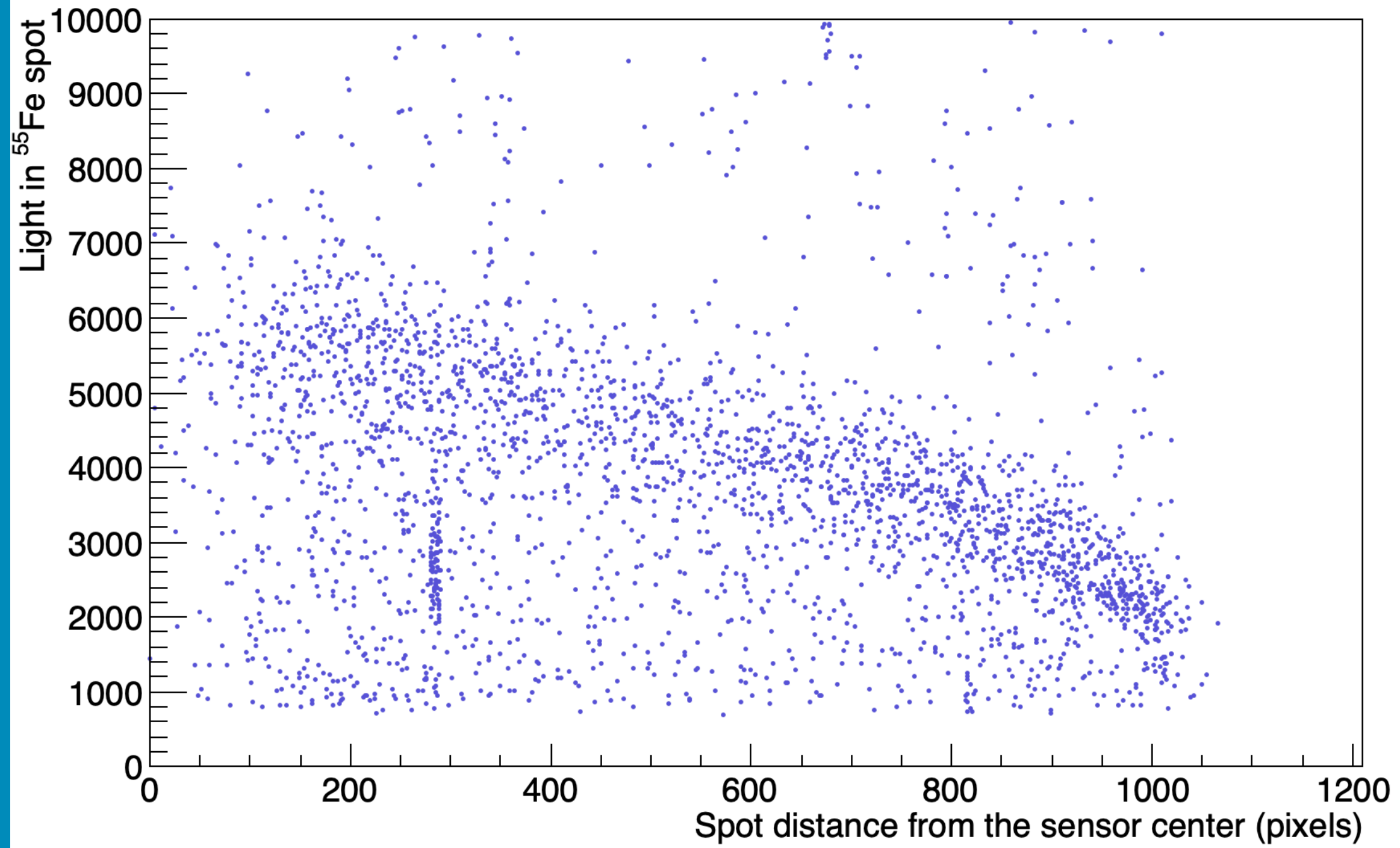
No evidence of large efficiency drop



GEM OFF
POSITION OF CLUSTERS



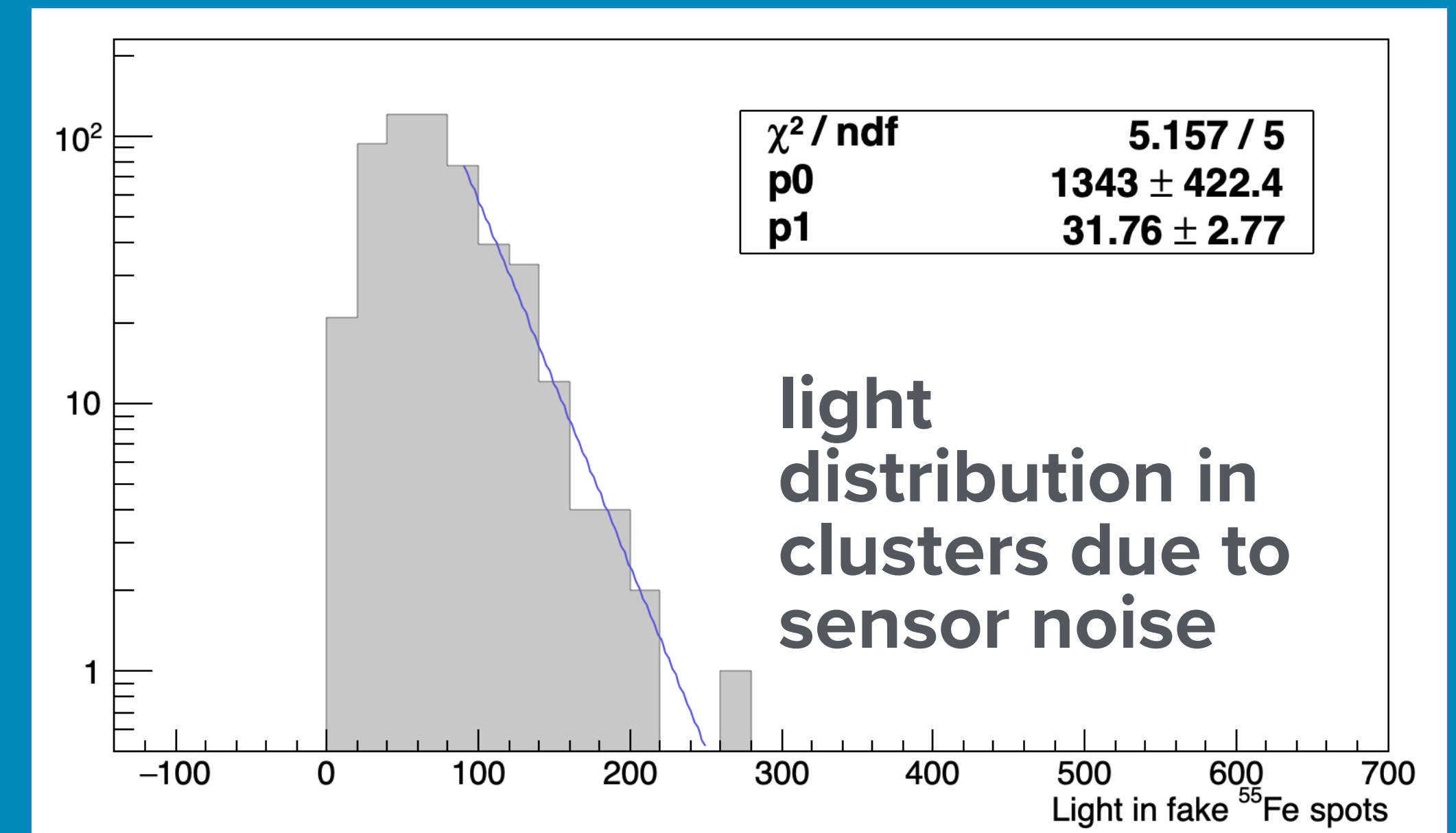
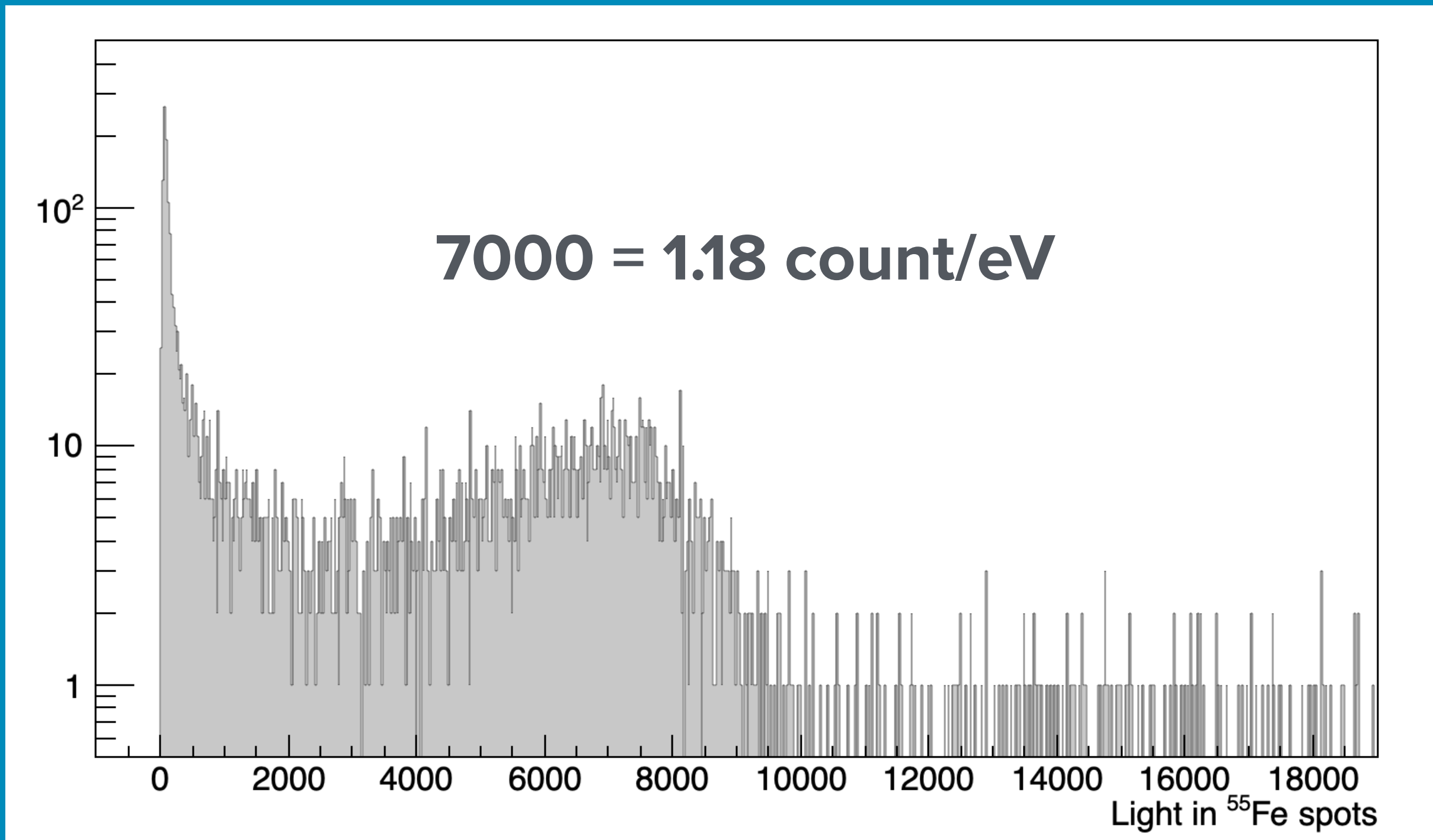
Z=15 CM (FROM GEM)



Charge Loss or Optical effect?

Let's assume 2.05 over 850 pixels

After a not-even-suboptimal linear correction



thr 1 keV = 1180 counts

acquired 0.3 sec (need to multiply by a factor 10^8 to evaluate 1 year);

number of “fake clusters” in 10 years < 0.0001 ;