ECal Status

02-06,10,2023
Belgrade, Serbia
I.Tyapkin

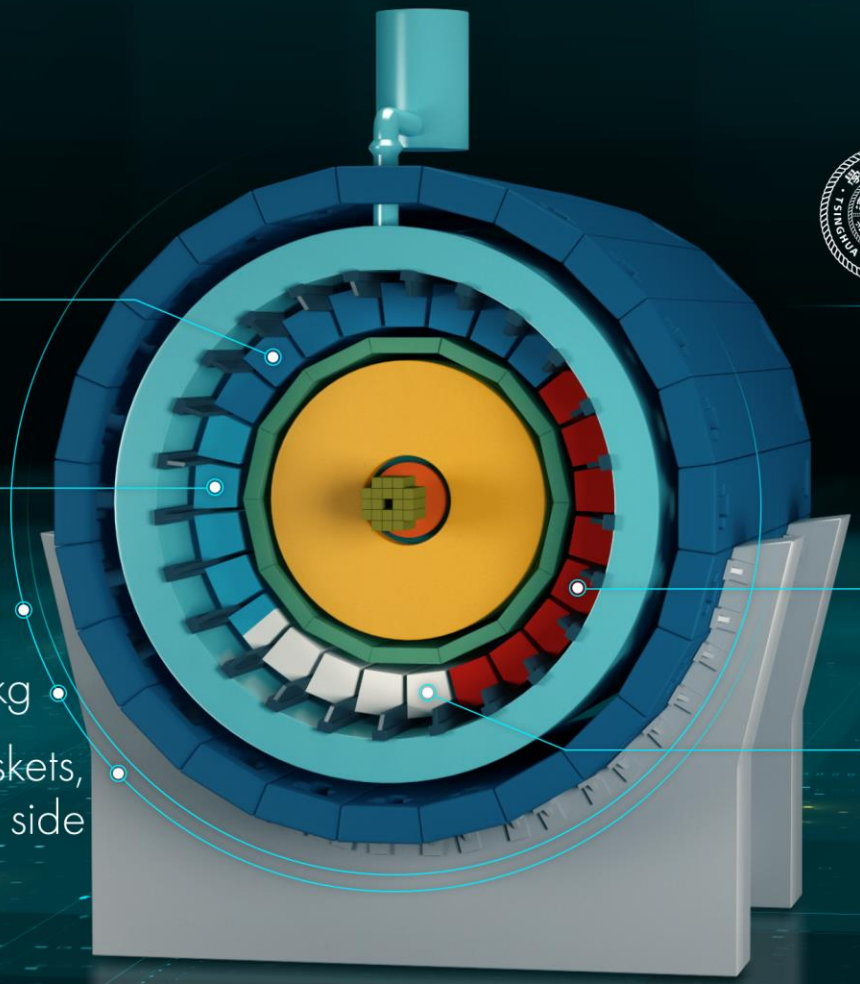
800 produced by JINR

400 in production at JINR

38,400 channels

2,400 modules in total, about 70,000 kg

50 slots for ECal baskets,
25 on each side

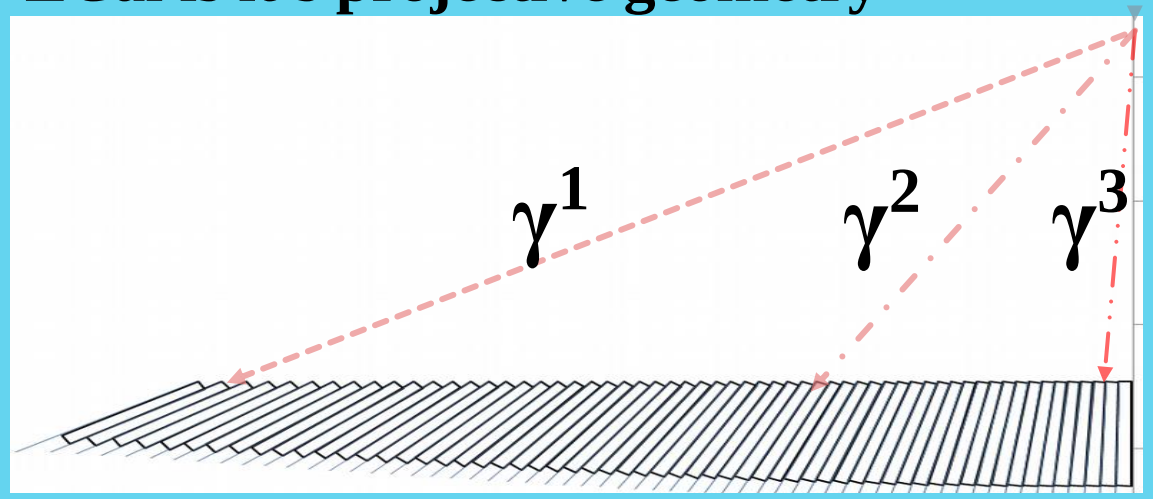


Chinese universities involved
in the calorimeter project

800 produced by China

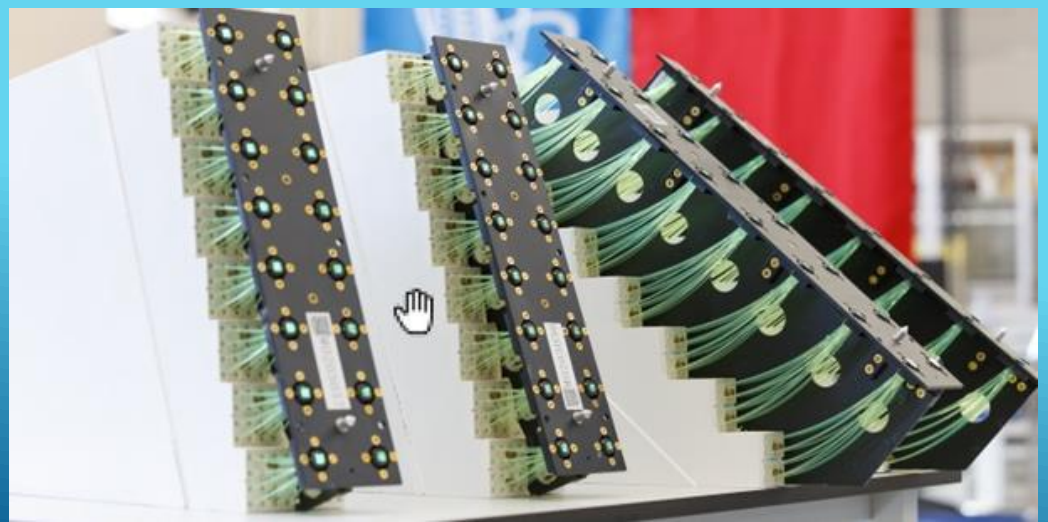
400 expected from China

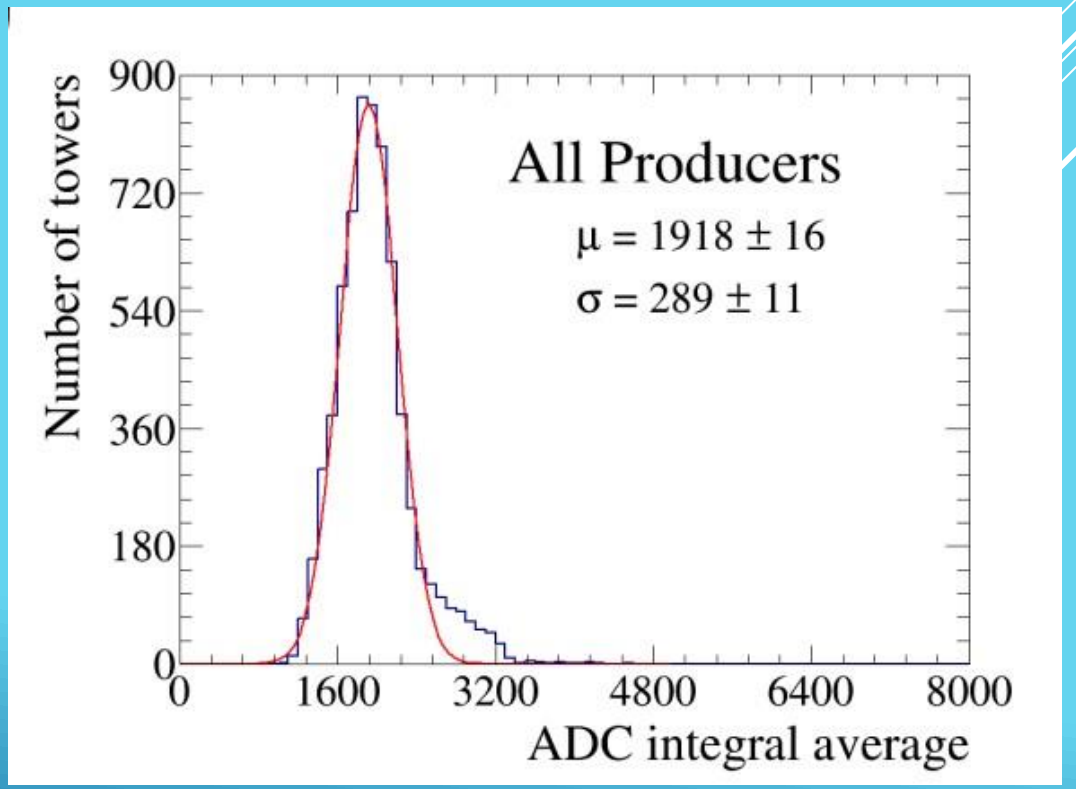
Main advantage and in the same time main construction complication of our ECal is it's projective geometry



In total 1600 modules produced in Russia and China
All modules are already tested by means of cosmic muons and none of modules was rejected due to the bad results of these tests.

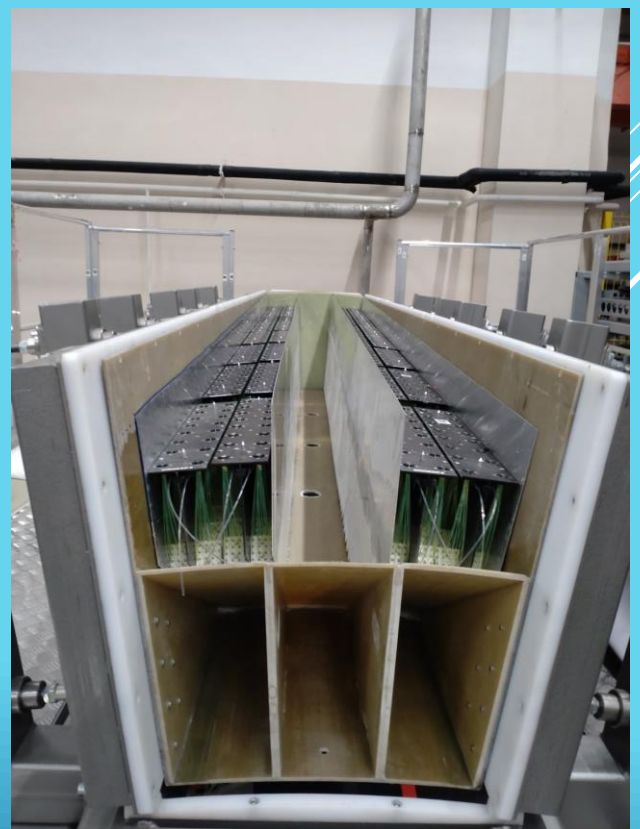
\+ **Better energy and space resolution**
\- **Many detector types with complicated shape**





Specially designed slipway used to assembly 16 modules of 8 types in one cluster.
100 clusters are already produced

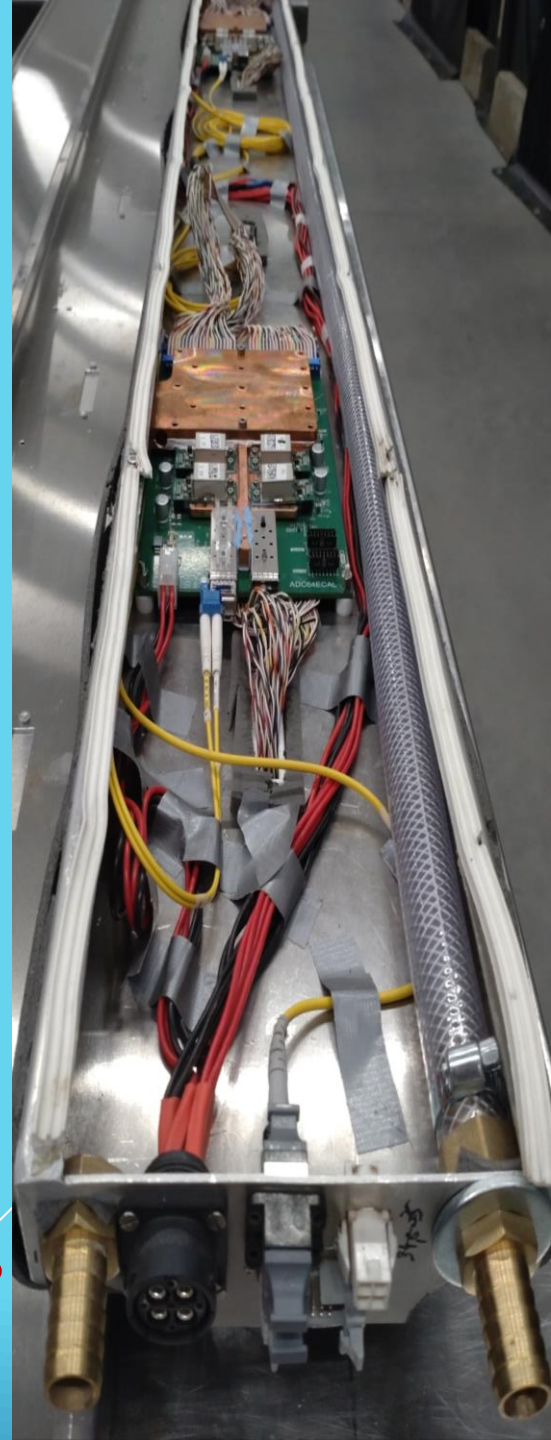
Each half sector basket consist of three clusters.
To fill basket by the clusters one more slipway designed and produced.
The main feature of this slipway is a very strong walls on the side to keep basket in the size limits of slots dedicated in the MPD.
32 baskets are assembled and ready for the final step of assembling procedure - installation of electronics.



Electronics mounted in the basket consist of HV+Slow Control boards mounted directly on each module and ADC boards in the cooling box.
Due to the rathe high power dissipation in the ADC boards they are separated from the detector volume in the cooling box.

One half sector basket is fully assembled with electronics and stay under stability test during last few months.
Results – in a minute

In September electronics mass assembling was started.
All materials and electronics components are in stock.
32 half sectors can be equipped with electronics and installed on the tests in few months.



In summarizing –
In the beginning of 2024 all produced modules may be installed in the 32 half sector baskets and will be ready to be inserted in the MPD in June 2024.

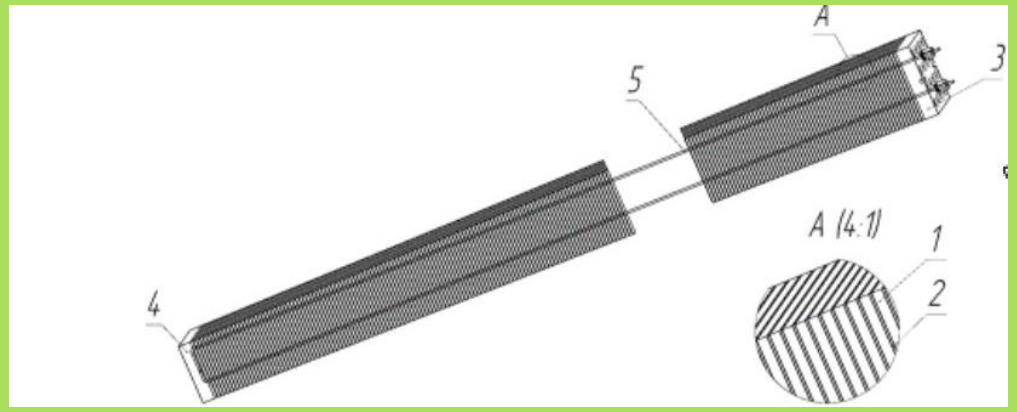
It will form 64% of full calorimeter.

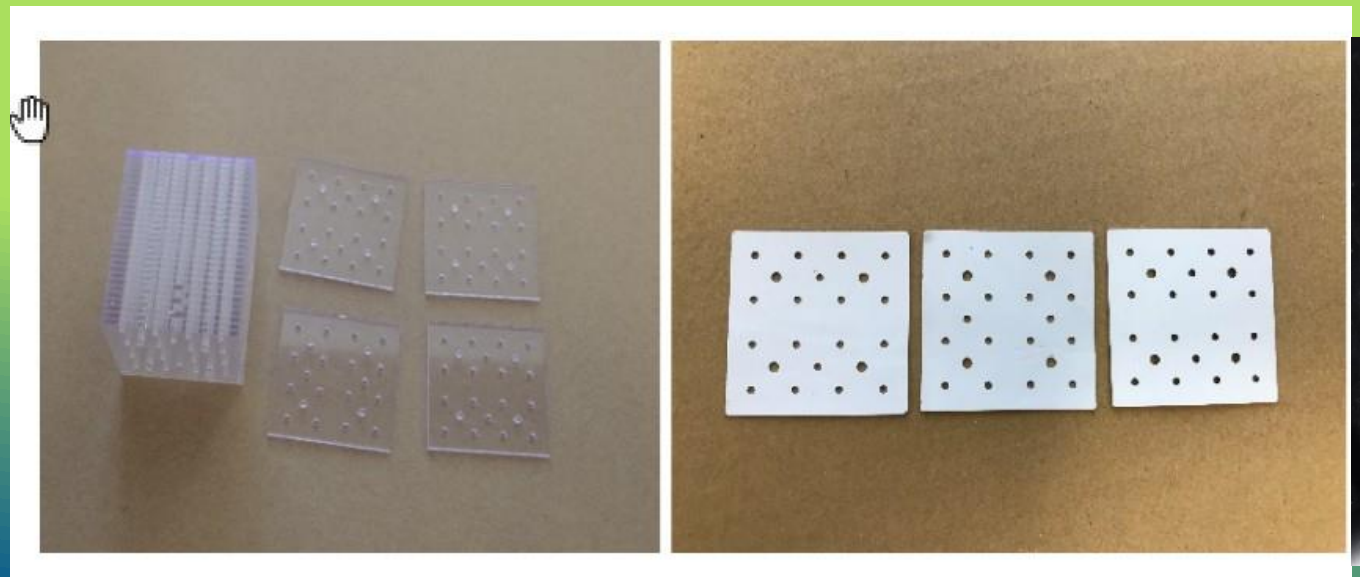
Next few slides will be dedicated to the possibility of the ECal coverage increase

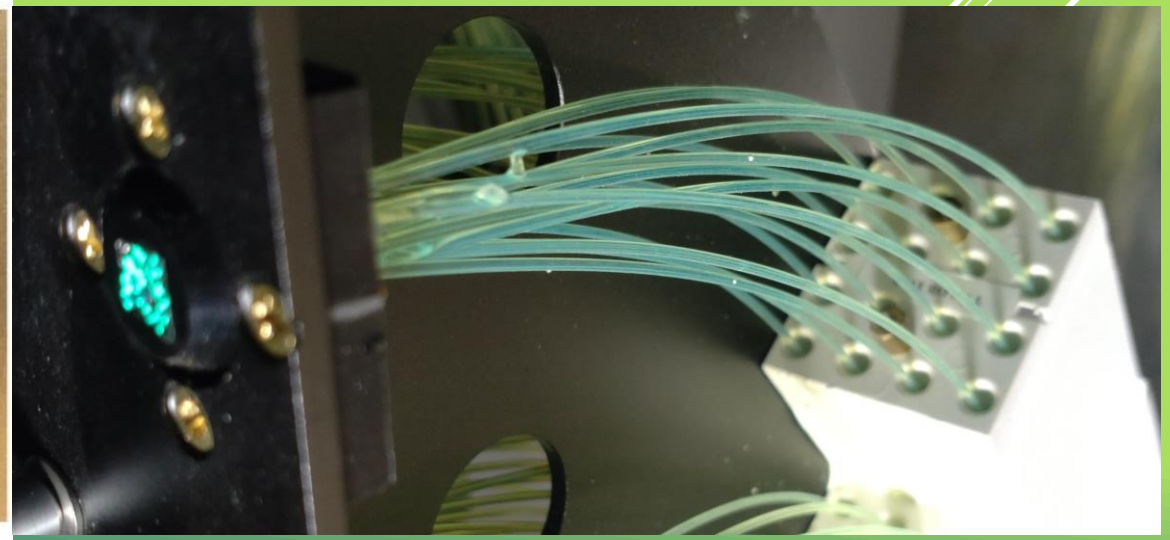
One of the key elements of calorimeter construction is WLS fiber from the KURARAY (Japan).
We can not get it any more

Solution

1600 ECal modules out of 2400 have been already manufactured
800 more modules needed to complete ECal building
All materials, equipment and competencies are in our hands to build those 800 modules.
Except WLS fibers which is most crucial element of module construction.







The only well known producer of WLS fibers, used in the high energy physics detectors, is KURARAY from Japan.
Number of serious barriers is appear now obstructing for us to use this provider –

1. Sanctions
2. Factory is closed right now for one year for modernization
3. Slow production rate

To find WLS producer a search was made in Russia

Moscow

The main goal of LumInnoTech LLC is research and development of novel functional materials for applications in high energy physics (plastic scintillators, wave lengths shifters) and organic optoelectronics (organic light-emitting diodes, solar cells, photodetectors).

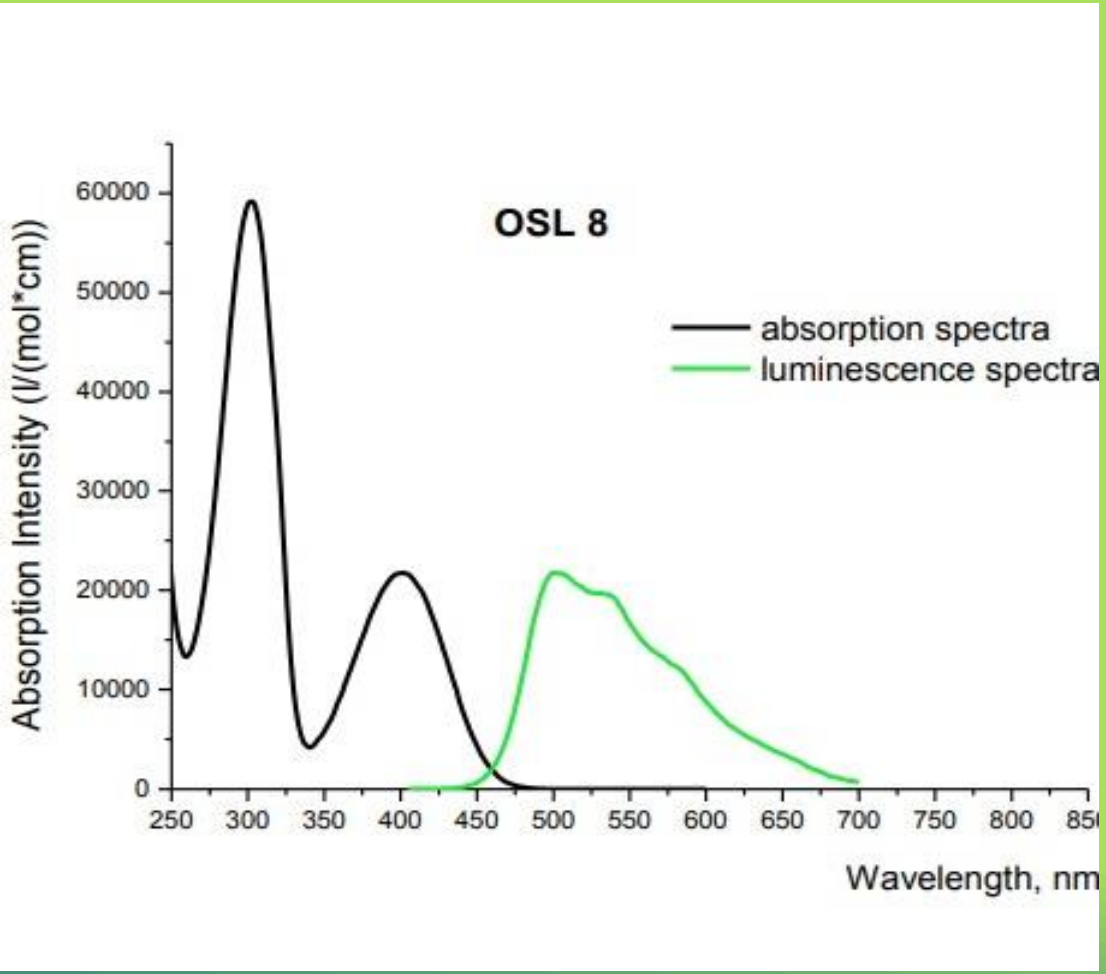
OrganoSilicon Luminofores OSL

Cat No.	Absorption λ_{max}, nm	Kext max, l/(mol*cm)	Luminescence λ_{max}, nm	PLQY, %	PL decay time , ns	Emission colour
OSL1	289	39400	352	93	0.75	
OSL2	305	56000	359, 375	91		
OSL3	364	69000	397, 420	94		
OSL4	366	69100	422	97	1.04	
OSL5	383	62700	431, 459	88		
OSL6	256 348	32200 39500	440*	98*	1.93* 2.76**	
OSL7	277 386	35600 14000	487	97	7.36	
OSL8	302 401	51000 21800	501	84	5.39	
OSL9	312 405	35000 11600	529	95	4.36	
OSL10	325 406	83000 33000	539	81	3.50	
OSL11	322 416	57100 27000	541	73	4.44	
OSL12	299 423	35800 17300	547	92	9.74	
OSL13	308 428	48300 20600	583	97	8.09	
OSL14	320 435	50200 25500	587	91	7.13	
OSL15	316 455	35100 19100	590	95	10.7	
OSL16	348 424	61100 40300	591	64	2.68	
OSL17	356 429	49100 46000	597	60	2.62	
OSL18	335 476	39200 28700	600	86	8.37	
OSL19	263 302 412	99900 18500 20100	610*	60*		

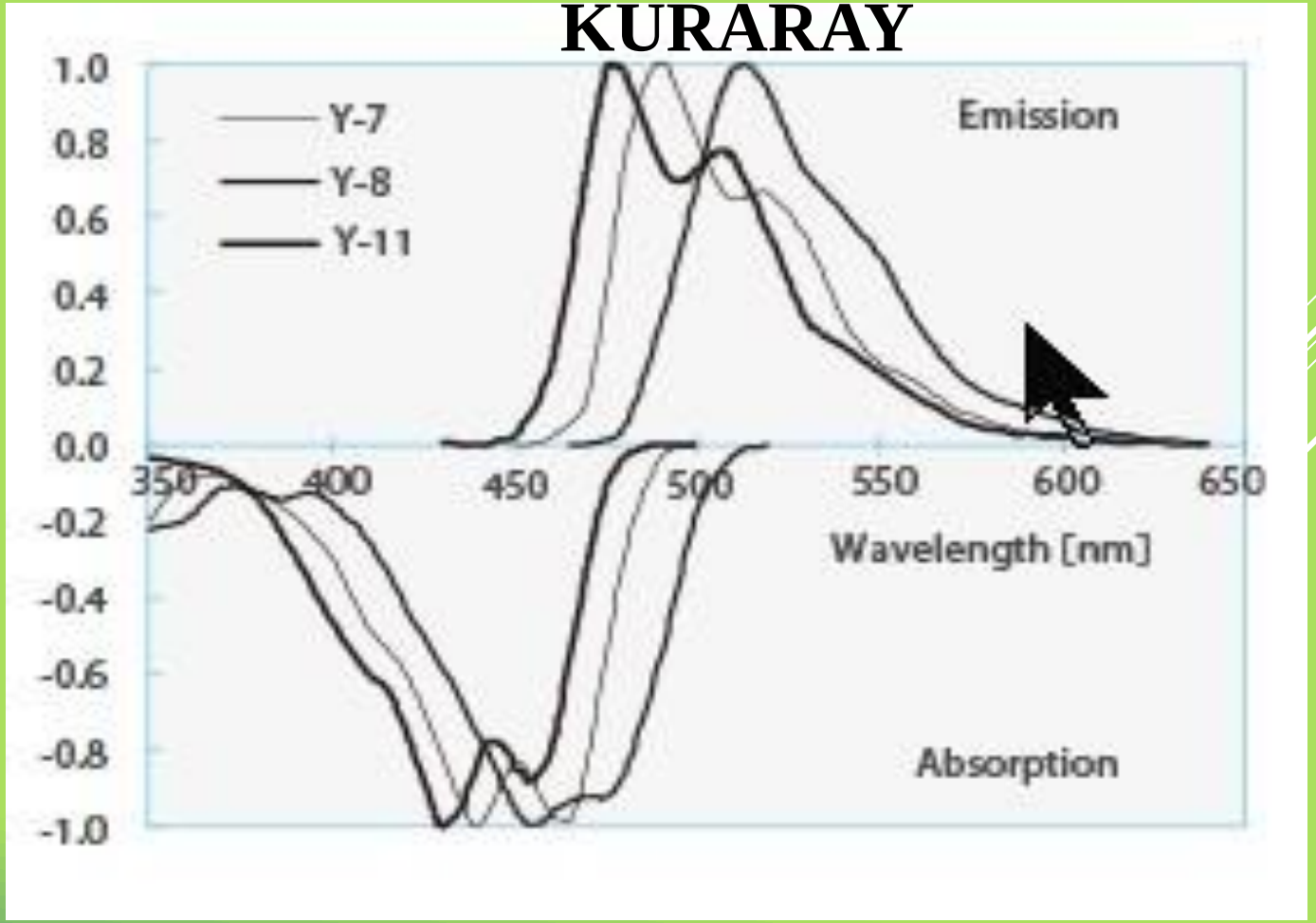
Nanostructured Organosilicon

Cat No.	Absorption λ_{max}, nm	K*10^4 M^{-1}*cm^{-1}	Luminescence λ_{max}, nm	FWHM, nm	PLQY, %	PL decay time, ns	Emission colour
NOL	213, 262, 335	5.0	390, 412	51	80	0.75	
NOL2	213, 262, 366	6.7	390, 420	42	78	0.86	
NOL3	213, 262, 335	5.8	377, 390	45	85	0.73	
NOL4	213, 262, 367	7.4	396, 420	65	96	1.04	
NOL5	213, 262, 375, 396	12.5	416, 436	60	82	4.47	
NOL6	213, 262, 316, 457	6.5	588	120	87	7.75	
NOL7	296, 367	9.6	396, 419	70	96		
NOL8	337, 348	6.6	396, 419, 443	38	85	0.87	
NOL9	327, 455	7.4	588	115	95	7.17	
NOL10	337, 513	6.1	655	95	78	5.23	
NOL11	332	11.7	396, 420	65	96	0.98	
NOL12	296, 369	9.8	398, 422	65	98	0.98	
NOL13	319, 400	7.1	502	105	83	4.70	
NOL14	302, 402	10.1	502	110	90	5.38	
NOL15	375, 455	7.5	588	110	65	6.55	
NOL16	296, 386	12.7	486	70	99	5.45	
NOL17	340, 385	7.7	438, 468	70	94	0.90	
NOL18	328, 388	8.4	438, 468	70	93	0.83	
NOL19	340, 385	6.4	438, 468	72	87	0.93	
NOL20	213, 262, 388	7.5	468	73	84		
NOL21	332	9.5	396, 420	68	93	0.93	
NOL22	321, 333, 345	11.5	398, 422	66	98	0.91	
NOL23	337, 348	7.3	396, 419, 443	44	74		
NOL24	308, 368	6.9	398, 419, 443	44	85		
NOL25	310, 342	9.0	390, 412	56	75		

OSL8	302 401	51000 21800	501	84	5.39	●



KURARAY



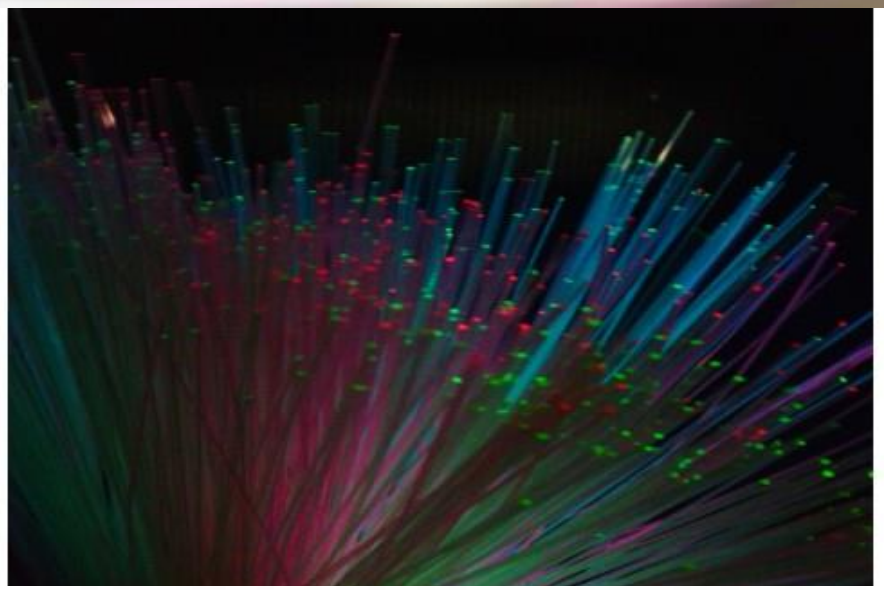
ТЕХНОЛОГИЧЕСКИЙ ЦЕНТР ПОЛИМЕРНОГО ОПТИЧЕСКОГО ВОЛОКНА

RU | EN

Tver’

Technologycal center of polymer optical fiber

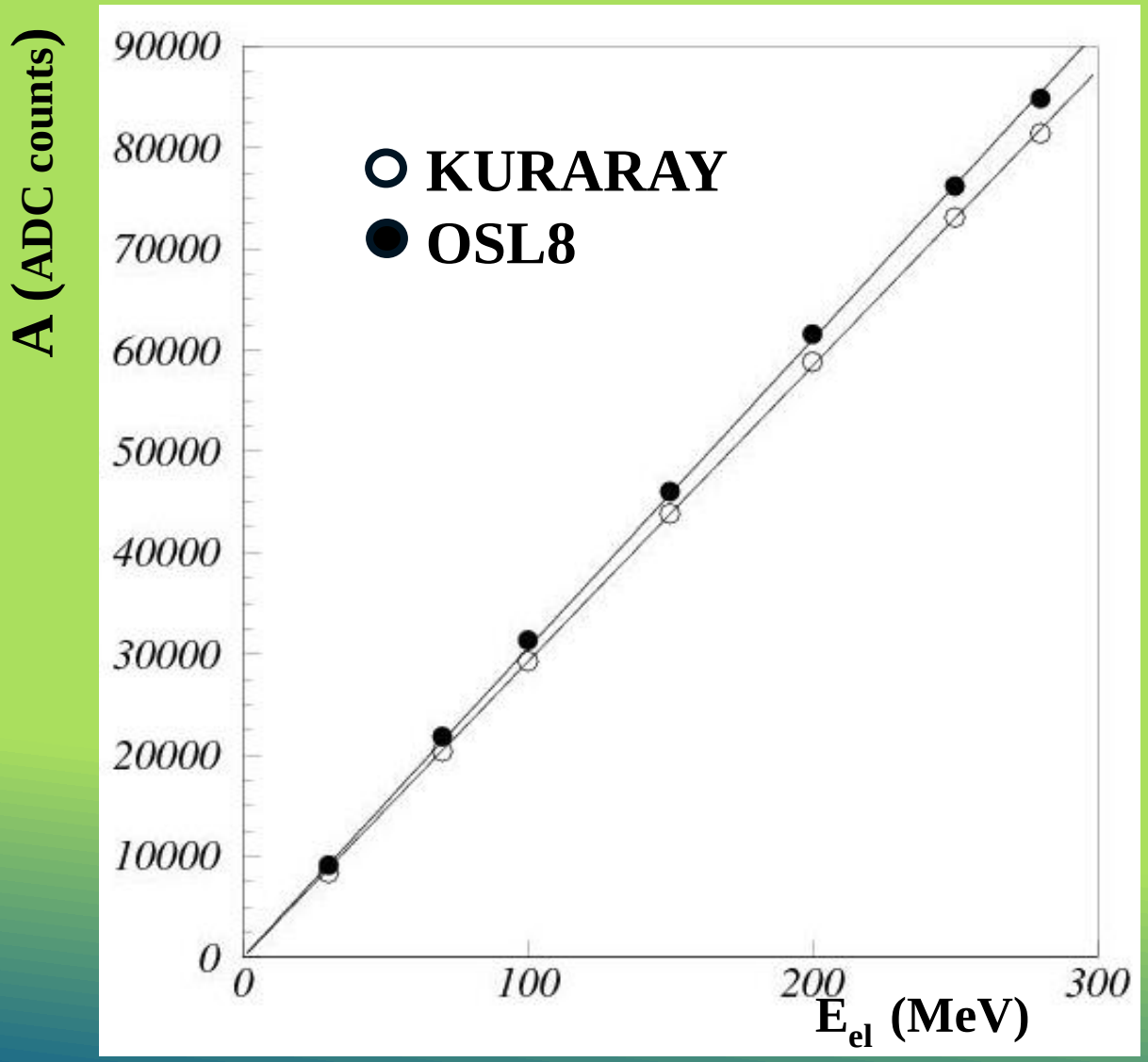
- Polymer optical fiber (0.15-3.0 mm)
- Optical fiber cable
- Multi-core optical bundles
- Side glow fiber
- Scintillating fiber
- **WLS fiber**
- .....

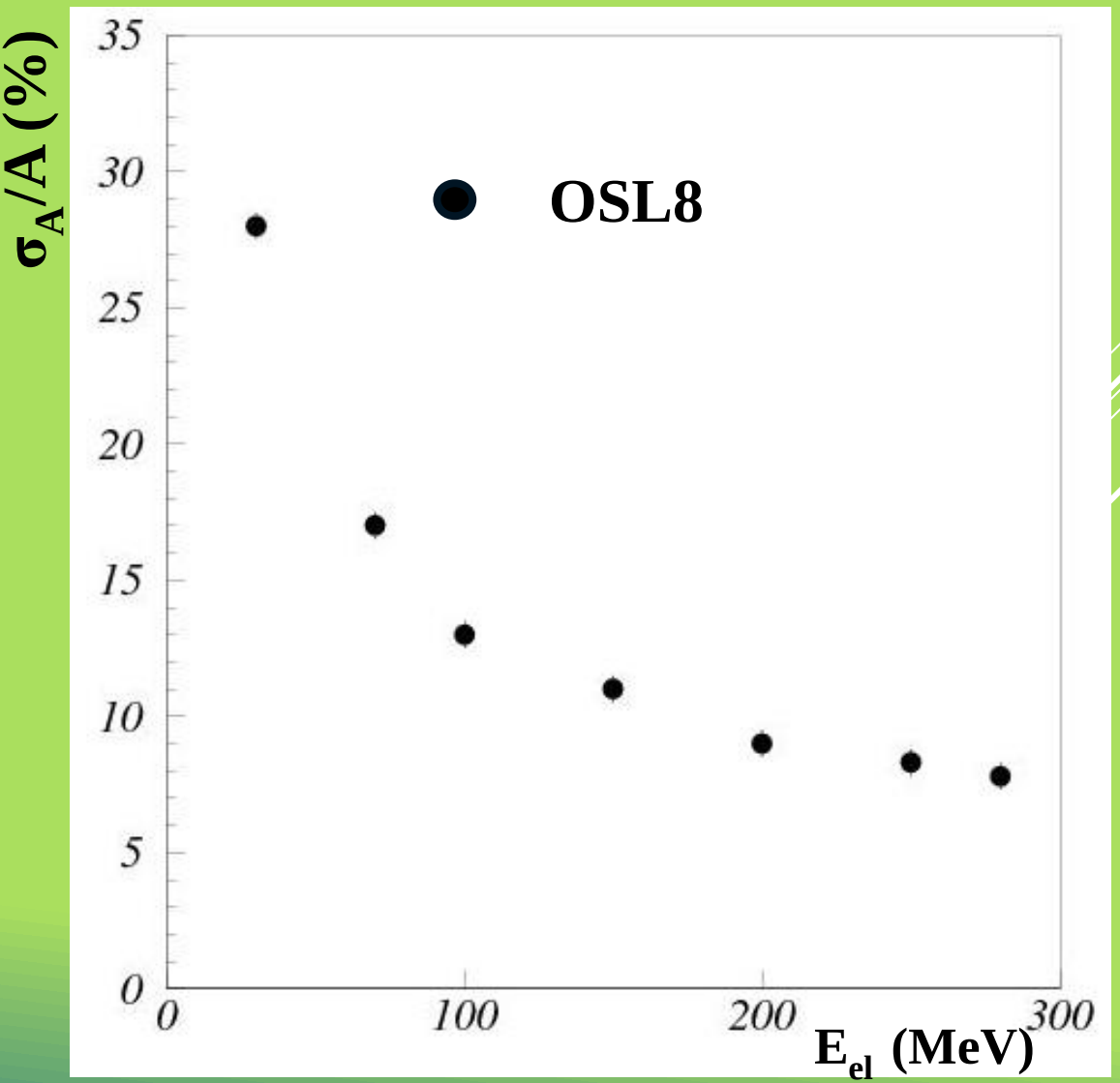


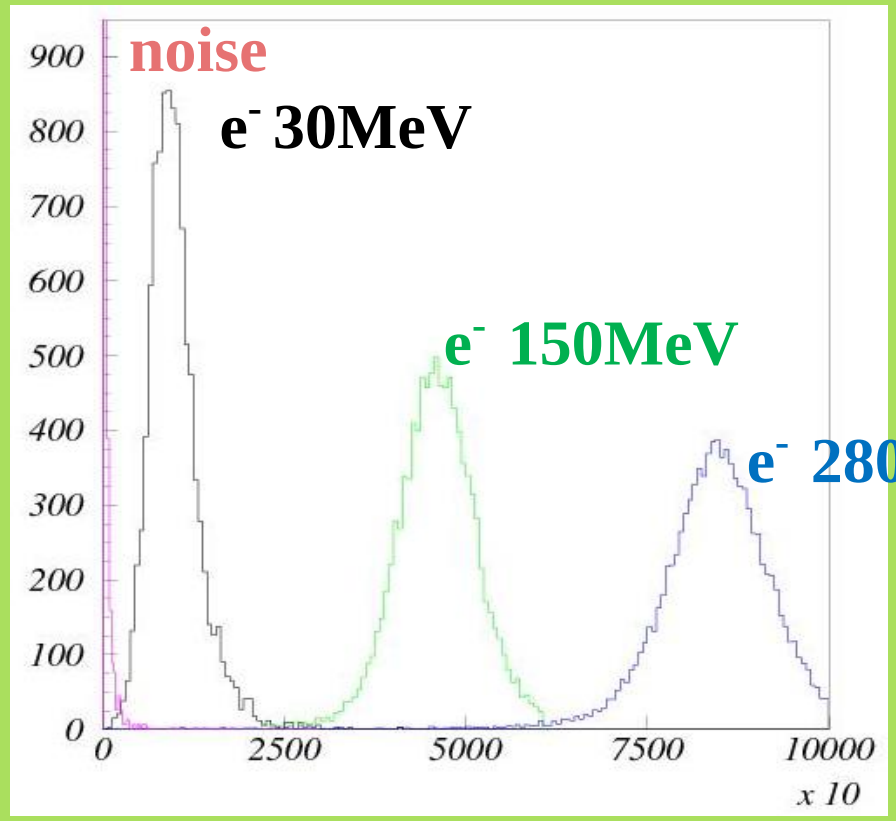
WLS fibers

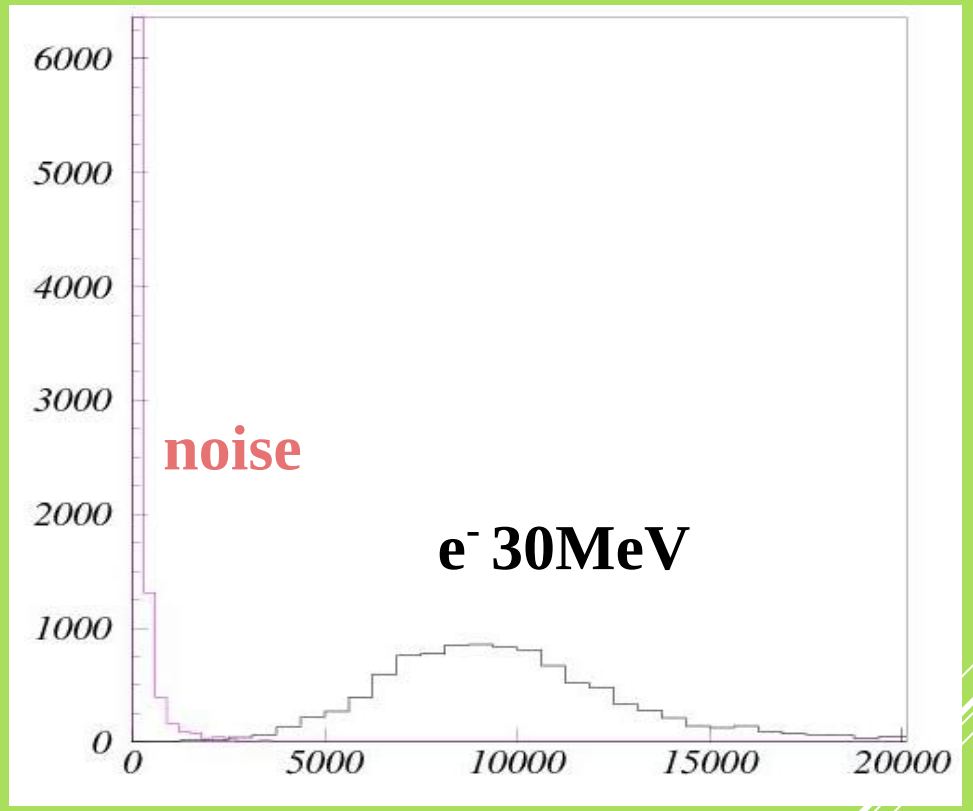
Module with OSL8 fibers has been manufactured

Test has been done in Troitsk. Electron beam









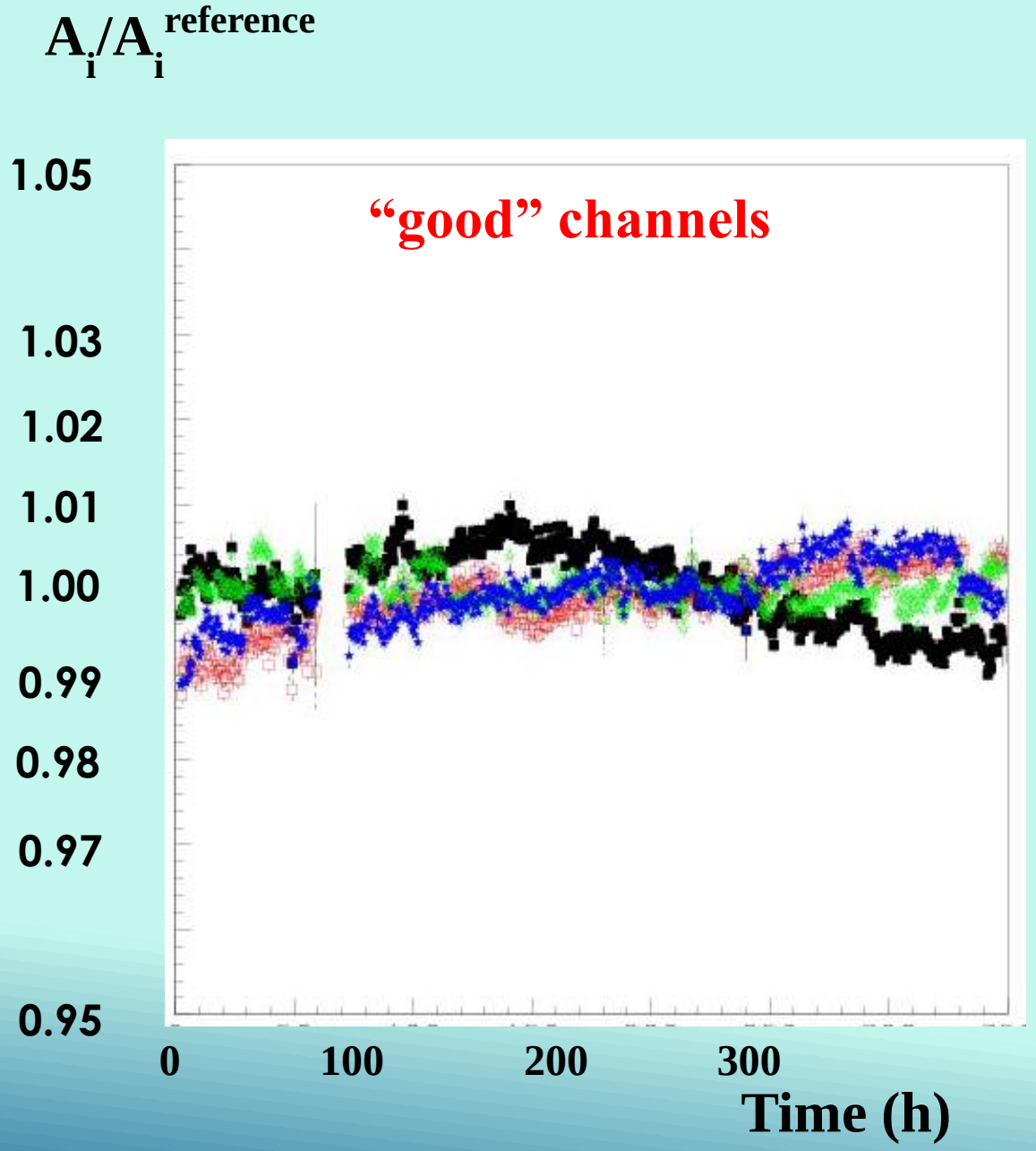
Tests of new modules equipped by the OSL8 WLS demonstrated good results very similar to the modules with KURARAY WLS fibers.

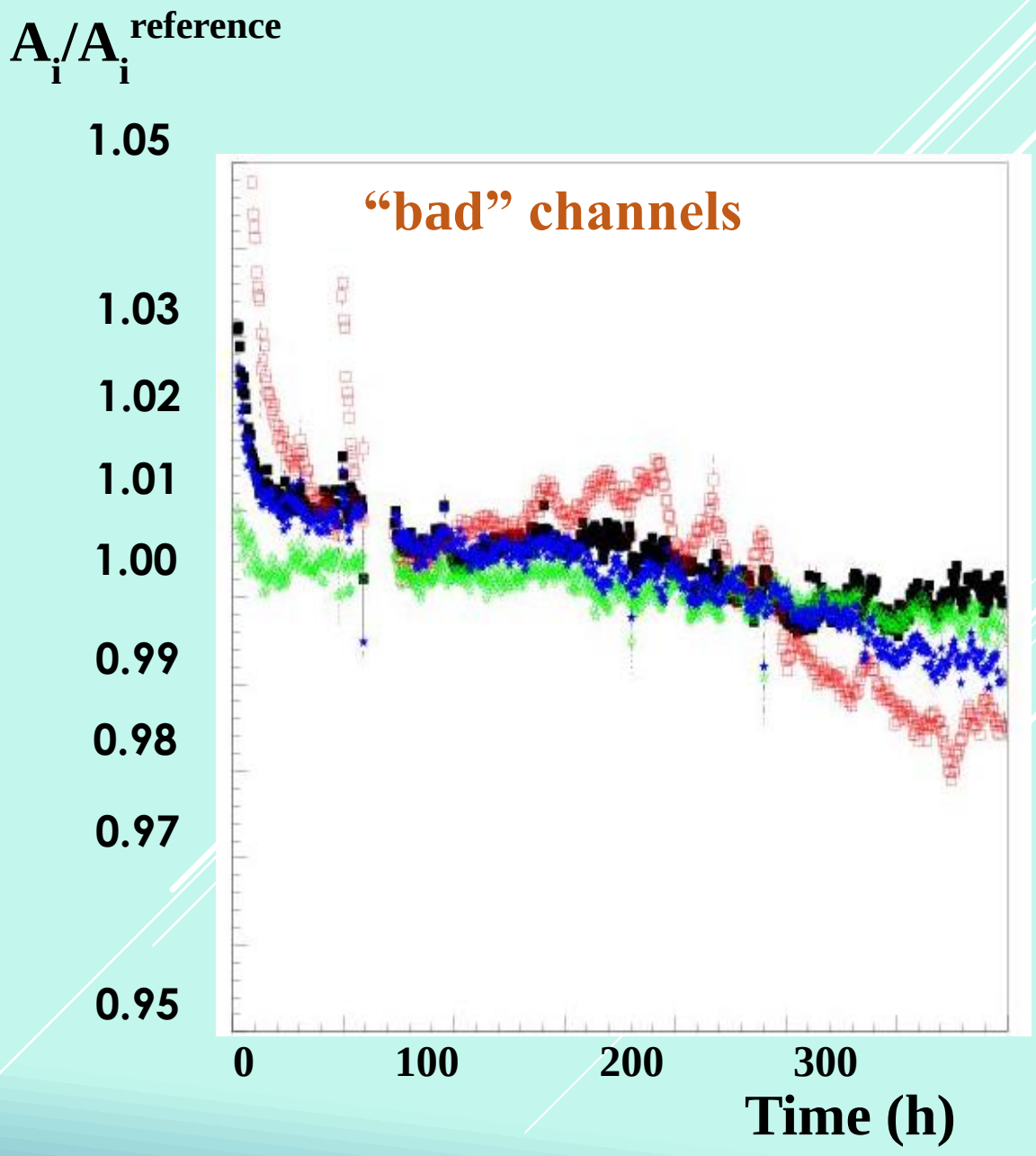
Production of 400 modules with SOL8 fibers started

Tests

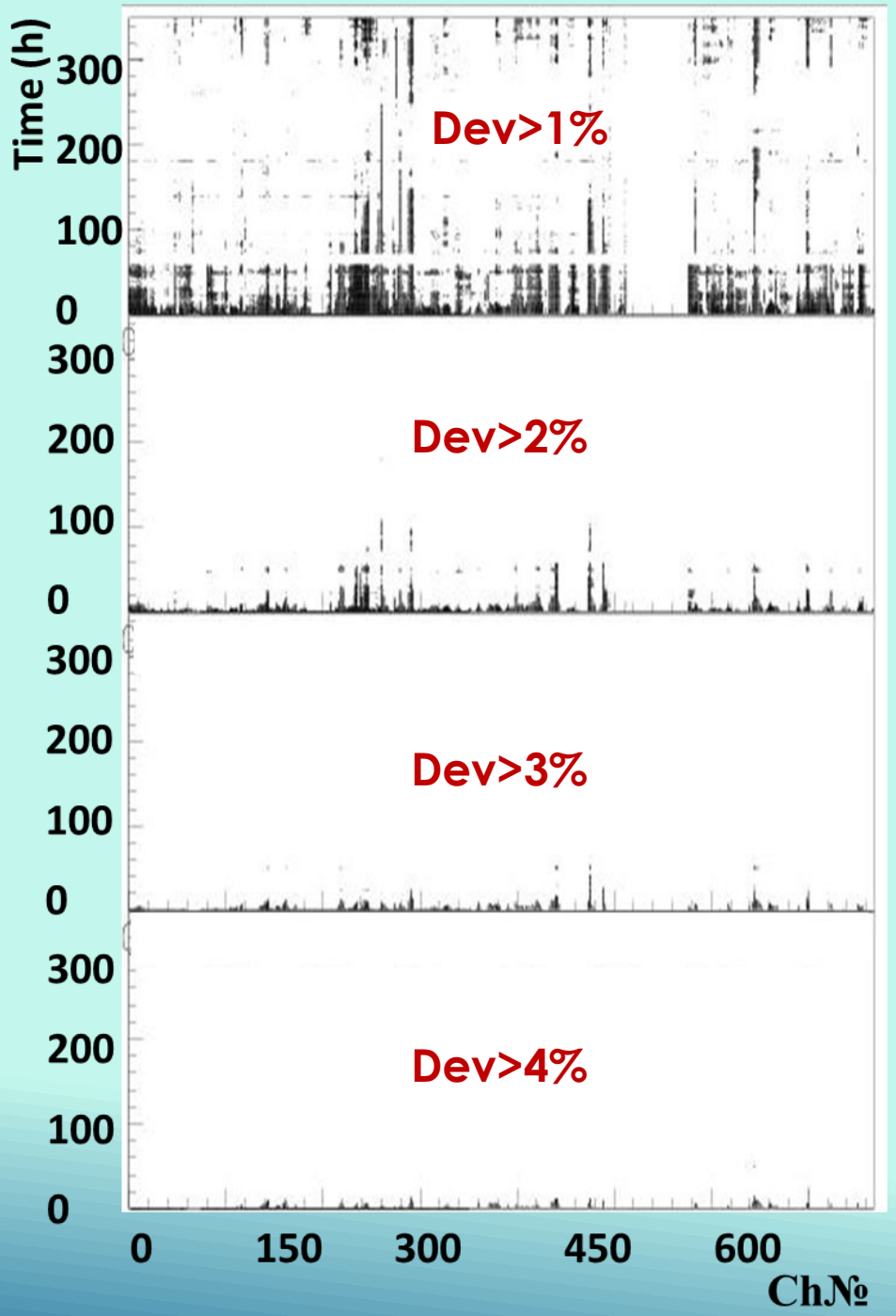
- Cosmic muons tests
- Operation Stability tests with LED

One half sector (768 channels) studied on the operation stability by LED illuminating the WLS fibers through side glow fiber
Signals deviation from the reference values was analyzed vs time

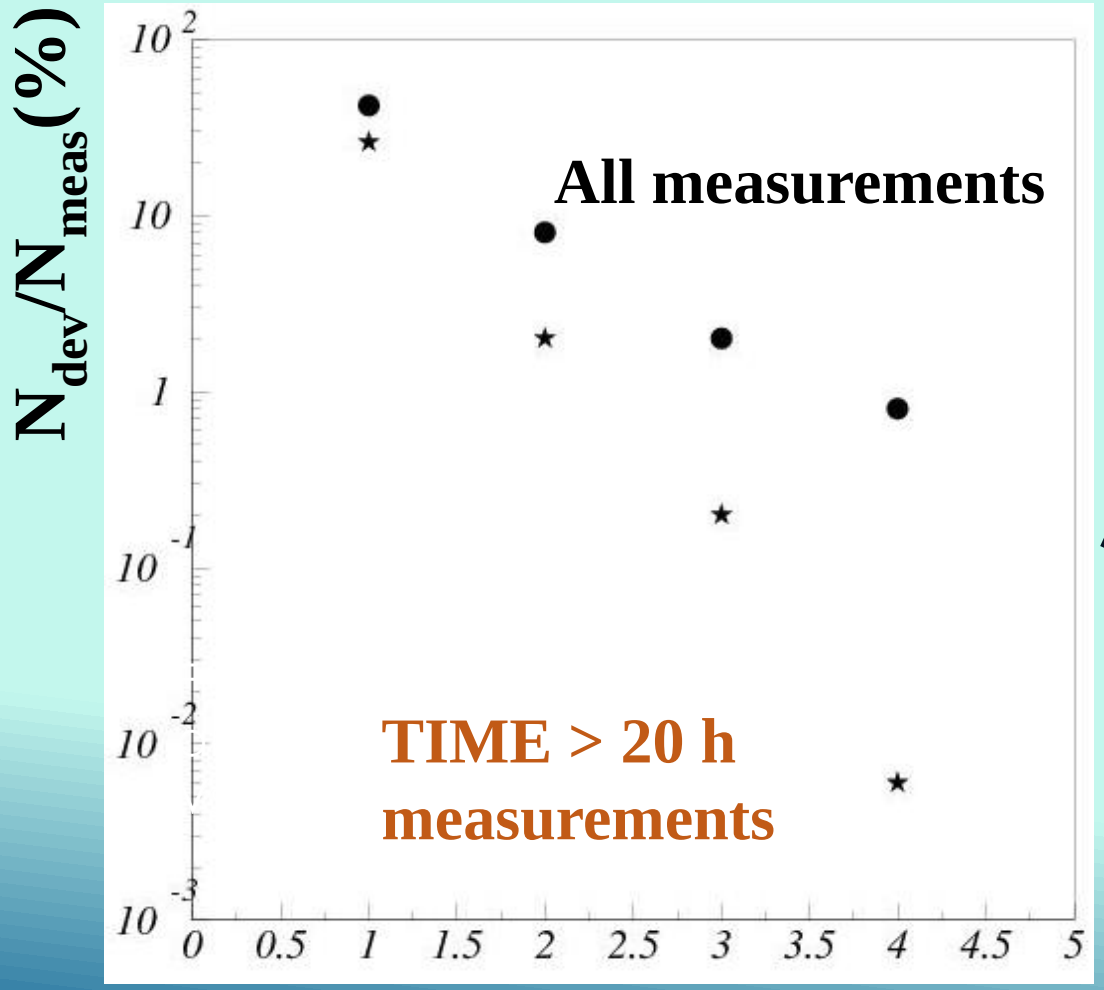

$A_i/A_i^{reference}$
"good" channels
1.05
1.03
1.02
1.01
1.00
0.99
0.98
0.97
0.95
0
100
200
300
Time (h)

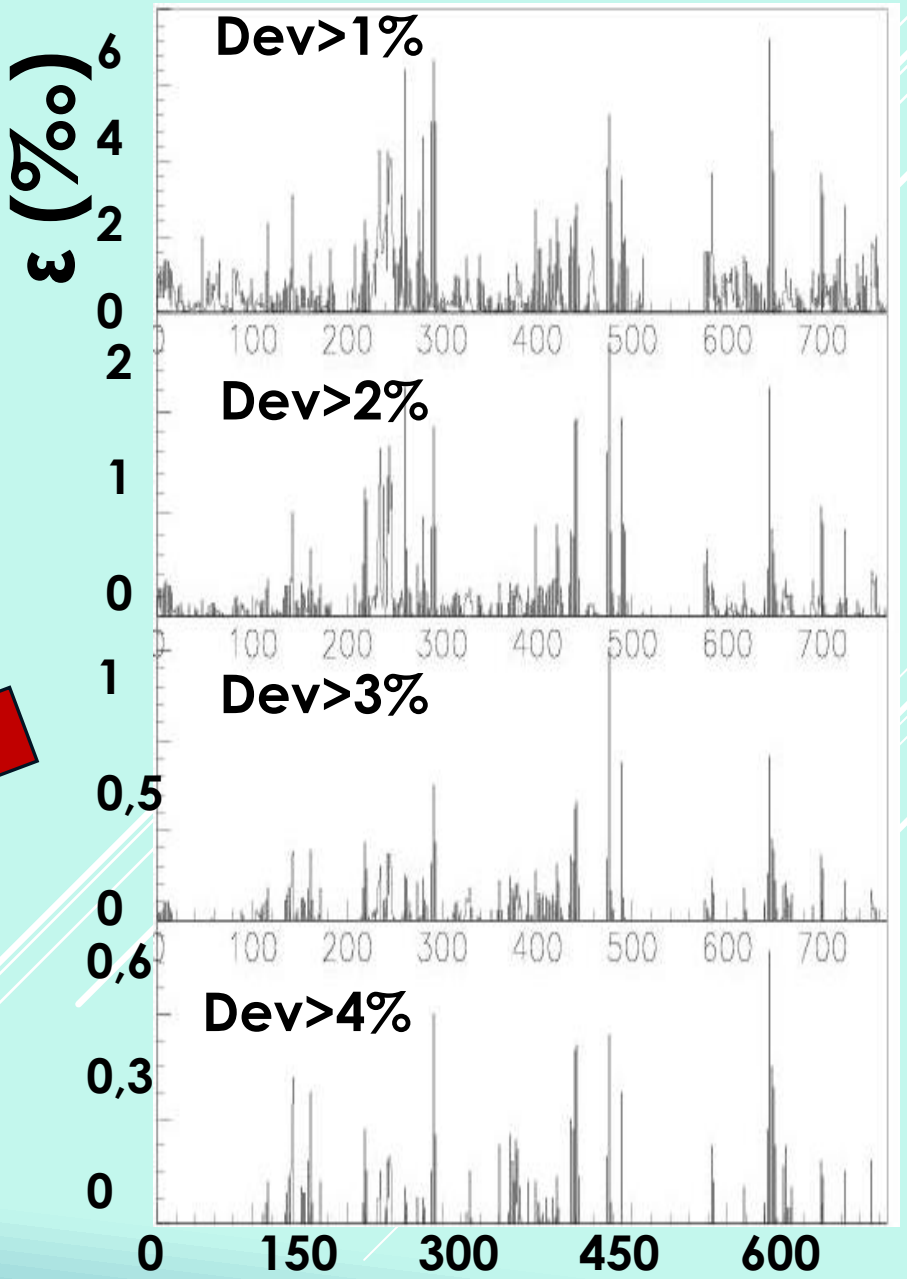

$A_i/A_i^{reference}$
"bad" channels
1.05
1.03
1.02
1.01
1.00
0.99
0.98
0.97
0.95
0
100
200
300
Time (h)

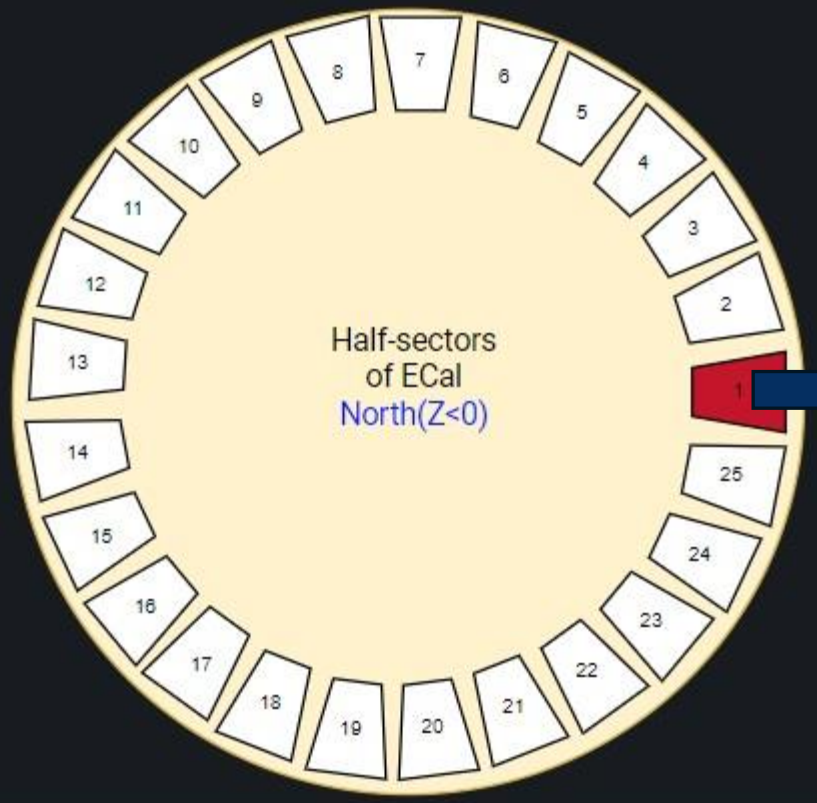
118356 measurements
During 400 h



Fraction of times for each channel when deviation of the signal from the reference value exceeds 1-4% of it's equilibrium







data_quantity 10000

2023-07-14 16:13:34

2023-07-17 14:

README. Period: 1. Run: 20. Sector: 1. Half_sector: 1. ADC: 8.

are used with the LED signal (records where apmlity 0 are skipped).

is colored according to the following rule for the selected time averaging:

one channel from the signal norm < 1%, then green;
one channel from the signal norm > 1%, then yellow;
3. max deviation of one channel from the signal norm > 2%, then orange;
4. max deviation of one channel from the signal norm > 3%, then red.

TABLE OF CORRESPONDENCE OF LOCAL CH NUMBERING WITH GLOBAL

Module with 17-32 channels

Module with 49-64 channels

Module with 1-16 channels

Module with 33-48 channels

Conclusions:

- First stage (64%) of ECal assembling is going well and will be completed in time (June 2024).
- Work is started to build 400 more modules increasing ECal coverage in the barrel region up to 82%.
- First assembled half sector is under long term tests. Stability of ECal operation demonstrated on the level of few % for 768 channels.

  Possibility to use cosmic muons for the calibration of the assembled ECal is demonstrated.
- ECal Slow Control and Stability Control software is under tests using assembled half sector.

There is a lot of interesting work ahead, both on detector study, as well as on the software development for this detector

We are inviting everybody, from students to experienced physicists, to cooperate in those exciting researches

Thank you for the attention!