KLOE-2: present status and upgrades

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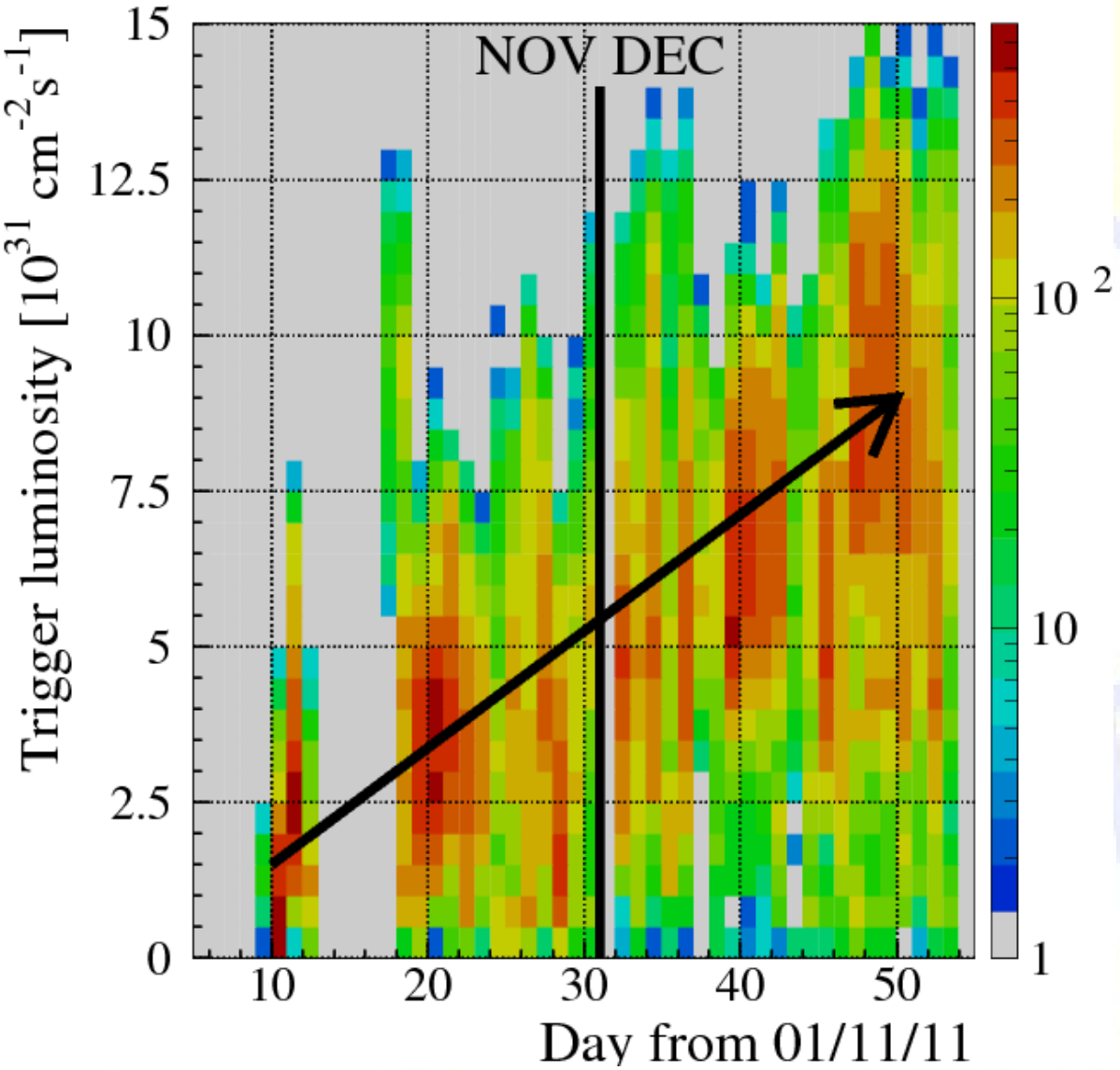
(KLOE-2 Collaboration)

43rd LNF Scientific committee meeting
19 Jan 2012

KLOE-2 Status

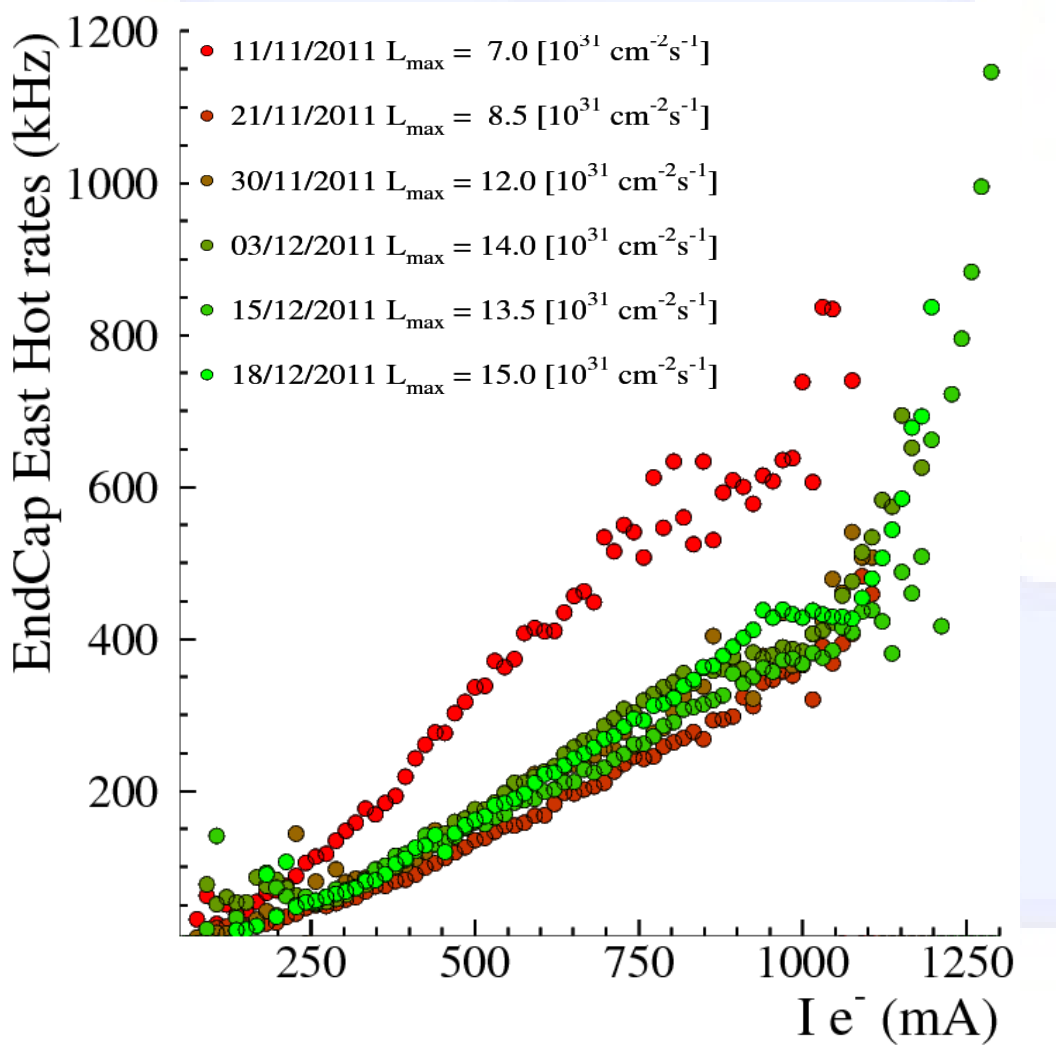
DAΦNE luminosity

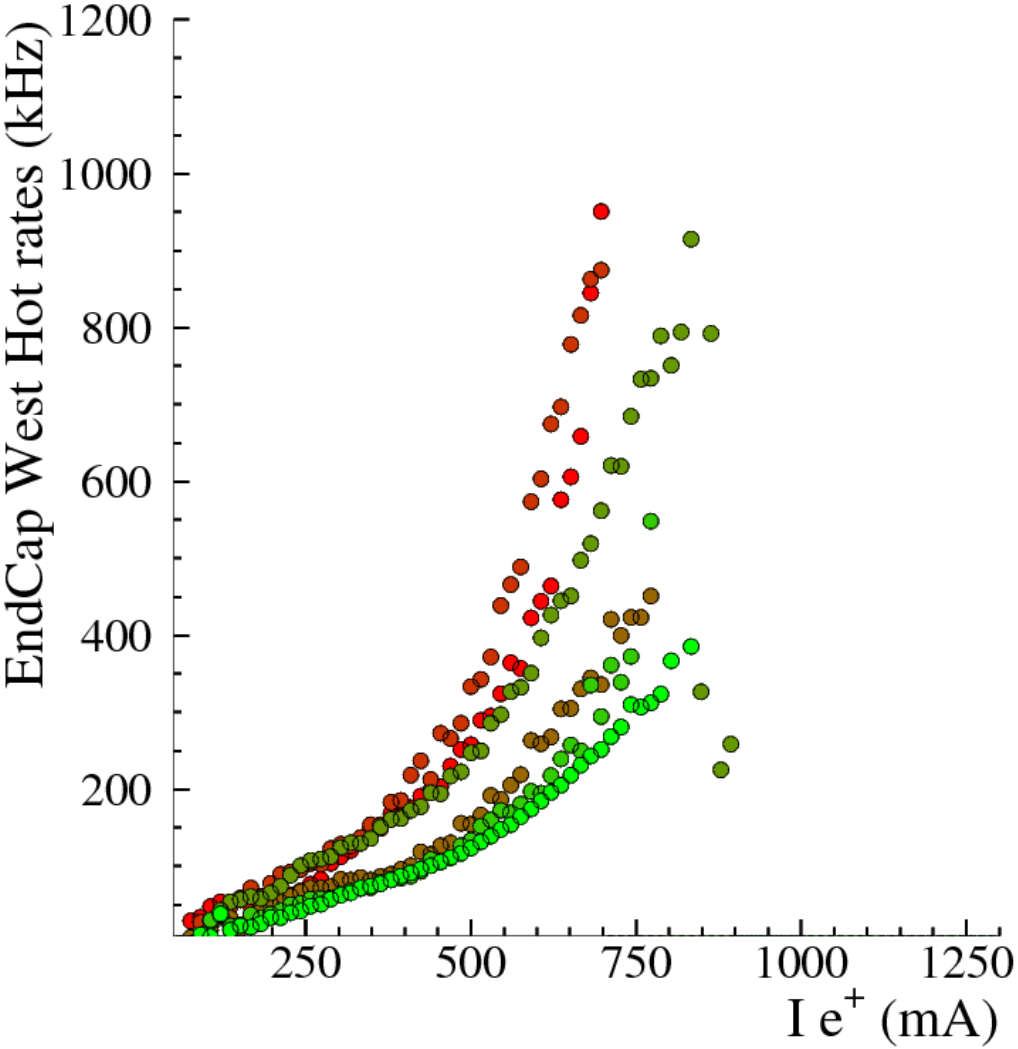


- DAΦNE performance during Nov-Dec continuously improves.
- The KLOE detector uptime was high (>80%) providing feedbacks for machine commissioning.
- Max integrated luminosity per unit time: 280 nb^{-1}/h

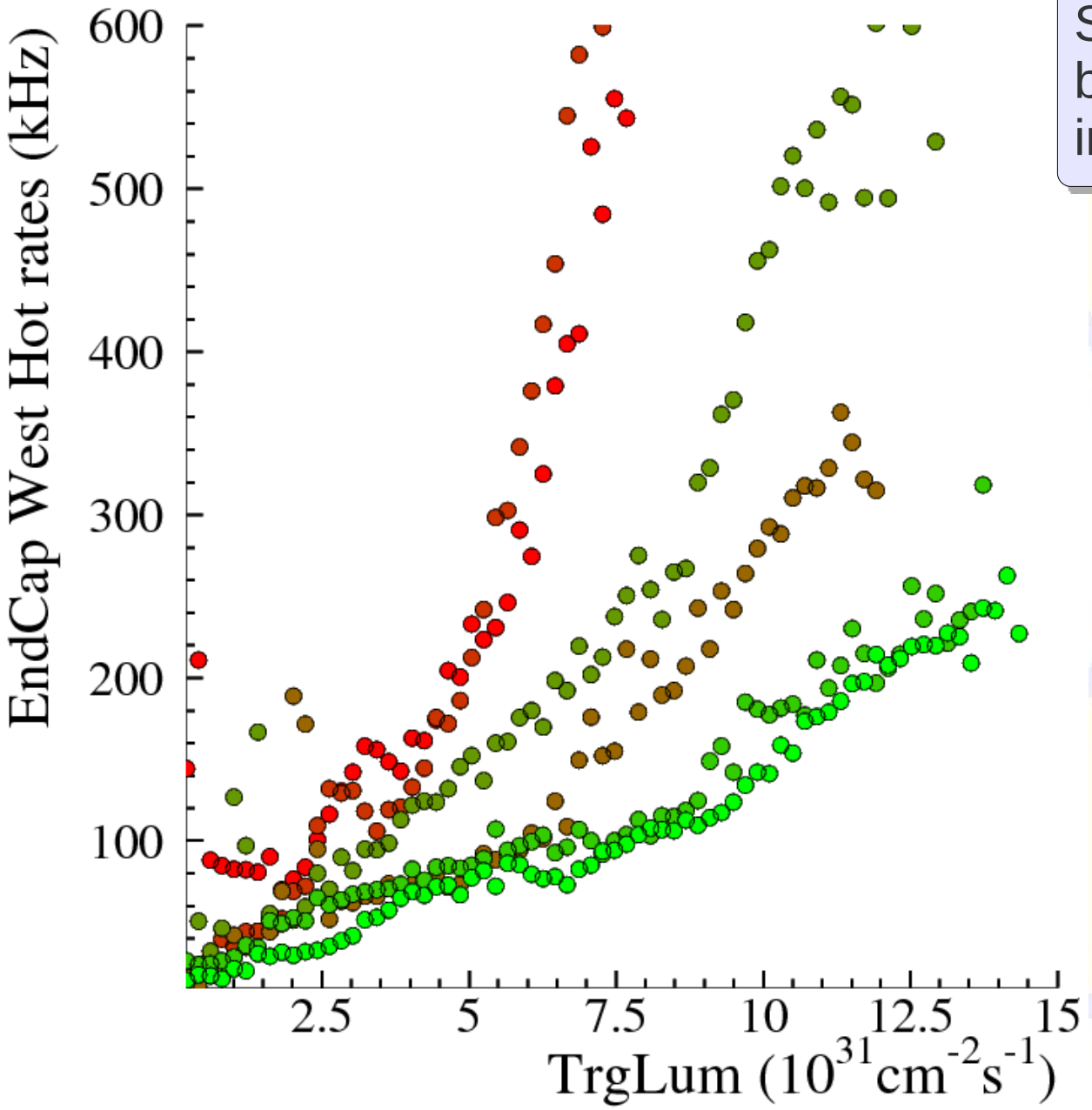
Background rates vs stored currents

- Background rates decreased significantly (~50% on both End-Caps).
- The electron machine reached reasonable levels by the end of Nov.
- The positron still requires some developments.





Background rates vs luminosity



Sizable reduction of background while increasing the L_{peak}.

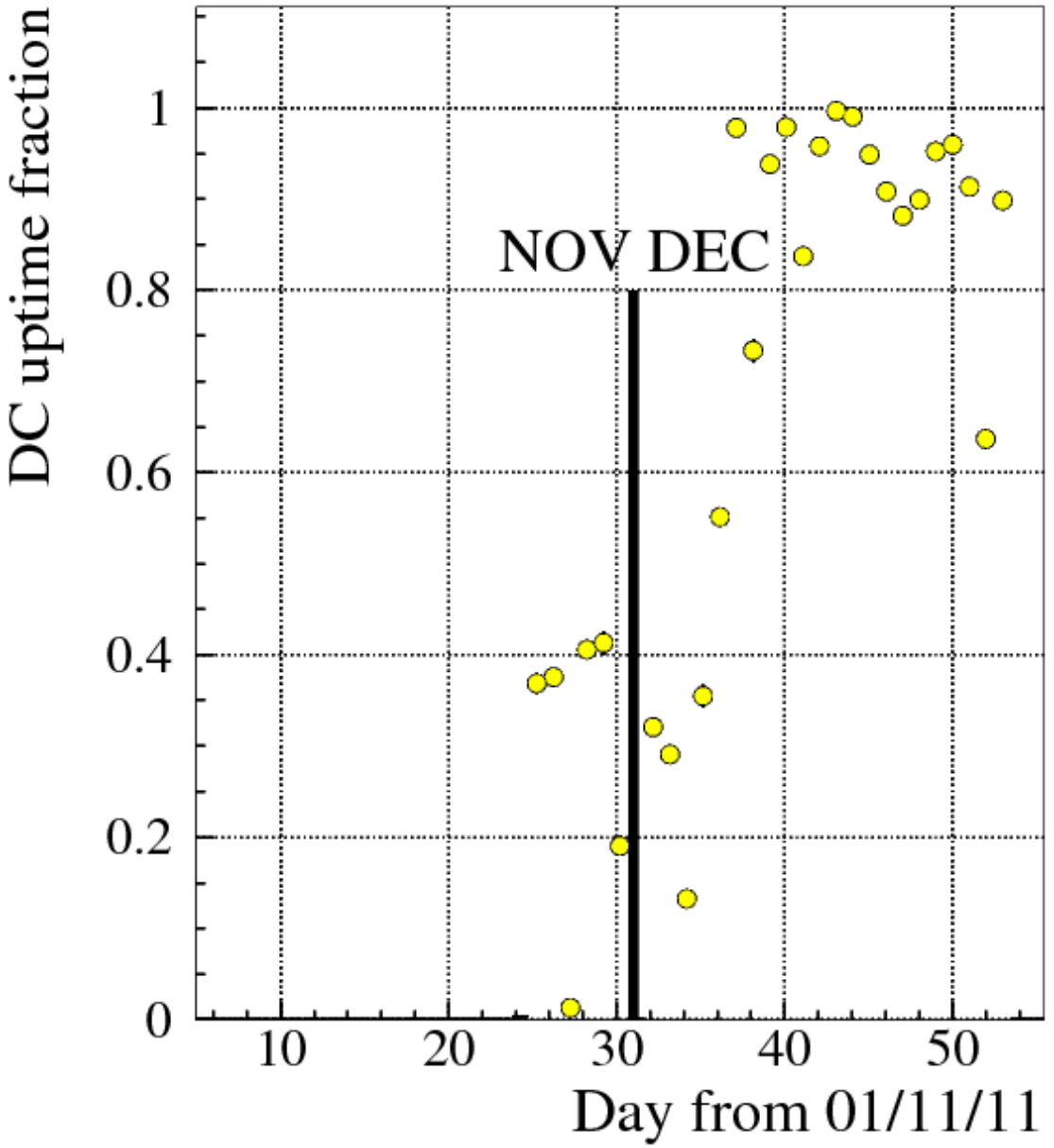
- 11/11/2011 L_{max} = 7.0 [10^{31} cm^{-2}s^{-1}]
- 21/11/2011 L_{max} = 8.5 [10^{31} cm^{-2}s^{-1}]
- 30/11/2011 L_{max} = 12.0 [10^{31} cm^{-2}s^{-1}]
- 03/12/2011 L_{max} = 14.0 [10^{31} cm^{-2}s^{-1}]
- 15/12/2011 L_{max} = 13.5 [10^{31} cm^{-2}s^{-1}]
- 18/12/2011 L_{max} = 15.0 [10^{31} cm^{-2}s^{-1}]

Detector uptime (EMC+DC)

During Nov the level of background and beam instability forced us to keep the DC off.

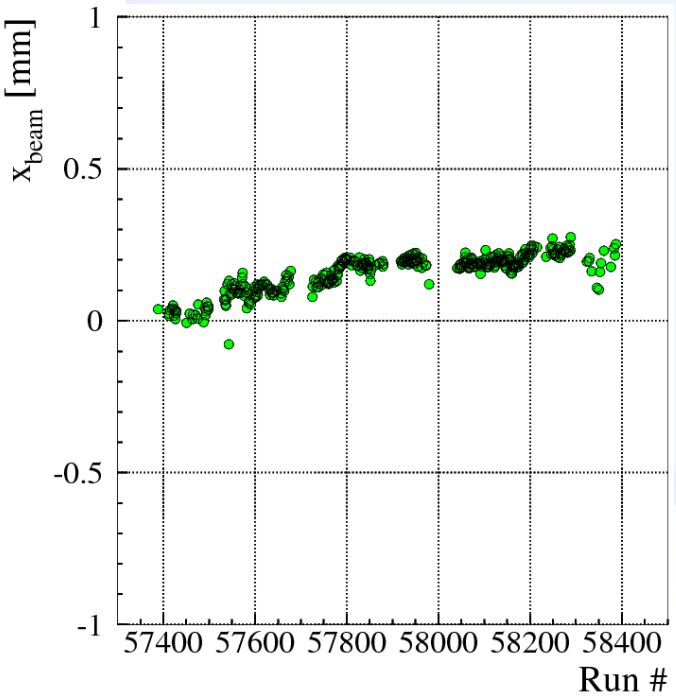
By the end of Nov the machine conditions allows to keep the DC on with very good uptime fraction.

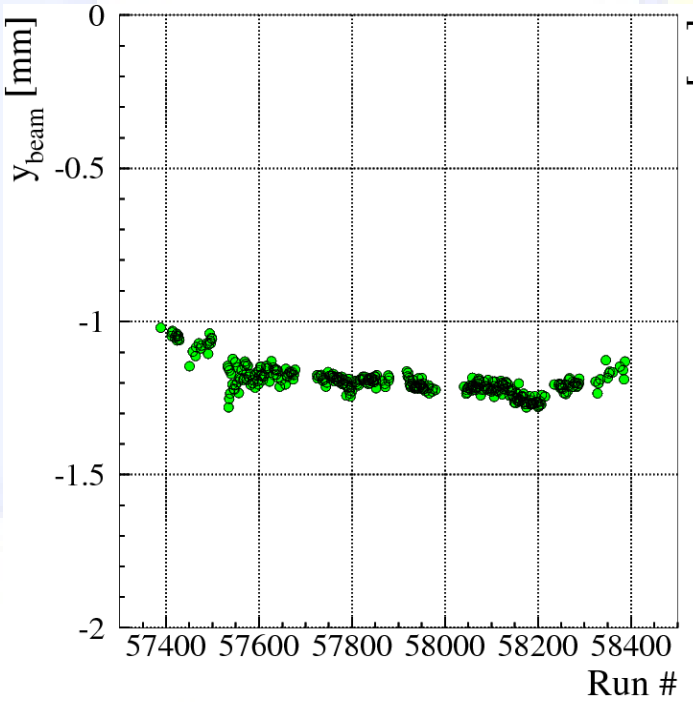
DC operation needed also to provide beam status feedbacks such as: ϕ boost, center of mass energy and luminous point position.

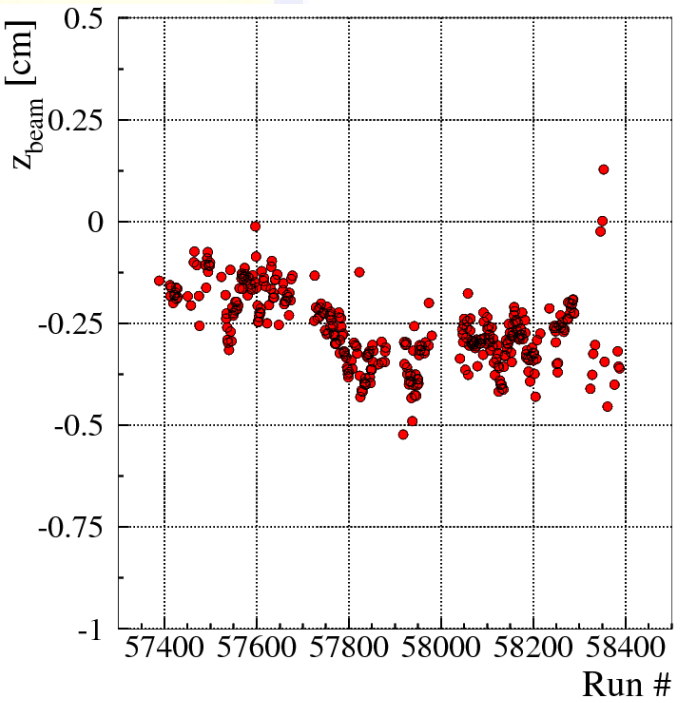


IP position monitoring

- Using online selected Bhabha events fully reconstructed (TRKMON)
- The vertex resolution (~1mm) allows us to monitor the bunch crossing length and the average IP position.

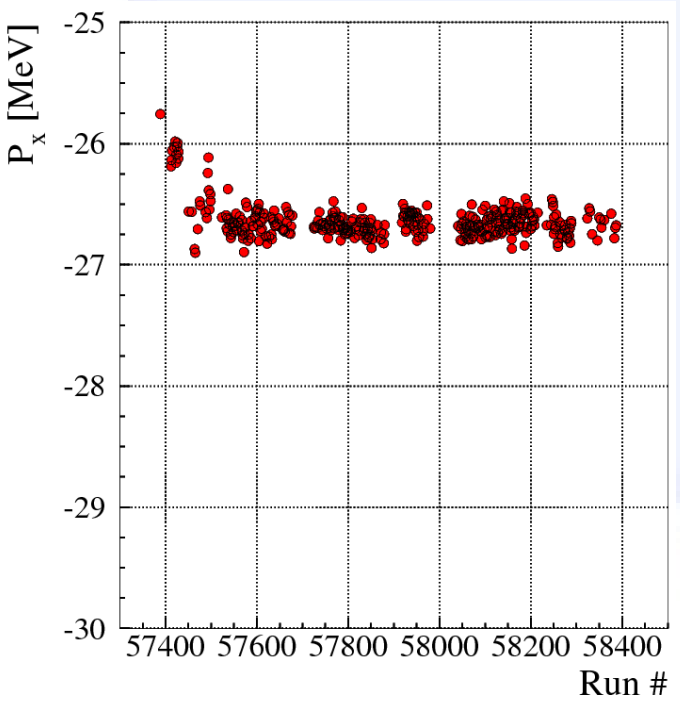


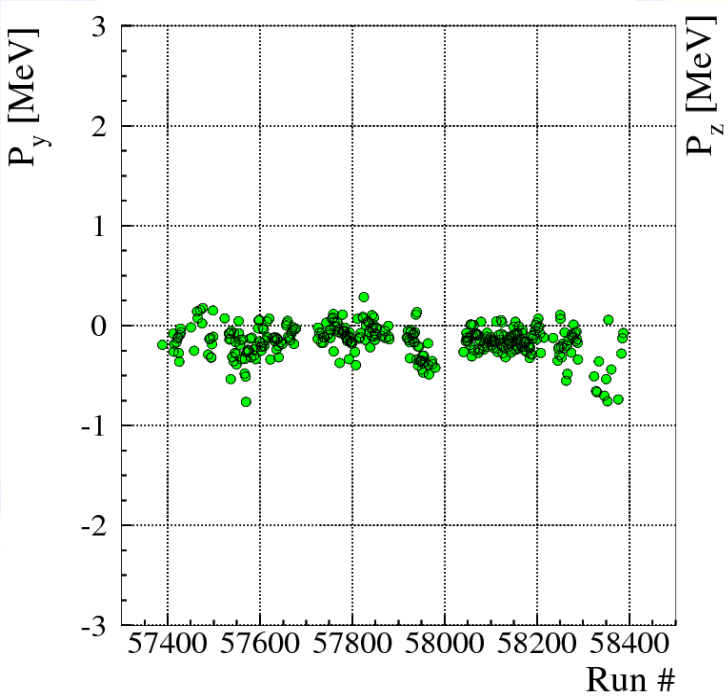


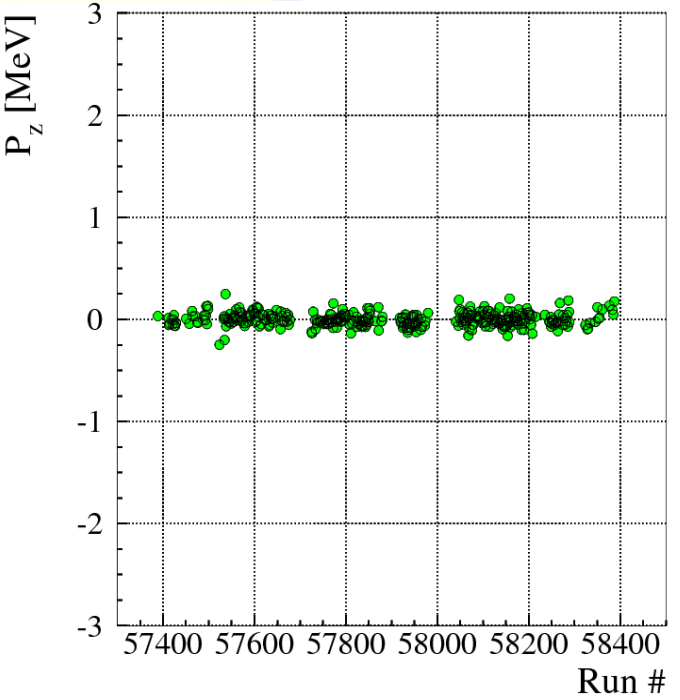


Center of mass momentum

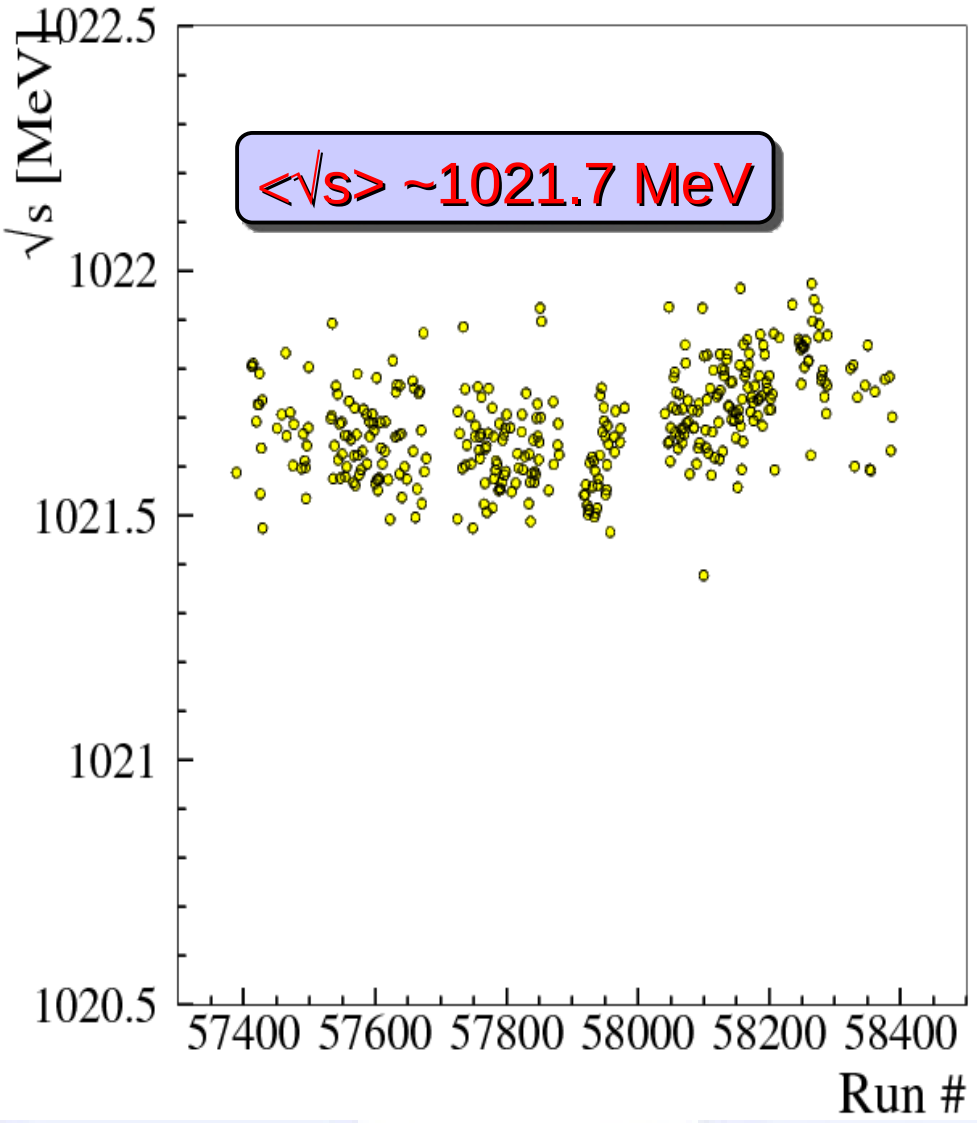
- x component is ~26.8 MeV towards DAΦNE center: x2 bigger than in the KLOE runs as expected (larger crossing angle);
- y (vertical) and z (along beam axis) components compatible with zero as expected for a symmetrical machine.







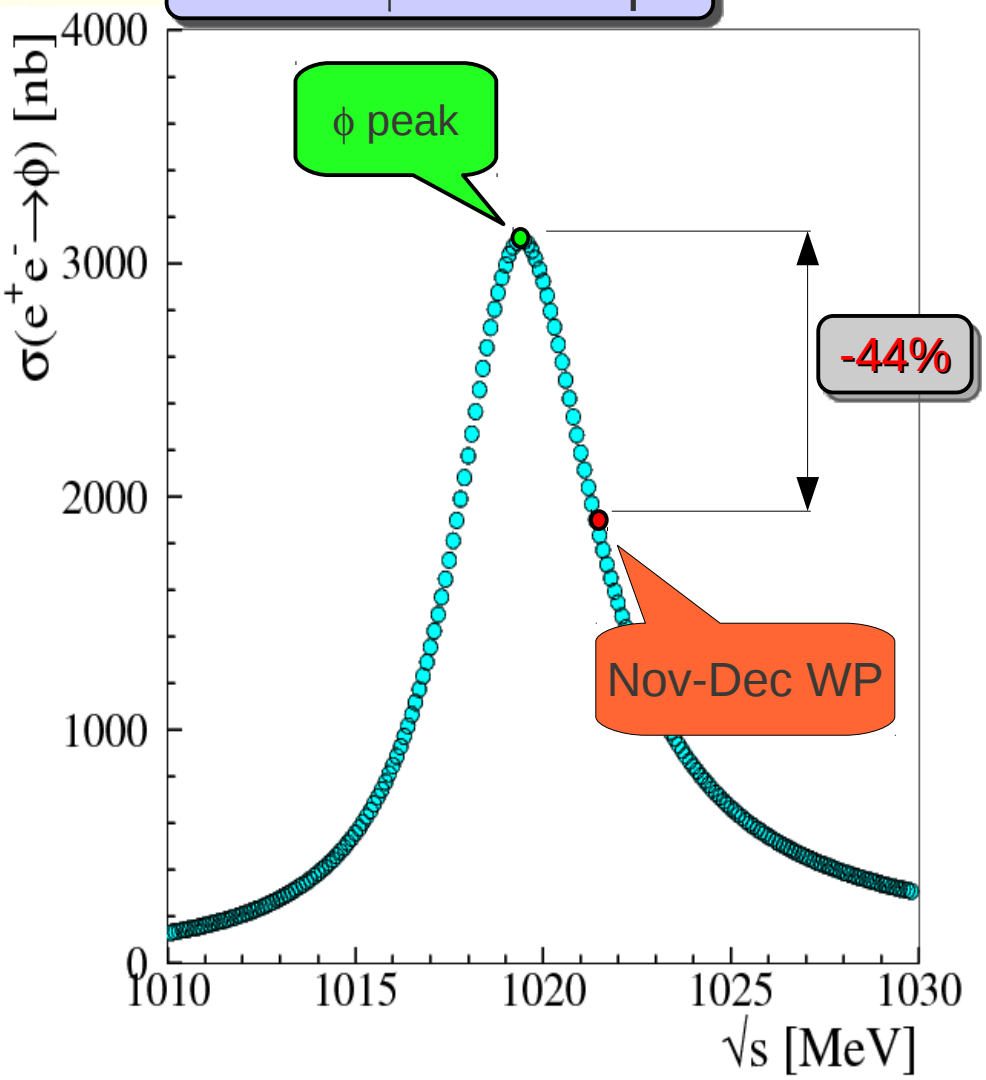
Center of mass energy



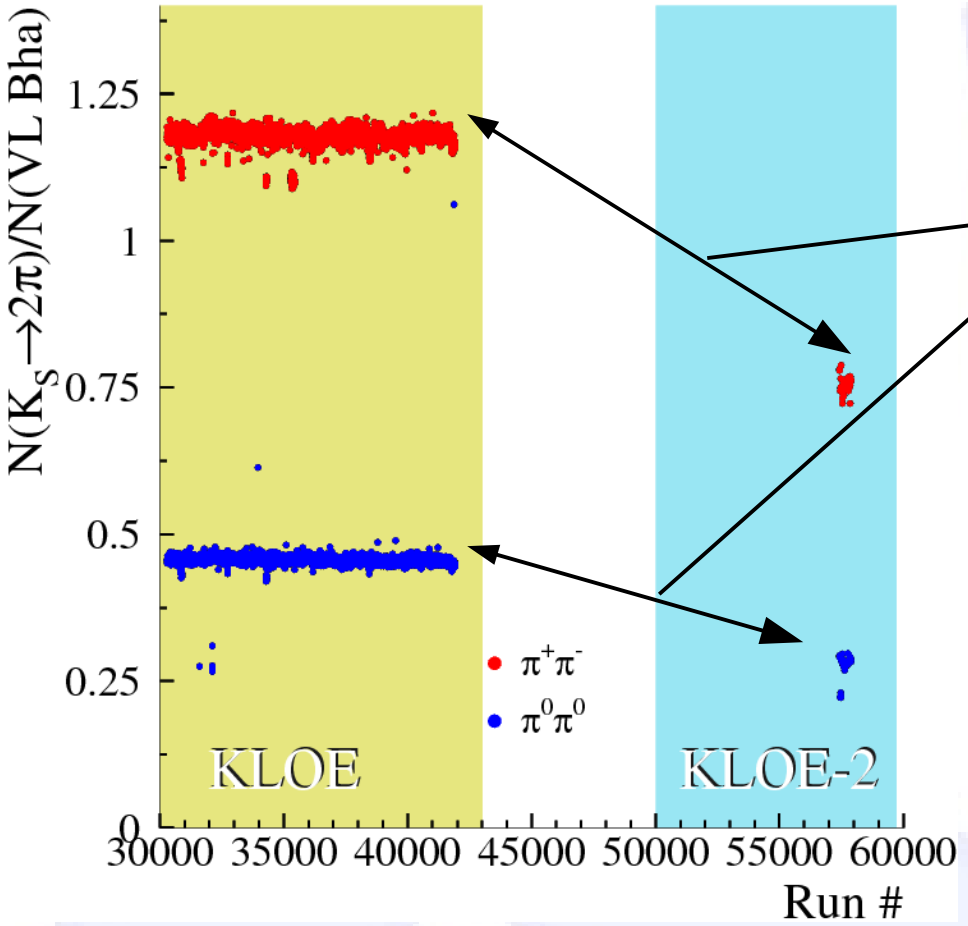
<√s> ~1021.7 MeV

Since January corrected

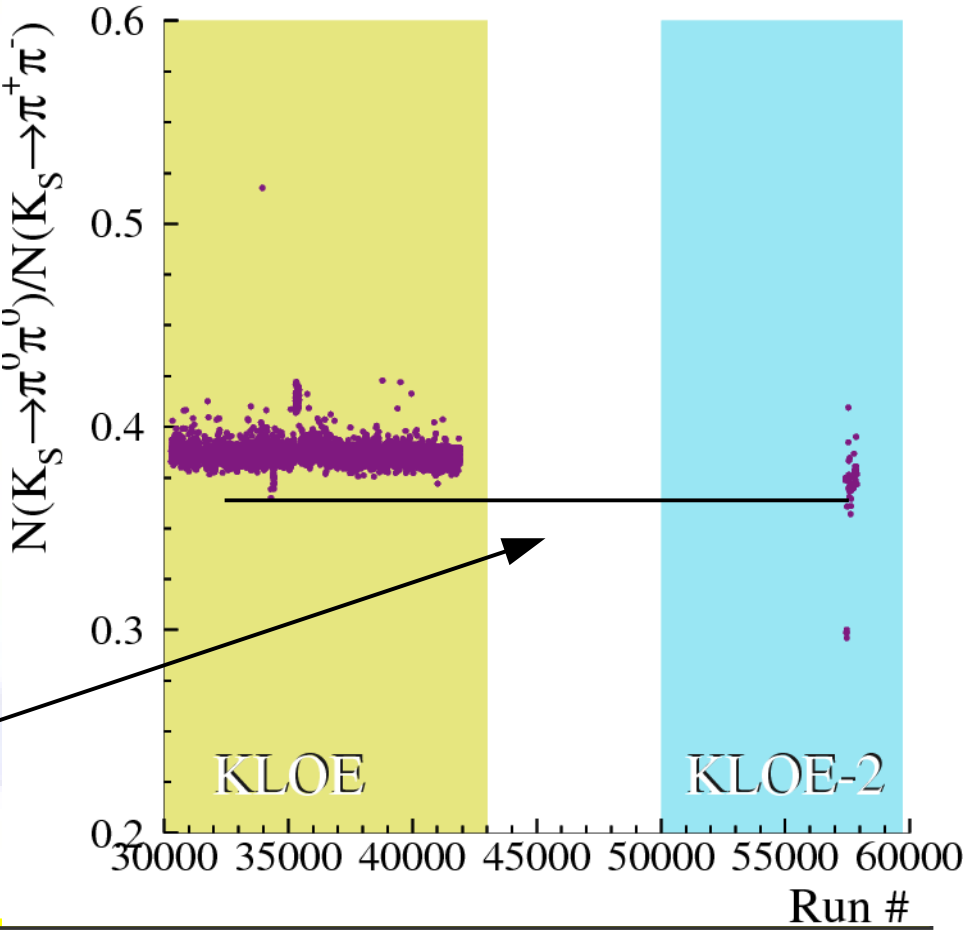
Visible ϕ line-shape



Effective cross section for K_S production



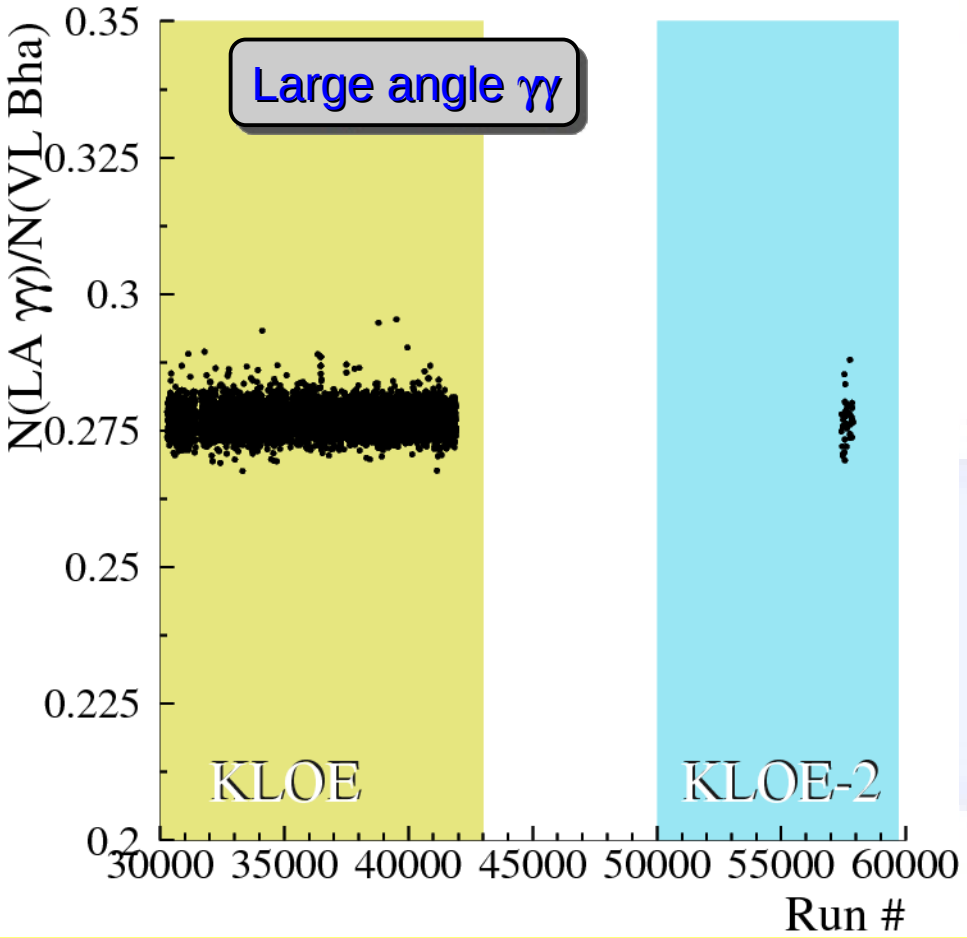
Variation compatible with effective ϕ cross section @ 1021.7MeV (-40%) observed.

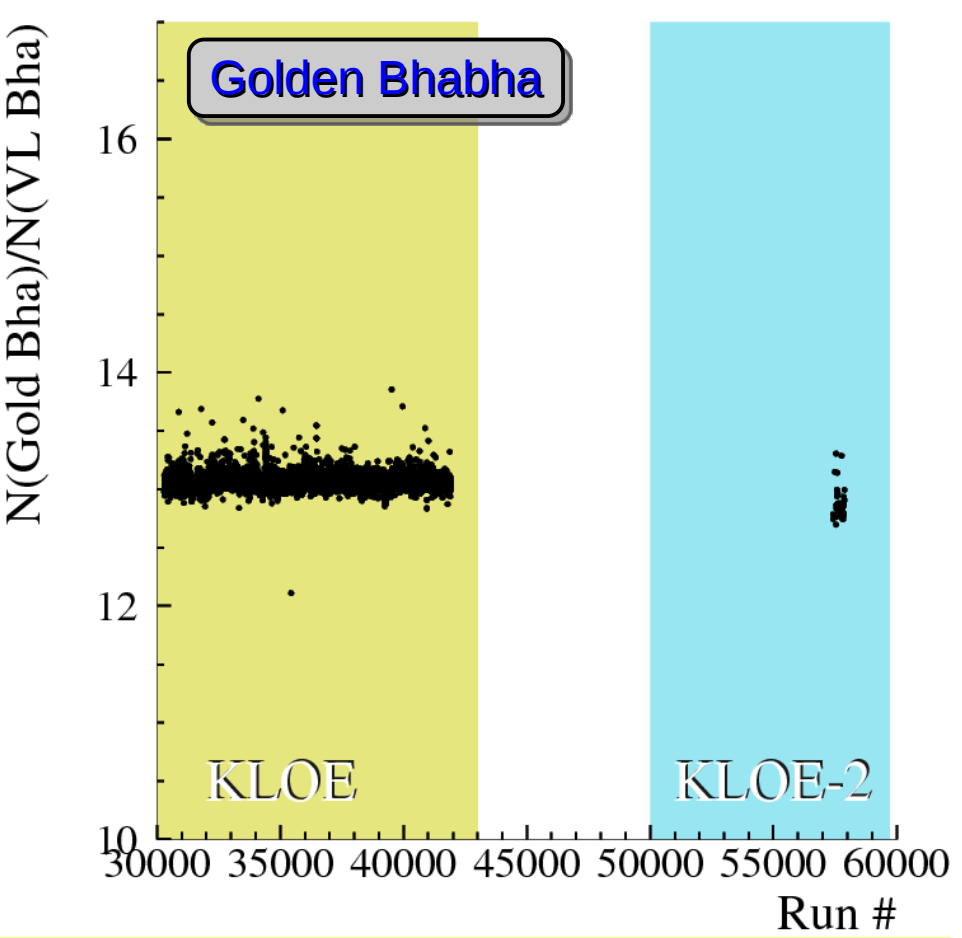


Ratio of neutral/charged counters is stable: background effects negligible on selection efficiencies.

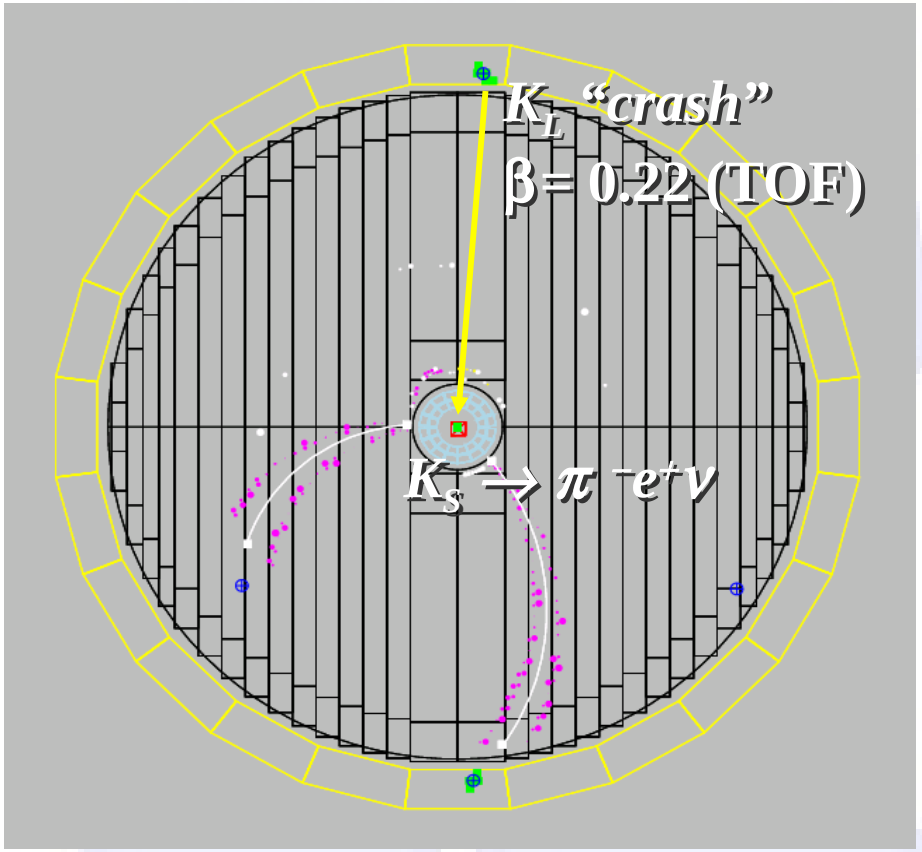
Reconstruction stability

- Relative cross sections of QED processes (Bhabha and $e^+e^- \to \gamma\gamma$).
- Ratios between EMC and DC (VLBha) selected samples.
- Good cross check of the global functionality of the detector.

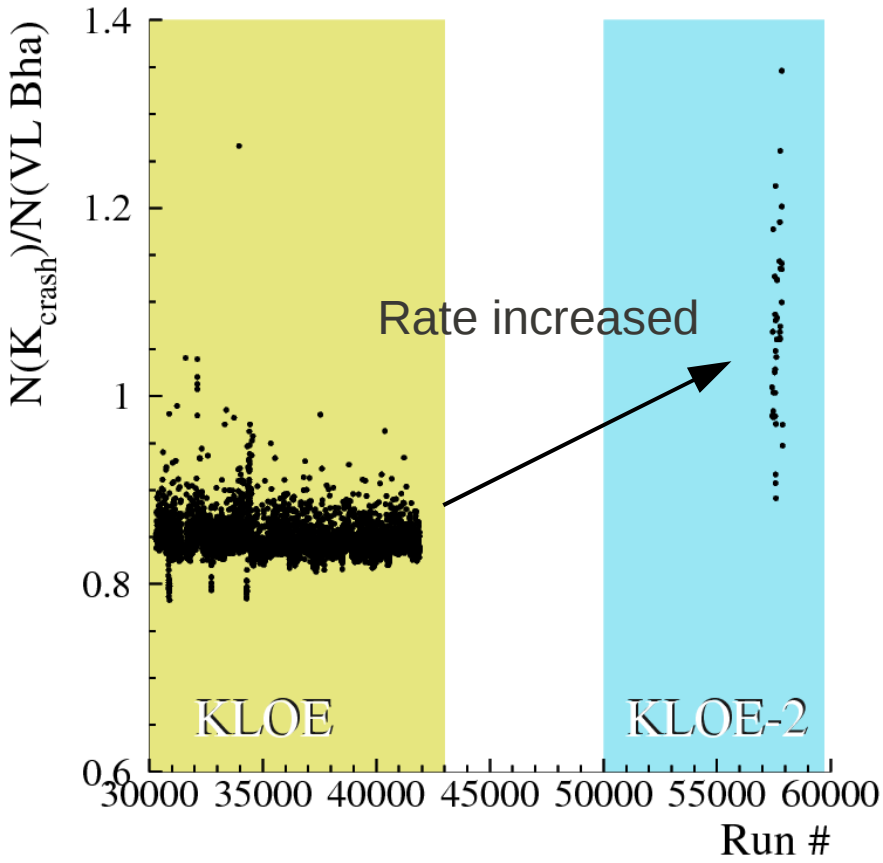




K_S tagging: the K_L interaction in EMC

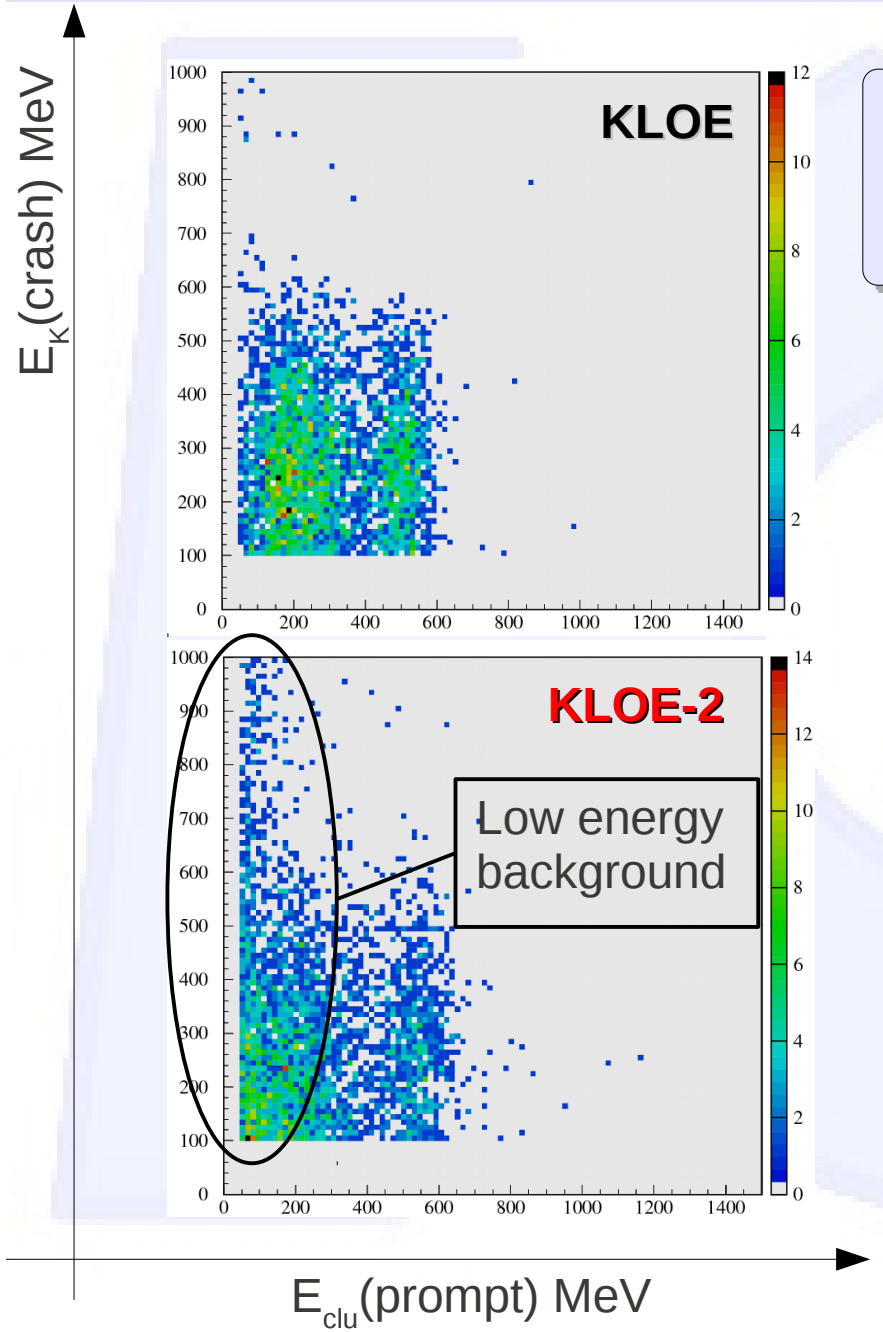


K_S tagging is based on K_L interaction on EMC (delayed cluster)

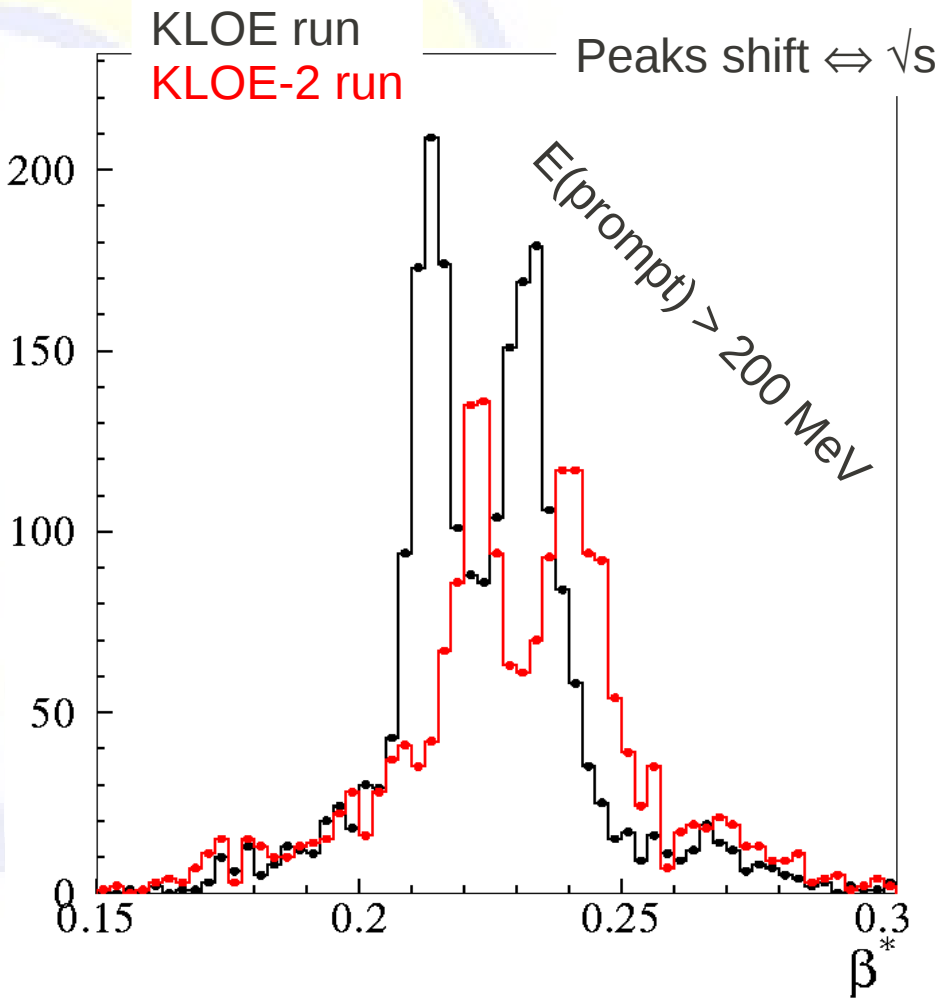


Out of time machine background (wrt trigger) could simulate a K_L-like EMC cluster.

Effective cross section for K_L(crash)

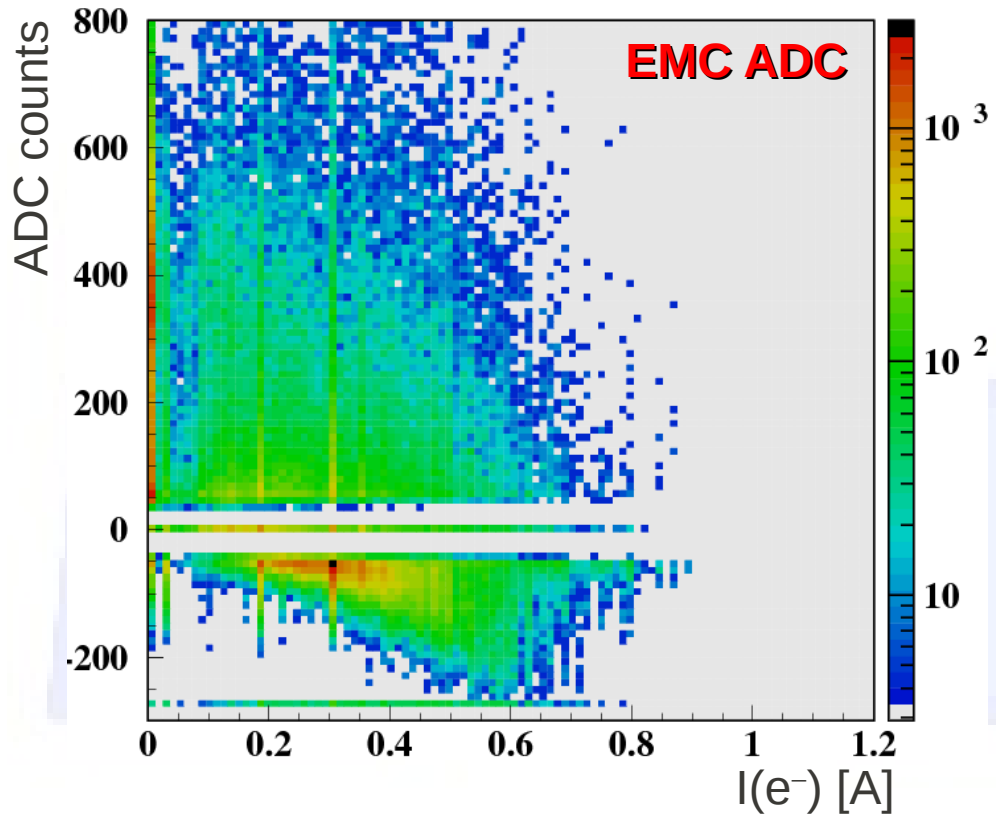


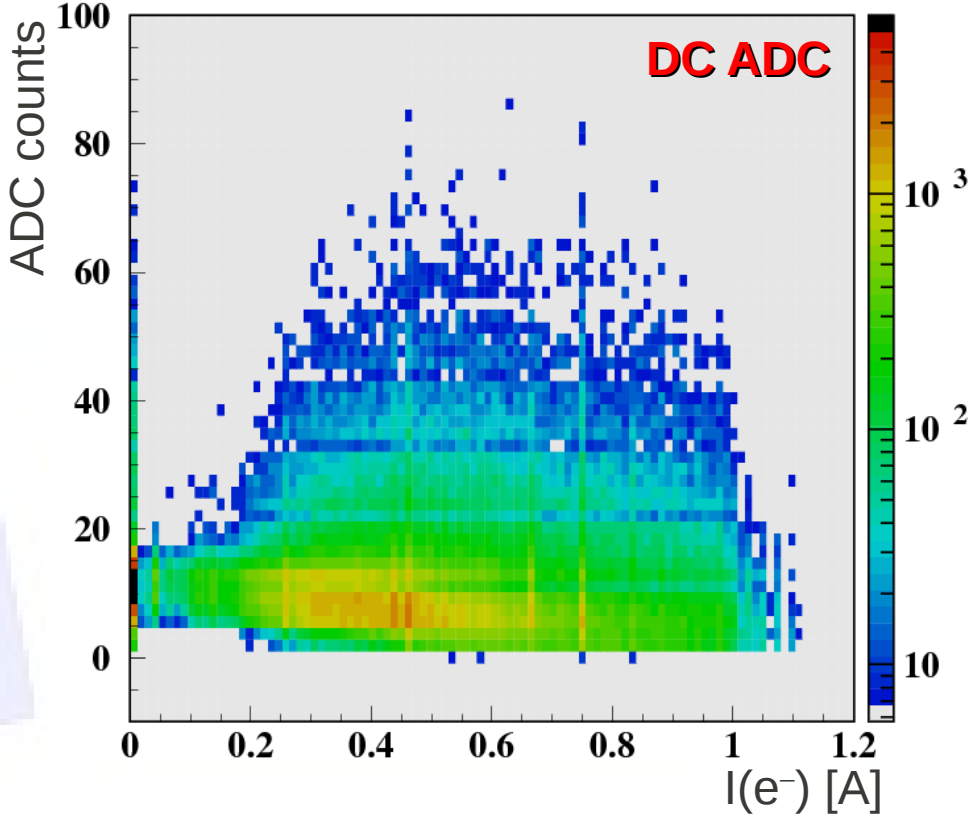
EVCL under revision:
cuts on prompt energy promising to lower the background.



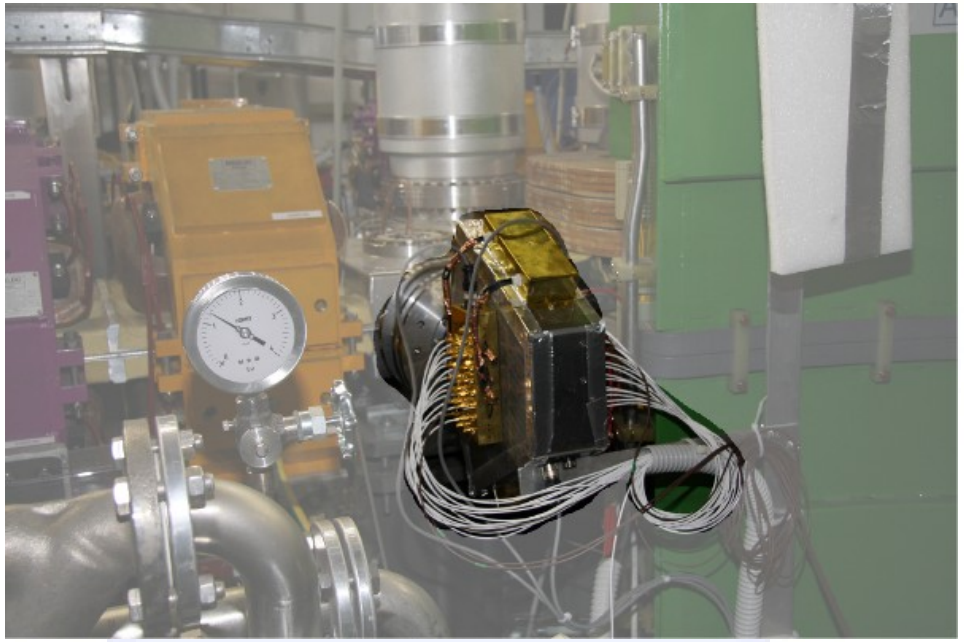
LET status & plans

- Data reconstruction and calibration procedures are almost complete
- The high rates (100 – 200 kHz/crystal) measured with first circulating beams was distorting the ADC spectra, due to the AC coupling of the EMC ADCs and to the preamplifier boards;
- Lab. tests of the full chain, LYSO crystal + UV led + SiPM + modified preamp + DC ADC, showed that the system properly works up to ~200 KHz (valuable also for the CCALT);
- Ongoing studies for the integration with the new QCALT.

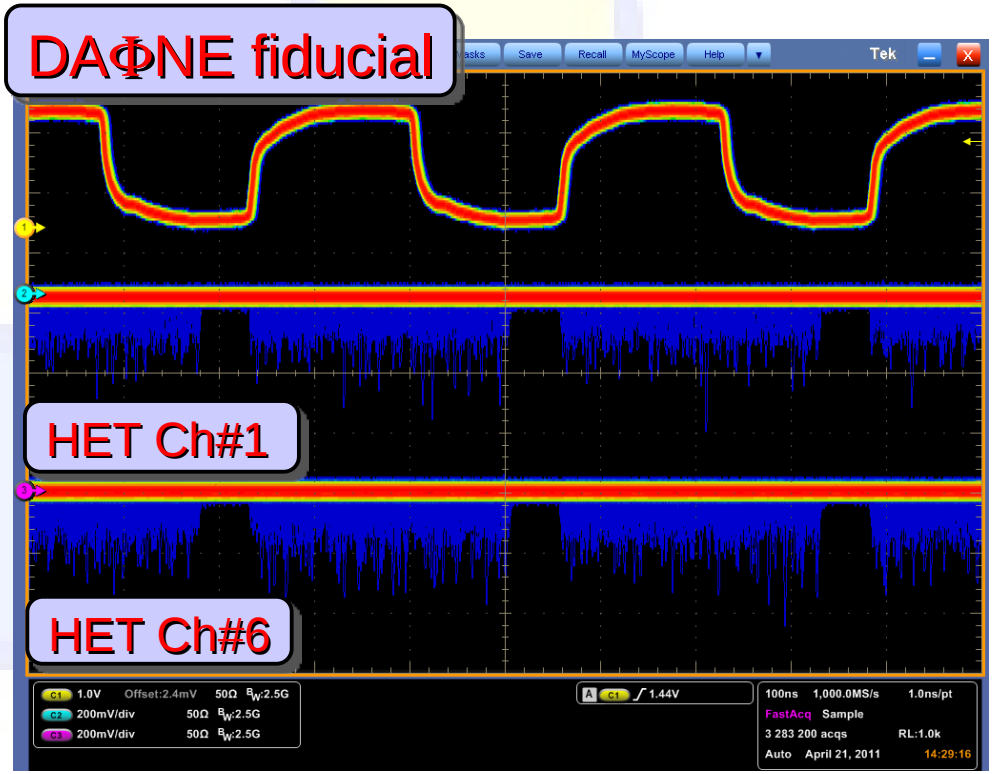




HET Status



- HET for electrons has been installed
- detector debugging in progress
- HET for positron installation planned for end of January



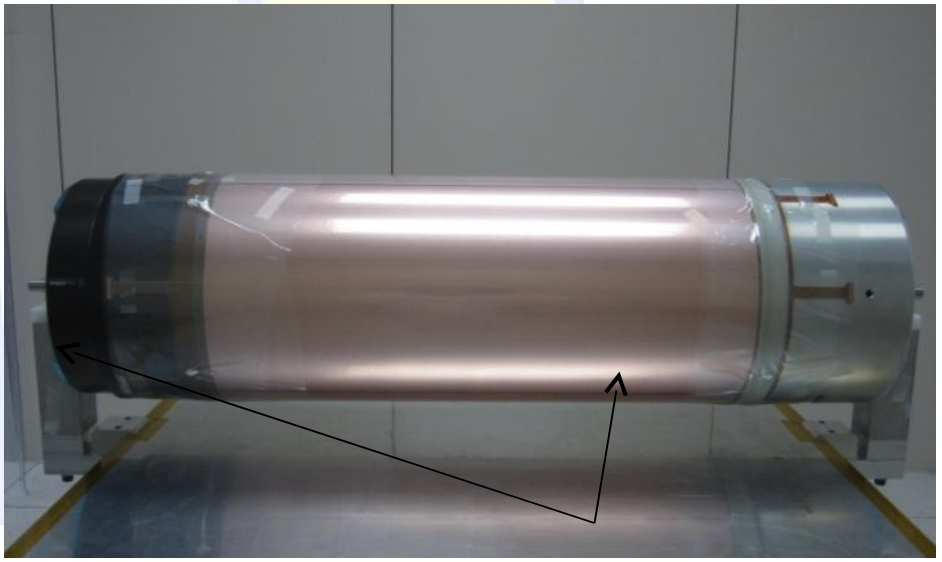
Upgrades

IT: building the cylindrical GEM

Electrode is wrapped on the cylindrical mold

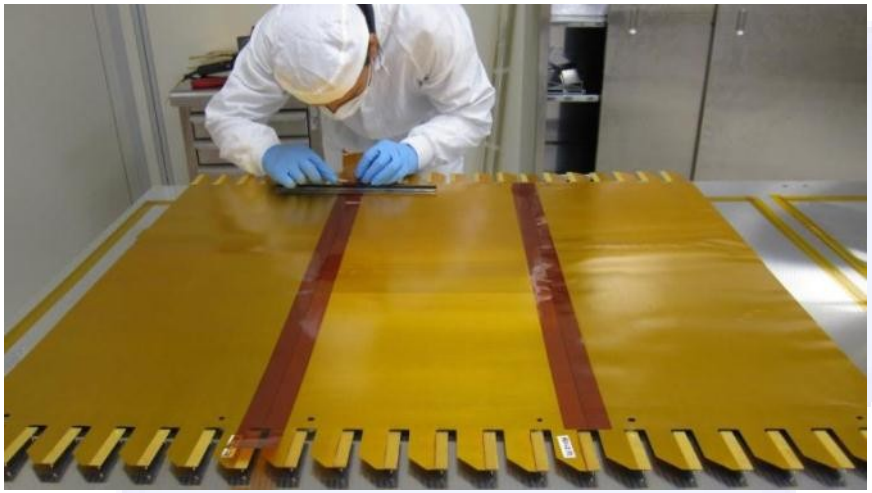
Transpirant tissue is placed around

Vacuum bag envelope

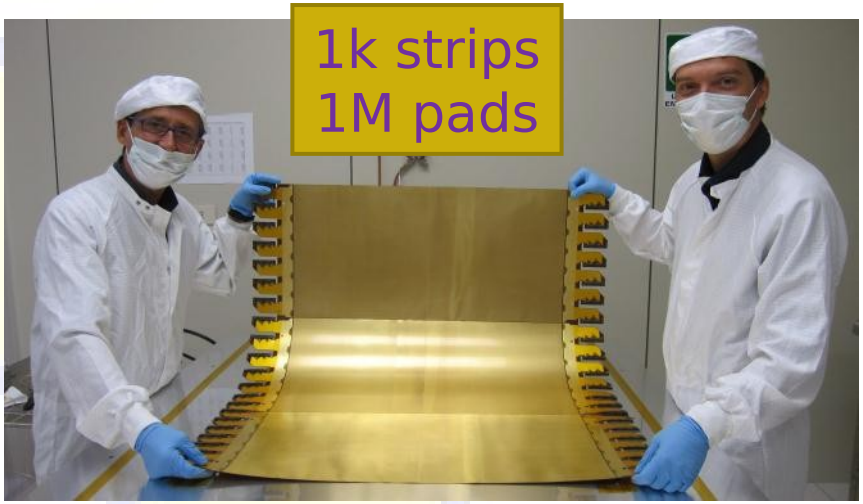


Final cylindrical GEM with rings

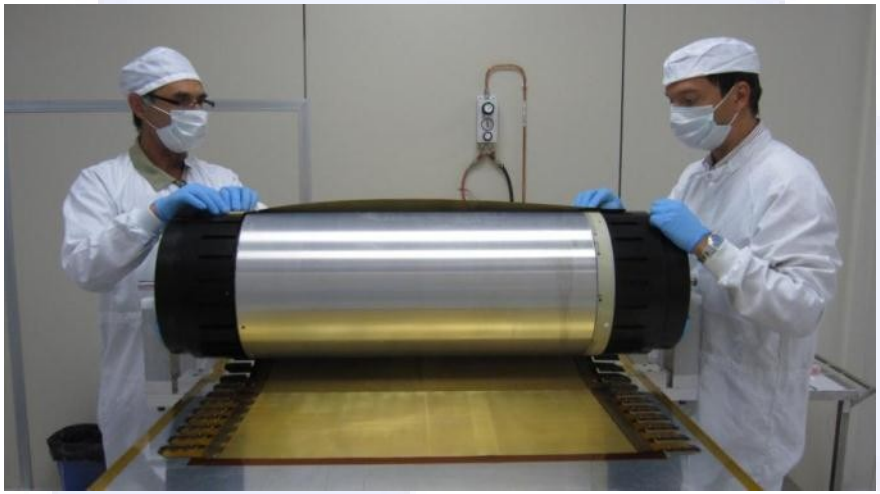
IT: building the cylindrical electrode



three foils are spliced without overlap: kapton strips are glued on the back of head-to-head joints



Final foil is ~1m long with three ~1mm wide dead zones.



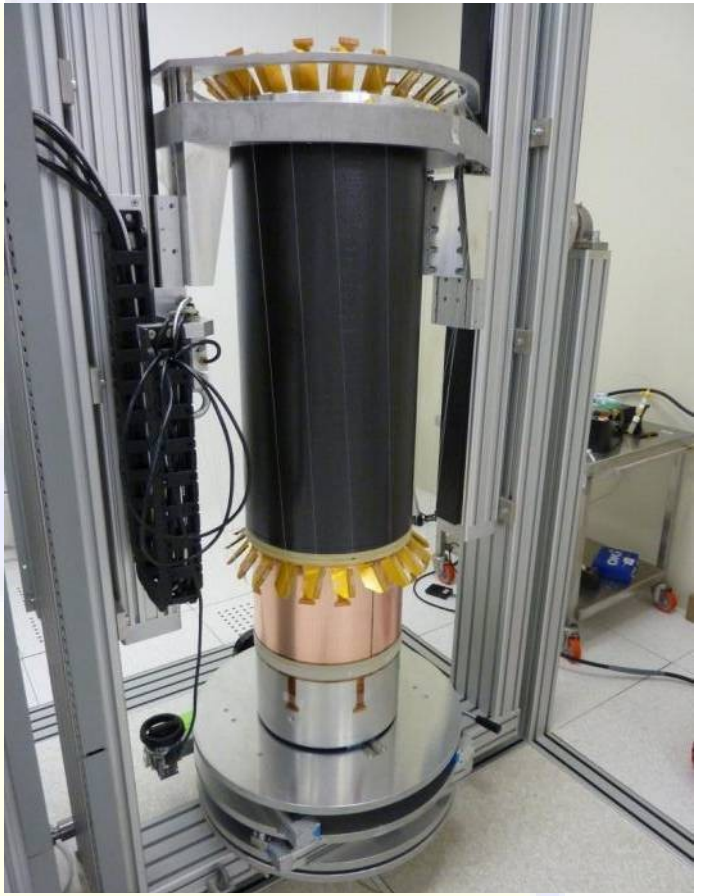
Foil is wrapped on the mold

...to obtain cylindrical electrode

IT: insertion of GEM

The GEM is placed on the Machine with its mold

Everithing is aligned with an axial precision of 0.1mm/1.5m



The Readout is moved down around the GEM

IT: status summary and schedule

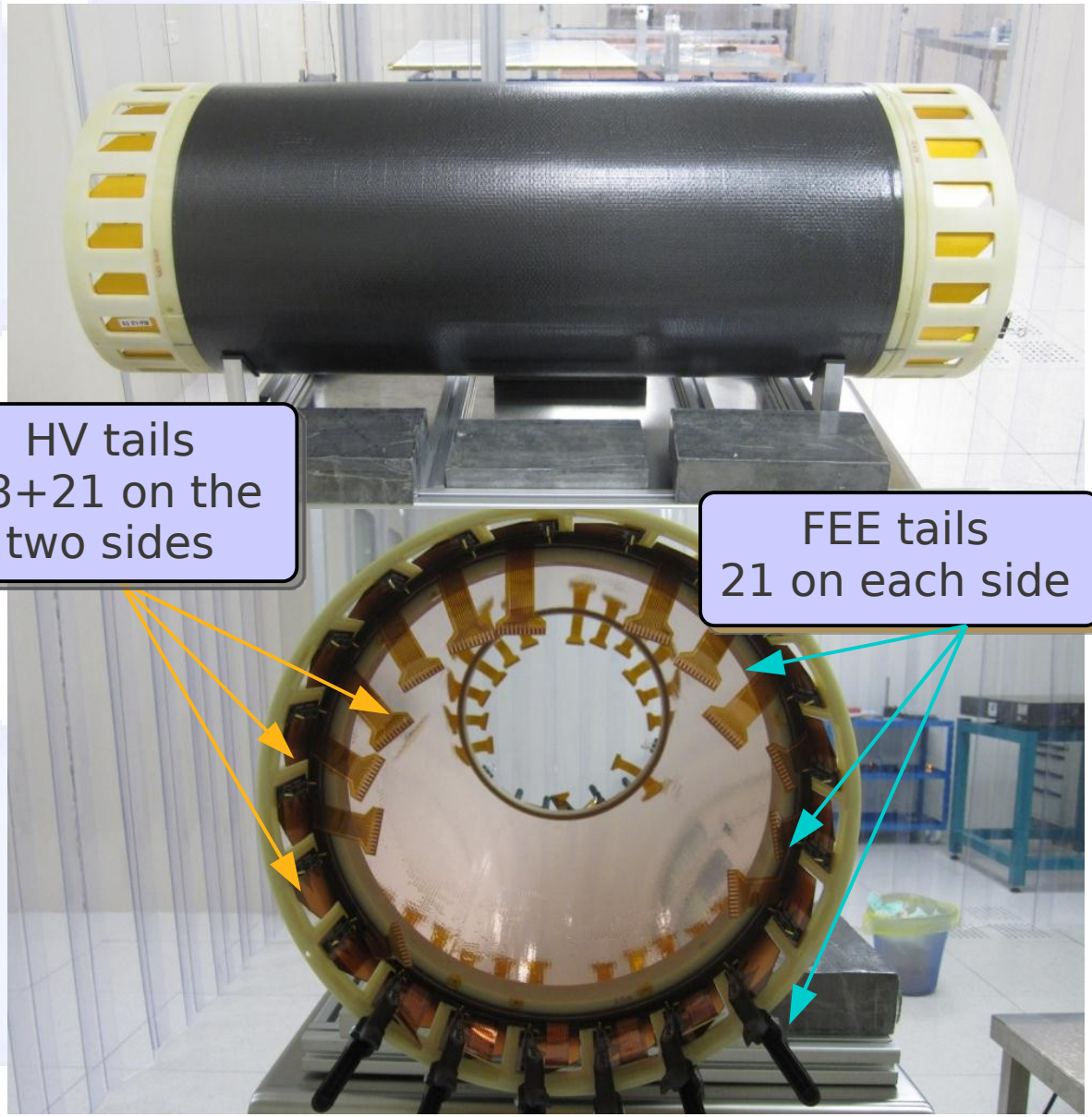
L2
- Gas tightness: OK
- X-Ray and temperature: in progress
- Dressing for the and of January
- Setup for Cosmic Ray test under finalization

L1
- Assembly in the middle of February

L3 and L4
- Molds delivered
- Durostone rings delivered
- L3 by the end of May

Electronics and Services
- GASTONE ready
- GIB ready
- HV patch-panel ready
- Gas System designed and parts ordered

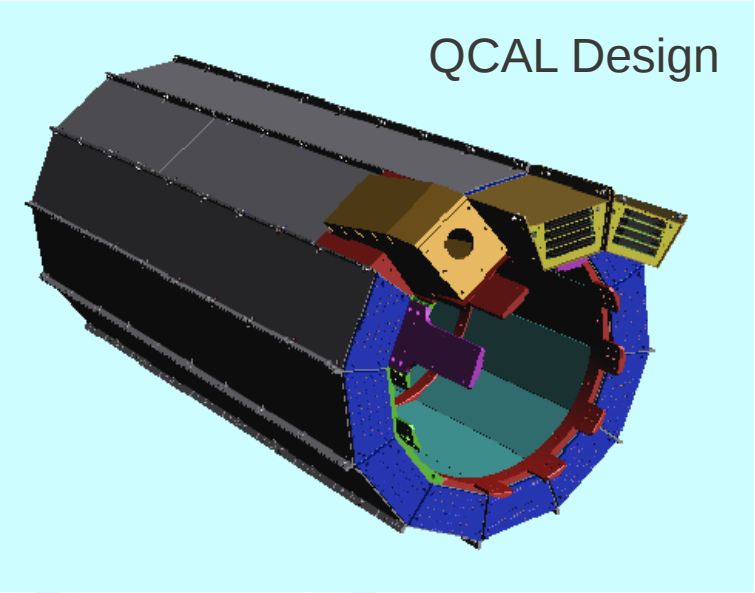
Several BTF periods booked:
20/02-4/03, 19/03-25/03, 11/06-17/06

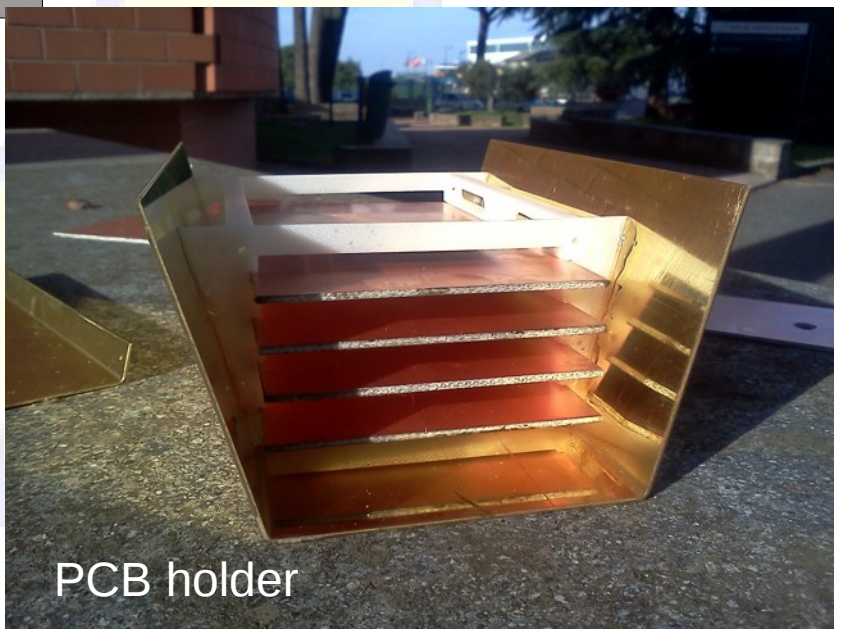


QCALT Detector status

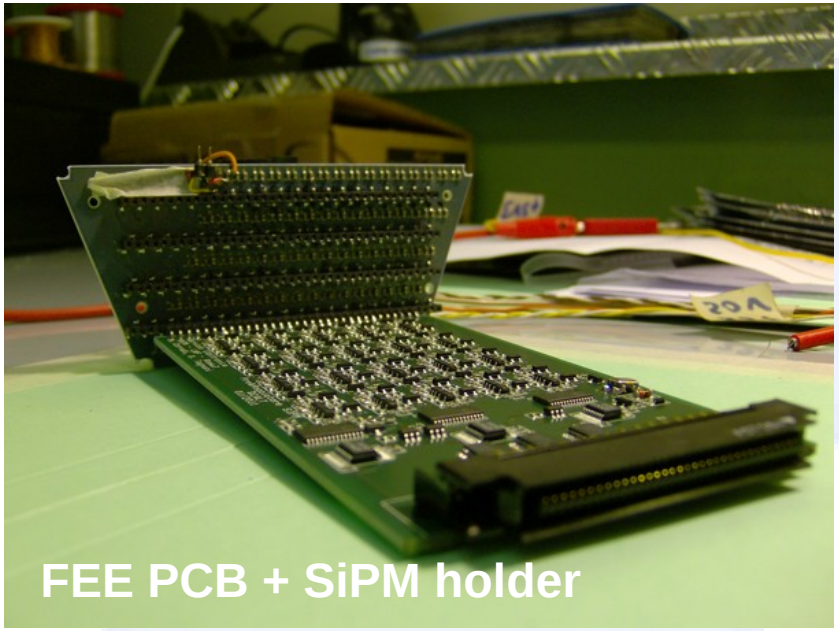
Final engineering drawings of all parts

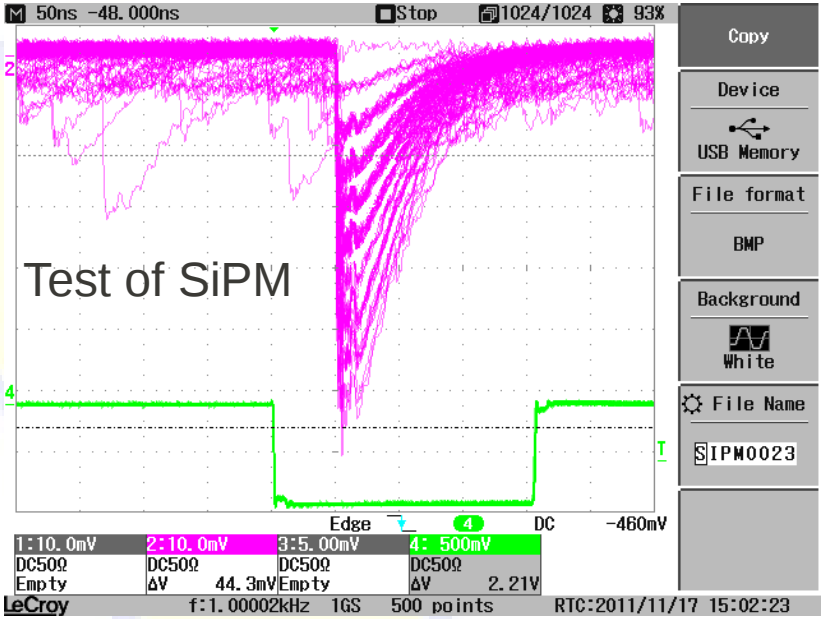
- ✔ Tiles, W/CU and fiber ready for first 6 modules
- ✔ Mechanical support and module trays ready
- ✔ Fiber-holder masks ready for all modules
- ✔ FEE holders ready





QCALT: FEE and plans





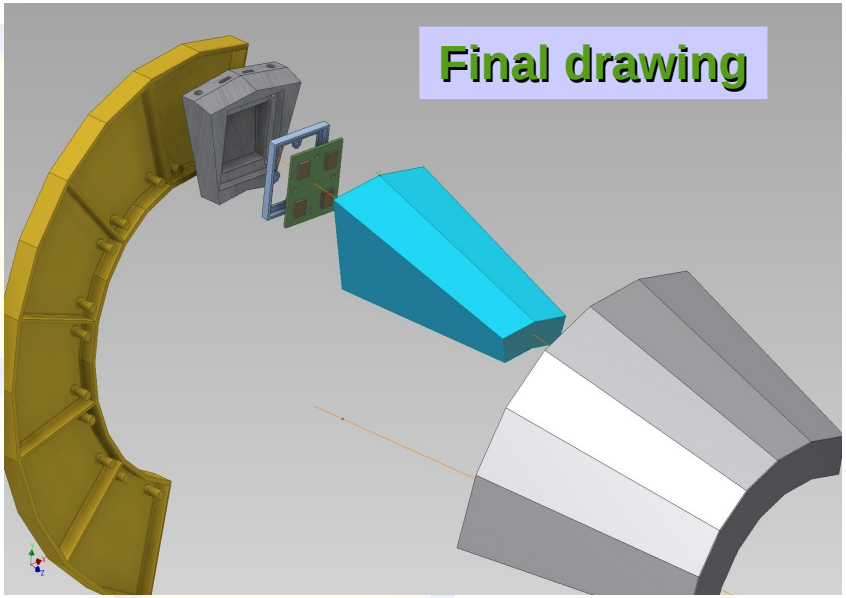
- Construction of first 6 modules ready to start, all material received –> 1 module/week, Completion end of March.

- SIPM and FEE construction started –> Completion for April

- Other 18 modules:
  1) Scintillator material received, milling in progress
  2) Bid for W/Cu absorber completed, 6/18 on March last 12/18 on April.
  3) Parallel construction of two modules/week in planning.
  4) Calorimeter test with CRS foreseen.

CCALT status and plans

- Production of the mechanical parts started (February shells from INFN – NA)
- Order for the 4x4 mm^2 SiPM from IRST-FBK placed (February-March)
- Crystal procurement under way (tender closed, contract in preparation)
- Tests of FEE electronics already performed (same technology used for LET calorimeter + standard KLOE calorimeter chain)
- HV supply and amplification ready



First sample of shells from INFN NA workshop

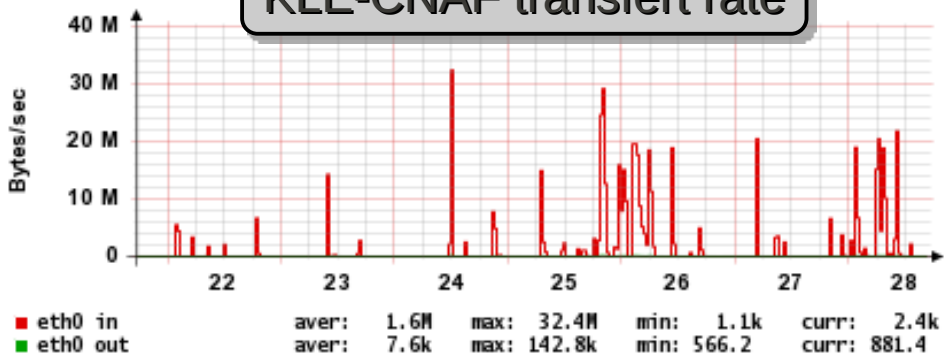
KLOE data analysis

Data reversal & backup status

LAST SC ... a bug in the hardware!

...NOW KLOE Dataset is ONLINE

KLE-CNAF transfert rate



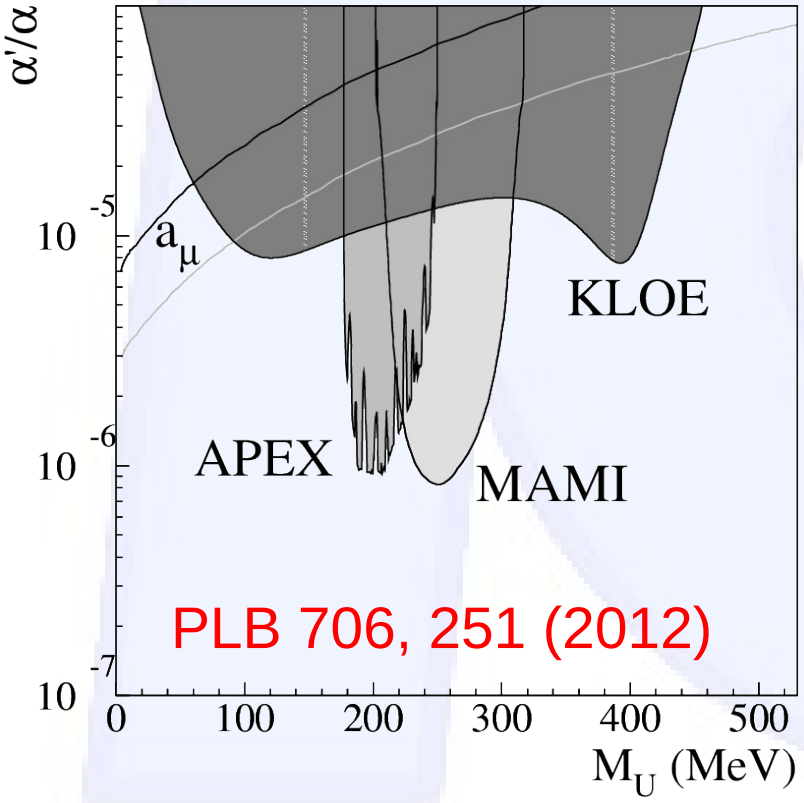
We upgraded the first KLOE tape library **completing the data reversal of ALL data** (raw, reconstructed and simulated) from the contaminated environments to the cleaner and safer place: KLOE CED.

We implement successfully the technique to send data to CNAF as request by CSN1. Currently all the data acquired during the first two months of data taking were sent to CNAF continuously without any interruption or losses.
We completely used the maximal allowed bandwidth (1Gbps).

New disks areas was installed and now are ready for user/offline jobs.

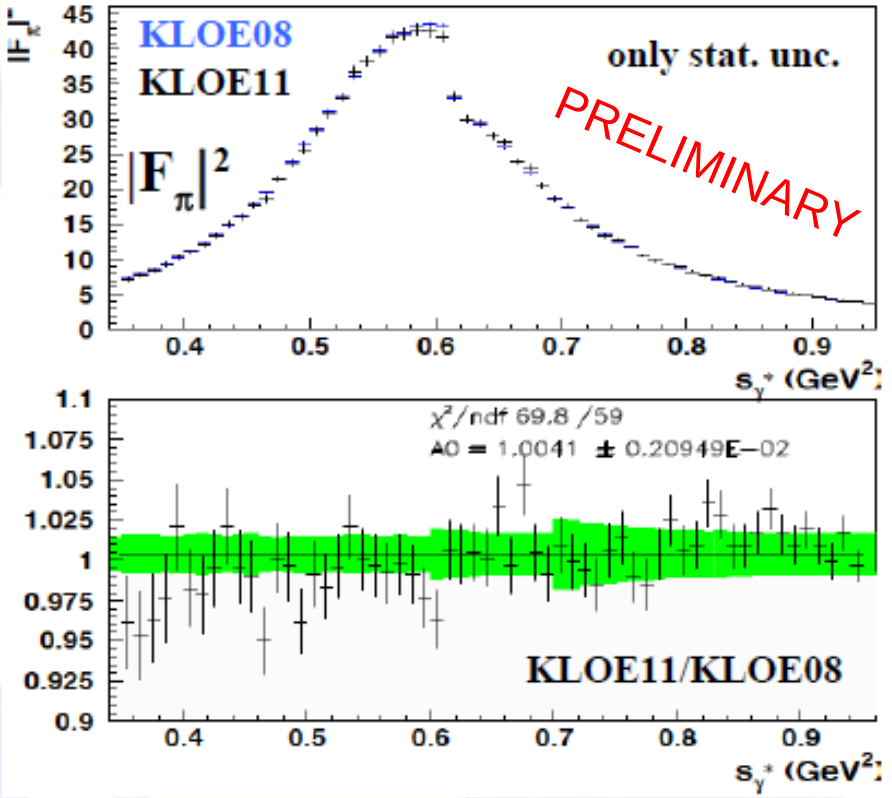
Updates on KLOE data analysis since last SC

Search for dark force mediator



PLB 706, 251 (2012)

$|F_\pi|^2$ from $\pi^+\pi^-\gamma/\mu^+\mu^-\gamma$ ratio



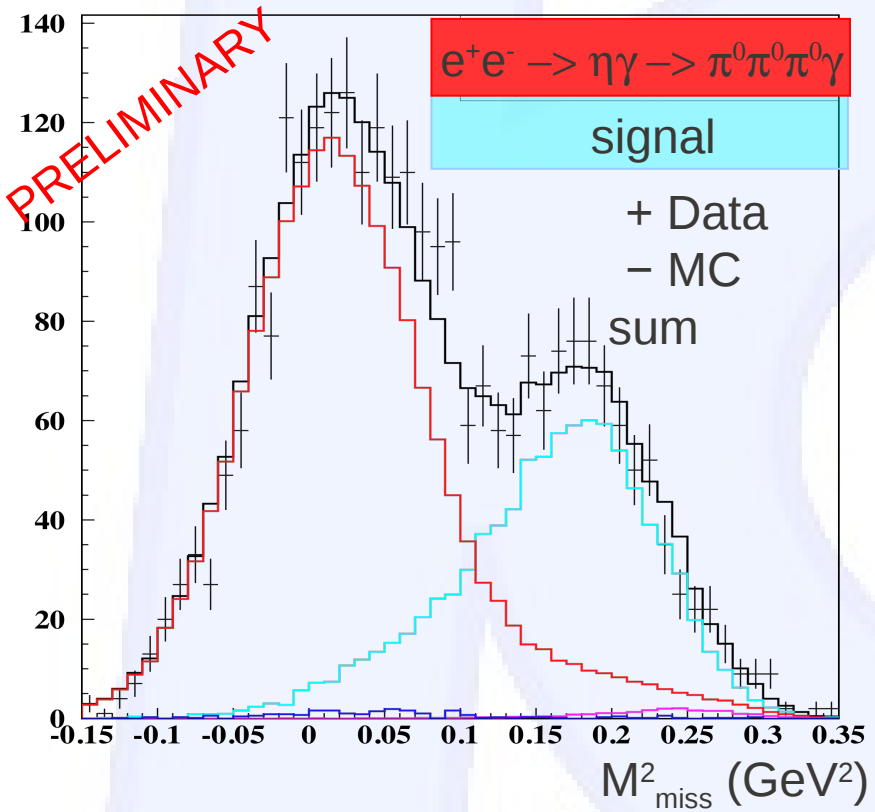
KLOE11: $a_\mu^{\pi\pi}(0.35\text{-}0.95\ \text{GeV}^2) = (384.1 \pm 1.2_{stat} \pm 4.0_{syst} \pm 1.2_{theo})10^{-10}$

KLOE08: $a_\mu^{\pi\pi}(0.35\text{-}0.95\ \text{GeV}^2) = (387.2 \pm 0.5_{stat} \pm 2.4_{syst} \pm 2.3_{theo})10^{-10}$

Good agreement within KLOE measurements

Updates on KLOE data analysis since last SC

$\gamma\gamma \to \eta \to \pi\pi\pi$



$3\pi^0$: $\sigma(\gamma\gamma \to \eta) = (37.0 \pm 1.4 \pm 2.2)$ pb

+−0: $\sigma(\gamma\gamma \to \eta) = (41.7 \pm 4.0 \pm \ldots)$ pb

U.L. on $BR(K_S \to \pi^0\pi^0\pi^0)$

Using 2.0 fb^{-1}, we have $N_{obs}=0$ events selected as signal and $N_{exp}=0$ in MC

SM prediction: 0.19 events after selection

PRELIMINARY

$$BR(K_S \to 3\pi^0) = \frac{N_{3\pi}/\varepsilon_{3\pi}}{N_{2\pi}/\varepsilon_{2\pi}} \times BR(K_S \to 2\pi^0) < 2.9 \times 10^{-8}$$

First observation possible at KLOE-2

Updates on KLOE data analysis since last SC

$\eta \to e^+e^-e^+e^-$	Published in August [PLB 702, 324 (2011)]
$\phi \to \eta U$, $\eta \to \pi^+\pi^-\pi^0$	Just published [PLB 706, 251 (2012)]
$\pi^+\pi^-\gamma/\mu^+\mu^-\gamma$	Preliminary on $\|F_{\square}\|^2$, $a_{\square}$ @ Summer Conf.
$K_S \to \pi^0\pi^0\pi^0$	Preliminary on U.L. @ Summer Conf.
$\eta \to \pi^+\pi^-\gamma$	Updates @ Summer Conf. [arXiv:1107.5733]
$\gamma\gamma \to \eta$	Updates @ Summer Conf.
$\gamma\gamma \to \pi^0\pi^0$	Updates @ Summer Conf.

Conclusions

- DAΦNE performance are improving;
- KLOE detector is fully operational;
- KLOE Dataset successfully restored;
- KLOE-2 data successfully reconstructed, event classification under revision;
- Low and High Energy Taggers under commissioning;
- Upgrades (IT/QCALT/CCALT) in advanced status;
- Integration of new interaction region almost final;
- KLOE data analysis still in progress;

.... waiting for the completion of the DAΦNE commissioning

SPARES

Integrated luminosity (KLOE-2)

RUN_YEAR	RUN_MONTH	RUN_DAY	NR_RUN	START_RUN	END_RUN	INTLUM_PB	RUN_TIME	LUMPERHOUR
2011	11	3	207	56845	57051	0	2.268	0
2011	11	15	9	57250	57258	0.007636	1.068	0.007151
2011	11	14	3	57247	57249	0.02419	4.164	0.00581
2011	11	13	5	57238	57242	0.08533	16.58	0.005148
2011	11	4	4	57053	57056	0.1656	1.726	0.09595
2011	11	5	2	57057	57058	0.6831	3.377	0.2023
2011	11	2	163	56682	56844	0.9295	9.146	0.1016
2011	11	1	48	56633	56680	2.527	11.4	0.2217
2011	11	23	11	57375	57386	35.43	5.72	6.194
2011	11	7	13	57099	57115	89.87	19.3	4.657
2011	11	6	38	57060	57097	126.3	16.61	7.607
2011	11	29	29	57494	57523	148.3	6.527	22.73
2011	11	9	13	57147	57159	189.9	18.25	10.41
2011	11	12	6	57231	57236	211.6	19.65	10.77
2011	11	24	5	57388	57393	350.3	9.096	38.52
2011	11	8	29	57117	57145	432.1	19.1	22.62
2011	11	10	15	57161	57178	478.1	21.32	22.42
2011	11	21	5	57364	57368	528.2	9.124	57.89
2011	12	12	30	57874	57910	599.9	16.99	35.31
2011	11	17	12	57261	57276	632.5	7.938	79.67
2011	12	7	18	57715	57732	683.4	15.91	42.97
2011	11	26	17	57423	57442	795.8	9.336	85.24
2011	11	25	16	57395	57420	800.4	10.84	73.83
2011	11	22	4	57370	57373	814.9	16.75	48.64
2011	12	4	6	57626	57632	1007	11.99	83.95
2011	12	6	35	57668	57713	1036	11.68	88.7
2011	11	28	33	57457	57492	1105	17.15	64.4
2011	11	30	14	57525	57538	1119	9.31	120.2
2011	11	27	12	57444	57455	1126	15.74	71.53
2011	12	13	17	57912	57930	1292	21.44	60.27
2011	12	22	12	58278	58292	1538	11.24	136.9
2011	11	19	22	57329	57350	1576	21.38	73.73
2011	11	20	11	57352	57362	1804	21.25	84.91
2011	12	2	16	57586	57605	1809	22.05	82.04
2011	11	11	51	57180	57230	1825	21.64	84.36
2011	11	18	49	57279	57327	2033	15.69	129.6
2011	12	15	56	57965	58021	2414	16.87	143.1
2011	12	1	35	57541	57584	2668	17.24	154.7
2011	12	10	39	57794	57833	2960	15.51	190.8
2011	12	5	24	57635	57665	3115	17.39	179.2
2011	12	20	46	58190	58243	3150	14.42	218.4
2011	12	14	31	57932	57963	3341	16.94	197.2
2011	12	3	12	57608	57625	3341	20.42	163.6
2011	12	9	29	57762	57792	3403	16.77	202.9
2011	12	11	40	57834	57873	3460	16.46	210.2
2011	12	21	26	58245	58275	4004	19.44	205.9
2011	12	8	27	57734	57760	4142	21.25	195
2011	12	19	27	58156	58187	4939	21.29	231.9
2011	12	16	47	58023	58069	5325	19.81	268.8
2011	12	18	31	58119	58154	5523	20.24	272.9
2011	12	17	42	58070	58116	5828	20.79	280.3

Total integrated luminosity and integrated luminosity per time unit during Nov-Dec 2011. Best performances achieved on December, 17 with 5.8 pb^{-1} during ~21h (290 pb^{-1}/h).

Integrated luminosity (KLOE-2)

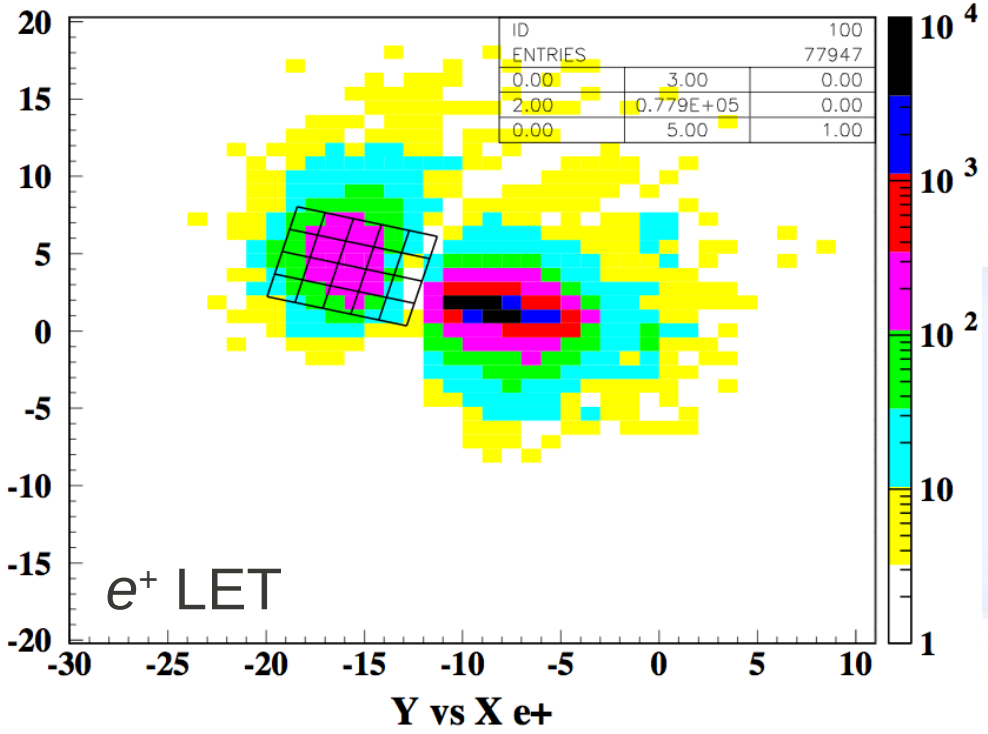
RUN_YEAR	RUN_MONTH	RUN_DAY	NR_RUN	START_RUN	END_RUN	INTLUM_PB	RUN_TIME	LUMPERHOUR
2004	11	21	36	33279	33315	6795	22.85	297.4
2005	9	30	34	39311	39351	6801	21.76	312.5
2005	10	30	33	40398	40430	6802	21.84	311.5
2005	11	7	41	40707	40747	6806	22.97	296.3
2005	10	17	38	39905	39946	6830	19.9	343.2
2005	9	9	34	38489	38522	6884	22.54	305.4
2005	10	7	31	39533	39570	6900	21.35	323.2
2005	6	5	36	37105	37142	6932	21.34	324.8
2005	9	8	33	38452	38487	6950	21.31	326.2
2005	11	27	44	41561	41606	6990	20.7	337.7
2005	4	8	32	35486	35518	6998	22.23	314.7
2005	9	12	35	38595	38637	7000	20.14	347.5
2005	9	17	36	38806	38841	7016	21.59	325
2005	10	19	31	40010	40042	7059	19.71	358.1
2005	5	8	35	36340	36376	7083	22.24	318.4
2005	10	15	36	39838	39874	7122	22.33	319
2005	11	26	39	41514	41559	7141	20.43	349.5
2005	11	28	51	41608	41663	7153	21.76	328.8
2005	10	21	51	40065	40115	7158	21.25	336.9
2005	5	24	35	36714	36753	7189	21.8	329.8
2005	11	23	67	41341	41414	7203	21.72	331.6
2005	6	2	37	36995	37032	7214	22.49	320.8
2005	5	10	34	36413	36446	7230	21.09	342.8
2005	9	13	38	38639	38685	7302	20.5	356.2
2005	9	21	34	38944	38978	7334	21.87	335.3
2005	10	10	37	39645	39682	7348	22.35	328.7
2005	6	1	35	36957	36993	7357	23.12	318.2
2005	10	12	37	39720	39757	7408	21.58	343.3
2005	10	9	34	39609	39643	7414	22.19	334.1
2005	11	3	37	40554	40598	7421	21.43	346.3
2005	10	22	35	40117	40152	7424	20.27	366.3
2005	10	31	39	40432	40470	7451	20.8	358.2
2005	10	3	35	39397	39432	7499	22.52	333.1
2005	9	15	37	38726	38762	7506	21.93	342.3
2005	11	24	49	41416	41473	7519	21.44	350.7
2005	9	18	36	38843	38878	7558	23.26	325
2005	11	1	35	40472	40508	7562	22.05	342.9
2005	9	11	36	38558	38593	7578	22.67	334.3
2005	9	23	40	39023	39064	7719	22.5	343.1
2005	9	28	36	39232	39267	7737	21.98	352
2005	4	10	36	35549	35586	7802	22.99	339.3
2005	11	4	38	40600	40639	7824	22.53	347.2
2005	10	13	38	39759	39796	7868	22.65	347.4
2005	5	22	36	36643	36679	7871	22.99	342.4
2005	11	2	39	40510	40552	7951	22.36	355.6
2005	9	24	40	39066	39106	7974	22.61	352.6
2005	11	29	45	41665	41715	8121	22.19	365.9
2005	9	25	39	39108	39146	8170	22.81	358.2
2005	9	29	41	39269	39309	8300	23.09	359.5
2005	9	16	40	38764	38804	8336	22.72	366.9
2005	9	26	40	39148	39188	8361	23.1	361.9
2005	12	2	42	41778	41819	8617	22.37	385.2

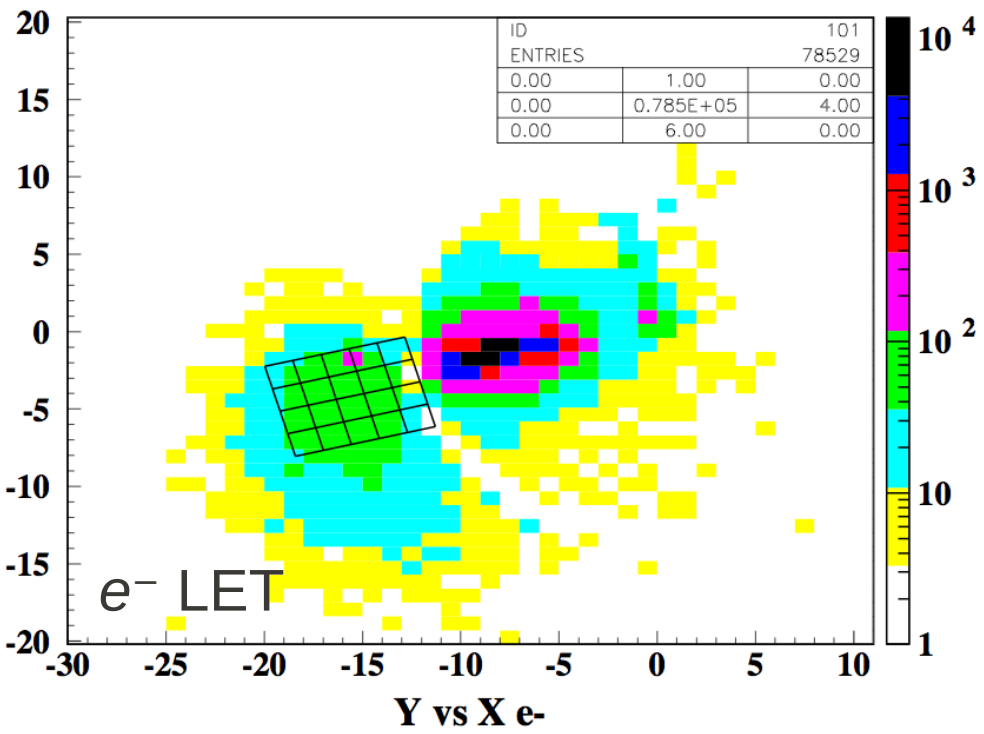
Best performance during KLOE run.
Total integrated luminosity and integrated luminosity per time unit. Best performances was achieved December 2, 2005 with 8.6 pb^{-1} collected during ~22h (~390 nb^{-1}/h).

LET plans for the physic run

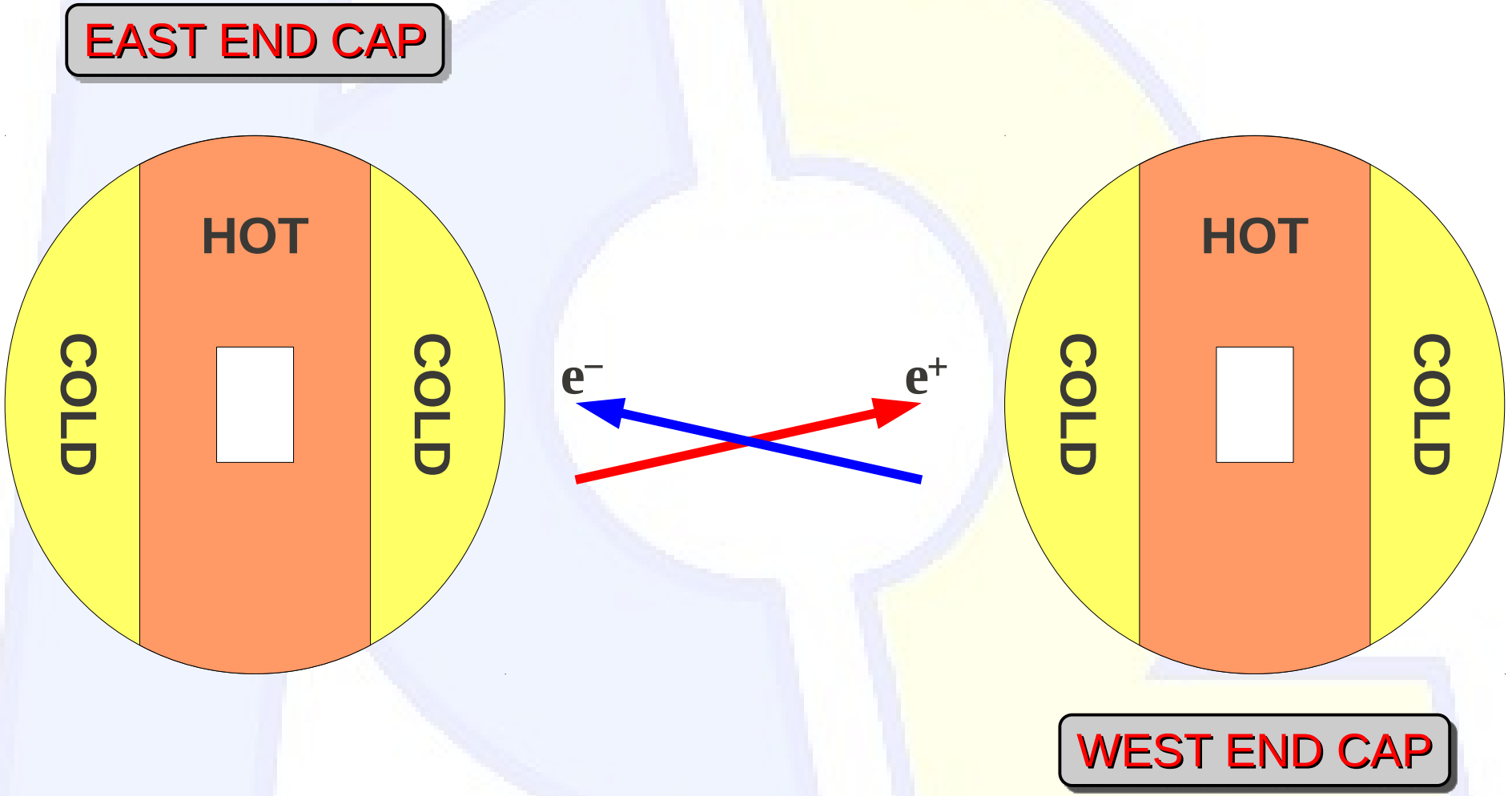
In view of the physic run with all upgrades inserted we are studying the best configuration possible and the needs for the final integration of all the detectors in the new interaction region.
MC simulation shows that the e- LET has to be rotated and beam pipe support, if possible, reshaped.

Simulation of the impact point of primary leptons on a plane parallel to the LET sensitive surface. Beam pipe support is assumed the one currently in use.

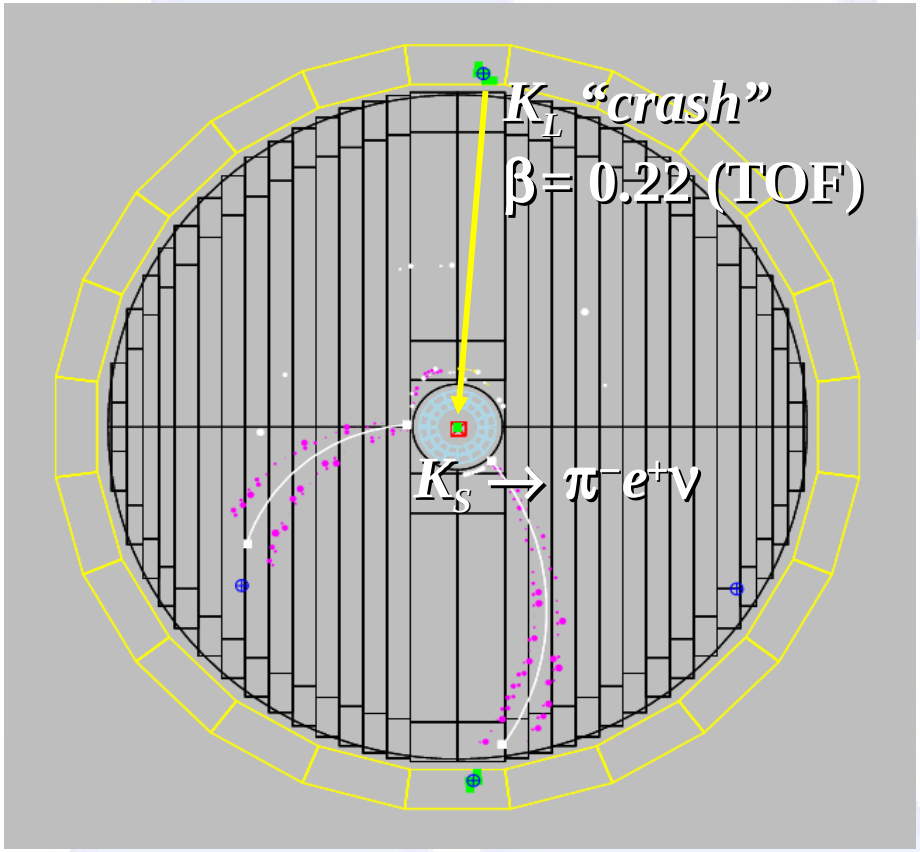


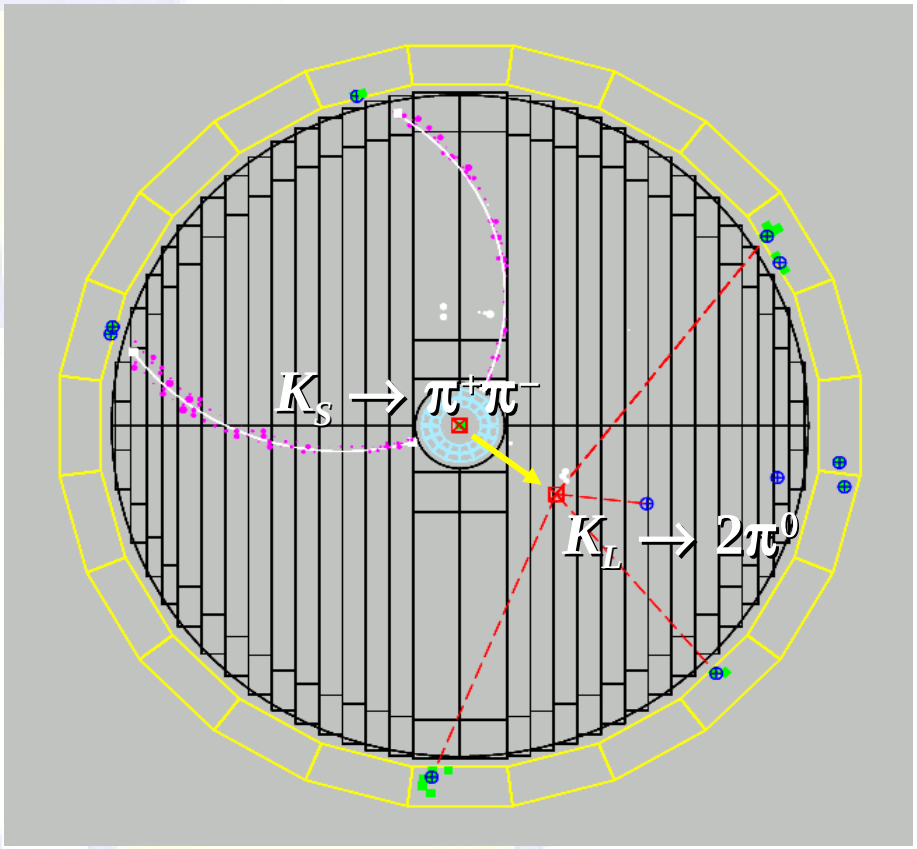


End Caps hot region definition



Neutral kaon tagging





K_S tagged by K_L interaction in EmC

Efficiency ~ 30% (largely geometrical)

K_S angular resolution: ~ 1° (0.3° in ϕ)

K_S momentum resolution: ~ 2 MeV

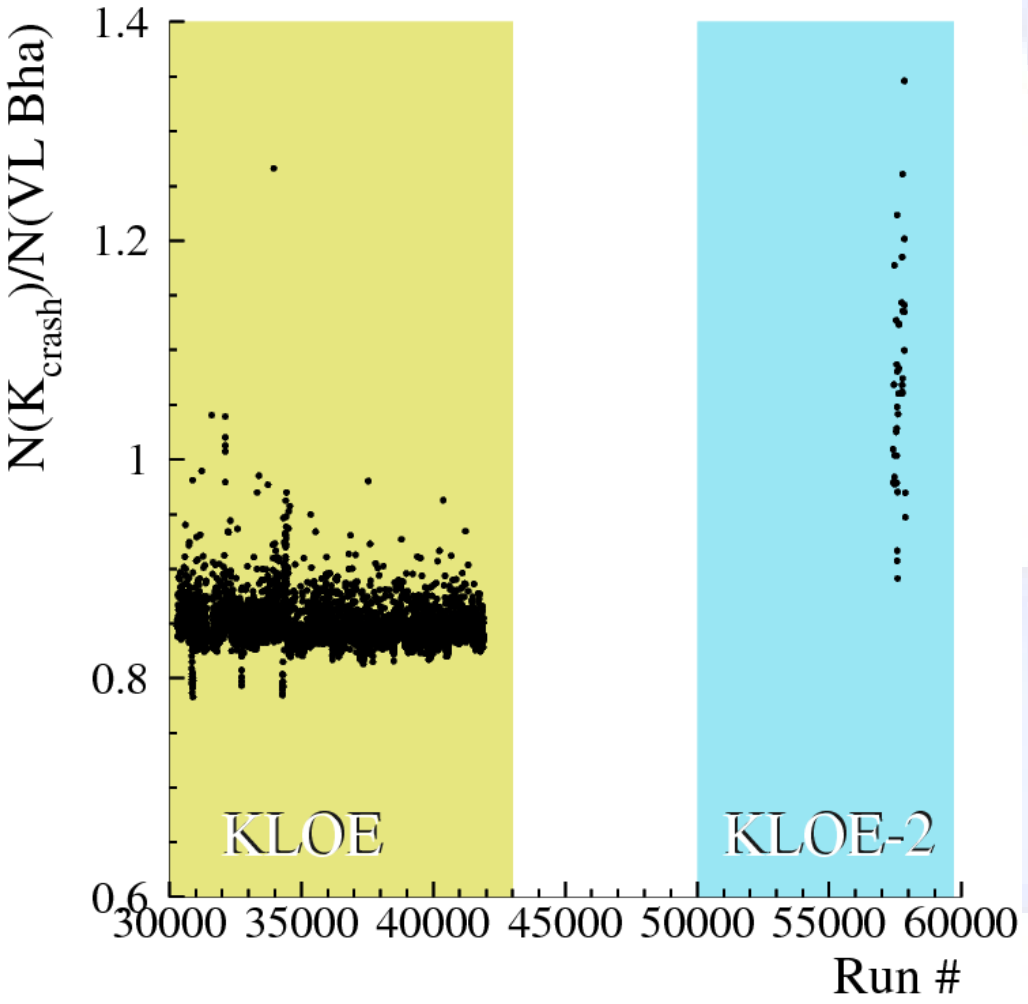
K_L tagged by $K_S \to \pi^+\pi^-$ vertex at IP

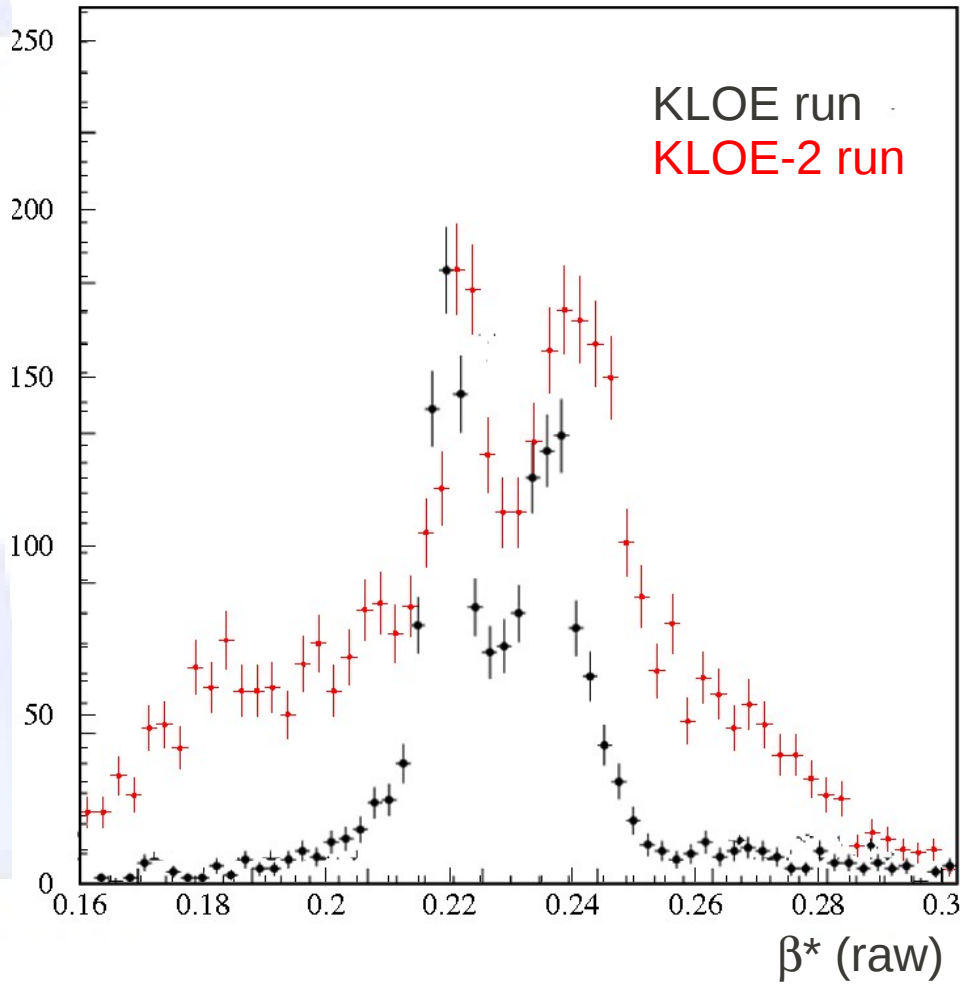
Efficiency ~ 70% (mainly geometrical)

K_L angular resolution: ~ 1°

K_L momentum resolution: ~ 2 MeV

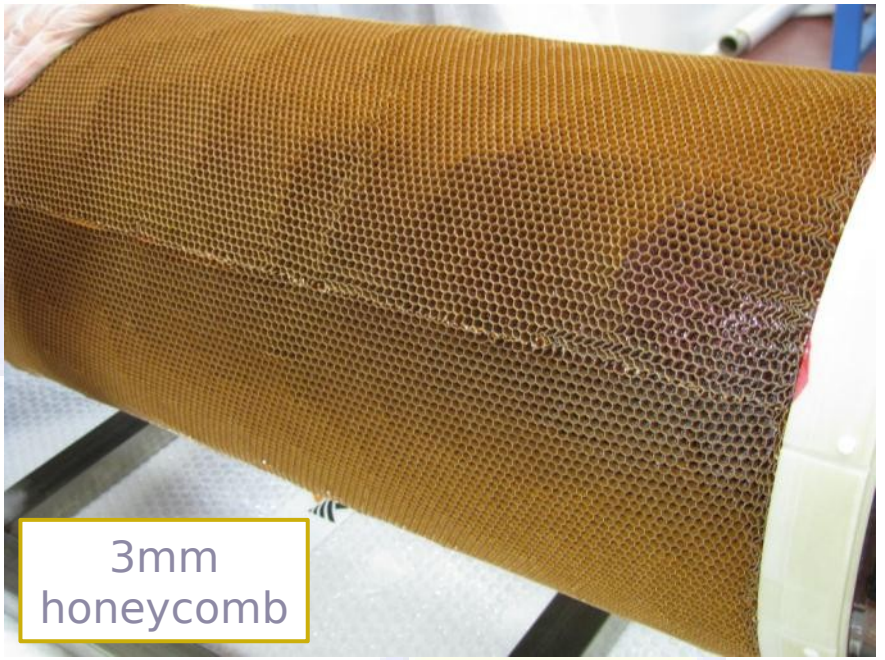
KS tagging: using same EVCL for new data



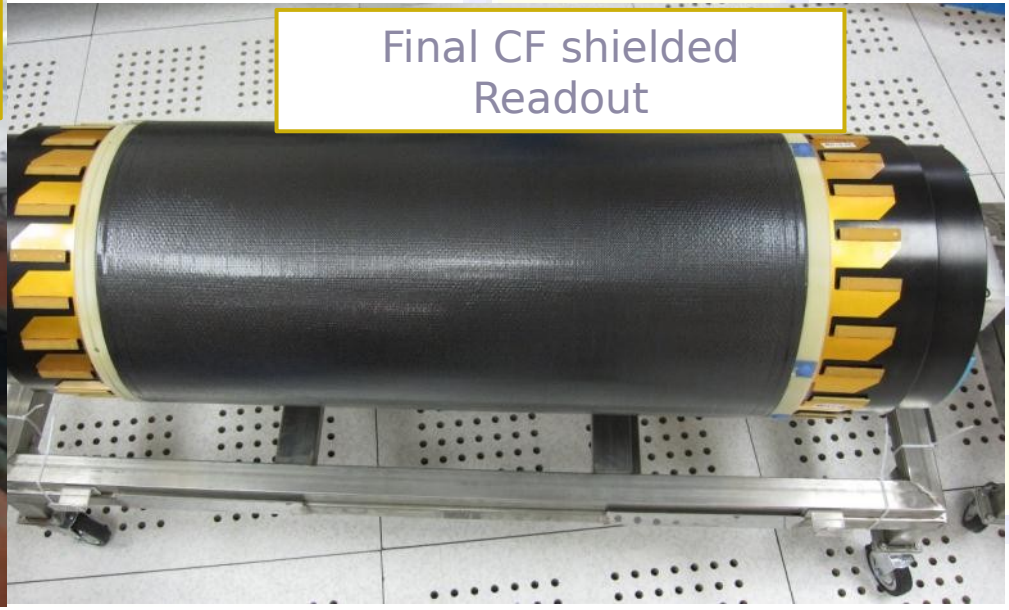


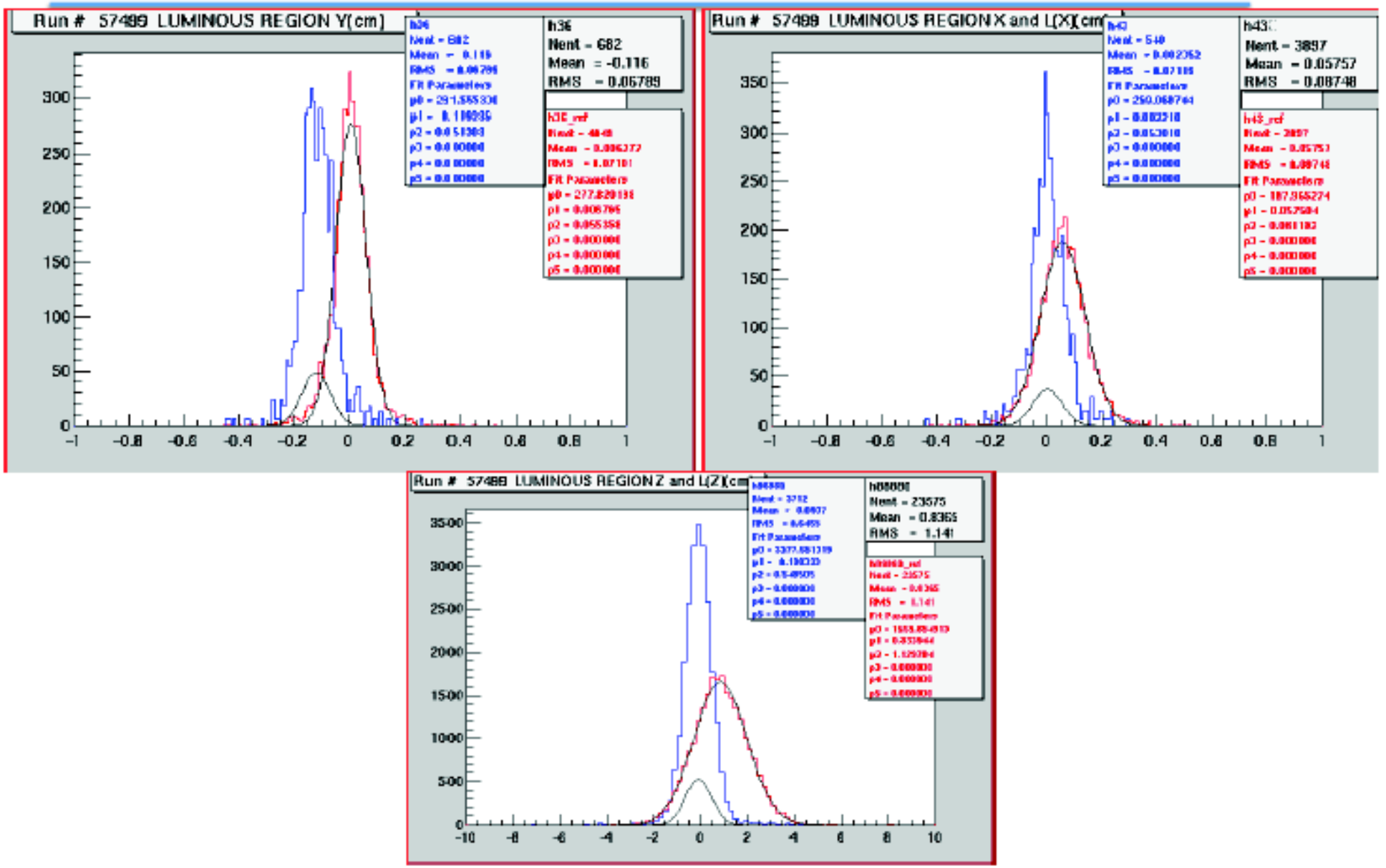
IT


first 90µm
CF skin


3mm
honeycomb


Curing in
autoclave


Final CF shielded
Readout


Run # 57499 LUMINOUS REGION Y(cm)
h36
Nent = 682
Mean = -0.116
RMS = 0.06789
Run # 57499 LUMINOUS REGION X and L(X)(cm
Nent = 3897
Mean = 0.05757
RMS = 0.08748
Run # 57499 LUMINOUS REGION Z and L(Z)(cm
Nent = 23575
Mean = 0.8365
RMS = 1.141