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STATUS REPORT ON LDC ANALYSIS AND MULTI-TRACK EVENTS

Paola La Rocca
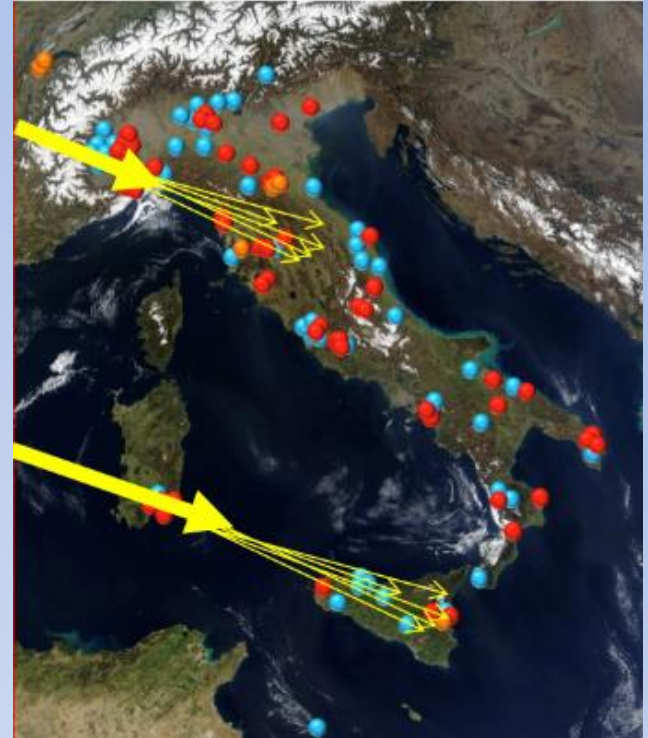
EEE MEETING
Rome – January 14, 2019

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A BRIEF SUMMARY

Analysis strategies:

1. **Correlations between telescope pairs (extensive air showers)**
   - ✓ Low spurious coincident rate between telescopes ($\sim 10^{-7}$ Hz)
   - ✗ Few sites with a cluster of telescopes (n. 10)

2. **Correlations between two and multi-track events in both telescopes**
   - ✓ High number of telescopes combinations (higher statistics)
   - ✓ More distances covered
   - ✗ Higher spurious coincident rate between telescopes ($\sim 10^{-6}$ Hz)

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A BRIEF SUMMARY

Analysis strategies:

1. Correlations between telescope pairs (extensive air showers)

Event	EEE pairs	Distance (km)	$|t_1 - t_2|$ (μs)	ϑ_{rel} (deg)	Expected events	p-value
(A)	BOLO-CAGL	614	86	27.1	0.0069 ± 0.0002	0.007
(B)	BOLO-LAQU	290	740	9.1	0.014 ± 0.001	0.014
(C)	CATA-TORI	1040	88	9.2	0.0265 ± 0.0005	0.026
(D)	GROS-TORI	377	297	14.4	0.032 ± 0.001	0.031
(E)	CERN-CATA	1200	248	9.3	0.049 ± 0.001	0.048

Eur. Phys. J. Plus (2018) 133: 34

- 3968 days of time exposure
- 96 observed events against 77.8 estimated background
- 5 candidate events with a p-value < 0.05

A BRIEF SUMMARY

Analysis strategies:

2. Correlations between two and multi-track events in both telescopes

Pre - selection of multi-track events:
- Chi2 < 50
- Parallelism constrain (scalar product with the seed track > 0.8)

Data set:
No. of telescopes: 39 telescopes + 5 clusters
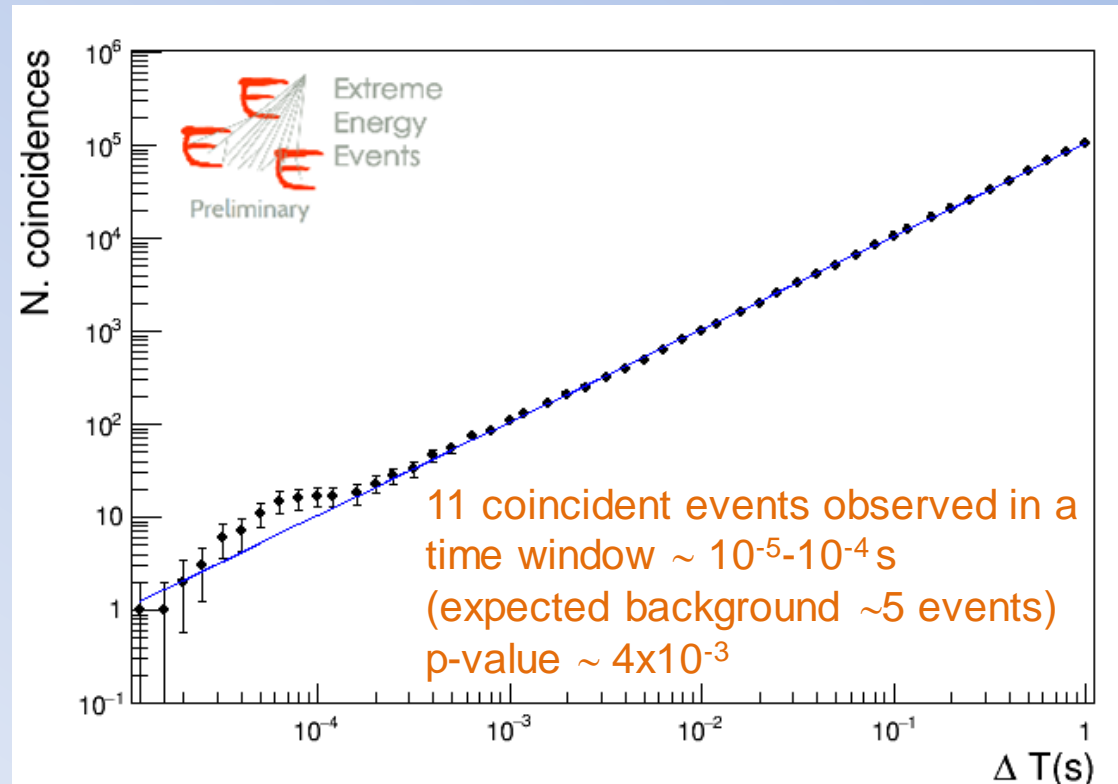No. of Events: 50 millions of events
Period: 2016-01-01 $\rightarrow$ 2018-03-26 (816 days)

Analysis cuts:
- Telescope distance > 5 km
- Ntracks > 4 on both telescopes

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A BRIEF SUMMARY

Analysis strategies:

2. Correlations between two and multi-track events in both telescopes

11 coincident events observed in a time window $\sim 10^{-5}$-10^{-4} s (expected background ~ 5 events) p-value $\sim 4 \times 10^{-3}$

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A BRIEF SUMMARY

Analysis strategies:

2. Correlations between two and multi-track events in both telescopes

Event	EEE pairs	$n_{tracks1}$	$n_{tracks2}$	Distance (km)	$\theta_{rel}(deg)$	Date
(A)	CERN-BOLOGNA	7	5	456	21	January 2016
(B)	L'AQUILA-BOLOGNA	7	6	290	41	April 2016
(C)	CERN-CATANZARO	5	7	1194	18	May 2016
(D)	L'AQUILA-TORINO	5	5	551	23	May 2016
(E)	LODI-SAVONA	5	5	137	24	October 2016
(F)	FRASCATI-REGGIO EMILIA	5	5	361	71	December 2016
(G)	CAGLIARI-LODI	6	5	675	50	January 2017
(H)	CERN-PATERNÒ	5	5	1208	41	March 2017
(I)	BOLOGNA-CATANZARO	6	5	767	36	March 2017
(J)	L'AQUILA-LECCE	6	5	456	64	June 2017
(K)	BOLOGNA-SAVONA	5	5	229	24	October 2017

Nucl. Phys. B Proc. Suppl.
(Proceeding for CRIS2018 Conference)

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MULTI-TRACK EVENTS

In order to investigate multi-tracks events:

- **data reprocessed**
- **additional info saved in the analysis tree**
  - Direction cosines of the tracks   **Thanks to Francesco!**
  - Chi2 of the tracks
  - Sum of the scalar products between tracks (degree of alignment)

Data set available:
- **3 x 10^7 coincident events (in +/- 2 seconds window)**
- **Full statistics (2013 -> 2018)**
- **42 telescopes + 5 clusters**

FIRST LOOK AT THE DATA
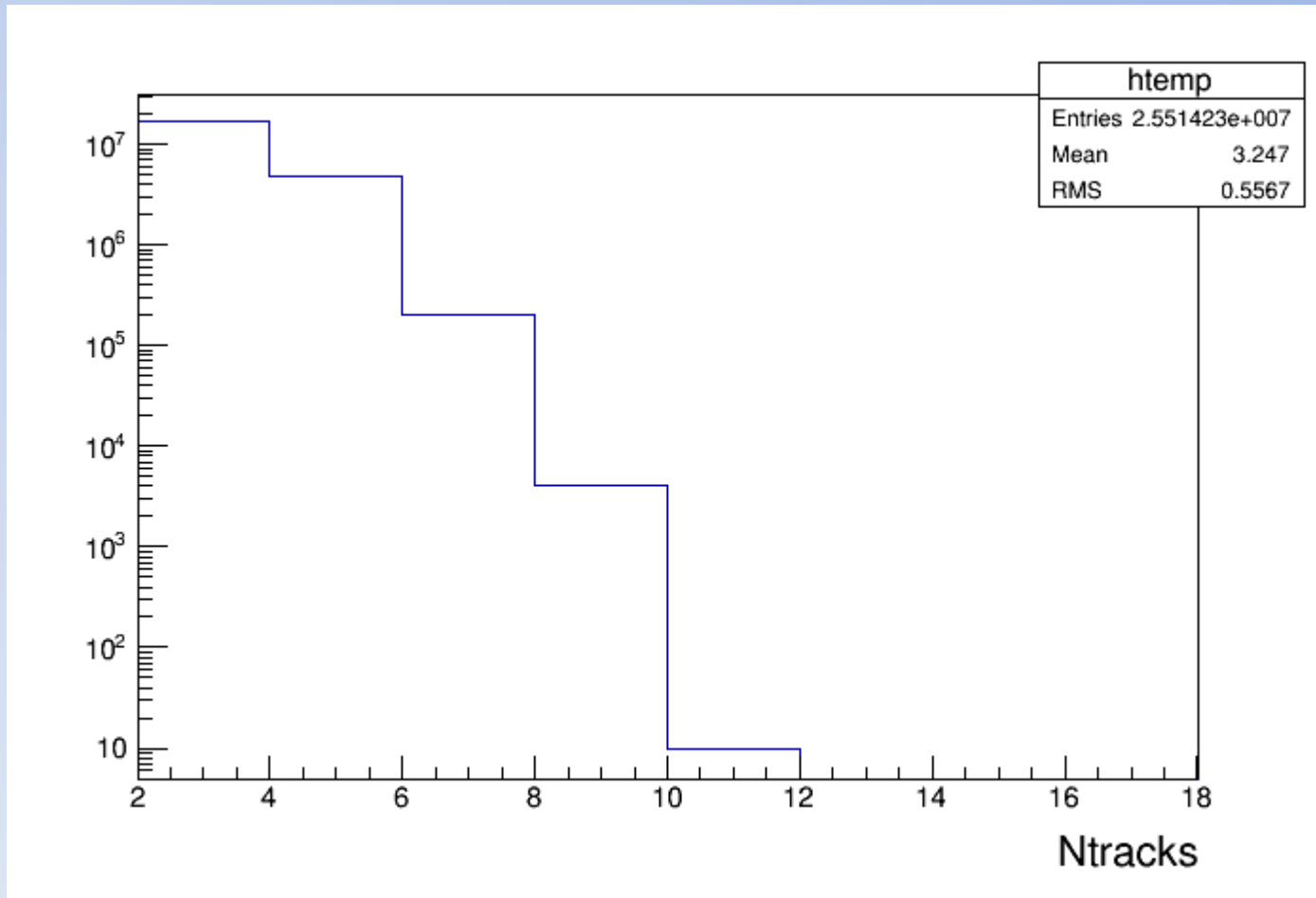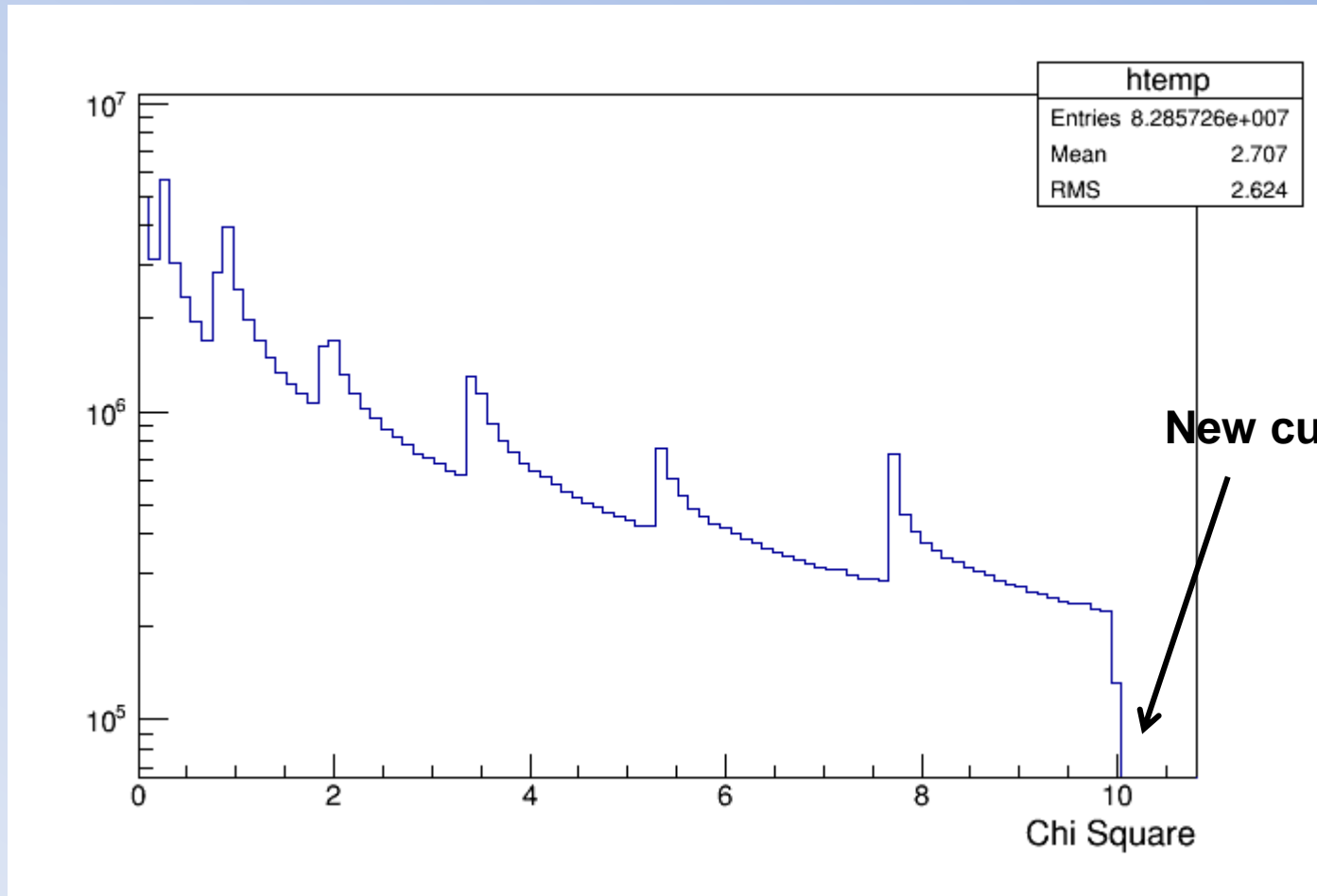
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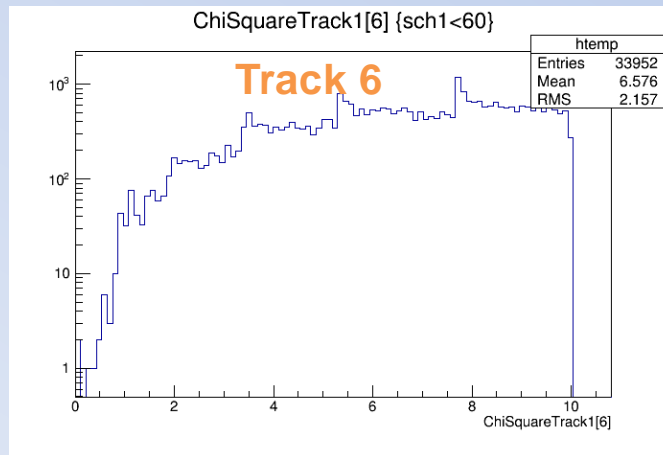Energy
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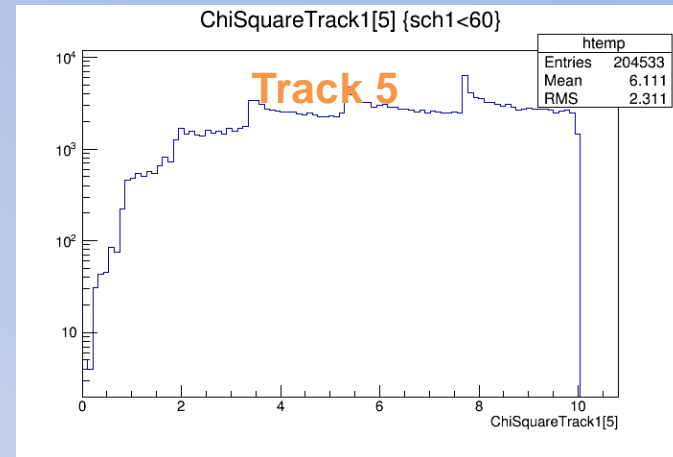
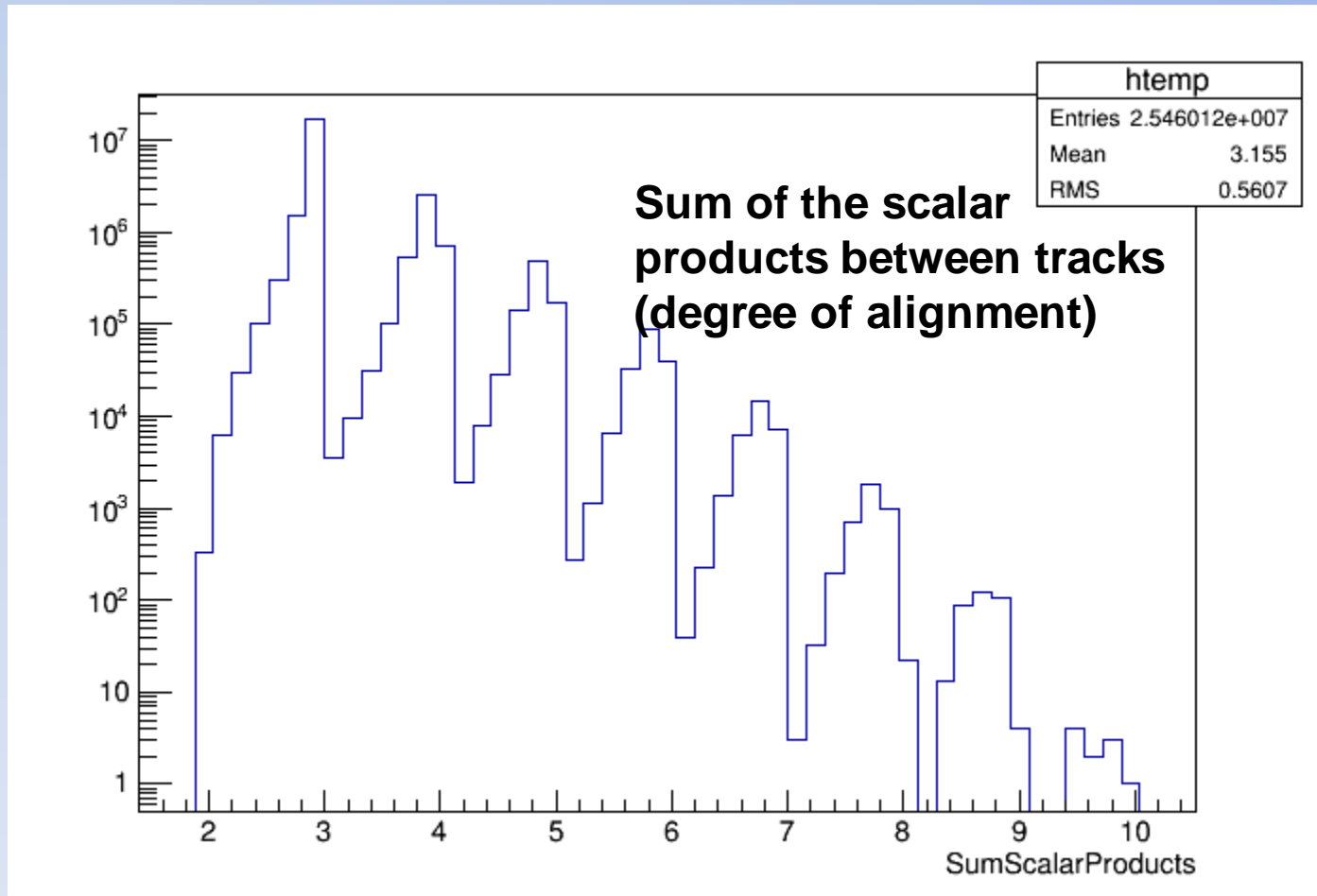# FIRST LOOK AT THE DATA

New cut

FIRST LOOK AT THE DATA

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FIRST LOOK AT THE DATA

Sum of the scalar products between tracks (degree of alignment)
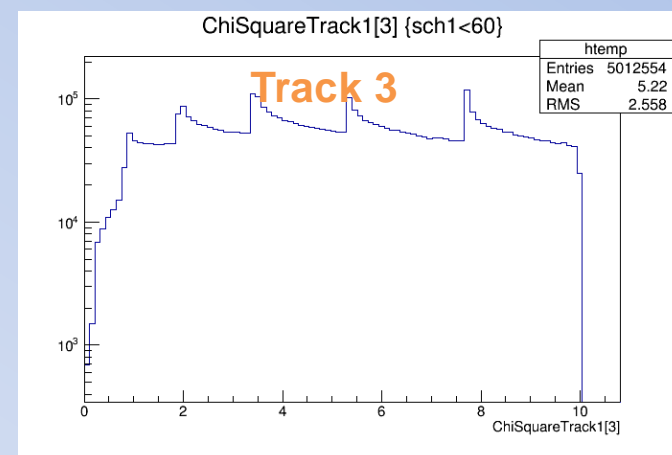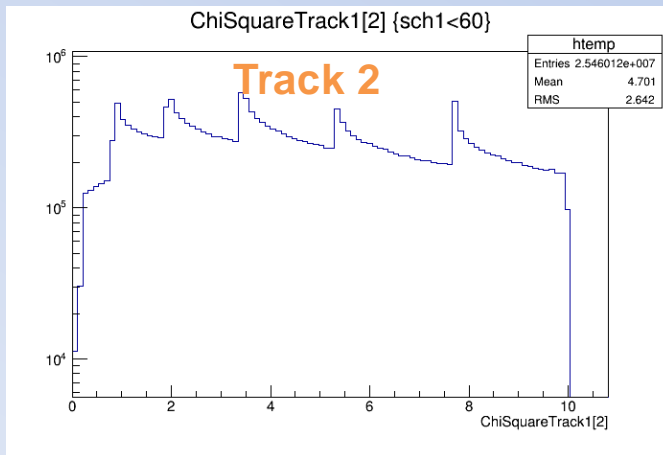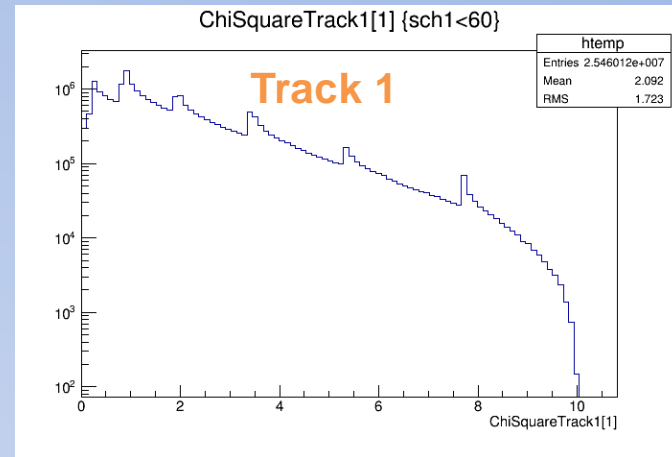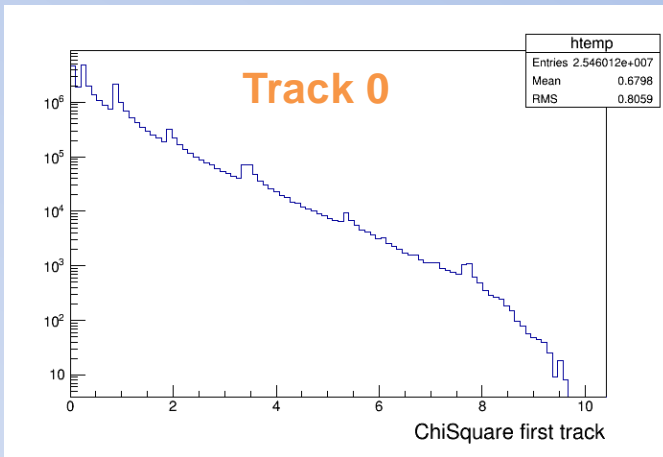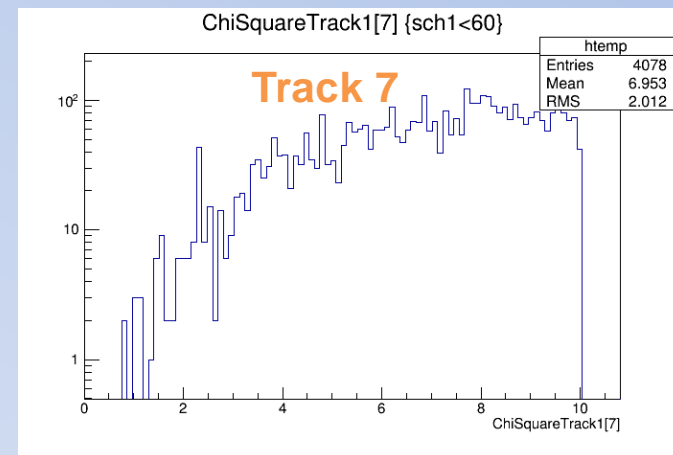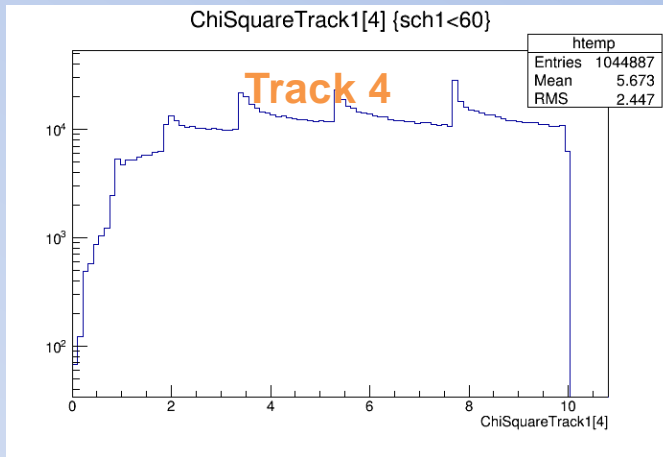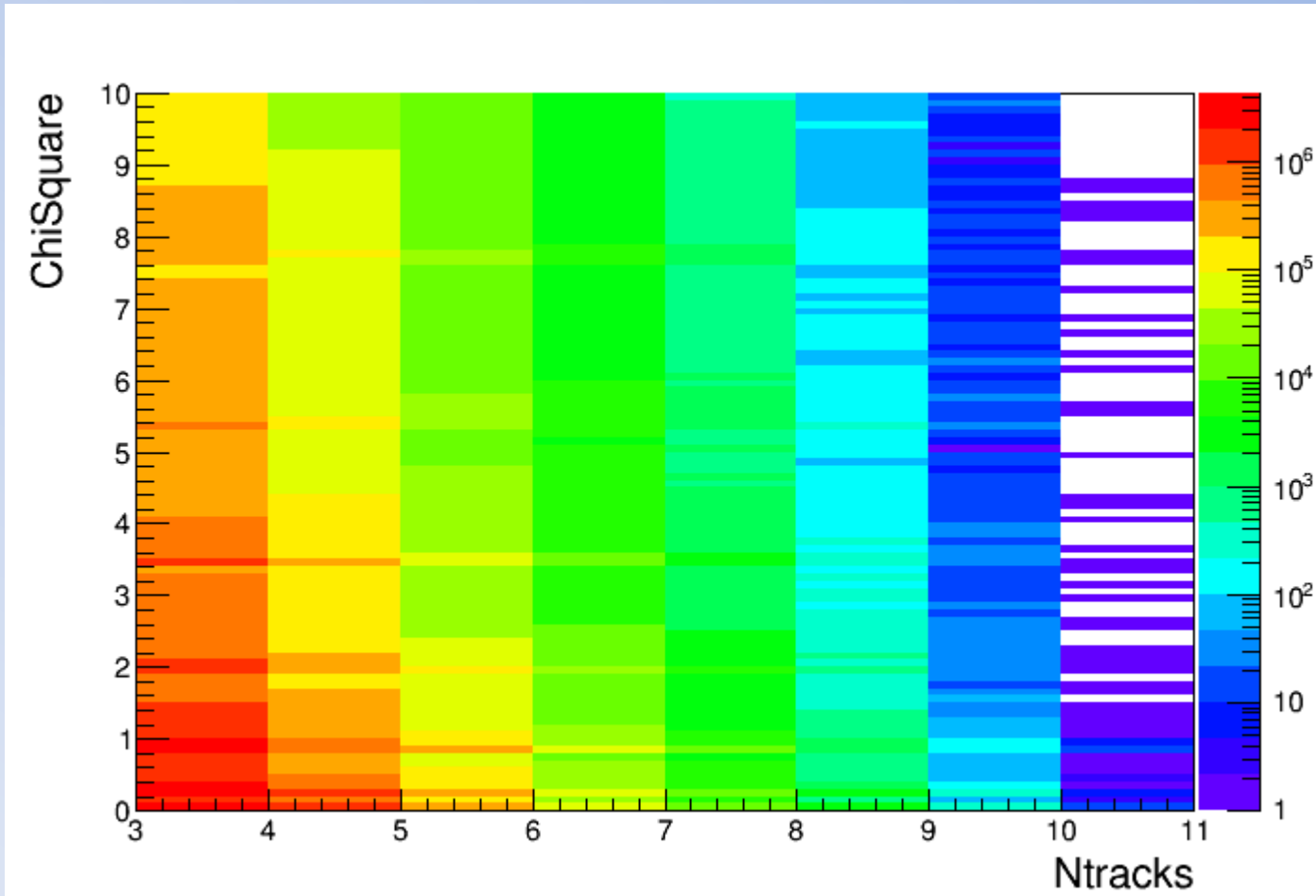
OUTLOOK

- **Need to deeply investigate multi-tracks events**

  - **Chi2 distributions**
  - **Parallelism of the tracks**

- **Study the effect of quality cuts on multi-track events for the LDC search**