10ª Conferenza dei Progetti del Centro Fermi - Progetto EEE

RUN ANALYSIS THROUGH TELESCOPE OPERATING PARAMETERS

Liceo Scientifico Vittorio Veneto, Milano
Lorenzo Gentile e Alessandro Invernici
6-7-8 Marzo 2019, Università di Torino

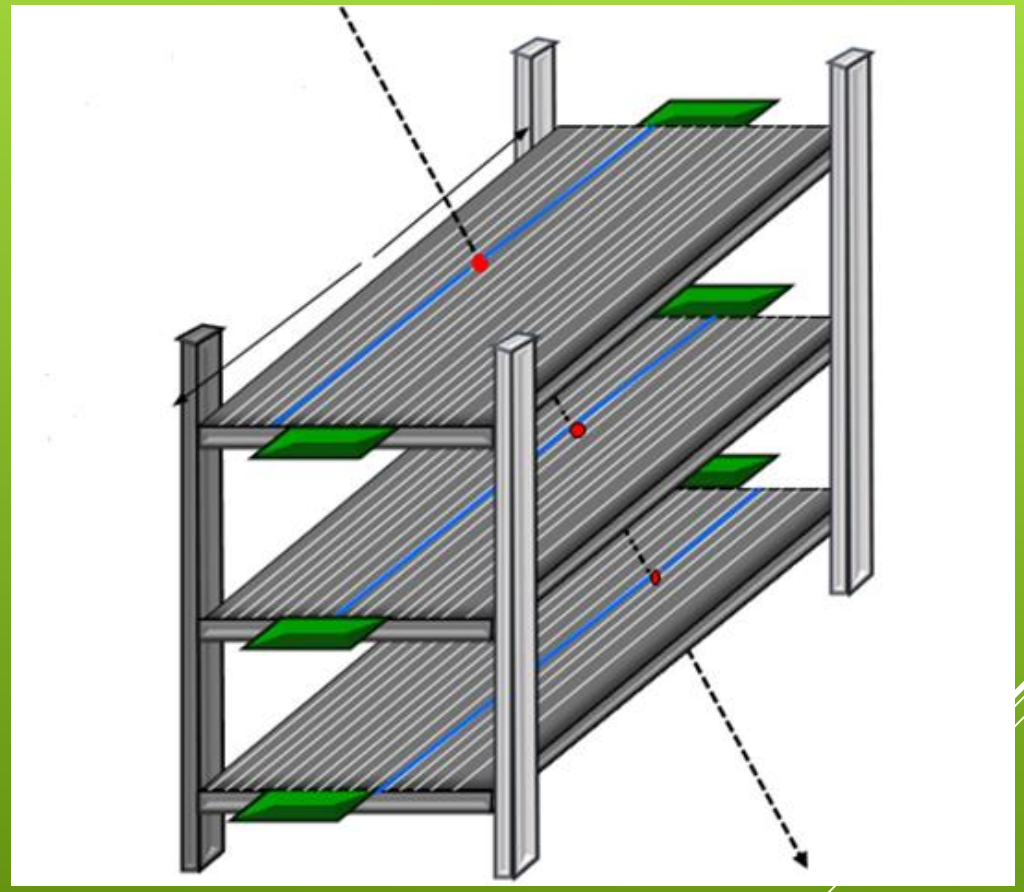
Aim of the research

Understand the cause of eventual anomalies found during the analysis

IN ORDER TO

Distinguish telescope malfunctions from significant events

Multi-gap Resistive Plate Chamber detector (MRPC)



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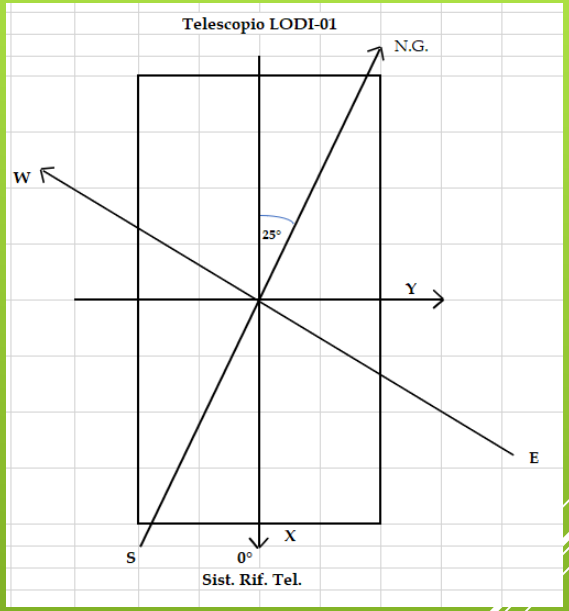
Multi-gap Resistive Plate Chamber detector (MRPC)

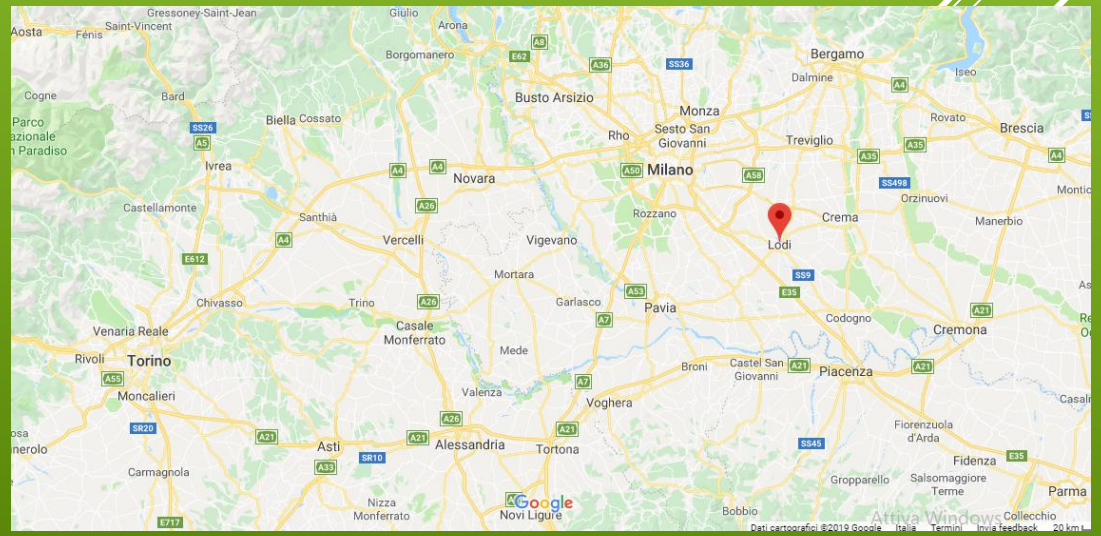
- Position and orientation of the telescope

  ⬇

  correct interpretation of the results.

- Lodi_01 is located near Milan and is rotated 155° compared to the North.





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Operating parameters

- The Excel program analyses a collection of 50.000 events (RUN).

- Important parameters:
  - Rate (Hz);
  - Measurement reliability (χ^2 test);
  - Time of Flight (T-o-F);
  - Events speed (V);
  - Angular distribution (φ,θ).

REPORT

Summary of significant RUN data			
LODI-01-	2017-06-02	-00002	
RUN n°	2	del	02/06/2017
Run Start			22h 23m 28s
Run End			22h 38m 24s
Δt			896s
UTC(Tempo Coord.Univ.) 20h 23m 28s	GPS(Global Positioning System		20h 23m 46s
LMST (Local Mean Sidereal Time)			14h 13m 4s
Total events			50.000
The percentages related to these two values are calculated on the total events.	Hits-events		43.360	86,72%
	NO-Hits-events		6.640	13,28%
All the percentages below are calculated on Hits events		$\chi2$ > 10	6.471	14,92%
		T-o-F < 0	2.575	5,94%
T-o-F<0 and $\chi2$ >10			2.345	5,41%
T-o-F<0 and $\chi2$ <10			230	0,53%
Events with $\chi2$ <10 and T-o-F> 0			36.659	84,55%
Events with speed <= 3,0 *10^8 m/s			22.635	52,20%
Events with speed > 3,0 *10^8 m/s			20.716	47,78%
Events with 2,9976*10^8m/s <V< 3*10^8 m/s (muons speed)			105	0,24%
Events with $\chi2$ <10, T-o-F> 0 and θ < 50°,5			36.343	83,82%
Events with $\chi2$ <10, T-o-F> 0 and θ > 50°,5			312	0,72%
Total Rate (calculated on 50.000 events)			55,8 Hz	
Track length Min			93 cm.	
Track length Max*: Hits-events			313 cm.	1 Tr>201
Events with a track length of 93 cm. at 98 cm. (0°<θ<18°)			5.629	12,98%
*The largest diagonal of the telescope measures 201 cm.				
La pressione e la temperatura sono scaricabili dal sito:			Pressure (hPa)	1008
https://iatw.cnaf.infn.it/eee/monitor/dqm2/LODI-01/			T (C°)-Indoor	28
		conversione C° -> K°		301,15

Rate (Hz)

Number of events detected by the telescope per second.

- The value is typical for each telescope, i.e. R ≈ 56 Hz for Lodi_01.

Events with $\chi 2$ <10, T-o-F> 0 and θ > 50°,5	312	0,72%
Total Rate (calculated on 50.000 events)	55,8 Hz	
Track length Min	93 cm.	
Track length Max*: Hits-events	313 cm.	1 Tr>201

312
55,8 Hz
93

It is average ✓

Measurement reliability

- Two categories of events automatically discarded by the program:

  - The ones that do not pass all 3 chambers (No-Hits-Events);

  - Those one that are not statistically reliable.

- Reliability granted by χ^2 test ($\chi^2 > 10$).

	Total events	50.000	
The percentages related to these two values are calculated on the total events.	Hits-events	43.360	86,72%
	NO-Hits-events	6.640	13,28%
All the percentages below are calculated on Hits events	$\chi 2 > 10$	6.471	14,92%

It is not average

Time of Flight (T-o-F)

How long the particle stays in the telescope.

T-o-F can be negative.

No unique interpretation for events with T-o-F<0.

They could come from the Southern emisphere of the Earth.

They could be the result of decays inside the telescope.

Events speed

How quickly the particle moves.

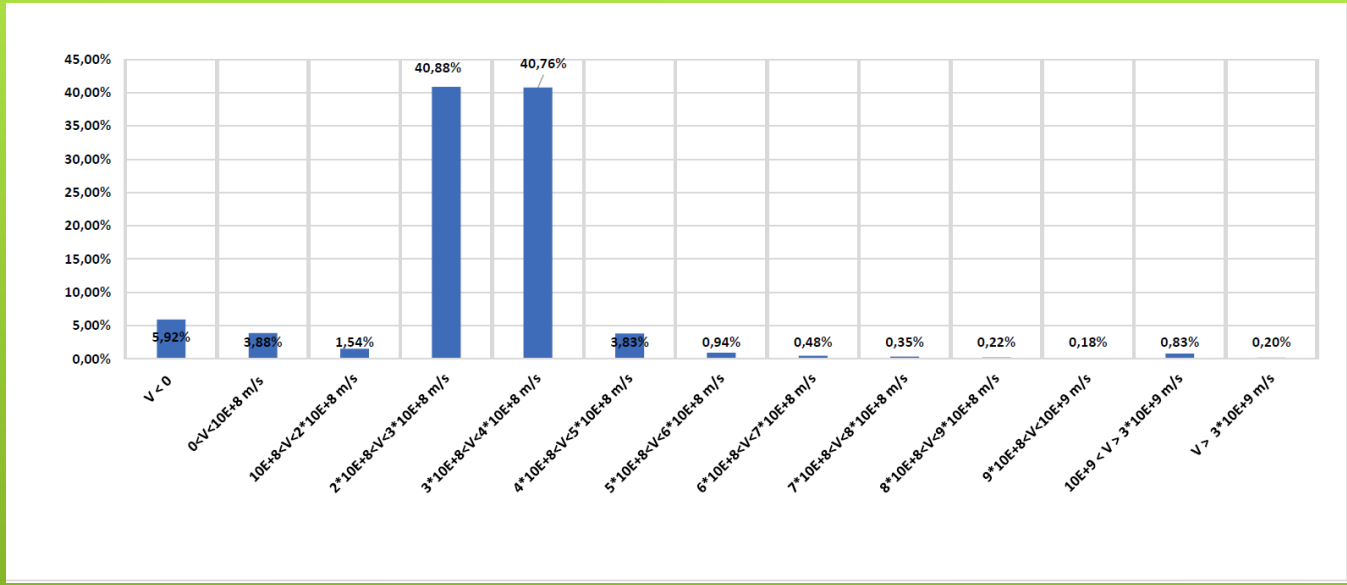
50% of events has a higher speed than light on average.

Probably due to the inaccuracy of the telescope.

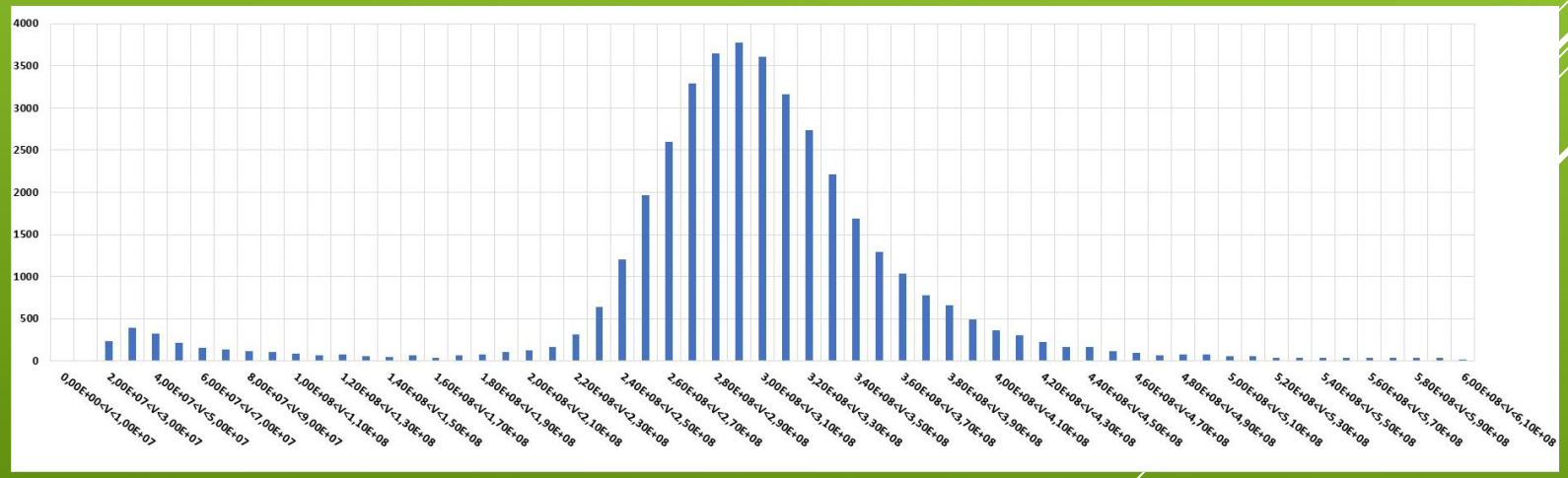
Events with speed <= 3,0 *10^8 m/s	22.635	52,20%
Events with speed > 3,0 *10^8 m/s	20.716	47,78%

It is average ✓

Graph1 → Number of events and speed.



Graph2 → Number of events over speed (normal distribution).



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Angular distribution

Where the particles come from.

- Most of events has θ<50°,5 → less atmoshpere to pass through.

Events with χ2 <10, T-o-F> 0 and θ < 50°,5	36.343	83,82%
Events with χ2 <10, T-o-F> 0 and θ > 50°,5	312	0,72%

It is average ✓

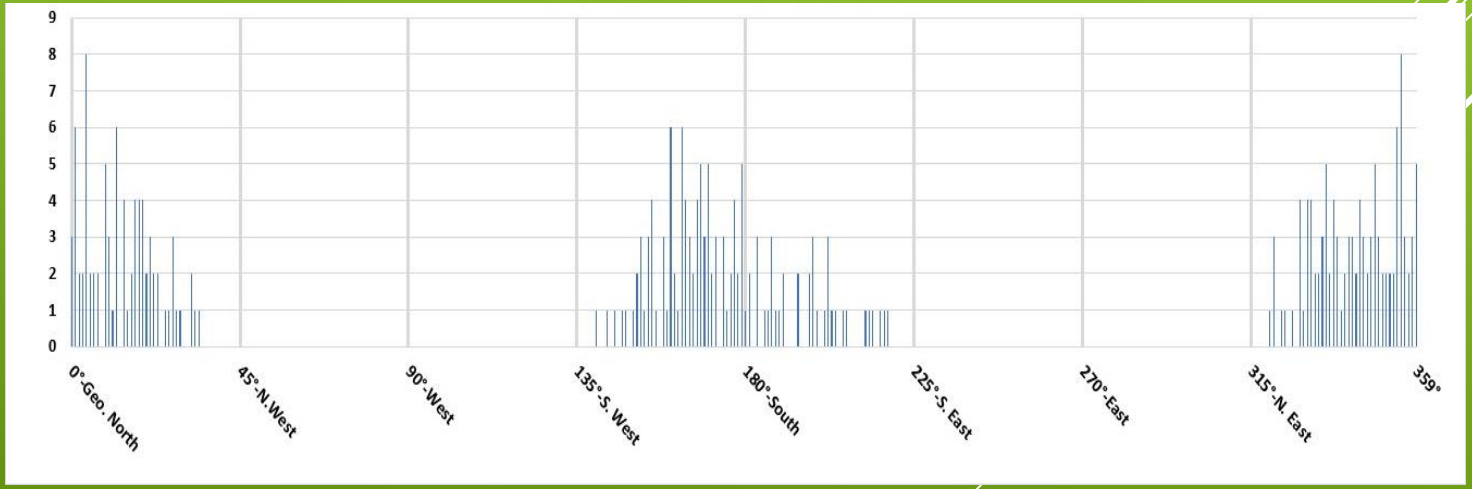
- In particular 12.98% has 0°<θ<18°.

(0°<θ<18°)	5.629	12,98%

It is average ✓

Graph3 → distribution of events according to the azimuthal angle φ θ<50.5°

Graph3 → distribution of events according to the azimuthal angle φ θ>50.5°



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Conclusions

- The survey is performed on 15-20 RUN recorded on different days.
- The RUN analyzed shows some anomalies → probably due to high temperatures during the relevation.

Pressure (hPa)	1008
T (C°)-Indoor	28
conversione C° -> K°	301,15

- We do not know the cause of these anomalies at the moment, so we are going to continue our work to find it out.

Thank you for your attention

Tutors: prof. Abele Bianchi, prof.ssa Cristina Re, prof.ssa Elena Servida, Nicolas Trojani (UNIMI),Vittoria Elvezia Gianolli (UNIMIB).

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