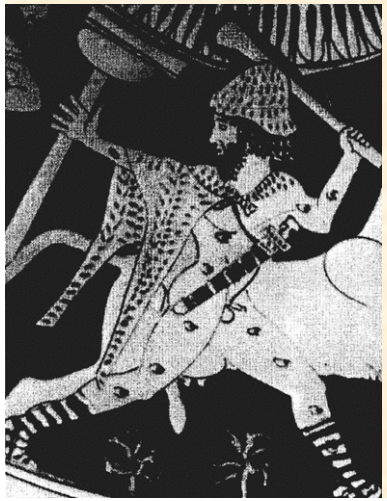
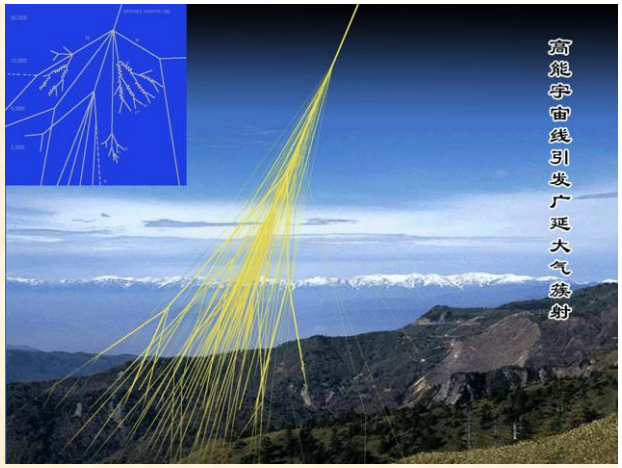
The Status of the ARGO Experiment at YBJ

Huihai He for the ARGO Coll.
IHEP, CAS

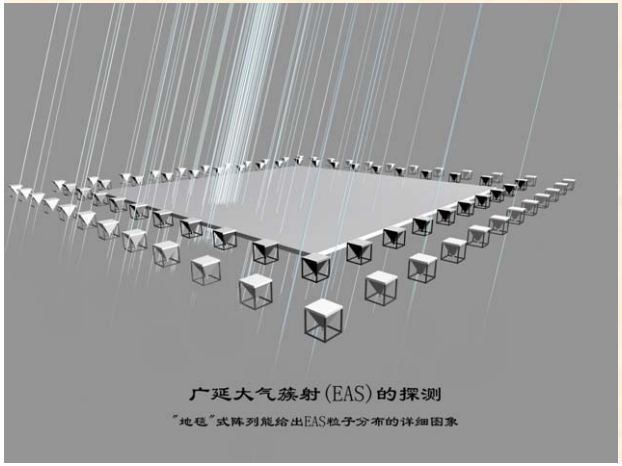


SpacePart06, Beijing, China
April, 2006

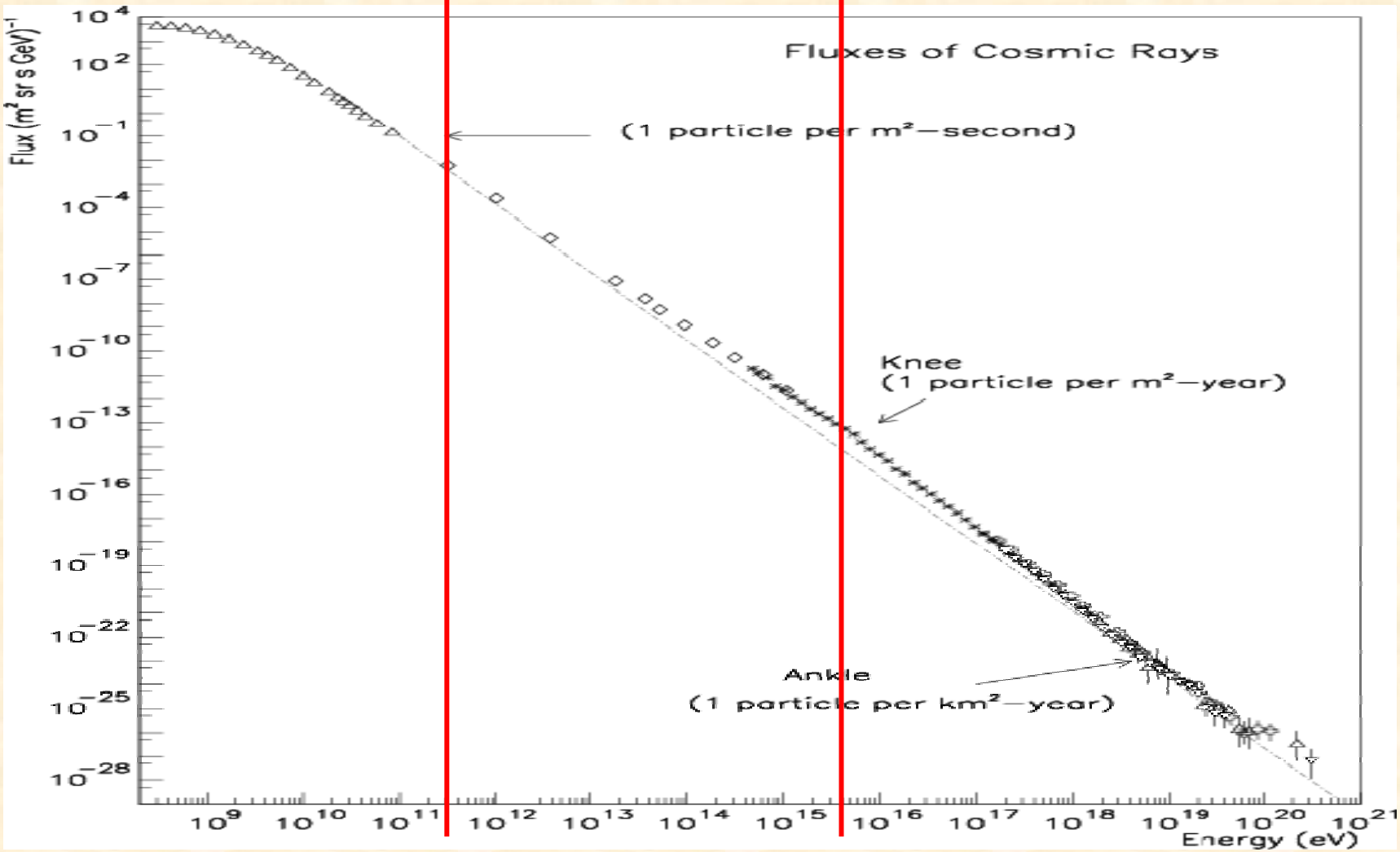
Outline



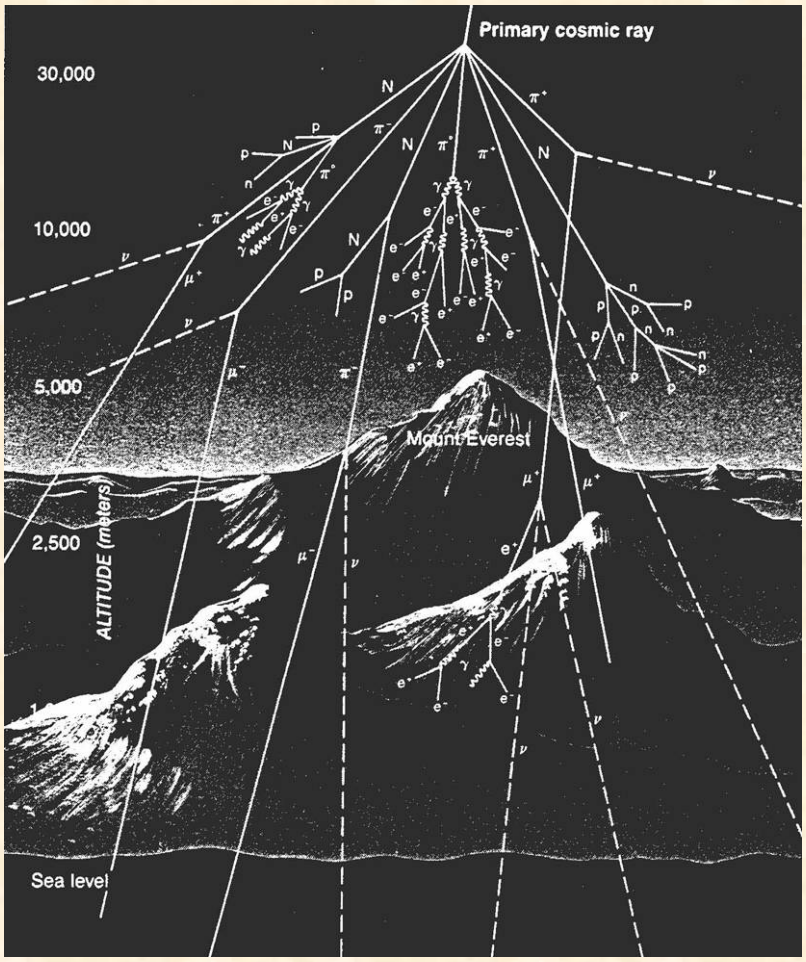
- **Introduction**
- **Construction & Operation**
- **Performance**
- **Preliminary Results**
- **Conclusion**

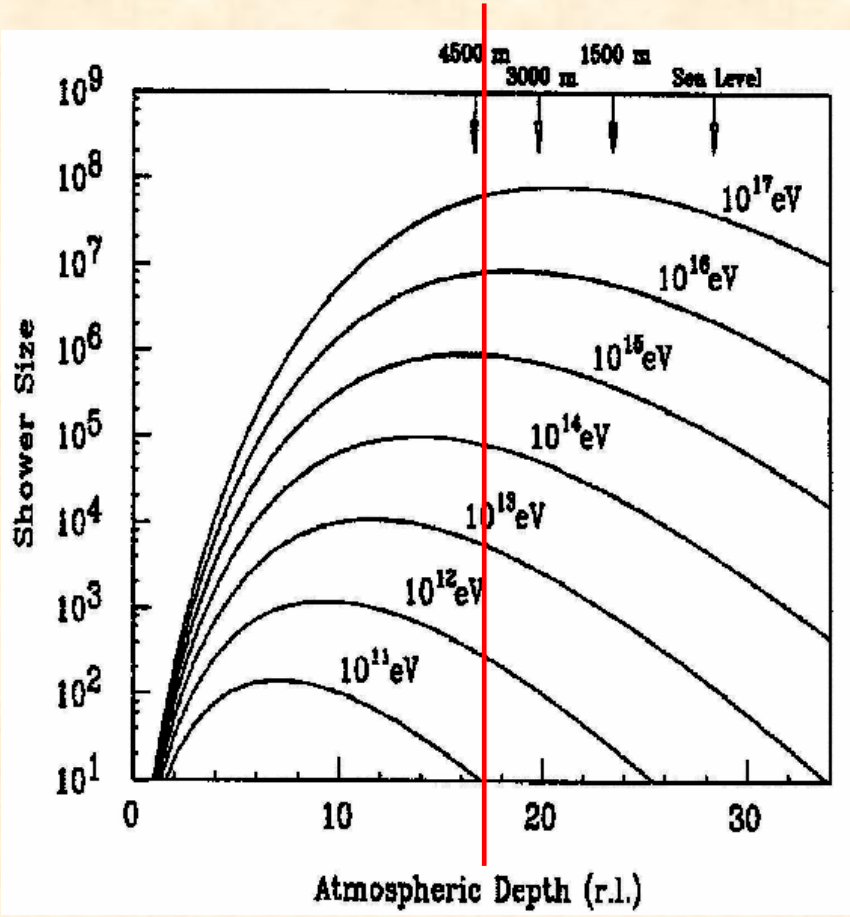


Cosmic Ray Spectrum

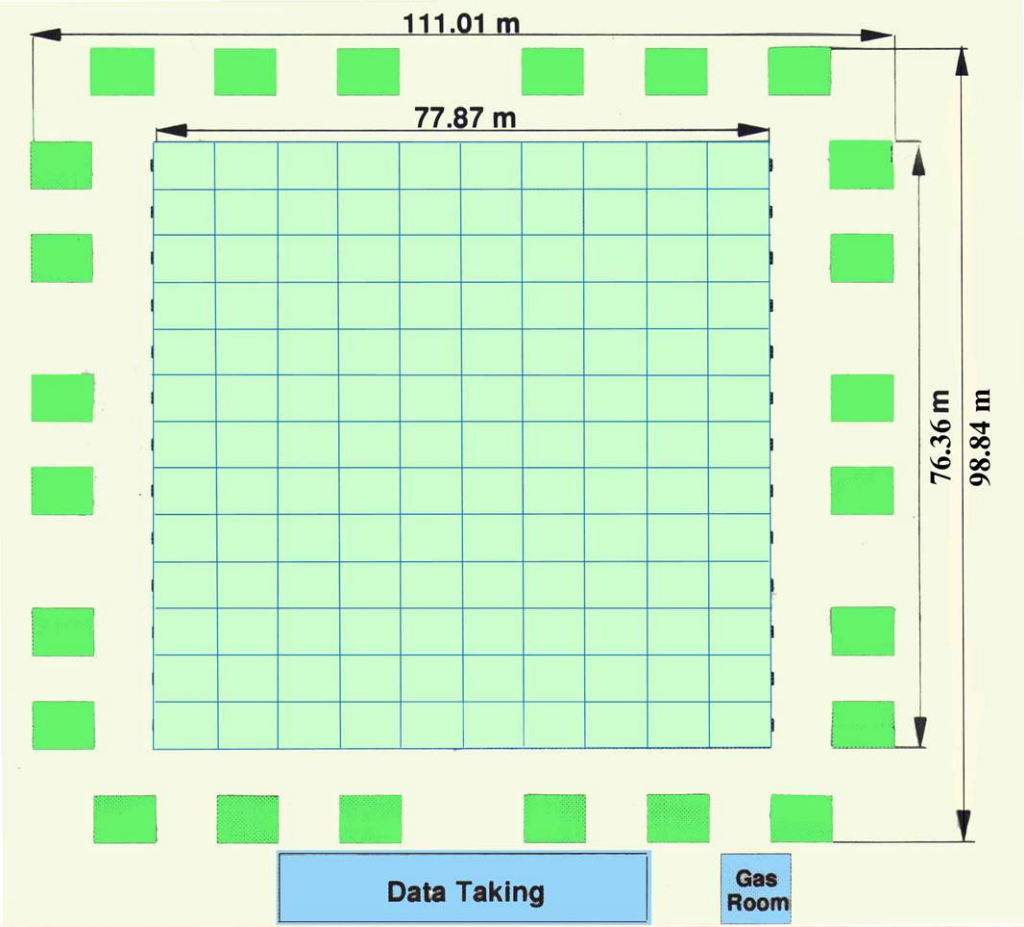


Extensive Air Shower





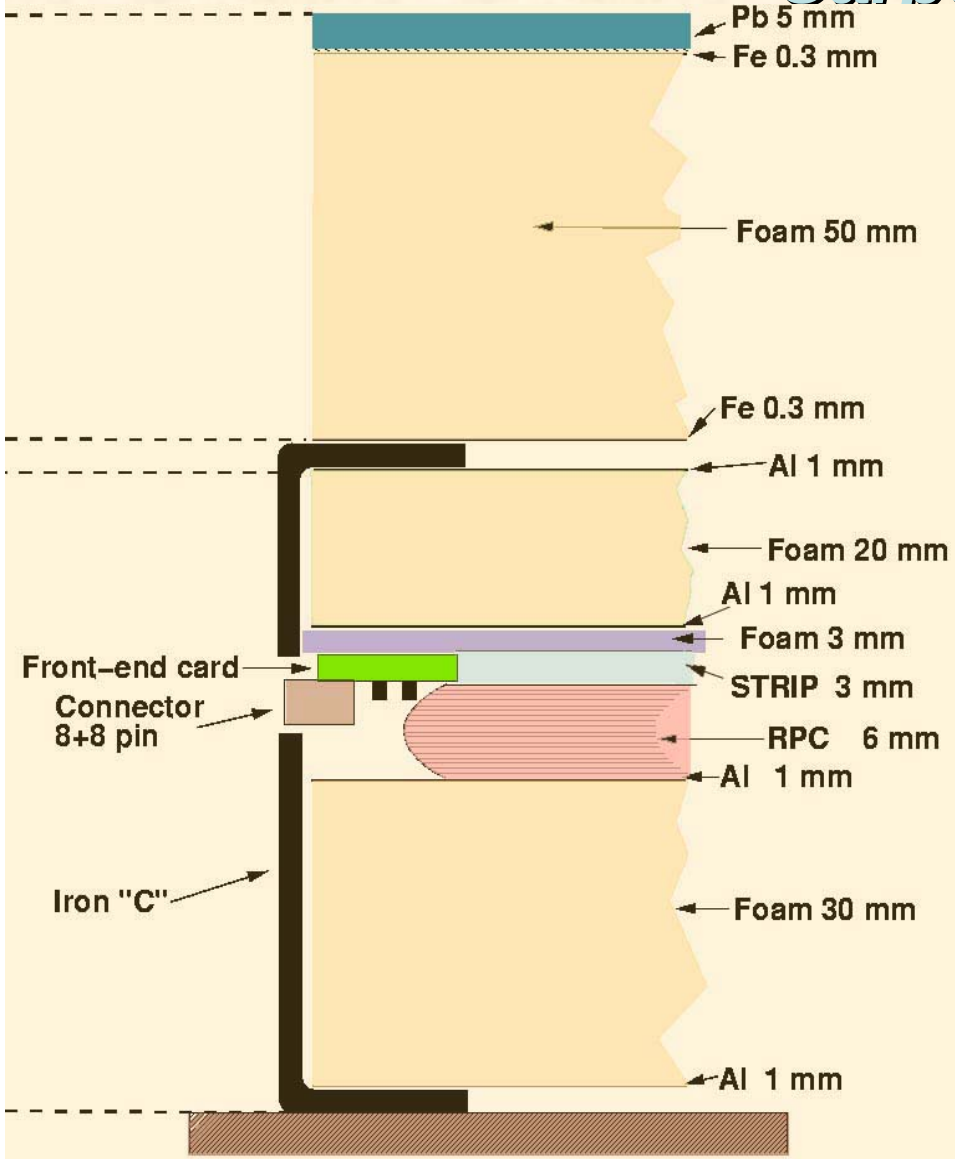
Yangbajing ARGO Experiment



- **154CLUSTERs**
- **18480PADs**
- **Total detector area: 6500m^2**
- **Central area: 5000m^2**
- **Angular Resolution 0.5^o（nhit>50）**
- **Measurement: time, number**

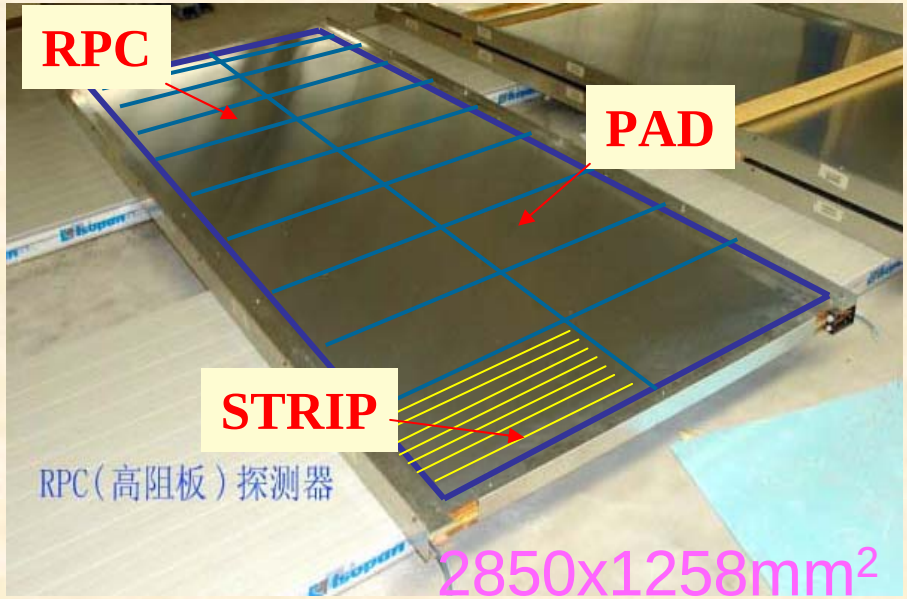
Full Coverage

RPC Satisfied the Requirements on Element of Carpet



Resistive Plate Chamber

Low cost , high efficiency, high space & time resolution (<1ns), easy access to any part of detector, robust assembling, easy to achieve >90% coverage, mounting without mechanical supports.



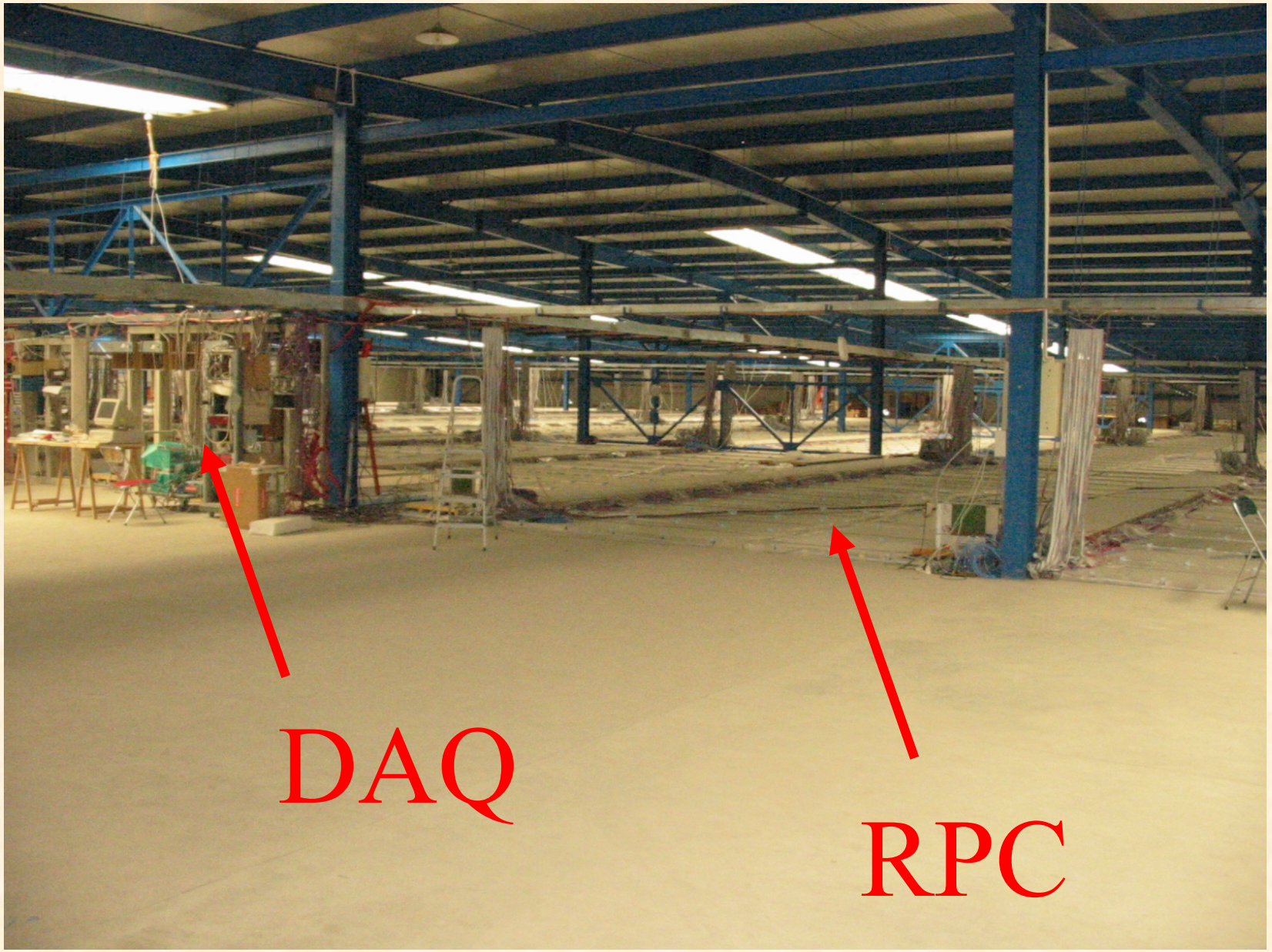
Main Physics Goals

90°31'50" E, 30°6'38" N
4300m a. s. l., 606g/cm^2

- γ astronomy（Sub-TeV，0.3I$_{Crab}$）
- Diffused γ sources（Sub-TeV）
- GRB（10GeV）
- Knee Physics
- Anti-p/p（300GeV）
- Primary Proton Spectrum（10TeV）
- Solar Physics

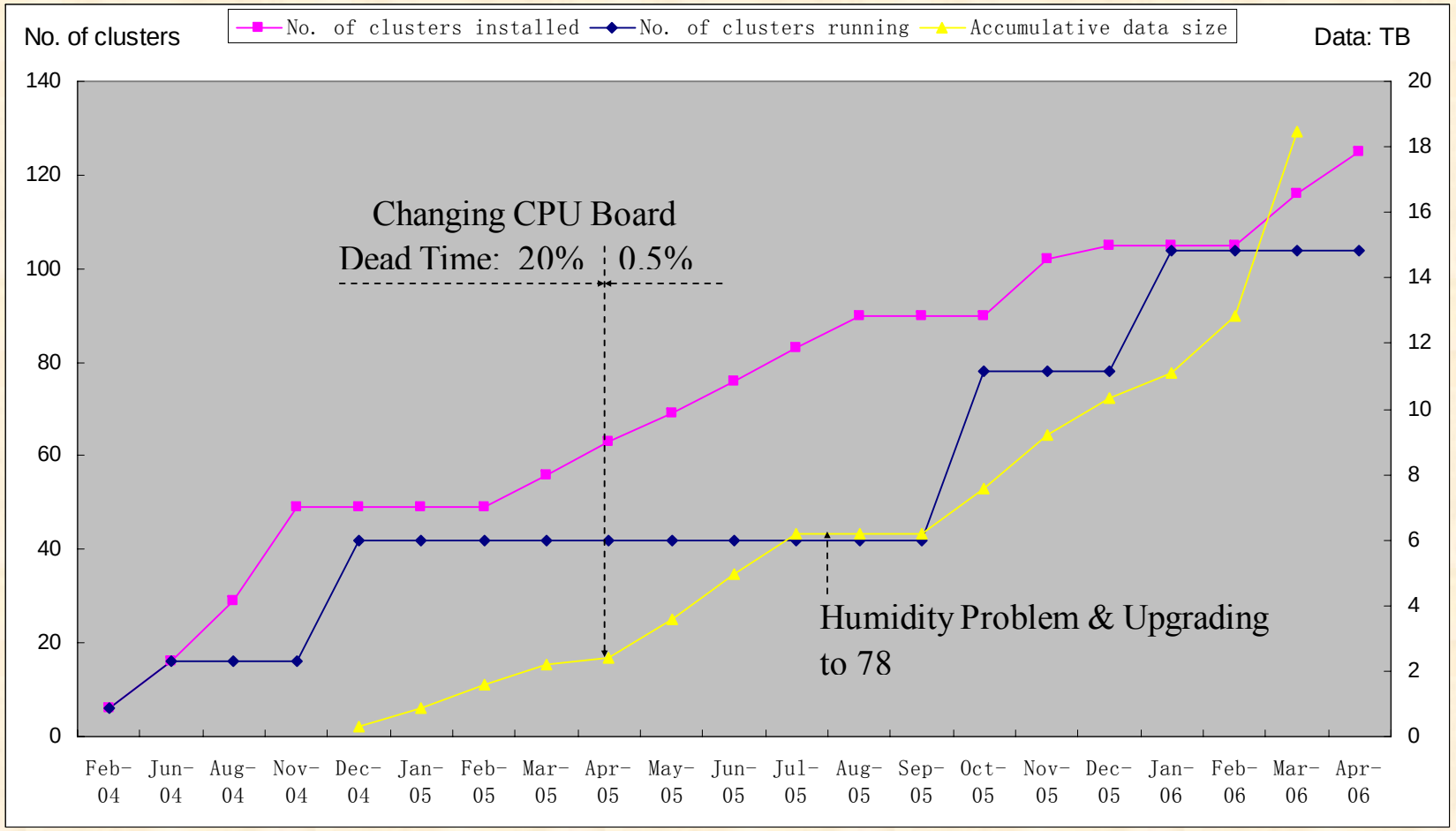
Construction & Operation

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38	39	40	41	42
43	44	45	46	47	48	49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80	81	82	83	84
85	86	87	88	89	90	91	92	93	94	95	96	97	98
99	100	101	102	103	104	105	106	107	108	109	110	111	112
113	114	115	116	117	118	119	120	121	122	123	124	125	126
127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154
155	156	157	158	159	160	161	162	163	164	165	166	167	168
169	170	171	172	173	174	175	176	177	178	179	180	181	182
183	184	185	186	187	188	189	190	191	192	193	194	195	196
197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224
225	226	227	228	229	230	231	232	233	234	235	236	237	238


DAQ
RPC

Detector Operation

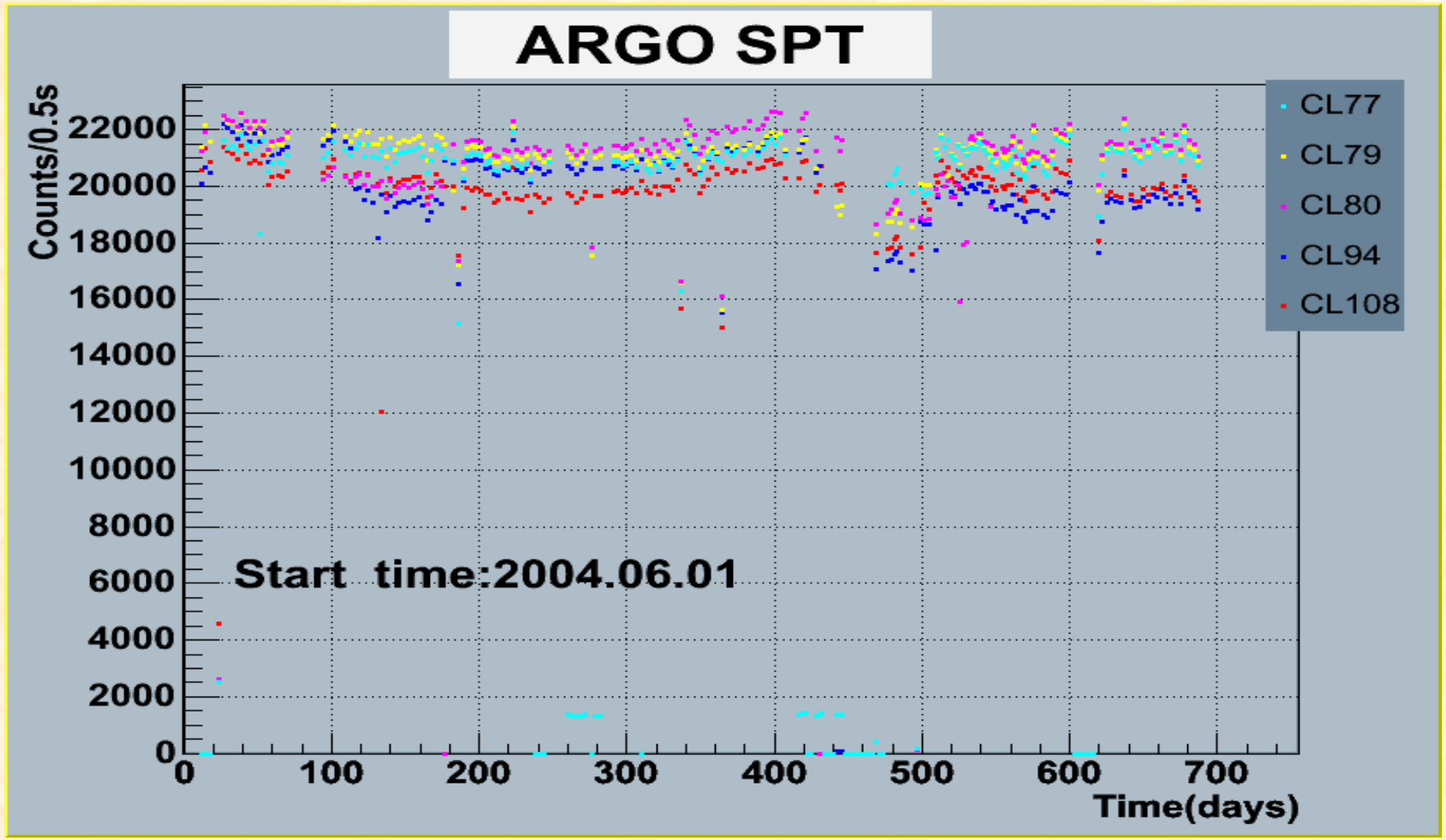
- 42 clusters (1900m^2) used for data taking
  - ~7TB data acquired, ~2x10^9 events recorded
  - Trigger condition: >60 hits/420ns
    (OR/100ns in a pad)
- 24 cluster (1000 m^2) tested for the analog readout
- Single Channel Rate counting for 104 clusters are taking data


No. of clusters
No. of clusters installed
No. of clusters running
Accumulative data size
Data: TB
140
120
100
80
60
40
20
0
20
18
16
14
12
10
8
6
4
2
0
Changing CPU Board
Dead Time: 20% 0.5%
Humidity Problem & Upgrading
to 78
Feb-04
Jun-04
Aug-04
Nov-04
Dec-04
Jan-05
Feb-05
Mar-05
Apr-05
May-05
Jun-05
Jul-05
Aug-05
Sep-05
Oct-05
Nov-05
Dec-05
Jan-06
Feb-06
Mar-06
Apr-06

Detector Monitoring

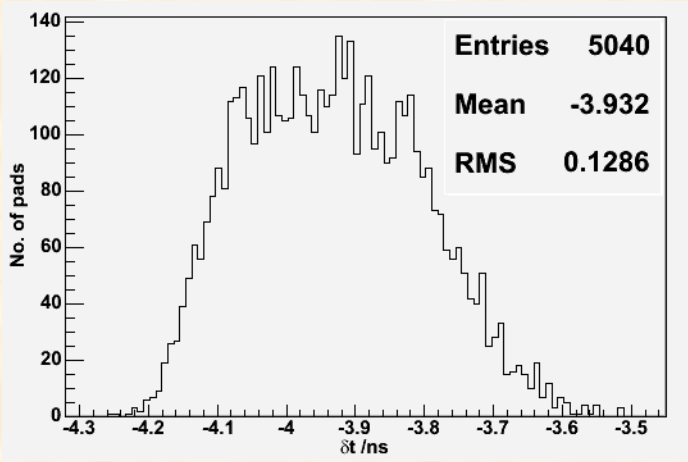
- DCS system is tested for long term since Dec. 2003
  - HV control
  - Gas flowing control
  - Environmental variables: P, T, H

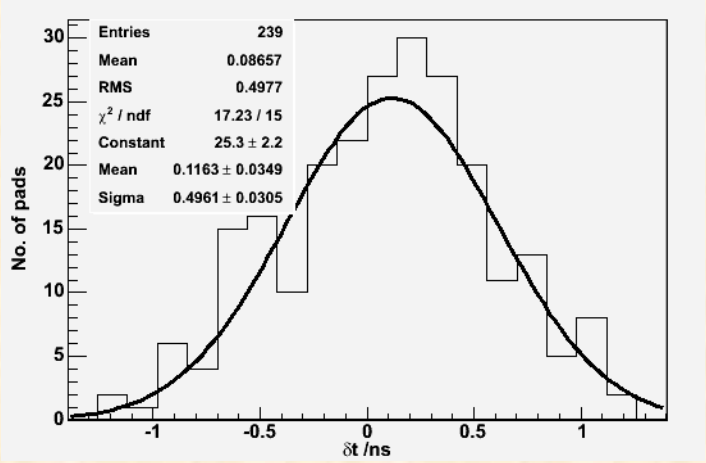
Single Counting Rate



Detector Calibration

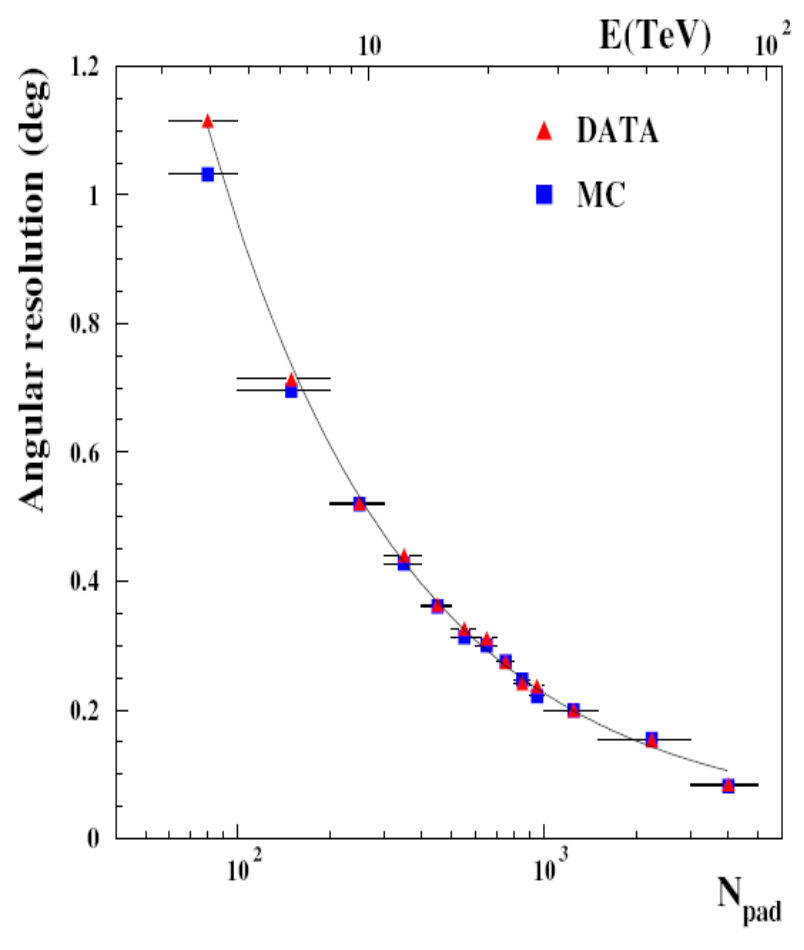
- Absolute calibration of 300 pad ~8% detectors of 42 clusters
- Off-line Calibration:
  - Characteristic plane method

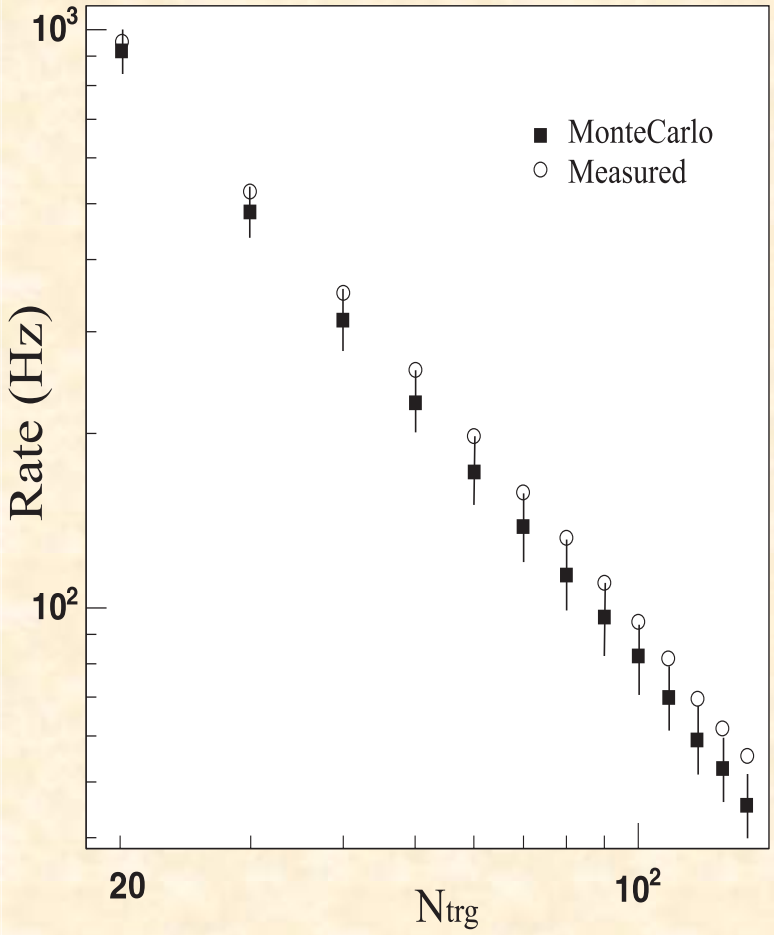




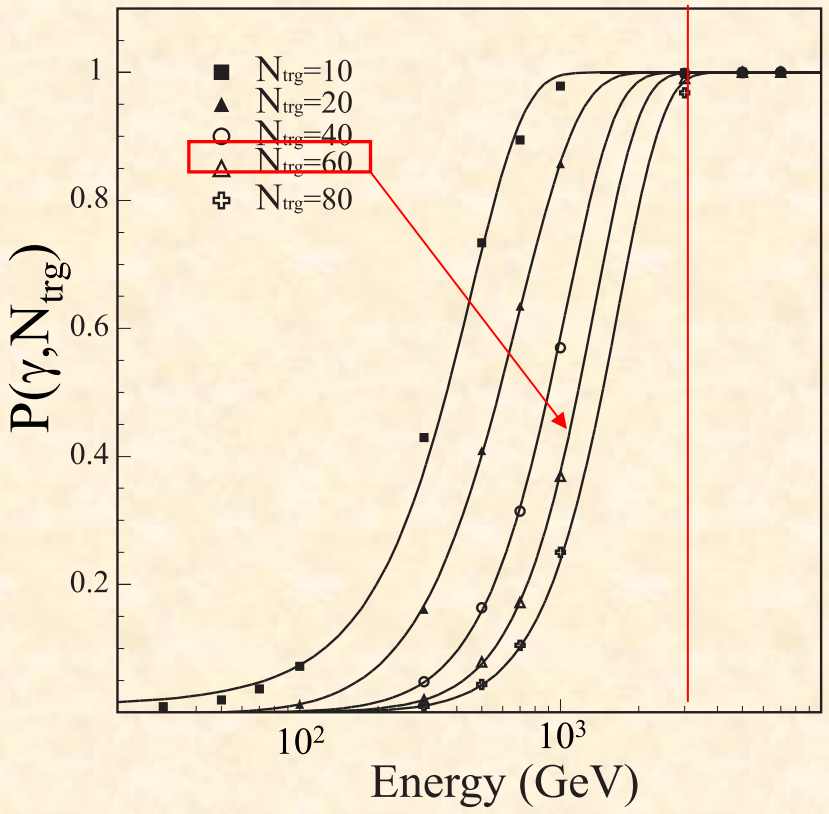
Performance

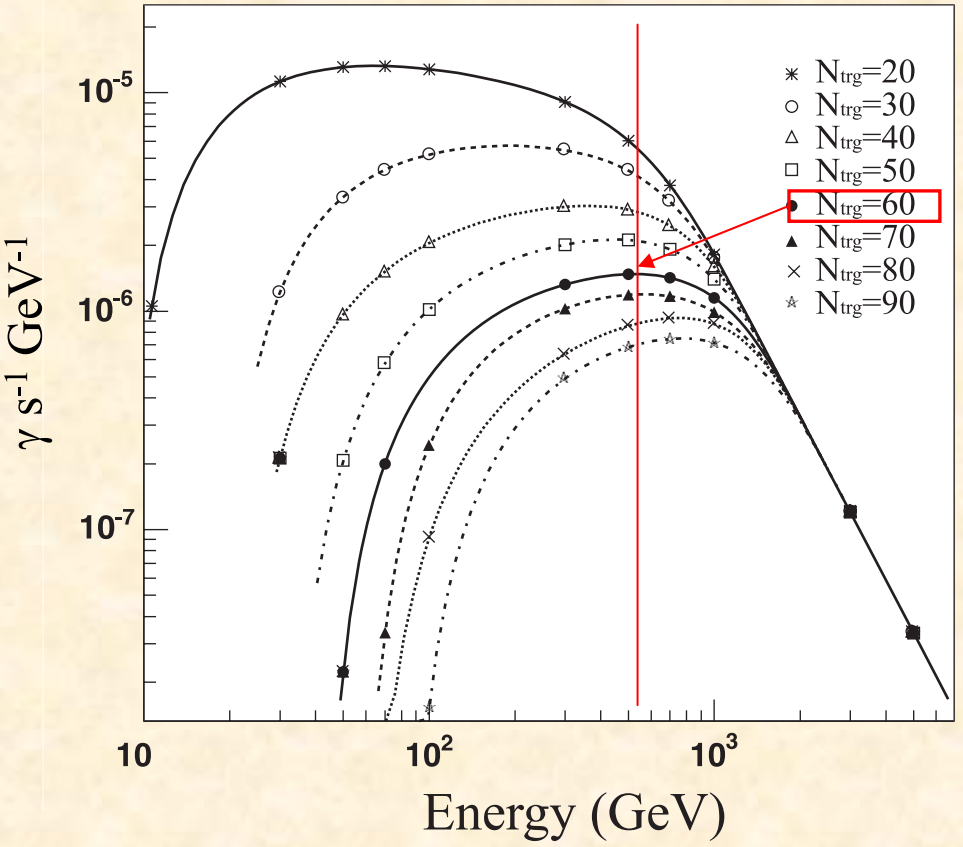
Performance of the 1900m^2 Detector



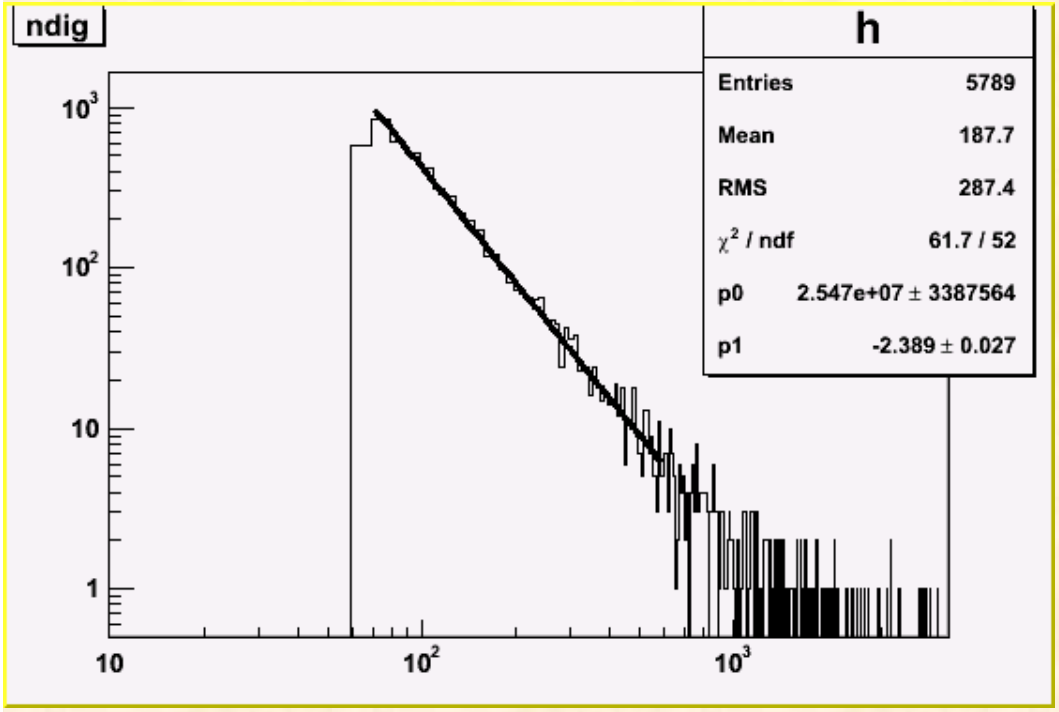


Energy Scale for the Test Run (>60hit/420ns)

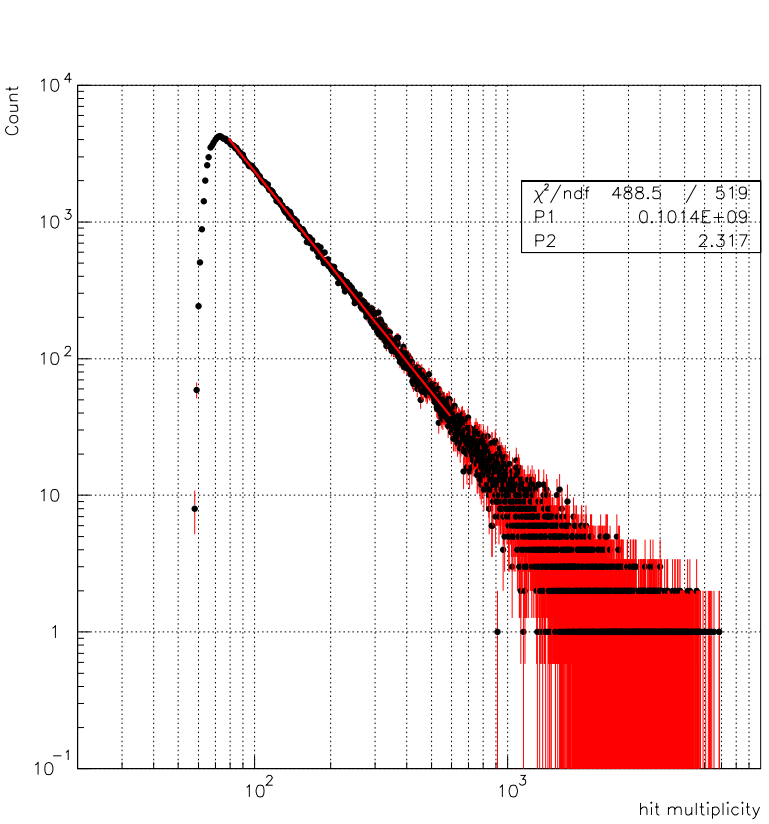




Hit multiplicity of 42 clusters(1900m^2)



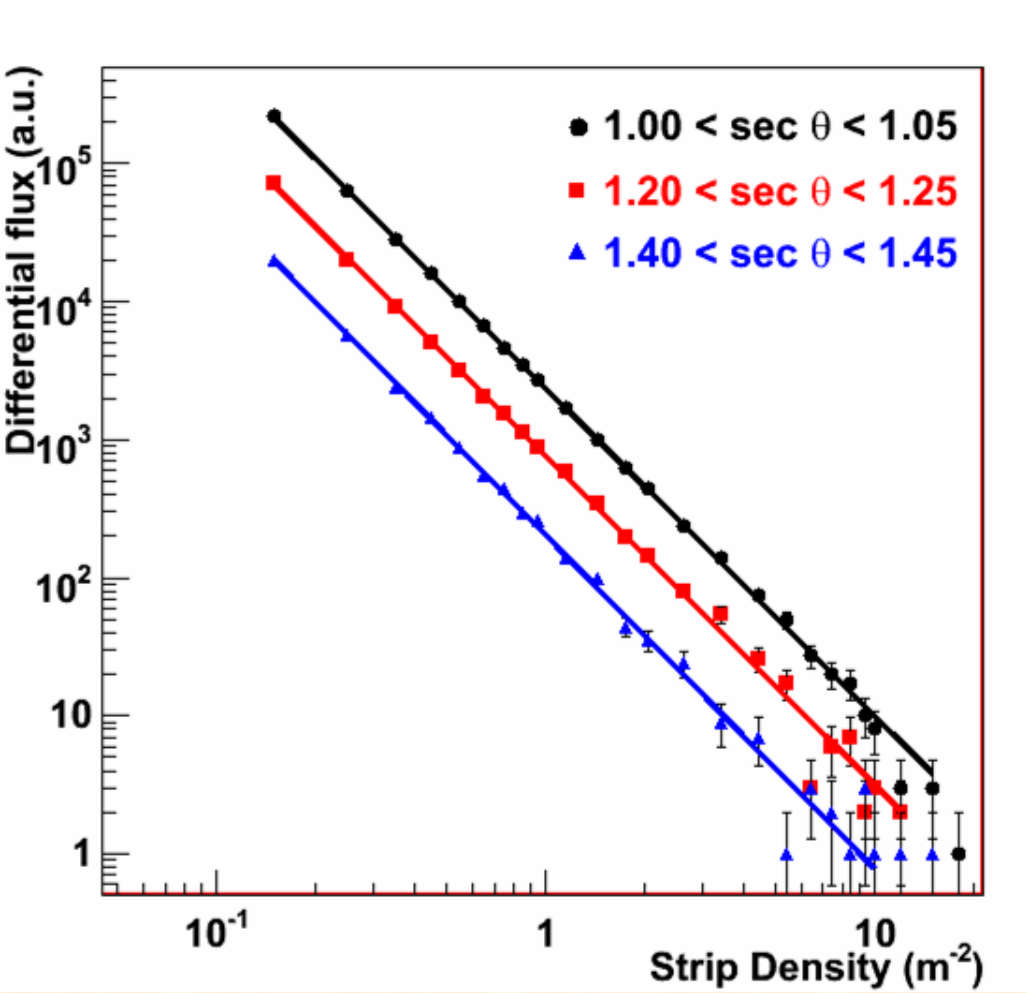
MC result



Data

Differential strip-density spectrum

similar to the size spectrum



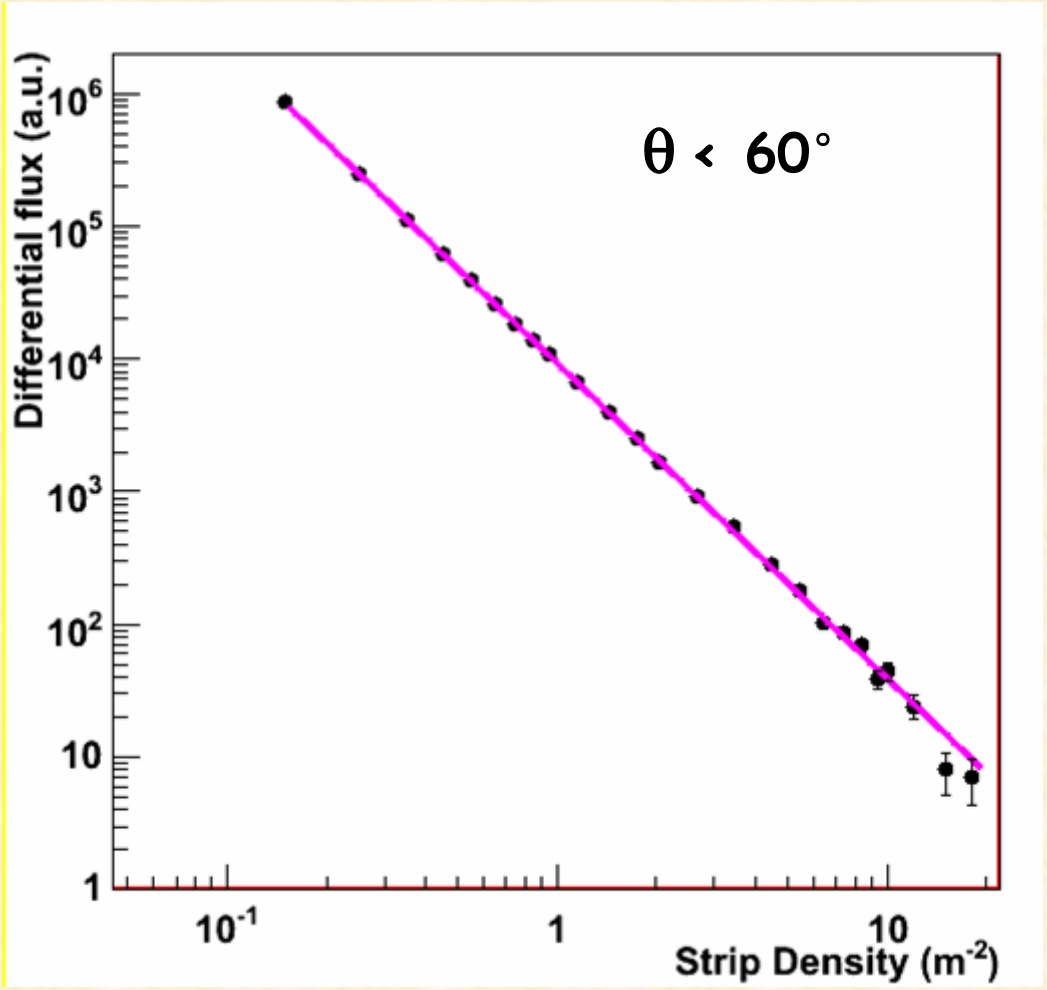
Density spectrum for different intervals of zenith angle:

- power law as expected
- very close shapes
  $\beta_1 = 2.37$, $\beta_2 = 2.38$, $\beta_3 = 2.41$

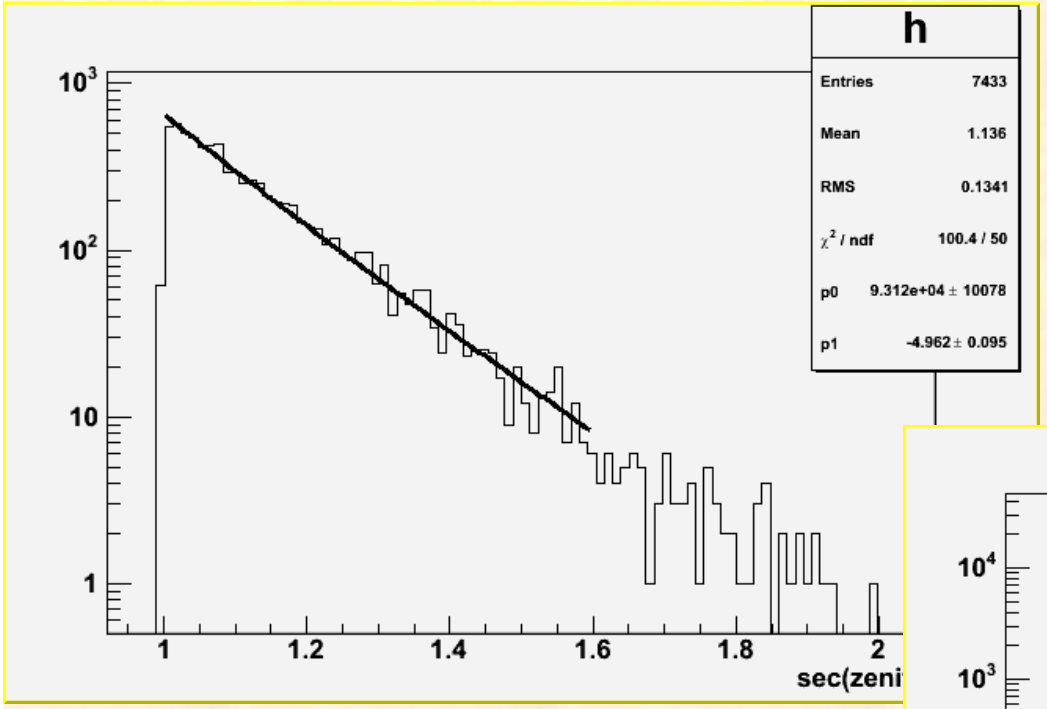
Differential strip-density spectrum

Slope in agreement with measured spectral index

$\beta = 2.37$

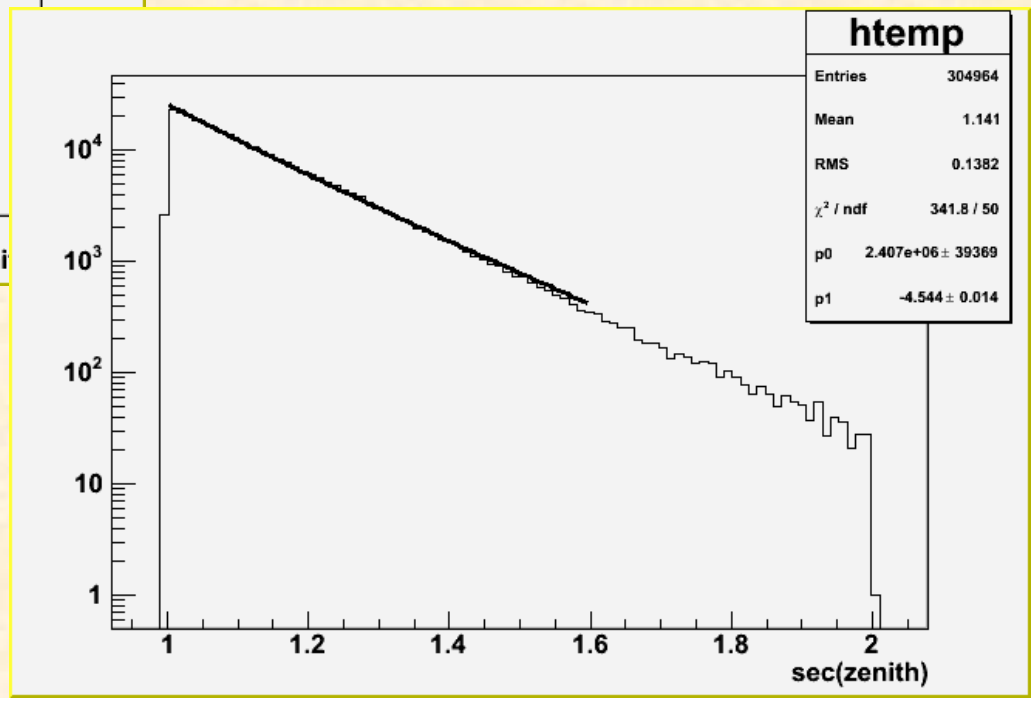


sec(θ) distribution: Attenuation MC vs. Data

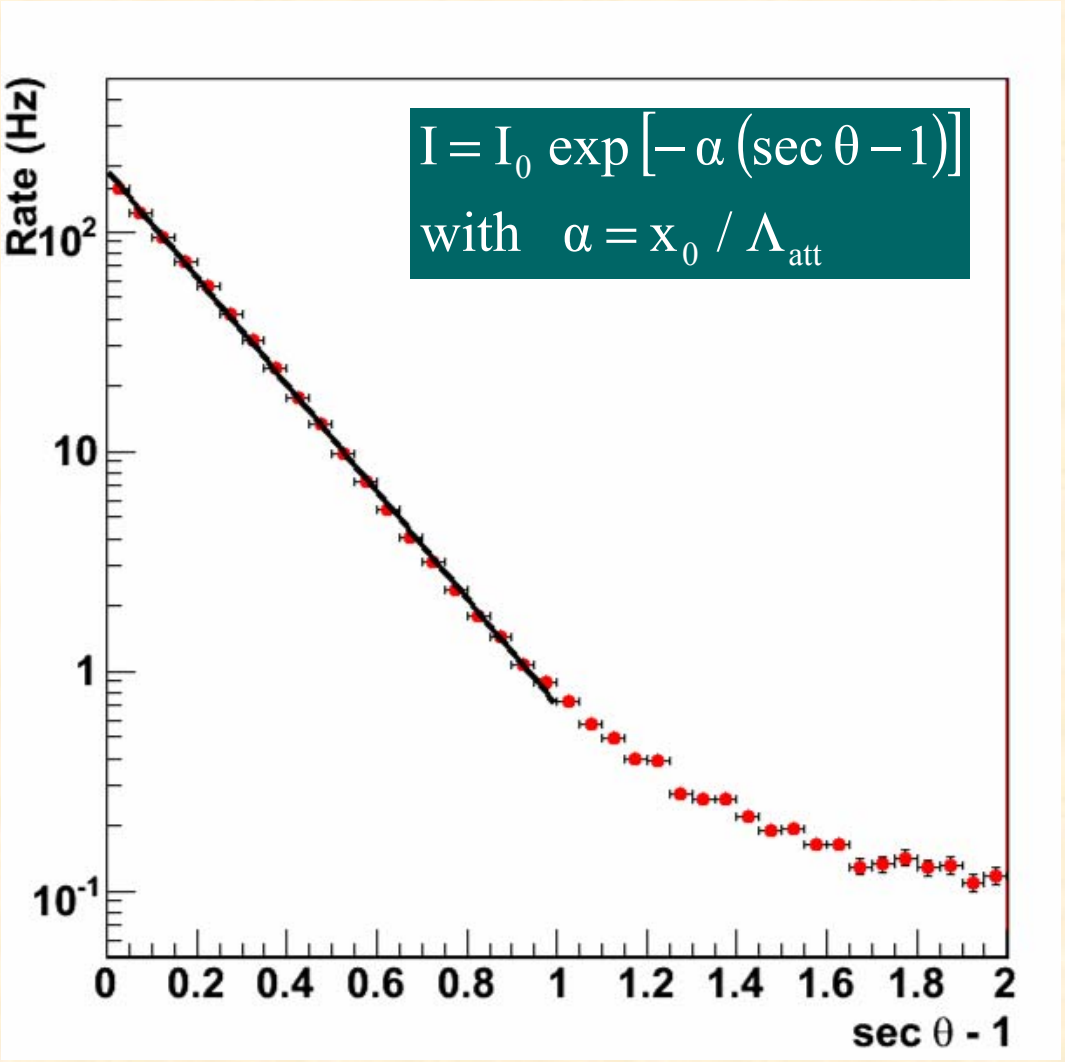


MC

Data



Exponential law in agreement with ARGO-YBJ data out to ~60°



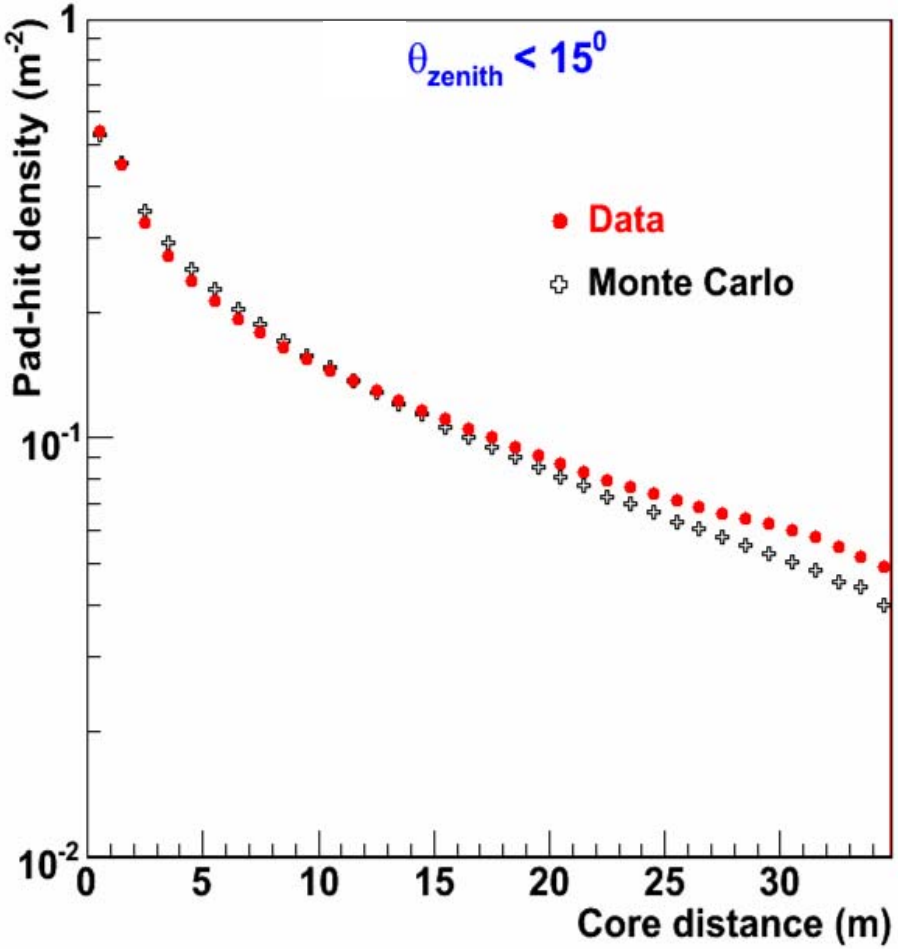
Fit parameters:

$\alpha = 5.60 \pm 0.11$

$I_0 = 189 \pm 12$ Hz

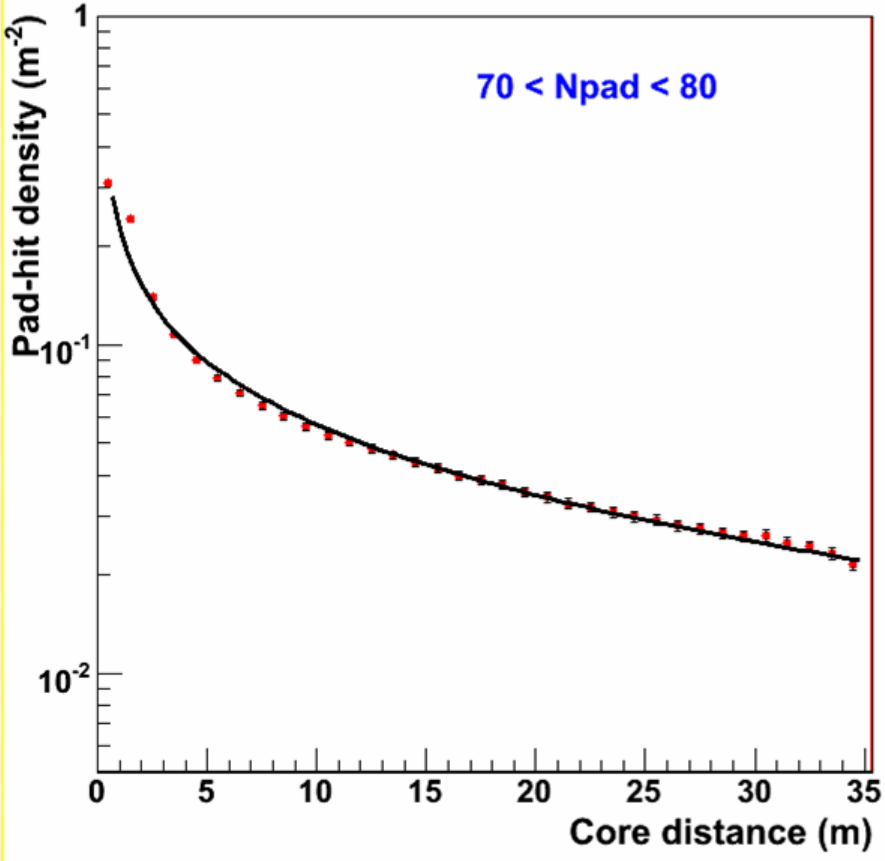
$\rightarrow \quad \Lambda_{att} = 108 \pm 2$ g/cm^2

Deviation for $\theta > 60°$ due to misreconstructed events, horizontal air showers, interactions in the lab building

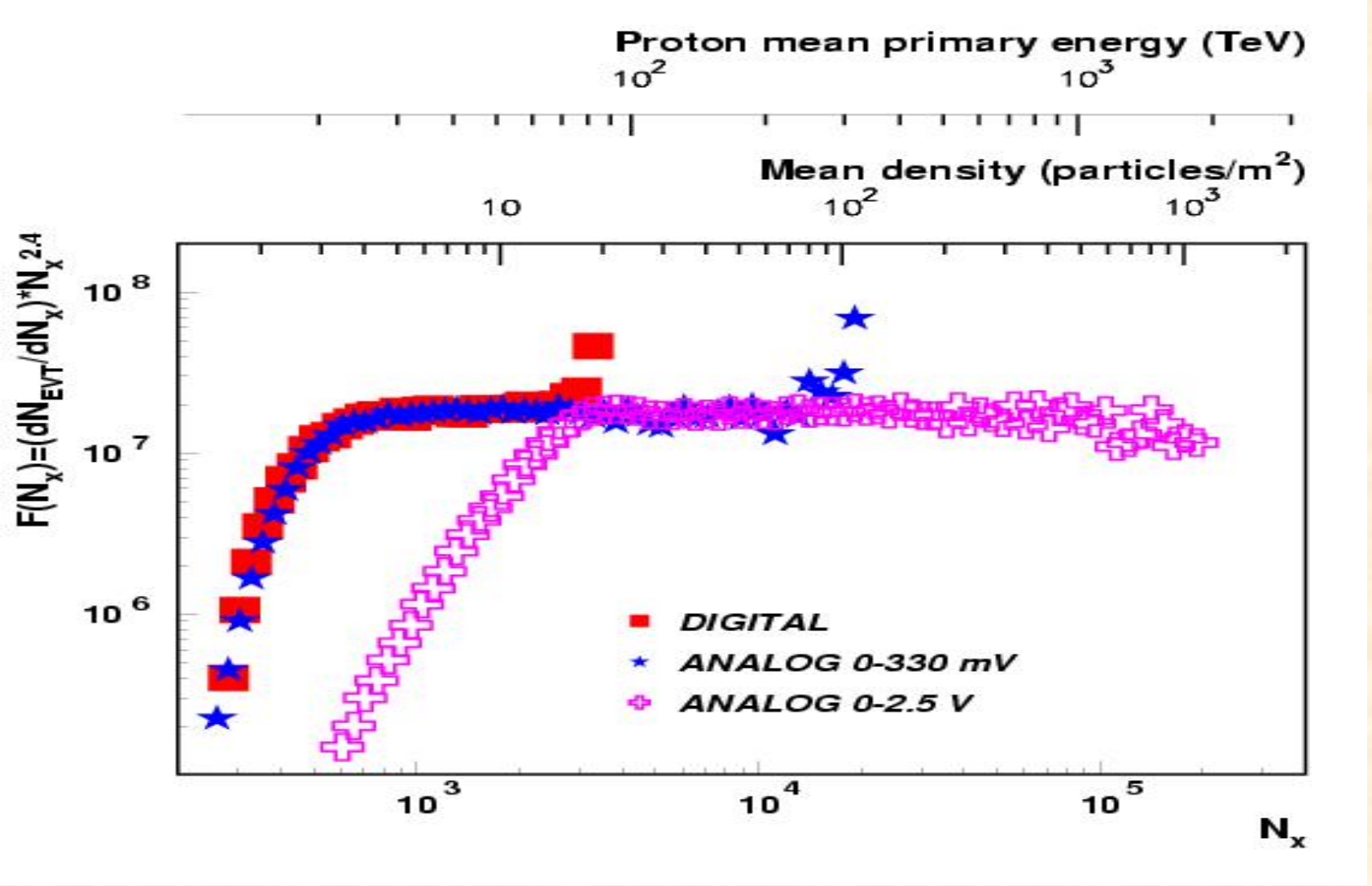


Lateral density profile
data and simulation
(300 GeV – 1000 TeV)

Lateral density profile
comparison with
an NKG-like function

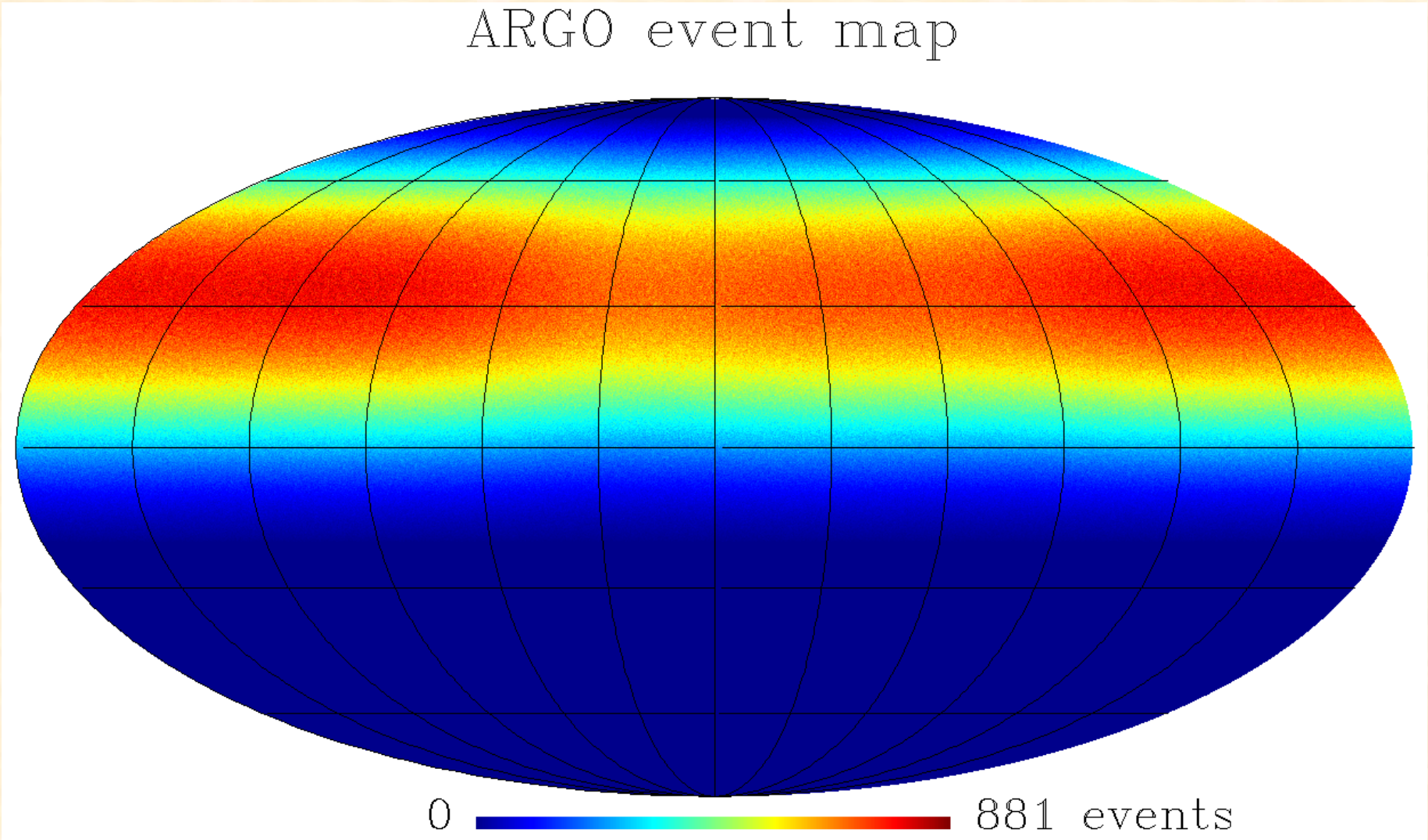


Analog Readout



Physics Analysis

- Full sky survey
- γ burst search using SPT data
- Cosmic ray spectrum up to 100TeV
- Forbush Decrease using SPT data

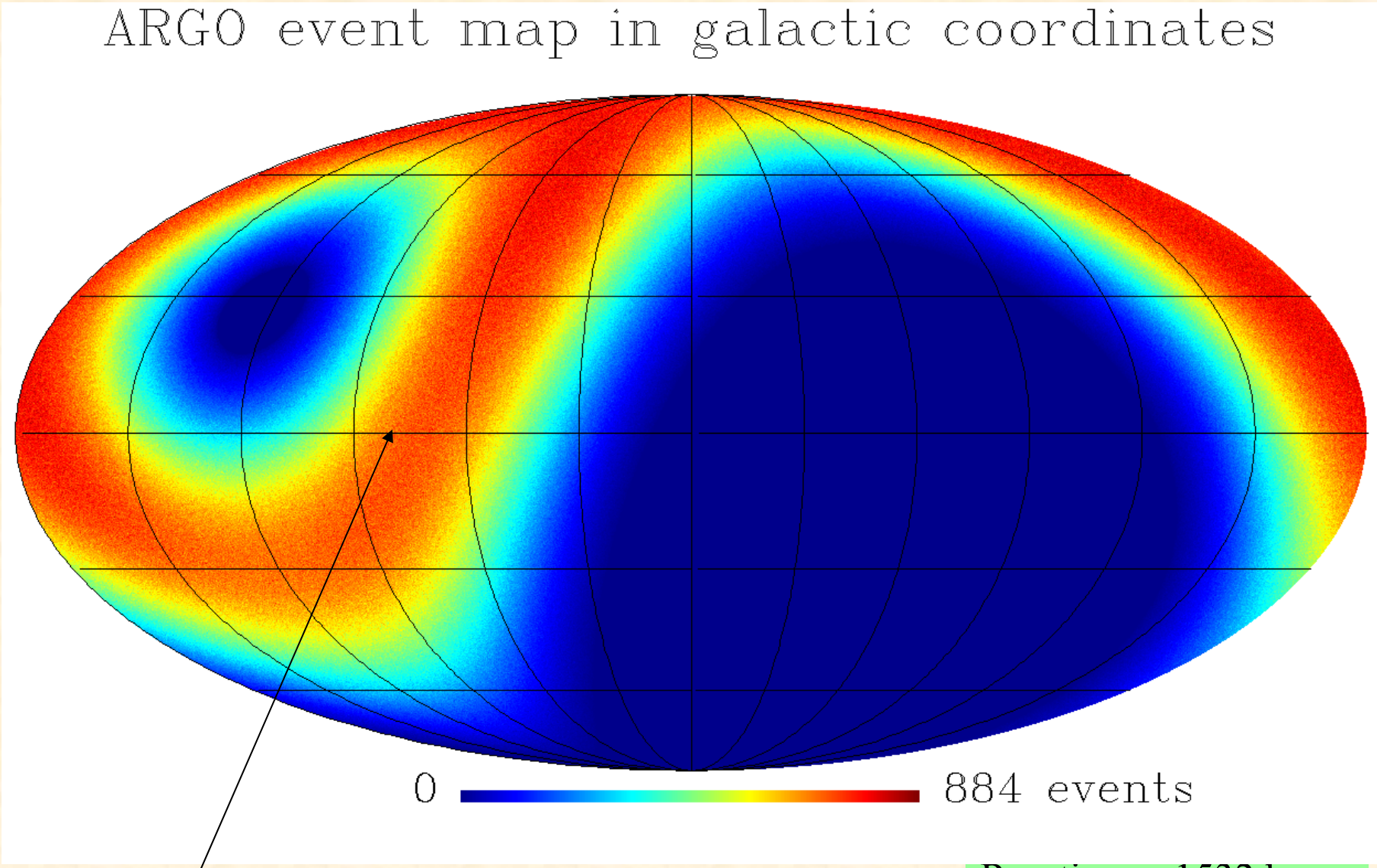


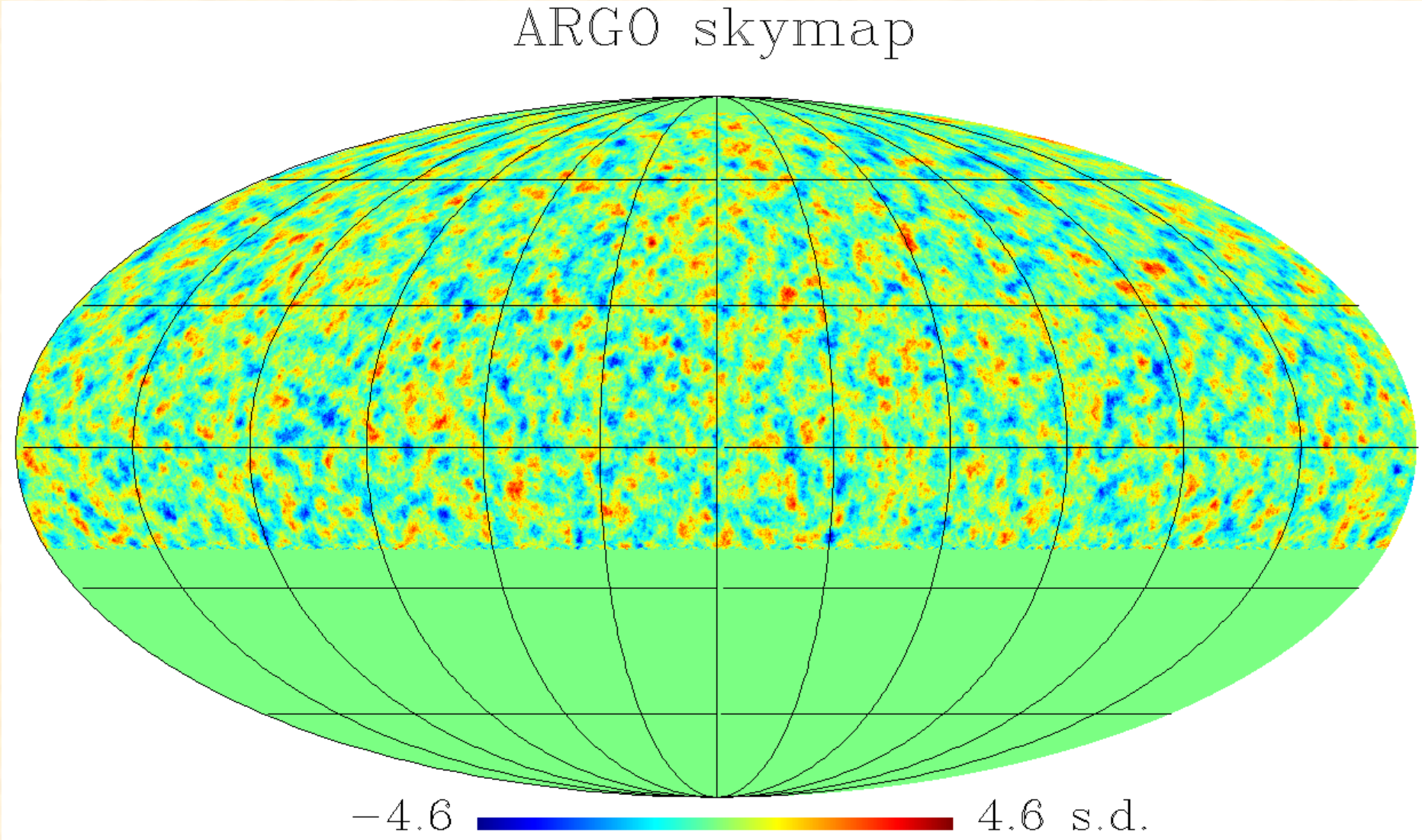
3.1×10^6 pixels

Pixel size $\approx$ 7 arcmin

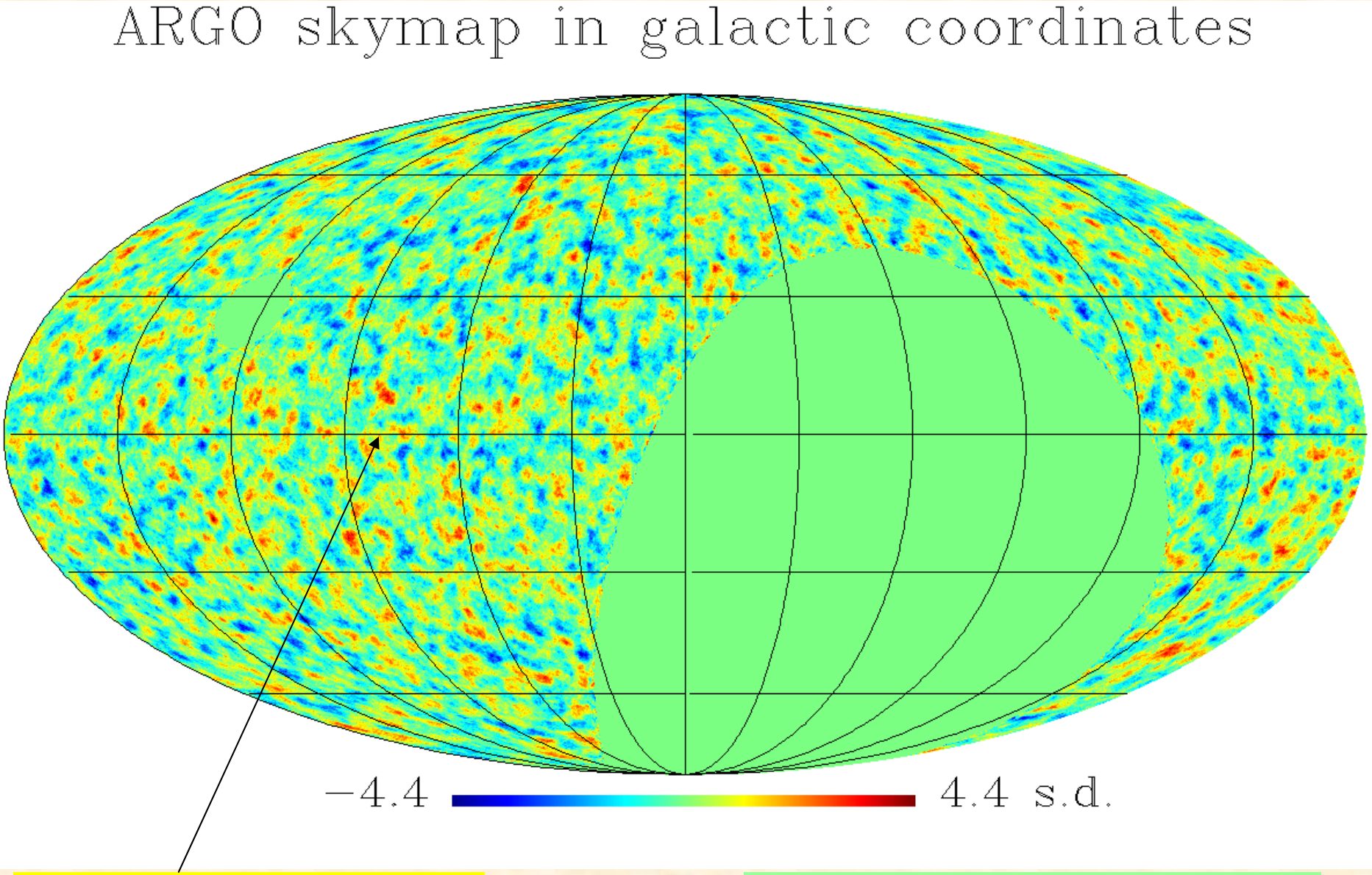
Run time = 1532 h

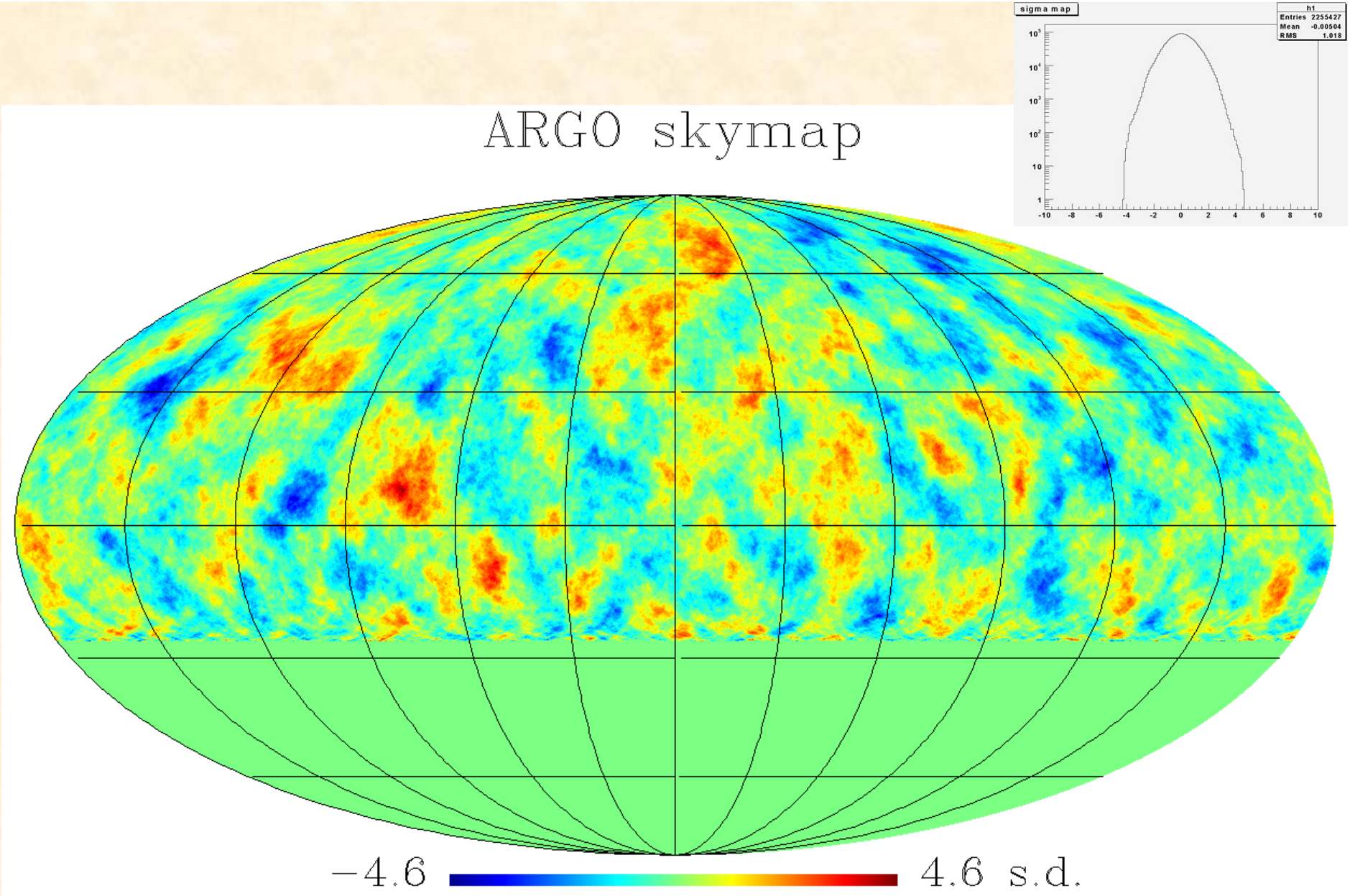
9.1×10^8 events $\quad \vartheta < 50^\circ$


ARGO event map in galactic coordinates
0
884 events
Position of Milagro excess
Run time = 1532 h
9.1×10^8 events

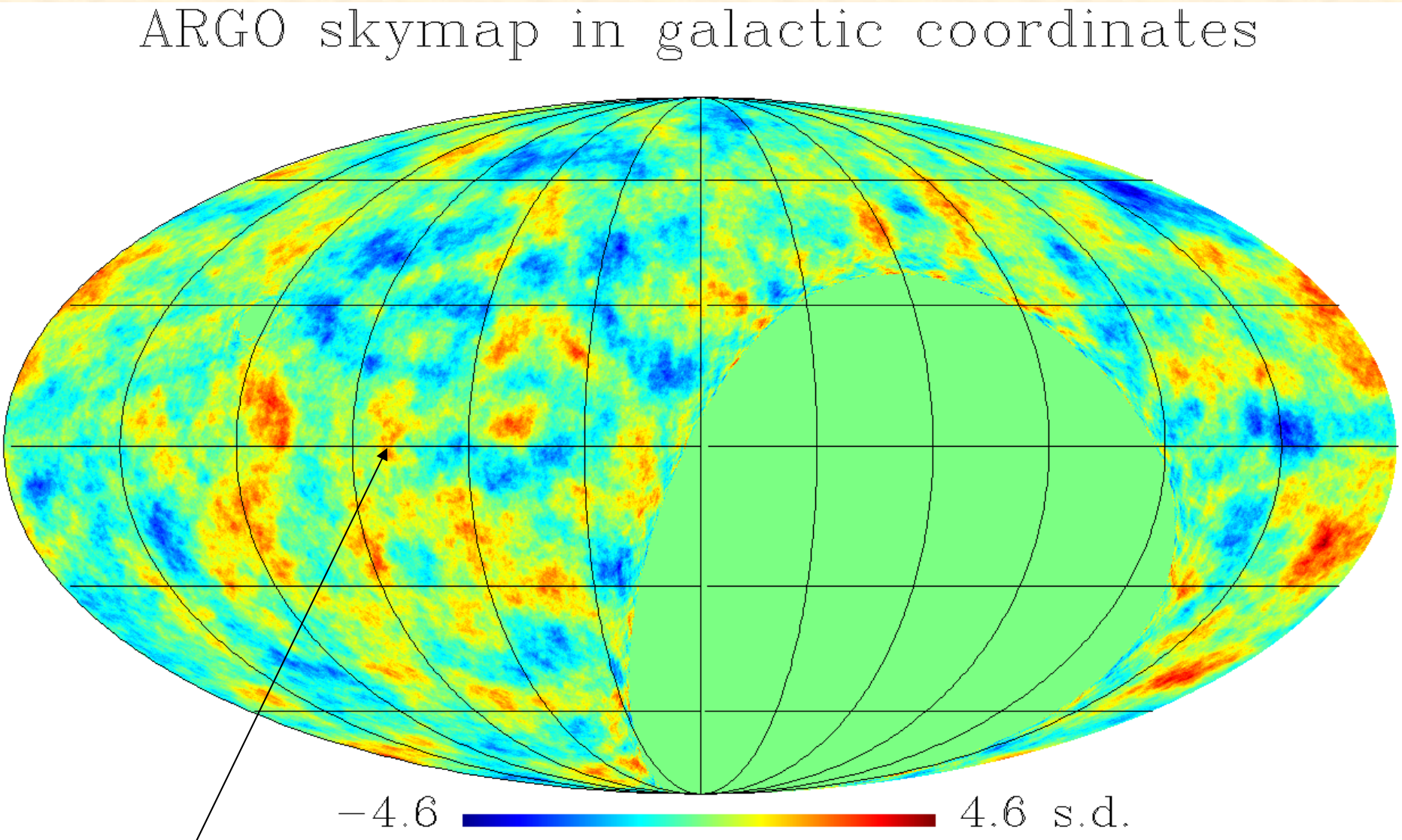


Smooth window radius = 1.5°


ARGO skymap in galactic coordinates
−4.4
4.4 s.d.
Position of Milagro excess
Smooth window radius = 1.5°



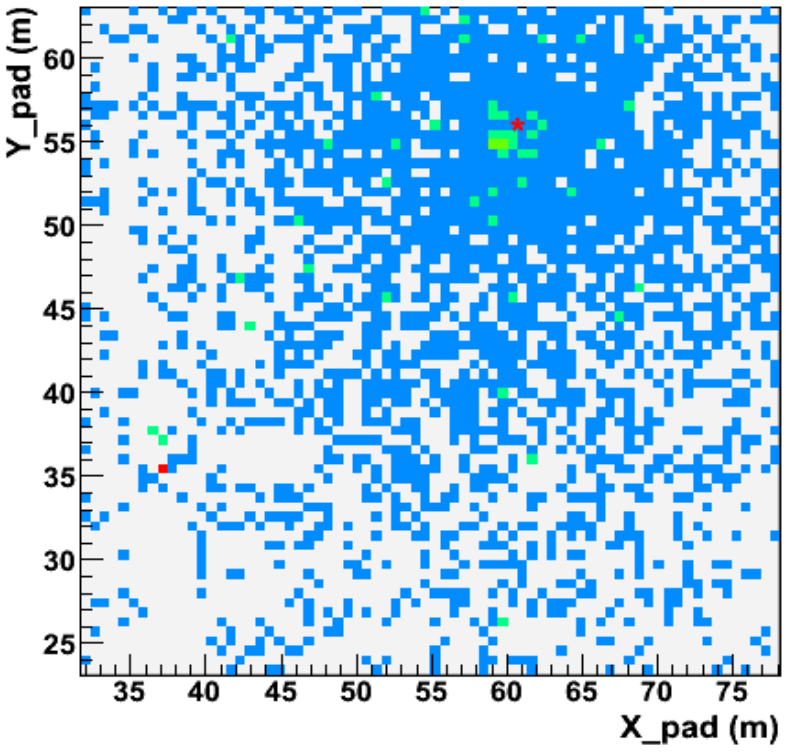
Smooth window radius = 5.9°

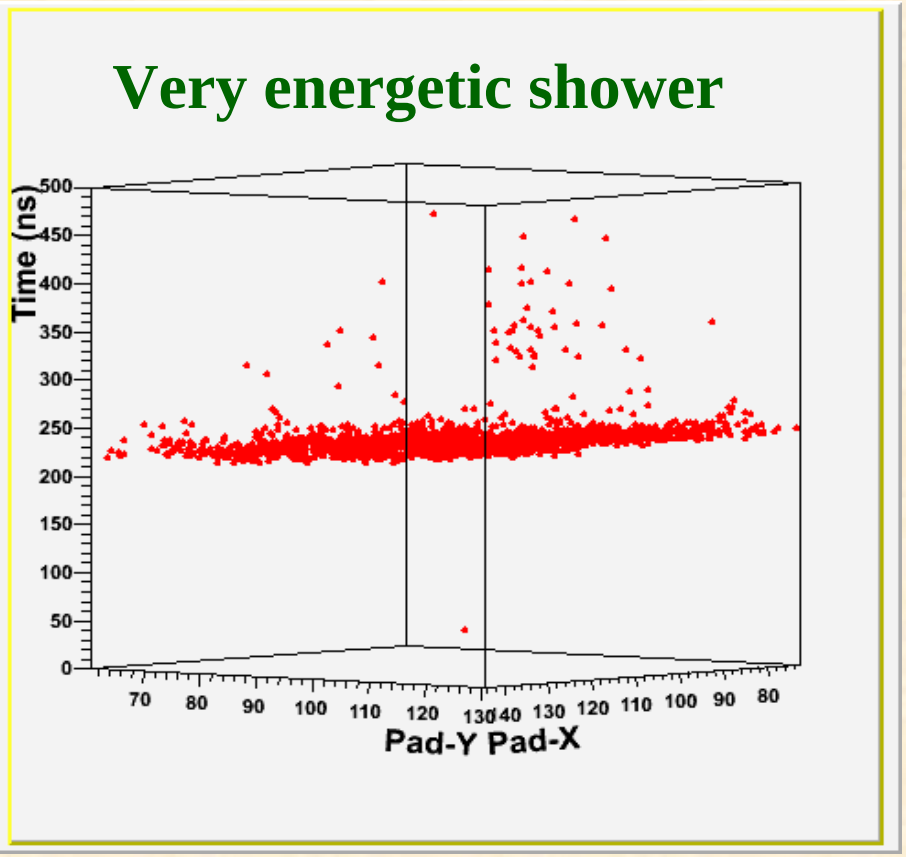

ARGO skymap in galactic coordinates
−4.6
4.6 s.d.
Position of Milagro excess
Smooth window radius = 5.9°

Shower phenomenology

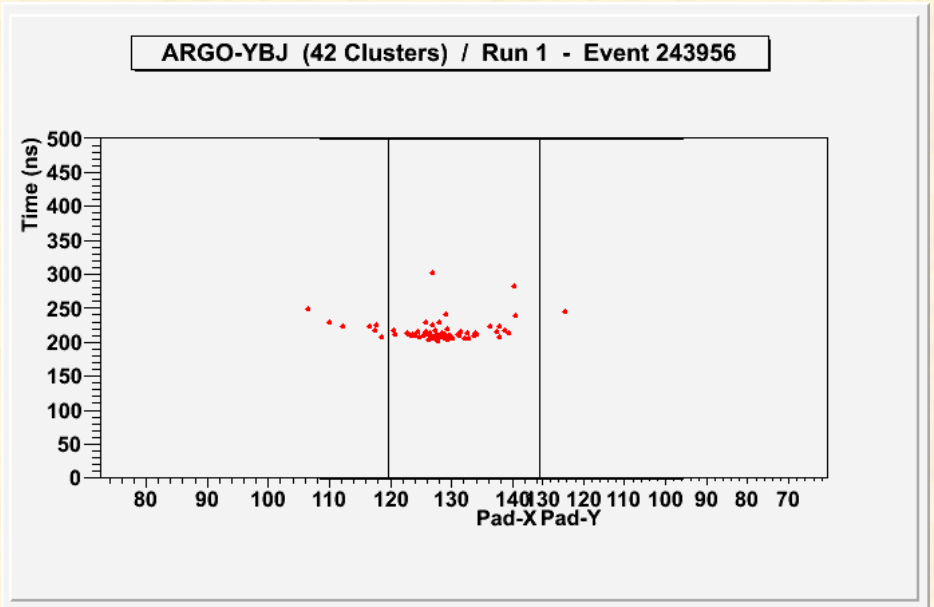
High space/time granularity of ARGO-YBJ detector permits to detect several kinds of events, characterized by different topologies and time structures.

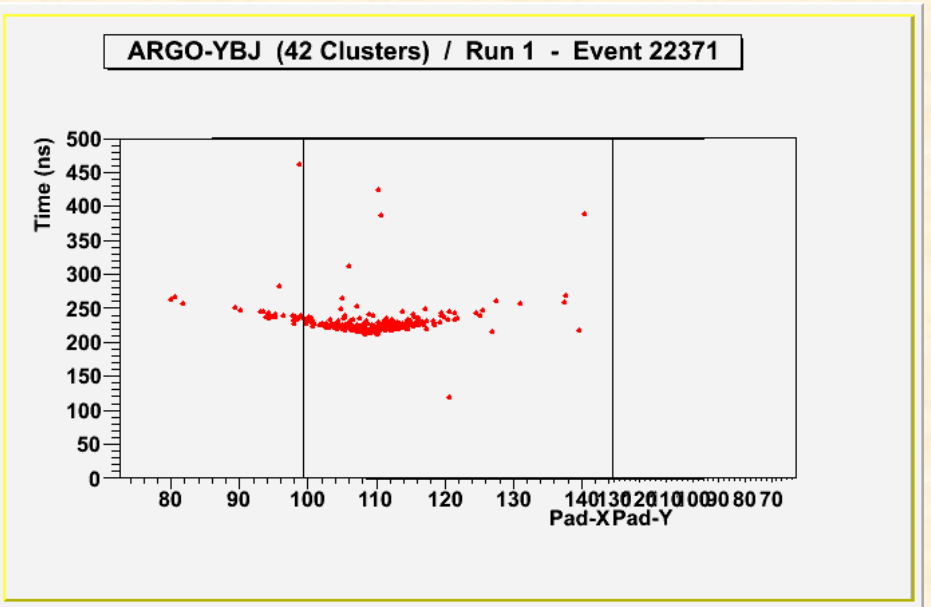
Deep inspection of a wide and possibly unexpected EAS phenomenology

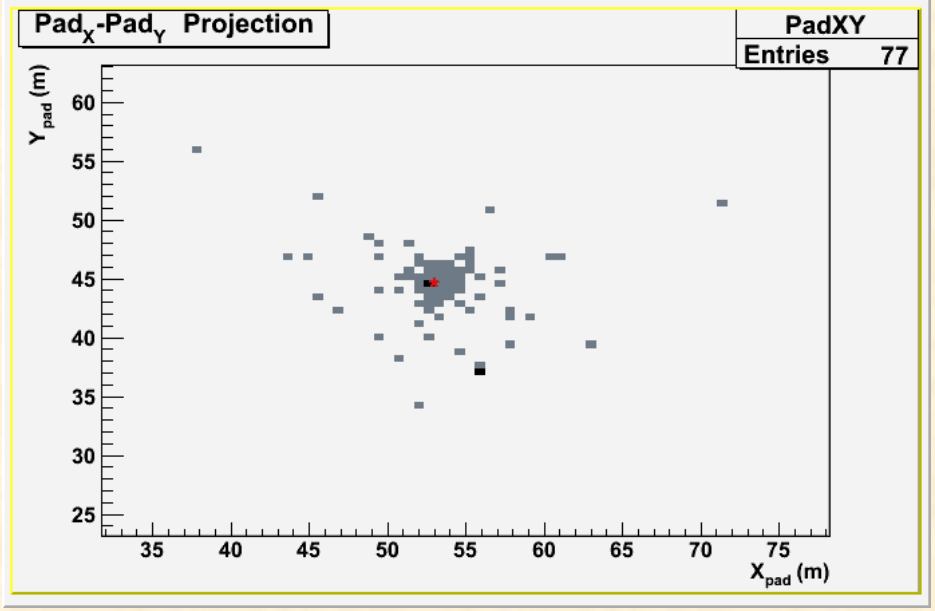


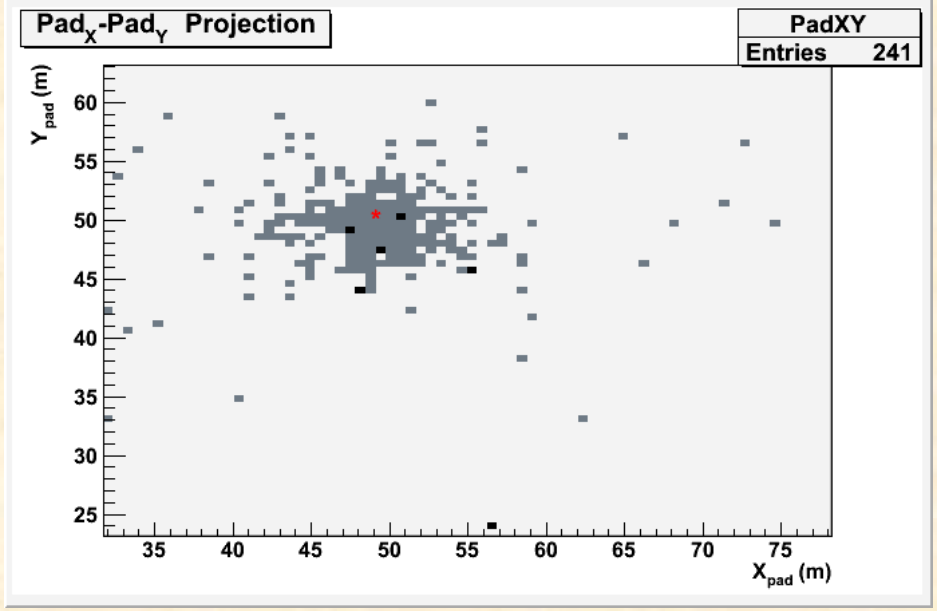


Evidence of strong conical shape









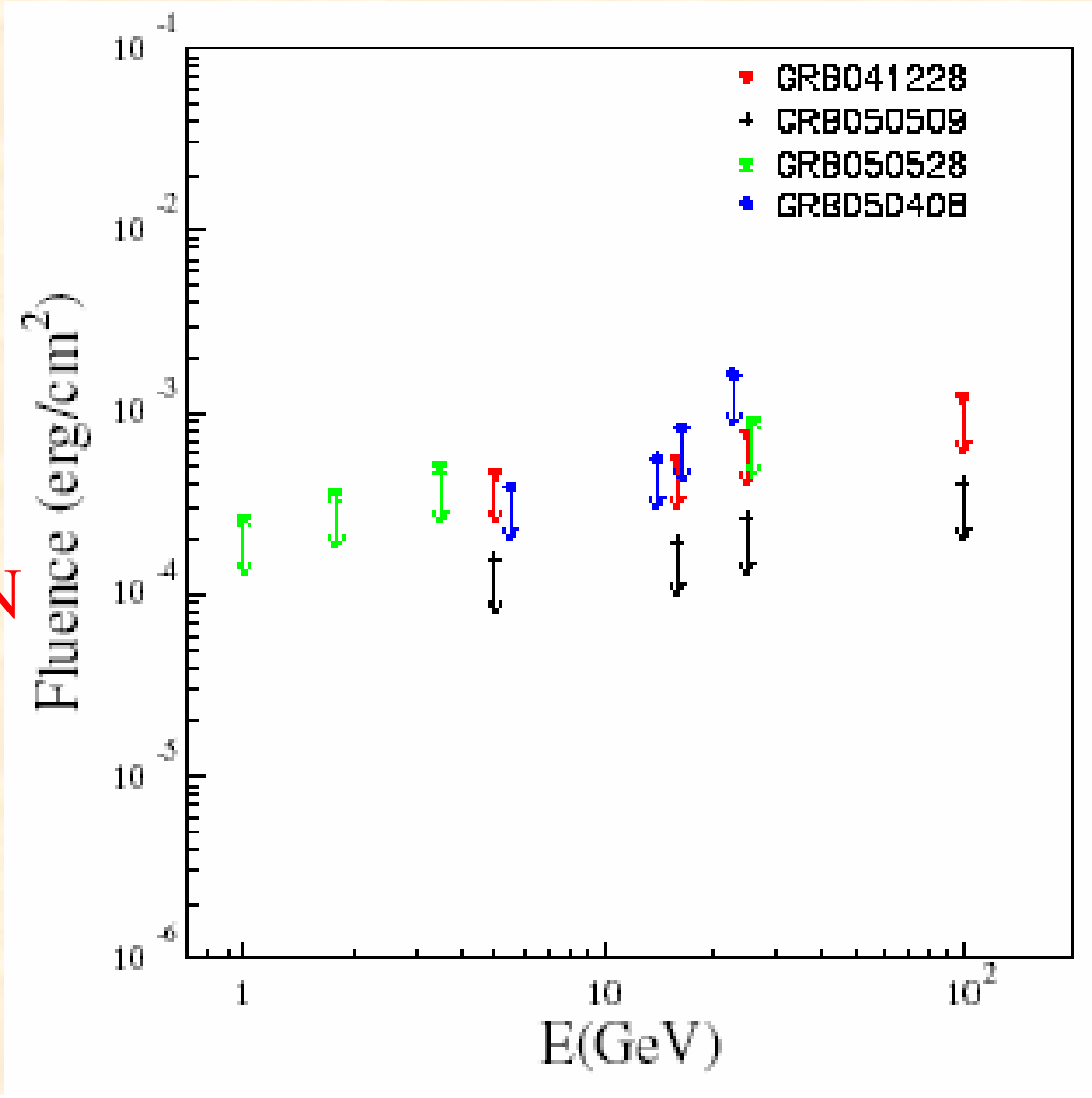
Burst Search Using SPT Rate

0.5s counting rate
Coincidence: 1
2
3
>4

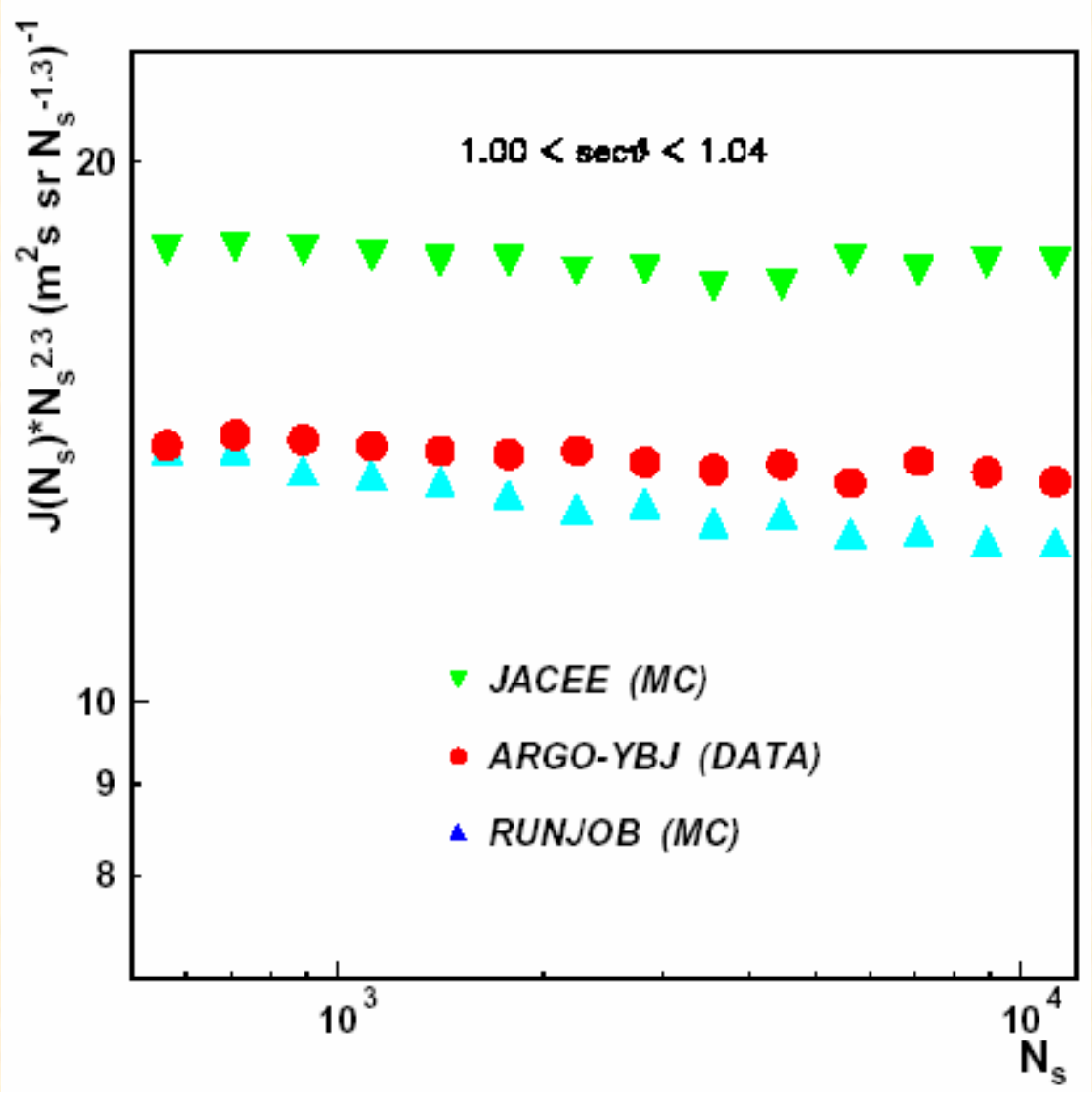
NO GRB BEING SEEN

Up limits:

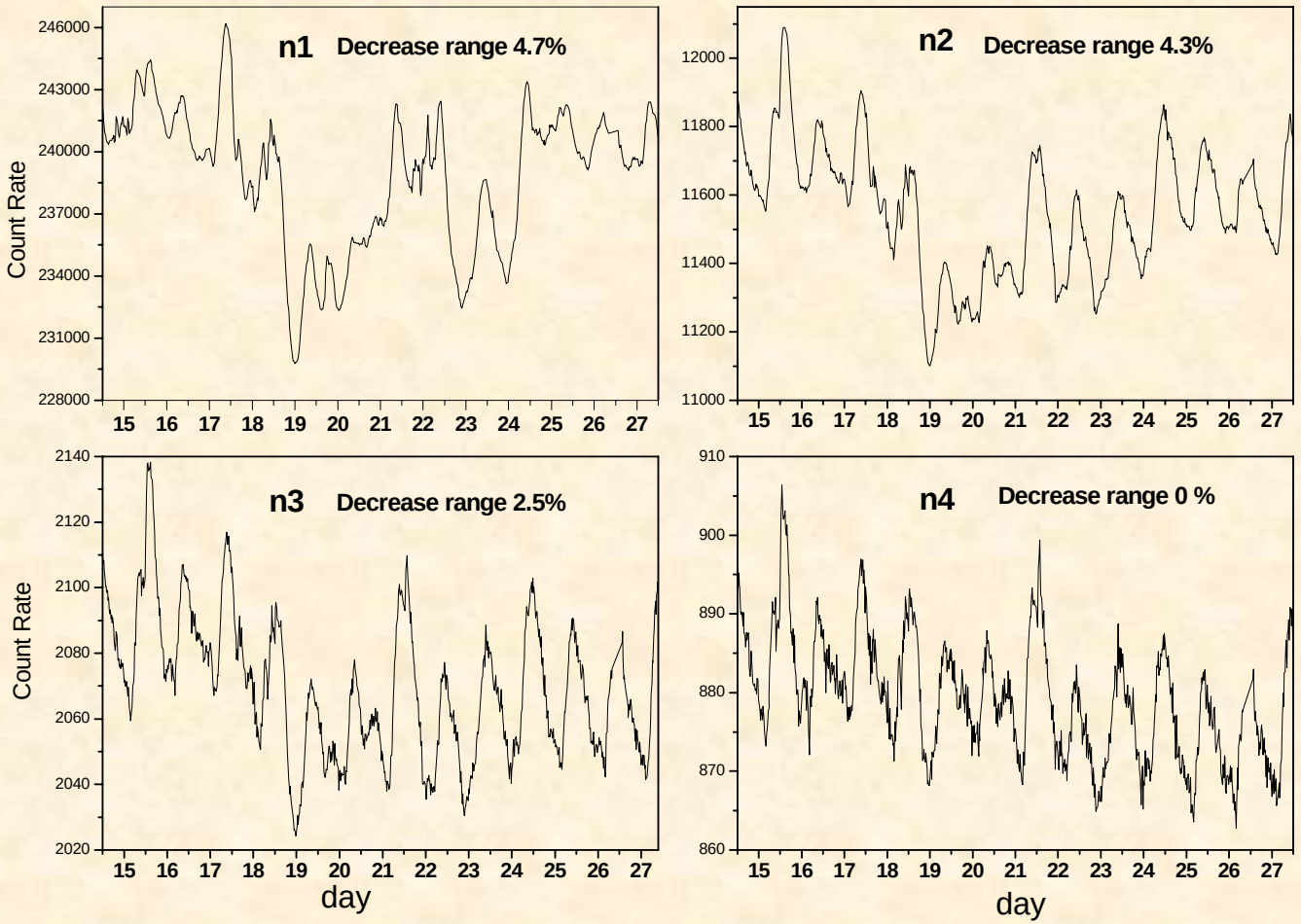
E_{cut}=100GeV
spectrum index -2



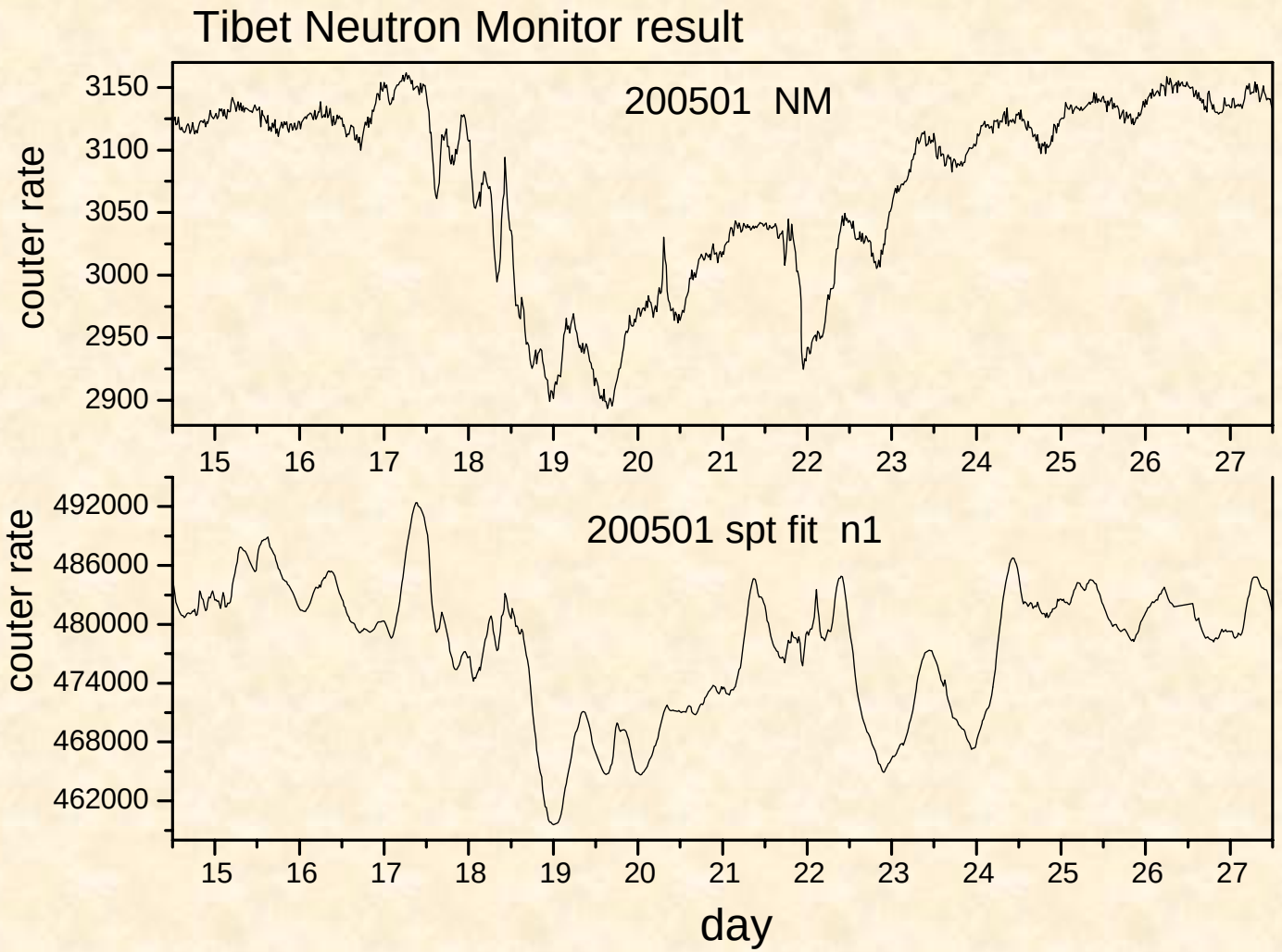
Cosmic ray spectrum up to 100TeV



Forbush Decrease @ 01/19/05



SPT rate
Coincidence:
$\geqslant 1$ (6.5GeV)
$\geqslant 2$ (11GeV)
$\geqslant 3$ (25GeV)
$\geqslant 4$ (52GeV)
Decreases:
4.7%
4.8%
2.6%
0%



ARGO SPT result ($n_{hit} \geqslant 1$)

Conclusion

- **Detector Construction is on Schedule**
- **Detector is Operational**
- **Preliminary Physics Results:**
  - **γ sources: N**
  - **γ burst: N**
  - **CR spectrum**
  - **Forbush decrease**

- **More results are coming soon**