

Francesco Colangelo, Giorgio Crescenzo - Liceo "G. Da Procida"



MUSEO
STORICO DELLA FISICA
E
CENTRO
STUDI E RICERCHE
ENRICO FERMI

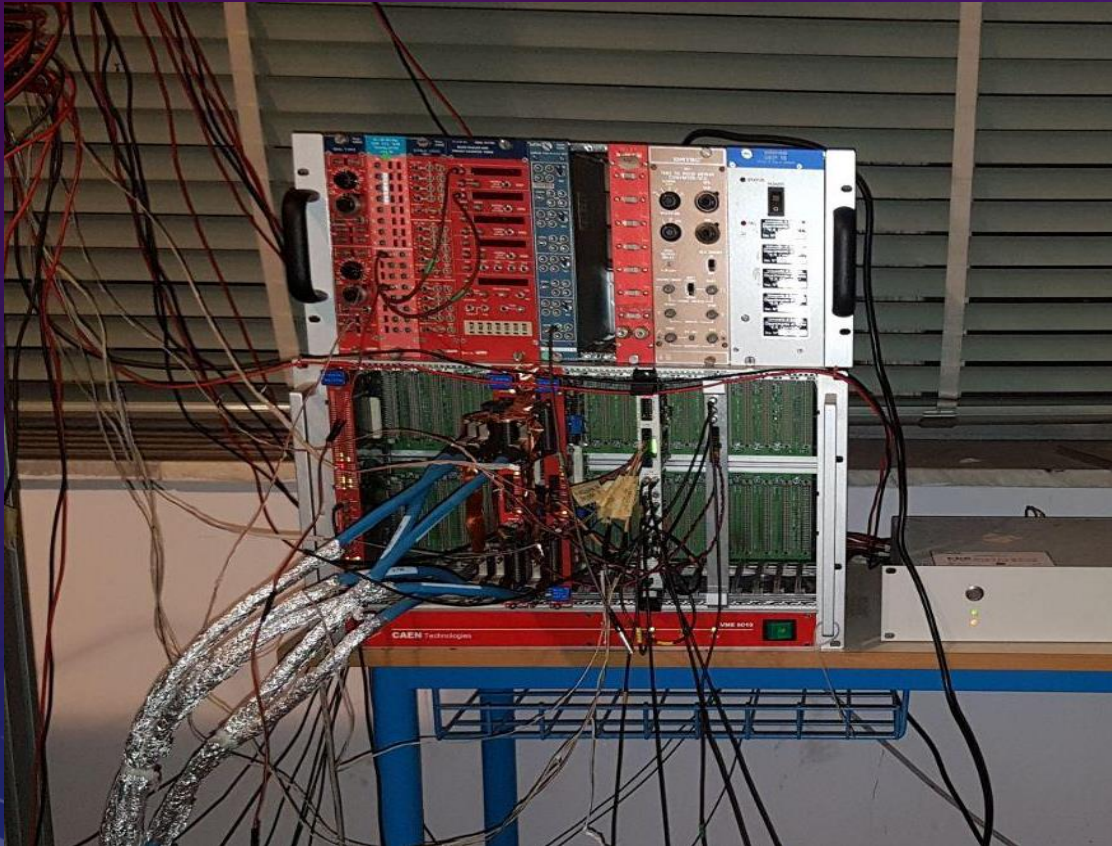


COSMIC RAYS ZENITHAL ANGULAR DISTRIBUTION

WHO WE ARE

- Francesco Colangelo and Giorgio Crescenzo
- Team of Liceo Scientifico G. Da Procida (Salerno, Italy)

WHO WE ARE – OUR TELESCOPE

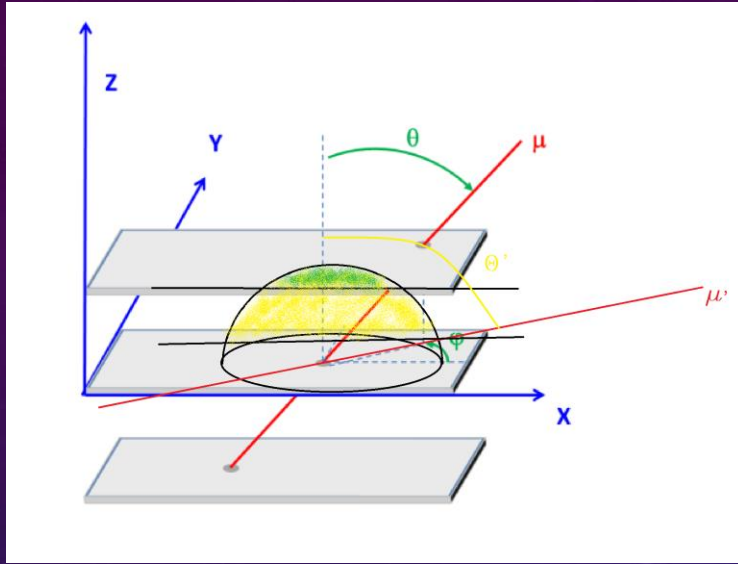


WHO WE ARE – OUR GROUP



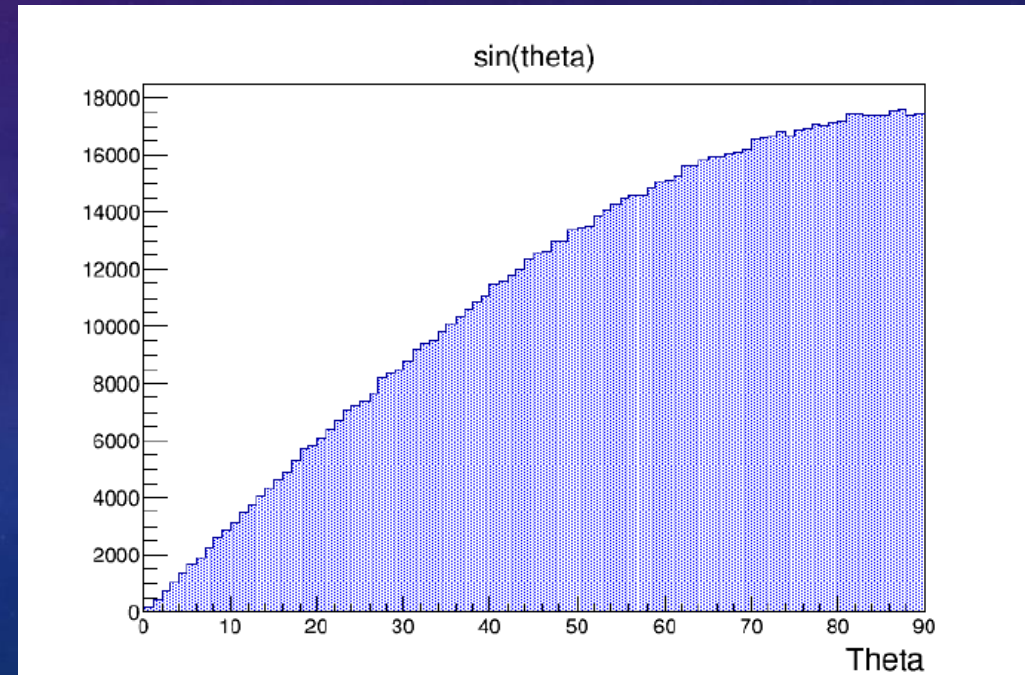
OBJECTIVE

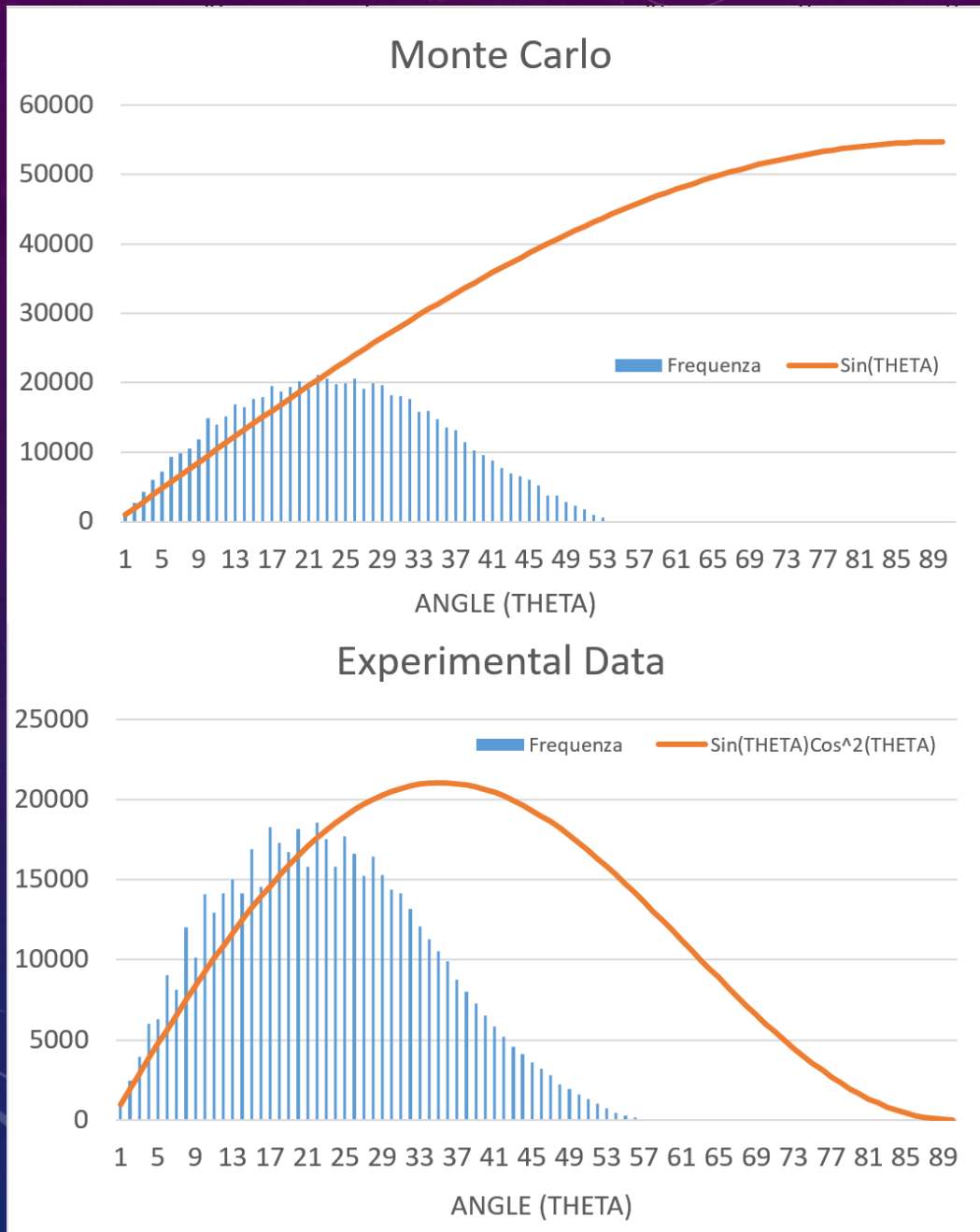
Our aim is to first show the experimental zenithal distribution from the data taken with our telescope (SALE-01) and then correct it by using the generated MC distribution



The first step is to simulate a MC distribution;
an isotropic distribution of the zenith
angle should correspond to a $\sin(\theta)$
function

Since angular distribution means
flux of muons falling within a
specific angle, a wider angle will
lead to a wider area and the
isotropic function will resemble a
sinusoidal path

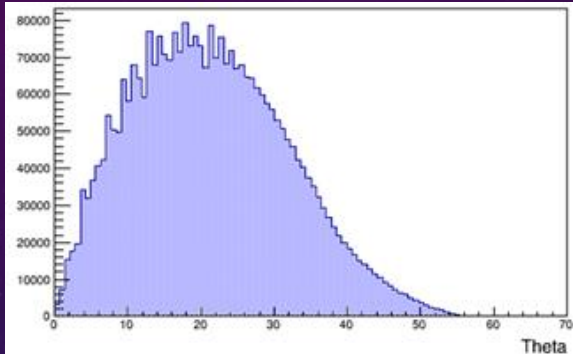




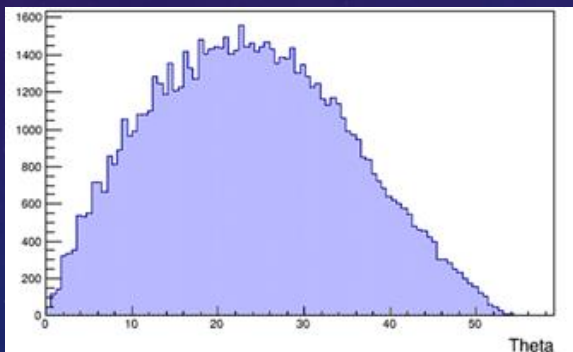
The most inclined muons are more easily absorbed by the atmosphere and this is clear by looking at this plot (greater theta values are suppressed)

The zenithal distribution is further modified by the telescope acceptance, that is not able to detect all the track directions

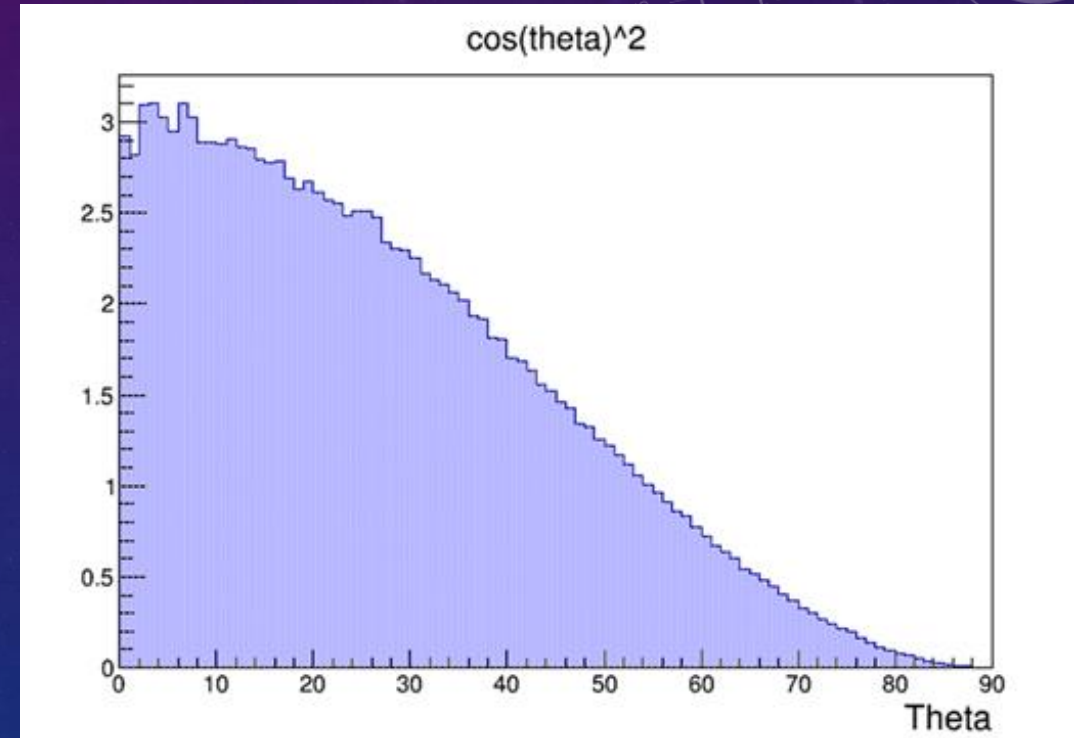
How To Correct Data With Simulated Distribution



EXPERIMENTAL DISTRIBUTION
 $\sin(\theta)\cos^2(\theta)$

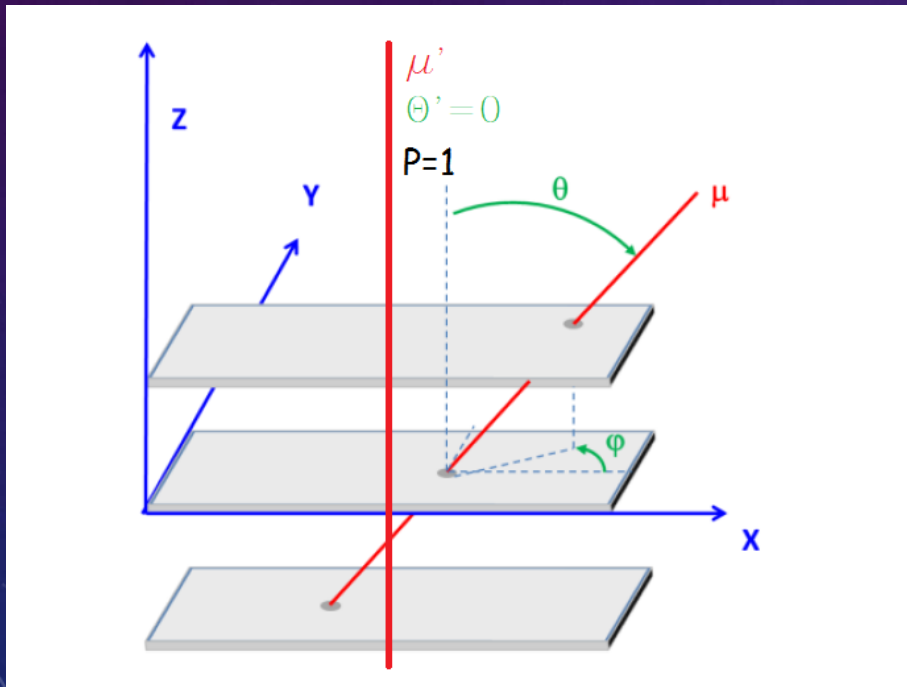


SIMULATED DISTRIBUTION
 $\sin(\theta)$



REAL ZENITHAL ANGULAR DISTRIBUTION
 $\cos^2(\theta)$

The aim of this operation is to underline how the atmosphere and the angular acceptance can affect the distribution of the muons belonging to the showers

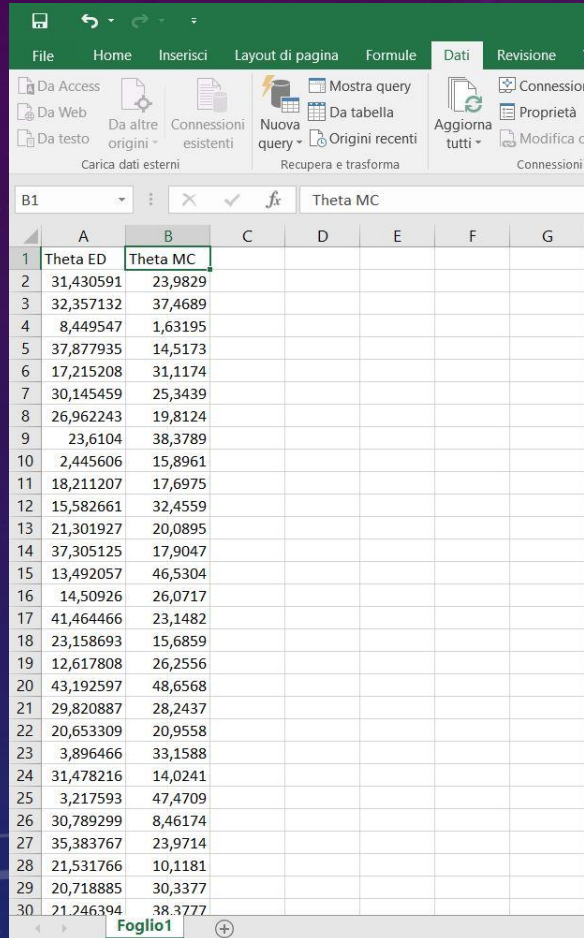


It is a cosinusoidal path as particles falling perpendicular to the ground will have a higher chance of being detected by the telescope

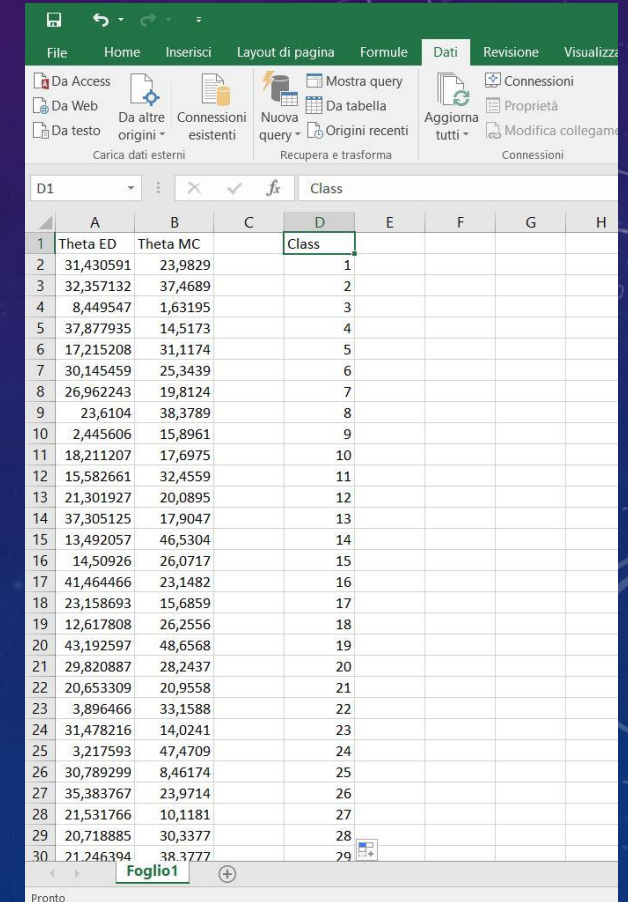
How to plot histograms

Firstly, we import the experimental and the simulated data into an Excel sheet...

... Then we add the classes containing the frequency of the distribution

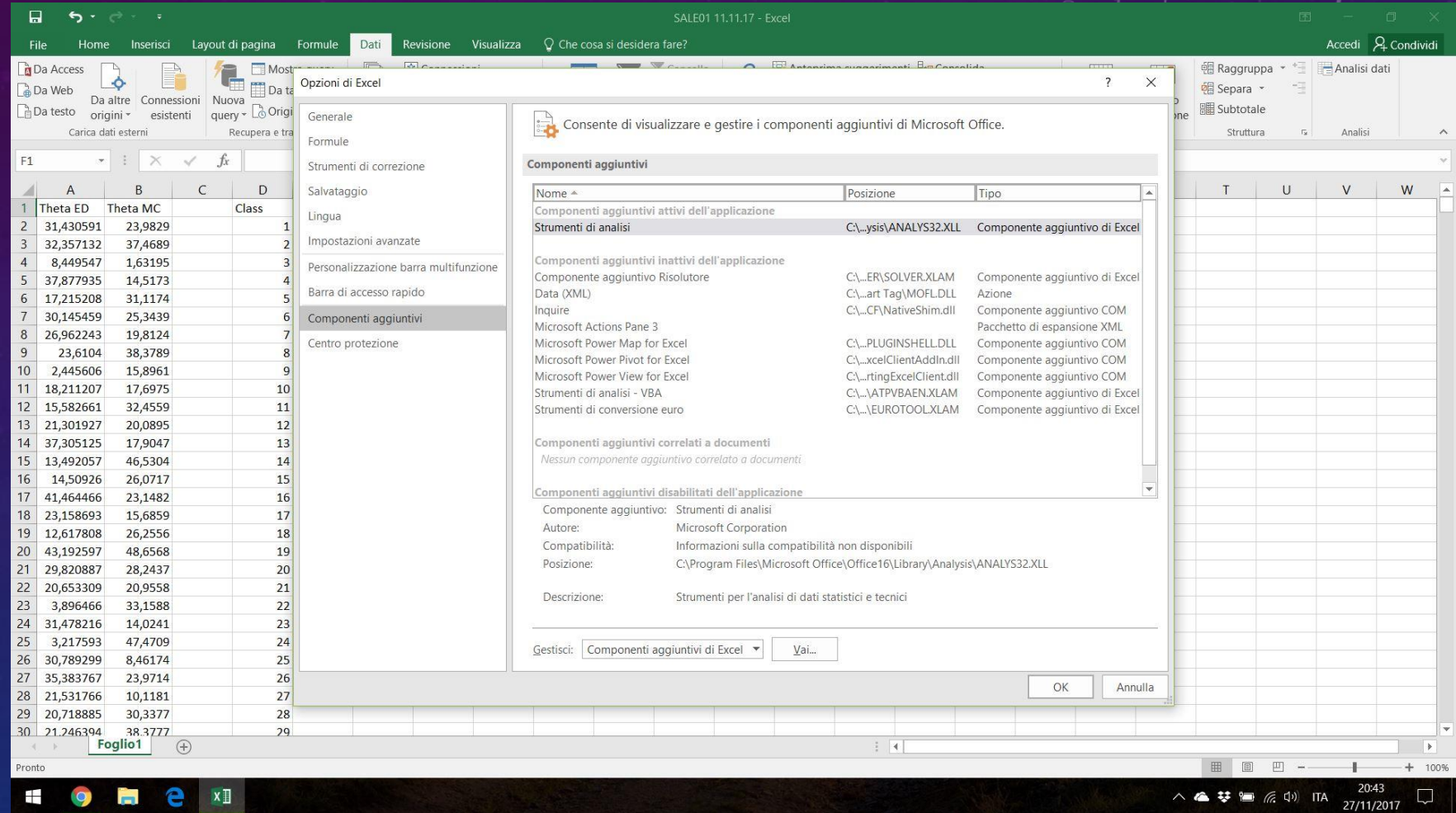


	A	B	C	D	E	F	G
1	Theta ED	Theta MC					
2	31,430591	23,9829					
3	32,357132	37,4689					
4	8,449547	1,63195					
5	37,877935	14,5173					
6	17,215208	31,1174					
7	30,145459	25,3439					
8	26,962243	19,8124					
9	23,6104	38,3789					
10	2,445606	15,8961					
11	18,211207	17,6975					
12	15,582661	32,4559					
13	21,301927	20,0895					
14	37,305125	17,9047					
15	13,492057	46,5304					
16	14,50926	26,0717					
17	41,464466	23,1482					
18	23,158693	15,6859					
19	12,617808	26,2556					
20	43,192597	48,6568					
21	29,820887	28,2437					
22	20,653309	20,9558					
23	3,896466	33,1588					
24	31,478216	14,0241					
25	3,217593	47,4709					
26	30,789299	8,46174					
27	35,383767	23,9714					
28	21,531766	10,1181					
29	20,718885	30,3377					
30	21,246394	38,3777					



	A	B	C	D	E	F	G	H
1	Theta ED	Theta MC		Class				
2	31,430591	23,9829		1				
3	32,357132	37,4689		2				
4	8,449547	1,63195		3				
5	37,877935	14,5173		4				
6	17,215208	31,1174		5				
7	30,145459	25,3439		6				
8	26,962243	19,8124		7				
9	23,6104	38,3789		8				
10	2,445606	15,8961		9				
11	18,211207	17,6975		10				
12	15,582661	32,4559		11				
13	21,301927	20,0895		12				
14	37,305125	17,9047		13				
15	13,492057	46,5304		14				
16	14,50926	26,0717		15				
17	41,464466	23,1482		16				
18	23,158693	15,6859		17				
19	12,617808	26,2556		18				
20	43,192597	48,6568		19				
21	29,820887	28,2437		20				
22	20,653309	20,9558		21				
23	3,896466	33,1588		22				
24	31,478216	14,0241		23				
25	3,217593	47,4709		24				
26	30,789299	8,46174		25				
27	35,383767	23,9714		26				
28	21,531766	10,1181		27				
29	20,718885	30,3377		28				
30	21,246394	38,3777		29				

Open the data analysis form that should be enabled in the Excel's option menù



FILE → OPTION → ADD-INS → DATA ANALYSIS

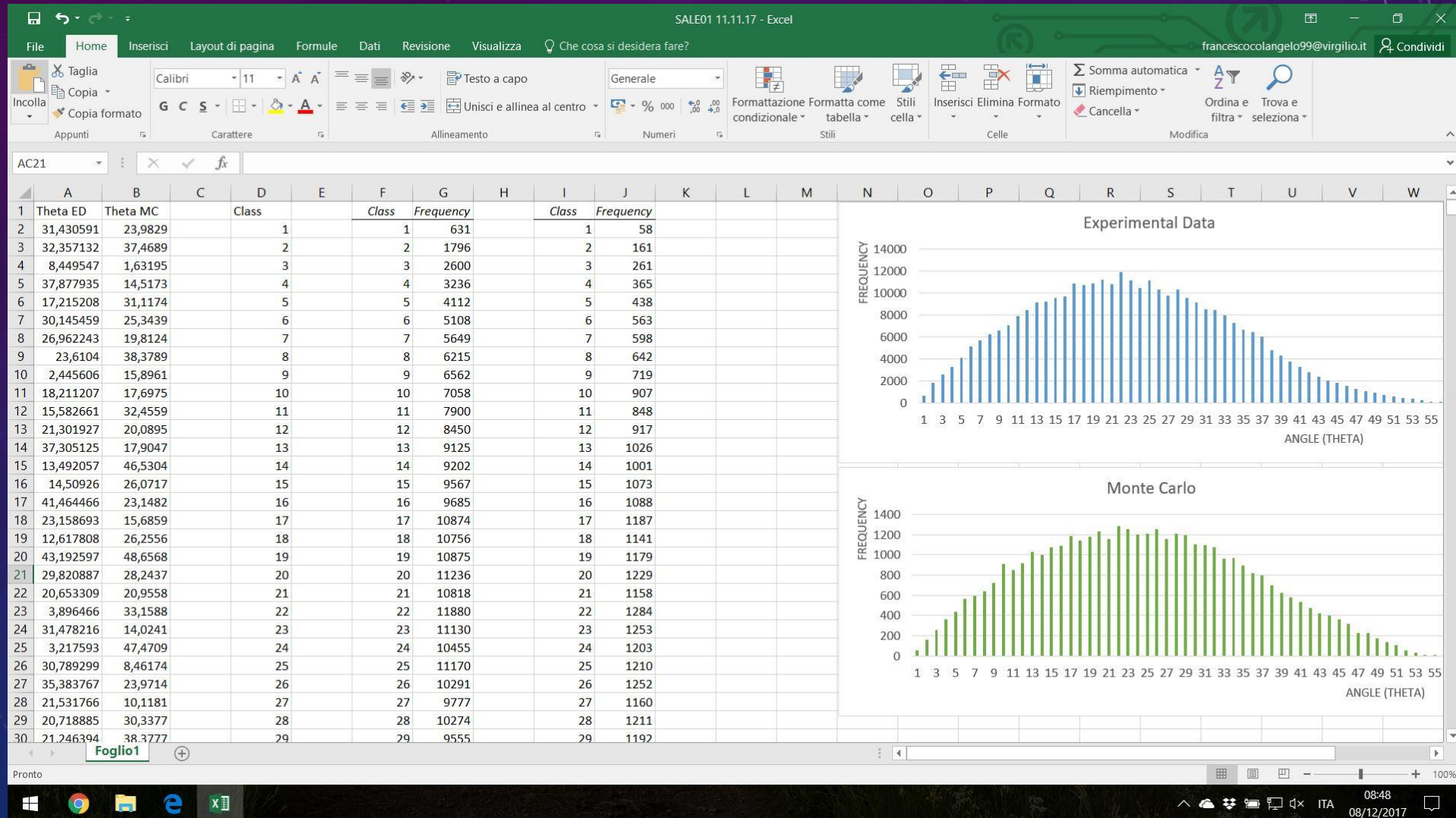
SALE01 11.11.17 - Excel

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Theta ED	Theta MC		Class		Class	Frequency										
2	31,430591	23,9829		1		1	631										
3	32,357132	37,4689		2		2	1796										
4	8,449547	1,63195		3		3	2600										
5	37,877935	14,5173		4		4	3236										
6	17,215208	31,1174		5		5	4112										
7	30,145459	25,3439		6		6	5108										
8	26,962243	19,8124		7		7	5649										
9	23,6104	38,3789		8		8	6215										
10	2,445606	15,8961		9		9	6562										
11	18,211207	17,6975		10		10	7058										
12	15,582661	32,4559		11		11	7900										
13	21,301927	20,0895		12		12	8450										
14	37,305125	17,9047		13		13	9125										
15	13,492057	46,5304		14		14	9202										
16	14,50926	26,0717		15		15	9567										
17	41,464466	23,1482		16		16	9685										
18	23,158693	15,6859		17		17	10874										
19	12,617808	26,2556		18		18	10756										
20	43,192597	48,6568		19		19	10875										
21	29,820887	28,2437		20		20	11236										
22	20,653309	20,9558		21		21	10818										
23	3,896466	33,1588		22		22	11880										
24	31,478216	14,0241		23		23	11130										
25	3,217593	47,4709		24		24	10455										
26	30,789299	8,46174		25		25	11170										
27	35,383767	23,9714		26		26	10291										
28	21,531766	10,1181		27		27	9777										
29	20,718885	30,3377		28		28	10274										
30	21,246394	38,3777		29		29	9555										

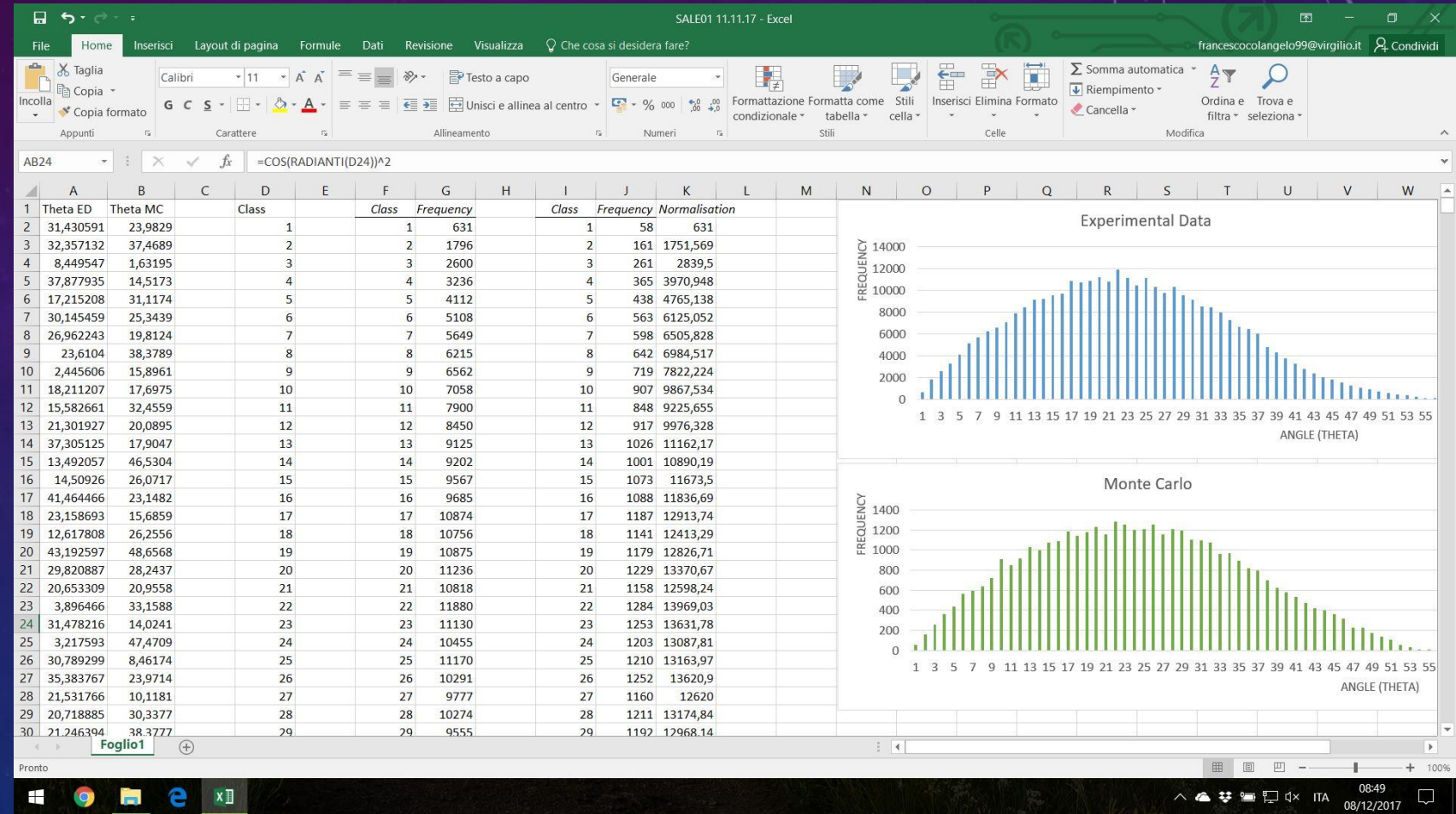
Foglio1

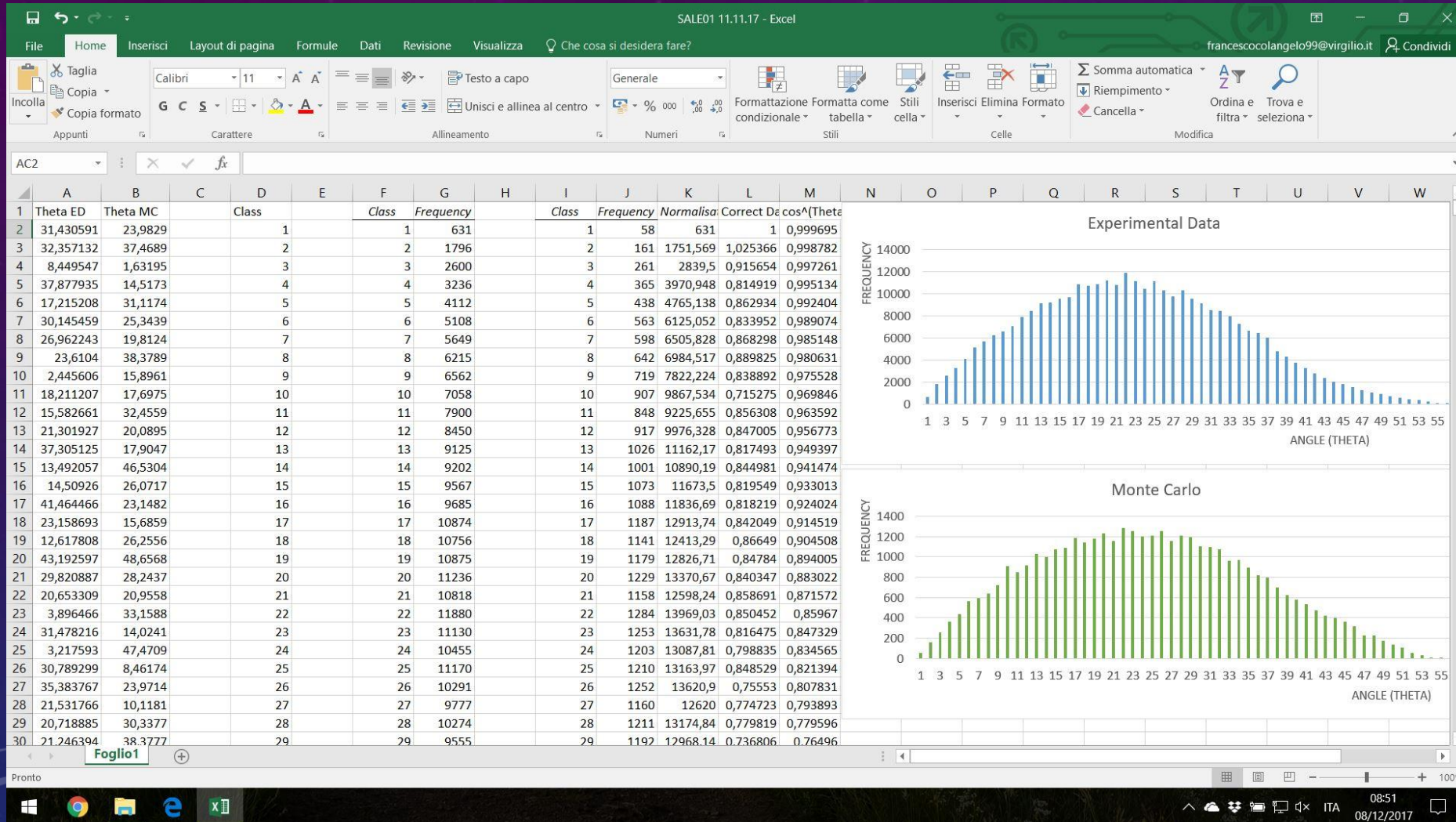
Launch the data analysis
and select the
'histogram' option,
repeating the process
for both the series of
data

The Resulting Graph Is



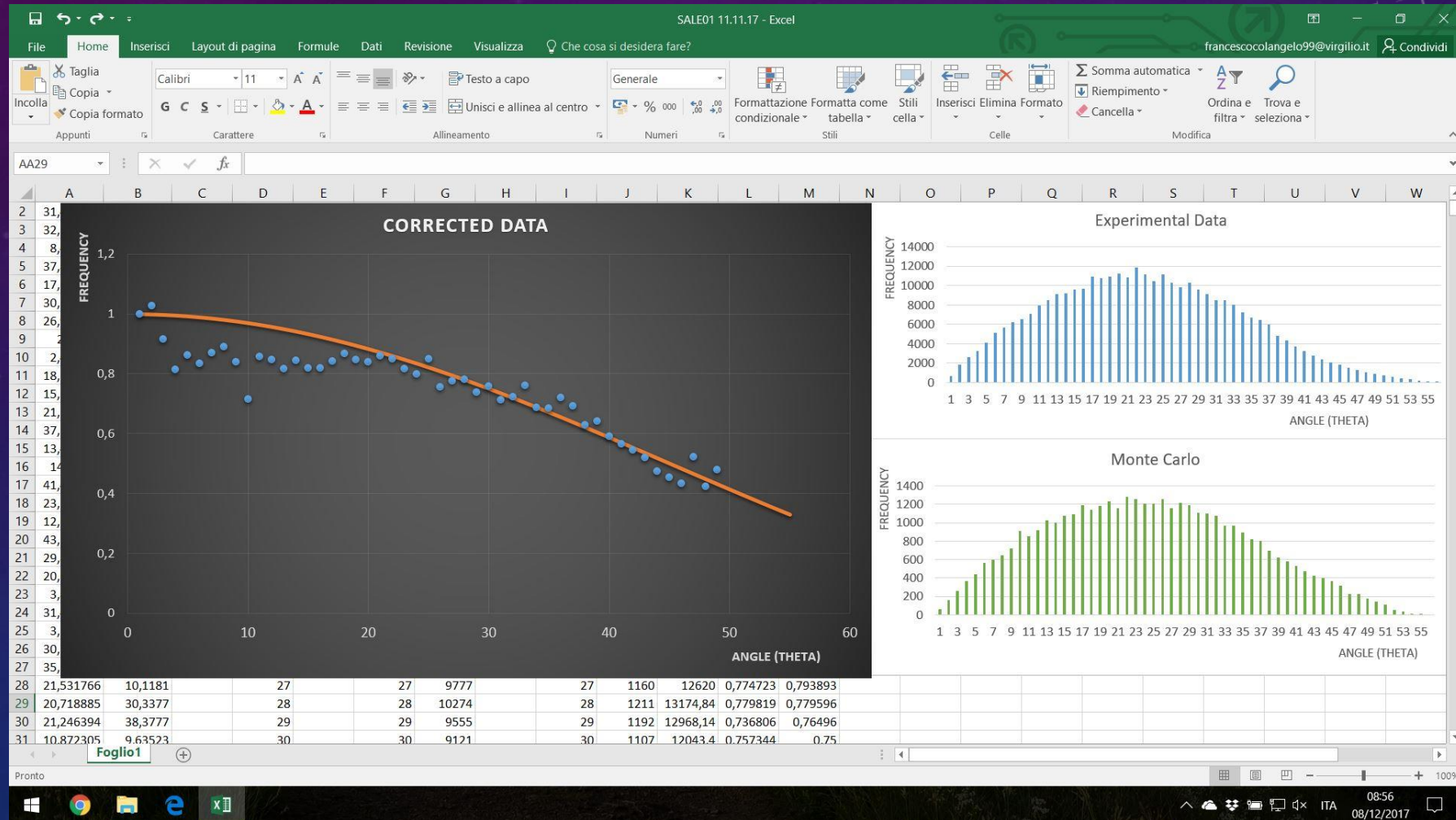
Since the simulated data have a much smaller amount of events, we have to normalise them in order to proceed with the mathematical operations

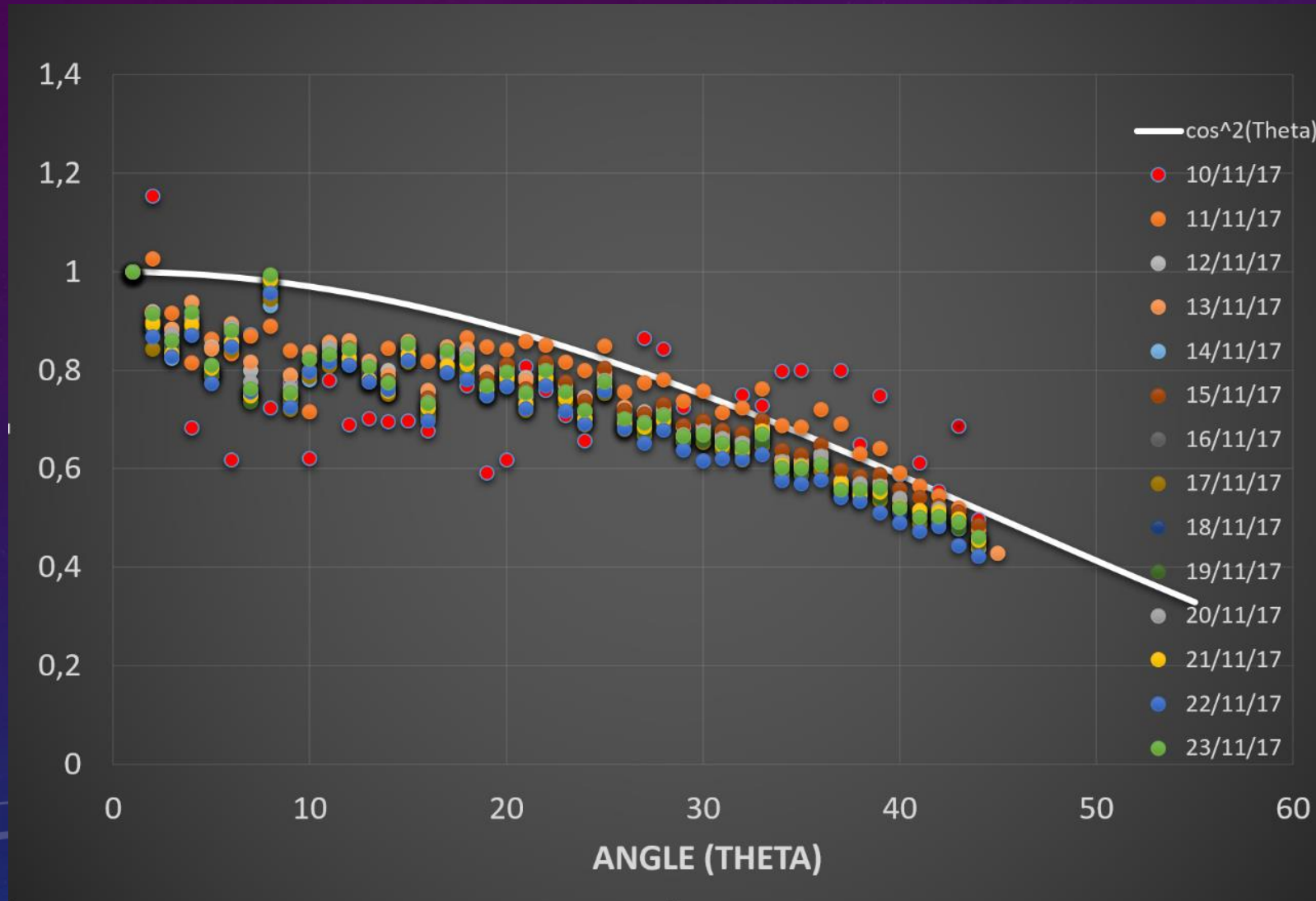




To obtain the corrected data, we divide the experimental data by the Monte Carlo data

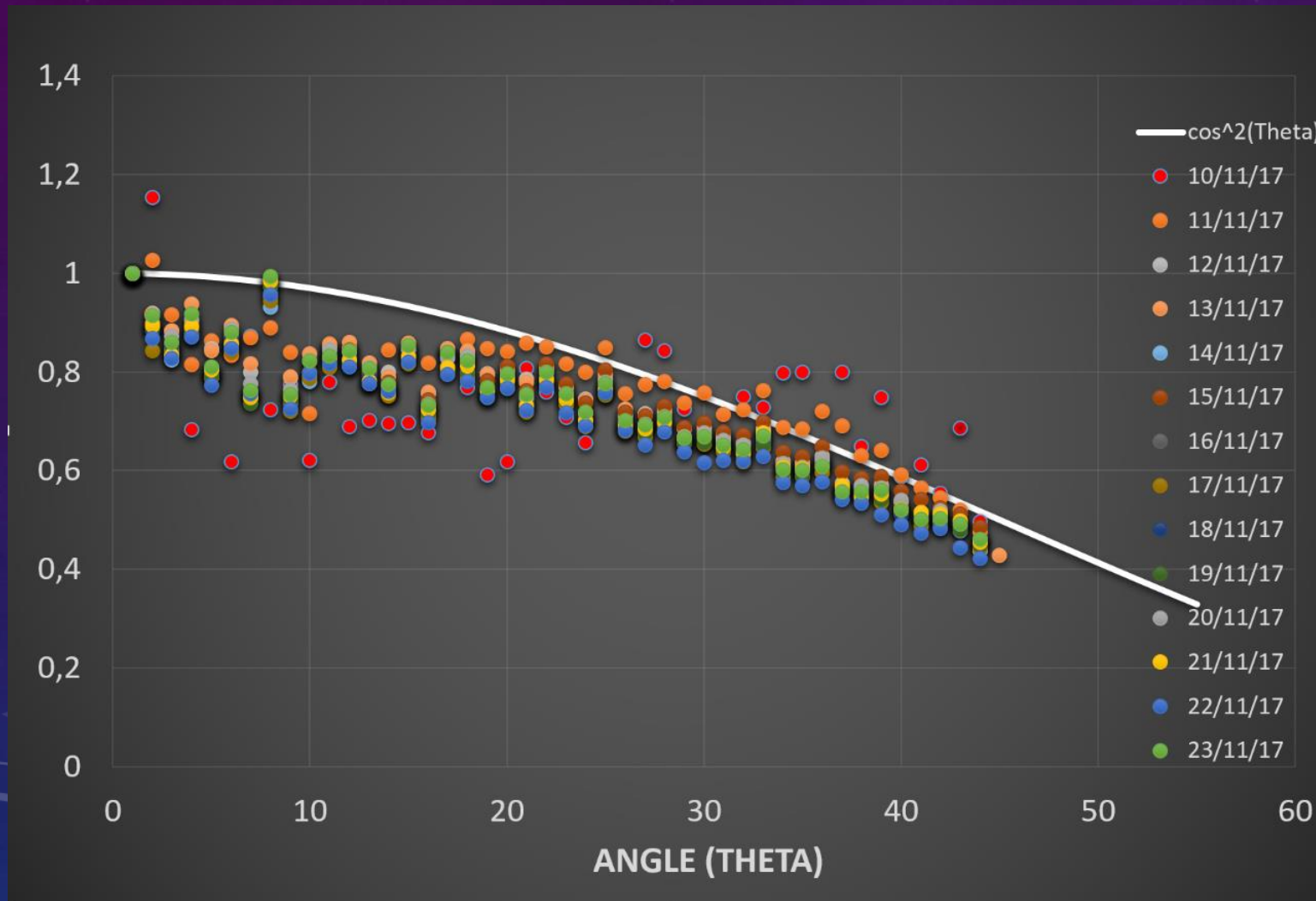
Final Angular Distribution Compared To A $\cos^2(\theta)$ Function





Day-By-Day
Graphic Evolution

In Conclusion...



...Using This Analysis We Can Notice That The Maintenance The Telescope Was Undergoing On 10/11 and 11/11 Produced An Irregularity In The Graph

Thank You For Your Attention!

- Colangelo, Francesco
- Crescenzo, Giorgio

L.S.S. "Giovanni Da Procida";
'SALE-01' EEE Telescope