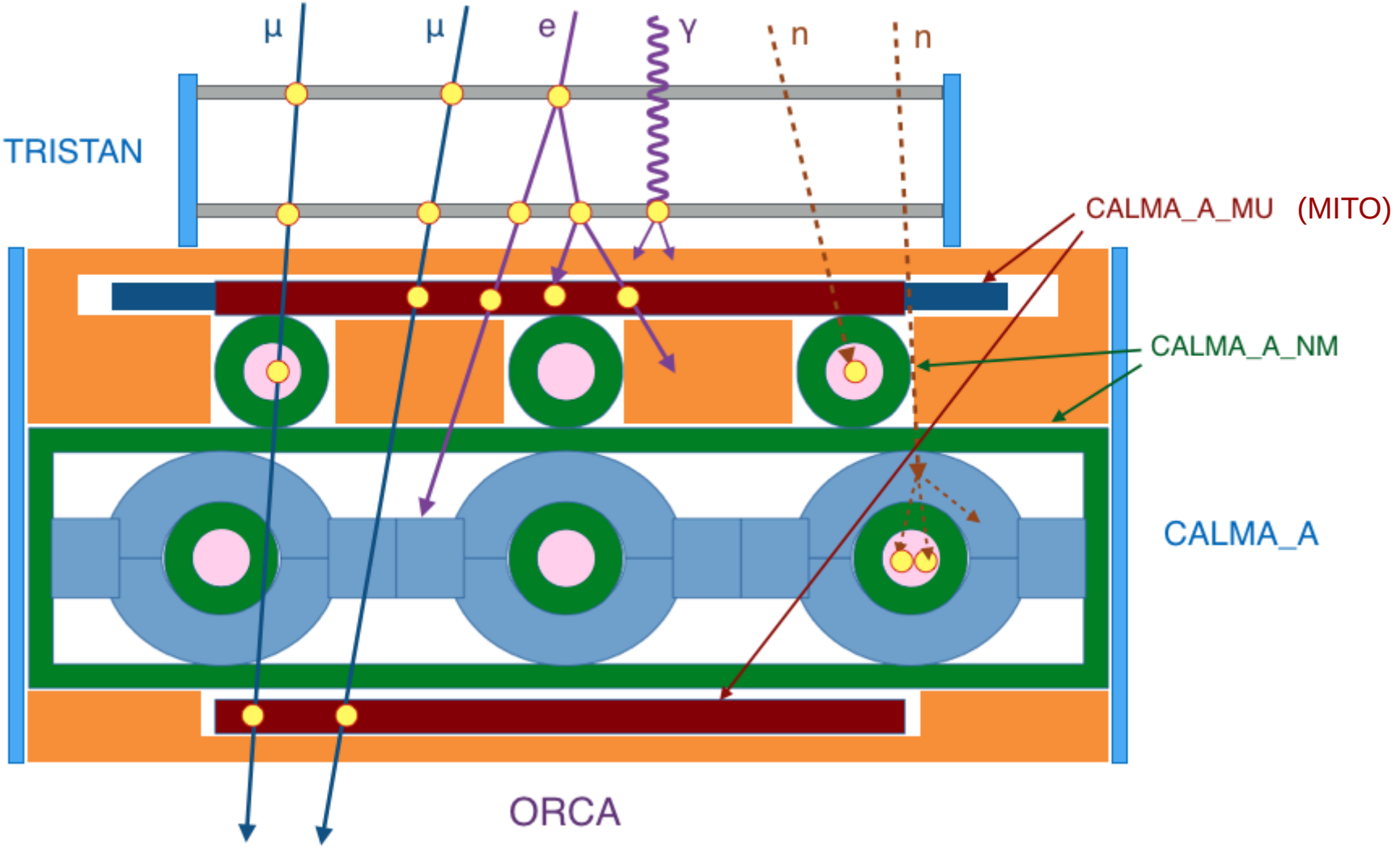
The future Spanish Antarctic Cosmic Ray Observatory (**ORCA**)

Our plan

To install a cosmic ray detector (ORCA) in BAE Juan Carlos I



Scientific Objectives

SO1. To install a detector (ORCA) for measuring secondary cosmic rays, neutrons and muons, in Juan Carlos I Antarctic Station.
SO2. To perform a cosmic ray latitude survey.
SO3. To study solar activity using data from ORCA.
SO4. To compare NMDB, and especially KIEL, CaLMa, TRAGALDABAS, with ORCA observations.
SO5. To characterize CaLMa-A response with respect to environmental variables.
SO6. To study local magnetic field variations and their relationship with cosmic ray flux.
SO7. To improve our knowledge of the relationship between cosmic rays and the temperature of the stratosphere and the climate.

Technical Objectives

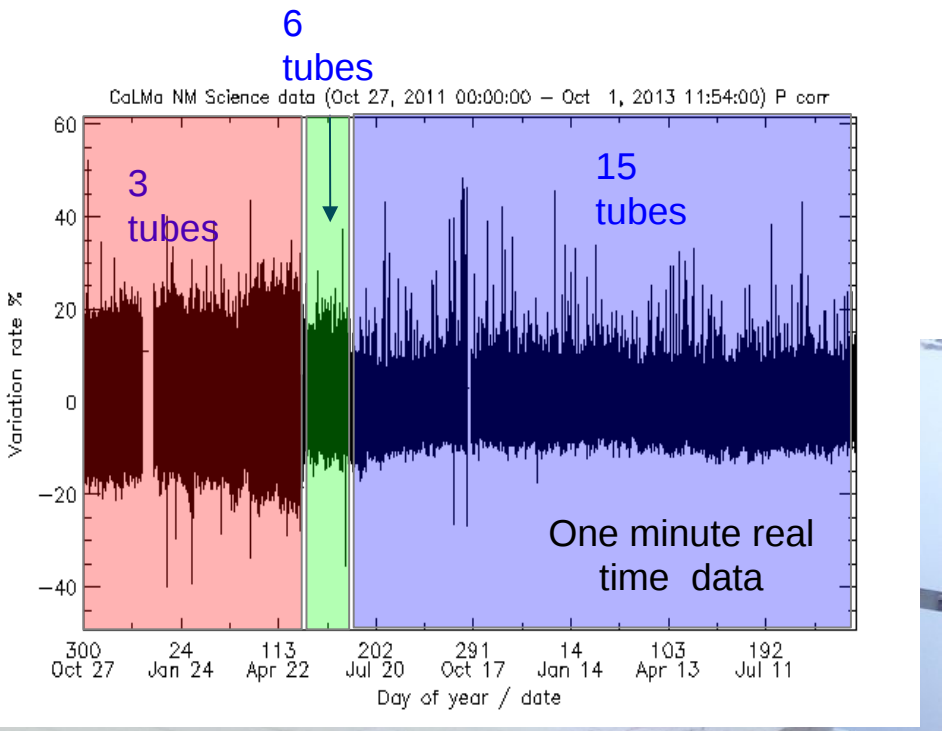
TO1. To make ORCA a real Space Weather instrument:
TO1a. To integrate ORCA in the NMDB.
TO1b. To get real time data from ORCA with 1-min resolution.
TO1c. To explore the possibilities of multiplicity analysis with a new FPGA core
TO2. To design a power management system that would combine available power sources to make the container energetically self-sustainable and independent.
TO3. To develop an integrated control system for the complete set of instrument and sensors
TO4. To design a communications hub that will take advantage of available data channels to establish a data link with the Internet to upload data and download commands.

Outreach Objectives

OO1. To design and build a portable dosimeter to be operated by high school students in their own High Schools.
OO2. To make a project web page with general information and data access.

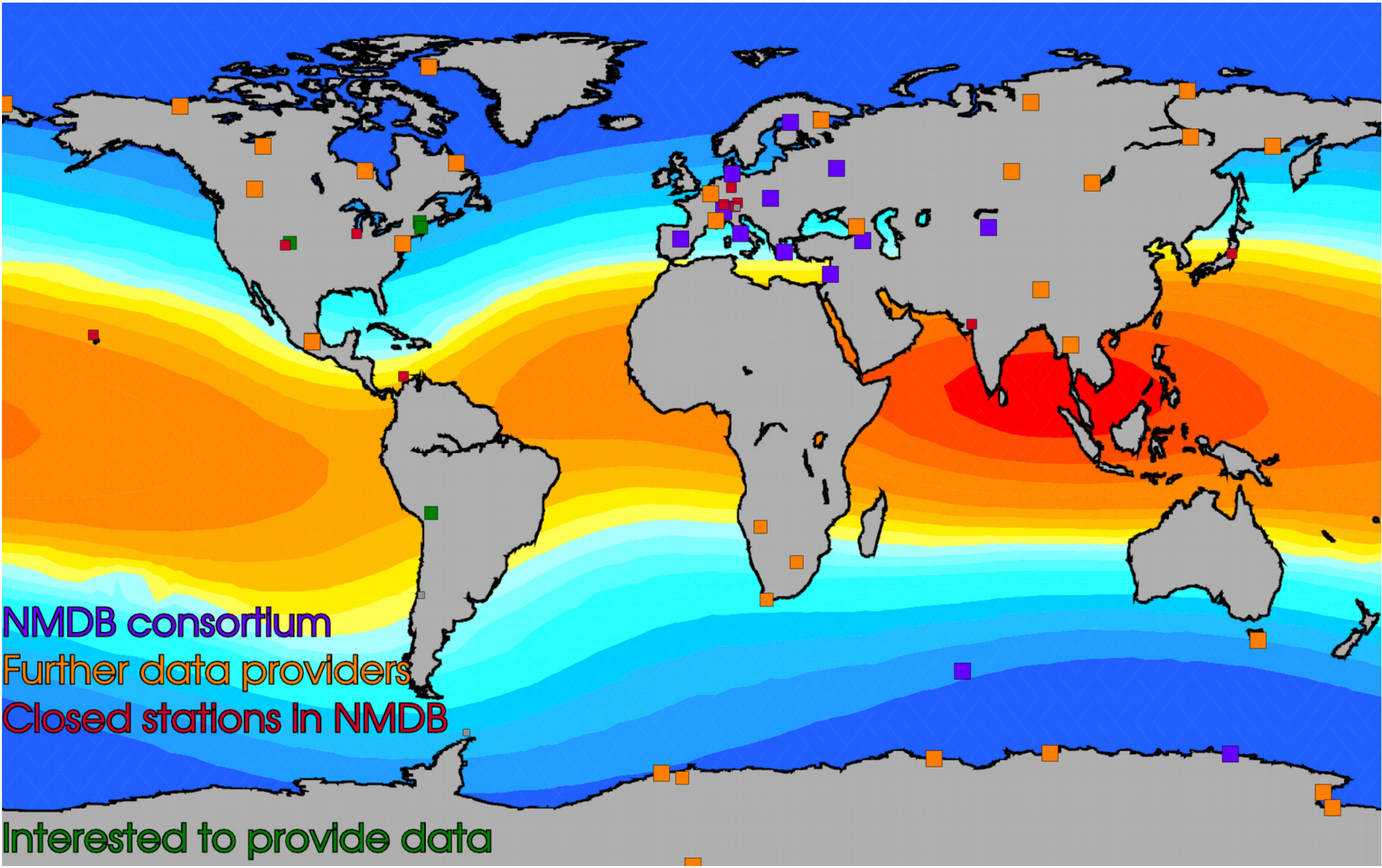
CaLMa

Guadalajara (40º38′N, 3º9′W) is located 55 km away from Madrid at 708 m above see level. The vertical cut off rigidity is about 6.95 GV



CaLMa operation started on October 26, 2011 with 3 BP28 tubes (3 NM64)
3 LND2061 tubes added on March 27, 2012 (6 NM64)
3 LND2061 tubes added on June 22, 2012 (9 NM64)
2 LND2061 tubes added on June 26, 2012 (11 NM64)
4 LND2061 tubes added on July 11, 2012 (15 NM64) final configuration

CaLMa
monitor de neutrones de Castilla-La Mancha neutron monitor
www.calmanm.es
Space Research Group (SRG) www.srg.uah.es
Universidad de Alcalá Spain www.uah.es


NMDB consortium
Further data providers
Closed stations in NMDB
Interested to provide data

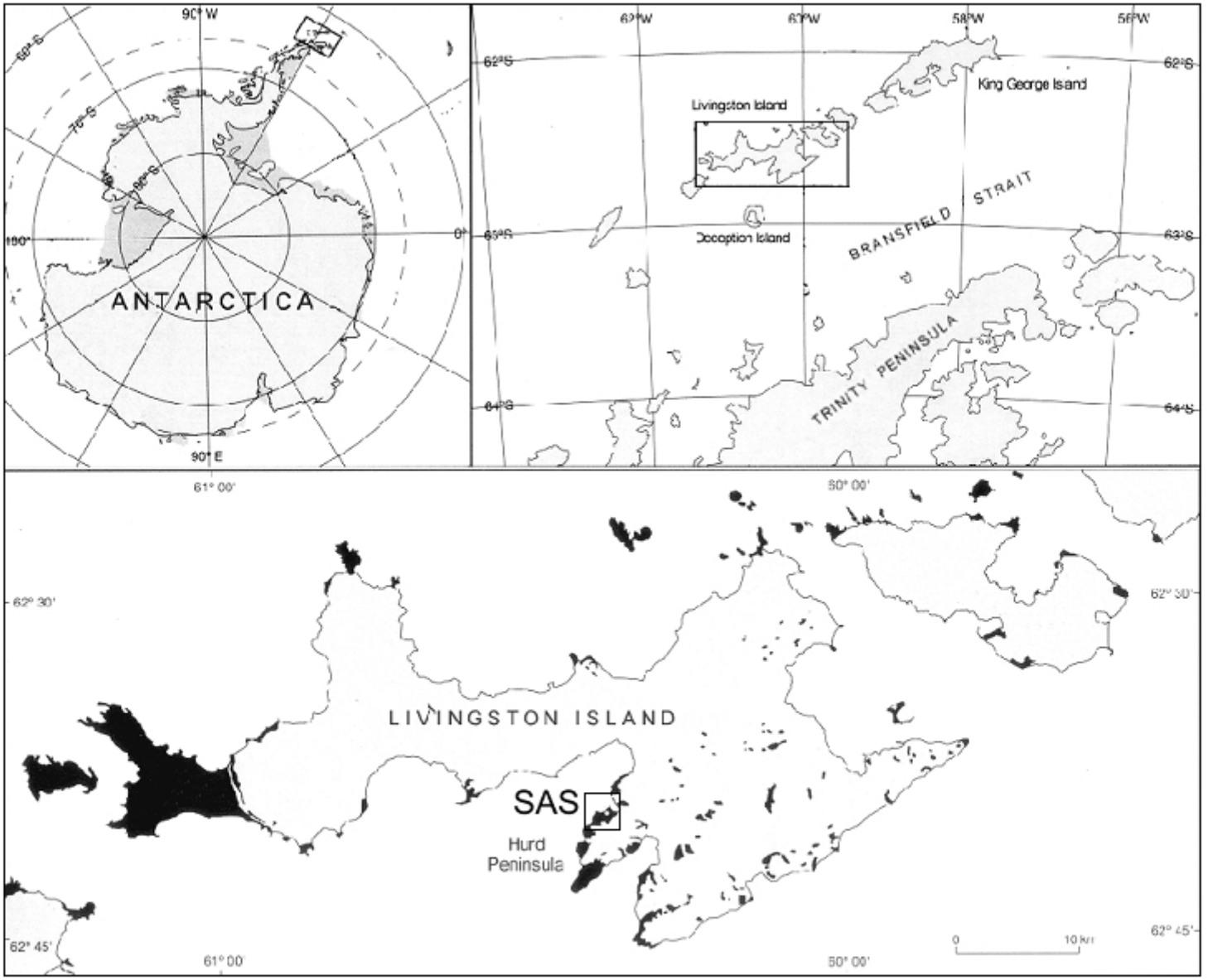


Figure 1: Map of the study area in the South Shetland Islands and the field site locations on Livingston Island. The small rectangle in the lower panel shows the location of the detailed map in Figure 2.

BASE ANTARTICA ESPAÑOLA
JUAN CARLOS I

ORCA Project

CAU
B. Heber
C. Steigies

U. Bordeaux
T. Kurtukian

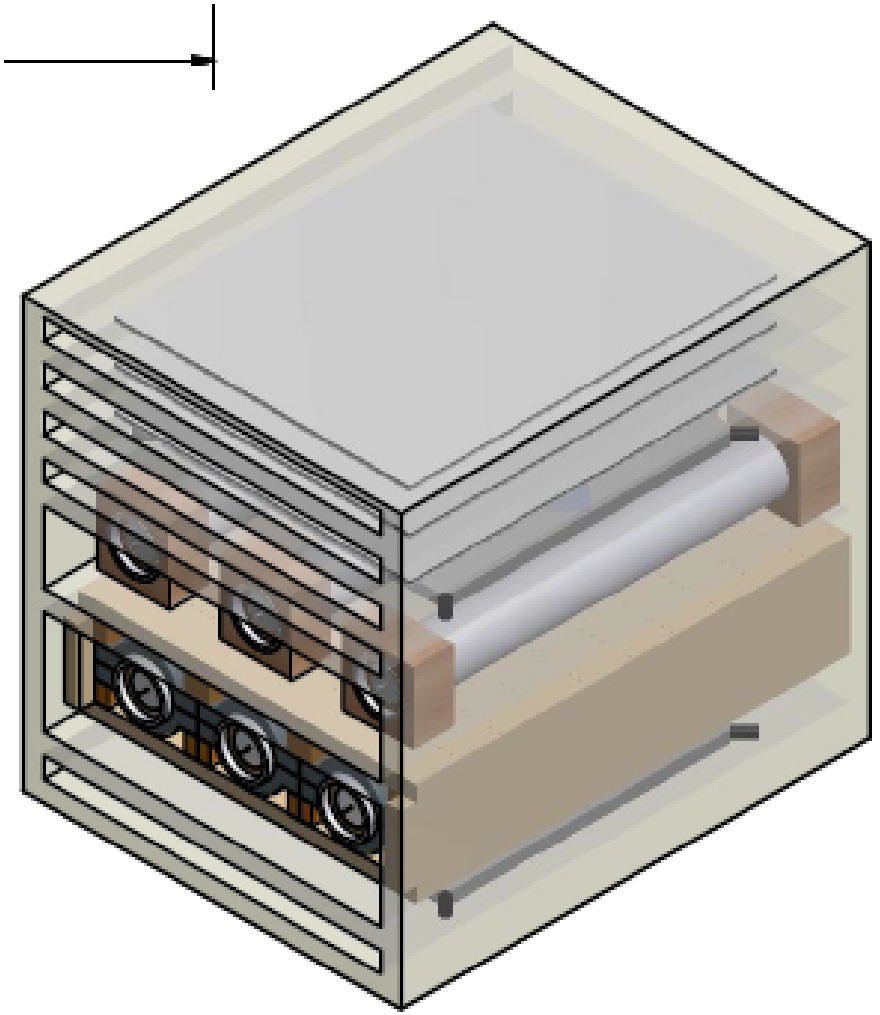
USG
J.Garzón
A. Pazos
D. González

UC
A. Morozova
A. Blanco

IGN
A. Gomis

SRG-UAH
S. Ayuso
J.J. Blanco
G. Díaz-Romeral
J. Medina
O. García
I. García
M. Prieto

- ORCA
  - Made by:
    - 2x MITO
    - 1x NM
    - 3x Tristán
  - Peso: 6.700 kg



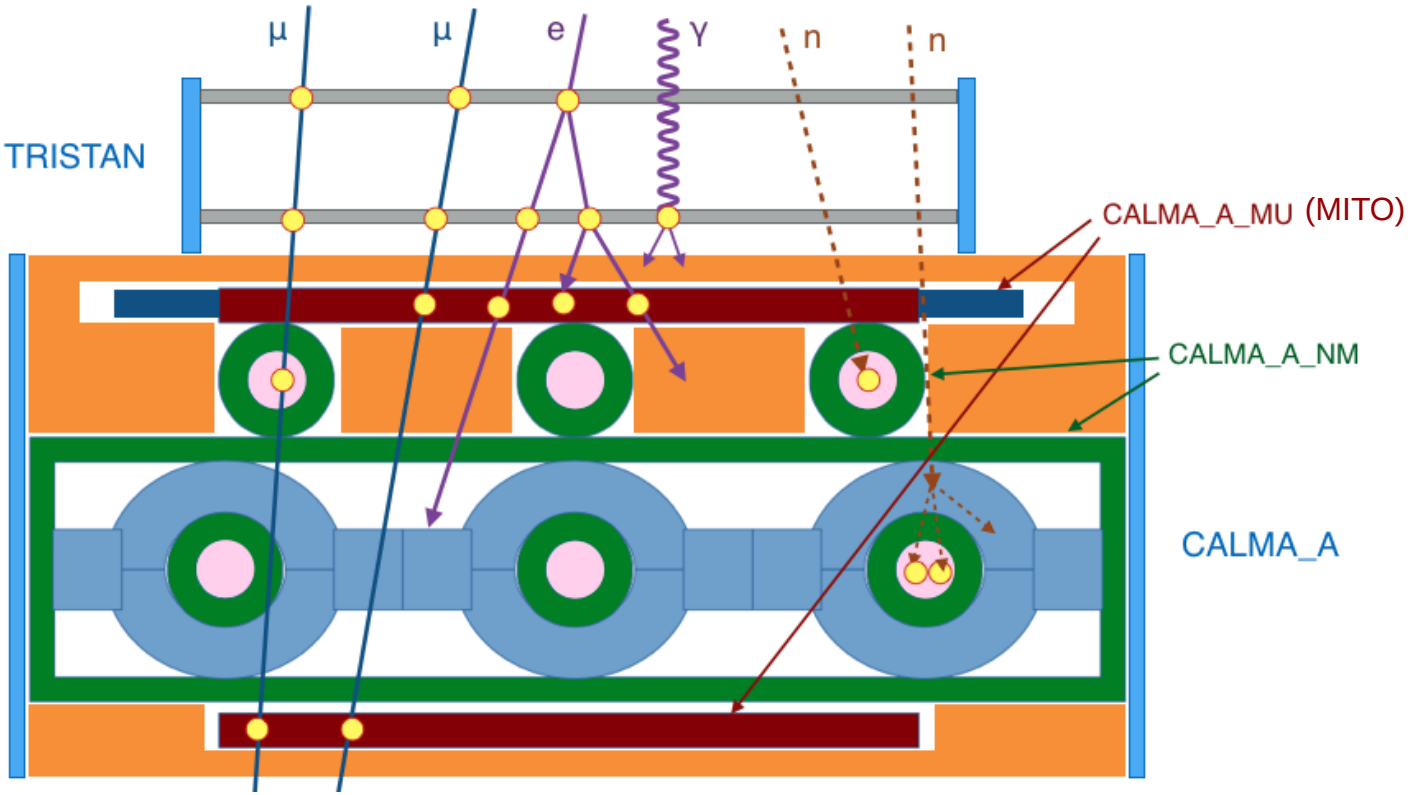


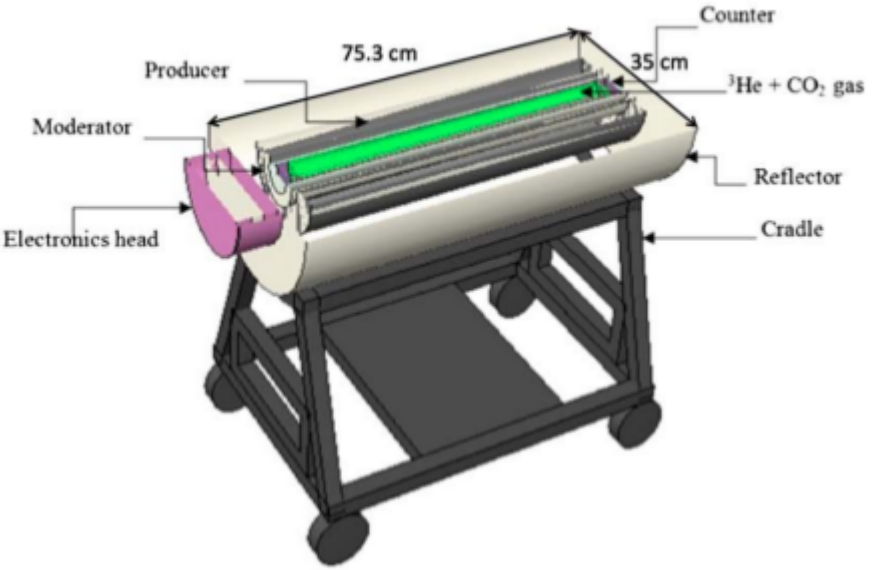
Table 1: Capability Matrix

Capability Matrix	real time	directional information	CR energy information	particles	environmental corrections
CaLMa-A-NM	Yes	No	Yes	neutrons	Yes: P
CaLMa-A-mu	Yes	Yes	No	Muons	Yes: P/T/Tlab
TRISTAN	No	Yes	Yes	muons, electrons and gammas	Yes: P/T/Tlab

Table 2: Operation Matrix (assuming worst case)

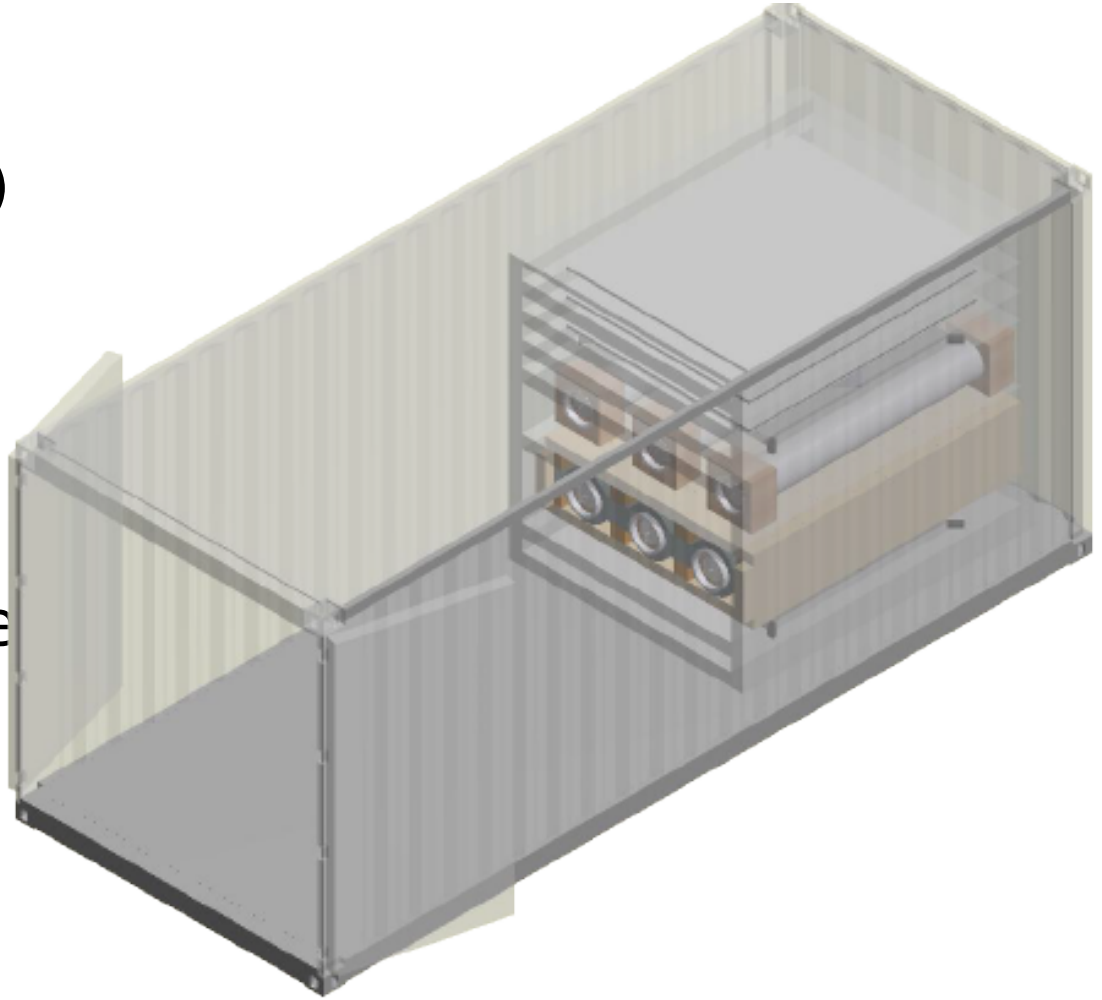
Operation Matrix	Size (m)	Power (W)	bit/rate	Data volume	Temp range (ºC)	Mass (kg)	Responsible
Container	5.8x2.3x2.3	4500	28 kB/day (**winter**)	--	--	2300	UAH
CaLMa-A-NM	2x1,5x1	150	14kB/day	55 GB/year	-10 to 30	8000	UAH
CaLMa-A-mu	1x1x0.05 two units	150	14 kB/day	55 GB/year	-10 to 30	150	UAH
TRISTAN	1.14x0.72x0.05 two units	300	42 kB/day	1TB/year	-10 to 40	100	USC

The mini neutron monitor



Housing

- 20 ft container
  - 6058 x 2438 x 2896 (mm)
  - Volume: 28.10 m3
  - Weight: 2500 kg
  - Enviromental control
  - Power, two sources:
    Base/ship and green powe



Communications

Different modes. Winter and Summer.

Summer communications → throughout base communications system (could be worst…)
Winter communications → ionospheric reflexions (two Kb per hour, transmission time 2 min)

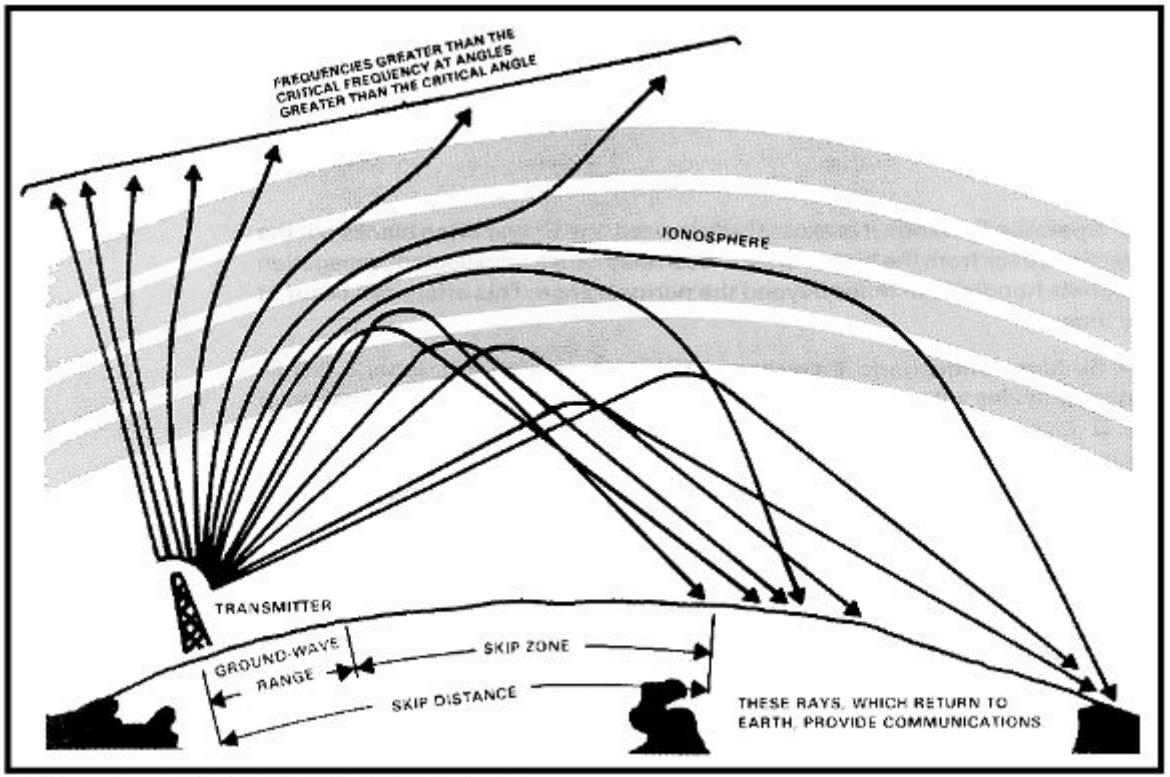
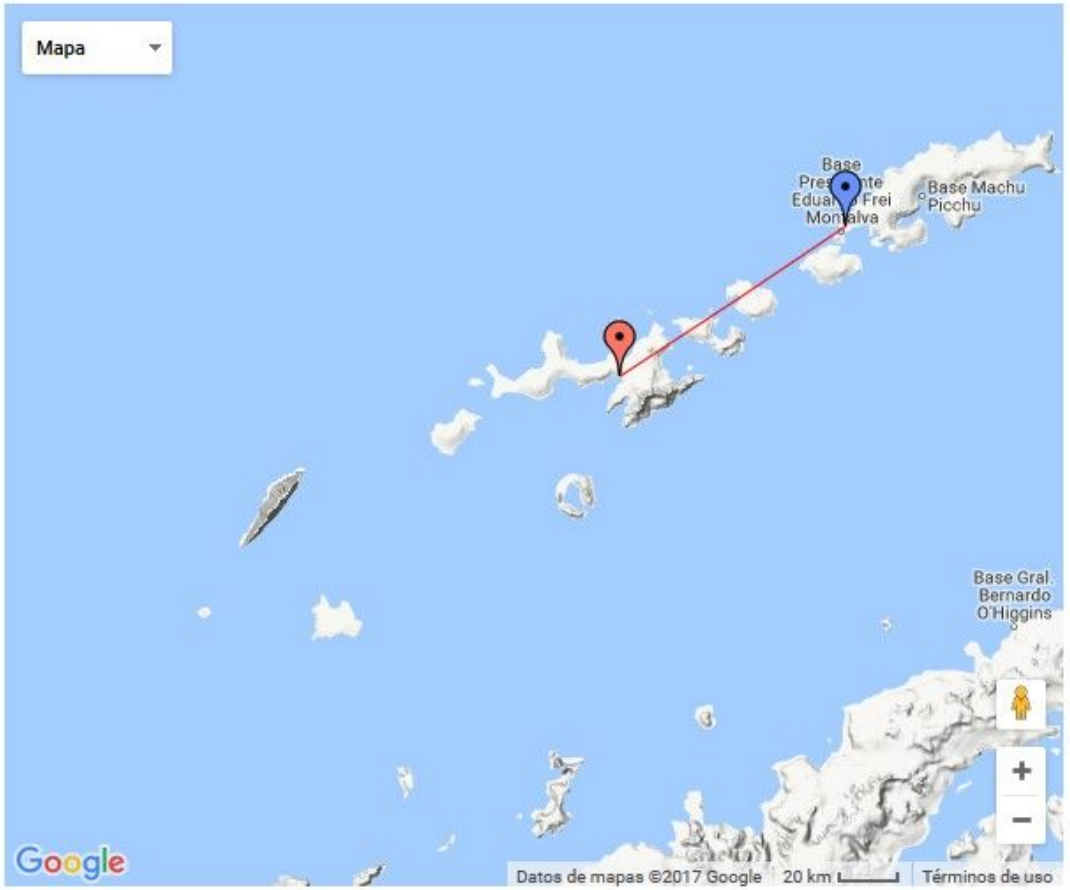
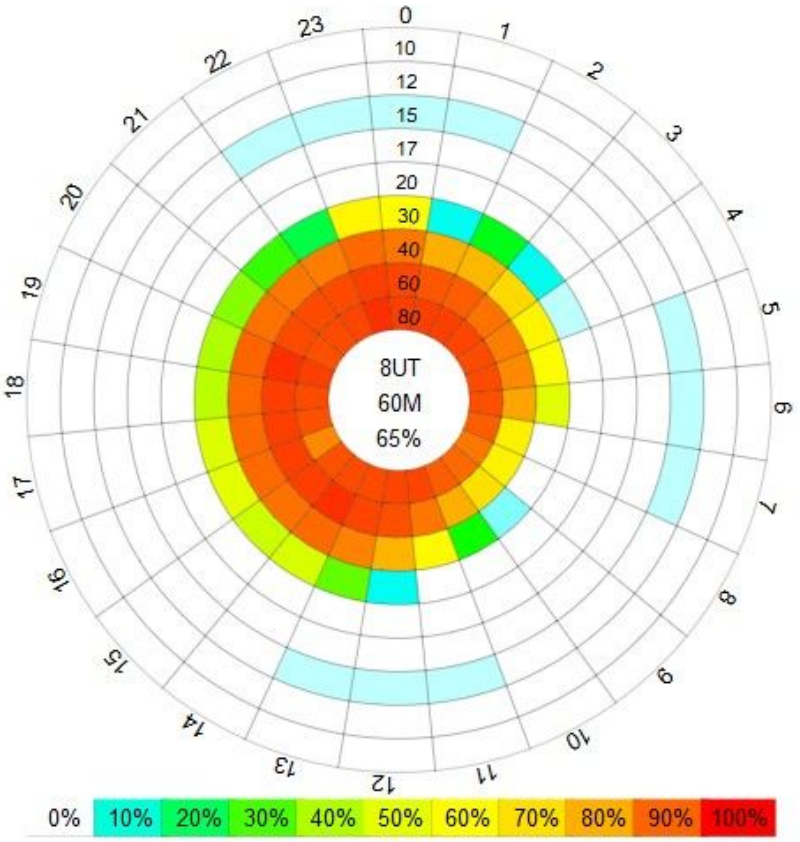


Figure 2-14. Sky wave transmission paths.





To RX: 87 km, 54 mi, 57 ° Grayline: 2017-03-01 10 : 18 Set Reset

Propagation Params

Es: No Model: Auto

SSN: Min.TOA: 0.1 °

Today's Sunrise/Sunset Times (UTC)

	Transmitter		Receiver	
	Rise	Set	Rise	Set
GND	09:09	23:21	09:04	23:14
D	08:14	00:16	08:10	00:08
F	06:46	01:43	06:45	01:33

Transmitter Site

QTH: << Select a location >>

Name: FC97tj Loc calc

Latitude: -62.6136 [-90..90]

Longitude: -60.3479 [-180..180]

TX antenna: Dipole @ 5M (17ft)

TX power: 10 W

TX mode: SSB

Specials: Swap TX-RX Short-path

Current point: Set Home Unset Home

Receiver Site

QTH: << Select a location >>

Name: GC07mt Loc calc

Latitude: -62.1809 [-90..90]

Longitude: -58.9412 [-180..180]

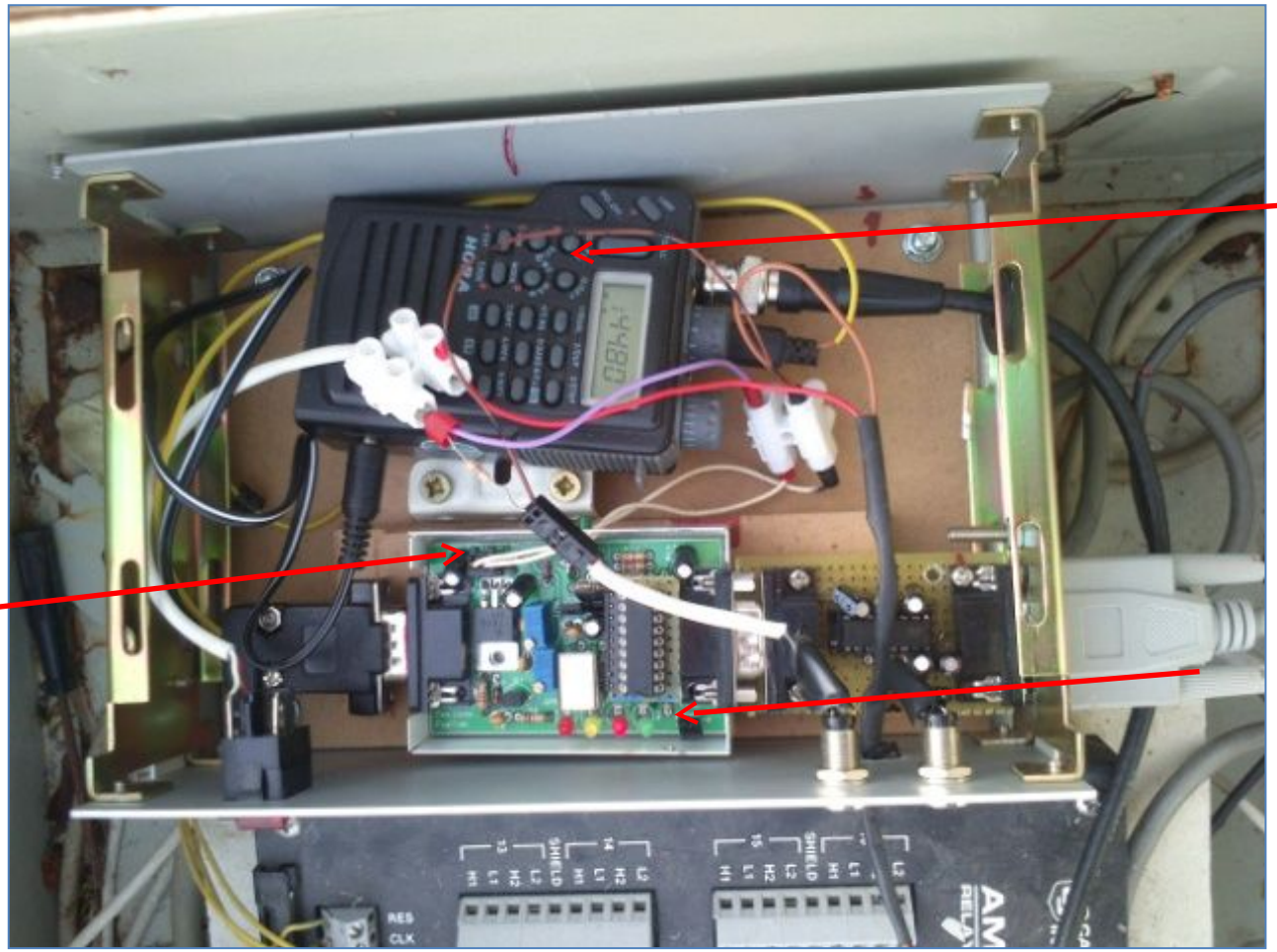
RX antenna: Dipole @ 10M (33ft)

Noise level: Quiet (153)

Run prediction!

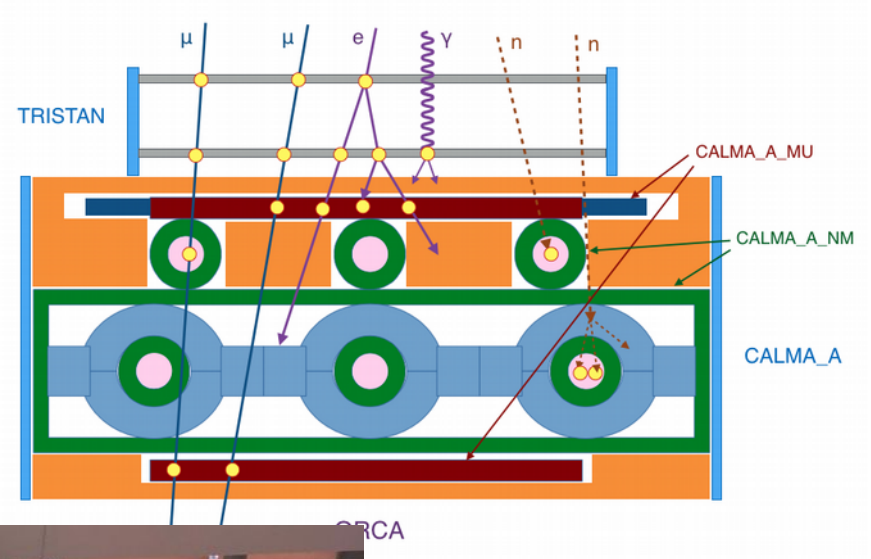
Prototype

- Already tested in UAH
- Connected to a meteorological station

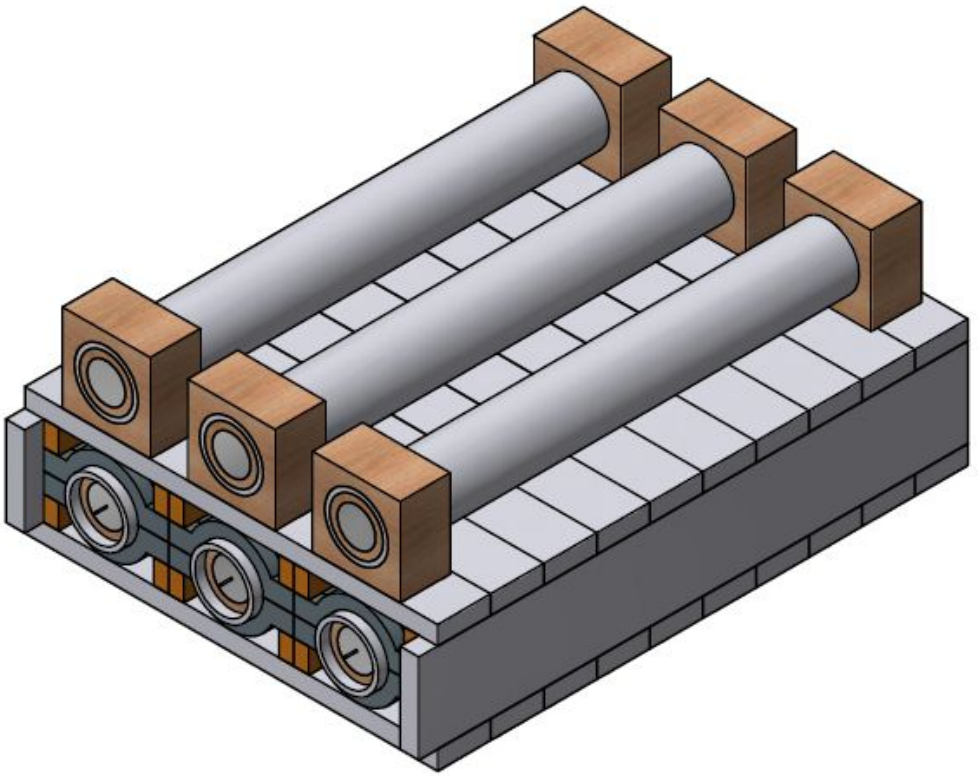


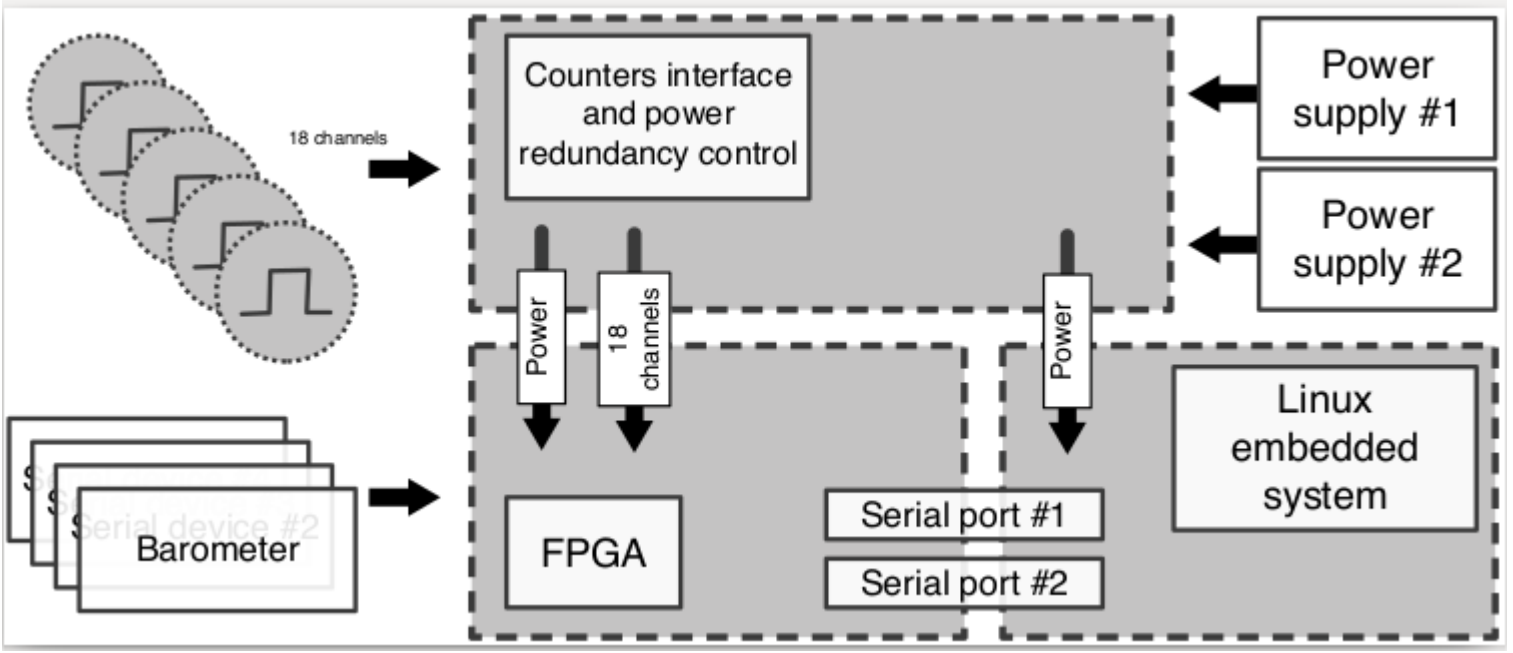
CaLMa_A_NM

3 bare BF3 counters
3 NM64 counters



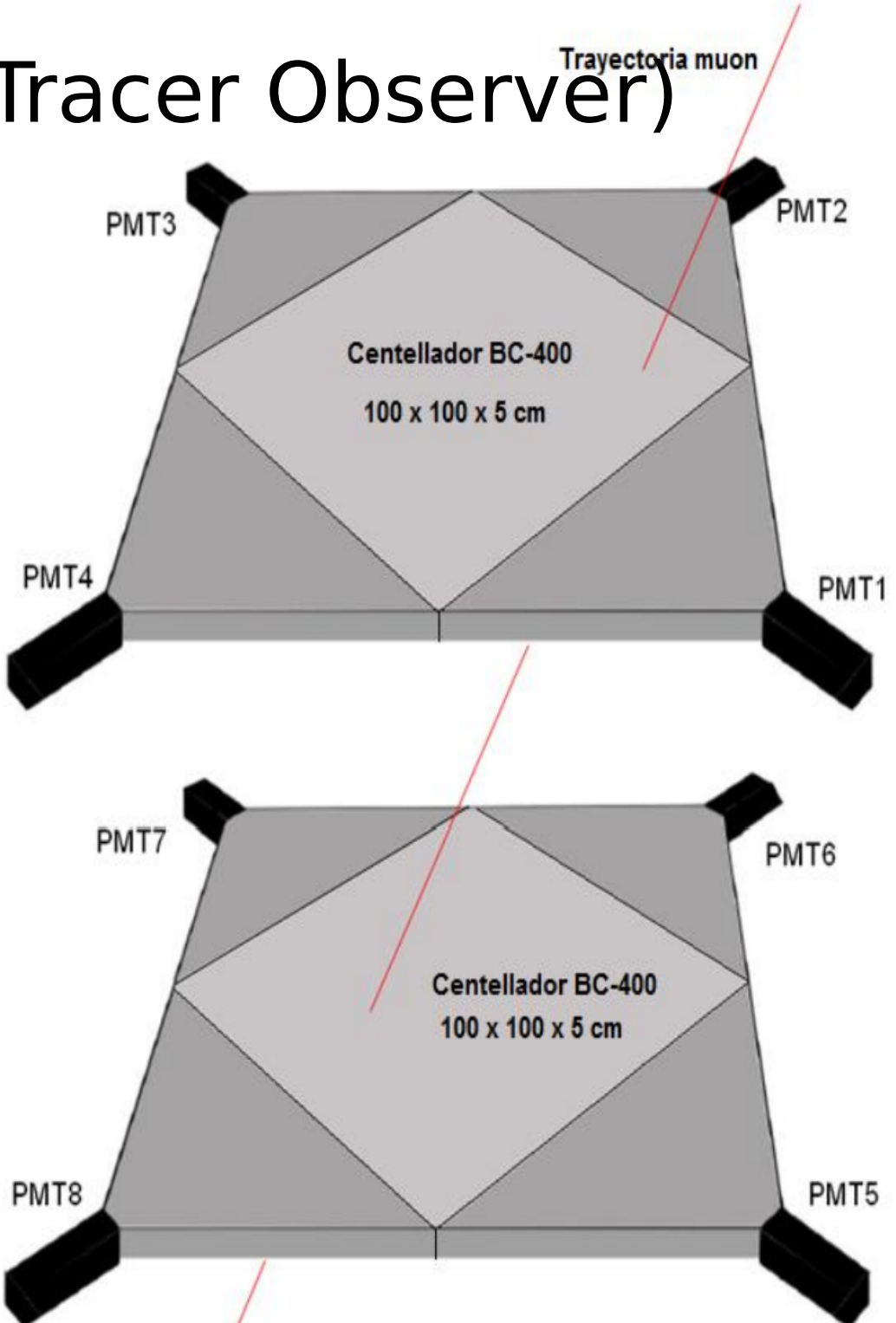
- NM (Neutron Monitor)
  - Made by:
    - 6x BF3 counters
      - 3 64NM
      - 3 bare
  - Weight: 6000 kg

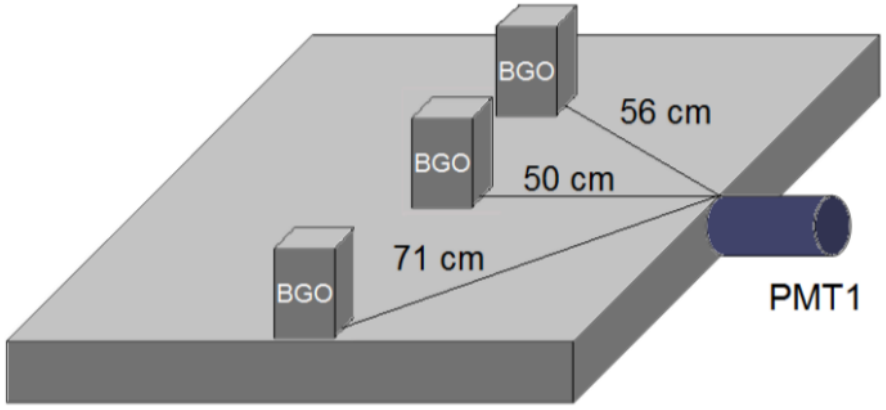


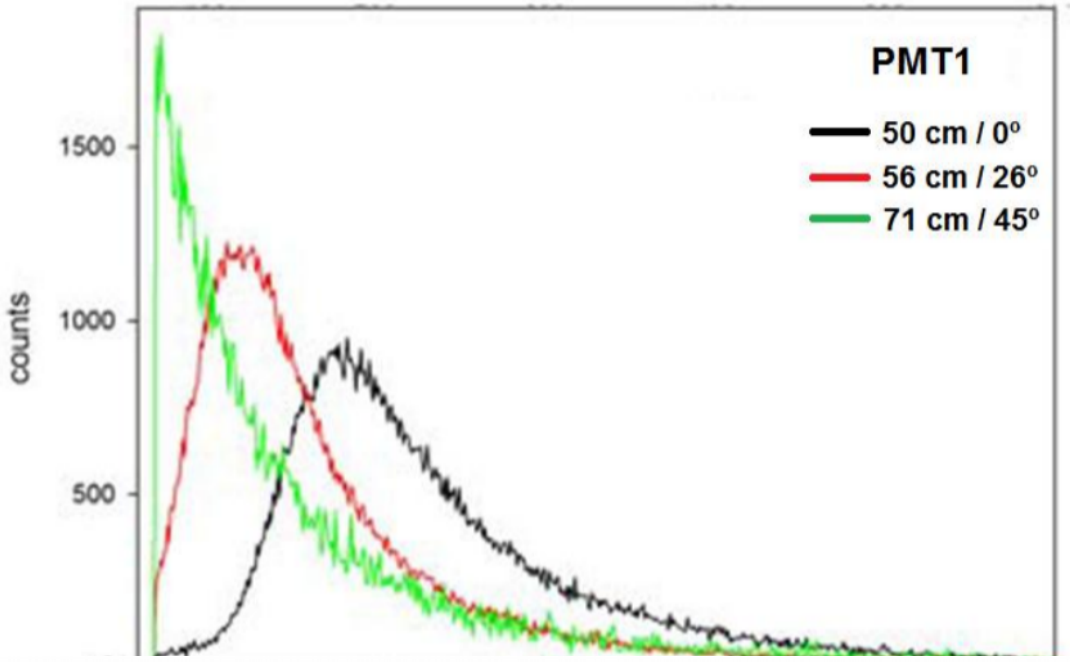


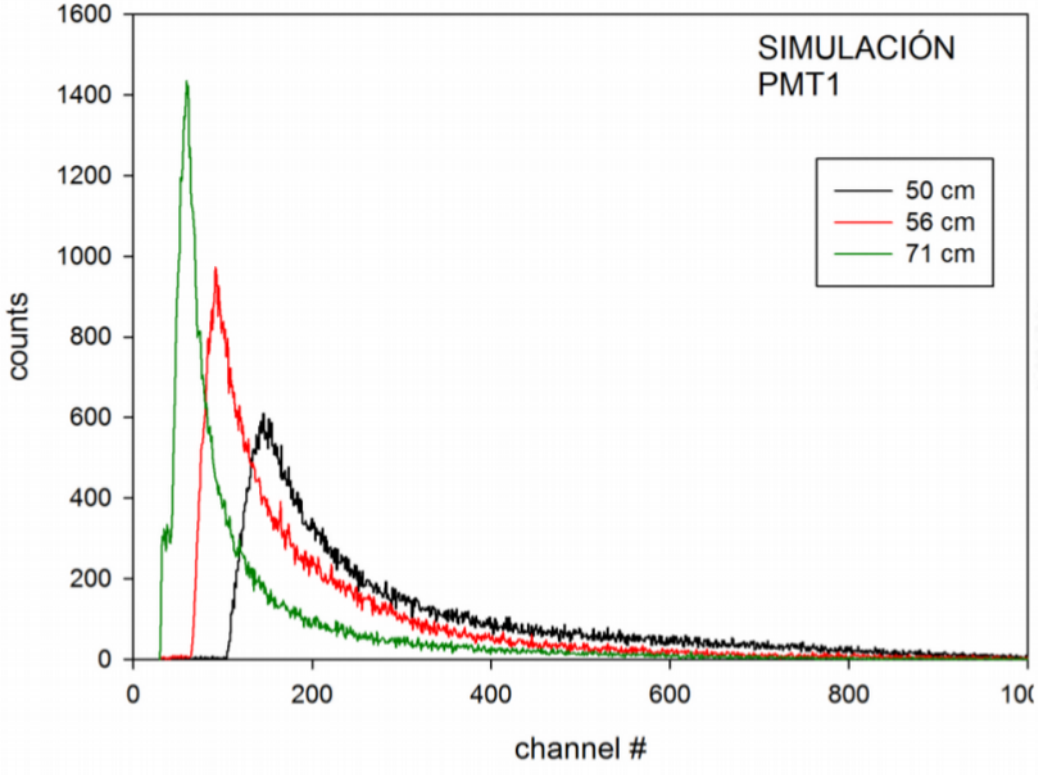
MITO (Muon Impact-Tracer Observer)

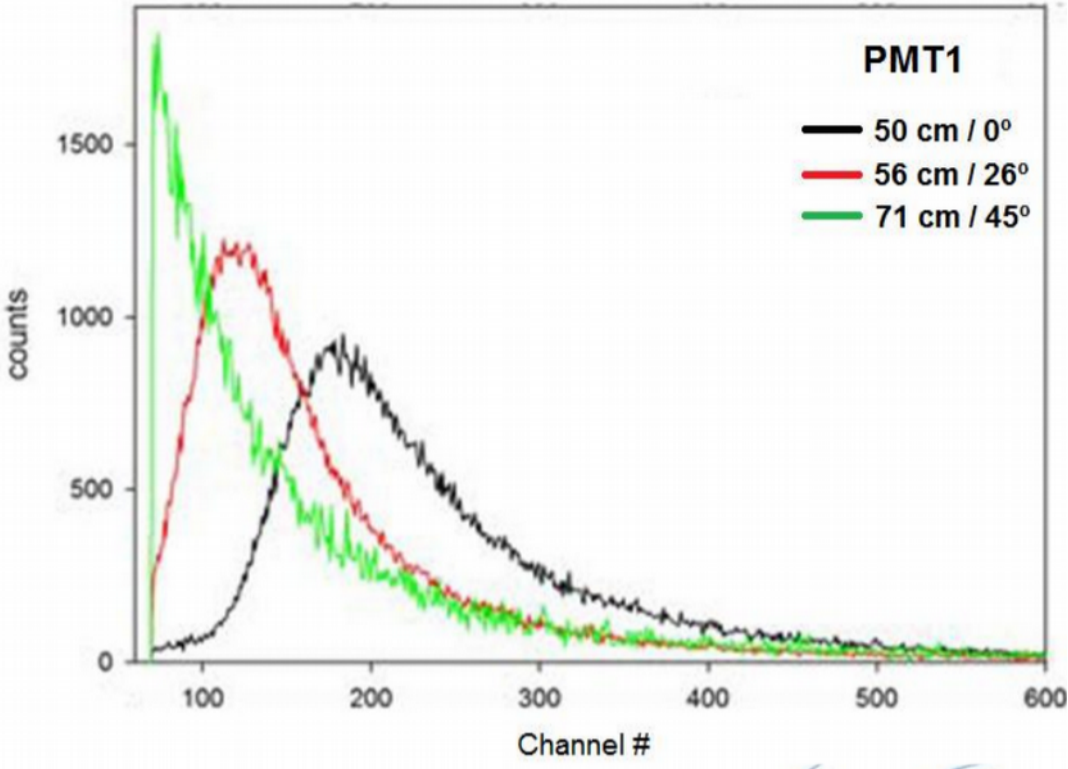
- A stack of two scintillators
  - BC_400 (100 x 100 cm)
  - 4 PMT's, taking light from the lateral faces
- Weight: 160 kg



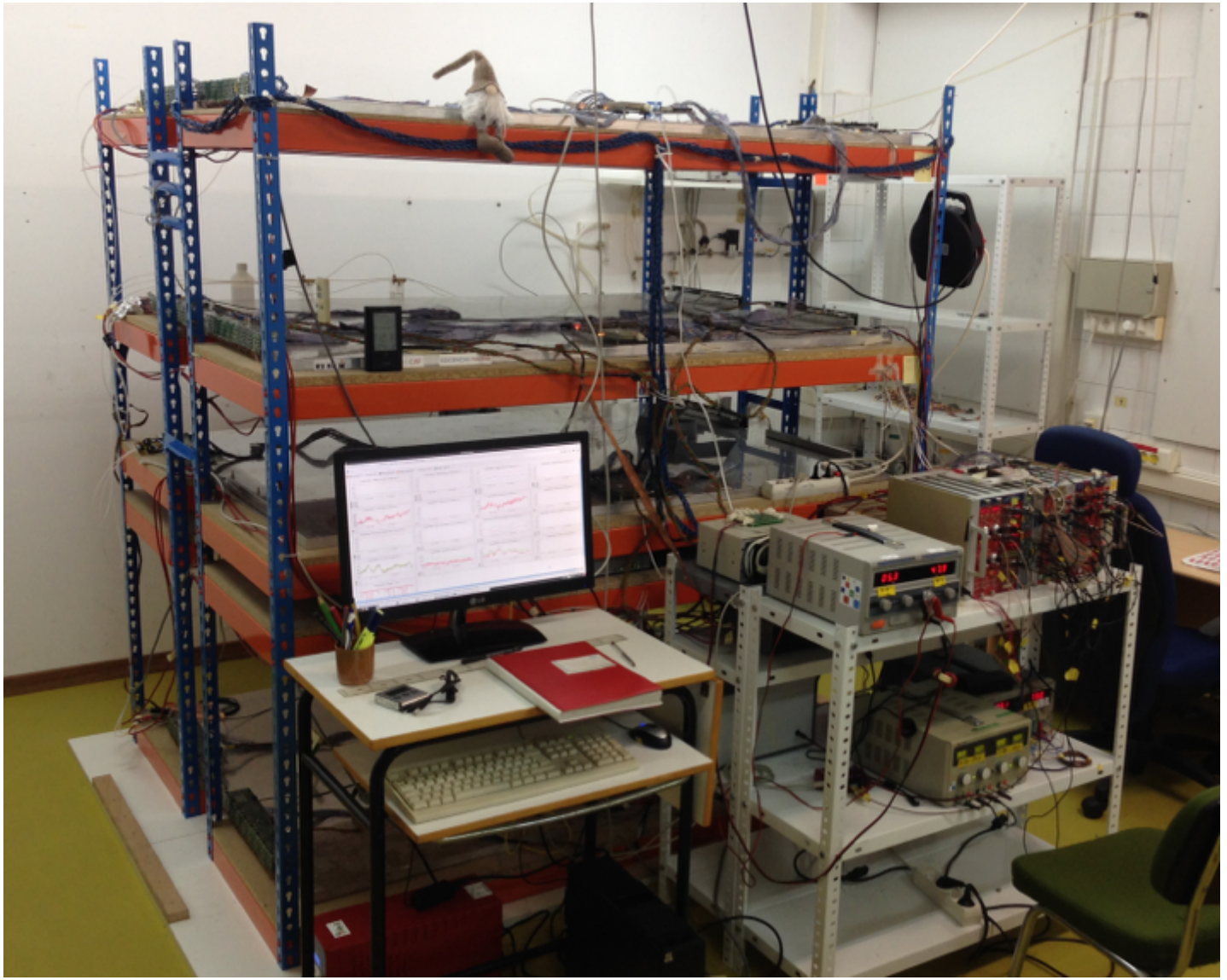

BGO
BGO
BGO
56 cm
50 cm
71 cm
PMT1

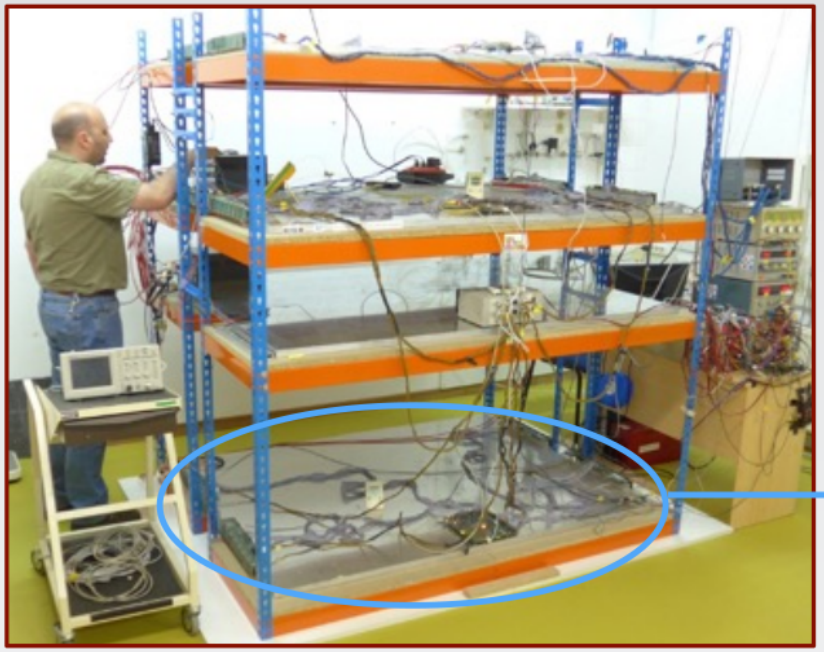

PMT1
50 cm / 0º
56 cm / 26º
71 cm / 45º
counts
1500
1000
500


SIMULACIÓN
PMT1
50 cm
56 cm
71 cm
counts
channel #
0
200
400
600
800
1000
1200
1400
1600

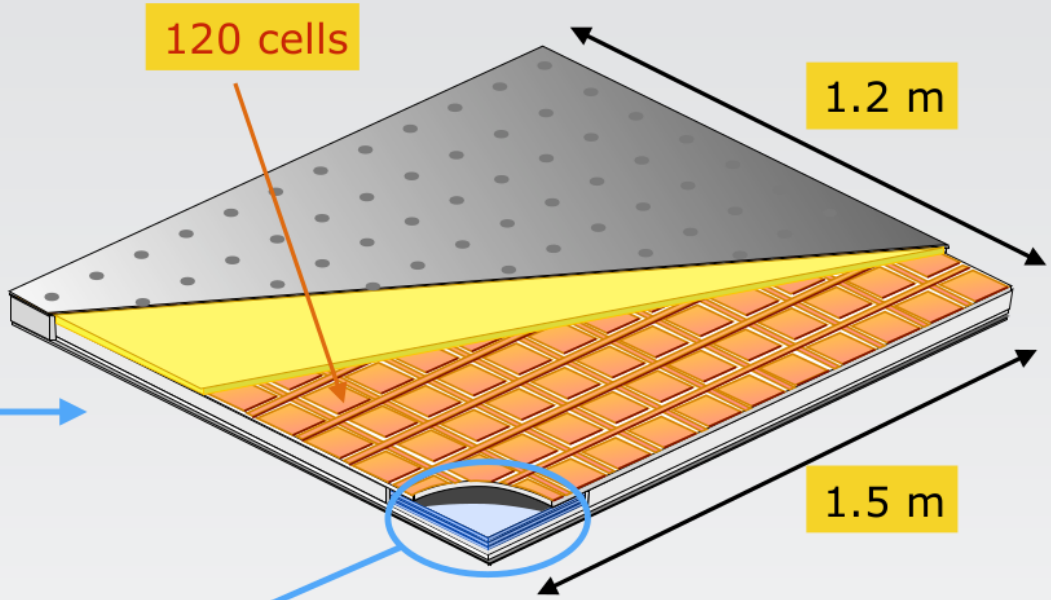

PMT1
50 cm / 0º
56 cm / 26º
71 cm / 45º
counts
Channel #
0
500
1000
1500
100
200
300
400
500
600

El trasgo Tragaldabas
LabCAF. Univ. Santiago de Compostela

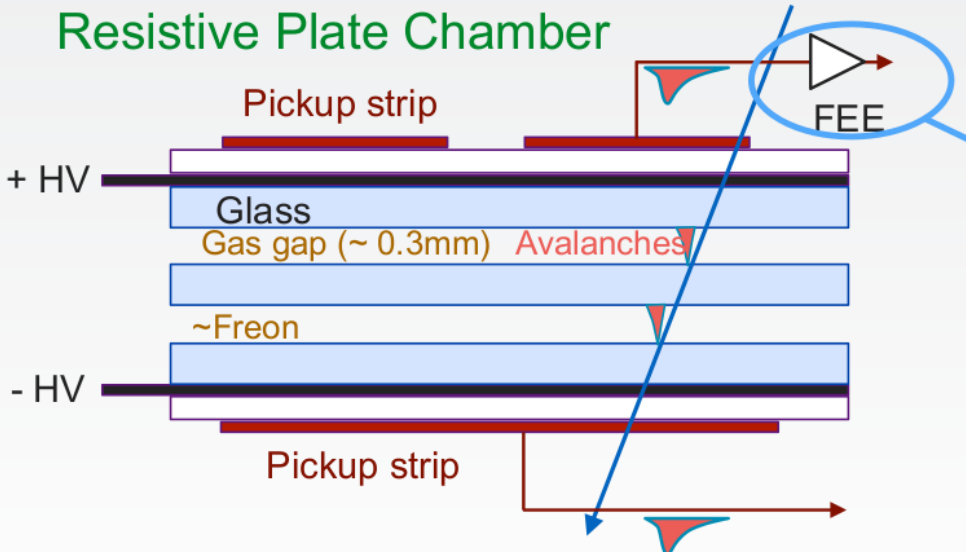


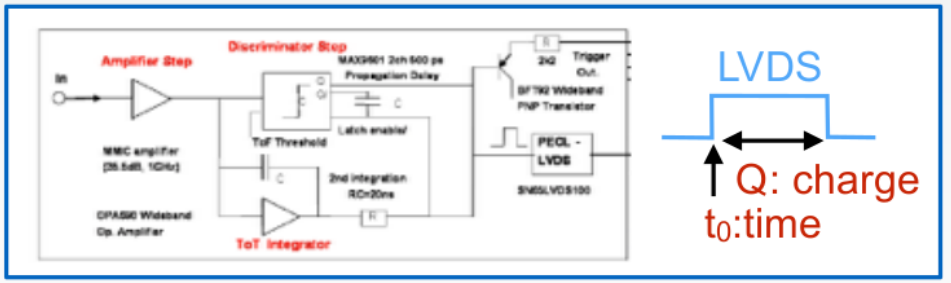


LIP-Coimbra Marta/ P. Auger RPCs

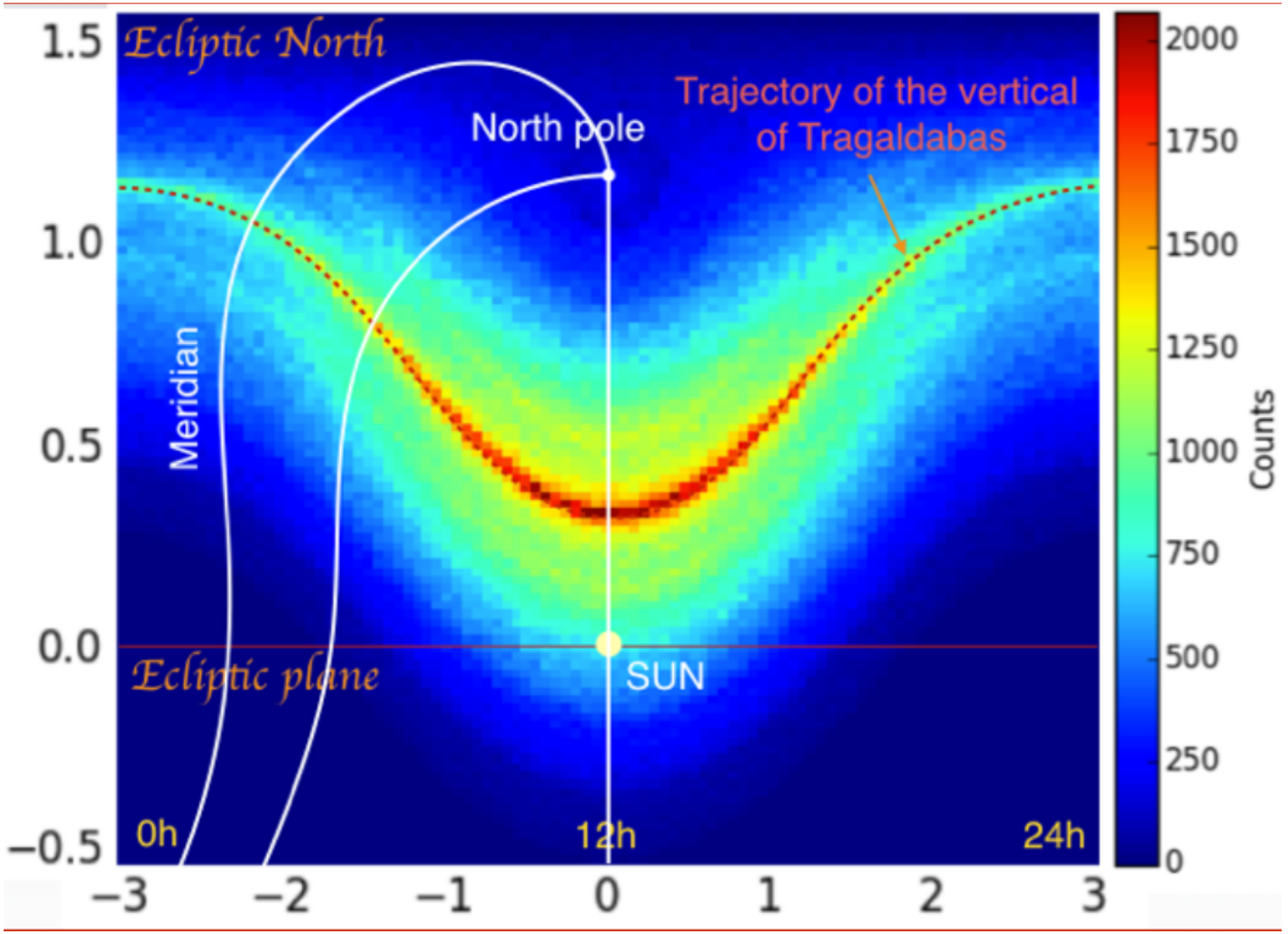


Resistive Plate Chamber





HADES-GSI FEE

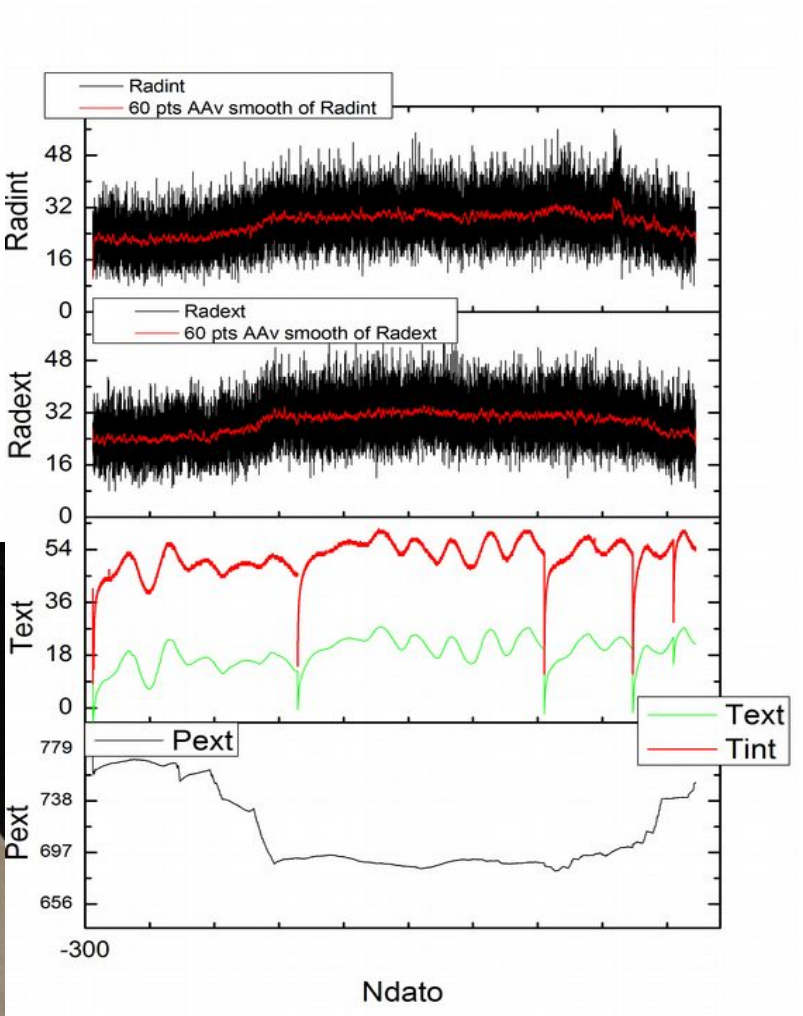

Ecliptic North
North pole
Trajectory of the vertical
of Tragaldabas
Meridian
Ecliptic plane
SUN
0h
12h
24h
Counts
2000
1750
1500
1250
1000
750
500
250
0
1.5
1.0
0.5
0.0
−0.5
−3
−2
−1
0
1
2
3

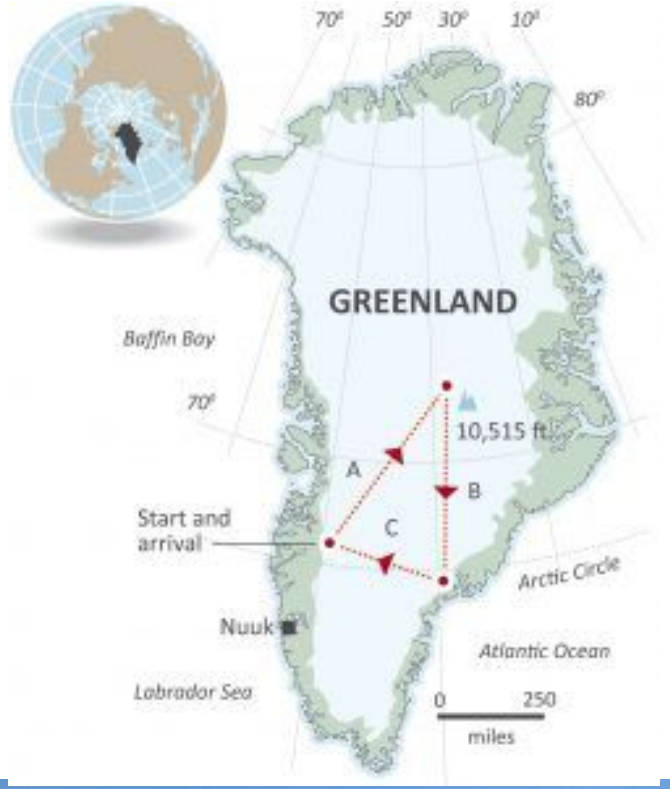
Schedule: End of 2017 beginning of 2018

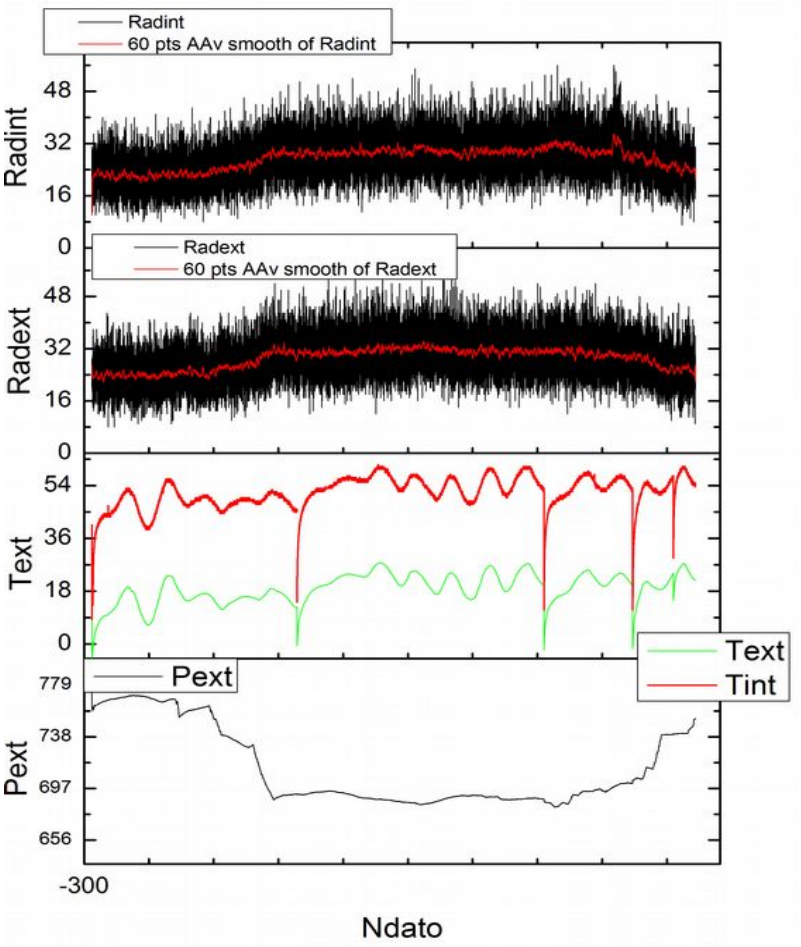
Prototype to check Base capabilities
Aims:

- Provide real measurements
- Communications
- Power

CRIO



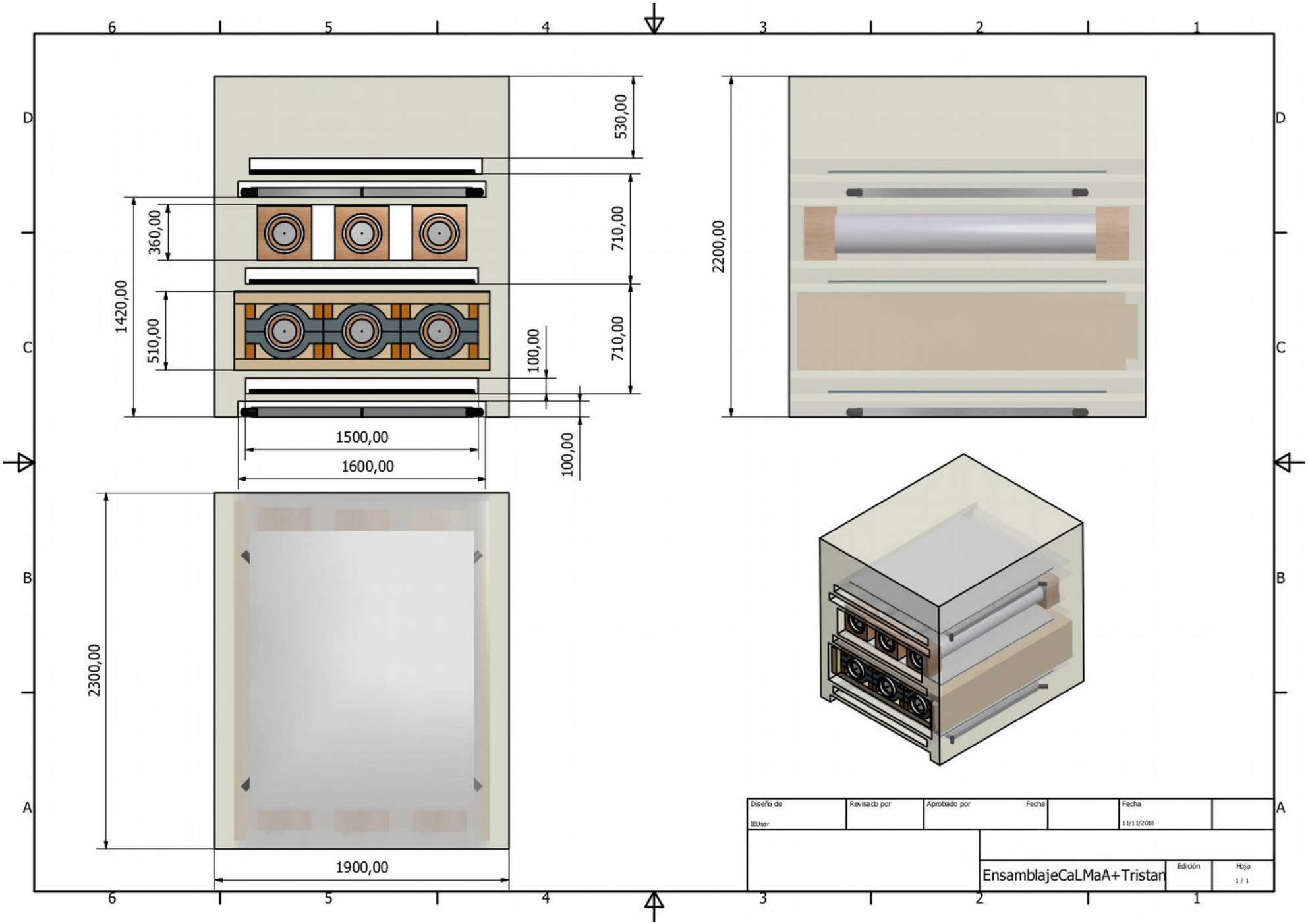




May-June 2016

http://greenland.net/windsled/greenland-ice-summit-expedition/

2017 - September 2018: asembly and comisioning in Alcalá (Spain)



2018: Latitudinal survey, solar minima?

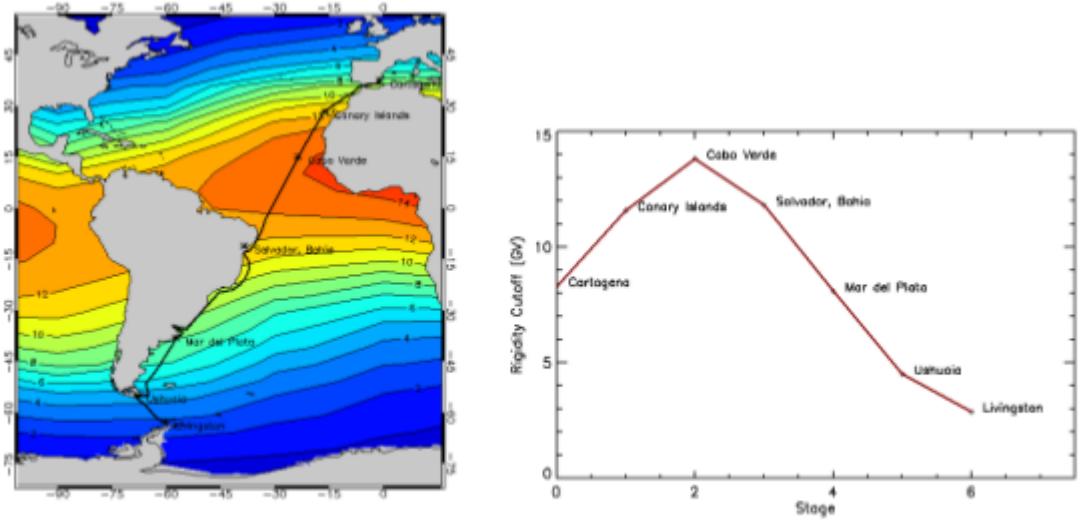
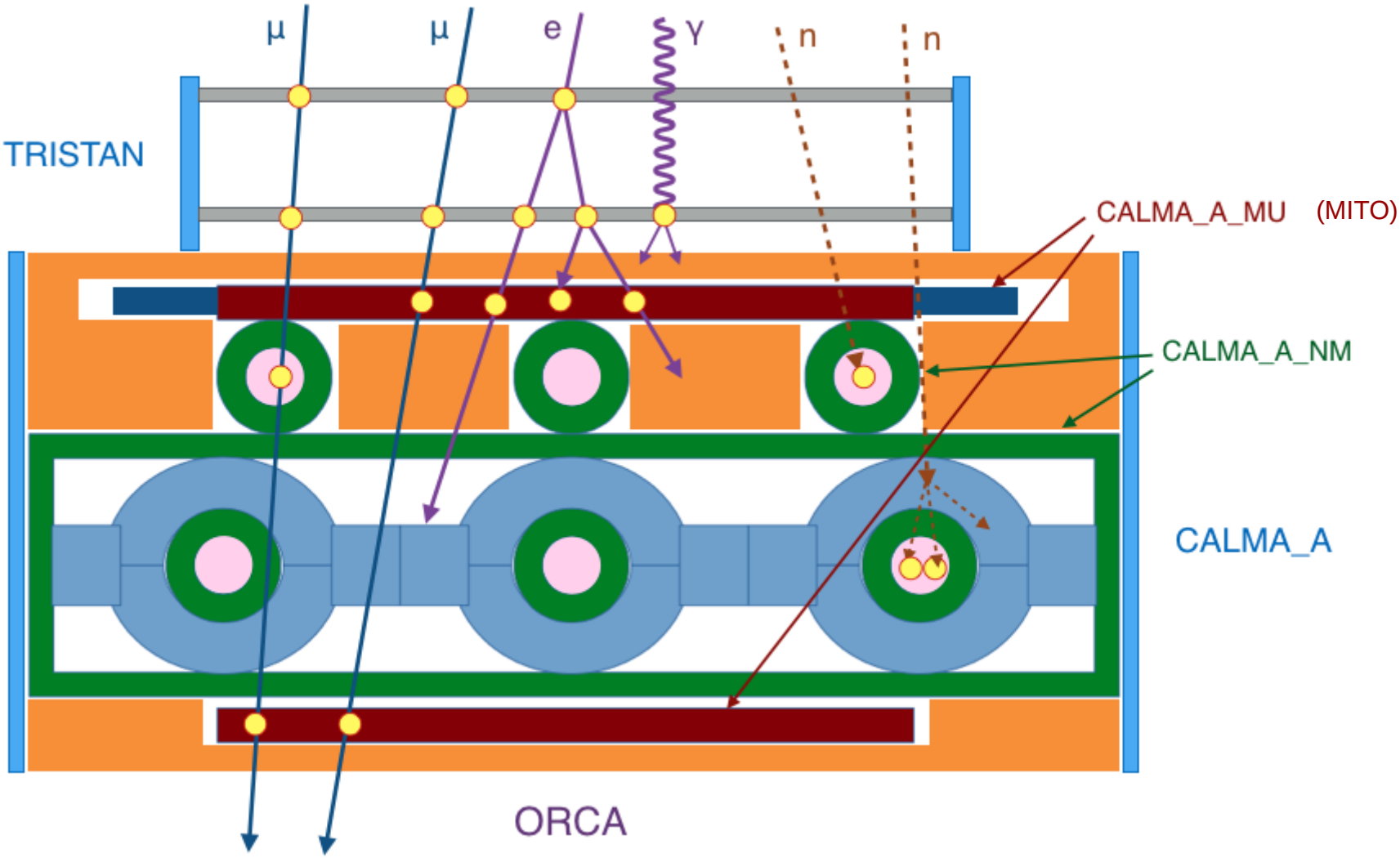


Figure 11. Right: Hespérides route. Cutoff-rigidities are color-coded (grid data from Smart and Shea, 2008). Left: Rigidity cutoff profile along the Hesperides' voyage.

2019: First year of observations




GRACIAS