

CaLMa: detectores empleados y algunos resultados recientes

REUNION DEL CEIDEN – GUN CNA (Sevilla)8 y 9 de junio de 2022

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Proyecto: PID2019-107806GB-100

CaLMA hace referencia a un conjunto de detectores distribuidos en diferentes localizaciones geomagnéticas cuyo objetivo principal es la observación de la actividad solar a través de la medida de rayos cósmicos de energías por debajo de 100 GeV/nucleon.

web: <https://neutronmonitors-srg-uah.web.uah.es/>

- CaLMA: Castilla-La Mancha Neutron Monitor
- ORCA: Observatorio de Rayos Cósmicos Antártico
- MiniCaLMA
- ICaRO: Izaña Cosmic Ray Observatory

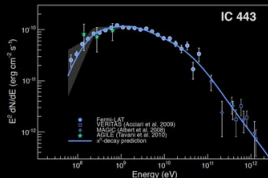
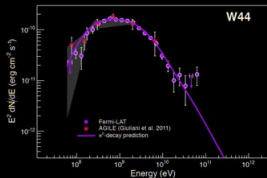


Supernova W44 & IC 443 Neutral Pion Decay Spectral Fit

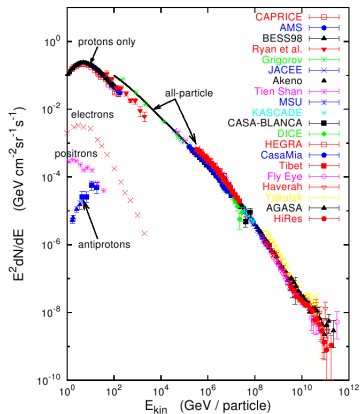
Image data from ESA-Herschel and XMM-Newton

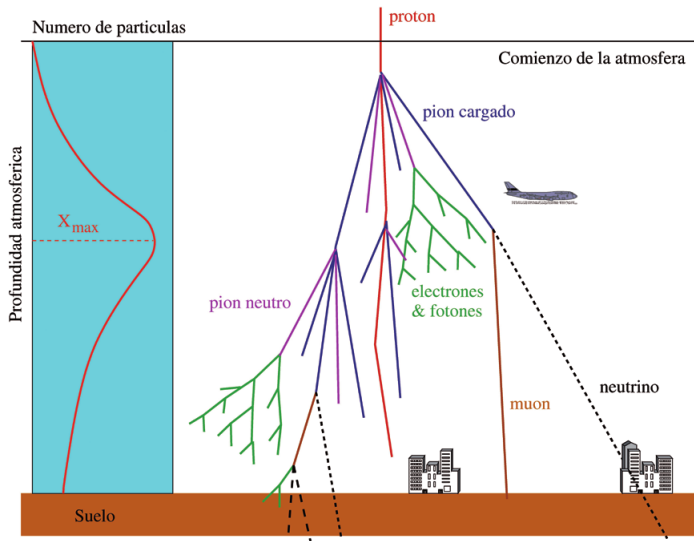


Image data from Chandra X-ray



Energies and rates of the cosmic-ray particles





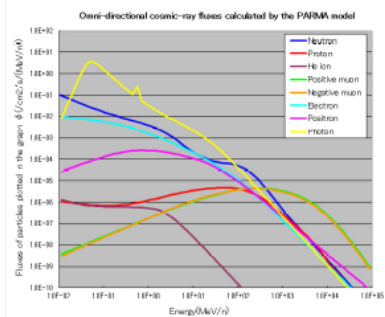
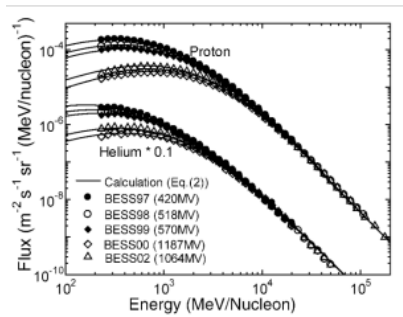
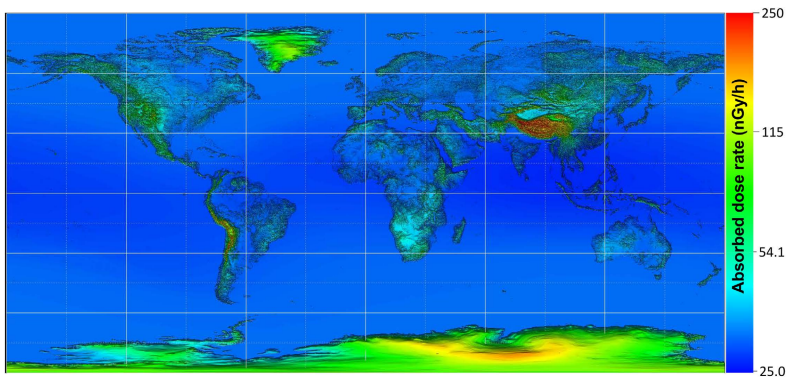
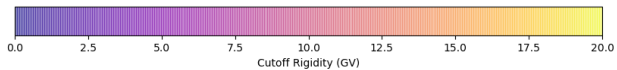
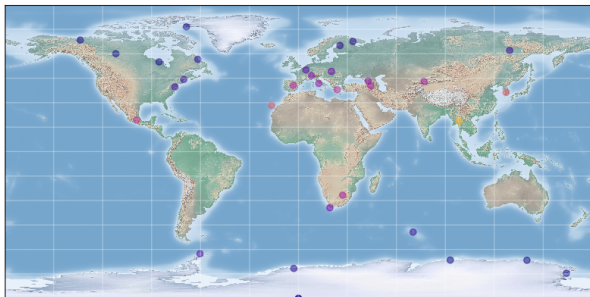
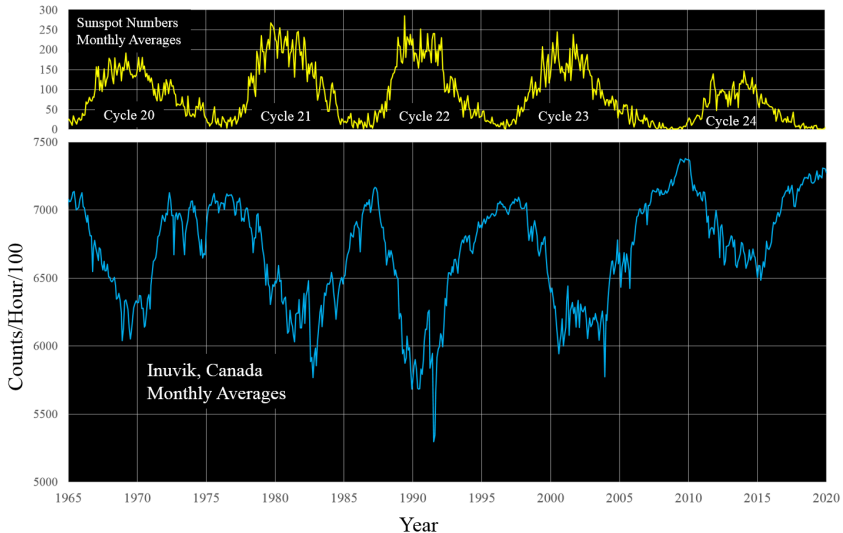


Figure: Sato et al., 2008

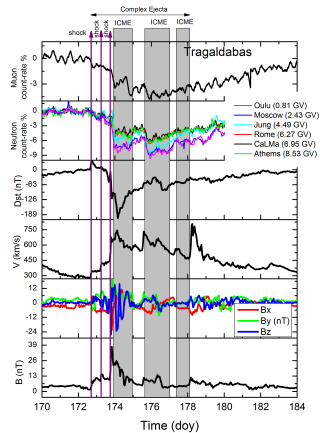
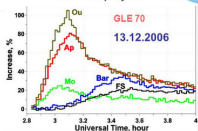
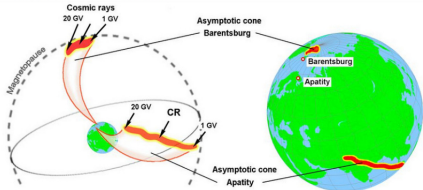


The Earth as a global detector





Monitores de neutrones



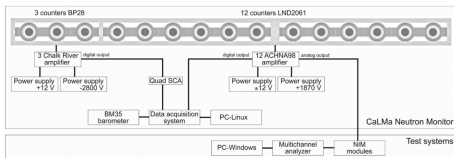
CaLMa ($R_{eff} = 6.95GV$)

Flujos de neutrones (5.3 /s /counter)



Guadalajara, Spain
($40^{\circ}38'N$, $3^{\circ}19'W$ at 708 m above sea level)

CaLMa	
Counter Type	LND2061
Effective diameter (mm)	149.1
Effective length (mm)	1956.3
Cathode material	Stainless steel
Gas filling	$BF_3(96\%^{10}B)$
Gas pressure (mmHg)	200
Operational voltage (V)	1800
Number of counters	12
Moderator (g/cm^2)	Polyethylene (1.84)
Producer (g/cm^2)	Lead (156)
Reflector (g/cm^2)	Polyethylene (7.0)

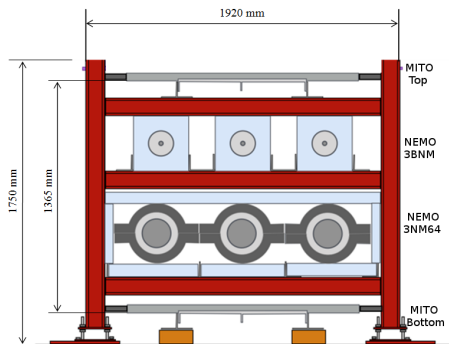


ORCA ($R_{eff} = 2.487GV$)

Penumbra for the Juan Carlos I Spanish Antarctic Base at ($S62.65^\circ$, $W60.38^\circ$), 12m asl at a date 2019-01-02 12:00:00 UT according to the results of the calculator at <http://crsv.izmiran.ru/cutoff> using the IGRF model. $R_d = 2,221GV$ and $R_u = 2,673GV$



ORCA & ICarO



ORCA: 11.7 /s /c, ORCB: 1.7 /s /c

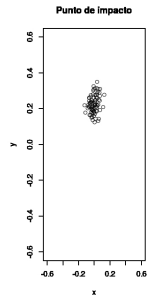
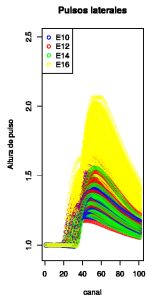
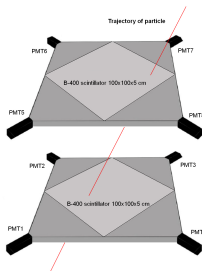
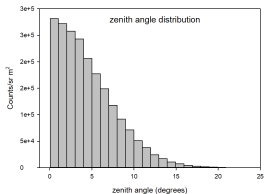
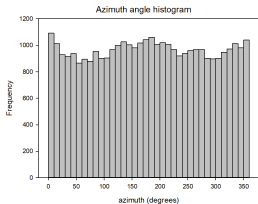
Top: 11479 /s , Bottom: 7774 /s and Coin8: 1729 /s

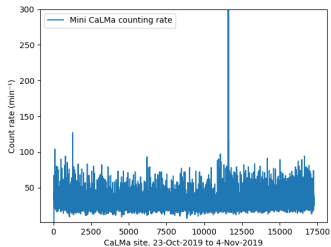
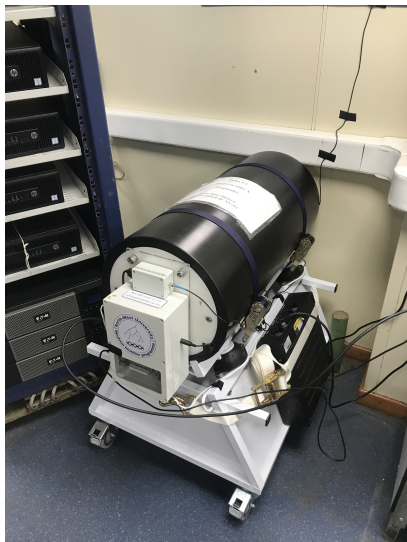
	NEMO 3NM64(ORCA)	NEMO 3BNM(ORCB)
Counter Type	BP28	LND2061
Effective diameter (mm)	148.5	149.1
Effective length (mm)	1908.0	1956.3
Cathode material	Stainless steel	Stainless steel
Gas filling	$BF_3(96\%^{10}B)$	$BF_3(96\%^{10}B)$
Gas pressure (mmHg)	200	200
Operational voltage (V)	-2700	1800
	MITO Top	MITO Bottom
Scintillator	BC400	BC400
Dimension (cm)	100x100x5	100x100x5
Operational voltage (V)	1000	1000
PMT	4 R2154	4 R2154
	Vaisala Meteorologic station	
PTU 301	500-1100 hPa	$\pm 0.05 hPa$
Pt100	-40 to 60°C	$\pm 0.2^\circ C$
HUMICAP 180C	0-100%	$\pm 1\%$

ORCB: neutrones $< 10eV$

ORCA: neutrones $> 100MeV$

Coin8: muones $> 350MeV$, protones $> 290MeV$, electrones No





MiniCaLMa	
Counter Type	LND2043
Effective diameter (mm)	89
Effective length (mm)	697
Cathode material	Stainless steel
Gas filling	$BF_3(96\% \text{ } ^{10}B)$
Gas pressure (mmHg)	700
Operational voltage (V)	2120–2370

ICaRO: futuro próximo

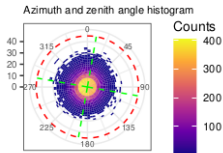
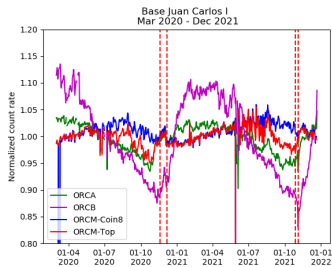
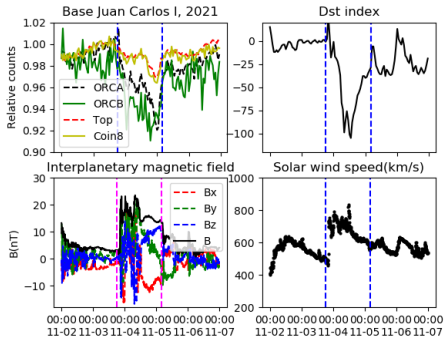
- Hermano gemelo de ORCA
- $28^{\circ}18'N$, $16^{\circ}29'W$, 2373 m a.s.l., $R = 11.5$ GV.
- Cubre un hueco en la NMDB [Artamonov et al.,2016.]
- Su altura y corte en rigidez magnética podría permitir la observación de neutrones solares
- Izaña Atmospheric Research Center (IARC)
- Güimar Geomagnetic Observatory (GGO)
- Observación de RC, condiciones atmosféricas y estado de la magnetosfera



Proyecto

PID2019-107806GB-100,
financiado por Ministerio de
Ciencia e Innovación.

Ejemplos de medidas



- Castilla-La Mancha neutron monitor, Medina et al., Nuclear Instruments and Methods in Physics Research A 727 (2013) 97–103
- The mini-neutron monitor: a new approach in neutron monitor design, Du Toit et al., J. Space Weather Space Clim. 2020, 10, 39.
- MITO: a new directional muon telescope, Ayuso et al., J. Space Weather Space Clim. 2021, 11, 13S.
- Cosmic ray observations from Livingston Island, Blanco et al., Advances in Space Research 69 (2022) 3514–3524