PLANS

CYGNO Experiment

- Riteniamo fondamentale che venga data priorità alla risoluzione dei problemi di linearità del guadagno e di individuazione di materiali idonei per GEM, Camera e dispositivi ottici;

Referee report to CSN2 - Sept 2020

INTERNAL BACKGROUND REDUCTION: GEM

	CYGNO	
Summary Table	**NR/yr 1-20 keV**	**ER/yr 1-20 keV**
GEM (LNGS)	5.07E+03	5.09E+05
GEM (TREX)	4.27E+03	3.61E+05
AcrylicBox (LNGS)		4.34E+05
AcrylicBox (SNO)		1.43E+04
CameraBody (no shield)		3.20E+06
CameraBody (with Cu shield)		4.46E+05
CameraLens (LNGS)		9.83E+05
CameraLens fused silica		6.15E+01
Cathode (Cu)	8.58E-01	3.63E+02
Cathode (Loomba)	2.76E-03	2.46E-01
Field Cage (Cu)	1.51E+00	2.00E+03
Field Cage (Kentaro)	5.15E+01	1.68E+04
External Gamma	0.00E+00	9.75E+02
External Neutrons	4.34E+00	4.68E+00
Total (LNGS)	**5.08E+03**	**2.38E+06**
Total (low rad)	**4.28E+03**	**8.24E+05**

GEMs are:

- principal producer of **alpha particles** that should be easily "**fiducialised**"

- responsible for **half** of the **ER**

We have to contact with CERN GEM producer and T-REX people that developed low-radioactivity MPGD to go on with the development of low radioactive GEM;

Background assessment for the TREX dark matter experiment

J. Castel[1,2], S. Cebrián[1,2,a], I. Coarasa[1,2], T. Dafni[1,2], J. Galán[1,2,3], F. J. Iguaz[1,2,4], I. G. Irastorza[1,2], G. Luzón[1,2], H. Mirallas[1,2], A. Ortiz de Solórzano[1,2], E. Ruiz-Chóliz[1,2]

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[2] Laboratorio Subterráneo de Canfranc, Paseo de los Ayerbe s/n, 22880 Canfranc Estación, Huesca, Spain
[3] *Present Address:* Shanghai Laboratory for Particle Physics and Cosmology, INPAC and Department of Physics and Astronomy, Shanghai Jiao Tong University, 200240 Shanghai, China
[4] *Present Address:* Synchrotron Soleil, BP 48, Saint-Aubin, 91192 Gif-sur-Yvette, France

Radiopurity of Micromegas readout planes

ːbrián[a], T. Dafni[a], E. Ferrer-Ribas[b], J. Galán[a], I. Giomataris[b], H. ez[a,*], F.J. Iguaz[a,1], I.G. Irastorza[a], G. Luzón[a], R. de Oliveira[c], A. Rodríguez[a], L. Seguí[a], A. Tomás[a], J.A. Villar[a]

[a] *Laboratorio de Física Nuclear y Astropartículas, Universidad de Zaragoza, 50009 Zaragoza, Spain*
[b] *CEA, IRFU, Centre d'etudes de Saclay, 91191 Gif-sur-Yvette, France*
[c] *European Organization for Nuclear Research (CERN), CH-1211 Genève, Switzerland*

We were funded for 2021 for this (LNF);

INTERNAL BACKGROUND REDUCTION: CAMERA

	CYGNO	
Summary Table	**NR/yr 1-20 keV**	**ER/yr 1-20 keV**
GEM (LNGS)	5.07E+03	5.09E+05
GEM (TREX)	4.27E+03	3.61E+05
AcrylicBox (LNGS)		4.34E+05
AcrylicBox (SNO)		1.43E+04
CameraBody (no shield)		3.20E+06
CameraBody (with Cu shield)		4.46E+05
CameraLens (LNGS)		9.83E+05
CameraLens fused silica		6.15E+01
Cathode (Cu)	8.58E-01	3.63E+02
Cathode (Loomba)	2.76E-03	2.46E-01
Field Cage (Cu)	1.51E+00	2.00E+03
Field Cage (Kentaro)	5.15E+01	1.68E+04
External Gamma	0.00E+00	9.75E+02
External Neutrons	4.34E+00	4.68E+00
Total (LNGS)	**5.08E+03**	**2.38E+06**
Total (low rad)	**4.28E+03**	**8.24E+05**

CAMERAs are responsible for **half** of the **ER**

Camera	Sensitivity (eV/count)	Resolution (%)	Noise (eV)	^{228}Ra (Bq)	^{228}Th (Bq)	^{226}Ra (Bq)	^{234}Pa (Bq)	^{40}K (Bq)	Total activity
Hamamatsu ORCA FLASH 4.0	2.96	15.2	4.6	2.1	2.1	1.9	7.0	1.9	15.0
ORCA FLASH sensor	2.6	15.2	8	1.0	1.0	1.1	1.1	4.3	8.5
Photometrics Prime BSI Mode 1	3.3	19.0	9.7	-	-	-	-	-	tbm
Photometrics Prime BSI Mode 2	1.12	16.4	4.5	-	-	-	-	-	tbm
Photometrics BSI Express Mode 2	0.84	13.4	3.0	1.3	1.8	1.0	6.0	3.6	13.7
Hamamatsu Fusion Closer (LEMON)	0.65	17.5	1.58	-	-	-	-	-	tbm
Hamamatsu Fusion Farther (LIME)	0.85	16.4	2.06	-	-	-	-	-	tbm
Thorlab Quantalux	tbm	tbm	tbm	0.3	0.6	0.2	3.0	1.2	5.3

?

We have to measure the Orca Fusion

Camera was unmounted and brought to LNGS separately evaluate radioactivity of its components.

We hope we can identify main source of radioactivity and remove/substitute/ move away it

INTERNAL BACKGROUND REDUCTION: MATERIALS

Since the beginning, the plan was to assemble LIME with material that can be found also in low-radioactive “version”;

The demonstrator will be assembled with low radioactive copper, acrylic, foils, lens.

We have to scrutinising all materials, from the point of view of the radioactivity and mechanical properties;

We were funded for 2021 for this

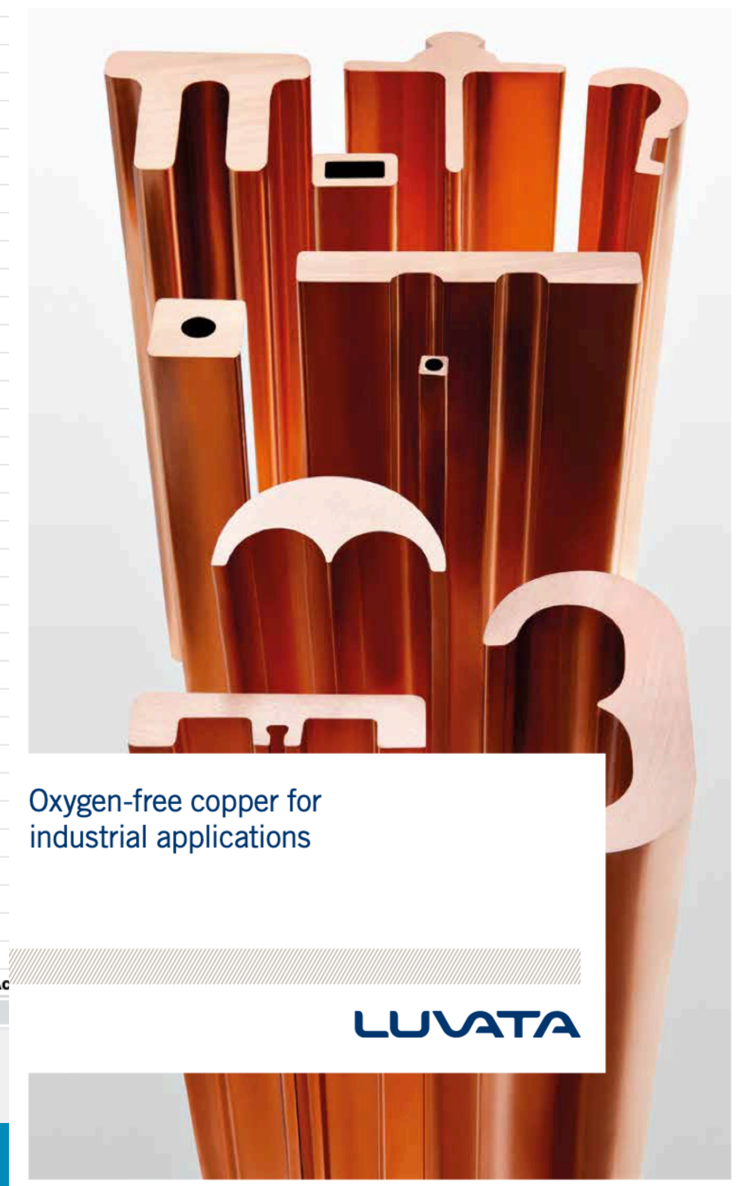
- glass for lens (RM1);

- copper and acrylic (LNF);

		CYGNO			CHINOTTO (scaled from CYGNO)							
GEM (Laubenst	Limit/Meas	evt/yr 1-20 keV	NR/yr 1-20 keV	ER/yr 1-20	evt/yr 1-20 keV	NR/yr 1-20 keV	ER/yr 1-20	Ref	Comments	Fraction materi	Gas fractio	
238U	M	2.24E+05	3.60E+03	2.21E+05	4.43E+04	7.11E+02	4.36E+04	Laubenstein @LNGS		4.44E-01	4.44	
232Th	L	4.96E+04	7.41E+02	4.88E+04	9.79E+03	1.46E+02	9.64E+03	Laubenstein @LNGS		4.44E-01	4.44	
235U	L	5.79E+04	7.32E+02	5.72E+04	1.14E+04	1.45E+02	1.13E+04	Laubenstein @LNGS		4.44E-01	4.44	
40K	L	1.78E+05	0.00E+00	1.78E+05	3.52E+04	0.00E+00	3.52E+04	Laubenstein @LNGS		4.44E-01	4.44	
60Co	L	1.43E+03	0.00E+00	1.43E+03	2.82E+02	0.00E+00	2.82E+02	Laubenstein @LNGS		4.44E-01	4.44	
GEM tot		**5.14E+05**	**5.07E+03**	**5.09E+05**	**1.02E+05**	**1.00E+03**	**1.01E+05**			4.44E-01	4.44	
GEM (only meas.)		**2.24E+05**	**3.60E+03**	**2.21E+05**	**4.43E+04**	**7.11E+02**	**4.36E+04**			4.44E-01	4.44	
Acrylic Box (Laubenstein)									NR not simulated			
238U	L	1.34E+05		1.34E+05	3.45E+04		3.45E+04	Laubenstein @LNGS		5.80E-01	4.44	
232Th	L	2.22E+05		2.22E+05	5.73E+04		5.73E+04	Laubenstein @LNGS		5.80E-01	4.44	
40K	L	7.83E+04		7.83E+04	2.02E+04		2.02E+04	Laubenstein @LNGS		5.80E-01	4.44	
Acrylic Box tot		**4.34E+05**		**4.34E+05**	**1.12E+05**		**1.12E+05**			5.80E-01	4.44	
Acrylic Box (only meas)		**0.00E+00**		**0.00E+00**	**0.00E+00**		**0.00E+00**			5.80E-01	4.44	
Camera Body (no shield)									Hamamatsu, orca-flash4.0, only gamma emitters			
238U	M	1.16E+06		1.16E+06	2.30E+05		2.30E+05	Laubenstein @LI	only gamma emitters	4.44E-01	4.44	
232Th	M	1.95E+06		1.95E+06	3.85E+05		3.85E+05	Laubenstein @LI	only gamma emitters	4.44E-01	4.44	
235U	M	0		0	0.00E+00		0.00E+00	Laubenstein @LI	not simulated	4.44E-01	4.44	
40K	M	6.30E+04		6.30E+04	1.24E+04		1.24E+04	Laubenstein @LNGS		4.44E-01	4.44	
60Co	L	6.12E+03		6.12E+03	1.21E+03		1.21E+03	Laubenstein @LNGS		4.44E-01	4.44	
137Cs	M	2.17E+04		2.17E+04	4.28E+03		4.28E+03	Laubenstein @LNGS		4.44E-01	4.44	
Camera Body tot (no shield)		**3.20E+06**		**3.20E+06**	**6.32E+05**		**6.32E+05**			4.44E-01	4.44E-01	
Camera Body only meas. (no sh		**3.20E+06**		**3.20E+06**	**6.32E+05**		**6.32E+05**			4.44E-01	4.44E-01	
Camera Body (shield)									Hamamatsu, orca-flash4.0, shield made of 5 cm copper + 5 cm fused silica, simulated only gamma emitters			
238U	M	1.71E+05		1.71E+05	3.37E+04		3.37E+04	Laubenstein @LI	only gamma emitters	4.44E-01	4.44E-01	
232Th	M	2.57E+05		2.57E+05	5.07E+04		5.07E+04	Laubenstein @LI	only gamma emitters	4.44E-01	4.44E-01	
235U	M	0		0	0.00E+00		0.00E+00	Laubenstein @LI	not simulated	4.44E-01	4.44E-01	
40K	M	1.37E+04		1.37E+04	2.70E+03		2.70E+03	Laubenstein @LNGS		4.44E-01	4.44E-01	
60Co	L	1.52E+03		1.52E+03	2.99E+02		2.99E+02	Laubenstein @LNGS		4.44E-01	4.44E-01	
137Cs	M	3.39E+03		3.39E+03	6.70E+02		6.70E+02	Laubenstein @LNGS		4.44E-01	4.44E-01	
Camera Body tot (shield)		**4.46E+05**		**4.46E+05**	**8.81E+04**		**8.81E+04**			4.44E-01	4.44E-01	
Camera Body only meas. (shield		**4.44E+05**		**4.44E+05**	**8.78E+04**		**8.78E+04**			4.44E-01	4.44E-01	
Camera Lens (glass)									Hamamatsu, orca-flash4.0, shield made of 5 cm copper + 5 cm fused silica, simulated only gamma emitters			
238U	M	1.95E+05	0.00E+00	1.95E+05	3.86E+04		3.86E+04	Laubenstein @LNGS		4.44E-01	4.44E-01	
232Th	M	4.66E+05	0.00E+00	4.66E+05	9.21E+04		9.21E+04	Laubenstein @LNGS		4.44E-01	4.44E-01	
235U	M	1.48E+04	0.00E+00	1.48E+04	2.91E+03		2.91E+03	Laubenstein @LNGS		4.44E-01	4.44E-01	
40K	M	2.83E+05	0.00E+00	2.83E+05	5.59E+04		5.59E+04	Laubenstein @LNGS		4.44E-01	4.44E-01	
60Co	L	4.20E+03	0.00E+00	4.20E+03	8.29E+02		8.29E+02	Laubenstein @LNGS		4.44E-01	4.44E-01	
138La	M	1.07E+05	0.00E+00	1.07E+05	2.12E+04		2.12E+04	Laubenstein @LNGS		4.44E-01	4.44E-01	
137Cs	L	1.01E+03	0.00E+00	1.01E+03	2.00E+02		2.00E+02	Laubenstein @LNGS		4.44E-01	4.44E-01	
Camera Lens tot (shield)		**9.83E+05**	0.00E+00	**9.83E+05**	**1.94E+05**		**1.94E+05**			4.44E-01	4.44E-01	
Camera Lens only meas. (shield		**1.07E+06**	0.00E+00	**1.07E+06**	**2.11E+05**		**2.11E+05**			4.44E-01	4.44E-01	
Cathode (copper TREX)												
238U	L	5.76E+01	6.41E-01	5.70E+01	1.14E+01	1.27E-01	1.13E+01	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
232Th	L	1.28E+01	2.17E-01	1.26E+01	2.54E+00	4.28E-02	2.49E+00	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
40K	M	6.37E+01	0.00E+00	6.37E+01	1.26E+01	0.00E+00	1.26E+01	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
60Co	L	7.43E+01	0.00E+00	7.43E+01	1.47E+01	0.00E+00	1.47E+01	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
137Cs	L	1.56E+02	0.00E+00	1.56E+02	3.08E+01	0.00E+00	3.08E+01	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
Field cage tot		**3.64E+02**	**8.58E-01**	**3.63E+02**	**7.19E+01**	**1.69E-01**	**7.18E+01**			4.44E-01	4.44E-01	
Field cage only meas.		**6.37E+01**	**0.00E+00**	**6.37E+01**	**1.26E+01**	**0.00E+00**	**1.26E+01**			4.44E-01	4.44E-01	
Field cage (copper TREX)												
238U	L	2.20E+02	1.19E+00	2.18E+02	4.34E+01	2.35E-01	4.31E+01	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
232Th	L	5.31E+01	3.25E-01	5.28E+01	1.05E+01	6.42E-02	1.04E+01	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
40K	M	1.91E+02	0.00E+00	1.91E+02	3.78E+01	0.00E+00	3.78E+01	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
60Co	L	8.22E+02	0.00E+00	8.22E+02	1.62E+02	0.00E+00	1.62E+02	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
137Cs	L	7.20E+02	0.00E+00	7.20E+02	1.42E+02	0.00E+00	1.42E+02	Cu from TREX: https://link.springer.com/content/pdf/10.1140/epjc/s10052-019-7		4.44E-01	4.44E-01	
Field cage tot		**2.01E+03**	**1.51E+00**	**2.00E+03**	**3.96E+02**	**2.99E-01**	**3.96E+02**			4.44E-01	4.44E-01	
Field cage only meas.		**1.91E+02**	**0.00E+00**	**1.91E+02**	**3.78E+01**	**0.00E+00**	**3.78E+01**			4.44E-01	4.44E-01	
GEM (T-REX)	**Limit/Meas**	**evt/yr 1-20 keV**	**NR/yr 1-20 keV**	**ER/yr 1-20**	**evt/yr 1-20 keV**	**NR/yr 1-20 keV**	**ER/yr 1-20**		**Comments**			**Activity CYGNO Ac**

Activity | Background | chains

Cakes						
Format	Width		Thickness		Weight/length*	
	inches	mm	inches	mm	lb/inch	kg/m
C416	15.94	405	6.30	160	32.4	577
C602	25.00	635	8.27	210	66.6	1,188
C698	27.17	690	7.09	180	62.0	1,107
C635	27.17	690	13.19	335	115.5	2,060
C732	28.35	720	12.60	320	115.1	2,053



GAIN LINEARITY: SATURATION & LUMINESCENCE

We need some more studies and data to understand the behaviour and how to correct gain saturation:

- Install PMT on LIME to exploit light signal from GEM2;
- Readout electrical signals on LIME from GEM2 and GEM3

We could avoid gain saturation by exploiting luminescence:

- Install metal grid (and then conductive foil) on LEMON to study electro-luminescence below the GEM

People from CERN Gas Detector Group is interested in both these studies and would like to collaborate, share info ideas and results with us

NEW MIXTURES

The use of hydrocarbons can help in lowering the effective threshold in DM - mass;

In Rome we have a simple set-up to study C_4H_{10} + He/CF_4 based ones;

In general we should investigate binary and ternary mixtures with several hydrocarbons. Coimbra people can play and important role on this;

LIME

- Per consolidare gli algoritmi di reiezione dei fondi è importante che LIME possa essere testato in ambiente underground.

Referee report to CSN2 - Sept 2020

We plan to install LIME al LNGS beginning of next year;

By June GAS and DAQ system prototypes have to be ready to start Unshielded Data Acquisition;

Brazilian group is working a lot on DAQ development and realisation;

UK people will be crucial for gas radioactivity reduction

PAPERS AND MILESTONES

A GEM-based Optically Readout Time Projection Chamber for charged particle tracking

V. C. Antochi,[1,a)] G. Cavoto,[1,b)] I. A. Costa,[1,c)] E. Di Marco,[1] G. D'Imperio,[1] F. Iacoangeli,[1] M. Marafini,[1,d)] A. Messina,[1,b)] D. Pinci,[1] F. Renga,[1] C. Voena,[1] E. Baracchini,[2] A. Cortez,[2] G. Dho,[2,e)] L. Benussi,[3] S. Bianco,[3] C. Capoccia,[3] M. Caponero,[3,f)] G. Maccarrone,[3] G. Mazzitelli,[3] A. Orlandi,[3] E. Paoletti,[3] L. Passamonti,[3] D

Prepared for submission to JINST

First evidence of luminescence in a ... gas mixture induced by non-ionizing electron...

PUBLISHED

Prepared for submission to JINST

A density-based clustering algorithm for the CYGNO data analysis

ANSWERING TO REVIEWERS

1 Identification of nuclear recoils in a gas TPC with
2 optical readout

3 E Baracchini[1,2], L Benussi[3], S Bianco[3], C Capoccia[3], M
4 Caponero[3,4], G Cavoto[5,6], A Cortez[1,2], I A. Costa[7], E Di
5 Marco[5], G D'Imperio[5], G Dho[1,2], F Iacoangeli[5], G Maccarrone[3],
6 M Marafini[5,8], G Mazzitelli[3], A Messina[5,6], R A. Nobrega[7], A
7 Orlandi[3], E Paoletti[3], L Passamonti[3], F Petrucci[9,10], D Piccolo[3],
8 D Pierluigi[3], D Pinci[5], F Renga[5], F Rosatelli[3], A Russo[3], G
9 Saviano[3,11] and S Tomassini[3]
10 [1]Gran Sasso Science Institute, L'Aquila, I-67100, Italy

Prepared for submission to JINST

Stability and detection perfor... a GEM-based Optical Readout TPC with ...based gas mixtures

PUBLISHING

Saturation on GEM-3

The CYGNO Experiment

E. Baracchini,[a,b], R Bedogni,[c], F Bellini,[e,f], L. Be... Capoccia,[c], M. Caponero,[c,d], G. Cavoto,[e,f], A. C... E. Di Marco,[e], G. D'Imperio,[e], G. Dho,[a,b], F. I... ...rone,[c], M. Marafini,[e,h], G. Mazzitelli,[c], A. Messina... A. Orlandi,[c], E. Paoletti,[c], L. Passamonti,[c], F. Petrucci... D. Pierluigi,[c], D. Pinci[e,*], F. Renga,[e], F. Rosatelli,[c], A. ... G. Saviano,[c,k], and S. Tomassini[c]

DRAFTING


THANKS!