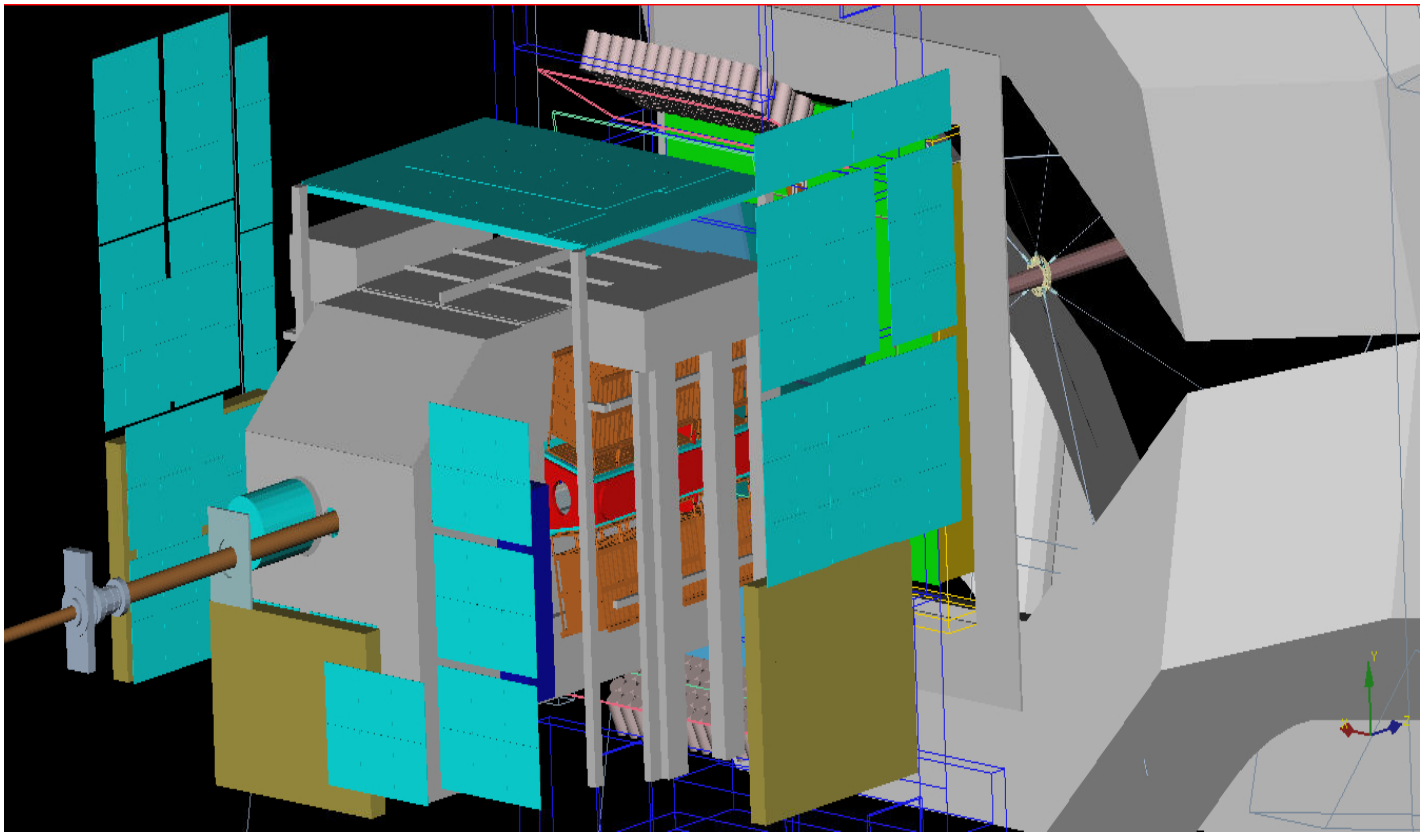
RoMOEDAL status report

V. Popa, for the RoMOEDAL team



ISAB – CERN-RO meeting, October 30 – November 5, 2020

Overview

- MoEDAL short reminder
- MoEDAL news (extensions, perspectives)
- RoMOEDAL activities: science, service tasks, technical developments
- Future perspectives
- Conclusions

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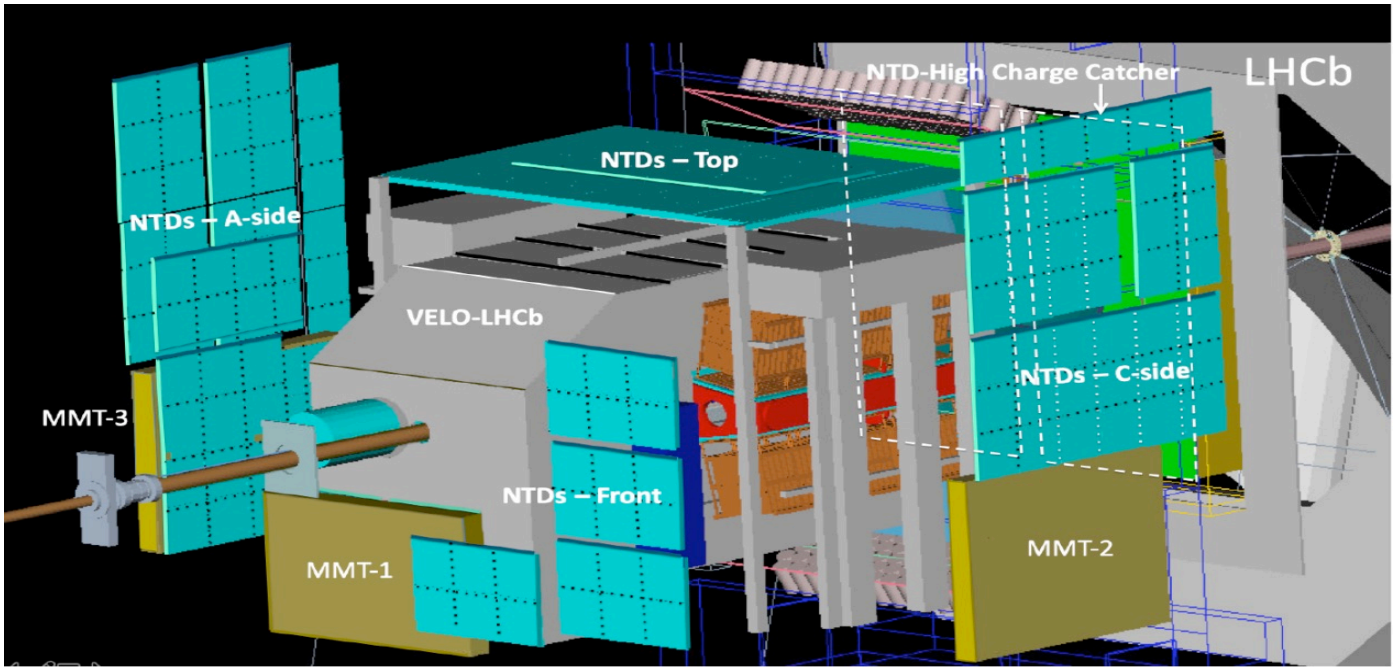
"Monopole Detection at LHC"

MoEDAL shares intersection point 8 on the LHC ring with LHCb

1) The main NTD array (low and high threshold, Z/β: CR39 and MAKROFOL)
2) The Very High Charge Catcher NTD array
3) The Monopole Trapping Detector (scanned at the ETH Zurich SQUID)
4) The TimePix radiation background monitor

$$g/e \approx 68.5$$



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Getting ready for Run 3

- MoEDAL geometry to be adapted to the ongoing VELO upgrade
- Getting active: MAPP phase one
- Expanding searches: the MALL detector at SNOLAB

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MoEDAL Apparatus for Penetrating Particles (mCharged)

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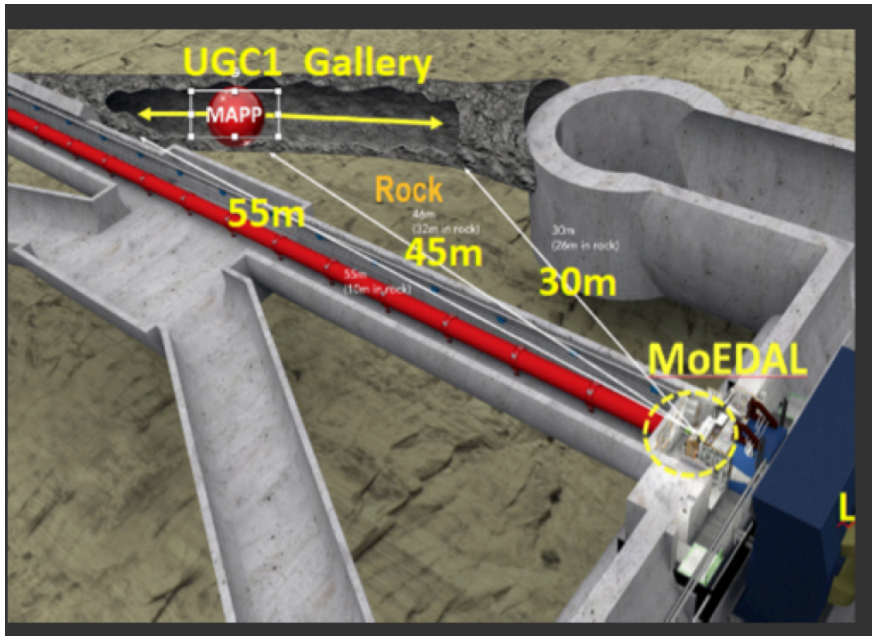
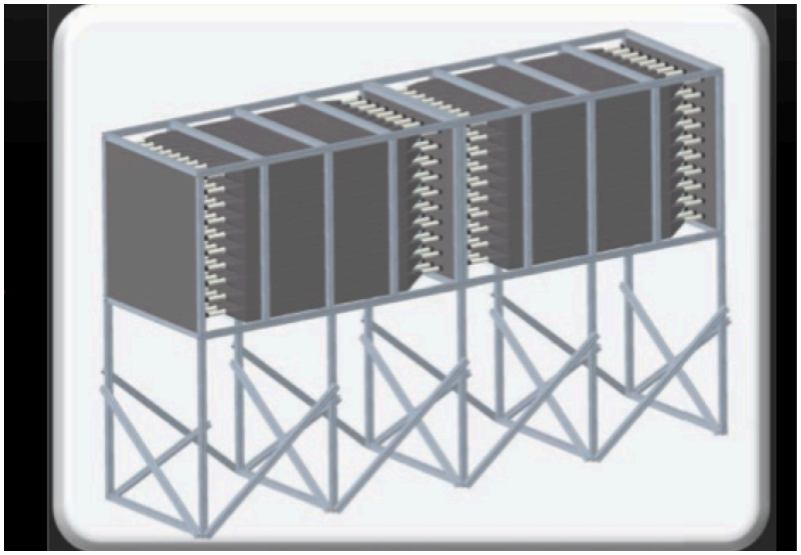
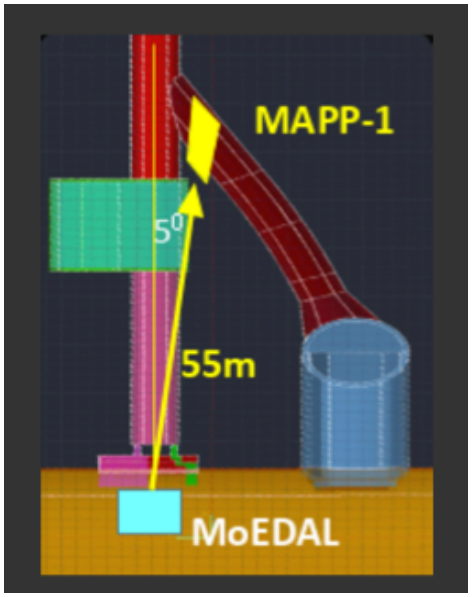
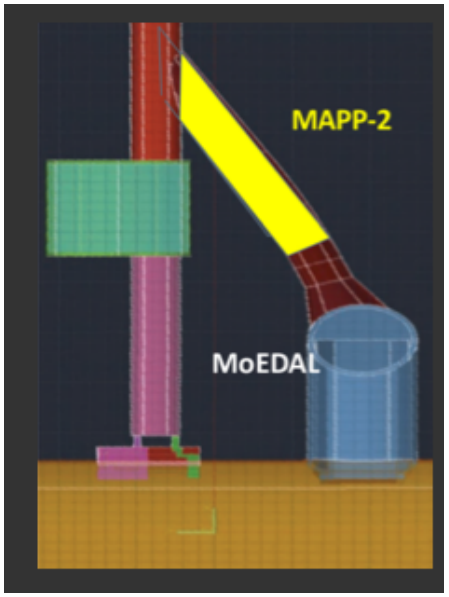
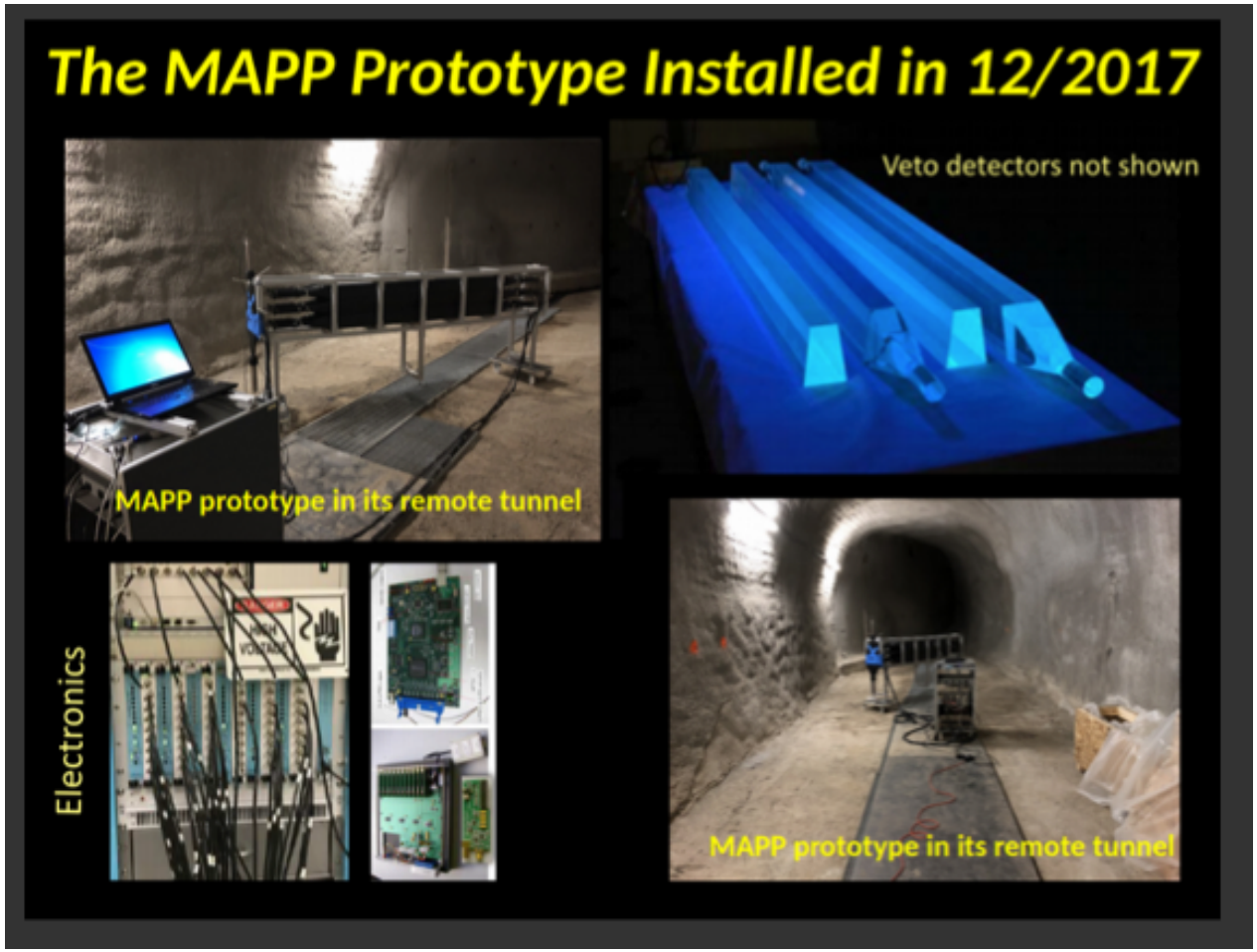




Pictures by Michael Staelens
(University of Alberta)







Few fb^{-1} of data collected during Run 2

Pictures by Michael Staelens
(University of Alberta)

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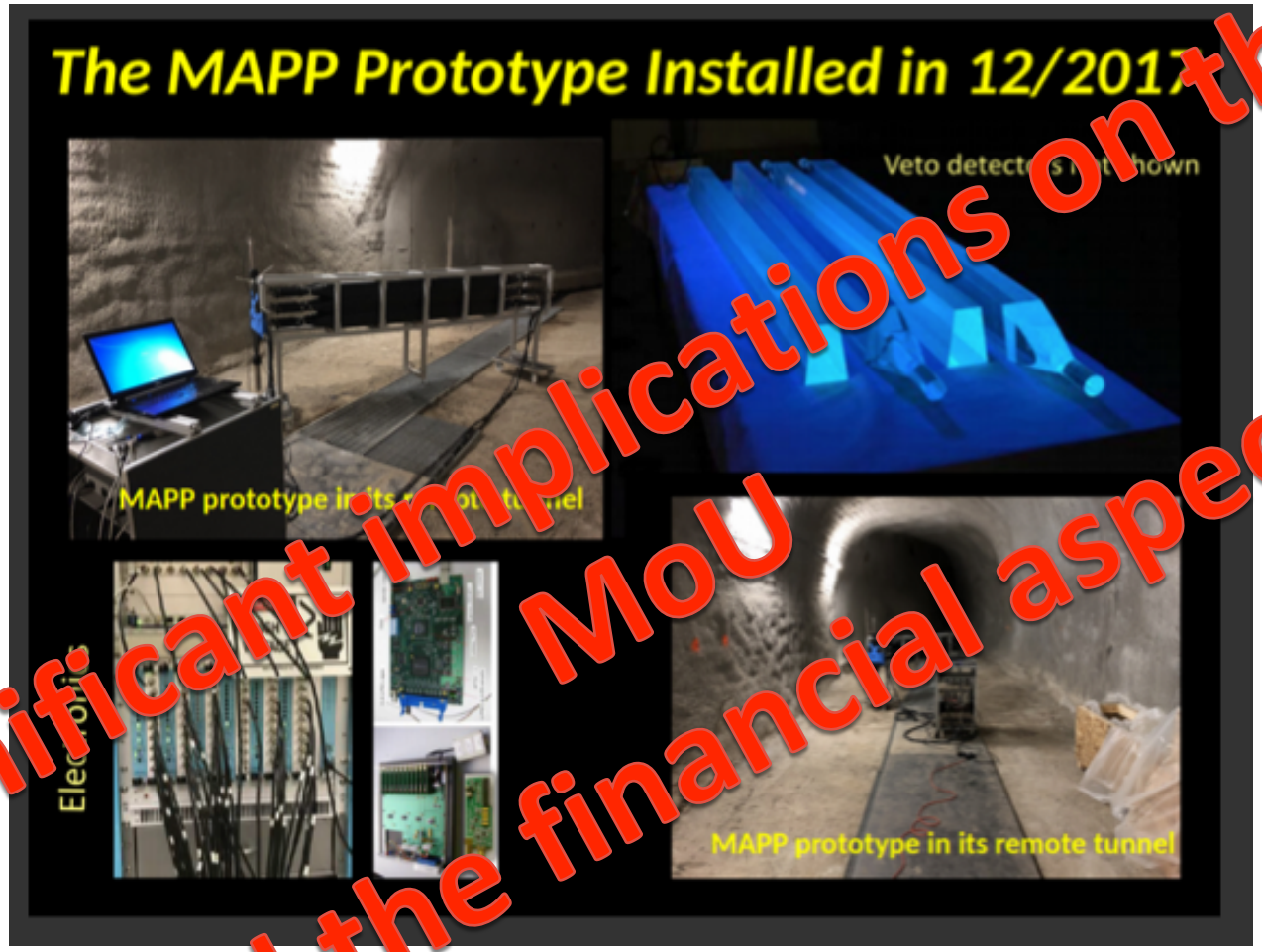

Significant implications on the MoU and the financial aspects

fb^{-1} of data collected during Run 2

Pictures by Michael Staelens
(University of Alberta)

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MoEDAL Apparatus for extremly Long Lived particles

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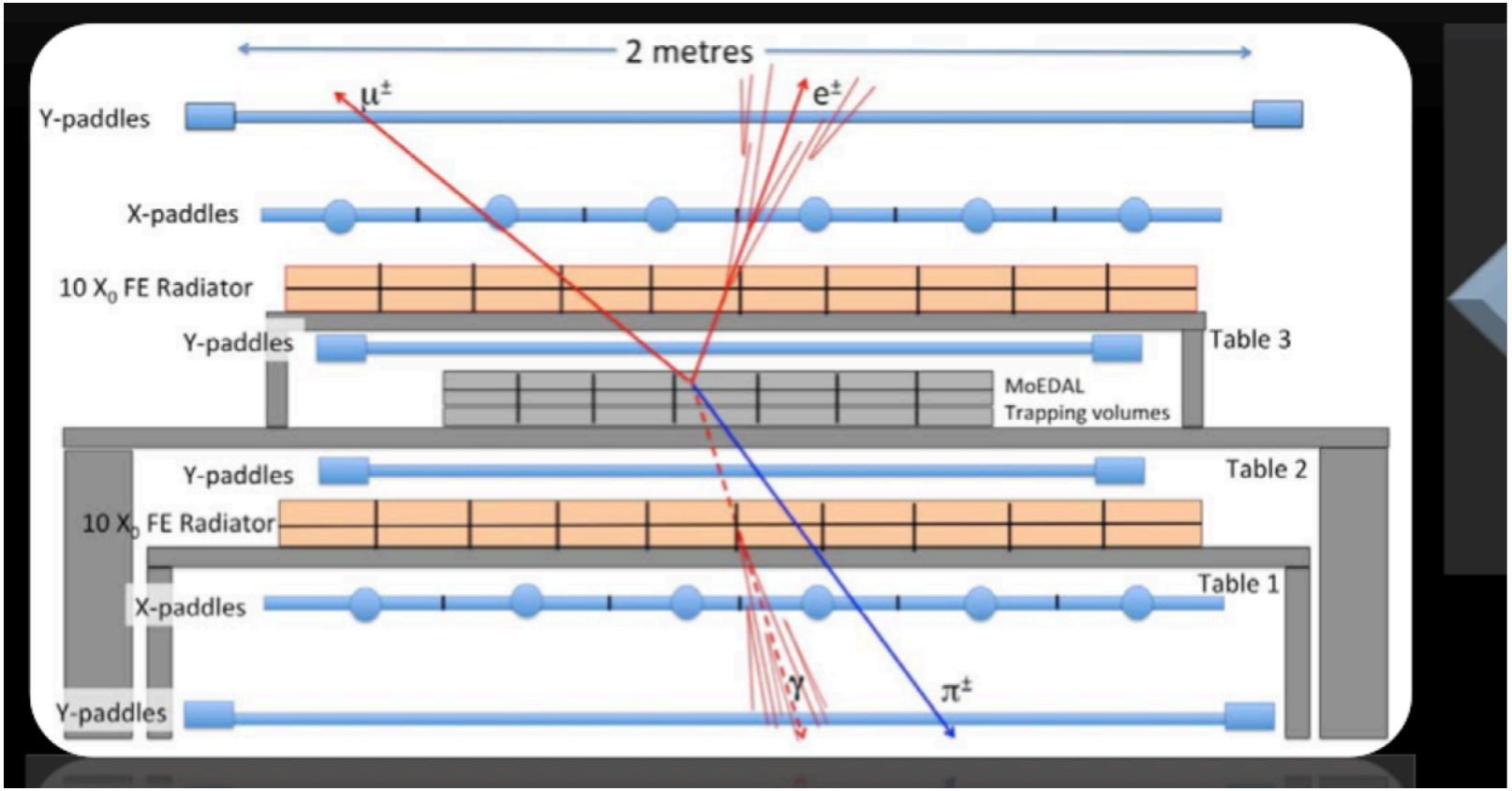


Monopole trapping detectors from Run 3 moved to SNOLAB for measurements

Overview

- MoEDAL short reminder
- MoEDAL news (extensions, perspectives)
- RoMOEDAL activities: science, service tasks, technical developments*

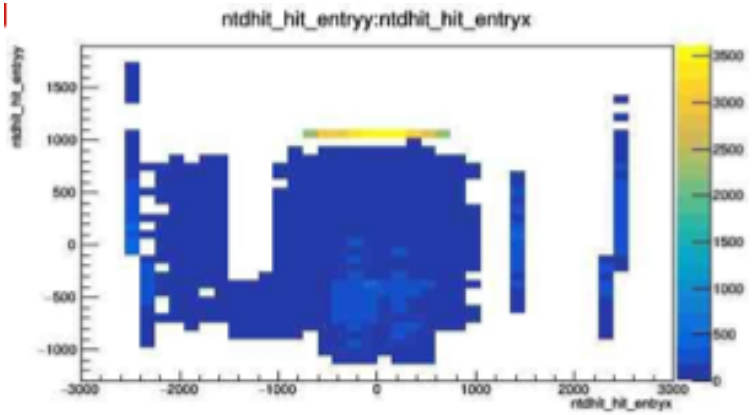
1. Software development for physics analyses (for Magnetic Monopoles, Dyons; analyses for other exotica can be foreseen for exotic long-lived particles, as the MoEDAL theory group will agree on the corresponding theoretical approaches).
2. Test of a novel NTDs scanning procedure.
3. Fulfilment of the responsibilities specific to the Software Coordinator of the MoEDAL Collaboration and VO administrator of vo.moedal.org.
4. Continuous update and maintenance for detector simulation (acceptance and efficiency estimation).

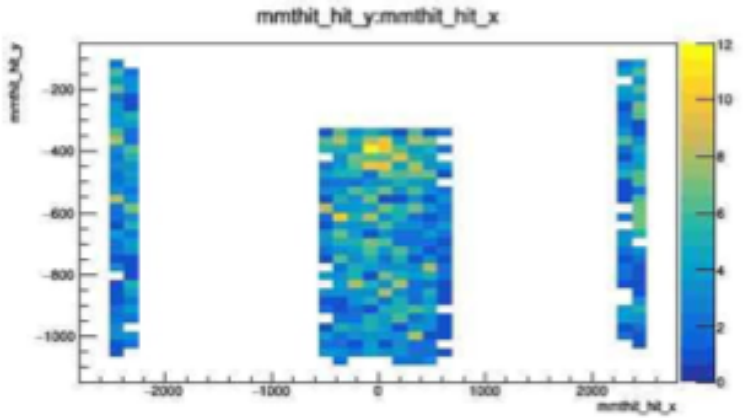
- Future perspectives
- Conclusions

* *Activities conducted under Contract IFA-CERN 08/2020*

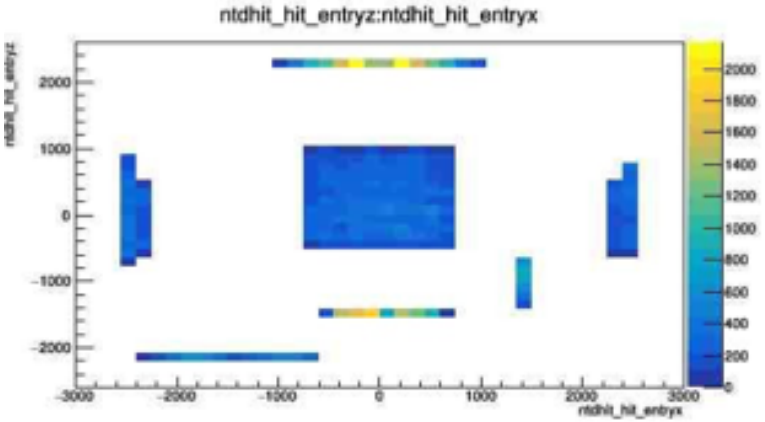
O1. Software development for physics analyses

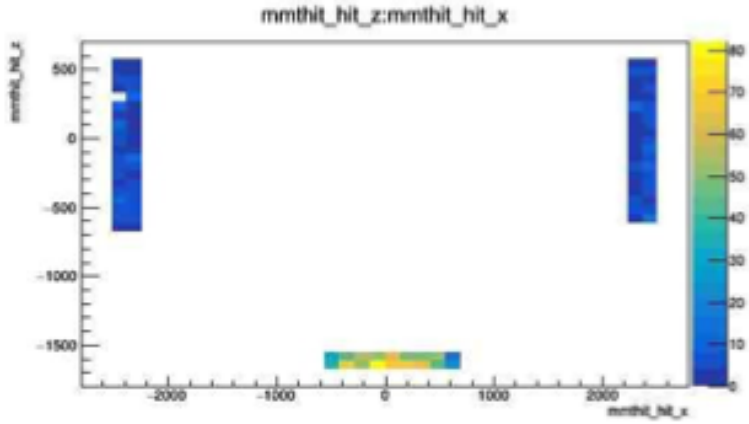
People involved: H. Brânzaș (PhD student), D. Felea, G.E. Păvălaș





HCC +NTD+MMT – DYONS TEST simulation: Gauss + GEANT4; Particle gun events generator
Number of events = 100000
Electric charge of DYON = 1e, Magnetic charge = 1gD
Dyon Mass = 1TeV, pp = 13 TeV





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Dyons

First search for dyons with the full MoEDAL trapping detector in 13 TeV pp collisions

B. Acharya,[1,*] J. Alexandre,[1] P. Benes,[2] B. Bergmann,[2] J. Bernabéu,[3] A. Bevan,[4] H. Branzas,[5] P. Burian,[2] M. Campbell,[6] S. Cecchini,[7] Y. M. Cho,[8] M. de Montigny,[9] A. De Roeck,[6] J. R. Ellis,[1,10,†] M. El Sawy,[6,‡] M. Fairbairn,[1] D. Felea,[5] M. Frank,[11] J. Hays,[4] A. M. Hirt,[12] J. Janecek,[2] M. Kalliokoski,[13] A. Korzenev,[14] D. H. Lacarrère,[6] C. Leroy,[15] G. Levi,[16] A. Lionti,[14] J. Mamuzic,[3] A. Maulik,[7,9] A. Margiotta,[16] N. Mauri,[7] N. E. Mavromatos,[1] P. Mermod,[14,§] M. Mieskolainen,[17] L. Millward,[4] V. A. Mitsou,[3] R. Orava,[17] I. Ostrovskiy,[18] P.-P. Ouimet,[9,¶] J. Papavassiliou,[3] B. Parker,[19] L. Patrizii,[7] G. E. Păvălaş,[5] J. L. Pinfold,[9,**] L. A. Popa,[5] V. Popa,[5] M. Pozzato,[7] S. Pospisil,[2] A. Rajantie,[20] R. Ruiz de Austri,[3] Z. Sahnoun,[7,††] M. Sakellariadou,[1] A. Santra,[3] S. Sarkar,[1] G. Semenoff,[21] A. Shaa,[9] G. Sirri,[7] K. Sliwa,[22] R. Soluk,[9] M. Spurio,[16] M. Staelens,[9] M. Suk,[2] M. Tenti,[23] V. Togo,[7] J. A. Tuszyński,[9] A. Upreti,[18] V. Vento,[3] O. Vives,[3] and A. Wall[18]
(THE MoEDAL COLLABORATION)

The dyon paper was resubmitted with some corrections requested by the reviewers.

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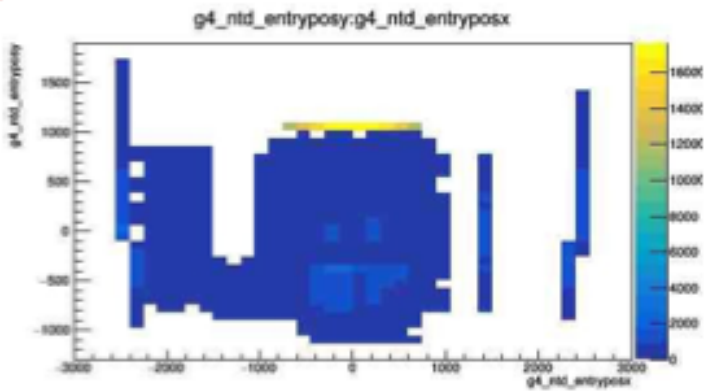
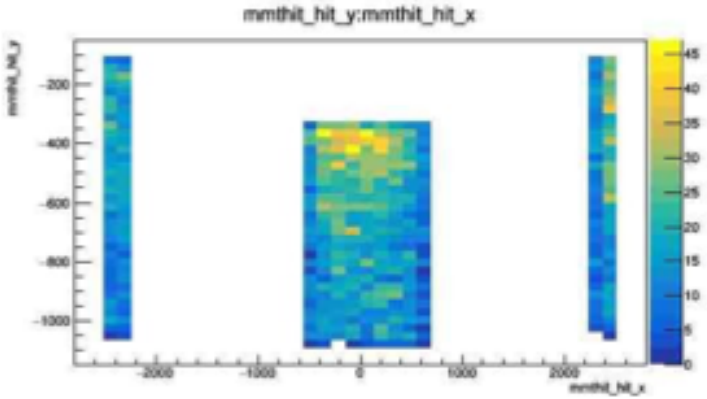
2. HECO (High Electric Charge Objects − new item. Simulation started.



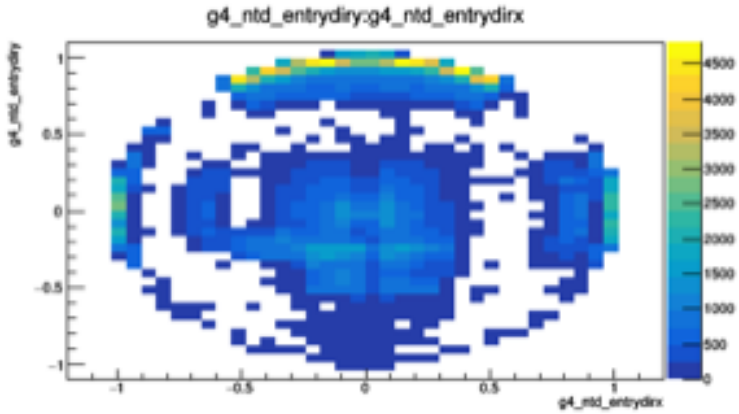


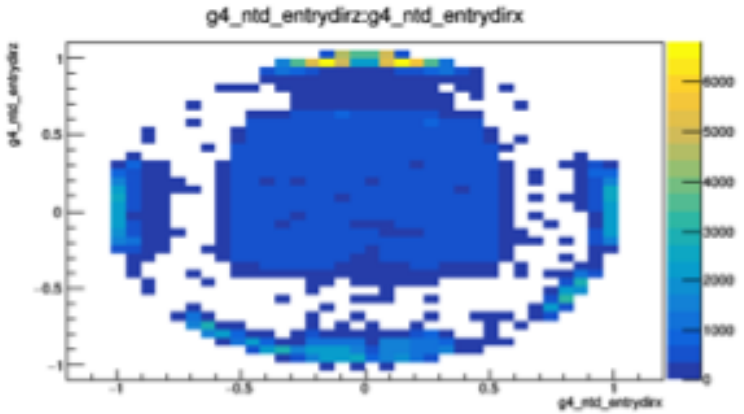
HCC +NTD+MMT – HECO test simulation: Gauss + GEANT4; Particle gun events generator

Number of events = 100000

Electric charge of HECO = 50 e

HECO Mass = 1Tev, pp = 13 TeV





3. Supersymmetric particles

Eur. Phys. J. C (2020) 80:431
https://doi.org/10.1140/epjc/s10052-020-7994-7

THE EUROPEAN PHYSICAL JOURNAL C

Regular Article - Experimental Physics

Prospects for discovering supersymmetric long-lived particles with MoEDAL

D. Felea[1,a], J. Mamuzic[2,b], R. Masełek[3,c], N. E. Mavromatos[4,d], V. A. Mitsou[2,e], J. L. Pinfold[5,f], R. Ruiz de Austri[2,g], K. Sakurai[3,h], A. Santra[2,i], O. Vives[2,6,j]

[1] Institute of Space Science, P.O. Box MG 23, 077125 Bucharest, Măgurele, Romania
[2] Instituto de Física Corpuscular (IFIC), CSIC-Universitat de València, C/Catedrático José Beltrán 2, 46980 Paterna, Valencia, Spain
[3] Institute of Theoretical Physics, Faculty of Physics, University of Warsaw, ul. Pasteura 5, 02093 Warsaw, Poland
[4] Theoretical Particle Physics and Cosmology Group, Department of Physics, King's College London, Strand, London WC2R 2LS, UK
[5] Physics Department, University of Alberta, Edmonton, AB T6G 2E4, Canada
[6] Departament de Física Teòrica, Universitat de València, C/ Dr. Moliner 50, 46100 Burjassot, Valencia, Spain

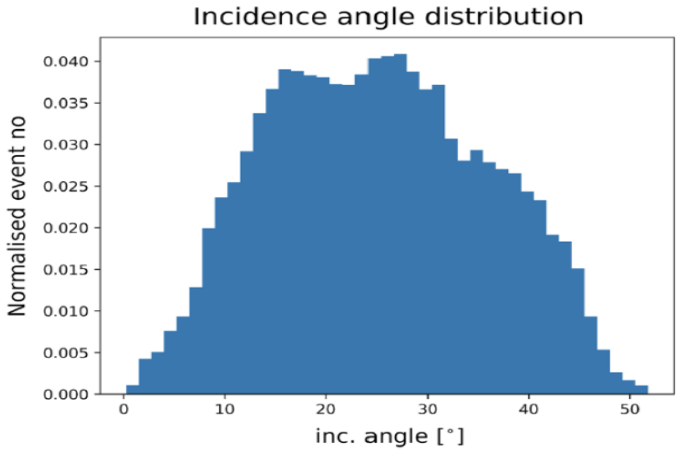


Fig. 5 The distribution of the incidence angle between the $\tilde{\tau}$ and an NTD panel assuming the Run-2 NTD geometry

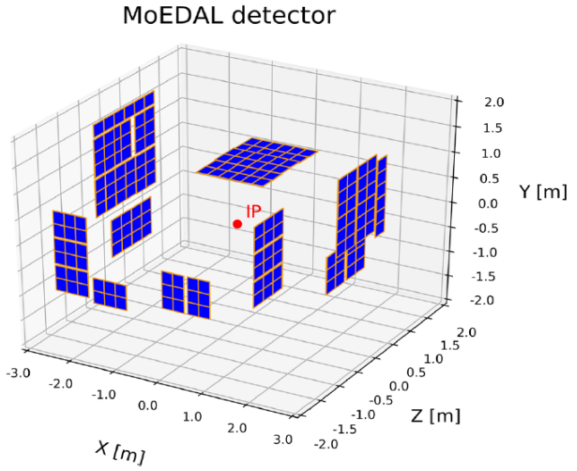
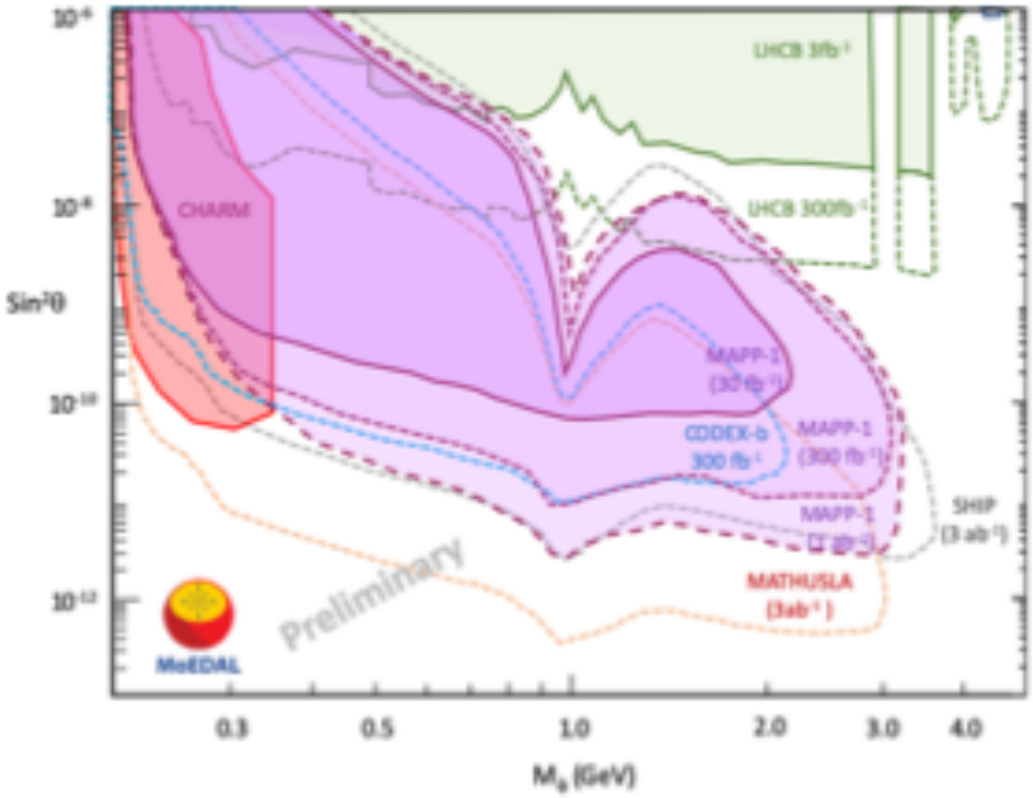


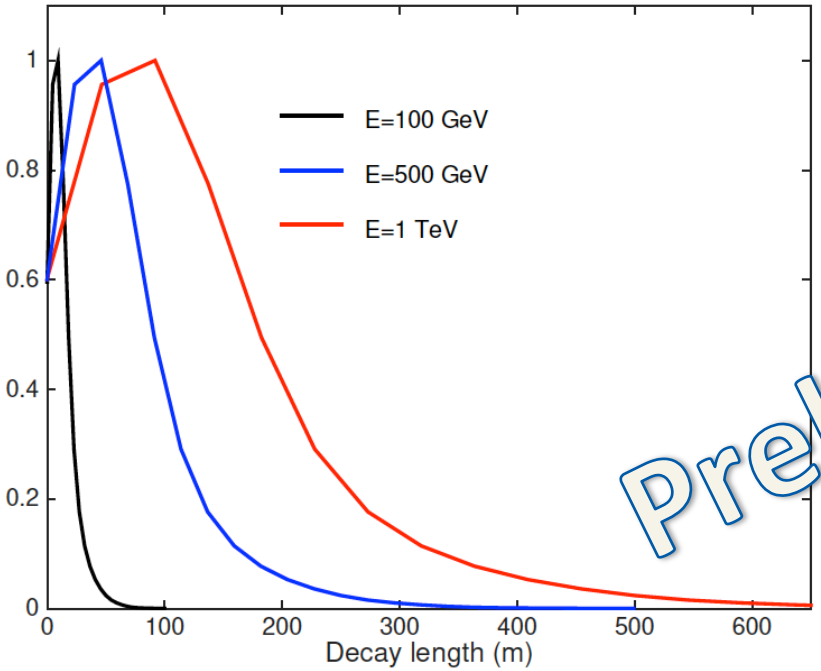
Fig. 4 The Run-2 NTD deployment of MoEDAL. NTD modules are depicted as thin blue plates with orange edges. The red point at the centre represents the interaction point. The z-axis is along the beams and the y-axis indicates the vertical direction

4. Prospects of new physics with MAPP

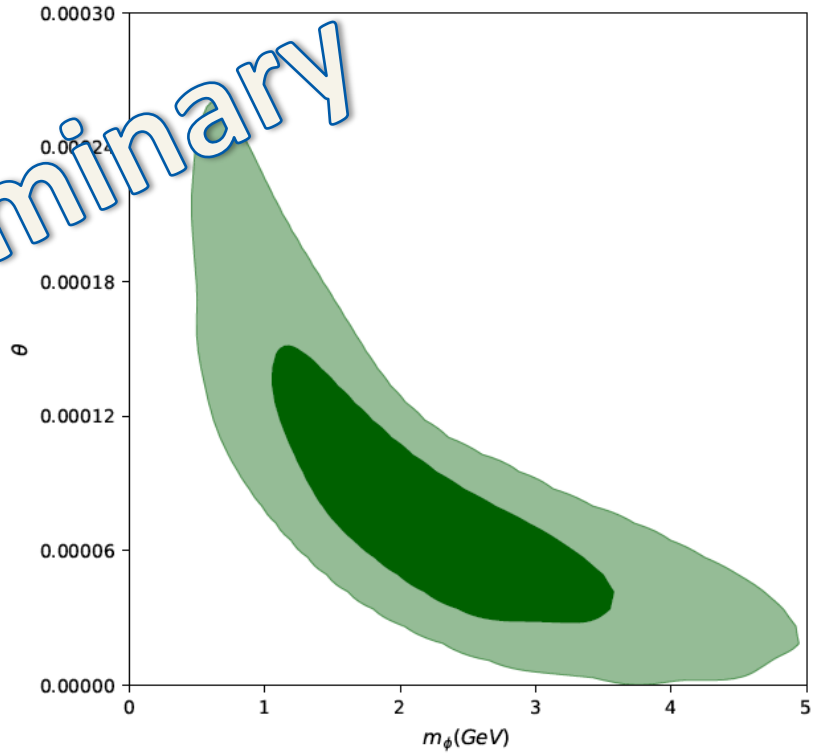


Dark Higgs coupling to lepton pairs (from M. Staelens presentation, CERN 2019)

The same subject, from the cosmological side.
L. Popa, she joined MoEDAL last December, not a project team member.



Dark Higgs as inflaton



Constraints (68% & 95% CL) on Dark Higgs inflaton parameter space from present astrophysical data

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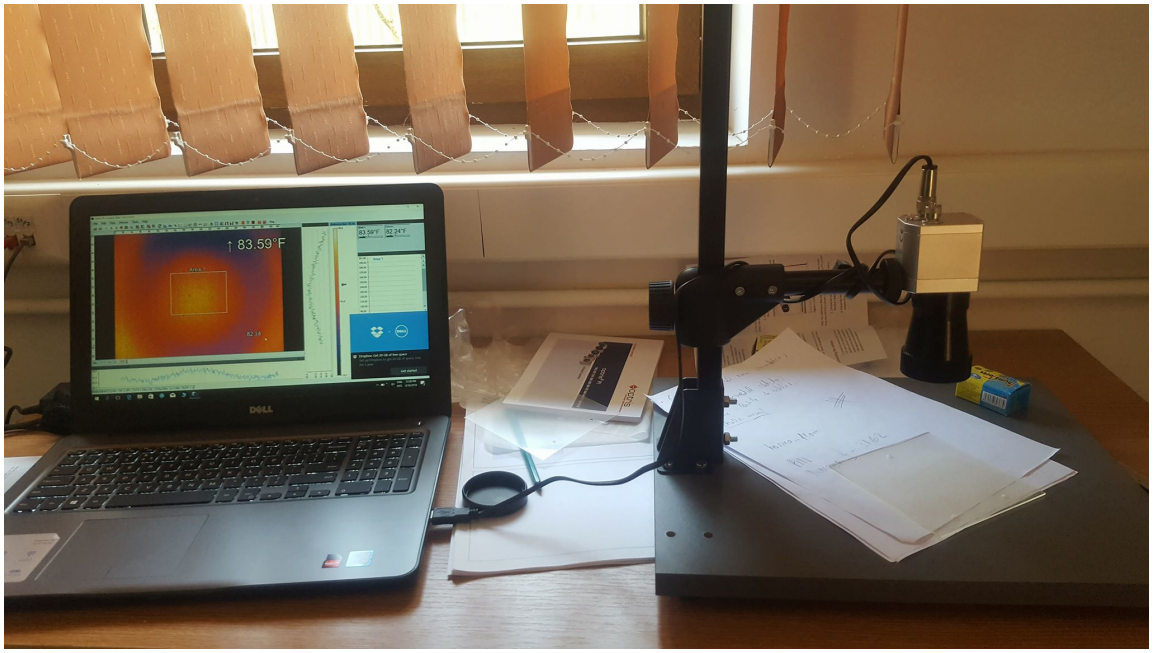
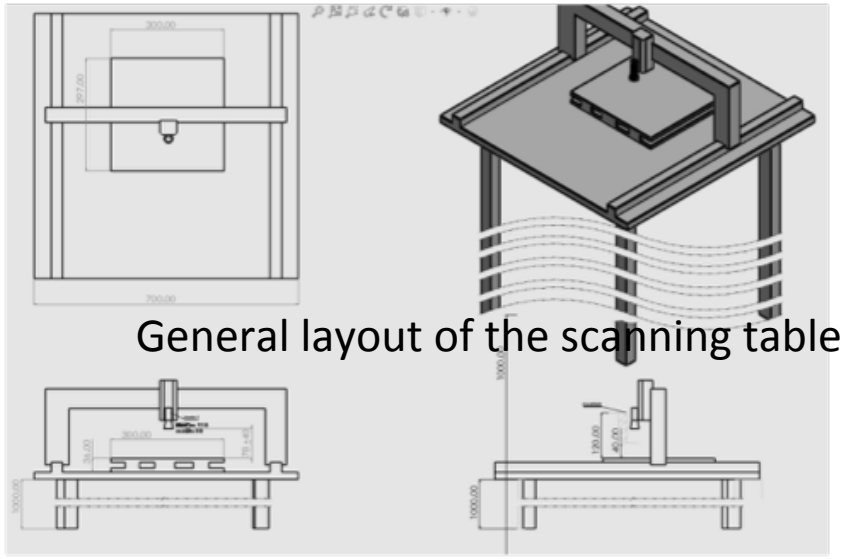
O2.Test of a novel (thermal) NTDs scanning procedure.

People involved: H. Brânzaș (PhD student), V. Constantinescu, V. Popa, G. Tordai

Activities slightly delayed by the Covid restrictions, but not critically. A simplified design was completed as well as part of procurement; the test device will be functional soon.

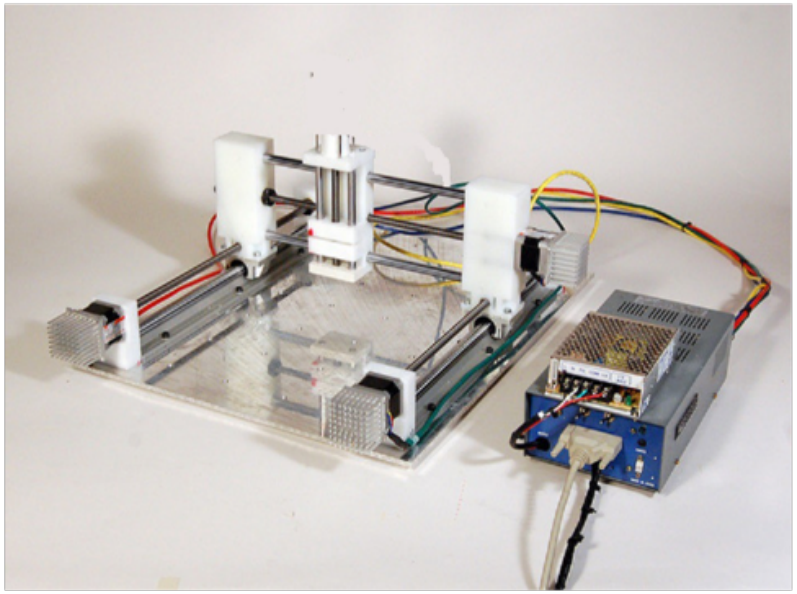




General layout of the scanning table

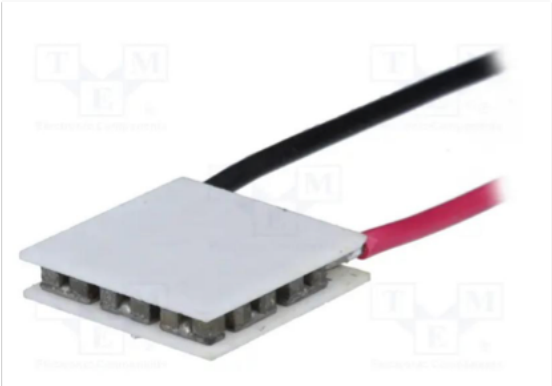
a

Fig 1



x/y movement controller (2mm steps)

z movement (focus) manual



Temperature control trough a Peltier module (up to 80^0)

Measuring cycle PC controlled:

- Positioning
- Heating
- Thermography (repeated)
- Cooling
- Thermography (repeated)
- Repositioning

To be optimized empirically, if proof of feasibility achieved.

First results expected by the end of 2020.

O3 & O4. Fulfilment of the responsibilities specific to the Software Coordinator of the MoEDAL Collaboration and VO administrator of vo.moedal.org and the continuous update and maintenance for detector simulation (acceptance and efficiency estimation).

Specific responsibilities of D. Felea

As the geometry of the detector and the distribution of other material in the LHCb – VELO area may change during the MoEDAL lifetime, this objective is considered as a permanent one. One of the key persons of the project team is already appointed by the Collaboration as the responsible of this objective. The objective comprises also the training of students from the Collaboration in order to contribute to this effort.

- ***Daniel Felea*** was assigned as **MoEDAL Simulation Software Coordinator** (*since the 29th of June 2017*), **VO admin of vo.moedal.org** (*since the 16th of February 2017*), and elected by the MoEDAL Collaboration Board as **MoEDAL Software Coordinator** (*beginning with 19th of October 2018*), having specific activities and responsibilities, in accordance with MoEDAL By-Laws :

1. *To organize and chair regular software meetings;*
2. *To liaise with the Analysis Coordinator and the Spokesperson to ensure that MoEDAL users have access to the software tools and computing resources they need;*
3. *To maintain fully functional and up-to-date versions of the required software libraries;*
4. *To provide the software tools to access computing resources necessary for analysis and simulations; this includes maintaining software functionality (Ganga, DIRAC) necessary to simulations in VO MoEDAL GRID;*
5. *To provide up-to-date user guides and TWiki pages to the software and also to the computing resources.*

- ***888990*** (February 14, 2020) : ***"MoEDAL software status and NTD hits with the latest Gauss CMT compiled – v49r15p1"*** – ***D. Felea***

- ***897392*** (March 13, 2020) : ***"Status of the Remaining Software Issues : HCC issue –> SOLVED –> RICH_1 : the culprit ?"*** – ***D. Felea*** ***and A. Santra***

- ***903425*** (March 27, 2020) : ***"MoEDAL software status and NTD hits with HCC shifted in the place of TT"*** – ***D. Felea***

- ***917160*** (May 08, 2020) : ***"Status of the Analysis and Software Matters – 08th of May 2020"*** – ***D. Felea*** ***and A. Santra***

- ***922011*** (May 22, 2020) : ***"Status of the Analysis and Software Matters – 22nd of May 2020"*** – ***D. Felea*** ***and A. Santra***

- ***925971*** (June 05, 2020) : ***"Status of the Analysis and Software Matters – 05th of June 2020"*** – ***D. Felea*** ***and A. Santra***

- ***925971*** (June 05, 2020) : ***"Maximal and Minimal Geometry in MoEDAL"*** – ***A. Santra and D. Felea***

- ***930945*** (June 19, 2020) : ***"BatchScript in MoEDAL"*** – ***A. Santra and D. Felea***

- ***939778*** (July 17, 2020) : ***"Acceptance plots – NTD + HCC – for the Technical Paper"*** – ***D. Felea*** ***and H.***

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Future perspectives

- MoEDAL will continue to take data during Run 3, at higher luminosity
- The MoEDAL set-up will be modified, according the VELO upgrades
- MAPP will start operating during Run 3, opening new fields of potential discoveries
- The timing of all above may be conditioned by the pandemic context…
- New MoEDAL papers (with Romanian contributions) are in preparations: the dyon paper was resubmited answering the referee's observations, the NTD (high threshold) paper is in finalisation, the bim pipe paper and the detector paper are in preparation.
- ROMoEDAL is going on!

Conclusions

Excepting some small delays and inherent difficulties produced by the pandemic situation, both MoEDAL and the RoMOEDAL project are going well.

The science coverage of the Romanian group extended to new research topics.

New researchers from ISS joined MoEDAL, as envisaged last year.

The study of a possible “thermal scanning” of NTDs is progressing; we hope to have the first test by the end of the year.

The “service tasks” are constantly executed and highly appreciated by the Collaboration.

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Thank you for your attention and Stay safe!