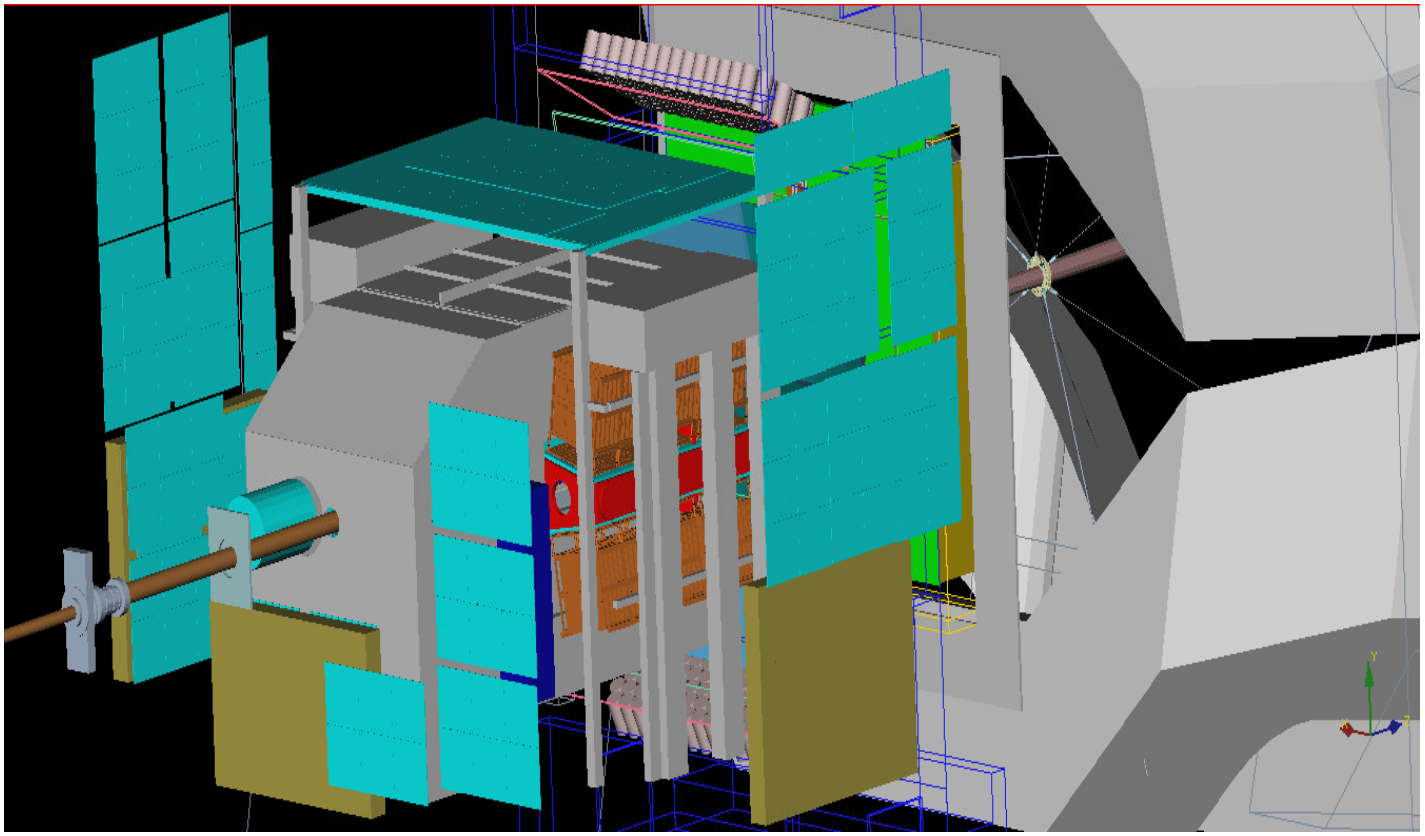
RoMOEDAL status report

V. Popa, for the RO-MoEDAL team



ISAB – CERN-RO meeting, November 15 – 17 2021

Overview

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

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MoEDAL

"Monopole and Exotics Detection at LHC"

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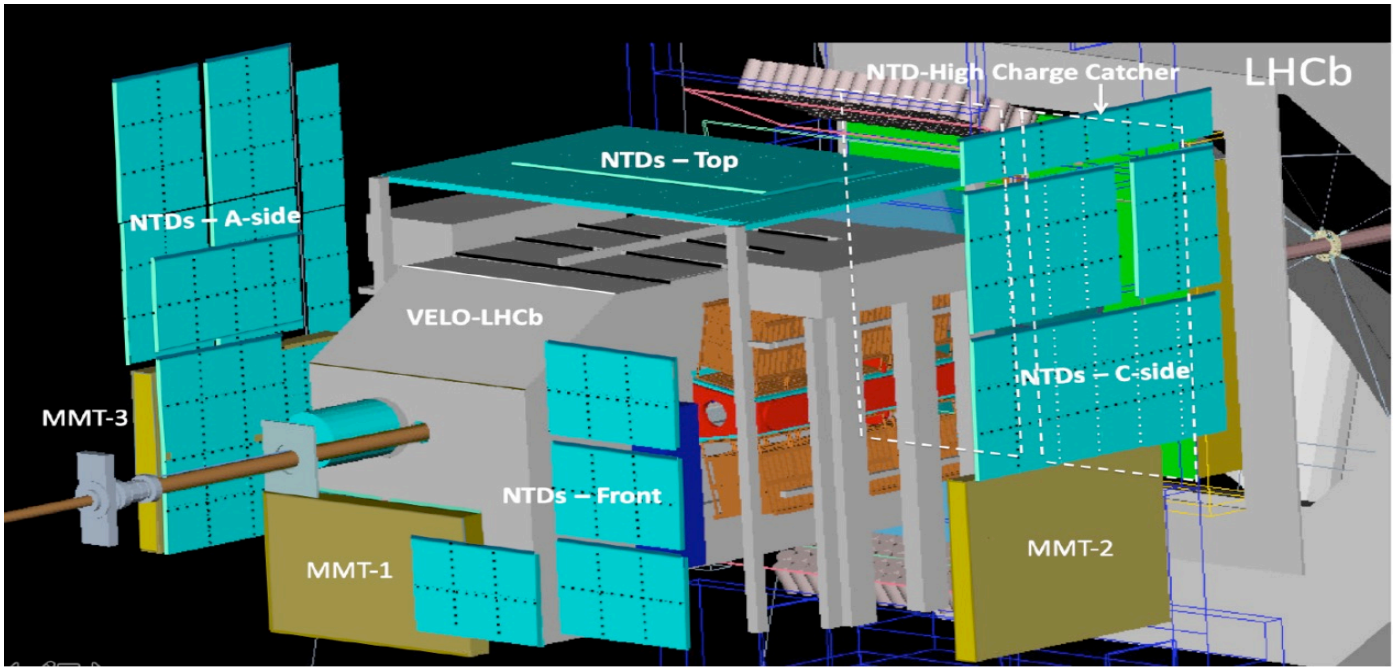
MoEDAL shares intersection point 8 on the LHC ring with LHCb

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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MoEDAL News – Preparing for Run 3

A) MoEDAL

We have presented an Installation request to reinstall MoEDAL to LHCb

- They have accepted it subject to CAD drawings in CATIA (CERN's CAD design system) being presented.
- We will submit a MoEDAL Technical Proposal as soon as we have the green light from LHCB.

The new MoEDAL geometry adapted to the LHCb – VELO evolution, including the PLUME (Luminosity monitor) deployment.

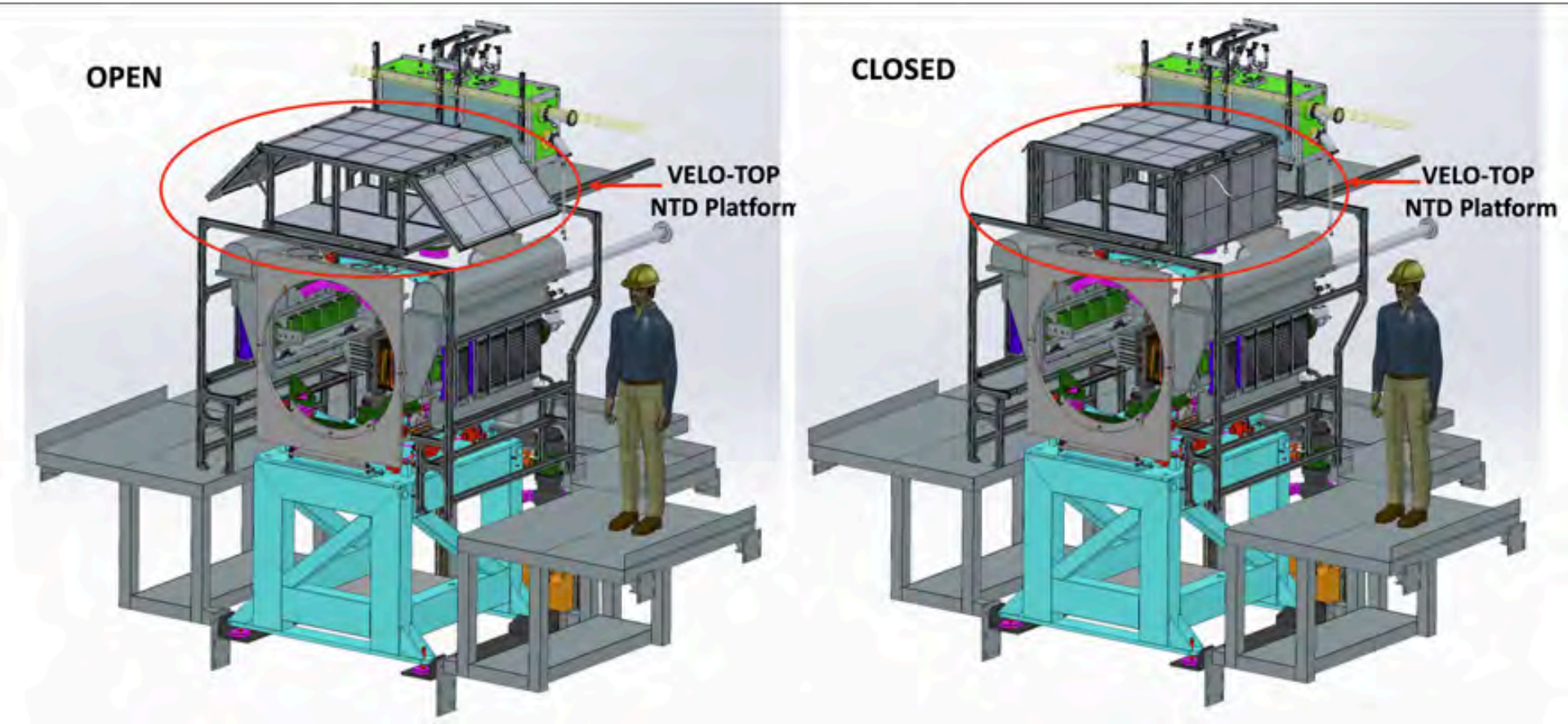
MoEDAL Installation & Operation at Run-3 and LHCb Resources

Version 2.0

September 2021

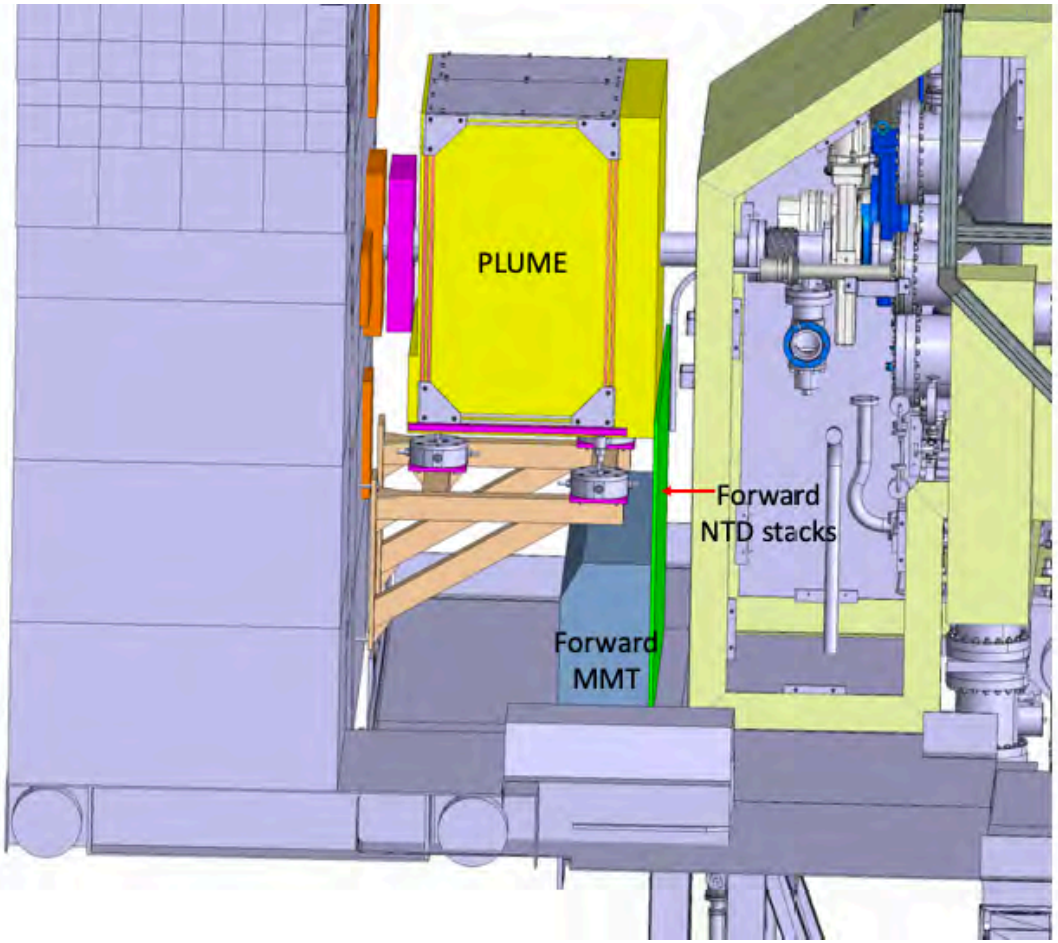
B. Acharya,[1,2] J. Alexandre,[1] P. Benes,[3] B. Bergmann,[3] J. Bernabéu,[4] A. Bevan,[5] H. Branzas,[6] P. Burian,[3] M. Campbell,[7] M. Campbell,[7] S Cecchini,[8] Y. M. Cho,[28], M. de Montigny,[9] A. de Roeck,[7] J. R. Ellis,[1,10] M. El Sawy,[7] M. Fairbairn,[1] D. Felea,[6] M. Frank,[11] J. Hays,[5] A. M. Hirt,[29] P.Q. Hung,[30] J. Janecek,[3] M. Kalliokoski,[18] D-W Kim,[13] A. Korzenev,[15] D. Lacarèrre,[7] S. C. Lee,[13] C. Leroy,[16] G. Levi,[8] A. Lionti,[15] A. S. Lobos, [9] J. Mamuzik,[4] A. Maulik,[8,9] A. Margiotta,[17] N. Mauri,[8] N. E. Mavromatos, [1] P. Mermod,[15] M. Miesikolainen,[18] L. Millward,[5] V. A. Mitsou,[4] R. Oravo,[18] I. Ostrovskiy,[19] P.-P. Ouimet,[9] J. Papavassilou,[4] B. Parker,[20] L Patrizii,[8] G. E. Păvălaş,[6] J. L. Pinfold,[9,*] L. A. Popa,[6] V. Popa,[6] M. Pozzato,[8] S. Pospisil,[3] A. Rajantie,[21] R. Ruiz de Austi,[4] Z. Sahnoun,[8,22] M. Sakellariadou,[1] A. Santra,[4] S. Sarkar,[1] G. Semenoff,[23] A. Shaa,[24] G Sirri,[8] K. Sliwa,[25] R. Soluk,[9] M. Spurio,[8] M. Staelens,[9] M. Suk,[4] M. Tenti,[27] V. Togo,[8] J. A. Tuszynski,[9] , A. Upreti,[19] V. Vento,[3] O.Vives,[4] A.Wall,[19]

MoEDAL News – Preparing for Run 3



The new NTD array on top of the VELO detector

MoEDAL News – Preparing for Run 3



Added MMT's bellow PLUME

MoEDAL News – Preparing for Run 3

B) MAPP (MoEDAL Apparatus for Penetrating Particles)

We have submitted a Technical Proposal (TP) for MAPP:
- The safety derogation for this detector that will be deployed at Run-3 has been approved;
- The LHC Machine Committee has approved the TP;
- The LHCC will consider the TP at the November LHCC meeting. (this week)

The MAPP position changed from gallery UGC1 to UA83; previous simulations updated consequently.

MAPP Phase-1 Technical Proposal

Version 2.0

October 25th 2021

B. Acharya,[1,2] J. Alexandre,[1] P. Benes,[3] B. Bergmann,[3] J. Bernabéu,[4] A. Bevan,[5] H. Branzas,[6] P. Burian,[3] M. Campbell,[7] M. Campbell,[7] S Cecchini,[8] Y. M. Cho,[28], M. de Montigny,[9] A. de Roeck,[7] J. R. Ellis,[1,10] M. El Sawy,[7] M. Fairbairn,[1] D. Felea,[6] M. Frank,[11] J. Hays,[5] A. M. Hirt,[29] P.Q. Hung,[30] J. Janecek,[3] M. Kalliokoski,[18] D-W Kim,[13] A. Korzenev,[15] D. Lacarère,[7] S. C. Lee,[13] C. Leroy,[16] G. Levi,[8] A. Lionti,[15] A. S. Lobos, [9] J. Mamuzik,[4] A. Maulik,[8,9] A. Margiotta,[17] N. Mauri,[8] N. E. Mavromatos, [1] P. Mermod,[15] M. Miesiolainen,[18] L. Millward,[5] V. A. Mitsou,[4] R. Oravo,[18] I. Ostrovskiy,[19] P.-P. Ouimet,[9] J. Papavassilou,[4] B. Parker,[20] L Patrizii,[8] G. E. Păvălaş,[6] J. L. Pinfold,[9,*] L. A. Popa,[6] V. Popa,[6] M. Pozzato,[8] S. Pospisil,[3] A. Rajantie,[21] R. Ruiz de Austi,[4] Z. Sahnoun,[8,22] M. Sakellariadou,[1] A. Santra,[4] S. Sarkar,[1] G. Semenoff,[23] A. Shaa,[24] G Sirri,[8] K. Sliwa,[25] R. Soluk,[9] M. Spurio,[8] M. Staelens,[9] M. Suk,[4] M. Tenti,[27] V. Togo,[8] J. A. Tuszynski,[9] , A. Upreti,[19] V. Vento,[3] O.Vives,[4] A.Wall,[19]

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[2]International Centre for Theoretical Physics, Trieste, Italy
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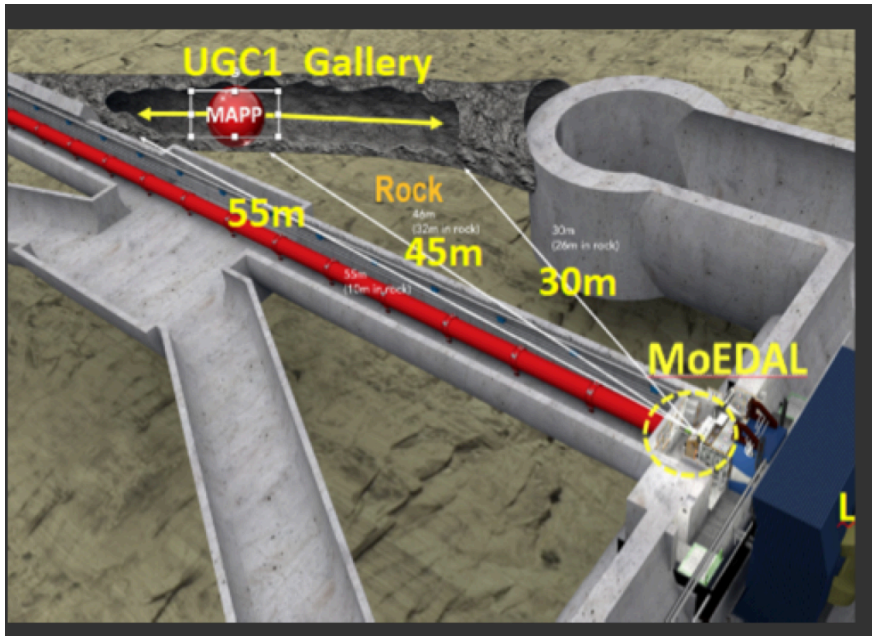
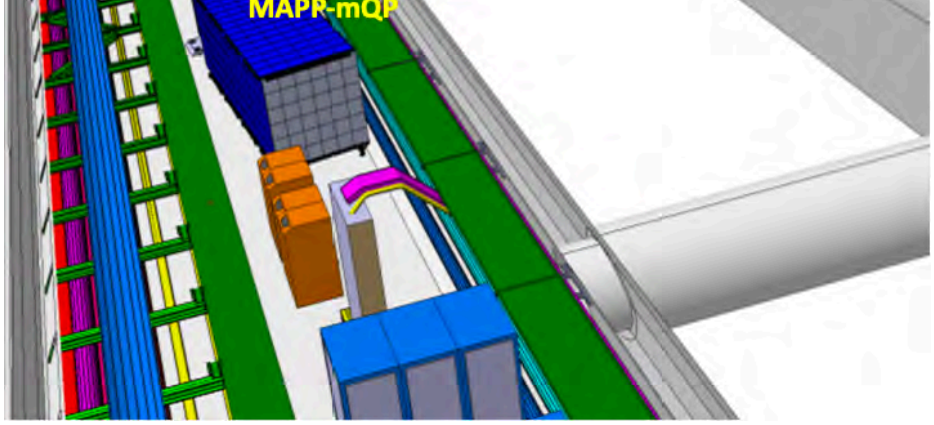
MoEDAL News – Preparing for Run 3





MoEDAL News – Preparing for Run 3

We will need to prepare a single MoU covering both these efforts.

This will be handled through the MoEDAL Collaboration Board.

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

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Dyons

PHYSICAL REVIEW LETTERS **126,** 071801 (2021)

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,[13] L. Millward,[4] V. A. Mitsou,[3] R. Orava,[13] I. Ostrovskiy,[17] P.-P. Ouimet,[9,¶] J. Papavassiliou,[3] B. Parker,[18] 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,[19] R. Ruiz de Austri,[3] Z. Sahnoun,[7,**] M. Sakellariadou,[1] A. Santra,[3] S. Sarkar,[1] G. Semenoff,[20] A. Shaa,[9] G. Sirri,[7] K. Sliwa,[21] R. Soluk,[9] M. Spurio,[16] M. Staelens,[9] M. Suk,[2] M. Tenti,[22] V. Togo,[7] J. A. Tuszyński,[9] A. Upreti,[17] V. Vento,[3] O. Vives,[3] and A. Wall[17]

(MoEDAL Collaboration)

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Schwinger mechanism

First experimental search for production of magnetic monopoles via the Schwinger mechanism

B. Acharya[1], J. Alexandre[1], P. Benes[2], B. Bergmann[2], S. Bertolucci[3], A. Bevan[4], H. Branza[5], P. Burian[2], M. Campbell[6], Y. M. Cho[7], M. de Montigny[8], A. De Roeck[6], J. R. Ellis[1,9], M. El Sawy[6], M. Fairbairn[1], D. Felea[5], M. Frank[10], O. Gould[11,12], J. Hays[4], A. M. Hirt[13], D. L. J. Ho[14], P. Q. Hung[15], J. Janecek[2], M. Kalliokoski[16], A. Korzenev[17], D. H. Lacarrère[6], C. Leroy[18], G. Levi[19], A. Lionti[17], A. Maulik[6,8], A. Margiotta[19], N. Mauri[3], N. E. Mavromatos[1], P. Mermod[17,†], L. Millward[4], V. A. Mitsou[20], I. Ostrovskiy[21,*], P.-P. Ouimet[8], J. Papavassiliou[20], B. Parker[22], L. Patrizii[3], G. E. Păvălaş[5], J. L. Pinfold[8], L. A. Popa[5], V. Popa[5], M. Pozzato[3], S. Pospisil[2], A. Rajantie[14], R. Ruiz de Austri[20], Z. Sahnoun[3], M. Sakellariadou[1], A. Santra[20], S. Sarkar[1], G. Semenoff[23], A. Shaa[8], G. Sirri[3], K. Sliwa[24], R. Soluk[8], M. Spurio[19], M. Staelens[8], M. Suk[2], M. Tenti[25], V. Togo[3], J. A. Tuszyński[8], A. Upreti[21], V. Vento[20], O. Vives[20]

[1] *Theoretical Particle Physics & Cosmology Group, Physics Dept., King's College London, UK*

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This paper was resubmitted with some corrections requested by the reviewers.

HECO search (Run 1)

Search for High Ionizing Particles in *pp* Collisions at the LHC's Run-1 Using the Prototype MoEDAL Detector

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

(THE MoEDAL COLLABORATION)

[1] *Theoretical Particle Physics & Cosmology Group, Physics Dept., King's College London, UK*
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[5] *School of Physics and Astronomy, Queen Mary University of London, UK*
[6] *Institute of Space Science, Bucharest - Măgurele, Romania*
[7] *Experimental Physics Department, CERN, Geneva, Switzerland*
[8] *Center for Quantum Spacetime, Sogang University, Seoul, Korea*
[9] *Physics Department, University of Alberta, Edmonton, Alberta, Canada*

The paper finalized in the Collaboration, ready for sumbission

Detector software development and maintenance

- ***Daniel Felea*** was assigned as **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.*

- ***995156*** (January 15, 2021) : ***"Status of the Remaining Software Issues – Photon Fusion Simulations"*** – ***D. Felea***

- ***1037713*** (June 03, 2021) : *At the* ***15th MoEDAL Collaboration Meeting (CERN, Geneva, Switzerland)***

"Report of the Software Coordinators" (/contributions/4382969) – A. Upreti and ***D. Felea***

- ***1050989*** (June 18, 2021) : ***"MoEDAL Software Updates" – D. Felea*** and ***A. Upreti***
- ***1075022*** (September 10, 2021) : ***"MoEDAL Software Updates" – D. Felea*** and ***A. Upreti***
- ***1079670*** (September 24, 2021) : ***"MoEDAL Software Updates" – A. Upreti*** and ***D. Felea***

- ***1012423*** (February 26, 2021) :***"MadGraph5 and Gauss v49r17 data analysis"*** – ***H. Brânzaş***
- ***1017639*** (March 12, 2021) : ***"MadGraph5 Cross Sections Update"*** – ***H. Brânzaş***
- ***1022303*** (March 26, 2021) : ***"MadGraph5 Cross Sections in PbPb"*** – ***H. Brânzaş***
- ***1055380*** (July 2, 2021) : ***"MadGraph5 Cross Sections in PbPb Update"*** – ***H. Brânzaş***

Search for dark Higgs inflaton with curvature couplings at LHC experiments

The results used in MAPP – Phase 1 Technical Proposal

Lucia Aurelia Popa

Institute of Space Science,
Bucharest-Magurele, Ro-077125 Romania

E-mail: lpopa@spacescience.ro

Abstract. We analyse the dark Higgs inflation model with curvature corrections and explore the possibility to test its predictions by the particle physics experiments at LHC.
We show that the dark Higgs inflation model with curvature corrections is strongly favoured by the present cosmological observation. The cosmological predictions of this model, including the quantum corrections of dark Higgs coupling constants and the uncertainty in estimation of the reheating temperature, lead to the dark Higgs mass $m_\phi = 0.919\pm 0.211$ GeV and the mixing angle $\theta = 1.492\pm 0.045$ (at 68% CL).
We evaluate the FASER and MAPP-1 experiments reach for dark Higgs inflaton mass and mixing angle in the 95% CL cosmological confidence region for an integrated luminosity of 3ab^{-1} at 13 TeV LHC, assuming 100% detection efficiency.
We conclude that the dark Higgs inflation model with curvature corrections is a compelling inflation scenario based on particle physics theory favoured by the present cosmological measurements that leaves imprints in the dark Higgs boson searchers at LHC.

Keywords: cosmic microwave background, inflation, dark Higgs, cosmological observations, LHC experiments

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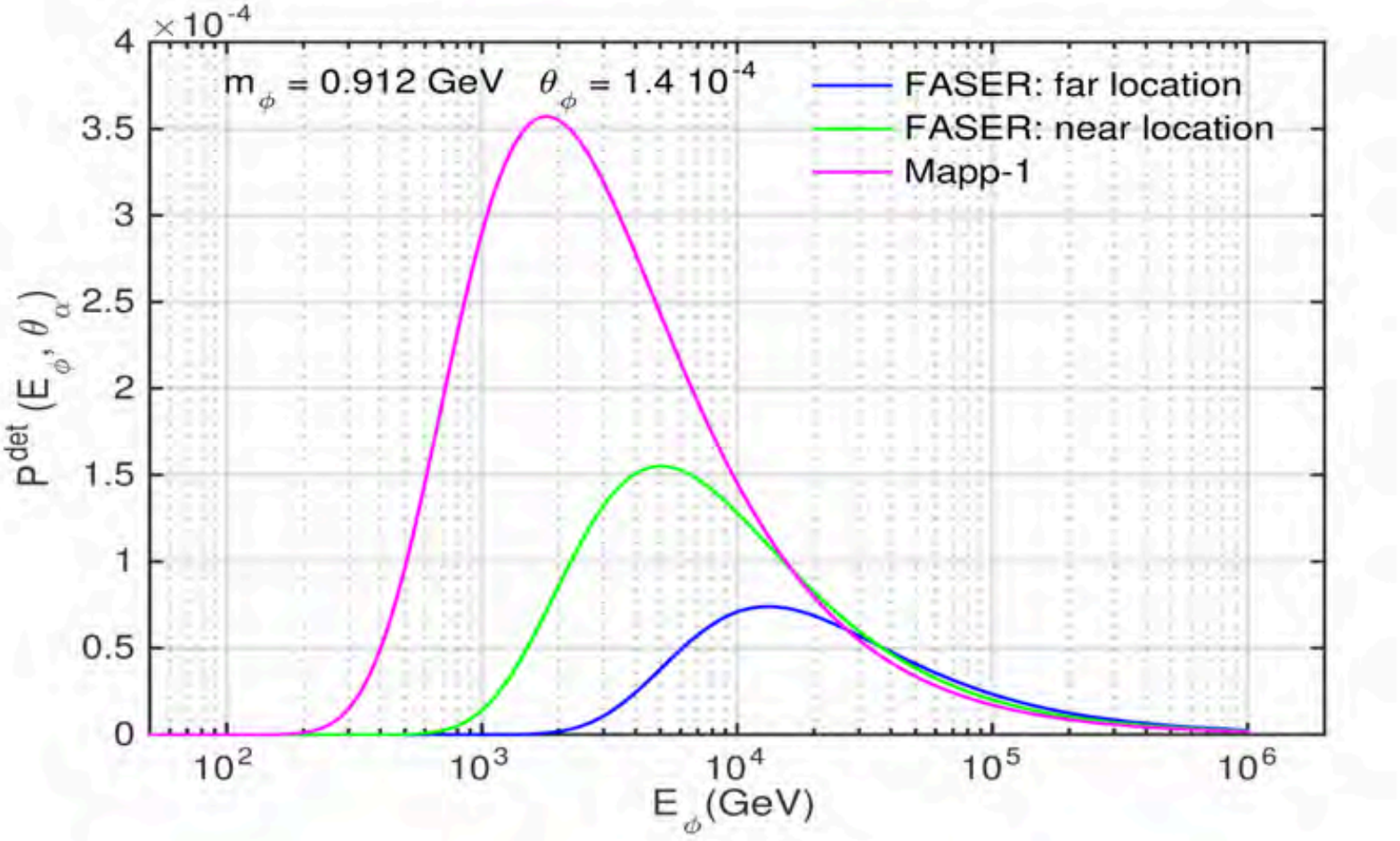
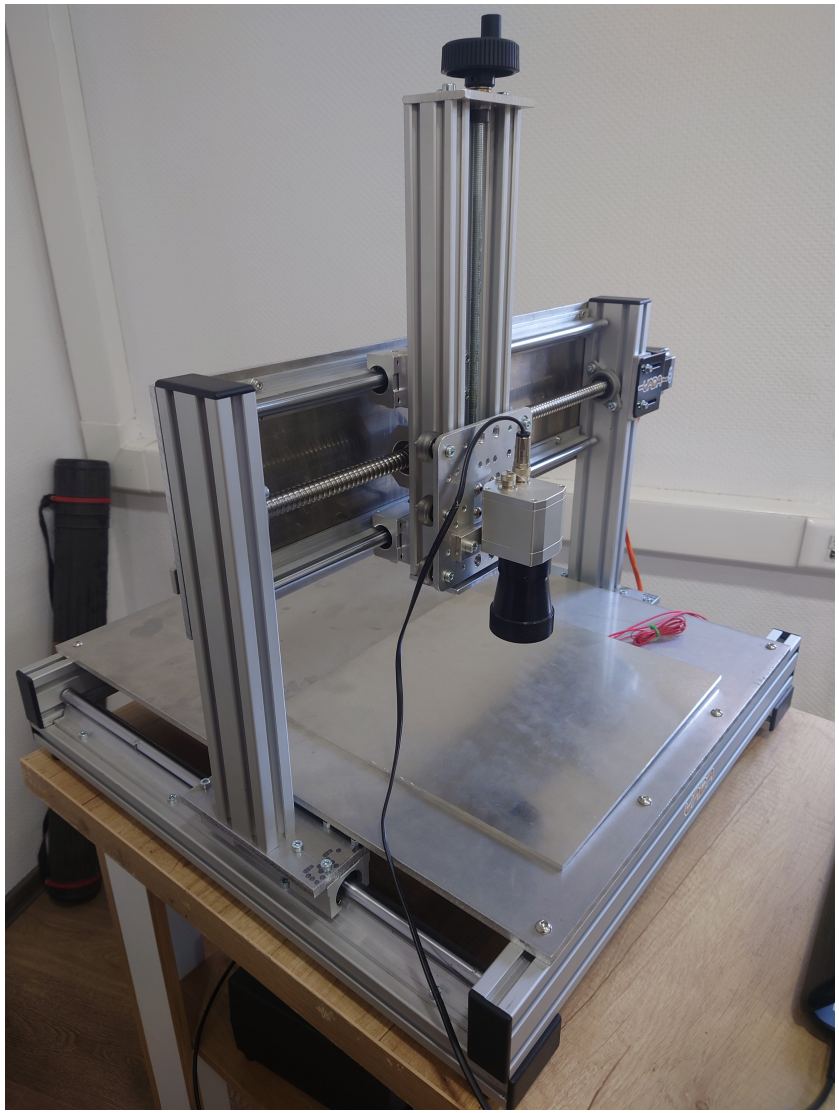
Prospects of new physics with MAPP



The thermal scanning idea

Thermal scanning setup

- Thermal camera: Optris PI 400
- X Y axis: computer-controlled movement, using stepper motors
- Z axis: manual adjustment of the focus distance
- Heated bed
- On-going update: Peltier cooling of the bed



MoEDAL

The thermal scanning idea

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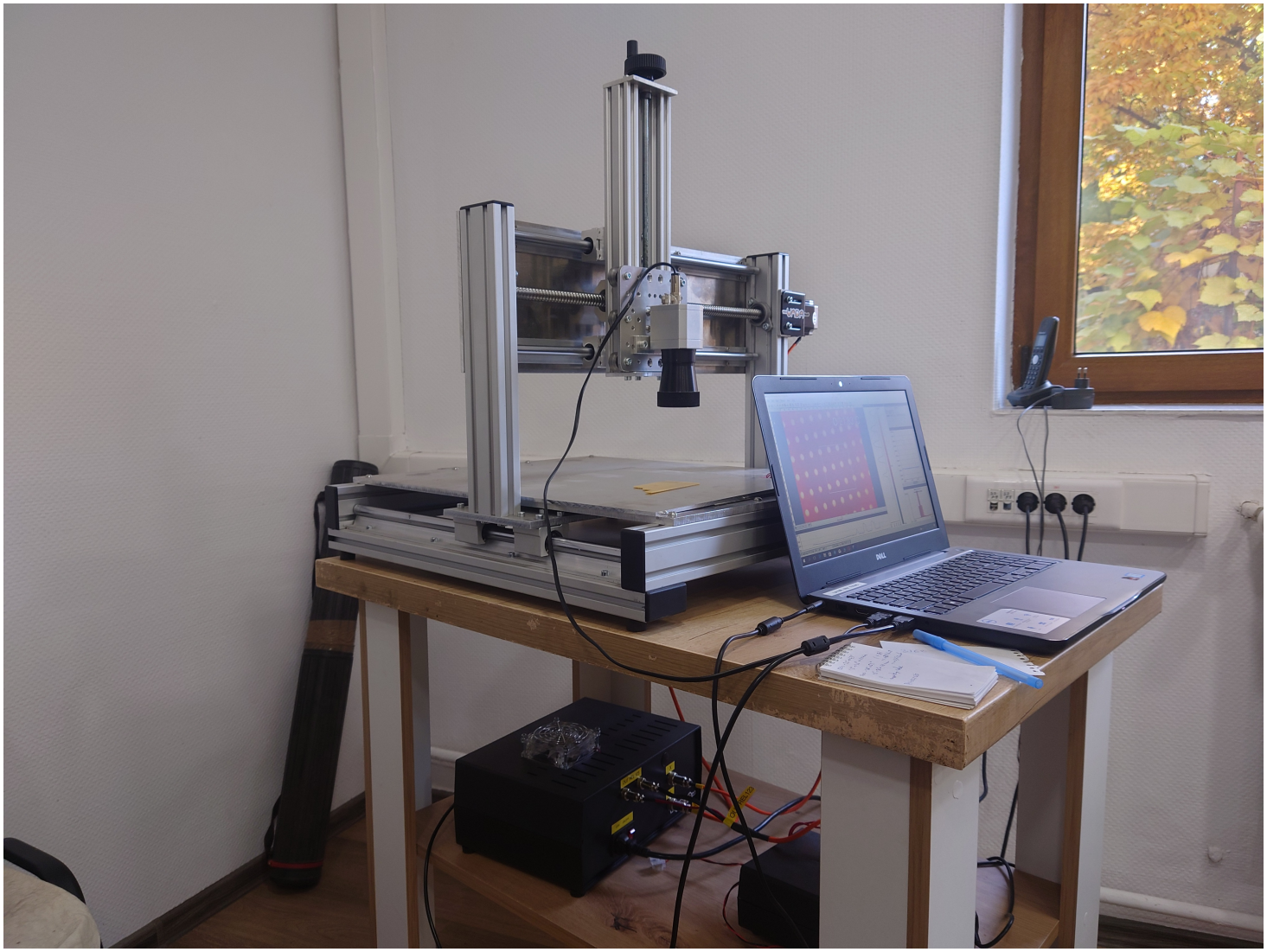
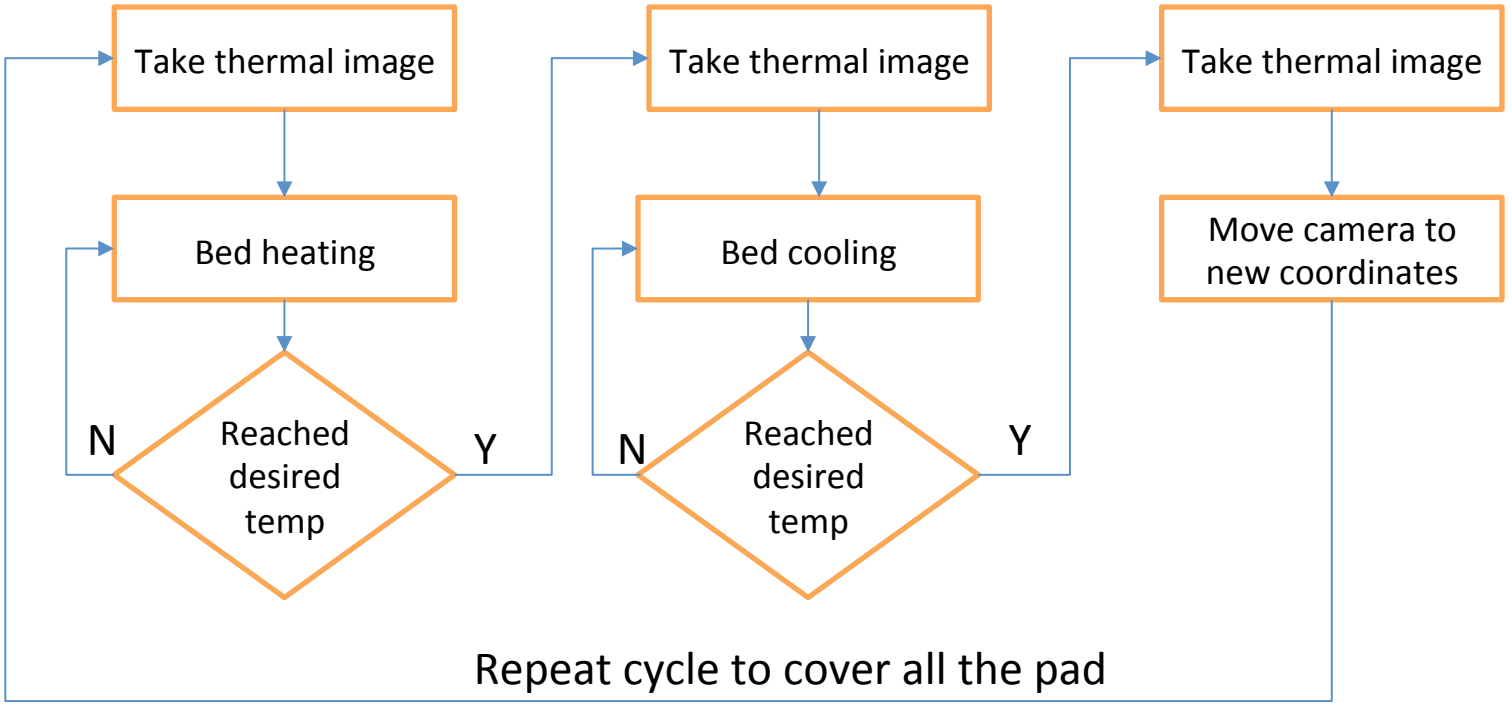
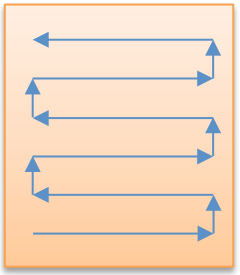


Thermal cycling

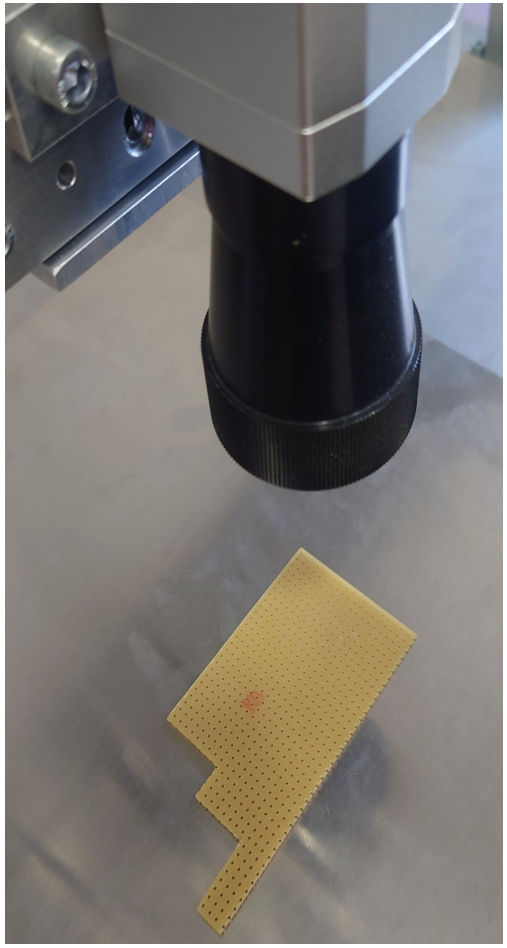


- The camera is moved in a S-shaped pattern in the XY plane to cover all the surface of the pad:

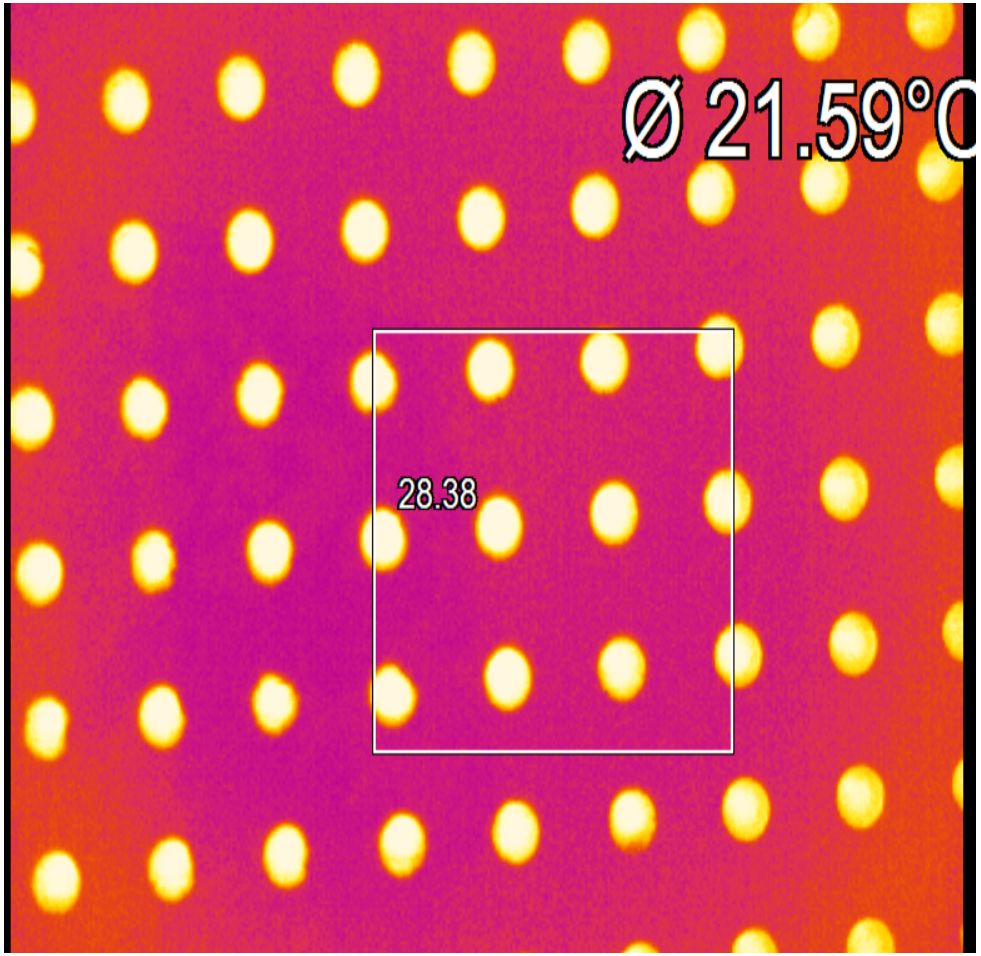


- The movement of the camera, heating and cooling to desired temperatures are controlled by the computer.

Thermal imaging first test runs



Test on prototyping PCB bord
~2mm distance between holes



Thermal image after heating

- Average temperature: 21.59 C
- Temperature through a hole: 28:38 C

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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) : the dyon paper was published, the Schwinger monopole paper was resubmitted after minor improvements, the HECO paper is finalised, the the NTD (high threshold) paper is in finalisation, the bim pipe paper and the detector paper are in preparation.
- RO - MoEDAL is going on with an enlarging team (since last year one senior scientist and one PhD student joined us!)

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Conclusions

Excepting some delays and inherent difficulties produced by the pandemic situation, both MoEDAL and the RO-MoEDAL projects are going well.

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

New researchers joined RO-MoEDAL, as envisaged last year.

The study of a possible “thermal scanning” of NTDs is progressing; the prototype is functional, fine tuning will follow.

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

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Thank you for your attention and Stay safe!