Progress in Lithuania

2023-05-04

Contents

CERN Activities at the National level

Ministry of Education, Science and Sport

Priorities of the Ministry regarding membership in CERN

- Capable, coordinated scientific potential and excellence
- A wide variety of scientific fields and topics
- Sustained and sufficient national funding
- Active participation of children and youth in initiatives
- New opportunities for business
- Solving socio-economic challenges
- International recognition
- Full membership in CERN

Objectives of the Ministry

- Focus and enhance the potential of particle physics and related topics
- Enable national targeted funding mechanisms
- Effective participation in CERN programs, other initiatives
- Attract business and create prerequisites for science-business cooperation and innovation
- To interest and involve schoolchildren and students
- Solve societal challenges and contribute to economic development

Obligations of the Ministry

- Action Plan of the Associate Membership of Lithuania in CERN 2022–2027 approved on October 2022
- Targeted funding for activities related to CERN membership planned:

Objective	Funding 2022-2027, M EUR
Strengthening the R&D&I potential	4,6
Representation and participation	0,7
Knowledge dissemination	1
Infrastructure development	3,2
Ensuring appropriate conditions	9 (6 – membership fee)
Business participation	0,5 (MoEI)

Particle Physics

Vilnius University

Main Activities 2022–2023 (1/2) at the Center

Drafting:

- Drafting earlier versions of Lithuanian CERN Action Plan 2022–2027.
- Arranging Vilnius Pixel lab preparations.
- Co-prepared a COST Action (on EWK/VBS and Higgs topics)
  - 2nd resubmission in 2022 Oct.

CMS research:

- Engaged in
  - $t\bar{t}H$ analysis (A. Rinkevicius, N. Chychkalo)
  - CMS online tools (D. Simelevicius, V. Rapsevicius)
  - DiHiggs analysis (A. Carvalho*, N. Chychkalo)
  - Pixel tracker (A. Carvalho*, A. Rinkevicius, N. Chychkalo)
- CMS “extended internships” (Cat A personnel)

Overall research:

- Projects with CERN, industry, and Lithuanian Research Council.

Main Activities 2022–2023 (2/2) at the Center

Studies and students:

- Teaching (and reworking) HEP courses.
- Student (undergraduate and graduate) supervision.

Knowledge transfer:

- Co-started DeepTech Entrepreneurship program with VU Business School, CERN Lithuanian BIC, CERN KT.

Baltic Events:

- Main organizer of 2nd CERN Baltic Conference (2022).
- Co-organization of 3rd CERN Baltic School (2023) in Palanga.

Outreach:

- A couple of masterclass events with KTU, LSMU, ...
- Various solo events

Experimental Particle Physics at VU 1/2

Background estimation for Drell-Yan differential cross-section measurement with full Run 2 data:

- Z/$\gamma*$ $\rightarrow$ee: preliminary results available for both prompt and fake lepton backgrounds, working on finalizing the results
- Z/$\gamma*$ $\rightarrow$ $\mu\mu$: preliminary result available for prompt lepton backgrounds, working on fake lepton background estimation
- Analysis Note in preparation by the DY group, aiming for preapproval soon

Pixel chip prototype testing for the Phase-2 upgrade of CMS Inner Tracker:

- Performing test data-taking measurements on RD53B-CMS (CROC) chip with a 3D sensor using a radioactive source
- Investigating a potential issue with the trigger or data readout timing

Experimental Particle Physics at VU 2/2

Theory–experiment comparison for EWWG V+jets group:

- Machinery of χ^2 estimator taking into account uncertainty correlations
- Reviewing possible recommendations for experimentators how to present the uncertainty correlations

Participating in CMS experiment M&O:

- 28 remote DAQ shifts during March–April

Theoretical Particle Physics at VU

- Dark Matter stabilization with $\mathbb{Z}_N$ group, search for discrete groups centers [1].
- One-loop corrections to $Zb\bar{b}$ vertex in CP-conserving left–right model [2].
- Charged Lepton Flavour Violating processes in Grimus–Neufeld model [3].
- Oblique parameter studies with $m_W \neq m_Z \cos\theta_W$ [4].

1. D. Jurčiukonis and L. Lavoura, "The centers of discrete groups as stabilizers of dark matter", PTEP **2023** (2023) no.2, 023B02.
2. D. Fontes, D. Jurčiukonis and L. Lavoura, "The $Zb\bar{b}$ vertex in a left-right model", submitted to Phys. Rev. D.
3. V. Dūdėnas, T. Gajdosik, U. Khasianevich, W. Kotlarski and D. Stöckinger, "Box-enhanced charged lepton flavor violation in the Grimus-Neufeld model", Phys. Rev. D **107** (2023) no.5, 055027.
4. V. Dūdėnas, S. Draukšas and L. Lavoura, "The oblique corrections when $m_W \neq m_Z \cos\theta_W$ at tree level", prepared for publication.

Theoretical Nuclear Physics at VU

- Nonlocal nucleon–nucleus optical potentials in Be and Mg.
- Energy-independent potentials for low-energy events.

1. A. Deltuva and D. Jurčiukonis, “Nonlocal optical potential with core excitation in $^{10}\mathrm{Be}(d,p)^{11}\mathrm{Be}$ and $^{11}\mathrm{Be}(p,d)^{10}\mathrm{Be}$ reactions”, Phys. Lett. B **840** (2023), 137867.
2. A. Deltuva and D. Jurčiukonis, “Nonlocal optical potential in the inelastic deuteron scattering off $^{24}\mathrm{Mg}$”, submitted to Phys. Rev. C.

Nuclear Physics

Vytautas Magnus University

NUCLEAR PHYSICS GROUP

Faculty of Natural Sciences | VMU

Activities:

1. Participation in 3rd Baltic School of High-Energy Physics and Accelerator Technologies 2023

2. Application for joint scientific projects of research in CERN research topics (with KTU) (“A new generation carbon optoelectronic sensor for the Compact Muon Solenoid detector”)

3. Participation in workshop “Particle therapy - future for the Baltic States? State-of-play, synergies and challenges” in May

NUCLEAR PHYSICS GROUP

Faculty of Natural Sciences | VMU

Ongoing research:

1. Chiral nuclear interaction application for the algebraic few-body system model (VMU Nuclear Physics group)

2. Neural network application for the angular momenta recoupling coefficient calculation (Together with the VMU Faculty of Informatics)

Nuclear Physics

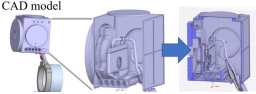
Lithuanian Energy Institute

Ongoing activities@LEI in collaboration with CERN MEDICIS in 2023

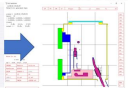
Nuclear analysis of high power molten targets at MEDICIS and ISOLDE for the production of radioisotopes

- CAD to MCNP conversion using McCAD code of LIEBE target.
- Nuclear analysis (proton/neutron/gama) flux, dose, activation etc.

CAD model

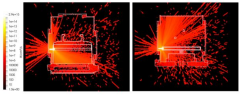


MCNP model

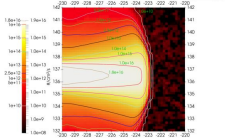


Proton flux in the target

- MCNP Monte Carlo code, FENDL-3.1 cross-section data library, 10^8 number of histories
- 1 mm radii 70 MeV – 100 μA proton beam.

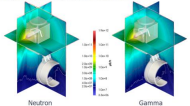


Proton flux in the target



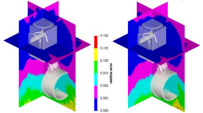
Neutron and gamma induced dose rate distribution

Gamma and neutron dose rates there reach almost 2 MSv/h each. However, around the target dose rates are much lower, around 361 Sv/h for gamma rays and 214 Sv/h for neutrons.

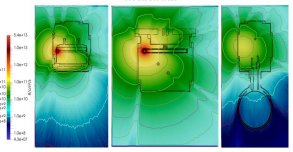


Neutron and gamma induced dose rate relative error

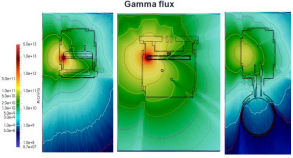
The maximum error for the dose rates reaches approximately 22 %.



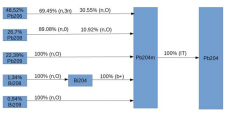
Neutron flux

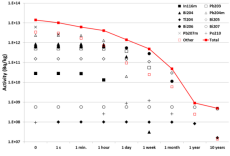


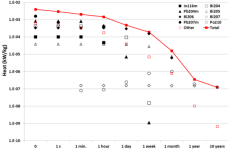
Gamma flux

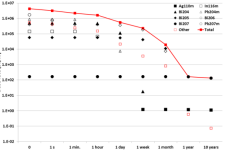


Inventory and pathway analysis

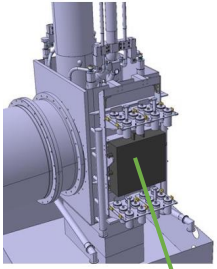


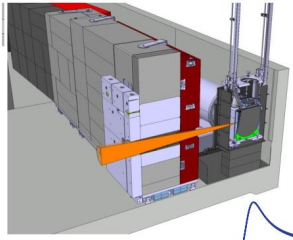


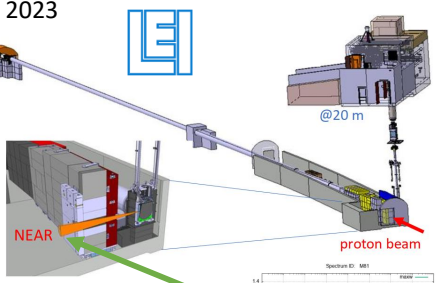




New activities@LEI in collaboration with CERN n_TOF in 2023

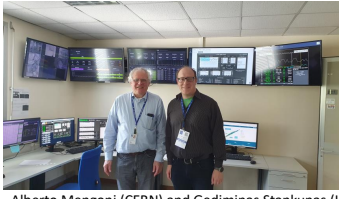




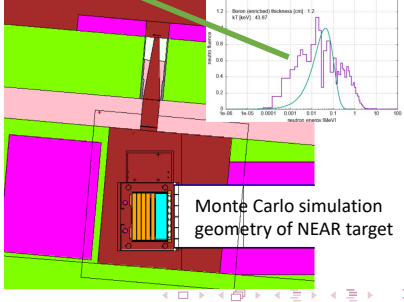


Neutronic simulation of neutron possible moderator cases:

- possible material assessment for neutron spectra to be irradiated samples;
- radiological maps inside/outside the experimental site;
- collaboration on student involvement in CERN n_TOF&LEI common activities



Alberto Mengoni (CERN) and Gediminas Stankunas (LEI) at n_TOF control center on 27-04-2023



Monte Carlo simulation geometry of NEAR target

Applied Physics and Material Science

Kaunas University of Technology

International Particle Therapy Masterclasses

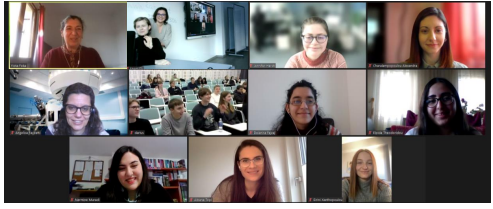
8th of March, 2023

ktu

Video bridge between KAUNAS and VILNIUS

~ 130 participants

https://indico.cern.ch/event/1241114/



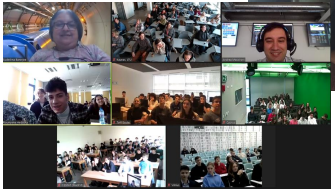
International CMS Masterclasses

29th of March, 2023

ktu

Video bridge between KAUNAS and VILNIUS

~ 120 participants



https://indico.cern.ch/event/1257963/

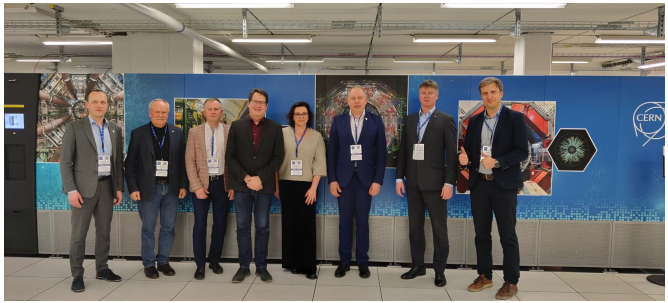
KTU Visits to CERN

ktu

November 27-29, 2022 - **dr. Brigita Abakevičienė**

March 27-28, 2023 - **KTU Rector with delegation**

https://indico.cern.ch/event/1269171/



Nuclear Medicine and Radiology

Lithuanian University of Health Sciences

LSMU CBG-associated activities

- Further implementation of CERN related radiobiology research *(will be presented separatelly).*
- CERN visit of representatives from Lithuanian University of Health Sciences 2022 Dec 13 – seeking to discuss the ways to expand the collaboration.
- Participation in organising comitee and educational activities of International Hadron Therapy Master Class.
- Organisation of 11th CERN Baltic group general meeting.

CERN visit

Entrepreneural Activities

KTU, Vilnius U.

Entrepreneural Activities

- KTU and Vilnius U. students participated in Idea^2 week (Oct 2022).
- VU DeepTech Entrepreneurship (MSc) program:
  - Made for Knowledge Transfer from DeepTech.
  - Admissions: 2021 18 (4 international), 2022 23 (7 int.) students.
  - Prepares for CERN, EIT, and other acceleration programs.
  - Launched five startup-grade MSc-student teams in 2023.