

“IDEATE: Instrumentation Developments for Experiments at Accelerator facilities and accelerating TEchniques”

- ❑ Collaboration between CNRS, CEA and Universities from French side and leading Research Institutes and Universities from Ukrainian side
- ❑ **Research** and **educational** components of the LIA: students become major actors in scientific projects
- ❑ **> 120 participants, > 30 FTE**

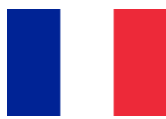
Web site : <http://ideate.lal.in2p3.fr/en/home/>

CERN-Ukraine 2024

May 28-29, 2024

Sergey Barsuk, IJCLab (CNRS and Paris-Saclay University)

sergey.barsuk@ijclab.in2p3.fr



LIA/IRP partners



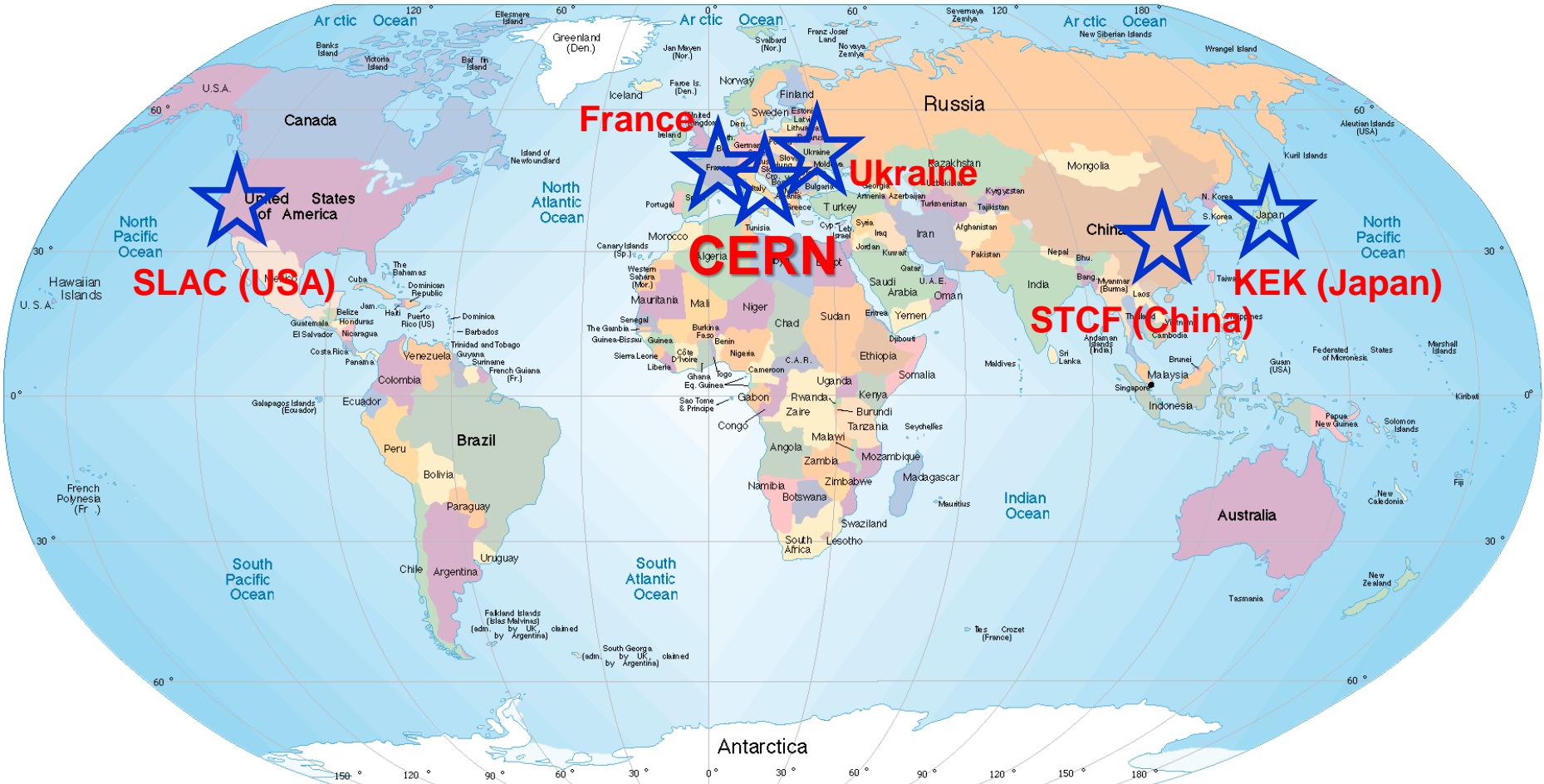
- ❑ Laboratoire de Physique des 2 Infinis Irène Joliot-Curie (CNRS and Paris-Saclay University)
- ❑ Laboratoire de Physique Corpusculaire (CNRS and Clermont Auvergne University)
- ❑ Laboratoire de Physique Nucléaire et de Hautes Energies (CNRS, Paris Diderot and Pierre et Marie Curie University)
- ❑ Laboratoire Leprince-Ringuet (IN2P3/CNRS and Ecole Polytechnique)
- ❑ Institut Pluridisciplinaire Hubert Curien (CNRS and Strasbourg University)
- ❑ Service de Physique des Particules (IRFU, DSM/CEA)
- ❑ Service de Physique Nucléaire (IRFU, DSM/CEA)
- ❑ Service d'Électronique des Détecteurs et d'Informatique (IRFU, DSM/CEA)
- ❑ Taras Shevchenko National University of Kyiv
- ❑ V.N. Karazin Kharkiv National University
- ❑ O. I. Akhiezer Institute for Theoretical Physics, NSC “Kharkov Institute of Physics and Technology”
- ❑ Institute of High-energy Physics and Nuclear Physics, NSC “Kharkov Institute of Physics and Technology”
- ❑ Institute of Applied Physics National Academy of Sciences of Ukraine
- ❑ Kyiv Institute for Nuclear Research National Academy of Sciences of Ukraine
- ❑ M. M. Bogolyubov Institute for Theoretical Physics National Academy of Sciences of Ukraine
- ❑ E.O. Paton Electric Welding Institute of the National Academy of Sciences of Ukraine
- ❑ Institute for Scintillation Materials of the National Academy of Sciences of Ukraine
- ❑ Department of Nuclear Physics in Uzhgorod National University
- ❑ Oles Honchar Dnipro National University

LIA/IRP IDEATE : basic principles

- ❑ Intimate **link between research and educational programs**
- ❑ Symbiosis of expertise of senior scientists and research work by the (Bachelor, Master and PhD) students within LIA program :
 - ❑ **PhD theses under joint supervision**
 - ❑ Students regularly enter **UPSaclay Master** programs (NPAC, GI, ...)
- ❑ (Other) **exchanges** (reduced during Covid and since RF invasion in Ukraine):
 - ❑ ~20-30 **visits of scientists** (both directions) per year
 - ❑ ~20 **student internships** per year, >40 student x months of internships per year, thereafter mostly remote internships
- ❑ **Joint publications:** >40 journal publications, >15 arXiv preprints, >20 published proceeding contributions
 - Plus more than 500 joint publications within large collaborations (mostly ALICE, LHCb and NEMO), including more than 20, where French-Ukrainian teams were playing a key role
- ❑ >150 joint presentations at **conferences and workshops**

LIA IDEATE on the map

- Joint contributions to the experiments/projects in France and Ukraine, at CERN, SLAC (USA), STCF (China), KEK (Japan)



LIA/IRP IDEATE: workshops 2013-2021, 50-80 participants

French-Ukrainian workshop
on instrumentation
development

French-Ukrainian workshop
on instrumentation
development
for high energy physics

1-3 october 2014 LAL-Orsay, France



French-Ukrainian
WORKSHOP

Instrumentation developments
for high energy physics

19-21. 2016 LAL - Orsay, France

French-Ukrainian
WORKSHOP

Instrumentation developments
for high energy physics

6-8, 2017 LAL - Orsay, France



French-Ukrainian winter
WORKSHOP on MEDICAL PHYSICS

March 3-4, 2016
T. Shevchenko National University of Kyiv

The workshop will cover state-of-the-art radiation detector technologies and advanced imaging systems for biological and medical research.

Invited Lectures:
E. Barannik (KNU, Ukraine)
O. Dymov (ISMA, Ukraine)
C. Deroulers (IMNC, France)
A. Gektin (ISMA, Ukraine)
P. Le Du (IPNL, France)
L. Ménard (IMNC, France)
CERN Speaker (CERN, Switzerland)

Organizing Committee: S. Barsuk (LAL, France), O. Bezshyyko (TSNUK, Ukraine), S. Fomin (KIPT, Ukraine), B. Grinyov (DFPD, Ukraine), L. Hubersky (TSNUK, Ukraine), I. Kadenko (TSNUK, Ukraine), V. Sharyy (IRFU, France), A. Stocchi (LAL, France), M. Titov (IRFU, France)

New developments in related instrumentation and techniques
Particle therapy and radio-guided operative cancer surgery
Quantitative models of tumors and possibility of storage and processing of medical data using GRID computing
CERN expertise in medical physics research

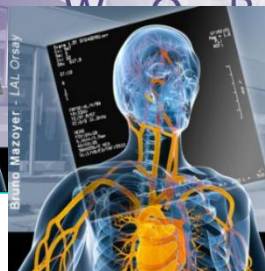
FRENCH-CERN-UKRAINIAN WORKSHOP ON
MEDICAL PHYSICS and IMAGING

April 20 - 21, 2017
V.N. Karazin Kharkiv National University
Kharkiv, Ukraine

Organizing Committee:
V. Bezshyyko (TSNUK, Ukraine)
Sergey Barsuk (LAL, France)
O. Dymov (ISMA, Ukraine)
Marek Gektin (ISMA, Ukraine)
Sergey Fomin (KIPT, Ukraine)
Igor Kadenko (TSNUK, Ukraine)
V. Sharyy (IRFU, France)

Invited Speakers:
Oleg AVJININ (KNURE, Ukraine)
Oleksandr DYMOV (ISMA, Ukraine)
Marek Gektin (ISMA, Ukraine)
Sergey Fomin (KIPT, Ukraine)
Igor Kadenko (TSNUK, Ukraine)
V. Sharyy (IRFU, France)

Logos of participating institutions: IDEATE, LIA, IMNC, ISMA, IPNL, CERN, TSNUK, KNURE, DFPD, IRFU, etc.



French-Ukrainian workshop

French-Ukrainian workshop

French-Ukrainian
WORKSHOP

Instrumentation developments
for high energy physics

October 19-23, 2020

IJClab - Orsay, France

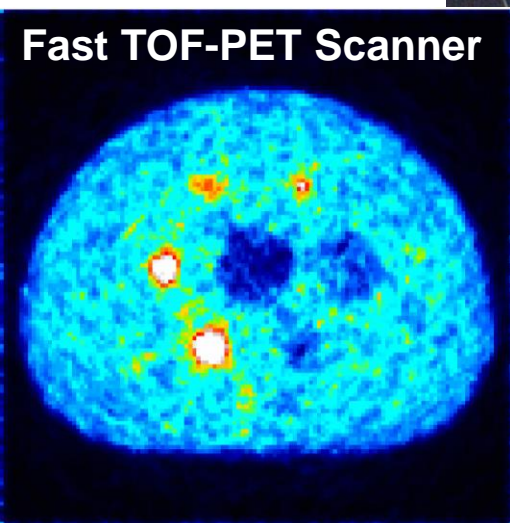
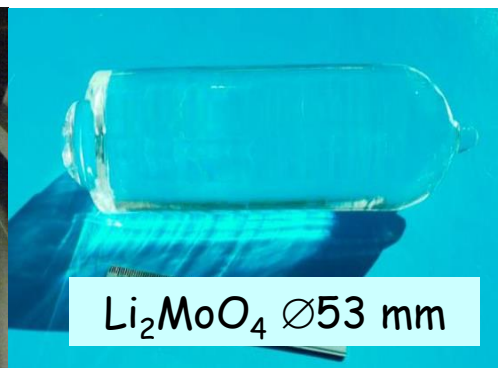


Main axes of the LIA/IRP IDEATE

18 laboratories/centers/institutes/universities: *unique combination of expertise*

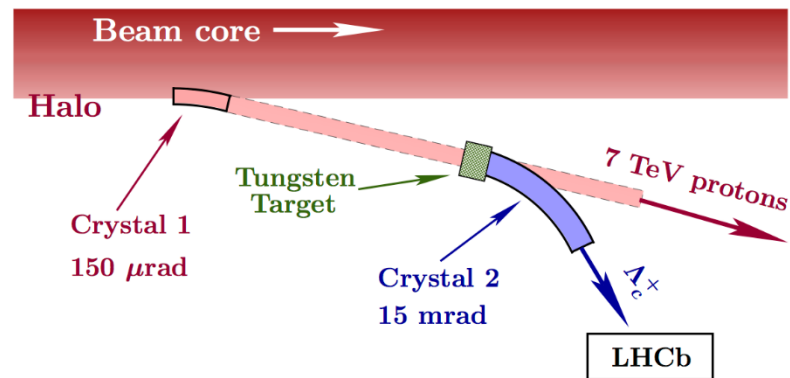
R&D on detector techniques, joint experimental platforms

Instrumentation for medical imaging

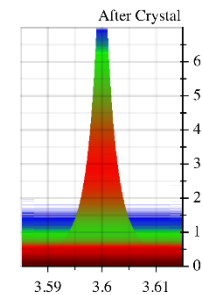
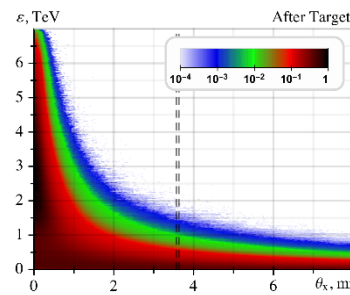
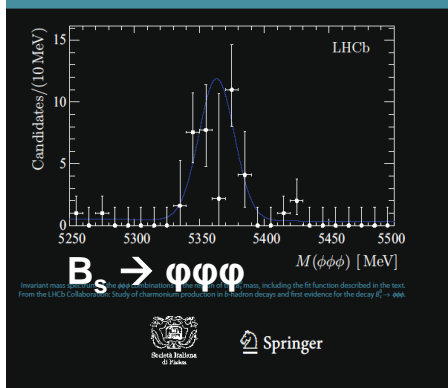


R&D on accelerator techniques

Measuring magnetic dipole moments of Λ_c at the LHC CERN using bent crystals



Developments for high-energy and nuclear physics



Pedagogical activities

Examples of joint developments

Many joint projects
Two examples shown below
Some other examples in other talks at this conference

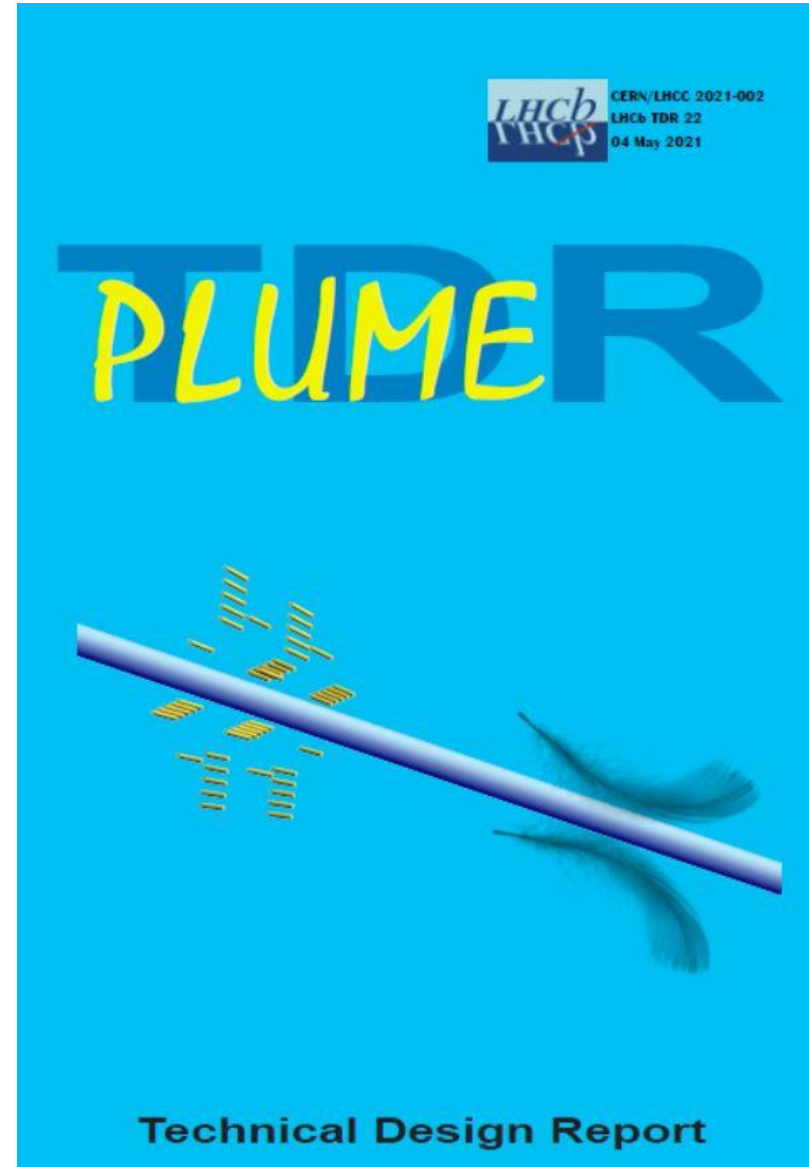
IJCLab – TSNUK – ISMA – KIPT – EPFL Lausanne – INFN Bologna – CERN

Main goal(s):

- Producing **fast alarm for LHCb and/or LHC**
- On(off)line luminosity measurement**
- Feedback to LHC for **luminosity levelling**
- Contribute to centrality determination
- Operate in a hostile radioactive environment:
80 .. 200 kGy; $\sim 5 \times 10^{13}$ n/cm²

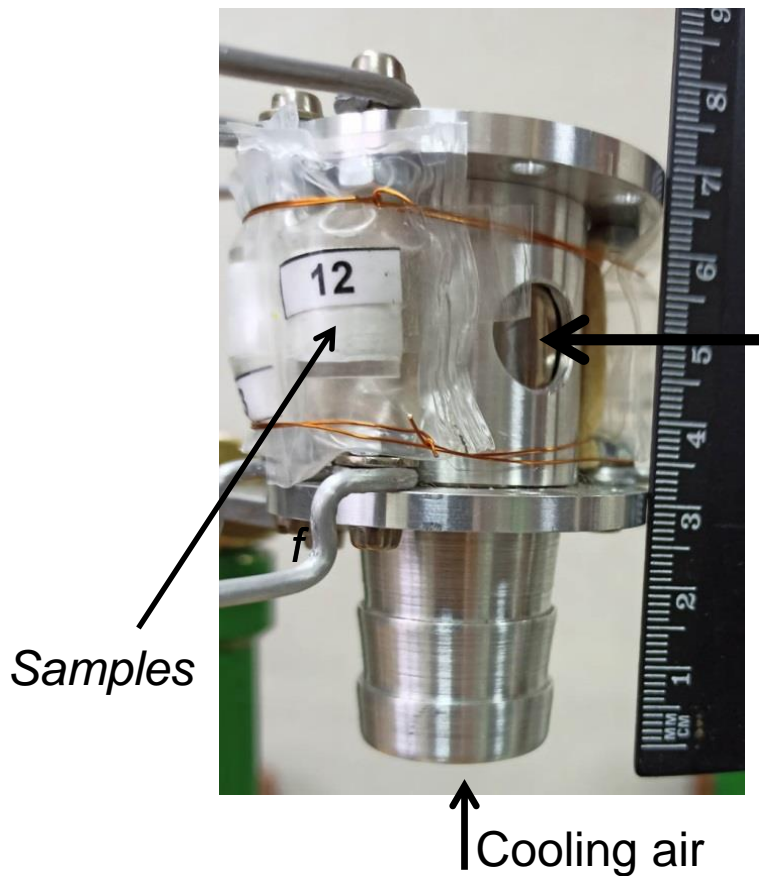
- Ukrainian groups contribution:** technology proposal, simulation and prototyping, beam tests, innovative aging studies

- Two projective planes of elementary counters detecting Cherenkov light** emitted by charged particles going in the upstream direction: PMT and quartz tablet



IJCLab – *TSNUK* – *ISMA* – *KIPT* – *EPFL Lausanne* – *INFN Bologna* – *CERN*

❑ Irradiation of materials with neutron at electron beam LUE-40 in *KIPT*



BEAM

For 11 hours of irradiation,
 Electron flux for irradiation time –
 $52 \mu\text{A}\cdot\text{h}$ ($1,16 \cdot 10^{18} \text{ e}$)
 Energy of electron beam $\sim 80 \text{ MeV}$

Yield of **neutrons** for irradiation time (11 h):
 $4.4 \cdot 10^{16} \text{ n}$
 Distribution – uniform spherical from the
 target

IJCLab – TSNUK – ISMA – KIPT – EPFL Lausanne – INFN Bologna – CERN

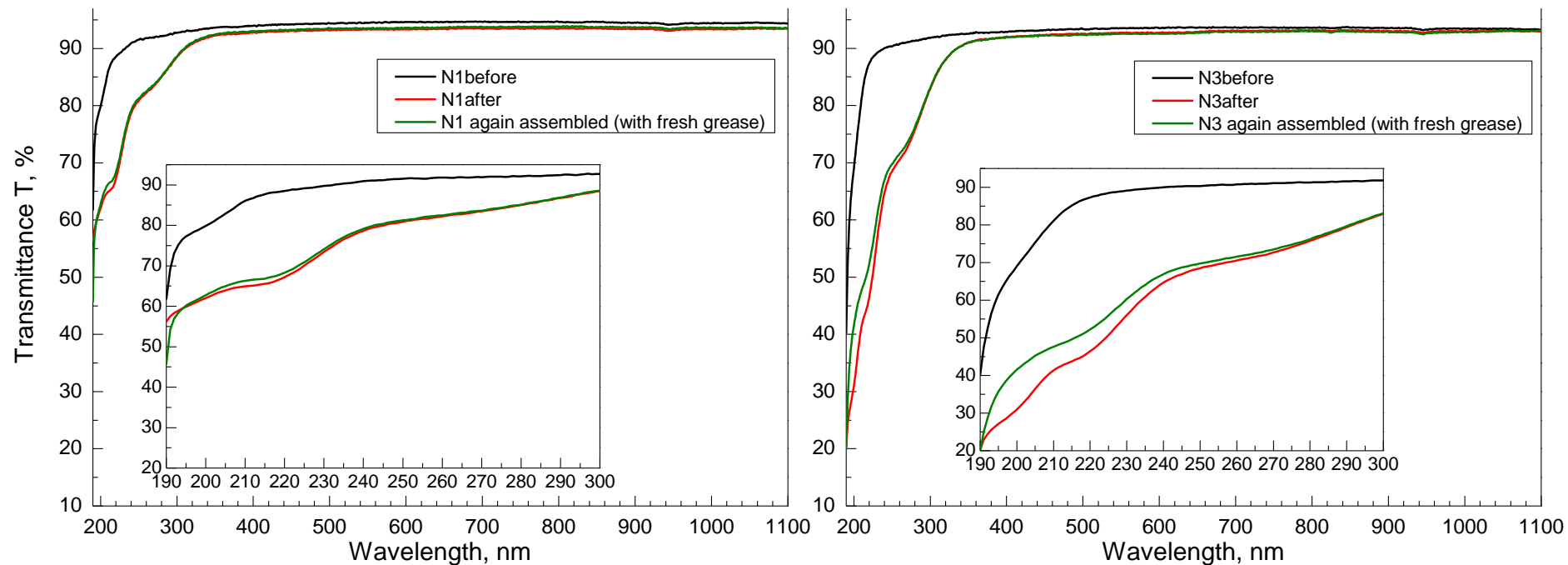
- ❑ Study **radiation resistance of optical contacts**: grease and glue samples
- ❑ Irradiation @ KIPT with e on Ta/W target (γ and neutrons) of sandwiches:

Corning HPFS 7980 quartz tablets

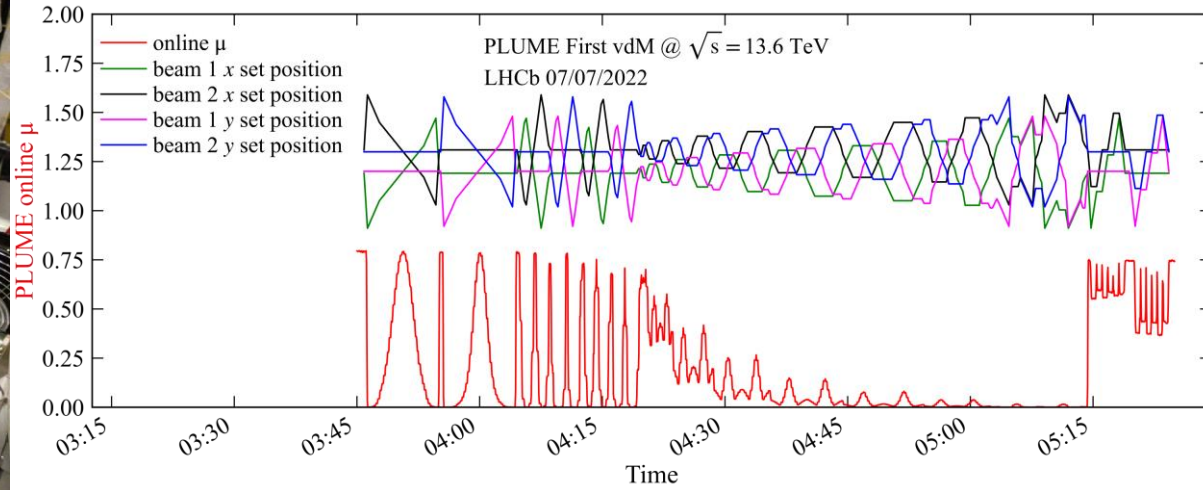
Seiko-Silicone Grease 50

TSF451-50M ⁺

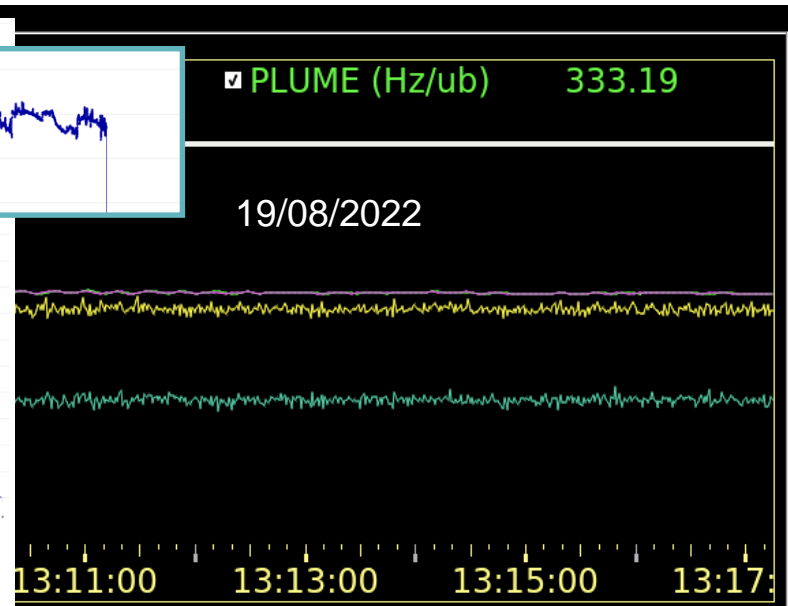
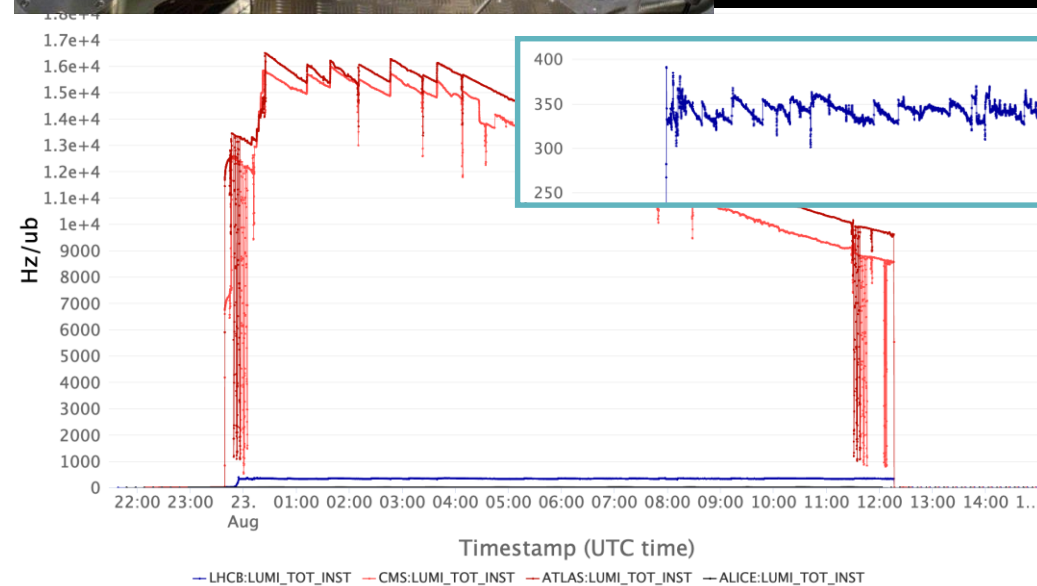
SilGel-612



☐ Calibration with the VdM scan, 09/2022



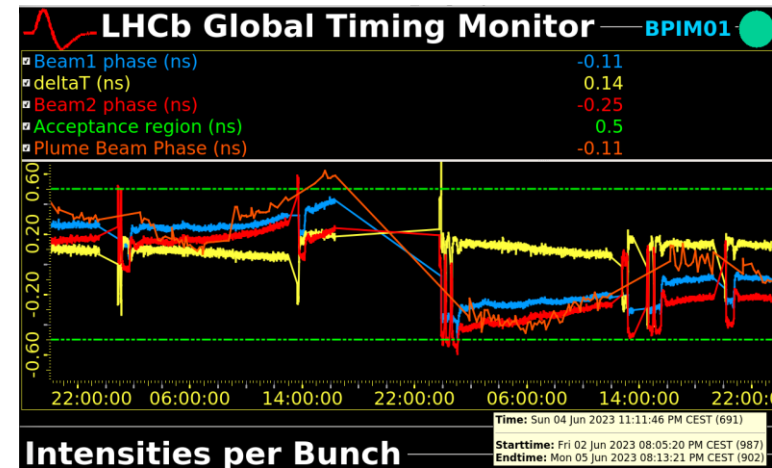
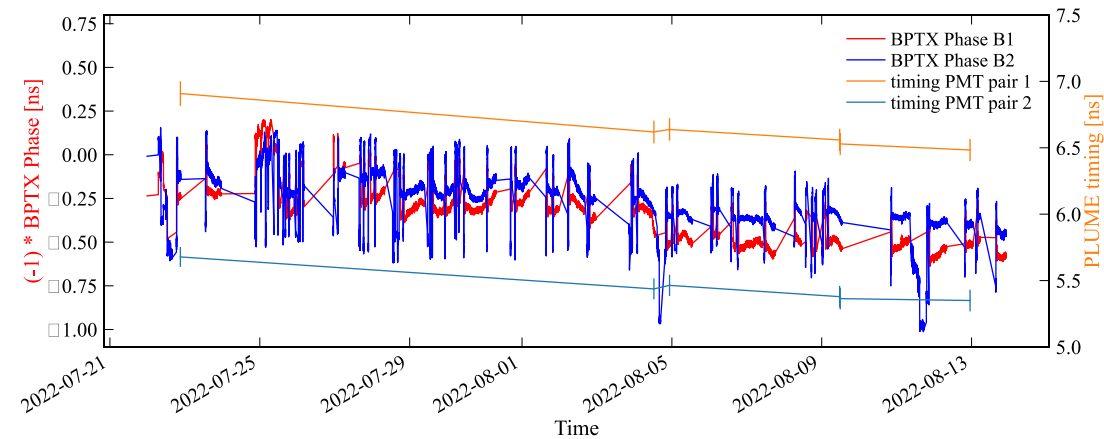
☐ First luminosity levelling in run 3, 08/2022



Time alignment LHCb vs. LHC

- ❑ LHC clock transmitted via underground fiber to LHCb, sensitive to temperature changes
- ❑ New technique developed to monitor this time with PLUME, two projective PMT pairs
- ❑ Based on S-shape analysis: measure sharing of the signal between two consecutive 25ns samplings as a function of a delay, implemented on calorimeter FEE
- ❑ Resolution ~ 70 ps on test bench
- ❑ Very first run 3 data (2021): **resolution of ~ 100 ps / track,**
resolution of ~ 200 ps / bxd \sim size of interaction region

Monitoring of the LHCb clock shift



- ❑ Online implementation (FEE) ongoing

- ❑ Team of young students and researchers received an early career LHCb prize in June 2022

VALERIYA ZHOVKOVSKA, MAARTEN VAN DIJK, FABIO FERRARI AND VLADYSLAV ORLOV

For their transformative contribution in the conception, optimisation, construction, testing and commissioning of the new PLUME luminometer, all within three years, in time for Run 3 operation.



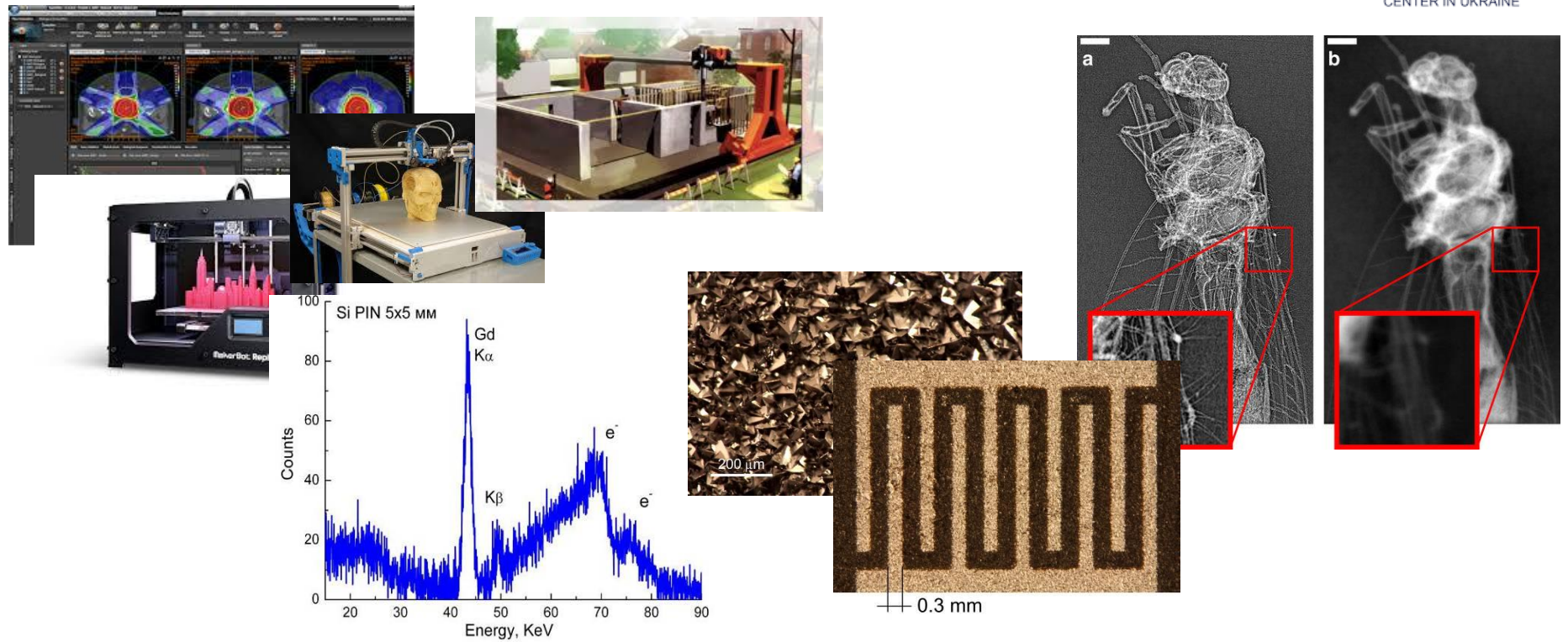
- ❑ ISMA and TSNUK became Associate groups of LHCb

LIA/IRP-Associated European project on R&D of instrumentation for medical physics 2018-2020

*Project by the LIA/IRP Ukrainian teams (56 participants)
STCU (SCIENCE & TECHNOLOGY CENTER IN UKRAINE)*



Two sites at major universities of Ukraine : T. Shevchenko National University of Kyiv and V. N. Karazin Kharkiv National University



□ Budget: 582kE, including 524kE from EC, 25kE from LAL, 18kE from Kyiv U, 15kE from Kharkov U

TSNUK during the war

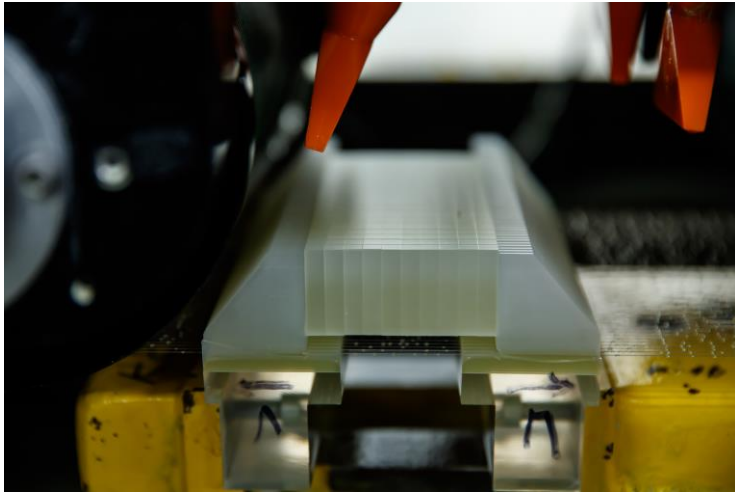


- ❑ Education/research activities in a reduced format
- ❑ Students participate in remote internships
- ❑ Followed LHCb DQ training session



ISMA during the war

- ❑ With the bombardments of Kharkiv, moved to underground premises
- ❑ Continue research and production for HEP (CMS, LHCb, FCC), but also for safety and defence



KIPT during the war

- ❑ Located in Pyatikhatki, ~20km from the border with RF, so heavily affected from the first day of the war
- ❑ KIPT retained more than 70% of personnel
- ❑ Due to logistic issues, only a small percentage of facilities are operated now



KIPT Institute for Solid State Physics,
Materials Science and Technologies



KIPT Neutron source building 17



Mykola F. Shulga (1947-2024)

Pedagogical collaboration

- ❑ Intimate **link between research and educational programs**
- ❑ Symbiosis of expertise of senior scientists and research work by the (Bachelor, Master and PhD) students within LIA program
- ❑ **Internships** in France (IJCLab, LPNHE, IRFU and LPC) → virtual since beginning of Covid19 and war, for male students
- ❑ **~50 virtual research projects supported by AUF**, since the beginning of the RF invasion to Ukraine
- ❑ **Framework agreements** signed between
 - Paris-Saclay University and Kyiv T. Shevchenko University
 - Paris-Saclay University and Kharkiv V. N. Karazine University
- ❑ Three **Erasmus+ ICM programs** of UPSaclay with Ukrainian universities
- ❑ **Winter (formally, suspended) and summer (resumed 2023) schools**

Competition of students' projects 2018 – 2020

2019 Competition of Students' Projects

High Energy and Nuclear physics
Medical physics
Accelerator techniques
Experimental platforms
Instrumentation

2020 Competition of Students' Projects

High Energy and Nuclear physics
Medical physics
Accelerator techniques
Experimental platforms
Instrumentation

Competition of Students' Projects

2018

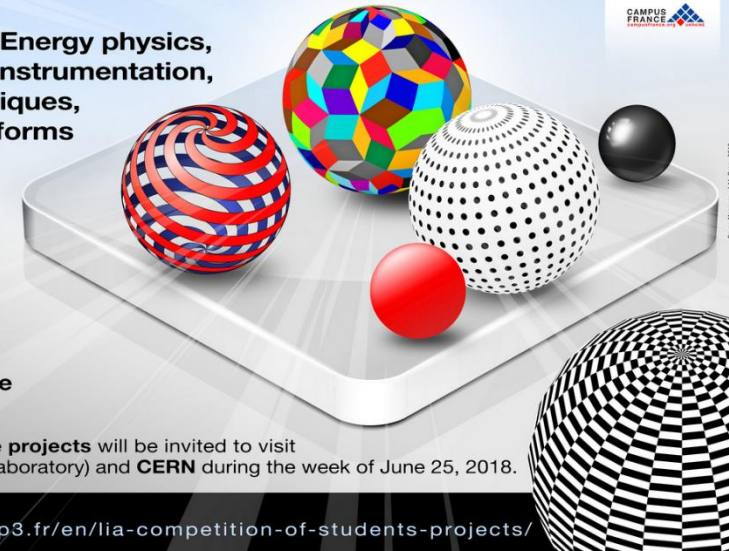
Topics:
Nuclear and High Energy physics,
Medical physics, Instrumentation,
Accelerator techniques,
Experimental platforms

To participate, students are invited to send before **February 15, 2018** an outline of their project (one page maximum) to bourge@lal.in2p3.fr

Pre-selected candidates will present their projects at the **mini-conference on March 7, 2018**

Authors of the **best three projects** will be invited to visit **LAL** (Linear Accelerator Laboratory) and **CERN** during the week of June 25, 2018.

<https://ideate.lal.in2p3.fr/en/lia-competition-of-students-projects/>



Students are invited to send before **February 15, 2018** an outline of their project (one page maximum) to bourge@lal.in2p3.fr

Pre-selected candidates will present their projects at the **mini-conference on March 7, 2018**

Authors of the **best four projects** will be invited to visit **LAL** (Linear Accelerator Laboratory) and **CERN** during the week of June 25, 2018.



Winners received a visit to Orsay laboratories and to CERN

Students are invited to send before **January 31, 2020** an outline of their project (one page maximum) to bourge@lal.in2p3.fr

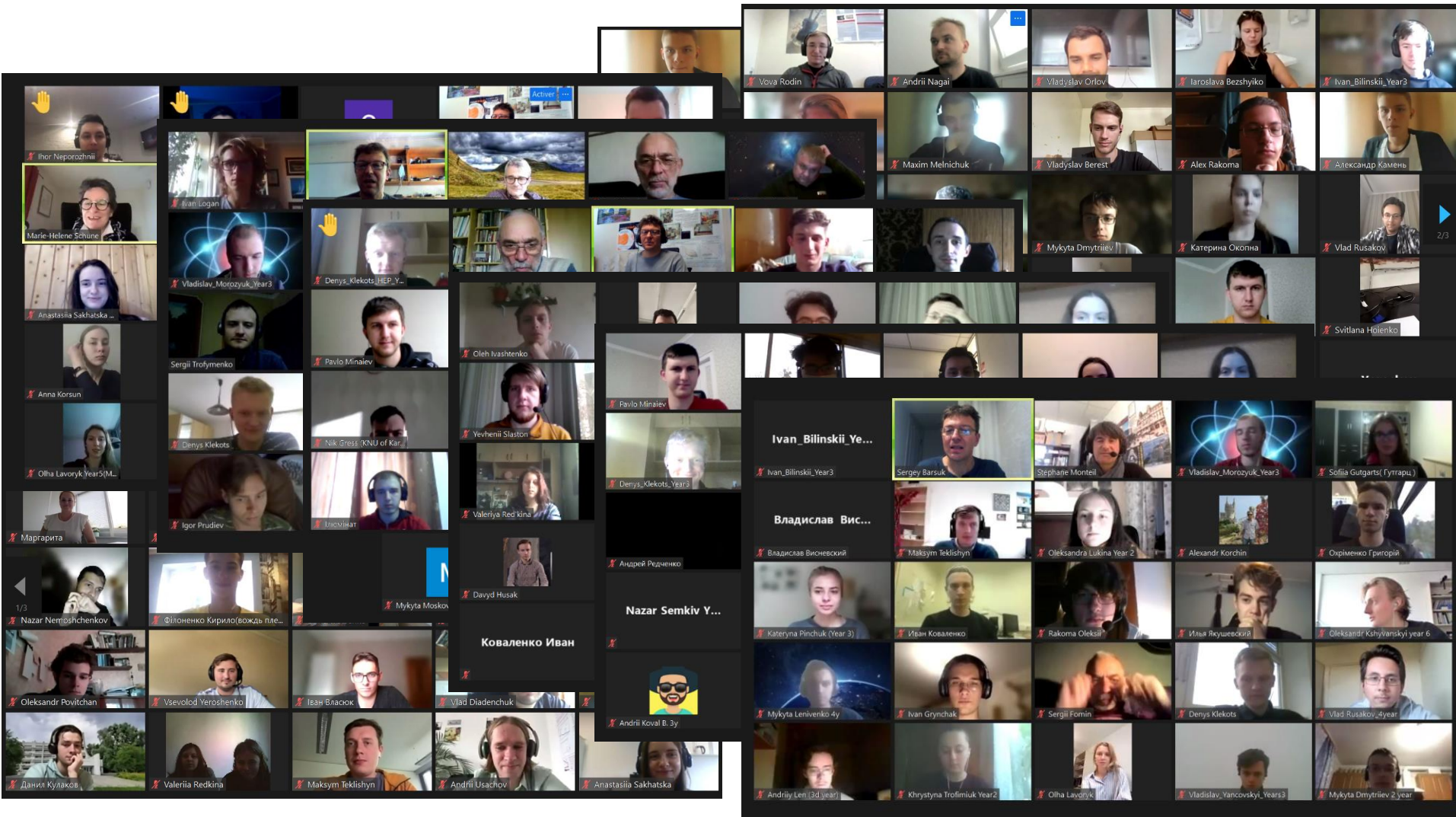
Pre-selected candidates will present their projects at the **mini-conference on February 17, 2020**

Authors of the **best four projects** will be invited to visit **FLUO** (Fundamental Laws of the Universe in Orsay) and **CERN** during the week of June 22, 2020.



Topical discussions with Ukrainian students, zoom, since 2021

- ❑ Monthly topical discussions between leading researchers and Ukrainian students
- ❑ High-energy, nuclear and medical physics, nuclear reactors, neutrinos, ...



<https://ideate.lal.in2p3.fr/en/topical-discussions-with-ukrainian-students/>

Interventions to high schools, until 2019

- ❑ Discussion with high-school children helps them to choose the university profile

Kharkiv 2019



Summer schools: 13 years of TESHEP

TESHEP is a platform, aiming at reinforcing **East-West Europe scientific and pedagogical links**.

Annual **summer school**, one of the main pillars of TESHEP, delivers lectures on high energy physics, mainly focusing on experimental particle physics, and brings together European students from different countries.

Professors and pedagogical /organising team:

Ukraine, France, Germany, Greece, Hungary, Italy, Poland, Romania, Serbia, Slovenia, UK, US, CERN, ...

Students: Belarus, Bulgaria, Czech Rep., China, Croatia, France, Georgia, Germany, Hungary, Italy, Latvia, Montenegro, Poland, Romania, Russia, Serbia, Slovenia, Spain, Sweden, Switzerland, Taiwan, Turkey, UK, Ukraine, CERN, DESY, ...

14th TESHEP in Poland 2023

La «Trans-European School of High Energy Physics» fête ses 10 ans



Dominique Longjumeau, LAL-ORNSAY 2016

Транс-Європейська школа фізики високих енергій
святкує **10** років

TESHEP 2023: Bezmiechowa Gorna

- ❑ Successful resuming of TESHEP
- ❑ Organized close to Polish-Ukrainian border
- ❑ ~10 Ukrainian (female) students attended



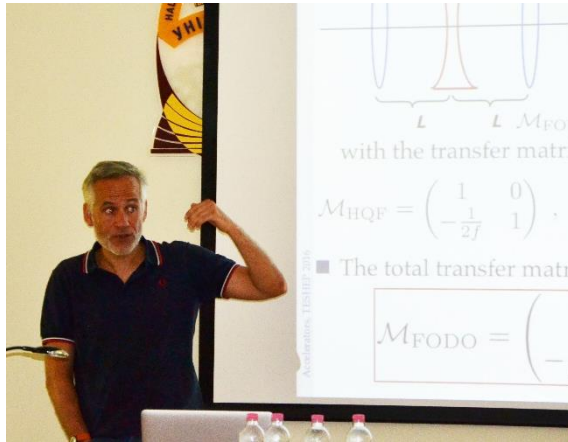
❑ **TESHEP 2024: July 11-20, 2024**

CERN-Ukraine 2024



Interplay with CERN

□ Historically, CERN support and participation in TESHEP and associated conferences



□ Two professors from CERN at TESHEP 2024

Interplay with CERN

- ❑ **Numerous joint contributions to CERN experiments**
- ❑ LIA IDEATE was formally part of the **road map for CERN-Ukraine program**
- ❑ **Ukraine became associated member of CERN** → LIA re-considered its role
- ❑ More focus on joint contributions to CERN experiments
- ❑ Participation and contributions to CERN-Ukraine meeting in March 2023:
<https://indico.cern.ch/event/1260301/>
- ❑ Proposing and participation in the definition of **remote CERN research projects for Ukrainian students**

Summary and outlook

- ❑ **LIA/IRP IDEATE is a performant virtual laboratory**, with visible joint projects and results, having always a synergy of contributions from experienced physicists and all-level students
- ❑ Strong **joint contributions with complementary expertises**, in particular to **CERN experiments**
- ❑ **LIA/IRP IDEATE is a live framework**, animating a large number of partnerships and continuing to **attract more partners**
- ❑ **LIA/IRP IDEATE has been STRONGLY affected by (Covid19 and) the invasion of RF to Ukraine.**

- ❑ Call for an **(outdated) equipment and tools**, for research and/or education
- ❑ Help for developing of an **equipment for demining** in Ukraine
- ❑ Help to Ukrainian researchers and students for a (remote) **access to European research and educational programs**
- ❑ Call for CERN to **be explicit to claim unacceptable the RF invasion in Ukraine.** Including a **stop of the agreement with JINR**