Equity, Diversity and Inclusion at International Conference on High Energy Physics
Jul 17-24, 2024, Prague

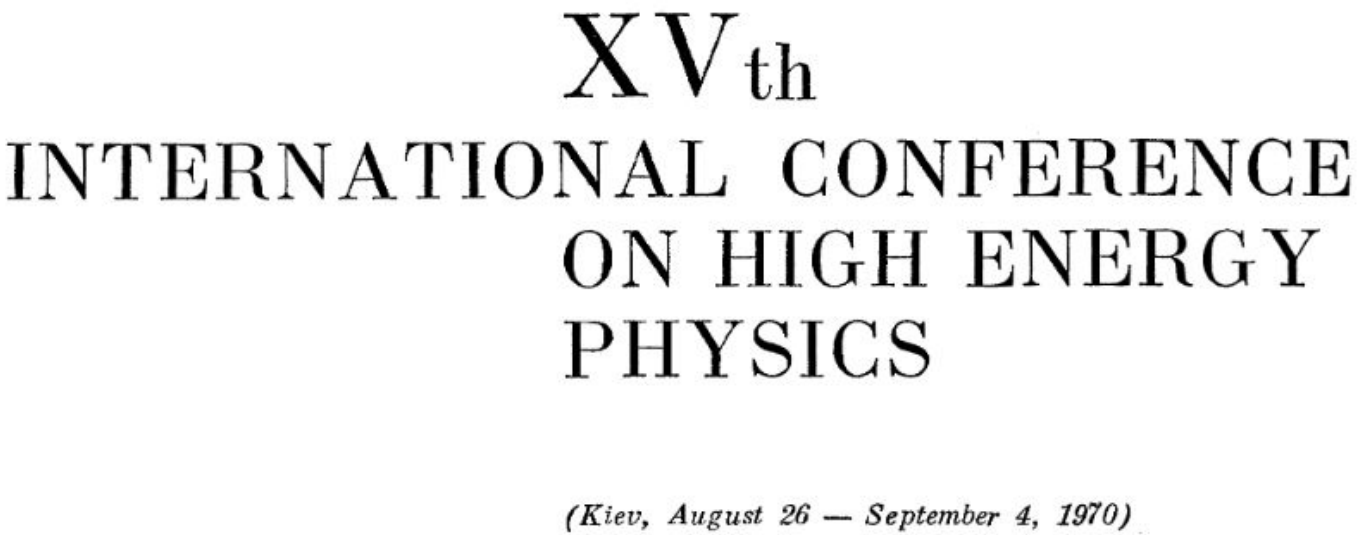
Ukrainian contribution to particle physics: historical perspective and prospects

Tetiana Hryn'ova: LAPP, Annecy
Igor Kostiuk: Nikhef, Amsterdam
Denys Timoshyn: Charles University, Prague

20.07.2024

ICHEP, Ukraine, Kyiv

ICHEP was held in Kyiv in years 1959 and 1970!



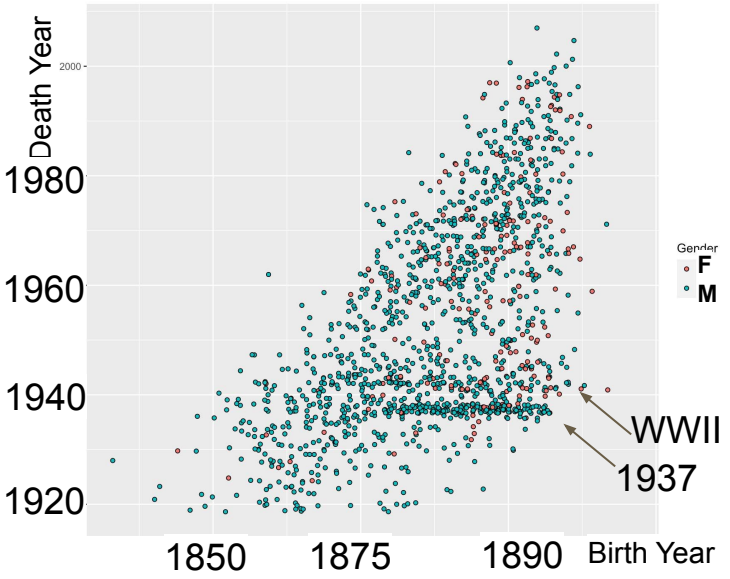
Why this talk?

We would like to highlight Ukrainian scientific contributions, overlooked until recently for two main reasons:

- In the past hundred years many scientists born in what is now Ukraine were killed (as in 1937 or now) or emigrated to save their lives and careers

- Foreign scientists were oblivious to the existence of Ukraine
  - In 1920s-30s Bohr, Van der Graaff, Dirac, Weisskopf and other foreign scientists visited Ukraine for conferences or to work (for example at the **Ukrainian Institute of Physics and Technology** in Kharkiv, then the capital of Ukrainian SSR)
  - *"In 1933 I went to Kharkov, **Russia** for almost a year, where it was possible to get a job with subsistence. Working in Kharkov at that time were Landau, Lifschitz, and Achiezer, and many other young **Russian physicists**."* (from Weisskopf, "My life as a Physicist")

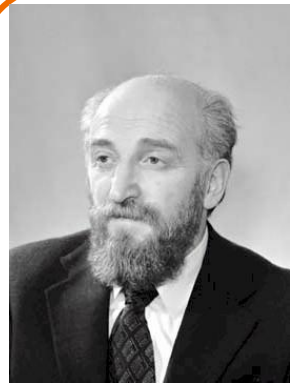
Members of Ukrainian Academy of Science (founded in 1918)



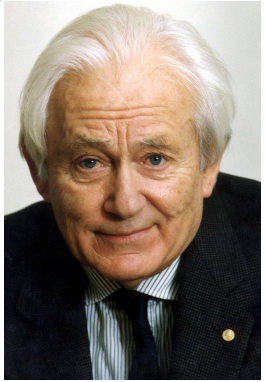
From O. Ignatenko, O Bolduriev

Selected internationally known scientists born in Ukraine

V. Veksler (Zhytomyr, 1907) invention of microtron & development of synchrotron, …

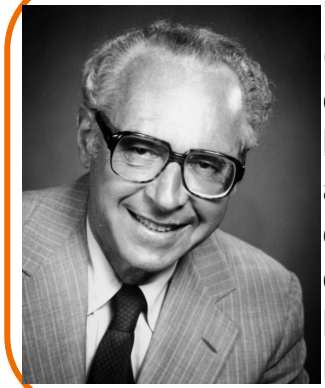


G. Budker (Murafa, 1918) invented electron cooling and proposed experiments on colliding beams, …



G. Charpak (Dubrovytsia, 1924) was awarded Nobel Prize in Physics for invention of multiwire proportional chamber, …

G. Breit (Mykolaiv, 1899) Relativistic Breit–Wigner distribution, Breit-Wheeler process, Breit equation…



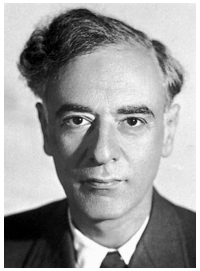
M. Goldhaber (Lviv, 1911) established that beta particles are identical to electrons, determined helicity of the neutrino, …

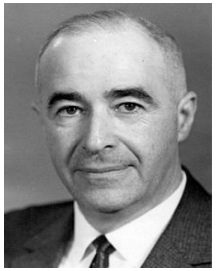
G. Gamow (Odesa, 1904) developed the Big Bang Theory of the universe, explained nuclear alpha decay, …

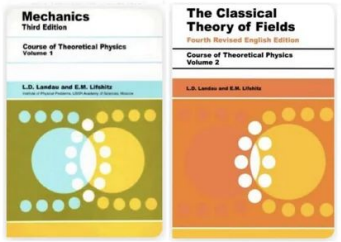
Formation of Ukrainian particle physics centers

- **Abram Ioffe** (Romny, 1880), known as “father of Soviet physics”, in 1920s initiated creation of institutes of Physics and Technology in Kharkiv (was **Ukrainian Institute of Physics and Technology**, now KIPT) and Dnipro

- **Lev Landau** (Baku, 1908), was a head of Department of Theoretical Physics at **Ukrainian Institute of Physics and Technology** in 1930s, with **E. Lifshitz** (Kharkiv, 1915) started to write their Course on Theoretical Physics in Kharkiv



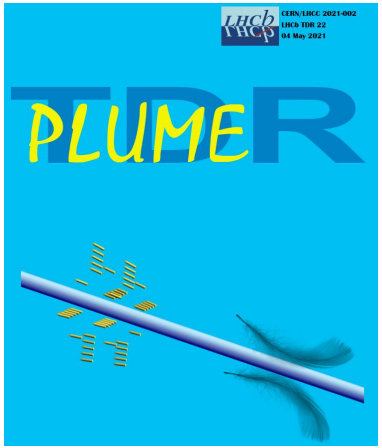




- **Nikolay Bogolyubov** spent his childhood and formative years in Ukraine. In 1966, Kyiv he founded Institute of Theoretical Physics (currently bears his name)

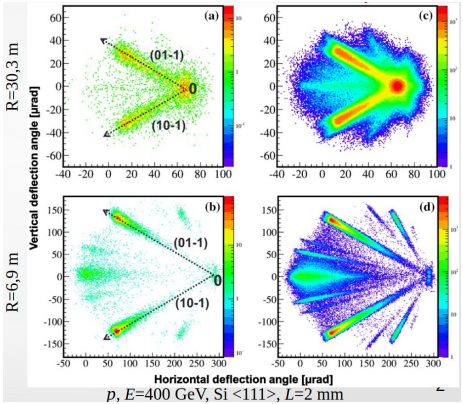
A few highlights

Lead tungstate crystals (PbWO4) discovered in the Institute for Single Crystals, Kharkiv in 1960s by **Ludmyla Nagornaya** are used for calorimeters of the ALICE and CMS detectors. Kharkiv scintillators were used in BaBar ECAL and ATLAS MBTS, are in Belle II ECAL, CMS HCAL and other detectors.



Kyiv University (TSNUK) – ISMA – KIPT contributed to technology proposal, simulation and prototyping, beam tests, innovative aging studies for the new LHCb luminometer.

Dmitrij Volkov (center), **Vladimir Akulov** (right) and **Vyacheslav Soroka** from KIPT played a crucial role in the development of supergravity and supersymmetry.



p, *E*=400 GeV, Si <111>, *L*=2 mm

Akhiezer and Shulga at KIPT developed quasi-classical theory of coherent radiation of channelled and over-barrier electrons and positrons in crystals. Ternovsky–Shulga–Fomin effect and Grinenko–Shulga mechanism have been recently confirmed experimentally by NA63 and UA9 experiments at CERN.

Science during the ongoing war (2014 - now)

- Despite ongoing Russian aggression Ukraine joined CERN as Associate member in 2016
- Full-scale invasion have caused massive disruption in lives. From UNESCO study:
  - 12% of Ukrainian scientists relocated internally or externally
  - 1443 building belonging to 177 scientific institutions were damaged
    - 643 pieces of research equipment damaged
- → Electricity can be absent for 10+ hours per day




Science and borders

- For over 10 years now international publishers (IOPScience, Springer, AIP, Elsevier...) and databases (arxiv, inspirehep, cds, Scopus) helped to reinforce Russia's illegal claims on Crimea and other occupied Ukrainian territories, contrary to the position of the international community

IOP Conference Series: Materials Science and Engineering

Table of contents

Volume 927

2020

← Previous issue Next issue →

XIII International Conference on Applied Mathematics and Mechanics in the Aerospace Industry (AMMAI'2020) 6-13 September 2020, Alushta, Russia

Accepted papers received: 02 September 2020
Published online: 25 September 2020

Volume 2503, Issue 1
13 October 2022

INTERNATIONAL CONFERENCE ON MODERN TRENDS IN MANUFACTURING TECHNOLOGIES AND EQUIPMENT 2021: ICMTMTE 2021

6–10 September 2021
Sevastopol, Russia

Authors and Affiliations

Institute of Natural and Technical Systems, 299011, Sevastopol, Russia
E. V. Vyshkvarkova & E. N. Voskresenskaya

Corresponding author

Correspondence to E. V. Vyshkvarkova.

Additional information

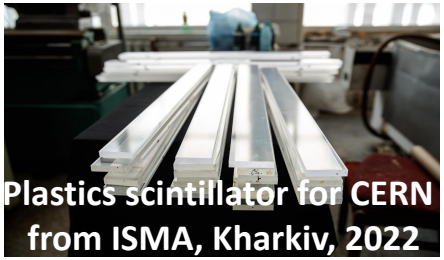
Translated from *Meteorologiya i Gidrologiya*, 2023, No. 10, pp. 66-76. https://doi.org/10.52002/0130-2906-2023-10-66-76.

Publisher's Note. Allerton Press remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

- Pasteur said "Science knows no country", but countries do have international borders which should be respected and we hope that these mis-affiliations can be rectified

Science during the ongoing war (2014 - now)

- But scientific activities continue and adapt in several spheres thanks to international support:
  - Many special programs to support Ukrainian researchers
    - A case in Czech Republic: CZEXPATS In Science, as well as numerous programs provided directly by Czech Universities
  - Number of publications did not drop significantly
    - International article publication down by 7%
  - EURIZON program on remote grants for Ukrainian researchers was overwhelmed to receive nearly 800 proposals and decided to triple its budget allocation
  - CERN Council waived Ukrainian financial contribution for late 2022, 2023 and 2024
  - New and expanded educational initiatives
    - Remote projects exclusively for students in Ukraine (IRIS-HEP, CERN remote project program, CERN summer school, DESY Summer/Winter School, mentioned at ICHEP24)
    - Remote schools and webinars for teachers and students (CERN Ukrainian Teacher Programmes, webinars of LIA-IDEATE and Junior Academy of Science of Ukraine…), masterclasses,...

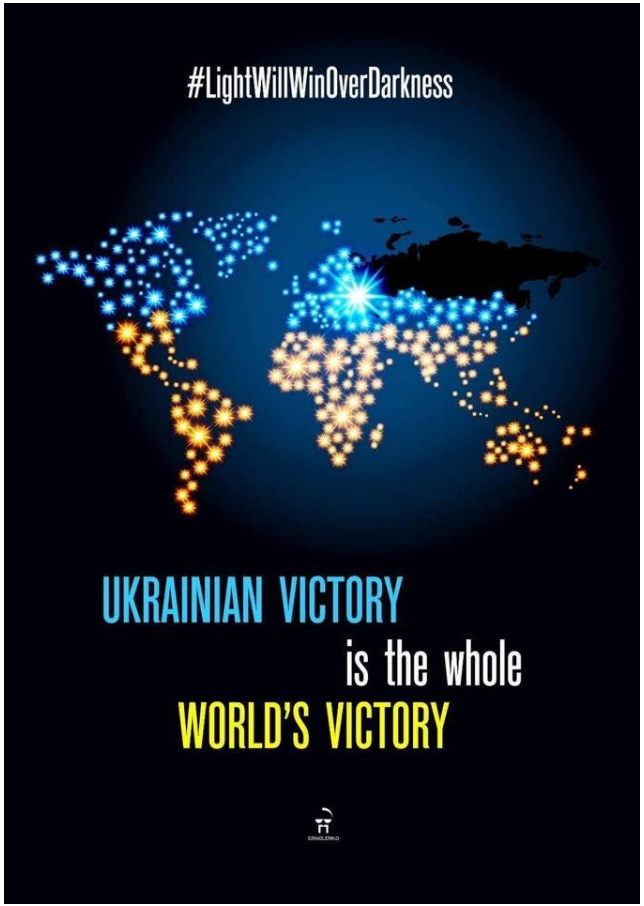

Plastics scintillator for CERN from ISMA, Kharkiv, 2022


TES-HEP School July 2023


CERN-Ukraine 2024, Kyiv May 2024

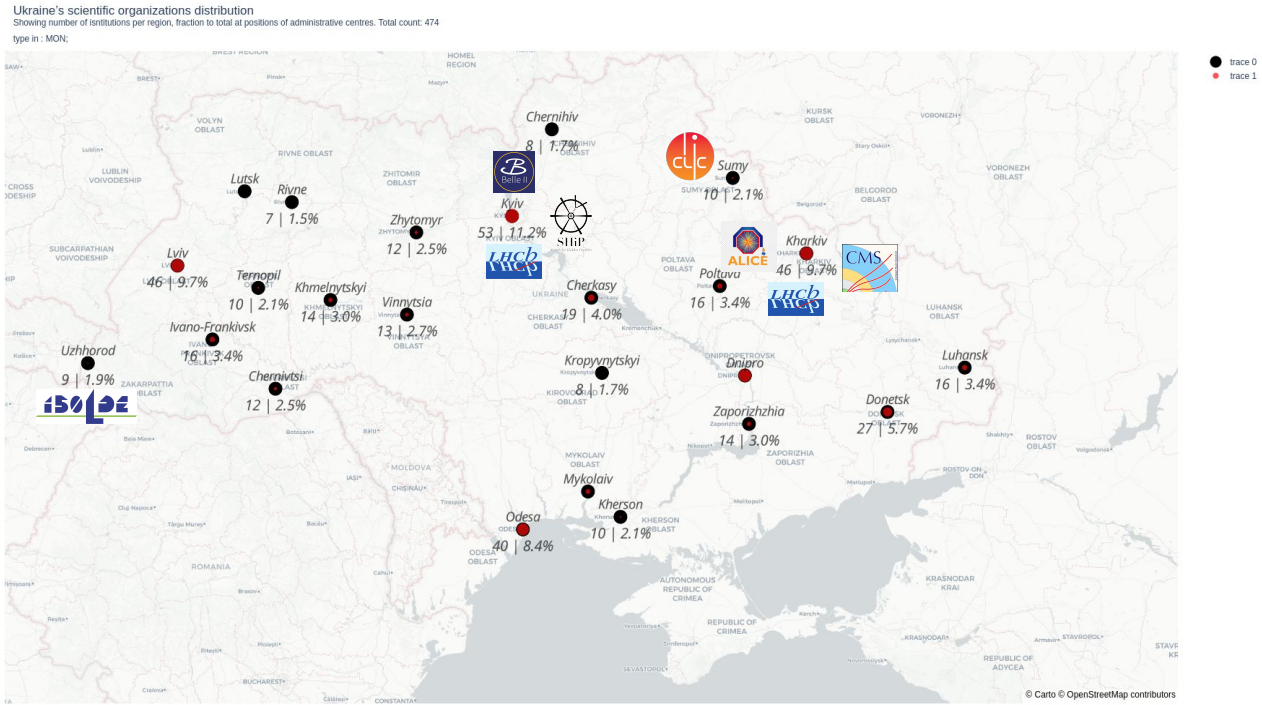
How to help

- Help to ensure Ukrainian sovereignty and legal borders in the journal publication author lists, references, etc.
- Expand collaborations with Ukrainian institutes (example: IDEATE France-Ukraine laboratory)
- Propose mentorships and remote projects for Ukrainian students (e.g. through IRIS-HEP or other HEP programmes)
- National Research Foundation of Ukraine is looking for experts for their grant reviews
- Ukrainian institutes would benefit from the transfer of used equipment (effort coordinated by CERN ILO)
- Enforce scientific sanctions to prevent military application of fundamental research
  - Letter from Ukrainian scientists



Potential

Despite historical particle physics centers, Ukraine has distributed network of scientific institutes



Of 200+ Ukrainian nationals affiliated with CERN only ~30 are based in institutes and universities in Ukraine, but common projects with other international institutions help to encourage scientists to work in Ukraine.

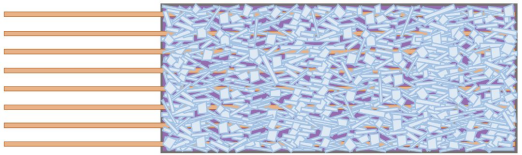
A lot of interest in remote HEP internships from students outside current Ukrainian particle physics centers, it shows potential for expanding the country's involvement!

Future projects

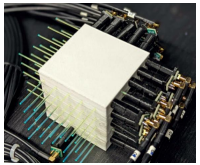
New EC office in Kyiv will help Ukrainian scientists to better integrate into international community.

CERN-Ukraine 2024 meeting held in Kyiv in May to organize preparations of Ukrainian contribution to the update of the European Particle Physics Strategy

SHiP



GRAiNITA



Detector 3D-printing

Ukrainian institutions participate in ongoing efforts for future HEP experiments, accelerators and detector R&D

Conclusions

- Ukrainian scientific community continues to do research despite the ongoing war because “Science is the highest personification of the nation” (Pasteur)

- We hope that this talk will start the trend to acknowledge the (past) Ukrainian scientific contributions as such

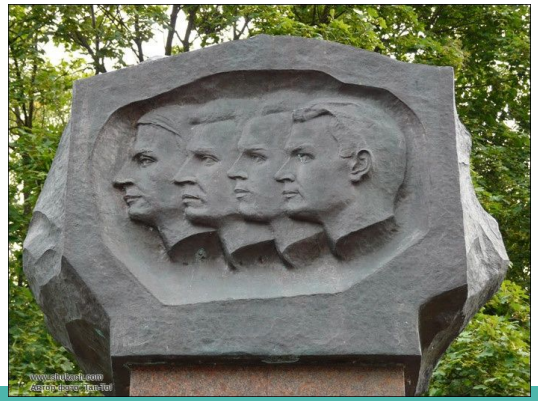
- We ask for your help to ensure that all research and its publications respect international laws and regulations because “Bad men need nothing more to compass their ends, than that good men should look on and do nothing.” (John Stuart Mill)

THANK YOU for your support!

Backup

Origins: Ukrainian Institute of Physics and Technology

- A. Ioffe (Romny, 1880), known as “father of Soviet physics” initiated creation of Ukrainian Institute of Physics and Technology (UFTI) in Kharkiv in 1928 to develop new areas of research (at that time - nuclear physics and solid state physics).
  - All staff members below 35 years old and many were trained abroad;
  - Bohr, Van der Graaff, Dirac, Weisskopf among many other foreign scientists, visited UFTI for conferences or to work;
  - Gamow, Kapitsa and Ehrenfest were among its scientific advisors.
- The first Soviet scientific journal in foreign language: "Physikalische Zeitschrift der Sowjetunion" (1932-1938)
- In late 1930s 16 UFTI scientists were arrested and 8 executed, foreign scientists were forced to leave Ukrainian SSR.
- After WWII UFTI was renamed Kharkiv Institute of Physics and Technology (KIPT)



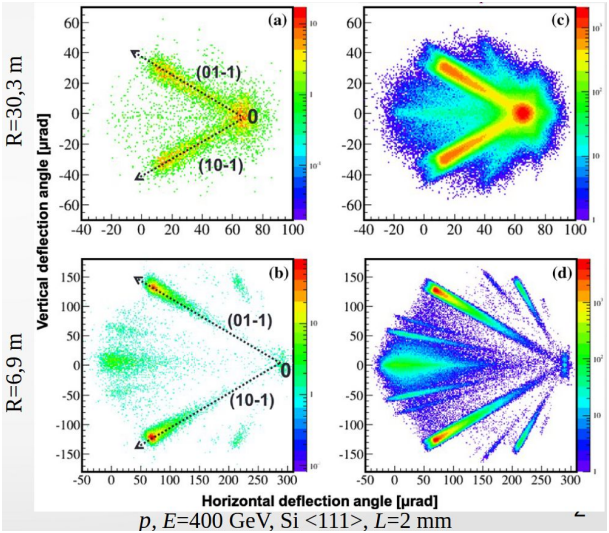
10/10/1932 Walter, Latyshev, O.Leypunsky and K.Synelnikov carried out the fission of the nucleus of the lithium atom, a few months after Cockroft & Walton in Cambridge

Van der Graaf with Kharkiv Van der Graaf Generator, 1936

Theory @ Kharkiv Institute of Physics Technology (KIPT)

Lev Landau (Baku, 1908) in collaboration with his student **Evgeny Lifshitz** (Kharkiv, 1915) started to write their Course on Theoretical Physics in 1930s at Kharkiv

Dmitrij Volkov (center), **Vladimir Akulov** (right) and **Vyacheslav Soroka** [played a crucial role in the development of supergravity and supersymmetry]



p, *E*=400 GeV, Si <111>, *L*=2 mm

Extensive work on quasi classical theory of coherent radiation of channelled and over-barrier electrons and positrons in crystals lead by **Akhiezer and Shulga**:

- In 2005–2010 the NA63 collaboration confirmed the suppression of bremsstrahlung radiation from ultrarelativistic electrons in thin layers of matter (**Ternovsky–Shulga–Fomin effect**).
- In 2009–2017 the UA9 collaboration confirmed his prediction of a stochastic **Grinenko–Shulga mechanism** of high-energy particle-beam deflection by a bent crystal. This mechanism allows the deflection of both positively and negatively charged particles, and is planned to be implemented at the PETRA IV synchrotron at DESY and future electron–positron colliders.

Theory @ Kyiv Bogolyubov Institute (BITP)

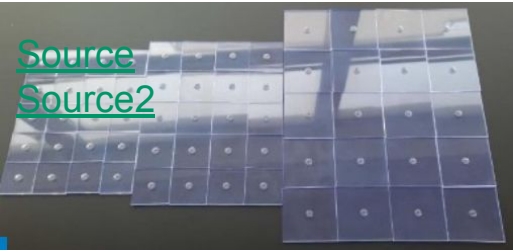
Known for his contributions to mathematical physics, **Nikolay Bogolyubov** spent his childhood and formative years in Ukraine. In Kyiv he founded Institute of Theoretical Physics (currently bears his name).

Wide range of theoretical contributions ranging from analytical and perturbative QCD to phenomenology and from hard probes and photons to hadrons and particle chemistry.

Genadiy Zinovjev (1941-2021) Deputy Chair of the ALICE Collaboration Board from 2011 to 2013

Oleksiy Sitenko (1927-2002) predicted diffractive splitting of the deuteron (with Akhiezer), developed the theory of quasi-elastic scattering of high-energy electrons on nuclei

Present



Source
Source2

R&D and beam-testing of scintillation material for the CMS High Granularity Calorimeter was performed by Kharkiv Institute of Physics and Technology (KIPT)

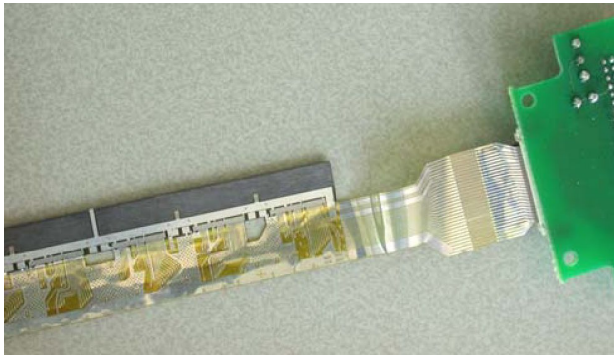
Source
Source2

Plastic scintillators for Minimum Bias Trigger Scintillators (MBTS) were studied and produced at Institute of Scintillating Material (ISMA), Kharkiv

Source

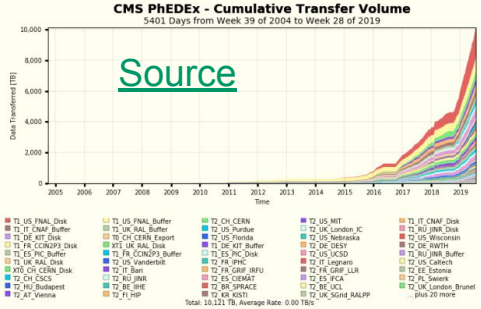
Lead tungstate crystals (PbWO4), were discovered, analysed and designed as components for ALICE and CMS detectors at Institute for Single Crystals, Kharkiv

Institute for Single Crystals, Kharkov. | Source

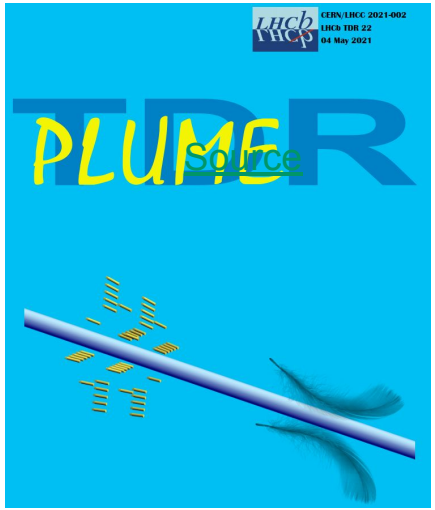


Low Mass Aluminium Micro Cable Technology for the ALICE Silicon Strip Detector developed in the SRTIIM institute in Kharkov

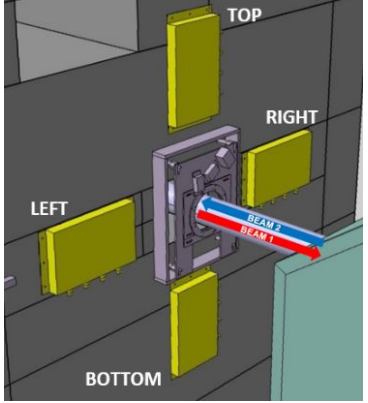
Present

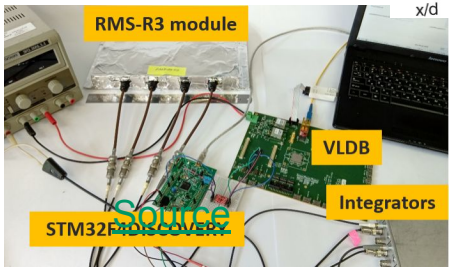


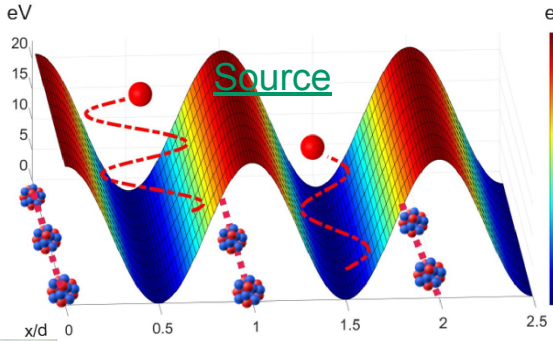
KIPT hosts a Tier-2 center of the computing Grid infrastructure.



TSNUK – ISMA – KIPT are contributing in technology proposal, simulation and prototyping, beam-testing and innovative aging studies for new LHCb luminometer







Bent crystals characteristics were studied for beam steering for the high energy and accelerator physics at KIPT

Institute for Nuclear Research (, NAS of Ukraine, the National Cancer Institute, Ministry of Health of Ukraine - do we need to include them?) participated in R&D as well as radiation tests of Radiation Monitor System