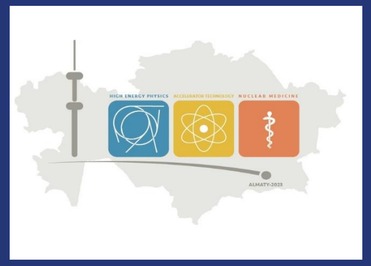
INSTITUTE OF NUCLEAR PHYSICS
OF THE MINISTRY OF ENERGY
OF THE REPUBLIC OF KAZAKHSTAN

International School
“Introduction to High-Energy Physics, Accelerator Technology and Nuclear Medicine”



Almaty, Kazakhstan 2023

HISTORY OF THE INSTITUTE OF NUCLEAR PHYSICS

The INSTITUTE OF NUCLEAR PHYSICS was created on the basis of the Physical-Technical Institute of the Academy of Sciences of the Kazakh SSR on July 25, 1957.

K.I. Satpayev

I.V. Kurchatov

K.I. Satpayev: «The huge expansion of the productive forces of Kazakhstan requires a corresponding strengthening of science in Kazakhstan and, first of all, the introduction of the latest achievements of nuclear physics in **all sectors** of **industry**, **agriculture** and **healthcare**»

BRIEF REFERENCE

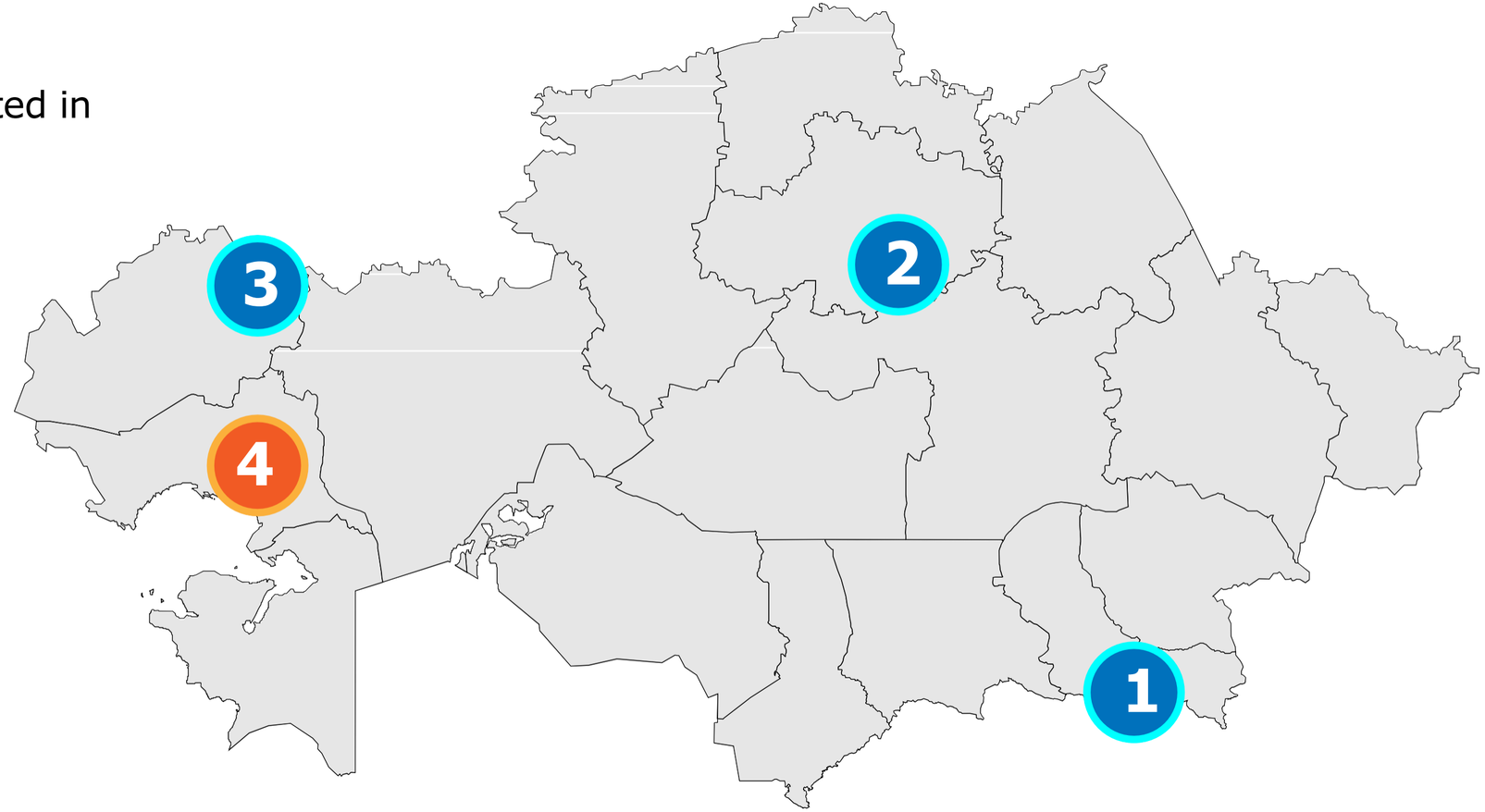
The main site of the Institute is located in Almaty. There are 2 branches of the Institute in Astana and Aksai cities.

1 Almaty
600 employees
7 basic facilities

2 Aksai branch
25 employees
LIRA facilities

3 Astana branch
50 employees
Heavy ions accelerator

4 Azgir
Expedition



INP staff in numbers

~700
employees

~150
young specialists

~74
specialists with academic degree

DIVISIONS, CENTERS AND BRANCHES

INSTITUTE OF NUCLEAR PHYSICS

NUCLEAR PHYSICS DIVISION

RADIATION PHYSICS DIVISION OF SOLID MATERIALS

SCIENTIFIC AND TECHNICAL DIVISION OF ACCELERATOR TECHNOLOGIES

NUCLEAR SECURITY TRAINING CENTER

CENTER FOR INTEGRATED ECOLOGICAL STUDIES

WWR-K RESEARCH REACTOR

ASTANA BRANCH

AKSAI BRANCH

BASIC FACILITIES

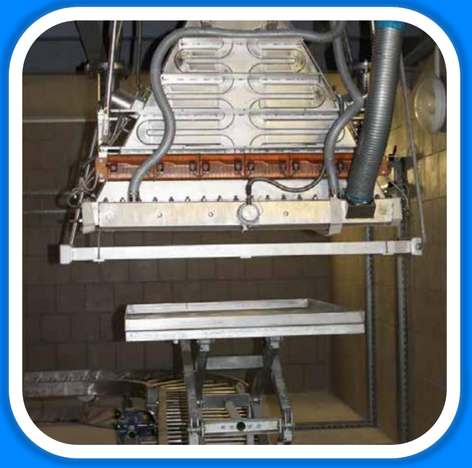
INSTITUTE OF NUCLEAR PHYSICS

Research reactor WWR-K

Critical Reactor Assembly

Electrons Accelerator ELV-4

Electrons Accelerator ILU-10



Cyclotron U-150M

Linear Accelerator UKP-2-1

Cyclotron Cyclone-30

Heavy ions accelerator DC-60

MAIN ACTIVITIES

INSTITUTE OF NUCLEAR PHYSICS

DEVELOPMENT AND APPLICATION OF NUCLEAR AND RADIATION TECHNOLOGIES

FUNDAMENTAL AND APPLIED RESEARCH IN NUCLEAR PHYSICS, SOLID STATE RADIATION PHYSICS, RADIO-ECOLOGY, RADIOCHEMISTRY

PRODUCTION OF RADIOISOTOPES FOR MEDICINE AND INDUSTRY

DEVELOPMENT AND APPLICATION OF NUCLEAR- PHYSICAL ANALYTICAL METHODS

PROVISION OF SERVICES IN NUCLEAR ENERGY SECTOR

TRAINING OF HIGHLY-QUALIFIED HUMAN RESOURCES FOR THE NUCLEAR INDUSTRY

PUBLICATION ACTIVITY

According to the 2022 results, INP took first place among Kazakhstan's research institutes and centers, having published the largest number of articles in the Web of Science indexed journals. In 2022, the publication activity of the Institute increased by 30%.

UNIVERSITIES AND RESEARCH CENTERS

№	Name	Number of articles
1	Nazarbayev University	877
2	Al-Farabi Kazakh National University	765
3	L.N. Gumilyov Eurasian National University	346
4	Satbayev University	213
5	**Institute of Nuclear Physics**	**149**
6	Asfendiyarov Kazakh National Medical University	111
7	Kazakh British Technical University	109
8	Buketov Karaganda University	95
9	Institute of Mathematics & Mathematical Modeling	89
10	Abai Kazakh National Pedagogical University	83

RK RESEARCH CENTERS

№	Name	Number of articles
1	**Institute of Nuclear Physics**	**149**
2	Institute of Mathematics & Mathematical Modeling	89
3	Institute of Experimental & Theoretical Physics	47
4	National Center for Biotechnology (NCB)	40
5	Institute of Combustion Problems	35
6	Center of Physical-Chemical Methods of Research &	28
7	Institute of Metallurgy & Ore Beneficiation	27
8	Kazakhstan National Nuclear Center	26
9	National Nanotechnology Laboratory of Open Type	25
10	Almaty Institute of Physics & Technology	22

RESEARCH PROJECTS

INSTITUTE OF NUCLEAR PHYSICS

Out of a total of **41 scientific programs** and projects funded by the Ministries of Energy and Science and Higher Education of the Republic of Kazakhstan, **28 were won in 2022-2023**.

The **total amount of annual funding** for scientific programs and projects implemented at the INP is about **2.5 B tenge (5.6 M USA dollars) as of July 2023.**

Also, the project "Creation of a site for the production of hydrogel dressings for medical use" received grant funding as the most promising project for the commercialization of the results of scientific and (or) scientific and technical activities for 2022-2024 from the Science Fund - 299 M tenge.

CURRENT NUMBER OF SCIENTIFIC PROGRAMS AND PROJECTS OF INP ME RK

Наименование гранта	Ministry of Energy	Ministry of Science and Higher Education
Program-targeted financing	3	3
Grant funding	-	23
Grant funding for young scientists	-	12

NPP NEEDS FOR STAFF

	TYPE OF REACTOR	POWER	TOTAL STAFF	INDUSTRIAL AND PRODUCTION PERSONNEL (IPR)	20% with HIGHER EDUCATION from IPR
中核集团 CNNC	HPR1000	1200 MW	2000	1500	300
KHNP KOREA HYDRO & NUCLEAR POWER CO., LTD	APR1400	1400 MW	2000	1500	300
РОСАТОМ	ВВЭР-1200	1200 MW	2000	1500	300
EDF	EPR1200	1200 MW	2000	1500	300

INP has the experience and potential to train personnel in the following specialties:

1. «Nuclear Physics and Technology»;
2. «Nuclear energy»;
3. «Nuclear reactors and materials».

TRAINING CENTERS

INSTITUTE OF NUCLEAR PHYSICS

Center was opened with the IAEA support.

2000

<2000 people

TRAINING CENTER FOR RADIATION SAFETY

- Radioecological monitoring and environmental rehabilitation;
- Training of specialists in:
  - ✓ radiation safety;
  - ✓ Dosimetric control.

Center was established under support of the US DoE.

2017

~1300 people

NUCLEAR SECURITY TRAINING CENTER

- Physical protection of nuclear and radioactive materials and facilities;
- Accounting and control of nuclear materials;
- Information Security.

Nuclear Security Training Center is included in the IAEA's international network of Nuclear Security Training and Support Centers.

Center was opened with the IAEA support.

2003

~800 people

TRAINING CENTER FOR NON-DESTRUCTIVE TESTING METHODS

- Handling of nuclear materials, ionizing radiation sources and radioactive waste;
- Testing of structural materials by non-destructive testing methods (testing of joints and units of plant pipelines during construction of a new NPP);
- Training of specialists in the area of non-destructive testing methods.

Center will be opened under support of the IAEA and Interpol.

2024

REGIONAL CENTER FOR NUCLEAR FORENSICS

INP is the official laboratory for forensic analysis of nuclear materials in Kazakhstan, working with law enforcement agencies on the actual analysis of prohibited materials. The RSE INP has developed and established a complex that provides an examination of various nuclear and radioactive materials and products.

About **10 IAEA experts** work at the INP.

BASE FOR TRAINING

INSTITUTE OF NUCLEAR PHYSICS

Institute of Nuclear Physics is:

1. **The only and largest Institute carrying out a full cycle of R&D;**
2. **1 place for publications in the Scopus database among SRI of the RK;**
3. **1 place for the amount of funding for scientific research in the field of atomic energy in the RK.**

Graduate/Postgraduate education

1. 300 Candidates and Doctors of Science trained for the nuclear industry of the Republic of Kazakhstan;

2. > 20 Candidates and Doctors of Science defended in the field of the nuclear industry within the framework of the RK - JINR double degree program.

3. > 200 students (bachelors and masters) trained under the RK-JINR double degree program.

INFRASTRUCTURE FOR EDUCATIONAL PROCESS

Over 38,000 sq.m. area and more than 20 buildings

Own library fund

Own medical department

INTERNATIONAL COOPERATION

IAEA
International Atomic Energy Agency

ОИЯИ

Massachusetts Institute of Technology

NEUTRONS FOR SOCIETY

CERN

CHIYODA CORPORATION

30+

FOREIGN FOREMOST RESEARCH INSTITUTES AND UNIVERSITIES

INTEGRATION OF KAZAKHSTAN IN MEGA-SCIENCE PROJECTS

The search for new particles and new physics is conducted within several different international scientific cooperation programs at CERN, JINR and Fermilab.

INP plans to join the following collaborations as a supplier of straw detectors:

NA62 → HIKE

NA62
2016 - 2025

Memorandum of Understanding signed in June 2023.

7 000 straw detectors

HIKE
2029 - 2038

"Letter of Intent" signed

8 000 straw detectors

INVESTIGATION OF RARE DECAYS OF K-MESONS

SPD

2028 - …

Memorandum of Understanding signed in March 2023.

Study of the spin structure of the proton and deuteron, as well as other spin-dependent effects in their interactions

25 000 straw detectors

NA64

2016 - 2028 (?)

Search for dark matter

1000 straw detectors

n_TOF

2001- …

Research of neutron-induced nuclear reactions

DUNE

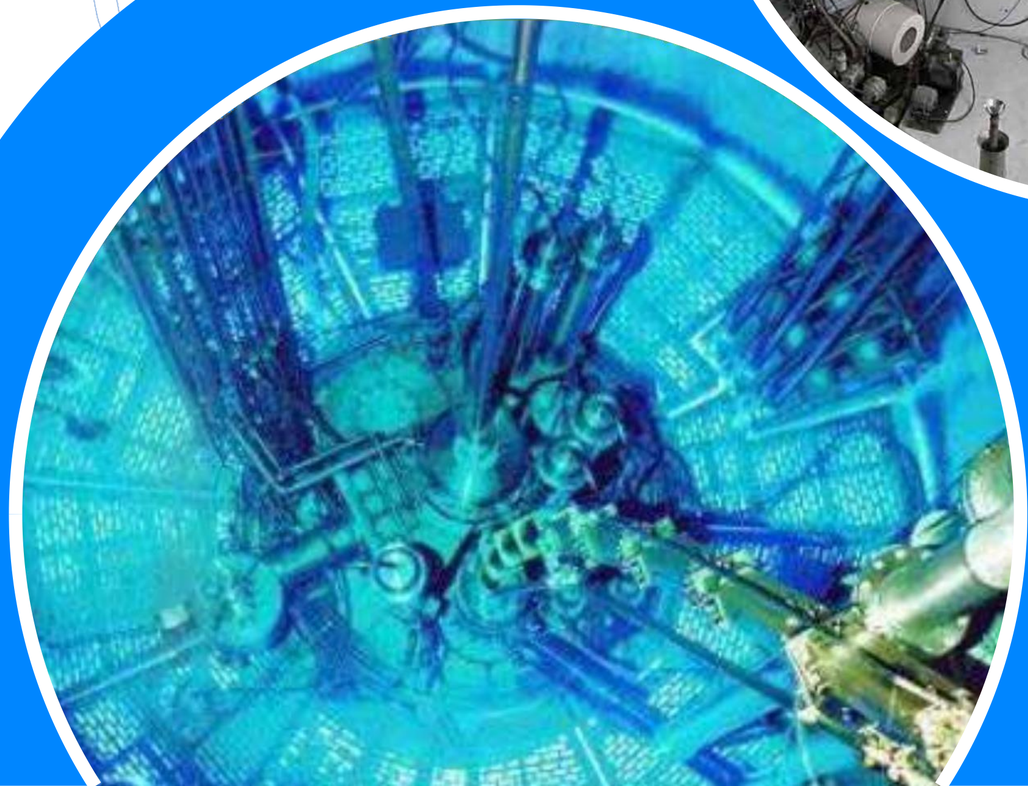
2028 (?) - …

Underground neutrino oscillation experiment

250 000 straw detectors

COOPERATION WITH THE LAUE-LANGEVIN INSTITUTE

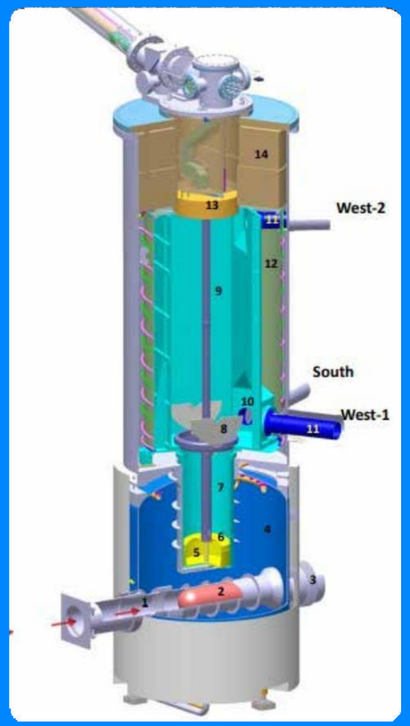
Under technical support of the Laue-Langevin Institute, the Institute of Nuclear Physics in Almaty can assemble **a high-intensity source of ultra-cold neutrons based on the research reactor WWR-K.**



“SOURCE OF ULTRA-COLD NEUTRONS” PROJECT

INSTITUTE OF NUCLEAR PHYSICS

ILL (France) plans to provide INP with a unique facility “GRANIT” (worth $10 million), by which the most powerful beam of ultra-cold neutrons in the world can be obtained at the reactor WWR-K. The intensity of this UCN source will be ahead of all other available analogues **by 2 orders!**



MATERIALS SCIENCE

- STUDY OF MATERIALS SURFACE;
- RESEARCH OF NEW MATERIALS;
- DEVELOPMENT OF NEW MATERIALS (NEW TYPES OF REFLECTORS FOR FUTURE GENERATIONS OF nuclear power plants).

EDUCATION

- Acquiring knowledge from the world’s renowned experts;
- Writing the thesis work UNDER SUPERVISION OF THE LEADING SCIENTISTS OF THE WORLD.

The project “Ultra-cold Neutron Source” in Almaty will be implemented in the framework of the user program. The following leading world Institutes can be the potential users:

1. Institut Laue-Langevin (ILL), Grenoble, France;
2. Japan Proton Accelerator Research Complex, Japan;
3. The University of Tokyo, Tokyo, Japan;
4. Los Alamos National Laboratory, New Mexico, United States;
5. Johannes Gutenberg University of Mainz, Mainz, Germany;
6. Paul Scherrer Institute (PSI), Villigen, Switzerland;
7. TRIUMF, Canada’s national particle accelerator center, Van couver, Canada;
8. North Carolina State University, Raleigh, North Carolina, United States;
9. Technical University of Munich, Munich, Bavaria, Germany
10. Joint Institute for Nuclear Research, Dubna, Russia;
11. Petersburg Nuclear Physics Institute, Gatchina, Russia;
12. University of Waterloo, Waterloo, Canada;
13. University of Vienna, Wien, Austria;
14. ETH, Swiss Federal Institute of Technology in Zürich, Zürich, Switzerland;
15. The University of Virginia, Charlottesville, United States.

THANK YOU FOR YOUR ATTENTION!