The collaboration between Budker Institute and leading Novosibirsk Universities

Aleksey Vasilyev,

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Location

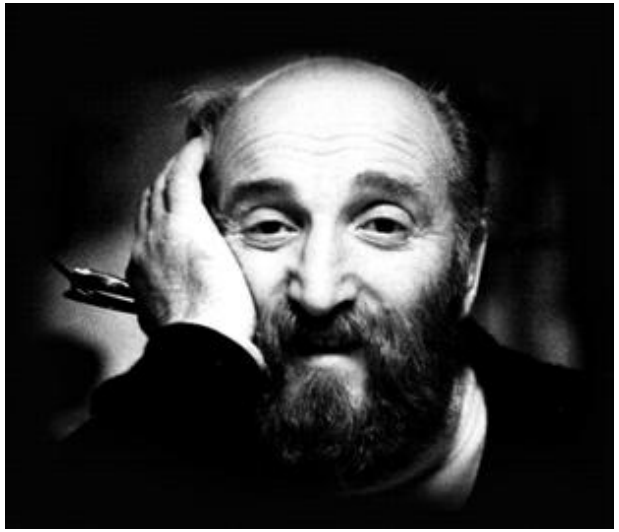

Moscow
Russian Federation
3000 km
Novosibirsk
Novosibirsk
30 km
BINP
Google earth

History

- Institute of Nuclear Physics was founded in 1958 as a lab in Moscow Institute of Atomic Energy (Kurchatov Insitute)

- The founder of INP was the prominent Soviet physicist Andrey M. Budker (1918-1977)

- In 1960 the Institute moved from Moscow to Novosibirsk



Academician A.M.Budker (1958-1977)

- Academician Aleksander Skrinsky – BINP director from 1977 till 2015 (now – Scientific Leader of the Institute).

- Academician Pavel Logatchev – BINP director from June 1, 2015.

- Today BINP is the largest institute in the Russian Academy of Sciences

A.Skrinsky

P. Logatchev

Budker Institute staff

Total staff of BINP is ~2700;

among them:

- Scientists ~ 400
- Engineers ~ 350

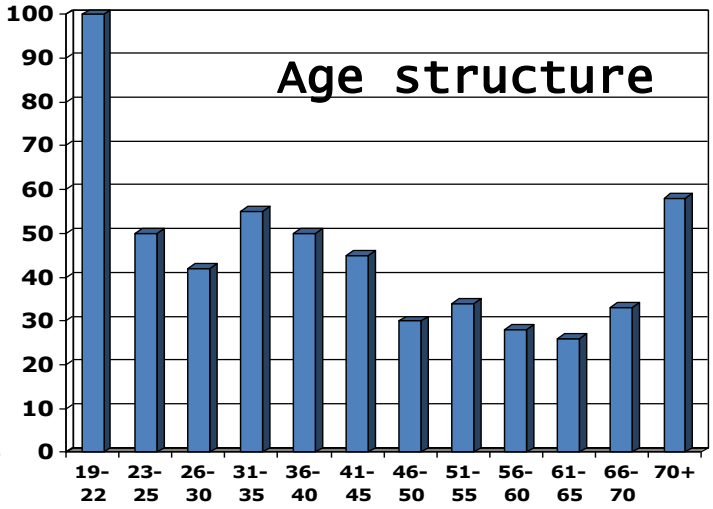
} researchers

- Students and PhD students ~ 250
- Laboratory technicians ~ 300
- Workshop personnel ~ 800
- Support personnel ~ 400
- Administration ~ 200

1/3 – accelerator physics

1/3 – HEP and PP

1/4 – plasma physics

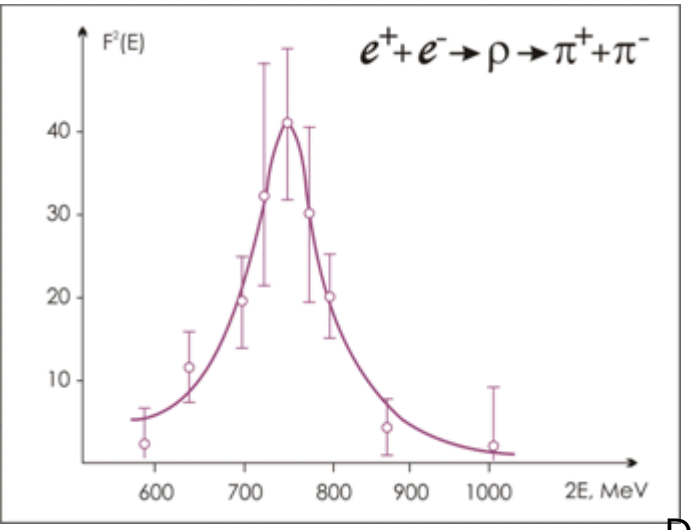


Basic and applied research

- ☐ High energy physics and e^+e^- colliders
- ☐ Accelerator physics and technology
- ☐ Thermonuclear research
- ☐ Synchrotron radiation and FEL
- ☐ Industrial accelerators
- ☐ Medical and safety application

HEP and colliders

- The first collider was demonstrated at BINP, Frascati LNF and SLAC
- Electron-positron colliders VEP-1, VEPP-2, VEPP-2M, VEPP-4 operated at BINP in the past
- VEPP-4M (5 GeV) and VEPP-2000 (1 GeV, round beams) are currently in operation



The world's first experiment at e^+e^- colliders

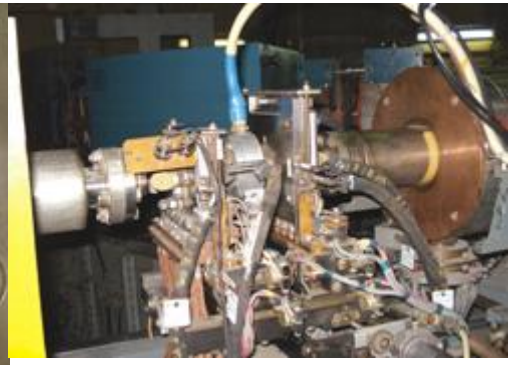
Detector KEDR at VEPP-4M

VEPP-2000 - the first collider with round beam option

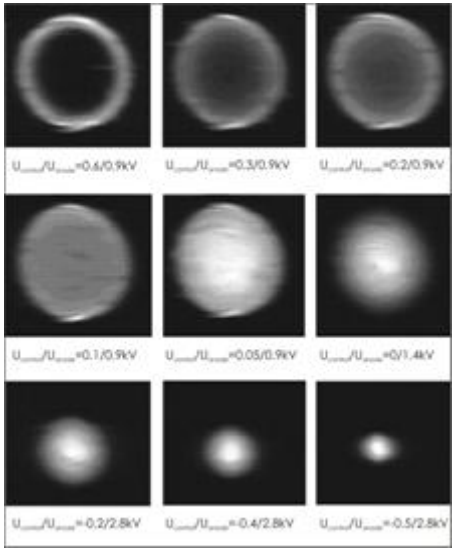
Accelerator technology

- ☐ Colliding beam method realization
- ☐ Electron cooling invention and realization
- ☐ Charge exchange injection development
- ☐ Proposing and development of the optical klystron – the FEL modification with the highest radiation power
- ☐ High field Li-lens has been proposed

High voltage accelerating columns



Li lens for positrons collection

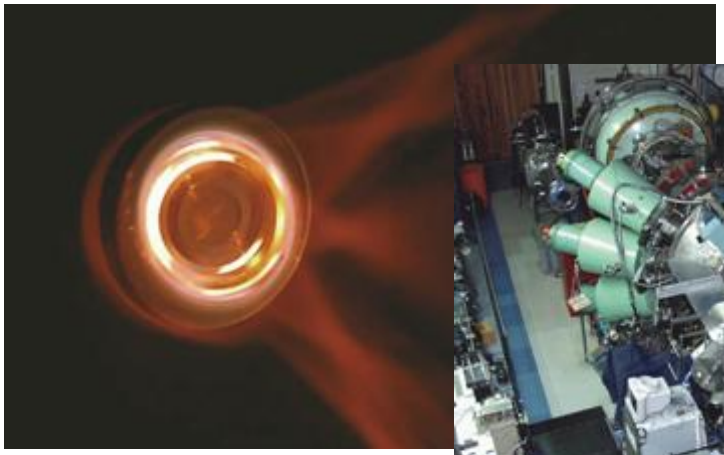


Electron cooling of a proton beam

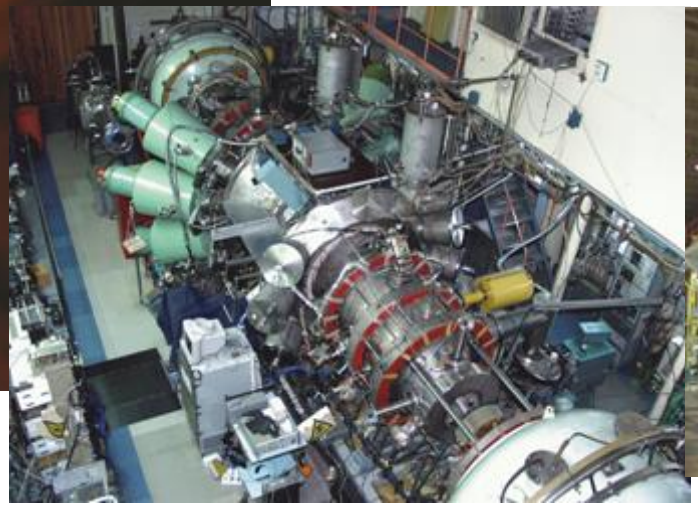
9 T superconducting magne

Thermonuclear research

- ☐ Mirror and multi-mirror traps for plasma have been proposed at BINP
- ☐ Ambipolar trap for plasma has been invented
- ☐ Gas-dynamic trap has been suggested and implemented
- ☐ Ion injectors with record-breaking parameters (beam power ~ 1MW) for the plasma heating have been developed



The light from hot plasma

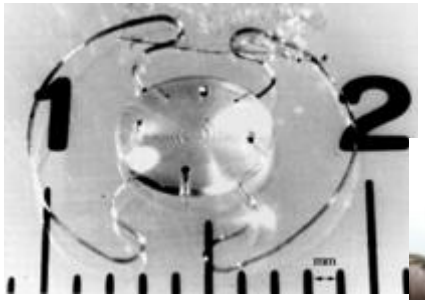


Gas-dynamic plasma trap

Multi-mirror plasma trap

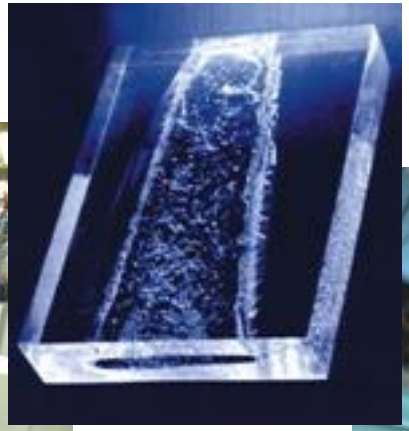
Synchrotron radiation and FEL

- Siberian Synchrotron Radiation Center is based at BINP
- SR researches at the storage rings VEPP-3 (2 GeV) and VEPP-4 (1 - 5 GeV)
- FEL with the record-high radiation power (500 W average) in the terahertz region



Artificial crystalline lens produced by the SR LIGA technology

SR research hall at VEPP-3



Hole melted in Plexiglas by powerful radiation

Terahertz light from FEL at the sample

Industrial accelerators

- Two types of small electron accelerators for industrial applications (radio-chemistry, food, drug, medical equipment sterilization, water and flue-gas treatment, etc.):
- ILU-type RF accelerators (electron energy up to 5 MeV)
- ELV-type rectifier type accelerators (energy 0.4-1 MeV, beam power up to 400 kW)

400 kW ELV Accelerator, Korea

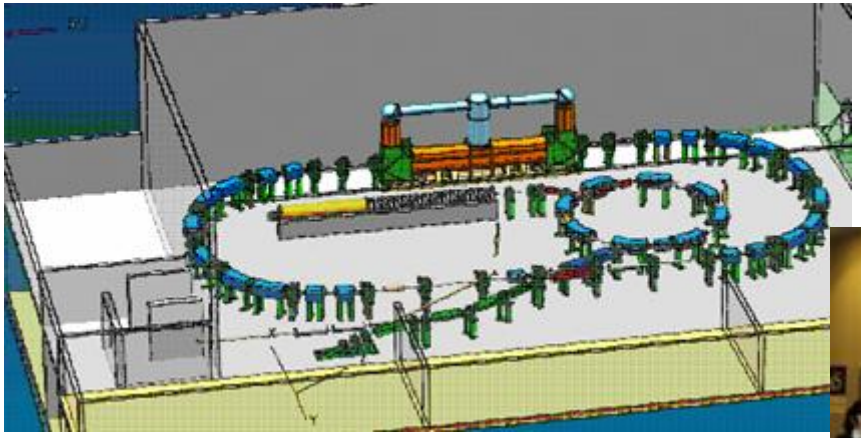
Compact ILU accelerator

More than 100 devices were supplied to China, Korea, Japan, USA, et.

Grain storage in China equipped with the ELV accelerator for insect sterilization

Medical and safety application

- ☐ Cancer therapy synchrotron project based on the electron cooling
- ☐ Extremely low dose X-ray imaging systems
- ☐ Medical stuff and equipment sterilization by powerful electron beam
- ☐ New drugs production with electron beam
- ☐ X-ray anti-terror system



Cancer therapy synchrotron project

Anti-terror X-ray system in airport

"Terrorist" with clearly seen plastic knife, gun and explosive

Development, design …

- Experienced scientists can develop any (new) product required by customer
- Design Department (100 designers) is equipped with the modern CAD software
- BINP designers are familiar with design standards, tools, procedures of CERN, DESY, GSI, BESSY, etc.

… and Manufacture

The Workshop comprises 150 technological divisions, sectors and specialized shops with the total area of 60000 m^2, about 1000 of workers, technologists and engineers

Main workshop Google view

Workshop departments view

Product groups (incomplete…)

Magnets

PS and electronics

Compact neutron source

Industrial
e- accelerators

SC wigglers

Undulators

AMS

MW ion source

High vacuum systems

BNCT

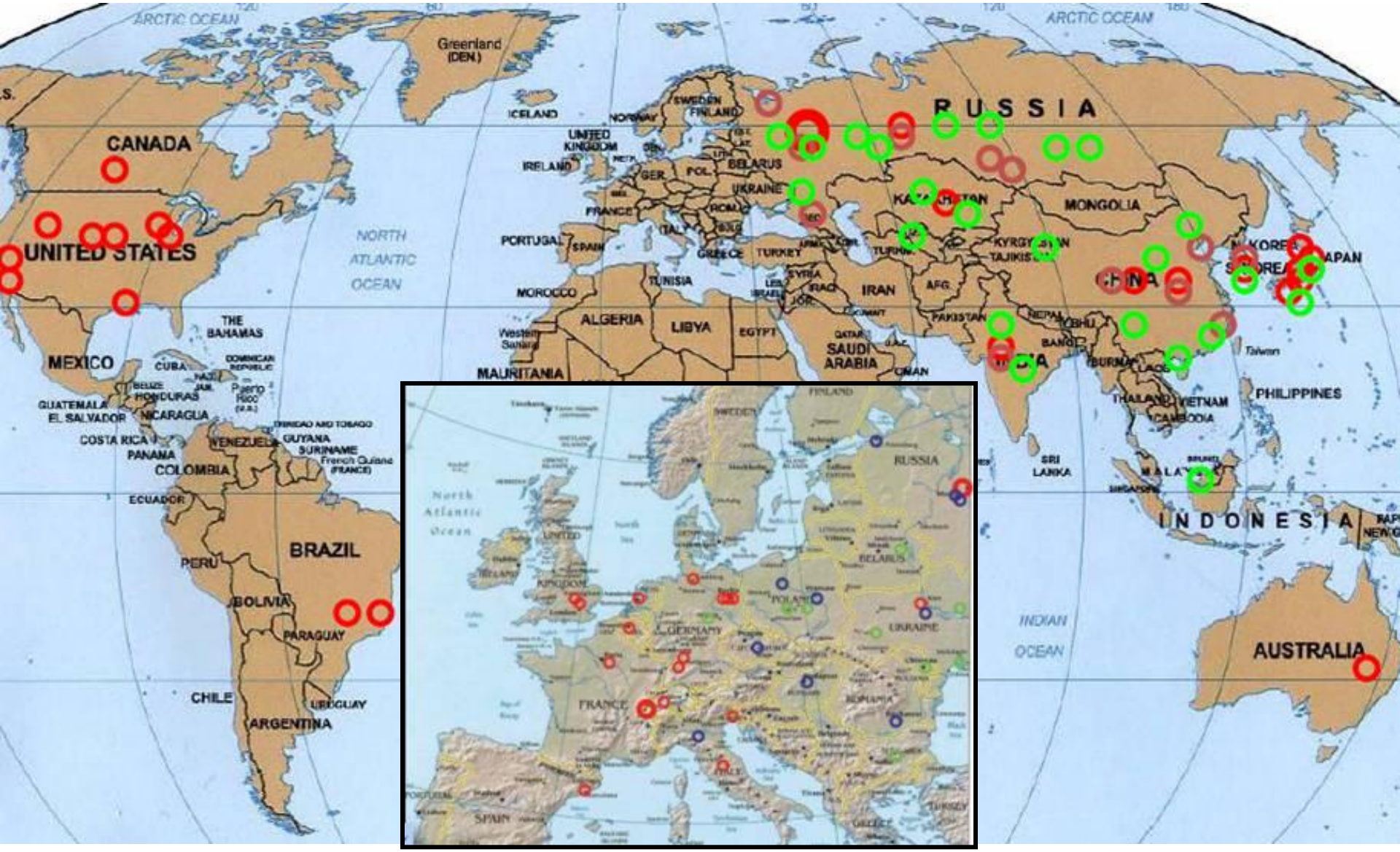
X-ray scanners

e- cooler

RF systems

Turn-key facilities

International collaboration map

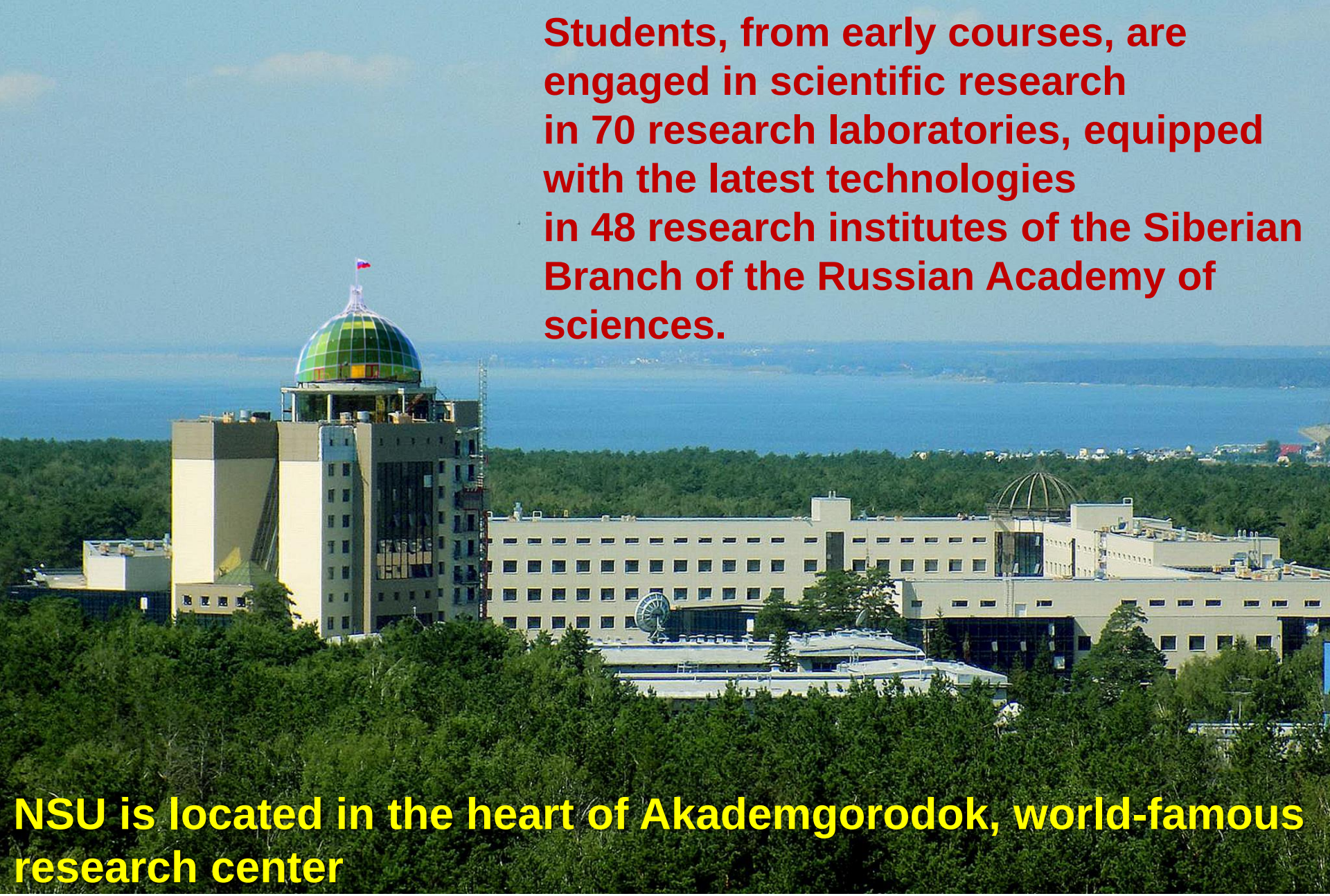


Distribution of the equipment produced by BINP in the world and in Europe

"We don't make you smarter, we teach you to think"

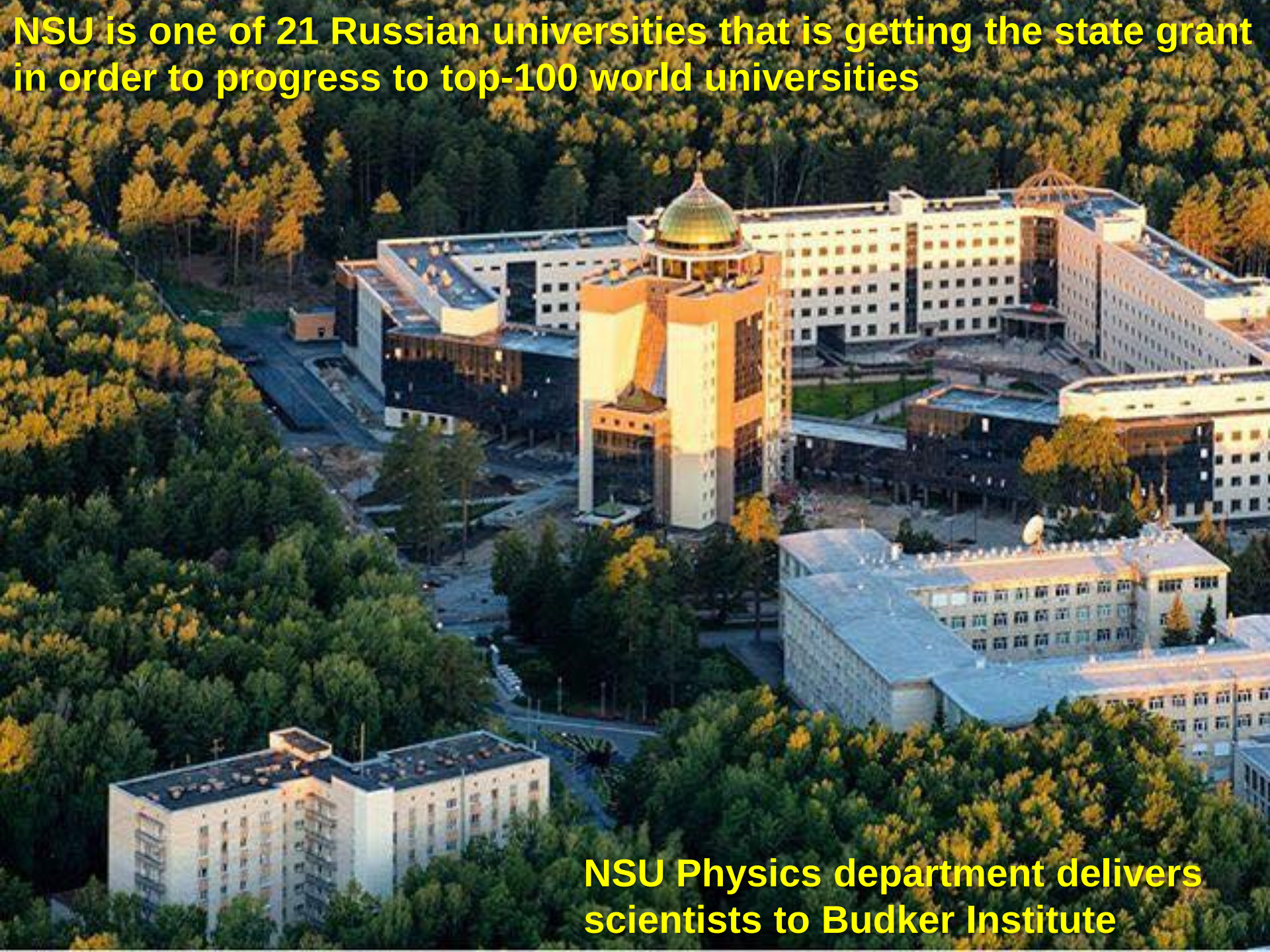
Novosibirsk State University

6000 students
13 faculties
2000 university teachers (80% of them are scientists from institutes of Russian Academy of Sciences)
880 associate professors, 570 full professors with doctorate degrees
60 members of the Russian Academy of Sciences



Students, from early courses, are engaged in scientific research in 70 research laboratories, equipped with the latest technologies in 48 research institutes of the Siberian Branch of the Russian Academy of sciences.

NSU is located in the heart of Akademgorodok, world-famous research center


NSU is one of 21 Russian universities that is getting the state grant in order to progress to top-100 world universities
NSU Physics department delivers scientists to Budker Institute

Novosibirsk State Technical University

Novosibirsk State Technical University is one of the largest universities in Siberia

The university has 17 faculties and institutes.
Approximately 3000 faculty members and employees work at the university.
Total number of enrolled students exceeds 25 thousand.
NSTU Physics-Engineering department delivers engineers, designers, technologists to Budker Institute

Institute-University collaboration: goals and mutual synergy

Our goals:

- **attract and select the best young brains from 1/10 of the Earth (eastern part of Russia, north Kazakhstan, …)**
- **Provide for them the best possible conditions for training, education and research in physics – from the school to the completed PhD**
- **Engage them into Budker Institute community.**

Mutual synergy:

- high-level researchers from Lab are involved in education process;

- high-impact publications with joint affiliation of researchers and students/PhD as co-author;

- possibility to get (select) best students (motivated) for research activity, to renew and support scientific schools of Budker Institute;

- joint laboratories, projects, grants, etc …

Educational system: tools and facts

- Multi-stage system of selection of talented students from Russia and even abroad (Kazaktstan);
- Specialized (in physics and mathematics) Boarding School at the University (up to 500 students);
- University departments are attached to the Budker Institute/ Laboratories and exploit experimental facility and personnel (so called ‘’base department’’);
- > 50% of Budker Institute scientific staff is involved into teaching activity (starting Boarding School, general disciplines in Universities, special courses, scientific supervision etc.);
- Fellowship program of Budker Institute: we support up to 50 students of Boarding School (to cover annual fee) and Universities;
- Promotion of science and Lab: excursions to the Institute (up to 2000 visitors/year), public lectures, public relations etc.

How we attract and select students?

- Early stage: general lectures of leading scientist at 1st and 2nd year, excursions, scientific quests (new and interesting!) – main goal is giving main ideas of BINP activity.
- Second year – first course work at lab (small study, theoretical or experimental). Main goal – first integration in the BINP environment, familiarizing with real scientific research work.
- Third year of education – students and tutors chose each other. Specialization (HEP, plasma, SR, accelerators, electronics, programming, etc.)
- 3rd, 4th and 5th, 6th years, PhD – amount of theoretical lectures decrease, amount of practical study increase.

Finally we have a young researcher which knows well the BINP environment, some experience of scientific research under supervision and ready for individual study.

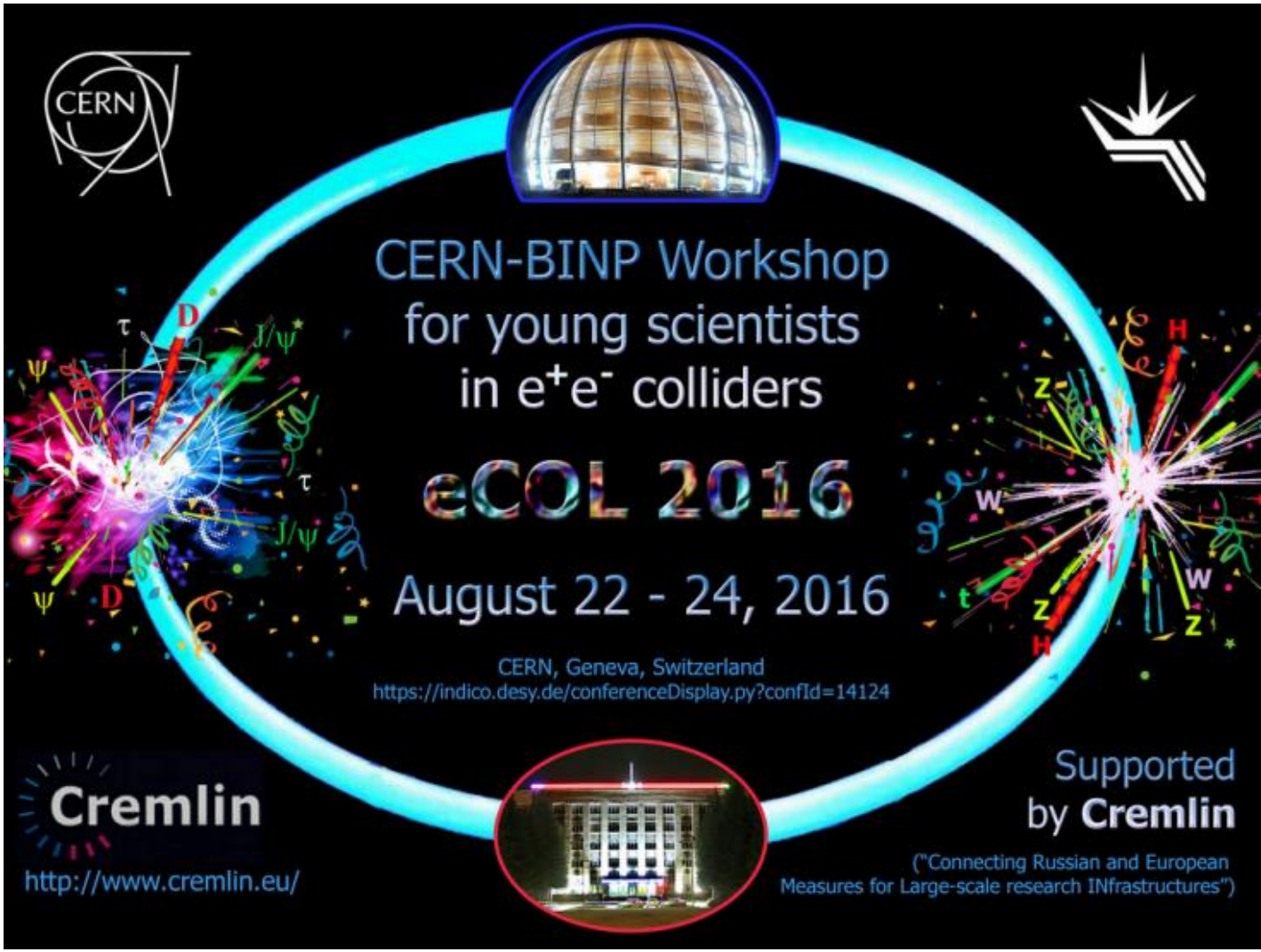
How we teach students?

- Teachers, lecturers and tutors 100% came from the same educational system and know it well.
- Teacher and lecturers are talented and well known scientists with experience not only in teaching but in scientific research as well.
- As teachers and lecturers work in the labs and they will get the students, they know precisely what is necessary to teach.
- Students are paid some amount when they work in the labs (also motivation). We cannot fight with banks for salary, but combination of interesting research work and some amount of money is still attractive for those who really want to work in science

How we estimate the education quality?

- Course work (twice per year) defense
- Bachelor degree defense after 4th year
- Master degree defense after 6th year

Young scientists' conference every year (winner may go to the real conference abroad)
Example: Cremlin CERN-BINP Workshop for young scientists – success!



Proposal

We propose to investigate possibility to combine efforts of different universities in accelerator science/technology teaching in order to make the education in this field more effective.

For this purpose a team of experienced lecturers/professors from several universities can be arrange. This team will study different courses from different universities/countries and decide their strong and weak points.

A workshop with preliminary title “How to teach accelerator science and technology in university?” can be arranged. Lecturers and students exchange between universities is possible.

Two of the universities based on BINP (Novosibirsk State University and Novosibirsk Technical University) with great experience in the subject can take part in such an activity.


Thank you for attention