Basic research VS innovations: confrontation of synergy?

Budker Institute experience

Aleksey Vasilyev,

Preamble

- It is important to note that the Budker Institute experience in innovation is completely unique. It is unlikely that it can be used and / or implemented directly in other labs, countries and continents.

- On the other hand, the BINP approaches in the field of innovations are not static. The Institute permanently identifies an existing and arising innovative practices in the country and in the world, tests them in its "ecosystem" and try to apply whenever it fits.

- This process should be enhanced and, probably, tuned on the way to construction (and then - operation) of a world-class large-scale research infrastructure – Super Charm-Tau Factory (SCT)

Outline

Innovations:

- Definitions and objectives
- role and place of research institute on innovation landscape

Budker Institute:

- R&D activities on brief
- "key principles"

Examples of innovations - ''*made in Budker*":

- Industrial accelerators
- X-ray scanners
- Accelerator-based neutron source for BNCT

Conclusion

Innovations: definitions and objectives

Following Google, there are about 40 different definitions of innovation. That means that the term has a history and potential for development

In general, this is any novelty (it may be an idea, a method, a technology, a product, a service) that improves something (performance, efficiency, quality) anywhere (in economy, society , etc)

The innovation cycle is a "chain of steps" leading to appearance of innovation.

Innovation Quest

Key issues are:

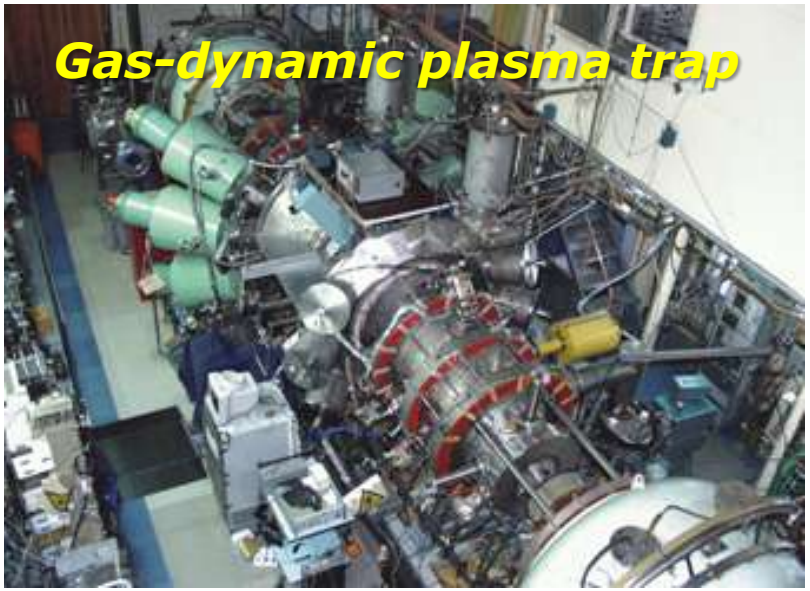
- Is an each step on this way an innovation itself? Or innovation is a turn-key product?
- In this sense, what is (should be) the role of research laboratory/center: produce an ideas (research steps) or a turn-key product? Rules VS exceptions?
- Actor of innovation process: initiator, customer, executor, coordinator, … What is the role of research organization? Again, rules VS exceptions?
- Are there specific competitive advantages of a large-scale research infrastructure for an innovation process?

How does the BINP experience reflect these questions?

Let's make a few minutes surf over the BINP, trying to catch the answers

Budker Institute in brief

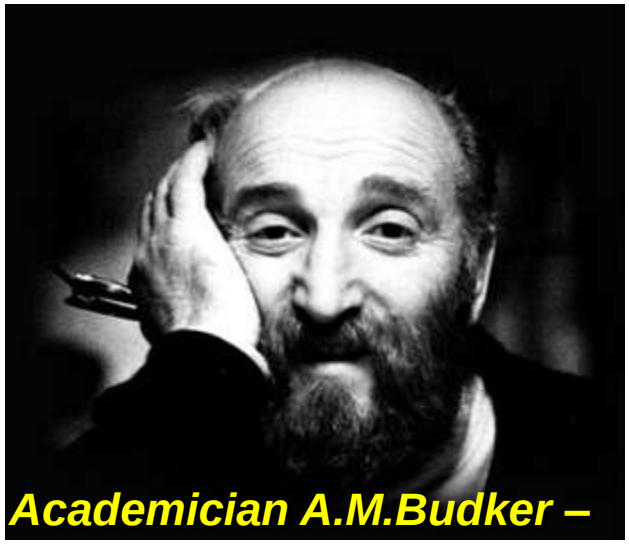
Budker Institute, with 2700 employers, is the largest academic institute of the Russian Federation, and one of the world's leading research centers in the field of particle physics, accelerator physics and technology, synchrotron radiation sources, free electron lasers, high-temperature plasma physics, and controlled thermonuclear fusion.



Budker Institute in brief (2)

A number of key ideas and developments that determine the current world level of accelerator science and technology were proposed and implemented at Budker Institute. It is the only laboratory in the world where for half a century since the appearance of the colliding-beam method at least one electron-positron collider has been operating. Today, two out of the six existing colliders are operating here.

Budker Institute key principles: Round Table



Academician A.M.Budker – INP founder and first Director (1958-1977)

the principle of the Round Table: a very nominal borders between departments, strong ''horizontal" contacts and comprehensive professional "on air" expertise of all aspects of the institute's life and activities

a potential to concentrate efforts and to consolidate resources on current interest tasks, internal mobility and flexibility of large organization

Round Table

Budker Institute key principles: turn-key research

a complete research chain: from an idea to the turn-key research product: convergent iterations and tuned feedbacks

large-scale design department and production workshop: unique technologies and experience to search optimal solutions

Budker Institute key principles: schools

- 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 large creative team - Budker Institute community.

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

Budker Institute key principles: collaborations

extensive scientific collaboration and cooperation: exchange of ideas, technologies, best practices

competences and experience of involving in complex projects and effective participation in them (examples: LHC, ITER, NSLS-II, XFEL, FAIR, SuperKEKB, …)

Five thousand tons of highly technological equipment was developed and manufactured at BINP, delivered and put into operation at CERN premises at a distance of 5 000 kilometers from Novosibirsk!

Innovation track

Following these principles, the Institute spends (roughly) of 50/50 (both resources and manpower) for basic research and for applied research, including innovation activity.

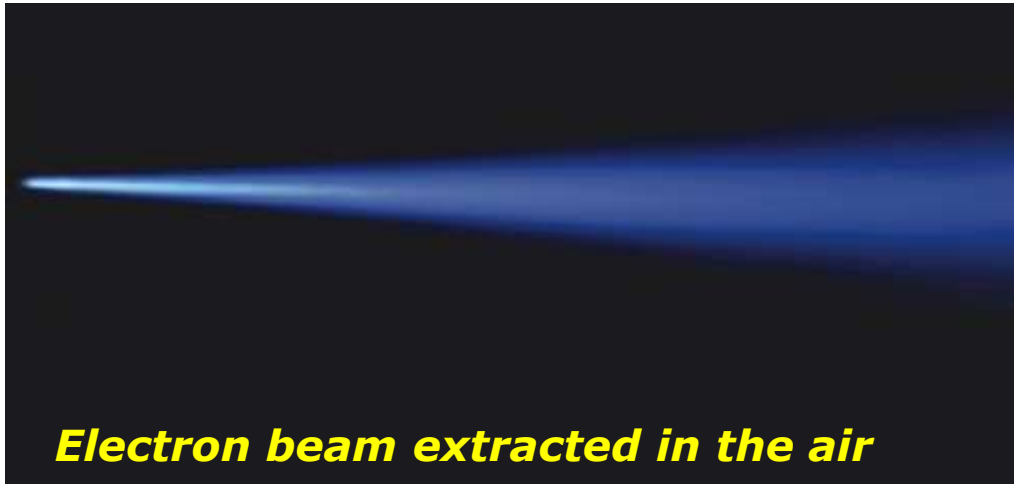
For the second business, there are two groups of customer: research laboratories and institutions around the world (red on maps) and industry

Examples: industrial accelerators, X-ray scanners for medicine and security, …

Industrial accelerators

Two types of compact electron accelerators for industry:

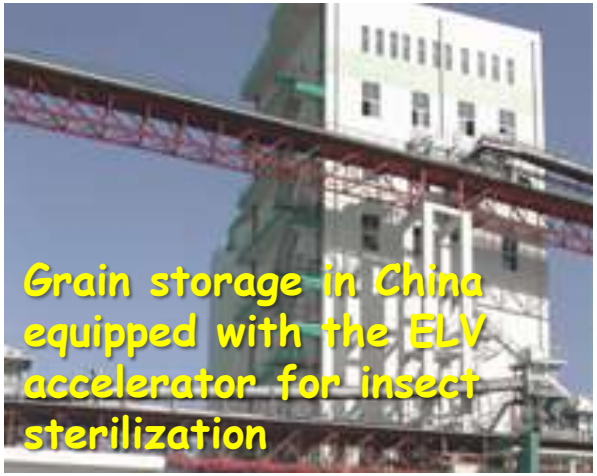
- ILU-type RF accelerators (energy up to 5 MeV, beam power up to 100 kW)
- ELV-type is DC-type accelerators (energy 0.4-2.5 MeV, beam power up to 400 kW)


Electron beam extracted in the air

Typical cost of M0.5-5$ per unit depending on equipment


400 kW ELV accelerator

Compact ILU accelerator


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

Industrial accelerators (contd.)

Applications:

- cable industry: radio-chemistry, shrinkable tubes, high-resistant isolation, …,
- medicine and health: medical equipment sterilization, food, drug, …
- ecology: water and flue-gas treatment, … etc…

Since 70-s, more than 200 accelerators have been manufactured and delivered , mainly – abroad (China, South Korea, Japan, USA, Kazakhstan, Germany, India, Poland, etc).


ILU-8 in Local Shield in Japan

ELV–8

Most of them are into operation now, among them (EU located):

- ✓ ELV at Leibniz-Institut fur Polymerforschung, Dresden
- ✓ ELV at Experimentelle Thermofluiddynamik Institut für Fluiddynamik, HZB
- ✓ Two units of ILU-type at RadPol plant (Czluchów)
- ✓ ILU in the Institute of Nuclear Chemistry (Warszawa)

Industrial accelerators (contd.)

On-site joint BINP-NSU facility for research and development of new radiation technologies:

- food and vegetable raw materials irradiation (pasteurization by electron beam);
- corrosion resistant alloys (e.g. titanium-tantalum);
- decontamination, utilization, new materials …;
- personnel training (chairs at Universities) …

Joint BINP-NSU facility for development of new radiation technologies and sterilization:

X-ray scanners for medicine and security

- ✓ Extremely low dose (≈ 1 μSv /scan, corresponds to 10′ flight),
- ✓ fast (5 sec/frame), HQR (no contribution from scattering, …)
- ✓ The only possibility to check body cavities (no tactile)

A few hundreds of units were produced by industry (Russia, China, Japan, S.Korea) under BINP license (most delicate equipment – BINP).

Splash of interest after terrorist attaks …

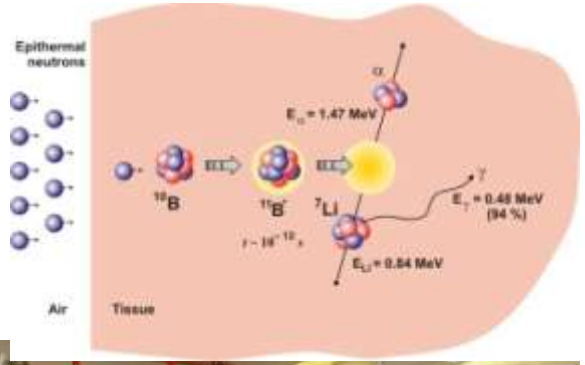
X-ray medicine scanner in Moscow perinatal clinic

X-ray inspection scanner in Novosibirsk airport

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

Compact accelerator based neutron source for Boron neutron capture therapy

- ✓ In the BINP a novel 2 MeV 10 mA compact proton accelerator for BNCT was proposed and developed (based on vacuum insulation tandem accelerator technique).
- ✓ A 5 mA proton beam has been already obtained, technical and engineering solutions are found (including neutron generating Li target). *In vivo* researches are in progress.



The possibility compact accelerator neutron source for clinical application has been proved!

Conclusion

1) Innovation activity of the BINP based on ideas and technologies developed for basic research (accelerators and detectors for HEP and thermonuclear research)

2) To be competitive, BINP innovation products are under ongoing improvements using know-how generating by basic research activity (wide spectra: ideas and solutions, methods, technologies, electronics and software, operational experience, etc.)

3) BINP key principles are competitive advantages. All in one: you get all what you need at once – expertise, R&D, manufacturing, operational and administrative support, etc...

4) Standard approach for innovation – selling of property rights – wasn't very successful. Different reasons: specifics of innovative products of BINP, features of the relevant market and, of course, lack of sufficient experience in related legal issues.

5) Should we use that "standard approach"? At least, we should be in the game and be open for "innovations" in innovation activity.


Thank you for attention
and
Welcome to Novosibirsk!