Contribution of Czech high-tech manufacturers to construction of JINR accelerator facilities

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Outline

- JINR Dubna - introduction of the Institute
- Key projects in Dubna
- Czech companies and JINR
- VAKUUM PRAHA - supplier of the sophisticated vacuum systems to JINR 1993 - 2013

JINR Dubna

The Joint Institute for Nuclear Research (JINR) is an international intergovernmental scientific research facility established through the Convention signed on the 26th March 1956 by eleven founding States and registered with the United Nations on 1st February 1957. Czechoslovakia was one of founders. At present time JINR has 18 member states and Czech Republic is one of the most respected members. Recognized scientists as well as students and post-gradual students are in the Czech team in Dubna. Moreover Dr Richard Lednický from the Institute of Physics in Prague has been elected as one of two vice-directors for this period. The pleni-potentiary of the Czech government in JINR is Dr Rostislav Mach. The Czech representatives in the Scientific Board of JINR are Prof. Wilhelm and Prof. Pospíšil.

JINR Dubna - an excellent partner for high-tech companies

JINR … demanding, challenging and reliable partner

interest of JINR in cooperation and exchange of ideas

interest of JINR in short and medium time scientific stays of Czech young researchers and technicians in Dubna

New projects

NICA, DC 280

JINR basic facilities

Nuclotron-M – NICA/MPD /SPD

Superconducting ion and polarized particle accelerator and ion collider

Physics of ultrarelativistic heavy ions, high energy spin physics

Cyclotron complex U400, U400M

Acceleration of heavy ions up to 50 MeV/u

Synthesis of supe-heavy elements

Impulse reactor IBR-2M and Source of resonance neutrons IREN

5 GHz pulses with 1,5 GW power and 10^{16} neutrons/cm^{2}sec

Accelerator driven neutron beam of 50 GHz up to10^{13} neutrons/sec

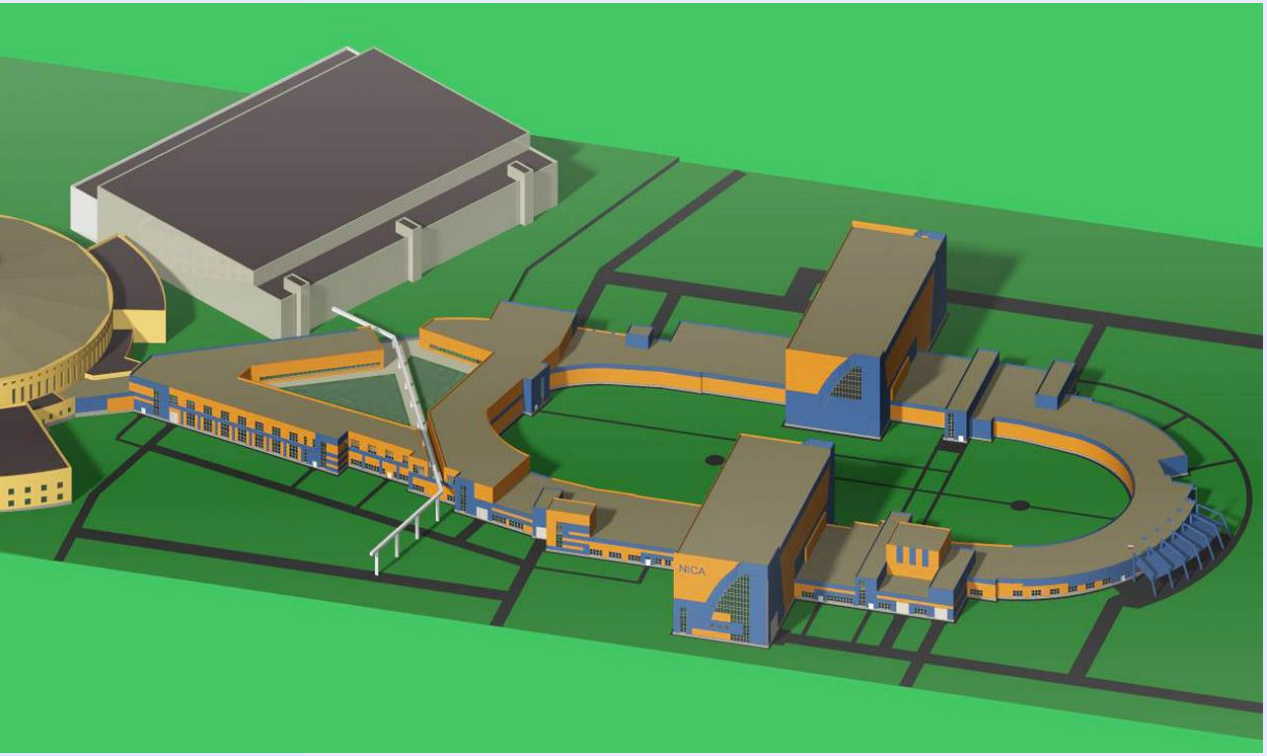
Nuclear physics with neutrons, Condense matter physics

JINR Phasotron

2 μA proton beam with the energy 660 MeV

Complex for Hadron Therapy

NICA – one of the top three Megaprojects of the Russian Federation

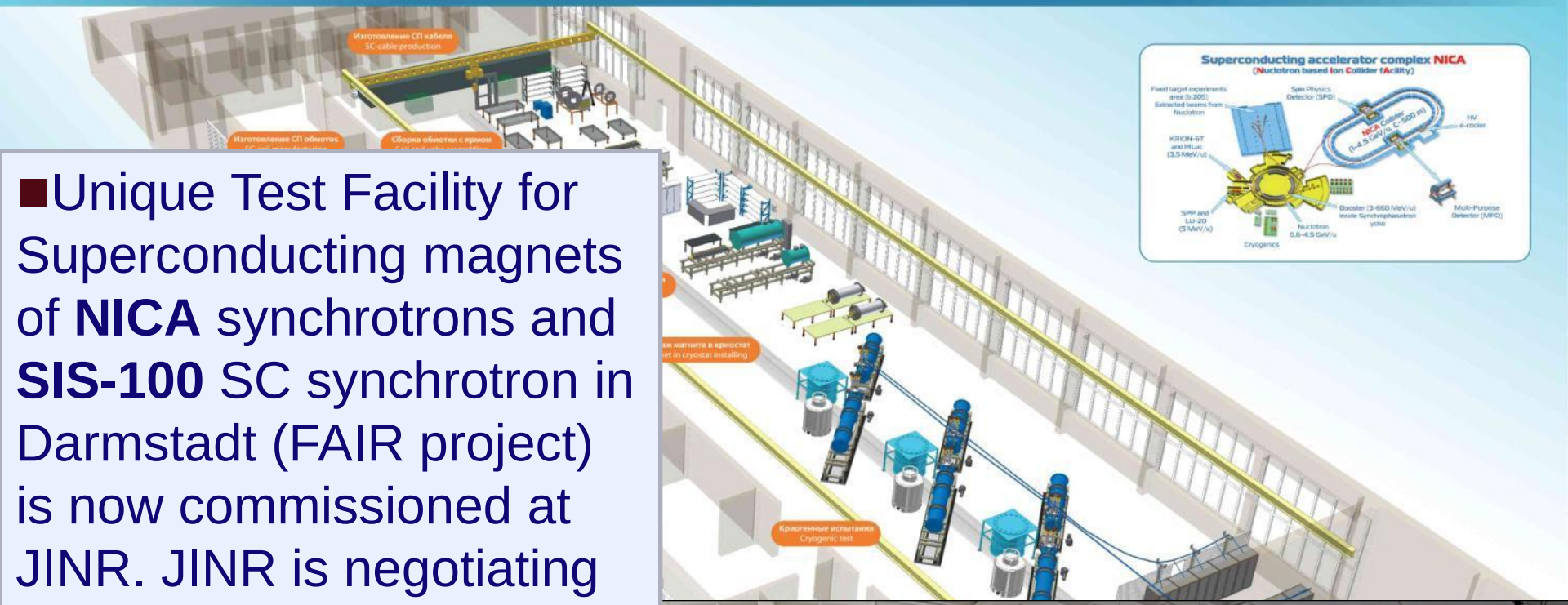


Five building companies have been chosen from 15 competitors in the second ballot, among them are two Czech companies (PSJ and PSG).

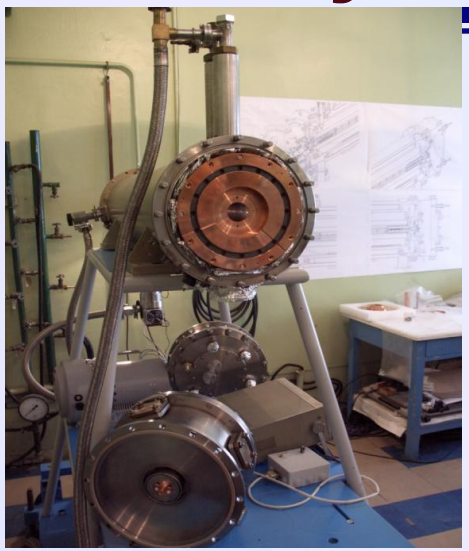
Czech lawyer company has been invited to serve as consultant for Conventional Facility & Siting (CF&S) tender

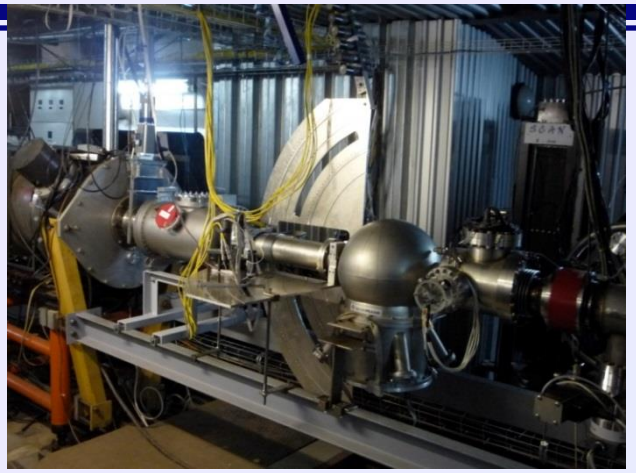
СТЕНД ДЛЯ СБОРКИ И ИСПЫТАНИЙ СВЕРХПРОВОДЯЩИХ МАГНИТОВ
TEST FACILITY FOR THE ASSEMBLING AND TESTING OF SUPERCONDUCTING MAGNETS

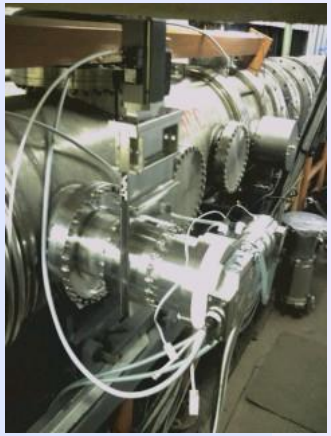
- Unique Test Facility for Superconducting magnets of **NICA** synchrotrons and **SIS-100** SC synchrotron in Darmstadt (FAIR project) is now commissioned at JINR. JINR is negotiating with Czech companies.

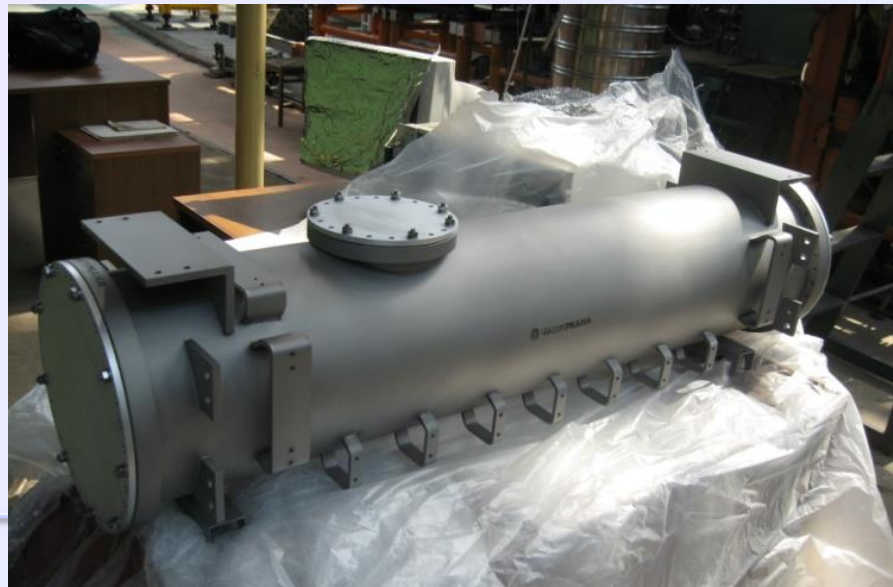


Upgraded Nuclotron vacuum system – the heart of NICA



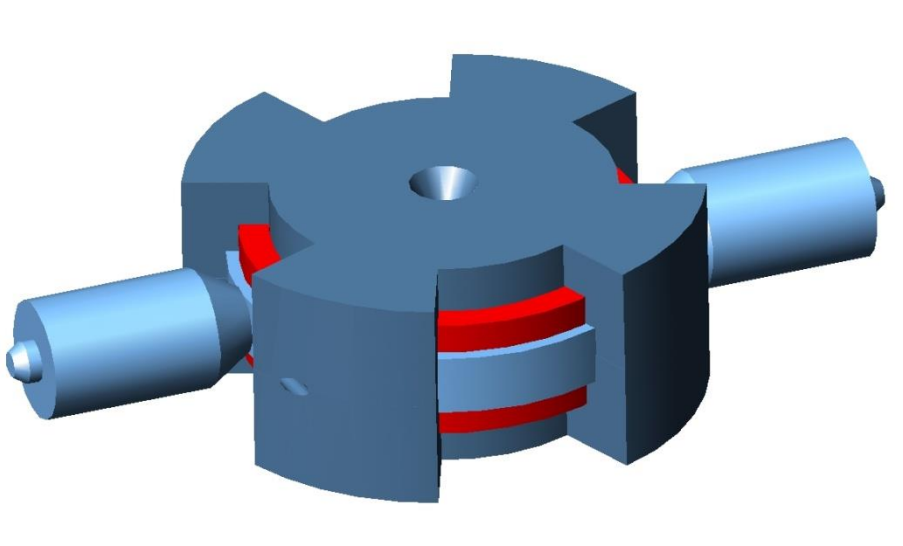






DC280 CYCLOTRON

SHE-factory (commission – 2015)



- Synthesis and study of properties of superheavy elements;
- Search for new reactions for SHE-synthesis
- Chemistry of new elements

DC280 (expected) E=4÷8 MeV/A		
Ion	Ion energy [MeV/A]	Output intensity
^{7}Li	4	1×10^{14}
^{18}O	8	1×10^{14}
^{40}Ar	5	6×10^{13}
^{48}Ca	5	$0,6\text{-}1,2\times10^{14}$
^{54}Cr	5	2×10^{13}
^{58}Fe	5	1×10^{13}
^{124}Sn	5	2×10^{12}
^{136}Xe	5	1×10^{14}
^{238}U	7	5×10^{10}

Future SHE factory
(under construction)

Design of the new building

Czech Hi-Tech Suppliers to JINR in 2012 -2013

- ENVINET
- KOPOS Kolín
- RAF Děčín
- Czech Technical University IEAP, ATEKO
- VAKUUM PRAHA

ENVINET

Cooperation with Laboratory of Nuclear Problems

Delivery of scintillation large-volume scintillation detectors for Laboratoire Souterrain de Modane, France

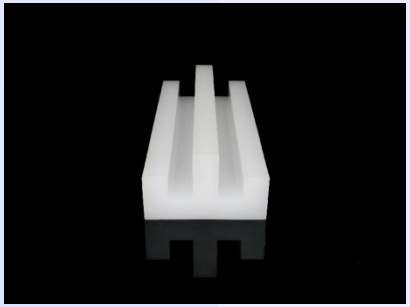
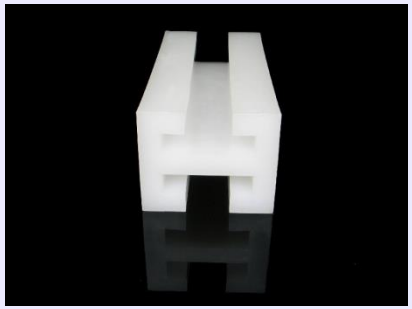
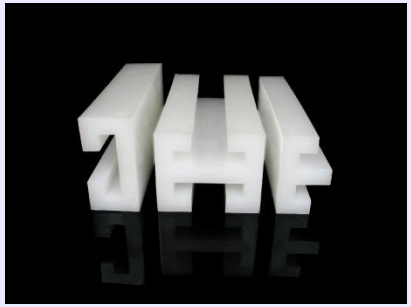
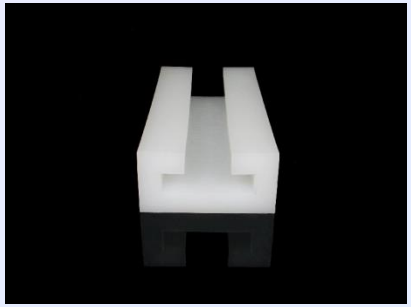
(Neutrino Ettore Majorana Observatory)

KOPOS Kolín

Shielding bricks NEUTROSTOP

Pure polyethylene … high contain of hydrogen … good neutron shielding.

Polyethylene bricks with 3,5 or 5 % of boron … good neutron and 2.2 MeV foton shielding

Institute of Experim. and Appl. Physics, Czech. Tech. Univ. in Prague

Radon suppression system

Free-Radon Air factory

IEAP CTU – JINR – CPPM – LSM – ATEKO Czech Rep.

activity of air: **A(^{222}Rn) < 10 mBq/m^3**

Flux: **150 m^3/h**

radon trapping on charcoal => radon decays during trapping

reduction factor 100 =>
„retention time“ T = 606 hours
(~ 25 days)

Philosophy of VAKUUM PRAHA and our partners worldwide

our clients = our partners

JINR = one of our best partners

Partners of VAKUUM PRAHA are universities, research labs and high-tech companies.

- **Formal contracts on scientific cooperation with universities and accelerator research labs.**
- **Cooperation with our partners on different projects as collaborators, project coordinators or suppliers.**
- **JINR belongs together with CERN, ETH Zürich, Charles Uni. Prague, Czech Acad. Sci., ČMI and high-tech companies, e.g. STAIB, ION-TOF, Ferrovac, Specs, TESCAN to our most important partners.**

20 years cooperation of VP with JINR Dubna

Motivation:

- improving the vacuum in existing JINR systems
- manufacturing of new vacuum systems with better parameters

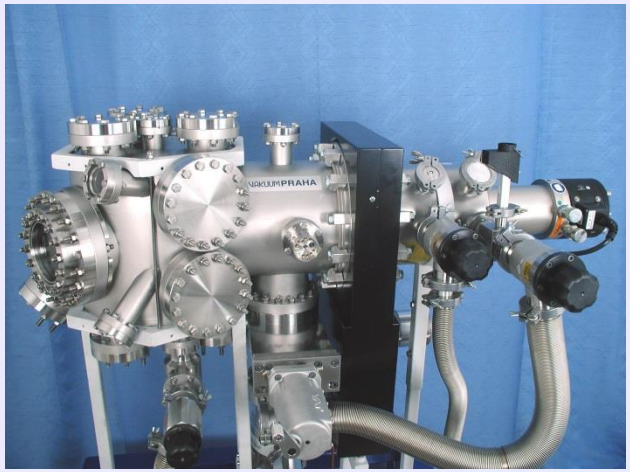
Results:

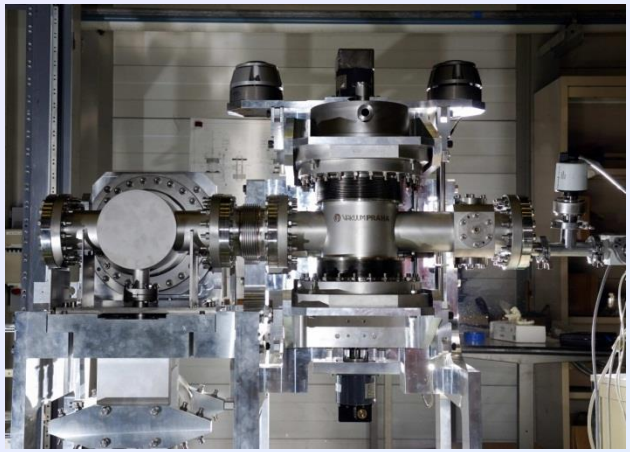
- the ultimate pressure in VP upgraded vacuum systems for JINR has been lowered by two orders of magnitude generally
- the ultimate pressure in new systems and beamlines … UHV
- the hydrocarbon content in VP systems … very low

Outcome:

- VAKUUM PRAHA = the most important hi-tech Czech supplier for JINR
- VAKUUM PRAHA = one of JINR world-wide leading supplier of ultra-high- vacuum systems

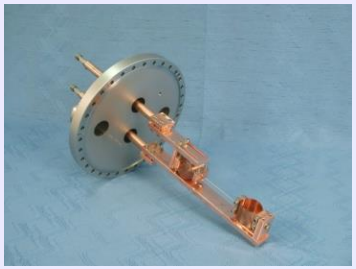
Products of VAKUUM PRAHA for HV – UHV – XHV





Solid State Electrotransport System

Partnership with Fac. of Math. & Physics, Charles Univ. and Toyama Prefect. Uni.

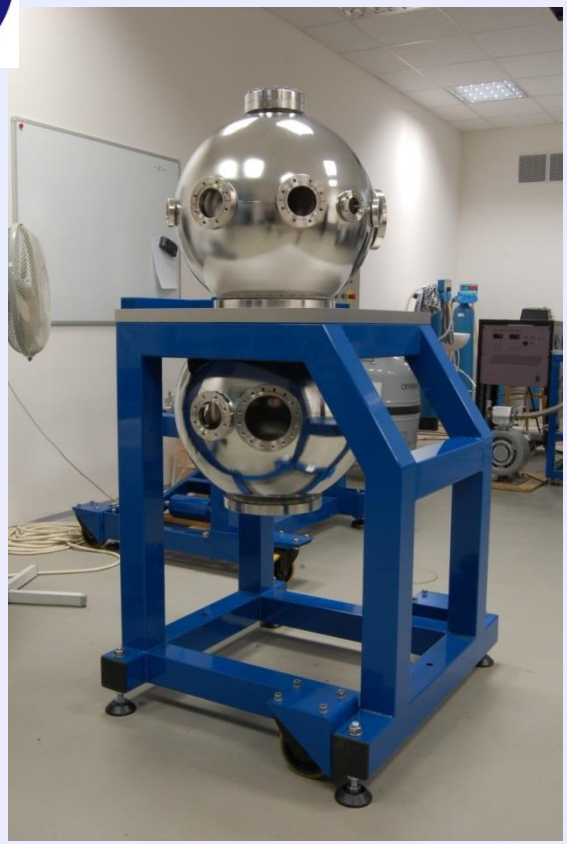


Purification of special materials -e.g. rare earth elements in UHV

Extra High Vacuum Calibration

Partnership with Czech Institute of Metrology and Faculty of Math. & Physics, Charles Uni.

UHV stage orifice flow standard



UHV stage dynamic extension

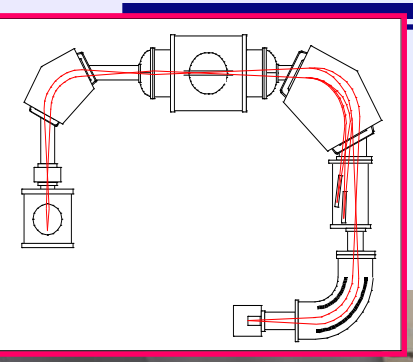
range 10^{-1} to 10^{-6} Pa
spherical chambers ϕ 500 mm
stainless steel, electropolished
tandem turbopumping

beryllium copper low outgassing rate 10^{-13} Pa m/s

specially designed cryopump achieving 5 K at the second stage

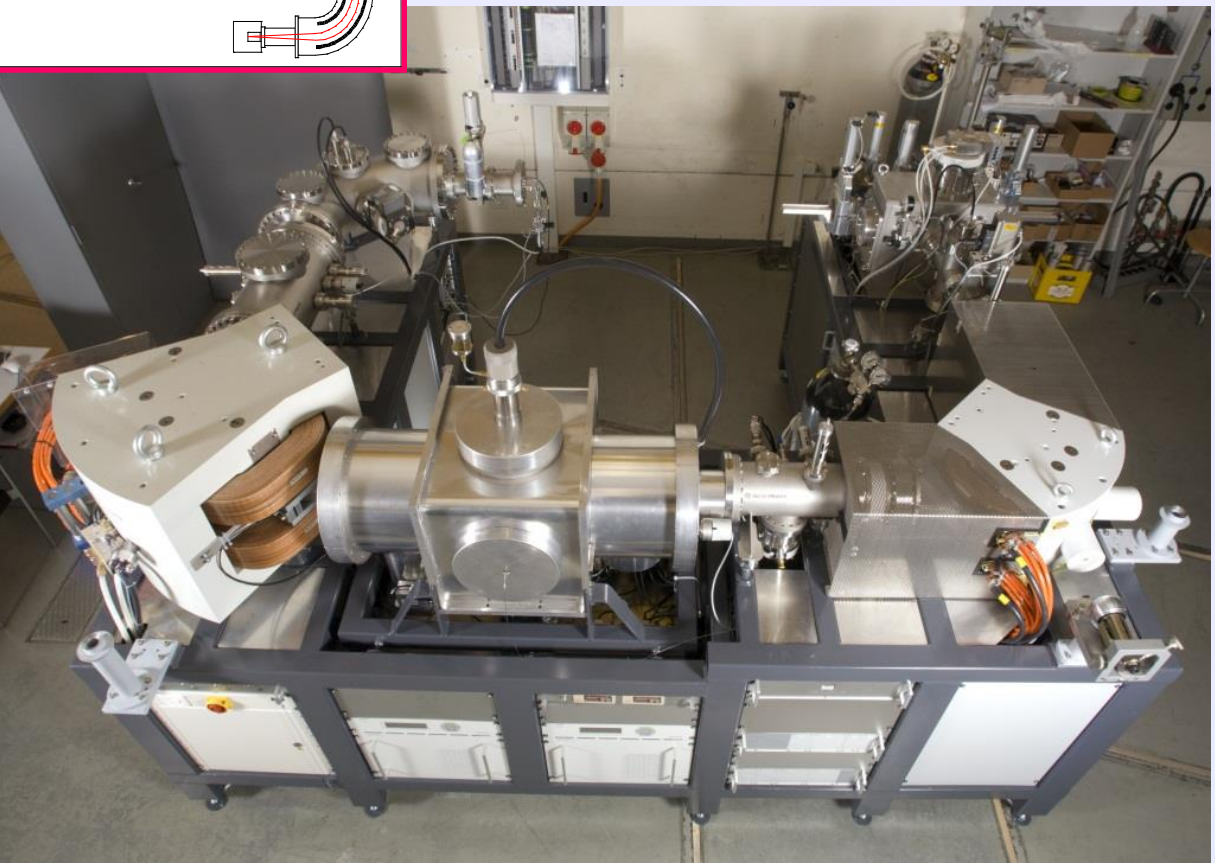
Vacuum System for AMS

Partnership with ETH Zürich



Accelerator Mass Spectrometer

Radiocarbon Dating



Leak testing of vacuum vessel for ESA

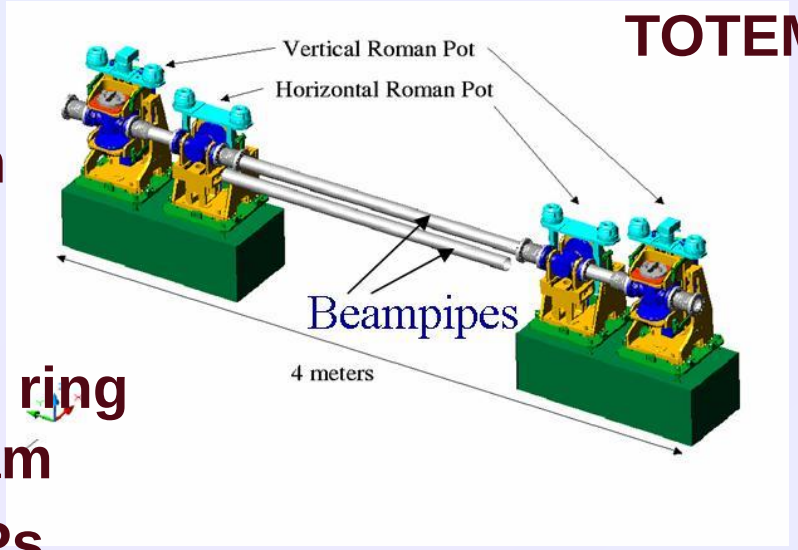
Roman Pot Vacuum Systems /LHC

Partnership with CERN LHC TOTEM+ATLAS and Institute of Physics, Czech Acad. Sci.

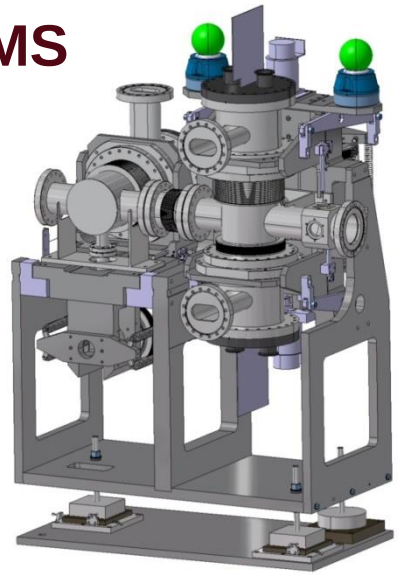
RPs: detection of forward protons from elastic or diffractive scattering (5 μrad)

- mounted in the LHC ring in the outcoming beam

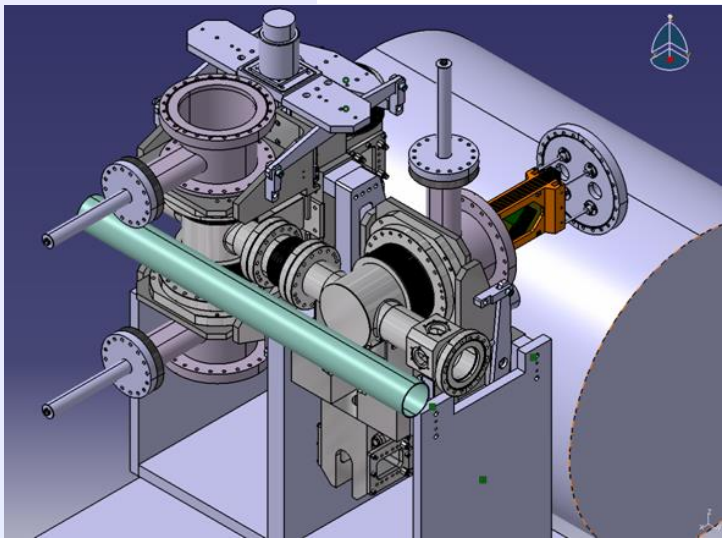
- detectors: inside RPs



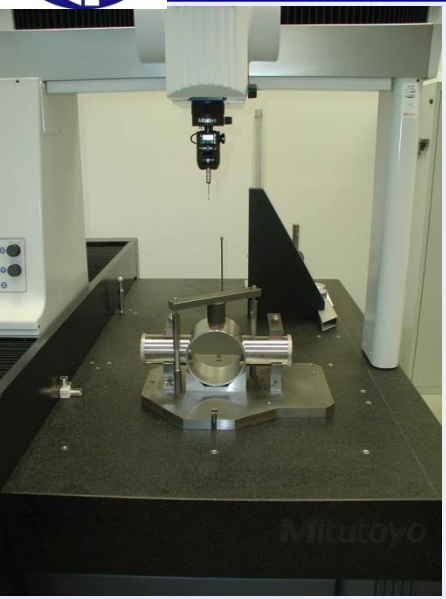
TOTEM/CMS

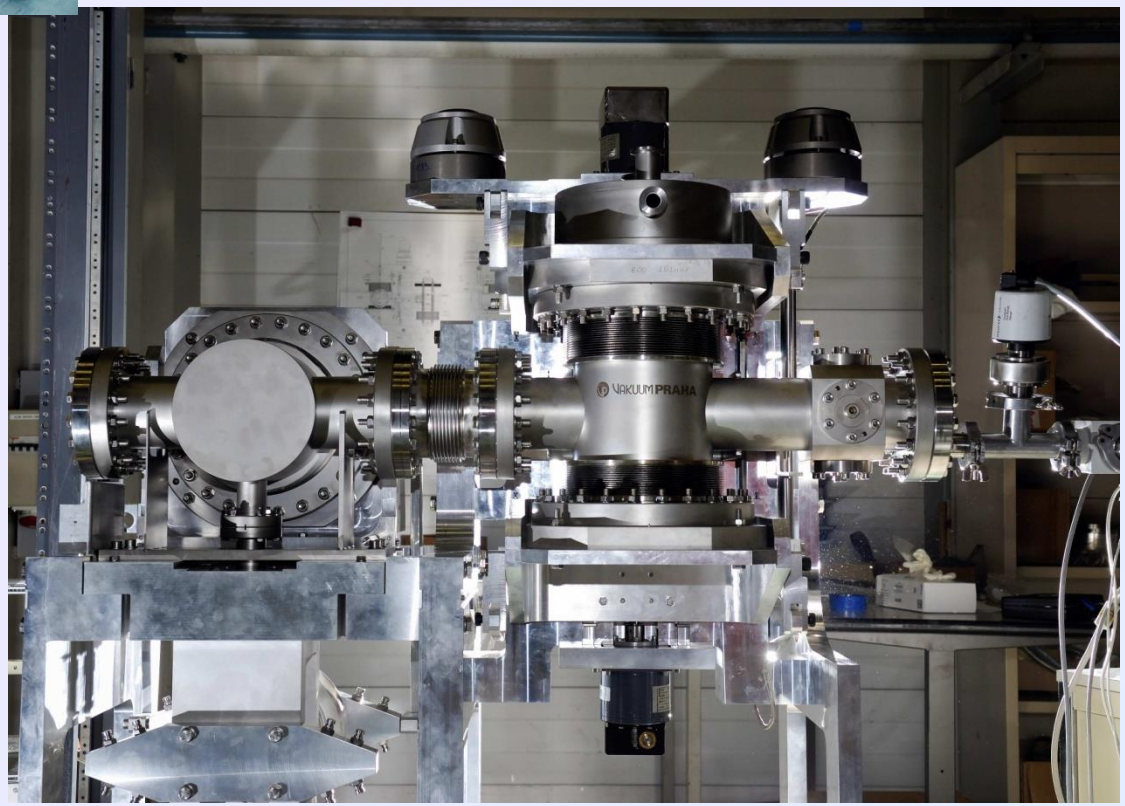


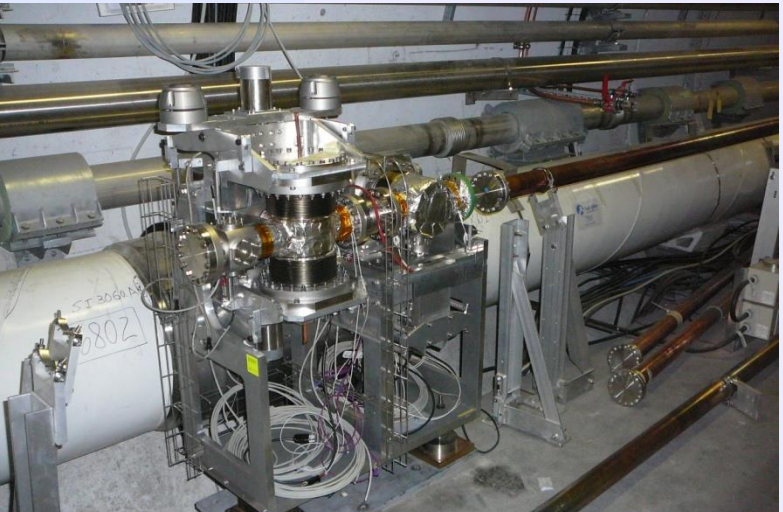
- **4 RP stations located symmetrically around the CMS interaction point at distances: ~147 m and ~220 m**
- **each RP station contains: 2 RP units with two vertical and one horizontal RPs**



Roman Pots – CERN - LHC







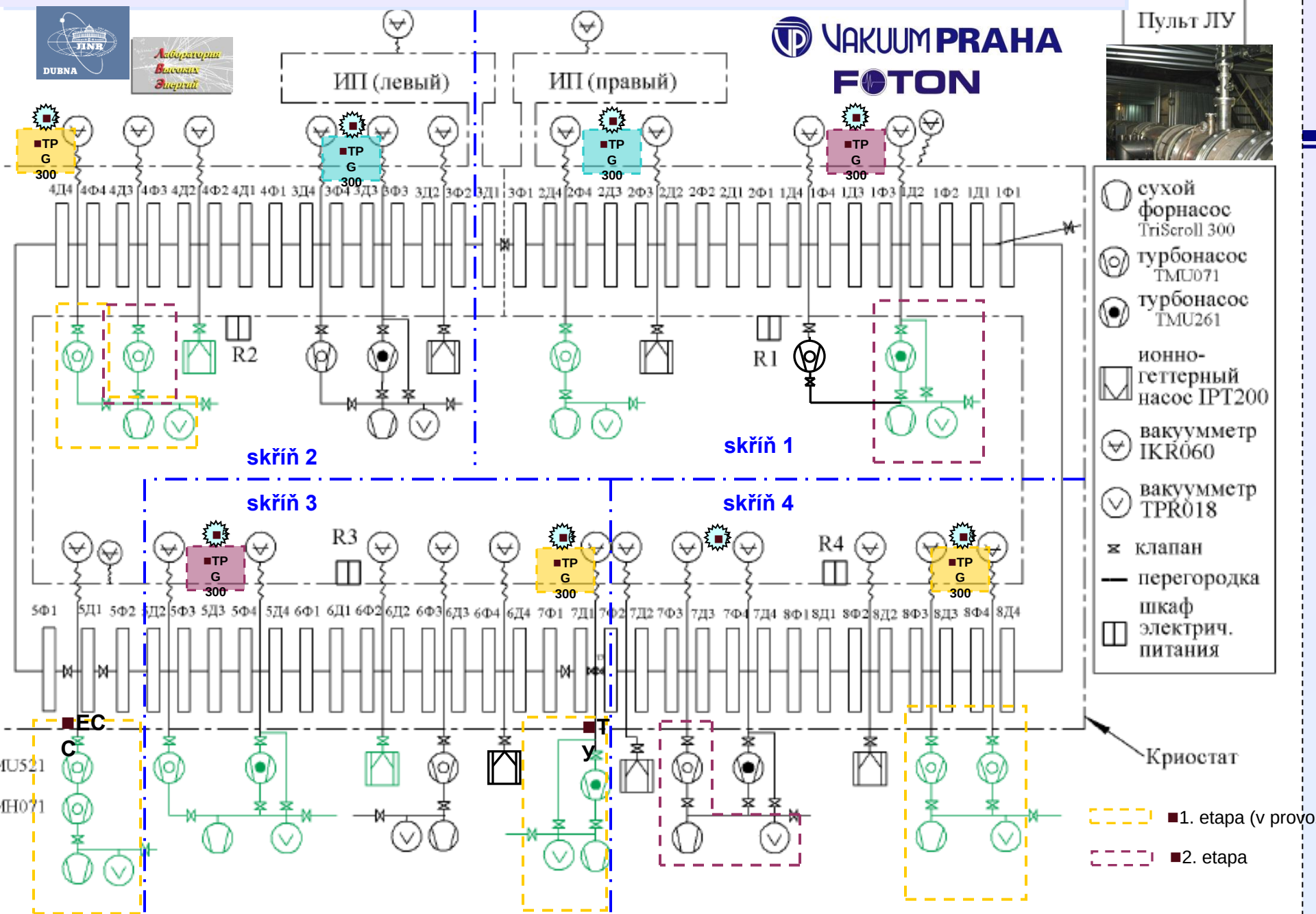
FLNR – beamlines and chambers for cyclotrons

DRIBS – Dubna Radioactive Ion Beams Systems

Upgrade of the IC100 vacuum system

Vacuum testing of chambers of cyclotrons DC60 and DC72 in VAKUUM PRAHA

VBLHEP - Upgrade of the Nuclotron Vacuum System



Special vacuum systems for FLNR and VBLHEP

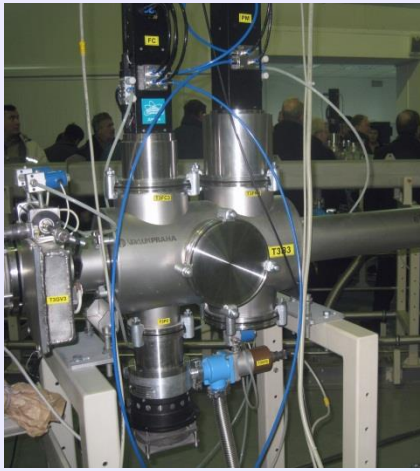
Double-wall reaction vacuum chamber for experiments with cryogenic tritium target-FLNR

Target chamber - VBLHEP

Target node for investigation of chemical properties - FLNR

Deliveries to third countries organized by JINR FLNR

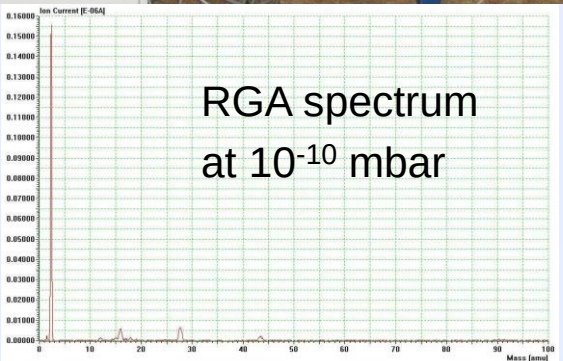
System for surface modification with ECR generated ions - Bratislava



Vacuum parts of the cyclotron DC60 - Astana

Deliveries to third countries organized by JINR DLNP

Vacuum systems for XFEL MCP detectors - DESY Hamburg



RGA spectrum at 10^{-10} mbar

JINR – perfect partner for today and tomorrow

JINR makes calls for proposals and invites you to technical cooperation and high-tech products supplying.

Thank you for your attention !