Brazil – JINR Forum:

"Frontiers in Elementary Particle, Nuclear and Condensed Matter Physics

JINR:

Past, Present and Future

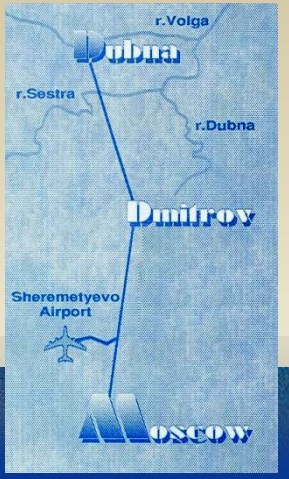
V. Matveev
(JINR, Dubna)

JINR, Dubna

15-19 June 2015

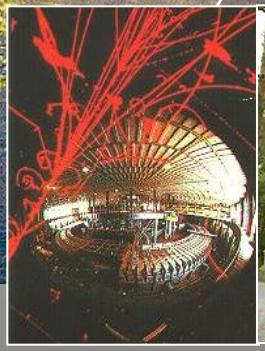
Russia

Moscow Region



Dubna

JINR



Volga

JOINT INSTITUTE for NUCLEAR RESEARCH

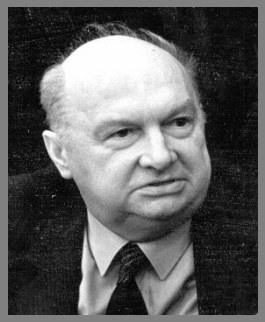
International Intergovernmental Organization

The Agreement on the establishment of JINR was signed on 26 March 1956 in Moscow

ATOM for PEACE

The results of the researches carried out at the Institute can be used solely for peaceful purposes for the benefit of mankind

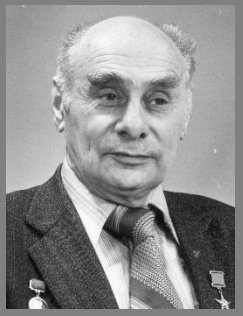
Founders of JINR


A.Baldin

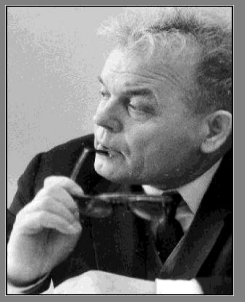

V.Dzhelepov

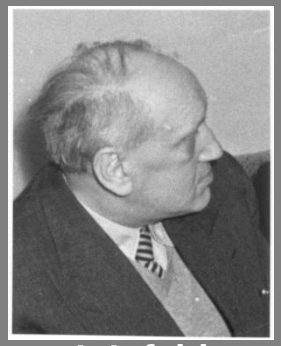

V.Veksler

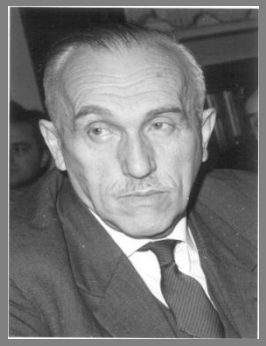

N.Bogoliubov, D.Blokhintsev

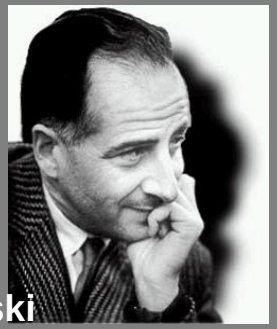

G.Flerov


I.Frank


M.Meshcheryakov

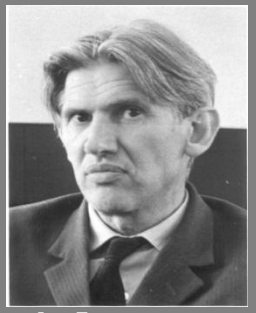

L.Infeld


G.Nevodnichanski


B.Pontecorvo


Wang Ganchang


H.Hulubeii


L.Janossy


V.Votruba


G.Najakov

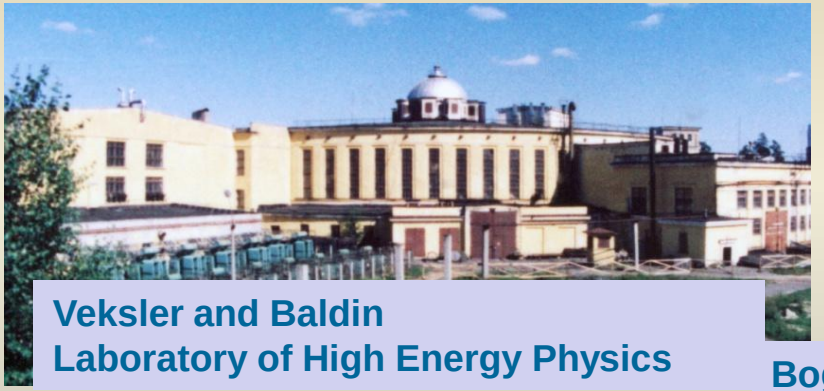
JINR has at present 18 Member States:

Armenia
Azerbaijan
Belarus
Bulgaria
Cuba
Czech Republic
Georgia
Kazakhstan
D. P. Republic of Korea Moldova
Mongolia
Poland
Romania
Russian Federation
Slovakia
Ukraine
Uzbekistan
Vietnam

Participation of Egypt, Germany, Hungary, Italy, the Republic of South Africa and Serbia in JINR activities is based on bilateral agreements signed on the governmental level.

JINR comprises 7 Laboratories, each being comparable with a large institute in the scale and scope of investigations performed

Dzhelepov
Laboratory of Nuclear Problems



Veksler and Baldin
Laboratory of High Energy Physics

Bogoliubov
Laboratory of Theoretical Physics

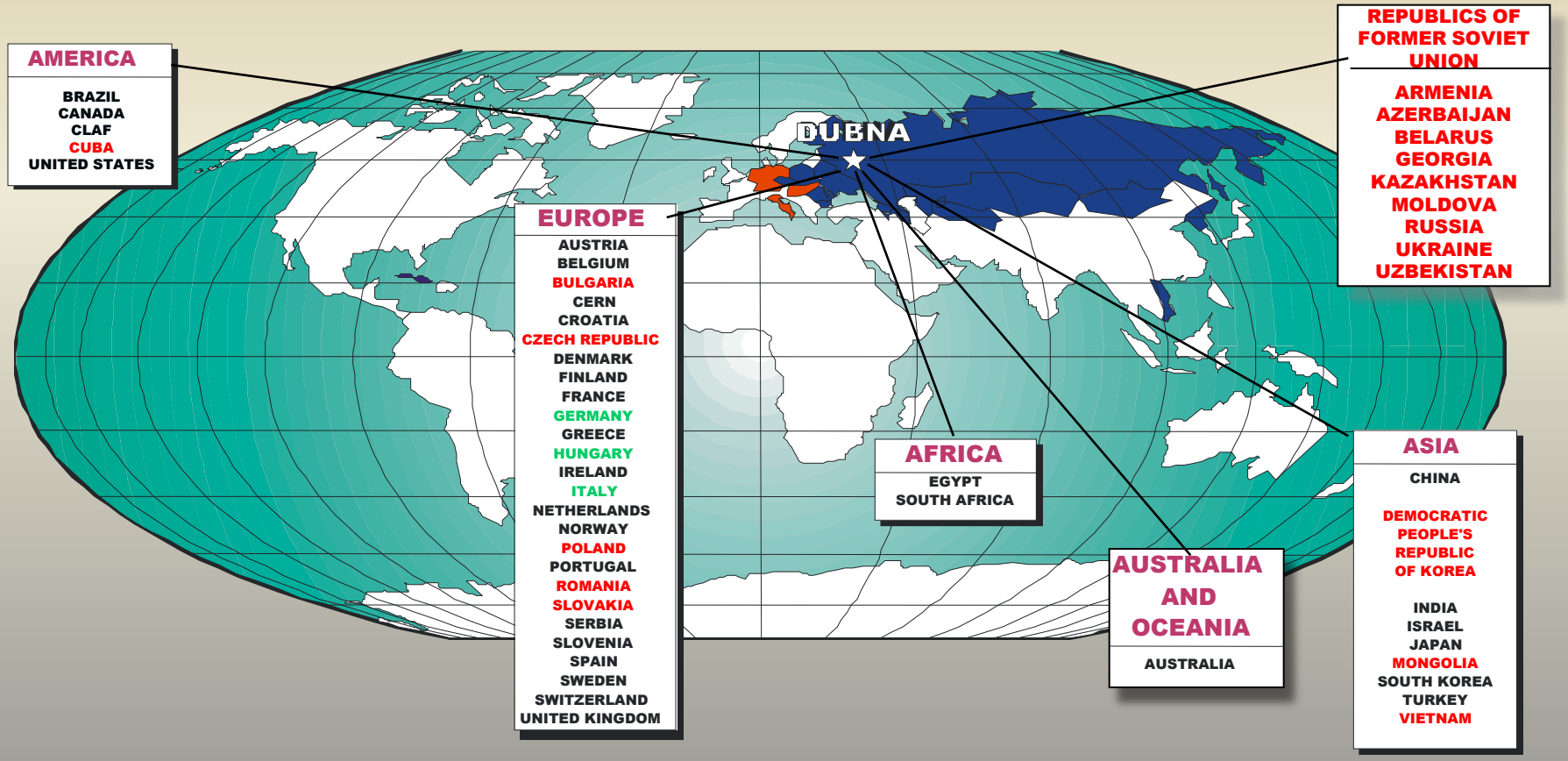
Frank Laboratory of Neutron Physics

Flerov
Laboratory of Nuclear Reactions

Laboratory of Radiation Biology

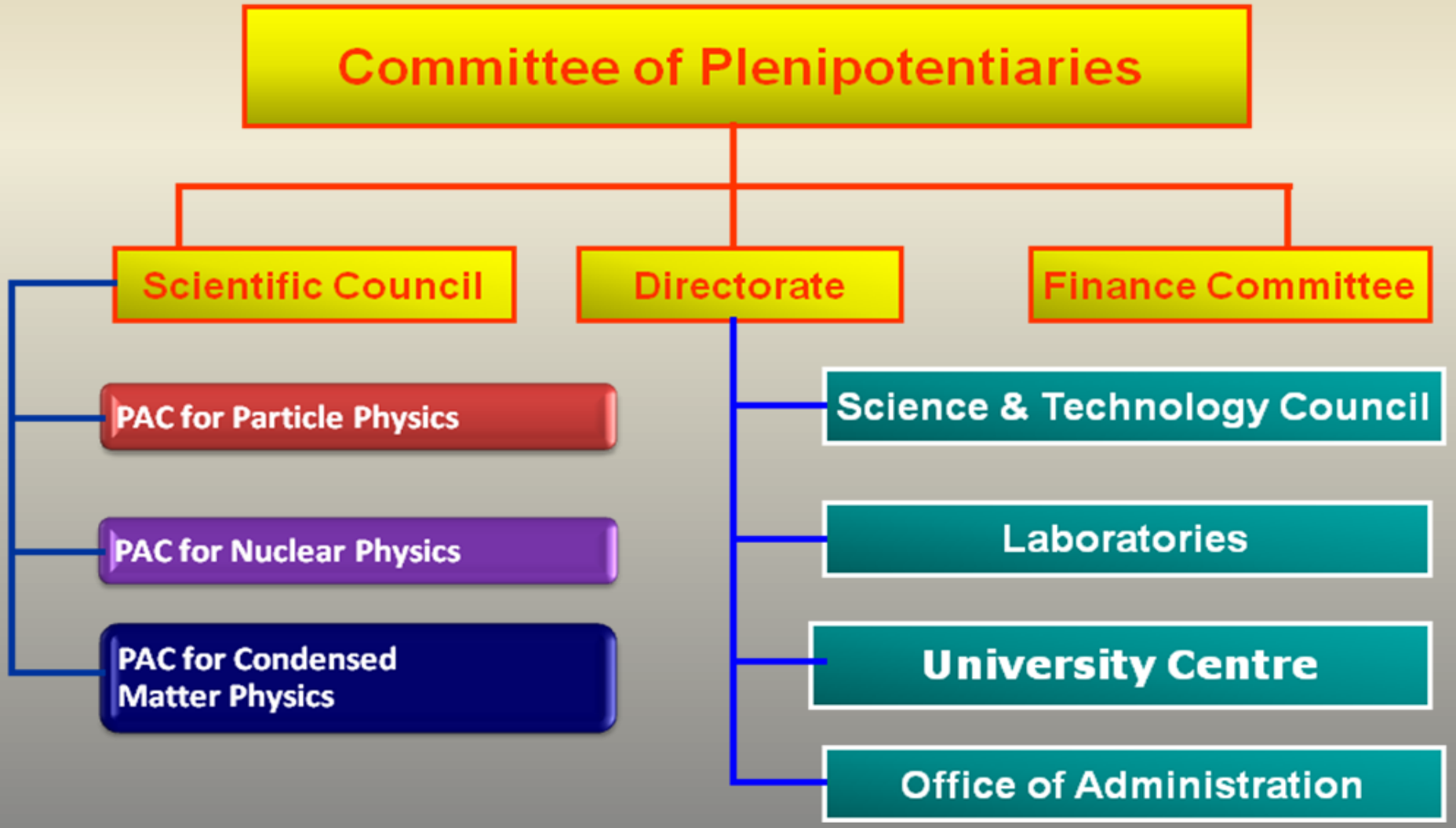
Laboratory of
Information Technologies

Science Bringing Nations Together



JINR's partners are about 700 institutions located in 60 countries, including about 300 institutions and universities from the JINR Member States

Governing Bodies & Structure



JINR's "Triangle" Science Policy

7-Year Program: '2010 – 2016'
New 7-Year Plan: '2017 – 2023'
in preparation

Fundamental Science

Innovative activities

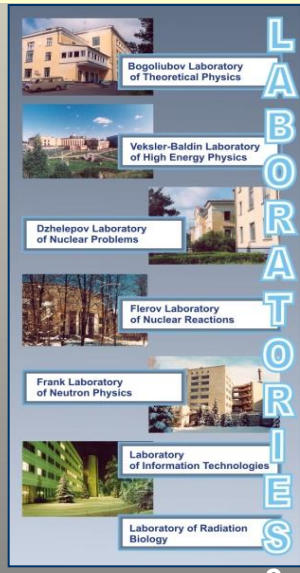
Education programme

Special Economic Zone "Dubna"
Public-Private-Partnership

UC, DIAS-TH
International Univ. "Dubna"

Basic Scientific Directions

- **High Energy Physics**
- **Nuclear Physics**
- **Condensed Matter Physics**



High Energy Particle and Heavy Ions Physics

@ JINR

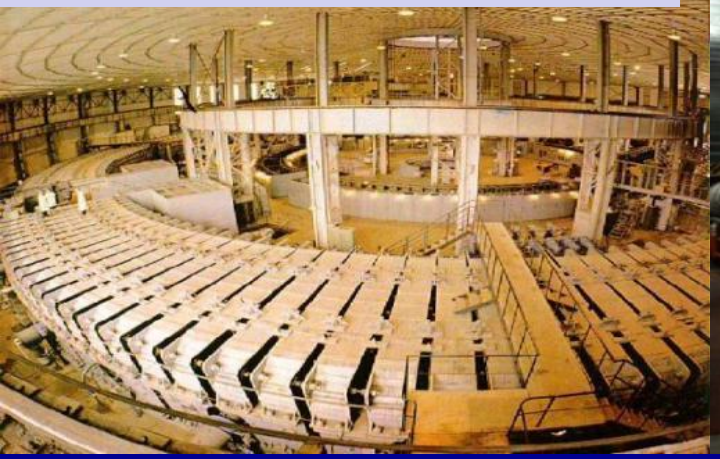
From Synchrophasotron to Nuclotron to NICA

1957 - Synchrophasotron

10 GeV proton accelerator – world leader in energy.

Beginning of era of high-energy physics

V.Veksler – phase stability principle discovery



1993 - Nuclotron

First in the world Superconducting Synchrotron of heavy ions

A.Baldin –start of relativistic nuclear physics era

2019 - NICA

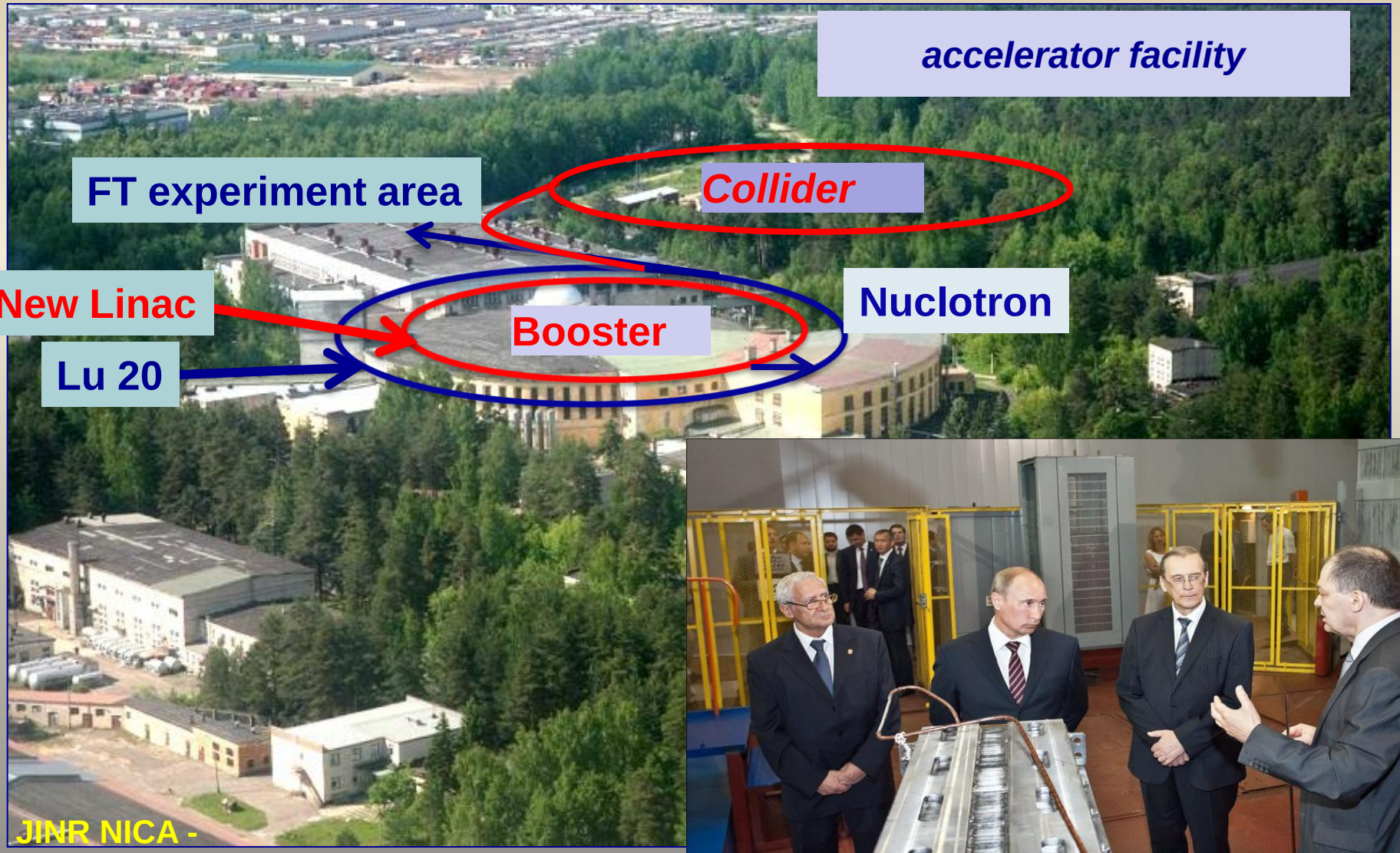
Superconducting collider of heavy ions

Study of baryonic matter at extreme conditions

The JINR 7-year plan (2010-16):

NICA – the JINR flagship project in HEP

Complex NICA @ JINR

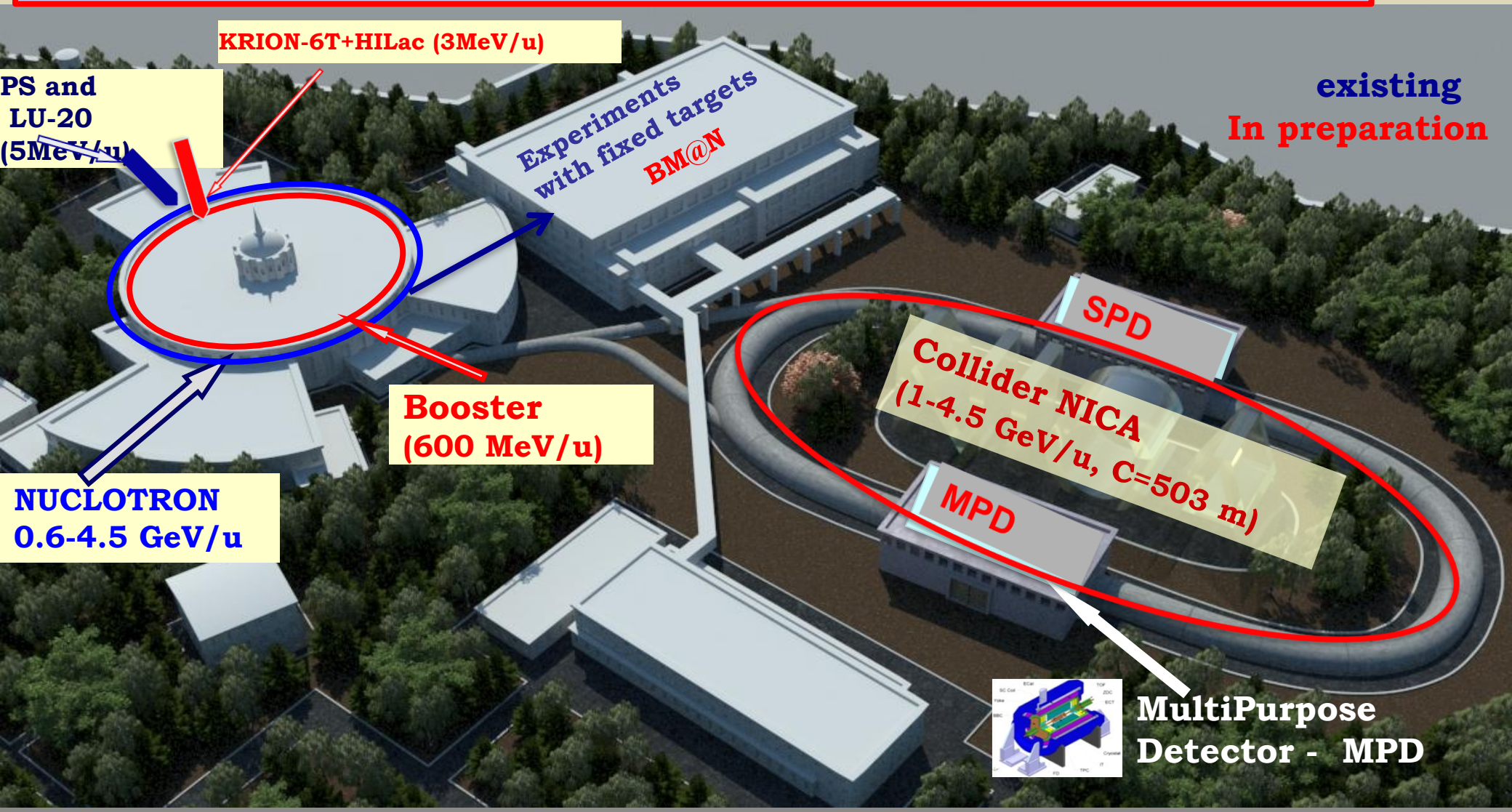


JINR NICA -
in the list of international
Mega-science projects in RF area

NICA Complex

Collider basic parameters:

$\sqrt{s_{NN}}$ = **4-11** GeV; ***beams***: *from* **p** to **Au**; **L~10^{27}** cm^{-2} c^{-1} (Au), ~**10^{32}** cm^{-2} c^{-1} (p)



Международная коллаборации проекта NICA

Belarus
NC PHEP BSU (Minsk)
GSU (Gomel)
…
…

Germany
GSI (Darmstadt)
JLU (Giessen)
UR (Regensburk)
Frankfurt/Main Univ.
FIAS
FZJ (Julich)
FAU(Erlangen)

Bulgaria
INRNE BAS (Sofia)
TU-Sofia
SU
ISSP BAS
LTD BAS
SWU
PU (Plovdiv)
TUL (Blagoevgrad)

Ukraine
BITP NASU, KSU (Kiev)
KhNU, KFTI NASU (Kharkiv)

Russia
INR RAS (Moscow)
NRC KI (Moscow)
BINP RAS (Novosibirsk)
MSU (Mscow)
LPI RAS (Moscow)
St.Pet. Univ ersity
RI (St.Petersburg)
…
…

Poland
Tech.University (Warsaw)
Warsaw University
Fracoterm (Krakow)
Wroclaw University
INP (Krakow)

Australia
Azerbaijan
CERN
China
France
Georgia
Greece
India

Czech Republic
TUL (Liberec)
CU (Prague)
Rzezh, …

RSA
UCT (Cape Town)
UJ (Johannesburg)
iThemba Labs

Italy
Japan
Moldova
Mongolia
Romania
Serbia
Slovakia
USA

NICA Mega-Science Project
International Consortium
6 countries

- Protocol signed by:
- Belarus, *Bulgaria,* Germany, Kazakhstan
- Russia, Ukraine

Dubna, August 08, 2013.

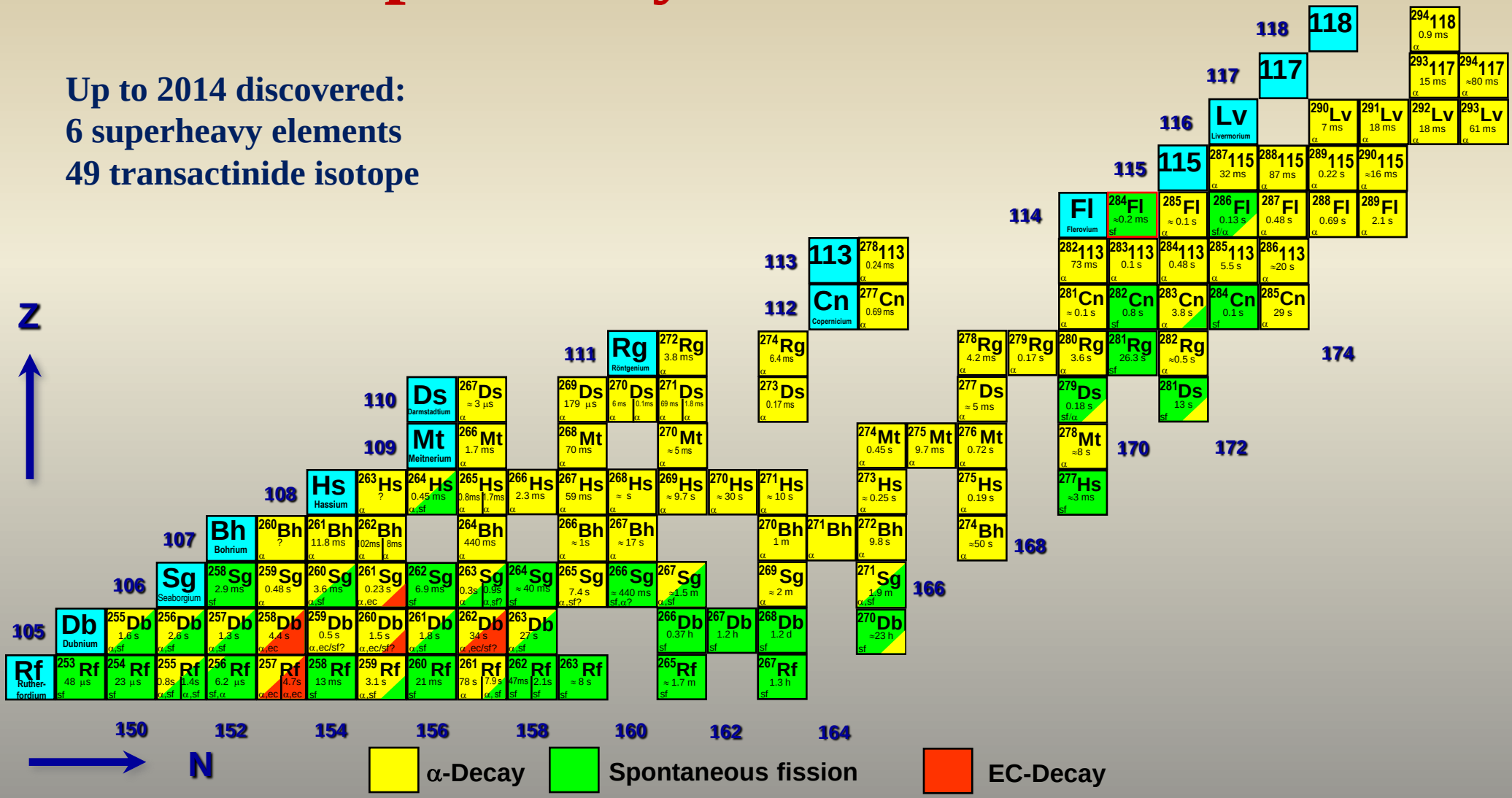
Recently:
JINR-China
Cooperation in NICA

Low Energy Nuclear Physics
Supper Heavy Elements

@ JINR

Superheavy Element Research

Up to 2014 discovered:
6 superheavy elements
49 transactinide isotope



D.I. Mendeleev
1834 - 1907

период	ряд	группы элементов																	
		а	I	б	а	II	б	а	III	б	а	IV	б	а	V	б	а	VI	б	а	VII	б	а	VIII	б
1	I																								
																							Гелий	2	
																							He	$1s^2$	
																							4,0026		
																							Helium		
2	II	Литий	3		Бериллий	4		Бор	5		Углерод	6		Азот	7		Кислород	8		Фтор	9		Неон	10	
		Li	$2s^1$		Be	$2s^2$		B	$2p^1$		C	$2p^2$		N	$2p^3$		O	$2p^4$		F	$2p^5$		Ne	$2p^6$	
		6,941			9,012182			10,811			12,011			14,00674			15,9994			18,9984032			20,1797		
		Lithium			Beryllium			Boron			Carbon			Nitrogen			Oxygen			Fluorine			Neon		
3	III	Натрий	11		Магний	12		Алюминий	13		Кремний	14		Фосфор	15		Сера	16		Хлор	17		Аргон	18	
		Na	$3s^1$		Mg	$3s^2$		Al	$3p^1$		Si	$3p^2$		P	$3p^3$		S	$3p^4$		Cl	$3p^5$		Ar	$3p^6$	
		22,989768			24,3050			26,981539			28,0855			30,973762			32,066			35,4527			39,948		
		Sodium			Magnesium			Aluminum			Silicon			Phosphorus			Sulfur			Chlorine			Argon		
4	IV	Калий	19		Кальций	20			21 Скандий			22 Титан			23 Ванадий			24 Хром			25 Марганец			26 Железо	
		K	$4s^1$		Ca	$4s^2$			$3d^14s^2$ Sc			$3d^24s^2$ Ti			$3d^34s^2$ V			$3d^54s^1$ Cr			$3d^54s^2$ Mn			$3d^64s^2$ Fe	
		39,0983			40,078				44,955910			47,88			50,9415			51,9961			54,93805			55,847	
		Potassium			Calcium				Scandium			Titanium			Vanadium			Chromium			Manganese			Iron	
	V		29 Медь			30 Цинк		Галлий	31		Германий	32		Мышьяк	33		Селен	34	9,75238	Бром	35		Криптон	36	
			$3d^{10}4s^1$ Cu			$3d^{10}4s^2$ Zn		Ga	$4p^1$		Ge	$4p^2$		As	$4p^3$		Se	$4p^4$		Br	$4p^5$		Kr	$4p^6$	
			63,546			65,39		69,723			72,61			74,92159			78,96			79,904			83,80		
			Copper			Zinc		Gallium			Germanium			Arsenic			Selenium			Bromine			Krypton		
5	VI	Рубидий	37		Стронций	38			39 Иттрий			40 Цирконий			41 Ниобий			42 Молибден			43 Технеций			44 Рутений	
		Rb	$5s^1$		Sr	$5s^2$			$4d^15s^2$ Y			$4d^25s^2$ Zr			$4d^45s^1$ Nb			$4d^55s^1$ Mo			$4d^55s^2$ Tc			$4d^75s^1$ Ru	
		85,4678			87,62				88,90585			91,224			92,90638			95,94			[98]			101,07	
		Rubidium			Strontium				Yttrium			Zirconium			Niobium			Molybdenum			Technetium			Ruthenium	
	VII		47 Серебро			48 Кадмий		Индий	49		Олово	50		Сурьма	51		Теллур	52		Иод	53		Ксенон	54	
			$4d^{10}5s^1$ Ag			$4d^{10}5s^2$ Cd		In	$5p^1$		Sn	$5p^2$		Sb	$5p^3$		Te	$5p^4$		I	$5p^5$		Xe	$5p^6$	
			107,8682			112,411		114,818			118,710			121,757			127,60			126,90447			131,29		
			Silver			Cadmium		Indium			Tin			Antimony			Tellurium			Iodine			Xenon		
6	VIII	Цезий	55		Барий	56			57 Лантан			72 Гафний			73 Тантал			74 Вольфрам			75 Рений			76 Осмий	
		Cs	$6s^1$		Ba	$6s^2$			$5d^16s^2$ La			$5d^26s^2$ Hf			$5d^36s^2$ Ta			$5d^46s^2$ W			$5d^56s^2$ Re			$5d^6 6s^2$ Os	
		132,90543			137,327				138,9055			178,49			180,9479			183,84			186,207			190,23	
		Cesium			Barium				Lanthanum			Hafnium			Tantalum			Tungsten			Rhenium			Osmium	
	IX		79 Золото			80 Ртуть		Таллий	81		Свинец	82		Висмут	83		Полоний	84		Астат	85		Радон	86	
			$5d^{10}6s^1$ Au			$5d^{10}6s^2$ Hg		Tl	$6p^1$		Pb	$6p^2$		Bi	$6p^3$		Po	$6p^4$		At	$6p^5$		Rn	$6p^6$	
			196,96654			200,59		204,3833			207,2			208,98037			[209]			[210]			[222]		
			Gold			Mercury		Thallium			Lead			Bismuth			Polonium			Astatine			Radon		
7	X	Франций	87	4,073	Радий	88			89 Актиний			104 Резерфордий			105 Дубний			106 Сиборгий			107 Борий			108 Хассий	
		Fr	$7s^1$		Ra	$7s^2$			$6d^17s^2$ Ac			Rf			Db			Sg			Bh			Hs	
		[223]			226,025				[227]			[261]			[262]			[266]			[267]			[269]	
		Francium			Radium				Actinium			Rutherfordium			Dubnium			Seaborgium			Bohrium			Hassium	
	XI	111			112			113			114			115			116			117			118		

109	Мейтнерий	Mt	[268]	Meitnerium	110	Дармштадтий	Ds	[269]	Darmstadtium
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s-элементы
p-элементы
d-элементы
f-элементы

Лантаноиды Lanthanides

Церий	Празеодим	Неодим	Прометий	Самарий	Европ	Гадолиний	б	Диспрозий	Гольмий	Эрбий	Тулий	Иттербий	Лютеций
Ce $4f^15d^1$	Pr	Nd $4f^4$	Pm	Sm $4f^6$	Eu	Gd $4f^75d^1$	$4f^8$	Dy $4f^{10}$	Ho $4f^{11}$	Er $4f^{12}$	Tm $4f^{13}$	Yb $4f^{14}$	Lu $4f^{14}5d^1$
140,115		144,24	[145]	150,36	151,96	157,25	534	162,50	42	167,26	168,93421	04	174,967
Cerium		Neodymium	Prom	Samarium	Europ	Gadolinium		Dysprosium		Erbium	Thulium		Lutetium

Актиноиды Actinides

Протактиний	Уран	туний	Плутоний	Ку	Калифорний	Эйнште	Фермий	Менделевий	Нобе	Лоуренсий
Pa $5f^26d^1$	U $5f^36$	Np $5f^46d^1$	Pu $5f^6$	Cm $5f^76d^1$	Cf $5f^{10}$	Es $5f^{11}$	m $5f^{12}$	Md $5f^{13}$	No $5f$	Lr $5f^{14}6d^1$
231,03588	238,028	[237]	[244]	[247]	[251]	[252]		[258]	[259]	
Protactinium	Uran	Neptunium	Plutonium	Curium	Californium	Einsteinium		Mendelevium	Nobelium	Lawrencium

112
Chemical identificationi n 2006

113
Discovered at JINR in 2003

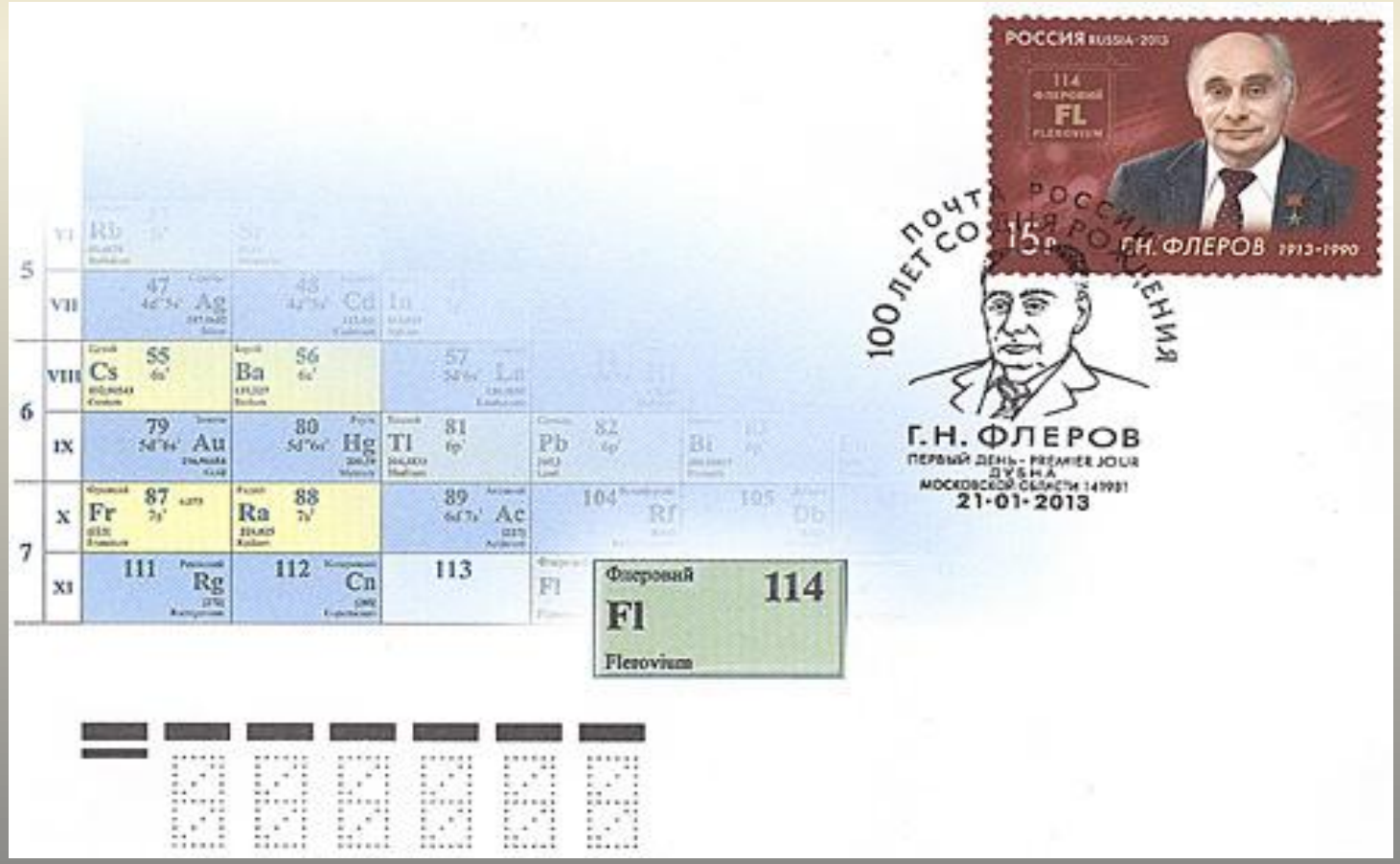
114
Discovered at JINR in 1999

115
Discovered at JINR in 2003

116
Discovered at JINR in 2000

118
Discovered at JINR in 2001

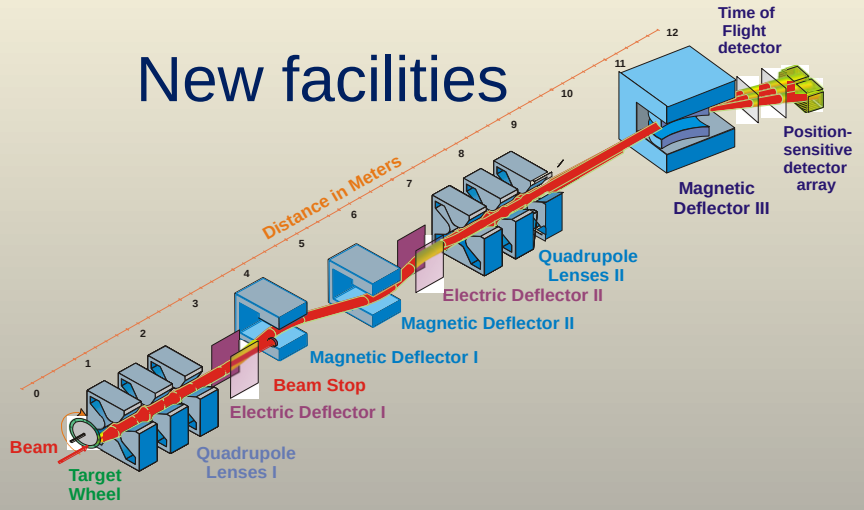
Super-Heavy Elements Program



Super Heavy Elements (SHE) Factory

High-current cyclotron
DC-280

New facilities



New experimental hall

Neutrino Physics @JINR

✸ Fundamental properties of ν

- Parameters of neutrino oscillations
- Mechanism of neutrino mass generation
- Dirac neutrino or Maiorana neutrino?
- Neutrinoless 2β-decay of nuclei (ν=ν̄)
- Leptogenesis
- Magnetic neutrino moment
- Sterile neutrino

Bruno Pontecorvo

✸ Astroparticle Physics

Leading Projects of the DLNP in the field of Neutrino Physics and Neutrini Astrophysics

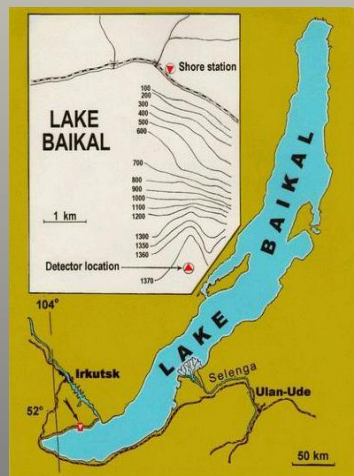
- Kalinin Nuclear Power Plant (Russia)

- Daya Bay / Juno (China)

- OPERA and Borexino at Gran Sasso (Italy)

NOVA and LBNO at FNAL (USA)

- Lake Baikal (Russia)



Condensed Matter Physics
Neutron Physics

Radio - Biology

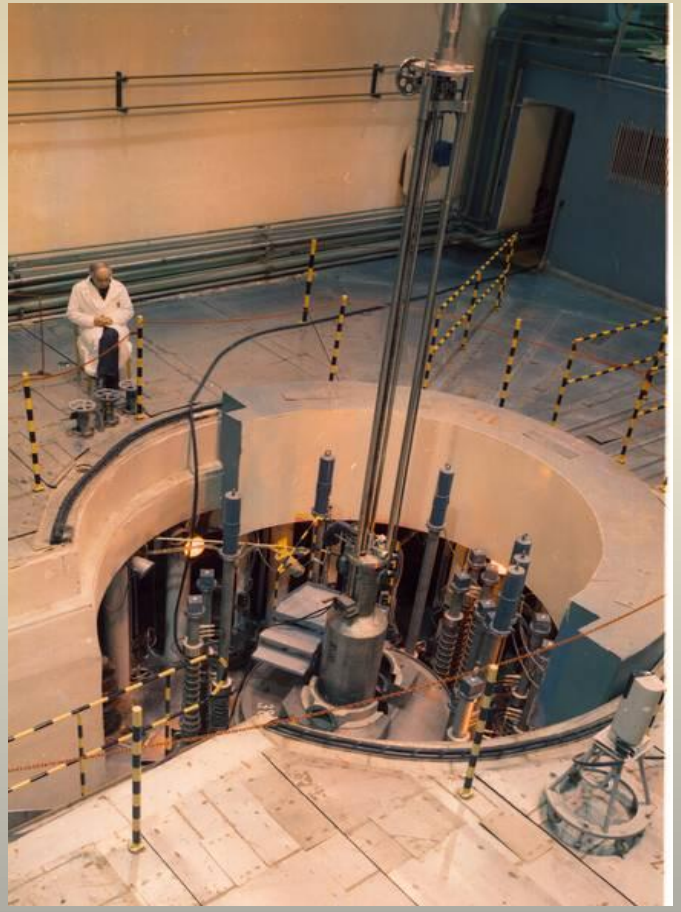
Cosmic Medicine

Astrobiology

Ecology

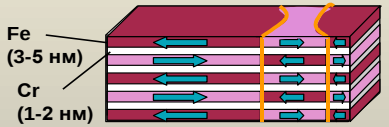
@JINR

Condensed Matter Physics

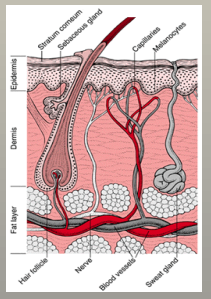


IBR-2 nuclear reactor is included in the 20-year European strategic research program in the field of neutron scattering

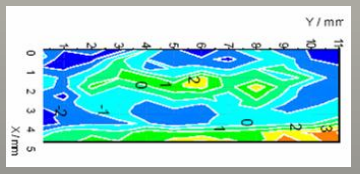
Nanosystems and Nanotechnology



Biomedical research



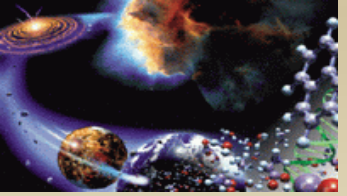
New materials



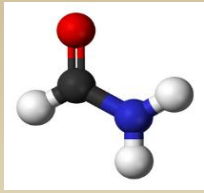
Diagnostics. Earth science.

IBR-2 (2 MWatt)

- Physics of high-temperature superconductivity
- Geological texture research
- Nanotechnology

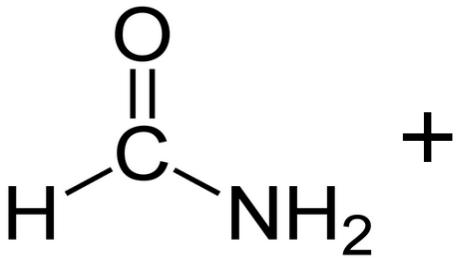


Astrobiology



Studying prebiotic molecule synthesis under ionizing radiation

In cooperation with the Sapienza University of Rome and Viterbo University (Italy)

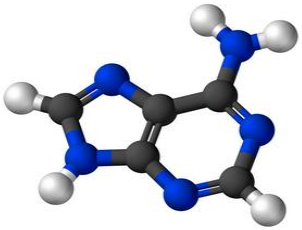


Formamide

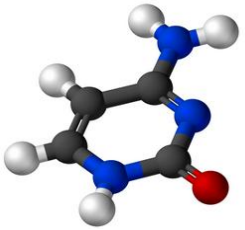
+

Meteorite surface

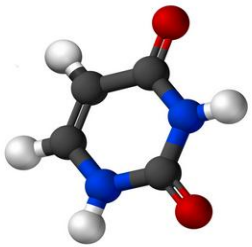
Irradiation by p^+,
170 MeV, 6 Gy



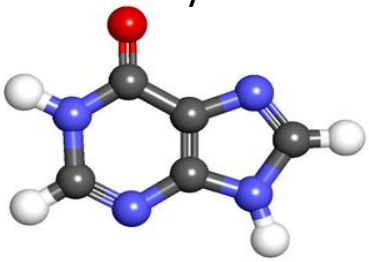
adenine



cytosine



uracil



hypoxanthine

Preliminary results suggest a possibility of prebiotic molecule synthesis (up to nucleosides) in the reaction mixture exposed to ionizing radiation

Computing @JINR

JINR Multifunctional Centre for Data Storage, Processing and Analysis

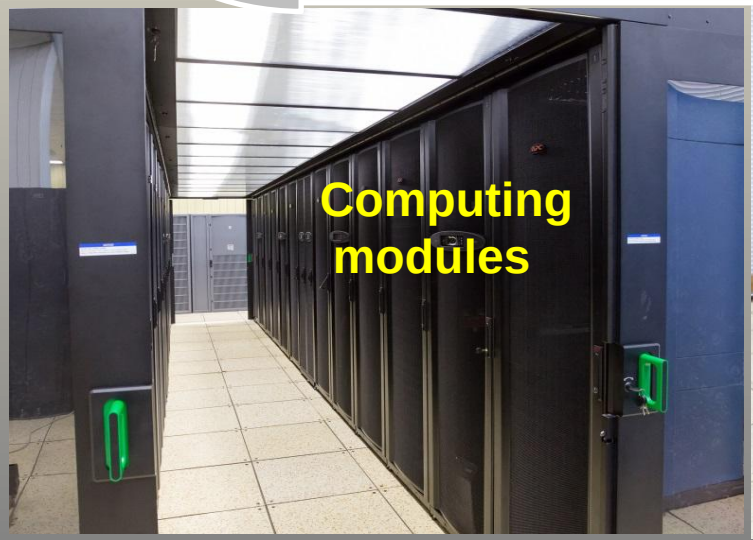
Grid-Infrastructure at Tier1 and Tier2 Levels

General Purpose Computing Cluster

Cloud Computing Infrastructure

Heterogeneous Computing Cluster HybriLIT

Education and Research Infrastructure for Distributed and Parallel Computing



THEORETICAL PHYSICS @ JINR

Main fields of research

- ❑Theory of Elementary Particles and Fields
- ❑Nuclear Theory, Nuclear Structure and Dynamics
- ❑Theory of Condensed Matter and New Materials
- ❑Modern Mathematical Physics
- ❑Research and Education Project "Dubna International School of Theoretical Physics (DIAS-TH)"

Conferences and Schools

Every year (> 1000 participants)

DIAS-TH and Helmholtz Schools (> 20 countries represented)

Educational Activity

Lectures courses at JINR UC, DIAS-TH, Moscow U., Dubna U., MPTI, etc.

JINR Educational Program

By the beginning of 2014/2015 academic year 226 graduate students have taken part in various JINR educational programs. The JINR PhD program is currently being updated according to the goals of the JINR 7-year plan (2009-2016).

International Student Practice (ISP)

In total 139 students from 9 JINR Member States have participated in three stages of ISP-2014:
ARE, Belarus, Bulgaria, Czech Republic, Poland, Romania, Slovakia, South Africa, Serbia

Name	Nationality	Education	Year of study	Image
Abbas Ehab Gamal	Egypt	Ain shams university Physics department Prof. Abdel nasser Tawfik heavy ion collisions physics	1st year of PhD	
Bielski Rafal	Poland	AGH University of Science and Technology Faculty of Physics and Applied Computer Science Department of Particle Interactions and Detection Techniques Experimental Particle Physics	5th year of study	
Brazevič Sabina	Poland	Adam Mickiewicz University in Poznań Department of Physics Quantum Electronics Medical Physics	4th year of study	
Kuczynska Marika Matylda	Poland	AGH University of Science and Technology Faculty of Physics and Applied Computer Science Department of Particle Interactions and Detection Techniques front-end electronics for radiation detectors and instrumentation of particle physics experiments	5th year of study	
Leyva Pernia Diana	Cuba	Center of Applied Technologies and Nuclear Development (CEADEN) Physics Department Detectors and Radiation Damage Laboratory Development, characterization and simulation of multipurpose radiation detectors	1st year of PhD	
Tichy Pavel	Czech_Republic	Czech Technical University in Prague - Faculty of Nuclear Sciences and Physical Engineering Department of Nuclear Reactors Nuclear Physics Institute, Academy of Sciences of the Czech Republic - Department of Nuclear Spectroscopy Transmutation of spent nuclear fuel, ADTT, simulations of sub-critical systems in MCNPX	1st year of PhD	
Калинин Георгий Викторович	Russia	ФГБОУ ВПО «Воронежский Государственный Университет» Химический Кафедра материаловедения и индустрии наносистем наноматериалы	5th year of study	
Тархов Андрей Евгеньевич	Russia	МГУ им. М.В. Ломоносова Физический Общей физики и волновых процессов Радиофизика	4th year of study	

JINR Summer Student Program (SSP)

http://students.jinr.ru

In 2014 JINR UC has launched the Summer Student Program. The main distinction of SSP from ISP is a selection of participants on a competitive basis.
In 2014 the SSP was organized in the field of accelerator physics and information technologies.
In 2015 SSP the scientific fields will be extended to include all JINR research areas.

Towards integration to the European Research Infrastructure

Physical Sciences and Engineering Strategic Working Group

The Strategy Working Groups play an important role in the evaluation and prioritisation process of projects included in the ESFRI Road Map.
The re-evaluation should be done especially according to the following criteria:

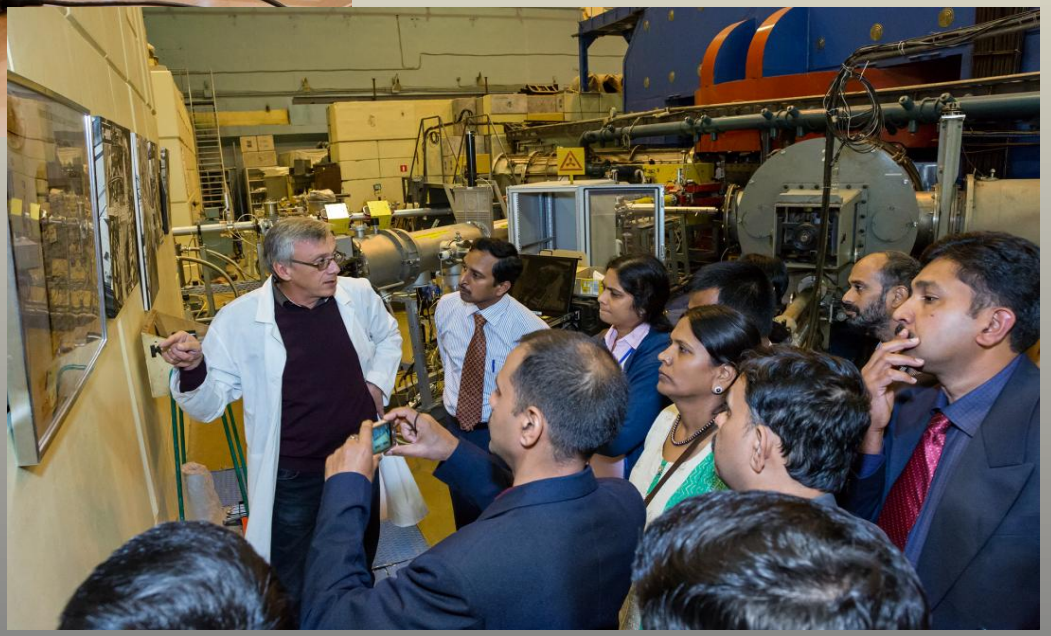
- Appropriate level of funding commitment from at least three MS or AC
- Concrete and credible plans for construction and operation including costs and financing over the whole life cycle of the project
- Scientific impact and scientific relevance for the respective scientific area
- Is it a real distributed Research Infrastructure or only a network or a research project?
- Social and economic impact including innovation potential and possible cooperation with industry
- European added value
- Timeliness

Expanding cooperation horizons: **India**

16 September 2014 Visit of 26 researchers and science officers

Dr. Inder Jit Singh

Joint Secretary
Department of Science & Technology



Expanding cooperation horizons: China

23-25 February 2014. Workshop with Institute of Plasma Physics

Expanding cooperation horizons: Latin America

22-24 March 2014.
JINR participated
in Rio-Russian seminar
in Rio de Janeiro

Participants:10 Brazilian universities
11 Russian universities and JINR

10 July 2014.
Ambassador
of Guatemala
visited JINR

Main target:
Possibility to cooperate
in life sciences

Expanding cooperation horizons: Latin America

4 March 2014. Ambassadors of 11 Latin American countries visited JINR

Organized by the Embassy of Cuba

One of the results: intensive contacts via Brazil embassy have started

The Ambassador Extraordinary and Plenipotentiary of the Federative Republic of Brazil in the Russian Federation Antonio José Vallim Guerreiro came on his first official visit to the Joint Institute for Nuclear Research on 26 January 2015.

Before leaving, Brazilian Ambassador shared his impressions:

"I see that the potential for expanding cooperation with Brazilian research centers is very high. A program called "Science without borders" is being implemented in Brazil, and, of course, we support the development of international cooperation, as well as we send students to study abroad. Brazil is a large country, maybe not as big as Russia, but it is rich in resources and, of course, its main priorities are given to research areas that contribute to our development."

At the Flerov Laboratory of Nuclear Reactions

СПАСИБО! *THANK YOU!*