

**INTERNATIONAL INTERGOVERNMENTAL ORGANIZATION**

**JINR**



**Dubna**

**JOINT INSTITUTE  
FOR NUCLEAR  
RESEARCH**



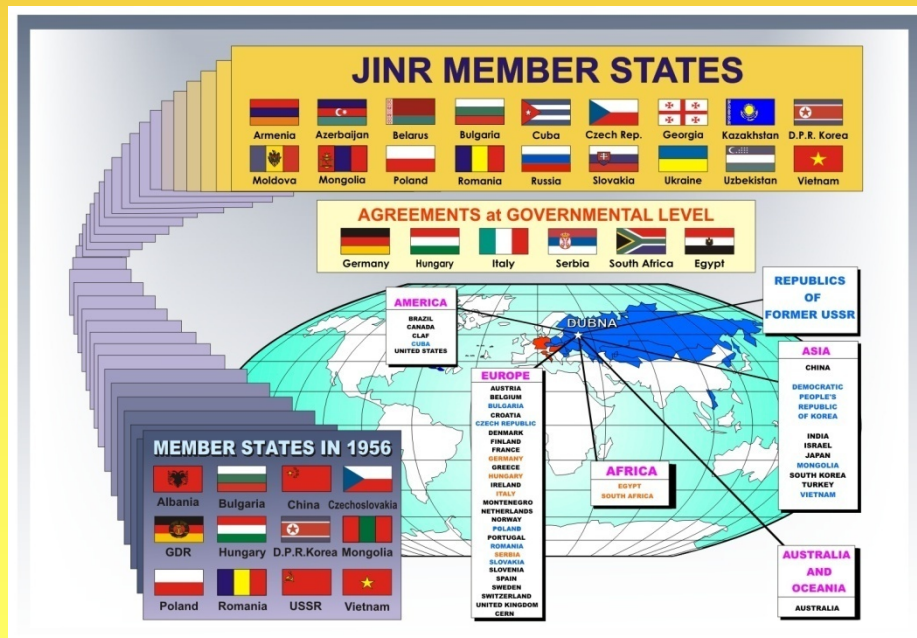
**WELCOME  
to the Joint Institute for  
Nuclear Research**

**JINR: Current activities and Prospects**

**Alexey Sissakian  
Director, Academician of RAS**

# JINR – a Centre of Broad International Partnership on the Russian Land

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



- 18 Member States
- 6 Associated Members States
- about 700 research partners in 60 countries
- staff members ~ 5500

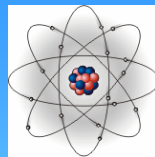
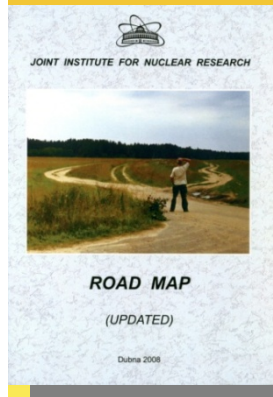
## Three Pillars of JINR:

- Great experience and world-wide recognized traditions of scientific schools.
- Large and unique park of basic facilities for fundamental and applied research.
- Status of an international intergovernmental organization.

# JINR's Science Policy

I.

- **7-Year Programme:** '2003 – 2009' (complete and successful realization)  
'2010 – 2016' (final draft approved by the Scientific Council, Sept. 2009 and CPP, Nov. 2009)
- **Road Map (2006-2017)**



## Fundamental Science

### Basic Scientific Directions

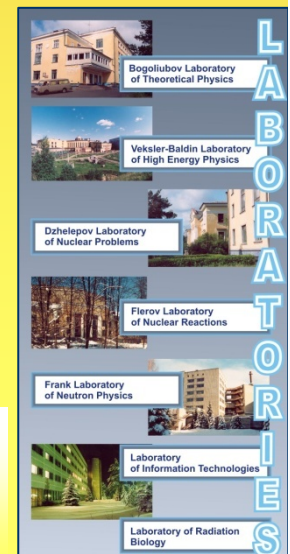
- High Energy Physics
- Nuclear Physics
- Condensed Matter Physics

Innovative activities

Education programme

Special Economic Zone "Dubna"  
Public-Private-Partnership

UC, DIAS-TH  
International Univ. "Dubna"



# Discoveries

## JOINT INSTITUTE for NUCLEAR RESEARCH

- 46 prestigious academic and state awards, and prizes of Russia, Bulgaria, Georgia, Romania, Czech Republic, Uzbekistan and other countries

### More than 40 discoveries, including:

- 1959 – nonradiative transitions in mesoatoms
- 1960 – antisigma-minus hyperon
- 1963 – element 102
- 1965 - a new quantum number of quarks - colour
- 1972 – postradiative regeneration of cells
- 1973 – quark counting rule
- 1975 – phenomenon of slow neutron confinement
- 1988 – regularity of resonant formation of muonic molecules in deuterium
- 1999-2005 – elements 114, 116, 118, 115 and 113
- 2006 – chemical identification of element 112

# JINR's Large-Scale Basic Facilities

II.

## Particle Physics and High-Energy Heavy-Ion Physics

### Nuclotron-M: Stage 1 of NICA (2010)

The main goal: to reach in 2010 the Nuclotron project parameters:

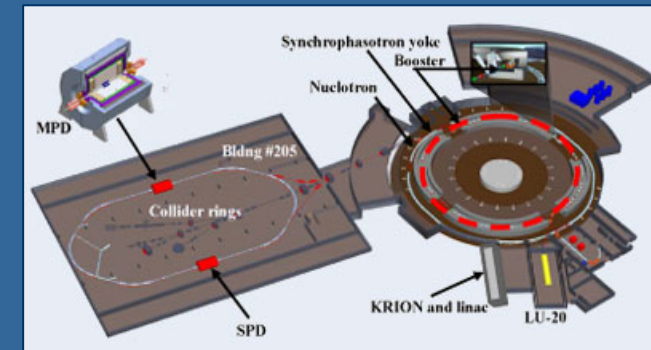
- accelerated heavy ions  $A \sim 200$
- beam intensity  $\sim 10^9$  ion/cycle (0.2-0.4 Hz) at kinetic energy  $\sim (1,0-4,5)$  GeV/u for  $\text{Au}^{79+}$



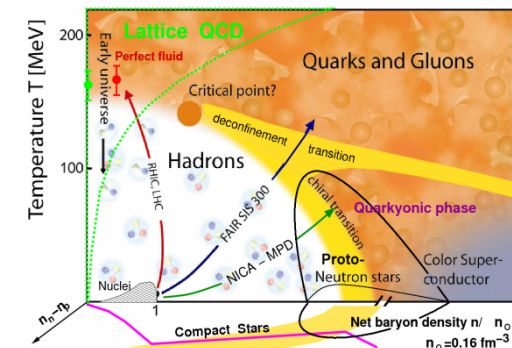
### NICA/MPD (2014 - 2015):

#### Heavy Ion Collider with:

- maximum collision energy of  $\sqrt{s_{NN}} = 11$  GeV
- average luminosity  $\sim 10^{27} \text{ cm}^{-2} \text{ s}^{-1}$  (for  $\text{Au}^{79+}$ )
- polarized proton beams with energy  $\sqrt{s} \sim 26$  GeV



**Experimental study of hot and dense strongly interacting QCD matter and spin physics.**



# International Expertise of NICA

II.



**First R-ECFA  
meeting in Russia  
8 – 10 October, 2009  
Moscow, Dubna**

**ECFA Chairman Prof. Tatsuya Nakada**

“I would like to mention that Russian physicists have been for long taking part in programmes at European accelerators with much success. Their ever-increasing contribution has become a great part of the process of the accelerator experiments’ development in the world.

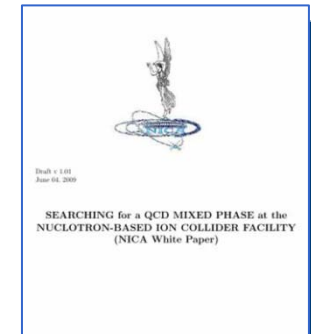
Concerning the NICA project, its already existing infrastructure and modern standards that are higher than in the present accelerators should be definitely considered as its advantages. The collider’s physics programme is very interesting”.

## **Round Table Discussion IV Physics at NICA**

**9-12 September 2009  
JINR, Dubna**

### **NICA MEMORANDUM**

The IV Round Table Workshop on “Physics at NICA” gathered 82 experts in nuclear physics representing leading research institutions of 16 countries. On the basis of this examination they have concluded that the NICA project possesses potential for truly outstanding discoveries.



**The implementation of the NICA project at Dubna brings JINR to the forefront of the current effort in high density nuclear physics.**

## International Partnership Programmes in Particle Physics

II.

CERN – participation in 15 projects,



including 3 LHC experiments: ATLAS, CMS, ALICE  
with the total contribution of 25 M Swiss francs

The JINR physics teams in ATLAS, CMS and ALICE are working on several important physics analysis subjects and strongly participating in preparation for the data taking.

### JINR-CERN cooperation panel

11 October 2009, Dubna

“We intend to sign a bilateral agreement at the beginning of the next year on JINR participation in CERN projects and CERN involvement in the NICA project that is very interesting for us and is actually a complementary project to the LHC at CERN”.

*R.Heuer*



CERN Director for Research and Computing Sergio Bertolucci, CERN Director-General Rolf Heuer, JINR Director Alexey Sissakian

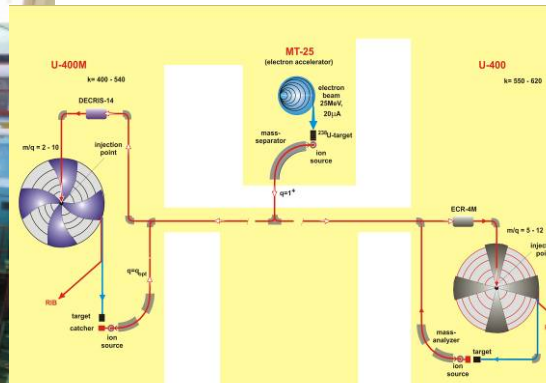


# JINR's Large-Scale Basic Facilities

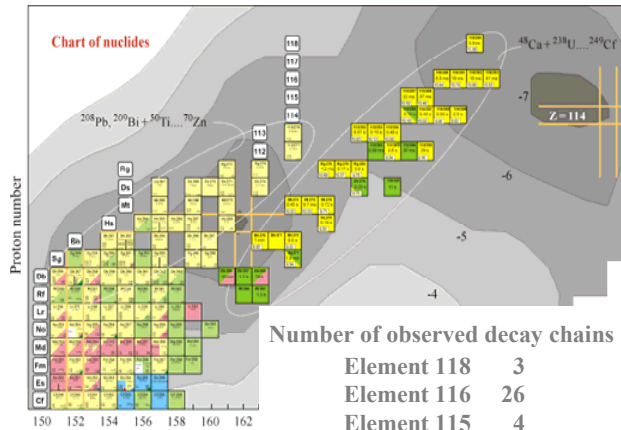
For the last decade JINR has become one of the leading scientific centres in the world in low energy heavy-ion physics.



U400 isochronous cyclotron



**DRIBs (I,II,III) –  
Dubna Radioactive  
Ion Beams**



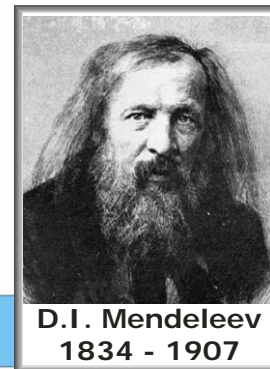
U400MR isochronous cyclotron

U400 and U400M isochronous cyclotrons are combined into the accelerator complex – project DRIBs which deals with the production of beams of exotic light neutron-deficient and neutron-rich nuclei in reactions with light ions.





период	группа	группы элементов																							
		a	I	б	a	II	б	a	III	б	a	IV	б	a	V	б	a	VI	б	a	VII	б	a	VIII	б
1	I	Водород 1 1,00794 Hydrogen																					Гелий 2 4,0026 Helium		
2	II	Литий 3 6,941 Lithium	Бериллий 4 9,012182 Beryllium		Бор 5 10,811 Boron		Углерод 6 12,011 Carbon	Азот 7 14,00674 Nitrogen		Кислород 8 15,9994 Oxygen	Фтор 9 18,9984032 Fluorine		Неон 10 20,1797 Neon												
3	III	Натрий 11 22,989768 Sodium	Магний 12 24,3050 Magnesium		Алюминий 13 26,981539 Aluminum		Кремний 14 28,0855 Silicon	Фосфор 15 30,973762 Phosphorus		Сера 16 32,066 Sulfur	Хлор 17 35,4527 Chlorine		Аргон 18 39,948 Argon												
4	IV	Калий 19 39,0983 Potassium	Кальций 20 40,078 Calcium		21 3d <sup>1</sup> 4s <sup>2</sup> Скандий 44,955910 Scandium		22 3d <sup>2</sup> 4s <sup>2</sup> Титан 47,88 Titanium	23 3d <sup>3</sup> 4s <sup>2</sup> Ванадий 50,9415 Vanadium		24 3d <sup>4</sup> 4s <sup>1</sup> Хром 51,9961 Chromium	25 3d <sup>5</sup> 4s <sup>2</sup> Марганец 54,93805 Manganese		26 3d <sup>6</sup> 4s <sup>2</sup> Железо 55,847 Iron												
	V	29 3d <sup>10</sup> 4s <sup>1</sup> Медь 63,546 Copper	30 3d <sup>10</sup> 4s <sup>2</sup> Цинк 65,39 Zinc		31 4p <sup>1</sup> Галлий 69,723 Gallium		32 4p <sup>2</sup> Германий 72,61 Germanium	33 4p <sup>3</sup> Мышьяк 74,92159 Arsenic		34 4p <sup>4</sup> Селен 78,96 Selenium	35 4p <sup>5</sup> Бром 79,904 Bromine		36 4p <sup>6</sup> Криптон 83,80 Krypton												
5	VI	Рубидий 37 85,4678 Rubidium	Стронций 38 87,62 Strontium		39 4d <sup>1</sup> 5s <sup>2</sup> Иттрий 88,90585 Yttrium		40 4d <sup>2</sup> 5s <sup>2</sup> Цирконий 91,224 Zirconium	41 4d <sup>3</sup> 5s <sup>1</sup> Нобий 92,90638 Niobium		42 4d <sup>4</sup> 5s <sup>1</sup> Молибден 95,94 Molybdenum	43 4d <sup>5</sup> 5s <sup>2</sup> Технеций 98 Technetium		44 4d <sup>6</sup> 5s <sup>1</sup> Рутений 101,07 Ruthenium										45 4d <sup>7</sup> 5s <sup>1</sup> Родий 102,90550 Rhodium	46 4d <sup>8</sup> 5s <sup>1</sup> Палладий 106,42 Palladium	
	VII	47 4d <sup>10</sup> 5s <sup>1</sup> Серебро 107,8682 Silver	48 4d <sup>10</sup> 5s <sup>2</sup> Кадмий 112,411 Cadmium		49 5p <sup>1</sup> Индий 114,818 Indium		50 5p <sup>2</sup> Олово 118,710 Tin	51 5p <sup>3</sup> Сурьма 121,757 Antimony		52 5p <sup>4</sup> Телур 127,60 Tellurium	53 5p <sup>5</sup> Иод 126,90447 Iodine		54 5p <sup>6</sup> Ксенон 131,29 Xenon												
6	VIII	Цезий 55 132,90543 Cesium	Барий 56 137,327 Barium		57 5d <sup>1</sup> 6s <sup>2</sup> Лантан 138,9055 Lanthanum		72 5d <sup>4</sup> 6s <sup>2</sup> Гафний 178,49 Hafnium	73 5d <sup>4</sup> 6s <sup>1</sup> Тантал 180,9479 Tantalum		74 5d <sup>4</sup> 6s <sup>2</sup> Вольфрам 183,84 Tungsten	75 5d <sup>5</sup> 6s <sup>2</sup> Рений 186,207 Rhenium		76 5d <sup>6</sup> 6s <sup>2</sup> <sup>Os</sup> Осмий 190,23 Osmium									77 5d <sup>7</sup> 6s <sup>2</sup> Иридий 192,22 Iridium	78 5d <sup>8</sup> 6s <sup>2</sup> Платина 195,08 Platinum		
	IX	79 5d <sup>10</sup> 6s <sup>1</sup> Золото 196,96654 Gold	80 5d <sup>10</sup> 6s <sup>2</sup> Ртуть 200,59 Mercury		81 6p <sup>1</sup> Таллий 204,3833 Thallium		82 6p <sup>2</sup> Свинец 207,2 Lead	83 6p <sup>3</sup> Висмут 208,98037 Bismuth		84 6p <sup>4</sup> Полоний [209] Polonium	85 6p <sup>5</sup> Астат [210] Astatine		86 6p <sup>6</sup> Радон [222] Radon												
7	X	Франций 87 [223] Francium	Радий 88 226,025 Radium		89 6d <sup>1</sup> 7s <sup>2</sup> Актиний [227] Actinium		104 Rutherfordium [261]	105 Дубний [263] Dubnium		106 Сибергий [269] Seaborgium	107 Борий [287] Bohrium		108 Хассий [289] Hassium		109 Мейтнерий [288] Meitnerium	110 Дармштадтий [289] Darmstadtium									
	XI	111	112		113		114	115		116		117		118											



D.I. Mendeleev  
1834 - 1907

- s-элементы
- p-элементы
- d-элементы
- f-элементы

Лантаноиды Lanthanides													
Церий Ce 4f <sup>1</sup> 5d <sup>1</sup> 140,115 Cerium	Прометий Pr 4f <sup>3</sup> 140,90765 Promethium	Неодим Nd 4f <sup>3</sup> 144,24 Neodymium	Прометий Pm 4f <sup>4</sup> [145] Promethium	Самарий Sm 4f <sup>5</sup> 150,36 Samarium	Европий Eu 4f <sup>6</sup> 151,965 Europium	Гадолиний Gd 4f <sup>7</sup> 5d <sup>1</sup> 157,25 Gadolinium	Тербий Tb 4f <sup>7</sup> 5d <sup>1</sup> 158,925 Terbium	Диспрозий Dy 4f <sup>9</sup> 162,50 Dysprosium	Гольмий Ho 4f <sup>10</sup> 164,93032 Holmium	Эрбий Er 4f <sup>12</sup> 167,26 Erbium	Тулий Tm 4f <sup>13</sup> 168,93421 Thulium	Иттербий Yb 4f <sup>14</sup> 173,054 Ytterbium	Лютеций Lu 4f <sup>14</sup> 5d <sup>1</sup> 174,967 Lutetium
Актиниды Actinides													
Торий Th 6d <sup>2</sup> 7s <sup>2</sup> 232,0375 Thorium	Протактиний Pa 5f <sup>2</sup> 6d <sup>1</sup> 231,03588 Protactinium	Уран U 5f <sup>3</sup> 6d <sup>1</sup> 238,02891 Uranium	Нептуний Np 5f <sup>4</sup> 6d <sup>1</sup> [237] Neptunium	Плутоний Pu 5f <sup>6</sup> [244] Plutonium	Америций Am 5f <sup>7</sup> [243] Americium	Кюрий Cm 5f <sup>7</sup> 6d <sup>1</sup> [247] Curium	Калифорний Cf 5f <sup>10</sup> [251] Californium	Эйнштейний Es 5f <sup>11</sup> [252] Einsteinium	Фермий Fm 5f <sup>12</sup> [257] Fermium	Менделеев Md 5f <sup>13</sup> [288] Mendelevium	Нобелий No 5f <sup>14</sup> [259] Nobelium	Лоуренсий Lr 5f <sup>14</sup> 6d <sup>1</sup> [260] Lawrencium	

112  
Chemical  
identification  
in 2006

113  
Discovered  
at JINR in  
2003

114  
Discovered  
at JINR in  
1999

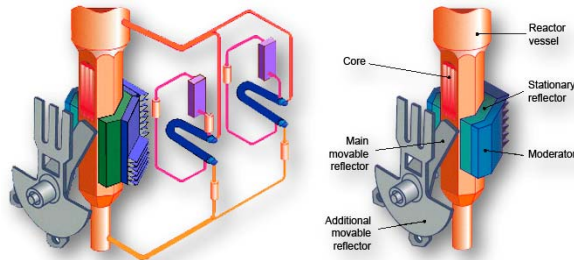
115  
Discovered  
at JINR in  
2003

116  
Discovered  
at JINR in  
2000

118  
Discovered  
at JINR in  
2001

# JINR's Large-Scale Basic Facilities

The IBR-2M pulsed reactor of periodic action is included in the 20-year European strategic programme of neutron scattering research.



## Parameters

<b>Fuel</b>	<b>PuO<sub>2</sub></b>
<b>Active core volume</b>	<b>22 dm<sup>3</sup></b>
<b>Cooling</b>	<b>liquid Na</b>
<b>Average power</b>	<b>2 MW</b>
<b>Pulsed power</b>	<b>1500 MW</b>
<b>Repetition rate</b>	<b>5 s<sup>-1</sup></b>
<b>Average flux</b>	<b>8·10<sup>12</sup> n/cm<sup>2</sup>/s</b>
<b>Pulsed flux</b>	<b>5·10<sup>15</sup> n/cm<sup>2</sup>/s</b>
<b>Pulse width (fast / therm.)</b>	<b>215 / 320 μs</b>
<b>Number of channels</b>	<b>14</b>

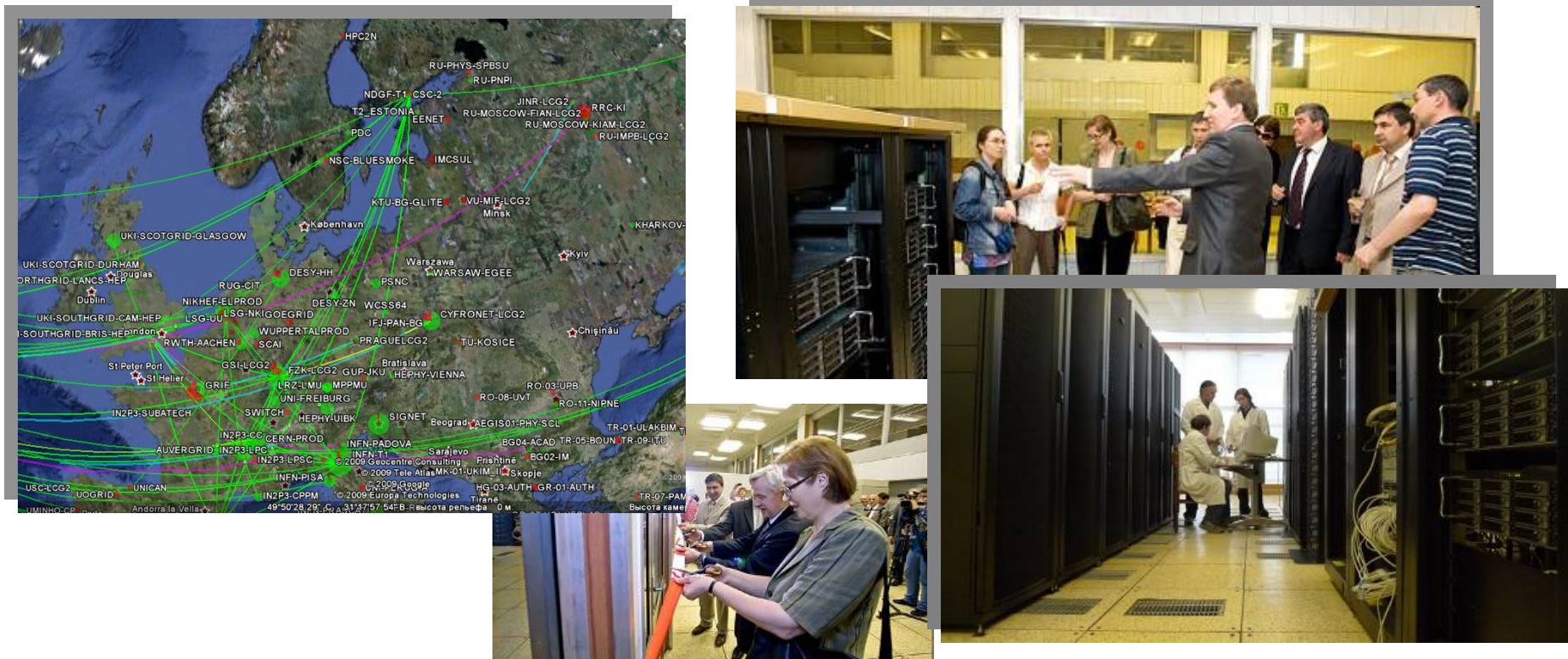
Fundamental and applied research in condensed matter physics and related fields — biology, medicine, material sciences, geophysics, engineer diagnostics — aimed at probing the structure and properties of nanosystems, new materials, and biological objects, and at developing new electronic, bio- and information nanotechnologies.

# Network and telecommunication

## 2009: two important projects completed

1. JINR - Moscow 20Gbps telecommunication channel was put into operation.
2. Increase of the JINR Central Information and Computing Complex performance up to 2400 kSI2K and the disk storage capacity up to 500 TB.

At present, JINR site is one of the 10 best sites of the worldwide Grid infrastructure (WLCG).



*A vitally important task is attracting of young people from all the Member States to science*

## EDUCATIONAL PROGRAMME



## JINR UNIVERSITY CENTRE

More than 300 students and postgraduates from Member States are trained at the UC

Chairs:

MSU

MIPT

MEPI

MIREA

others

**JINR is a school of excellence for the Member States!**

“Dubna” International University



**DIAS - TH**

Dubna International Advanced School on Theoretical Physics



The UC offers graduate programmes in the fields of:

- ◆ Elementary Particle Physics
- ◆ Nuclear Physics
- ◆ Theoretical Physics
- ◆ Condensed Matter Physics
- ◆ Technical Physics
- ◆ Radiobiology

# **INNOVATION ACTIVITIES**

# General Information



# President D. Medvedev Visits JINR on 18 April 2008

г. Дубна, Московская область, Россия, тел.: (7-49621) 6-50-77, факс: (7-495) 6-66-66  
Общество с ограниченной ответственностью "ЦИКЛОН"

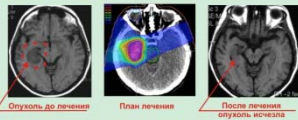
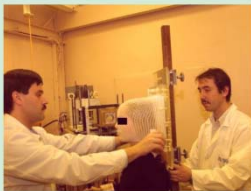
**РОСОЗ**

## ЦЕНТР РАДИАЦИОННОЙ МЕДИЦИНЫ В ДУБНЕ

В России ежегодно заболевают раком около 500 тысяч человек, из них 50 тысяч могут быть пролечены только с применением протонной терапии.

Протоны в 2 раза уменьшают лучевую нагрузку на окружающие опухоль нормальные ткани по сравнению с гамма-лучами, они эффективны при облучении глубоко залегающих опухолей большого размера.

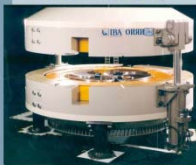
### Опыт ОИЯИ



- Пioneерские работы начаты в 1967 г.
- Один из 3-х центров протонной терапии в России
- В медико-техническом комплексе проходит курс лечения около 100 больных в год

### Конкурентоспособность

Сотрудничество ОИЯИ с мировым лидером по производству медицинской техники для протонной терапии — бельгийской фирмой Ion Beam Applications S.A. (IBA)



В мире создано 25 специализированных центров протонной терапии.

Потребности российского рынка — 30-50 протонных центров со стоимостью оборудования каждого центра около 850 млн. рублей и стоимостью здания около 400 млн. рублей.

Кабинет для протонной терапии

Объединенный институт ядерных исследований

**Центр радиационной медицины в Дубне**

Правительство Московской области  
Администрация г. Дубны

г. Дубна, Московская область, Россия тел.: (7-49621) 6-50-59, факс: (7-495) 632-78-80, e-mail: post@jinr.ru, http://www.jinr.ru

**ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ**

МЕЖДУНАРОДНАЯ МЕЖПРАВИТЕЛЬСТВЕННАЯ ОРГАНИЗАЦИЯ

## Проект Международного инновационного центра нанотехнологий стран СНГ

Комитет полномочных представителей правительств государств-членов ОИЯИ на совещаниях 27-28 ноября 2007 г. и 14-15 марта 2008 г. поддержал создание Международного инновационного центра нанотехнологий стран СНГ (МИЦНТ СНГ) и рекомендовал директору Института представить необходимые документы в Правительство Российской Федерации.

Международный инновационный центр нанотехнологий стран СНГ

- Центр коллективного пользования оборудованием ОИЯИ
- Нано-Грид
- Центр трансфера технологий
- Образовательный проект
- Правительства и компании стран СНГ

Государственные институты развития РФ  
Частные корпорации

Концепция МИЦНТ СНГ на базе ОИЯИ и особой экономической зоны «Дубна»  
Центр обеспечит комплексное использование и коллективное использование уникального оборудования в интересах компаний — резидентов ОЭЗ в странах СНГ.

Элементы МИЦНТ СНГ создаются в партнерстве с институтами развития и другими частными и государственными программами России

Участки ЦКП, НаноГРИД, Центр трансфера технологий, Образовательный проект

ГОСУДАРСТВЕННАЯ КОРПОРАЦИЯ РОСНАНО  
РОССИЙСКАЯ КОРПОРАЦИЯ НАНОТЕХНОЛОГИЙ

РОСОЗ

ИЯИ

**Центр выступит в роли локомотива для формирования на пространстве СНГ ЕДИНОГО РЕГИОНАЛЬНОГО РЫНКА НАНОИНДУСТРИИ**

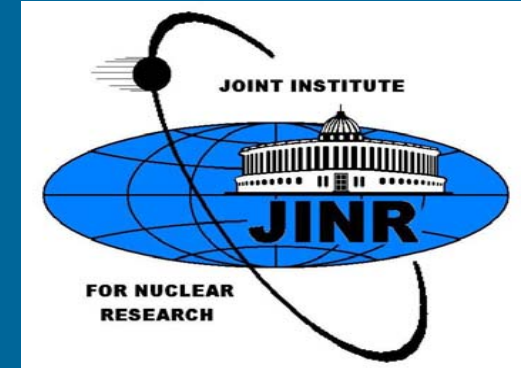
Процедура создания МИЦНТ СНГ:



President D. Medvedev noted the importance of the future realization of the large-scale project, proposed by JINR: establishment at Dubna of an International Innovative Nanotechnology Centre



# Cooperation with Italy



The Joint Institute for Nuclear Research has been maintaining scientific contacts with Italian physicists since the JINR establishment



# Cooperation with Italy

JINR cooperates with 3 Italian scientific centres and 13 Universities in 23 research topics in the following scientific fields:

- Theoretical physics 5 topics
- Elementary particle physics and  
• Relativistic nuclear physics 13 topics
- Nuclear physics 4 topics
- Networks, computing,  
Computer physics 1 topic

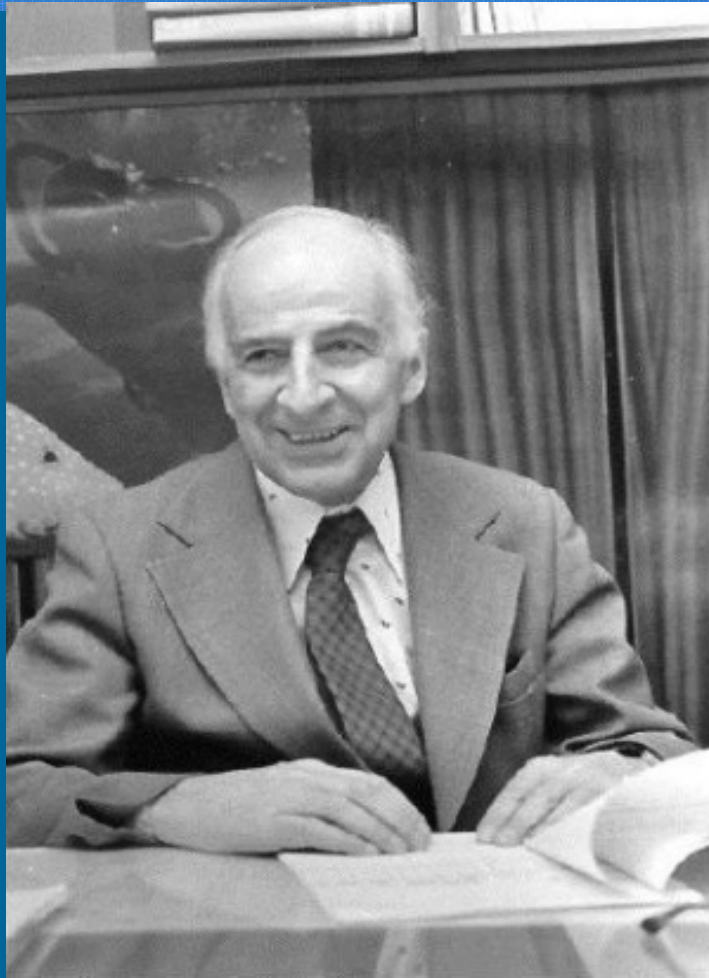


# Cooperation with Italy

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Visits of Italian scientists	21	42	38	32	19	15	23	24	26	21
Visits of JINR staff members to Italy*	150 (47)	135 (41)	149 (52)	152 (27)	179 (46)	190 (49)	170 (32)	177 (54)	152 (48)	142 (39)

\* Including conferences

# Cooperation with Italy

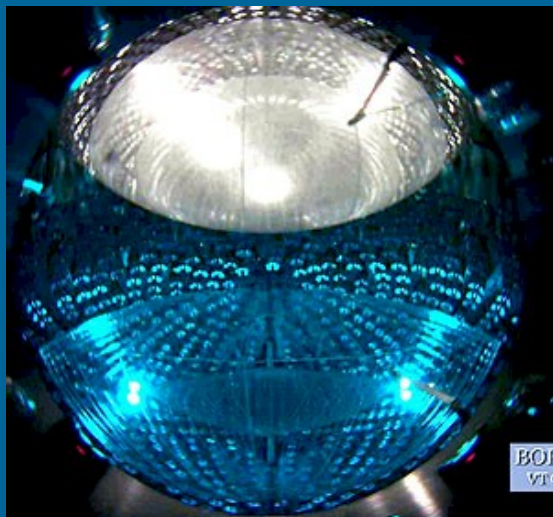


Academician Bruno Pontecorvo

In 1995 the prestigious international Bruno Pontecorvo Prize in elementary particle physics was instituted at JINR in his memory. The prize is awarded annually by the Joint Institute for Nuclear Research to a single scientist for valuable scientific work in elementary particle physics. Among the Prize winners are such outstanding scientists as Y.Totsuka, A.Suzuki, S.Bilenky, A.Zichichi, and many others.

# Cooperation with Italy

BOREXINO collaboration



OPERA collaboration





# Cooperation with Italy



2009. Members of the PAC for nuclear physics at the IREN facility



# Cooperation with Italy

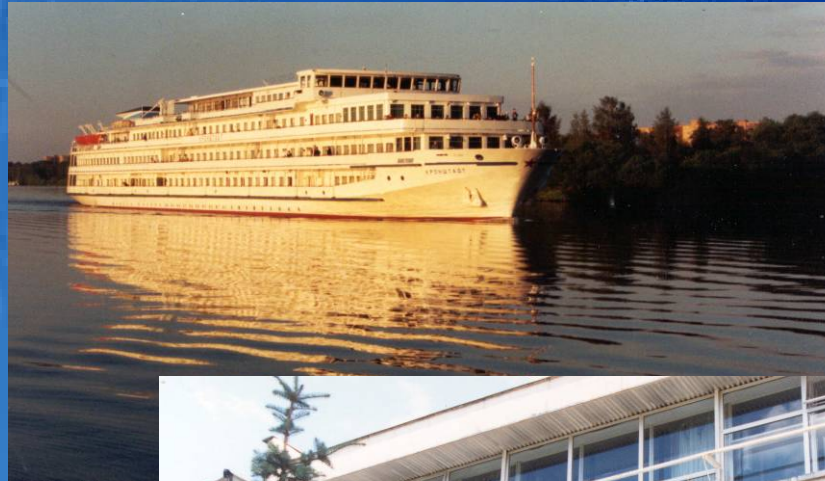


G.Piragino (left) and D.Pontecorvo



P.Spillantini

# Welcome to JINR (Dubna)



# Welcome to JINR (Dubna)!

J  
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R



D  
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# Thank you for attention!