



# Intense Resonance Neutron Source at JINR: Status and Perspectives

V. Shvetsov



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.

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

7 Laboratories and University Center, 5000 staff;

180 M\$ budget for 2015, around 200 M\$ for 2016 and future;

Superconducting relativistic heavy ions accelerator NUCLOTRON;

Complex of low energy heavy ions accelerators;

Proton synchrotron for 660 MeV;

Fast pulsed reactor IBR-2 and IREN neutron sources;



# Neutron Physics

[About Laboratory](#)[Events](#)[Internal Structure](#)[IBR-2 Pulsed Reactor](#)[IREN Facility](#)[Issues Archives](#)[Annual Reports](#)[Local Network](#)

## IBR-2 Pulsed Reactor

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The IBR-2 reactor with its unique technical approach produces one of the most intense pulse neutron flux at the moderator surface among the world's reactors:  $\sim 10^{16}$  n/cm<sup>2</sup>/s, with a power of 1850 MW in pulse.

Nevertheless, the reactor is "ecologically friendly": it consumes very little electrical energy comparing to other research reactors, has practically no emissions, uses a very little amount of fuel (less than 20 l) that is changed once in 15-20 years.

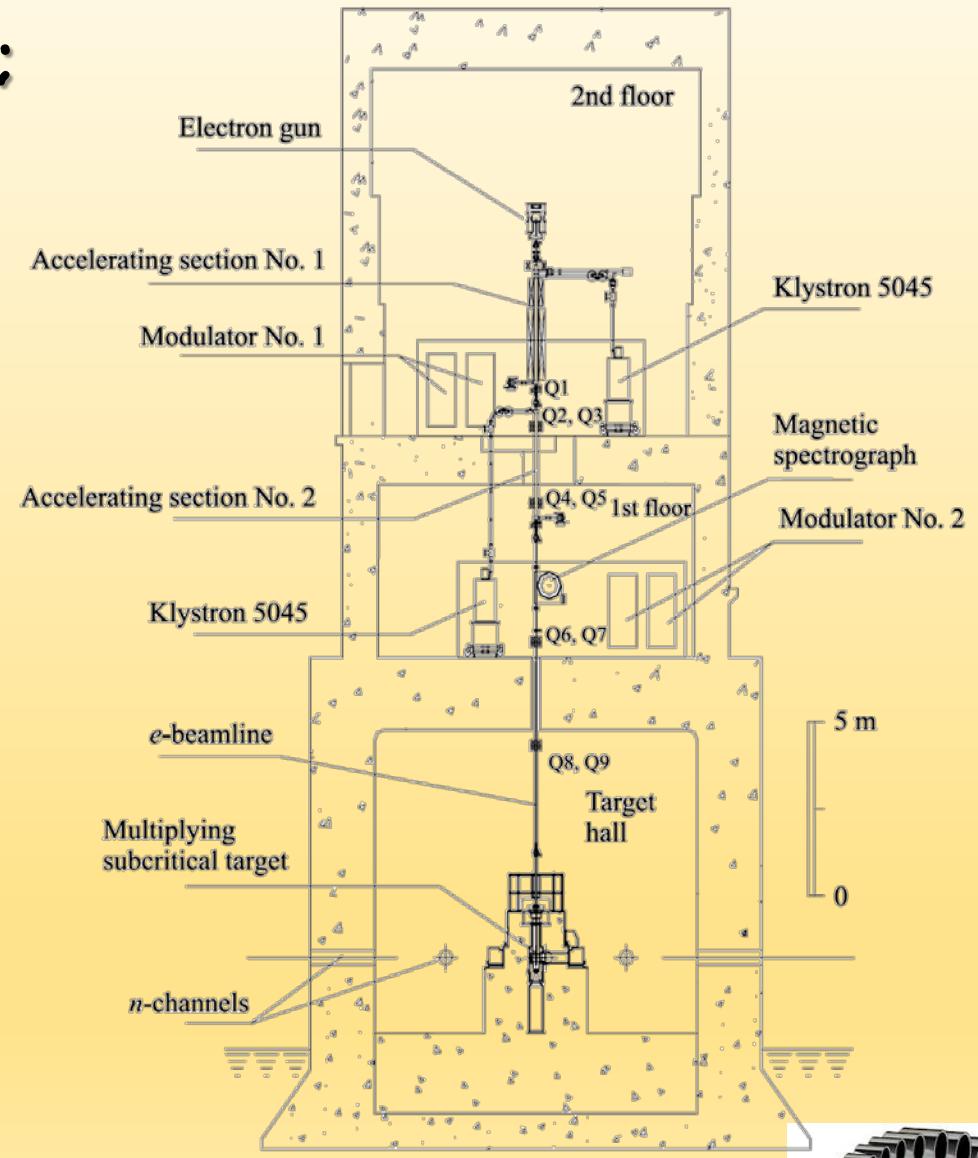
The reactor operates continuously for a 12 day cycle followed by a shutdown to prepare for the next experiments. In addition, there is a longer shutdown to carry out necessary maintenance work during the summer time. Normally there are about 9 cycles a year.

[Archive of the most important data of IBR-2 power](#)

[Virtual excursion on the complex of spectrometers of the IBR-2 pulsed reactor](#)

# IREN Neutron Source: Initial Parameters

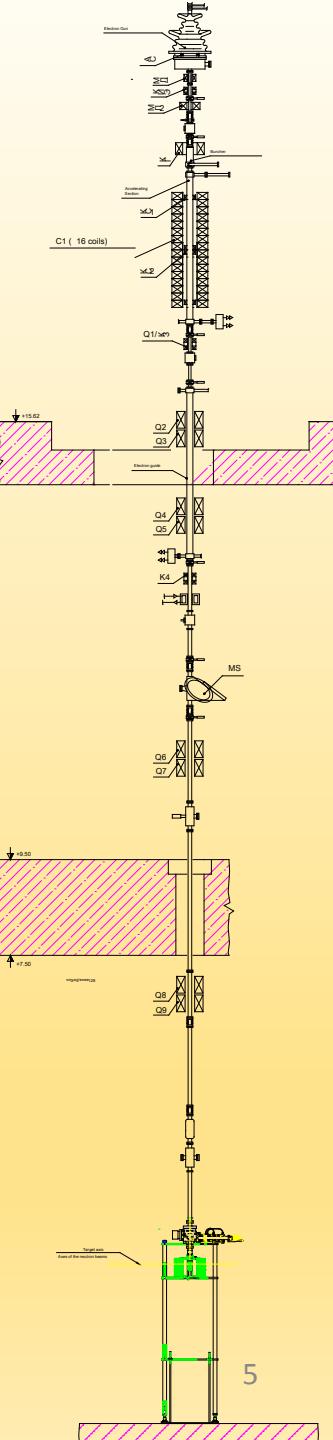
- Electron beam average power, kW - 10;
- Electron energy, MeV - 200;
- Pulse current, A - 1.5;
- Acceleration, MeV/m - 35;
- Operation frequency, MHz - 2856;
- RF power 5045 klystron - (SLAC);
- N. of accelerating sections - 2;
- Beam pulse duration, ns - 250;
- Repetition rate, Hz - 150;
- Pu subcritical core with  $k_{\text{eff}} < 0.98$ ;
- Neutron yield n/s -  $10^{15}$ ;

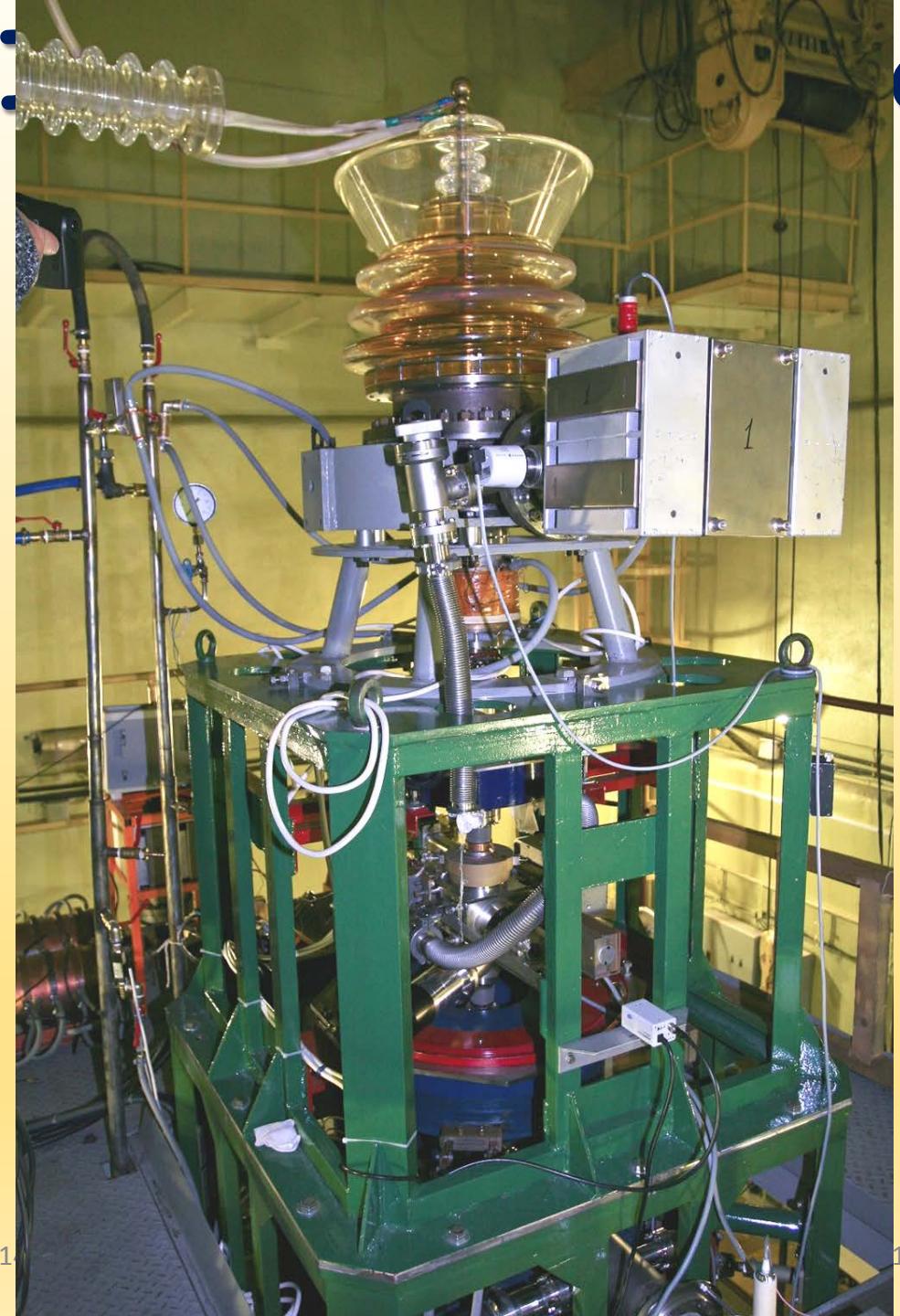




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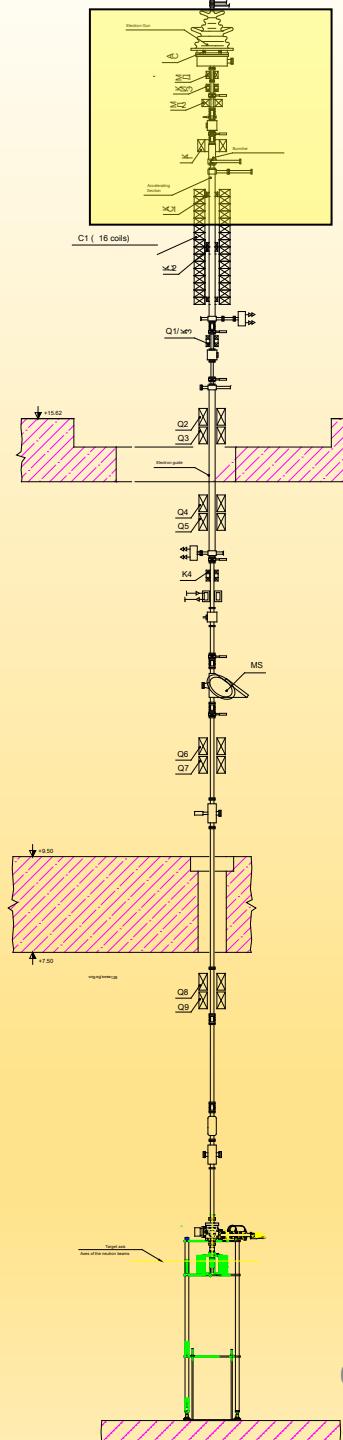
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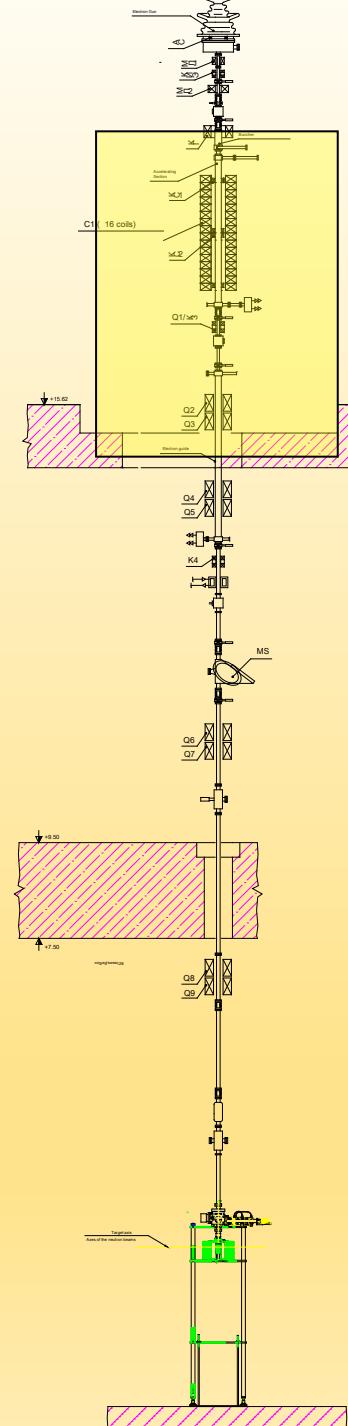
15 INFN Laboratori Nazionali di Legnaro





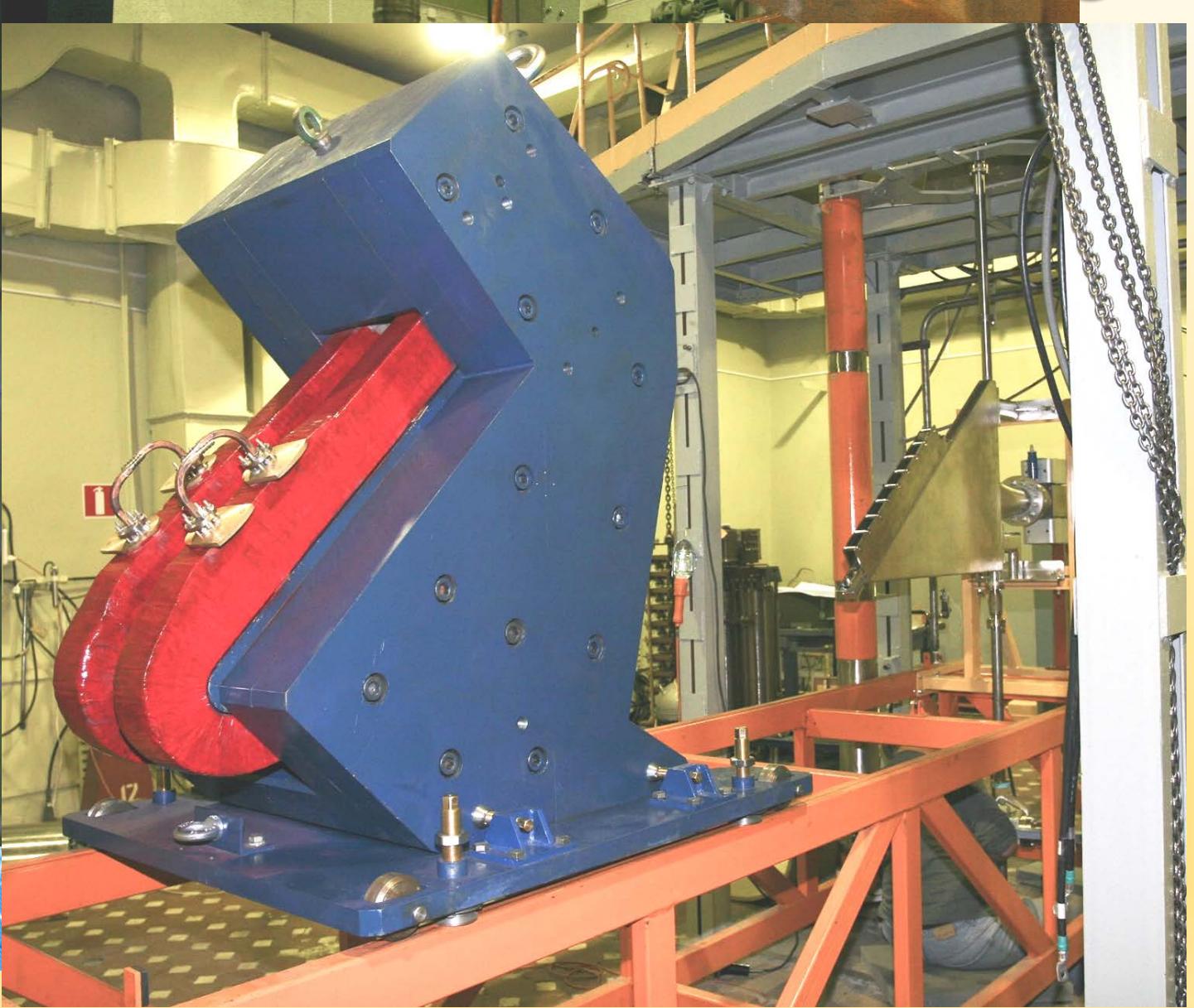
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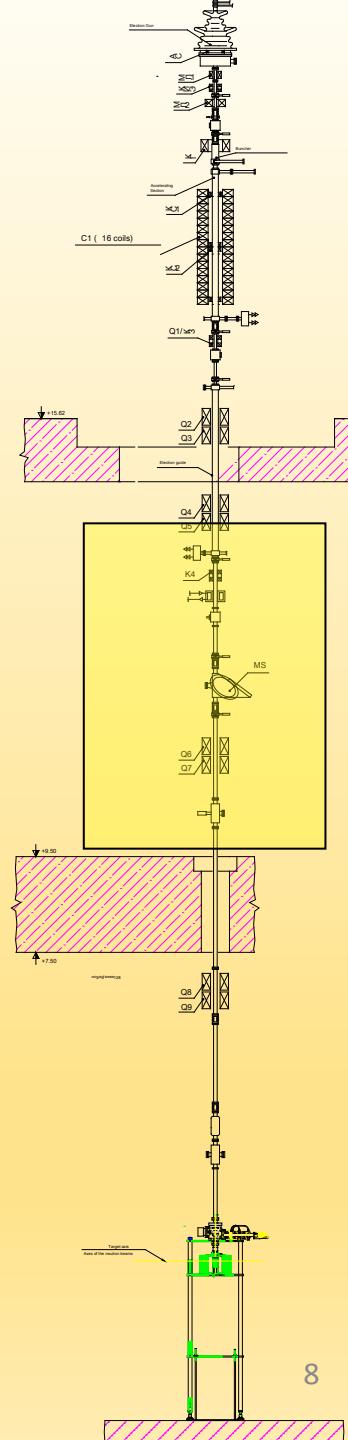




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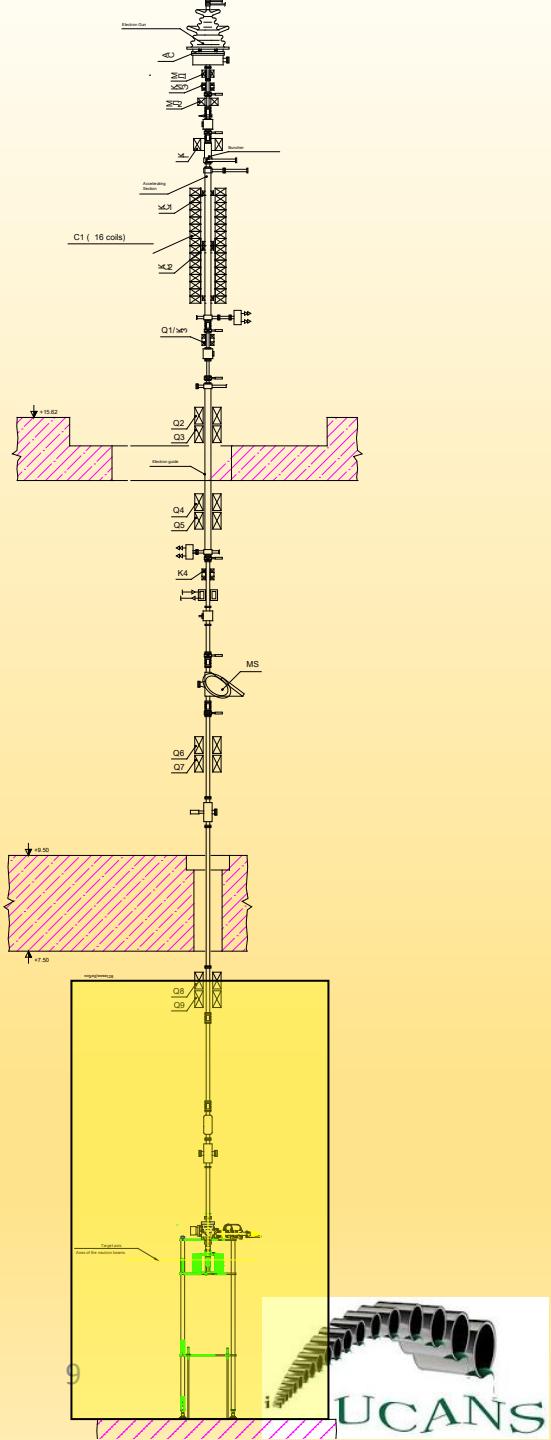
# IREN Current Status



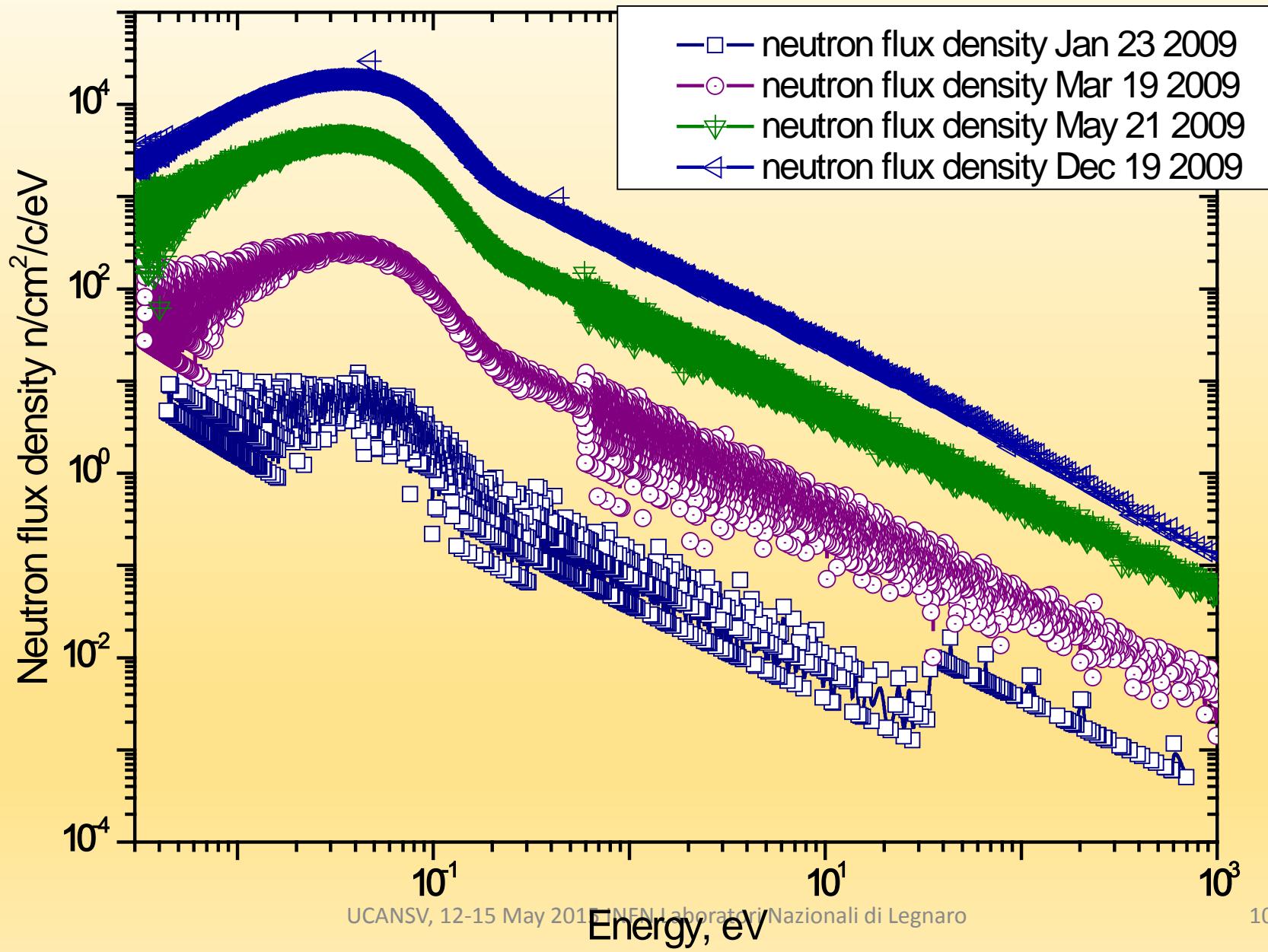
Target hall January 15 2009

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# Neutron Spectra at 50 Hz, 100 ns Pulse, 10 m Flight Path



# IREN Current Parameters

- Average energy of the accelerated electrons
  - 30 MeV;
- Peak current - 3 A;
- Pulse width - 100 ns;
- Repetition rate - 25-50 Hz;
- Beam power - up to 450 W;
- Target - nonmultiplying W;
- Integral neutron yield - about  $5 \cdot 10^{11}$  n/s;

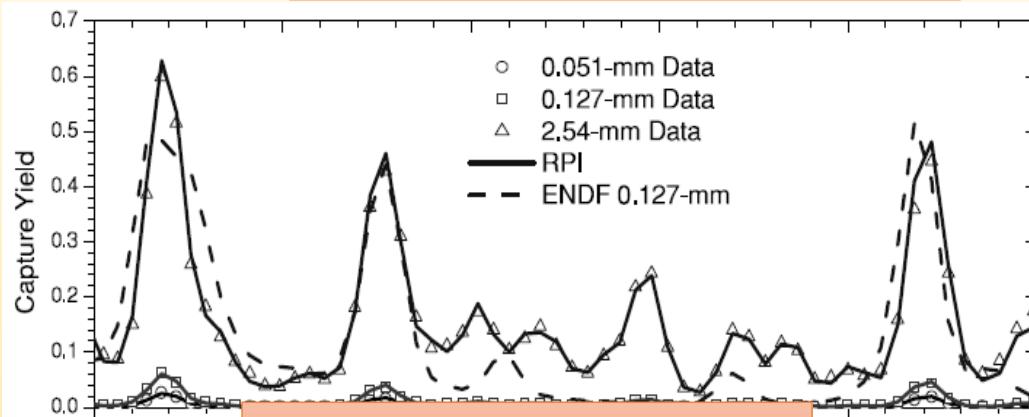


# Experimental Activity at IREN

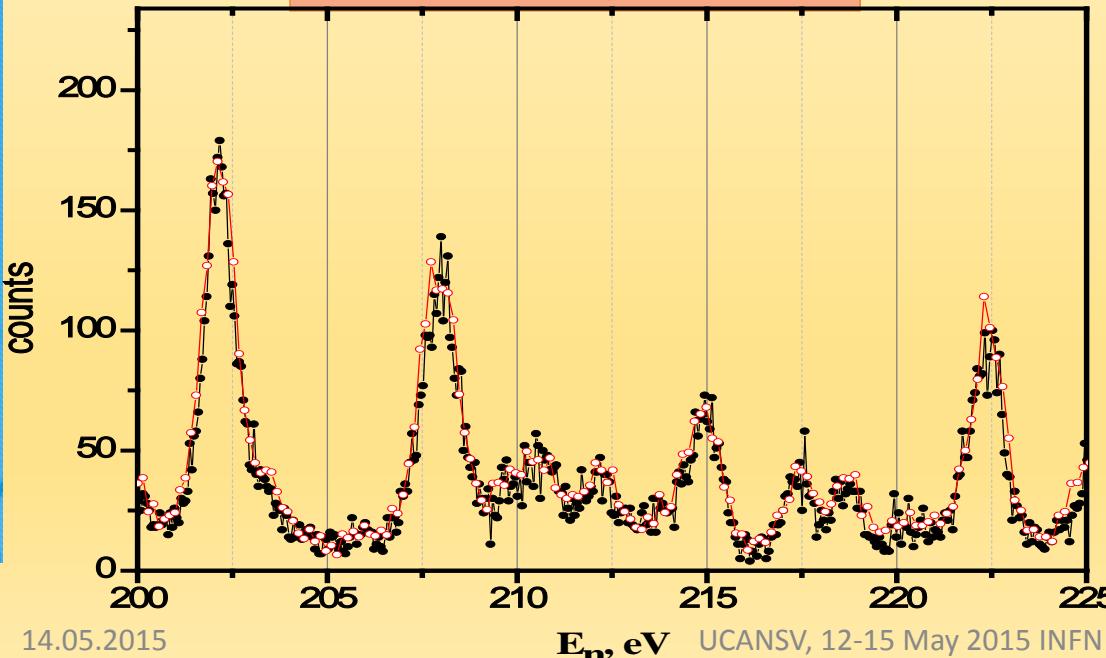
- Cross-section measurements;
- Neutron Resonance Capture Analysis;
- Experimental simulation and measurements of the neutron spectra from Ga neutron producing target;
- Experimental measurements of the gaseous and scintillator sensitivity to neutrons;



RPI Linac, neutron yield  $10^{13} / \text{s}$



V.N. Shvetsov et al. (2010)  
IREN, neutron yield  $10^{11} / \text{s}$



$^{nat}\text{Gd} (n, \gamma)$

$^{152}\text{Gd}$	- 0.20%
$^{154}\text{Gd}$	- 2.18%
$^{155}\text{Gd}$	- 14.80%
$^{156}\text{Gd}$	- 20.47%
$^{157}\text{Gd}$	- 15.65%
$^{158}\text{Gd}$	- 24.84%
$^{160}\text{Gd}$	- 21.86%

Sample:

$m_g = 172.8 \text{ g}$   
size:  $11.2 \times 14.5 \text{ cm}^2$   
 $\rho = 1.064039 \text{ g/cm}^2$   
 $d = 1.35\text{mm}$

IREN, Dubna

$f = 25 \text{ Hz}$

$I_e = 2\text{A}; t_e = 100\text{ns}$

$L = 58.6\text{m}$

- $dt = 100\text{ns}$   
 $t_{mes} = 14h40'$
- $dt = 40 \text{ ns}$   
 $t_{mes} = 19h00'$

# Near-term Prospects (by the end of 2016)

- Pulse duration: 20 - 200 ns;
- Peak current : 3 A;
- Repetition rate: 1-120 Гц;
- Electron energy: up to 180 MeV;
- Target:  $^{238}\text{U}$ ;
- Integral neutron yield: up to  $5.8 \cdot 10^{13}$  n/sec;



# THANK YOU FOR YOUR ATTENTION



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