IREN Current Status and Perspectives

V. Shvetsov

IREN Designed Parameters

Neutron Energy	**1- 10^4 eV**
Pulsewidth (FWHM)	**400 ns**
Repetition Rate	**150 Hz**
Neutron yield	**10^{15} n/s**
Number of beamlines	**8**

Research Program

- Symmetries violation in neutron induced reactions;
- Neutron induced fission;
- Neutron fundamental properties;
- Nuclear structure;
- Nuclear data;
- Resonance capture and transmission analysis;

IREN Concept

Electron Linac LUE-200

e

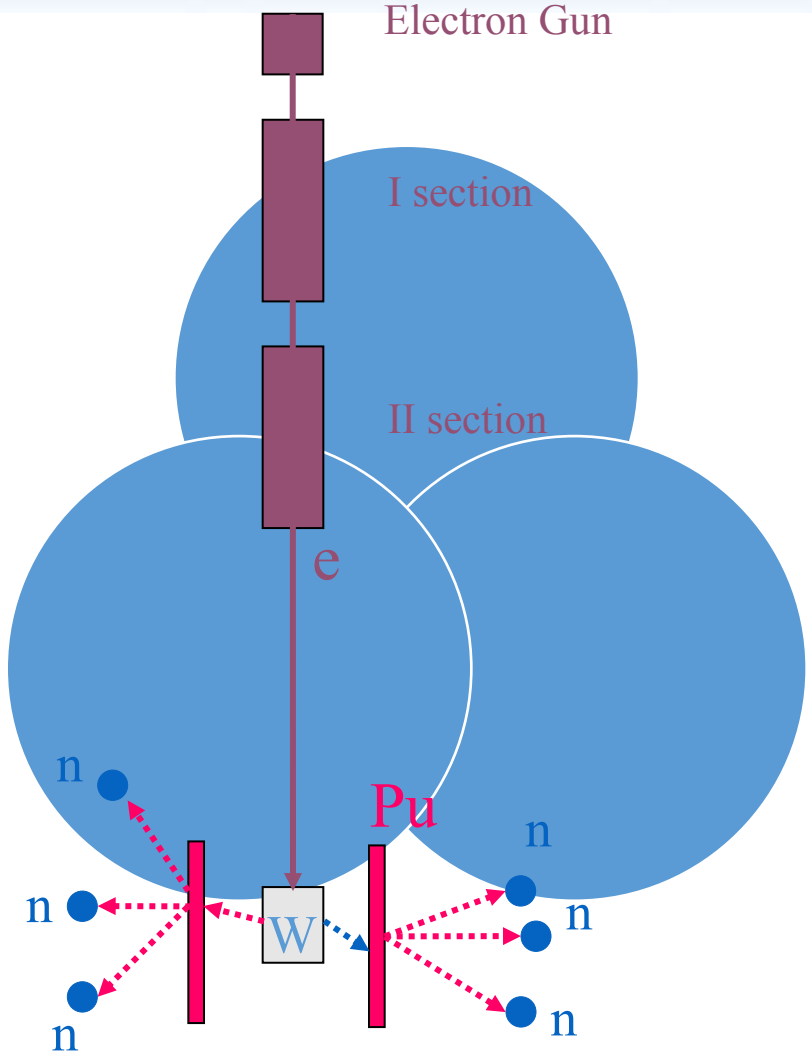
Target - Converter (W)

γ

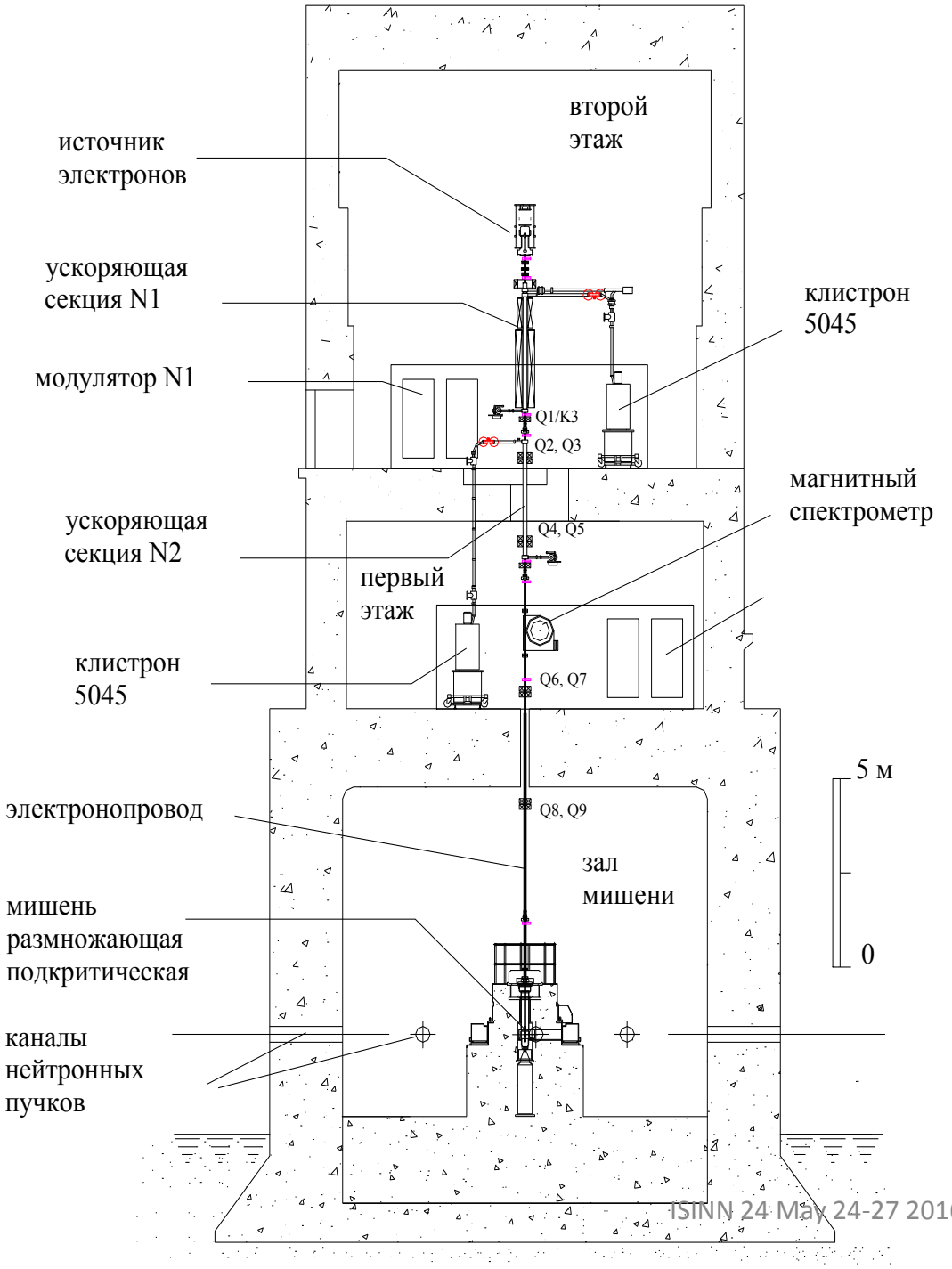
n

Subcritial Core (Pu^{239})

n n n

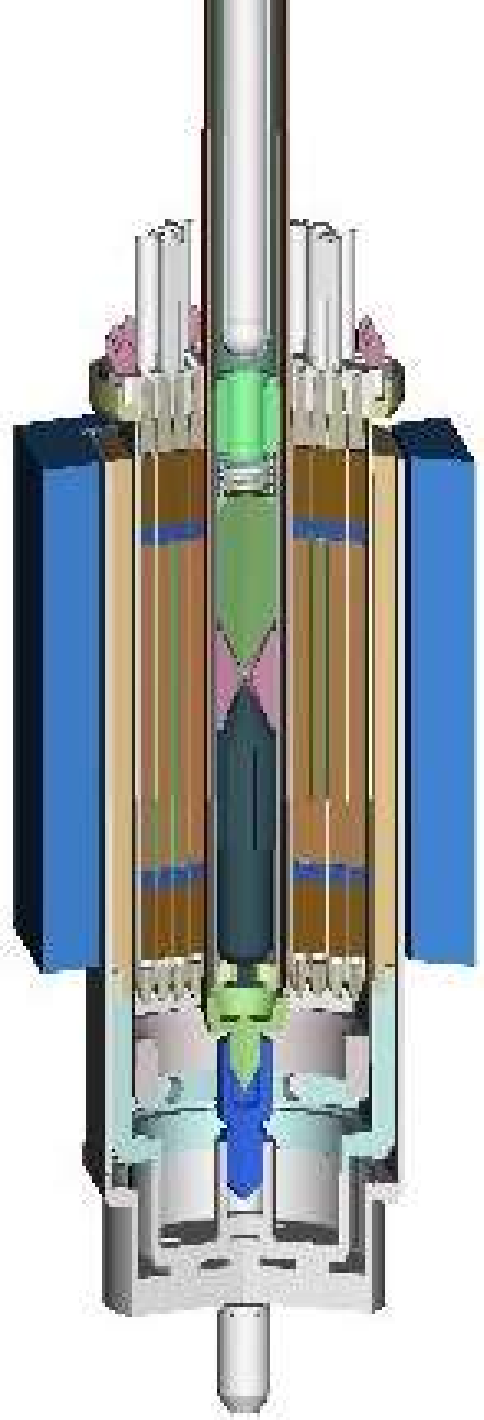


Allocation


второй этаж
источник электронов
ускоряющая секция N1
модулятор N1
клистрон 5045
Q1/K3
Q2, Q3
магнитный спектрометр
ускоряющая секция N2
Q4, Q5
первый этаж
клистрон 5045
Q6, Q7
5 м
0
электронопровод
Q8, Q9
зал мишени
мишень размножающая подкритическая
каналы нейтронных пучков

Subcritical Core

Electron beam power	Up to 10 kW
Fission Power	Up to 12 кW
Target Converter	W
Fuel	**Pu**^{239}
Fuel load (**Pu**^{239})	24.84 кг
FE number	108
Fast neutrons pulse width	420 ns
$K_{эфф}$	0.9694
Coolant	He (gas)

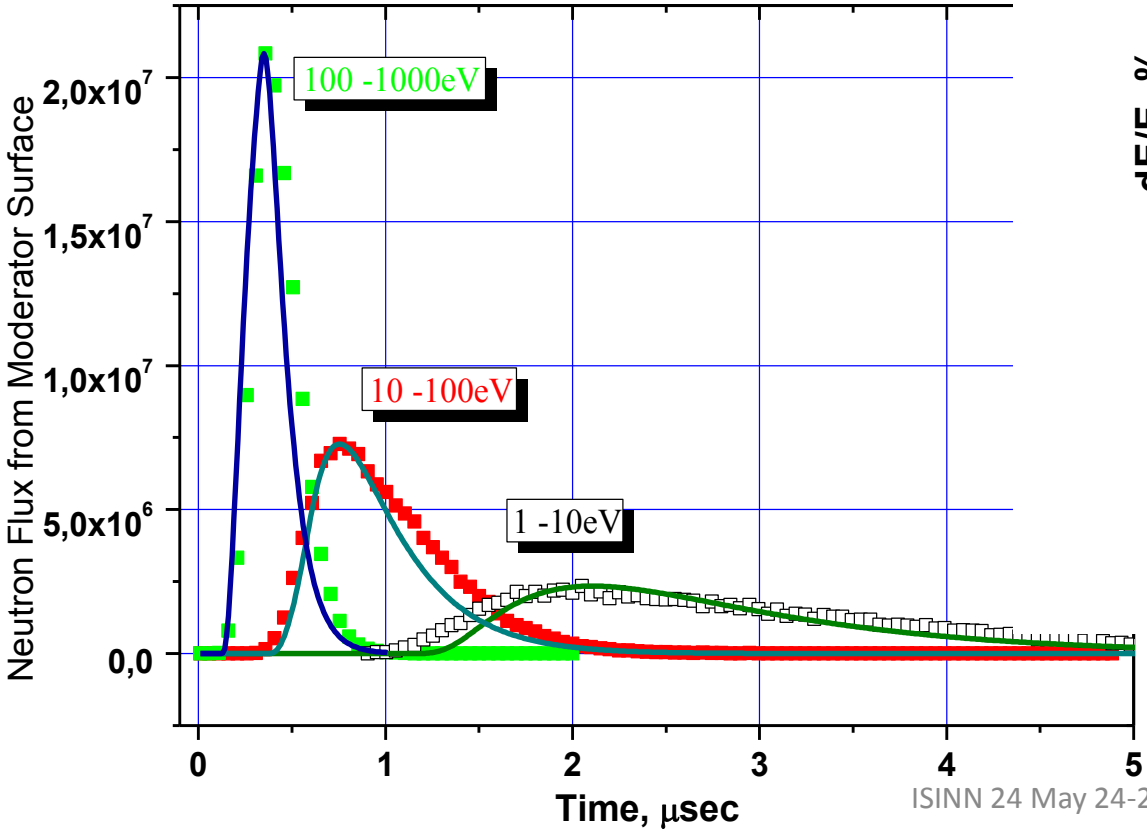


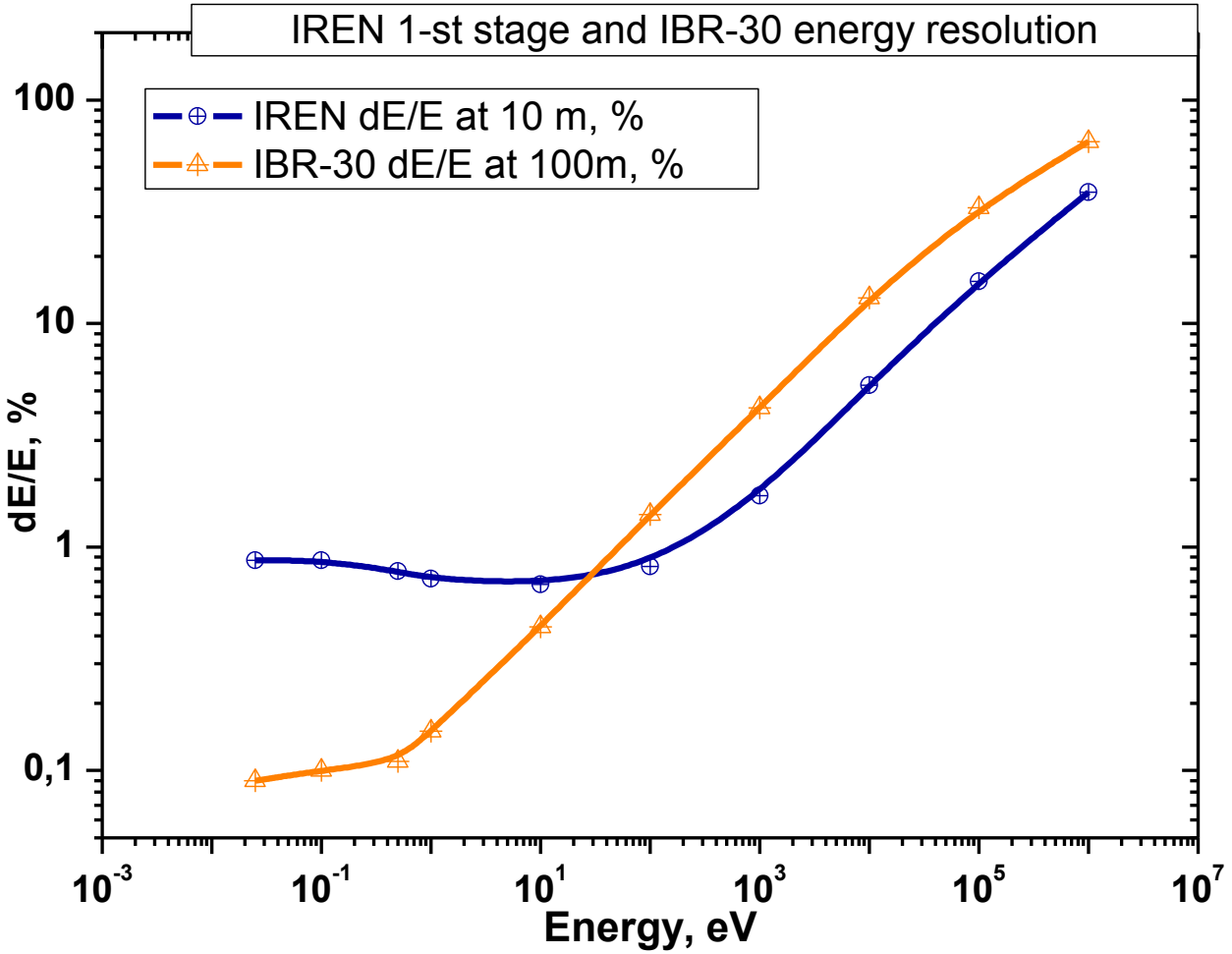
IREN 1st stage parameters

Initial data: E=100 MeV, I=2.5 A, dt=100 ns, f=50(150) Hz

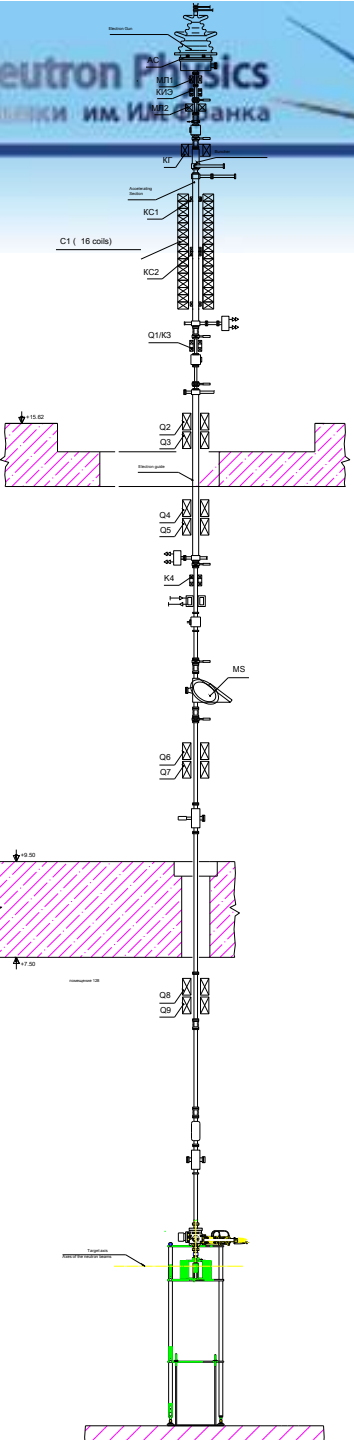
Parameter	IREN	IREN-1
Peak current (A)	1.5	2.5
Repetition rate (Hz)	150	50 (150)
Electron pulse duration (ns)	250	100
Electron energy (MeV)	200	100
Beam power (kW)	11.25	1.25
Multiplication	30	1
Neutron intensity (n/s)	$6\ 10^{14}$	$2.5(7.5)10^{12}$ (tungsten); $0.69(2.1)\ 10^{13}$ (uranium)
γ-intensity, s^{-1}		10^{15}
Intensity loss		240(80) (tungsten); 87(29) (uranium)

IREN timing

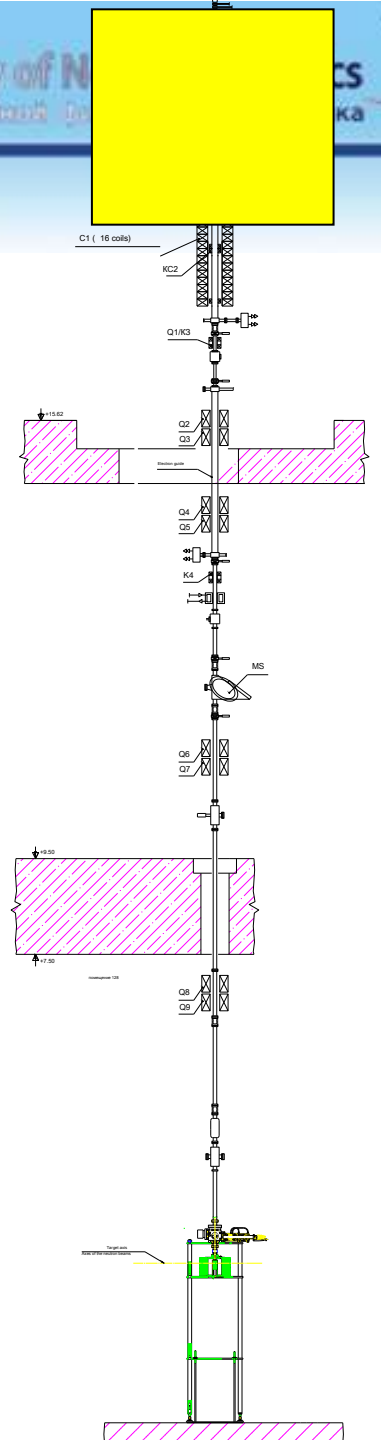

100 -1000eV
10 -100eV
1 -10eV
Neutron Flux from Moderator Surface
2,0x10^7
1,5x10^7
1,0x10^7
5,0x10^6
0,0
0
1
2
3
4
5
Time, μsec


IREN 1-st stage and IBR-30 energy resolution
IREN dE/E at 10 m, %
IBR-30 dE/E at 100m, %
dE/E, %
100
10
1
0,1
10^-3
10^-1
10^1
10^3
10^5
10^7
Energy, eV

us



...atus



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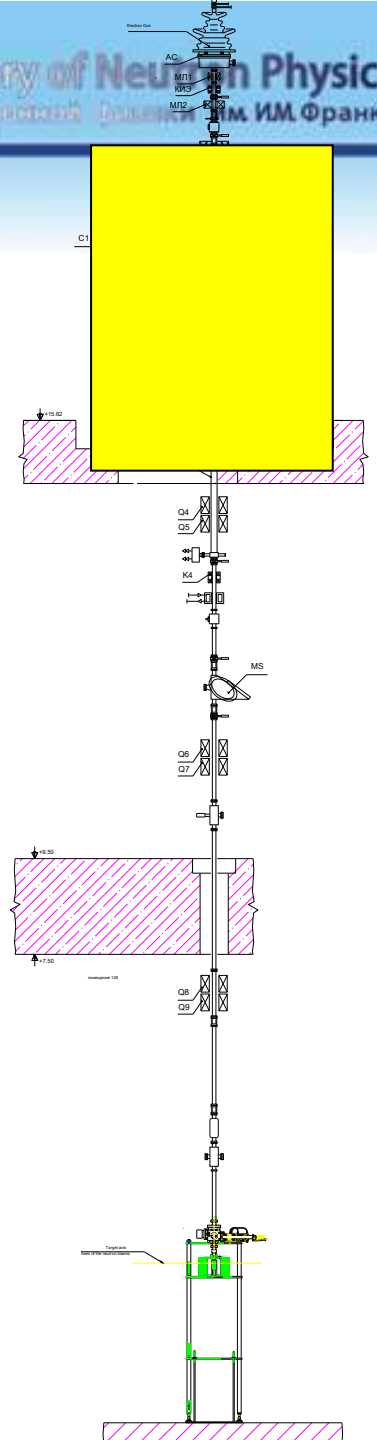
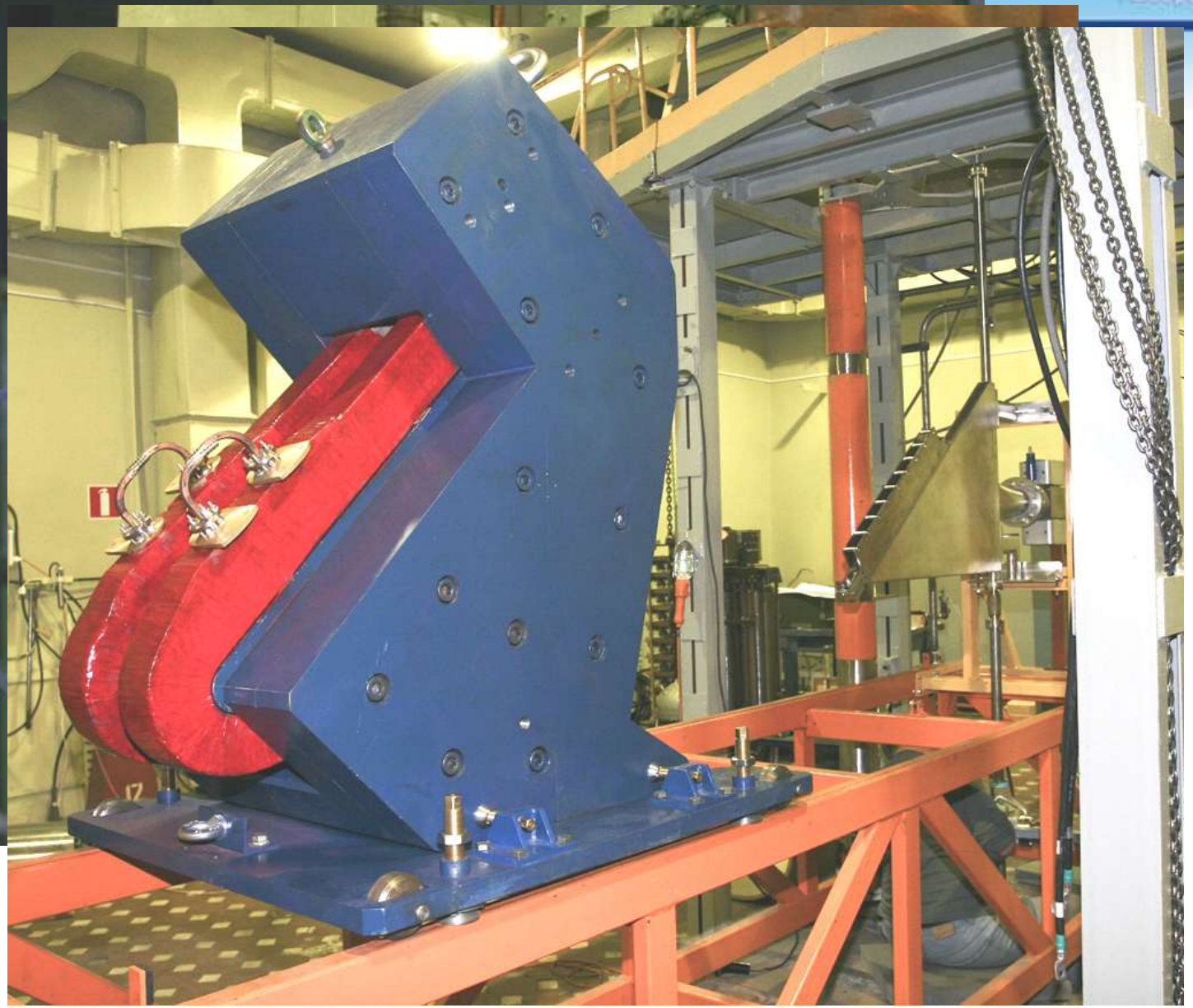
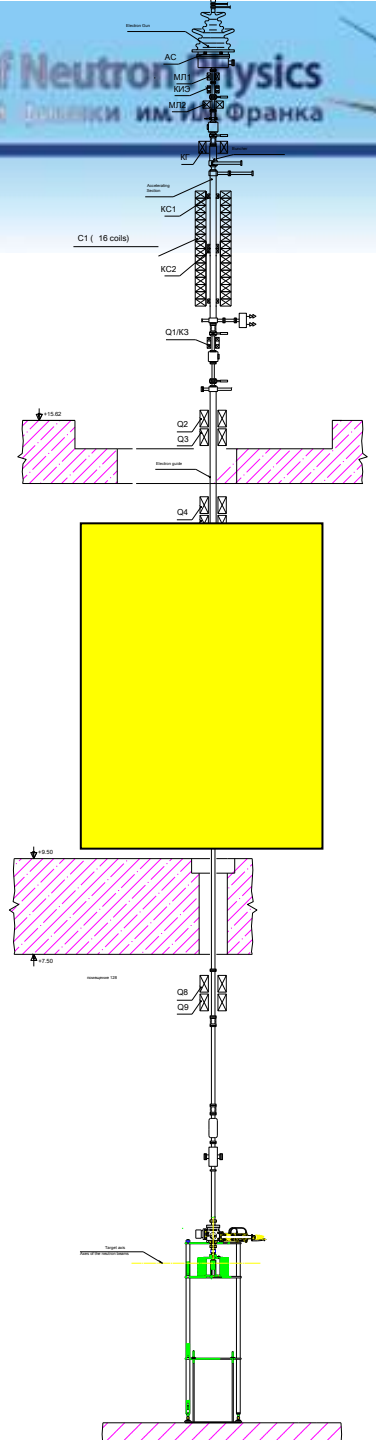
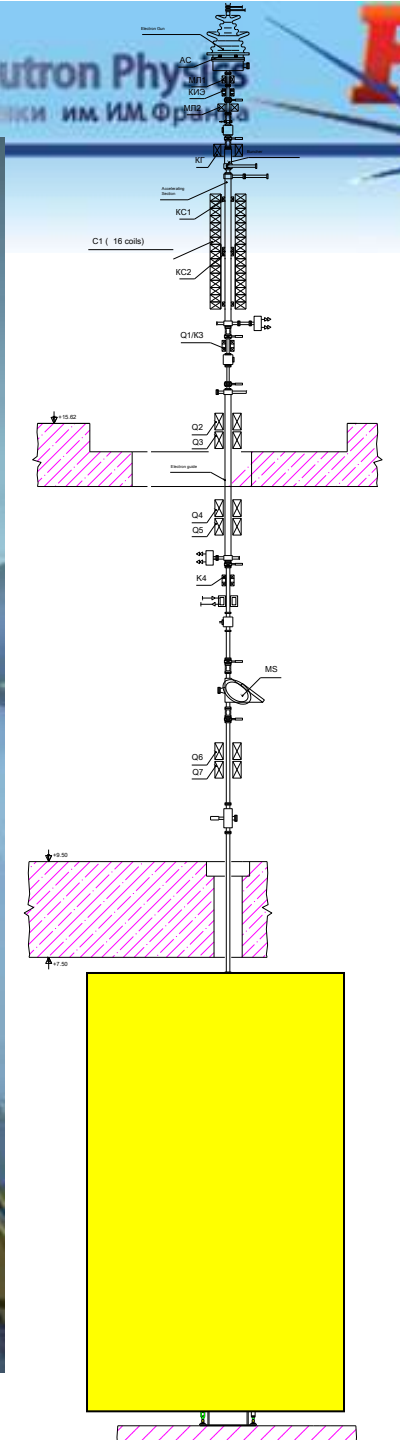





AC
МП1
КИЭ
МП2
КС1
C1 (16 coils)
КС2
Q1/K3
Q2
Q3
Q4
Q8
Q9


AC
KI3
KI2
KI1
KT
KC1
C1 (16 coils)
KC2
Q1/K3
Q2
Q3
Q4
Q5
K4
MS
Q6
Q7

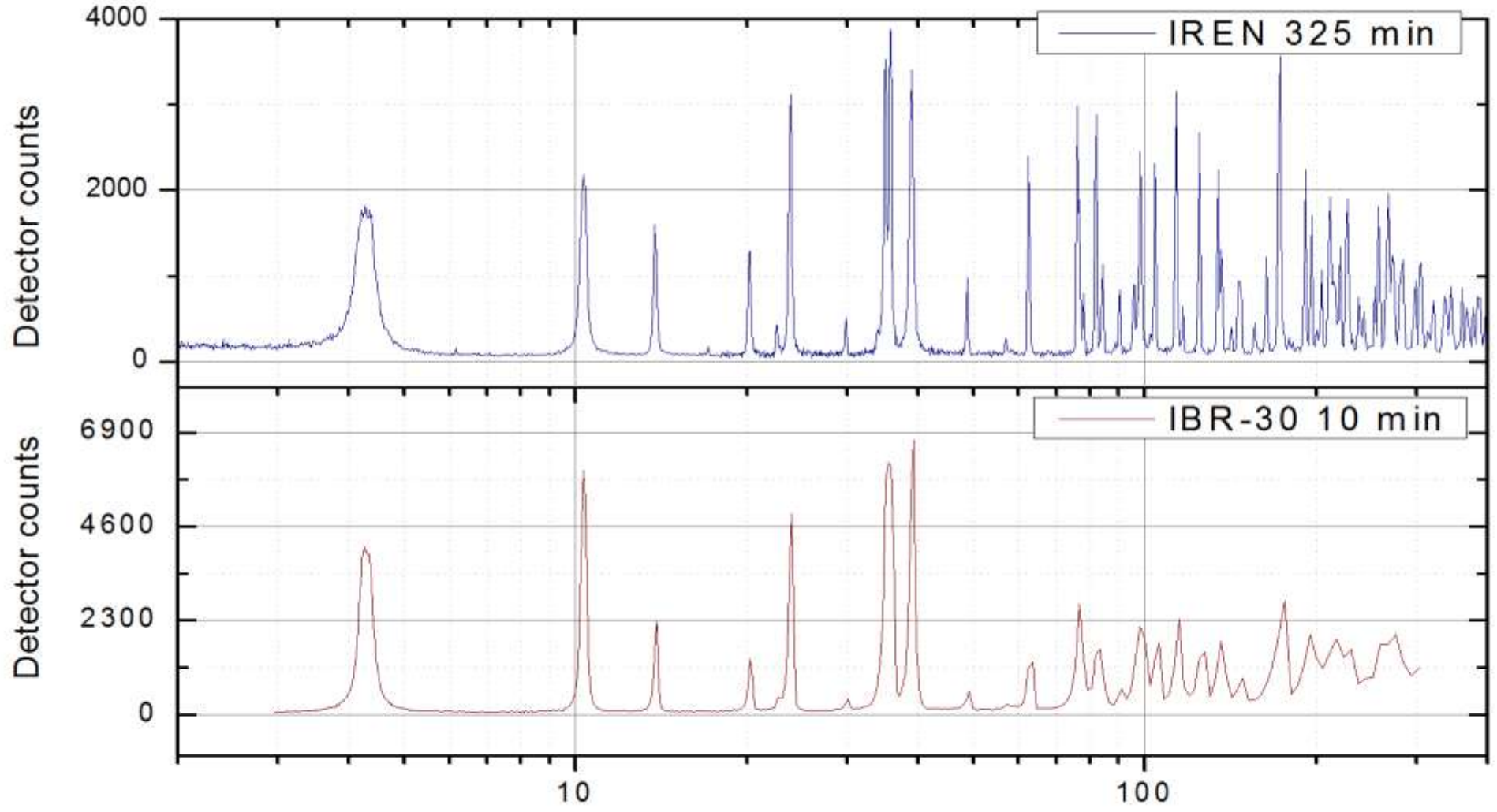
IREN Current Parameters

- 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

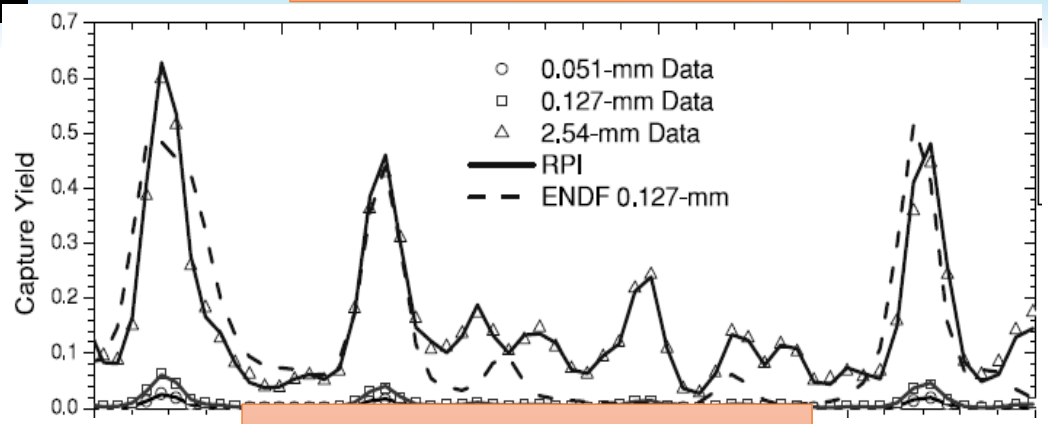
- Cross-section measurements;
- Neutron Resonance Capture Analysis;
- Experimental simulation and measurements of the neutron spectra from Ga neutron producing target;
- Experimental measurements of the gaseous and scintillator sensitivity to neutrons;

IREN vs IBR-30 (Ta (n,γ))



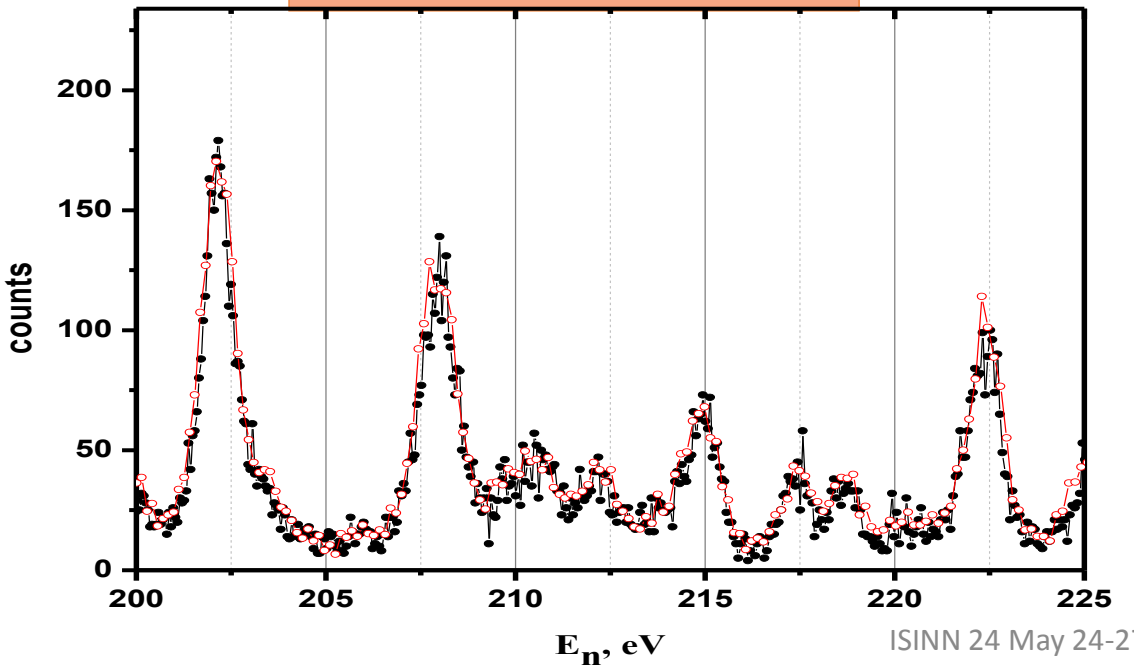
G. Leinweber et al., Nucl. Sci. Eng., 154 (2006) 256

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



V.N. Shvetsov et al. (2010)

IREN, neutron yield 10^{11} /s



^{nat}Gd (n, γ)

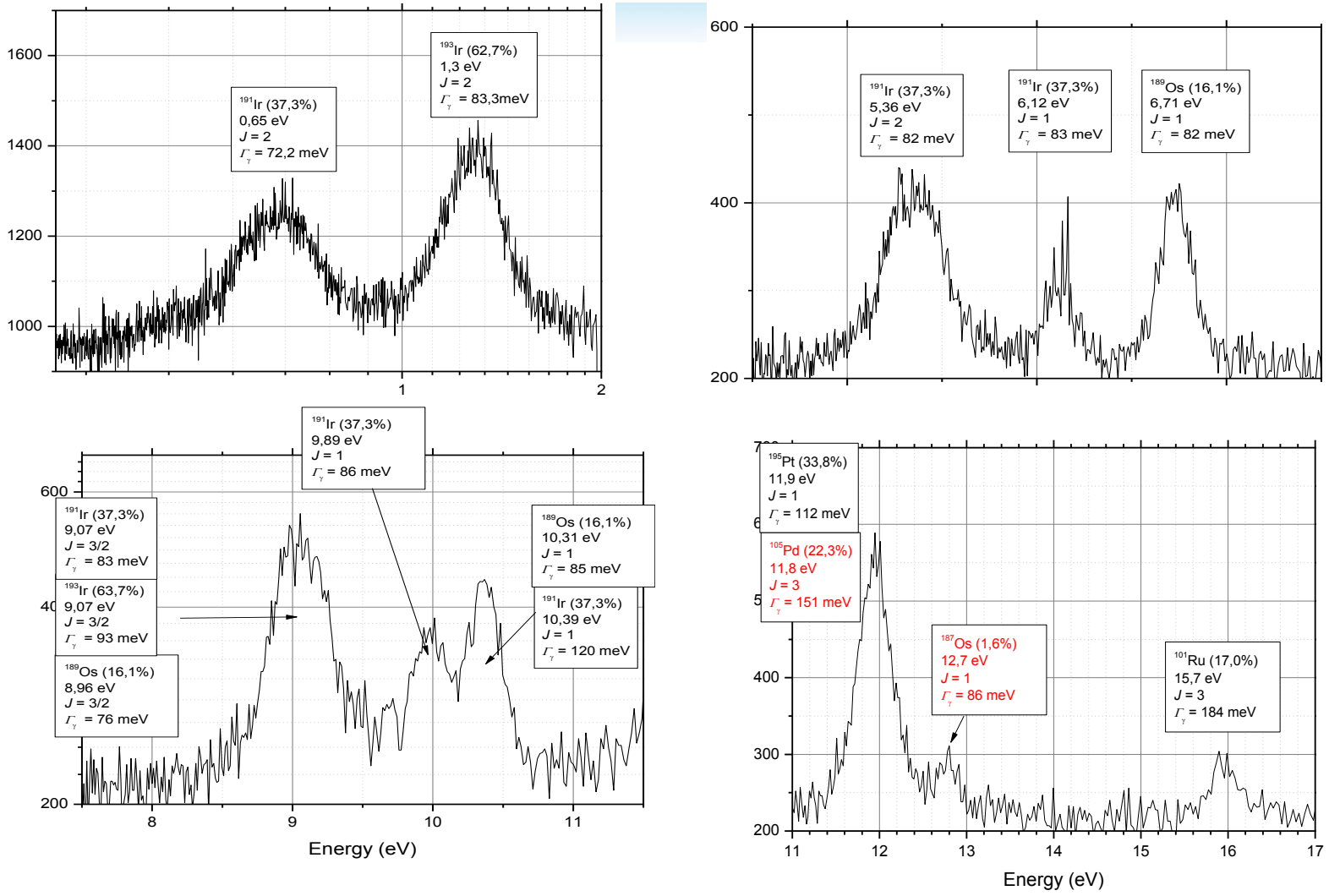
^{152}Gd - 0.20%
^{154}Gd - 2.18%
^{155}Gd - 14.80%
^{156}Gd - 20.47%
^{157}Gd - 15.65%
^{158}Gd - 24.84%
^{160}Gd - 21.86%

Sample:
m_g = 172.8 g
size: 11.2 x 14.5 cm^2
ρ: 1.064039 g/cm^2
d: 1.35mm

IREN, Dubna
f = 25 Hz
I_e = 2A; t_e=100ns
L = 58.6m

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

Neutron Capture Analysis



Gamma-resonance from Ir, Os, Pt, Pd, and Ru isotopes registered at the neutron beam of the IREN facility. Elemental content is under evaluation

Near-term Prospects (by the end of 2017)

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


2016.05.23


2016.05.23


2016.05.23

Scientific program for the IREN: short term perspectives

- **Nuclear data (cooperation with Bulgaria and Republic of Korea) for:**
  - **Gen IV reactors;**
    - **VHTR;**
    - **SCWR;**
    - **GFR;**
    - **SFR;**
    - **LFR;**
  - **ADS;**
  - **Advance Fuel Cycles;**
  - **Fusion;**
- **Resonance neutrons induced fission;**
- **Photonuclear reactions;**
- **Gamma and neutron activation analysis;**
- **Neutron Resonance Capture Analysis (NRCA);**
- **Educational program;**

Which nuclear data are of particular interest?

- Differential and integral cross-sections;
  - ^{239}Pu fission between 1 MeV and 1 keV and below 1 eV;
  - ^{239}Pu capture below 1 eV;
  - ^{240}Pu capture at the first resonance;
  - ^{241}Pu fission between 1 MeV and 1 keV;
  - ^{238}U capture between 0.2 MeV and 2 keV and between 400 eV and 10 eV;
  - ^{242m}Am fission between 1 MeV and 10 keV;
- Gamma quanta and neutron yields;
- Isomeric ratios;
- Doppler effects;

International coopera

NEA Nuclear Data High Priority Request List

HPRL-Main | Search | New request template | New request guidelines | Related references

Results of your search in the request list

Requests are shown from the following list(s):
High Priority (H)
General (G)

Explanations of each column can be found in the table heads. To view the details of a request, please click on the **link symbol** after the request, and click on the **'letter'** symbol there.

Energy range	Sec.E/Angle	Accuracy	Cov	Field
hold-20 MeV	4 pi	20	Y	Fusion
MeV-20 MeV	See details		Y	Fission
hermal-Fast	Eg=0-10MeV	7.5	Y	Fission
hermal-Fast	Eg=0-10MeV	7.5	Y	Fission
0.5-5.0 keV		4	Y	Fission
keV-1.0 MeV		9	Y	Fission
MeV-20 MeV	1MeV-20MeV	30		Fission,ADS
1 MeV-1 MeV	0-180 Deg	5	Y	Fission
rmal-10 keV		.5	Y	Fission
keV-200 keV		5		Science,Fusion
1 meV-1 eV		1	Y	Fission
00 eV-1 MeV		3	Y	Fission
hold-65 MeV		20	Y	Fusion
eV-2.0 keV		8	Y	Fission
Thermal	See details			Fission
Eth-10 MeV		10		ADS
Eth-10 MeV		10		ADS
keV-20 MeV	Emis spec.	See details	Y	Fission
9 keV-6 MeV	See details		Y	Fission
keV-20 MeV	See details		Y	Fission
5 keV-6 MeV	See details		Y	Fission
5 keV-6 MeV	See details		Y	Fission
5 keV-6 MeV	See details		Y	Fission
MeV-1.3 MeV	Emis spec.	See details	Y	Fission
eV-1.35 MeV	See details		Y	Fission
eV-1.35 MeV	See details		Y	Fission
MeV-20 MeV	Emis spec.	See details	Y	Fission
eV-1.35 MeV	See details		Y	Fission
0 eV-25 keV	See details		Y	Fission
5 keV-5 MeV	See details		Y	Fission
0 keV-2 MeV	See details		Y	Fission
keV-20 MeV	See details		Y	Fission
4 MeV-6 MeV	See details		Y	Fission
5 MeV-6 MeV	See details		Y	Fission
5 MeV-6 MeV	See details		Y	Fission
MeV-20 MeV	4 pi	1-2	Y	Standard

Number of requests found: 36 (out of a total of 36 requests).
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NEA Nuclear Energy Agency

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OECD

Home > Nuclear science > Working Party on International Nuclear Data Evaluation Co-operation (WPEC)

Working Party on International Nuclear Data Evaluation Co-operation (WPEC)

The NEA's nuclear data evaluation co-operation activities involve the follwowing evaluation projects: ENDF (United States), JEFF (Data Bank member countries), JENDL (Japan). The participation from projects in non-OECD Member countries, such as BROND and CENDL, is channelled through the Nuclear Data Section of the International Atomic Energy Agency (IAEA).

The working party was established to promote the exchange of information on nuclear data evaluations, measurements, nuclear model calculations, validation, and related topics, and to provide a framework for co-operative activities between the participating projects. The working party assesses nuclear data improvement needs and addresses these needs by initiating joint evaluation and/or measurement efforts.

Activities

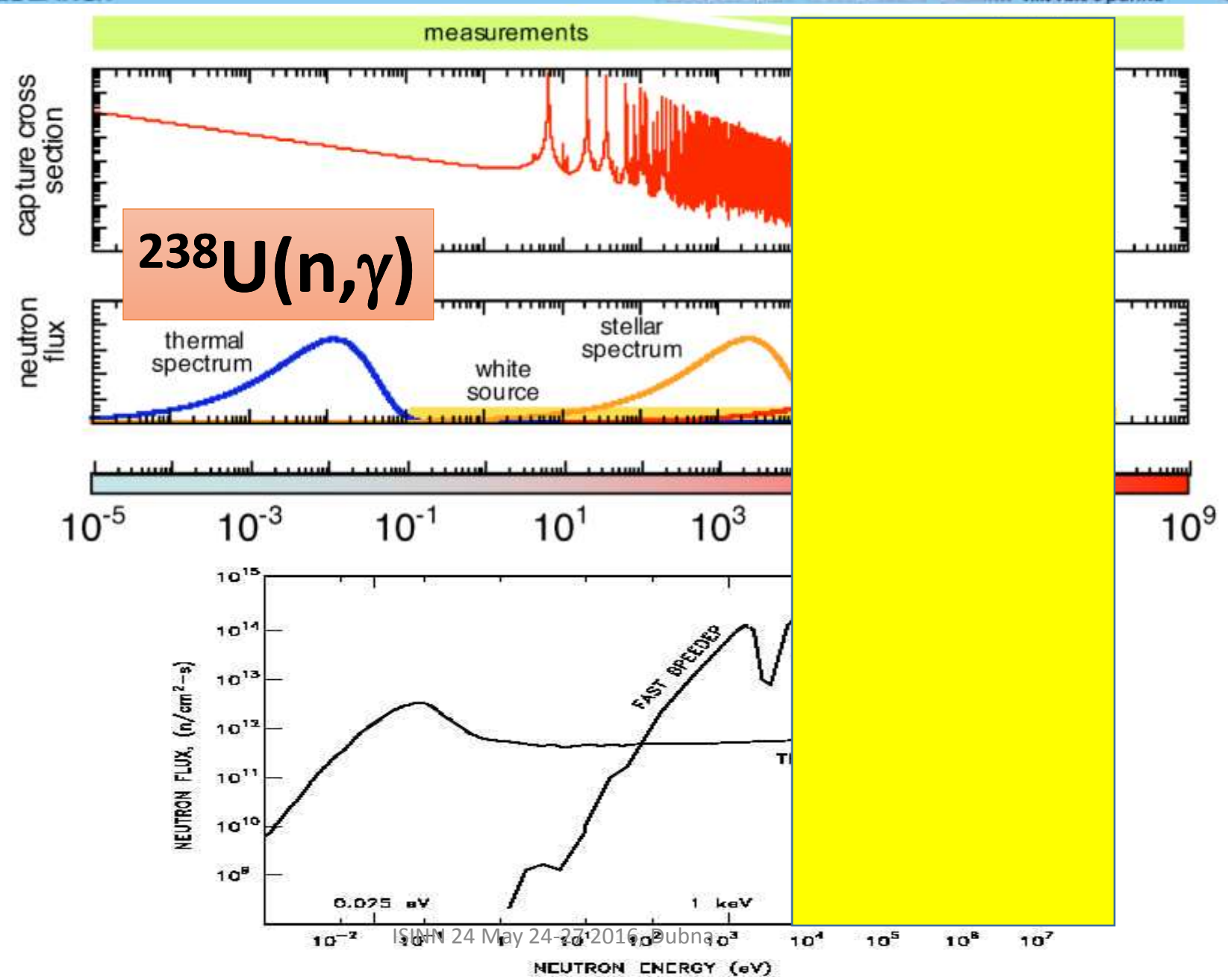
Long-term subgroups

C **High Priority Request List**

The main objectives of the cooperation are to:

- improve the quality and completeness of the evaluated nuclear data libraries by means of an international co-operation, and to
- coordinate the nuclear data measurements required within this framework.

Why nu


measurements
capture cross section
neutron flux
^{238}U(n,γ)
thermal spectrum
white source
stellar spectrum
10^{-5}
10^{-3}
10^{-1}
10^{1}
10^{3}
10^{9}
NEUTRON FLUX, (n/cm²-s)
FAST BREEDER
0.025 eV
1 keV
NEUTRON ENERGY (eV)

Electron accelerator based neutron sources – nuclear data mining facilities

Facility	Location	particle	E, MeV	Target	Pulse width, ns	Beam power, kW	Pulse rate, Hz	Flight paths, m	Neutron yield, s^{-1}
RPI	RPI, Troy, USA	e-	60	Ta	5, 5000	0.45	500	15-250	$1.8 \cdot 10^{12}$
ORELA	ORNL, Oak Ridge, USA	e-	180	Ta	2-30	60	12-1000	9-200	$1.0 \cdot 10^{14}$
GELINA	EC-JRC-IRMM, Geel, Belgium	e-	100	U	1	10	40-800	5-400	$3.4 \cdot 10^{13}$
PNF	PAL, Pohang, Korea	e-	75	Ta	2000	0.09	12	11	$2.1 \cdot 10^{11}$
KURRI	Kumatori, Japan	e-	46	Ta	2, 4000	6	300	10, 13, 24	$8.0 \cdot 10^{11}$
IREN now	JINR, Dubna, Russia	e-	50	W	100	0.4	25	10-500	$3.0 \cdot 10^{11}$

IREN is already in the list of world electron accelerator based facilities

Thank You for Your Attention!