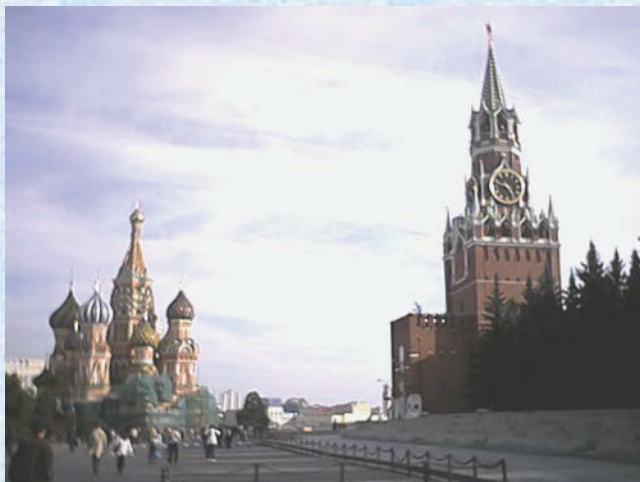


INR HIGH INTENSITY PROTON LINAC. STATUS AND PROSPECTS.

A.Feschenko, L.V. Kravchuk, V.L.Serov



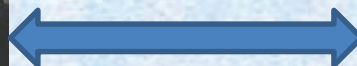
Moscow



Troitsk



41 km



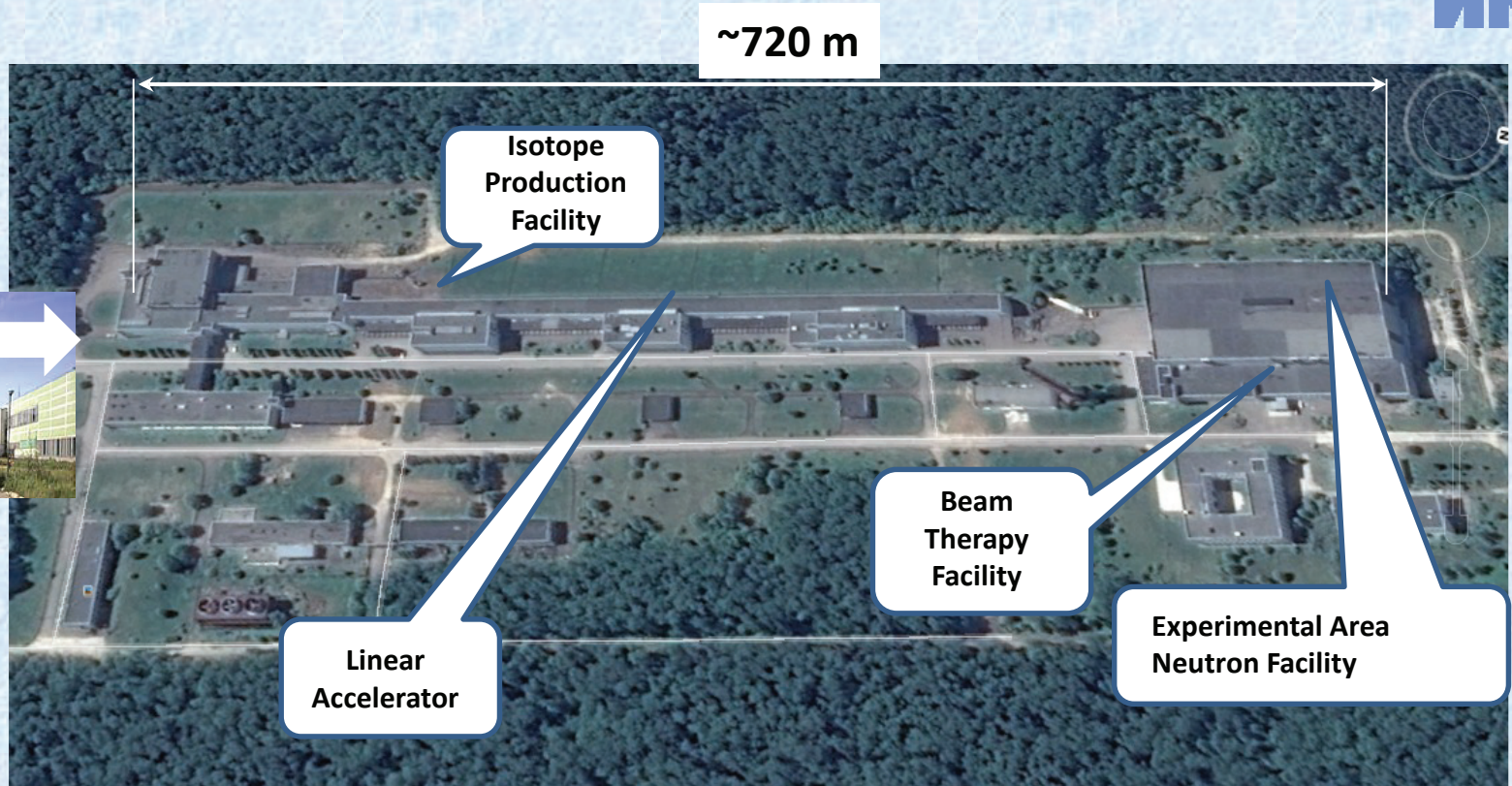
INR LINAC



2 km

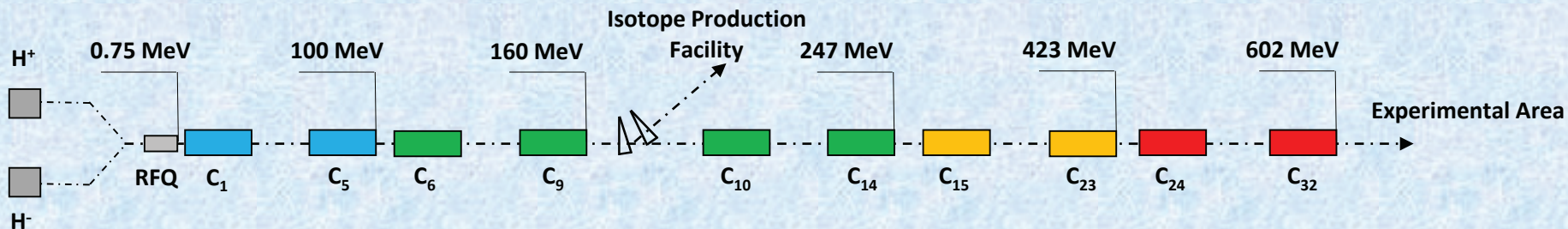


View from Google map

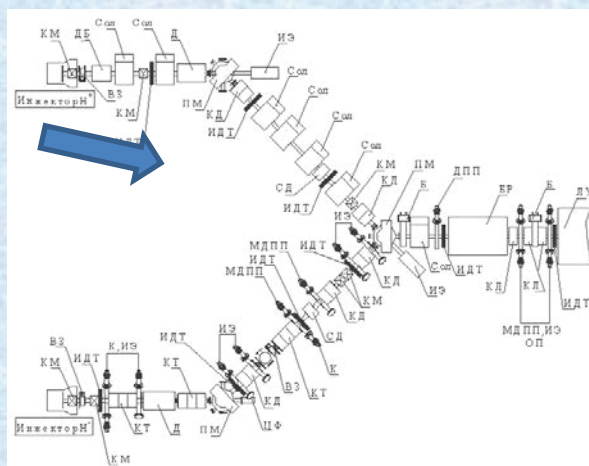


1. **Linear Accelerator**
2. **Experimental Area**
 - **RADEX facility**
 - **Spallation neutron source IN-06**
 - **LNS-100 spectrometer**
 - **Beam Therapy Complex**
3. **Isotope Production Facility**

Linear Accelerator



Proton Injector



Injection Lines



Low Energy Part (Drift Tube Linac)

750 keV

20 MeV

49 MeV

74 MeV

94 MeV

100 MeV

RFQ

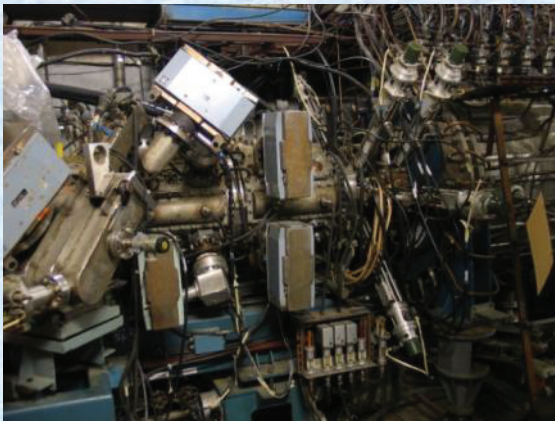
Tank 1

Tank 2

Tank 3

Tank 4

Tank 5



Booster RFQ



5 Drift Tube Tanks

Frequency – 198.2 MHz

Output energy- 100 MeV



Inside Drift Tube Tank

High Energy Part (Coupled Cavity Linac, 100-600 МэВ)



27 four-section Disk and Washer cavities

Frequency 991 MHz



Accelerating cavities in the tunnel



Klystron Gallery

The main accelerator parameters

Parameter	Design	Obtained	November, 2016
Particles	p, H-minus	p, H-minus	p, H-minus
Energy, MeV	600	502	247
Pulse current, mA	50	16	15
Repetition rate, Hz	100	50	50
Pulse duration, μ s	100	200	0.3÷200
Average current, μ A	500	150	130

Accelerator Operation

1993 – Beginning of regular beam runs

From 1993 to 2016 - **124** accelerator beam runs, total duration **45351 hours**

Including :

2007 – **2040** hours (7 runs);

2008 – **1300** hours (5 runs);

2009 – **1208** hours (6 runs);

2010 – **1700** hours (7 runs);

2011 – **1652** hours (5 runs);

2012 – **1590** hours (5 runs);

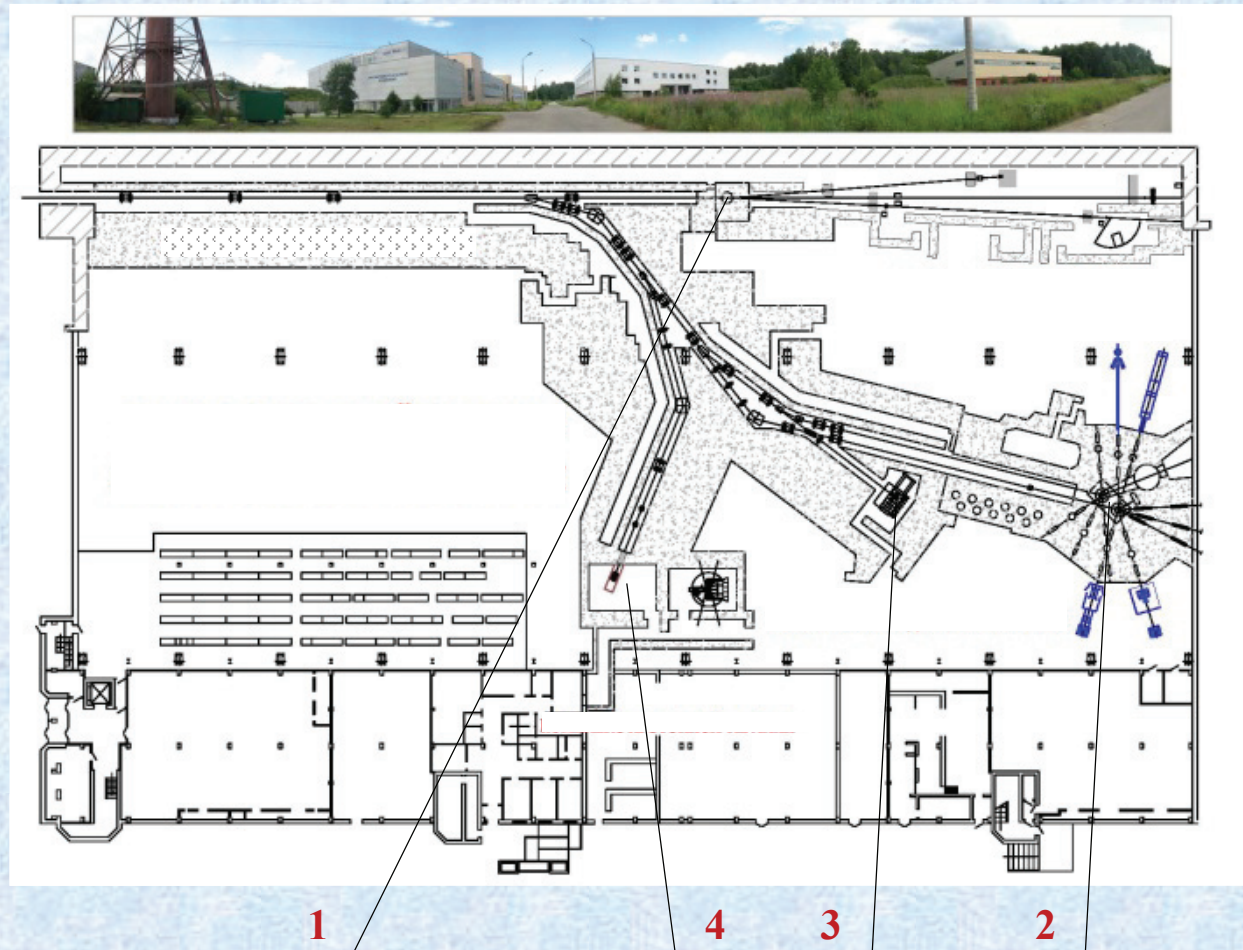
2013 – **1212** hours (4 runs);

2014 – **1812** hours (5 runs);

2015 – **1677** hours (5 runs);

2016 – **2006** hours (6 runs);

Experimental Area



- 1 - RADEX facility
- 2 - Spallation neutron source IN-06
- 3 - LNS-100 spectrometer
- 4 - Beam Therapy Complex

The main current tasks

1. Providing of accelerator maintenance and performance
2. Increasing of energy
209...247...300...350 MeV
3. Increasing of beam intensity
Beam pulse current: 15 mA (limit)
Beam pulse duration: 200 μ s (limit)
Beam pulse repetition rate: increasing from 50 Hz to 100 Hz
- 3a. *Increasing of tolerable beam intensity*
4. Increasing of multitasking functionality

Increasing of beam pulse repetition rate up to 100 Hz

1) Injector

100 Hz for protons (done)

50Hz protons + 50Hz H-min (done)

2) RF power supply system. Main problems with low energy part.

A.Kvasha et al. Development of the INR Linear Accelerator DTL RF System, THXSH0

A. Kvasha, V. L. Serov. Powerfull RF Triode as Anode Modulator Vacuum Tube,

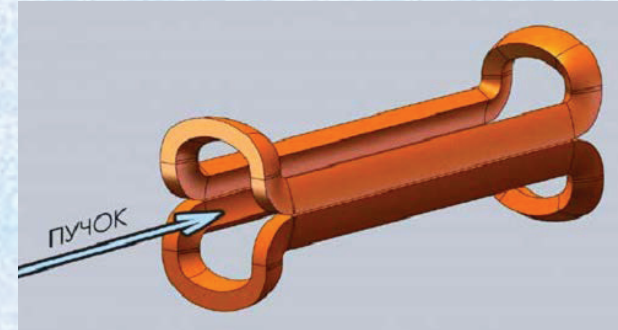
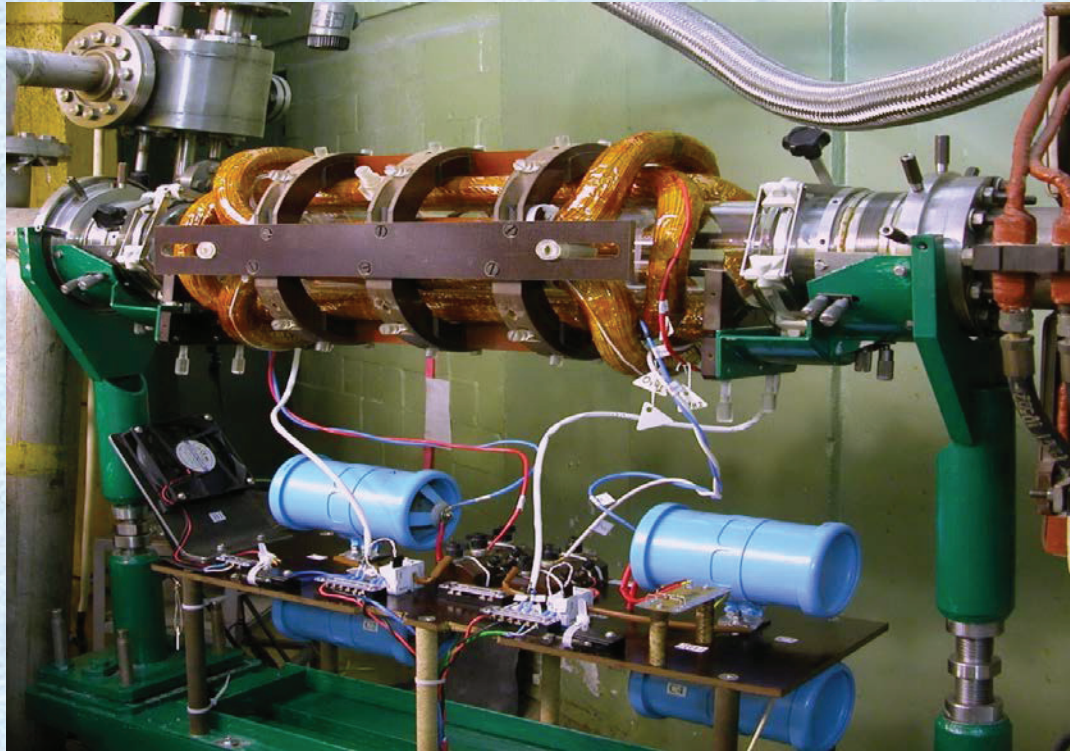
TUPSA037

3) Accelerating system

I.Rybakov et al. Proposal of the Accelerating Structure for the First Cavity of the Main Part of INR Linac, TUPSA004

Increasing of tolerable beam intensity

Isotope Production Facility: 100 μA130 μA

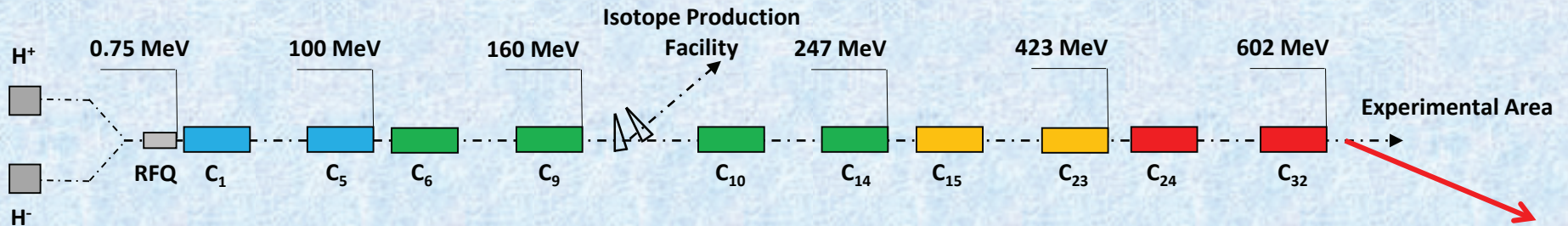


Beam rastering deflector in the beam line of the Isotope Production Facility

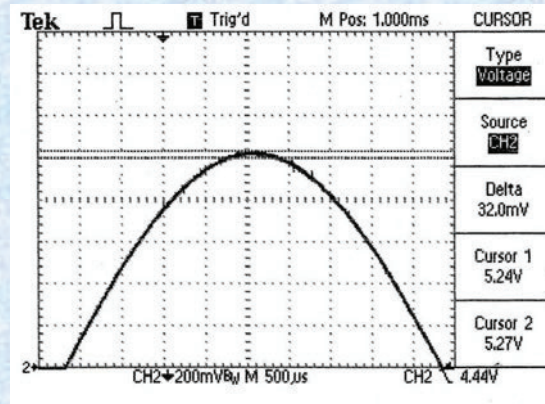
The deflecting coils are elements of the resonant circuits → Power consumption is only 500 W

The deflecting frequency 5000 Hz → full circle within one 200 μs beam pulse

Increasing of multitasking functionality



1) Beam pulse separation at 160 MeV area



Low intensity
Irradiation Channel

2) Low intensity Irradiation Channel

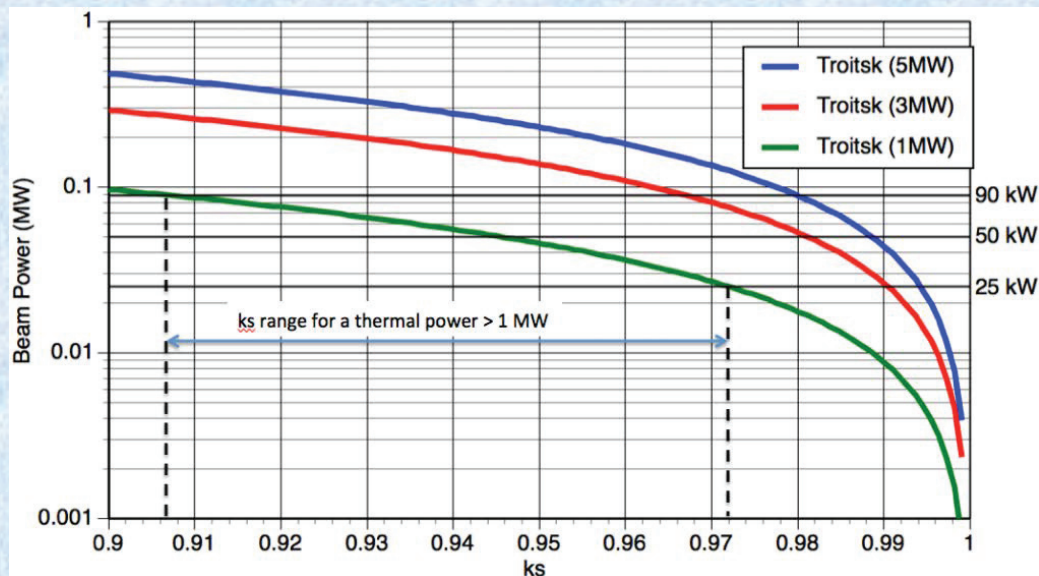


international Thorium Energy Committee

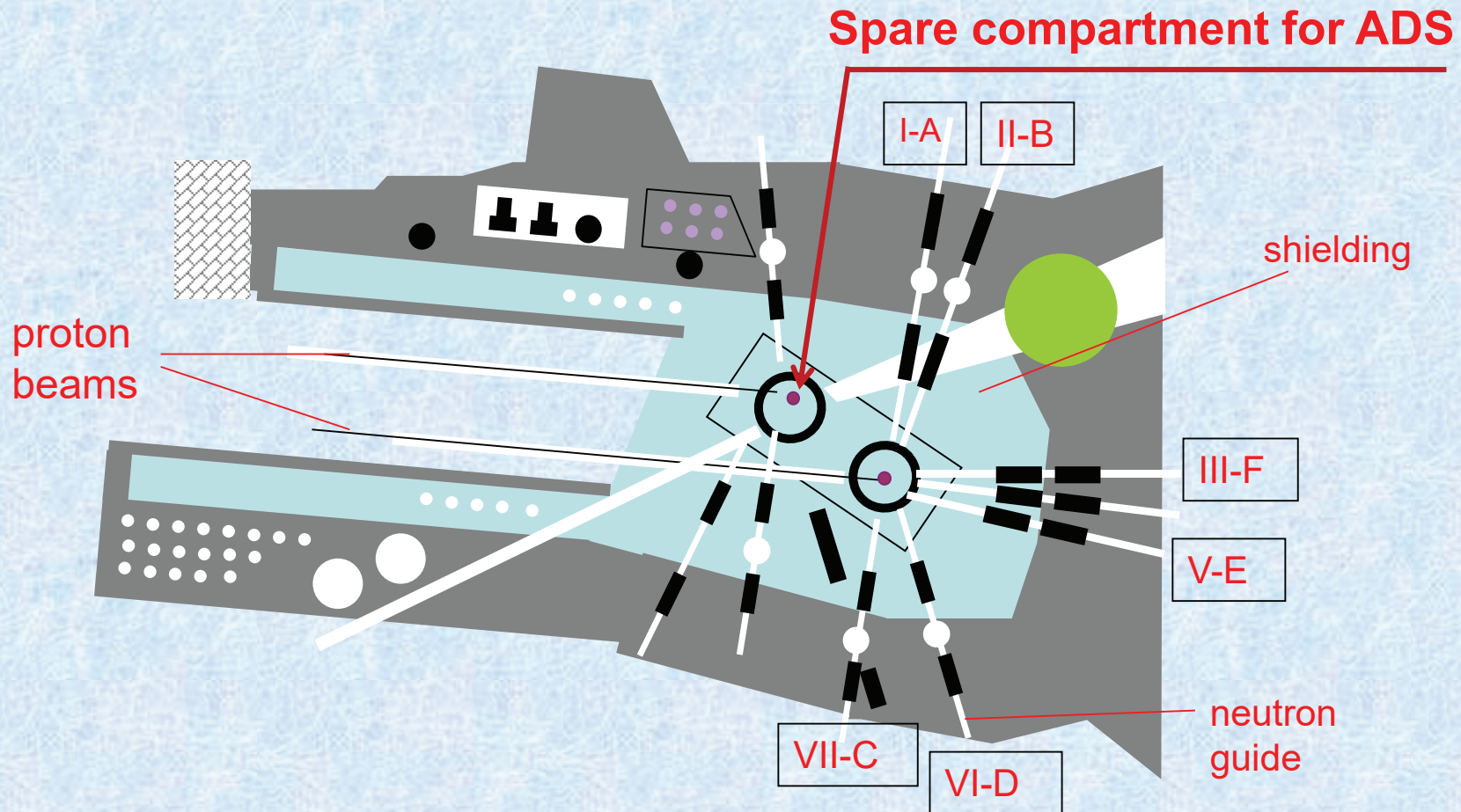
www.ithec.org

Troitsk-ADS

According to iThEC, INR facility is the most suitable place in the world where the demonstration ADS experiment can be performed at a relatively modest cost and on a relatively short time scale.



IN-06 Neutron source



- A** DIAS diffractometer (installed)
- B** MNS multifunctional spectrometer (partially installed).
- C** Reflectometer «Horizon» (construction in progress).
- D** Hercules neutron physics facility (constructed).
- E** Inelastic scattering spectrometer of straight geometry (project).
- F** Small-angle scattering diffractometer (project).

Instead of Conclusion

**Many Thanks for Your
Attention**