VCN Test Facility as the Initial Phase of the UCN Facility Development

ISINN-31

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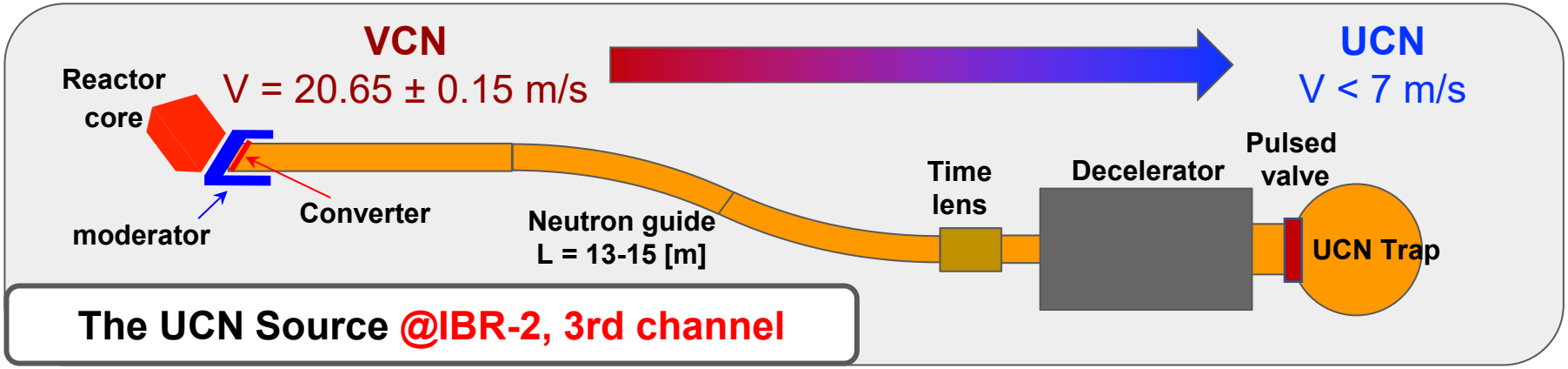
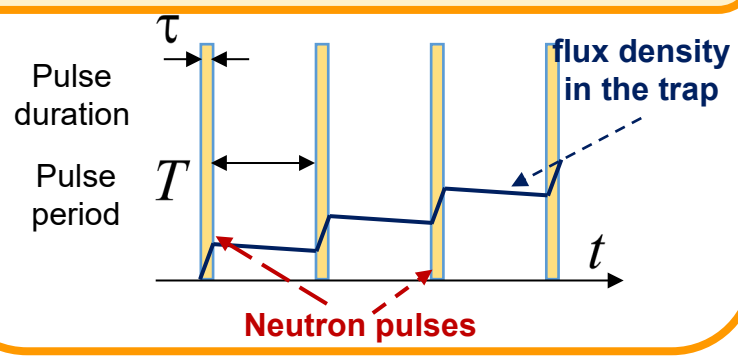
The concept of the UCN Source



Report by G.V. Kulin 30.05.25

The main idea is effective **pulsed accumulation** of UCN in the trap

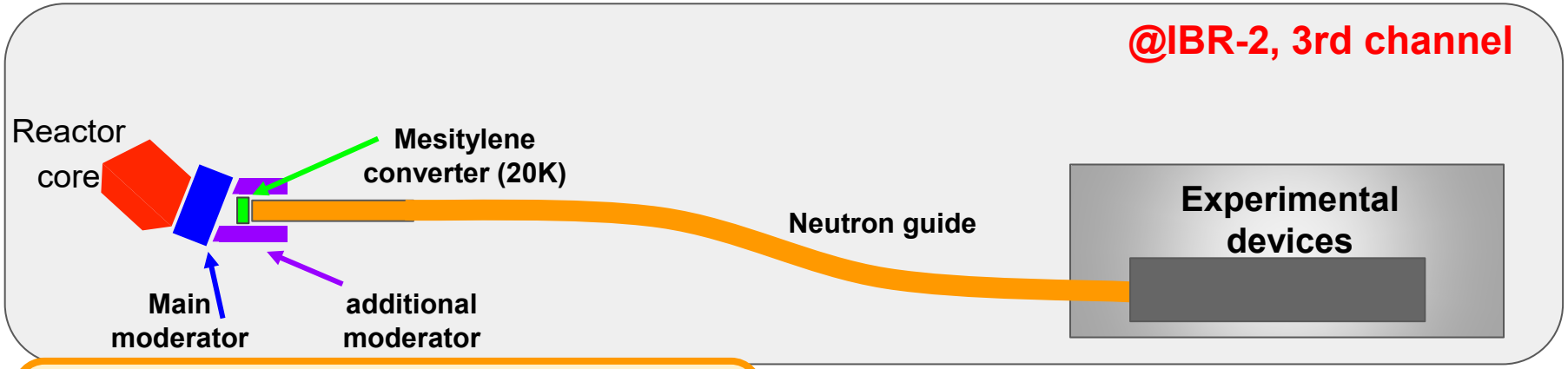


Strict requirements for the neutron guides:

$\delta t/t = 4*10^{-4}$,

t – monochromatic neutron flight time

VCN test facility – prototype of the UCN source



Range of interest in VCN velocities is 20 ± 1 m/s
We also expect to get some UCN flux

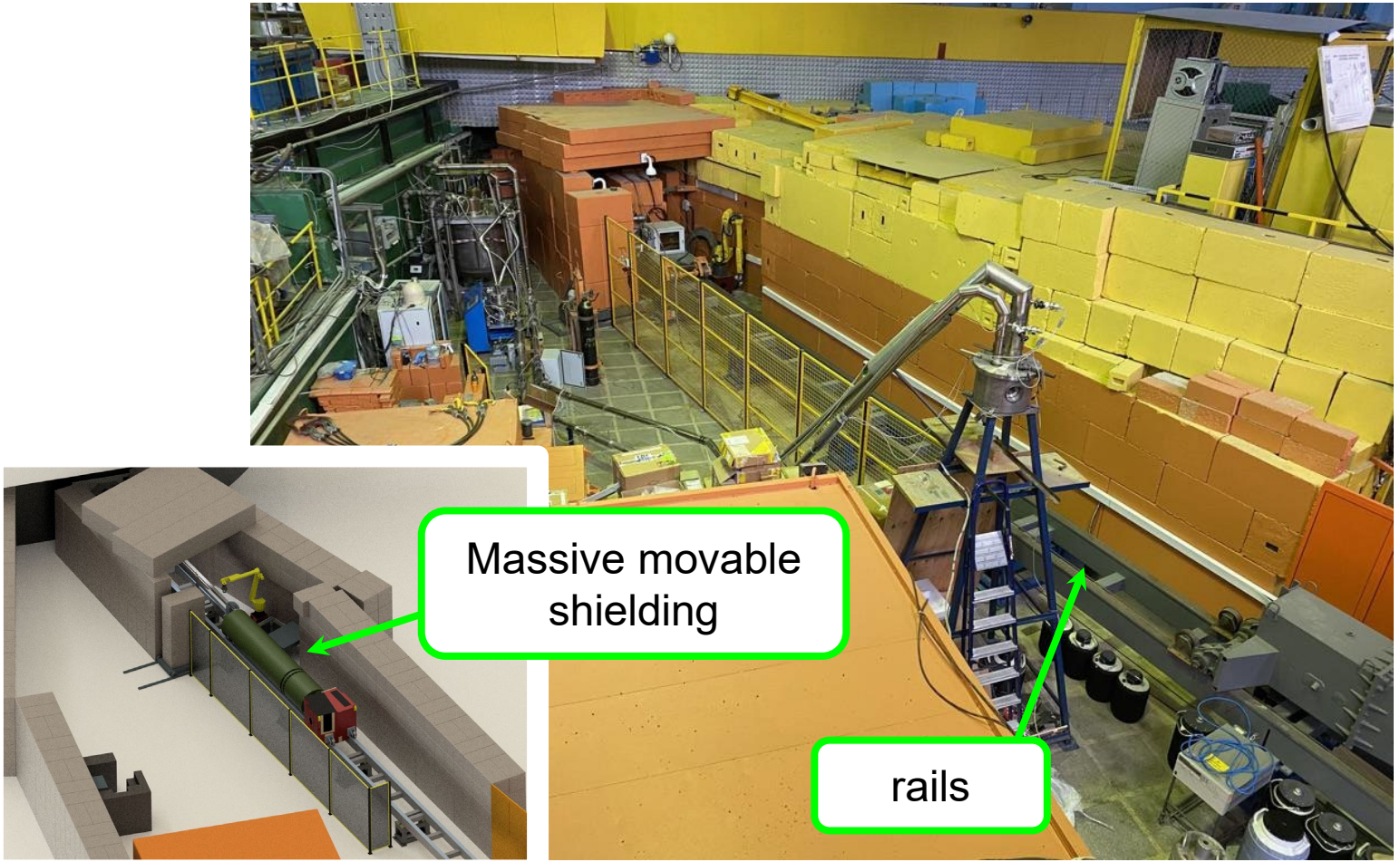
Project will be considered at 61th PAC for Nuclear Physics

***VCN test facility** will be used for:*

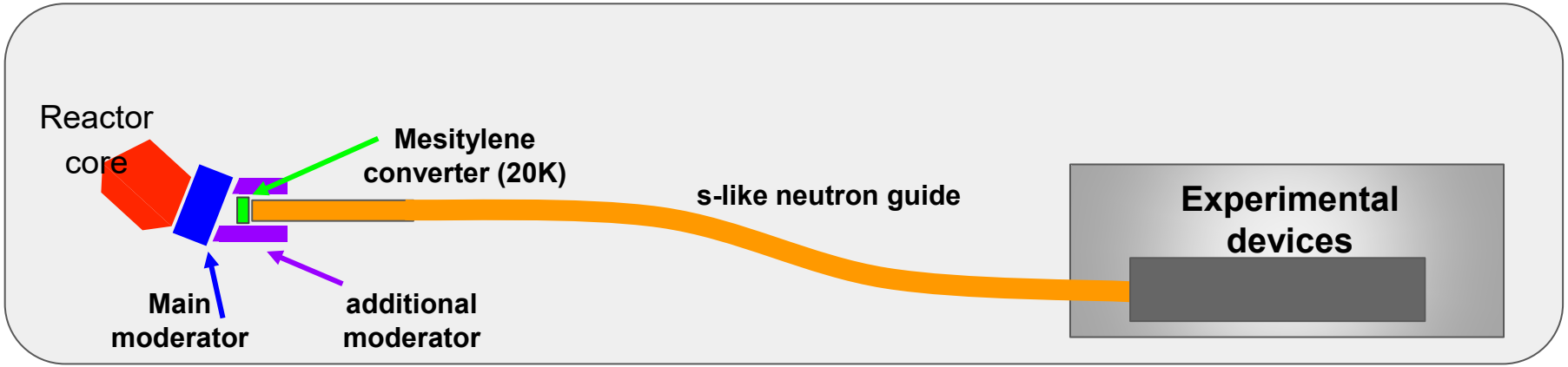
- researches to find the most suitable design and material of the main Source VCN neutron guide.
- carrying out experimental researches with VCN (if sufficient VCN flux will be achieved)
- test experiments to find the material and coating of the UCN trap to increase the storage time.

VCN test facility will provide the first practical experience of VCNs and UCNs for an essential part of the newly forming group.

IBR-2, 3rd channel

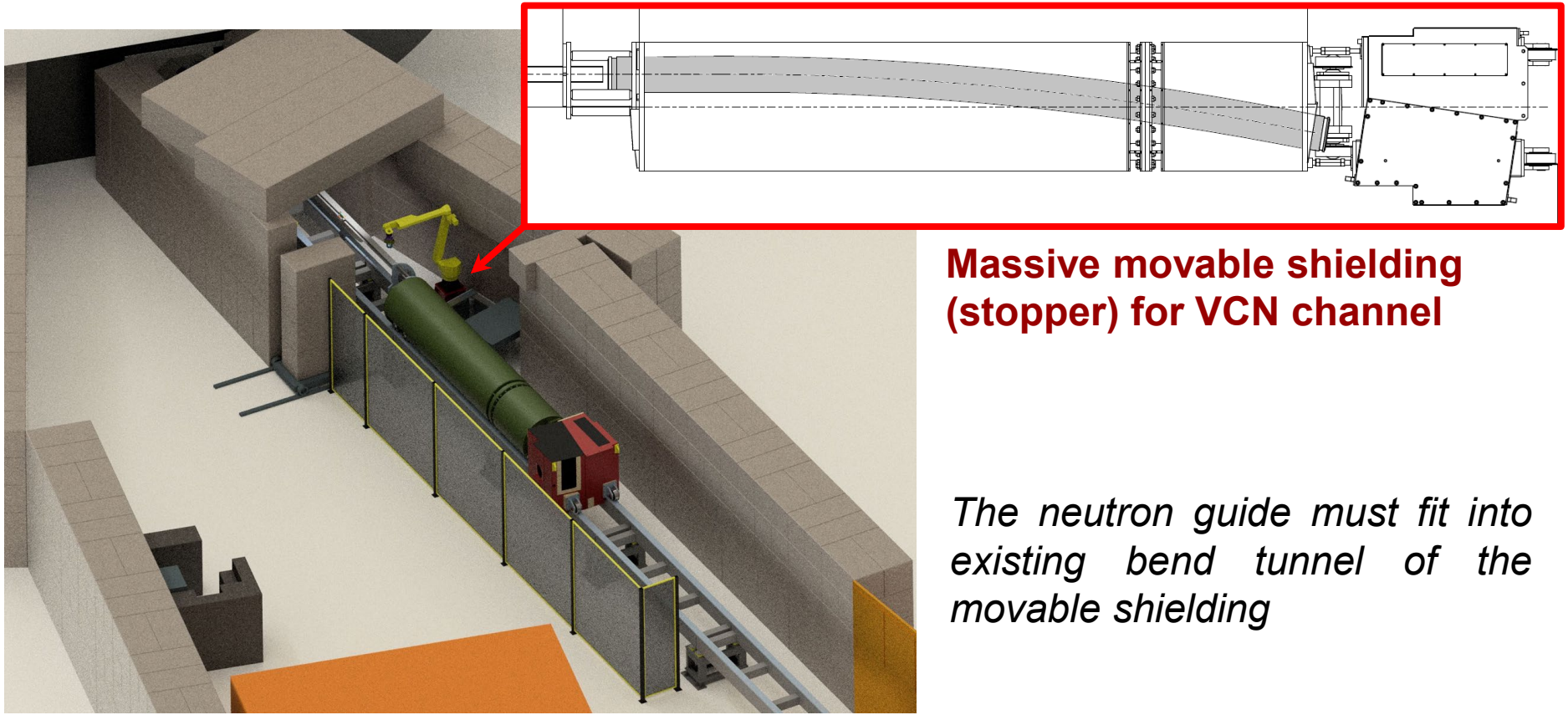


VCN test facility – the neutron guide requirements



- Neutron guide have to be bend to prevent direct view of the main moderator.
- Inner surface of the neutron guide doesn't need to meet as strict requirements as the neutron guide in the planned UCN source.
- Total length is about 12 m.

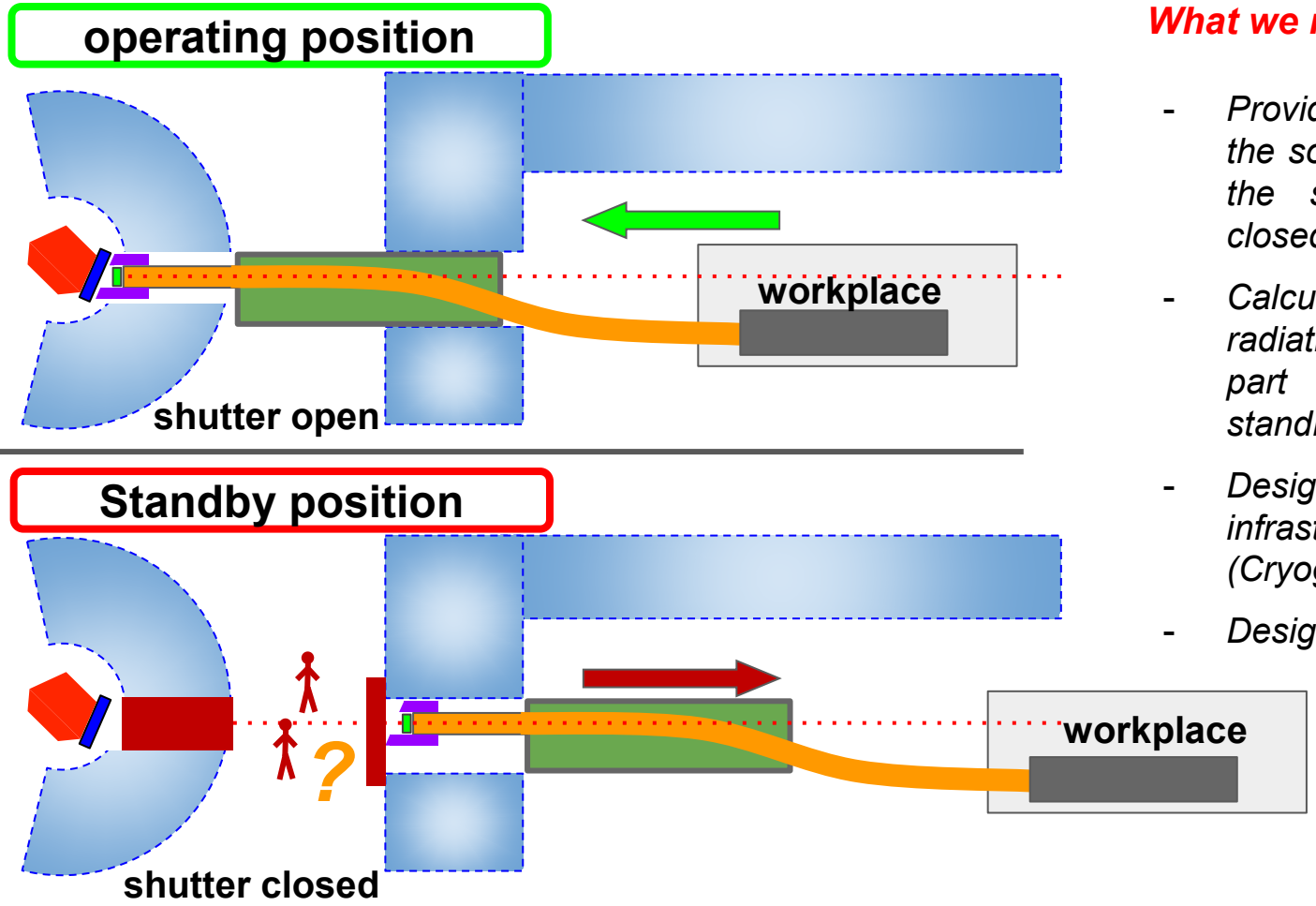
VCN test facility – the neutron guide requirements



Massive movable shielding (stopper) for VCN channel

The neutron guide must fit into existing bend tunnel of the movable shielding

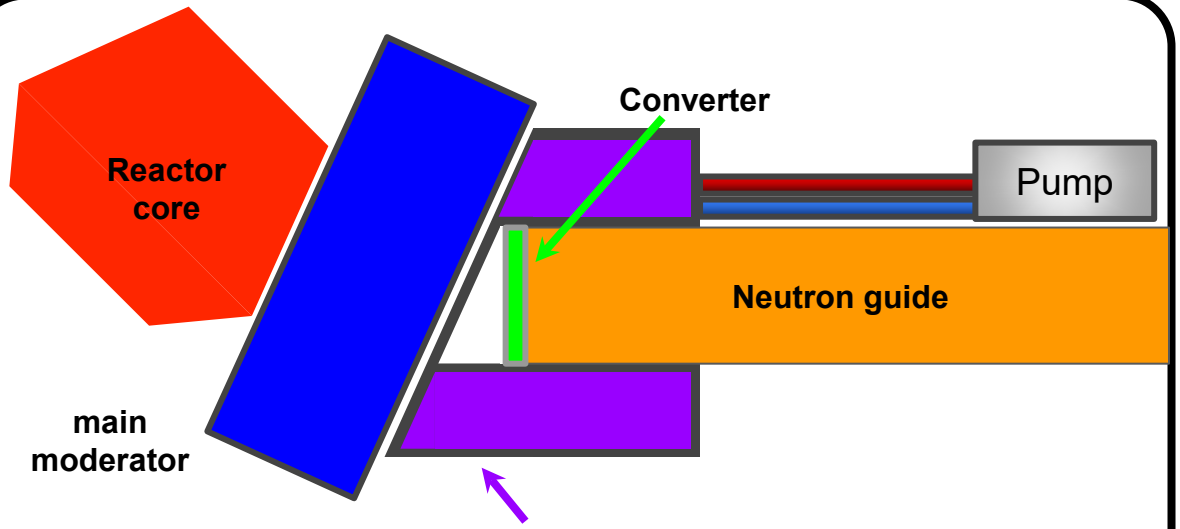
VCN test facility requirements



What we need to do:

- *Providing the possible moving of the source from the operating to the standby position with a closed shutter.*
- *Calculations and designing radiation shielding of the head part of the beamline in the standby position*
- *Design of the engineering infrastructure of the source (Cryogenics, Vacuum, …)*
- *Design of the **workplace***

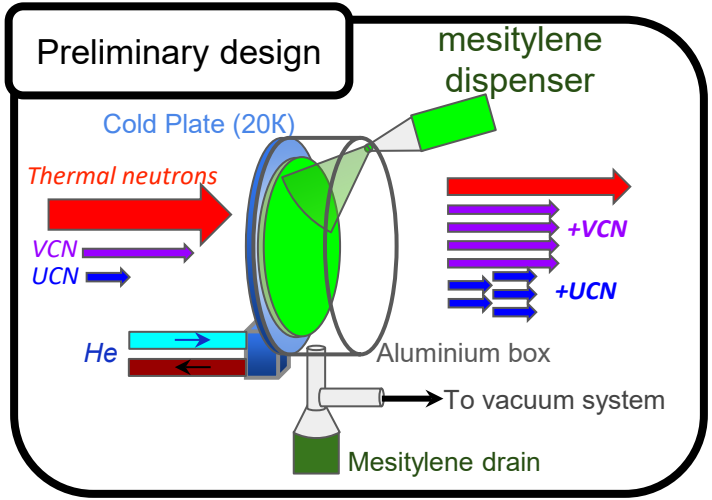
VCN test facility – Additional water moderator

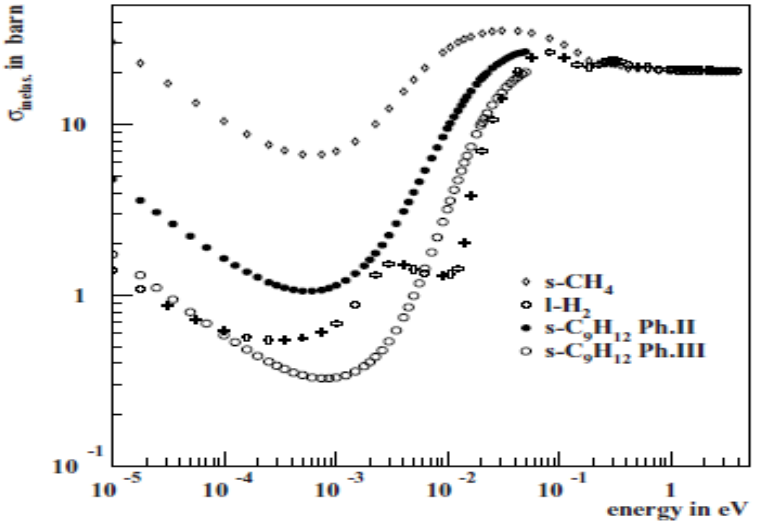


It is necessary to estimate:

- *the influence of additional water moderator on reactivity of the reactor*
- *a heat load to the moderator*

VCN test facility – Cold (20K) mesitylene converter





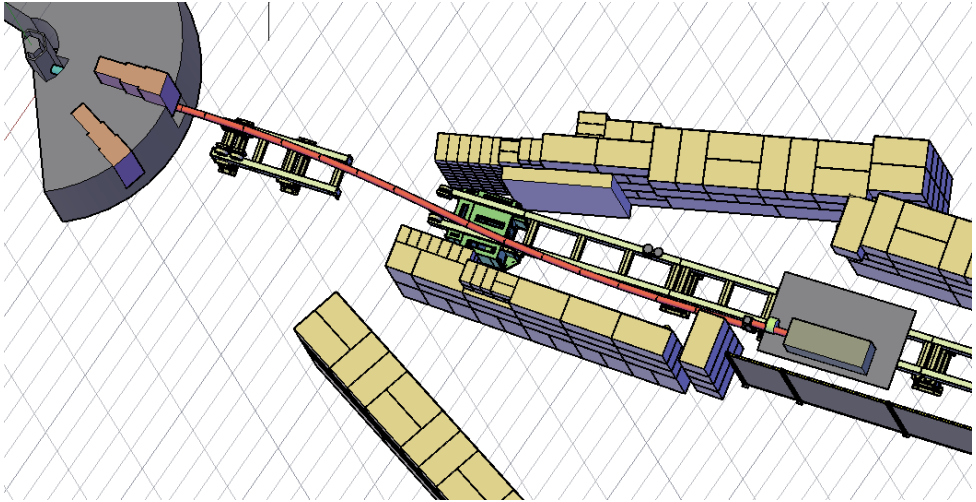
Necessary:

- *To estimate a heat load to the converter*
- *To design system for preparation of the thin mesitylene converter and its evaluation at the end of the cycle*
- *To design thin exit window*

G-factor for VCN/UCN ~ **10**
Mesitylene thickness ~ 1-2 mm (20 ml)
Separated vacuum volume

The experience of creating this converter will be useful for creating the main source converter

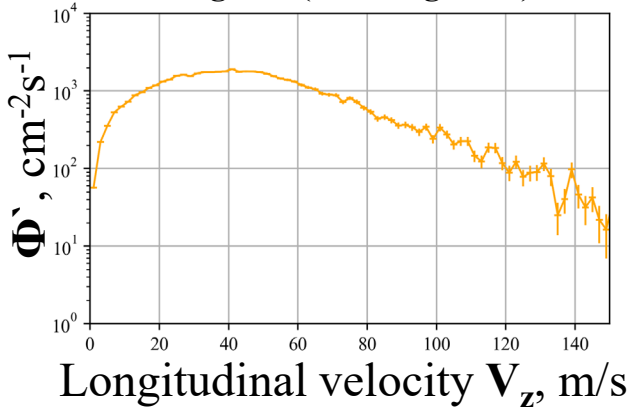
VCN test facility – the neutron guide design



We need:

- *To estimate neutron guide transmittivity for VCN with realistic roughness*
- *To optimize a geometry of the neutron guide*
- *To do engineering design of the neutron guide*

Estimated flux density at the exit of the specular neutron guide (w/o roughness)



Estimated VCN flux density with V_z = 20±1 m/s
at the exit in ideal case ~ **1300 $cm^{-2}s^{-1}$ (G=1)**

Estimated UCN flux is ~ **500 s^{-1} (G=1)**
at guide transmission about 0.03
S ≈ 80 cm^2

The first stage scientific equipment

- *VCN TOF-detector*
- *UCN detector*
- *Monochromator Δv/v ~5-7% (see poster report by V.S. Shpilevskaya)*
- *Chopper*
- *UCN experimental kit*

We are ready to start!