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COMPACT VERY COLD NEUTRON VELOCITY SELECTOR

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Annotation

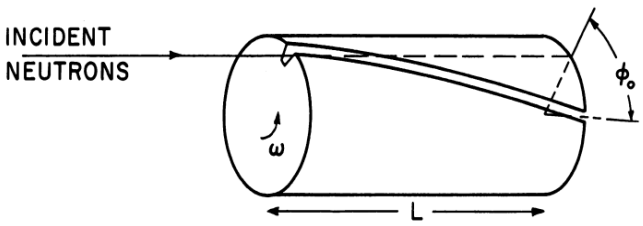
In neutron physics experiments, the knowledge and determination of the velocity of the considered neutrons and their energy is necessary to conduct a full-scale experiment. To select velocity of slow neutrons, an experimental tool called a neutron velocity selector is needed. In the experiments of the group of the FLNP JINR to determine the reflection coefficient of very cold neutrons, the most important part is the neutron velocity selector [1]. Thus, for the purposes of the experiment, the goal was to create a new neutron velocity selector with high transmission and moderate resolution, which is optimal for its use in the experiment. The neutron velocity selector is a rotating cylinder made of an absorbing material with a certain diameter, along the periphery of which helical slots of the required width were located along the entire length of the cylinder along the entire length of the cylinder with a given shift angle of the inlet and outlet holes of the slot. This paper presents a theoretical calculation of a neutron velocity selector for a very cold neutron beam in the wavelength range of 20–200 A, as well as a procedure for optimizing the geometry. The transmission and resolution functions are calculated depending on the wavelength. The divergence effects of the incoming beam are also evaluated.

Neutron velocity selector: theory

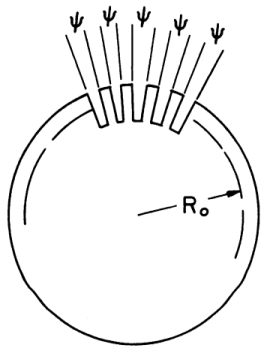
The neutron velocity selector is an experimental tool for obtaining a monoenergetic neutron beam.

$$v_0 = \frac{L}{\varphi_0/\omega} = \frac{\omega L}{\varphi_0} \qquad \lambda_0 = \frac{h}{m\omega L}\varphi_0 = \frac{h}{m\omega R_0}\theta$$

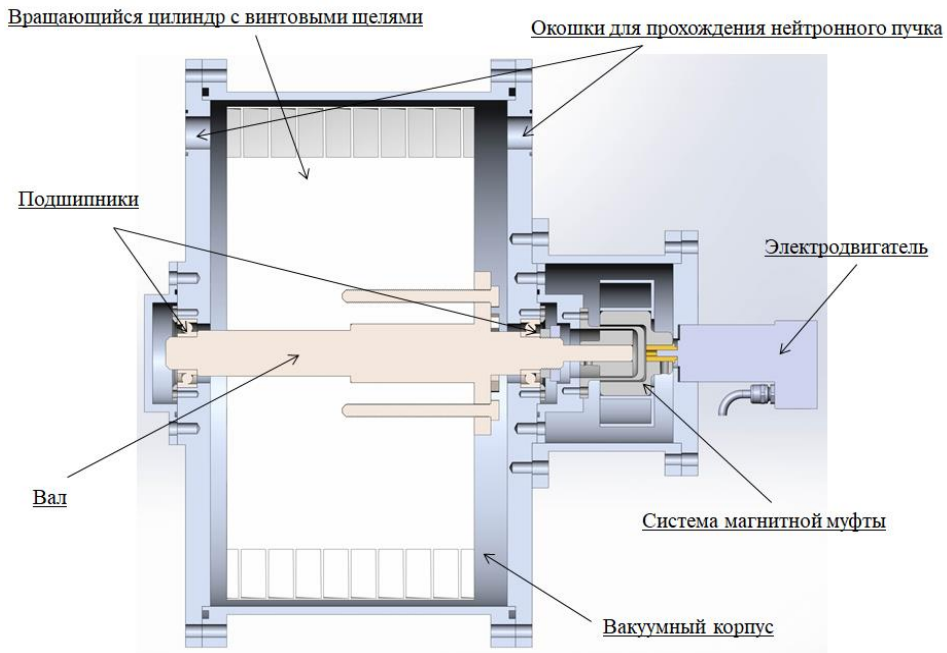
The neutron velocity selector is a rotating cylinder made of absorbing material with a certain diameter, along the periphery of which helical slots of the required width and height were located along the entire length of the cylinder, along the entire length of the cylinder with a given shift angle of the inlet and outlet holes of the slot.



$$T(\lambda) = T_0\left(1 - \frac{m\omega L}{h\psi}|\lambda - \lambda_0|\right)$$

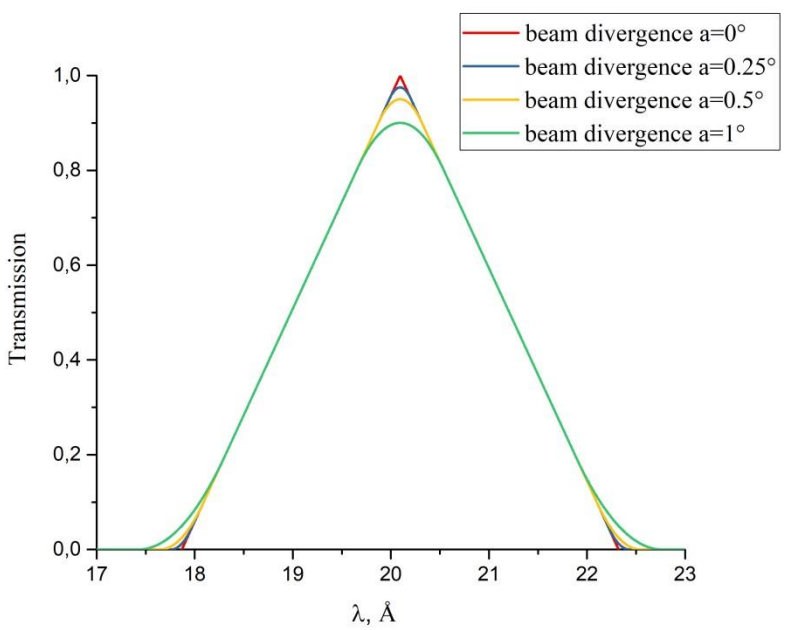


Construction and characteristics

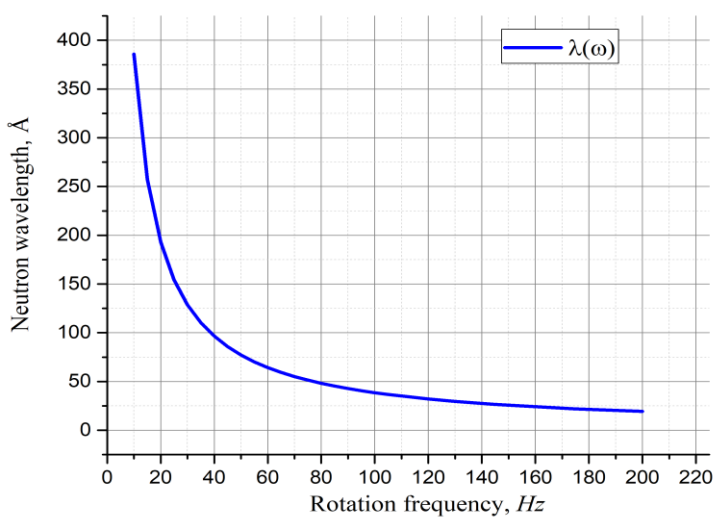


Characteristic	value
Rotary cylinder length	150 mm
Distance from the axis of rotation of the selector to the axis of the neutron beam	120 mm
Slot height	30 mm
Angular rotation of the slot along the length	0.94 rad **(**54°C**)**
Rotation speed interval	1000-12000 rpm
Interval of emitted neutron wavelengths	20 – 200 Å
Transmission of useful neutrons	~90%
Neutron Wavelength Resolution	~10%
The weight	~30 kg

Transmission function



Transmission function for different neutron beam divergences.



Wavelengths of transmitted neutrons depending on the rotation speed

1. E.V. Lychagin, A.Yu. Muzychka, V.V. Nesvizhevsky, G. Pignol, K.V. Protasov, A.V. Strelkov. Storage of very cold neutrons in a trap with nano-structured walls // Physics Letters B 679 (2009) 186–190