Neutron Leakage Spectra from Iron Spheres with ^{252}Cf Neutron Source

B.V. Devkin, M.G. Kobozev, S.P. Simakov, V.V. Sinitsa, V.A. Talalaev, U. Fischer[1], U. von Möllendorff[1]

[1]*Forschungszentrum Karlsruhe, Institut für Neutronenphysik und Reaktortechnik, Karlsruhe, Germany*

Testing of neutron data in spherical benchmarks is considered as important step on the way of validation of evaluate data libraries. Traditionally scintillation detectors and pulse height technique was used for neutron spectroscopy in the benchmarks with ^{252}Cf source [1]. In 1988 we have proposed and tested the time of flight method for the spectroscopy of the neutrons leaking from the spheres with ^{252}Cf source in the center [2]. The source was a fast ionzation fission chamber. The advantage of this technique is that neutron leakage spectra and efficiency are measured simultaneously in the one experiment (Cf in the sphere and bare source, respectively). In the present work we report the results of the measurements and comparison with transport calculations for five iron spheres, the parameters of which are listed in the Table 1.

Table 1. Parameters of iron spheres.

Sphere No.	Sphere Radius, cm		Wall thickness		Hole diameter, cm	Weight kg
	outer	inner	cm	λ		
1	4.5	2.0	2.5	0.6	2.0	2.4
2	12.0	4.5	7.5	1.7	3.0-3.2	50.9
3	12.0	2.0	10.0	2.3	2.0-3.2	53.3
4	20.0	1.9	18.1	4.2	1.9-2.5	258.0
5	30.0	2.0	28.0	6.4	2.0-4.0	874.0

Transport calculations have been made with one-dimensional code ANISN and three-dimensional - MCNP 4.a, data files being taken from the BROND-2, FENDL-1, ENDF-B6, JENDL-3. The MCNP code was used as well for estimation of the specific corrections. For example, the effect connected with the employing of the time of flight method in the experiment. These results to the shifting of the resonance like structure in the experimental spectrum to the lower energy, because of the time delay of the scattered neutrons in the shell. Fig. 1 demonstrates this effect for the case of thickest sphere #5, where time independent and time-dependent (neutron time of arrival spectrum was converted to energy one) Monte Carlo calculations are shown.

The comparison of transport calculation with experimental data did not indicate any significant discrepancies except for the case of the shell #5.

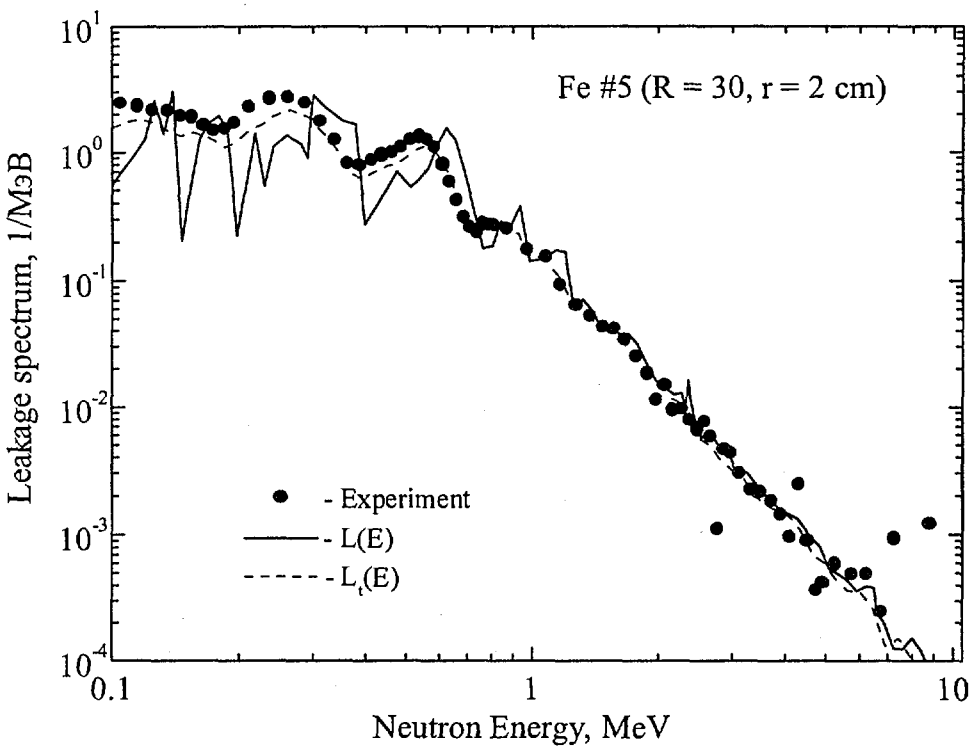

Fig. 1. Neutron leakage spectrum for Fe shell #5. Points – experiment, solid curve –time-independent calculation MCNP4.a/FENDL-1, dashed – the same, but time-dependent.

References

1. В.И. Горячев, Ю.И. Колеватов и др. Интегральные эксперименты в в проблеме переноса ионизирующих излучений. М.: Энергоатомиздат, 1985
2. S.P. Simakov et al. Report ZFK-646, Dresden, 1988, p. 111