Hello, my name is Aleksandr Vasilev. I researcher in the North-Eastern Federal University, Yakutsk Russia.

Title of my talk is State change modal method for numerical simulation of dynamic processes in a nuclear reactor.

Let’s start from introduction. The physical processes in nuclear reactor is depend on the distribution of neutron flux, whose mathematical description is based on neutron transport equation. This equation is of integro-differential form and depends on time, energy, spatial and angular variables. For practical computations use simplified forms of the neutron transport equation. Most popular and having sufficient accuracy is Multigroup diffusion approximation.

To characterize the reactor dynamic processes some spectral problems were considered. For modeling the dynamics processes in a nuclear reactor, standard methods for the approximate solution of non-stationary problems are used. The most attention is paid to twolayer schemes with weights, also Runge-Kutta and Rosenbroek schemes are used.

The dynamic method is very time consuming. Not suitable for real-time calculation. The quasistatic method is associated with the multiplicative representation of the space-time factorization methods. But, when using the quasistatic method, the problem is significantly simplified. For this reason, we use modal method (Stacey, 1967). In this case, the solution is represented in the form of a sum of several dominant eigenvalues with time-dependent coefficients.

Neutron flux dynamics is considered within a bounded 2D or 3D domain Omega with a convex boundary partial Omega. The neutron diffusion is described by the following system of equations.

System of equation complemented by albedo boundary conditions.

We consider boundary problem with following initial conditions.

For convenience, we rewrite boundary problem in operator formulation. We define the vector and the matrices. And we solve the Cauchy problem.

For space approximation, we use finite element method.

And we get the variational formulation.

The nuclear reactor is always non-stationary. Dynamic processes can be considered as a change of states. At a time t an instantaneous change of state occurs. The state s is defined by the parameters in equations.

The standard approach for the decomposition of the function over the system of non-orthogonal functions consists in using the biorthogonal system of functions.

I want to note that delayed neutron also separation of time scale.