Implementations of the Finite Element Method for the Collective Model of Atomic Nuclei

Alexander Gusev[1,2], Balt Batgerel[3], Ochbadrakh Chuluunbaatar[1,3,4], Sergue Vinitsky[5,6], Galmandakh Chuluunbaatar[1,2], Ján Buša Jr.[1,7], and Luong Le Hai[8]

[1]*Meshcheryakov Laboratory of Information Technologies, JINR, Dubna, Russia*

[2]*Dubna State University, Dubna, Russia*

[3]*Institute of Mathematics and Digital Technology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia*

[4]*School of Applied Sciences, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia*

[5]*Bogolyubov Laboratory of Theoretical Physics, JINR, Dubna, Russia*

[6]*Peoples' Friendship University of Russia (RUDN), Moscow, Russia*

[7]*Alikhanian National Science Laboratory (YerPhI), Yerevan, Armenia*

[8]*Ho Chi Minh City University of Education, Ho Chi Minh City, Vietnam*

We propose new computational schemes, algorithms and programs of the finite element method for solving elliptic multidimensional boundary value problems in a polyhedral d-dimensional domain.

To reduce the boundary value problems to an algebraic one, the desired solution is sought as an expansion over the basis of piecewise polynomial functions constructed by joining Hermite interpolation polynomials and their derivatives at the boundaries of adjacent finite elements in the form of d-dimensional parallelepipeds.

The performance of the developed finite element schemes, algorithms and programs is demonstrated by solving benchmark boundary value problems for the five-dimensional harmonic oscillator used in the collective model of atomic nuclei. Calculations of the spectrum, quadrupole momentum and electric transitions of ^{154}Gd and ^{238}U isotopes is discussed.

This talk is based on [1]–[3].

References

[1] A. A. Gusev et al, *Mathematics in Computer Science* **17** (2023) 18.

[2] B. Batgerel et al, *Journal of Mathematical Sciences* **279** (2024) 738–755.

[3] B. Batgerel et al, *Lecture Notes in Computer Science* **14938** (2024) 63–81.