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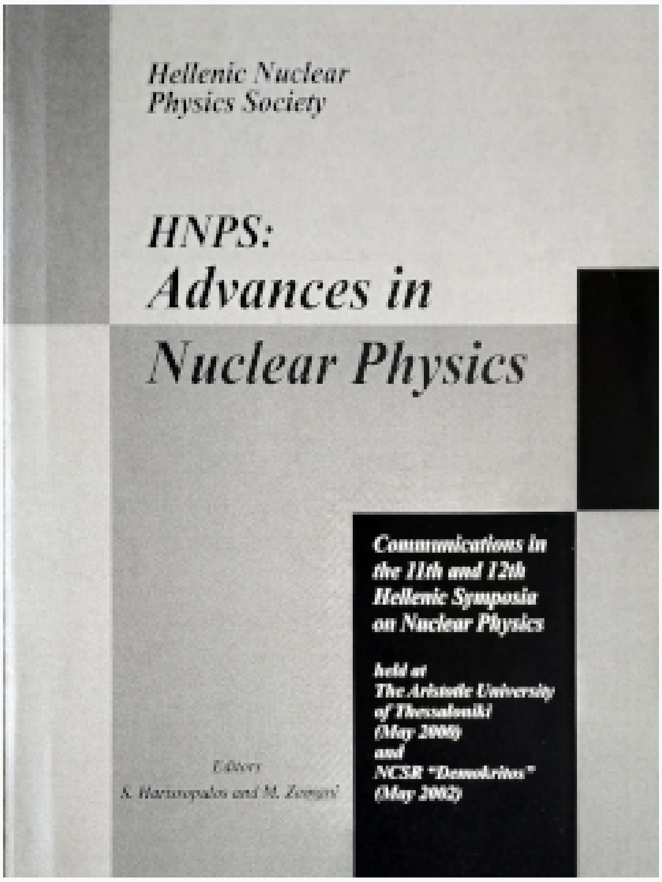

Neutron separation energies from nuclear mass systematics using neural networks

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Neutron separation energies from nuclear mass systematics using neural networks

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Statistical modeling of data sets by neural–network techniques is offered as an alternative to traditional semi-empirical approaches to global modeling of nuclear properties. There is need for such systematics driven by fundamental investigations of nuclear structure far from stability, conducted at heavy–ion and radioactive–ion beam facilities. There is also great current interest from the perspective of astrophysics and of nuclear technology.

In this work we evaluate the one and two neutron separation energies based on global models for the masses of nuclides developed with the use of neural networks[1] and compare them with the experimental ones as given by Audi at Atomic Mass Data Center web site [2]. Our work on masses is a continuation of the work reported in ref. [3]. We have used enriched data sets together with a novel training algorithm and various coding schemes to achieve high performance both in learning and prediction. Our performance is comparable to the best of other evaluations of separation energies based on global models for the masses of nuclides (like those of Möller et al. [4] and Pearson et al. [5] that are rooted in conventional Hamiltonian theory), whereas the number of parameters is larger.

Neural network modeling, as well as other statistical strategies based on new algorithms for artificial intelligence, may prove to be a useful asset in the further exploration of nuclear phenomena far from stability.

References

1. S. Athanassopoulos, E. Mavrommatis, K. A. Gernoth, and J. W. Clark, *"Explorations of nuclear mass systematics using neural networks"*, in submission
2. http://csnwww.in2p3.fr/AMDC/web/masseval.html (files 'rct1_exp.mas95 and rct2_exp.mas95)
3. S. Gazula, J. W. Clark and H. Bohr, *Nucl. Phys.* **A540** (1992) 1 ; K. A. Gernoth, J. W. Clark, J. S. Prater and H. Bohr, *Phys. Lett.* **B300** (1993) 1 ; K. A. Gernoth and J. W. Clark, *Comp. Phys. Commun.* **88** (1995) 1 ; E. Mavrommatis, S. Athanassopoulos, K. A. Gernoth, and J. W. Clark, *Condensed Matter Theories*, Vol. 15, edited by G. S. Anagnostakos et al. (Nova Science Publishers, N.Y. 2000) 207
4. P. Möller, J. R. Nix, W. D. Myers, and W. J. Swiatecki, *At. Data Nucl. Data Tables* **59** (1995) 186 and references therein
5. S. Goriely, F. Tondeur and J. M. Pearson, *At. Data Nucl. Data Tables* 77 (2001) 311