Contribution ID: **60** Type: **Oral report**

INFLUENCE OF NEUTRON SHELLS ON SURFACE TENSION IN NUCLEI

Thursday 15 October 2020 16:50 (25 minutes)

Estimation of the surface tension coefficients in the even-even nuclei could be performed due to connection of surface tension and nuclear rigidity [1]. The values of rigidities are connected with the mean squared deformations of nuclei [2]. The estimation of the surface tension coefficients in the even-even nuclei were presented in [3]. The coefficients σ show great fluctuations: from $\sigma \approx$ 1.0÷1.8 (for 150<A<198) up to $\sigma \approx$ 34 MeV/fm^2 (for ^{208}Pb, ^{210}Pb). The comparison of these values with the data on nuclear charge radii reveals the impact of the filled out neutron shell peculiarities on σ.
In the figures the calculated [3] surface tensions for Calcium and Zirconium isotopes together with the values of r_0 coefficients are shown. The surface tension in nuclei is highly influenced by the shell structure, especially of the neutron subshells near the surface: $(1d_{3/2})^4_n(1f_{7/2})^8_n$ for ^{48}Ca and $(1g_{9/2})^{10}(2d_{5/2})^6$ for ^{96}Zr . The highest σ corresponds as well to the highest values of pressure p (according to the Laplace formula $p \approx \frac{2\sigma}{R}$). It is obvious that filling out two near neutron subshells leads to grow of pressure on the proton component of the nuclei and, as consequence, to decreasing of the charge radii.
For ^{208}Pb and ^{210}Pb the surface tension is close to the maximum among all even-even nuclei ($\sigma \approx 34$ MeV/fm^2). It is approximately $0.75 \cdot 10^{20}$ higher than σ for water at 20 °C.

References

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Author: Dr GONCHAROVA, Natalia (Lomonosov Moscow State University, Faculty of Physics)

Co-author: DOLGODVOROV, Aleksey (Nuclear Safety Institute of the Russian Academy of Sciences)

Presenter: DOLGODVOROV, Aleksey (Nuclear Safety Institute of the Russian Academy of Sciences)

Session Classification: Section 1. Experimental and theoretical studies of the properties of atomic nuclei

Track Classification: Section 1. Experimental and theoretical studies of the properties of atomic nuclei.