РОССИЙСКАЯ АКАДЕМИЯ НАУК
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МИНИСТЕРСТВО НАУКИ И ТЕХНОЛОГИЙ РОССИЙСКОЙ ФЕДЕРАЦИИ
РОССИЙСКИЙ УНИВЕРСИТЕТ ДРУЖБЫ НАРОДОВ
ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ
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HEAVY ISOTOPES OF TRANSFERMIUM ELEMENTS: SHELL CLOSURES AT N=162 AND Z=108

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In the last four years we carried out a series of experiments designed to provide a direct and decisive test of the theoretical predictions regarding the existence of the new shell closures in the vicinity of Z=108 and N=162. Experiments performed within the Dubna-Livermore collaboration by employing the Dubna gas-filled recoil separator have resulted in the discovery of the new nuclides $^{262}104$, $^{265}106$, $^{266}106$, $^{267}108$, and $^{273}110$. The ground-state decay properties that we established for $^{266}106$ and $^{262}104$ reveal a large enhancement in their stability against alpha and spontaneous-fission decays by a factor of ~1000 as compared to that of nuclides with *lower* Z or N values. This provided a strong indication of the existence of deformed shell closures near N=162 and Z=108. Another test of the theory was the observation of a decrease in stability for nuclides with Z, N *beyond* the predicted magic numbers. The alpha-particle energy measured for $^{273}110$ with N=163 provided direct and convincing evidence that a neutron shell closure indeed exists and is located at N=162 and not at a higher value of N. The production and positive identification of the nuclide $^{273}110$ signifies the observation of the element 110.

The principal result of our work is the direct experimental evidence for a strong shell closure at N=162. The discovery of significantly increased nuclear stability near N=162 and Z=108 creates new opportunities for extending the chart of the nuclides at its upper edge. Providing a decisive test of and a new credit for the current nuclear theory, this result offers predicted spherical shells at Z=114 and N≈178-184 to be a major challenge for future experimental explorations.

Forthcoming $^{244}Pu+^{48}Ca$ experiment designed to produce superheavy nuclei with Z=114 and N=174-176 is discussed.