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Discovery of Enhanced Nuclear Stability near the Shell Closures N = 162 and Z = 108

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In the last four years, within the Dubna-Livermore collaboration, we carried out a series of experiments designed to test the existence of the theoretically predicted shell closures in the vicinity of Z=108 and N=162. Experiments performed 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 were established for $^{266}106$ and $^{262}104$ revealed 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 was a strong indication of the existence of shell closures near N=162 and Z=108. A direct 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 evidence that a neutron shell closure indeed exists and is located at N=162 and not at a higher value of N. 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.

Nuclide	Principal decay mode	Alpha-particle energy, MeV	Half-life	Synthesis reaction
$^{273}110$	α	11.35	$0.3^{+1.3}_{-0.2}$ ms	$^{244}Pu+^{34}S$
$^{267}108$	α	9.74 to 9.87	19^{+29}_{-10} ms	$^{238}U+^{34}S$
$^{266}106$	α	8.63±0.05	10–30 s	$^{248}Cm+^{22}Ne$
$^{265}106$	α	8.63 to 8.91	2–30 s	— ″ —
$^{262}104$	SF		$1.2^{+1.0}_{-0.5}$ s	— ″ —