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Exploring the Limits of Nuclear Stability: Production of the Heaviest Elements[1]

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The Dubna/LLNL collaboration has been investigating the nuclear and chemical properties of the heaviest elements since 1989. Elements 113 – 118 have been synthesized and characterized [see J. Phys. G: Nucl. Part. Phys. **34** (2007) R165 and PRL **104** (2010) 142502] using fusion-evaporation nuclear reactions of ^{48}Ca beams on actinide targets (^{237}Np, ^{242,244}Pu, ^{243}Am, ^{245,248}Cm, ^{249}Bk, and ^{249}Cf, respectively) at the U400 cyclotron located at the Flerov Laboratory of Nuclear Reactions in Dubna, Russia. This talk will discuss the ramifications of the experimental work during the last 10-15 years on the synthesis of elements 113 – 118, including the recent IUPAC acceptance of element names for 114 (flerovium) and 116 (livermorium) and a discussion of the prospects for expanding the periodic table even further beyond element 118. Prediction of the heaviest element possible is highly uncertain because of the complex interplay of strong nuclear forces, Coulomb forces, surface/volume effects and shell corrections. For some combination of protons ($Z > 118$) and neutrons, the strong nuclear force which binds nucleons together will not be able to counter the Coulomb repulsion of the protons in a nucleus, and thus nuclei will cease to exist. Experimental and theoretical efforts to locate and access the next region of doubly-magic spherically-shaped nuclei, the Island of Stability, will be presented.

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