APR13-2013-000974

Abstract for an Invited Paper
for the APR13 Meeting of
the American Physical Society

The Quest for New Elements

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In 1966 Myers and Swiatecki predicted a new closed shell, centered at an element with Z=126 and A=310. In this region, now referred to as the "Island of Stability," shell-effects were predicted to stabilize elements with $Z \approx 114$-126 against fission, leading to predicted half-lives of years or longer and the predicted existence of so-called "superheavy" nuclei. By comparison, the heaviest known element at that time was rutherfordium (Rf), with Z=104 and a half-life of about one minute. Some of the theoretical calculations even predicted half-lives longer than the age of the universe, suggesting that these superheavy elements may even exist in nature. Later predictions suggested that nuclides in the Island of Stability might be produced at rates more characteristic of element with $Z \leq 100$. Initial experiments were unsuccessful in discovering superheavy nuclei in nature or at particle accelerators, leading to a concerted effort by experimentalists and theoreticians to i) improve the theoretical predictions ii) develop techniques to improve the sensitivity of experiments and iii) to progressively extend the known elements towards this region. Over the next five decades, fourteen new elements with $Z \geq 105$ and more than a hundred isotopes were discovered. Experimental sensitivies were increased by six orders of magnitude. Within the last decade, six new elements and more than fifty new isotopes with $Z \geq 112$ have been discovered. These most recent discoveries have begun to approach the edges of the Island of Stability. The nuclei exhibit longer lifetimes and higher production rates than those found in some of the lighter elements. This presentation will discuss the advances that have led us to the shores of the Island of Stability and where the field goes from here.