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Toward the Discovery of New Elements

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In the past two decades, significant progress has been made with the discovery of elements Z=114-118 through reactions between ^{48}Ca beams and actinide targets, achieving production rates of atoms-per-day or more. Unfortunately, the pursuit of elements beyond Oganesson (Z=118) faces substantial challenges. The synthesis of elements with Z=119 or 120 using ^{48}Ca would necessitate targets of Es (Z=99) or Fm (Z=100), but these elements cannot be produced in sufficient quantities. This limitation necessitates exploring new reaction pathways.

Numerous theoretical studies have aimed at predicting production rates for new elements using actinide targets and heavier ion beams. While these models reliably reproduce excitation functions for SHE production with ^{48}Ca beams, predictions diverge significantly for reactions involving heavier beams. For instance, the predicted cross sections for reactions to produce Z=120 vary by more than three orders of magnitude and tens of MeV. These discrepancies hinder experimental efforts, as the low expected cross sections suggest the detection of only one event every few weeks or months under ideal conditions. Berkeley Lab has been proactively addressing these challenges to push beyond E118. By testing theoretical predictions, we have begun the ^{50}Ti +^{244}Pu experiment to understand the impact of using ^{50}Ti instead of ^{48}Ca beams on cross sections. This presentation will highlight significant upgrades to our experimental facilities, including ion sources, target setups, detectors, and electronics, aimed at enhancing our capability to produce and detect elements beyond E118. We will also present the initial results from the ^{50}Ti + ^{244}Pu experiment, showcasing our progress in this ambitious endeavor.

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