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Production of the heaviest elements using radioactive beams

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Previously we have evaluated quantitatively the prospects for the synthesis of transactinide nuclei using radioactive beams (PRC **76**, 014612 (2007)). We have revised these calculations to include current approaches to properly deal with the excitation energy dependence of shell and pairing corrections along with recent experimental advances in our understanding of the fusion probability, P_{CN} and the capture cross sections for very neutron-rich systems and the expected beam intensities at FRIB. Using our simple formalism for calculating the complete fusion cross sections that reproduces the known heavy element production cross sections over six orders of magnitude, we calculate the production rates for transactinide nuclei with $Z \leq 120$. All possible projectile and target combinations are evaluated. Exciting new possibilities for studies of the atomic physics, chemistry and nuclear spectroscopy of the heaviest elements should be realized at a modern radioactive beam facility. Examples of possible experiments at pre-FRIB facilities will be discussed. The synthesis of new heavy elements is best undertaken at stable beam accelerators.