

**Comment on “Possibility of synthesizing a doubly magic superheavy nucleus”**

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In a recent paper, Aritomo discusses the possibility of forming a doubly magic superheavy nucleus using reactions with radioactive beams. I point out the suggested reactions have negligible rates.

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In a recent paper, Aritomo [1] discusses the possible ways of synthesizing doubly magic  $^{298}114$ . He points out that to do this synthesis using hot fusion reactions, one needs to make a more neutron-rich compound nucleus, such as  $^{304}114$ . He calculates the cross sections for producing  $^{304}114$  using the radioactive beam induced reactions  $^{46}\text{Si} + ^{258}\text{Fm}$  ( $\sigma_{\text{evr}} \sim 10^6$  pb),  $^{60}\text{Ca} + ^{244}\text{Pu}$  ( $\sigma_{\text{evr}} \sim 10^5$  pb),  $^{72}\text{Cr} + ^{232}\text{Th}$  ( $\sigma_{\text{evr}} \sim 3 \times 10^3$  pb), and  $^{152}\text{La} + ^{152}\text{La}$  ( $\sigma_{\text{evr}} \sim 3$  pb). The point of this Comment is to remind one that when considering reactions induced by radioactive beams, it is important to evaluate the “cross section x beam intensity” product. For the radioactive beams  $^{46}\text{Si}$ ,  $^{60}\text{Ca}$ ,  $^{72}\text{Cr}$ , and  $^{152}\text{La}$ , the expected production rates at a modern radioactive beam facility [2] are estimated to be  $1.2 \times 10^{-3} \text{ s}^{-1}$ ,  $0.3 \text{ s}^{-1}$ ,  $0.08 \text{ s}^{-1}$ , and  $8 \times 10^6 \text{ s}^{-1}$ , respectively (where the published intensities have been multiplied by a factor of 4 to simulate the use of a 400 kW driver accelerator instead of the quoted 100 kW

driver). The modern facility used for these estimates is the now defunct Radioactive Ion Accelerator (RIA) project which is thought to represent something approximating the maximum available beam intensities. Assuming target thicknesses of  $0.5 \text{ mg/cm}^2$ , the expected production rates for the  $^{46}\text{Si}$ ,  $^{60}\text{Ca}$ ,  $^{72}\text{Cr}$ , and  $^{152}\text{La}$  induced reactions cited by Aritomo are  $1.4 \times 10^{-15} \text{ s}^{-1}$ ,  $3.7 \times 10^{-14} \text{ s}^{-1}$ ,  $3.1 \times 10^{-16} \text{ s}^{-1}$ , and  $4.8 \times 10^{-11} \text{ s}^{-1}$  (assuming one could make a  $^{152}\text{La}$  target). To reemphasize the point, the time to produce one atom of  $^{304}114$  by these reactions would be  $2.3 \times 10^7$  yr,  $8.6 \times 10^5$  yr,  $1 \times 10^8$  yr, and 670 yr. It is important when considering reactions induced by radioactive beams to consider both the beam intensity and cross section. [3]

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[1] Y. Aritomo, Phys. Rev. C **75**, 024602 (2007).[2] [http://www.phy.anl.gov/ria/ria\\_yields/reaccelerated.html](http://www.phy.anl.gov/ria/ria_yields/reaccelerated.html)

[3] W. Loveland, Phys. Rev. C (submitted).