# Subbarrier fusion enhancement in neutron-rich radioactive $^{132}$Sn on $^{64}$Ni*

J. F. Liang[1], D. Shapira[1], C. J. Gross[1], J. R. Beene[1], J. D. Bierman[2], A. Galindo-Uribarri[1], J. Gomez del Campo[1], P. A. Hausladen[1], Y. Larochelle[3], W. Loveland[4], P. E. Mueller[1], D. Peterson[4], D. C. Radford[1], D. W. Stracener[1], and R. L. Varner[1]

[1]*Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830, USA*
[2]*Physics Department, AD-51, Gonzaga University, Spokane, Washington 99258, USA*
[3]*Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37966, USA*
[4]*Department of Chemistry, Oregon State University, Corvallis, Oregon 97331, USA*

The cross section for subbarrier fusion of heavy ions is often found to be enhanced over the one-dimensional barrier penetration model prediction. It has been suggested that the fusion yield may be further enhanced when the reaction is induced by unstable neutron-rich nuclei[1, 2, 3, 4]. If this is true such reactions may be applied to synthesize heavy elements.

We have measured evaporation residue cross sections using neutron-rich radioactive $^{132}$Sn beams incident on a $^{64}$Ni target in the vicinity of the Coulomb barrier. This is the first experiment using accelerated $^{132}$Sn beams to study nuclear reaction mechanisms. The average beam intensity was $2 \times 10^4$ particles per second and the smallest cross section measured was less than 5 mb. A large subbarrier fusion enhancement was observed compared to evaporation residue cross sections for $^{64}$Ni on stable even Sn isotopes. The enhancement cannot be accounted for by a simple barrier shift. Coupled-channels calculations including inelastic excitation and neutron transfer underpredict the measured cross sections below the barrier. The presence of several neutron transfer channels with large positive Q-values suggests that multinucleon transfer may play an important role in enhancing the fusion of $^{132}$Sn and $^{64}$Ni. Future experiments using even more neutron-rich radioactive beams will be discussed.

*Research sponsored by the Office of Science, U. S. Department of Energy, under contract DE-AC05-00OR22725 with UT-Battelle, LLC.

[1] N. Takigawa, H. Sagawa, and T. Shinozuka, Nucl. Phys. **A538**, 221c (1992).

[2] M. S. Hussein, Nucl. Phys. **A531**, 192 (1991).

[3] C. H. Dasso and R. Donangelo, Phys. Lett. B **276**, 1 (1992).

[4] V. Yu. Denisov, Eur. Phys. J. A **7**, 87 (2000).