

**Texas A&M University-Commerce  
Federal Initiative Request FY 2011**

**Title: National Security with Nuclear Science**

**Description:** The major goal of the National Nuclear Security Administration (NNSA) Stockpile Stewardship Program is an accurate and complete modeling of the behavior and performance of devices in the nation's aging nuclear weapons stockpile. Old nuclear weapons can fail or act unpredictably. Their radioactive plutonium/uranium cores are potentially unreliable, and many nuclear reactions involving plutonium/uranium (and of other actinides) are not known with the desired accuracy. Texas A&M University-Commerce has two internationally recognized professors who are leading experts in nuclear and astrophysics, having published an average 20 publications/year in peer reviewed scientific journals, and in great demand for seminars in research universities, national laboratories and international conferences. Now A&M-Commerce aims to build a national center, involving students, postdocs and visiting scholars completely dedicated to the development of alternative nuclear theories to improve the accuracy of nuclear reactions. This is central to the continuing process of certifying both the safety and reliability of the stockpile without a resumption of nuclear testing. The project is crucial for the leadership in science and technology in the state of Texas and in the US. They will develop simulation codes which incorporate the reaction rates of very short-living radioactive nuclei, the equation of state, diffusion and hydro- and thermodynamics of radioactive materials. Dr. Li and Dr. Bertulani have developed novel analytical tools and advanced computational techniques, which are required for nuclear stockpile stewardship. This project will also contribute to the Advanced Fuel Cycle Initiative of the Department of Energy, which aims at developing reprocessing and fuel treatment technologies that are cleaner, more efficient, less waste-intensive, and more proliferation-resistant. These technologies are needed for next-generation nuclear energy systems.

**Relevance and Background:** What is the reliability of the country's nuclear weapon stockpile in an era without testing? The answer largely depends on the quality of simulation models which we can develop. These models are extremely complex, involving processes and input as varied as hydrodynamics, plasma physics, materials science, nuclear physics, and fluid flow phenomena. They are normally calibrated with data collected and archived during underground nuclear tests from radiochemical analyses of nuclear bomb debris. Since the vast majority of the isotopes involved have very short lifetimes, it has never been possible to collect enough of a given isotope to allow measurements of their reaction rates. Thus the simulation models are forced to use theoretical estimates that currently have significant uncertainties. To improve the situation dramatically, the scientists at A&M-Commerce will develop novel analytical tools and advanced computational techniques to extract from new data that became available recently from experiments at several accelerator-based radioactive nuclear facilities around the world. The project will couple analytical and computational techniques with combined data from earlier nuclear explosions and new laboratory experiments. The scientists at A&M-Commerce have the necessary expertise to carry out and oversee the project. The project is ambitious, attainable, and necessary to preserve the leadership of nuclear science within the US borders. It will have an enormous impact in the development of new technologies for nuclear weapons and nuclear energy generation. Our results will be reported to the DOE, DOD and NNSA, with the perspective to engage them in a long term funding for the continuation of this research.

**Amount Requested:** \$1,776,918

## Budget

Postdoc Salaries (4)	\$325,000
Visiting Nuclear Scientists (2)	\$244,852
Faculty Salaries	\$190,000
Administrative Secretary	\$41,066
Graduate Students (4)	\$110,000
Equipment (16+ terabytes racked cluster computer system)	\$792,000
Travel	\$48,000
Supplies, Materials, Publication Costs	\$26,000
Total	\$1,776,918

Total amount requested: \$2,761,836 (\$1,776,918, FY 2011 and \$984,918, FY 2012)

### Agency/Agencies Targeted:

Department of Energy  
National Science Foundation  
National Nuclear Security Administration  
Department of Defense

### Investigator Information

Principal Investigator

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Co Principal Investigator

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