Project: New Technologies For Defense Against Threats From Space

Brief Description: Montana State University requests $2 million to generate high fidelity data for modeling space vehicle signatures and for demonstrating a concept for a space-based laser in support of MDA and Air Force projects.

Executive Summary: When a missile or other space vehicle flies through the outer atmosphere of the Earth at suborbital and orbital altitudes, its outer surfaces and any gases it emits may chemically react with the residual atmosphere to produce radiation ("glow") which can be used as a signature of the vehicle. This project will 1) produce data that will enable detailed understanding of the signature needed to utilize it for space warfare, and 2) investigate use of similar chemical reactions to produce a space-based laser.

Project Description: *Space vehicle signatures, space situational awareness, and kill assessment*. The spectral signature of the space vehicle glow depends on the nature of the vehicle gases or surfaces, its velocity, and which part of the atmosphere the vehicle is traveling through. Therefore, the glow can provide information for threat identification, tracking, targeting, and kill assessment. For example, kill vehicles need to be able to distinguish between plume radiation caused by exhaust gases and "hard-body" radiation caused by the actual missile surfaces in order to identify and "home in" on an enemy missile. The plume radiation can be many times larger than the "hard body" making the signature information critical. In addition, the debris cloud from a destroyed missile will have a radiation signature that can be used to determine if the intercept was successful and what type of payload the missile was carrying -- nuclear or chemical explosives, as well as chemical or biological weapons. In general, radiation signatures can be monitored by space- and ground-based sensors as a vital component of space situational awareness. (Note that the most recent Quadrennial Defense Review, 2006, said that the US must have "unfettered, reliable, and secure access to its space assets, assured for now by improving space situational awareness") Theoretical models are being developed to understand rocket signatures, but the lack of high fidelity data has made it impossible to validate the models, slowing progress toward utilization of such signatures in the battlespace. This component of the proposed work will provide high quality laboratory data to DoD modelers who will incorporate the fundamental data generated at a unique MSU facility into computer codes used for plume signature models, sensor design, and field data analysis.
Atmosphere-powered space-based laser. Space-based lasers have been investigated since the 1970s, because of their potential to destroy enemy missiles just after launch. In 1999, the Missile Defense Agency (MDA) and the U.S. Air Force created a joint venture—the Space-Based Laser Integrated Flight Experiment (SBL-IFX)—that included Boeing, Lockheed Martin, and TRW. Their proposed laser system requires the transport of extremely dangerous and highly corrosive fluorine gas to space, and countless materials problems must be overcome if this laser is ever to function as envisioned (a 2012 test of SBL-IFX has already been canceled). The PI has recently discovered that the same phenomenon that causes spacecraft glow has potential for use as the energy source in a space-based laser. A laser that utilizes atmospheric atomic oxygen would only require the transport of one relatively harmless gas to space, and the issues associated with corrosion from fluorine would be circumvented. This component of the proposed work will demonstrate an atomic-oxygen chemical laser in the laboratory, with the goal of transferring the technology to a private industry for scale-up and possible in-space testing.

Congressional Action Needed: An appropriation of $2,000,000 in FY2011 is requested.

Importance to Montana: The appropriation will use MSU's in-house technology to enhance a research program that has already become an invaluable resource for the Air Force and the Missile Defense Agency (see attached endorsement). Such a resource simply does not exist anywhere else in the world, yet it contributes more useful data to the missile defense and space situational awareness efforts than air- or space-borne measurements at a *tiny fraction of the cost*. Furthermore, the expertise and infrastructure at MSU will be broadened by the involvement of a new faculty member, who will assist in the development of a space-based laser concept, and by a new hire in theoretical chemistry. There is also enormous potential for Montana's optics companies to become involved in the development of the space-based laser.

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