ARES Upgrade: Time-resolved Spectral Measurements of Bio-aerosols

by **P. J. Hargis, R. L. Schmitt, S. M. Sickafoose, M. W. Smith, T. A. Ashlock, M. Johnson, K. Sandquist, K. S. Rawlinson, D. Baiocchi, C. Boney, J. Daniels, C. Hrncir, B. Keeler, M. Pedroncelli, I. Shokair, and J. Grossman**

Motivation—Ares is a van-based UV laser-induced fluorescence (LIF) light direction and ranging (LIDAR) technology designed to detect biological agent clouds at up to 5 km. The original implementation utilized an intensified charge-couple device (ICCD) for time-gated spectrally dispersed fluorescence detection. While the system did have integrated cloud location and tracking, it was not able to separately collect dispersed fluorescence simultaneously from two different clouds and identify the individual clouds. In order to increase Ares' utility and provide the ability to measure spectra from different clouds within the same field-of-view separately, a multi-anode photomultiplier tube (MAPMT) was selected to replace the ICCD.

Accomplishment—Over the last year, the Ares system has undergone a dramatic overhaul, including the redesign of electrical and mechanical systems, as well as the development of new control and analysis hardware and software in order to accommodate the new MAPMT detector.

The multidisciplinary Ares upgrade team included electrical, optical, mechanical, and software engineers from multiple organizations, led by members of the Lasers, Optics, & Remote Sensing Department.

The MAPMT detector collects the dispersed fluorescence over 32 spectral channels in time bins of 10 ns, which is equivalent to a spatial resolution of 1.5 meters away from Ares over a total distance of up to 5.1 km.

The testing and integration of the new detector required laboratory measurements of the sensitivity, responsiveness, and signal-to-noise of the detector to various levels of illumination, as well as a performance assessment of the new electronics.

Following reconstruction, the new and improved Ares was relocated to the sled track in order for the full system to be tested under near field test conditions. These tests permitted debugging and characterization of the entire Ares system. Real deployment occurred in late August 2007.

These extensive upgrade efforts culminated in a two-and-a-half week field test at Dugway Proving Ground, Dugway, Utah as part of the Joint Biological Stand-off Detection System (JBSDS) Increment II test. During this field test, bioaerosols including bioagent simulants and typical interferents were released at two different facilities, and time-resolved laser-induced fluorescence was measured with Ares. One facility was a controlled breeze tunnel and one was an open-air release area. In both cases, the improved Ares was able to effectively collect the dispersed fluorescence from the various bio-releases. The interpretation and analysis of the data is ongoing and will provide a quantitative measurement of the new detector system.

Significance—The ability to interrogate and identify multiple clouds, in real time, at multiple distances relative to the point of observation is a critical component for defense either on the battlefield or for homeland security. Ares is an easily fieldable research instrument capable of the detection and identification of multiple bioaerosols at multiple distances in real time.

Sponsors for various phases of this work include: Department of Energy, Department of Defense/Joint Biological Standoff Detection System (JBSDS)

Contact: Shane M. Sickafoose; Lasers, Optics, & Remote Sensing, Dept. 1128
Phone: (505) 845-8362, Fax: (505) 844-5459, E-mail: smsicka@sandia.gov

Figure 1. Ares instrument during deployment at Dugway Proving Ground, Utah in August 2007.

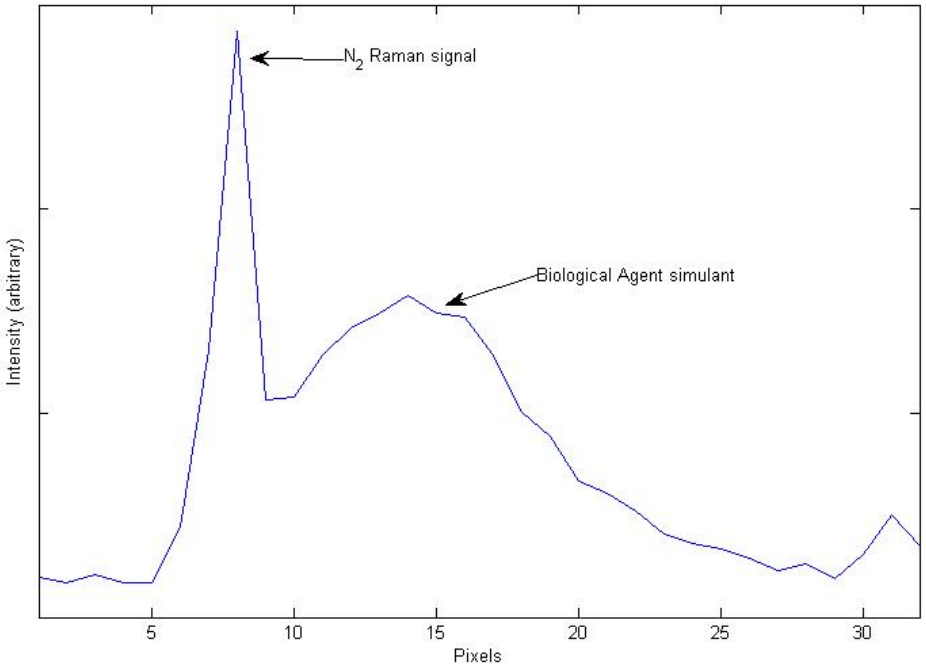

Figure 2. Dispersed fluorescence spectrum of N_2 Raman line and biological agent simulant released at Dugway Proving Ground.