

# Development of a Low-Cost, Low-Power, Miniature Sector Mass Spectrometer with IonCCD Detection

James Ha<sup>1</sup>, Deborah Hunka<sup>1</sup>, Augustin Ifarraguerri<sup>2</sup>, Tim McPhail<sup>1</sup>, Meredith Melendez<sup>1</sup>, Noah Christian<sup>1</sup>, Gottfried Kibelka<sup>3</sup>, Chenye Yang<sup>4</sup>, Luis Velasquez-Garcia<sup>4</sup>, Carol Livermore<sup>5</sup>

<sup>1</sup>Leidos; 10260 Campus Point Dr, San Diego, CA 92121

<sup>2</sup>Leidos; 4001 Fairfax Dr, Arlington, VA 22203

<sup>3</sup>CMS Field Products; Xylem Inc, 2148 Pelham Parkway, Bldg. 400, Pelham, AL 35124

<sup>4</sup>MIT; Microsystems Technology Laboratories, Building 39; 77 Massachusetts Ave, Cambridge, MA 02139

<sup>5</sup>Northeastern University; 334 Snell Engineering Center, 360 Huntington Ave, Boston, MA 02115

Under the Intelligence Advanced Research Projects Activity (IARPA) Molecular Analyzer of Efficient Gas-phase Low-power INterrogation (MAEGLIN) program, Leidos and its partners (CMS Field Products, Northeastern University, and MIT) and vendors (Ardara Technologies) have developed technology for low cost chemical detection and identification using a compact magnetic sector mass spectrometer. This mass spectrometer incorporates several innovations for low-power, including a low power non-thermionic ionization system based on electron tunneling of field emitters, permanent magnet magnetic sector that does not use any power for mass separation, and an arrayed detector using an IonCCD for simultaneous detection of all ions. The short ion path length facilitates operation at higher pressures than typically required for a sector field instrument, further lowering power and improving fieldability. Because all ions are collected simultaneously on an arrayed detector, there is no loss of signal that would normally occur from a scanning or pulsed instrument, such as a conventional magnetic sector, electric/magnetic sector, time-of-flight, ion trap, or a quadrupole instrument.

The research is based upon work supported by the Office of the Director of National Intelligence (ODNI), Intelligence Advanced Research Projects Activity (IARPA), via Air Force Research Laboratories contract FA8650-17-C-9103, and work supported by Leidos Exploratory Research and Development Funding. The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of the ODNI, IARPA, or the U.S. Government. The U.S. Government is authorized to reproduce and distribute reprints for Governmental purposes notwithstanding any copyright annotation thereon.