

# Optimal Dynamic Detection of Explosives

### Applications:

- Stand-off detection of explosive materials

### Benefits:

- Enables stand-off detection from safe distances
- Detects target materials in high background environments
- Enables detection of very small and trace amounts of target materials
- Highly specific; very low false-positive rate

### Contact:

Robert Dye  
(505) 667-3404  
rcdye@lanl.gov  
tmt-2@lanl.gov

Technology Transfer Division

### Summary:

Scientists at Los Alamos National Laboratory (LANL), in collaboration with colleagues at Princeton University, are working on an innovative laser-based explosives detection technology called Optimal Dynamic Detection of Explosives, or ODD-Ex. This technology, when fully developed, will be a highly reliable "stand-off" explosives detector that can detect very small quantities of explosive molecules at considerable distances, even in cases where there are large amounts of interfering or background materials.



*Team member Margo Greenfield makes small adjustments to the optics in the Shaped Ultra-Fast Laser Pulse lab at Technical Area 35.*

The technology depends on shaped, ultra-fast laser pulses coupled with machine learning, an idea first investigated at LANL to enhance the safety of explosive detonations by initiating the explosion at laser powers much lower than required using usual (unshaped) lasers. By using ultrafast laser pulses with a specific optimal time dependent electric field (the "shape"), the ODD-Ex system excites molecules specific to explosive materials (for example, nitrates), allowing the system to "see" only those targeted molecules, despite the presence of large amounts of other kinds of molecules. ODD-Ex spectroscopically detects the excited molecules, alerting operators to the presence of even trace amounts of explosive materials as well as identifying those materials.

Unlike current state-of-the-art explosives detection technologies, ODD-Ex has a very low false-positive rate because the shaped laser pulses only produce signals in the target molecules, and not in any surrounding material. Additionally, laser beams can travel significant distances, enabling the ODD-EX detection system, and hence its operator, to detect explosive materials from a safe distance of up to 50 meters.

### Development Stage:

Proof-of-concept experiments ongoing, prototype under development.

### Additional Information:

For further information regarding this technology, please contact Robert Dye by phone at (505) 667-3404 or by email at rcdye@lanl.gov.