REMOTE SENSING

Terawatt-class laser can detect biowarfare agents

Detecting a cloud of biological warfare agent could become easier thanks to a nonlinear lidar being developed by a French-German consortium. What's more, the Teramobile team says that the technique should have a range of up to 4 km and a resolution of under 0.5 m (*App. Phys. B* 78 535).

Université Jean Moulin Lyon 3/DAVM/Alexis Gratié

Teramobile involves four research institutes in Berlin, Jena, Lyon and Palaiseau.

The approach involves inducing two-photon fluorescence from natural fluorophores present in the aerosols. The fluorescence is collected by a telescope and focused onto a spectrally resolved detector where it is recorded as a function of distance and wavelength.

Teramobile is the world's first mobile terawatt-class laser and can emit femtosecond pulses at 800 nm courtesy of a Ti:sapphire system. In the aerosol tests, the researchers generated a plume of 1 µm water droplets 45 m away from the Teramobile. Each droplet contained a small amount of riboflavin, a compound naturally found in bacteria that fluoresces at 540 nm. They then fired 80 fs, 5 TW pulses at the plume at a repetition rate of 10 Hz and collected the fluorescence.

"The detected spectrum clearly identifies the presence of riboflavin-containing particles and the lidar range resolution allows the precise spatial localization of the biological aerosol plume," say the researchers in their paper. "The plume is measured to be spread over some 10 m. The spatial resolution is 45 cm and is limited by the fluorescence lifetime of 3 ns for this transition."

The team also simulated the performance of a laser that emits femtosecond terawatt pulses at 530 nm. Although such systems are not available today, they could be used to excite two-photon fluorescence from a fluorophore called tryptophan. The benefit is that the concentration of tryptophan is typically 10^4 times higher than riboflavin in bacteria.

Calculations show that the distance beyond which a two-photon system is more efficient than a one-photon system depends on the ozone concentration. In particular, a two-photon system would prove invaluable in urban areas with high ozone concentrations. While a one-photon system would be limited to a detection distance of several hundred metres, the team thinks a two-photon system could detect bacteria up to 4 km away.