Lawrence Livermore National Laboratory

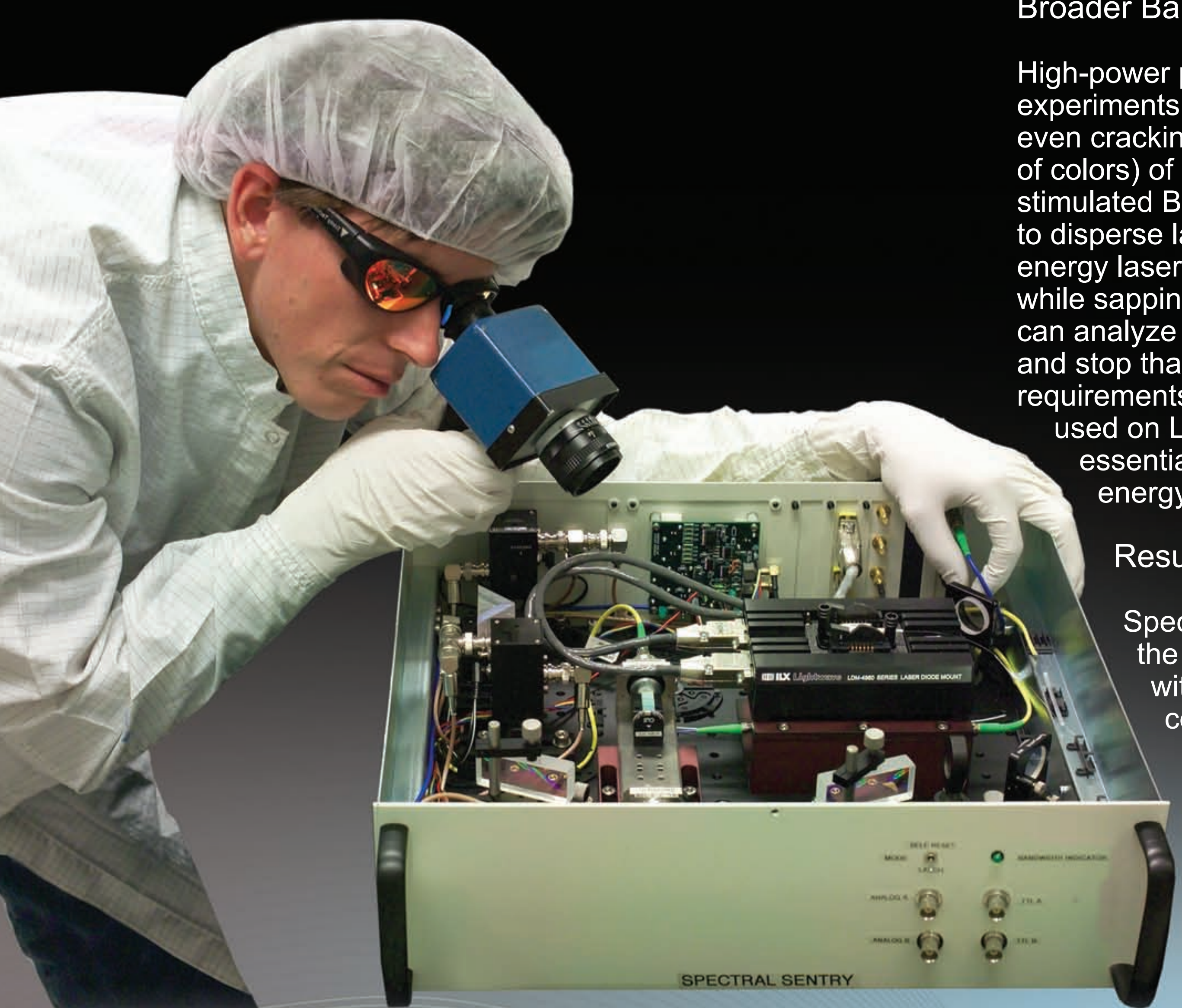
2009 Award Winner

Light-Speed Spectral Analysis of a Laser Pulse

Livermore's spectral sentry technology is a lightning-fast solution to the threat of damaging laser light on a high-intensity laser system's optical components. Spectral sentry ensures that high-intensity laser systems amplify only laser pulses with sufficient bandwidth, preventing potentially damaging low-bandwidth, high-energy laser pulses from being produced.

Broader Bandwidth Solution

High-power pulses can create intense acoustic waves that ruin experiments by distorting the pulses, scattering useful light, or even cracking laser optics. Broadening the bandwidth (range of colors) of the laser light before amplification can suppress stimulated Brillouin scattering, a damage-process that tends to disperse laser light perpendicularly or backward toward low-energy laser components, creating damage sites on optics while sapping energy from the laser beam. Spectral sentry can analyze a single laser pulse traveling at the speed of light and stop that pulse if it does not meet the minimum bandwidth requirements. The device has been successfully tested and used on Livermore's Mercury laser. In the future, it could be essential for a range of other broad-bandwidth and high-energy lasers worldwide.



Results within Nanoseconds

Spectral sentry completes its work in three steps, all in the span of 34 nanoseconds. The tremendous speed with which this detection and analysis process is completed allows it to be used on lasers with pulse repetition rates up to 5 million shots per second. As technology improves and laser energy levels and repetition rates continue to climb, spectral sentry can be expected to safeguard laser systems in many areas of research, including inertial fusion energy, defense, materials processing, and high-energy-density physics.

Spectral sentry development team: (front row, from left) Rob Campbell, William Molander, Paul Armstrong, Christopher Ebbers, and Noel Peterson; (back row) Steven Telford, Richard Shuttlesworth, Glenn Huete, Rodney Lanning, Nick Schenkel, and Andy Bayramian.

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