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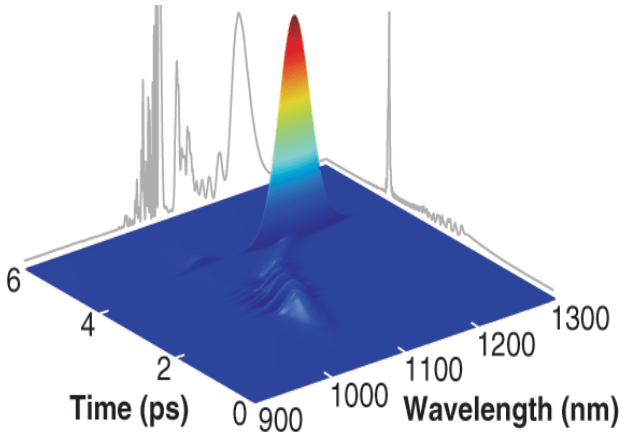
OPTICAL THEORY: Scientists capture optical ‘rogue waves’

“Once thought to be mythical, giant waves on the open ocean that could swallow entire ships before vanishing without a trace were finally recorded for the first time at the Draupner oil platform in the North Sea.1 Now, for the very first time, such “rogue waves” have been predicted and captured in an optical system by scientists at the University of California at Los Angeles.”

“Oddly enough, the scientists at UCLA were able to draw a comparison between the physical attributes of rogue waves in the ocean and the physics of supercontinuum generation within nonlinear optical fibers. By launching intense seed pulses into a nonlinear microstructured optical fiber at or near its zero-dispersion wavelength, a broad-band supercontinuum source can be created. The supercontinuum is comprised of solitons that shift toward the red as they propagate through the fiber. Modulation instabilities within the fiber cause the output spectrum to be extremely sensitive to the initial conditions of the pulse, which amplifies the input noise.”



“By analyzing the temporal and spectral properties of the initial conditions of the noise, the scientists found that if it contains energy with a frequency shift of about 8 THz within a 0.5 ps window centered about 1.4 ps before the pulse peak, a rogue-wave event occurs. Simulations also show that the optical rogue waves survive for an unpredictable amount of time before they suddenly collapse. “Optical rogue waves bear a close connection to their oceanic cousins,” says Daniel Solli, the researcher who led the investigation. ‘Optical experiments may help to resolve the mystery of oceanic rogue waves, which are very difficult to study directly.’”