Type I Entanglement Two Photon Absorption Spectrometer

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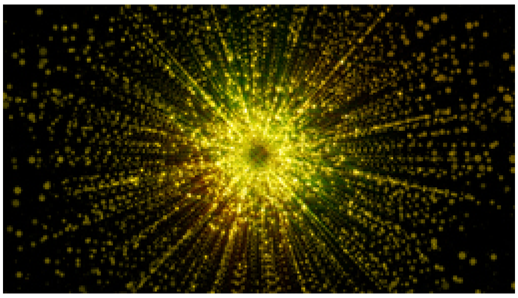

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Category
Hardware
Engineering & Physical Sciences

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OVERVIEW

Two-photon fluorescence spectrometer utilizing quantum entangled photons

- Tunable quantum spectroscopy in a bench top, turnkey instrument
- Improved signal-to-noise at 1 millionth the light intensity of other two photon systems

BACKGROUND

Two photon excitation fluorescence (TPEF) is a spectroscopy technique that utilizes long wavelength light (usually near infrared, NIR) to generate a fluorescence signal, usually from biological materials. TPEF requires two photons to be absorbed nearly simultaneously for every one photon emitted as the fluorescence signal. Traditional approaches have relied upon the use of high intensity lasers in order to generate a fluorescence signal strong enough to be detected.

INNOVATION

Researchers at the University of Michigan have developed an approach to TPEF that utilizes quantum entangled two photon absorption (ETPA). This technique represents the first ever demonstration of ETPA spectroscopy using type-I degenerate spontaneous parametric down-conversion (SPDC) pumped by a continuous wave (CW) laser to yield fluorescence from an organic chromophore. The system also uses a spatial light modulator to tune the excited state population, and the design lends itself to the development of a turnkey, all-in-a-box, benchtop spectrometer that can be operated by trained laboratory personnel who are not laser spectroscopy specialists.

The use of a CW-pumped laser, rather than ultrafast pulsed lasers, reduces the size, weight, complexity, and cost of the system. This novel quantum spectrometer utilizes a CW photon flux that is a million times smaller than conventional TPEF. The reduced light intensity enables the use of fluorophores prone to photobleaching and also dramatically increases the sensitivity and detection limit of the instrument. Signal-to-noise (SNR) is improved and, in contrast to approaches without ETPA, is not limited by the standard quantum limit. Moreover, certain molecular characteristics can be visualized which are hidden when probed by conventional spectroscopic tools.