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Single-molecule absorption three ways

By [Physics Today](#) on November 8, 2010 9:31 AM | [No Comments](#) | [No TrackBacks](#)

Since its advent 20 years ago, room-temperature optical detection of single molecules has found application in biology, materials science, and other fields. Typically, the molecules are detected by their fluorescence, but not all molecules fluoresce. Now, three groups have independently detected single molecules by their optical absorption. Each group used a different technique. [Yahid Sandoghdar](#) and his colleagues at ETH Zürich in Switzerland measured the absorption directly, by detecting the minute intensity change of a laser beam passing through the sample. [Michel Orrit](#) and his colleagues at Leiden University in the Netherlands used a two-laser technique based on the photothermal effect: The molecule to be detected absorbed photons from the first laser and converted their energy to heat, thereby changing the refractive index in the surrounding material. The researchers detected the scattering of a second laser beam off that refractive-index inhomogeneity. And [Sunney Xie](#) and his colleagues at Harvard University used a different two-laser technique called ground-state depletion microscopy. One laser, whose amplitude was modulated at 1.75 MHz, repeatedly pumped the molecule out of its ground state, which caused the absorption of a second laser to be modulated at the same frequency. By isolating the high-frequency fluctuations of the second laser, the researchers separated the absorption signal from the laser's inevitable intensity noise. (P. Kukura, M. Celebrano, A. Renn, V. Sandoghdar, *J. Phys. Chem. Lett.* **1**, 3323, 2010; A. Gaiduk, M. Yorulmaz, P. V. Ruijgrok, M. Orrit, *Science* **330**, 353, 2010; S. Chong, W. Min, X. S. Xie, *J. Phys. Chem. Lett.* **1**, 3316, 2010.)—Johanna Miller

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