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CHE-0317110

Multi-dimensional spectroscopy has revolutionized magnetic resonance, with applications ranging from biomolecule structures to magnetic resonance imaging (MRI). 2D spectroscopy with femtosecond pulses of light[1] exhibits many effects not found in magnetic resonance, such as “frozen” molecular motions, polarization signatures for the angles between dipoles, and distortions caused by sample absorption (seen in the lower panels at right). Such spectra provide insight into dynamics in disordered materials and may enable quantitative analysis of mixtures without physical separations.

[1]D.M. Jonas, “Optical Analogs of 2D NMR” Science 300, 1515-1517 (2003).

