Two-Dimensional Fourier Transform Spectroscopy

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Two dimensional Fourier transform (2DFT) spectroscopy is a powerful tool for probing complex systems. 2DFT spectroscopy requires precise control of the phases of the incident pulses and measurement of the phase of emitted signal. By taking a Fourier transform, the signal phase can be correlated with the excitation phase, allowing information about coupling be resonances to be discerned. We are applying 2DFT spectroscopy to the exciton resonances in semiconductor nanostructures. The pulse ordering and how they are scanned determines the type of information gained. When the conjugated pulse arrives first, we can determine the homogeneous and inhomogeneous widths of the excitons and biexictons as well as provide unique insight into many-body interactions. If the conjugated pulse arrives last, we probe two-quantum coherences, which cannot be directly observed in non Fourier transform measurements. Our results show that many-body interactions dominate the non linear optical response of excitons in semiconductors. This is true for both one-quantum, where it was evident from previous measurements, and two-quantum coherences, where it was not previously appreciated.