

**Plenary Talk**                      PV XII   Fr 9:15   E 415 und E 214  
**Two-Dimensional Electronic Spectroscopy: Coherence, Entanglement and Photosynthesis** — ●GRAHAM FLEMING — University of California Berkeley, 221 Hildebrand Hall, Berkeley, CA 94720

Two-dimensional (2D) electronic spectra contain information about the combined spatial, energetic and temporal landscapes of condensed phase systems. Because they are recorded at the amplitude level, they are directly sensitive to the presence of quantum coherence. In addition, differing sequences of polarizations of the four fields involved can suppress or enhance specific features in the spectra. An example is given by a sequence which reveals only peaks that have arisen through

coherence transfer as opposed to population transfer. In this talk these ideas will be applied to natural photosynthetic light harvesting systems. These pigment-protein complexes contain chlorophyll molecules at very high spatial density, leading to delocalized excited states. The experiments reveal long-lived quantum electronic coherence and substantial coherence transfer leading to speculations about the physiological consequences of quantum effects, and the potential applications in quantum theory. New theoretical methods are required to address these questions and a formally exact, reduced hierarchy approach will be used to describe the experiments and explore more subtle quantum mechanical questions such as the presence of entanglement in natural systems.