Assemblies of weakly interacting molecules (so-called molecular aggregates) have become remarkably versatile quantum systems with applications in photography, opto-electronics, solar cells, and photo-biology. The remarkable properties of these aggregates stem from the strong transition dipole-dipole interaction between the individual molecules which leads to eigenstates with excitation shared coherently by a large number of molecules. As a consequence, electronic excitation can migrate through the aggregate and new superradiant optical properties emerge.

In this talk I will give an introduction on the relationship between the structure of the aggregate (spatial arrangement, molecular properties, environment) and the resulting optical and transfer properties with a focus on the the important role of coupling to vibrational modes. As examples I will discuss superradiant emission of molecules on dielectric surfaces and energy transfer in biological light harvesting systems.
A. Eisfeld received his PhD (physics) in 2006 from the university of Freiburg (group of J.S. Briggs). After postdoc positions in Freiburg, MPIPKS Dresden and Harvard (DFG research fellowship) he is now group leader at the MPIPKS (since 2012).

His main research interests are collective effects and quantum-transport in atomic, molecular and nano-scale many-body systems. Examples are photosynthetic light-harvesting systems, aggregates of organic dyes or assemblies of ultra-cold Rydberg atoms. To handle these large and complex systems often multi-scale approaches are used which combine molecular dynamics simulations, quantum chemistry methods, non-adiabatic quantum dynamics and open quantum system formalisms. One particular research interest is solving non-Markovian open quantum system dynamics using efficient stochastic Schrödinger equations.