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[L] Aligning and imaging molecules inside helium nanodroplets with laser pulses

Monday, 25 June 2018 16:00 (30 minutes)

I will show how laser pulses can align molecules embedded in helium nanodroplets and how the ability to place molecules in advantageous spatial orientations enables structural determination of molecular complexes. The talk will focus on the following topics:

1) Impulsive alignment with pulses much shorter than the molecular rotational periods. Here the focus is on understanding how the coherence of rotational wave packets is influenced by the dissipative environment of the helium droplets.

2) Alignment induced by pulses that are turned-on on the time scale of molecular rotations. It will be shown how the 0.4 K temperature of the molecules inside the droplets enables unprecedented high degrees of alignment at the peak of the alignment. In addition, we show that when the pulse is rapidly turned-off the strong alignment persists for 10-15 ps thanks to the impeding effect of the helium environment on the molecular rotation. This creates molecules that are strongly aligned, either 1D or 3D, under conditions that are essentially laser-free. The method works particularly well for large, complex molecules.

3) Alignment of molecular dimers in He droplets. We show how sharply aligned dimers makes it possible to image their structure through fs-laser-induced Coulomb explosion. Results for both small linear molecules such as carbonylsulfide and larger molecules such as tetracene are presented.

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