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59 - Carbon disulfide superrotors in helium nanodroplets

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The behaviour of fast rotating molecules immersed in superfluid helium is studied. More specifically, the system of interest is carbon disulfide "superrotors" inside helium nanodroplets. Droplets ideally capture a single carbon disulfide molecule and are then exposed to two laser beams. The first beam, a laser pulse whose linear polarization undergoes accelerated rotation around the direction of the laser beam, called an "optical centrifuge", excites them to the extreme rotational states. The second beam, a femtosecond "probe", ionizes the molecules. The recorded velocity map ion image is analyzed to determine the rotational state, or degree of confinement to the rotational plane, of the molecules.

Confinement to the rotational plane is characterized by < cos2Θ2D > which is the average value of the cosine of the angle between the probe polarization and the rotational ion velocity vector projected onto the detector screen. By observing how < cos2Θ2D > evolves in time after the centrifuge pulse is gone, inferences about the coupling strength of helium to the superrotor can be made. If helium couples strongly to the rotor then < cos2Θ2D > is expected to be low and decay quickly. If coupling is weak then < cos2Θ2D > is high and lasts for a long time. This is measured for carbon disulfide doped droplets and the evolution of < cos2Θ2D > is presented, which is an exciting first step in understanding how the rotation dynamics of a molecule can probe the superfluid behaviour of the nanodroplets.

Primary author: FORDYCE, Jordan (Jordan)

Co-authors: MACPHAIL-BARTLEY, Ian; WASSERMAN, Walter; STIENKEMEIER, Frank (University of Freiburg); MILNER, Valery (UBC)

Presenter: FORDYCE, Jordan (Jordan)

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