Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

**Molecular stopwatches, cogwheels and "spinflakes": studying the dynamics of molecular superrotors** ALEKSEY KOROBENKO, ALEXANDER MILNER, Department of Physics and Astronomy, University of British Columbia, JOHN HEPBURN, Department of Chemistry, University of British Columbia, VALERY MILNER, Department of Physics and Astronomy, University of British Columbia — Using the technique of an optical centrifuge, we excite diatomic molecules to ultrafast synchronous rotation. Femtosecond velocity-map imaging allows us to visualize and study the coherent dynamics of molecular superrotors under field free conditions and in external magnetic field. We demonstrate that when the created rotational wave packet is narrow, its free evolution is nondispersing and follows the motion of a classically rotating dumbbell or a hand of the smallest natural stopwatch. For wider rotational distributions, we observe the breakdown of classical rotation, when a dumbbell shape changes to that of a "quantum cogwheel" – a molecular state simultaneously aligned along multiple direction. Our measurements in external magnetic field reveal other peculiar aspects of the rich dynamics of molecular superrotors. The rotation of a non-magnetic molecule interacts with the applied field only weakly, giving rise to slow precession of the molecular angular momentum around the field direction. In contrast, the electronic spin of a paramagnetic superrotor mediates this interaction, causing the initial disk-like angular distribution to split into several spatial components, each precessing with its own frequency determined by the spin projection.

Aleksey Korobenko
Department of Physics and Astronomy, University of British Columbia

Date submitted: 28 Jan 2015 Electronic form version 1.4