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**CFEL – Building 99, seminar room I+II (ground floor)**

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## **Effect of rotational-state-dependent molecular alignment on the optical dipole force**

The properties of molecule-optical elements such as lenses or prisms based on the interaction of molecules with optical fields depend in a crucial way on the molecular quantum state and its alignment created by the optical field. Herein, we consider the effects of state-dependent alignment in estimating the optical dipole force acting on the molecules and, to this end, introduce an effective polarizability which takes proper account of molecular alignment and is directly related to the alignment-dependent optical dipole force. We illustrate the significance of including molecular alignment in the optical dipole force by a trajectory study that compares previously used approximations with the present approach. The trajectory simulations were carried out for an ensemble of linear molecules subject to either propagating or standing-wave optical fields for a range of temperatures and laser intensities. The results demonstrate that the alignment-dependent effective polarizability can serve to provide correct estimates of the optical dipole force. Furthermore, theoretical calculations are compared with measurements based on velocity map imaging techniques.

*Figure 1 (a-d) The velocity map ion images of CS<sub>2</sub> molecules and (e) their profiles along the  $v_x$  axis. ‘(a)’ and ‘(b)’ are the measured and the simulated images without any IR laser beams, respectively. ‘(c)’ and ‘(d)’ are similar images with the pulsed optical standing wave made of two counter propagating IR laser beams of their peak intensities  $I_0 = 4.7 \times 10^{10} \text{ W/cm}^2$ . The color bar in the image denotes the fraction of the molecules. ‘(e)’ shows the profiles of the four images.*

