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Using streaked electron diffraction as an alternative to conventional femtosecond pump-probe electron diffraction

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Abstract content
   (Max 300 words)

Femtosecond electron diffraction has become an important technique to directly study photoinduced structural dynamics in crystalline molecules on the sub-picosecond time scale. One of the major hurdles in this field is maintaining femtosecond temporal resolution in these experiments when increasing the electron number in the pulses. Increasing the electron number is required to increase the signal-to-noise as well as decrease the data collecting time of the experiment. Increasing the electron number however dramatically increases space-charge broadening within the electron pulse which results in a several picosecond pulse after only a few centimetres of propagation. Current trends to eliminate this problem involve recompressing the electron pulse using photo-triggered or conventional RF cavity compressors.

In this poster we propose an alternative solution that utilises the temporally broadened electron pulse to our advantage. As in the conventional pump-probe set up we have a ˜200fs laser pump pulse, but instead of an ˜400fs electron probe pulse we use a several picosecond long electron pulse to probe our sample. In this method different temporal components of the electron pulse probes the sample at different times after photoexcitationThe different temporal components of the probe pulse are then spatialy separated on the detector screen by means of a photo-triggered streak camera also developed by our group.

Advantages of this technique include the following: (a) The electron number can be increased by orders of magnitude thus decreasing the signal-to-noise and data acquisition time, (b) there is no need for a delay stage as in conventional pump-probe experiments since the information of the entire temporal evolution of the sample is contained in a single shot. With no delay stage there are fewer moving parts which make pump-probe overlap easier to maintain. In order to demonstrate the successful implementation of this streaked electron diffraction technique we investigated the time-resolved photoinduced dynamics in the charge density wave compound 4Hb-TaSe2 which we have previously investigated with conventional pump-probe electron diffraction.

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