Photo-controlling the dissociation of adenine by acting at extreme time scales

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The interaction between a molecule and ultrashort laser pulses allows for triggering and investigating ultrafast electron dynamics. Such dynamics may play a role in the reactivity of chemically-relevant molecules, opening the way for photo-controlling chemistry at extreme time scales [1,2].

Here we present an overview of experimental studies aiming for the above-mentioned goal. In particular, we will focus on a time-resolved study of photo-fragmentation of the nucleobase adenine, one of the key building blocks of DNA, following ionization by an XUV attosecond pulse. It is known that ionizing radiation causes mutations and irreparable damage to DNA. However, nucleobases also exhibit relatively high inherent photo-stability. The complexity of these molecules makes it a challenging task to elucidate in detail all the physical mechanisms activated by ionization including fragmentation, internal energy dissipation and electronic correlation effects. Our most intriguing observation is that a stable dication of the parent molecule can be produced if (and only if) the probing NIR pulse is very briefly delayed from the XUV pulse. This delay (2.3 fs) is explained as the time required for a shake-up process to occur.

References

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