Ultrafast neutralization dynamics of highly charged ions upon impact on 2D materials

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Heavy ions in high charge states carry a large amount of potential energy in addition to their kinetic energy. The potential energy can amount to several 10keV and is released upon neutralization [1]. We recently showed that neutralization of slow highly charged Ar and Xe ions proceeds on a sub-10fs time scale, i.e. during transmission through the very first monolayers of a solid [2]. This feat makes highly charged ions an intriguing tool for efficient modification of 2D materials preventing significant damage to a substrate at the same time. Here we present data on the neutralization dynamics of slow highly charged ions in freestanding single layer graphene and freestanding single layer MoS$_2$. Special emphasise is put on charge exchange of the ions, their kinetic energy loss, and the emission of secondary electrons/photons from the interaction process.