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ION IMPACT INDUCED IONIZATION/FRAGMENTATION DYNAMICS OF RARE GAS DIMERS

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Synopsis We have measured the ionization and fragmentation of Helium, Neon and Argon Dimers induced by ion impact and observed two different pathways, the sequential ionization on each atom and the interatomic Coulombic decay.

Rare gas atoms can form weakly bound molecules, held together by the van der Waals force. We investigated the ionization fragmentation dynamics of He_2, Ne_2 and Ar_2 caused by ion impact with a COLTRIMS reaction microscope. Dependent on how electrons are removed from the dimers atomic sites different decay pathways are open. We focus on the following two:

1.) The direct mechanism, where the projectile ionizes both atoms due to 2 separate projectile-atom interactions. Other than covalent bound molecules the dimer's constituents have ionization properties similar to those of a single atom. Up to now, large impact parameters b, dominate ionization are believed not to leads to momentum transfers, that are smaller which is rameter dependent ionization probability P(b) will lead to a maximum tilt angle of the molecular axis to the ion beam up to which both atoms can be ionized. Measuring this molecular orientation gives a unique tool to test the predictions ternuclear distance of the dimer open a new way to access the impact parameter. The impact pa of impact parameter dependence of ionization [1].

Accessible through any momentum transfer measurement between the nuclei. The large in 2.) In addition to the direct ionization mecha than the momenta transferred by the ejected electrons. This makes the impact parameter in large impact parameters Rutherford scattering nism, where the dimer's atoms are subsequently be an observable that can be measured. For ionized there is also a second mechanism, which called the interatomic Coulombic decay (ICD). Predicted in 1997 [2] and in photoionization experimentally shown in 2004 [3], ICD probably plays a significant role for radiation damage in living tissue and for ion radiation therapy [4, 5, 6].

References

[1] J Titze *et al* 2011 *Phys. Rev. Lett.* **106** 033201
[2] L Cederbaum *et al* 1997 *Phys. Rev. Lett.* **79** 4778
[3] T Jahnke *et al* 2004 *Phys. Rev. Lett.* **93** 163401
[4] B Boudaïffa *et al* 2000 *Science* **287** 1658
[5] T Jahnke *et al* 2010 *Nat. Phys.* **6** 139
[6] H Kim *et al* 2011 *Proc. Natl. Acad. Sci. USA* **108** 29

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