

Abstract Submitted  
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**A Direct Measurement of the Dissociative Lifetimes for Superexcited States of Molecular Oxygen** HENRY TIMMERS, NIRANJAN SHIVARAM, ARVINDER SANDHU, The University of Arizona — Using an attosecond extreme ultraviolet (XUV) pump-probe set up, we performed a *direct* measurement of the dissociation lifetime of superexcited states corresponding to the  $nl\sigma_g(c^4\Sigma_u^-)$  Rydberg series of  $O_2$ . Superexcited states are highly-excited, neutral molecular states which lie far above the first ionization potential. These states are found to play a major role in the chemistry of the upper atmosphere but are difficult to model due to their non-Born-Oppenheimer behavior. Using a direct time-domain scheme, we measured a dissociation lifetime of  $\tau_d = 105 \pm 8$  fs, a factor 1.5 longer than dissociation lifetimes reported for the molecular ion-core. These results indicate the influence of the Rydberg electron on the ultrafast fragmentation dynamics of the ion-core and can provide insight into interaction between electronic and nuclear degrees of freedom in the non-Born-Oppenheimer regime.

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