Coherent Control of Bond Making

Liat Levin,[1] Wojciech Skomorowski,[2] Leonid Rybak,[1] Ronnie Kosloff,[3] Christiane P. Koch,[2] and Zohar Amitay[1]

[1] *The Shirlee Jacobs Femtosecond Laser Research Laboratory, Schulich Faculty of Chemistry, Technion-Israel Institute of Technology, Haifa 32000, Israel*

[2] *Theoretische Physik, Universität Kassel, Heinrich-Plett-Straße 40, 34132 Kassel, Germany*

[3] *Fritz Haber Research Centre and The Department of Physical Chemistry, Hebrew University, Jerusalem 91904, Israel*

(Dated: November 7, 2014)

I will report on a achieving a milestone in coherent control of bond making. A joint experimental and theoretical study achieves coherent control of photo-induced bimolecular chemical reactions. The starting system is hot magnesium vapour. Strong-field multiphoton femtosecond photoassociation generates a strong chemical bond. The yield of detected magnesium dimer molecules is found to be enhanced for positively chirped pulses and suppressed for negatively chirped pulses. Our *ab initio* model shows that control is achieved by purification via Franck-Condon filtering combined with chirp-dependent Raman transitions. Experimental closed-loop phase optimization using a learning algorithm yields an improved pulse that utilizes vibrational coherent dynamics in addition to chirp-dependent Raman transitions. Our results show that coherent control of binary photo-reactions is feasible even under thermal conditions.

PACS numbers: 42.65.Re, 82.50.Nd, 82.53.Eb, 82.53.Kp