

Crete Team

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Research Interests

Theofanis N. Kitsopoulos Rachel L. Toomes

The group is interested in studying chemical dynamics. Specifically my experiments aim towards the determination of the state-to-state differential cross sections for a chemical process be it a full or half collision. Our main experimental methodology involves velocity mapping or ion imaging. Initial experiments conducted on Crete have been concerned with determining the Branching Ratios for the various electronic states of hot atoms or radicals produced by photofragmentation. Recently we made a major improvement in traditional photofragment imaging that we call *slice imaging*. This new method improves the sensitivity to spatial anisotropy parameters such that we are able to measure the photofragment alignment and orientation from single ion images, that offers additional detail information on the structure and dynamics of multiple / interfering excited electronic states. In a second series of experiments we have been investigating the reactivity of photolytically produced species (hot atoms or radicals). There are two types of experimental approaches. The first is *photoloc* product imaging, where precursor reagents are premixed and co-expanded. The hot atom or radical is produced photolytically and products are rovibrationally state selected using resonant enhanced multiphoton ionization (REMPI). The speed distribution is measured using velocity mapping and analysis using either direct or Fourier basis set analysis yield the state resolved differential cross section (SRDCS). The reactions of Cl+ethane and Cl + Butane reaction have been studied using this technique. More recently a major breakthrough has been achieved where we have been able to measure SRDCS using a crossed molecular beam setup and (2+1) REMPI detection of products. This novel approach lends itself to a plethora of polyatomic chemical reactions to be studied with rotational resolution.

AWARD: Theofanis Kitsopoulos was awarded the 2003 Bodossaki Foundation Scientific Prize for work in Basic Sciences

Recent Publications

1. B. Martínez-Haya, P. Quintana, L. Bañares P. Samartzis, D. J. Smith, and T. N. Kitsopoulos, **The photodissociation of CH₃SCH₃ and CD₃SCD₃ at 220–231 nm investigated by velocity map ion imaging**, *J. Chem. Phys.* **114**, 4450 (2001).
2. D.H. Parker, B.L.G. Bakker, P.C. Samartzis, and T.N. Kitsopoulos, **A study of Rydberg states of Cl₂ and low lying electronic states of Cl₂⁺ through a dissociative continuum**, *J. Chem. Phys.* **115**, 1205 (2001).
3. T.P. Rakitzis, P.C. Samartzis, and T.N. Kitsopoulos, **Complete Measurement of S(¹D₂) Photofragment Alignment from Abel-invertable Ion Images**, *Phys. Rev. Lett.* **87**, 123001 (2001).
4. C.R. Gebhardt, T. P. Rakitzis, P.C. Samartzis, V. Ladopoulos and T. N. Kitsopoulos, **Slice Imaging: A New Approach to Ion Imaging and Velocity Mapping**, *Rev. Sci. Instrum.* (2001) **72**, 3848.
5. T. N. Kitsopoulos C.R. Gebhardt, and T. P. Rakitzis, **Photodissociation Study of CS₂ at 193 nm using Slice Imaging**, *J. Chem. Phys.* **115** 9727 (2001).
6. T. P. Rakitzis and T. N. Kitsopoulos, **Measuring the Cl and Br photofragment alignment using Slice Imaging**, *J. Chem. Phys.* (2002).
7. Alrik J. van den Brom, T. Peter Rakitzis, Jeroen van Heyst, Theofanis N. Kitsopoulos, Sebastian R. Jezowski, and Maurice H. M. Janssen, **State-to-state photodissociation of OCS(v=2,1|J/M). I. The angular recoil distribution of CO (X ¹Σ⁺, v=0/J)**, *J. Chem. Phys.* **117**, 4255 (2002).
8. T.P. Rakitzis, P.C. Samartzis, R. Toomes, L. Tsigaridas, M. Coriou, D. Chestakov, A.T.J.B. Eppink, D. H. Parker and T.N. Kitsopoulos **Photofragment alignment from the photodissociation of HCl and HBr**, *Chem. Phys. Lett.* **364**, 115 (2002)
9. R.L. Toomes, and T.N. Kitsopoulos **Rotationally resolved reaction product imaging using crossed molecular beams** *PCCP* (2003) in press
10. M.J. Bass, M. Brouard, C. Vallance, T.N. Kitsopoulos, P.C. Samartzis, and R.L. Toomes, **The dynamics of the Cl + C₂H₆ → HCl(v', j') + C₂H₅ reaction at 0.24 eV: is ethyl a spectator?**, *J. Chem. Phys.* (2003) submitted