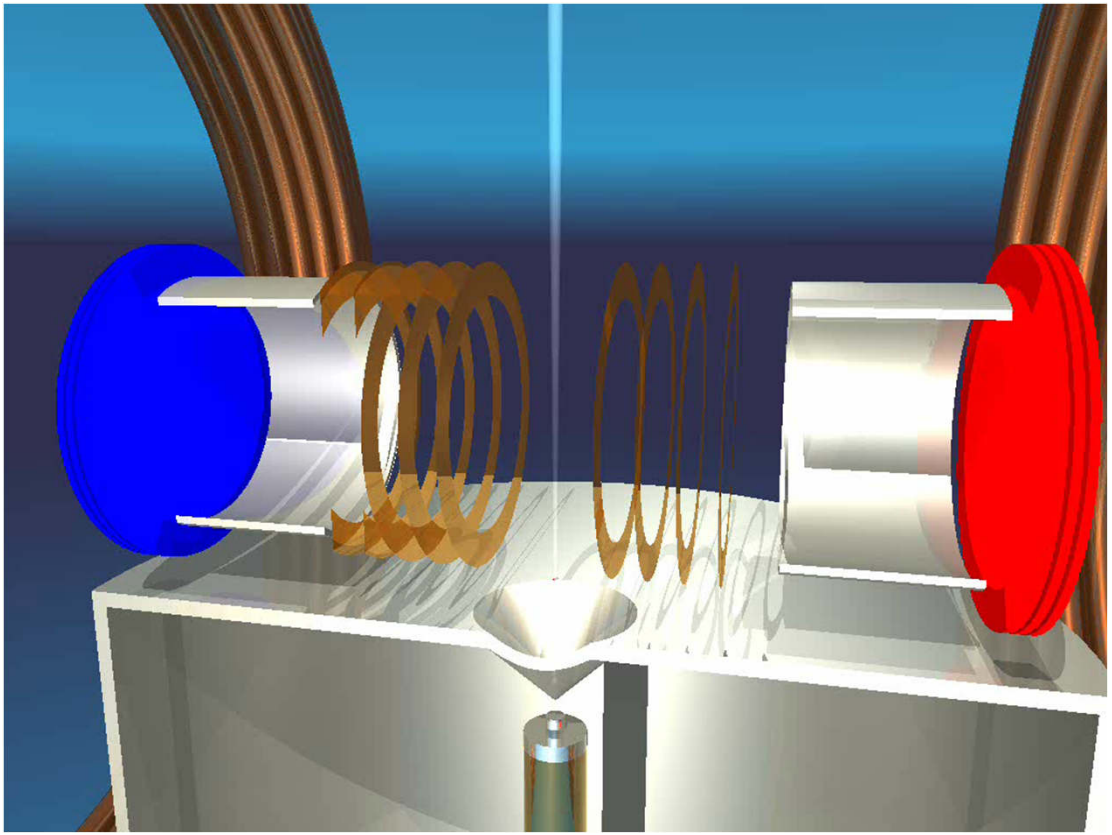
III: Photoelectron recoil and Compton above 40 keV with COLTRIMS



Photoelectron recoil for imaging and controlling nuclear packet

Compton scatting for imaging the electron orbital:
beyond the molecular movie

Photoelectron Recoil with SX (SR)

[1] W. Domcke and L. S. Cederbaum, J. Electron Spectrosc.Relat. Phenom. 13, 161 (1978). For homonuclear diatoms, photoelectron recoil energy goes to vibrational (1), rotational (2), and translational (3) eneries (degree of freedoms).

[2] E. Kukk et al., Phys. Rev. Lett. 95, 133001 (2005).
First observation of C1s photoelectron-recoi-induced vibratoinal excitation in CH4

[3] T. D. Thomas et al., J. Chem. Phys. 128, 144311 (2008)
C1s photoelectron-recoil-induced vibratoinal excitation in CF4

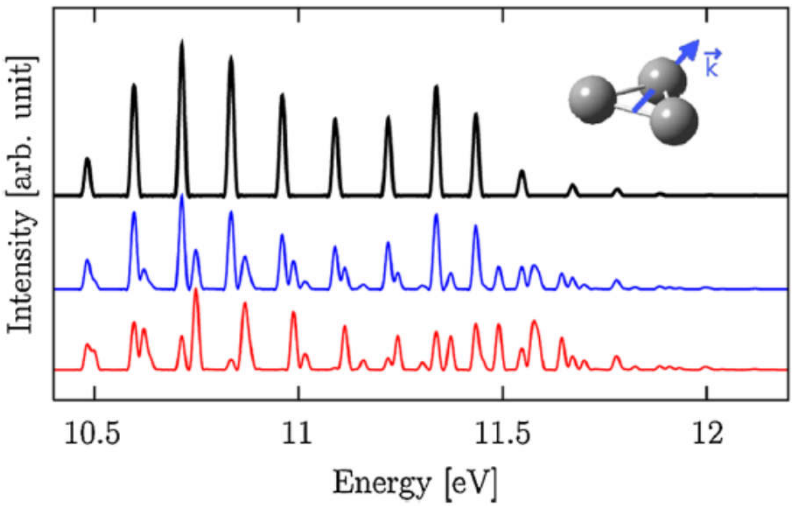
[4] T. D. Thomas et al., Phys. Rev. A 79, 022506 (2009).
Photoelectron-recoil-induced rotational excitation in N2

[5] K. Kreidi et al., Phys. Rev. Lett. 103, 033001 (2009)
Recoil-induced dynamics of ICD – COLRIMS

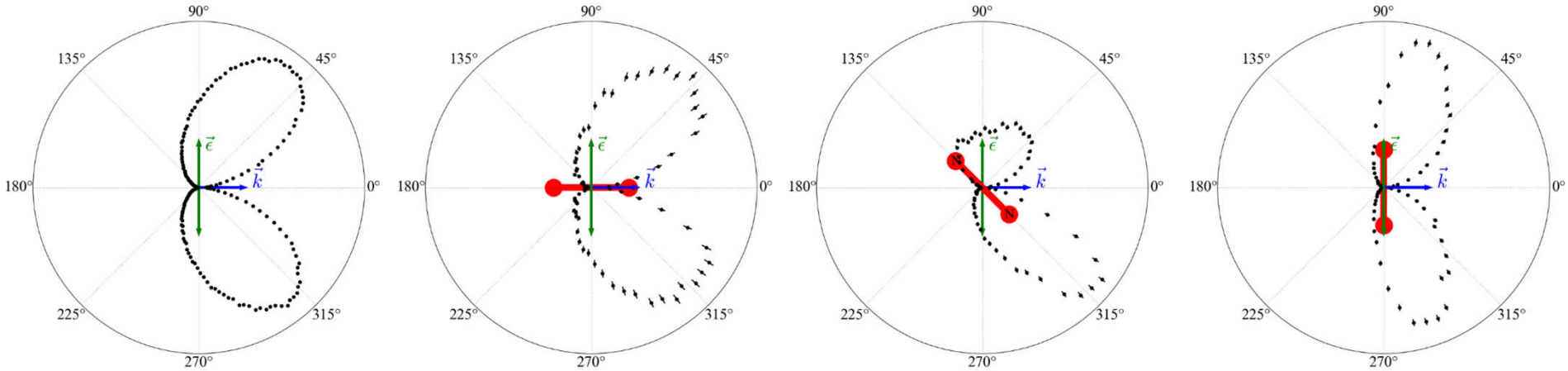
More experiments in Tender X-rays.

….

[6] L. S. Cederbaum and M. Basler,
Phys. Rev. Lett. 103, 133001 (2009)
Nonadiabatic Effects by Photoelectron Recoil
No observation so far…



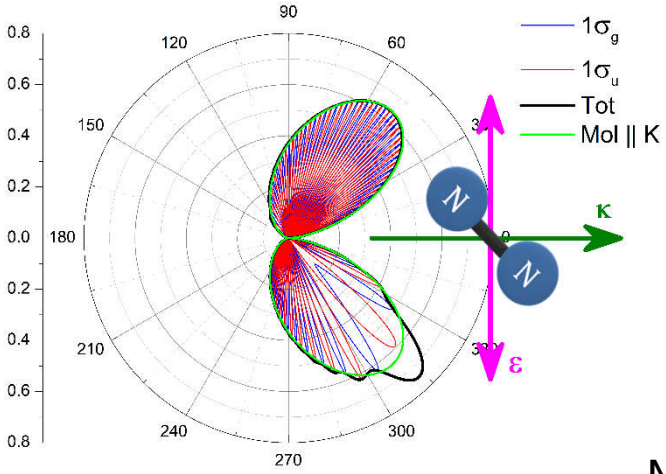
Photoelectron recoil at 40 keV

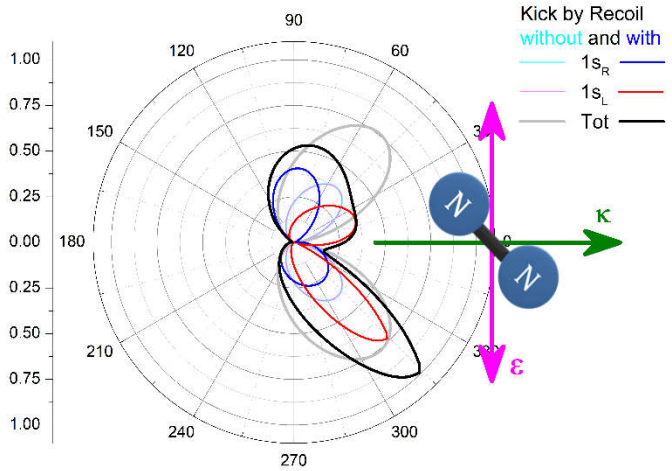


no electron recoil

Theory:

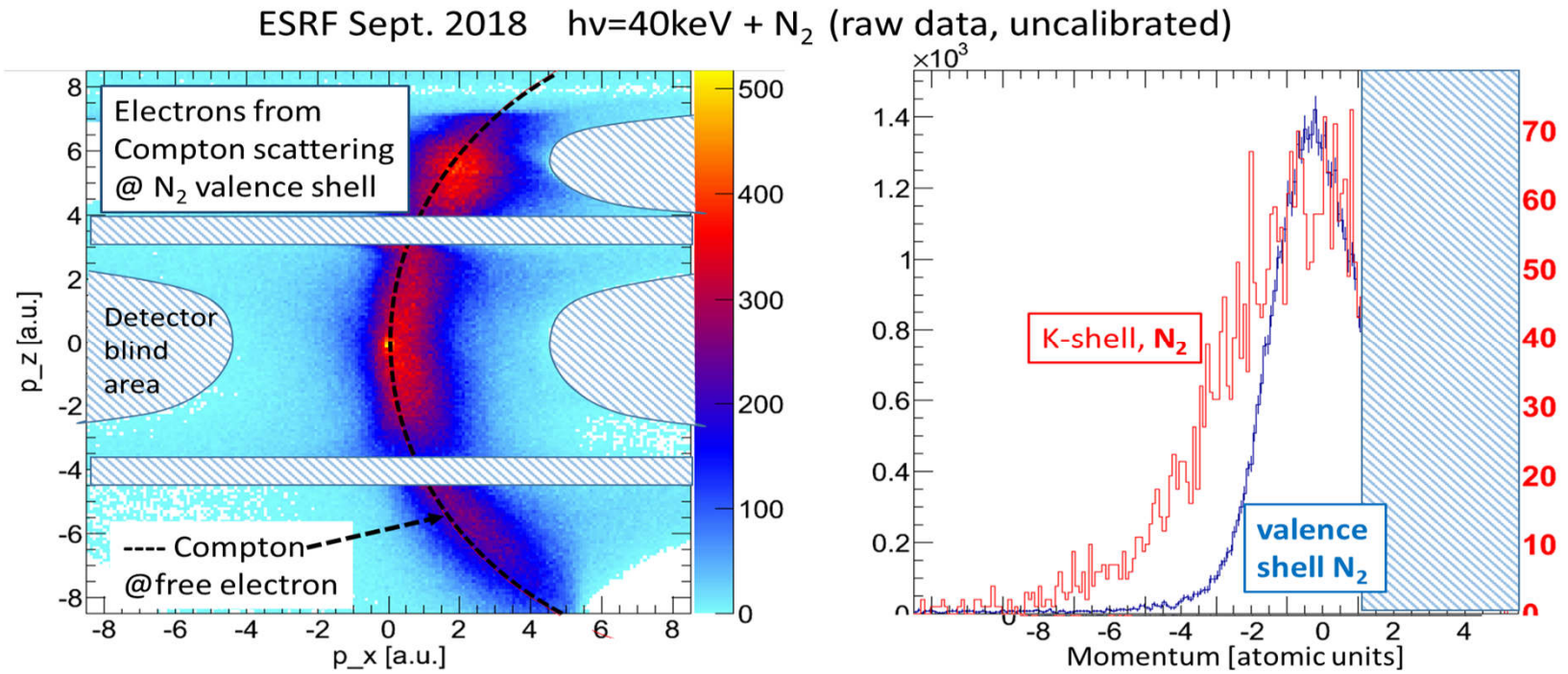
with electron recoil





M. Kircher et al

Compton at 40 keV



i) The molecular orientationan, specifying individual orbital from which the electron was ejected (from the fragmentation).

ii) Taking this together Compton scattering gives momenta of molecular orbitals including correlations.

iii) Taking this to a pump probe experiment to see the electronics wavefunction to evolve in time.

Beyond the molecular movie

M. Kircher et al

Proposed experiment above 40 keV

Exploring Nonadiabatic Effects by Recoil of ~40 keV Photoelectrons probing them by ~20 keV Photoelectrons

Evolution of molecular orbitals by Compton scattering during laser-induced reactions:
beyond the molecular movie

Collaborators

Frankfurt Uni.
M. Kircher
R. Dörner
T. Jahnke
M. Schöffler
J. Rist
M. Waitz
S. Grundmann
I. Vela-Perez
N. Melzer
T. Mletzko
A. Pier
N. Strenger
J. Siebert
R. Renka

DESY
F. Trinter
K. Bagschik

Uni. Kassel
P. Demekhin

Uppsala Uni.
M. N. Piancastelli

UPMC
M. Simon

Turku Uni.
E. Kukk

Tohoku Uni.
K. Ueda