

### Plenarvortrag

PV IV Di 9:15 Audi-A

**“Making the Molecular Movie”: Quest for the Structure-Function Correlation of Biology** — ●R. J. DWAYNE MILLER — Departments of Chemistry and Physics, Institute for Optical Sciences, University of Toronto, Toronto, Ontario, Canada

Femtosecond Electron Diffraction harbours great potential for providing atomic resolution to structural changes as they occur, essentially watching atoms move in real time – directly observe transition states. This experiment has been referred to as “making the molecular movie” and has been previously discussed in the context of a classic gedanken experiment, outside the realm of direct observation. With the recent development of femtosecond electron pulses with sufficient number density to execute nearly single shot structure determinations, this experiment has been finally realized. A new concept in electron pulse generation was developed based on a solution to the N-body electron propagation problem involving up to 10,000 interacting elec-

trons that has led to a new generation of extremely “bright” electron pulsed sources that minimizes space charge broadening effects. Previously thought intractable problems of determining  $t=0$  and fully characterizing electron pulses on the femtosecond time scale have now been solved through the use of the laser pondermotive potential to provide a time dependent scattering source. Synchronization of electron probe and laser excitation pulses is now possible with an accuracy of 10 femtoseconds to follow even the fastest nuclear motions. The camera for the “molecular movie” is now in hand with electron based sources. Atomic level views of the simplest possible structural transition have been obtained under strongly driven conditions (up to warm dense matter conditions) as well as electronically driven atomic motions as a direct probe of the many body electron correlation effects on the forces related to bonding. The overall objective is to extend this approach to biological systems to directly observe the structure-function correlation – the fundamental underpinnings of biology.