General Physics Seminar
Rijnhuizen Seminar Room

19 October, 11:30 hours

Molecular Physics Experiments using FELIX

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In most molecules, infrared light probes the vibrations of the atoms. An infrared spectum of a molecule can give thus important information on its structure. Experiments in the infrared regime are however often difficult due the absence of bright, tunable lasers and sensitive infrared detectors.

Hot gas-phase molecules and clusters have several cooling pathways available. The most common ones are radiation of photons and dissociation. Very strongly bound molecules and clusters, however, have another cooling channel available. They can thermally emit an electron, the microscopic equivalent of the thermionic emission of electrons from heated surfaces. This process can be exploited in a technique for ultra-sensitive, mass-selective, infrared spectroscopy of gas phase molecules and clusters that we call “infrared resonance enhanced multiphoton ionization” (IR-REMPI). In IR-REMPI, the species of interest are irradiated by pulsed, tunable IR radiation from a free electron laser. When the radiation is resonant with a vibrational mode in the molecule or cluster, the absorption of many (several hundred) photons can take place. When the internal energy is high enough, the thermal emission of an electron can take place. The resulting ions can be detected mass selectively in a time of flight mass spectrometer. Monitoring the mass specific ion yield as a function of IR wavelength then yields the IR spectrum of that species. IR-REMPI spectra of fullerenes [1] and metal clusters [2,3] will be presented.

References:
1) G. von Helden, I. Holleman, G.M.H. Knippels, A.F.G. van der Meer, G.Meijer, Phys. Rev. Lett., 79, 5234 (1997).
2) D. van Heijnsbergen, G. von Helden, M.A. Duncan, A.J.A. van Roij, G. Meijer, Phys. Rev. Lett., 83, 4983 (1999).
3) G. von Helden, A.G.G.M. Tielens, D. van Heijnsbergen, M.A. Duncan, S. Hony, L.B.F.M. Waters, G. Meijer, Science, 288, 313 (2000).