MOLECULAR PHYSICS STUDIES WITH FREE ELECTRON LASERS AND MOLECULAR DECELERATORS

GERARD MEIJER, *FOM Institute for Plasma Physics Rijnhuizen, Edisonbaan 14, NL-3430 BE Nieuwegein, The Netherlands, http://www.rijnh.nl, and Department of Molecular and Laser Physics, University of Nijmegen, Toernooiveld 1, NL-6525 ED Nijmegen, The Netherlands*.

At the FOM-Institute for Plasmaphysics 'Rijnhuizen' in Nieuwegein, The Netherlands, intense research activity in the field of molecular physics has recently been started. In the 'molecular dynamics' group, the unique possibilities offered by the 'Free Electron Laser for Inrared eXperimnts' (FELIX) [a], a pulsed laser that is continuously tunable throughout the 5–250 μm region, are exploited. In a variety of double-resonance experiments, IR spectra of neutral and cationic aromatic hydrocarbons and of their rare-gas van der Waals complexes have been recorded [b]. IR multiphoton excitation schemes leading to either dissociation or ionization (thermionic electron emission) are used to unravel IR spectral properties of strongly bonded molecules and clusters [c]. In the 'cold molecules' group, pulsed beams of slow dipolar neutral molecules are produced using an array of time-varying electric field stages [d]. The operation principle of this so-called 'Stark-decelerator' has strong similarities to the operation principle of linear accelerators used for charged particles. The pulsed molecular beams exiting the Stark-decelerator can have translational temperatures in the mK range, while their absolute velocity can be tuned over the 300–10 m/s range. These beams hold great promise for a variety of (novel) molecular beam studies, and are ideally suited as an injector for a trap and/or storage ring for neutral molecules.

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