Applied Mathematics

McGill & CRM Applied Mathematics Seminar

2:35 pm Monday 29th March 2004
At McGill, Burnside Hall 1205

Molecules in Intense Laser Fields- Femto to Atto second Quantum Dynamics in the Nonlinear Nonperturbative Regime via Supercomputer Simulations

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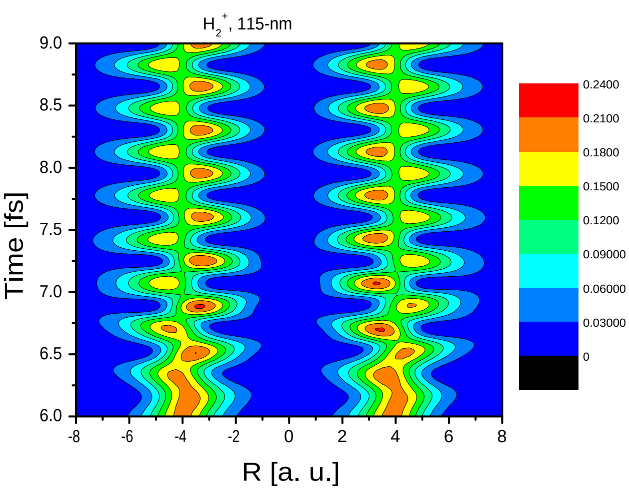
Coffee and refreshments will be served after the seminar

Abstract: Current laser technology allows for the creation of ultrashort ($t < 10$ femtosec (10^{-15} sec)) intense ($I > 10^{14}$ W/cm^2) laser pulses. Such intensities create electric fields exceeding the internal Coulomb forces in atoms and molecules. and such short times allow for the visualization and control of electrons and nuclei on their natural timescales, from femto(10^{-15} sec) to atto (10^{-18} sec). Numerical simulations of the nonlinear nonperturbative response of electronic and nuclear motion of matter in the presence of such pulses require solutions of the time-depenedent Schroedinger equation, which is a multidimentional ($N > 3$) PDE. These simulations have been at the forefront of research in this new area of science of matter exposed to extreme conditions, and have led to considerable advances in the experiments. In particular CFI has just funded the creation at INRS-Varennes of an international center in laser science, in order to develop this nonlinear science. Examples of numerical methods and problems encountered in such simulations will be presented illustrating the search for "control" of electrons and nuclei from molecular to nuclear physics, the "Holy Grail" of modern science.



Electron density in the 3-body problem: H2+, 1 electron + 2 protons illuminated by an attosecond pulse (600 asec= 6×10^{-16} sec) thus inducing the electron to jump periodically from one proton to the other on a 350 asec time scale.