P6 66 Producing Rydberg States of Helium Using STIRAP* O. KRITSUN, B. DIETZEK, H. METCALF, *Physics, S.U.N.Y. Stony Brook NY 11794-3800 USA* We are building a system to produce a beam of He Rydberg atoms for atom optics such as collimation, deflection, slowing, or acceleration by inhomogeneous electric fields[1]. We plan to use STIRAP[2] because it enables the transfer of most of the atoms from $2\ ^3S$ to the Rydberg states with modest laser power, and is very tolerant of experimental conditions such as intensity and frequency fluctuations, Doppler shifts, etc. The atomic population is adiabatically driven from the metastable 2^3S state to the *ns* or *nd* states using $\lambda = 389$ nm and $\lambda \sim 790$ nm light that couples through the 3^3P state without ever populating it. The *uv* light is produced by frequency doubling the output of a Ti:Sapphire laser that is locked to the He* transition by saturated absorption in a weak discharge. For the *ir* light, we lock one spectrally-narrowed diode laser to the Rb transition at $\lambda = 780$ nm, and then lock a cavity to this beam. The $\lambda \sim 790$ nm light from a second narrowed diode laser is then locked to the same cavity, separated by polarization. It will be tuned to the Rydberg states by an AOM whose frequency ranges up to half that of the cavity's FSR.

*Supported by ONR, NSF, and ARO

[1]F. Tudorica et al., *Bull. Am. Phys. Soc.* **43**, 1365 (1998).
[2]U. Gaubatz et al., *J. Chem. Phys.*, **92**, 5363 (1990).

P6 67 Semiclassical Treatment of Complex Atoms in External Fields* BRIAN E. GRANGER, *ITAMP, Harvard-Smithsonian Center for Astrophysics* CHRIS H. GREENE, *JILA and the Department of Physics, University of Colorado* We report progress in the theoretical description of complex atoms in external electric and magnetic fields. While semiclassical methods have had great success in describing the photoabsorption spectrum of light atoms (H, He, Li) in these environments, more complex atoms involve a number of difficulties. More specifically collisons between the Rydberg electron and the complex ionic core must be included. We have formulated a very general treatment of these systems using semiclassical scattering matrices and quantum defect theory. After describing the general features of our approach, we show results for nontrivial cases, such as rubidium in a strong magnetic field.

*Funded in part by the U.S. Department of Energy, Office of Science

P6 68 Classically Scaled Quantum Calculations for Direct Comparison with Experimental Scaled Energy Spectra J.D. WRIGHT, *Wesleyan University* F. STAEHLE, *Wesleyan University* H. FLORES-RUEDA, *Wesleyan University* R. BLUMEL, *Wesleyan University* T.J. MORGAN, *Wesleyan University* The classical equation of motion for the Stark Effect in Hydrogen obeys a scaling relationship between the energy and field strength. The same scaling relationship does not hold for the corresponding quantum system. However maintaining the classical scaling relationship between the energy and field strength in experimental spectroscopy of the quantum system enhances its classical features. We present a method of solving the Schrodinger Equation in a way that maintains the classical scaling. Using this method, we model the experimentally measured absorption and recurrence spectrum of Rydberg Helium atoms in an electric field.

P6 69 ATOMIC AND MOLECULAR COLLISIONS AND INTERACTIONS

P6 70 Molecular Transition Moments at Large Internuclear Distances XI CHU, ALEX DALGARNO, *ITAMP, Harvard-Smithsonian Center for Astrophysics* The long range behavior of the transition moment at large internuclear distances in heteronuclear molecules is important in determining the profiles of absorption and emission lines of gaseous mixtures near the line centers. We analyzed the behavior of the dipole moments of molecular transitions as a function of the internuclear distance R for asymptotically allowed transitions. We show that for a heteronuclear system which separates to a pair of atoms, one of which may be excited but not the other, the departure of the dipole moments from the limiting atom value varies as R^{-3} with a coefficient that may be obtained from the dynamic polarizability of the unexcited atom evaluated at the transition frequency of the other atom. The formula is useful in predicting the behavior of the dipole moments with R and in assessing the accuracy of *ab initio* calculations.

P6 71 Quantum mechanical study of the $F + H_2(v = 0, j = 0 - 1)$ reactions in the temperature range 50 − 500K CHENG ZHU, NADUVALATH BALAKRISHNAN, ALEX DALGARNO, *Institute for Theoretical Atomic and Molecular Physics, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, Massachusetts 02138* Quantum mechanical reactive scattering calculations have been performed on the $F + H_2(v = 0, j = 0 - 1)$ system. With the inclusion of the total angular momentum up to $J = 20$, we have obtained rate coefficients for both para- (j=0) and otho- (j=1) H_2 in the temperature range 50 − 500K. The calculated rate coefficients are in good agreement with experimental data and consistent with previous theoretical values.

P6 72 Singlet oxygen quenching rate in pure oxygen and gas mixture B. V. ZHDANOV, D. K. NEUMANN, T. HENSHAW, R. J. KNIZE, M. P. MURDOUGH, *Laser and Optics Research Center, U. S. Air Force Academy, CO 80840 USA* The collisional deactivation of the lowest singlet states of molecular oxygen is of great interest for many applications An interesting feature of these collisions which has been proposed is that the singlet sigma state is quenched exclusively to the singlet delta state and not to the ground state. Direct measurement of this fraction is not very easy task because of very long life time of the singlet delta state (more than 60 minutes) and a long wavelength of the fluorescence emission (1268 nm). In this report we present the first direct measurement of the decay rates of the excited metastable molecular oxygen singlet states as functions of ground state oxygen pressure and of the pressure of other buffer gases: Ar, He and N_2. A steady state model for determining the quenching rate of the singlet sigma state into the singlet delta state by oxygen was developed. These results yielded a branching fraction into the singlet delta state that is near unity. The main uncertainty factor in these calculations is a value of the natural lifetime of the oxygen singlet states.