ANDREWS PHYSICS FAQ SHEET

Faculty Research Interests

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THEORETICAL AND EXPERIMENTAL OPTICAL SPECTROSCOPY
The unique optical properties of the lanthanide elements in solid state media have found a wide array of important technological uses in the past few years, with much current research progressing in diverse areas such as laser cooling, self-doubling and summing lasers, and the development of new luminescent materials that will be required for mercury-free fluorescent lamps and plasma displays. The work done here develops new methods of calculating and interpreting measured crystal-field energy levels and transition intensities in solid state media – the spectroscopic data necessary for the development of next-generation optical devices incorporating lanthanide elements.

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ATOMIC THEORY, PHOTOIONIZATION STUDIES, AND ASTRONOMY.
Photoionization of atoms is an ideal method to probe the various ways in which electrons interact with each other. Dr. Kutzner works along with students to develop theoretical techniques to incorporate many-electron effects such as core-relaxation and core-polarization in the photoionization of atoms and ions. Whenever possible, calculations are compared with experimental results from synchrotron facilities. Much of this work is applicable to astronomy and x-ray imaging. Dr. Kutzner has published articles in scholarly journals which have included a dozen undergraduate students as coauthors on the manuscripts. This work is funded in part by a grant from the National Science Foundation.

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SPECIAL AND GENERAL RELATIVITY, COSMOLOGY, LABORATORY EQUIPMENT DESIGN
Development and design of laboratory experiments that illustrate fundamental laws of physics in a clear and insightful manner.

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HIGH ENERGY PARTICLE INTERACTIONS AND JETS
The strong force *(ie. the nuclear or "color" force)* is not well understood. Neither is the structure of the proton. Collisions between protons and electrons make it possible to explore a number of models by which something may be said about the distribution and properties of matter within the proton and the mechanisms that drive the energy evolution during an interaction. Beams are accelerated in the Deutsches Elektronen-Synchrotron (DESY) and injected into the HERA storage ring where they intersect and create a spray of new particles which are detected by ZEUS tracking and calorimeter components. Analysis of the experimental data is supported by an extensive computer farm and Monte Carlo simulated data generated in a global distributed computing environment. Occasionally Andrews students have helped with handware testing *(eg. the Barrel PreSampler)* and installation *(eg. the Straw Tracker)* as well as analysis projects.

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SOLID STATES AND MATERIAL SCIENCE
Research in association with Stanford University, Argonne National Labs, and Brookhaven National Lab has yielded some of the purest sulfur available. Studies are made using xray synchrotron radiation.