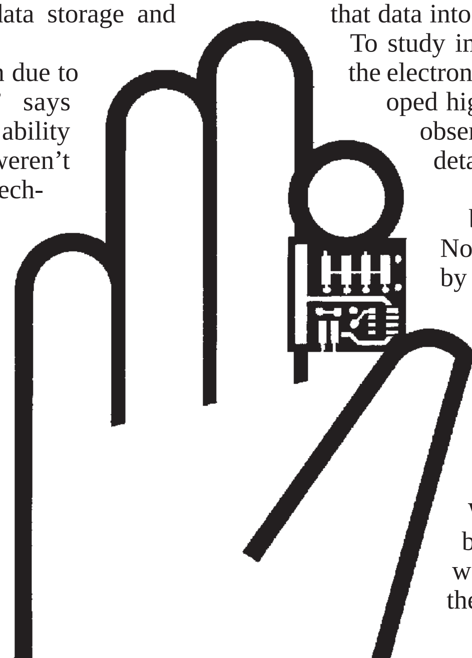
Nanostructure in Computer Memory

New atomic-scale materials will allow computer manufacturers to pack more computer memory into ever-smaller spaces and at less cost. That's according to Prof. **Dan Waddill** who is studying the new materials. These materials, often called "nanoscale" materials because of their extremely small size, will result in a 20- to 30-fold increase in a computer's storage capacity over the next several years. Computer manufacturers are beginning to use the newly created atomic-scale materials for data storage and retrieval in computer hard drives and disks.

"Prices of computers keep coming down due to enhancements in materials processing," says Waddill. "We have had a real takeoff in our ability to fabricate materials and structures that we weren't capable of doing until very recently. This technology is showing up in your day-to-day life, whether you realize it or not."



These materials are composed of tiny superstructures made of a combination of layers of different metals or substances three to ten atoms thick. "They are very small, and it's only recently have we been able to grow these materials in a reproducible fashion," Waddill says.

Waddill hopes to learn why atomic-scale layers produce different properties than the same combination of metals or substances in bulk form. Some nanoscale materials, such as layered metals, are stronger than metals produced in the traditional way.

"The exciting thing about these layered structures is that they exhibit a huge enhancement in magneto-resistance," Waddill explains. Data storage potentially increases by 20 to 30 times in computers and tape recorders with the improved magneto-resistance these materials bring. A small metal "needle" sees each magneto-resistance variation as a piece of data and translates that data into useable information.

To study improved magneto-resistance, Waddill excites the electrons of these tiny materials with a recently developed high powered X-ray beam. This allows him to observe the materials distribution, as well as the detailed structure on an atomic scale.

This research will be substantially aided by the ultra high vacuum system that alumnus Norman Pond (BS '59) arranged to be donated by Intevac, Inc., reported elsewhere in this Newsletter.

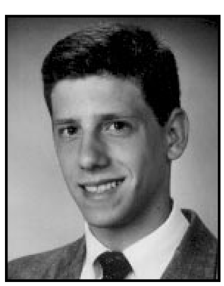
Although researchers know how to create these new materials with high magneto-resistance, much remains unknown about them.

"What we don't really understand is why these materials work the way they do," Waddill says. "Understanding the physics behind the magnetic properties is where I would like to come in. If we understand how they work, chances are we'll be able to make better materials than we do now."

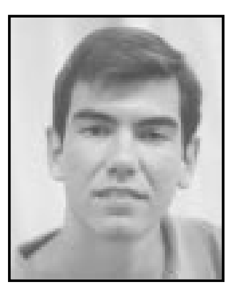
Two Undergraduates Are National Research Winners

Two physics majors, **Dan Chitwood** and **Chris Maloney,** were winners this year in the annual undergraduate research competition sponsored by the Division of Atomic, Molecular and Optical Physics (DAMOP) of the American Physical Society. Both Dan and Chris do research under the supervision of Prof. **Don Madison.**

An international committee of physicists selected the five winning undergraduate from across the nation. All expenses of each winner will be paid to attend the annual DAMOP meeting this May in Santa Fe, NM, where they will be honored at a special ceremony. They have also been invited to present talks about their research.



Dan Chitwood



Chris Maloney

Dan examined competing ionization processes in electron-atom collisions. In one ionization process, the incident electron knocks a second electron out of the atom. In a competing process known as autoionization, the incident electron excites an atomic electron into an unstable state. An electron is ejected when the atom decays back to its ground state. Quantum mechanics predicts an interference pattern from the competing decay processes. Dan has calculated its expected form and will compare his predictions with experimental measurements being performed at the University of Kentucky.

Chris is studying electron impact excitation of laser-excited argon. His earlier work on ground-state argon will soon be published in the *Journal of Physics B.* Experiments are now underway at the University of Wisconsin on excited atoms like those studied by Chris. At Santa Fe, he will compare the predictions of his calculations with the new experimental data.