

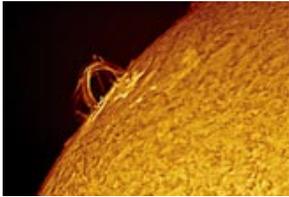
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PHYSICS REPORT ON THINGS OF NOTE

VOLUME 7 NUMBER 6

Summer Research News



Sun Might Hold Secret of Dark Matter

Source: *Space.com*
The identity of the mysterious dark matter thought to pervade the

universe has eluded astrophysicists for decades. Now, for the first time a team hopes to look inside the sun for one of the prime candidates. The invisible stuff called dark matter is thought to make up as much as 90 percent of the universe's matter. To date, astrophysicists have only inferred the existence of some mysterious substance by identifying its gravitational effects on visible matter such as stars and galaxies. (For instance, dark matter makes galaxies spin faster than otherwise expected.)

Two hypothetical particles have become the prime suspects to explain the fundamental make-up of dark matter: so-called axions and WIMPs (Weakly Interacting Massive Particles). Tens of teams are on the hunt for the heavyweight WIMPs, such as the GLAST team, which hopes to detect the gamma rays produced when, hypothetically, WIMPs and their antimatter selves annihilate each other. Only a handful of groups are searching for the lightweight particles called axions. For both sociological and technical reasons, WIMP searches far outnumber axion ones, according to **David Tanner**, a physicist at the University of Florida, and others. For instance, he said, detectors for WIMPs build more on the expertise of many astrophysicists. In addition, these massive particles are more fantastical. "WIMPs also imply things about supersymmetry and extra dimension," Tanner told *SPACE.com*. "And so if they were detected, they would give theorists lots of new toys to play with, and new ideas to follow.

Read full article at: <http://www.space.com/scienceastronomy/080617-st-dark-matter.html>

Physicists tweak quantum force, reducing barrier to tiny devices

Source: *UF News*
Cymbals don't clash of their own accord – in our world, anyway.

But the quantum world is bizarrely different. Two metal plates, placed almost infinitesimally close together, spontaneously attract each other.

What seems like magic is known as the Casimir force, and it has been well-documented in experiments. The cause goes to the heart of quantum physics: Seemingly empty space is not actually empty but contains virtual particles associated with fluctuating electromagnetic fields. These particles push the plates from both the inside and the outside. However, only virtual particles of shorter wavelengths — in the quantum world, particles exist simultaneously as waves — can fit into the space between the plates, so that the outward pressure is slightly smaller than the inward pressure. The result is the plates are forced together.

Now, University of Florida physicists have found they can reduce the Casimir force by altering the surface of the plates. The discovery could prove useful as tiny "microelectromechanical" systems — so-called MEMS devices that are already used in a wide array of consumer products — become so small they are affected by quantum forces.

"We are not talking about an immediate application," says **Ho Bun Chan**, an assistant professor of physics and the first author of a paper on the findings that appears in the online edition of the journal *Physical Review Letters*. "We are talking about, if the devices continue to be smaller and smaller, as the trend of miniaturization occurs, then the quantum effects could come into play."

Read full article at: <http://news.ufl.edu/2008/07/14/quantum/>

Scientists edge closer to unlocking secrets of mysterious Crab Pulsar

Source: *UF News*

Like a celestial top, the spinning neutron star known as the Crab Pulsar is slowing, a phenomenon that astronomers have yet to fully understand. Now, researchers with the Laser Interferometer Gravitational Wave Observatory Scientific Collaboration — an international collaboration headed by a University of Florida physicist — have ruled out one long-hypothesized cause: emission of gravitational waves. "We can now say definitively that gravitational waves play only a minor role at best in this phenomenon," says **David Reitze**, a UF professor of physics and spokesperson for the collaboration. "Our measurements tell us that no more than 4 percent of the energy loss of the pulsar is caused by the emission of gravitational waves." **Read full article at:** <http://news.ufl.edu/2008/06/02/crab-pulsar/>

Upcoming Fall 2008 SEMINAR Schedule

Astrophysics
Fridays @ 4:00pm in
Room 2165 NPB

**Condensed Matter
Physics**
Mondays @ 4:05pm
in
Room 2165 NPB

**High Energy
Physics**
Tuesdays @ 2:00pm
and Fridays @
2:00pm in Room
2165 NPB

**Physics
Colloquium**
Thursdays @ 4:05 in
Room 1002 NPB

Quantum Theory
Wednesdays @
4:05pm

EDITORS
Alan Dorsey, Chair
Pam Marlin



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Faculty attend Spring & Summer Meetings

Symposium on Coupled Cluster Theory



Professor Rod Bartlett was the primary organizer of a 5 week workshop at the Institute of Nuclear Theory, University of Washington, Seattle, on coupled-cluster theory, June 23- July 25, 2008. The workshop brought together nuclear physicists, atomic physicists, and quantum chemists that are all using coupled-cluster theory (as developed in quantum chemistry) in their disciplines. In fact, several nuclear physicists reported on using CCSD, CCSD[T], CCSDT-1 and EOM-CC in their

applications, all of which were first introduced by Bartlett's group. In atomic physics the emphasis is on relativistic effects and particularly the parity violation problem. To get the accuracy required also demands coupled-cluster theory. Their main tool is what quantum chemists would call the Fock-Space CC method, as they want to describe a few electrons outside a core.

During the second week of the meeting, a Symposium on Fifty years of Coupled-cluster theory was held, honoring three of the founders, Herman Kuemmel, Jiri Cizek, and Joe Paldus. The symposium attracted approximately 50 people including UF speakers, **Henk Monkhorst**, who gave an invited talk on his idea to go beyond the Born-Oppenheimer approximation for molecules with the coupled cluster method, **So Hirata**, **Monika Musial**, **Andrew Taube**, and **Bartlett**. In connection with this meeting, Bartlett was also asked to present a talk on Ab Initio DFT" to describe how we tie CC theory to DFT in chemistry for the UNEDF group (Universal Nuclear Energy Density Functional) at Pack Forest, outside Seattle.

CLEO CONFERENCE

OPTICS | CONVERSATIONS

OPN Talks with ...

David Reitze

LIGO Expert and CLEO/QELS Plenary Speaker

Angela Stark



David Reitze works with the Laser Interferometer Gravitational-Wave Observatory (LIGO) on developing large-scale gravitational wave interferometers, the world's largest precision optical instruments. LIGO was designed to probe the universe in a fundamentally new way by detecting gravitational waves, which occur as a result of violent events

a strain of roughly 10^{-21} (a hair) in the LIGO interferometer. That's roughly the equivalent of measuring the diameter to the nearest atom, Alpha Centauri, to the width of a human hair. To put it another way, LIGO measures the change in distance of two mirrors separated by 4 km to less than 10^{-10} m.

There are many sources of noise that

from the coalescence of binary neutron star systems.

>> What is needed to develop a laser that will help detect gravitational waves?

Laser developments for gravitational wave interferometers is fairly mature. In the short term, the real need lies in develop-

Professor David Reitze gave a plenary presentation on LIGO (Laser Interferometer Gravitational Wave Observatory) at the 2008 Conference on Lasers and Electro-optics (CLEO) in San Jose, California on May 5, 2008 which garnered a lot of press.

Approximately 1000 people were in the audience. The PowerPoint slides and audio of the plenary presentations can be viewed at http://www.cleoconference.org/Conference_Program/plenary.aspx

To read an interview given by Reitze (*above image*) to Optics and Photonics News (the optics world equivalent of Physics Today) prior to the CLEO meeting please visit <http://www.phys.ufl.edu/publications/downloads/reitze-interview.pdf>

AAPT MEETING

For the national AAPT (American Association of Physics Teachers) meeting, **Robert Deserio** was a presenter for the Advanced Lab Workshop held at the University of Alberta Physics Department in Edmonton, Alberta, Canada. The photos show DeSerio discussing

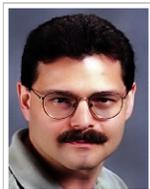


DeSerio pictured far right



DeSerio pictured far left

the dynamic light scattering experiment from PHY4803L advanced physics laboratory with various attendees and other presenters.



Faculty News

Andrew Rinzler has been promoted from the rank of Associate Professor to the rank of Professor, effective August 16, 2008. Congratulations to Andrew on this well-earned distinction!



Student News

Scholarship received for summer

Daniel Pajerowski, a 3rd year graduate student working with **Professor Mark Meisel**, received a full scholarship, including travel and room and board support, to attend the 5th Annual LANSCE Neutron Scattering School, which focuses on magnetism in bulk and nanostructured materials as investigated by neutron elastic and inelastic scattering. The school was held at Los Alamos National Laboratory in New Mexico from July 23 to August 1, 2008 and was supported by the US Department of Energy.

Preliminary Exam information for Fall 2008

The next Preliminary Examination will be given on:

Thursday, August 21, 2008

- o Part A: 9am to 12pm
- o Part B: 2pm to 5pm

Friday, August 22, 2008

- o Part C: 9am to 12pm
- o Part D: 2pm to 5pm

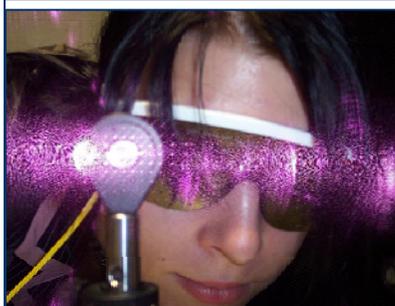
Please meet in 1213 NPB about 15 minutes prior to the starting time of the examination. Please bring pencils, calculators, and standard math tables (if you think you will need them). If you have any questions, please contact **Professor Khandker Muttalib**, muttalib@phys.ufl.edu. Results of the Prelim Exam are expected to be known shortly thereafter.

New Graduate Coordinator



Professor Jim Fry will take over as graduate coordinator in early August when current coordinator, **Professor Steve Hill**, leaves the department to take a position as the Director of the Electron Magnetic Resonance program at the National High Magnetic Field Laboratory in Tallahassee; the position comes with a tenured faculty appointment in the Florida State University Department of Physics.

REU *Research Experience for Undergraduates - Summer 2008*



Darsa Donelan (Massachusetts College of Liberal Arts) works on the LISA project under the mentorship of **Prof Guido Mueller**

Each summer the Department of Physics hosts a 10-week summer research program for students contemplating a career in the physical sciences. Supported by the National Science Foundation and UF, the REU program services 15 undergraduates per year, drawn to Gainesville from all over the country.

The Summer 2008 program included:

- Mentored research on individual projects (experiment or theory)
- Scientific seminars, lab visits, and communications workshops
- Joint activities with other REU sites UF and the NHMFL
- Social activities on and off campus
- End-of-summer research symposium presented by Site participants

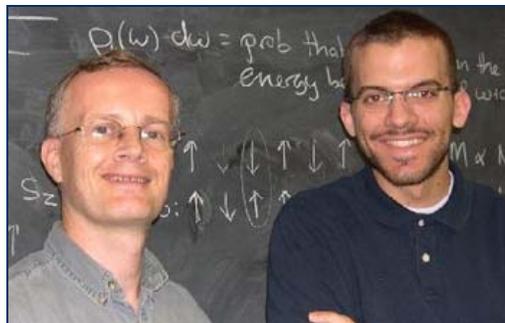
The program also supports follow-up presentation by participants at local and national scientific meetings.



Group photo of REU participants



Peter Lunts (Indiana University) working in **Prof Mark Meisel's** lab



Prof Kevin Ingersent (I) worked with **Brian Friesen** (Oklahoma Baptist University)



Around the Department

Newly Constructed Evaporation Chamber

The thermal evaporation chamber integrated with the glove box allows for fabrication of devices using air-sensitive materials in an inert atmosphere free from oxygen and water. Samples are loaded into the system from the adjacent cleanroom. Devices to be fabricated will include: light emitting diodes, thin film transistors, and solar cells using novel materials in new device architectures.



Bill Malphurs, Engineer with the Physics Machine Shop, is pictured with the chamber at its earlier stage. Malphurs assisted in construction of the chamber.



Front view showing the evaporation chamber enclosed by the glove box.



Mitchell McCarthy, student with Professor **Andrew Rinzler**, is pictured with the chamber and instrumentation to the right. Both chamber doors are open allowing line of sight view clear through the chamber.



Inside view of the chamber from the front. Crystal monitor on top with turbo pump block plate attach behind. 4 pocket evaporation source with pneumatic shutter.



Rear view of the chamber showing the turbo pump on top and feedthroughs for the ionization gauge (right of turbo pump) and crystal monitor (left of turbo pump). Box shaped piece of metal on the left is the counterweight which allows easy opening and closing of the door.

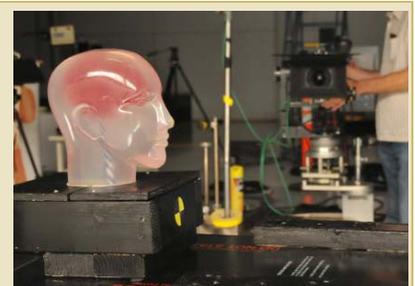


Rear view of the entire system. Bottom right is the purifier (blue box with white door). On top of the purifier is the instrumentation panel consisting of the power supply, ionization gauge controller, source selector, turbo pump controller and evaporation PID controller. Between the chamber and the instrumentation panel is the stainless steel piping and valves for the purifier and solvent trap.

Physics Demonstrations Used



John Mocko (photo left), Senior Teaching Lab Specialist with the Physics Department, was recently involved in building some physics demonstrations for a movie on the physics of injuries that occur inside the body during car crashes. Mocko worked with the Insurance Institute for Highway Safety at the Vehicle Research Center Car Crash Test Facility outside Ruckersville, Virginia. Included in the experiments he built was the red "brain" (photo right) in a clear head that showed the acceleration that the



brain goes through during a crash. In addition to copies of the completed film, Mocko will also receive high speed footage of the experiments that might be useful for PHY 2053 classes. Thousands of dollars were spent filming Mocko's experiments. "It was a bit surreal to see something I built in my garage being used in such an elaborate setting," say Mocko, "Everything worked well and the director liked what he saw at the time." Mocko also mentioned that he witnessed a live car crash where they performed a side impact on a 2009 Ford Flex SUV/Crossover vehicle. It was hit with a 3,500lb sled car traveling at 31 mph. It was an impressive show. In return for his services the department will receive a black and white high speed video camera system that shoots 500 to 3000 frames per second. To see more photos of the movie shoot please visit http://picasaweb.google.com/John37m/VRC_Movie?authkey=k_BleKWadK0.

