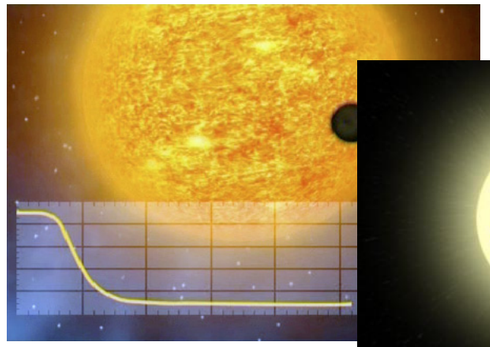
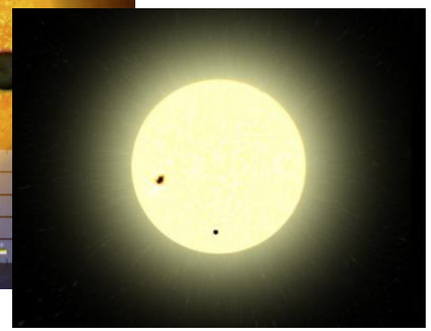
A New Planet
COROT-EXO-7b

by Alicia Swift

The smallest planet known outside our planetary system was found earlier this month by the French-led "COnvection ROtation and planetary Transits" (COROT) mission, with Austria, Belgium, Germany, Spain, and Brazil as supporting countries.





Dubbed COROT-Exo-7b, the planet has an orbital period of about 20 hours and a diameter 1.7 times that of the earth. Its surface temperature is in the range of 1000 to 1500 degrees Celsius. The central star is located 390 light years from Earth in the Monoceros constellation, which is Greek for "unicorn".

In addition to being the smallest planet yet found, COROT-Exo-7b is believed to have similar composition to Earth, with a rocky surface covered in either lava or water vapor. With further study, it could prove the existence of an "ocean planet" which initially is partially covered in ice until it moves closer to its star. The ice would melt and form immensely deep oceans with unknown chemical and physical properties.

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Detecting Gravity Waves

By Bryce Bolin

One of the most monumental discoveries in physics may have just recently occurred. A couple weeks ago, it was reported that the GEO 600 gravitational wave detector in Sarstedt, Germany was receiving a strange and as yet unidentified signal. Fermilab physicist, Craig Hogan, claims to have found an explanation that this noise is a result of the holographic principle in the GEO 600 data. New experiments will be carried out in the coming months to verify Hogan's hunches. Hogan speculates that the mirrors in an interferometer wander in short steps relative to each other in quantities near the Plank length, 1.6×10^{-35} m, which will sum up to a measurement as large as what a gravitational wave would produce.

The holographic principle states that the entire universe can be described in two-dimensions, splattered on a palette comprised as an observable boundary. This implies that the actual universe is many times larger than our observable universe, where observation in three dimensions is only effectively descriptive at low energy levels.

The GEO 600 is capable of detecting gravitational waves between frequencies 50hZ and 1.5 KhZ. To verify if the noise is caused by the holographic principle, the detector's sensitivity will be shifted to a higher range. The range of the detector is adjusted to where the detection sensitivity is strongest for a particular phenomenon from black hole mergers to supernovae. Holographic noise found at higher frequencies corresponding with the noise found at the lower frequency will provide a strong basis for further investigation.

Like the implication in the data for a holographic universe, other interesting and surprising discoveries may occur as gravitational wave detector technology is developed and improved. For the GEO 600 detector, the vacuum chamber in which microscopic quantum convolutions are observed will be replaced with a squeezed variation and a mode filter will be added to the vacuum chamber. Unlike it's larger cousins, such as the LIGO detector, the GEO 600 uses its beam splitter's lateral movements and relies on signal recycling to make up for its smaller design. However, holographic noise makes a lateral signal, thus implying that the GEO 600 is the only gravitational wave detector currently available to test

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Development in Physics:
The Search For Dark Matter

by Victor Albert

During the 1930s, a scientist named Fritz Zwicky discovered that the masses of clusters of some galaxies were 400 times more than Newton's Laws allowed. The scientific community has studied thousands of galaxies since, and has shown that there is an inconsistency between the velocity and mass distributions of those galaxies and Newton's laws, i.e., one of the two are "wrong." Since stating that Newton's laws are incorrect is like taking a brick out of the foundation of physics, high energy physicists are in general agreement about which theory is more likely incorrect. They theorize that there is mass out there that we can't see, aptly named "dark" matter. In addition, the multi-pole decomposition of the anisotropy of the microwave background radiation (look it up) claims that 22% of the universe is composed of matter that we have yet to see.

Since the '30s, there have been a multitude of different dark matter candidates proposed. These candidates are either baryonic or non-baryonic . Baryonic matter consists of baryons, sub-atomic particles that interact with ordinary matter via electromagnetic forces. Non-baryonic matter is postulated to consist of exotic particles which have no electromagnetic interaction and do not contribute to the formation of elements. As of today, physicists are quite sure that dark matter makes up about 22% of the universe, and they also know from recent cosmic microwave radiation experiments that baryons can make up about 16% of that dark matter. Thus what remains is postulating the make-up of non-baryonic matter.

Non-baryonic matter consists of various particles that theorists have postulated. It can be classified further into "hot" particles (particles moving very close to the speed of light), and "cold" particles (which travel in the non-relativistic limit). The primary concentration has been on cold dark matter, in which the primary candidates are WIMPS (Weakly Interacting Massive ParticleS, such as neutralinos and Kaluza-Klein particles) and axions. Previously, the leading candidates were the neutralino and the axion. The neutralino arises from supersymmetry, an extension of the standard model that postulates that every particle has a corresponding supersymmetric particle of different spin. The axion, an extremely light particle (compared to the neutralino), is a postulated particle from quantum chromodynamics. Previously, axions and WIMPS were believed to be indistinguishable, but very recently, Professor Pierre Sikivie and Qiaoli Yang have shown that axions actually form a Bose Einstein condensate (BEC), something that WIMPS do not do, thus making axions distinguishable from other WIMPS. Sikivie and Yang found that axions are better dark matter candidates than other WIMPS because:

1. Other Cold Dark Matter (CDM) has a smaller scale structure than axions. In other words, if CDM were the proper dark-matter candidate, the universe would be much clumpier than it is. Simulations say that the number of clumps in CDM would lead to many more massive objects in the universe (such as

CONTINUED ON INSIDE

who we are

UP is a monthly undergraduate physics newsletter sponsored by the University of Florida's chapter of the Society of Physics Students, for students, by students. We seek to strengthen the undergraduate physics community at the University of Florida by providing a forum for undergraduates to share their views and experiences with each other and to act as a source of information for opportunities and events in physics.

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Coffee Time
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Professors, staff, and students are all invited!
Coffee, tea, hot cocoa, and cookies only 50 cents

what's UP
in this issue

Unix and Linux

by James Stankowicz

UNIX might be another "four letter word" to the un-acquainted. It is, in actuality, a computer operating system. I remember my first experience with it came at one of the Thursday physics colloquia, when a visiting professor was unable to get his UNIX based laptop to jive with the predominantly Microsoft equipment in the physics building. I thought to myself, "Well, that's dumb. Why would anyone want to use UNIX anyways?" Turns out (as I deduced then) there are various, very good reasons to use UNIX, particularly in the world of science and academia.

Unlike "Bill Gate's Microsoft" or "Steve Jobs' Apple," UNIX doesn't have that one-name association with it. Like the C programming language, it can trace its roots back to the AT&T think-tanks (with contributors from GE and MIT) of the late 1960s. The operating system evolved in various forms under various names and various distributors over the last 4 decades, and now lives mostly on servers, but with some use in personal computers, and substantial use in "UNIX-like" operating systems, such as Linux.

"What makes an operating system 'UNIX-like,'" you ask. "The kernel!" I answer rather unsatisfactorily and incompletely. The kernel of an operating system is the code that interacts at the most basic level with the computer's processor, handling tasks like memory allocation, networking, and organizing the system's files. UNIX-like operating systems, without getting into too much detail, follow either loosely or exactly the UNIX standards, as laid out in Single UNIX Specification. These standards dictate that the user gets nearly direct access to the kernel through the keyboard and mouse. The most useful part about this setup, particularly for computational purposes in the sciences, is that there is no extra gunk (such as Window's registries whose exact purpose is to separate user and kernel) to keep the user from fully utilizing every last bit of computing power.

Linux systems utilize the Linux kernel, which is itself UNIX-like. Linux primarily utilizes software under GNU GPL (which stands for "GNU Not Unix General Public License" - the repeated 'GNU' is not a typo, but rather a computer scientist's idea of an iterative joke iterative joke iterative joke). The GNU means that Linux, unlike UNIX, is as free as the cookies before the colloquium. If you already have a computer (doesn't everyone?), and a spare CD to burn to, you could , without paying a penny, have a Linux operating system up and running in the time it takes to download and install about 700mb. Some Linux distributions will even install and run as programs within Windows or Mac, so there's no potentially messy and complicated repartitioning of your hard drive. Compare the free-ness of Linux to the $99.95 that even the most basic upgrade from XP to Vista costs even now, 2 years after the operating system came out.

There are various Linux distributions such as Ubuntu, Fedora, PCLinuxOS, and so on, which use various 'desktop environments' (that's the software that gives Windows its windows) like GNOME, and KDE. These installations have various differences. You can, for instance, install a "developer" version of PCLinux, which might not install some games (like Freecell), but will instead give you every kind of programming application imaginable. And of course, since Linux is based entirely on the GNU GPL, you can download for free any software that may not come as default with your distribution. If you've used programs like Open Office or Firefox, you've had a taste of the kind of power and ability that these GNU programs can have. Imagine saving $500 on the newest version of Photoshop, and instead downloading a free program that is equally and perhaps even more functional for your Linux system.

So if Linux is so inexpensive, why doesn't everyone use it? For one, there's a learning curve to it, and people don't like learning curves (there are still people who can't make Windows XP work right). Another problem, as the speaker I referenced in the first paragraph demonstrated, is that there is not substantial hardware support for Linux, at least on the surface. Turns out if you're willing to dig deep enough, you can figure out even the most complicated configurations, but it can get messy, be a bit time consuming, and feel at times like you're poking around your computer's innards. Even if you can't find solutions to your problems in literature, there are humongous communities of eager Linuxers willing and waiting to help answer your questions – just don't expect them to handle you with the kid gloves – that's for Microsoft and Apple!

REU *Research for Undergraduates*

by Stephen Hochman

On Thursday February 5th Dr. Kevin Ingersent gave a talk to undergraduates students here at UF about National Science Foundation (NSF) Research Experience for Undergraduates (REU) programs. It was hosted by the UF SPS. The goal of an REU is to expose undergraduates to basic research and promote graduate education.

Programs usually last between 8-10 weeks in the summer. These programs include individual research visits to various laboratories, lectures, and workshops at the location of the REU. There is a typical stipend of $400-$500 a week, and often housing and allowance are also covered by the REU program, although different programs offer different stipend packages. There are over 200 REU's in total with over 100 in physics and physics related areas.

In order to apply to an REU you must be enrolled in a bachelors program, be a US citizen or permanent resident, and meet the application deadline (usually between February and April). Application requirements vary slightly in different REUs, so it is best to check each application.

The website for the UF REU is: http://www.phys.ufl.edu/reu/

The website for the NSF REU list is: www.nsf.gov/crssprgm/reu

A PDF of Dr. Ingersent's talk will be on the SPS website shortly.

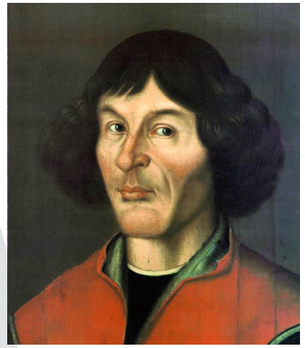
Religion and Science: Scientists *who believed in* GOD

by Daniel Bannoura

I argued in the November issue of UPNews that science and theism are valid systems of inquiry since they both strive after knowledge and understanding. Of course, the two disciplines seek truth using radically different methods, but they share a common conviction that there is an absolute truth to be sought. However, any claim to truth should meet the standards of logical consistency, empirical adequacy, and experiential relevance.

The belief in God has not been an issue of inconsistency or irrationality for many scientists. Furthermore, throughout history, many of them even found it necessary and compatible. The following is a small sampling of scientists who contributed to the development of modern science while believing in God:

1. Nicholas Copernicus (1473-1543) Pictured below.

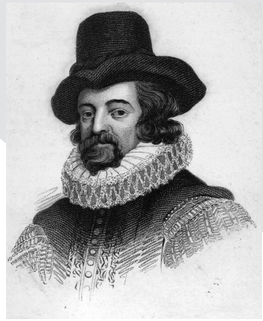


Copernicus was the Polish astronomer who put forward the first mathematically based system of planets going around the sun. He attended various European universities, and became a Canon in the Catholic Church in 1497. His new system was actually first presented in the Vatican gardens in 1533 before Pope Clement VII who approved, and urged Copernicus to publish it around this time. Copernicus was never under any threat of religious persecution, and was urged to publish both by Catholic Bishop Guise, Cardinal Schonberg, and the Protestant Professor George Rheticus. Copernicus referred sometimes to God in his works, and did not see his system as in conflict with the Bible.

2. Sir Francis Bacon (1561-1627) Pictured on the right.

Bacon was a philosopher who is known for establishing the scientific method of inquiry based on experimentation and inductive reasoning. In De Interpretatione Naturae Prooemium, Bacon established his goals as being the discovery of truth, service to his country, and service to the church. Although his work was based upon experimentation and reasoning, he rejected atheism as being the result of insufficient depth of philosophy, stating, "It is true, that a little philosophy inclineth man's mind to atheism, but depth in philosophy bringeth men's minds about to religion; for while the mind of man looketh upon second causes scattered, it may sometimes rest in them, and go no further; but when it beholdeth the chain of them confederate, and linked together, it must needs fly to Providence and Deity."

[Editor's Note:] A few members of the UPNews staff, being the inquisitive folk we are, got to questioning Daniel (a fellow staff writer) about his religious views. Daniel is a Christian and



a scientist. The staff was very curious about how he reconciled two view points that some scientists (physicists, especially) see as deeply contradictory. Extrapolating from our curiosity and Daniel's particular paradigms, we decided to look at great physicists of the past, and their views on religion. This is intended to be informative only. We hope that this topic provokes thought among our readers, and do not intend to (or expect to) offend any one's sense of political correctness.

Dark Matter CONTINUED FROM FRONT

Magellanic Clouds and galaxies) than what astronomers observe. Conversely, neutrinos, a form of hot dark matter, (and previous potential candidate,) are "not clumpy enough."

2. A specific type of caustic that dark matter makes is expected in a BEC model and not in a CDM model. Light caustics are lines of light that one would see at the bottom of a swimming pool. The water bends planes of light on top of themselves, thus creating overlap and higher concentrations of light. The higher concentrations of light are "caustics". Galaxies do the same thing to the flow of dark matter. A specific type of caustic that Dr. Sikivie has studied is explained if the particles that make up the matter form a BEC.

Sikivie and Yang's paper places axions in the position of "primary dark matter candidate." Thus, if proven true, about 22% of the universe would consist of a Bose-Einstein condensate of primordial axions. Dr. Sikivie's and Yang's manuscript can be found on arXiv:0901.1106v2.

Disclaimer: Due to the author's limited knowledge of the topic, the science in this article will be highly qualitative.