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CORONA DISCHARGE TESTS IN HIGH VOLTAGE WIRES. Renee Goertzen*, Cleveland State University; M. Rijssenbeek, M. Thioye, J. Steffens, State University of New York at Stony Brook.

ATLAS (A Toroidal LHC ApparatuS) is a multi-purpose detector, which will record proton-proton collisions at the Large Hadron Collector at CERN. Constantan wires are needed to carry high voltage within the detector. Because corona, a repetitive discharge from the wire to the cryostat or from wire to wire, can occur at high voltages, tests were conducted to verify that corona would not degrade the wires and insulation. The ability to detect corona was verified, and then the frequency of corona pulses was investigated. The final experiment, with conditions identical to those which will be used at CERN, demonstrated that corona occurs only in the first minute after the current has started and hence will not cause any damage to the wires. This experiment was funded by NSF Grant No. PHY 99-12312.

TEMPERATURE DISTRIBUTION AND HEAT FLOWS IN THE HIGH VOLTAGE FEEDTHROUGH PORTS FOR THE ATLAS LAR CALORIMETERS. John Dulka*, Carleton College; Robert McCarthy, Michael Rijssenbeek and Marian Zdrazil, State University of New York at Stony Brook.

Heat flow through the high voltage feedthrough port is calculated using the principle of conduction:

$$H = -\kappa A\,(dT/dx) \qquad (1)$$

The heat flow through a conductor of cross sectional area A is determined by the thermal conductivity of the material (κ) and the temperature gradient. The high voltage feedthrough consists of ten different component parts: warm pipe; stainless steel ring; cold pipe; G-10 spacer; bellows; funnel; plate; constantan wire; peek and the liquid argon. Each component part acts as a resistance against heat flow. A simple circuit is constructed that models the resistances from the different component parts of the high voltage feedthrough port. The liquid argon is the ground. The high voltage feedthrough heat flow model generates the following:

$$\text{Change in Voltage} = \Delta V = \Delta T \qquad (2)$$

$$\text{Current} = i = H \qquad (3)$$

$$\text{Resistance} = R = x / (k A) \qquad (4)$$

$$V = i R \qquad (5)$$

Using equation (5) resistance is calculated from equation (4); the change in temperature (Voltage) is measured; and the current "i", which is the total heat flow, is calculated. Because of the small cross sectional area of the bellows most of the temperature change in the cold wall occurs in the bellows. However, if the bellows is considered part of the cold wall then the heat flow is about 0.4 Watts less than the heat flow through the constantan wire. The liquid argon will rise in the high voltage feedthrough cold pipe until the temperature of the constantan wire or steel of the cold wall reaches the boiling temperature of the liquid argon. The liquid argon will rise l.7 cm above the aluminum to stainless steel transition near the constantan wire, but the liquid argon is able to rise higher near the steel. It is concluded that the argon will boil first near the wire and as long as the feedthrough port is leak free the rise of the liquid argon will be manageable. This study was supported by NSF Grant No. PHY 99-12312.

DETECTING LEAKS IN CRYOSTAT OF A LIQUID ARGON CALORIMETER FOR ATLAS PROJECT. Ken Miller*, Bridgewater State College.

The ATLAS project consists of building a detector for colliding beam experiments. Part of this detector consists of Liquid Argon Calorimeters for detecting charged particles and photons. The calorimeter is a cryostat chamber filled with liquid argon, through which run about 5000 high-voltage wires. The cryostat must be checked for leaks so that the argon does not leak out, or impurities do not enter and affect the data being taken. To do this, a molecular drag pump was used to bring the inside pressure of the cryostat to approximately 5x10E-3 torr. Helium sprayed on the outside of the cryostat will be pulled in by the relative vacuum inside if there are big enough leaks. The cryostat was connected to a vacuum that channeled the inside gasses into a mass spectrometer, which detected whether helium was entering the cryostat. We found the cryostat to have a maximum helium leak rate of 10^{-9} STP cc of helium per second. This study was supported by NSF Grant No. PHY 99-12312.

OBSERVING THE NEGATIVE PRESSURE CONTRIBUTION TO GRAVITA-TIONAL MASS. Jory Meltzer*, Alfred Goldhaber, State University of New York at Stony Brook.

General relativity includes a beautiful geometrical idea, that the trajectory of a particle in space is determined by initial conditions and space-time geometry, which in turn is determined by the distribution of matter and energy. One important consequence is that, in the common-sense meaning of the term, gravitational mass is not simply equal to inertial mass. A major part of the discrepancy is pressure, which contributes to the space-space components of the stress-energy-momentum tensor. Here we investigate potential ways in which to observe the effect of negative pressure, i.e., tension, on gravitational mass. We find that a successful lab experiment would have to be extremely sensitive, perhaps beyond what will be possible in the near future. This study was supported by NSF Grant No. PHY 99-12312.

A NON-VACUUM SELF-DUAL SPHERICAL SOLUTION. Carlos E. Martinez-Torteya*, Instituto Tecnológico y de Estudios Superiores de Monterrey; Alfred S. Goldhaber, C.N. Yang Institute for Theoretical Physics, State University of New York at Stony Brook.

A self-dual spherically symmetric geometry was studied; Consider an ordinary Schwarzschild solution for the region outside the event horizon and a solution that is Schwarzschild for a variable proportional to 1/r for the inside, so the complete solution is continuous at the event horizon. This kind of solution bears a resemblance to that of some Baby-Universe and wormhole solutions. Such a geometry is free of singularities (except the coordinate singularity at the horizon) unlike the Schwarzschild solution. That clearly is a source-free solution everywhere but at the horizon. It was shown that the Stress-Energy Tensor indeed has a Dirac delta function behavior having a zero radial pressure term, and nonzero density and tangential pressure terms with non-vanishing trace, as measured by an observer far away from this object. A stability analysis of the geometry is still needed to gain a better understanding of the nature of this object. This study was supported by NSF Grant No. PHY 99-12312.

EFFICIENT NEUTRALIZATION OF AN IONIZED ALKALI BEAM. A.L. Roberts, State University of New York at Stony Brook; T.J. Mog, University of Nevada; B.A. Johnson, G.D. Sprouse, Department of Physics and Astronomy, State University of New York at Stony Brook.

Francium is ideal for studying the weak interaction because it is the heaviest of the simple elements. Since Francium has a half-life of twenty minutes at the most and thus is not naturally found in large quantities, we synthesize it by colliding the ^{18}O beam from the Van de Graaff with a gold target. The Francium that boils off the gold target is missing electrons. We neutralize the Francium by placing a small, hot, low work-function metal in front of the trap. The Francium hits the neutralizer, takes electrons, and then evaporates off into the trap. The present design, a small, flat strip of metal, allows Francium atoms to evaporate off in all directions so that many Francium atoms miss the trap entirely. A long, narrow, cylindrical tube would focus the evaporated atoms forward, easily improving the efficiency of the neutralizer by a factor of two. As the neutralizer must be small and uniformly heated, its fabrication is deceptively difficult. Most of the designs we tried failed, but ultimately a small cylinder welded to a rigid outer cylinder was both small enough and heated evenly. This neutralizer will provide more Francium atoms for our experiments than the previous design did. This study was supported by NSF Grant No. PHY 99-12312.

DEVELOPING AND TESTING THE SEPARATION OF FRANCIUM FROM OTHER IONS USING MAGNETIC AND ELECTRIC FIELDS. T. J. Mog*, University of Nevada; B. A. Johnson, A. Roberts, G.D. Sprouse, Department of Physics and Astronomy, State University of New York at Stony Brook.

The Stony Brook Francium group is developing an apparatus for measuring the effects of the weak interaction in a francium atom. Since francium is a radioactive element and has no stable isotopes, it must be created using Stony Brook's accelerator. This also creates other elements that make it difficult to optimize a francium beam into a magneto-optical trap where they are studied. A pure francium beam must be obtained by mass separation. Manipulating magnetic and electric fields can accomplish the deflection of all non-francium ions away from the target area in the ion transport system. Since the magnetic force is velocity dependent, different masses will feel different forces giving the experimenter a choice on which ions are allowed to enter the trap. The francium ions must also be neutralized before laser beams can trap them. This is accomplished by guiding them onto a metallic surface that has a low work function. This surface must allow ions to diffuse out at around 800-900 Celsius and not evaporate in a vacuum. The element that best satisfied these criteria of low work function, low vapor pressure, and fast diffusion was uranium. Even though depleted uranium emits alpha particles that can damage the trap's coating, it was found that this amount is negligible when compared to the alpha particles emitted by francium. This study was supported by NSF Grant No. PHY 99-12312.

HOLOGRAPHIC INTERFEROMETRY. Doug Broege*, John Noe, and Harold Metcalf, Laser Teaching Center, State University of New York at Stony Brook.

A hologram is a way of recording and recreating the complex optical wavefront that comes from an illuminated object. When this wavefront is combined with another beam of light, known as the reference beam, an interference pattern is created which can be recorded photographically on a high-resolution plate or film. When the developed plate is re-illuminated with a beam similar to the reference beam it acts either as a diffraction grating or a series of mirrors to transform the reference wavefront into the original one. Stability is one of the most important factors when creating a hologram. If either the object or the plate moves even a quarter of a wavelength of light over the span of the one-minute exposure, the interference pattern is destroyed.

This sensitivity to movement can have a positive side as well. For example it can be used to study the vibrational modes of a certain object, such a musical instrument. When an object is moved during the exposure, dark fringes will appear on its image. The number of fringes that appear is directly proportional to the number of wavelengths that the object moved during the exposure. This is useful when measuring small changes in the surface or edge of something that can't been seen with the naked eye. Also, when an object is vibrating at a single mode, the nodal lines (which don't move) can be clearly seen while circular fringes appear between these lines. My experiments thus far have involved making double exposures of objects moved with a micrometer, and creating a viable setup that will make a clear image of a tuning fork. One important result is that a HeNe laser -- even one with less than one mW output power -- provides much clearer images and a more versatile setup than the 3 mW uncollimated diode laser originally used. This study was supported by NSF grant No. PHY99-12312.

SINGLE-BUBBLE SONOLUMINESCENCE. Fernando Enrique Ziegler*, The University of Texas at Austin; John Noé and Harold Metcalf, Laser Teaching Center, State University of New York at Stony Brook.

Single-bubble sonoluminescence (SBSL) is the process of creating light from the gas in a tiny bubble suspended inside a flask of water by means of intense ultrasonic sound waves. Under ideal conditions of dissolved gas and sound field a single micron-sized bubble will undergo sustained contractions and expansions in step with the sound pressure fluctuations for many minutes, emitting very brief (50 picoseconds) flashes of mostly blue and ultraviolet light every 35 microseconds. We used the standard SBSL setup in which the intense 25 kHz sound field is created with two piezo-electric transducers attached on opposite sides of a standard 100 mL spherical flask and a third smaller transducer picks up the interaction of the sound waves and the bubble for display on an oscilloscope. After some experiments with the degassing procedure, sonoluminescence was achieved, although the light output seemed to be less than reported by some others. Our efforts were then directed at improving and fine tuning the setup to increase the light intensity. For example, the shape and frequency of the acoustical resonance was studied as a function of the precise volume of water in the flask and the degree of degassing. Work is also under way to observe the sonoluminescence light with a sensitive photomultiplier tube. This study was supported by NSF Grant No. PHY99-12312.

INTERCOMPARISON OF ANTARCTIC STRATOSPHERIC TEMPERATURES FROM DIFFERENT SOURCES. Ellen Bennert*, Florida Institute of Technology; Dr. Robert de Zafra, Department of Physics and Astronomy, and Institute for Terrestrial and Planetary Atmospheres, State University of New York at Stony Brook.

We compare the relative consistency of direct temperature measurements made by balloons to remote-sensing satellite temperature measurements above the South Pole. Ozonesonde balloon temperature data were obtained from the National Oceanic and Atmospheric Association (NOAA). Independent analyses of TIROS satellite data were obtained from the National Centers for Environmental Prediction (NCEP) and the United Kingdom Meteorological Office (UKMO). The temperature differences between the different types of data were plotted against the day of the year, at eleven pressure levels. We made a control study using data from Hilo, Hawaii. The difference between data sets is typically less than ±3K. However, our plots showed much larger systematic seasonal differences in both the NCEP and UKMO data, suggesting a common error arising from the TIROS data. These occur around the 50mbar level during the Antarctic summer and exist at least from 1994 through 2000. A check of data from 1979 was ambiguous. No systematic seasonal trend is found in the Hilo data, suggesting the phenomenon is confined to polar latitudes. We consider two theories for the origin of this discrepancy. (a) The satellites use a pressure-temperature algorithm developed in the 1970s to produce data. The Antarctic ozone hole has developed since then, resulting in less absorption of sunlight in spring and summer, and consequently less atmospheric expansion. If the TIROS data analysis algorithms were not adjusted for this change, the measurements may be incorrect. (b) The pressure sensors on the balloons may become faulty at high altitudes in the summer, resulting in invalid data.

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EXPLORATIONS INTO THE WONDROUS WORLD OF ACOUSTIC WAVES AND THE ALLEGED EQUATIONS OF MOTION. Nathan Borggren*, Northern Arizona University, John Wilson, Kevin Schultz, Corrie Vaa and Peter Koch, State University of New York at Stony Brook.

Acoustic waves in circular plates have been explored since cavemen beat on drums. Much development has occurred since the Paleolithic age including acoustics, partial differential equations (PDEs), and electricity. These three marvels of the modern world were presented to explore experimentally and analytically acoustic waves in a circular drum. Galvanized sheet metal was used instead of mammoth hides, and the waves were induced using speakers and piezo crystals rather than saber-tooth tiger tibias. Sand was used to show the orientation and patterns of the nodal structures of different modes. A fourth order PDE was solved with and without homogeneous boundary conditions and analytical results were compared with experimental data. Insufficient time disallowed a phenomenon not known by many to even exist called "ray splitting" to be thoroughly explored. This study was supported by NSF Grant No. PHY99-12312.

DATA ANALYSIS FOR LOCATION OF VERY HIGH REDSHIFT GALAXIES IN THE HUBBLE DEEP FIELD. James Osborne*, Oregon State University; Joshua Hellhake Carnegie Mellon University; Kenneth Lanzetta, Noriaki Yahata, and Hsiao-Wen Chen, State University of New York at Stony Brook.

The overall goal was to locate and better analyze very high redshift galaxies. Images from the Hubble Space Telescope were used in conjunction with ground-based images. Since the galaxies that are being looked for have redshifts greater than z=5, the photometric redshift technique is used instead of spectroscopic. In order to obtain data for these high redshift galaxies, they must lie between a very intense point light source and us. Quasars, an excellent distant, bright point light source, were examined to determine if there exist galaxies between them and us. Quasars located in the Hubble Deep Field North were analyzed along with ground based images of the same field. Ideally, a point-spread function can be simulated to represent the qso. Distant galaxies can be located by comparing the absorption spectrum of the qso to that of the simulated point spread function. This method allows for more concrete evidence of galaxies with redshifts greater than z=6. This study was supported by NSF Grant No. PHY 99-12312.

MODELING GALACTIC SPECTRUM AND APPEARANCE FOR PRE- AND POST-REIONIZATION GALAXIES. Joshua Hellhake*, Carnegie Mellon University; Kenneth Lanzetta, Alberto Fernandez-Soto, and Hsiao-Wen Chen, State University of New York at Stony Brook.

Two models were created to model the light emission from galaxies before and after the epoch of reionization, which was when the intergalactic medium (IGM) of hydrogen became predominately ionized as it is today. The post-reionization model was constructed and normalized with established values of D_a for redshifts in the range z = 2 to z = 5. Following this, a clustering model was added to cluster the absorption lines in the Lyman-α forest. It was found that the average D_a decreased slightly and the error on D_a increased as the clustering coefficient, the average number of absorption lines per cluster, was increased. This model was finally executed with varying clustering coefficients for redshifts of z = 6 to z = 9. The pre-reionization model incorporated the effects of the Stromgen sphere and Lyman- α halo that are created by the neutral hydrogen IGM. The Stromgen sphere is a region of ionized hydrogen surrounding a galaxy, and the Lyman- α halo is a region where Lyman- α photons are scattered many times by the neutral hydrogen. This model could not be completed so additional work must be done to obtain and verify the output. This study was supported by NSF Grant No. PHY 99-12312

DESIGN AND CONSTRUCTION OF A MICROWAVE CAVITY. Julio Vargas*, Universidad Michoacana de San Nicolas de Hidalgo; E. Gomez, L. A. Orozco, State University of New York at Stony Brook.

We studied how to build an open microwave cavity for frequencies from 40GHz to 50 Ghz based on a near confocal Fabry Perot resonator. We designed the geometry of the cavity: curvature of mirror, convenient dimensions, structure, and coupling system. We also designed and constructed a closed cavity with a box form to test the coupling systems. We studied its mode structure and compared it to theoretical results. The microwave cavity will be used it in a Francium spectroscopy experiment to measure hyperfine transitions of Francium isotopes. Support from US-Mexico Science Foundation Mexico (FUMEC) and NSF.

DESIGN AND CONSTRUCTION OF AN OPTICAL FABRY PEROT CAVITY. Salvador Hernández*, Benemérita Universidad Autónoma de Puebla; J. E. Reiner and L. A. Orozco, State University of New York at Stony Brook.

We have designed and built a Fabry Perot cavity, with high reflectivity mirrors (transmission 228 ppm), and found its resonant modes. The design had many requirements: small mirror-separation (less than 0.5 mm), possibility of lateral access for an optical lattice, and vacuum compatibility. Working under vacuum (40 mtorr), first we excited it with a helium-neon laser (632 nm) to align the set up, then we used a titanium-sapphire laser (780 nm) overlapped, and measured the finesse of the cavity ($20*10^3$). This cavity will be used in the cavity QED project, to study the interaction between material qubits and optical qubits. This study was supported by the U.S.-México Science Foundation (FUMEC) and NSF.

SIMULATING MUON MOMENTUM DISTRIBUTIONS IN PHENIX. Andrew Grover*, Brown University; Ralf Averbeck and Thomas Hemmick, State University of New York at Stony Brook.

PHENIX is an experiment in Relativistic Heavy Ion Physics. By colliding packets of Gold nuclei at high energies, PHENIX produces Quark-Gluon plasma (QGP) and measures various properties of it. One such property is the energy of a muon coming out of the QGP. Because a muon could originate from any one of various decays, a plot of muon number versus energy would not be a simple, well-described curve. The best course of action is to model these decays and try to predict the curve; hence the computer program EXODUS. With the functionality added this summer to EXODUS, new predictions have been produced. This study was supported by NSF Grant No. 99-12312.

ONLINE MONITORING OF PHENIX DRIFT CHAMBER. Ryan Hecox*, Louisiana State University; Sergey Butsyk and Thomas Hemmick, State University of New York at Stony Brook.

The PHENIX experiment located at Brookhaven National Laboratory is designed to study rare events produced by collisions of high-energy gold nuclei. During operation, it is necessary to monitor the status of the separate detector subsystems to insure data quality. A framework was created such that each subsystem could develop a specific program to monitor relevant information. Drift chamber monitoring consists of tracking noisy and dead channels, detector efficiency, and time distribution of signal detection. A display screen was also developed to provide information on anomalous conditions to the shift crew when necessary. As this is the first full year of operation for PHENIX, the online monitoring system will continue to be adapted and modified as understanding of the detector increases. This study was supported by NSF Grant No. PHY99-12312.

POSTCARDS FROM THE EDGE: PRODUCING PHENIX PICTURES FOR THE PRESS. Sean Burke*, State University of New York College at Geneseo.

Over the course of the last eight weeks, a Perl script was developed that automatically compiles PHENIX DST data into an image suitable for press releases and announcements. Furthermore, a Java script was written that will post these images in a viewer that may be seen on the PHENIX website. The main purpose of the two programs is to streamline an otherwise tedious process whose execution can take upwards of five minutes. It is hoped that the continual production and review of these images can help the PHENIX group pick out the “interesting” events from the mediocre. This study was supported by NSF Grant No. PHY99-12312.