Archaeology

(No meeting this year)

Astronomy, Mathematics and Physics

PREONS, NUCLEON FISSION CHAIN REACTIONS, AND CELESTIAL POWER TRANSIENTS. Charles A. Bly, Dept. of Nuc. Engr., UVa. Charlottesville VA 22903. Nuclear fission and fusion power have developed as bombs and power plants for the past sixty years. One can move on to explore the natural limits of nuclear power development. The author began research into nucleon fission reactors in 1990 at Westinghouse in Pittsburgh, Pennsylvania. The author's research goal is to facilitate the extraction of power from more fundamental layers of matter. Interactions can be seen as preon surface chemistry amid the orbiting preons of quarks and leptons. Among reactions providing subnuclear fission chain reaction power are neutrino-stimulated proton decay chain reactions. Supernovae and hypernovae provide natural prototypes from which one can glean valuable insights. One can compare the nucleonics of a supernova "reactor" to that of a commercial nuclear power plant. Microscopic fission cross sections decrease by 21 orders of magnitude. Fuel density increases 13 orders of magnitude. Reactor fuel volume increases 9 orders of magnitude. Both reactor types are driven by neutral radiations with long mean free paths. Hence, criticality formulations for nuclear fission reactors can be applied to celestial nucleon fission reactors. Baryon number conservation and its violation can be managed by engineering lepton-Z boson interactions. Dark matter acts as a catalyst.

ROLE OF OPTICAL FEEDBACK DELAY TIME ON DIODE LASER BEHAVIOR. Rachel Chisolm, Jordan Bittle, Courtenay Glisson & David Sukow, Department of Physics and Engineering, Washington and Lee University, Lexington Virginia 24450. We studied the fundamental properties of semiconductor diode lasers under conditions of delayed optical feedback. Optical feedback occurs when the laser beam is reflected directly back into the laser. This feedback causes a chaotic system with power dropouts. We measured the average time between power dropouts for long external cavities and found the relationship between the cavity length and the average time between power dropouts. Our preliminary research seems to indicate a positive relationship between the cavity length and the average time between power dropouts.

LIGHT FLASHERS: TESTING AND PROTOTYPING. Charles W. Arnold & Kevin L. Giovanetti, Department of Physics, James Madison Univ., Harrisonburg VA. 22807. In an effort to calibrate 360 photomultiplier tubes for the MuLAN experiment, we are building tiny LED pulsers. The pulsers borrow their design from pulsers use in the KamLAND project but with modifications to tailor them to our needs. Our prototype encountered several setbacks including signal translation, power distribution, and undesired pulse properties. All of these problems have been corrected through careful investigation of the properties of our pulse producing system.

BARNARD'S STAR: PLANETS OR PRETENSE. J. L. Bartlett, Dept. of Astronomy, Univ. of Virginia, Charlottesville VA 22903 & P. A. Ianna, NSF, Arlington VA 22230. A time-series analysis of photographic plates taken of Barnard's Star at the Leander McCormick Observatory (LMO) reveals no evidence of periodic perturbations indicative of planetary companions. These observations indicate a parallax of $0''.5482 \pm 0''.0017$ and a proper motion of $10''.3324 \pm 0''.0002$/yr. In 1963, Van de Kamp claimed to detect the first extra-solar planet orbiting this star. He used Sproul Observatory plates from 1938 to 1981 and determined that 2 companions with 12- and 20-yr orbits best fit the perturbation he observed. He estimated that both objects are each less massive than Jupiter. Using various techniques, other observers failed to detect clearly any companions. Of these, only one search was sufficiently sensitive to detect planetary bodies. In view of the continuing controversy, we reviewed over 900 exposures made on photographic plates between 1969 and 1998 at LMO. After the LMO microdensitometer scanned the plates, we calculated the parallax and proper motion. We combined the resulting residuals into annual normal points for which we analyzed separate Lomb periodograms in RA and dec. In neither case does the power at any frequency indicate a signal at a significance level of 50% or better. We acknowledge support from NSF grant AST 98-20711 and from Litton Marine Systems, Inc.

BEAM TESTING AT PSI: STOPPING MUONS IN A TARGET. Andrew W. Werner & Kevin L. Giovanetti, Department of Physics, James Madison Univ., Harrisonburg VA. 22807. The μLan collaboration is an effort to determine the lifetime of the muon to one part per million. Experimental work for this is done at the Paul Scherrer Institute (PSI) in Switzerland. The muon beam used is an offshoot of the neutron spallation experiments at the cyclotron on site. This beam must then be focused and sent to a sulfur target inside a soccer ball shaped detector, which will monitor the decay rate of the muon thereby giving the lifetime for the particle. The detector incorporates 360 individual photomultiplier tubes (PMTs), all of which must be calibrated. The calibration is being done with a modified version of the KamLAND LED pulser for <10ns pulse widths of blue (400nm) light coupled with a fiber optic to deliver the light directly to the PMTs.

CHANDRA OBSERVATIONS OF NUCLEAR X-RAY EMISSION FROM A SAMPLE OF RADIO-LOUD ACTIVE GALAXIES. Jessica Gambill[1], R. M. Sambruna[1], J. Pesce[1], G. Chartas[2], C. C. Cheung[3], L. Maraschi[4], F. Tavecchio[4], & C. M. Urry[5], [1]Dept. of Phys. & Astro., George Mason Univ., [2]Dept. of Astro. & Astrophys., Penn State Univ., [3]Dept. of Phys., Brandeis Univ., [4]OSSA di Breraand [5]Dept. of Astro., Yale Univ. We present the X-ray properties of the cores of sixteen radio-loud quasars (RLQs) and one low-power radio galaxy observed with the *Chandra X-ray Observatory (CXO).* The targets were selected for large-scale radio properties to optimize new detections from X-rays in the regions of resolved radio jets. The study of the nuclei was based on the emission detected in a 2"-radius aperture, with the photon counts limited to the range 0.5-8 keV for optimal sensitivity. Timing analysis finds one variable source (~25 minutes). One source shows evidence from spatial analysis for an X-ray halo (~25 kiloparsecs). Analysis of the X-ray spectrum finds that the favored model is a power law plus fixed Galactic absorption (N_H) with luminosities, $L_{2\text{-}10keV} \sim 10^{45}$ ergs s^{-1}. Six spectra have soft (<1.2 keV) energy excess and one source has an intrinsic absorber ($N_H \sim 5 \times 10^{23}$ cm^{-3}). A surprising result for this beamed sample is the evidence for Fe K-shell line emission (at 6.4 keV) found in two or three sources. This is a new property for the nuclear emission of RLQs. Statistical analysis of the sample shows neither a trend for the photon index generally, nor a trend within the core- and lobe-dominated sub-groups.

SILICON BASED THERMO-ELECTRIC MICROSENSORS. Steven L. Hearn, Integrated Science and Technology, James Madison University, Harrisonburg VA 22801. The purpose of this research is to investigate, design, fabricate, and characterize thermal microsensors. This project includes determining effective designs for thermopiles, finding appropriate materials with high Seebeck coefficients, and characterization and calibration of fabricated microsensors. Magnetron sputtering and evaporation deposition techniques are employed to fabricate thin films while photolithography and chemical etching are used to pattern the films. Metal-metal and metal-boron doped silicon semiconductor junctions are investigated. Prepared microsensors are inspected microscopically and characterized using surface profilometry and Scanning Electron Microscopy with Energy Dispersive X-Ray Analysis (SEM-EDS) to determine the surface and volume characteristics. Seebeck sensitivity measurements and four-point probe resistivity techniques have been employed to determine important electrical characteristics. The results of these studies and applications of this research to thermal microsensors, energy measurements, and gas sensing are discussed.