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Saturday, April 22, 2006 1:30PM - 2:42PM –

Session C11 SPS: SPS Undergraduate Research Hyatt Regency Dallas Cumberland E

1:30PM C11.00001 Lorentz-Violating Electrodynamics and the Hydrogen Spectrum ADAM HINKLE, MATTHEW MEWES, Marquette University — Atomic spectra have provided sensitive tests of Lorentz symmetry. The hydrogen spectrum from the fermion sector of the Lorentz-violating Standard-Model Extension (SME) has been well studied. Here we present an analysis of the spectrum from the less studied photon sector.

1:42PM C11.00002 Debye Model of Steps on Vicinal Crystal Surfaces[1] , CLINT A. GREENE, HOWARD L. RICHARDS, Texas A & M University-Commerce — The steps on a vicinal crystal surface can be mapped onto the world lines of spinless fermions, with the average direction of the steps (the y-direction) being mapped to time. If the interaction energy per unit length between neighboring steps is given by $V(L)=A/L^2$ (as is common), this resulting quantum system is integrable for only three values of $\tilde{A}\equiv\tilde{\beta}A/(k_{\rm B}T)^2$. For other values of $\tilde{A}$, the Pairwise Einstein Model gives an excellent approximation for the Terrace Width Distribution (TWD, the histogram of $x_{i+1}(y)-x_i(y)$) but is severely limited in describing $g_x(\Delta y)\equiv\langle[x_i(y+\Delta y)-x_i(y)]^2\rangle$, particularly for $\Delta y>\xi$, the correlation length. Here we show how the one- dimensional Debye model correctly gives $g_x(\Delta y)$ even for large Δy. The Pairwise Einstein Model also suggests a relationship between the compressibility of the steps and the tails of the TWD, a relationship we clarify using the Debye model.

[1]Supported by TAMU-Commerce and Research Corporation.

1:54PM C11.00003 Hardware Controls System Upgrade for the STAR Experiment[1] , MATTHEW BRNICKY, Creighton University, STAR COLLABORATION — The hardware controls system for the STAR (Solenoidal Tracker At RHIC) experiment is being upgraded to accommodate new detectors. The number of items monitored and controlled will increase from 25000 to 40000. While reliable, the current system uses processors designed when the first system tests were carried out in the mid-1990's. Such computing hardware is not appropriate for the new front end electronics. Specialized workstations are being replaced by new personal computers. Additionally, many aging processors housed in electronics crates will be replaced by PC's. A prototype upgrade is being tested during the Spring 2006 run. Software systems are currently being redesigned to require less operator intervention while maintaining backward compatibility. A stand-alone distribution kit has been developed to make the controls tools available to the new subsystems. Implementation and aspects of the new control hardware and software will be presented.

[1]Supported by the Office of Science, US Department of Energy.

2:06PM C11.00004 Analyzing Orbits of Bodies Accreting into Schwarzschild and Kerr Black Holes , JAFET MORALES, RICHARD CARDENAS, St. Mary's University — The purpose of this report is to use Maple to study the orbits of bodies accreting into Schwarzschild and Kerr black holes. A Schwarzschild black hole is a spherically symmetric black hole with no charge and no angular momentum, while a Kerr black hole has charge and angular momentum. In this study, I wrote Maple programs to look at these types of black holes under a variety of initial conditions. In addition, I compared these general relativistic solutions to a classical model. My research was focused mainly on studying general relativity and black holes. I studied geodesics near both Schwarzschild and Kerr black holes with the use of computer algorithms in Maple. I also designed an algorithm that will help understand null geodesics coming from the accretion disk of Kerr black holes, and how they can be affected by several factors, such as the torus around the BH, and ionized gas.

2:18PM C11.00005 Singularity formation with the harmonic map and a distributed data analysis tool. , JASON WILLIAMS, STEVE LIEBLING — I have developed a new tool which can analyze data from numerical relativity. It runs in parallel and is easily extensible. With help from this tool I have implemented a model to find solutions to the harmonic map ($M^{\{3+1\}} \rightarrow S^2$) within a distributed adaptive mesh refinement (AMR) code in order to study the formation of singularities in flat space.

2:30PM C11.00006 Development of a Low-Cost Spectrophotometric Sensor for ClO_2 Gas , JESSICA CONRY, Henderson State University, DANE SCOTT, ALLEN APBLETT, NICHOLAS MATERER, Oklahoma State University — ClO_2 is of interest because of it's capability to kill biological hazards such as E. coli and mold. However, ClO_2 is a toxic, reactive gas that must be generated at the point-of-use. Gas storage is not possible due to the possibility of an explosion. The need to detect the amount of ClO_2 at the point-of-use necessitates a low cost sensor. A low-cost spectrophotometric sensor based on a broad-band light source, a photodiode detector and a band-pass filter is proposed. To verify the design, precise determinations of the gas-phase cross-section and characterization of the optical components are necessary. Known concentrations of ClO_2(g) are prepared using the equilibrium relationship between an aqueous solution and the gas phase. The aqueous solutions are obtained by generating the gas via a chemical reaction and passing it through water. The concentrations of the aqueous solutions are then determined by chemical titration and UV-visible absorption measurements. For the solutions, a maximum absorption is observed at 359 nm, and the cross section at this wavelength is determined to be 4.79×10^{-18}cm^2, in agreement with previous observations. Using a broad-band source, the absorption of ClO_2 gas is successfully analyzed and concentrations are determined as low as 100 ppm. A more recent prototype based on an UV LED can measure down to concentrations as low as one ppm.