

SCHOOL OF SCIENCE AND MATHEMATICS

UNDERGRADUATE RESEARCH POSTER DISPLAY

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Science and Technology Building Lobby

BIOLOGY • CHEMISTRY

COMPUTER SCIENCE

EARTH SCIENCES • MATHEMATICS

NURSING • PHYSICS

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B I O L O G Y

1) **Eastern Bluebird (*Sialia sialis*) Winter Flock Behavior**

Coster, Jessica and Boal, Jean

The eastern bluebird (*Sialia sialis*) is highly territorial in the spring breeding season, but not much is known about its behavior in the winter. This study was designed to address whether bluebirds defend group territories with greater food and nest resources more aggressively than they defend less well-provisioned sites. Playback experiments were performed twice, once in January and once in March, at four sites in Lancaster County, Pennsylvania. Each playback consisted of a two-minute clip of a bird call and song. Two of the four sites had supplemental feeding stations for the two-month interval between playbacks. The responses were compared between the sites. In the non-supplemented feeding sites bluebirds sang more in January than in March, while that pattern was reversed at the supplemental feeding sites. The difference between the two types of sites was significant. Territorial defense in wintering bluebirds appears to be related to territorial quality.

2) **Contribution of Floating Algal Mats to the Wwater Column Primary Production in a Mangrove Channel**

Gregg, Tiffany and Ambler, Julie W.

The presence of numerous filter feeders indicates that phytoplankton may play a significant role in primary production of mangrove channels offshore of Belize. Benthic mats (flocs) containing single celled algae lift off the bottom of the channel in late afternoon and float to the surface. Primary production of floating detritus was compared to that of phytoplankton present in the morning when no flocs were present by incubating light and dark bottles *in situ* at 0.5 m depth intervals. Mean NPP and GPP of the water column (containing no floc) rarely exceeded 0.05mg/L/hr. Mean NPP and GPP floc incubated at the surface were 0.83mg/L/hr and 0.96mg/L/hr, respectively. The NPP and GPP of floc incubated at 0.5 m were consistently higher (maximum 1.46 mg/L/hr and 1.68mg/L/hr) than surface NPP and GPP floc measurements. Algae contained within floating detritus contributes a significant fraction of primary production to the water column and, perhaps, to total ecosystem NPP.

3) **Light Dark Preference in Two Species of Jumping Spiders: *Salticus scenicus* and *Metaphidippus galathea***

Jaffe, Glory

Salticids are free-roaming spiders which use vision to catch prey. I used a Y-maze to test light-dark choice in two jumping spider species, *Metaphidippus galathea* and *Salticus scenicus*. The spiders did not show a side bias or a preference for either light or dark. Salticids may not require light when prey and mating are not involved.

4) Long Term Effects of Botfly Parasitism on *Peromyscus leucopus*, *Peromyscus maniculatus*, and *Tamias striatus*
Jaffe, Glory and Zegers, David

The white-footed mouse (*Peromyscus leucopus*), deer mouse (*Peromyscus maniculatus*), and eastern chipmunk (*Tamias striatus*) have evolved a close host/parasite relationship with *Cuterebra* (botfly) species. We explored this relationship by analyzing twenty years of small mammal data from a permanent trapping grid at Powdermill Biological Station in southwestern Pennsylvania. Overall *P. leucopus* and *P. maniculatus* were infected at similar rates while *T. striatus* was infected at a higher rate. Adults of *P. leucopus* and *T. striatus* were infected at a higher rate than juveniles. Adult and juvenile *P. maniculatus* had similar infection rates. Males and females were infected at statistically the same rate in all three species. Individuals that experienced botfly infection tended to remain significantly longer in the trapping area and presumably had longer lives than did individuals that did not experience infection. Infected individuals were more likely to meet our criteria for “residents” than were uninfected individuals. In this report we question the relative harm of botfly parasitism to individuals of these three small mammal species.

5) Pseudouridine Synthases Do Not Play a General Role in *HOT1*-Associated Recombination in *Saccharomyces cerevisiae*

Moon¹, M.M, Fogell, H.E.¹, Roff, A.N.¹, Keil, R.L.², and Hepfer, C.E.¹

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In the yeast *Saccharomyces cerevisiae*, a specific type of genetic exchange known as *HOT1*-associated recombination has been implicated in maintaining homology between repeated ribosomal RNA genes. Disruption of the *DEG1* gene reduces this type of recombination and prevents cell growth at 37°C. The mechanism by which *DEG1* impacts these phenotypes is unknown. Pseudouridine synthase 3 (Pus3p), the product of the *DEG1* gene, modifies the anticodon arm of transfer RNA at positions 38 and 39 by catalyzing the conversion of uridine to pseudouridine. These residues enable transfer RNA molecules to achieve the three-dimensional conformation necessary for their transport to the cytoplasm and efficient participation in protein synthesis. No relationship between the pseudouridylation of transfer RNAs and genetic recombination has been established. It is possible that *DEG1*'s effect on recombination is simply a consequence of slowed cellular metabolism due to the impaired functioning of unmodified transfer RNAs. If this is the case, disruption of any gene coding for a pseudouridine synthase should have a similar impact on recombination. To test this hypothesis, yeast strains deficient in four different pseudouridine synthases (Pus1p, Pus2p, Pus3p and Pus4p) were created using PCR technology. PCR products were generated that included the *kan^r* gene, coding for geneticin resistance, flanked by sequences lying immediately 5' upstream and 3' downstream of the targeted *PUS* gene. Each PCR product was used to transform wild-type yeast that contain substrates enabling quantification of recombination rates. Successful integration of the *kan^r* gene and disruption of the targeted *PUS* gene was verified by PCR or Southern analysis. Each verified transformant was evaluated for *HOT1*-associated recombination and growth at 37°C. Comparison to wild-type yeast indicated that only the Pus3p disruption reduced recombination rates. This shows that the *DEG1* gene's effect does not result from a general change in cellular metabolism. The exact mode of action of this gene is still under investigation.

6) Identification of the Active Site Responsible for *Aplysia brasiliana* Attraction: Attraction of *A. brasiliana* to *A. vaccaria* Attractin

Nichols¹, A.E., Painter², S.D. and Nagle², G.T.

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Attractin is a 58-residue peptide that functions as a water-borne pheromone in the marine mollusk *Aplysia*. It is synthesized by a gland in the female portion of the reproductive tract, secreted onto the eggs, and elutes into the surrounding seawater following deposition. It functions to attract other *Aplysia* to the area. There is a family of attractin-related peptides in *Aplysia*, five of which have been isolated and partially or completely sequenced. Although the *A. brasiliana* peptide differs from the *A. vaccaria* peptide at 34 positions, they both have six cysteine residues which form three intramolecular disulfide bonds for peptide stability and an IEECKTS sequence at positions 30-36. To determine whether the conserved sequence is important for receptor activation in *A. brasiliana* and attraction, T-maze assays were used to examine whether *A. brasiliana* was attracted to *A. vaccaria* attractin. Although previous studies have shown that *A. brasiliana* is attracted to 1 or 10 pmol of *A. californica* attractin (which differed by 3 residues from its own peptide), it was not attracted by equivalent amounts of *A. vaccaria* attractin. When the amount of attractin tested in the T-maze was increased to 100 pmol, however, a significantly larger number of animals were attracted. This suggests that the conserved sequence is an active site for the attractin receptor producing attraction in *A. brasiliana*. The loss of potency suggests that other parts of the peptide contribute to its pheromonal activity and that these have changed in the *A. vaccaria* pheromone. Future investigations will be conducted using *in vitro* mutagenesis, of attractin in *A. brasiliana* and *A. vaccaria*, and bioassays to examine the importance of the conserved sequence.

7) Oxytocin Receptors in the Male Rat Reproductive Tract

Pakyz, Ruth E., Rothacker, Amanda, and Cosentino, M. James

Oxytocin (OT), a hormone most readily associated with uterine contraction and milk ejection in females, is also detected in males. Studies over the last 15 years have begun to elucidate OT's role in male reproductive physiology. OT has been localized in the Leydig cells of the testis and may be responsible for modulating contractions of the seminiferous tubules that ultimately lead to spermiation and propulsion of the sperm from the testis into the epididymis. We have noted that OT also affects epididymal contractility in the rat. Consequently OT's effect on sperm maturation in this organ may provide a means by which reproductive outcomes may be influenced in the male. The objective of this study was to further investigate OT's role in the male reproductive tract. In order to elucidate the sites responsive to OT, immunohistochemistry was employed to detect the presence of OT receptors throughout the reproductive tract of the male rat. OT receptors were found on spermatocytes in the testis. The OT receptors are located on the sperm head at the attachment site of the tail. Although OT is found in the Leydig cells of the testis, receptors for OT present only on spermatocytes may further support OT's role in spermiation and sperm maturation. The expression of OT receptors diminishes as the sperm are transported through the epididymis. Distribution of the OT receptors varied between the smooth muscle causing contraction and the epithelial cells in different regions of the epididymis. Thus we conclude that OT acts on the epididymis to facilitate sperm transport and maturation. Alteration of this function may be the basis for development of a male contraceptive. OT receptors located in the epithelium and interstitial tissue of the prostate suggests an heretofore undiscovered role of OT in the prostate and warrants further study with the idea of manipulating this mechanism in treatment of prostate cancer.

8) Macroinvertebrate communities on freshwater sponges with special focus on spongillafly (Sisyridae:*Climacia* sp.) populations dynamics

Roach, Laura and Wallace, John R.

The purpose of this study is to provide baseline descriptive information on the invertebrate fauna inhabiting freshwater sponges and document aspects of the population biology of spongillaflies. Our objectives included: describe the aquatic habitat of larval spongillaflies in terms of physical/chemical attributes; compare the diversity and abundance of the invertebrate taxa inhabiting freshwater sponges as a function of depth and sponge microhabitat and; compare larval spongillafly growth rates as a function of depth and microhabitats. Freshwater sponges were collected in a quarry from three depths – Shallow – 23-24 feet – Middle – 27-29 feet – Deep – 33-38 feet – and three locations – quarry wall, floor and submerged structure – and examined for spongillaflies and other macroinvertebrates. Spongillafly abundance was significantly greater than any other invertebrate found on the sponges. Other macroinvertebrates inhabiting sponges included chironomids, other diptera, Ceraclea caddisflies, anisopteran and zygopteran odonates, amphipods, isopods and snails. Spongillaflies were most abundant on the quarry floor and in the deepest water. Ceraclea caddisflies and amphipods were most abundant on sponges at shallow depths. Chironomids were more abundant on sponges located on submerged structures such as boats.

9) Contractile Changes in the Rat Epididymus at Various Ages Through Sexual Maturity

Sylvester, A.J. and Cosentino, M.J.

Previous laboratory experiments have shown that the hormone oxytocin influences epididymal contraction and sperm transport. The purpose of this study is to observe developmental changes in the rat epididymus throughout various ages.

The caput segments of Epididymides were observed in vitro in a solution of modified Tyrode's solution. Tissue preparations were observed from 19, 30, 35, 42, 51, and 70 day old animals. Observation occurred under a compound microscope and movement was recorded using videomicrography for a period of ten minutes. Each epididymus was then analyzed in order to determine the number of contractions per minute, the speed of contraction, the tubule's resting luminal diameter, the tubule's contracted luminal diameter, and the height of contraction the specified tubule.

It was seen that, as the rats approached sexual maturity, the number of contractions per minute and the speed of contraction increased (both: $p > 0.05$). It was observed that the average resting luminal diameter and the average contracted luminal diameter also increased with age (both: $p > 0.05$). The height of contraction increased as the animals aged as well ($p > 0.05$). These findings suggest that the physiological changes that occur in the rat epididymus, from 19 to 70 days of age, play a role in male rat fertility development.

10) 2002: A West Nile Virus Surveillance Update in Lancaster County, Pennsylvania

Trivett, L., McPherson, Neale, and Wallace, J.R.

Mosquito surveillance in Lancaster County continued in 2002 for West Nile virus. The surveillance program involved larval and adult mosquito sampling from in or around permanent marshes, temporary ponds, catch basins, tire piles and sewage treatment plants. In 2001, 24 species of mosquitoes were collected from Lancaster County, to date in 2002, 15 species have been identified in the county. We compared surveillance efforts between 2001 and 2002 for larval adult mosquito diversity. We report virus isolations in mosquitoes and dead birds between the two years.

C H E M I S T R Y

11) Hemoglobin Electrochemical Response at a Surfactant Covered Electrode

Guessford, Christopher A., Neal, Colleen M., and Rickard, Lyman H.

Because many proteins function in biological systems to transfer electrons there is considerable interest in the electrochemical behavior of these proteins at electrode surfaces. Recent investigations have shown an increased electrochemical response for heme proteins at electrode surfaces that have been modified with a surfactant film. Results will be presented that compare the response of hemoglobin at a surfactant covered glassy carbon electrode to the response at a bare glassy carbon electrode.

C O M P U T E R S C I E N C E

12) Elastically Deformable 3D Organs for Haptic Surgical Simulation.

Webster, Roger, Ph.D.¹, Haluck, Randy, M.D.², Ravenscroft, Rob, Ph.D.¹, Mohler, Betty¹, Crouthamel, Eric¹, Frack, Tyson¹, Terlecki, Steve¹, Sheaffer, Jeremy¹

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This paper describes a technique for incorporating real-time elastically deformable 3D organs in haptic surgical simulators. Our system is a physically based particle model utilizing a mass-springs-damper connectivity with an implicit predictor to speed up calculations during each time step. The solution involves repeated application of Newton's 2nd Law of Motion: $F = ma$ using an implicit solver for numerically solving the differential equations. Our system is a physically based particle model utilizing a mass-springs-damper connectivity with an implicit predictor to speed up calculations during each time step. This system consists of a set of point masses (nodes) connected to each other with a network of springs and dampers. Each vertex in the organ geometry has a mass and is connected to every other vertex with springs and dampers. The solution involves repeated application of Newton's 2nd Law of Motion: $F = ma$ using an implicit solver for numerically solving the differential equations. The dynamics equation for each mass point is $m_i \ddot{x}_i = -\gamma_i \dot{x}_i + \sum g_{ij} + f_i$ where m_i is the mass at point $x_i \in \mathbb{R}^3$, $-\gamma_i \dot{x}_i$ is the damping force to prevent instabilities, g_{ij} is the linear Hookian force exerted on mass i by the spring between i and j , f_i is the sum of the external forces acting on mass i (gravity, pushing and probing the 3D organ). Combining the vectors of all mass points produces: $M\ddot{x} + D\dot{x} + Kx = f$, where M is the mass matrix, D is the damping matrix, K is the stiffness matrix, and f is the aggregate force vector. As the system progresses through time dt , the first order differential equations are: $v = M^{-1}(-Dv - Kx + f)$, $\dot{x} = v$, where v is the velocity vector. Baraff and Witkin have used a similar technique effectively in modeling cloth systems for special effects in the motion picture industry. The fundamental problem with these implicit solvers is that they need to solve a linear system at each time step, which is not practical with today's computers. To get around this computational expense, we incorporate a technique, based upon the work of Desbrun et al., with an approximate solver that pre computes the solution to a linear system. In addition, we have written a pre-processor that builds the matrices for the predictor for each organ and writes them out to a file. The matrix generation process may take considerable time to calculate (several minutes). The surgical simulation application, however, can simply load a file with the prediction matrices pre-built.

13) **Integrating Haptics into an Undergraduate Computer Science Curriculum**

Webster, Roger W., Ph.D.¹, Haluck, Randy, M.D.², Hutchens, David, Ph.D.¹, Zoppetti, Gary Ph.D.¹, Benson, Aaron¹, Boyd, Josh¹, Charles, Nathan¹, DeSanto, David¹, Reeser, Jon¹, Sampson, Shanna¹

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The goal of this joint research project is to integrate haptics into an undergraduate Computer Science curriculum. Undergraduate students work on research projects using the Sensable Technologies' PHANToM haptic device, the "Reachin Display" unit, Crystal Eyes stereo glasses, the Immersion Virtual Laparoscopic Interface, and the Immersion haptic Laparoscopic Surgical Workstation (LSW). Haptic surgical simulation is used as the application. The graphics programming environment is C++ OpenGL calls using our own MUOpenGL graphics API. The haptics programming environment is Sensable Technologies' GHOST C++ API calls. The control computer is a dual Pentium processor workstation with an OpenGL graphics accelerator running Windows XP. Haptics is now integrated in four undergraduate computer science classes in our ABET accredited CS program: CS375 3D Graphics and Virtual Reality; CS406 Haptic Programming Environments; CS425 Human-Computer Interaction; and CS498 Independent Research. Since the project began in 1999, this research project has generated 13 publications in peer reviewed journals and conference proceedings. Over 250 students have been exposed to programming haptic devices. Twenty students have completed independent research projects and co-authored the results with faculty members. Twenty percent have gone on to graduate school engaging in research in 3D graphics, haptics, scientific visualization, and deformable models.

EARTH SCIENCE

14) Lightning Strike Density and Correlation with Elevation in Southeastern Pennsylvania

Babij, Michael and DeCaria, Alex

Southeastern Pennsylvania lightning strikes (obtained courtesy of Vaisala-GAI, Inc.) for 1995 through 2001 were analyzed using Geographical Information System (GIS) software. Through the capabilities of GIS, the average of the seven-year lightning strike density was joined with Pennsylvania digital elevation model data. Graphical representation of the initial findings suggests a very slight positive correlation between lightning strike density and elevation.

15) SuomiNet: GPS at Millersville University

Demko, J. Cory, Aiello, Nicole, Slodysko, Nicole, Cousins, David and Clark, Richard D.

SuomiNet is a university-based, real-time, national Global Positioning System (GPS) network being developed for atmospheric research and education with funding from the National Science Foundation and cost-sharing from collaborating universities. Millersville University of Pennsylvania was one of the first universities to establish a SuomiNet site for the purpose of high resolution atmospheric sensing of tropospheric integrated water vapor (IWV) and ionospheric total electron content (TEC). SuomiNet is using Unidata's well-established Internet Data Distribution (IDD) software and protocols to coordinate network sensors and distribute data in real time via the IDD system. A description of the instrumentation, installation, operation, raw data collection, and the processing of integrated water vapor and TEC products is presented in order to demonstrate the concept of a national geophysical instrument and its potential for interdisciplinary research and education. With over 100 universities participating in SuomiNet, the strategies and procedures employed by Millersville University can serve as guidance for others. As Millersville students, we can use the SuomiNet data to construct 3-D products of IWV and TEC as a component of the course "Earth System Data Visualization and Modeling (IDL)," and for student research projects. These products will be made available to GPS and the atmospheric sciences community via the Millersville Web site (www.atmos.millersville.edu), or via the IDD system.

16) Using MODIS to Investigate a Canadian Wildfire Smoke Event

MacKenzie, Jr., Wayne M. and Scala, John R.

The Moderate Imaging Spectrometer (MODIS) sensor flying on a NASA operated satellite (Terra) provides unique perspectives of the Earth's atmosphere, ocean and land surfaces. The high spatial and spectral resolution provided by the 36 channel instrument differentiates Earth emission from solar reflectance, vegetated from non-vegetated surfaces, and details atmospheric profiles of temperature and moisture. The Aerosol Product, which monitors aerosol optical thickness, and aerosol size distribution, is applied to a smoke/haze event that occurred over several large metropolitan cities in the mid-Atlantic on July 6-8, 2002. The pollution resulted from rapid transport of wildfire products southward from Northern Québec. These fires were sparked by lightning associated with a mid-latitude cyclone. The high aerosol content of this plume saturated the algorithm over land preventing the instrument from differentiating cloud mass from the fire products. However, characterization of the aerosol plume over water immediately downwind of the coast (e.g., NYC metropolitan area) provided more information on key properties of the plume including corrected aerosol optical thickness, aerosol content, mass concentrations, reflectance and backscattering.

17) The Effect of Large-Scale Global Atmospheric-Ocean Interactions on Local Weather Conditions. A Case Study: Lancaster, PA.

Miller, Carrie J., Hain, Christopher, Yalda, Sepideh, and Muller, Andrew

This study examines the effects of significant El Niño-Southern Oscillation (ENSO) processes on the average seasonal temperature and precipitation patterns for Lancaster, Pennsylvania during the summer months of June, July, and August over the period of 1914-2002. Four approaches were employed to demonstrate any existing correlation: 1) significant ENSO events based upon the Japanese Meteorological Agency (JMA) Index were compared with the mean temperature and precipitation values for Lancaster, 2) extreme temperature and precipitation anomalies were examined for possible correlation with significant ENSO events, 3) an analysis of variance (ANOVA) was performed to test whether a statistically significant difference exists for temperature and precipitation during ENSO events, and 4) the Tukey-Kramer Means Comparison Test was used to determine which ENSO phases were significantly different statistically in regard to temperature and precipitation for each month.

18) Fine-Scale Hydrographic Survey of Chincoteague Inlet

Miller, Carrie J., Soong, Yin S., and Ambler, Julie W.

Data collected in June and July of 2001 and 2002 using a Seabird Sealogger 25 CTD in and off of Chincoteague Inlet shows a belt of high chlorophyll concentrations extending from the inlet to approximately 57 km offshore. This belt exists at depths of 8 to 18 meters and it corresponds to dissolved oxygen data. Several possible explanations for this belt of high chlorophyll are: outflow of nutrients from the inlet itself during ebb tide, upwelling due to wind or bottom topography as seen from upward bending isotherms, and possibly internal waves which would also mix nutrients. Fluorometric CTD data was confirmed using chemical analysis of chlorophyll. Backscatterance showed higher suspended particles within the inlet and a decline in suspended sediments farther from land, which is to be expected. Offshore, seasonal thermoclines were either present or beginning to form during this timeframe.

19) Physiological Responses of *Halodule wrightii* to Imposed Shading in the Indian River Lagoon, FL

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Light availability is generally recognized as the most important environmental factor regulating seagrass growth and productivity. Increased light attenuation caused by increases in suspended solids, water color, or chlorophyll *a* levels can significantly reduce seagrass productivity and survival. Physiological responses to light deprivation were investigated to assess the tolerance of *Halodule wrightii* to short-term periods of light reduction in Indian River Lagoon, a shallow estuary in Southeast Florida. *H. wrightii* was subjected to three different intensities of light reduction using *in situ* shade screens and compared to controls in the same bed. The following parameters were measured for 6 replicates for each screen treatment: chlorophyll content, chlorophyll *a/b*, epiphytes, and leaf growth. *H. wrightii* exhibited tolerance to light deprivation during the 41-day experimental period. No significant ($p < 0.05$) physiological changes to light reduction treatments were observed. The tolerance of *H. wrightii* to short periods of light deprivation may explain its abundant distribution and biomass in the Indian River Lagoon.

M A T H E M A T I C S

20) **Periodic Orbits in Triangular Air Hockey**

Baxter, Andrew, Gemmer, John, Laverty, Sean, Weaver, Steve, Umble, Ron and Shao, Zhoude

This project investigates periodic orbits on a triangular air hockey table. A periodic orbit is any path followed by the puck that eventually retraces itself. In the equilateral case, we use a tessellation of the plane to prove that given any integer N , there exist periodic orbits of length greater than N . In fact, there are infinitely many infinite families of periodic orbits. Although one cannot apply tessellation methods to general non-equilateral triangles, some of the ideas apply. For general acute triangles, we prove a theorem of parallels and use it to construct an infinite family of periodic orbits of order 6. Results are graphically displayed with software created for this purpose.

21) **Geometric Analysis of Geodesics on a Conical Cup with Lid**

Mohler, Joel B. and Umble, Ron

There exist distance minimizing paths connecting two arbitrarily chosen points on the surface of a conical drinking cup with lid. These minimal length paths are geodesics, which can be found and analyzed by unrolling the cup and studying equivalent problems in the plane. General properties of geodesics on a cone will be discussed including results specific to geodesics near the cone point and geodesics connecting points near the rim.

We can parametrize the surface of the conical side, mapping from a sector of a circle in \mathbf{R}^2 to \mathbf{R}^3 . With this parametrization for the cone, we can find the curves in the plane that map to geodesics on the cone. We find that the geodesics on the cone correspond to straight lines in the plane.

Suppose point B is on the lid of the cup and point A is on the conical side. If we roll the lid along the edge of the sector in the flat model of the cone, point B traces out an epicycloid. We use this analysis in the plane to find geodesics over the rim that minimize the distance between A and B .

P H Y S I C S

22) **Guided Waves on a Drumhead**

Marek, James and Miziumski, Conrad R.

We report on the measurement and analysis of waves on a membrane. We focused on a sequence of guided wave modes through a waveguide attached to a rubber membrane on a drum head. The guided waves exhibit a low frequency cut off that will not allow waves below the cut off to propagate in the guide. It has been found experimentally that the frequency cut off depends on the width of the waveguide. This low frequency cut off can also be understood through an analysis of the wave vectors inside the guide.

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