



The Mathematics and Physics Institute NEWSLETTER

Director: Elizabeth Stoddard, Ph.D.
Associate Director: Richard Delaware, Ph.D.

February 1, 2003

mpi@umkc.edu

Vol. 17, No. 4

FIRST SEMESTER – TOP TEN

By taking the arithmetic mean of their college calculus and physics grades for the first semester, we have determined our current Top Ten MPI students. We congratulate them all. Listed alphabetically by schools, they are:

Jason HamiltonCenter Place Restoration
Cathy MartensCenter Place Restoration
Caleb PostlethwaitCenter Place Restoration

Edgar VargasHickman Mills

Kevin ChowTruman
Doug HillTruman
Adam NicholsTruman
Matt OrlovickTruman
Matt PerryTruman

Jillian OhrmanWilliam Chrisman

TO ALL MPI ALUMNI:

HAVE YOU GRADUATED FROM COLLEGE?

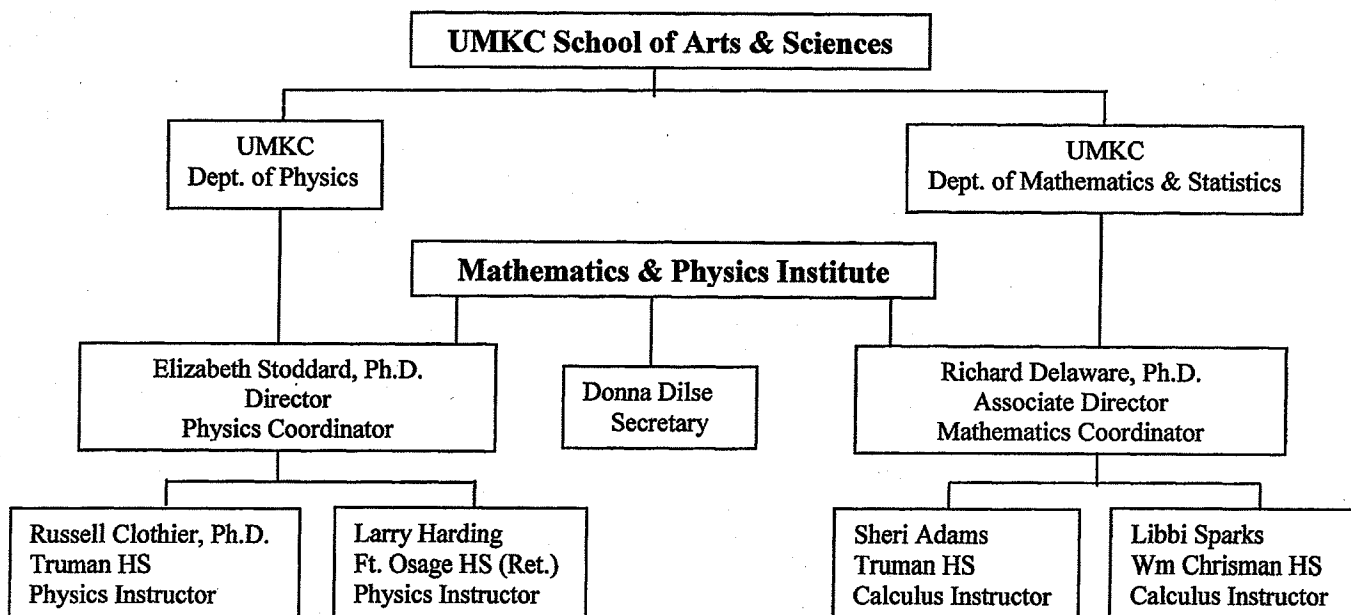
IF SO:

PLEASE CONSIDER BEING AN
- ENRICHMENT SPEAKER -
CALL (816) 235-1272

Or contact us at mpi@umkc.edu

MPI Alumni who have spoken:

Doug Bullock (84-85)
Brent Harding (84-85)
Pam Deters/Stephen Koop (84-85)
Seth McMenemy (88-89)
Tony Thornton (88-89)
Mitch Dobson (89-90)
Rachel Allen (92-93)



ODDS AND ENDS

December 20, we held our MPI Christmas Breakfast.

Around December 23 we received a card from Ed Kiker, former MPI enrichment speaker and now a general engineer in the technical support office for the U.S. Army Space Command at Peterson Air Force Base in Colorado. He points our students to a new organization called the Federation of Galaxy Explorers at www.foge.org.

On January 10, Lyndsey Main (MPI 99-00), a Computer Science major at UMKC, began work on designing an MPI web site.

On January 11, Richard Delaware spoke at the KCATM (Kansas City Area Teachers of Mathematics) Annual Conference at UMKC on "Resources for Teaching History of Mathematics."

On January 27-28, we held our MPI Recruitment days for juniors and interested faculty and administrators from participating districts. A report will follow in the April issue of this newsletter.

ENRICHMENTS

FOLLOW UP

On Friday, December 20, Frank Booth, a forensic chemist from the Kansas City Regional Crime Laboratories spoke on **SCIENCE IN THE CRIME LAB**.

Students responded:

■ Frank Booth, Forensic Chemist, for the Kansas City, Missouri, Police Crime Lab, gave an interesting presentation on Science in the Crime Lab. He began by describing the many divisions of the crime lab: Chemistry, photography, firearms, trace evidence, and DNA. When a lab does not have the means to fully analyze a piece of evidence, it is outsourced. Mr. Booth described some of the important evidence that they look for, such as ballistic evidence, point of entry, prints, and DNA. Mr. Booth also gave an interesting demonstration of how luminol works. Luminol reacts with blood and gives off a blue light in the dark.

■ He explained to us that when a gun is fired, it leaves a lot of things behind. They can look at these things, bullets, gunpowder, and cartridges, to find out what gun was used and from how far away. I learned that these guys are good and know what they are doing. I am not going to commit a crime any time soon.

■ Frank told us how they use ultraviolet lights to identify shoeprints. They can find them on almost any floor and it helps solve a lot of cases. An old speedometer would smack the glass at the speed it was going when the accident happened. Also, a fingerprint can be used. They can now take a fingerprint off cloth. To match fingerprints, six common points must be found. He said that 17 points in common make it undoubtedly that person.

■ I thought that it was a good topic to speak about. It was real interesting to find out about some of the different ways that they solved who the killer was. How they could figure out who a killer was just from a red piece of fiber on a women's sock. Impressive!! The demonstration was cool too.

■ Good timing for that guy to come in. Good way to finish the semester.

■ Very informative! With all of this new knowledge, I can now perpetrate the perfect crime. – ha-ha!

■ He was very good. I like how he told real actual stories. It was really good. I enjoyed it. I like watching "On the Case" Mondays on the Learning channel.

■ Very interesting presentation. I would have liked to see more demonstrations and perhaps samples of evidence. It was neat to actually see luminol work in person rather than in movies and TV shows like C.S.I.

Our 18th annual **PANEL DISCUSSION AND REUNION** was held on January 7th in Room 207, and moderated by Richard Delaware. As usual, each of the panelists discussed their college experience, their major, and/or work experience.

The alumni panelists this year were:

Jennifer Brown (94-95)

BA French, Minor: Spanish
MBA Business and Finance
University of Missouri – Kansas City

Hattie Williams (94-95)

BA Psychology, Sociology, & Philosophy
University of Missouri – Kansas City
MIDT (Master's Instructional Design & Technology)
Emporia State University

Jenny Green (97-98)

BS Chemistry
Texas Lutheran College

Ph.D. Chemistry Student
University of Missouri – Columbia

Angelina Walls (98-99)
Communications & Theology Major
Creighton University

Ken Denton (99-00)
Wildlife Biology Major
University of Missouri – Columbia

John Hershberger (99-00)
Chemistry Major
University of Missouri – Rolla

Lyndsey Main (99-00)
Computer Science Major
University of Missouri – Kansas City

Chris Nevans (01-02)
Mathematics & Physics Major
Truman State University

Leslie Tiensvold (01-02)
Biochemistry Major
Freed-Hardeman University

Hattie Williams (94-95) also brought a 3-page handout with some tips for our students, such as:

- Choosing a major is not very important in the first two years.
- Once you choose a major, I highly advise that you join a professional organization. Student rates are discounted and it will give you early exposure to your field.
- If you are headed for the corporate world, take a project management course, regardless of your major.
- If you want to be an educator, keep your eyes open for possible masters' degrees to pursue. Teachers with MA's make something closer to a livable wage.
- Careful with BS in Computer Science. It was hot once, but now you really have to be an Ace or have a specialty. This is where those 4 years in a lower level of the business comes in handy.
- Don't waste electives on courses that will *only* enhance your G.P.A. Select electives that will accent your major or make you well rounded.
- Sometime in your four years, join at least one interest group, one volunteer group, and one academic group to diversify your experience.
- If possible do an internship in your junior or senior year summer.

Other MPI Alumni attending were:

Tim Colyer (01-02)
University of Missouri – Columbia

Andrew Gibler (01-02)
Longview Community College

Reva Hertlein (01-02)
Pharmacy Major
University of Missouri – Kansas City

Matt House (01-02)
University of Missouri – Rolla

Dustin Sullivan (01-02)
Electrical Engineer & Computer Major
University of Missouri – Kansas City

Some specific current MPI student comments were:

■ MPI alumni spoke about what they did after MPI and what they are doing now. Those that have graduated spoke about their careers. The panel also went into detail about college life and living on campus. They then spoke about classes, scheduling, and problems with teachers and class sizes. Finally, the panel told how the MPI helped them and took questions from the students.

■ It was interesting to hear all their stories about colleges. They were very informative about how to live your college life. They said it will be hard to adjust, but you have to find your own groove and stick with it. They said that MPI helped them on their way because they knew how dedicated you had to be for college.

■ The information they provided about college life will probably help me along the way in my college decisions. I especially found Ms. Williams' handout very helpful and organized. I truly think that Alumni Day is an excellent idea and not just because we did not have to do any work.

■ Extremely informative!

■ I really enjoyed it! It was cool to get the college students' view of what's to come.

■ I enjoyed this and I think I learned a lot from the graduates.

On Friday, January 17, Keith Ashman, UMKC Department of Physics, spoke on **THE HUBBLE TELESCOPE: NASA'S TIME MACHINE.**

Students responded:

- It was a perfect Enrichment.
- I like the accent.
- Dr. Ashman first spoke about the design of the Hubble telescope, and also the flaw in the mirror that was later corrected. He also spoke about all of the different fields that contributed to the design of the telescope. Then, he spoke about the work that the Hubble does, and showed slides of some of the pictures it has taken, explaining parts of astronomy at the same time.
- Keith talked about some of the things he worked on when he was still on the Hubble project. I loved his comment on the end of the universe.
- Perhaps the best Enrichment yet!
- This speaker was very interesting and funny, and his pictures were cool.
- He was an excellent speaker. He put his own experiences and recommendations into this presentation. You could obviously see this was one of his passions.
- Awesome pictures! I would enjoy work with something like the Hubble.
- Ashman worked at the Space Telescope Science Institute where the Hubble was designed. To correct the slight defect in the main mirror, NASA sent up some gizmos to add some "corrective lenses" to the Hubble (telescope contacts). Hubble is a "time machine" because images we see are actually in the past because of the amount of time it takes for the light to reach earth. Great speaker. Definitely the best performance of the year and good topic. Great pictures.
- Dr. Ashman did a fantastic job. He was hilarious, and I know it has nothing to do with anything but I love his accent.
- This was the funniest and most entertaining speaker all year, as well as the most well-educated.
- He's absolutely awesome!!

UPCOMING:

On January 31, Caroline Davies, UMKC Geosciences, will speak on "Using Lacustrine Sediments to Reconstruct Paleoenvironments of the Middle East".

On February 28, we'll take a two-part field trip to UMKC, separated by lunch, to visit both the Physics Dept. laboratories in the Flarsheim building, and the Rare Book Room of Linda Hall Library of Science, Engineering & Technology. In Physics, last year we toured labs in Atomic Force Microscopy, Scanning-Tunneling Microscopy, High Pressure Physics, Chaos/NonLinear Dynamics, Photoelectron Spectroscopy, and Photo-Luminescence. At Linda Hall Library, we viewed rare and historically significant mathematics books including the first calculus textbook (1696), books by Newton and Leibniz, co-inventors of the calculus, several versions of Euclid's Elements, and about 20 more books. MPI students will also be required to write a short response paper for calculus class.

On March 14, we have not yet scheduled a speaker.

On March 28, Mitchell Dobson (89-90), will speak on **PRINCIPLES AND ADVANCEMENTS IN PROSTHETICS**.

WE HEAR FROM PAST STUDENTS

Teresa Orth (Schlueter) (96-97)
BS Biology: Cellular/Molecular; Minor: Chemistry,
Northwest Missouri State University
M.D./Ph.D. Physiology Major, University of Kansas
School of Medicine

"MPI is a great program to teach students about college level expectations. Keep up the good work!"

Dianne Le (97-98)
BS Journalism, University of Kansas
Master of Journalism Student, University of North
Texas

"I am still glad I was a part of MPI. Especially coming from the Kansas City School District - MPI offers a challenge that ordinary high school curriculum does not have. After graduating from KU, I made a big choice to move to Texas and leave many friends and family behind. Now I am working on my masters and having a great time in Texas. Life is all about the choices you make. Thanks again MPI!!"

Brent Thompson (97-98)
BS Electrical Engineering; Minor: Math
University of Missouri - Rolla

"MPI did an excellent job preparing me for college. Thanks to MPI's added workload and

increased pace of study, I was more prepared to deal with my first semester of classes at UMR. High school seniors would be foolish to pass up the opportunity to attend MPI.”

Jeffery Weston (97-98)
BS Computer Engineering
University of Missouri – Rolla

“I graduated in May and got a job in Washington, DC. I’m doing network-related research at the Naval Research Laboratory. I’ll probably get a Master’s degree while I’m there, but I’ve only just begun to look at the different programs in the area.”

Nathan Johnson (99-00)
Architecture Engineer Major
Kansas State University

“MPI was the most hands-on educational experience I’ve ever had. It taught me so much more than just Calculus and Physics. The study skills I picked up helped me be successful in courses that I’ve taken since. It has helped me in so many ways.”

Lyndsey Main (99-00)
Computer Science Major
University of Missouri Kansas City

“At MPI, the classes were smaller and I felt more comfortable asking questions. I also felt like the instructors at MPI cared about my success and me. At college, it’s every man for himself!

I believe that MPI prepared me for the college experience by teaching me more about time management and personal accountability. It also showed me that math and physics were not as “scary” as I thought they were.”

Rachel Yeargin (99-00)
Electrical Engineering and Business Major; Minor:
Spanish
University of Missouri – Kansas City

“The instruction in the courses at MPI was much better than any of the other math classes I have taken. In Physics courses the instruction has been fairly comparable, but the professors at MPI cared about the students much more as individuals.

It spoiled me!! Seriously, it has helped me so much, it helped me to get ahead in many of my courses just by the simple advantage of having learned the material previously. It also allowed me to take a lighter course load my first couple of semesters in college. Familiarized me with the setup of a

collegiate course, the transition to college from high school was easier for me than most of the people in my classes.”

David Smith (00-01)
Communication Major; Minor: French
University of Missouri - Columbia

“MPI helped me realize how much work it really takes to succeed at the next level in college. Through the free credit I earned at Truman and MPI, I am now considered a junior although this is my third semester of college. Taking college work in high school let me start taking courses in my major early.

I want to encourage the prospective MPI students that enduring MPI will benefit you in college and high school.”

Reva Hertlein (01-02)
Pharmacy Major
University of Missouri – Kansas City

“Well, I basically learned how to manage my time better and how to map a study schedule. I pushed myself to do more rather than take the easy way out and that boosted my level of self-confidence. I felt like I really did something that was difficult and although I didn’t get all A’s, I’m proud of myself.

It lowered my high school GPA, but that doesn’t really matter. I could have taken easier courses but I wouldn’t have had a feeling of accomplishment.

I am very grateful to the MPI because it gave me a nice jump on the people in my program at UMKC. Plus, since my tuition rates are outrageous, I am sure my parents are grateful that I got 12 free hours.”

Matt House (01-02)
Civil Engineering Major
University of Missouri – Rolla

“[Since the MPI,] I get things done the day they are assigned. I study a lot more than I used to. I’m much more prepared. Since I’m planning on becoming an Engineer, I definitely have to think “outside the box.” I’m much more confident in some of my harder courses. I am able to meet and study with people with an equal or greater aptitude than myself, which helped me. I can’t think of any experiences at MPI that set me back or caused harm to me.

MPI definitely helped me in preparing for college. It gave me a wake-up call before it was too late. I really enjoyed the faculty and the help I received. It’s a lot harder at college since the class

sizes are much larger. At MPI I was able to get help at any time.”

Courtney Olson
Fort Osage High School
Fort Osage School District

MORE 2002-2003 STUDENT IMPRESSIONS

“At first, I was only a little anxious for MPI to start. The only thing that scared me was the prospect of waking up at 6:00am. From what I had heard, MPI was difficult, but in my head, it was going to be nearly impossible. As the year has progressed, I have found that, while it is not easy, it is not unmanageable. All of the teachers are really wonderful, and I am not just sucking up. I’d really suggest that anyone interested in math or science attempt to attend the MPI.”

Doug Hill
Truman High School
Independence School District

“I think MPI is a great program. The challenges it brings demands lots of time, which in turn prepare you for college. It takes a lot of hard work to be a MPI student, but the benefits pay off!”

Jullian Ohrman
William Chrisman High School
Independence School District

“The MPI challenges you like no public school can. It forces you to apply all the skills you should have learned in high school: studying, homework, and test taking. Also, the MPI gives you the most accurate college experience possible. It has prepared me for college and if you are a serious math student it will prepare you.”

Andrew Gnefkow
William Chrisman High School
Independence School District

“There are many things that can be said about MPI. Frankly, I must say I’m partial to the program. What other school program allows a person to be late for school every day? Plus, class is only 50 minutes long, so if a person has a short attention span he or she doesn’t lose out too much.

There are also days where we don’t do anything, like problem solving or (even better) Enrichment days. Sure, things are required to be done on those days, but they’re still lazy in comparison to other days. I could insert the generic “The teachers and environment are best geared for learning” line right here, but I won’t take the time. When a program reaches this point that really goes without saying.”

“MPI is a great program that has challenged me and inspired me to do better. When I signed up for MPI last year I didn’t really know what to expect. I knew it wouldn’t be like my normal high school classes, but I still thought it would be pretty easy.

I was right that it wasn’t like my normal classes. At MPI you must be attentive and take notes. They treat you like college students. I think MPI is giving me a feel for real college life and this has motivated me to do more.”

Mike Gordon
St. Mary’s High School

“At first glance MPI seems hard and it is. Tons of homework, the new teachers, the early mornings are all a part of this new experience. One cool aspect of MPI, though, is that you get to meet new people from all over that are interested in the same things and career paths as you are. The teachers are very nice and easy to talk to and the classes are small so you never feel uncomfortable.”

Jerah Bates
Center Place Restoration School

A SOLUTION TO MATHEMATICS CHALLENGE #76

Recall the problem statement:

Prove the surprising fact that for any fixed positive integer $n \geq 2$, the function

$$f(x) = \cos(x\sqrt{1}) + \cos(x\sqrt{2}) + \dots + \cos(x\sqrt{n})$$

is not periodic for real values of x .

Recall: A function $f(x)$ is periodic if for some positive real number p we have $f(x + p) = f(x)$ for all real values of x .

[From: Mathematical Chestnuts From Around the World, by Ross Honsberger, MAA, 2001, problem #3, p. 25, from the East German Olympiads.]

SOLUTION:

We prove this by contradiction. Suppose $f(x)$ is periodic. In this case, for some positive real number p , we have

$$f(x+p) = f(x) \quad \text{for all values of } x.$$

For $x = 0$, this yields

$$f(p) = f(0) = \sum_{k=1}^n \cos(0) = \sum_{k=1}^n 1 = n;$$

this is to say,

$$f(p) = \cos(p\sqrt{1}) + \cos(p\sqrt{2}) + \dots + \cos(p\sqrt{n}).$$

Since $\cos(t)$ is never greater than 1, this could only be true if each term $\cos(p\sqrt{k}) = 1$. In particular, we must have both

$$\cos(p\sqrt{1}) = 1 \quad \text{and} \quad \cos(p\sqrt{2}) = 1.$$

But $\cos(t) = 1$ only for $t = 2\pi s$, an integral multiple of 2π . Thus, for some integers s and t ,

$$p\sqrt{1} = 2\pi s \quad \text{and} \quad p\sqrt{2} = 2\pi t.$$

Dividing these results we get the contradiction that

$$\sqrt{2} = \frac{t}{s}, \quad \text{a rational number.}$$

Thus $f(x)$ cannot be periodic.

A SOLUTION TO PHYSICS CHALLENGE #67

Recall the problem statement:

Another Special Relativity question: Say an astronomer found an earth-like planet 200 light years away from earth. Given that nothing can travel faster than the speed of light and that people cannot live for much more than 100 years, do you think that it would be physically possible to send a single person to visit that planet and return alive? Let's assume that technical problems such as propulsive energy and protection from cosmic radiation could be overcome.

SOLUTION:

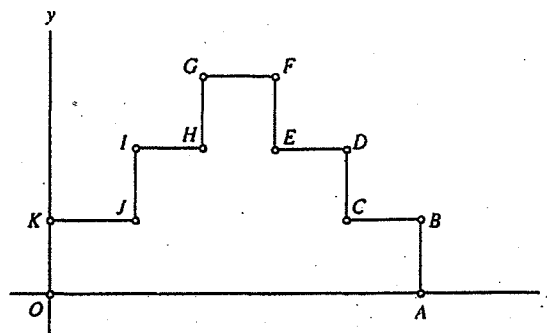
Besides the idea of simultaneity being lost, there is another interesting result of Einstein's 2nd postulate of relativity. Namely, clocks moving at high speeds relative to you tick slower than yours, which remains at "rest" (in your opinion, anyway). This statement is equally true for any type of clock, including biological processes, heartbeats, aging, etc. This effect is called time dilation. The faster you travel with respect to a chosen "rest" frame of reference (say earth), the slower your clocks tick according to the viewers at rest. To you, of course, your clock seems just fine.

For instance, if a rocket full of people travels at 99.99% of the speed of light, when one year has passed for the travelers, they have traveled 70 light years, during which time, about 70 years has passed on earth. Clearly, at these speeds, lifespan does not limit our ability to travel any distance at all, but technology presently prohibits this level of high-speed travel.

Noticing that the one thing that the travelers and nontravelers agree on is their relative velocity, the travelers believe that they traveled this great distance not due to time dilation, but due to length contraction, meaning space shrunk in their direction of travel.

MATHEMATICS CHALLENGE #77

In the polygon shown below, side OA has length 5, while all the other sides of the polygon have length 1.



Find the (x,y) -coordinates of the point X on the boundary of the polygon so that the line segment OX bisects the area of the polygon.

[From: Mathematical Chestnuts From Around the World, by Ross Honsberger, MAA, 2001, problem #3(ii)(a), p. 126, from Bulgaria.]

PHYSICS CHALLENGE #68

Here's a relativity question known as the "Twin Paradox":

Let's say you have a twin who decides to become an astronaut and go on a high-speed trip through space. When your twin takes off, you think, "I am at rest and you are very quickly moving away from me." Your clock is running too slow, and you are aging more slowly than I am! But, your twin looks out the window, and thinks, "No, it is you who

are very quickly moving away from me!" It is your clock that is going too slow and you who are aging more slowly.

Since each frame of reference is a valid "rest" frame, both of you should be correct. However, when your twin returns to earth, which twin has aged more?

Editor/Writer: **Richard Delaware**

This $M\pi$ Newsletter is typed in Microsoft Word 97 and published five times a year on the first of the month during the months of August, October, December, February and April, at the Mathematics and Physics Institute (MPI), 600 W. Mechanic, Room 224, Independence, MO 64050, Phone: (816) 235-1272, E-Mail: mpi@umkc.edu. Please address all correspondence concerning this newsletter to 'M π Newsletter'.

University of Missouri-Kansas City
Mathematics and Physics Institute
600 W. Mechanic, Room 224
Independence, Missouri 64050-1799

