AIMath

The Newsletter of the American Institute of Mathematics

AIM celebrates its 100th workshop

The American Institute of Mathematics celebrated its 100th workshop on Monday, May 12, 2008, with the beginning of the workshop, *Ferroelectric Phenomena in Soft Matter Systems*. "We are pleased to reach this milestone," said Executive Director J. Brian Conrey. "During the past six years, AIM has developed a workshop style that has been successful at bringing together different groups of researchers to work toward a common goal. Each field brings its own perspective to a problem, along with its tools and techniques, and exciting things can happen when groups start talking and sharing ideas."

The goal of the 100th workshop was to overcome present obstacles in the modeling and simulation of liquid crystal systems and other ferroelectric phenomena. Specifically, researchers hoped to better understand the process of switching, both for a liquid-like ferroelectric model and for a solid material with liquid features. The organizers assembled a cross-disciplinary group of participants to tackle this issue. Experimental and theoretical physicists worked with analytical and computational mathematicians to explore new techniques for modeling these unusual but ubiquitous systems. During the week, an exciting breakthrough was made where a team of researchers developed a system of differential equations that closely models experimentally observed phenomena in a particular type of liquid crystal environment.

Participants of AIM's 100th workshop: Ferroelectric Phenomena in Soft Matter Systems.

From the Director

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Greetings from Palo Alto!

This year has been a good one mathematically. Our workshop program continues to support research in all areas of the mathematical sciences, and our new SQuaREs program offers a unique opportunity for small groups to establish a long-term collaboration. In keeping with the AIM principle of *focused collaborative research*, our workshops continue to have 'collaboration building' as a primary goal. This year, again, saw many new collaborations beginning at AIM; their results are apparent in the numerous papers in our preprint series.

Some highlights from our workshops include one which exhibited the world's first transcendental degree-3 *L*-function. We also celebrated our 100th workshop: "Ferroelectric phenomena in soft matter physics" which turned out to be exceptional! The group made significant advances in a field that has the potential to be as revolutionary as the silicon chip—plastics! You can learn more about these advances in the "Organizer's Perspective" article by Carme Calderer.

K. Soundararajan, AIM's first Five-Year Fellow, and a recently hired professor at Stanford, made a major breakthrough this year. Together with Roman Holowinsky from the University of Toronto, Soundararajan proved the holomorphic analog of the Quantum Unique Ergodicity conjecture of Rudnick and Sarnak. The proof has two completely new ideas, one introduced by Holowinsky (a new kind of sieving technique) and one by Soundararajan (which he calls weak subconvexity), each of which works for all but a few cases. Happily, exactly when one of the ideas doesn't work, the other one does!

AIM awarded its latest Five-Year Fellowship to a truly outstanding candidate, Travis Schedler of the University of Chicago. Our other current Five Year Fellows: Yi Ni, Elizabeth Meckes, Joel Kamnitzer, and Jacob Lurie are all doing well. Jacob was just appointed as an associate professor with tenure at MIT.

We are delighted to have appointed Estelle Basor to the Deputy Director position. Estelle was a professor at Cal Poly San Luis Obispo, and brings a lot of energy to this position. She works in operator theory and random matrix theory.

At the same time, Steven Krantz ended his term as Deputy Director. Steven brought many innovations to AIM during his two years, including accounts of each AIM workshop written for the non-specialist. Samples are included in the "Workshop Snapshot" section of this newsletter.

Other additions to our staff include Wei Kang, who has been appointed to the newly created position of Director of International and Business Collaborations; Brianna Donaldson, Director of Special Projects; David Holmstrom, Math Specialist for our Morgan Hill Math programs; and Shaquana (Quanie) Mitchell, Executive Assistant, who replaced Meghan Criswell who had been with us for eight years but couldn't resist an opportunity to move to the Big Apple.

This year saw the introduction of a new program at the National Science Foundation called "Cyber-enabled Discovery and Innovation" (CDI). It represents a major, cross-disciplinary initiative and each of the seven NSF-funded math institutes assisted the Division of Mathematical Sciences in rolling out this program. AIM's part in this was to host an intensive grant writing workshop for teams that were preparing proposals. Altogether, the NSF received more than 1000 proposals, of which 42 have received funding.

Our own grants activities were very successful. AIM was awarded a new Focused Research Grant (FRG). With co-PIs Michael Rubinstein of the University of Waterloo and William Stein of the University of Washington, its focus is to create a database and encyclopedia of *L*-functions. We were also instrumental in two CDI projects that were funded. The first deals with cancer research (called "Simulation of ultrasonic-wave propagation with application to cancer therapy" with Oscar Bruno of Caltech as PI). The second investigates how scientists can best utilize Web tools to manage and curate their bibliographic data, interpreted in a very broad sense, for collaborative research purposes (called "Bibliographic Knowledge Network" and led by Jim Pitman of UC Berkeley).

We are in the second year of our new SQuaREs initiative. This program brings together four to eight researchers who meet for an

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J. Brian Conrey

Estelle Basor - AIM's New Deputy Director

AIM is pleased to introduce our new Deputy Director, Estelle Basor. She began in July, 2008.

Estelle Basor received her PhD from the University of California at Santa Cruz in 1975 under the direction of Harold Widom. She recently retired from California Polytechnic State University in San Luis Obispo after 32 years. She also held visiting positions at UC Santa Cruz and Bryn Mawr College, and was a member of MSRI in the spring of 1999. At Cal Poly, she was coordinator of the graduate program and actively involved undergraduates in several research projects.

Her research interests are in the area of operator theory. She has worked mostly to find asymptotic expansions of determinants of convolution type operators. These expansions have broad applications in mathematical physics. Originally, many of the problems were motivated in order to understand and model phase transitions; currently several of these problems overlap with understanding the statistics of eigenvalues of random matrices.

Her non-professional interests include traveling, tennis, cooking, and trying (after several years of not playing) to relearn bridge.

Estelle Basor,
AIM Deputy Director

Collaborations with Business & Abroad

The American Institute of Mathematics recently announced the appointment of Wei Kang as the Director of International and Business Collaborations. Wei is responsible for developing and enhancing collaborative research programs between AIM and other organizations, laboratories, and industries, both regional and international.

Wei Kang received his PhD in Mathematics in 1991 from the University of California, Davis. His research interests lie in the field of control theory and its applications. He served as an associate editor of *Automatica* and *IEEE Transactions on Automatic Control*. He is a Fellow of IEEE and has been a plenary speaker at two international conferences of SIAM and IFAC. He is also a professor of applied mathematics at Naval Postgraduate School.

Wei Kang,
Director of International & Business Collaborations

Schedler named Five-Year Fellow

When describing how he became interested in mathematics, Travis Schedler, the new AIM Five-Year Fellow, cited a series of people and experiences touching his life since elementary school. "I was accelerated in math in school because I'd learned a lot of arithmetic at home," Schedler said in a phone interview. As a result, he began learning with a private tutor, Dr. Marvin Zeman, a mathematics professor at Southern Illinois University-Carbondale. "It was a stimulating experience, learning math in a rigorous way," Schedler said.

Math research caught his interest in high school. He participated in the Research Science Institute program, working with Professor Pavel Etingof. Their work resulted in a joint publication in the Duke Mathematical Journal. "Ever since then, I've been excited about research," Schedler said.

As an undergraduate at Harvard University, Schedler also took a few classes with Etingof. Although he considered majoring in physics, he "found the math courses more interesting." After a year abroad in the Paris Ecole Normale Supérieure, Schedler began graduate studies at the University of Chicago, where he worked with Professor Victor Ginzburg in the area of non-commutative geometry. "My advisor has been really helpful and inspiring," Schedler said.

Schedler's thesis studied differential operators in non-commutative systems. A non-commutative system, he explained, is one where the order of an operation cannot be reversed; for example, 5 minus 3 is not the same as 3 minus 5. The Heisenberg Uncertainty Principle provides another example. "There's an operator that measures position or momentum, but you can't reverse the order," Schedler said. "Measuring the position of a particle, then its momentum is not the same thing as measuring its momentum, then its position."

"I tried to develop a theory of differential operators in non-commutative space," he said. Previous work in non-commutative geometry provided the motivation for Schedler's research. Considering a paper by Michel Van den Bergh, which extended Poisson geometries to a non-commutative setting, Schedler's work "was a natural step to take," he said.

In his thesis, Schedler extended the area of differential operators into non-commutative geometry in such a way that the geometric techniques are analogous to those for normal commutative geometry. Such continuity has applications in other areas, for example the Batalin-Vilkovisky formalism.
During his tenure as an AIM Fellow, Schedler plans to begin with a post-doc at MIT. "I already have a three-year appointment there," he said. "I will talk with the people I know there, continue my current projects and expand into new areas."

Schedler is grateful for the opportunities the Fellowship will give him. "The five years after graduation are the most crucial time for developing your career," he said. But like his mentors before him, Schedler is interested in more than just research. "I think it's great that the Fellowship allows some flexibility to do teaching as well. As a mathematician, you start with research, then improve your teaching." At the University of Chicago, he taught a few mathematics courses. "It's both stimulating and enjoyable, but also a challenge to teach and research," he said. "Students ask questions that you should have asked yourself."

-Lily Beauvilliers

Travis Schedler: AIM's newest Five Year Fellow

Math Mardi Gras 2008: something for everyone

Q How do you bring together more than 300 people and have them spend an afternoon actively engaged in solving math puzzles and having fun?

A *Run an event in the style of AIM's Math Mardi Gras in Morgan Hill.*

This year saw the third annual Math Mardi Gras at the Morgan Hill Community Center, and it was the most successful one yet! Local students ranging from grades 2 through 12 and their families, along with other community members, participated in a day of family math activities and friendly competitions.

Once again, the main room of the Community Center was a bustle of activity with Math Jeopardy continuously running at one end of the room, competitions of SET, Sudoku, and Rubik's cube in the middle, and challenging math booths around the perimeter. This year, players of Math Jeopardy were able to face their peers in this fast paced, buzzer-hitting game on a new "game show" set designed by AIM's own Executive Assistant Meghan Criswell. Game show host Dave Holmstrom (a MathCounts coach) joined in the fun and donned a '70s costume, complete with a pair of over-sized, gold glasses.

Math Jeopardy contestants

A new feature this year had the audience on the edge of their seat; we invited adult members of the community, including Morgan Hill Mayor Steve Tate, to challenge two of our top math students, Bryant Gamboa (9th grade) and Mark Holmstrom (7th grade). Contestants worked to be the first to hit their buzzer and correctly answer such questions as: "How many different positive, four-digit integers can be formed using the digits 2, 2, 9 and 9?" [6] and "Stan drove 300 miles in 5 hours, 20 minutes. Next, he drove 360 miles in 6 hours, 40 minutes. What was Stan's average speed in miles per hour for the total trip?" in less than a minute. Mark Holmstrom was the grand champion, barely beating out Gamboa and Mike Fine, a local dad.

Morgan Hill Mayor, Steve Tate, at Math Jeopardy

The popularity of the Rubik's cube competition continues to grow. A total of ten contestants were able to complete the Rubik's cube in under two minutes, thus qualifying to compete in the final, on-stage round at the end of the afternoon. Alvin To, a tenth grader, had a winning time of 39.1 seconds. The final round of SET, a visual matching game, was a family affair, as Maggie Luu, a 9th grader, barely beat her sister, Michelle Luu, to take first place in the competition. New activities this year included Origami, Pizza-by-the-Slice (a game involving fractions with food), and Algebra Thrills.

The Sudoku table was constantly buzzing with pencil-gnawing contestants as kids teamed up with an adult to try to solve a Sudoku puzzle

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Workshop Snapshot

Deputy Director Steven Krantz provided a summary of all AIM workshops. The full text of all workshops can be found at ***www.aimath.org/~skrantz/Blurbs***

Higher-order Methods for Computational Wave Propagation & Scattering
Organized by Oscar P. Bruno and Rainer Kress *(September 2007)*

The participants in this workshop are considering large systems of linear partial differential equations with complicated geometric conditions and many unknowns. Typically these systems describe important physical systems; but they tend to be intractable. The goal is to develop qualitative techniques for understanding this important physical model.

How do we see things? Light is the key factor in vision. Light is a form of electromagnetic radiation. Light will strike an object and then be reflected. Upon reflection, it is directed to the eyes. The light penetrates the optical nerve, and the retina converts the light to electrical impulses which communicate with the brain.

(continued on www.aimath.org/~skrantz/Blurbs/scatter.html)

Triangulations, Heegaard Splittings, and Hyperbolic Geometry
Organized by Jennifer Schultens and Maggy Tomova *(December 2007)*

Low-dimensional topologists study 3- and 4-dimensional surfaces or manifolds. Here a manifold is a topological space M that locally looks like Euclidean space R^k for some positive integer k. We call k the dimension of the manifold, and we call M a k-manifold. People like to say that if you were a myopic insect living on a 2-dimensional manifold then you would think you were living in the plane. The residents of Earth in the fifteenth century fit that description: everyone in those days thought that the Earth was flat.

(continued on www.aimath.org/~skrantz/Blurbs/heegaard.html)

Enhancing the Problem Authoring Capabilities of WeBWorK *(August 2007)*
Organized by Robert Cervone, Michael Gage, and Arnold Pizer

At many colleges and universities, calculus and other elementary mathematics courses are taught in large, impersonal lecture environments. Often there are insufficient resources to grade homework. An obvious and unfortunate upshot is that the students do not do the homework, they become disaffected with the class, they fall behind, or they drop out.

The new software WeBWorK, developed by these organizers at the University of Rochester and allied colleges, addresses this problem head-on. WeBWorK is an OnLine system that allows the student to do homework problems in real time and have them graded immediately.

(continued on www.aimath.org/~skrantz/Blurbs/webwork.html)

The Uniform Boundedness Conjecture in Arithmetic Dynamics *(January 2008)*
Organized by Matthew Baker, Robert Benedetto, Liang-Chung Hsia and Joseph H. Silverman

A primary goal of the workshop is to develop tools and a strategy for proving the first (highly) nontrivial case of the uniform boundedness conjecture in dynamics, namely for quadratic polynomials in one variable over Q. This special case represents a dynamical analog of Mazur's theorem that elliptic curves over Q have bounded torsion.

(continued on www.aimath.org/~skrantz/Blurbs/unif-bdd.html)

Call for Proposals

AIM, the American Institute of Mathematics, sponsors week-long activities in all areas of the mathematical sciences with an emphasis on focused collaborative research.

Workshop Program

AIM invites proposals for its focused workshop program. AIM's workshops are distinguished by their specific mathematical goals. This may involve making progress on a significant unsolved problem or examining the convergence of two distinct areas of mathematics. Workshops are small in size, up to 28 people, to allow for close collaboration among the participants.

SQuaREs Program

AIM also invites proposals for a new program called SQuaREs, Structured Quartet Research Ensembles. More long-term in nature, this program brings together groups of four to eight researchers for 1-2 weeks of focused work on a specific research problem in consecutive years.

More details are available at:

http://www.aimath.org/research/

AIM seeks to promote diversity in the research mathematics community. We encourage proposals which include significant participation of women, underrepresented minorities, junior scientists, and researchers from primarily undergraduate institutions.

Organizer's Perspective

***Maria-Carme Calderer**, Professor of Mathematics at the University of Minnesota, gives an account of the "Ferromagnetic Phenomena" workshop at AIM, May 12-16, 2008.*

Between May 12 and 16 of 2008, a multidisciplinary group of mathematicians and physicists came to AIM to discuss the complex issues surrounding ferroelectricity of soft matter systems, in particular liquid crystals. The interest in liquid crystals, which are at the foundation of various applications ranging from medicine to telecommunications, is due to their long-range, orientational nature and their exceptional responsiveness to excitation, whether from external electric fields, variations in temperature, etc.

The ability to use an electric field to trigger a response in a liquid crystal allows for their use as *switches* or *valves* which are at the heart of many technological applications. Examples include the feedback control mechanism of robotic arms as well as the electronics behind liquid crystal displays in watches, calculators, and other visual display monitors. Future applications could include responsive aircraft wings and smart, light-sensitive filters. Currently, this technology is based on the weaker, dielectric properties of liquid crystals. However, the use of ferromagnetic materials greatly enhances the switching power of these devices and enables equivalent results with samples of even smaller size. As a consequence, switching rates promise to increase by orders of magnitude. Also, the 'plastic' nature of liquid crystals has two other advantages. Firstly, their flexibility over the more rigid structure of solid semiconductors makes possible a new realm of smaller, more flexible nano-materials with exciting new applications in biology and offering attractive alternatives to the fiber optics industry. Secondly, liquid crystals require a much reduced electric field strength to accomplish equivalent levels of polarization.

The focus of the AIM workshop was to study the interaction between the applied electric field and the flow in ferromagnetic liquid crystals. In particular, we wanted to develop a better model for obtaining predictions of ferromagnetic fluid flow arising from an applied electric field, and conversely, the generation of an electric voltage as a consequence of ferroelectric fluid flow. The promise that ferromagnetic materials hold for these exciting new applications is because of the strong polarization effects produced by external electric fields. However, it is exactly this characteristic that makes them difficult to model. The strength of the interaction prevents the use of perturbation techniques, and new approaches are needed.

Starting with basic physical principles and experimental facts, we sought to formulate mathematically sound equations amenable to analysis and to the application of numerical methods for their simulation. Ultimately, such studies may support these new devices, particularly those made from plastic.

The Key Question

The question at the core of this workshop was to mathematically investigate how the coupling between the polarization and the applied electric field affects the material's ability to generate and maintain flow. This flow triggers the switching between two distinct polarized states and each state has its own optical and mechanical properties. Solving this problem involves several components: modeling and analysis of the governing system of differential equations, numerical studies of the discretized system, and the development of simulations that can lead to experimentally testable predictions. To make progress, we brought together researchers with different backgrounds and complementary expertise. We planned the workshop activities around the idea of exploring this problem from the following perspectives: physical, experimental, modeling, analytical, and numerical.

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"The entire workshop really felt like a group of scientists and mathematicians 'rolling up their sleeves' to actually develop the topics, starting with the very challenging aspect of setting up equations."

Math Teachers' Circle Program continues to expand

When Mary Fay-Zenk, a math teacher and assistant principal at Miller Middle School in Cupertino, CA, attended math circles with her students, she loved the math—but hated being relegated to the sidelines. "They have a rule that adults are not allowed to participate," she explained. "This was very frustrating because it was so interesting! It was then that I decided that we needed something like this for teachers." Fay-Zenk teamed up with Tatiana Shubin, a professor of mathematics at San Jose State University, and her Math Circle colleagues, Tom Davis, formerly of Silicon Graphics; Joshua Zucker, then a math teacher at Castilleja School in Palo Alto; and Sam Vandervelde, co-founder of the Mandelbrot Competition, to organize a workshop at the American Institute of Mathematics. This event launched the first Math Teachers' Circle (MTC) in August, 2006.

The success of this original MTC has led to AIM's current initiative to launch 100 MTCs nationwide by 2014. Two years after the first workshop, AIM's MTC program has grown to encompass seven active MTCs in seven different states, with an additional twelve teams of teachers, mathematicians, and administrators from ten more states who plan to begin MTCs within the next year. With the addition of these twelve new circles, MTCs will be meeting in a total of 19 communities in 17 states by the end of next summer.

The Rational Tangles or "rope dance" session, led by Tom Davis (center), was especially popular at both workshops.

The national MTC program is aimed at math teachers at U.S. middle schools. Its mission is to enrich the teachers' experience of mathematical problem-solving and enable them to tackle open-ended problems with confidence. Each local MTC consists of a residential summer immersion week for 20 to 25 middle school teachers, followed by monthly meetings during the next academic year, and indefinitely thereafter. MTC meetings are based on the Eastern European model of student math circles, which typically involve middle or high school students meeting after school with a mathematician for collaborative problem-solving. Through their participation in a local MTC, middle school math teachers engage in an ongoing dialogue about math with colleagues and professional mathematicians and also develop a base of support as well as resources that empower them to promote open-ended problem-solving in their classrooms.

The location of existing and future Math Teachers' Circles.

People often wonder why the MTC program focuses on the middle school level. The short answer is that "Elementary school is too hard and high school is too late," says Joshua Zucker, a founding co-organizer of the MTC program. Indeed, there is ample evidence that U.S. middle school mathematics education is in need of some extra attention. According to the recently released Mathematics Teaching in the 21st Century study,

conducted at Michigan State University and funded by the National Science Foundation, middle school math teachers in the U.S. ranked in the middle to the bottom internationally in terms of content knowledge. In addition, middle school math teachers tended to be less prepared pedagogically than their elementary school counterparts and less prepared mathematically than secondary school math teachers. The performance of U.S. middle school students has also been lackluster, with U.S. eighth graders scoring significantly below nine other countries (five Asian and four European) in the latest Trends in International Mathematics and Science Study.

While the MTC program focuses on math enrichment for teachers, an underlying consequence is that it will result in better middle school math education for students as well. "The beauty of the program is that by exposing one teacher to the kind of open-ended problem solving you encounter in a Math Teachers' Circle, you can potentially affect thousands of students over the course of that teacher's career," explained AIM Executive Director Brian Conrey. "By the time we have 100 Math Teachers' Circles around the country, the program will impact up to five percent of all U.S. middle school students each year."

The nationwide MTC initiative got off the ground in the summer of 2007 with the first "How to Run a Math Teachers' Circle" workshop. Seven teams comprising teachers, mathematicians, and administrators, from seven different states attended that workshop and spent the week participating in mock MTC sessions as well as developing plans for how to launch their own MTC, specific to their own particular challenges. Six of those seven teams—Charlotte, NC; Lincoln, NE; St. Louis, MO; Salt Lake City, UT; South Bend, IN; and Tucson, AZ—currently have active MTCs. Each of these MTCs has preserved the program's focus on problem-solving but has also developed creative "hooks" to attract teachers. These include having a classroom-ready handout at each meeting (Lincoln), using the successes of an existing student math circle program (Salt Lake City and Charlotte) as a starting point, or even hosting "Math and Margarita" nights (South Bend) to attract potential recruits.

> *"I decided that we needed something like Math Circles for teachers."*
>
> *— Mary Fay-Zenk*

In 2008, twelve additional teams attended "How to Launch a Math Teachers' Circle" workshops. One of these was held in June in Palo Alto; the second took place in July at the Mathematical Association of America's Carriage House conference facility, in Washington, D.C. Support for the D.C. workshop came from the Mathematical Association of America, the American Mathematical Society, the National Security Agency, and the National Science Foundation. Shubin, Davis, Zucker, and Matthias Beck, an assistant professor of mathematics at San Francisco State University, organized both workshops. The summer workshops began each day with mock MTC sessions. While many of the sessions were run by the organizers, guest mathematicians also participated. David Patrick of the *Art of Problem Solving* led a math session at the Palo Alto workshop, and Professors Paul Zeitz of the University of San Francisco and Dan Ullman of George Washington University led sessions at the D.C. workshop.

In the afternoons, workshop facilitators guided teams through some of the important aspects of planning their MTC, including developing a team vision and strategies for recruitment, evaluation, and fundraising. The

(Continued on page 20)

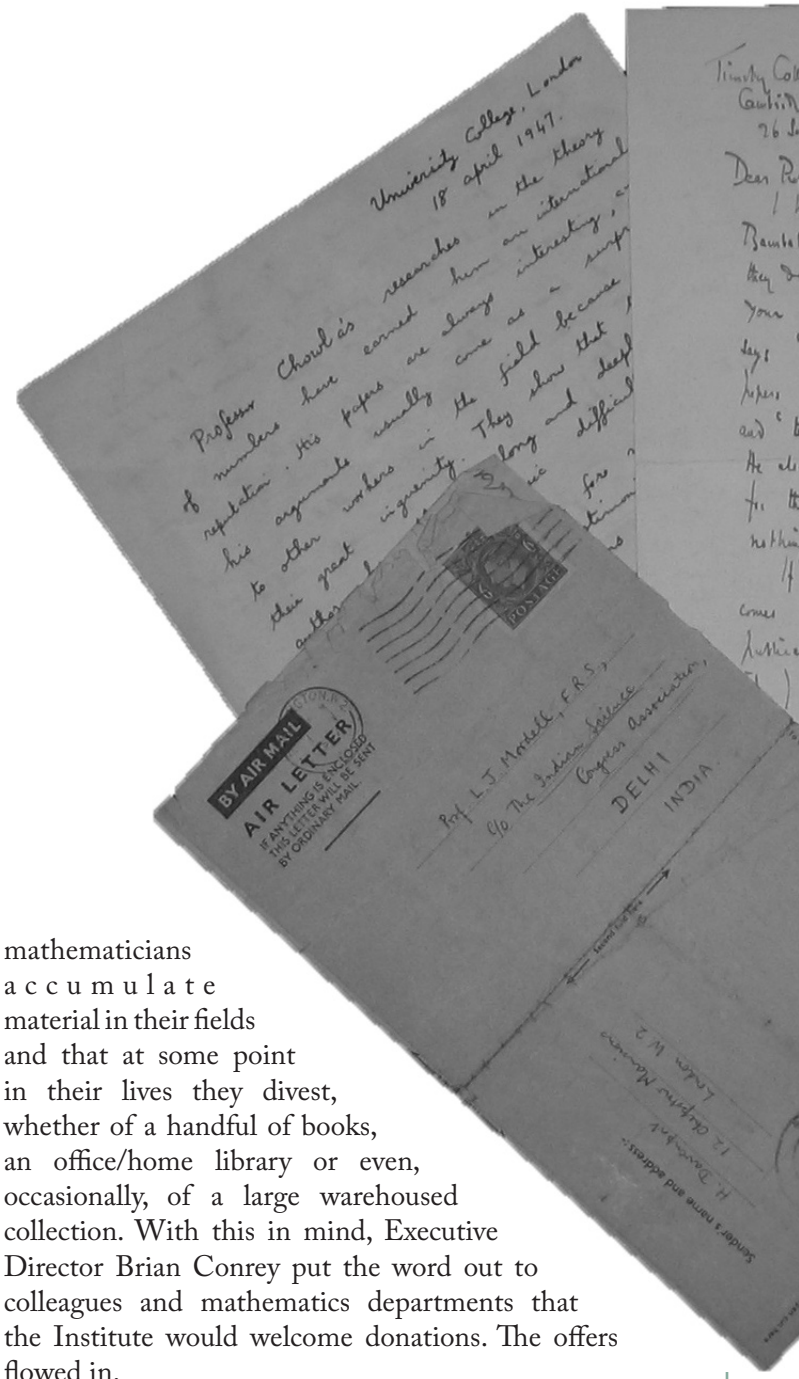
Participants in the D.C. workshop explore the geometry of Zome tools.

The Library at AIM -a collaborative effort

The AIM Library grew from the premise that the practice of mathematics depends on a close relationship with its past scholarly literature. "The library is the mathematician's laboratory," said Paul Halmos and our library exists to advance the study of mathematics. Beyond this essential goal, it exists to preserve the history of mathematics. To these ends, AIM acquires and conserves original materials, makes them accessible to staff and visitors via cataloguing and collection management, supports research, and educates with displays and exhibitions.

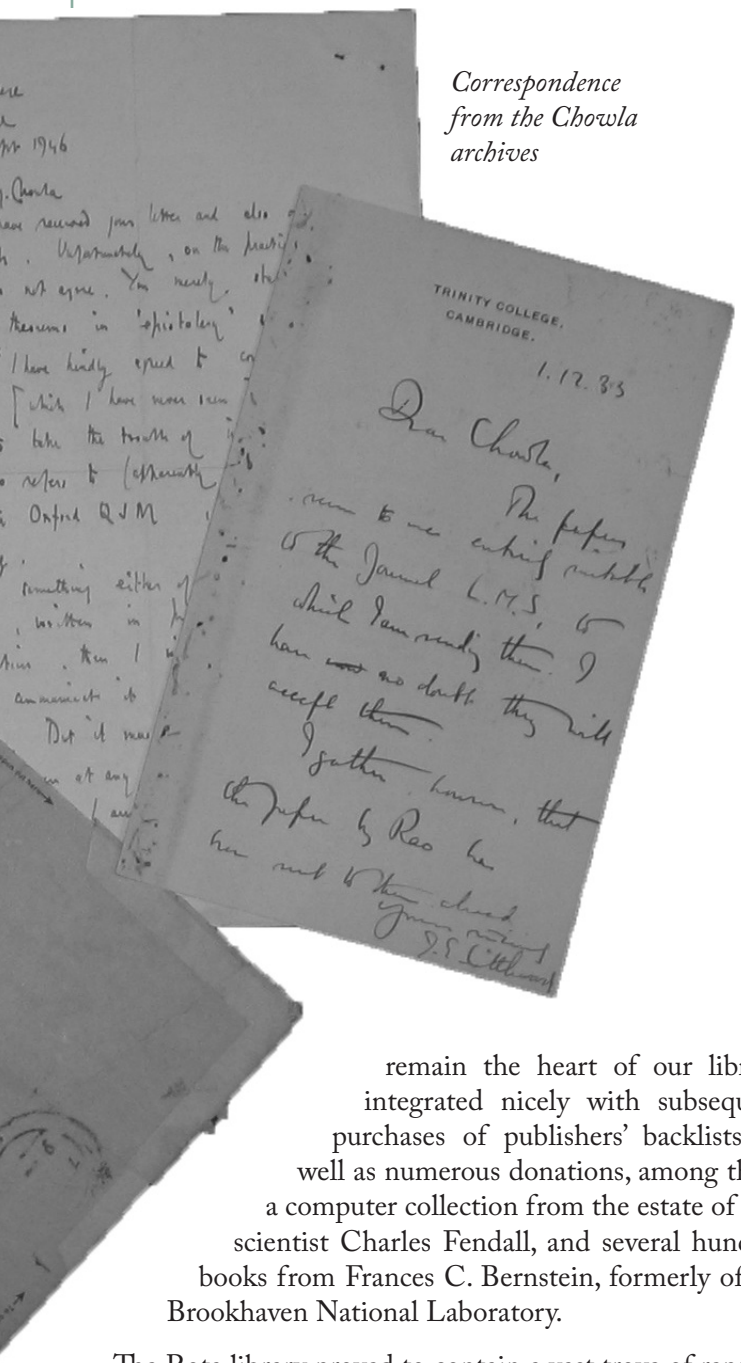
In its ten years, the AIM Library has developed its holdings at a rapid rate, both by donation and by purchase. Our collections fall into four categories: the general printed collection (i.e. the working library), rare books, reprints/journals, and archives. The working library currently numbers 12,000 books while the rare book collection, housed in a separate location, showcases items from the 15th through 20th centuries. Perhaps our strongest asset is the reprint collection, now representing several thousand mathematicians in 100,000+ offprints and preprints. AIM actively solicits the reprints of mathematicians the world over, knowing this material to be an enormously rich resource, worthy of preservation. We are unique among libraries in assembling a comprehensive reprint repository. Similarly, AIM believes that the study of collateral, nonprinted materials—drafts, manuscripts, lecture notes, correspondence, etc.— is key to the understanding of a mathematician's oeuvre. We therefore seek to add archives to our collections whenever possible.

Substantial as the library now is, it grew from a modest though inspired beginning—from the idea that nearly all mathematicians accumulate material in their fields and that at some point in their lives they divest, whether of a handful of books, an office/home library or even, occasionally, of a large warehoused collection. With this in mind, Executive Director Brian Conrey put the word out to colleagues and mathematics departments that the Institute would welcome donations. The offers flowed in.



The library at AIM

The working library was the first beneficiary, gratefully accepting contributions from the libraries of Doris Schattschneider, Franklin Peterson, Oscar Rothaus, and David Gilbarg, to mention just a few of the initial donors. We went into full gear upon the acquisition of some 7,000 books (4,000 of them mathematical) from the estate of MIT professor Gian-Carlo Rota. The Rota mathematics books



Correspondence from the Chowla archives

remain the heart of our library, integrated nicely with subsequent purchases of publishers' backlists, as well as numerous donations, among them a computer collection from the estate of IBM scientist Charles Fendall, and several hundred books from Frances C. Bernstein, formerly of the Brookhaven National Laboratory.

The Rota library proved to contain a vast trove of reprints and this, added to several significant early donations —Samuel Eilenberg's papers from the Columbia University math department, Sarvadaman Chowla's archives from Jeff Mozzochi, and Emil Grosswald's papers given by Marvin Knopp—kicked off our reprint library. The Alfred Tarski papers and the reprint collection of Armand Borel given by the Institute for Advanced Study followed in short order. We are also indebted to the generosity of such AIM supporters as Keith Dennis, Gerald Alexanderson, Marilyn Peterson, Alice Mackey, Andrew Gleason, Dana Scott, Paul Bateman, Heini Halberstam, and Virginia Halmos, not to mention the legion of workshop participants who have contributed their papers to our burgeoning shelves.

Mathematicians donate to AIM in the well-founded belief that we can easily absorb a vast array of material. The staff has extensive experience in handling books, reprints, and archives. Access is integral to the AIM library philosophy: we currently maintain three catalogues (two of them online at *www.aimath.org/library*) and plan to launch an online manuscript catalogue on our move to Morgan Hill. All books and reprints, apart from the rare books, are shelved in supervised open stacks, readily available to researchers. So too, the displays: the new facility at Morgan Hill will offer ample space for revolving and permanent exhibitions.

To staff, visitors, and workshop participants, the AIM library is a rich resource, constantly renewed by acquisitions and by donations from members of the mathematics community who endorse the effort to preserve personal collections. Like the Institute itself, it takes collaboration to a new level.

-Ellen Heffelfinger

AIM Librarian, Ellen Heffelfinger

Call for Donations

The AIM Library actively seeks donations of books, reprints, journals and archives in mathematics and related fields. If you have material to donate, please contact Ellen Heffelfinger at *heffel@aimath.org*.

Morgan Hill Math:
young people + mathematics = success

Morgan Hill Math collectively describes the many AIM-sponsored activities for young people in the local Morgan Hill community. Its goal is to spread the enjoyment and appreciation for mathematics in all its many forms, and to challenge students through extra-curricular activities. Different events are planned throughout the year and smaller groups are formed around the various levels of the students. In addition, leaders for each group plan regular events and prepare their students for regional and national math contests—with proven success. The following is a sample of these activities.

MathCounts

Designed to expose students from 6th to 8th grade to multi-step word problems, several MathCounts groups meet weekly from October through January. Recent topics included logic, counting, probability, statistics, and number theory. MathCounts students are encouraged to compete in the American Mathematics Competition, AMC-8, a nationwide math test and also in the regional MathCounts contest. In March this year, Mark Holmstrom (7th grade) progressed to the MathCounts State Competition for Northern California, held at UC Davis and placed 18th out of 152 participants!

AIM Executive Director Brian Conrey with Murphy M.S. MathCounts team.

Congratulations to Bryant Gamboa from Principal Nick Boden.

High School Math Clubs

Math clubs are active at both Sobrato High School and Live Oak High School. Former MathCounts student Joshua Yip leads the bi-weekly meetings at Sobrato High while AIM Executive Director Brian Conrey coaches the Live Oak High School Math Club. Meetings often involve discussing and exploring challenging mathematical problems, and preparing students for the Math League Competition and the American Mathematics Competition AMC-10. This year, Bryant Gamboa, a ninth grader, placed in the top 1% in the nation and progressed to the American Invitational Mathematics Exam.

Finally, students from each club play an integral role in the success of the Math Mardi Gras, running the SET competition, assisting with Math Jeopardy, and running the "Win the Mardi Gras Lottery" (probability) booth.

Director's Circle

Outstanding students from our 6th-12th grade Morgan Hill Math programs are invited to join this group. Coached directly by AIM Executive Director Brian Conrey, students embark on more formal aspects of the discipline of mathematics. Some sessions introduce the concept of 'proof' and discuss the elements of proof-writing in a very practical manner. Other meetings involve exploring specific problem-solving techniques and concepts such as the 'Pigeon Hole Concept,' and preparing for BAMO (the Bay Area Mathematical Olympiad) contest. Each summer, members of the Directors' Circle are invited to participate in SMART (Summer Mathematically Advanced Research Team). This multi-day experience introduces students to more substantial problems requiring time for experimentation and investigation. They are introduced to *Mathematica*, a powerful computer algebra system, widely used by professional mathematicians.

This year they studied random sequences. For instance, they considered the problem: Show that there exists a power of 2 that ends in one thousand ones and twos. The quantity of '1000' can be replaced by any number and, in fact, an understanding of this reveals a unique infinite sequence of 1s and 2s for which the sequence of length 1000 above is just the initial part. This leads naturally to the following question: Does this infinite sequence appear to be random? The students were set the task of figuring our how to generate the sequence and to then perform various tests to determine whether the sequence is random. Joshua Yip and Peter Mains are continuing to work on this project and plan to prepare a submission to the science fair this year.

Britton Math Students Head for State Championship—Again!

This article celebrating the success of the Britton Middle School MathCounts team appeared in the Morgan Hill Times.

For the second consecutive year, the Britton Middle School math team has qualified for the State MathCounts Championship with an outstanding performance at the Monterey Bay Chapter MathCounts Competition held on Saturday, February 2nd in Salinas. In addition, also for the second consecutive year, a Britton student has earned first place in the individual competition. This competition included 81 sixth-through-eighth grade students from 14 schools. Morgan Hill schools were represented by 27 students from Britton Middle, Martin Murphy Middle, Charter School of Morgan Hill, Nordstrom Elementary, Paradise Valley Elementary, and Los Paseos Elementary.

Moira Foster, Jingyi Wei, and Amber Thomas working together.

In the Individual Competition, Mark Holmstrom, a seventh-grader at Britton, earned first place and advanced to the State Championship at UC-Davis in March. Other notable place finishers included James Gabbard (8th place; sixth-grader at Paradise Valley), Ernest Yip (10th place; eighth-grader at Britton), and Roger Kuo (11th place, eighth-grader at Martin Murphy).

In the Team competition, the relatively young Britton team (consisting of one eighth-grader and three seventh-graders) took second place, also qualifying them for advancement to the State Championship. Team members included Ernest Yip, Mark Holmstrom, Jingyi Wei, and Amber Thomas.

A third "Jeopardy style" Countdown Round Competition was held for the top twelve individuals in the overall competition. James Gabbard, a sixth-grader from Paradise Valley, was awarded third place.

MathCounts is an international middle school math competition program. In preparation for these competitions, all Morgan Hill MathCounts teams have been training weekly throughout the school year. The Morgan Hill teams are sponsored by the American Institute of Mathematics, led by Executive Director, Dr. Brian Conrey.

— Elizabeth Mandel

The Britton Middle School MathCounts team.

Math Mardi Gras 2008 *(Continued from page 5)*

as quickly as possible. The delight of winning was apparent on the face of Rachel MacMillan (a 6th grader) as she and her dad, Jeff MacMillan, held the prize envelope for first place in the final round of Sudoku.

For those visitors new to any of the above games, there were "How To" tables to teach them the basics. Enthusiastic volunteers staffed the booths and introduced new-comers to the rules and strategies of each game. Building on the strong response from this year's warm-up session, AIM Executive Director Brian Conrey gave two presentations on "Learn How to

The "Pizza-by-the-Slice" booth was new this year.

Do Killer Sudoku" to standing-room-only crowds. SET was a hot selling item at our mini-bookstore, stocked by a local, independent bookstore, BookSmart, and run by a gracious American Association of University Women volunteer, Donna Dicker.

At the heart of the Math Mardi Gras were carnival-style booths where visitors tried their hand at various math problems. In a recent interview with Lori Mains, AIM Outreach Coordinator and the co-originator of the AIM's Math Mardi Gras, Mains described what she feels is unique about AIM's Math Mardi Gras. "While the idea of having a math fair with various stations is certainly not new, there are two things that make the Math Mardi Gras unique. Firstly, we have a teaching element, both at the individual booths and the "How To" tables. Secondly, we

Intense games of SET alternated between silence and shouts.

have a two-tiered question structure, designed to challenge each visitor at his/her level. The net effect is a program in which everyone enjoys participating, from the novice student to the ardent competitor."

Mains went on to explain that the booths are color coded by grade level (2nd-3rd is green; 4th-5th is yellow; and 6th-8th is blue) with each participant receiving the appropriately colored bracelet as they enter the door. She then used the example of a 2nd-3rd grade booth, "Time Flies" to illustrate both the teaching element and the two different challenge levels of a booth. At the "Time Flies" booth, the booth leader takes the students through several examples of telling time. Then, each student selects from one of the clocks placed face down in a bowl and writes down the time. The vast majority of booth attendees are able to achieve this level (some with more help than others) and thus earn a colorful (e.g. red) Mardi Gras bead necklace for their efforts. Those who want more of a challenge, once they have earned the colorful beads, may ask the booth leader for an "expert" black bead challenge. They are then given a worksheet containing several tasks that deal with elapsed time—clearly a much harder concept, but still within the same subject area. Approximately twenty percent of the booth goers successfully complete a black bead worksheet.

To illustrate how the system works well for kids with various levels of interest, Mains cited examples from this year's event. "I talked to one Brownie leader who described how the girls in her troop started off by doing both the colorful bead and the black bead questions, but then they quickly decided that they just wanted to do the fun, hands-on activities. They earned some colorful beads and had a great time. On the other hand, we had a three-way tie for the 'Queen of Mardi Gras' in that age group. Each of these young girls earned thirty points (the maximum number), by successfully completing both the regular and 'challenge' level problems at each of the ten booths designed for their age level. They challenged themselves at every booth."

"The end result of having the two-tiered challenge system is that kids of all skill levels seem to thoroughly enjoy and *benefit* from the Math Mardi Gras," says Mains. "There is a palpable feeling of excitement in the air as the kids go around with the well-earned Mardi Gras beads around their neck—a wonderful visual effect." ■

Rubik's Cube Final. Participants meet the challenge in less than 2 minutes.

Math Mardi Gras Highlights

Volunteers— an essential ingredient

The repeated success of the Math Mardi Gras lies in the numerous volunteers who graciously give their time, enthusiasm, and energy every year. This year, more than seventy volunteers from the greater Morgan Hill community planned and prepared every aspect of this wonderful event.

Volunteers included students from the Future Business Leaders of America club of the Live Oak High School, headed by Kiki Namaguchi, as well as Math Club members from both the Sobrato and Live Oak schools. Middle school volunteers were MathCounts representatives from Britton Middle School, Martin Murphy Middle School, and the Charter School of Morgan Hill. These students created four new booths, modified several existing booths and did a "dry run" of their booths in the months leading up to the Math Mardi Gras. On the day of the fair, they carefully explained their booth's subject and cheerfully led the participants through the various booth activities. High school students also graded worksheets at the "black bead" table and entertained pre-schoolers in the special area set aside for younger siblings.

In addition, a large number of members from the American Association of University Women (AAUW) participated in all aspects of the planning and hosting of the event, including the running of a bookshop selling some of the games from the Mardi Gras. Event goers were treated to a table of tasty snacks, thanks to the efforts of Mary Cox, a long-standing AAUW member.

From planning to cleanup, members of the Morgan Hill community pulled together to make the third annual Math Mardi Gras a tremendous success.

Math Mardi Gras Standing Committee. From left to right: (back) Joshua Yip, Mark Holmstrom, Jennifer Holmstrom, Jessica Yip, Meghan Criswell, Rich Gamboa, Alysa Freitas; (front) Pete Mains, Jan Conrey, Lori Mains, committee chair, Brian Conrey, Elizabeth Mandel, Dave Holmstrom.

From the Director *(Continued from page 2)*

intensive week at a time over the course of a three-year period. The goal of these repeated meetings is to support long-term research initiatives that we hope will result in significant advances. We are very happy with this new program. One of the SQuaREs is led by Pete Casazza; his group is trying to solve the Kadison-Singer problem.
Another is the SQuaRE titled "Hausdorff geometry of complex polynomials." This collaboration has produced results that led to the solutions of some long-standing problems.

The Math Teachers' Circle program seems to be really taking off, thanks in part to the appointment of Brianna Donaldson to oversee it. This unique program brings together groups of middle school math teachers and professional mathematicians to "create a culture of problem solving." The goal is to provide teachers with the resources to build confidence in their ability to embrace problem solving as a primary focus of their classroom activities. Jointly with the Mathematics Association of America (MAA), we hosted two workshops this summer, one at AIM in Palo Alto and one at the MAA's Carriage House in Washington, D.C. The two workshops, both entitled "How to run a Math Teachers' Circle," brought twelve teams from twelve different cities to develop plans for launching their own Math Teachers' Circle in the coming year.

The Morgan Hill Math program continues to flourish. In the MathCounts part of it, Mark Holmstrom, a seventh grader at Britton Middle School, won first place in the Monterey competition, and placed 18th in the Northern California competition. Well done, Mark! The program expanded in two directions: there is now a fourth and fifth grade program, coached by Lori Mains, Rick Rickard, and Dave Holmstrom (Mark's father), and there are efforts at the two Morgan Hill high schools to create Mu Alpha Theta chapters. More than 150 students participate in these programs. And once again, the annual Math Mardi Gras was an exciting event, with attendance at its highest level yet.

A new organization, called Friends of AIM (FAIM) recently started in Morgan Hill. Its mission is to support AIM in its goal to become a truly world-class mathematics institute. The backing of such a great group of enthusiasts is unbelievably helpful and uplifting. I think great things will come from FAIM.

Construction of the Morgan Hill facility is progressing. With the excavation complete, we are now awaiting the foundation permit.

Be sure to read Ellen Heffelfinger's article about the AIM library collection. As librarian, Ellen has been collecting rare books and papers for more than fifteen years. If you're interested in this perspective on mathematics history and rare books, you'd do well to invite Ellen to give a talk on this fascinating subject.

If you will be in Washington for the Joint Meetings this year, please stop by our booth to say 'hi.' Also be sure to attend the Math Institutes' reception where you will enjoy the best free food of the meeting AND learn about lots of interesting opportunities at the same time.

Inside this newsletter, please find flyers reminding you that we are always looking for good proposals for workshops and SQuaREs (deadlines are November 1; please see *www.aimath.org* to apply). In addition, we will be searching for our twelfth AIM Five-Year Fellow. So, if you know of an exceptional new PhD, please encourage him or her to apply by December 31.

Finally, we would like to thank our sponsors, Fry's Electronics and the National Science Foundation, for their continued support!!

Call for SQuaREs Proposals

The American Institute of Mathematics (AIM) is committed to developing productive collaborations among mathematical scientists. The SQuaREs Program supports long-term, major research initiatives for small collaborative teams.

Research facilities and financial support are provided for groups of 4-8 researchers to meet for periods of 1-2 weeks at AIM throughout a three-year period. The goal of this program is to make major inroads into some of the most important questions currently challenging mathematics.

AIM seeks proposals for SQuaREs to begin in Summer, 2009 or later. We solicit SQuaREs in all areas of pure and applied mathematics. Instructions and an application form are available on the AIM web-site

www.aimath.org/research/squares.html.

Proposal deadlines are November 1.

Preference is given to groups which contain a mix of junior and senior researchers, and to groups which have not previously collaborated. SQuaREs typically meet during weeks when there are no workshops at AIM.

Organizer's Perspective *(Continued from page 7)*

Structure of the Workshop

As organizers, we knew that bringing together different groups of researchers to work on a very specific problem could pose some difficulties. When deciding on the structure of the first few days, we asked representatives from each group to take some time to familiarize the rest of the participants with their current goals and challenges. These talks became the morning activities for the first few days. Each morning began with two expository, informal talks with plenty of time for questions along the way. The afternoons, however, were dedicated to discussions and work in smaller groups.

We organized the talks so that progress would happen in a certain direction. We had thought carefully about the type of talks to solicit, their sequence throughout the week, and what we expected from each talk. By inviting the correct balance of physicists (experimental and theoretical), along with numerical analysts and computational scientists, we were in a position to draw upon many different resources, and it was this that allowed us to make the breakthroughs that we did.

Since we were bringing together researchers from such diverse fields, we decided to begin with a presentation of the underlying physics relating to these materials. Jonathan Selinger (physicist, Liquid Crystal Institute, Kent State) presented an introduction to the physical principles of ferroelectricity in liquid crystals, with emphasis on their molecular properties. This was followed by a presentation by Antal Jakli (also of the Liquid Crystal Institute) which described the experiments performed in his laboratory on the flow and rheological properties of such materials.

After a leisurely lunch, the workshop participants returned for an afternoon discussion session. Focusing on the specific issues raised by the morning talks, problems were identified and recorded on the board. These problems then formed the starting point for several groups who then went off to work.

Another main goal of the workshop was to develop efficient numerical methods to study the problem in general flow geometries. A talk by Jie Shen (mathematician, Purdue) on Tuesday summarized the numerical methods that have been successful in flow problems, with special attention to *phase field methods*. These methods have proven particularly successful in modeling free surface flow, for instance in droplet formation in nematic (i.e. predominantly dielectric) liquid crystals. In his presentation on Wednesday, Xiobing Feng (mathematician, Tennessee) addressed theoretical challenges encountered in the numerical discretization of liquid crystal systems. Then Allison Ramage (mathematician, Strathclyde) presented alternate numerical methods for liquid crystal flow modeled with order tensor rather than director field. Her presentation directly complemented that of Qi Wang on the previous day. On Thursday, much interest was generated by Marie Rognes' (mathematician, Oslo) presentation of an open-source, finite element software in which she showed—in real time—how one can use it to solve dynamical flow problems.

(Continued on page 18)

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Organizer's Perspective *(Continued from page 17)*

Group Work in the Afternoon

Each day, the participants gathered into three groups for afternoon work. While the themes discussed in each group varied in scope, typically there was one group that began with the issues presented in the morning, exploring some of the topics in a more detailed fashion, and emphasizing the special issues in connection with the application to the problem of ferroelectric flow. One group consistently gathered around the theme of numerical methods, with some discussions on existing software that may be of use to simulate the ferroelectric flow. Finally, extensive discussions were devoted to the formulation of boundary conditions for the flow and the electric polarization.

Another group, led by Robin Selinger, explored the elasticity theory for liquid crystals. In fact, throughout the workshop Robin performed a simultaneous translation of fluid modeling into solids. Although our main focus was on bent-core molecule liquid crystals, materials made of cross-linked polymers and with permanent polarization are also of current interest.

Thursday's Breakthrough

During Thursday's afternoon session, one of the groups formulated a prototype problem in a special (shearing) geometry, for which the governing system of partial differential equations reduces to one space variable. They developed the boundary conditions and succeeded in obtaining a dissipation law. Specifically, they developed a system of differential equations admitting solutions with opposite polarization and studied the flow that connects them. This flow is activated by application of an electric field and it shows the experimentally observed properties of the push-pull effect, that is, the capability of material to be transported by an applied electric field. Although the equations show some features indicating well-posedness, such as the dissipation property, work still remains to be done in order to establish existence of solutions of the initial boundary value problem. Nonetheless, this is a very important step in the modeling and analysis of ferroelectric liquid crystals, and it constitutes a significant breakthrough after ten years of effort. In the case of the shearing geometry, the coupling terms between flow and electric field clearly reveal the mechanism of driving a flow by an applied voltage that polarizes the material. Overall, the group worked out the prototype of a valve to transport material by applying an electric field. Since the mathematical properties of the system do not depend on the specific shearing geometry, the model can be extended to domains of interest in industrial applications. It remains a major challenge to model the dynamics of polarized materials (both, solid and liquid) that account for the interactions between material dipoles and electromagnetic field, and stresses. Within this context, our work is poised to have a real impact in advancing this important issue for liquid crystals.

A group of workshop participants including graduate students and postdocs are continuing the work started at AIM to more deeply explore this development numerically, so that it can be used in the design of devices.

I would like to point out that, in addition to the scientific and mathematical issues that were discussed, there were two main aspects that, from my point of view, made this workshop very unique. First of all, the technological goal of building mathematical and modeling support to the manufacturing of ferroelectric devices made of plastic is a very exciting one, especially for mathematicians coming from analysis. This helps to reinforce the idea that mathematics "is everywhere" and has a very special place on the drawing board of any exciting innovation.

The AIM Style of Workshop

As organizers, Jie Shen and I found this workshop very different than any previous ones.

Although in "standard" mathematical and materials sciences workshops good levels of interdisciplinary communications may be achieved, the AIM workshop reached beyond such goals. The entire workshop really felt like a group of scientists and mathematicians "rolling up their sleeves" to actually develop the topics, starting with the very challenging aspect of setting up equations. The scientific discussions involved in proposing and writing equations are often missed in more standard workshops. In addition to reaching for physically sound equations, that is, ensuring that the basic physical principles of balance laws, invariance, and thermodynamics are properly set up, one very exciting aspect is experiencing and dealing with the cultural differences that workers from different disciplines bring into the team.

I also found this working format highly efficient, since the different parties to the problem are present in the same room and speaking the language of science. I think that such formats are educationally very rich, and are very helpful to young researchers. In our workshop, they seemed to grasp all the ingredients that are needed to set up and analyze a problem, starting with a technological idea. We are very grateful to AIM to foster and provide such a unique environment. ■

"... it constitutes a significant breakthrough after ten years of effort."

The American Institute of Mathematics
thanks
Fry's Electronics
for its continued support of our vision.

Math Teachers' Circle *(Continued from page 9)*

workshops culminated in team presentations of each group's plans. D.C. participant and professor of mathematics at Iowa State University Elgin Johnston remarked, "The Math Teachers' Circle workshop was outstanding. The experience will be very valuable in helping us bring a fun, enriching, and rewarding mathematics experience to central Iowa mathematics teachers."

Several common themes emerge when teachers who attend MTCs are asked about their experience with the program. First and foremost, they say they are more confident in the classroom and more knowledgeable about math. Says one participant from the original AIM MTC, "When I was taught basic arithmetic, geometry, and algebra, I was never taught the underlying math inherent to these ideas. My understanding has been enhanced, and therefore my teaching has improved." Another teacher, who credits winning *Teacher of the Year* in part to her participation in MTC meetings, summed up her MTC experience by writing, "The collaborative effort of solving a complex problem has been a new experience for me.... I have found that math 'comes alive' when it is shared and used to reach a common goal."

The sense of mathematical community developed through the program is valued by the teachers and mathematicians alike. To be a part of their closest MTC, teachers have often made extraordinary commitments. To attend the Lincoln meetings, teachers regularly travel up to 50 miles each way; one Utah teacher drives over 200 miles each way and stays overnight in order to attend meetings of the Salt Lake City MTC. Mathematicians also appreciate being able to share their enjoyment of math in a relaxed atmosphere. Harold Reiter, a professor of mathematics at UNC-Charlotte and a leader of the Charlotte MTC, says that "Saturday morning meetings are my favorites" because of the winning combination of coffee, bagels, and math.

AIM is pleased to announce two "How to Run a Math Teachers' Circle" workshops next summer, to be held June 22-26, 2009, in Palo Alto, and July 27-31, 2009, at the MAA Carriage House in Washington, D.C. Applications are now being accepted from teams of teachers, mathematicians, and administrators or other community representatives who are interested in launching their own MTC. For more information and to apply, please visit *http://www.mathteacherscircle.org/program.html.* For general information about the MTC Program, please see *http://www.mathteacherscircle.org.* ■

"My understanding has been enhanced, and therefore my teaching has improved."

Activities at the recent "How to Run a Math Teachers' Circle" workshop in Washington, D.C.

"The collaborative effort of solving a complex problem has been a new experience for me.... I have found that math 'comes alive' when it is shared and used to reach a common goal."

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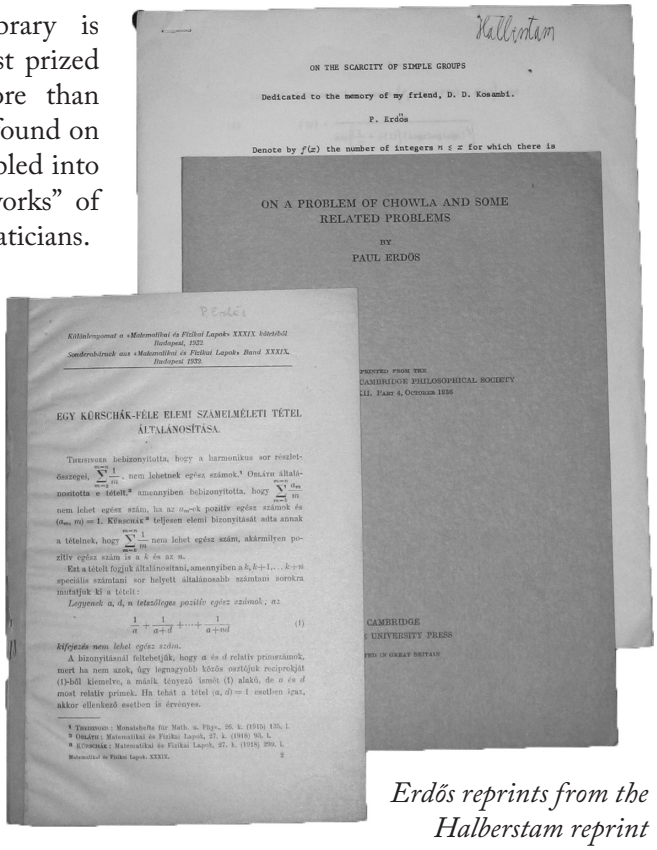

Hallerstam

ON THE SCARCITY OF SIMPLE GROUPS

Dedicated to the memory of my friend, D. D. Kosambi.

P. Erdős

Denote by $f(x)$ the number of integers $n \leq x$ for which there is

ON A PROBLEM OF CHOWLA AND SOME RELATED PROBLEMS

BY

PAUL ERDÖS

P. Erdős

Különlenyomat a «Matematikai és Fizikai Lapok» XXXIX. kötetéből

Budapest, 1932.

Sonderabdruck aus «Mathematikai és Fizikai Lapok» Band XXXIX.

Budapest 1932.

EGY KÜRSCHÁK-FÉLE ELEMI SZÁMELMÉLETI TÉTEL ÁLTALÁNOSÍTÁSA.

Erdős reprints from the Halberstam reprint collection.

Washington D.C. hosts 2009 Joint Math Meetings

The annual joint meeting of the American Mathematical Society and the Mathematical Association of America provides a time to generate interest and awareness in AIM's many activities. Brian Conrey, Estelle Basor, Leslie Hogben, and David Farmer can be found at the AIM booth in the exhibit area, and are happy to talk with people about AIM and its various programs.

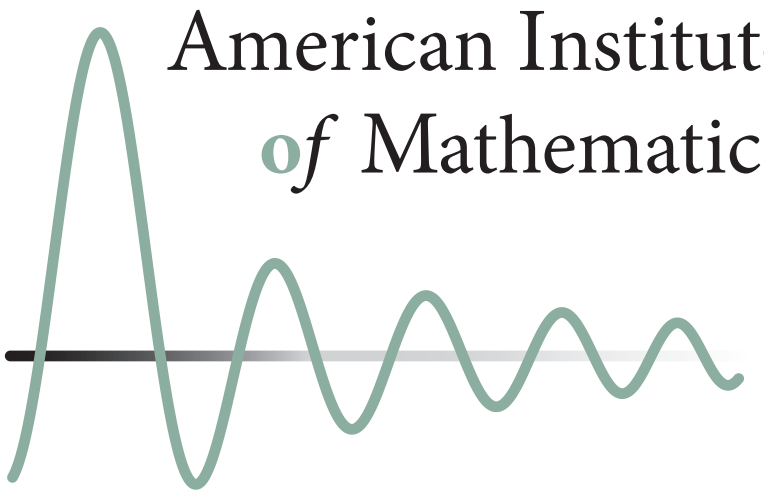
While many stop by to learn about upcoming workshops, they are often surprised that they may apply to attend as fully-funded participants. On other occasions, casual conversations have formed the seed of successful workshop proposals and library donations.

AIM also joins in hosting the Mathematical Institutes' Open House reception. This event is open to all conference participants and provides another venue to learn about each institute's programs and to meet with institute members. Please join us at the Institutes' Reception, from 5:30 - 8:00 p.m., Monday, January 5 in Washington, D.C.

Please join us at the Mathematical Institutes' Open House Reception

Monday, January 5, 2009

5:30 P.M. - 8:00 P.M.



invites applications for the

AIM Five-Year Fellowship

The Fellowship will support an outstanding new PhD pursuing research in an area of pure mathematics. It will cover 60 months full-time research as well as funds for travel and equipment. Mail applications to:

AIM Five-Year Fellowship
American Institute of Mathematics
360 Portage Avenue
Palo Alto, CA 94306

All materials should be received by December 31, 2008 for consideration of an award to be made by January 31, 2009. This Fellowship is for new PhDs: candidates expecting to receive a Ph.D. in the year 2009 are eligible to apply. An application consists of a cover letter, a vita, 3 letters of recommendation, and a research plan.

For more information visit **www.aimath.org**

American Institute of Mathematics

Research Conference Center

The AIM Research Conference Center (ARCC) hosts week-long focused workshops in all areas of the mathematical sciences. ARCC focused workshops are distinguished by their emphasis on a specific mathematical goal, such as making progress on a significant unsolved problem or examining the convergence of two distinct areas of mathematics. Workshops are small in size, up to 28 people, to allow for close collaboration among the participants.

Call for Proposals

Proposals are sought for workshops which will take place in 2009 - 2010.

Proposals require:

- a list of organizers
- a list of potential participants
- a description of the workshop goals
- an outline of how these goals will be met

Proposals will be accepted until November 1, 2008.

Workshops will be held at AIM in Palo Alto. More details and an online application are available at:
http://www.aimath.org/research

ARCC seeks to promote diversity in the research mathematics community. We encourage proposals which include significant participation of women, underrepresented minorities, junior mathematicians, and researchers from primarily undergraduate institutions.

The future home of ARCC in Morgan Hill, California

Major funding for ARCC is provided by a grant from the National Science Foundation.

From the AIM Library

Bericht

über die

zur Bekanntmachung geeigneten Verhandlungen der Königl. Preuſs. Akademie der Wissenschaften zu Berlin

im Monat November 1859.

Vorsitzender Sekretar: Hr. Encke.

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3. Nov. Gesammtsitzung der Akademie.

Hr. Steiner las über einige allgemeine Bestimmungsarten der Curven und Flächen zweiter Ordnung und daraus folgenden Sätzen.

Hierauf trug Hr. Kummer folgende von Hrn. Riemann, Correspondenten der Akademie, mittelst eines an den Sekretar Hrn. Encke gerichteten Schreibens vom 19. October d. J. eingesandte Mittheilung „über die Anzahl der Primzahlen unter einer gegebenen Gröſse" vor:

Meinen Dank für die Auszeichnung, welche mir die Akademie durch die Aufnahme unter ihre Correspondenten hat zu Theil werden lassen, glaube ich am besten dadurch zu erkennen zu geben, daſs ich von der hiedurch erhaltenen Erlaubniſs baldigst Gebrauch mache durch Mittheilung einer Untersuchung über die Häufigkeit der Primzahlen; ein Gegenstand, welcher durch das Interesse, welches Gauss und Dirichlet demselben längere Zeit geschenkt haben, einer solchen Mittheilung vielleicht nicht ganz unwerth erscheint.

Bei dieser Untersuchung diente mir als Ausgangspunkt die von Euler gemachte Bemerkung, daſs das Product

$$\Pi \frac{1}{1-\frac{1}{p^s}} = \Sigma \frac{1}{n^s},$$

First expression of the Riemann hypothesis,
***in* Monatsberichte der Berliner Akademie, November 1859**