NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
September, 2003

The OAPT Conference of May 2003

By: Patrick Whippey

Wow, what a conference! Eighty physics teachers from as far away as Ottawa and British Columbia gathered at Western for a Physics-fest of workshops, tours and talks that featured medical physics, material science, analysis of traffic accidents, teaching tips, optical illusions, Dan Falk on the Theory of Everything, plus, most importantly, the camaraderie of a shared purpose and vision. Jerry Battista, Blaine Chronik and Aaron Fenster gave a series of talks on Friday morning devoted to medical physics that painted a canvas with vibrant pictures of the research and progress being made in medical imaging. The three dimensional ultrasound images of twins were stunning. At the banquet, David and Jean Surry reflected on a shared lifetime in engineering. Pedro Goldman has toured many of the universities across Canada to talk about the state of physics education, and out of this has grown a major initiative to try to persuade NSERC that we need their support to promote the health of Physics in Canada, just as the National Science Foundation does in the United States. What could you do if you could get a grant of $5000 to do a small research project in your school? John Twelves showed us how to build a drag sled to measure the coefficient of kinetic friction between tire and road, and how modern accelerometers are used to analyze traffic accidents. If every teacher spends a lesson doing this, and interleaves the message that speed plus inexperience kills, then we can truly save lives. Jim Hunt gave a beautiful presentation of some subtle optical illusions, providing a graceful end to a wonderful two days of talks. Whenever we see a picket fence, we will look for a wagon to travel behind it so that we can see the illusion of the curved spokes, common in the days of Ann of Green Gables, but now rarely seen. Nine teachers gave wonderful contributed papers, which can be viewed here: http://www.physics.uwo.ca/news/conferences/oapt_2003/index.html .

As we return to our classrooms, let us ask what we can do as an association to promote the vision so marvellously articulated by Pedro Goldman. Please do come to the next conference to be held at the University of Ontario Institute of Technology, in Oshawa.

About the author: *Patrick* is a professor of physics with the Department of Physics & Astronomy at The University of Western Ontario. It is primarily through his effort, and the hospitality shown by the U of W that this conference was such a success. Many thanks Patrick!

President's Message

By: Elzbieta Muir

WELCOME to the new year 2003/2004!

First of all, a big Thank You to the past executive and our President Vida for all their involvement, leadership and interesting initiatives.

It is a great pleasure to have an organization like the OAPT to which to belong. Particularly in these challenging times of labour unrest, hostility, and change, it is good to belong to an association which provides professional motivation and development, encouragement, and happy camaraderie.

Our OAPT Conferences in May are the highlight of each year where we satisfy our intellectual curiosity, update our knowledge in Science and Technology, learn new things to take to our students, and have invaluable professional interaction that keeps us strong in the whole chain of educating new generations of Canadians. OAPT has just completed its 25th annual conference. We are already looking forward to continuing this tradition with the 26th conference in May 2004.

Our OAPT Newsletters keep us in touch throughout the year and provide an on-going forum to exchange ideas in teaching.

Our OAPT Contest, written by thousands of students each year, with such a long tradition reminds us that we are there for all of our students, irrespective of their abilities.

Members of the OAPT are volunteers. Thank you to all who chip in their expertise, ideas, and organizational efforts. Your contributions are greatly appreciated by all.

With many friendly greetings,

Elzbieta Muir
OAPT President 2003/2204.

Controlling Light with Photonic Crystals

By: Jessica Mondia

(article previously published in U of T's Dept. of Physics newsletter InterActions)

To an outsider's eyes it is "only a speck of silicon, glinting with blue-green iridescence" similar in appearance to an opal gem or the multi-coloured scattered light from butterfly wings. In fact many things in nature have these types of beautiful hues but to people in the photonics community it takes on new meaning, particularly for those working in the field of photonic crystals.

This relatively new field of optics research first began in 1987 with a paper published by Professor Sajeev John in which he describes materials with the ability to trap light in 3D.
The idea of controlling light on micron scale opened the door to the idea of the all-optical chip, a replacement to current electronic devices. Not only could these materials localize light and be used as devices to guide light, but they also have interesting dispersion relations making them ideal optical devices for amplification and wavelength division multiplexing.

Photonic crystals are materials fabricated with a periodicity in the refractive index on the order of the wavelength of light. For example in 1D one could imagine a stack of alternating materials such as Si, SiO_2. Most light at normal incidence on this structure will be transmitted. However, when the wavelength of the light is comparable to the periodicity of the stack, Bragg scattering will take effect and that component of light will be reflected. The larger the refractive index contrast the wider the stop gap, i.e., range of reflected light frequencies. This idea also extends to 2D and 3D.

As can be imagined the field of photonic crystals took a brief hiatus while the experimentalist were hard are work trying to produce good quality crystals with a periodicity on the micron scale similar to that of telecommunications wavelength of 1.5 microns. By the end of the 1990's the field flourished once more as crystals were being produced all around the world and in particular here at the University of Toronto. In a collaboration between Prof. G. Ozin from the Chemistry department, Prof S. John and Prof. H. van Driel and Prof F. Meseguer in Spain the first 3D Si-inverted photonic crystal with a stop gap at 1.5 microns was developed.

A clever fabrication process was used to make this crystal which consisted of inter-connected air spheres surrounded by silicon. First, Silica spheres of ~850 nm were placed in a viscous solution. The spheres then settled into the lowest entropy state being a face centered cubic lattice. The solution was then allowed to evaporate and the structure sintered (heated). This provided a link between spheres. The sample was then placed into a chemical vapour deposition chamber infiltrated with silicon. Finally the structure was inverted by placing the sample in HF acid which seeped through the sample to etch away the silica spheres. Work using this method of inversion is on going with the final goal of designing an optical-chip that could potentially work in 3D.

Since then several new groups on campus and in Canada are working hard to develop better quality crystals and discover new and interesting properties related to them. Our group (under the supervision of H. van Driel) has taken to studying various types of switching effects using nonlinear properties of the materials. It has often been said that photonics crystal are the next big telecommunication revolution. Only time will tell but until then it is an exciting place to be.

About the author: *Jessica* is with the Department of Physics at the University of Toronto. Her email address is mondia@physics.utoronto.ca.

The Demonstration Corner

Pressure vs. Particle Movement – The Dance

by Diana Hall, Bell High School
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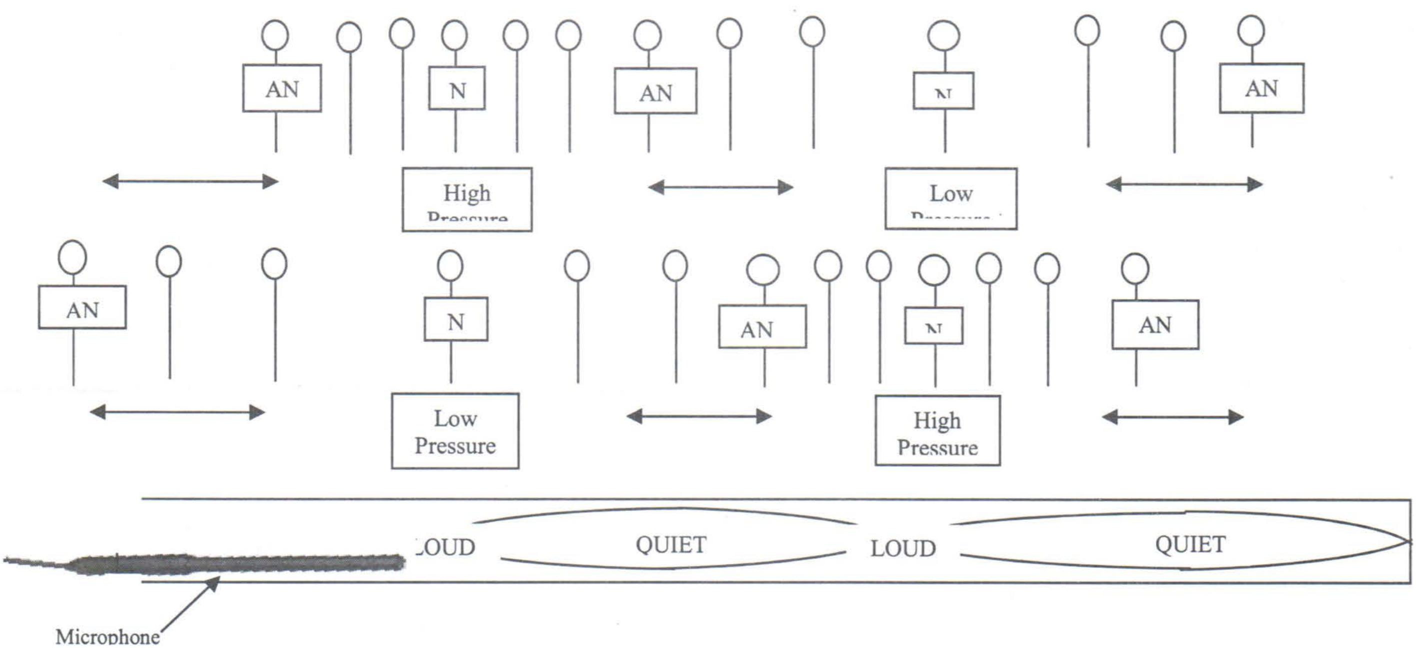
When discussing standing waves in air columns most textbooks focus on the movement of particles and show nodes at closed ends and antinodes at open ends. When thinking about the loudness of sound at different points we have to remember that the sound is loud when the pressure difference is the greatest and that sound is a longitudinal wave. This occurs at nodes (where particles move least) and not the antinodes (where particles move most). I use my students to demonstrate this difference.

Have students line up. Individual students represent particles at different positions along an air column. We know that a series of nodes and antinodes will be set up. If we label the students according to the motion of the particles, the nodes will not move while the antinodes will move most. I actually label the nodes and antinodes with masking tape. Since sound is a longitudinal wave, the antinodal particles will move back and forth from side to side by the most (greatest amplitude). The particles beside the antinodes will move less etc. The antinodes will alternate left to right. I then ask the nodes what they felt. It turns out that the nodal people report the biggest difference in pressure while the antinodes report the least. This means that the loud points actually occur at the nodes for particle movement. Using a large tube and a computer interface equipped with microphone, this phenomenon can be tested and confirmed.



Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
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Submissions describing demonstrations will be gladly received by the column editor.

Let's Play: Quotable Quotes!

Here's the deal. Identify the individual who said the quote below. Be the first person to email your response (c/w mailing address) to the editor, Paul Passafiume, at paulpassafiume@hotmail.com and you'll win a prize! It's that easy. Here we go!

"Never seem more learned than the people you are with. Wear your learning like a pocket watch and keep it hidden. Do not pull it out to count the hours, but give the time when you are asked."

Do you want to give back to your profession? Participate in the OAPT!

This wonderful organization needs volunteer help in the following capacities:

- Guest presenters
- Conference organizers, and facilitators
- Members of the executive committee
- Article, and classroom idea contributors for the Newsletter

New articles, ideas, or other information items may be sent to Glen Wagner (glenn.wagner@cwdhs.ugdsb.on.ca) or Paul Passafiume (paulpassafiume@hotmail.com). Ideas for demos may be sent to Ernie McFarland (elm@physics.uoguelph.ca).

Membership Matters!

Join the Ontario Association of Physics Teachers! Members receive a Newsletter and reduced registration rates at the annual conference.

As well, from time to time, the Association makes available special resources. Examples have included reprints of **"Demonstration Corner"** articles from the **Newsletter**, and the videotape, **"The Physics of Dance,"** from a presentation at one of the annual conferences.

To become a member of the OAPT, send a cheque for $8 (or a multiple thereof) payable to OAPT to:

Ernie McFarland
OAPT Membership Coordinator
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The Art of Physics Competition 2003 !

This competition, organized by the Canadian Association of Physicists, challenges any student, class, or teacher to capture in a single photograph any physics phenomenon and then explain it in less than 200 words. Great prizes are up for grabs!

Details may be found at the following web sites: http://www.cap.ca , or cap@physics.uottawa.ca. Also, you may email Elzbieta Muir at emuir@sympatico.ca.

Beta Testers of Physics Software Needed

Are you looking for physics software to augment your lessons this year? Shawn Leclaire has coded three programs that investigate the solar system, waves, and optics and is looking for users to test them before making them generally available. Details may be found at http://www.LivingGraphs.com/.