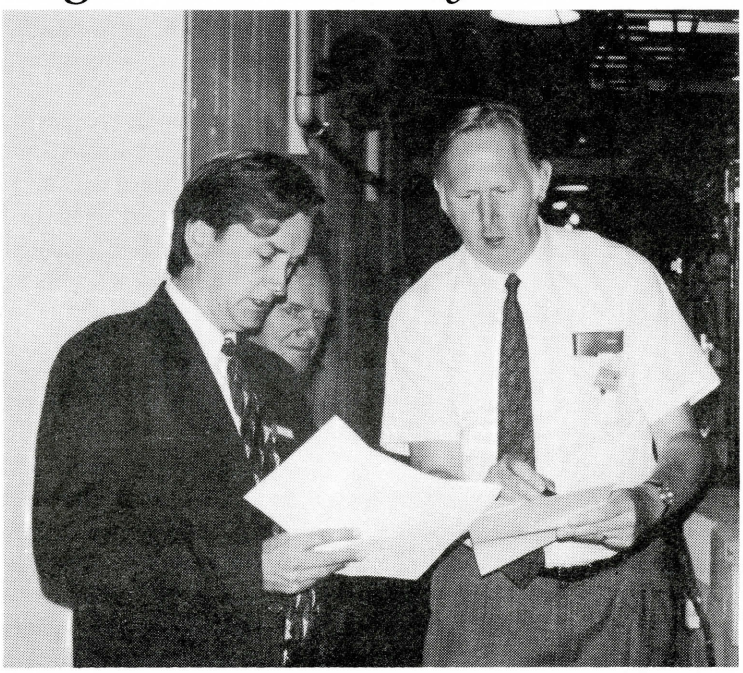
THE PULSE

For the Personnel of the Laboratory for Nuclear Science

Volume 5 Number 6 ********** August 1997

http://mitlns.mit.edu/~elsye/pulse.html

Congressman Tierney Visits Bates



Congressman Tierney, Stanley Kowalski and Christoph Tschalaer plan the Bates Tour *Photo by: Stan Sobczynski*

U.S. Representative John F. Tierney (D - sixth district) visited Bates on Monday, June 30. Although the visit was brief, Tierney managed to tour the entire facility and answer questions asked by Bates personnel at a meeting held after the tour. Representative Tierney is serving his first term in Congress. He serves on the Education and Workforce Committee and the Government Reform and Oversight Committee.

In this Issue

Computer Information

Ultrix Support Expires

The Laboratory has been supporting a small number of DEC Ultrix machines. The software maintenance contracts for these machines expired June 30. Ultrix is not the primary DEC unix operating system, and LNS will not renew the maintenance contracts.

Marie has been downgraded to a generic workstation, where it will remain until it dies of old age. The computer group is in the process of moving all essential services from Marie to faster, more reliable hosts. Users should be aware of the following:

- The NIS server has moved from Marie to Ralph2. To change your unix password, you must now login to Ralph2 and use the 'passwd' command.

- Most home directories have moved to Ralph2. To check your unix disk quota, you must login to Ralph2 (or wherever your home directory is) and use the 'quota' command.

- Unix print queues and the World-Wide Web server are moving from Marie to Pierre. After the move is complete, Marie will forward service requests to Pierre as long as possible. The LNS home page is already available at http://Pierre.mit.edu. The alias www-lns will change from Marie to Pierre.

- If you maintain Web pages on Marie that are not under your home directory or

- If you have an anonymous FTP directory on Marie, please move these to Pierre.

- If you receive and read e-mail on Marie (or kayak, nsbart, goose, or mittp2), plan to change your forwarding to another host. For example, the command echo galley@pierre.mit.edu > ~/.forward would change my forwarding to Pierre. Then move your old incoming mail file to your home directory, and start reading e-mail on the other host.

- We hope to move the AutoCAD software from Marie to a SGI Indy. At this time we are discussing software licensing issues with the vendor. We expect that AutoCAD will be available.

We have tried to plan for a smooth transition, but because the computer group is understaffed, we may have overlooked something. If there are any other functions that we have not mentioned here, or if you have any questions about these changes, please contact Stu Galley at galley@ralph2.mit.edu or x3-0355 or Dave Woodruff at dsw@mitlns.mit.edu or x3-6943.

--Stu Galley

THE PULSE is a publication of the Laboratory for Nuclear Science for the LNS Community.

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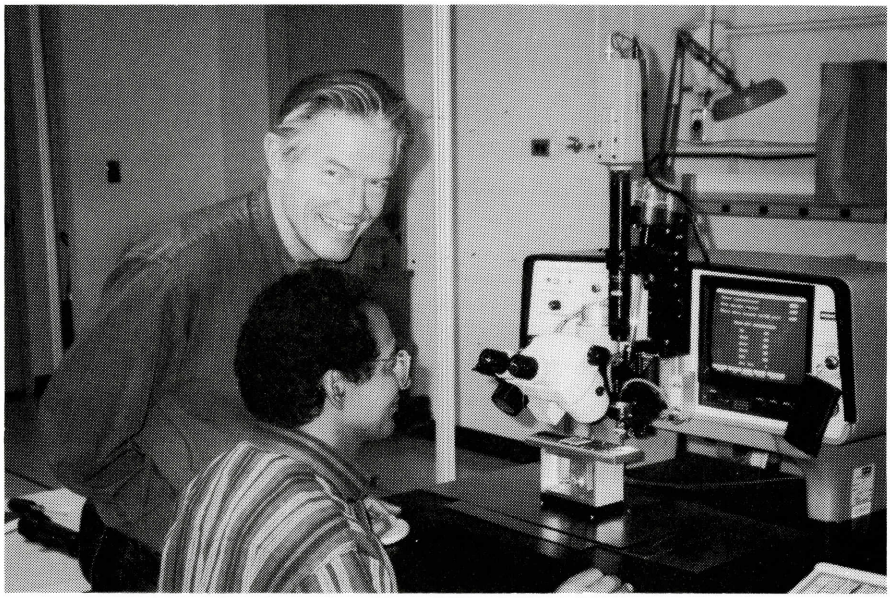
The Wire Bonder in the LNS Electronics Facility



Dr. Ogmundur Runolfsson of the OPAL group at CERN, Geneva Switzerland helps Cristiano Gomes learn how to use the machine ***Photo by: B. Wadsworth***

Dr. Ogmundur Runolfsson of the OPAL Group at CERN visited the LNS Electronics Facility for two weeks in May to help setup the Hughes 2470-V wire bonder recently donated to the Facility by Seagate Technology's Recording Heads Group of Bloomington, Minnesota. In the fields of experimental high energy and nuclear physics, Runolfsson is a leading expert in the assembly and wire bonding of fine-pitch silicon sensors and front-end electronics. During his stay, he evaluated the performance of the Facility's bonder, instructed LNS personnel in its operation, and demonstrated bonding of key microelectronics assemblies for the Phobos front-end electronics system. It is expected the bonder will prove a vital resource when the Phobos front-end electronics moves into full-scale production in 1998.

Seagate Technology, Inc. is the world's largest, independent supplier of disc drives and related components. Its top-of-the-line disc drive is a 3.5-inch unit which spins at 10,000rpm and stores more than 9Gbytes; the company's production of magnetic recording heads alone exceeded one million units per week in 1996. Founded in 1979, the company is based in Scotts Valley, California and has offices and manufacturing facilities worldwide.

Correction

Gerald Fiumara and Pamela Bondanza were married on February 16, 1997. In the last issue of Pulse, ***Bondanza*** was misspelled and we apologize for this error and send the bride and groom our best wishes.

Welcome

Fabio Casagrande - Postdoctoral Associate, CTP.

Pier Chacon - Transfer, Admin. Asst., Fiscal Office.

Robert Lutton - Machinist A, Machine Shop.

Lawrence O'Brien - Rehire, Assist. Group Leader Operations, Bates.

Michael Tanguay - Design Drafter, Bates.

Robert Trepsas - Tech C E-M, Bates.

Wolfgang Wander - Scientific Computation Facility Manager, Central Facilities Group.

Alan Wolcott - SRS Technical, Bates

Promotions

George Antonopoulos - to Senior Tech E-M

David Bethka - to Tech A E-M

Richard Coviello - to Mechanic A (Maintenance)

Peter Goodwin - to Project Tech E-M

Petr Kulinich - to Research Associate

Christopher Vidal - to Project Tech E-M

Edward Zibkowski - to Senior Tech E-M

Departures

Stephen Bradley - Bates

Joseph Dzengeleski - Bates

George Kingsley - Bates

From my Desk

The George's Bank: The Fight for Survival Exhibit at New England Aquarium

Because of my affiliation with the New England Science Writers, I was invited to the press preview of the new exhibit at the New England Aquarium Education Center, and I decided to attend. This exhibit opened to the public on Wednesday, July 16, 1997 and is the first of many issue-oriented exhibits.

So what's the exhibit like? Many of the exhibits are hands-on. The exhibits breakdown the habitat and explain the complex ecosystem which sustains abundant sealife and shows how ocean currents and tides move around the bank and how this affects temperature and the nutrient-rich ocean floor. Overfishing has impaired George's Bank's ability to sustain itself and this jeopardizes the delicate balance of life.

The exhibit's timeline starts in 1747 with the first fishing trip to George's Bank which departed from Marblehead, Massachusetts. Now New England and especially Massachusetts is one of the East Coast's major seafood centers. Historic photographs illustrate how the fishing industry evolved. In 1960 for example, Soviet factory trawlers arrived on George's Bank and throughout the 60s and 70s, trawlers from a number of European countries and Japan joined in. In 1982 the groundfish populations rebounded and the New England Council abandoned catch limits, but the rebound was only temporary and in 1997 Gloucester officials advocated rebuilding a herring and mackerel fishery. Scientific studies suggest that the recent management efforts may be paying off and that haddock and yellow tail flounder numbers are increasing.

What is George's Bank and where is it? George's Bank is located one hundred miles off the New England coast. The 12,000-square-mile plateau extends from Cape Cod to Nova Scotia, Canada. The depth that the plateau is submerged varies from 10 feet to over 300 feet. This allows for a complex interaction of biological and physical conditions that scientists are just beginning to understand. The clockwise current which encircles the plateau works like a liquid fence and encloses nutrients, fish eggs, and fish larvae. Although the tides change twice a day the water is not carried far. This creates a complex interaction of biological and physical conditions.

If you have relatives to show around this summer or the kids are bored, explore Massachusetts' maritime heritage and visit the New England Aquarium on Center Wharf, Boston. The education center is located in front of the main Aquarium near the parking garage.

Famine Memorial Dedicated

On Wednesday, July 23, 1997 at 11:30 a.m. on Cambridge Common, Harvard Square the Irish Famine Memorial was dedicated. President of Ireland Mary Robinson dedicated the memorial. The memorial represents and recognizes the plight of the Irish, and is a reminder that there is still hunger in the world.

The memorial shows a woman cradling her dying child in her arms as she raises her hand in a gesture of blessing and farewell to her son. Her son is holding his child in one arm and reaches out with the other for a final good-bye to his mother and the country that he must leave behind. The memorial was designed by Maurice Harron of Derry, Northern Ireland. John O'Connor, President of Greenworks Company in Cambridge led the effort to build the memorial to raise public awareness of the Great Irish Famine and to remind us, "that hunger has not gone away." O'Connor is also leading the effort to collect money for hunger relief and to establish an education committee that will develop a teaching unit about the famine for both public and private schools in Massachusetts.

This year marks the 150th anniversary of Black 47, the worst year of starvation and immigration for the Irish during the Great Hunger. It wasn't that there was no food in Ireland -- there was! Food was exported every day and there was plenty of food in the markets. However, the potato crop was destroyed by a blight that ironically came from a ship from the United States. The potato was the sole subsistence for many of Ireland's poor. The English had already taken the land from the Irish and had not allowed them to practice their religion or be educated and finally they wanted the Irish off the land because it was cheaper to pay their passage to the U.S. or to raise cattle on the land. One million Irish died and two million emigrated during the famine decade. And when the Irish came here some were already sick from the subhuman conditions on the coffin ships and those that did survive lived only about 5 years after their arrival.

Stop by the Cambridge Common and see the Irish Famine Memorial. It is a touching tribute to the Great Irish Famine and a reminder that we must put an end to hunger.

--Jean Flanagan

In Memoriam

Our friend and former co-worker *Emerson Munroe* died on Monday, June 19, 1997 after a short illness. Burial services were private. Emmy worked in the General Services group from February 8, 1982 to July 31, 1993.

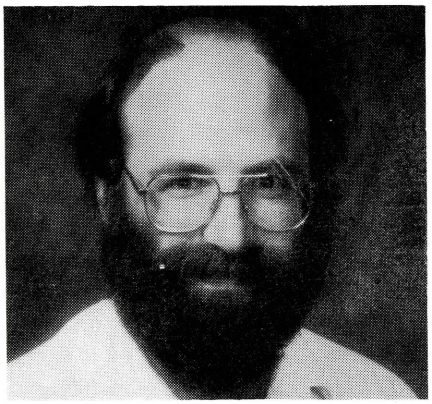
Reprinted from the **MIT Tech Talk**
Wednesday, May 21, 1997 * Vol. 41 No. 31

MIDA AITKEN

Word has been received of the March 5 death of *Mida Aitken*, 83, of Hookset, NH, a retired staff member in the Laboratory for Nuclear Science. She worked at MIT from 1946 to 1978. Survivors include a sister, Stella Eaton of Hookset.

Arthur Scully and his first Passenger

Arthur Scully received his private pilot license on March 9, 1997. Art poses with his first passenger, his sister-in-law, Susan Scully.



"Ask a Physicist"

Leslie J Rosenberg
x3-7589, MIT room 24-506,
ljr@mitlns.mit.edu

Q: What is an axion?

A: Briefly, the axion is a hypothetical elementary particle resulting from a mechanism (the "Peccei-Quinn Mechanism") that prevents CP violation in weak interactions from appearing in strong interactions.[1]

Less briefly, let's start with quarks. Quarks are elementary particles that have both strong and weak interactions. QCD, the underlying theory of strong interactions, is expected to have relatively large CP violating interactions.[2] Now it is well known that quarks do indeed have CP violating interactions. But these interactions are only observed in the neutral kaon system and have a comfortable interpretation in terms of weak interaction effects. There is no evidence for the expected QCD-induced CP violation.[3] For some reason, the expected level of CP violation is missing in the strong interactions (in a sense the ratio of weak to strong CP violation must be greater than a billion or so); this mystery has been dubbed the "Strong CP Problem."

This Strong CP Problem is a blemish on the successful Standard Model of particle physics. Many schemes have been proposed on how to evade this problem. Perhaps the least clever idea (and therefore a very appealing one) is to somehow have a quark with zero mass. Unfortunately, a zero mass quark seems unlikely given our understanding of hadron masses. Therefore, one needs a cleverer idea. The cleverer idea that most appeals to me is to make a slight extension of the Standard Model in such a way to introduce a special new symmetry rule--the "Peccei-Quinn Symmetry" or PQ symmetry. This symmetry scrambles the types of quarks in a special way that leaves the system unchanged. Now, this PQ symmetry is not exact. It seems quarks have masses and it therefore is not the case that scrambling the types of quarks in the PQ way will leave the system unchanged. If nothing else, the system will not weigh the same.

There are two important outcomes of this additional broken symmetry. First, recall in the Standard Model, it's difficult to have weak CP violation without strong CP violation.[4] The beauty of adding PQ symmetry is then QCD-induced CP violating effects vanish for the same reason an apple falls: An apple falls because the potential energy of an apple goes down as the apple falls. In QCD with PQ symmetry, the potential energy contains the CP violation. Due to this "PQ Mechanism," a bag of quarks then naturally "falls" to the minimum of the potential energy and therefore the minimum of CP violation. This suppression of CP violation happens by itself, no one need adjust a parameter to one part in a billion or so.

Second, the PQ symmetry is broken. There is a very important result in particle theory, the Goldstone Theorem. It approximately states that there is a massless particle associated with the breaking of certain symmetries. The search for the Higgs particle at the LHC is a search for the Goldstone particle associated with broken symmetry in the standard model. This thinking leads to there being a particle associated with the broken PQ symmetry. This particle (originally called the Higglet) is the axion.[5]

Summarizing, axions are a hypothetical particle resulting from the breaking of PQ symmetry. Axions solve the Strong CP problem. In addition, axions have the right properties to be a strong cold dark matter candidate. Searches are underway for axions, and their discovery would have enormous importance for particle physics and cosmology.

Footnotes:

[1] Think of weak and strong interactions as two new kinds of forces, like new kinds of gravity or electric forces. However, while gravity can affect things over large distances, the weak and strong forces act over nucleon-sized distances.

[2] CP is the operation of taking something, say a spinning charged baseball, and first changing the sign of the charge--the C operation, then looking at the system in a mirror--the P operation. CP is violated when the original baseball and the transformed one are different (perhaps the shape or number of stitches changed). Changes like this are rare in our macroscopic world, but are common in the microscopic world of elementary particles.

[3] The most stringent limits (using a neutron in place of a spinning baseball) are many orders of magnitude below the expected level of QCD--induced CP violation.

[4] For experts: Weak CP violation is contained in phases of the elements of the CKM matrix. These phases are perhaps around 0.1 to 0.5. Strong CP violation is contained in the phase of the determinant of the quark mass matrix. This phase is 10^{-10} or less. Another way to pose the Strong CP Problem is to ask how phases in one can be so highly suppressed in the other.

[5] Although the axion is a massless Goldstone particle, it does eventually acquire a small mass through a mechanism not discussed here.