# Fusion Power Report

Complete Coverage Of Worldwide Fusion Developments

**Vol. 24 No. 7/8** **July/August 2003** **Page 25**

## SLANTS & TRENDS

**Initial operations of four of the planned 192 beams of the National Ignition Facility (NIF) have set** have set new records for energy from a single beam line.

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**A report from the European Commission to the European Council** summarizes the status of planning for construction of the International Thermonuclear Experimental Reactor (ITER).

*See Story on page 26.*

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**The Republic of Korea** has joined the European Union, Japan, Russia, Canada, China and the United States in the negotiations for the construction of ITER.

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**A formal meeting of high level government personnel** was held July 16 in Vienna, launching the final stage of preparations for site selection and construction for ITER.

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**A spokesman for the White House Office of Science and Technology Policy (OSTP) cautions** that the U.S. government has not made a commitment to develop commercial fusion power on any specific timetable.

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### *Inside This Issue*



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## NIF Progress Continues

Impressive progress continues to be made with initial operations of the National Ignition Facility (NIF) four-beam system. Tests have been conducted into a Precision Diagnostic System for both the fundamental 1.06 micron frequency and at the frequency-tripled frequency.

At the fundamental frequency, energy levels exceeding 20 kilojoules per beam were achieved, surpassing the design requirement. The total of 83 kilojoules achieved sets a new record for this configuration. Tests at the tripled frequency yielded 10.4 kilojoules from a 13.65 kilojoule fundamental frequency beam (76% conversion efficiency). At 3.9 terawatts, this was the highest power fundamental frequency beam ever fired on the NIF. The overall result scales to 2 MJ for the full 192-beam NIF, compared to the design level of 1.8 MJ. These are the highest energy levels ever achieved in a single beam line at these frequencies.

In a test of operational efficiency, NIF fired three shots per day for three days in a row, giving researchers confidence that the ultimate design target of 700 shots per year will be achieved when NIF becomes fully operational.

For further information, contact NIF project manager Ed Moses (moses1@llnl.gov).

## Alcator C-Mod Posts Progress

The U. S. Department of Energy (DOE) held a review of the MIT Alcator C-Mod program renewal proposal for the next five year period (November 2003 - October 2008) in mid May. The review panel included: Jim Luxon (GA, Chair), Don Batchelor (ORNL), George Cava (DOE Princeton Area Office), Dave Hill (LLNL), Bob Kaita (PPPL), Sergei Krasheninnikov (UCSD), Fritz Leuterer (IPP Garching), Takahisa Ozeki (JAERI), and Doug Post (LANL). Attending from the DOE Office of Fusion Energy Sciences (OFES) were John Willis and Rostom Dagazian.

Viewgraphs from the presentations summarizing progress and plans can be found at:
http://www.psfc.mit.edu/cmod/sciprogram/5_Yr_Review_03/00_agenda.html

## EU Summarizes ITER Status

A formal communication dated 30 April 2003 from the European Commission to its parent body, the European Council, "summarizes the state of negotiations conducted by the Commission on behalf of the European Union concerning the ITER nuclear fusion energy research project."

The report notes "the total cost of the construction phase is estimated at 4.57 billion Euros, at 2000 values." It says "ITER implementation will include a construction phase lasting about ten years, an operation phase lasting about 20 years and a decommissioning phase." It estimates the total cost of all three phases at 10.3 billion Euros.

The report says that in negotiations so far "Agreement has been reached on the legal status of the entity which would be responsible for ITER implementation. However, fundamental points have still to be discussed, such as choice of site, sharing between the parties of the costs of and responsibilities for supplying components for the project and their management. This contribution 'in kind' will form the main part of the overall contribution of each party during the construction phase."

The legal entity responsible for ITER implementation "would have a duration of thirty-five years with the possibility of an extension of a maximum of ten years," according to the report. "It would have legal existence and would be granted privileges and immunities by the parties and the host country which are similar to those normally granted to international organisations." The report says "A Director-General and a project team will be responsible for the proper day-to-day running of the Organisation." It says, "Given the scale and complexity of the project, it has also been accepted that each party should have only one clearly identified interface with the Organisation, managing its contribution both in cash and in kind."

The report notes that presently four sites have been proferred: Canada, Japan, France and Spain. However, the report says, "it is appropriate now to converge towards the identification of (one) EU site candidate through a consensual and well regulated process." The report says "Recognising the political sensitivity of the subject, the Commission urges France and Spain to pursue actively and constructively their bilateral discussions" on selecting a single EU candidate site. The report says it envisages

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a Council decision on a European site in September 2003.

The report notes that, prior to the entry of China and the U.S., a working assumption within the EU on cost sharing was the host country would pick up about 20% of ITER costs for local construction elements (called "non-common area" costs), with the remaining, primarily machine, costs (called "common area" costs) shared by Russia (14%), EU (33%) and Japan (33%). The report notes that several factors have led to a rethinking of this formula, namely the expectation that Russia would pay a smaller fraction, that the U.S. and China and perhaps others would pick up a substantial fraction, and a proposal from Japan stating that, as a smaller economic party compared to Europe, they wished to pay a smaller fraction than the EU. The EU paper notes that the Canadian site proposal is being restructured within Canada, since it originally did not envisage any Canadian contribution to the common area costs. The paper proposes a new working distribution of the 80% common area costs as China + Russia + USA (more than 30%) and EU + Japan (less than 50%).

The report brings up the issue of international funding for an International Fusion Materials Irradiation (IFMIF) facility that could begin construction around 2009-2010 as a way to accelerate the development of fusion power plants, following ITER. It says that if ITER is built in Europe, then it is unlikely that IFMIF would be in Europe, in which case they estimate the European contribution to IFMIF to be around 15-20 million Euro per year over ten years. Such a fusion development plan (called "fast track") "would naturally require additional funds for the research programmes that will follow (the current funding plan) even if savings could be achieved through wider international cooperation on materials research...."

The report concludes: "The Commission hereby notifies (the Council and the European Parliament) of its intention to submit by the end of 2003 two proposals for decisions, one concerning the international agreement on ITER implementation and the other the structure of the joint undertaking which will be responsible for the European contributions to this project."

The full report is posted at http://fire.pppl.gov

## Korea Joins ITER Negotiations

The Republic of Korea has joined the negotiations to construct the International Thermonuclear Experimental Reactor (ITER), becoming the seventh Party. The others are European Union, Japan, Russia, Canada, United States and China.

In a May 30 letter requesting approval of the other Parties, subsequently received, South Korean Minister of Science and Technology Ho-Koon Park stated "I am honored to announce that our government formally requests to join the on-going negotiations on the Joint Implementation of the International Thermonuclear Experimental Reactor (ITER) project." He said, "Korea intends to provide a substantial contribution to the Joint Implementation of ITER, comparable to what is currently envisaged by some of the Participants in the present Negotiations, and is willing to participate in the ITER Transitional Arrangements."

The full text of the letter is posted at http://fire.pppl.gov

## High Level ITER Preparations

Since November 2001, eight ITER Negotiations meetings have been held, paving the way to the first high level ITER Preparatory Meeting June 19 at the International Atomic Energy Agency (IAEA) in Vienna, Austria. High level government officials from the European Union, Japan, Russia, Canada, United States, China and Republic of Korea participated.

The meeting discussed the following topics: (1) the site for ITER, (2) key personnel to head the ITER management structure, (3) procurement allocations, i.e., which Party provides which components, and (4) cost sharing formulas for the construction, operation and decommissioning phases of the ITER project. At the June 19 meeting, a schedule and work plan was agreed upon with the goal to reach agreement on these matters in Autumn 2003. The next meeting is scheduled for early October in Vienna.

Further information on ITER and the negotiations is posted at http://www.iter.org

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## OSTP Dampens Fusion Hopes

During the summer 2002, the President's Science Advisor and Director of the Office of Science and Technology Policy (OSTP), Jack Marburger, asked fusion community leaders if it would be possible to prepare a U.S. plan to put fusion-generated electricity on the grid within about 35 years. He had been told of such a plan within the European Community by his counterparts there. Subsequently, such a plan was formally requested in a September 10, 2002 letter from U. S. Department of Energy (DOE) Office of Science Director Ray Orbach to his Fusion Energy Sciences Advisory Committee (FESAC). The plan was completed and transmitted to Orbach on March 5, 2003.

However, in a May 5, 2003 presentation to the National Academies Burning Plasma Assessment Committee entitled "Administration Perspective on ITER and Fusion Energy", Marburger aide Patrick Looney, OSTP Assistant Director for Physical Science and Engineering, told the committee "There is no agreed upon fusion energy development timeline." Though acknowledging that President Bush stated "The results of ITER will advance the effort to produce clean, safe, reliable and commercially-available fusion energy by the middle of this century," Looney said there were "large error bars" on the President's estimate and did not constitute a timeline commitment. Furthermore, Looney said "This is energy science not (underline not) an energy technology." He said the U.S. decision to join ITER negotiations is not part of a "broader fusion initiative." "The ITER decision will not imply endorsement of other fusion-related initiatives," Looney said. He said, "As (ITER) construction does not begin until FY06, the (ITER) decision will be overall budget neutral until FY06." He also said "If the U.S. joins ITER it would not be as a lead player," and "the U.S. is absolutely neutral on the issue of site." "The U.S. has no interest in hosting ITER," he said.

On the positive side, Looney said that the decision to join ITER negotiations was in part based on a recognition that "a burning plasma experiment is the crucial element missing from the world fusion energy science program." "ITER provides U.S. scientists access to the world's most sophisticated burning plasma experiment," he said.

Looney's vugraph presentation is posted at http://fire.pppl.gov

## Fusion Article in Newton

The very popular Japanese graphic science magazine, Newton, has published a richly-illustrated, colorful 32 page article on fusion in its issue dated 6-2003. The article ends with interviews with Dr. Stephen O. Dean, president of Fusion Power Associates and Dr. Robert J. Goldston, director of the Princeton Plasma Physics Laboratory. Unofficial translations of those interviews are provided below:

### Interview with Dr. Stephen O. Dean

In Japan, major research activities are for magnetic fusion whereas in the US, laser fusion research activities are also very strong. The president of the Fusion Power Associates Dr. Steve Dean has played a role to bridge the government and research institutes in the US. The journal heard from him about the future prospects of fusion research and the research strategies in the US, with focus on laser fusion research that has been led by the US.

Newton: Fifty years have passed since fusion research started in the US. How do you see the present status?

Dean: I think "fusion has a tail wind now". It is highly probable that sooner or later fusion may become the most favored energy source. The reason is the fuel supply problem for energy production, in addition to global warming. Fossil fuels will become more and more expensive and eventually will be nearly exhausted.

Newton: what are the advantages of fusion?

Dean: One advantage of fusion is that the fuel can be extracted from water and is thus available to everyone. Not every area of the world has access to frequent sun, wind, geothermal or coal but every country has water.

Newton: When will fusion electricity generation be achieved?

Dean: It depends upon the government policy. In my prediction, the first fusion power plant will be in operation by 2040, at a probability of 50 %, and by 2060 at 90 %.

Newton: Can fusion power compete, in its generation cost, with other energy sources?

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Dean: If one builds a fusion power plant with the present knowledge, its generation cost might be about twice that of a conventional power plant. However, the cost of fusion power will be reduced in the coming few tens of years due to development, whereas generation cost of the fossil fuel plants will increase, due to fuel scarcity and/or environmental regulations
.

Newton: What are the reasons for expecting a reduction in fusion electricity cost in the future?

Dean: As research advances, technology is improved and cost is reduced. Also, if many power plants are built, the cost is reduced further. On the other hand, if such things do not take place, fusion will not become practical.

Newton: In 1999, the US withdrew from ITER, but she announced to rejoin it in 2003. What are the reasons behind this?

Dean: In 1999, US fusion funding had been cut by about 40 % so that there was a possibility to damage other fusion activities if the US joined the ITER construction. After that, ITER cost was reduced down to about a half, i.e. to 5 B$, compared with 10 B$ then estimated in 1999. The success of the cost reduction is one of the reasons of the US rejoining.

Newton: We understand that in the US, an important issue is electricity generation cost in the future.

Dean: In fusion, there are various approaches and among them are candidates that may produce far cheaper electricity. However, our knowledge on those candidates is limited so that we can not be so optimistic. Nonetheless, as our knowledge advances, a winner may appear and cost may be further lowered.

Newton: We understand fusion can be used for other than electricity generation. What are the other possibilities?

Dean: It is possible to think about generation of hydrogen from water, which can be used for fuel cells. It may be also possible to diminish radioactivities of radwastes from fission power plants, by irradiating the radwastes by neutrons generated in a fusion plant.

Newton: Comparing magnetic fusion with laser fusion, which is more close to practical use, in your view?

Dean: According to our present knowledge, it is not possible to answer clearly that question. However, at present it seems that inertial confinement fusion has a possibility to achieve electricity generation sooner, at less generating cost, with less R&D cost.

Newton: What are the advantages of laser fusion?

Dean: A laser fusion device has a simpler core structure and a device to generate a certain power is smaller. The reason for this is that all the fusion reactions in laser fusion take place in a tiny fuel pellet. Of course, we may encounter problems in the future. When we upgrade our present devices, we may encounter difficulties. Therefore, it is too early to make a definite comment.

Newton: In Japan, fusion research activities are more for magnetic fusion. How about in the US?

Dean: For magnetic fusion, 9.8 B$ was spent since it started in 1951, and for laser fusion 6.5 B$ since it started in 1963. Since US laser fusion research is supported as a part of the nuclear weapons (hydrogen bombs) program, at present the funding is about twice of that for magnetic fusion. Equations to predict the physics of laser fusion can be used also for designing hydrogen bombs, but one can not design a bomb only with the physics of laser fusion.

Newton: I now understand that laser fusion research does not connect directly to military. We know that in the US a large project of laser fusion called NIF is underway. What is this project?

Dean: Using 192 laser beams, NIF aims at, within 10 years, ignition of a small pellet of fusion fuel (energy generated by fusion exceeds that of the injected energy so that the fuel burns naturally). NIF is to generate about 10 to 20 times more energy from fusion than the injected energy. However, repeated irradiation by the NIF laser is not possible -- only one injection at a time.

Newton: In order to achieve laser fusion, a high repetitive irradiation laser is necessary. How do

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you think about the prospect to develop such a laser?

Dean: Prospect is high. For example, a method using a gas laser (one using gas discharge for laser source) can irradiate repetitively. Or, instead of using a laser, there is a technique to use ion beams from an accelerator. It can generate repetitive pulses. There are other options.

Newton: In laser fusion, Osaka University achieved a success in fast ignition process that attracted attentions of people. How do you think about it?

Dean: The success on fast ignition by Osaka University is praised very much among the experts in the US fusion community. In the US also, this method is pursued as one of the methods to reduce the cost of fusion power plant.

Newton: Thank you very much.

## Interview with Dr. Robert J. Goldston

The Princeton Plasma Physics Laboratory has led world fusion research since its dawn time. The Mecca of magnetic fusion research PPPL conducts research aiming at development of a low cost fusion reactor in the era after the next step experimental machine of ITER. The director of PPPL Dr. Goldston told Newton of the possibility of realization of a magnetic fusion reactor as well as others.

Newton: Are you sure about the realization of a fusion reactor?

Goldston: We have a great confidence to generate fusion energy at an industrial level. In experiment with ITER, it will definitely be able to generate fusion energy at an industrial level. The most difficult issue is to make it competitive, i.e. to the one usable at a commercial base. I think it is possible. If one can not make it sufficiently cheap, it will not be usable as an energy source and valuable as we expect.

Newton: There may be many issues to be resolved for a commercial reactor. Will it be possible to develop a reactor wall material that can withstand high heat as well as neutrons generated by fusion reactions?

Goldston: Yes, I think it will be possible. A recently achieved dramatic advancement is with so-called ferritic steel. It has a high resistance to neutrons. Another hopeful material is a composite material, a silicon carbide sandwiched by silicon carbide fibers. It is a very advanced material, which remains at a very low radioactivity with neutron bombardment.

Newton: Would you please tell us the achievements made with the large Tokamak at PPPL (TFTR) that completed the experiments in 1997?

Goldston: In TFTR, we discovered that plasma current could be maintained by the plasma itself. It is called bootstrap current. With the results, people came to consider plasma completely differently.

Newton: We now understand that with the results of TFTR, a large Tokamak at JAERI JT-60 could operate continuously by this bootstrap current. At present, Tokamak is main line in magnetic fusion research. Will the Tokamak line be also the most attractive for commercial reactor in the future?

Goldston: A simple Tokamak system which will not have a large bootstrap current will be very expensive, so that it will not be able to make a success as a commercial fusion power plant. In order to make Tokamak system successful, I think we need to improve it to a so-called "advanced Tokamak". The advanced Tokamak will have a possibility to become a commercial reactor.

Newton: We understand that a spherical Tokamak experiment studied at PPPL, NSTX, is an advanced Tokamak.

Goldston: In a spherical Tokamak, we need a simple and cheap magnet to hold a big plasma. Therefore, it has a possibility to become a less expensive machine. We consider that some of the problems of Tokamak may be resolved by the spherical Tokamak.

Newton: The US announced to rejoin ITER project in 2003. How will the US participate in the ITER project?

Goldston: It may not participate suddenly at the same magnitude as those of EU and Japan, but will enhance gradually the degree of its participation.

Newton: Considering both magnetic fusion and laser fusion, which will realize first a commercial fusion power plant?

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Goldston: I believe that both be pursued. If ITER is built, it becomes a powerful machine of magnetic fusion path. In view of demonstrating technology, not only science, it will become a far larger one than NIF. If ITER achieves a big success, probably people will say "Great! Probably OK! Let us go with magnetic fusion!". If ITER can not generate good results, in due course advantage may be given to laser fusion. At present, both lines are competing closely. I myself have been studying magnetic fusion so that I have a strong confidence, but it is undoubtedly that both lines are competing closely. This competing race may be finished at about 5 years after initiation of ITER operation, i.e. 2019.

Newton: When will fusion reactor be realized?

Goldston: If everything goes well after ITER, perhaps a decision will be made by 2030 as to whether to build a demonstration power plant. The demo will start operation 5 to 6 years after the decision, so that electricity will be supplied to the grid.

Newton: Since global environmental problems are increasing, hopes are given also to the natural energies, such as solar power and wind power.

Goldston: Because of fluctuation in the natural energies, many people believe that in practice the natural energies can not become the major electric power source. In the past 100 years, among the people hunting for the concessions for energy resources such as oil, many wars were fought. If fusion power plant is realized, troubles for seeking for energy resources can be avoided, so that such wars can be avoided.

Newton: We sincerely wish it be realized. Thank you very much.

## Next FESAC Meeting July 31 - August 1

The next meeting of the DOE's Fusion Energy Sciences Advisory Committee will be held at the Gaithersburg Marriott on July 31 and August 1. Details about logistics will be posted on the FESAC homepage: http://www.ofes.fusion.doe.gov/More_HTML/FESAC_Charges_Reports.html.

The Committee will work to complete its charges on alternate (non-electric) applications for fusion and on future workforce development for which a charge will be presented shortly. A more complete agenda will also be posted when it becomes available.

If you have questions or need information about FESAC, or if you would like to make comments during the scheduled Public Comments portion of the next meeting, please contact Al Opdenaker at 301-903-4927 or by e-mail: albert.opdenaker@science.doe.gov.

## FPA Annual Meeting Nov 19-21

Fusion Power Associates annual meeting and symposium, "Forum on the Future of Fusion," will be held November 19-21 at the Capitol Hill Club in Washington, DC. Hotel and registration information are posted at http://fusionpower.org (Click on 2003 Annual Meeting, Nov 19-21).

The symposium will include the latest information on ITER negotiations, high level summaries of progress in all aspects of fusion and a discussion of fusion policy. Details of the agenda are still under development.

## Kathy McCarthy Promoted

Kathryn McCarthy, Ph.D., has been promoted to the new position as director of Nuclear Science and Engineering within the INEEL's Nuclear Energy division. For the past five years, McCarthy has been the manager of the Nuclear Engineering Design and Research Department.

Last year, McCarthy was elected to the American Nuclear Society's board of directors. She received the ANS Women's Achievement Award in 2000 for outstanding personal dedication and technical achievement by a woman for work she performed in the fields of nuclear science, nuclear engineering, research and education. Last year, she also served as chair of the Idaho section of ANS.

McCarthy came to the INEEL in 1991 with a doctorate in nuclear engineering from the University of California, Los Angeles. She has worked in the INEEL Fusion Safety Program focusing on examining the behavior of materials in the plasma facing components of proposed fusion reactors. She also led a number of important experimental projects

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that have contributed to an understanding of the consequences of fusion reactor accidents.

In 1994, she received the Fusion Power Associates Board of Directors' Excellence in Fusion Engineering Award for her "very important contributions to fusion safety engineering and in recognition of impressive leadership qualities."

In 1996, she received the International Thermonuclear Experimental Reactor Program Certificate of Merit for outstanding technical excellence and leadership in ITER Safety Research and Development.

## New Appointments at MIT

Professor Ian Hutchinson has been appointed the new Head of the MIT Nuclear Engineering Department, starting July 1, 2003, He will step down as Head of the Alcator Project at that time. In making the announcement, MIT Plasma Science and Fusion Center (PSFC) director Miklos Porkolab said, "I want to take this opportunity to thank Ian for his outstanding leadership of the Alcator Project for the past 15 years, and we wish him much success in his new position as Department Head. Ian will remain affiliated with the Alcator Project, and will conduct research and supervise students as his schedule allows."

Porkolab also announced the appointment of Dr. Earl Marmar, Senior Research Scientist in the MIT Physics Department and at the PSFC, as the new Head of the Alcator Project, starting July 1, 2003. Presently, Dr. Marmar is the Executive Head of the Alcator Project, and in this capacity he has been involved in nearly all aspects of the day-to-day operation of Alcator, as well as in preparation of proposals, budgets, and reviews. Porkolab noted, "He has been a member of the Alcator team for nearly 25 years and is extremely well qualified to lead the project. Please give him all the support you can to make this challenging job a great success."

Professor Jeffery Freidberg will step down as Head of the Nuclear Engineering Department as of July 1, 2003, and will become an Associate Director at the PSFC, a position he held before becoming Nuclear Engineering Department Head. Dr. Rick Temkin, Senior Research Scientist in the Physics Department and at the PSFC, will remain an Associate Director of the PSFC, and Dr. Peter Catto, Senior Research Scientist at the PSFC, will remain an Assistant Director and Head of the Theory Program at the PSFC. Porkolab said "Professor Freidberg will assist me in improving the quality of graduate and undergraduate educational programs affiliated with the PSFC. In addition, he will assist me with overseeing magnetic fusion research, and in particular, ITER-relevant (burning plasma) activities at the institutional and national level. For example, Jeffrey is already serving on the US Burning Plasma Advisory Committee, and on FESAC, the Fusion Energy Sciences Advisory Committee. Jeffery will also become more active in plasma and fusion-relevant theory research, as well as in supervision of graduate students. Rick Temkin will remain in charge of educational outreach programs, as well as helping me oversee the plasma and fusion technology and engineering programs at the PSFC."

For further information contact Prof.Miklos Porkolab (Porkolab@psfc.mit.edu)

## Kilkenny Joins GA; Dahlburg Returns to NRL

Dr. Joseph Kilkenny is joining General Atomics (GA) Energy group as Manager of the Inertial Fusion Technology Division. Joe is replacing Dr. Jill Dahlburg who is returning to the Naval Research Laboratory (NRL).

GA Vice President Mike Campbell said, "Joe has had a distinguished career in Inertial Fusion and High Energy Density Physics research and he brings to GA a wealth of expertise and experience in all aspects of its science and related technology. This experience and familiarity with the program and its participating laboratories will be of great value to GA and the GA/Schaffer Team in supporting the target fabrication needs, including characterization, of the laboratories today and in the future."

Kilkenny was educated at Imperial College, London University, receiving his B.Sc (first class) in 1968 and Ph.D in 1972. In 1985, he joined the Lawrence Livermore National Laboratory (LLNL) as a staff physicist where he had positions of increasing responsibility, eventually becoming Deputy Associate Director for the ICF Program and NIF. He is presently a senior physicist at LLNL while also serving as Associate Director of Science

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and Technology at Laboratory for Laser Energetics (LLE) of the University of Rochester.

Campbell states, "Joe was a major contributor to the program on Nova that explored the physics critical to ignition that was required to convince the DOE and scientific community of the value and promise of NIF. He also was instrumental to the development of the Weapons Program's interest in ICF facilities and on NIF and to their present recognition of the role of these facilities in the Stockpile Stewardship Program."

## In Memoriam: Don Arnush

Donald Arnush, Adjunct Professor at UCLA, succumbed to cancer on April 24, 2003.

A 1961 graduate of M.I.T., Arnush afterwards went to Germany and studied under Heisenberg. His career in theoretical physics started in space, with polar and auroral electrojets, later going to parametric instabilities and laser theory.

He was employed at TRW, Inc., in Manhattan Beach, California, where he worked on missile and military satellite programs. His work on the scattering of blue-green light by a turbulent medium led to a scheme for detection of clear-air turbulence. To treat nonlinear plasma effects of intense laser beams in air, he invoked Raman scattering well before this became a problem in laser fusion.

In the 1970s Arnush was the scientific director of the PSP project at TRW, in which the Dawson Isotope Separation method was developed and applied successfully to pure uranium plasmas. In this capacity, he supervised the writing of ANTENA, a code for excitation of radiofrequency waves, which is often used in ion cyclotron heating. In the 1980s, he rose to Manager of the Applied Physics Lab at TRW and to Assistant Manager of the Electro-Optics Technology and Applied Physics Center, initiating projects on high-power microwave sources, free electron lasers, and ion sources for neutral beams.

Because of his gentle, soft-spoken, and modest manner, Don's many scientific accomplishments are not well known, even to his friends and colleagues. However, they all remember his warm personal interactions with them. Students he has worked always remember how he used to come down to the lab helping them figure stuff out, always optimistic and enthusiastic about the projects, always seemingly in a good mood, with plenty of jokes. They can't remember a time when he didn't have something encouraging to say. His many friends around the world will feel his loss greatly. He was a highly kind and intelligent man, and an excellent physicist.

## In Memoriam: Gerhart von Gierke

On June 28th, 2003, Dr. Gerhart von Gierke died at the age of 81. He was Scientific Member Emeritus of the Max-Planck-Institute for Plasma Physics (IPP) in Garching, Germany.

For over 30 years he stood at the forefront of German and international fusion research. Beginning in 1957 he worked with Werner Heisenberg at the Max-Planck-Institute for Physics and Astrophysics in Gottingen. In 1960 he co-founded the IPP in Garching and belonged to the IPP Directorate until 1981. From 1965 until his retirement in 1987, he was a member of the Scientific Council of the IPP. Beginning in 1970 he headed the newly-formed experimental department E3, building first the Pulsator tokamak and then the divertor tokamak ASDEX. In his last professional years, he returned from management to research. On ASDEX his interest was plasma stability at the beta limit.

Gerhart von Gierke started the two most successful fusion concepts in the IPP, the stellarator and the tokamak. Both continue to form the backbone of the experimental programme of the IPP. In particular, the operation of ASDEX in the eighties led to decisive contributions to the progress of fusion research, and paved the way for the implementation of ASDEX-Upgrade at the IPP.

Gerhart von Gierke served on many research committees. He represented the IPP in the "Groupe de Liaison"; he was a member of the JET-supervisoryboard, in the JET "Executive Committee" - later he became its vice-chairman- and he was member and chairman of the "International Fusion ResearchCouncil" of IAEA in Vienna.

The international fusion research community mourns his passing.

For further information, contact Prof. Friedrich Wagner (fritz.wagner@ipp.mpg.de).

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# Calendar

July 21-23 4th IAEA Technical Meeting on Control, Data Acquisition and Remote Participation for Fusion Research. San Diego, CA http://fusion.gat.com/conferences/iaia-tm-computing/

Aug 3-8 Laser-generated and Other Laboratory X-ray and EUV Sources, Optics and Applications (AM303). San Diego, CA. http://spie.org/Conferences/Calls/03/am/conferences/index.cfm?fusaction=AM303

Aug 11-14 Plasma Technology Training School. University of Glasgow, Scotland. http://www.astro.gla.ac.uk/PITTS/

Sep 1-5 4th International Symposium on Applied Plasma Science. Kyoto, Japan. Contact: kobayasi@jwri.osaka-u.ac.jp

Sep 1-12 Sixth Carolus Magnus Euro-summer School on Plasma and Fusion Energy Physics. Brussels, Belgium. Contact: michael.van.schoor@rma.ac.be

Sep 3-5 Ninth International Workshop on Plasma Edge Theory in Fusion Devices (PET-9). San Diego, CA. http://cerfe.ucsd.edu/pet9.html

Sep 7-10 18th International Conference on Numerical Simulation of Plasmas. Cape Cod, Massachusetts. http://web.mit.edu/ned/ICNSP/

Sep 7-12 Third International Conference on Inertial Fusion Sciences and Applications. California. Contact: hogan5@llnl.gov

Sep 8-10 10th European Fusion Theory Conference. Helsinki, Finland. http://www.hut.fi/Units/AES/eftc10

Sep 8-12 International Topical Conference on Plasma Physics: Complex Plasmas in the New Millenium. Santorini Island, Greece. http://itcpp.conferences.gr

Sep 8-13 Tenth International Conference on Ion Sources(ICIS2003). Dubna,Russia. http://www.jnr.ru/icis2003/

Sep 9-12 International Conference on Research and Applications of Plasmas. Warsaw, Poland. http:..plasma2003.cbk.waw.pl

Sep 15-17 Spherical Tokamak Workshop 2003. Culham, England. http://www.fusion.org.uk/stw/index.html

Sep 15-19 Fourth International Conference on Plasma Physics and Plasma Technology. Minsk, Belarus. http://imaph.bas-net.by/pppt-4/

Sep 16-19 Symposium on Plasma in Laboratory & Universe. Como, Italy. http://www.ifp.cnr.it/conference/como03

Sep 17-19 Tenth International Workshop on Carbon Materials for Fusion Applications (Carbon-10). Juelich, Germany. http://www.fz-juelich.de/carbon-10/

Sep 22-26 14th Stellarator Workshop. Greifswald, Germany. http://www.ipp.mpg.de/stellarator-workshop

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