Vol 2003 / 5
October 5, 2003

newsletter

EUROPEAN FUSION DEVELOPEMENT AGREEMENT

Issued by the EFDA Close Support Unit Garching

Contents

http://www.efda.org

News

ITER at the European Council of Ministers

At their meeting of 22nd September, the Competitiveness Council took note of a presentation by the Commission on the state of the process for identifying a European candidate site for ITER. The two sites proposed, Vandellos in Spain and Cadarache in France, have been analysed by a group chaired by Sir David King, Chief Scientific Adviser to the UK Government. The report of this ITER site analysis group was presented at the Council. The Council has decided that discussions would continue on this question with a view to reaching a decision at its session on 27th November 2003. The Commission has the intention to submit by the end of 2003 proposals for decisions related to ITER:

- the international agreement on ITER implementation ; and
- the structure of the Joint Undertaking which will be responsible for the European contribution to the project.

For more information please see:
ftp://ftp.cordis.lu/pub/focus/docs/229en.pdf and http://ue.eu.int/pressData

Progress in the ITER Negotiations

The 10th Negotiators' Standing sub-group (NSSG-10) meeting was hosted by the European Union. Delegations from Canada, the European Union, Japan, south Korea, the People's Republic of China, the Russian Federation and the United States of America met at the Culham Research Center, UK, on 25 September. This followed an intense week of work for various sub-groups, who reported at the NSSG-10 meeting. Important progress has been made in particular, upon the Procurement Allocation Scheme and Intellectual Property Rights guidelines. Delegations have recalled the importance attached by their governemnts to the ITER project and their wishes to reach consensus on the site as soon as possible and finish up the Negotiations possibly by the end of this year. It is foreseen that the next Negotiation meeting will be held in Beijing in November.

Aznar visits Vandellós

On 9 September the Spanish Prime Minister, José Maria Aznar, visited Vandellós (Spain), the site where his government proposes to host ITER. He was accompanied by Juan Costa, the new Spanish Minister for Science and technology and Jordi Pujol, President of the Government of Catalonia (Spain). Prime Minister Aznar at this occasion reiterates his strongest support to fusion energy research and outlines the qualities of the Spanish site proposal.

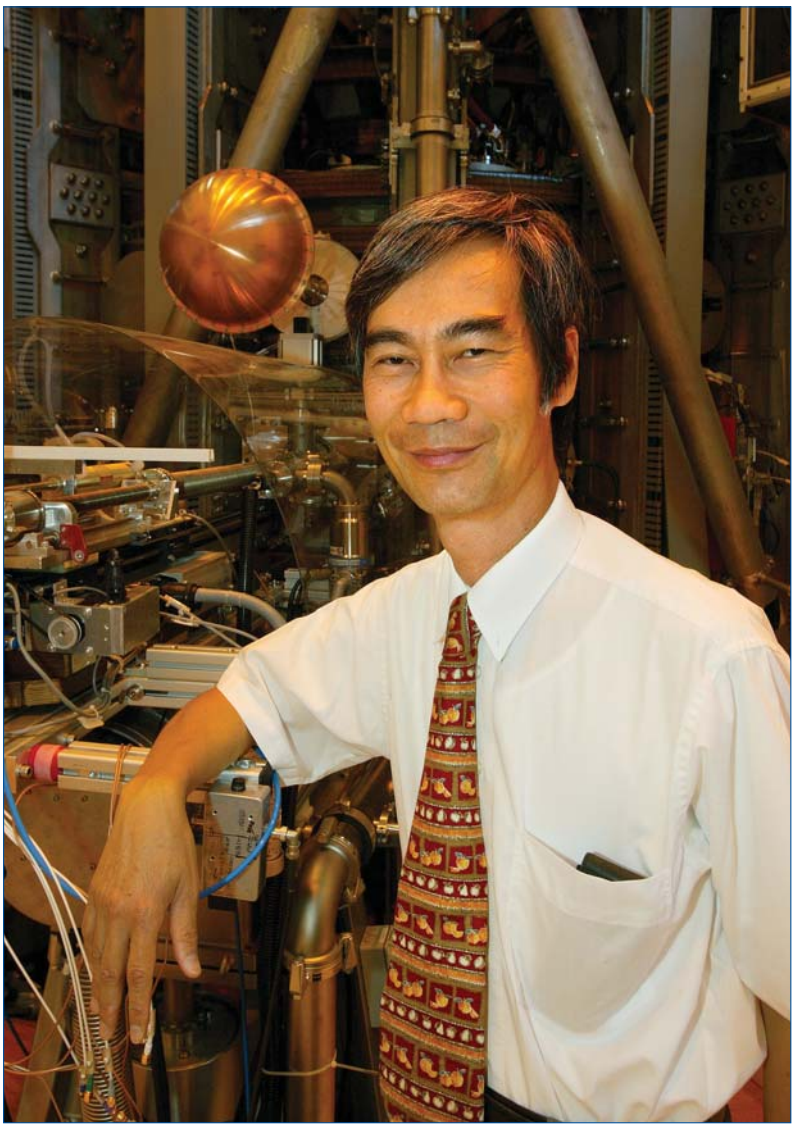
For more information see: http://www.ciemat.es/eng/

People

New EFDA Leadership

"EFDA is now a key element of the European fusion programme. I would first like to pay a tribute first to my predecessor, Professor Karl Lackner. As the first EFDA Leader, Karl has helped build up the whole EFDA organisation and has led it through its first years, the most critical ones. He was helped in this by two Associate Leaders, Dr. Roberto Andreani for Technology and Dr. Jérôme Paméla for JET, who also acted as EFDA leader ad interim for about a year. Their experience, their intimate knowledge of the system and their commitment to advancing fusion will be invaluable in guiding my first steps in this new challenge.

Fusion energy research has fascinated me since my undergraduate years at the Swiss Federal Institute of Technology in Lausanne. Coming from Vietnam, an energy hungry country, I am deeply convinced that a vigorous development of all energy sources in general, and of fusion in particular, is obligatory if we are to offer a perspective of sustainable development to future generations. It is therefore with a deep sense of responsibility and humility that I am taking up my new duties.



The ITER negotiations will soon be complete and EFDA, within a new European frame for the fusion programme, will continue to play an important role. Why am I so convinced of this? The most visible reasons are the wealth of scientific and technical results obtained at JET and the R&D advances for ITER. Secondly, within EFDA we have successfully developed novel ways of working together in our extremely complex scientific and technical enterprise. This will be an enormous asset during the construction and exploitation phases of ITER.

ITER will also bring many changes to the European programme. An Accompanying Programme in Physics and Technology and a new programme structure are presently under discussion. These should allow us to maintain our present European leadership in fusion science and technology and to train a new generation of scientists, the "ITER generation" as it was dubbed by one JET Task Force Leader. I shall serve the community by helping to develop this important transition phase.

The commitment of everyone in the Fusion Programme to collaborate closely has been the key to the success of EFDA. As the EFDA Leader, I believe in the value of continued dialog. It is only through such dialog that the specific characters and strengths of each laboratory can be recognised and an optimal European programme be built and implemented around them. I am convinced that all of you will share this view. Together, by gathering all our skills in physics, technology and management, you will help me in my dream of a young undergraduate student in the late sixties: seeing the promise of fusion."

Prof. Minh Quang Tran

Interview

New ITER Interim Project Leader to continue fruitful cooperation

EFDA Newsletter (E.N.): *Your first name – Yasuo – means "peaceful man". This seems to be a very good precondition to lead a team of different international scientists and engineers!*

Yasuo Shimomura (Y.S.): I'm sure that the cooperation within our ITER project is peaceful and nice! After joining it I recognized that the difference between the nationalities is much smaller than the difference between the personal characters. But to give an example for national differences: the traditional Japanese are probably more calm and think more before they start to express their opinion. This is sometimes helpful, but sometimes it's better to discuss the items amongst all people, even at a very preliminary stage. Other nationals are thinking while talking. These kind of people stimulate the discussion very easily, but sometimes they just cause confusion. So you have always advantages and disadvantages, but I think exactly this fact creates very fruitful working conditions.

E.N.: *You had an impressive series of leading positions starting as leader of the first divertor tokamak in the world, the JFT-2a/DIVA at JAERI (Japan). How do you see your new position as ITER project leader?*

Y.S.: The first time I was involved in ITER was at the end of 1986, when its objectives and activities were defined. In 1992 I was deputy to the ITER Director, first with Dr. Rebut and then with Dr. Aymar. I have been working for many years on position two, so the work of the ITER project leader is not very new to me. But at the same time, the time scale is very short as we are entering the construction phase, so my position is under much more pressure. The technical side of ITER construction preparation is clear. But in order to start construction quickly and smoothly it is important to set up a construction team and this is difficult without having the Director-General nominated. A team built up by another person will not meet his requirements. We also will have to upgrade new tools like a document control and the CAD system before the ITER site is selected.

E.N.: *As a Japanese native, deep in your heart you surely support Rokkasho as the ITER site?*

Y.S.: Actually I don't doubt that all Japanese want ITER as a very important scientific centre in their territory, but for me personally it is not so important where ITER will be built. By using information technology, scientists can use ITER from anywhere in the world. For fusion development the site itself is not important.

E.N.: *Meanwhile the number of ITER partners has increased to 7. Do you see any problems, which could arise from that fact?*

Y.S.: The components of the machine will be fabricated by different partners. If the partners don't understand that the sharing among them should be technically reasonable and simple, we have a high risk of having a delay in construction or to have an unreliable machine. But except for this point I see much more positive points. If you look at Europe or Japan or the US, all the scientists and engineers are getting old. We actually have few young persons in this research area. But in Korea or in China we have excellent and very active groups of young people. This will help ITER a lot. So, during the ITER operation I think mostly people from the new Parties will contribute highly to develop the basis for a future fusion power plant.

E.N.: *21 years ago you already spent some time in Garching to work on the ASDEX machine at the Association-Euratom IPP. What do you like best in Germany?*

Y.S.: My wife, my three sons and I enjoy hiking in the mountains and I like the excellent German public transportation system, as driving myself means, to me, wasting my time. And of course I like very much *Schweinshaxn and beer!

Interview: D. Lutz-Lanzinger

*Bavarian expression for "knuckle of pork"

Dr. Yasuo Shimomura became Interim Project Leader of the ITER International team in July 2003 and moved to Garching (Germany). He succeeded Dr. Robert Aymar who was elected Director-General at CERN, the European Organization for Nuclear Research in Geneva (Switzerland).

You can find a short CV of Dr. Shimomura on the EFDA and ITER WEB!

http://www.efda.org

http://www.iter.org

ITER R&D: Report

Dr. Roberto Andreani

Main strategic R & D lines in the European Technology Programme in view of ITER construction

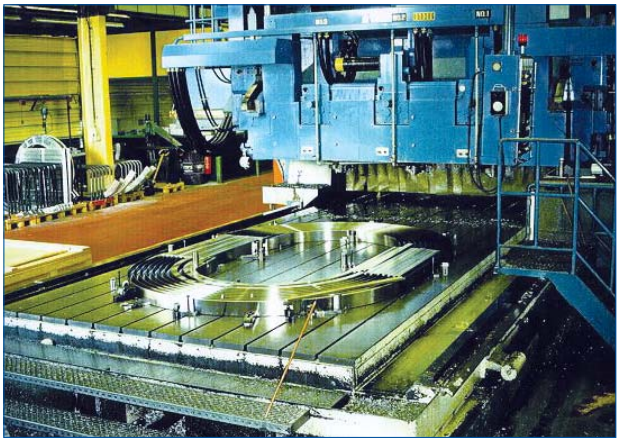
The European support to ITER, in terms of design and R&D, has been maintained without interruptions during all the design development period, starting in 1992 and continuing through all the phases of the project. Now that the construction of ITER is close to becoming a reality, and hopefully in a European site, it is very important to assure the best matching between the R&D activities and the construction. EFDA has therefore concentrated on the fields of activities which are crucial to the success of ITER construction and operation.

Magnets (Toroidal Field coils, Central Solenoid)

The design of the Toroidal Field coils and Central Solenoid have already been validated by the correct operation of the two large coil models built and tested. Six European companies have been assigned a contract to fabricate test samples of the strand. By the end of 2004, the quality of the complete conductor manufactured with these strands will be tested. Europe has developed the competences necessary to build all the components of the magnetic system of ITER, apart from the Central Solenoid.

Vacuum Vessel

A segment of vessel, implying, during manufacture, all the most relevant technical problems to be encountered in the construction and assembly of the entire vessel, is going to be manufactured. Studies on the expected distortions and on the inspection methods are continuing.



Superconducting Winding of the Toroidal Field Model Coil during fabrication

Plasma Facing Components

There are two main lines concerning the first wall (beryllium armour) and the divertor, in particular the outer vertical target (two zones with respectively tungsten tiles and carbon fiber reinforced graphite tiles). An extensive programme of fabrication and test of samples and prototypes is under way, in industry and in the Associations. It aims at consolidating and demonstrating the right recipe to build these components, subject to demanding thermo-mechanical fatigue, with the needed reliability.

Remote Handling

The splitting of R&D with Japan during the ITER Engineering Design Activities (EDA) has taken Europe to concentrate on the Divertor RH system. Two large test facilities were built during the ITER EDA to demonstrate the reliable operation of the system and to study refurbishment operations. As a consequence of the major changes in design going from the large version of ITER to the present one, we plan to build a prototype of the new main mover, the Cassette Multifunctional Mover, and to demonstrate its operation in a smaller facility.

Heating & Current Drive Systems

We are trying to put Europe ahead of competition by developing state of the art radiofrequency generators in the ECRH and ICRH fields. Test beds will be realized in the Associations to demonstrate the performance of the systems. For the Negative Ion Beams, development activities continue in the European laboratories to improve key aspects of the system like radiofrequency ion sources and 1 MeV accelerating structures. Also in this case, a specialised test bed will be realised in an Association.

For each of these projects, an analysis has been performed of the needs of the project, of the status of the present activities, of their compliance with the ITER requirements, of the time schedule to be respected in order to properly match the project time schedule.

The main result of this internal effort has been that we have not found lines on which we would not deliver on time, assuming that the needed resources, human and financial, be available as planned.

Dr. Roberto Andreani

For **more information** on the ITER R&D projects see:

http://www.iter.org

Associations

Christopher Llewellyn Smith appointed to Key Post

Chris Llewellyn Smith

UKAEA announced on July, 30, 2003 the appointment of Professor Sir Chris Llewellyn Smith FRS as Director of Culham (UK), responsible for developing and implementing the strategy for the UK's fusion research programme. Chris Llewellyn Smith's scientific achievements and leadership have been recognized by awards and honours in seven countries on three continents. He succeeds the late Derek Robinson FRS and is an enthusiast for fusion.

For the Press Release please see:
http:// www.fusion.org.uk/news/n030730_director.html

JET: Families and Friends Open Day at Culham Science Centre

A great success – that was the verdict on the Families and Friends Open Day at Culham on 6 September. Some 1300 staff and guests (including Sir Chris Llewellyn Smith who took up his post as Culham Director the following Monday) took advantage of a wonderfully sunny day to view the major experimental areas at Culham and take in displays, talks and activities throughout the day. It was also a splendid opportunity for recently arrived EFDA secondees to explore the whole site. Liquid nitrogen, JET robot arm and pressure suit demonstrations were particularly popular with children (of all ages!) and due to high demand, queues built up at times to enter the JET torus hall, but no-one seemed to mind. A virtual reality JET "fly-through" created by JET Remote Handling staff was another huge attraction, with 12 PCs in action all day. Even grandparents who had never operated a computer before were persuaded to try their hand at finding their way through a "virtual JET". Talks on fusion, JET and ITER, and the new interactive Fusion Road Show, describing fusion science with tricks and demonstrations and derived from the original Dutch Association Road Show, were all packed out.

Children were well catered for with magic shows, a mobile planetarium and a room full of scientific puzzles and experiments. They could also enter a competition drawing or relating their experience of the day, with a prize of a levitating magnetic top as used in the Fusion Road Show. A jazz band entertained in the restaurant at lunchtime and the pig roast staff never stopped carving from noon till two. Many diners chose to eat al fresco in the warm sunshine. The brilliant weather was matched by the enthusiasm and good humour of the ninety staff "on duty" and the question everyone was asking at the end of the day was "when's the next one?" Quote from Chris Warrick: "Staff at Culham are proud of what they do – and clearly relished the chance to show this off to families and friends. The high numbers attending clearly demonstrated this."

"Fusionauts" at the Friends & Families Day

Associations

The **ASDEX Upgrade** tokamak (**A**xially **S**ymmetric **D**ivertor **EX**periment) went into operation at the Association Euratom-IPP in Garching (Germany) in 1991. This fusion device, Germany's largest at present, is for investigating crucial problems in fusion research.

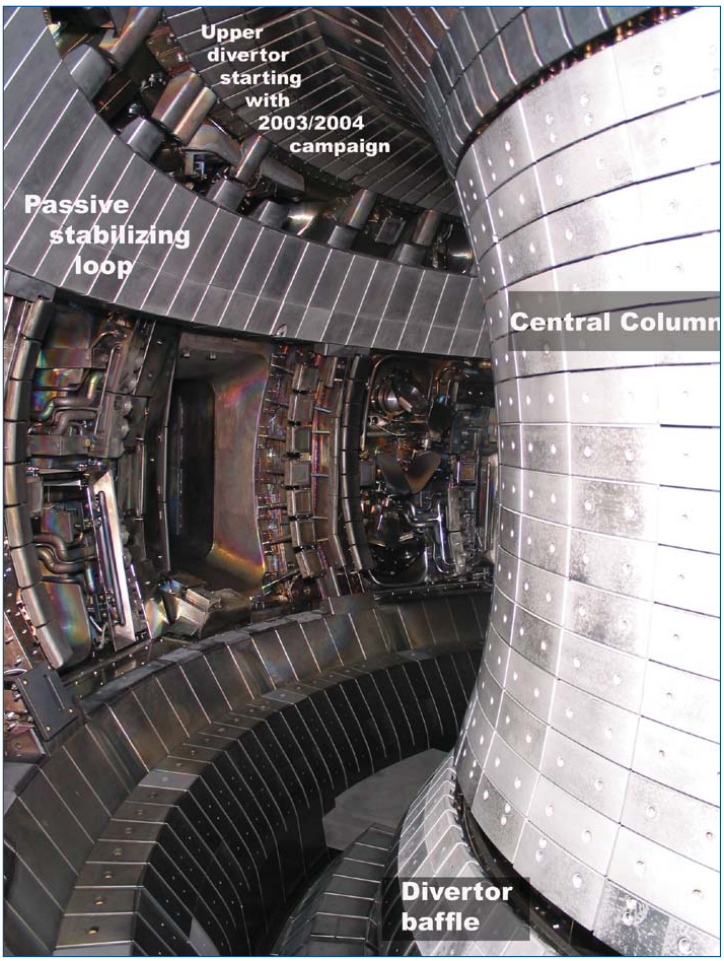
For **more information** on ASDEX Upgrade see:

http://www.ipp.mpg.de/eng/index.html

ASDEX Upgrade - en route to an all tungsten device

All major design studies of future fusion research and reactor devices employ tungsten (W) on plasma-facing components (PFCs) at least in a part of the divertor region, since in general, the erosion rate for low-Z materials like carbon or beryllium seems to be far too high in a steady state power-producing device. Additionally, the use of large area carbon based materials may absorb tritium, leading to excessive co-deposition of carbon and tritium. Metal walls avoid this problem. The applicability of molybdenum is tested in FTU (Frascati, Italy) and Alcator C-mod (USA). Tungsten, which will be used in ITER, has a low erosion yield and a high sputtering threshold, its use implies the risk of unduly high radiative losses in the central plasma, and concentrations above 10^{-4} would prevent DT-burn.

However, the experience with tungsten in present-day fusion devices is comparatively small and ASDEX Upgrade is the only major fusion device which uses tungsten as a plasma-facing material on a large scale. Starting from preliminary studies, a full tungsten divertor was installed in ASDEX Upgrade for the 1995/1996 campaign, before it was replaced by the optimized divertor DIV II. Since the experimental campaign 1999 the central column of ASDEX Upgrade has been equipped with tungsten-coated graphite tiles in a step by step approach. In 2002, 14.6 m^2 of newly tungsten-coated tiles were mounted in the main chamber, representing about 40% of the total plasma facing components. For the 2003/2004 campaign, another 13.6 m^2 of W-coated wall tiles will be added, finally including also the complete upper divertor as well as also the baffles at the lower divertor. In preparation for these experiments, W-coating techniques have been tested in cooperation with commercial manufacturers with regard to their suitability for plasma facing components which are subject to power loads of up to 20 MW/m^2. New spectroscopic tools have been developed, which allow measurement of the W-influx and detection of central W-concentrations (cW) below 10^{-6}. Deposition probe measurements and post mortem analyses of the tiles yielded important results on the erosion and migration of tungsten in a mixed material device. The deposition pattern in the divertor clearly shows that the inner divertor as well as the far scrape-off layer region in the outer divertor strike zone are strongly deposition-dominated. The main thrust of the W-experiments in ASDEX Upgrade is the demonstration and documentation of the compatibility of fusion plasmas with tungsten plasma-facing components. The results of several tungsten campaigns can be summarized as follows: most of the relevant discharge scenarios are not hampered in any way and cW remains below 10^{-5}, which would be sufficiently low in a future device. At the same time, regimes were identified which are prone to higher cW or to tungsten accumulation. Unlike with carbon PFCs, a strong difference between limiter and divertor operation is found, and care has to be taken in designing the plasma shape in order to provide adequate wall clearance. Nevertheless, the start-up of the plasma at a W surface is possible without leading to a deterioration of the plasma performance in the subsequent flat top phase. In discharges with peaked density profiles in combination with low diffusive transport the central cW was increased. It could be reduced drastically by applying central heating, as typical for an ignited plasma. This procedure is routinely used and has been verified by other devices in the case of the accumulation of mid-Z impurities. ELM-free discharges or discharges with low ELM frequency, which are produced typically at the L-H confinement mode power threshold, showed increased W-concentrations. These could be overcome by controlling the ELM frequency through pellet injection.



Inside ASDEX Upgrade: the white marked areas are tungsten-coated

In summary, ASDEX Upgrade follows the route to a virtually carbon-free device and will deliver important benchmarks for the use of W in a future device.

ITER

Swedish Industry visits EFDA CSU Garching

A seven strong delegation consisting of leaders from Swedish industry and research organisations in the fusion area visited the EFDA CSU Garching (Germany) on 8 and 9 September 2003. The Swedish guests were interested in the latest developments of the ITER project as well as in seeing the plans for long term research in fusion. The actual aim of their study tour was to find out new ways to strengthen the contribution of Sweden in the fusion programme, especially in the area of industrial contracts. Sweden is an active partner of the fusion research community and is looking for possible areas of interest for their own industry.

During the two days, several presentations and discussions were held starting with an overview by the ITER Interim Project Leader, Dr. Y. Shimomura, on the situation of the ITER project and followed by the EFDA Associate Leader for Technology, Dr. R. Andreani, about the goals and achievements of the EFDA technology development programme. In the meeting, all the fields of special interest of the guests were discussed, after introductions by the EFDA field coordinators, such as Vessel/In-vessel, Diagnostics, Site preparation, Materials and Safety. First of all, new potential areas for deepening the co-operation were identified. It was agreed that the technical challenges and complexity of ITER and fusion are in general on a very high level but they exceed the capabilities of European industry only in some limited areas. Plasma heating systems and diagnostics are such items, where the ITER project is still dependent on the technical capability of the laboratories of the EFDA Associations. The management and financing structures of the project were also discussed and the need for new models not so far employed in industrial history was clearly foreseen.

Dr. R. Andreani confirmed that EFDA has an open policy regarding knowledge sharing with its partners: “We at EFDA are open to this kind of information exchange with organisations in our partner countries and are pleased to provide them with all the necessary additional information that they need in planning of activities.” He reminded his listeners that this kind of exchange is always useful to both parties: “Our Swedish guests, with their large experience of the present industrial practice on many fields important to ITER, can give us plenty of valuable feedback here at EFDA.”

At the end of the meeting, the members of the Swedish delegation expressed their satisfaction about their considerably improved knowledge level concerning the ITER project and, as the most important, awareness on the opportunities this project can present to Swedish industry. As professor Lars Börjesson from the Swedish Research Council stated: “We have to start to do our homework with our industry right now, to inform them on the possibilities, and find and motivate companies so that they are well prepared when the qualification for ITER procurement begins.”

Delegates:

Prof. L. Börjesson (Swedish Research Council, Deputy Secretary General, Natural and Engineering Sciences)

http://www.vr.se/english/index.asp

C. Dahlberg (Swedish Trade Council)

http://www.swedishtrade.com

N. Hellström (Swedish Research Council, Industrial relations)

http://www.vr.se/english/index.asp

J.M. Holt (Studsvik Nuclear AB, President)

http://www.studsvik.se/index.php?lang=en

Dr. P. Karlsson (Swedish Research Council, Administrative Coordinator of the Swedish fusion programme)

http://www.vr.se/english/index.asp

Dr. J. Martinsson (former General Manager of R&D at ABB Sweden)

http://www.abb.com/
http://www.abb.se/

Dr. S.-I. Ragnarsson (Swedish Agency for Innovation Systems)

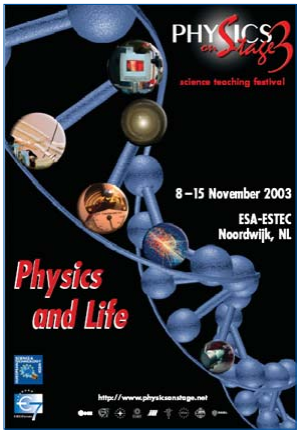
http://www.vinnova.se/index_en.htm

Events

EIROforum Event: Physics & Life

The next EIROforum event is called “Physics and Life” and it will be held at ESTEC, Nordwijk (NL) from November 8 to 15. A report will be presented in the next EFDA Newsletter issue.

For more information see: http://www.physicsonstage.net



Fusion Expo

Budapest (Hungary)
Millenáris Park
October 10 - 26, 2003

Obituaries

In Memoriam: René Pellat

On August 4, 2003, René Pellat unexpectedly passed away. Born February 24, 1936, he graduated from Ecole Polytechnique as well as from the Corps des Ponts et Chaussées. René Pellat also earned a PhD in Physical Sciences in 1967. Seconded as an engineer to the Plasma Physics and Controlled Fusion Department in the CEA (French Atomic Energy Commission, Fontenay-aux-Roses Center), he worked on theoretical research projects from 1962 to 1971. Apart from being a member of and chairing various scientific boards, René Pellat was appointed President of the National Center for Space (Cnes) in 1992 and took over several other responsible positions. Since 1987 he was visiting professor at UCLA (University of California, Los Angeles).
R. Pellat was one of the most well known fusion scientists worldwide following his early work in the field. He has also made significant contributions in several other fields of science such as astrophysics.

As chairman of the Coordinative Committee for the Euratom fusion programme (CCE-FU) since 1999 he played a key role in promoting the ITER project in both the scientific and political world.

Since 2001 he was Head of the Defense Nuclear Safety Authority and Atomic Energy High Commissioner from 1998 to 2003.

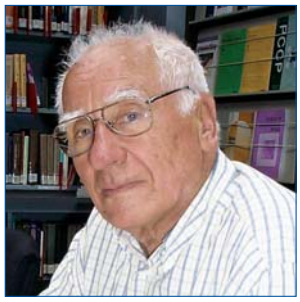
René Pellat

For more information see our EFDA website:

http://www.efda.org
and additionally
http://www.jet.efda.org
http://www.iter.org

Dutch Fusion Pioneer Cees Braams Passed Away

Cees Braams, founding father of the Dutch research on nuclear fusion, suddenly passed away on July 29, 2003. He was born in 1925 and studied physics and mathematics at the Utrecht University (The Netherlands), where he received his doctorate in 1952. In 1965 he received his PhD with first class honors. From the foundation of the FOM-Institute for Plasma Physics in Nieuwegein (The Netherlands) in 1956 to his retirement in 1987 he was the director of the institute. He was appointed professor in plasma physics at the Utrecht University, which he remained till 1987. His enthusiasm, his vision and his keen insights in scientific questions have formed an important and lasting contribution to the prosperous development of nuclear fusion research, both in the Netherlands, and abroad.



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