# PARTICLES

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**A Newsletter for those interested in proton, light ion and heavy charged particle radiotherapy.**

Number 16 July 1995 Editor: Janet Sisterson Ph. D., HCL

Mailing Lists: PLEASE help to keep the Particles mailing list up-to-date by sending me **address, telephone** number, **fax** number and **e-mail** additions/corrections. If you live in the UK, I NEED your new phone numbers! At the PTCOG meeting in San Francisco, it was decided that we would make the Particles mailing list available to others. **If you DON'T want your name included when the list is given out, YOU MUST LET ME KNOW**.

Costs: At the PTCOG XIX meeting in Cambridge, the Steering Committee decided to continue allocating a portion of the registration fee for PTCOG meetings to cover some of the costs of producing both Particles and the abstracts of the PTCOG meetings. More financial help is needed, so HCL is always happy to receive financial gifts to help cover these costs; all such gifts are deductible as charitable contributions for federal income tax purposes. The appropriate method is to send a check made out to the "Harvard Cyclotron Laboratory".

Facility and Patient Statistics: I am still collecting information about all operating and proposed facilities, regarding patient statistics, machine, scheduling and treatment characteristics. Please send me up-to-date information.

Particles on the Internet: There have been many requests for an on-line version of Particles. I am in the process of setting up a Particles Home Page on World Wide Web. I hope that it will be ready by the beginning of 1996. At that time, you will be able to down load the whole newsletter, an article of interest, meeting information etc. Sometime in 1996, I plan to have all back issues of Particles and abstracts from selected PTCOG meetings on-line. Only the PTCOG meeting abstracts that I circulated with Particles will be available.

E-mail address Directory: It has been suggested that a directory of e-mail addresses should be maintained and kept on a central computer. I am willing to maintain such a database, if it can be set up.
I am trying to assess how many people have access to the Internet and so could read an electronic version of Particles. Please e-mail me if you have access to the Internet.

## ARTICLES FOR PARTICLES 16

The **deadline for news for Particles 17 is November 30 1995**, for the January 1996 issue. I will send reminders by fax or e-mail.

Address all correspondence for the newsletter to:

Janet Sisterson Ph. D.
Harvard Cyclotron Laboratory
44 Oxford Street
Cambridge MA 02138

Telephone: (617)495-2885
Fax: (617)495–8054
E-mail: SISTERSON@HUHEPL.HARVARD.EDU

Articles for the newsletter can be short but should **NOT** exceed two pages in length. I **DO** need a good clean copy of your article and figures as I am using a scanner to get everything into the computer. If you FAX me an article, please send a good copy by mail. If I only get a single-spaced FAX copy, you may get typos! I think I can scan a double-spaced copy. The best method, however, is to send the article as an ASCII file using e-mail for down-loading to my MAC.

## CALL FOR NOMINATIONS FOR THE PTCOG STEERING COMMITTEE

Michael Goitein
June, 1995

PTCOG is holding an election for the Steering Committee. This committee meets at each PTCOG meeting and has the responsibility of guiding PTCOG's plans and policies - which are always ratified at the subsequent PTCOG business meeting. The steering committee's meetings are open and interested members are encouraged to attend and participate in the committee's deliberations.

In the past, the steering committee has been made up of the elected PTCOG officers and the chairs and co-chairs of the working committees. Since the working committees have largely achieved their functions and no longer meet on a regular basis, the existing procedures need to be modified.

Please see the enclosed flyer for details and the nomination form that is to be returned to Janet Sisterson by one of the ways listed in this issue of Particles.

## FUTURE PTCOG MEETINGS

The times and locations of the next PTCOG meetings are as follows:-

| | | |
|---|---|---|
| PTCOG XXIII | Cape Town South Africa | October 17-19 1995 |
| PTCOG XXIV | Detroit, Michigan, USA | April 24-26 1996 |
| PTCOG XXV | PSI, Switzerland | September 9-10 1996 |
| PTCOG XXVI | Boston Massachusetts USA | Spring 1997 |

If you have questions about **PTCOG**, please contact the secretary of PTCOG, Dan Miller, Department of Radiation Oncology, Loma Linda University Medical Center, 11234 Anderson Street, Loma Linda CA 92354. Telephone (909) 824-4378.

## PTCOG XXIII; October 17-19 1995 Cape Town, South Africa.

The XXIII meeting of PTCOG will be held in Cape Town, South Africa from 17-19 October 1995. This meeting follows the 14th International Conference on Cyclotrons and their Applications (Cyclotrons '95) which is also being held in Cape Town from 8-13 October 1995. The latter conference will include two sessions on medical applications which will be held on Thursday 12 October. Although both meetings are being hosted by the National Accelerator Centre (NAC), they are being organised independently and are being held at different venues.

PTCOG XXIII will be held at the Ritz Inn (where a block booking has been made), in the suburb of Sea Point. The hotel is close to the sea and on a main bus and taxi thoroughfare and on the shuttle bus route to Cape Town's Waterfront shopping, bar, restaurant and entertainment complex. The bed and breakfast tariff is single: R199 (South African Rands), double: R219. Alternative accommodation will also be offered to delegates. The registration fee will be R700 which will cover costs of all lunches and social functions. Cyclotrons '95 is being held at the Cape Sun Hotel in downtown Cape Town which is about 5 km from the Ritz Inn. It is recommended that delegates attending both meetings move to the latter for PTCOG XXIII although there is public transport between the two venues should they wish to remain at the Cape Sun.

A visit to the NAC and several social functions are planned for PTCOG XXIII and an optional sight-seeing excursion on Monday 16 October will be offered. Assistance will also be provided with arrangements for pre- or post-meeting tours to game parks, scenic areas and holiday resorts.

October is a very pleasant time of the year in Cape Town with an average maximum temperature of 21.3 $^{o}$C and an average minimum temperature of 10.4 $^{o}$C. Cape Town can be reached easily by flights from many major cities on all continents on South African Airways (which offer discounted fares for

PTCOG delegates) or other international carriers. Flights terminate either in Cape Town or Johannesburg where one has to change aircraft for the 2-hour flight to Cape Town.

If you have not received the PTCOG XXIII registration package with hotel reservation details and information on tours please contact:

Dr D T L Jones
National Accelerator Centre
P O Box 72
Faure
7131 SOUTH AFRICA

Phone: +27-24-843-3820
Fax: +27-24-843-3525
E-mail: JONES@NAC.AC.ZA

For information on tours contact the nearest South African Tourism Board (SATOUR) office or:

Talk Travel
P O Box 6878
Roggebaai
8012 SOUTH AFRICA

Phone: +27-21-797-1861/3/6
Fax: +27-21-797-7810

## Abstracts for PTCOG XXIII

Authors are encouraged to submit an abstract of their talk, which will be published with the January 1996 issue of Particles.

Abstracts will be collected at the meeting by Dan Jones or they can be sent directly to Janet Sisterson by one of the methods listed above in "articles for Particles". THE VERY BEST WAY is by **e-mail**. The **deadline** for accepting abstracts will be **November 15 1995**.

The space allocated for each abstract is ONE HALF page; PLEASE try and keep to this length. Each abstract must have a title and a list of authors with addresses; graphs and line drawings are welcome.

## PTCOG XXIII: Session on clinical protocols and future international collaboration.

At PTCOG XXII in San Francisco, the Steering Committee decided to organize a session on methods and proposals to develop clinical protocols and future international collaborations. This session will be held during the Cape Town Meeting and will explore the possibility of creating working groups which might share clinical experiences, protocols and maybe the results of their work with reports and publications.

**Riccardo Santoni** will organize this session and has/will send out questionnaires to all interested centers asking three important questions:-

1) How many new patients a year (total number of new cases/year and numbers by tumor site) are usually referred to your center?

2)Which type of tumor(s), among those usually referred to your center might be, in your opinion, a good candidate for dose escalating protocols? is it possible to point out 5 of them?

3) Would you be interested in organizing one or more extensive searches (personal data and data from the medical literature) to provide evidence of the actual local control probabilities in these tumor sites? Do you agree that to initiate the process towards the production of common clinical protocols it is first of all necessary to perform this type of analysis and to collect as many data as possible from all interested centers?

The results of this inquiry will be presented for discussion at PTCOG XXIII. This session will also include presentations from interested centers on a practical example of a 3-D treatment plan with clinical data on a particular tumor site that is thought to be a good candidate for a future clinical protocol.

In the future, it is hoped that a common data base can be set up for all the information collected for these future clinical protocols. This data base would then be available to all.

For more information contact:- Dr. Riccardo Santoni
Radioterapia
Policlinico di Careggi
Viale Morgani 85
50134 Firenze
Italy

Telephone: +39-55-4379930
Fax: +39-55-4378051

**PTCOG XXIV: April 24-26 1996**
**DETROIT, MICHIGAN, USA.**

PTCOG XXIV in conjunction with an International Particle Therapy Meeting, will be hosted by the Detroit Medical Center and the Wayne State University Radiation Oncology Center, and will be held at the Atheneum Hotel in the Greektown area of downtown Detroit.

The meeting will include sessions on proton therapy, external beam neutron therapy and will be followed by a short $^{252}Cf$ brachytherapy workshop.

The Atheneum, the conference hotel, is a modern all suite hotel offering accommodation for $89.00 per night + 6% tax (single or double). There will be a welcoming reception at the hotel on Tuesday, April 23, from 6 to 9 pm, where pre-registration will be available.

The provisional registration fee is set at $160 and will include lunch on Wednesday, April 24 and Thursday, April 25, and a conference dinner.

For more information please contact

Dr. Richard L. Maughan
Gershenson Radiation Oncology Center
Harper Hospital
3990 John R
Detroit, MI 48201
U.S.A.

TEL: (313) 745-2487
FAX: (313) 745-2314

Cay Bernock
Radiation Oncology Center
4201 St. Antoine
Detroit, MI 48201.
U.S.A.

TEL: (313) 745-2484
FAX: (313) 745-2314

**FIFTH WORKSHOP ON HEAVY CHARGED PARTICLES IN BIOLOGY AND MEDICINE,**
**August 23 - 25 1995**
**GSI, DARMSTADT, GERMANY**

Purpose: This workshop will be dedicated to the presentation and discussion of new results of experiments and theories in particle radiation biophysics. The main topic will be the application of charged particle beams like protons and heavier ions in tumor therapy. In addition, biological, biochemical and physical problems related to radiobiology using beams of heavy charged particles will be discussed.

Abstracts: The workshop will be structured into general presentations and short presentations, posters and discussions. A book of extended abstracts of the presentations will be published as a GSI report and will be available at the beginning of the conference. Therefore, all abstracts (camera ready, maximum 4 pages including figures, lists and references) have to arrive at Darmstadt before **July 15 1995**.

Members of the International Scientific Committee are:-

K. Ando, NIRS, Japan
H. Blattmann, PSI, Switzerland
G. Kraft, GSI, Germany
G. Munkel, PSI, Switzerland
H. Tsujii, NIRS, Japan
M. Belli ISS, Rome, Italy
J. Kiefer, U. Giessen, Germany
A. Kronenberg, LBL, USA
J. R. Milligan, UC San Diego, USA

For Information: Contact

G. Kraft
GSI mbH
Planckstrasse 1
D-64291 Darmstadt

Germany
Telephone: +49-6159-71-2607 Fax: +49-6159-71-2106
**ATTENTION: !! These are <u>New</u> Telephone and Fax numbers !!**

**PTCOG News:** The following reports were received by June 1995.

"reprinted from the Dallas Morning News, Wednesday, May 17 1995"

## EDITORIALS

# THE EPILOGUE

Super Collider's assets will not be reused

Snakebit by a congressional cutback. What's left of the Superconducting Super Collider just got bit again.

Congress canceled the partially constructed, $11 billion physics lab in 1993. Ever since, a few scientists and consultants have been searching for another use for the project's assets.

Last week, state leaders gave up. Legislators decided to liquidate Texas' collider assets and use the proceeds, along with cash from the federal government, to start paying off $250 million in general obligation bonds. The decision, while understandable, is a great disappointment.

The decision means there will be no proton therapy center at the former collider site outside Waxahachie. The federal government gave Texas $65 million to build the center. Texas would have contributed about $5 million annually to operate the facility.
When first proposed, the proton center would have piggybacked on the collider. Overhead costs would have been relatively modest. The center would have used fast moving subatomic particles, called protons, to treat malignancies such as prostate cancer. The only regularly operating proton centers in the country are in Massachusetts and California.

Once the collider was canceled, the proposed center became a stand-alone facility. It would have been more expensive and logistically difficult to operate than the original center – which made administrators at the University of Texas Southwestern Medical Center at Dallas lose interest in the project. If Southwestern didn't want it, legislators quite reasonably didn't want to fund it.

Nevertheless this decision hurts. It's also frustrating that it took so long to reach this conclusion. Wishful thinking, politics and self-interest may have occasionally subverted a rational evaluation of proposals to re-use the collider's assets.

Texas will reduce its collider-related debt by selling off assets. But legislators shouldn't be hasty about auctioning off the 10,500 acres of land it acquired. Profits from land sales wouldn't equal the millions dollars Texas spent to acquire the acreage. And it took thousands of hours of work to assemble the parcels of rolling prairie.

The state should bank the land until a more farsighted use can be found. It is a unique and flexible asset. Future Texans may need it for an educational institution, a research station, a wildlife preserve or a state home. The current Legislature shouldn't rob future generations of those options.
submitted by *Richard Sah, Texas National Research Laboratory Commission, Central Laboratory Facility - Mezzanine, 2275 North Highway 77, Suite 100, Waxahachie, Texas 75165.*

Heavy Ion Therapy at **GSI, Darmstadt, Germany:**

In May 1995, the beam line into the medical cave has been completed including magnets, beam diagnostics and vacuum pumps. The last part, the vacuum chamber of the rasterscan magnets, is presently being installed. In the next few weeks, the first beam will be tuned into the cave using, to a large extent, the newly installed controls and monitors in the medical control room. For the rasterscan test, the old control from the biology cave will be used in the beginning, but the new and faster control unit for patient treatment will be available by the end of the year.

Besides the scanner software, a large effort is presently being made in the development of the hardware and software of the fast, position-sensitive counter that will be finally installed in front of the patient and serve as the most important unit of the safety system. The PET cameras for the online detection of the beam path are presently being transported from Dresden to GSI and will be installed in the next few weeks. The PET system will be used also as additional safety control.

Other inputs for the safety system will come from the accelerator, the diagnostics of the beamline, the scanner control, the access control system, other control units, and from a manual cut-off. In case of a malfunction, the safety system will have a flexible response consisting of warnings to the operator and can slowly cut down the irradiation if the patient's safety is not immediately questioned, or will have a fast response, cutting the beam in less than one millisecond when the exposure is not in accordance with the treatment plan.

Considerable progress has been made in treatment planning and radiobiological experiments. For an extended and irregularly shaped target volume, the relative biological efficiency varies from point to point because of the changes in the beam composition concerning the energy distribution of the primary particles as well as the contribution of the fragments. Based on fragmentation and scattering experiments, a model has been developed that describes the physical parameters of the penetration of the beam into the extended target.

Based on this model, the actual RBE values have been calculated using a refined track structure model. In the first experiments, a tumor of two centimeters in diameter in the middle of a 16 cm water tank has been simulated using CHO cells as biological detectors. The scanned beam entered the water tank from two opposite sides and the volume was filled by using 20 energy steps where two different energies were delivered from the accelerator and the additional steps using a digital range shifter. The results of these experiments agree to within a few percent of the calculation.

In another radiobiological experiment, two mini-pigs were exposed to a scanned carbon beam in order to compare the actual skin reaction with X-rays applied at the same time and to test the accuracy of the density correction to be made for complex tissues (in cooperation with the FRZ, Rossendorf and the University of Dresden). Up to now, six weeks after the exposure, the skin reaction of carbon and X-rays is identical. However, it is too early to measure the fibrosis generated along the beam path inside the body using CT techniques. Other components essential for the patient treatment are underway.

The patient couch is being modified at the DKFZ Heidelberg and will be installed soon. The plans of the medical annex building have been submitted for approval by government administration as well as the general safety and operating procedures. According to the present progress of the project, the first patient treatment should be possible by the middle of next year.

Detailed information on the project will be given at the Fifth Workshop on Heavy Charged Particles in Biology and Medicine, to be held at GSI, August 23-25, 1995. *G. Kraft, GSI mbH, Planckstrasse 1, D-64291 Darmstadt, Germany*

## Dosimetry at **Indiana University Proton Radiation Center, Indiana, USA**; Part II

As previously reported in the PARTICLES #15 by C. Bloch (see his report "Developments at Indiana University Proton Radiation Center", pp 8-9), alanine-based dosimeters were used at the IUCF proton clinical beam line to intercompare the NIST standard of dose with the IUCF exposure-based dosimetry. Five alanine detectors manufactured and absolutely calibrated at the Ionizing Radiation Division at NIST were placed into a polystyrene holder and irradiated at the mid-point of a spread-out Bragg peak in a WT1 ("Solid Water") phantom. A wide laterally uniform field distribution used in the experiment was calibrated with a Markus ionization chamber according to a routine technique employed at the laboratory.

Additionally, to evaluate the polystyrene-induced component in the ESR signal from alanine detectors (since polystyrene presents in the detector material as a binder) five pellets of pure polystyrene were irradiated in the same field that was used for the alanine detectors irradiation.

In both of irradiations, a piece of radiochromic film (type MD55) was used to map the actual lateral dose distribution.

Read-outs of irradiated alanine detectors and polystyrene samples were performed at NIST. The agreement between the IUCF dosimetry and the NIST standard of dose was observed to be $D(IUCF)/D(NIST) = 0.969 \pm 1.4\%$ for a single exposure.

The ESR signal was judged to be negligible compared with the alanine component while using alanine-based detectors for the purpose of proton therapy. *Dmitri Nichiporov, Dept. of Medical Physics, ITEP, B. Cheremushkinskaya, 25, 117259 Moscow, Russia.*

## News from **Loma Linda University Medical Center, California, USA**:

In mid-1995, proton-beam irradiation at LLUMC might be said to be in its adolescence. Patient numbers continue to accrue and some experiences are approaching sufficient maturity to permit reporting of outcomes. The Proton Treatment Center is fully operational, both as a clinical facility and a research center.

Treatments are administered via three gantries and the stationary beam lines. The "uptime" of the synchrotron and these delivery systems continues to exceed 98%. As of March 31, 1262 patients had completed treatments, nearly 60% of them for adenocarcinoma of the prostate. Protons also are being delivered to patients having melanomas and other ocular and orbital malignancies; sub-retinal neovascular membranes (SNVMs); pituitary adenomas; arterio-venous malformations (AVMs); acoustic neuromas, meningiomas, craniopharyngiomas, astrocytomas and other brain tumors; chordomas and chondrosarcomas; cancers of the head and neck; pelvic neoplasms other than prostatic cancer; paraspinal tumors; and soft-tissue sarcomas. The following table summarizes the patient totals by site for the calendar year 1994 and from the opening of the facility (October 1990) to March 31, 1995:

| DIAGNOSTIC CATEGORY | 1994 | THROUGH 3/1995 |
|---|---|---|
| Choroidal melanoma | 13 | 41 |
| Pituitary adenoma | 5 | 38 |
| Acoustic neuroma | 3 | 10 |
| Meningioma | 8 | 43 |
| Astrocytoma | 6 | 41 |
| Other brain tumors | 9 | 29 |
| Head and neck tumors | 26 | 78 |
| Craniopharyngioma | 1 | 4 |
| Orbital tumors | | 7 |
| Paraspinal tumors | 6 | 27 |
| Chordoma/Chondrosarcoma | 21 | 66 |
| Prostate | 234 | 742 |
| Other pelvic tumors | 4 | 23 |
| Sarcoma | 12 | 23 |
| Misc. chest tumors | 11 | 21 |
| Misc. abdominal tumors | 5 | 6 |
| AVM | 31 | 33 |
| SNVM | 21 | 30 |
| TOTAL | 416 | 1262 |

The second and third gantries were commissioned in spring, 1994. The facility's four treatment beam lines now permit throughput of up to 100 patients per day. The research beam room now has three functioning beam lines, providing dedicated space for radiobiological, physics and engineering research. Heretofore, researchers had used the clinical beams during non-clinic hours. The new gantries feature a beam-spreading system which ultimately will deliver protons to fields as large as 40 x 40 cm.

Clinical research continued at LLUMC through participation in cooperative groups and in collaboration with other proton therapy investigators in the Proton Radiation Oncology Group (PROG).

Basic and applied research continued, with a major focus on establishing national and international standards for proton-beam dose calibration.

In December 1994, LLUMC and the National Aeronautics and Space Administration (NASA) signed a memorandum of agreement to formally establish a scientific collaboration which will utilize LLUMC's staff and proton facilities to assist NASA researchers in protecting astronauts and scientific equipment from the natural radiation of space. The agreement permits NASA researchers to use the proton facility to simulate the proton radiation emitted by the sun during solar flares; establishing, in effect, a NASA laboratory at LLUMC. The five-year program does not involve experiments on human subjects. Gregory Nelson, Ph.D., of NASA, will begin full-time work at LLUMC in summer, 1995. The collaboration between NASA and LLUMC will not affect patient treatments; simulated space-capsule experiments will be conducted with tissue cultures and invertebrate animals. Protons make up one-third to one half of the radiation in space that emanates from solar flares. Although such flares are rare, they cannot be easily predicted and thus avoided. The LLUMC proton synchrotron will be used to simulate the effect of proton

radiation in space on living human tissue cultures. *Jerry Slater, Loma Linda University Medical Center, Dept. of Radiation Medicine, 11234 Anderson Street, Loma Linda, CA 92354.*

Update on the **Berlin eye treatment facility**, **Berlin, Germany**:

The funding of the Berlin eye treatment facility is now guaranteed. A contract between the Hahn-Meitner-Institut and the university hospital Benjamin Franklin of the Free University Berlin about the installation of the treatment room and the implementation of patient treatments will be signed on May 26, the money for the installation will then be available.

Due to the time delay we are now planning the first treatments in October 1996. *Juergen Heese, Hahn-Meitner-Institut GmbH, Abt. Ionenstrahltechniken, Glienickes Str. 100, Berlin D-14109, Germany.*

Pion studies completed at **TRIUMF, Vancouver, Canada**:

Two randomized studies have now been completed at the TRIUMF cyclotron in collaboration with the British Columbia Cancer Agency, Vancouver, Canada. With the completion of these studies, the pion program has been halted, pending their outcome.

The first study randomized 83 patients with high grade brain tumours (astrocytomas grade 3 and 4) to pion therapy (36Gyπ/15 fractions) or photon therapy (60Gy□/30 fractions). Results show there was no difference in overall survival, time to tumor recurrence, toxicity, or quality of life between the two groups, who were well matched for all known prognostic factors. These results are of interest, as one might have expected increased late toxicity with pions, as has been seen with neutrons and neon ions with brain tumours.

Our second study randomized 219 men with locally advanced (stage T3 and T4) prostate cancer to pion (37.5Gyπ/15 fractions) or photon (66Gy□/33 fractions) therapy. As prostate cancer is a slow growing cancer, full results will take several years to mature, and we are not anticipating meaningful results until 1998. Toxicity data are, however, available. We have seen increased early toxicity in the pion arm (probably related to the short overall treatment time of 3 weeks), but reduced late toxicity. This further confirms that the late tissue RBE of pions is no higher that the acute RBE (as our brain study, and previous clinical and experimental work also suggested). *Tom Pickles, Head, Particle Therapy Group, B.C. Cancer Agency, 600 West 10th Ave, Vancouver, B.C. V5Z 4E6, Canada.*

Operation of the **NAC Particle Therapy Facilities, Faure, South Africa**.

In order to avoid possible confusion in the particle therapy community resulting from the publication of a communication from Tygerberg Hospital which appeared in PARTICLES #15 (January 1995) a brief clarification of the modus operandi of the NAC particle therapy facilities is necessary.

All patients, including those from other parts of the country and from neighbouring territories, are referred for treatment at the NAC through the respective Departments of Radiation Oncology at Groote Schuur Hospital (University of Cape Town) or Tygerberg Hospital (University of Stellenbosch). At present all patient assessment is undertaken at these two teaching hospitals. Although many patients are housed in the on-site NAC hospital for the duration of their treatment, others attend as out-patients.

Treatment planning for neutron therapy and for simple proton treatments is undertaken on commercial photon planning systems at the two hospitals. A sophisticated 3-D planning system has recently been implemented on the NAC's VAX computer network and is now used routinely for the planning of proton

treatments of patients referred to NAC by both Groote Schuur and Tygerberg Hospitals. This latter system is used exclusively at the NAC and is entirely based on the VOXELPLAN planning system which was made available to NAC by the DKFZ, Heidelberg, Germany together with a proton therapy module which was provided by the Royal Marsden Hospital, UK. The latter module has been modified and refined by the NAC's Division of Medical Radiation to make the system (which is now called PROXELPLAN) suitable for clinical applications.

A pc-based proton treatment planning system called PROTEUS is under development for the Department of Radiation Oncology of Tygerberg Hospital by H Breuer and Stellenbosch Scientific Instruments CC. However, the staff of the NAC's Division of Medical Radiation and of Groote Schuur Hospital's Departments of Radiation Oncology and Medical Physics are not associated in any way whatsoever with the development of PROTEUS. Furthermore, they do not endorse this system or advocate its use, nor have they been involved in assessing the accuracy of the calculations. *D. T. L. Jones, National Accelerator Centre, P. O. Box 72, Faure 7131, South Africa.*

News from **PMRC, Tsukuba, Japan**:

As of March 1995, 444 patients with various diseases have been treated with proton irradiation at Proton Medical Research Center (PMRC), University of Tsukuba. Of the patients, 367 were treated for possible cure. Of the 367 patients, 117 had hepatocellular carcinomas (HCC), 35 malignant tumors in the central nervous system, 32 the esophageal carcinomas, 27 arteriovenous malformations, 26 the uterine cancers, 25 carcinomas in the head and neck, 25 malignant tumors in the lung and the mediastinum, 24 transitional cell carcinomas of the urinary bladder, and the remaining had miscellaneous tumors. We are impressed with excellent results obtained for patients with HCC. Of 117 patients with HCC, 112 were evaluated. Of the patients, six had T1 tumor (1987 UICC staging), 29 T2, 51 T3, 15 T4. There were four patients who had either lymph node metastasis or distant metastasis. Five year survival rate for all the patients evaluated was 40%, and local control rate 90%.

We have been trying to acquire a fund for a plan to build a new proton therapy facility at the campus of University of Tsukuba Hospital. Since the present facility is located at the National High-Energy Laboratory 8 km apart from the university, and that the proton beams of 500 MeV are primarily produced for the study of physics, a new facility for medical use only is planned. It is yet unclear whether we would succeed to have the plan funded in the near future.

Dr. Yasuyuki Akine has moved to PMRC from the National Cancer Center to replace Dr. Hirohiko Tsujii, who left for the National Institute of Radiological Science to direct the HIMAC project. Dr. Tetsuo Inada, Head of the Physics Division of PMRC, has also left. We are in the process of searching for his successor. *Yasuyuki Akine, M.D., Institute of Clinical Medicine, University of Tsukuba, 1-1-1 Tennoudai, Tsukuba, Ibaraki 305, Japan.*

## Proton Radiation in Cancer Treatment: Clinical and Economic Outcomes

A report from France.

In France, there are currently two proton beam treatment facilities (Orsay and Nice). The issue of the optimal facility number has been raised by the French Ministry of Health. In order to answer this question, the Medical Technology Assessment Department of the French National Agency for Medical Evaluation (ANDEM) was requested to assess the effectiveness of the proton beam in cancer treatment compared to conventional radiotherapy. Current status, future prospects, and economic implications are addressed in a report published in March 1995.

For the clinical evaluation, we assessed the effectiveness of proton radiation therapy in the treatment of uveal melanoma, and skull base cancer because they are the most frequently proposed tumors for protons. In order to evaluate the outcomes, we used 3 criteria: local-regional control, survival, and complication rates. This task was accomplished by critical appraisal of published clinical trials. For the economic evaluation, the proton therapy costs were compared to photon/electron conformal radiotherapy for two reasons: first, photon/electron conformal radiotherapy is the most advanced conventional radiotherapy; second, this is the only type of comparison published in the economic literature. The results were then discussed with an expert panel that included five radiotherapy specialists for both conventional and proton radiotherapy, one ophthalmologist, and three physicists. (Mrs. Brassard (Nice, France), Mr. Breteau (Orléans, France), Mr. Chauvel (Nice, France), Mrs. Desjardins (Paris, France), Mr. Habrand (Orsay, France), Mr. Maylin (Paris, France), Mr. Mazal (Orsay, France), Mr. Sabatier (Orléans, France), Mr. Wambersie (Brussels, Belgium))

For uveal melanoma, there are studies, including one randomized clinical trial, showing that proton radiation therapy is more effective than brachytherapy. For skull base cancers, although we only found case series, we concluded that, given the high observed local control rate with protons, this radiation therapy should be proposed with surgery. Other tumors have been suggested for this type of treatment but there is too little scientific evidence to recommend its use. According to the capital and the staffing cost analysis, it appears that the costs of proton therapy are likely to be two or three times greater than those of photon electron/conformal therapy.

According to the clinical and economic published literature, proton beam therapy should be proposed as a routine treatment only for uveal melanoma and skull base cancers. Based on the current scientific evidence, and given the incidence rate of these tumors, and the time and material requirements, the current French proton beam facilities can face the demand. For other cancers, the medical and economic potential of proton therapy is still an open question. One way of dealing with these uncertainties may be to require specific conditions for promoting prospective comparative clinical trials. These trials should include the assessment of aggregate treatment costs, including both pre- and post- irradiation periods. Moreover, due to the high capital and the staffing cost of these facilities, rather than cost minimization analysis, cost-utility analysis is probably the most appropriate procedure to use in order to define the incremental therapeutic potential gains with proton beam therapy. *F. Fleurette, S. Charvet-Protat, P. Metral, B. Roche; Agence Nationale pour le Développement de L'Evaluation Médicale (ANDEM), 159 rue Nationale, 75013 Paris, FRANCE*

## BOOK REVIEWS

**Hadrontherapy in Oncology**. (adapted from the review of Raffaella Cambria). Proceedings of the First International Symposium on Hadrontherapy, Como, Italy, 18-20 October 1993. U. Amaldi & B. Larsson Editors. Excerpta Medica, International Congress Series 1077, ELSEVIER 1994, p. 755.

In October 1993 the first "International Symposium on Hadrontherapy" was held at Villa Olmo, Como, organized by the TERA Foundation. In 755 pages, the Proceedings of the Symposium with 77 articles covers all aspects of proton, neutron, pion and light ion beams used in radiation therapy.

Cancer and Hadrons presents the most recent data regarding the incidence of "cancer" and the possibility of "curing it" and the techniques available i.e. surgery, chemotherapy and radiotherapy. The problems and conditions for which hadron particle beams would be appropriate are discussed, together with "conventional" radiation. An often overlooked aspect, the socio-economic study on the cost of hadrontherapy is also included. Low-LET hadrontherapy and High-LET hadrontherapy analyse and review all the experience with protons, light ions, neutrons and pions respectively. Accelerators for Hadrontherapy considers in detail, the accelerators in existing centres and those in the project phase, including the first Italian project for a National Centre of Oncological Hadrontherapy (CNAO). Beam delivery, treatment planning and radiotherapy covers all aspects of the delivery and dosimetry of treatment beams and treatment planning. "Active" and "passive" systems of beam delivery are analysed, concentrating on problems related to conformal therapy. Gantry issues are discussed. The development of new detectors including the silicon "pixel" detectors to the "super-heated drop" detectors, for measurement of the dose and verification of the therapeutic beam are covered. Treatment planning issues discussed include the development of dedicated algorithms for 3D treatment planning. Neutron Capture Therapy and Photon Activation Therapy illustrate two therapies presently under study. To achieve better dose localization, an external beam of either thermal neutrons or synchrotron light induce reactions in a substance localised in the tumor. Various aspects of the techniques are discussed including the production of the therapeutic beam and the possible compounds needed for therapy. An overview covers the possible uses of the synchrotron light for diagnosis and therapy. Radionuclide Therapy explores the use of radionuclides to concentrate the radioactivity in the target volume and covers the important issues which are the compatibility of a "carrier" used for concentrating a drug in the tumour and of the radionuclide used for labelling the drug. Radiobiological basis for hadrontherapy describes the radiobiological and micro-dosimetric aspects resulting from the interaction of the beam with a biological system. Using the clinical experience of both protons and ion beams, the issues relating to the biological effectiveness of these modalities compared to conventional radiation therapy are presented and the need and importance of further work in this area is stated.

The volume contains a complete and thorough review of Hadrontherapy, and will be of interest to health physicists, radiotherapists and oncologists who are interested in knowing the frontiers of physics, clinical and radiobiological research in the field of radiotherapy.

The book can be purchased for $90 from:-

Fondazione TERA
Via Puccini, 11
28100 Novara, Italy
Phone and fax: +39 321 32000/32090

**Out of Sight!** From Quarks to Living Cells.
Sven Kullander and Börje Larsson, Cambridge University Press, 1994.

In simple terms, the authors introduce us to the world of the cell and atom that can only be seen using advanced technology. An overview is given of the physics and chemistry involved with individual nuclei, atoms and molecules as well as the biology of living cells. The scope of the book is well described by the table of contents: Preface; Introduction; Light; Darkness; Invisible radiation; Four forces; Matter; Living matter; Cosmic perspective; Postscript and outlook for the future.

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## Proposed NEW FACILITIES for PROTON & ION BEAM THERAPY
## July 1995

| INSTITUTION | PLACE | TYPE | 1ST RX? | COMMENTS |
|---|---|---|---|---|
| P.S.I | Switzerland | p | 1995 | 200 MeV, var. energy, gantry, dedicated line |
| TRIUMF | Canada | p | 1995 | eye beam line constructed and tested |
| Berlin | Germany | p | 1996 | 72 MeV cyclotron; eye treatment beam line. |
| G.S.I Darmstadt | Germany | ion | 1996 | First Carbon beam in the medical cave 7/6/95 |
| KVI Groningen | The Netherlands | p | 1997? | plan:- 200 MeV accel.; 2 rms; 1 gantry; 1 fix. |
| NPTC (Harvard) | MA U.S.A. | p | 1998 | at MGH; 235 MeV cyclotron; gantry; 4 horiz beam |
| NC Star | NC U.S.A. | p | 1999? | synchrotron; 70-300 MeV; 2 horiz; 1 gantry |
| Regensburg | Germany | p | 1999? | gantry;1 fixed beam; 1 eye beam. |
| Hyogo | Japan | ion | 2000 | protons & ion; 2 gantries; 1horiz; 1 vert; 1 45$^{o}$ deg. |
| TERA | Italy | ion | 2000? | $H^-$ accel;60-250 MeV p; +BNCT; isotope prod. |
| AUSTRON | Austria | ion | ? | protons and light ions. |
| Beijing | China | p | ? | 250 MeV synchrotron. |
| Brookhaven | NY U.S.A | p | ? | linear accelerator. |
| Clatterbridge | England | p | ? | upgrade using booster linear accelerator. |
| ITEP Moscow | Russia | p | ? | 3 horiz.-1 fix beam, 2 gantry, 1 exp., $H^-$ accel. |
| Jülich (KFA) | Germany | p | ? | exp. beam line; plans for therapy. |
| Krakow | Poland | p | ? | 60 MeV proton beam. |
| Kyoto | Japan | p | ? | 250 MeV synchrotron; gantry; 1 fixed horiz beam. |
| Proton Development N.A. Inc. | IL USA | p | ? | 300 MeV protons;therapy & lithography |
| Tsukuba | Japan | p | ? | 230 MeV ; 2 rms; 1 vert+1 h beam; 1 gantry |

## WORLD WIDE CHARGED PARTICLE PATIENT TOTALS

July 1995

| WHO | WHERE | WHAT | DATE FIRST RX | DATE LAST RX | RECENT PATIENT TOTAL | DATE OF TOTAL |
|---|---|---|---|---|---|---|
| Berkeley 184 | CA. U.S.A. | p | 1954 | — 1957 | 30 | |
| Berkeley | CA. U.S.A. | He | 1957 | — 1992 | 2054 | June-91 |
| Uppsala | Sweden | p | 1957 | — 1976 | 73 | |
| Harvard | MA. U.S.A. | p | 1961 | | 6444 | July-95 |
| Dubna | Russia | p | 1967 | — 1974 | 84 | |
| Moscow | Russia | p | 1969 | | 2877 | May-95 |
| Los Alamos | NM. U.S.A. | π- | 1974 | — 1982 | 230 | |
| St. Petersburg | Russia | p | 1975 | | 904 | Nov-94 |
| Berkeley | CA. U.S.A. | heavy ion | 1975 | — 1992 | 433 | June-91 |
| Chiba | Japan | p | 1979 | | 86 | June-93 |
| TRIUMF | Canada | π- | 1979 | — 1994 | 367 | Dec-93 |
| PSI (SIN) | Switzerland | π- | 1980 | — 1993 | 503 | |
| PMRC, Tsukuba | Japan | p | 1983 | | 444 | April-95 |
| PSI (SIN) | Switzerland | p | 1984 | | 1785 | Dec-94 |
| Dubna | Russia | p | 1987 | | 39 | July-95 |
| Uppsala | Sweden | p | 1989 | | 65 | Spring-95 |
| Clatterbridge | England | p | 1989 | | 620 | May-95 |
| Loma Linda | CA. U.S.A | p | 1990 | | 1262 | April -95 |
| Louvain-la-Neuve | Belgium | p | 1991 | | 21 | Nov-93 |
| Nice | France | p | 1991 | | 472 | Nov-94 |
| Orsay | France | p | 1991 | | 468 | Oct-94 |
| N.A.C. | South Africa | p | 1993 | | 67 | April-95 |
| IUCF | IN USA | p | 1993 | | 1 | Dec-94 |
| UC Davis | CA U.S.A | p | 1994 | | 19 | Dec-94 |
| HIMAC, Chiba | Japan | heavy ion | 1994 | | 25 | Feb-95 |
| | | | | | 1100 | pions |
| | | | | | 2512 | ions |
| | | | | | 15761 | protons |
| | | | | TOTAL | 19373 | all particles |

**See Page 15.**
**for**
**The Proposed New Facilities Table**