PARTICLES

sponsored by

PROTON THERAPY CO-OPERATIVE GROUP

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

Number 24 July 1999 Janet Sisterson Ph.D., NPTC

Costs: At PTCOG XIX, the Steering Committee decided that part of the registration fee for PTCOG meetings would be used to help produce both Particles and the abstracts of the PTCOG meetings. Only part of the costs are covered in this way, so more financial help is needed from the community. PTCOG is always happy to receive financial gifts; 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 "Massachusetts General Hospital" and sent to Janet Sisterson at the address given below. We thank Krsto Prelec for his kind donation in support of Particles.

Facility and Patient Statistics: I continue to collect information about all operating or proposed facilities. Please send me your information. The latest published summary of the world wide patient statistics with detailed patient data through 1997 can be found in the following reference.

"World wide proton therapy experience in 1997."
J. M. Sisterson,
CP475, Application of Accelerators in Research and Industry, eds. J. L. Duggan and I. L. Morgan, AIP Press, New York (1999), p959-962. Copies available from me on request.

Particles on the Internet: The URL for the Harvard Cyclotron Laboratory is:-

- http://neurosurgery.mgh.harvard.edu/hcl/ or http://brain.mgh.harvard.edu:100/hcl
  This contains links to recent issues of Particles.

Other proton therapy links:

- Northeast Proton Therapy Center: http://www.mgh.harvard.edu/depts/nptc/nptc.htm
- LLUMC, California: http://www.llu.edu/proton
- U of California, Davis: http://crocker.ucdavis.edu/cnl/research/eyet.htm
- Midwest Proton Radiation Institute: http://www.iucf.indiana.edu
- National Association for Proton Therapy: http://www.proton-therapy.org/
- Prolit - database of particle radiation therapy: http://proton.llu.edu
- TRIUMF, Canada protons: http://www.triumf.ca/welcome/proton_thrpy.html
- TRIUMF, Canada pions: http://www.triumf.ca/welcome/pion_trtmt.html

- PSI, Switzerland: http://www.psi.ch/
- Proton Oncological Therapy, Project of the ISS, Italy: http://top.iss.infn.it
- TERA foundation, Italy: http://www.tera.it
- GSI homepage: http://www.gsi.de
- The Svedborg Laboratory, Sweden: http://www.tsl.uu.se/
- Clatterbridge Centre for Oncology: http://synaptic.mvc.mcc.ac.uk/simulators.html
- Tsukuba, Japan: http://www-medical.kek.jp/index.html
- Tsukuba, Japan - new facility plans: http://www-medical.kek.jp/devnewfac.html
- HIMAC, Chiba, Japan: http://www.nirs.go.jp/ENG/particl.htm (ENG case sensitive)
- NAC, South Africa: http://www.nac.ac.za/~medrad/

ARTICLES FOR PARTICLES 25

November 30 1999 is the deadline for news for Particles 25, the January 2000 issue. I will send reminders by fax or e-mail.

Address all correspondence for the newsletter to:

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Articles for the newsletter can be short but should **NOT** exceed two pages in length. The best way to send an article is by computer. If you mail or fax an article, remember that I scan them into the computer so I need a good clean copy of any figures.

PLEASE, when you send me a file by computer **GIVE IT AN UNIQUE TITLE** that will indicate to **me** the **source** of the article. You have no idea how many files I have on my computer that are called ptles24.doc or something similar!!

PTCOG BUSINESS and FUTURE PTCOG MEETINGS

Chair: Michael Goitein
Department of Radiation Oncology
Massachusetts General Hospital
Boston MA 02114

Secretary: Janet Sisterson
Northeast Proton Therapy Center
Massachusetts General Hospital
Boston MA 02114

Steering Committee Members

USA	Europe	Russia	Japan	South Africa
W. Chu	U. Amaldi	V. Khoroshkov	K. Kawachi	D. Jones
M. Goitein	H. Blattmann		H. Tsujii	
D. Miller	J.-L. Habrand			
J. Sisterson	G. Munkel			
James Slater	E. Pedroni			
A. Smith	A. Wambersie			
H. D. Suit				
L. Verhey				

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

PTCOG XXXI	Bloomington, IN, USA	October 11 - 13 1999
PTCOG XXXII	Uppsala, Sweden	April 16 - 19 2000
PTCOG XXXIII	host TERA; Lake Maggiore, Italy	?

Summary of the Steering Committee Meeting,
Tuesday April 13 1999, Cape Town, South Africa.

Present: K. Kawachi, H. Tsujii, E. Pedroni, F.-J. Prott, C. Bloch, D. Jones, W. Chu, D. Pistenmaa, N. Tilly, S. Lorin. J.-L. Habrand, J. Sisterson.

1) **Future meetings**:

Definite
Fall 1999: Indiana, USA.
Spring 2000: Uppsala, Sweden

Tentative
Fall 2000: TERA; Lake Maggiore, Italy.
Spring 2001: Boston, USA
Fall 2001: Tsukuba, Japan
Spring 2002: Berlin, Germany

2) **Organizing a focus session at a PTCOG meeting**: This topic provoked much discussion. Eros Pedroni commented that nobody responded to his request for help which he published in Particles. After much discussion of the difficulties encountered by people who had organized such sessions, it was recommended that there should be a maximum of two focus sessions or workshops at each PTCOG meeting; one biological/medical and one physics/engineering. The chairperson for the focus session would arrange for one keynote speaker, organize the contributed papers and make sure that there was lots of time for discussion.

3) **Topics for focus sessions**: Many topics were suggested.
For the Indiana meeting, the focus sessions proposed were:

- Beam delivery and gantry design;
- Radiosurgery.
- A round table discussion on intensity modulated proton and photon therapies.

For the Uppsala meeting, the proposed focus sessions were:

- Radiobiology
- Beam scanning.

Other suggested topics for focus sessions were;

- What is the usefulness of a gantry in the clinical situation?
- Treatment of spinal and paraspinal tumors - this might be a good topic for the Boston meeting.
- Comparison of conformal proton therapy and IMXT.
- Intensity modulated proton therapy.
- Small field dosimetry.
- Dose fractionation schedule
- Toxicity of the CNS and spinal chord from the perspectives of biology, clinically and technically.
- Costs of running a proton therapy facility and which treatment sites are benefited by proton therapy.

4) **Summer school for proton therapy**: The projected increase in the number of proton therapy facilities indicate that it might be time to organize a summer school in proton therapy. David Pistenmaa commented that the TENET corporation expect to institute a training program at their first operational facility, in part to train personnel to staff their own operations.
5) Should there be 1) **a subscription for Particles** and 2) **should everyone get a paper copy**. Janet Sisterson stated that we have discussed this before and that the cost of hiring someone to organize the subscriptions far exceeds what we could charge for Particles. Many of our PTCOG members do not have easy access to either the internet or e-mail, so Particles should still be mailed to all.
6) **Should the abstracts from the PTCOG meetings be published as a supplement to some journal**? It was concluded that maybe we should investigate this. Do you have any good suggestions?
7) We have discussed before the idea of **holding PTCOG meetings in conjunction with major meetings** such as ASTRO and ESTRO. Several steering committee members still thought this was a good idea.
8) It was suggested that it might be nice to publish in Particles **a summary of each focus session**. This would require the session chairperson to write a summary which after review by all the session participants would be published in Particles. See this issue for a report on the Beam Scanning Workshop.
9) It was proposed to **change the name of PTCOG** (P for protons) to PTCOG (P for Particle). The steering committee had no strong feelings about this, so we stay with Protons.
10) It was suggested that we should **rebalance the composition of the steering committee**, once many of the proposed new proton therapy facilities come online.
11)The issue was raised about whether one (particularly clinicians) could get **accreditation for attending PTCOG meetings** (I believe this is mainly a USA issue). There was much discussion about this issue both in this meeting, and in Boston after my return. I think this maybe an issue that will be left for each PTCOG meeting organizer to decide.

PTCOG XXXI
Indiana University Cyclotron Facility, Bloomington, IN USA
October 11 - 13, 1999

SUBMISSION OF TITLES or ABSTRACTS

Persons who would like to present a talk at PTCOG XXXI should submit the title by August 30, 1999 to Susan Klein. Please refer to the preliminary program for specific areas of interest for this meeting. Dr. Allan Thornton has graciously agreed to chair the focus session designated for this meeting: stereotactic radiosurgery. We specifically encourage submissions in this area. Please contact Dr. Thornton directly for more information.

Abstracts may be submitted to Janet Sisterson, in formats specified earlier in this issue.

REGISTRATION

Complete meeting information is available and you can register on-line at http://nike.iucf.indiana.edu/ptcog.html. For hard copy registration information, contact sklein@www.iucf.indiana.edu.

Registration fee includes conference materials, receptions, one luncheon, tours of the Indiana University Cyclotron Facility, daily refreshments and three continental breakfasts. We have scheduled a banquet to conclude the conference, and invite you to make your reservation and purchase your banquet ticket on the place provided on the registration form.

On-site registration will be held from 10:00 a.m. 6:00 p.m. on Sunday, October 10, 1999 in the Indiana Memorial Union.

Registration fees are fully refundable up to October 1, 1999.

HOUSING

Please call the Indiana Memorial Union directly to arrange for your housing (tel: 1 800 209 8145; rate $72-91 per night; identify yourself as a member of PTCOG XXXI, conference # 168-99). Alternative housing is available. For more information, please refer to the registration information.
Deadline: September 20, 1999.

TRAVEL

For door-to-door travel arrangements, you may contact:
Carlson Wagonlit Travel

in the US:	(800) 467-7800
outside the US	(812) 339-7800
fax:	(812) 330-5290

CME CREDIT

Continuing Medical Education Credit towards the AMA Physician's Recognition Award has been arranged through the Indiana University School of Medicine. If you are interested in obtaining CME credit, please request registration information from sklein@www.iucf.indiana.edu, or refer to the online registration at http://nike.iucf.indiana.edu/ptcog.html.

LATEST INFORMATION

http://www.iucf.indiana.edu

PRELIMINARY PROGRAM

Sunday, October 10, 1999

- Reception, *Indiana University Art Museum*

Monday, October 11, 1999

- **Focus Session**: Stereotactic Radiosurgery *Chair: Allan Thornton*
- Social Hour, *IUCF*
- Tour of IUCF

Tuesday, October 12, 1999

- PTCOG Steering Committee Meeting
- **Discussion Session**: Intensity Modulated Treatments
- Poster Session
- **Business Meeting**
- Eye Treatments
- Small Field Beam Dosimetry
- Gantries and Beam Delivery Systems
- Radiobiology
- Banquet

Wednesday, October 13, 1999

- **Panel Discussion:** Treatment Planning

REGARDING PROTON THERAPY TREATMENT PLANNING

As the organizing chairperson for PTCOG XXXI, I would like to extend an invitation to anyone who is developing proton therapy treatment planning software. We will make space available for you to set up your hardware and demonstrate your package to the attendees throughout the meeting, including times designated specifically for this activity. Because treatment planning software development is critical to the evolution of this modality, and because I believe that both users and developers can benefit from an exchange of information, I hope you will consider accepting my invitation.

If you are interested, please contact Susan Klein, at sklein@iucf.indiana.edu.

Proton Beam Radiotherapy
British Institute of Radiology
18 November 1999

This meeting concerns the present and future role of proton radiotherapy in the UK. The preliminary program includes: clinical physics of proton beams; management of ocular melanoma, proton beams in ocular oncology; radiotherapy in macular degeneration; radiotherapy and the eye; treatment of chordomas and other CNS tumors; British experience in combined surgery and proton therapy for chordomas; French and European developments in proton therapy; referral of UK proton therapy patients; costs of proton therapy.

For more information contact Andrzej Kacaperek (andrzejk@ccotrust.co.uk), or the B. I. R., 36 Portland Place, London W1N 4AT. Tel: +44 171 307 1429; Fax: +44 171 307 1414; e-mail: admin@bir.org.uk

PTCOG Information/News/Reports:

The following reports and articles were received by July 1999.

Report on the Beam Scanning Workshop, April 12 1999, Cape Town, South Africa

During the first day of the PTCOG XXX meeting in Cape Town a dedicated workshop on aspects of the scanning beam technique was organized as a parallel session. This workshop was a follow-up of the one organized prior to PTCOG XXVIII in Rancho Mirage, April 1998. Then about 25 people discussed different aspects of scanning beams (see Dan Jones, Particles 22 July 1998) and they decided that some special topics should be addressed by small groups at future meetings. The intention of the Cape Town workshop was chosen to be focussed on dosimetry and those who had shown their interest were invited to prepare a contribution to the workshop, which could be discussed in a "round table" format. In several ways the workshop turned out to be different from these plans. First of all, the topics were not confined to dosimetry, but also more general talks on beam scanning were given and it became clear that especially the tutorial aspects were appreciated. During the workshop 9 contributions were presented but since about 80 people attended the workshop, the round table could not be used. However, due to the informal character of the meeting, the details revealed by the authors and the ample time per contribution, lively discussions took place and different points of view could be expressed clearly. In most contributions answers were given on specific questions raised by the organizers. Below I will briefly list the topics of the contributions and add some remarks.

General beam-scanning topics dealt with:

1. **Biological effects due to high dose rates (Chu)**
   In a scanning beam the instantaneous dose rate in some voxels can be several orders of magnitude larger than in a scattered beam. Effects from biology, chemistry, physics and dosimetry were discussed. No serious effects were reported, but the dosimetry and control system require extra attention.
2. **Analysis of scanning techniques (Holy)**
   The quality of the dose distribution of a scanning system has been investigated as a function of the ripple in beam intensity and the spot size. The limits of an acceptable working regime were explored.
3. **Pencil beam scanning methods developed by IBA (Marchand and Jongen)**
   The size and theoretical penumbras of pencil beams were discussed. The method to accomplish the necessary speed and control was explained. The control loop is essentially a feed forward system which adapts the beam intensity from the ion source to the required dose rate during the scanning procedure.
4. **The scanning system developed in Uppsala (Lorin and Tilly)**
   The Uppsala scanning head consists of 2 orthogonally oriented scanning magnets, where the second magnet moves mechanically with the beam as deflected by the first magnet. The steering and control system, the performance of this system and the relevant dosimetry procedures were explained.
5. **Requirements on beam energy and intensity (Miller on behalf of Coutrakon)**
   The effect of energy variations, lateral positioning errors and beam intensity fluctuations on the depth-dose uniformity were analyzed.
6. **A review of scanning methods (Kawachi)**
   A historic overview of different scanning techniques was discussed and the current developments at NIRS were presented.

Contributions mainly dealing with dosimetry were:

1. **Review of different dosimetry approaches (Schippers)**
   To obtain the shape and (absolute) magnitude of the dose distribution in a patient or a phantom, 3 different approaches can be distinguished:
   a) *Direct measurement*: (multiple) dose measurements with ion chamber(s) in a phantom. The thus obtained 3D dose matrix is compared to a pre-calculated treatment plan.
   b) *Indirect measurement*: In the nozzle measurements are performed of the beam energy (or range), the lateral position of the pencil beam and the shape of the pencil beam. From these measurements one calculates how the dose distribution looks like and makes a comparison with the treatment plan.
   c) *Derived measurement*: Measurements are performed in a phantom, but the measuring device has a response which depends for instance on dose rate, or beam energy (eg. film, scintillating screen, PET). One does not obtain a 3D dose matrix but rather a 3D signal matrix. The response of the detector is folded into the treatment planning and this outcome is then compared to the measured signal matrix.
2. **Experience and procedures concerning dosimetry at GSI (Haberer)**
   A detailed overview of the equipment and techniques for absolute as well as relative dosimetry as used at GSI was given. "Indirect" measurements are performed with multiwire chambers and a stack of parallel plate ion chambers, sandwiched between plastic sheets. Also the contribution of a PET system to the verification of the dose distribution was discussed. An analysis was given of on-line checks (e.g. interlock thresholds) and the optimum number of measurement points in a 3D dose distribution.
3. **The scanning system developed in Uppsala (Lorin and Tilly)**
   The dosimetry system consists of ion chambers equipped with segmented foils to obtain on-line verification of the lateral beam position. For phantom dosimetry a pixel chamber is developed. It is interesting to note that the Uppsala group has chosen to perform the monitor unit measurement before the last element (the range modulator) in the nozzle. This is also the case at the PSI setup, but at GSI one has chosen to have no beam modifying elements down stream of the last beam monitors. In a discussion it became clear that both methods have their pro's and con's.
4. **Developments around the Magic-Cube (Schippers on behalf of Cirio)**
   The Magic cube consists of a stack of 10 parallel plate ion chambers, equipped with strip anodes for information in the transversal direction, and sandwiched between plastic sheets to obtain depth information. A simpler version, which has no lateral position sensitivity is installed at GSI and it works as an "indirect" analyzer of the dose distribution Also the recent developments with pixel chambers (64 pixels and one with 1024 pixels) were presented.
5. **A scintillating screen as 2D dosimeter (Schippers)**
   The properties of a scintillating screen observed by a CCD camera were briefly summarised and its sensitivity was demonstrated. Examples were shown of its application in inhomogeneous dose distributions created with scanning beams as well as its application in irradiations with small fields. The small decrease of sensitivity in the Bragg peak region can be taken into account if the screen is used in a "derived measurement" mode.

Some general conclusions were:

1. Only "indirect" or "derived" measurements are never sufficient for reliable measurements of a 3D dose distribution.
2. There is no single technique for dosimetry and in a protocol complementary techniques must be used.

3. On-line checks during dose delivery are necessary. At least one should monitor the beam position and the dose per voxel. Preferably one should monitor the beam shape and the beam energy (or range).
   Interrupt thresholds are system (e.g. scanning speed, accelerator) dependent.
4. The minimum number of points where the dose must be measured depends on the shape of the dose distribution, but a typical number of 30 seems reasonable (GSI).
5. When one adds phantom-dose measurements from several incident beam directions, one should be careful in the comparison with treatment plans, since the range difference between phantom and patient may distort the result.
6. In all existing or planned scanning systems (except the PSI system), there is a strong coupling between the scanning procedure and the accelerator. This indicates that it is very difficult to regard/design a scanning system as a separate entity in the nozzle, working independent from the accelerator.
7. The specific properties of each accelerator type and local circumstances do not allow to design the "best scanning system" which is suitable for use at any facility.

At the workshop no decision was made if and how to continue with the working group on scanning beams. The organizers have the impression that sessions focussed on detailed contributions on special topics are suitable for future PTCOG meetings. We are open to any comment or suggestion (send to Jones@nac.ac.za or Schippers@kvi.nl).

For those who are interested, a copy of the transparencies can be obtained by sending an email to me. I would like to thank Bill Chu and Dan Jones for their help with this workshop. *Marco Schippers, Kernfysisch Verneller Instituut, 9747 AA Groningen, the Netherlands.*

Proton dosimetry intercomparison based on the ICRU Report 59 protocol

S. Vatnitsky[1], M. Moyer[1], D. Miller[1], G. Abell[1], J. M.Slater[1], E.Pedroni[2], A. Coray[2], Mazal[3], W. Newhauser[4], O. Jaekel[5], J. Heese[6], A. Fukumura[7], Y. Futami[7], L. Verhey[8], I. Daftari[8], E. Grusell[9], A. Molokanov[10], and C. Bloch[11].[1]Loma Linda University Medical Center, Loma Linda, CA, USA, [2]Paul Scherrer Institute, Villigen, Switzerland, [3]Proton Therapy Center of Orsay, Orsay, France, [4]North-East Proton Therapy Center, Boston, MA, USA, [5]German Cancer Research Center, Heidelberg, Germany, [6]Hahn-Meitner Institute, Berlin, [7]National Institute of Radiological Sciences, Chiba, Japan, [8]University California-San Francisco, San Francisco, CA, USA, [9]Uppsala University Hospital/ The Svedberg Laboratory, Uppsala, Sweden, [10]Joint Institute for Nuclear Research, Dubna, Russia, [11]Indiana University , Proton Radiation Center, Bloomington, IN, USA.

The full paper is published in Radiotherapy and Oncology, V. 51, 1999

Abstract: *Background and purpose*. A new protocol for calibration of proton beams was established by the ICRU in Report 59 on proton dosimetry. In this paper we report the results of an international proton dosimetry intercomparison, which was held at Loma Linda University Medical Center. The goals of the intercomparison were, first, to estimate the level of consistency in absorbed dose delivered to patients if proton beams at various clinics were calibrated with the new ICRU protocol, and second, to evaluate the differences in absorbed dose determination due to differences in ^{60}Co-based ionization chamber calibration factors.
Materials and methods. Eleven institutions participated in the intercomparison. Measurements were performed in a polystyrene at a depth of 10.27 cm water equivalent thickness in a 6-cm modulated proton beam with an incident energy of 135 MeV. Most participants used ionization chambers calibrated in terms of exposure or air kerma. Four ionization chambers had ^{60}Co -based calibration in terms of

absorbed dose-to-water. Two chambers were calibrated in a ^{60}Co beam at the NIST both in terms of air kerma and absorbed dose-to-water to provide a comparison of ionization chambers with different calibrations.
Results. The intercomparison showed that use of the ICRU report 59 protocol would result in absorbed doses being delivered to patients at their participating institutions to within ±0.9 % (one standard deviation). The maximum difference between doses determined by the participants was found to be 2.9 %. Differences between proton doses derived from the measurements with ionization chambers with N_K -, or N_W – calibration type depended on chamber type.
Conclusions. Using ionization chambers with ^{60}Co calibration factors traceable to standard laboratories and the ICRU report 59 protocol, a distribution of stated proton absorbed dose is achieved with a difference less than 3 %. The ICRU protocol should be adopted for clinical proton beam calibration. A comparison of proton doses derived from measurements with different chambers indicates that the difference in results cannot be explained only by differences in ^{60}Co calibration factors. *S. Vatnitsky, Loma Linda University Medical Center, Loma Linda, CA, USA.*

News from the **Centre Antoine-Lacassagne's** Medical Cyclotron in **Nice, France**:

Since the opening of the facility in June 1991 to March 1999, 1300 patients were treated with the 65 MeV proton beam. 1150 presented with a malignant ocular pathology and 150 with an age-related macular degeneration. This last indication started in July 1997. From November 1993 to December 1995, 57 patients were treated with the neutron beam p(60)+Be. By the end of 1995, the central French health administration demanded the suspension of this activity on the pretext of an insufficient activity and decreasing of the costs. The energy savings were almost non-existent, but a general reorganization of the teams allowed to decrease the cost of proton treatments of 1/3 between 1996 and 1998. Protontherapy was therefore authorized for a new 7 years period (general rule for authorization of radiotherapy facilities in France). A formal request for a partial reopening of the neutrontherapy facility in the framework of a randomized clinical trial for locally advanced prostate cancers has been introduced. A physics activity was maintained on the neutron beam and the treatment room is always functional, waiting for the good news. Some aspects of the activity and results of protontherapy were presented during the PTCOG XXX in Capetown. *P.Chauvel, N.Iborra-Brassart, J.Hérault, Centre Antoine-Lacassagne – Cyclotron Médical, 227 avenue de la Lanterne 06200 Nice – France.*

News from the **Northeast Proton Therapy Center,** Boston, MA:

The Northeast Proton Therapy Center is a 3-room (2 gantries) proton beam treatment facility being built at the Massachusetts General Hospital in Boston, MA, USA. The planning and construction of the building was performed by the Bechtel Corporation (teamed with the architectural firm of Tsoi, Kobus and Associates and John Moriarty Associates, constructors). The proton therapy equipment was designed and is being built by Ion Beam Application s.a. in Louvain-la-Neuve, Belgium.

The building was essentially completed over two years ago, on schedule and within budget. It is a handsome facility that promises to support the intended functions very well. The proton therapy equipment is still under construction. The bulk of the hardware has been built and installed at the NPTC. Preliminary testing has been done which suggests that the facility will deliver high quality beam according to specifications. However, this testing has been undertaken with prototyping low-level software at the subsystem level. The development of the final control system software has proven to be a bigger and more complicated task than was originally appreciated and this has contributed to

significant delays in delivery of the final system and its testing. IBA has brought in a sub-contractor to help complete the software development. The schedule calls for the facility to be ready for acceptance testing in December of this year. After acceptance tests, the facility will go through intensive commissioning tests and first treatments are envisioned for May, 2000.

Meanwhile, several development efforts are underway at the Northeast Proton Therapy Center. These include: the development of a 3D scanner for beam characterization during testing and commissioning; the development of a device to rapidly check the beam-to-patient pointing accuracy; the investigation of optimal aperture and compensator geometries; and, with IBA, studies directed towards the development of beam scanning – which is the pre-requisite for delivering intensity-modulated proton therapy.

Treatments at the Harvard Cyclotron Laboratory will continue until the Northeast Proton Therapy Center opens. Then, the MGH's treatment program will be transferred to the NPTC over the next two or three months. Janet Sisterson has already transferred from the HCL to the MGH, and we hope and expect that several of the HCL staff will do likewise as the new facility gets underway. *Michael Goitein, Northeast Proton Therapy Center, Massachusetts General Hospital, 30 Fruit Street, Boston, MA 02114.*

News from the **Proton Medical Research Center, Tsukuba, Japan**:

Proton Medical Research Center, University of Tsukuba has been performing proton therapy in KEK, High Energy Accelerator Research Organization in Japan, using the booster synchrotron since 1983. During the period, we mainly focused our study on deep-seated tumors like liver cancers and esophageal cancers with promising results. The study was made possible based on the respiration-gated irradiation technique developed in our facility. Since we share the beam with other physics experimental groups, time allocated for therapy is limited to about 120 days per year and three hours per day. Under such conditions, we treated only about fifty to sixty patients per year at maximum. Therefore we planned to build a new facility dedicated to proton therapy and related researches. After a long-term period of promotion, National Government finally permitted us to build such a facility inside the University campus in 1997.

In 1998, a 250 MeV proton synchrotron (maximum capacity is 270 MeV) has been manufactured by Hitachi Co. Ltd. In 1999, building construction started in February. And the other equipment like a beam line, two rotating gantries for therapy, two fixed-beam ports for basic researches, a control system, a treatment planning system, a database system, medical equipment (CT, MRI, X-ray simulator), a radiation protection and safety system, is under construction. The building is a 4-story one built on the ground. The total gross area is about 5100 square meters. The level of the beam line is 1.25m above the second floor level. The building will be connected to the existing building of University Hospital. The building construction will be completed in February 2000.

The accelerator is a slow-cycling, strong-focusing proton synchrotron with a 7MeV LINAC (3MeV RFQ + 7MeV DTL) as an injector. The injector is tested in the factory. We use an untuned RF cavity to accelerate the beam. It becomes a compact one by using a Finemet core with excellent high-frequency characteristics. We adopt a diffusive RF knockout method for beam extraction to obtain a stable beam. This method of beam extraction enables the fast beam off within several hundred microseconds. The beam line magnets are made of laminated core in order to enable the energy scanning by accelerator in the future. Since the nozzle design is optimized for proton therapy of deep-seated tumors in the abdominal and thorax regions, we adopt a double scattering method using the first scatterer and the dual-ring second scatterer, which is a well-established method of obtaining a stable beam distribution. The nozzle can be upgraded to make the beam scanning possible in the future.

The maximum usable irradiation field is a circular region of 20cm in diameter. The maximum covered depth will be 32 g/cm^2. Ten steps of accelerator energies will be used in the early stage to cover

the wide depth region. In the future, we'd like to extract the beam with patient-specific energy. The dose rate of more than 2 Gy/min will be obtained for all targets. We'll try to pre-trigger the accelerator by the respiration signal of patient in the case of respiration-gated irradiation. Upon request, the accelerator starts to accelerate the beam and waits for the gate signal from the respiration signal processing system, by which beam extraction starts.

Two sets of X-ray source and X-ray I.I. are mounted on each gantry structure for precise alignment of patients. The one is in the nozzle and the other is placed perpendicular to the one. By the arrangement, we can make nearly simultaneous exposure of X-ray for precise alignment. The X-ray I.I.s are connected with DR (Digital Radiography) system.

The installation is scheduled to be completed until March 2000. After tuning of equipment and beam test, we hope that we will be able to start patient treatment in early 2001. *Yoshihisa Takada, Ph.D., Proton Medical Research Center, University of Tsukuba, 1-1-1 Tennoudai, Tsukuba-shi, Japan.*

News from the **Clatterbridge Centre for Oncology, UK:**

As well as continuing with regular ocular melanoma work, the randomised trial of proton treatment (against no treatment) of age-related macular degeneration (ARMD) will continue until further notice. This trial started in Dec. 1997 in collaboration with the St Paul's Eye Unit in Liverpool. The treatment is given in four fractions using a prescribed of 18 Gy based on previous experience with choroidal haemangiomas. Circular fields are used based on the lesion diameter and a 3mm margin. The patient eye is positioned using a simple field light technique which avoids the anterior eye. The patients are recruited in the UK north-west health region and are followed at 3 monthly intervals with fundus fluorescein angiography and visual acuity checks.

The Clatterbridge Centre for Oncology, which includes the proton radiotherapy, has been granted ISO 9001 status since last year. Amongst other things, this provides for the systematic documentation of proton treatment and cyclotron procedures, and the recording of all patient treatment data. The aim of this quality assurance programme is to provide consistency, security and transparency in patient treatment and other procedures.

During the spring, the Daresbury Laboratory at Warrington, collaborated with the Unit, in assessing the suitability of using the present 62 MeV cyclotron as an injector to a proton linac 'booster'. The beam emittances in both planes were at or better than expected values of about 2-3 mm-mrad and the energy spread appeared very good at better than 0.1% (rms). Also, beam pulsing by a combination of RF phase and amplitude modulation was demonstrated although the limits in pulse width and frequency have yet to be determined. The work was presented at the EPAC'98 meeting in Stockholm.

The Unit hosted two dosimetric intercomparisons with two Italian groups, the Catania group (CATANA eye therapy project) and the TERA group from Milan. The second visit involved a three-way Faraday cup intercomparison as well as a variety of ion chambers. Results will be presented at a future PTCOG meeting.

The Unit participated in a four-way dosimetric intercomparison hosted by OPTIS, with the Italian groups, at the Paul Scherrer Institute where the emphasis was on comparing the dosimetry of flat, parallel-plate ion chambers.

The Unit has established scientific contact with the Bratislava group (Slovakia) with the aim of sharing expertise in cyclotron running and preparation for proton eye therapy. This is being administered by the British Council for the IAEA. The first visitor on placement has just started a 6-month stay.

There is now a web page for Clatterbridge; see the URL given in the list on page 1 of this newsletter. *Andrzej Kacperek PhD, Douglas Cyclotron Unit, Clatterbridge Centre for Oncology, Bebington, Wirral, L63 4JY, UK.*

Another venerable old machine – A short history of the **role of the EMI CT scanner** in Proton Therapy:

As we approach the beginning of a new era for proton therapy in Boston Massachusetts, one workhorse for proton radiation (the 160 MeV Harvard Cyclotron) will be more than fifty years old and ready for retirement from patient treatments. At the same time another critical tool for treatment using fixed horizontal particle beams, the EMI 7070/H CT Body Scanner, will move on from its Harvard home.

The EMI 7070 has been used for planning particle treatment since 1978. At 22 years it is a mere youngster compared to the Harvard Cyclotron (circa 1949), but it is probably the oldest CT scanner on the planet which continues to operate. It is certainly the only one capable of scanning a seated or standing patient by virtue of its gantry, which pivots ninety degrees.

In the late seventies Massachusetts General Hospital, Lawrence Berkeley Laboratory, and Los Alamos each acquired an EMI 7070 for their particle therapy programs. These scanners have been integral in the accurate delivery of charged particle beams to over 1500 patients.

MGH and LBL had their scanners adapted to allow the scanning of vertical patients. The one now at Harvard has been well traveled, from its manufacture in England, it moved to Berkeley and has been at Harvard for six years. Upgrades and newer x-ray sources keep it working at a usable level of .75 mm resolution with high contrast. The other EMI scanners are history now.

The Harvard scanner has been kept running for this long with the environmental support some of us remember from 1970 style mainframe computers, chilled rooms, raised floors, and stacks of disk drives. Also the care and feeding from the only remaining expert on such machines, Attila Antal, has been essential. No current manufacturer has offered a CT with a horizontal scan plane, and considering the alternatives of not treating with posterior or anterior beams, this machine remains essential for patient treatments.

Where will the EMI 7070 go when its work at Harvard is over? Do you want to own a piece of particle therapy history? Contact Attila Antal at 1.970.468.6859 or email attila_antal@csi.com for more details.*Stanley Rosenthal, Ph.D., Northeast Proton Therapy Center, Massachusetts General Hospital, Boston, MA.*

In Memoriam: Timothy R. Renner, 1950 - 1998

Timothy R. Renner of the Lawrence Berkeley National Laboratory, died November 17, 1998 at his home in Piedmont, California after a long battle against cancer. He was 48.

Tim was born in Weatherford, Texas, and grew up on the Caribbean Islands. He obtained his undergraduate degree in physics from the University of Texas at Austin, and received his doctorate from the University of Chicago in 1978, during which time he participated in experiments at the Argonne National Laboratory in Illinois and at Chalk River Laboratory in Canada. Tim was a postdoctoral fellow at State University of New York at Stony Brook. He continued his postdoctoral work in the Nuclear Sciences Division at Berkeley Lab, and then joined the Biomedical group at the Bevalac, where clinical trials were conducted on heavy-ion cancer therapy.

For more than ten years Tim worked to provide relativistic ion beams for cancer therapy at the Bevalac until its closure in 1993. Tim contributed greatly to successful clinical trials, in particular, in developing treatment control system, dosimetric detectors, and three-dimensional conformal therapy. Tim was responsible for daily operation of the therapy program at the Bevalac. He realized that the crucial part of the therapy system is a reliable control system to safeguard the patient safety. The control system report Tim produced (Renner, Nyman, and Singh, “Control Systems for Ion Beam Radiotherapy Facilities”, in *Ion Beam in Tumor Therapy*,

ed. Ute Linz, Chapman & Hall, London (1995), pp 256-265.) became the standard for the hadron therapy community. Tim also co-authored a comprehensive review article in the Reviews of Scientific Instrument on instrumentation for treatment of cancer using proton and light-Ion beams. The review is widely used by international hadron therapy centers, and Tim was especially happy to see the article translated into Japanese. Tim developed three-dimensional conformal therapy dose delivery (beam wobbling and scanning), and won two R&D-100 Awards for Berkeley Lab. Tim's reliable ionization chamber designs (patented) have been replicated for many particle therapy facilities worldwide.

In 1993 the Bevalac was closed, and abandoned with it was the Biomedical facility which was in many ways Tim's lifetime achievement. Soon after, it was decided to transfer the technology, that is, to build an eye treatment facility at the Crocker Nuclear Laboratory cyclotron at UC Davis. Tim led a team to complete the Davis facility, and as a result it became one of the most active proton eye treatment facilities in the world. Visitors to the Davis facility now would see a plaque proudly proclaiming that it is "The Timothy R. Renner Eye Treatment Facility".

From 1993 to weeks before his death, Tim was one of the team leaders of a project in the Berkeley Lab's Advanced Light Source. Under Tim's leadership, his team successfully created and built a system that reliably directs x rays to targets one-fiftieth the diameter of a human hair, a technique permitting future improvements in precise work dealing with microscopic-size structures. Tim's reputation was one of a creative scientist who with modesty and quiet enthusiasm could draw from all the needed facilities of the sprawling laboratory complex in the Berkeley hills, and stimulate loyalty and commitment among team members working with him.

Above all, Tim loved his family and spent frequent weekends and vacations backpacking with his family in Northern California and the Sierras. Tim is survived by his wife, Susie Renner; a son, Ian, a daughter, Zoe, and his mother, Paula Renner.

We at Berkeley Lab and many others known Tim around the world truly miss him.

--Bill Chu and Bernhard Ludewigt

Proposed NEW FACILITIES for PROTON & ION BEAM THERAPY - July 1999

INSTITUTION	PLACE	TYPE	1ST RX?	COMMENTS
INFN-LNS, Catania	Italy	p	1999	70 MeV; 1 room, fixed horiz. beam
NPTC (Harvard)	MA USA	p	2000	at MGH; 230 MeV cyclotron; 2 gantries + 2 horiz
Hyogo	Japan	p, ion	2001	2 gantries; 2 horiz; 1 vert; 1 45 deg;under construction
NAC, Faure	South Africa	p	2001	new treatment room with beam line 30° off vertical.
Tsukuba	Japan	p	2001	270 MeV;2 gantries;2 fixed (research);under construction
CGMH, Northern Taiwan	Taiwan	p	2001?	250MeV synchrotron or 230Mev cyclotron;3 gantry,1 fixed
Wakasa Bay	Japan		2002	multipurpose accelerator; building completed mid 1998
Bratislava	Slovakia	p, ion	2003	72 MeV cyclotron; p; ions; +BNCT, isot prod.
IMP, Lanzhou	PR China	C-Ar ion	2003	C-ion from 100MeV/u at HIRFL expand to 900 MeV/u at CSR; clin. treat; biol. research; no gantry; shifted patients
Shizuoka Cancer Center	Japan		2002?	synchrotron 230? MeV; 2 gantries; 1 horiz; funded.
Erlangen	Germany	p	2002?	4 treatment rooms, some with gantries.
CNAO, Milan & Pavia	Italy	p, ion	2004?	synchrotron; 2 gantry;1 fixed beam rooms;1 exp. room
AUSTRON	Austria	p, ion	?	2p gantry;1 ion gantry;1 fixed p;1 fixed ion;1 exp room
Beijing	China	p	?	250 MeV synchrotron.
Central Italy	Italy	p	?	cyclotron; 1 gantry; 1 fixed
Clatterbridge	England	p	?	upgrade using booster linear accelerator to 200 MeV?
TOP project ISS Rome	Italy	p	?	70 MeV linac; expand to 200 MeV?
3 projects in Moscow	Russia	p	?	including 320 MeV; compact, probably no gantry
Krakow	Poland	p	?	60 MeV proton beam.
Proton Development N.A. Inc.	IL USA	p	?	300 MeV protons; therapy & lithography

WORLD WIDE CHARGED PARTICLE PATIENT TOTALS

July 1999

WHO	WHERE	WHAT	DATE FIRST RX	DATE LAST RX	RECENT PATIENT TOTAL	DATE OF TOTAL
Berkeley 184	CA. USA	p	1954	— 1957	30	
Berkeley	CA. USA	He	1957	— 1992	2054	June-91
Uppsala	Sweden	p	1957	— 1976	73	
Harvard	MA. USA	p	1961		8160	Jun-99
Dubna	Russia	p	1967	— 1974	84	
Moscow	Russia	p	1969		3100	Dec-98
Los Alamos	NM. USA	π^-	1974	— 1982	230	
St. Petersburg	Russia	p	1975		1029	Jun-98
Berkeley	CA. USA	heavy ion	1975	— 1992	433	June-91
Chiba	Japan	p	1979		96	Oct-96
TRIUMF	Canada	π^-	1979	— 1994	367	Dec-93
PSI (SIN)	Switzerland	π^-	1980	— 1993	503	
PMRC, Tsukuba	Japan	p	1983		606	Mar-99
PSI (72 MeV)	Switzerland	p	1984		2753	Dec-98
Dubna	Russia	p	1987		41	Jun-99
Uppsala	Sweden	p	1989		147	Feb-98
Clatterbridge	England	p	1989		817	May-98
Loma Linda	CA. USA	p	1990		4330	May-99
Louvain-la-Neuve	Belgium	p	1991	– 1993	21	
Nice	France	p	1991		1350	Jun-99
Orsay	France	p	1991		1219	July-98
N.A.C.	South Africa	p	1993		310	May-99
MPRI	IN USA	p	1993		9	Dec-98
UCSF - CNL	CA USA	p	1994		214	Jun-99
HIMAC, Chiba	Japan	heavy ion	1994		473	Sept-98
TRIUMF	Canada	p	1995		47	Dec-98
PSI (200 MeV)	Switzerland	p	1996		20	Dec-98
G.S.I Darmstadt	Germany	heavy ion	1997		20	Dec-98
Berlin	Germany	p	1998		30	Dec-98
NCC, Kashiwa	Japan	p	1998		8	Jun-98
					1100	pions
					2980	ions
					24494	protons
				TOTAL	28574	all particles

The Proposed Facilities List is on the previous page.