PARTICLES

sponsored by

PROTON THERAPY CO-OPERATIVE GROUP

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

Number 14 July 1994 Editor: Janet Sisterson Ph.D., HCL

This is the **fourteenth** issue of Particles, a newsletter devoted to matters of interest to all those involved, or planning to become involved in proton, light or heavy ion and heavy charged particle radiation therapy.

Mailing Lists: PLEASE help to keep the Particles mailing list up-to-date by sending me address corrections. **To stay ON the mailing list you MUST send back the enclosed flyer**; to reduce costs, I need to remove all unwanted mailings.

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".

Gifts: I am very happy to acknowledge the very generous gift from Varian Associates which will be used to help cover the expenses for this issue of Particles.

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-dated information.

ARTICLES FOR PARTICLES 15

The deadline for news for Particles 15 is November 30 1994, for the January 1995 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 the text into the computer, but cut-and-paste the figures. If you FAX me an article, please indicate if a clean copy is in the mail. If I only get a single-spaced FAX copy, you may get typos! I think I can scan a double-spaced copy. As far as I am concerned, the very best way to receive an article is by using e-mail as then I only have to down-load it from the VAX to my MAC; I would like to see more people make use of this method.

FUTURE PTCOG MEETINGS

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

PTCOG XXI	Japan	November 14-16 1994	
PTCOG XXII	San Francisco, CA, USA	probably May 1-3 1995	possibly 8-11 May 1995
PTCOG XXIII	South Africa	probably October 15-17 1995	
PTCOG XXIV	North America	Spring 1996	

If you wish **to join 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 XX; November 14-16 1994 Chiba, Japan.

PTCOG XXI will be hosted by the Research Center of Charged Particle Therapy, National Institute of Radiological Sciences and will be held in the Institute, Chiba, Japan. NIRS will organize the meeting as "International Seminar on the Application of Heavy Ion Accelerator to Radiation Therapy of Cancer" in cooperation with the International Atomic Energy Agency.

Registration forms for the conference and hotel accommodation are included in this mailing.

PTCOG XXI (Chiba) Secretariat:-

Dr. Kiyomitsu Kawachi (Chair) Dr. Eiichi Takada (Secretary)
Accelerator Physics & Engineering Division
NIRS
4-9-1 Anagawa, Inage-ku, Chiba-shi 263
Japan

Telephone (from abroad): +81-43-251-2111 ext 610
or +81-43-256-0122 Direct
Telefax : +81-43-287-0417 or +81-43-251-1840
E-mail: ptcog21@nirs.go.jp or takada@uexs32.nirs.go.jp (Internet)

Registration
Registration will take place at the conference site on Monday 14 November from 8:30 am.

The registration fee is set at ¥15,000 (fifteen thousand yen), which includes box lunch on Monday 14 and Tuesday 15 November; a banquet on the evening of Tuesday 15; and a visit and buffet reception at HIMAC on Monday 14. Guests are welcome but will be charged for the banquet.

The registration fee is collected at the registration desk. It is payable in cash, Japanese currency, Yen, only. Sorry, no cheques, no credit cards.

Hotel Information
Block bookings have been reserved at hotels listed below. Although JR railway connects the nearest stations between the Institute and the hotels in 5 minutes or so, you would experience well-known 'rush' crowd. Shuttle bus will be arranged to commute.

You must make your own reservation at the hotel by Monday October 17 in order to reserve a room in the PTCOG block. When booking a room, mention the PTCOG XXI meeting: Please fill the accommodation form and send it by mail or fax.

All hotels are priced per night and include a breakfast. The hotels are:

Hotel Sun-Garden Chiba
1-11-1 Chuo, Chuo-ku
Chiba
Tel: +81-43-224-1131
Fax: +81-43-224-1156
Room rate ¥11,300 single
¥18,540 twin
c/o Ms. Hoshi

Sankei City Hotel Chiba
3-9-5 Chuo, Chuo-ku
Chiba
Tel: +81-43-227-3330
Fax: +81-43-227-2873
Room rate ¥7,000 single
¥11,800 twin
c/o Mr. Shiina

A map of the city and other information will be available with the next flyer/circular.

Flights
Narita (New Tokyo) airport is the best port to come to Chiba. JR Trains leave about once an hour from the underground floor of the airport. (Do not take Narita EXpress, which serves more frequently but goes directly to Tokyo without a stop in Chiba area!)
A Taxi fare will be about ¥8,000 to ¥10,000 (per cab) from the airport to these hotels. It will take 50-60 minutes.
A limousine bus service is also available, again about once an hour. It costs ¥1,200 from the airport to Chiba-Chuo Station, and takes 75 minutes.

Please find whether you need a visa to come to Japan and apply for it promptly if you need one.

Preliminary Agenda

Since HIMAC will have started clinical trial this summer, we would like to focus on the following topics in the seminar.

- Beam Quality Assurance at the commissioning phase -
  --What is to be done in the beginning stage of new facility, and how ? --
    including various aspects such as from accelerator performance to
    organizational problems of national 'network' of doctors..

- Biological study of heavy charged particles as a basis of particle radiation therapy -
  --How do we determine RBE value of heavy ion ? --
    in light of recent experience of proton RBE value
  --What RBE is relevant to therapy ? --
  --What is the characteristic feature of high LET radiation ? --

- Clinical (and biological) Problems of heavy ion therapy -
  --Volume effect of biological response--
    How does it affect 3D Treatment Planning, patient immobilization etc..
  --Dose fractionation--
    What should be taken into account ? and Why ?

These are among the most relevant themes of our efforts in the last few months. Another important agenda is dosimetry intercomparison and standardization, suitable for the seminar that IAEA takes part. We encourage contributions addressing these topics.

Of course, it does not exclude other topics. In fact, sessions will be organized in the following categories:

-HIMAC, the new facility at NIRS, how it comes to reality and starts therapy	(Castro*, Kawachi)
-Biology especially of high LET	(Blakeley*, Ando)
-Facilities/On-going projects	(Smith*, Inada)
-Treatment Planning, 3D/Conformal	(Kacperek*, Endo)
-Beam Delivery/Quality/Dosimetry	(Renner*, Kanai)
-Clinical Results, Protocols	(Slater*, Tsujii)

Suggestions and ideas from other groups and centers would be appreciated. The names in parentheses show coordinators who organize a session (*: to be confirmed). It is planned to leave sufficient time for discussion.

Proceedings

Speakers are invited and strongly encouraged to submit a contribution paper in a photo-ready form. The contribution will be published as a Proceedings book either in a special issue of a Journal or in a NIRS publication.

Presentation
Both slide projectors and overhead Projectors are available. Computer Graphics can be projected directly from your data files via computer network. (Contact secretariat for arrangements beforehand.)There will be a space for limited number of poster presentation.

Social Events
Events for accompanied persons will be announced later. Downtown Tokyo is about one-hour ride on JR local/rapid train from Chiba. History museum, botanical garden and others (including Tokyo Disney Land) are also located in Greater Chiba city area. A one-day post-conference tour to Tsukuba area on Thursday 17 is being planned. Itinerary will include;

- visit to proton-therapy facility of Tsukuba University at KEK (National Laboratory for High-Energy Physics)
- visit to Mt. Tsukuba or Ushiku wine cellar
- visit to Kasama shrine and pottery place (if time allows.)

Additional fee may be charged for transportation.

PTCOG News

The following reports were received by June 1994.

News from **NAC, South Africa**

Up to 31 May 1994, 24 patients had been treated on the NAC's horizontal beam proton therapy facility. Of these, 9 had undergone SOBP irradiations and 15 plateau crossfire treatments. Conditions which have been treated include brain metastases, meningiomas, AVMs, acoustic neuromas and skull-base tumours. Treatment volumes ranged from 1.6 to 43 cm^3 and treatments were given in 1 to 4 fractions with 1 to 5 fields per fraction. Proton therapy takes place at present on Fridays only, but Monday is being considered as an additional proton treatment day. The stereophoto- grammetric patient positioning system is working most satisfactorily. A coaxial x-ray tube has recently been installed and is routinely used for treatment field verification. Shaped collimators made from cast cerrobend, and wax compensators to correct for oblique incidence in SOBP treatments, are now being used. The VOXELPLAN treatment planning system from DKFZ, Heidelberg has been installed at NAC together with the Royal Marsden Hospital's proton therapy package. With these systems it is hoped that more sophisticated treatment planning can be done in the future.

Dosimetric and radiobiological intercomparisons were undertaken at NAC during November 1993. Groups from PRMC, Japan and UCL, Belgium as well as NAC participated. The dosimetry results were in good agreement while the final radiobiology data are still awaited. Initial results of the mouse jejunum crypt cell assay indicate an RBE of 1.1 in the plateau and 1.2 at the distal edge of the SOBP.

Neutron therapy is still given on Tuesdays, Wednesdays and Thursdays and continues to flourish: to date a total of 596 patients have been treated on this facility. *Dan Jones, National Accelerator Centre, P.O. Box 72, Faure, South Africa.*

Beginning of the commissioning of the 200 MeV proton therapy facility at **PSI**

The installation of the isocentric gantry at PSI is almost complete. The first beam was transmitted through the gantry on the 25 of April 1994. We are now in the phase of installing the devices for beam scanning and will start to test the mechanics of the gantry in a few weeks from now. We hope to be able to perform some treatments on veterinary patients already this summer, before the start of the winter shut-down of the PSI accelerator. First treatments of human patients are scheduled for the beginning of 1995. *E. Pedroni, Medical Division Paul Scherrer Institute, Villigen PSI, Switzerland.*

News from the **Northeast Proton Therapy Center, Massachusetts General Hospital,USA**

The Northeast Proton Therapy Center (NPTC) will be built on the Massachusetts General Hospital campus. The current schedule calls for the commissioning of the proton therapy equipment to be completed on July 1, 1998, and for patient treatments to begin immediately thereafter. Funds for the NPTC, which are being shared between MGH and the National Cancer Institute, have been secured and the major contracts have been signed.

Bechtel Corporation will be the design/build contractor. Bechtel, providing total project management services and construction management, is teamed with Tsoi/Kobus & Associates, Architect; McNamara/Salvia, Inc., Structural Engineer; McPhail Associates, Geotechnical Engineer; and John Moriarty & Associates, Construction Contractor. Bechtel will build a two-level facility, one underground, having three treatment rooms, at least one and probably two with gantries and the others being equipped with fixed beams and capable of gantry installation.

IBA (teamed with General Atomics and the University of Louvain) was selected as the equipment vendor. IBA will deliver a high-field, room temperature cyclotron proton accelerator which will produce 235 MeV protons with a continuous beam intensity of up to 300 nanoamps. The maximum energy corresponds to a depth range of about 34 g/cm^2 in the absence of absorbing or lateral beam spreading elements in the beam line. If passive scattering methodology is used to achieve a 25 cm x 25 cm field size, the depth of penetration would be about 28 g/cm^2. In addition to a passive beam spreading system, IBA will build a beam wobbling system to achieve large treatment fields. Using the wobbler, a penetration of 32 g/cm^2 can be achieved for a field size of 25 cm x 25 cm. A variable energy degrader will be integrated with the cyclotron which will allow energy changes from 235 MeV down to 70 MeV in a few seconds.

General Atomics will construct the beam lines, gantries and patient positioners. The gantries will be conventional in design. The patient positioners will be designed to meet the particular needs and precision requirements of proton therapy. The isocentric gantries will have a 360 degree rotational capability with beam delivery elements designed to bend the proton beam achromatically while allowing for different focusing conditions. The flexibility in focusing conditions will accommodate both passive beam spreading and pencil beam scanning. The beam lines and gantries will accommodate rapid energy changes and switching among treatment rooms.

The beam delivery nozzles will be designed by the Cyclotron Research Center of the University of Louvain in collaboration with their proton therapy group and members of the Harvard Cyclotron Laboratory and will be manufactured by IBA. The design will be based on the beam spreading technology developed by Gottschalk et al. at the Harvard Cyclotron Laboratory. The nozzle will contain

an XY sweeping magnet, appropriate for beam wobbling. The transition to raster scanning will be straightforward.

The NPTC is expected to treat 400 patients during the first year. This patient load is planned to increase to 750 by the fifth year and 1000 by the tenth year of operation. New clinical research protocols for the NPTC are being written and a transition plan for moving the clinical operations from the Harvard Cyclotron to the NPTC is being formulated. *Stan Durlacher, Jay Flanz, Michael Goitein, Anne Levine, John Munzenrider, Al Smith, Herman Suit, Susan Woods, Northeast Proton Therapy Center, Massachusetts General Hospital, Boston MA 02114.*

News from the proton therapy facility at **TRIUMF**, Canada

The development of the eye facility is proceeding according to plan but is several months behind schedule. As of June 1994, we are at the point of the installation of the treatment chair, assembly of the therapy control hardware and the final writing of the therapy control software.

At the TRIUMF cyclotron, proton therapy has to share the machine with different users at different times that require different cyclotron operating configurations. Preliminary tests indicate that some particular tunes have significant deleterious effects on the quality and stabilities of the proton beam extracted for therapy. However, it was also demonstrated that for good tunes, the beam delivery and dosimetry can be reproducible to 1% for a duration of at least a week, which is the expected length of one session of our monthly proton treatment.

We have now completed the determination of all the beam parameters required for the treatment plan EYE obtained from Clatterbridge, and are studying in more detail other beam parameters that the treatment planning program EYE does not handle, such as (i) uniformity of the SOBP in terms of effective dose, (ii) variation of the physical penumbra with depth with and without wedges and (iii) variation of entrance dose profiles with size of collimator.

In treatment planning, a modified code has been developed such that for a given tumor configuration, the average doses to all the 12 normal structures are calculated for all the possible fixation angles (using a grid of 5 degrees in polar and 30 degrees in azimuthal angles). For each fixation angle, a sub-code is used to design, if necessary and possible, the position and angle of a wedge to reduce the dose to the macula or the optic disc if they are adjacent to the tumor. These dose-angle maps are then merged together by appropriate weighting to form a single map to facilitate the final selection of fixation angles.

We also have a program of radiobiological measurements on the proton beam in order to provide some radiobiological inputs to the treatment planning for the present eye therapy program and for the proposed large field facility. Most of these radiobiological measurements use the techniques that were developed for the pion therapy program at TRIUMF. It is expected that an “in-house” determination of RBEs would provide a more meaningful measure of the “effective dose” quoted for our proton treatments. The first set of such measurements in March 1994 indicates that the RBE may be increasing slightly over the SOBP with a mean value of 1.2±0.1. These results are, indeed, very similar to those observed on our pion beam. If these preliminary results are confirmed by further measurements, the RBE information will be incorporated into our range modulation schemes to provide uniform effective doses instead of the present uniform physical dose. *G. Lam, S. Atkins, E. Blackmore, S. Chavez, K. Gardey, E. El-Khatib, M. Nicolic, U. Oelfke, K. Paton, T. Pickles, J. Rootman, L. Skarsgard and J. Vincent, TRIUMF, University of British Columbia, Vancouver, Canada.*

News from the **Centre de Protontherapie d'Orsay (CPO), France**

We are treating more than 150 eye patients per year, making a total of 400 at the end of May 1994. The ophthalmological line has been adapted to be used at full energy (200 MeV) and medium fields (Ø ≤10 cm). In last December, we performed the first treatment of a patient with an intracranial target.

At this time, we finished a "three years trial period", with positive results and the project has been officially authorized to continue operating as a public hospital.

Next developments include technical improvements to speed up the eye treatments, and software of two treatment planning systems. Treatments of base of the skull tumors are planned for the end of 1994.

In 1995, in parallel with the eye and intracranial program, we shall develop a second treatment room (treatments with a fixed horizontal line in 1996). Plans for a gantry are under discussion. *Ale Mazal & Jean-Louis Habrand for the CPO staff, CPO, Centre Universitaire, Bâtiment 101, 91400 Orsay, France*

Start of treatments at **UC Davis,** California:

A proton eye treatment facility has recently been completed at the 76 inch cyclotron at the Crocker Nuclear Laboratory on the campus of the University of California, Davis. This cyclotron, originally built by E.O. Lawrence in 1937 was used by Dr. Stone for the early neutron radiotherapy trials at Lawrence Berkeley Laboratory. It was also used to produce some of the heavy, short lived nuclei, like Seaborgium, which was recently named. The cyclotron was moved to Davis in the early 70's and converted to an isochronous cyclotron, with a maximum energy of 68.5 MeV protons. It also is being used for heavy ion physics research at UCD.

The eye treatment facility was built by Tim Renner from LBL in collaboration with Mark Nyman (control system) , R.P. Singh and Mario Cepeda. The beam line elements were mostly from the Helium Ion beamline at the Bevelac.

With the variable water absorber in place, the maximum penetration of the proton beam is 30 mm. The field is flat to within ± 3% over 3 cm and ± 5% over 5 cm diameter. Modulator wheels have been constructed out of plastic using diode depth dose scans as the source of calculation data. The treatment dose rate has been set to be 600 cGy/min, using less than 1% of the maximum beam intensity of the cyclotron. The facility is being operated by the Dept. of Radiation Oncology at the University of California, San Francisco. Lynn Verhey and Paula Petti are planning the patients, Dr. Joe Castro is the physician in charge, Dr. Devron Char is the Ophthalmologist and Inder Daftari from UCDMC is performing the daily treatment operations and routine beam dosimetry.

As of June 30, 4 patients have been treated. The treatment protocol calls for 4800 cGy in 4 fractions given over 4 days. Approximately 15 treatment weeks will be used during the first year of operation, treating a total of approximately 40 - 50 patients. *Lynn Verhey, Department of Radiation Oncology, UCSF, L-25, Box 0226, San Francisco, CA 941443-0226.*

In Memorium

Jacob I. Fabrikant, 1928-1993

When Dr. Jacob I. Fabrikant passed away in his home on 3 May of last year after a lengthy illness, it marked the end of a long and distinguished career in radiological sciences. Jack received his M.D. in 1956 from McGill University and his Ph.D. in Biophysics in 1964 from the University of London. After residency training in Surgery, Pathology and Radiology, he joined the Radiology faculty at Johns Hopkins University in 1964. Subsequently, he was appointed as Professor and Chairman of the Department of Radiology at the University of Connecticut (1970) and McGill University (1975). In 1978, he came to Berkeley as Senior Scientist at Lawrence Berkeley Laboratory (LBL) and as Professor of Radiology at the University of California, San Francisco and Berkeley.

It is for his work at LBL with helium-ion radiosurgery that Jack will best be remembered by many of the readers of Particles. His initial efforts at LBL's Donner Laboratory were directed to the radiosurgical treatment of pituitary adenomas. In 1980, Jack established LBL's program for helium-ion Bragg-peak radiosurgery of arteriovenous malformations of the brain. Prior to 1987, this program and Dr. Kjellberg's at the Harvard Cyclotron Laboratory were the only stereotactic radiosurgery programs in North America.

Jack's many and varied scientific efforts have been documented by more than 300 publications spanning nearly 40 years. In addition to his research with therapeutic charged-particle irradiation, Jack was internationally recognized for his work on radiation effects on populations. He served on numerous commissions, including ICRP, NCRP, and National Academy of Sciences committees. He chaired the NAS radon-effects report on the Biological Effects of Ionizing Radiation and the President's Commission on the Health Effects of the Accident at Three Mile Island.

Jack was a warm, energetic and refined gentleman. He will be missed by his many friends, professional colleagues and former students.

R. P. Levy, Donner Pavilion, Lawrence Berkeley Laboratory, University of California, Berkeley California.

WORLD WIDE CHARGED PARTICLE PATIENT TOTALS

July 1 1994.

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		6138	June-94
Dubna	Russia	p	1967	— 1974	84	
Moscow	Russia	p	1969		2550	Oct-92
Los Alamos	NM. U.S.A.	π-	1974	— 1982	230	
St. Petersburg	Russia	p	1975		891	June-94
Berkeley	CA. U.S.A.	heavy ion	1975	— 1992	433	June-91
Chiba	Japan	p	1979		86	June-93
TRIUMF	Canada	π-	1979		314	June-93
PSI (SIN)	Switzerland	π-	1980	— 1993	503	June-93
PMRC, Tsukuba	Japan	p	1983		393	Mar-94
PSI (SIN)	Switzerland	p	1984		1574	Dec-93
Dubna	Russia	p	1987		31	Apr-94
Uppsala	Sweden	p	1989		34	May-93
Clatterbridge	England	p	1989		513	May-94
Loma Linda	CA. U.S.A	p	1990		805	Feb-94
Louvain-la-Neuve	Belgium	p	1991		21	Nov-93
Nice	France	p	1991		338	Dec-93
Orsay	France	p	1991		402	May-94
N.A.C.	South Africa	p	1993		6	Nov-93
Indiana Cyclotron	IN USA	p	1993		1	Dec-93
UC Davis	CA U.S.A	p	1994		4	June-94
					1047	pion beams
					2487	ion beams
					13974	proton beams
				TOTAL	17508	all particle beams

Proposed NEW FACILITIES for PROTON & ION BEAM Therapy

July 1994

INSTITUTION	PLACE	TYPE	1ST RX?	COMMENTS
P.S.I	Switzerland	p	1994	200 MeV, var. energy, gantry, dedicated line
HIMAC, Chiba	Japan	ion	1994	first ion beams extracted December 1993.
TRIUMF	Canada	p	1994	adapt existing proton beams for therapy use.
Berlin	Germany	p	1995	72 MeV cyclotron; eye treatment beam line.
Munich	Germany	p	1995?	64 MeV protons; eye treatments
G.S.I Darmstadt	Germany	ion	1996	new cave for treatment has been designed.
ITEP Moscow	Russia	p	1996	3 horiz., 1 fix beams, 2 gantry, 1 exp., H- accel.
Jülich (KFA)	Germany	p	1997	Plans for a proton therapy beam line at COSY.
KVI Groningen	The Netherlands	p	1997?	plan:- 200 MeV accel.; 2 rms; 1 gantry; 1 fix.
NPTC (Harvard)	MA U.S.A.	p	1998	new facility to be built at MGH
NC Star	NC U.S.A.	p	1999?	synchrotron; 70-300 MeV; 2 horiz; 1 gantry
TERA	Italy	ion	2000?	H- accel;60-250 MeV p; +BNCT; isotope prod.
Novosibirsk	Russia	p	?	180 - 200 MeV linear accelerator
Proton Development N.A.	IL U.S.A	p	?	250 MeV accelerator; private facility.
Clatterbridge	England	p	?	upgrade using booster linear accelerator.
Tsukuba	Japan	p	?	230 MeV ; 2 rms; 2 vert+1 h beam; 2 vert.
Krakow	Poland	p	?	60 MeV proton beam.