PARTICLES

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

Number 15 January 1995 Editor: Janet Sisterson Ph.D., HCL

Mailing Lists: PLEASE help to keep the Particles mailing list up-to-date by sending me address corrections. **IF you received one, you MUST send back the enclosed flyer to stay ON the mailing list** ; to reduce costs, I need to remove all unwanted mailings. I thank everyone - nearly 400 of you - who returned their forms already.

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 gifts from Philip Livdahl and GMW 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.

Particles on the Internet: There have been many requests for an on-line version of Particles. I hope to be able to set up a Home Page on World Wide Web. If I have time this will happen in 1995. Particles will then be available on-line; this will include all the text and tables and all good quality diagrams or pictures which are sent to me as part of 'news' articles. If you can help me in this, let me know.

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. If you are willing to help me in this, let me know.

ARTICLES FOR PARTICLES 16

The **deadline for news for Particles 16 is May 30 1995**, for the July 1995 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. 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.

FUTURE PTCOG MEETINGS

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

PTCOG XXII	San Francisco, CA, USA	April 24-26 1995
PTCOG XXIII	Capetown South Africa	October 17-19 1995
PTCOG XXIV	North America	Spring 1996
PTCOG XXV	PSI, Switzerland	Fall 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 XXII: April 24-26 1995
San Francisco, California USA.

The University of California-San Francisco and Varian Oncology Systems are pleased to jointly sponsor the PTCOG XXII Meeting scheduled for April 24-26, 1995 at the Sheraton Hotel on Fisherman's Wharf in San Francisco, California.

Registration Information : Registration fee for this meeting is $160 (US dollars) This amount covers the cost of some of the lunches and the Monday Evening Banquet. The daily registration fee - $50. The cost of the Monday Evening Banquet at the Maritime Museum for daily registration participants and guests is $55 per person. The registration information packet will be sent out in January. If you have not received a packet by the end of January, please contact Jan Roth by fax at 415/ 424-8617 or by e-mail at jan.roth@VKN.VARIAN.COM.

Hotel Registration Information: Reservations must be received by **March 3, 1995,** to qualify for the special meeting rate at these hotels.

Meeting Site
Sheraton at Fisherman's Wharf
2500 Mason Street at Beach St.
San Francisco, CA 94133
Rate: $115 single/double room

Backup Hotel
Travelodge Hotel at Fisherman's Wharf
250 Beach Street
San Francisco, CA 94133
Rate: $65 single/double room

PTCOG XXII Presentation Information: The meeting will center around three special focus sessions which will be about 4 hours in length. The first focus session will concentrate on comparative treatment planning of nasopharynx tumors - both proton and conformal x-ray techniques. The second session will discuss proton dosimetry and radiobiology and the third will concentrate on new developments in proton beam delivery systems. There will also be two 'short paper' sessions on general proton topics and a poster session for presentations which are best presented visually. If you wish to make a presentation at this meeting, please contact Lynn Verhey at Univ. of California-San Francisco, Dept. of Radiation Oncology, San Francisco, CA 94143-0226 or by e-mail at verhey@radonc4.ucsf.edu. It is possible that some suggestions will not be able to be accommodated. Deadline for submission of presentations is **March 15th.**

PTCOG XXII Program: Please plan to arrive Sunday evening, the conference begins with a Welcome Reception at 6:30 pm at the Sheraton Hotel. You may also register on-site at this time. The program begins on Monday at 8:30 am and has been organized to provide a full day of stimulating discussion in a forum format, finishing up with the banquet that is scheduled for 6:30 -10:00pm. On Tuesday afternoon, buses will depart for the Univ. of California in Davis at 4:00pm for a tour and reception. On Wednesday, the meeting adjourns at 3:00pm.

We look forward to seeing you in April!

PTCOG XXIII; October 17-19 1995 Capetown, 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. Cyclotrons '95 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 completely independently and are being held at different venues.

PTCOG XXIII will be held at the Ritz Protea Hotel, 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 (US$56), double: R219 (US$62). Alternative accommodation will also be offered to delegates. Cyclotrons '95 is being held at the Cape Sun Hotel in downtown Cape Town which is about 5 km from the Ritz Protea Hotel. It is recommended that delegates attending both meetings move to the Ritz Protea Hotel 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 21.3C and an average minimum temperature of 10.4C. Cape Town can be reached easily by flights from many major cities on all continents on South African Airways 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.

Full particulars of PTCOG XXIII with registration and hotel reservation forms and information on tours will be sent out in May 1995.

For further information on PTCOG XXIII or Cyclotrons '95 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 Tourist office or:

Talk Travel
P O Box 6878
Roggebaai
8012 SOUTH AFRICA

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

Report from PTCOG XXI; November 14-16 1994 Chiba, Japan.

PTCOG XXI was a very interesting meeting with many short presentations covering radiobiology, dosimetry, new facilities and clinical results, for both proton therapy and where appropriate, heavy ions. It was the first time that Japan had hosted a PTCOG meeting and I was pleased that so many of our Japanese colleagues took the opportunity to tell us about their projects. Each evening there was a magnificent social event which did give ample time to discuss the daily sessions. I think that our Japanese colleagues have set a standard for the evening social programs that all subsequent PTCOG meetings will find hard to beat.

PTCOG meetings: an historical minute

This list of all the PTCOG meetings was compiled by Michael Goitein and presented at PTCOG XXI, Chiba, Japan.

PTCOG	a.k.a	Date	Location	
	Fermilab I	1/23/85	Batavia IL	USA
	Fermilab II	8/22/85	Batavia IL	USA
I	PTCOG formation	9/18/85	Boston MA	USA
II	first technical mtg.	10/24/85	St Louis MO	USA
III	Fermilab III	1/22/86	Batavia IL	USA
IV	Fermilab IV	6/26/86	Batavia IL	USA
V	LBL I; Int. Wkshp	12/1/86	Berkeley CA	USA
VI	Fermilab V	4/13/87	Batavia IL	USA
VII	Loma Linda I	10/12/87	Loma Linda CA	USA
-	workshop at LBL	1/19/88	Berkeley CA	USA
VIII	Vancouver I	4/7/88	Vancouver BC	Canada
IX	MGH/HCL I	9/29/88	Cambridge MA	USA
X	Fermilab VI	4/3/89	Batavia IL	USA
XI	PSI I	9/18/89	Villigen	Switzerland
XII	Loma Linda II	5/6/90	Loma Linda CA	USA
XIII	LBL II	11/1/90	Berkeley CA	USA
XIV	MGH/HCL II	5/21/91	Cambridge MA	USA
XV	GSI I	9/23/91	Darmstadt	Germany
XVI	Vancouver II	3/30/92	Vancouver BC	Canada
XVII	Loma Linda III	10/26/92	Loma Linda CA	USA
XVIII	first split mtg.	4/16/93	Orsay and Nice	France
XIX	MGH/HCL III	10/31/93	Cambridge MA	USA
XX	Clatterbridge I	5/16/94	Chester	England
XXI	HIMAC I	11/14/94	Chiba	Japan
XXII		4/24/95	San Francisco	USA
XXIII	NAC I	10/17/95	Capetown	South Africa

An Historical Perspective: Extracts from **"Radiological Use of Fast Protons"**
Robert R. Wilson
published in Radiology 47, 487-491 (1947).

Nearly 50 years ago, this paper suggested proton beams could be used to advantage in radiation therapy. These extracts from the paper let us share the vision of R. R. Wilson.

"These properties make it possible to irradiate intensely a strictly localized region within the body, with little skin dose. It will be easy to produce well collimated narrow beams of fast protons, and since the end of range of the beam is easily controllable, precision exposure of well defined small volumes within the body will soon be feasible"

"It will be simple to collimate proton beams to less than 1.0 mm. diameter or so or to expand them to cover any area uniformly"

"First, the energy loss of the proton is a statistical effect due essentially to the production of ions along its path; hence, not all protons of the same energy will stop at the same distance beneath the skin. This effect is called range straggling and is easy to calculate. The results of such calculations can be summarized by saying that the longitudinal width in which most protons come to rest is about 1 per cent of the initial range"

"A second effect is due to the many small angle scatterings of the proton as it passes the nuclei of the atoms of the tissue. This is called multiple scattering, and its effect is to spread the end of the beam out transversely. It is also easy to calculate, and it turns out that the transverse width which an infinitely narrow starting beam would have at the end of its range is about 5 per cent of the initial range. Both effects are small, but they do indicate the limitations of precision available"

"A third effect is that due to the nuclear absorption and scattering of the protons. The exact behavior of protons in nuclear reactions at such high energies as considered here must be determined by experiments to be carried out in the future.....In any case, the probability of a proton impinging on a nucleus after traveling 10 cm. in tissue will be about 25 per cent"

"A similar effect is that due to elastic scattering of the protons by nuclei. The probability of this type of scattering is essentially the same as that of absorption. In this case, however, the proton is not stopped but continues at the same energy but in a different direction. The effect, then, is to diffuse by about 20 to 40 per cent of the beam. For fairly broad beams this would not be noticeable because such scattering will be predominately forward.
The above should be the principal effects, and we see that our original picture of a proton beam proceeding without spreading until it is stopped at high-specific ionization in the tissue is only slightly modified. It will be possible to treat a volume as small as 0.1 c.c. anywhere in the body and to give that volume several times the dose of any of the neighboring tissue. The exact behavior of protons of the energy considered here will become known only when such protons are available for experiment.
In treating large tumors for example, one will want to cover the whole volume with the very high ionization density which obtains over the last few millimeters. This can easily be accomplished by interposing a rotating wheel of variable thickness, corresponding to the tumor thickness, between the source and the patient.

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PTCOG News: The following reports were received by December 1994.

News from **Clatterbridge, UK** and **Nice, France**: PROBLEMS ENCOUNTERED DURING EYE TREATMENT PLANNING AND MODIFICATIONS NEEDED IN 'EYEPLAN':

In the past few years, the EYEPLAN planning program, initially set-up in Boston and further modified at PSI-Villigen and Clatterbridge, gave the possibility of performing ocular protontherapy in quite a satisfactory manner. Some developments have been added allowing a better representation of structures such as eyelids, but other problems remain unresolved which are of great importance for eye modelling. One of these is the impossibility of representing irregular or asymmetric eyes which could lead to a false anatomical representation and consequently to a erroneous calculation of range, modulation and dose distribution. In addition, the general shape of the tumour is sometimes more artistic than accurate. It would be of great interest to incorporate into the EYEPLAN program fundus views, CT scan and MRI images obtained after Ta clip insertion, thus benefiting from the ocular anatomical information available from the CT and tumour information from both the fundus photographs and MRI.

Some of these possibilities exist in the plaque dosimetry program of Astrahan and have demonstrated their effectiveness. If protontherapy wishes to maintain its position in the field it is necessary to enhance the reliability of the treatment planning programs. This evolution would be hard to manage solely in Clatterbridge or would take too much time. One suggestion would be for all the facilities involved in ocular protontherapy to pool some financial resources in order to fund some software support to elaborate this newer version of EYEPLAN which would be written to function on either VAX or PC and/or Macintosh computers.

Please contact us if you are interested in this development and proposal. *P. Chauvel*[*], *M Sheen*[†] *and A Kacperek*[†], **Centre Antoine-Lacassagne, Bio-medical Cyclotron, 227 Avenue de la Lanterne, Nice 06200, France.*[†]*Douglas Cyclotron Unit, Clatterbridge Centre for Oncology, Bebington, Wirral L63 4JY, UK.*

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

The basis of this project is a joint proposal of Radiology and DKFZ, both at Heidelberg and GSI Darmstadt submitted to the German government in May 1993.
The major difference between this and all other particle therapies is the active scanning of a carbon beam using an intensity controlled rasterscan and energy variation from the accelerator to perform a tumor conform beam delivery. After the design phase in 1993 the medical cave has been constructed early this year including a beam dump for test experiments. The beam line to the cave has been completed in its magnetic components. Presently the vacuum pipes and the beam line in the cave are under construction. The first beam in the medical cave is expected for Spring 1995. Fast and position sensitive transmission detectors and a PET system as proposed for an on line beam control are in preparation. Prototypes of multiwire chambers have been tested successfully and the PET system has been assembled and will be also tested in the beginning of next year. The components of the rasterscan system for patient treatment have been ordered and all physical components for beam delivery and control are expected to be available in the mid of next year when testing of the complete system will start.

Using magnetic scanning the physical and radiobiological properties of the beam have to be known very precisely. Therefore fragmentation measurements of all relevant therapy beams from carbon to neon have been performed as well as precision measurements of Bragg curves before the decision in favor of a carbon beam was made. Calculations of beam fragmentation are confirmed by those measurements and used for treatment planning.

For the biological beam characterization, cell experiments have been performed with carbon ions at various energies with and without nuclear fragmentation. The result of these experiments are compared to calculations on the basis of a novel parameter free model. Good agreement has been found. The biological and the physical beam characterization are now used to produce volumes of isodose or biological isoeffect of arbitrary shape. These experiments with high energetic ions are paralleled with the incorporation of a particle module into the existing treatment planning system 'Voxelplan' of the DKFZ. From the progress of the technical equipment the start of patient treatment in 1996 seems to be possible. *Gerhard Kraft, Biophysik GSI, Plankstr. 1, P.O. Box 552, Darmstadt D 6100, Germany.*

Developments at the **Indiana University Proton Radiation Center:**

Our last report (Particles 13) described the first patient treated with protons at Indiana University (IU). Over a year after being treated for anaplastic astrocytoma the patient continues to do well. This patient had been experiencing seizures as frequently as 12 times per month. At his last examination, that frequency was down to 3-5 per month. The patient is otherwise asymptomatic.

Near the end of June, the Food and Drug Administration approved the IU proton therapy investigational device exemption (IDE), however treatments have not resumed. Our intent is not to continue such treatments until such time as we can establish a sound clinical program. Toward that end we commissioned an independent panel to visit our facility and write a report of their recommendations. The distinguished committee (Drs. J. Cox of M.D. Anderson, committee chair, P. Grigsby of Mallinckrodt, J. Dicello of Clarkson, J. Tepper of Univ. of N. Carolina, T. Lawrence of Univ. of Michigan, and G. Harsh of Massachusetts General Hospital) visited us Sept. 25-26, and should provide their report soon.

We are also investigating other ways to make contributions to proton therapy, and toward that end have recently participated in 2 proton dosimetry inter-comparisons. We were pleased to have Ken Gall (of Mass. General Hospital) here to do an ion chamber inter-comparison. Very good agreement was obtained between these exposure-based dosimetry measurements. More recently Dmitri Nichiporov (from ITEP in Moscow, but working this past summer at the National Institute of Standards and Technology here in the U.S.) brought alanine dosimeters here (and we were equally pleased to have him). The alanine results agree quite well with our exposure-based dosimetry, and I am sure Dmitri will be making more detailed results available soon.

Our newest effort is in the area of radiobiology. Eleanor Carter (an undergraduate from Amherst College) was here for the summer as part of the Research Experience for Undergraduates (REU) program at the IU Cyclotron Facility. Eleanor did a preliminary investigation into the effects of radiation on xenopus embryos. Her work sparked the interest of two Indiana University biologists (George Malacinski and Tony Neff) who served as Eleanor's supervisors and have studied xenopus for a number of years. They are determined to continue the study which Eleanor started, and have been assisted by Andy Bacher, a member of the IU physics department. In addition, two other IU biologists, Susan Klein and Mimi Zolan from IU's Institute for Molecular & Cellular Biology, have begun other preliminary radiobiology investigations. *Charles Bloch, Indiana University Cyclotron Facility, 2401 Milo B. Sampson Lane, Bloomington, IN 47408-0768, USA.*

News from **Tygerberg, South Africa:**

The Tygerberg Teaching Hospital helps to manage patients at the National Accelerator Centre. These patients include suitable patients referred to the Tygerberg Radiation Oncology Unit, as well as some patients referred from other oncology centres in the RSA to facilitate treatment.

Tygerberg co-operates fully with developmental work on "Voxelplan" of DKFZ but has also acquired a dedicated Bragg Peak Planning System. Presently a 2D system for neurosurgical use is being upgraded to a 3D system and will be co-developed with Voxelplan. The system is called "Proteus".

It has many good graphical features, and is very fast. Isodoses have been checked against measured beams transversing a phantom. *Ben Smit, Department of Radiation Oncology, Faculty of Medicine, University of Stellenbosch, P. O. Box 19063, Tygerberg, 7505, Republic of South Africa.*

Proposed NEW FACILITIES for PROTON & ION BEAM THERAPY
January 1995

INSTITUTION	PLACE	TYPE	1ST RX?	COMMENTS
P.S.I	Switzerland	p	1995	200 MeV, var. energy, gantry, dedicated line
TRIUMF	Canada	p	1995	adapt existing proton beams for therapy use.
Berlin	Germany	p	1995	72 MeV cyclotron; eye treatment beam line.
G.S.I Darmstadt	Germany	ion	1996	new cave for treatment has been designed.
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.
Kobe	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.
Munich	Germany	p	?	64 MeV protons; eye treatments
Tsukuba	Japan	p	?	230 MeV ; 2 rms; 1 vert+1 h beam; 1 gantry

WORLD WIDE CHARGED PARTICLE PATIENT TOTALS

January 1 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		6287	Jan-95
Dubna	Russia	p	1967	— 1974	84	
Moscow	Russia	p	1969		2782	Sept-94
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		314	June-93
PSI (SIN)	Switzerland	π-	1980	— 1993	503	
PMRC, Tsukuba	Japan	p	1983		414	July-94
PSI (SIN)	Switzerland	p	1984		1785	Dec-94
Dubna	Russia	p	1987		36	Nov-94
Uppsala	Sweden	p	1989		34	May-93
Clatterbridge	England	p	1989		570	Dec-94
Loma Linda	CA. U.S.A	p	1990		1100	Nov-94
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		54	Dec-94
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		3	Nov-94
					1047	pions
					2490	ions
					15220	protons
				TOTAL	18757	all particles

See Page 9
for
The Proposed New Facilities Table