PARTICLES

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

Number 19 January 1997 Editor: Janet Sisterson Ph.D., HCL

Mailing Lists: PLEASE help to keep the Particles mailing list up-to-date by sending me **address, telephone** number, **fax** number and **e-mail** additions/corrections.

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. HCL 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 "Harvard Cyclotron Laboratory".

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

Particles on the Internet: We have set up a home page for the Harvard Cyclotron Laboratory on the Internet from which you can access recent issues of Particles.

- To find Particles use the URL for the Harvard Cyclotron Laboratory:- http://neurosurgery.mgh.harvard.edu/hcl/

ARTICLES FOR PARTICLES 20

The **deadline for news for Particles 20,** the July 1997 issue, **is May 31 1997**. 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.

PTCOG and FUTURE PTCOG MEETINGS

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

Secretary: Janet Sisterson
Harvard Cyclotron Laboratory
44 Oxford Street
Cambridge MA 02138

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

PTCOG XXVI	Boston, Massachusetts USA	April 30 - May 2
PTCOG XXVII	Chiba, Japan	November 17 - 19 1997
PTCOG XXVIII	Loma Linda, CA USA	Spring 1998
PTCOG XXIX	Lake Maggiore, Italy	Fall 1998

PTCOG XXVI meeting in Boston, Massachusetts, USA
April 30 - May 2 1997

Details of this meeting are in a **SEPARATE** package in this mailing. Here are some facts:

- The registration fee will be <$200; we have not set it yet.
  If you send in the registration form by **March 10 1997**, we will reduce your registration fee by $25.
  Please pay using cash, a check in dollars on a US bank or travelers checks.

Address all questions to:

Mrs. Dawn Trenchard,
Dept. of Radiation Oncology,
Massachusetts General Hospital,
Boston, MA 02114.
fax; 617-724-9532;
e-mail; trenchard@hadron.mgh.harvard.edu.

- **Deadline** for hotel registration: **March 29 1997**. Contact the following hotels directly.

The rooms are reserved as the **PTCOG** group.

Holiday Inn Select
5 Blossom St.
Boston, MA 02114
TEL: (617) 742-7630
FAX: (617) 742-7804
Single and Double: $149.95

Royal Sonesta Hotel
5 Cambndge Parkway
Cambndge, MA 02142
TEL: (617) 491-3600
FAX: (617) 661 -5956
Single and Double: $149.00

Armed Services YMCA
150 Second Ave
Charlestown, MA 02129
TEL:(617) 241-8400
FAX: (617) 241 -2856
Double rooms only: $59.00

John Jeffries House
14 Embarkment Rd
Boston, MA 02114
TEL: (617) 367-1866
FAX: (617) 742-0313
Singles and Doubles: $75.00-$135.00

- **Deadline** for requests to present a paper or poster: **April 1 1997**.
  Send requests to Janet Sisterson; **E-MAIL** is best.

- **Session headings**: Northeast Proton Therapy Center; Measurement of 3D dose distributions; Analysis of the technology and cost of delivering proton therapy and the relationship of these to conventional photon therapy; evening at HCL; Clinical issues of dosimetry and radiobiology; Clinical trials, data base design, and proffered papers - clinical; Treatment planning intercomparisons - nasopharynx and proffered papers; PTCOG organizational meeting; Conference dinner; 2 sessions of proffered papers, both clinical and physics.

Abstracts for PTCOG XXVI in Boston

Authors are encouraged to submit an abstract of their talk, which will be published with the July 1997 issue of Particles. The ideal space allocated for each abstract is **ONE HALF** page; **PLEASE** try and keep to this length. **DO NOT EXCEED** one page. Please do not use a small typeface. Each abstract must have a title and a list of authors with addresses; graphs and line drawings are welcome.

6th Workshop on Heavy Charged Particles in Biology and Medicine
Baveno, Lago Maggiore, Italy
September 10 - 12 1997

The workshop will be organized by ISE of Baveno, Lago Maggiore, on September 10 12 1997, the week before the International Conference on Medical Physics in Nice, France.

It will be dedicated to the presentation and discussion of the new results of experiments and theory in particle radiation biology. The main topic will be the application of charged-particle beams like protons and heavy ions to tumor therapy. In addition, biological, biochemical and physical problems related to radiobiology using beams of heavy charged particles will be discussed.

For further information, please contact:

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WORLD CONGRESS ON MEDICAL PHYSICS AND BIOMEDICAL ENGINEERING
Nice, France, September 14 - 19 1997

From 14 - 19 September 1997, the **WORLD CONGRESS ON MEDICAL PHYSICS AND BIOMEDICAL ENGINEERING** will take place in Nice on the French Riveria. After Kyoto (1991) and Rio (1994), it will provide an unique opportunity for scientific exchanges and discussions on various topics of interest for all those involved in "Particle therapy".

Jean-Claude ROSENWALD
Co-chair for the Scientific Committee

For information about the meeting:
NICE' 97 - SEE
48, rue de la Procession
F75724 PARIS CEDEX 15, FRANCE
Phone: + 33 1 44 49 60 60
Fax: + 33 1 44 49 60 44

For Scientific contacts on
"protons, neutrons & heavy ions in radiotherapy"
Alejandro MAZAL
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91402 ORSAY CEDEX, FRANCE
Phone: + 33 1 69 29 87 00
Fax: + 33 1 69 07 55 00

PTCOG Meeting Reports: PSI and CERN. September 1996

The *Second International Symposium on Hadrontherapy* , was held in Switzerland partly at PSI - Villigen (9-11 September) and partly at CERN - Geneva (11-13 September). The first part was the 1996 fall PTCOG meeting. The Symposium was organized as a joint meeting of EHTG - European Heavy Particle Therapy Group, PTCOG - Proton Therapy Co-operative Group - and TERA - Foundation for Oncological Hadrontherapy - under the sponsorship of CERN, ICRUM and PSI. The second part of the Symposium, "*Advances in Hadrontherapy and its Techniques*", tackled recent developments - which are the background of technologies used on particle accelerators - and more general aspects of oncology and hadrontherapy along the lines of the *First International Symposium on Hadrontherapy*, held in Como (Italy) in October 1993.

The use of hadrons in medicine has come a long way and the presence at CERN of Bob Wilson, Fermilab's first director, who realised the potential of protons to kill cancer tumours 50 years ago, has given the opportunity to set an ideal bridge between past, present and future of hadrontherapy (R. Wilson: "A Paper of Fifty Years Ago: Radiological Use of Fast Protons" and, among the others, S. Dische: "Status and Future Directions of Tumour Therapy"; M. Goitein: "Technology of Hadrontherapy: A Review of the Existing Technologies, their Pluses and Minuses"). A global overview of the different working areas has been given by world experts in the various fields: from status and future directions of tumour therapy, with a review of past and existing hadrontherapy protocols and a deep insight into boron neutron capture therapy, (B. Larsson: "Boron Neutron Capture: A Review of the Zürich Meeting") to the role of radiobiology in hadrontherapy centres, using bioinformatics, networking and the recent developments in accelerators and detectors but giving always the central role to the human being and to the related ethical issues. (J. Bernier: "Clinical Trials and Ethical issues in Cancer Research").

Other talks were given by J. Castro " Clinical programmes: a review of past and existing hadrontherapy protocols, their results and future perspectives"; G. Kraft on "What radiobiology should be done in a hadrontherapy centre ?"; P. Zanella on "Advances in computing and trends in bioinformatics"; D. Sendall on "The invention of WWW and future developments in world-wide networks"; F. Sauli on the "Recent developments in radiation detectors"; G. Bachy on the "Advances in large and precise mechanical structures"; O. Ratib on the "Medical applications of computers and networks"; J. Yarnold on the "Impact of modern biology on clinical radiotherapy"; and A. Wambersie summarized the meeting in the "Concluding remarks".

During the Symposium, the presence at CERN of the travelling exhibition *Hadrons for Health* - set up for the first time last year by the TERA Foundation, Italy and CERN for the celebration of one hundred years of radiation physics, and appointed to make the tour of whole Europe - provided a successful and effective visual frame to the whole scientific event.

The proceedings are at present under preparation and will be published by Elsevier, Amsterdam, as was done for the *First International Symposium,* with contributions ranging from the biophysical and therapeutical to computing, measurement and treatment planning issues by around 50 contributors from all over the world, with the title "*Advances in Hadrontherapy*". This will be the second of a set of two volumes, the first of which entitled "*Advances in Boron Neutron Capture Therapy*", which contains the Proceedings of the BNCT Meeting held in Zürich from September 4th to 7th, 1996. *Ugo Amaldi, CERN, Geneva, CH-1211, Switzerland.*

PTCOG News/Reports:

The following reports were received by January 1997.

Hot news from **IBA**: the **Northeast Proton Therapy Center** equipment

The beam tests on the NPTC cyclotron are progressing well at IBA factory in Belgium. The maximum energy of 235 MeV was reached with the internal beam in late November. The beam was extracted in December and by early January 1997, a maximum current of 1200 nA had been extracted. This is four times the design goal of a 300 nA extracted beam.

At the same time, most of the beam transport magnets are completed at the Sigmaphi factory in France, while the major parts of the gantry are undergoing final machining. The first gantry assembly will take place late February in the Cockerill Mechanic Industries factory in Belgium. *Yves Jongen, Ion Beam Applications, Chemin du Cyclotron 2, Louvain-la-Neuve, B-1348, Belgium.*

News from the **PSI Proton Therapy** Program:

Looking back on 1996, one is tempted to start at the end, as we treated the first human patient on the PSI proton gantry in November 1996. This was the event we had been working for since some years, and we succeeded in a satisfying performance of the therapy. But to be reasonable, we should reveal the events of 1996 in the right order, which points out how our project developed in it's final phase before going into operation.

On January 30, 1996, PSI celebrated the official inauguration of the gantry with a lot of public relation, press, TV, guests and contributions from different speakers. Prof. Herman Suit and Prof. Michael Goitein gave presentations to the Proton Users Group at PSI during their assembly in the morning of that day as well as to the general audience during the official ceremony in the afternoon. This event had to take place early in 1996 for logistic reasons, though the facility was not yet ready for patient treatments. The next important date for the proton project was April, when the whole Life Science Department was audited. Amongst the different projects, proton therapy was judged to be of first priority for PSI's future activities. In June, experts from Berkeley, Boston and Darmstadt came for a safety review. It was the first safety review for the gantry project, and the outcome was not only an excellent and very detailed report with recommendations, but also an additional challenge for our group to improve the project as far as possible. Beside this we had also our own plans for technical developments which we wanted to complete before treating human patients. During summer and fall we worked on the recommended changes and refinements of hard- and software, in parallel we irradiated three animal patients (dogs with spontaneous nasal and brain tumors). In September we had the pleasure to host PTCOG XXV and to show the new facility to our interested guests.

The first human patient was referred in November by the University Clinic of Zurich for a boost treatment of a brain metastases from a malignant melanoma. A safe performance of the treatment, which had to be finished before the onset of the shutdown in December, was the main goal. The patient had had 46 Gy whole brain irradiation before, we boosted the visible lesion in the thalamus area with 4 x 2.5 CGE. The patient had a whole body mold and head fixation with a mask. Before each treatment we did a position check with orthogonal CT scout views and additional x-rays on the gantry. The clinical status of the patient improved during the treatment. He was dismissed from the nearby hospital in Brugg to his family, who takes very good care of him. A follow up CT of the brain is planned at the end of January.

The medical activities on the gantry will restart in April 1997 after the shutdown of the main PSI accelerator. *Gudrun Munkel, Division of Radiation Medicine, Paul Scherrer Institute, Villigen, CH-5232, Switzerland.*

News from the **National Accelerator Centre**, Faure, South Africa:

Up to 30 November 1996 a total of 880 patients had been treated in the neutron therapy programme (since September 1988), while 175 patients had been treated on the proton therapy facility (since September 1993), mainly for intracranial lesions.

The design of a multiblade post-collimator trimmer for neutron therapy is well advanced. This device should be installed early next year and will provide more flexible and convenient beam shaping. A new protocol for the treatment of advanced breast cancer with neutrons has recently been implemented while treatment in a new prostate protocol will begin next year.

A preliminary design study for fixed near-vertical (15 degree) and horizontal beam lines in an empty vault is in progress. Magnets and power supplies from a physics experiment which may be dismantled could be used, resulting in a significant cost saving.

The tenure of Prof Gerd Schmitt (University of Dusseldorf) as Consultant Radiation Oncologist has just ended. We are most grateful to him for the valuable contribution he has made to our clinical programme during the last 3 years.

NAC PROTON THERAPY PATIENTS
(all treatments fractionated)

DIAGNOSIS	**Up to 31 Dec 1995**	**Since 1 Jan 1996**	**Total**
AVM	28	12	40
Acoustic neuroma	14	10	24
Meningioma	15	6	21
Brain metastasis	14	1	15
Pituitary adenoma	13	6	19
Glioma (low grade)	5		5
Craniopharyngioma	4	1	5
Oropharyngeal ca.	2		2
Carcinoma of the orbit	1	5	6
Prostate ca. (boost)	2		2
Glioma (high grade)	2	3	5
Skull base ca.	3	5	8
Skull base sarcoma	1	2	3
Paranasal sinus ca.	2	3	5
Choroidal melanoma	1		1
Haemangiopericytoma	1	1	2
Paraspinal metastasis	2	1	3
Lachrymal sac carcinoma	1		1
Tongue -base carcinoma	1		1
Adenocarcinoma of nose	1		1
Adenocystic ca.of hard palate	1		1
Osteosarcoma		1	1
Rectal ca.		1	1
Haemangioblastoma	1	2	3
TOTALS	**115**	**60**	**175**

Dan Jones, National Accelerator Centre, P. O. Box 72, Faure 7131, South Africa.

FLUKA and GEANT: Real and Simulated Data Comparative Studies for Proton Energy Loss:

Various problems need to be solved using simulation codes in hadrontherapy; among these we direct our attention to dE/dx for low energy (lower than 1 MeV) and to detector dimensions. The simulation

codes used were originally designed for high energy physics experiments and it thus necessary to verify their behaviour at the energies of interest. Of these we consider GEANT and FLUKA. GEANT is a code developed at CERN in which one of the packages for describing hadronic showers is FLUKA. FLUKA is a stand alone code and only the parts dealing with hadronic interaction have been included in GEANT.; they do not usually represent the latest FLUKA developments. We also use the FLUKA standalone, in which the field of application has been extended for its use in hadrontherapy and it is still in development.

To obtain protons dE/dx we consider a pencil beam which interacts with a thin volume. The detector sections is (1 x 1) cm^2 and the thickness selected is 1/100th of the range for precise energy deposition. When this is not possible the lowest thickness selected is 1 x 10^{-3} cm which is the limit of GEANT stepping. For FLUKA there is no limitation for step choice. The materials with which the beam interacts are hydrogen, oxygen and lead as elements and air, water and equivalent tissue (A150) as compounds. The energy range goes from 10 keV to 1 MeV with small energy steps and from 1 MeV to 200 MeV with larger steps.

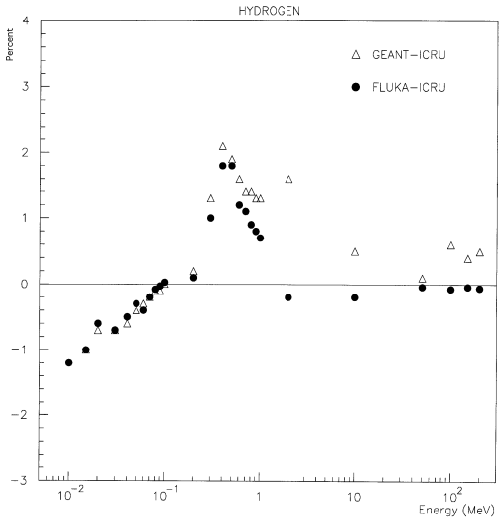

Figure 1.

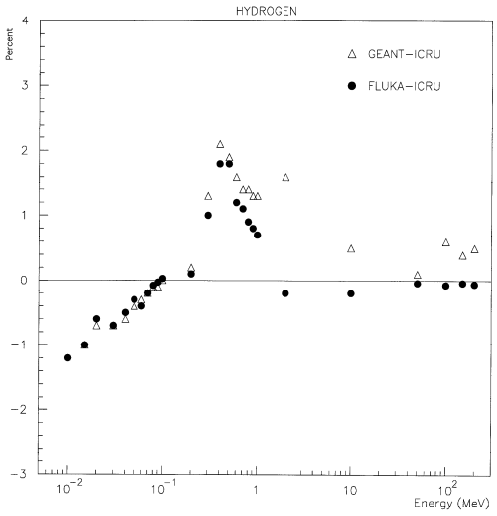

Figure 2.

Figure 1 shows the hydrogen percentage difference between the dE/dx values simulated with GEANT and FLUKA and the ones tabulated in ICRU. As can be seen, there is little difference between the results obtained with the two codes although the smaller difference with respect to the ICRU data is obtained using FLUKA. In Figure 2., where we show the results for equivalent tissue, an evident difference can be seen; until 800 keV only the FLUKA simulation is possible because the thickness selected is lower than the thickness limit accepted by GEANT. When GEANT is usable, FLUKA gives the better results.

The first approach to the use of simulation codes originally written for high energy physics leads us to the following results: the minimum detector width for FLUKA is 1 nm and 1 x 10^{-3} cm for GEANT. When the proton energy is below one MeV, however, the use of FLUKA is still very approximate and the conclusions we can reach must be considered with particular care. Even though our simulation framework is very simple, we know that simulating complex geometry is easier using GEANT. Using FLUKA, however, it is possible to score energy in a binning structure which is independent of the geometry simulated. *S. Garelli, S. Giordano and S. Squarcia, Dipartimento di Fisica e Sezione INFN di Genova, Italy.*

Proposed NEW FACILITIES for PROTON & ION BEAM THERAPY
July 1996

INSTITUTION	PLACE	TYPE	1ST RX?	COMMENTS
Berlin	Germany	p	1997	72 MeV cyclotron; eye treatment beam line.
G.S.I Darmstadt	Germany	ion	1997	First Carbon beam in the medical cave 7/6/95
KVI Groningen	The Netherlands	p	1998	plan:- 200 MeV accel.; 2 rms; 1 gantry; 1 fix.
NPTC (Harvard)	MA U.S.A.	p	1998	at MGH; 235 MeV cyclotron; 2 gantries + 3 horiz.
Kashiwa	Japan	p	1998	235MeV cyclotron;2gantries;1horiz; under construction
NC Star	NC U.S.A.	p	1999?	synchrotron; 70-300 MeV; 2 horiz; 1 gantry
Hyogo	Japan	ion	2000	protons & ion; 2 gantries; 1 horiz; 1 vert; 1 45 deg.
TERA	Italy	p, ion	2002?	H- accel; 60-250 MeV p; +BNCT; isotope prod.
AUSTRON	Austria	ion	?	protons and light ions.
Beijing	China	p	?	250 MeV synchrotron.
Central Italy	Italy	p	?	cyclotron; 1 gantry; 1 fixed
Clatterbridge	England	p	?	upgrade using booster linear accelerator.
ISS (Italian “NIH”)	Italy	p	?	200 MeV linac;1eye room; gantry?;under construction
ITEP Moscow	Russia	p	?	3 horiz.-1 fix beam, 2 gantry, 1 exp., H- accel.
Jülich (KFA)	Germany	p	?	exp. beam line; plans for therapy.
Krakow	Poland	p	?	60 MeV proton beam.
Kyoto	Japan	p	?	250 MeV synchrotron; gantry; 1 fixed horiz beam.
Proton Development N.A. Inc.	IL USA	p	?	300 MeV protons; therapy & lithography
PROTOX	England	p	2001?	existing RAL synchrotron; 250 MeV; 3 treat. gantry
Regensburg	Germany	p	?	gantry;1 fixed beam; 1 eye beam.

WORLD WIDE CHARGED PARTICLE PATIENT TOTALS

July 1996

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		6972	Dec-96
Dubna	Russia	p	1967	— 1974	84	
Moscow	Russia	p	1969		2838	May-96
Los Alamos	NM. U.S.A.	π-	1974	— 1982	230	
St. Petersburg	Russia	p	1975		969	Dec-95
Berkeley	CA. U.S.A.	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		462	July-95
PSI (72 MeV)	Switzerland	p	1984		2261	Dec-96
Dubna	Russia	p	1987		40	Nov-96
Uppsala	Sweden	p	1989		81	Mar-96
Clatterbridge	England	p	1989		698	June-96
Loma Linda	CA. U.S.A	p	1990		2000	July-96
Louvain-la-Neuve	Belgium	p	1991		21	Nov-93
Nice	France	p	1991		636	Nov-95
Orsay	France	p	1991		673	Nov-95
N.A.C.	South Africa	p	1993		175	Nov-96
IUCF	IN USA	p	1993		1	Dec-94
UCSF - CNL	CA U.S.A	p	1994		92	Nov-96
HIMAC, Chiba	Japan	heavy ion	1994		150	Aug-96
TRIUMF	Canada	p	1995		23	Dec-96
PSI (200 MeV)	Switzerland	p	1996		1	Dec-96

	1100	pions
	2637	ions
	18226	protons
TOTAL	21963	all particles

See Page 9
for
The Proposed New Facilities Table