PARTICLES

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PROTON THERAPY CO-OPERATIVE GROUP

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

Number 11 January 1993 Editor: Janet Sisterson Ph.D., HCL

This is the **eleventh** 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.

The mailing list now stands at ~500, of which ~ 60% is from the U.S.A.

I am happy to acknowledge the gift from GMW Associates, Menlo Park, California which will be used cover some of the direct cost of producing this issue of Particles.

I thank the organizers of both PTCOG XVII and XVI for contributing part of the registration fees for those meetings to help defray the costs. It is proposed to continue to include in the registration fee for PTCOG meetings a small fee to cover the costs of producing both Particles and the compilation of the abstracts from the PTCOG meeting. In addition, HCL is always happy to receive financial gifts to help cover the cost of producing Particles; all such gifts are deductible as charitable contributions for federal income tax purposes. The appropriate method is to send a check to me made out to the "Harvard Cyclotron Laboratory".

Facility and Patient Statistics: I am still collecting information about all facilities, both operating and proposed, regarding patient statistics, machine and treatment characteristics. I thank all of you who filled in and returned Questionnaires 1 and 2. To date, the data do not exist in any summarized form, but I would be happy to supply any information that you need. When I have enough replies (those of you who DIDN'T send Questionnaires 1 and 2 back will get them again!), I plan on summarizing the patient data in a future issue of Particles and then updating it each year.

Future e-mail and fax directories: While I do have e-mail addresses and fax numbers for many people, I don't have enough information to publish directories. However, please feel free to contact me for information.

ARTICLES FOR PARTICLES 11

The deadline for the next newsletter is May 31 1993, so that Particles 11 can come out in July 1993. 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 the text into the computer, but cut-and-paste the figures. If I only get a FAX copy, there may be typos! 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 XVIII	Nice and Orsay, France	April 15-18 1993
PTCOG XIX	maybe Boston, MA USA	Fall 1993
PTCOG XX	North America, but ? where	Spring 1994

As of January 1993, little information is available about the future schedule of PTCOG meetings. However, it should be noted that the general policy of PTCOG is to hold two meetings in North America for every one held elsewhere, so the Spring meeting in 1994 is likely to be held somewhere in the United States or Canada.

For further information about **PTCOG XVII** or 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 (714) 824-4378.

PTCOG XVIII; April 16-19 1993, Orsay - Nice France

The Centre de Proton thérapie d'Orsay and the Centre Antoine-Lacassagne are jointly organizing the next **PTCOG** meeting in France and thought that it could be relevant to take this opportunity to present these two new facilities to the member of the group. The meeting will start in Orsay, near Paris in order to facilitate the intercontinental arrivals, on Friday and Saturday and continue in Nice on Sunday and Monday. Aware of the potential touristic attraction of the two sites, it has been decided to let each one organize his own travel arrangements and transfer to Nice. We only need to know as soon as possible your participation, your arrival dates in each site, and your needs for hotel accommodation. For your information two direct transatlantic flights depart from Nice to Montréal (Air Canada) and New York (Delta Airlines).

PROVISIONAL PROGRAM

ORSAY	Friday April 16	Morning	"Future Directions"
		Afternoon	"Future Directions"
		Evening	*Synchrocyclotron visit*
ORSAY	Saturday April 17	Morning	Workshop on "Treatment Planning"
		Afternoon	*free*
NICE	Sunday April 18	*Morning*	*free*
		Afternoon	Workshop on "New technological developments"
		Evening	*Cyclotron visit and buffet*
NICE	Monday April 19	Morning	"Ophthalmology"
		Afternoon	"Controversies in the management of ocular melanomas"

Included on the **second to last page of Particles** is a REGISTRATION form. The organizers want your answer AS SOON AS POSSIBLE, if possible by fax.

Address all queries to:-

Dr. Pierre Chauvel, - Dr. Jean-Louis Habrand
PTCOG XVIII Local Organizing Committee Secretariat
Centre Antoine-Lacassagne, Biomedical Cyclotron
227 avenue de la Lanterne 06200 NICE FRANCE
Phone (33) 93 18 80 22 **Fax (33) 93 18 04 33**

Abstracts for PTCOG XVIII

More details will be available in future mailings but speakers are invited and encouraged to submit an abstract of their presentation. The abstract must include the title, authors and affiliation and not exceed 1/2 page in length.

PTCOG News

The following reports were received by December 1992.

News from the **Douglas Cyclotron Unit, Clatterbridge, UK:**

Introduction:

Since last April, the unit has been transferred from the Medical Research Council and is now administered by the Clatterbridge Centre for Oncology. One of the reasons for this was the recognition of proton eye therapy, by the Dept. of Health, as the treatment of choice for certain types of uveal melanoma. The need for clinical trials, comparing proton therapy with enucleation, was further diminished following the publication of the study by the Boston/HCL group (JM Seddon et al, 'Relative Survival Rates after Alternative Therapies for Uveal Melanoma', Ophthalmology, 97, 769-777, 1990).

In the past 3 years, 312 uveal melanoma patients have been treated as well as one case of a melanoma of the conjuctiva. Patients are referred from two centres in the UK:- Moorfields Eye Hospital in London, under J. Hungerford and the Western Infirmary in Glasgow, under B. Damato. Both centres perform surgery to attach the Ta markers which designate the tumour base and assist in patient positioning.

Progress on the proton linac booster

The design of the proton linac 'booster' by AEA Technology (Culham, UK) has completed the technical feasibility stage. A final proton beam energy of 200 MeV and beam current of 20 nA have now been specified for a 21 cm diameter beam.

Initial building plans envisaged that the 200 MeV beam would enter the existing proton eye-treatment room. Further reflection has shown that two separate additional treatment rooms would enable patients to be set-up and treated alternately. This would leave the existing eye therapy room unaffected by construction work in the short term and free for simulations during high-energy proton therapy. Beam changeover time is aimed to be 5 minutes.

Proton beam and dosimetry measurements

Recent proton beam dosimetry intercomparisons, using ionization chambers, with NAC (Faure) and the Svedborg Laboratory (Uppsala) yielded overall uncertainties of ±1.3% and ±0.7% respectively, in a spread-out Bragg distribution. However, significantly lower measurements were obtained on the Faraday cup. This was traced to higher proportion of scattered protons, by measurement with a proton spectrometer (NE102a plastic scintillator). This leads to the conclusion that at this centre at least, meaningful dose measurements with a Faraday cup should only be made in conjunction with proton spectrum measurements.

Preliminary results of the use of TLD-100 dosemeters in proton dosimetry have shown 'saturation' effects at relatively low-doses. Bragg peak measurements with TLD-100 have yielded slightly poorer results when compared with small diodes, but are significantly better when compared to film.

Radiobiology
RBE measurements have been performed in conjunction with Moorfields Eye Hospital and the Institute of Cancer Research using 3 melanoma cell-lines (2 ocular, VUP and OM431 and 1 cutaneous, HX34). The proton irradiations were performed in the spread out distribution and yielded RBE values of 1.18 to 1.3.

Further work was performed irradiating the HX34 and VUP cells in a fully modulated depth distribution. The Survival Fractions (at 4Gy) showed a marked decrease with depth. This may be related to increasing proton LET towards the end of the proton range. Microdosimetric measurements made at the positions of the cells showed increased averaged lineal energies from 3 kev/mm at the entrance and 7 kev/mm towards the end of the proton range.

Developments in eye therapy planning
A much improved version of the EYEPLAN program includes more realistic representations of the upper and lower eyelids. The rim of each lid is drawn on a beam's eye view, and its thickness modelled as:-

(a) a spherical shell of given thickness - "orange peel"
or
a straight surface in vertical cross-section - like a curtain, but of variable angle to the vertical -

with: (b) a rim of given thickness
or (c) a rim of arbitrary parabolic shape.

The eyelids are included in the range and dose calculations, and permit a more accurate estimation of the isodose distribution around the tumour. They are dependent on the accuracy of the eyelid measurement at patient simulation.

An example is shown in Fig. 1, with the upper lid modelled as (a) and the lower as (b).

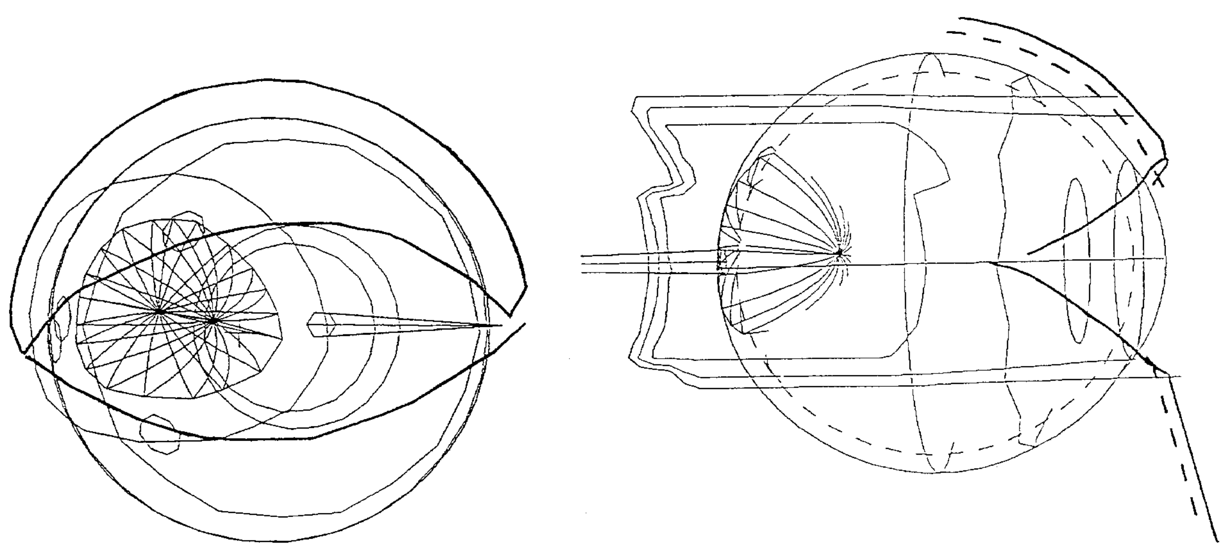

Fig. 1(a) Beam's eye view of upper and lower lid rims (eyelid structures emphasized)

Fig 1(b) Vertical cross section showing isodoses

A. Kacperek, M.A. Sheen, M.E. Butler, R.D. Errington, T.E. Saxton, Douglas Cyclotron Unit, Clatterbridge Centre for Oncology, Bebington, Wirral L63 4JY UK

News from **Joint Institute for Nuclear Research (JINR), Dubna** and **Cancer Research Center of Russian Academy of Medical Sciences, (CRC RAMS), Moscow, Russia:**

In 1992 the following progress of the method of rotation scanning irradiations of deeply located tumours was achieved. We treated two patients with impassable oesophagus tumours. In these cases we could not insert the miniature silicon detector for body's depth measurements inside the oesophagus. For the overlapping of the Bragg peak and tumour we used only calculations on the basis of X-ray tomographic images, measured in the same position in the same rotation chair immediately before irradiation run. Radiation therapy was carried out by the medical personnel from CRC RAMS and engineering personnel from JINR. Up to August 1992, 19 patients with cervix utery cancer and 5 patients with oesophagus cancer were treated. *V.M. Abazov, A.G. Molokanov, G.V. Mytsin, O.V. Savchenko, V.P. Zorin. Joint Institute for Nuclear Research, Laboratory of Nuclear Problems, Head Post Office, P.O. Box 79, Moscow, Russia. and B.V. Astrakhan, V.K. Poidenko. Cancer Research Center of Russian Academy of Medical Sciences, 115478, Kashirsckoe schosse, 24, Moscow, Russia.*

News from **Loma Linda University Medical Center, CA, USA:**

Proton radiation therapy, used alone or in conjunction with conventional irradiation, continues to advance at Loma Linda University Medical Center. As of December 1, 1992, 369 patients had completed their courses, 39 were undergoing daily treatment, and 33 other patients' cases were pending. Presently, personnel in the department of radiation medicine are administering proton-beam radiation therapy for patients who have melanomas and other tumors within the eye; many different forms of cancer affecting the brain and central nervous system; cancers of the head and neck; pelvic malignancies, including a large number of patients with adenocarcinoma of the prostate; and selected thoracic cancers. Men with prostate cancer have accounted for 49% of all patients receiving protons.

Developmental work continues. The clinical physics group is supplying conceptual input and clinical physics requirements for the enhanced beam-delivery system to be placed in the two new gantry treatment rooms, both of which are scheduled to open in 1993. A double scattering system that allows continuously variable energy selection for patient portals, conserves residual range, provides for larger field sizes, and increases beam intensity for smaller fields, is under development.

A numerical model for calibrating patient treatment portals has been implemented on a pilot basis. This system is designed to eliminate physical measurement calibrations for a range of treatment conditions.

Basic proton dosimetry studies are continuing with the help of visiting Russian physicist Stanislav Vatnitsky. In November the water calorimeter developed by Robert Schulz at Yale was acquired to support these investigations.

Achromatic optics offer more advantages than that of allowing transport of a beam with a large momentum spread. Achromatic optics have recently been adapted to the Loma Linda gantry with surprisingly good results. Beams can be tuned faster and with better positional accuracy due to the insensitivity of the beam to magnetic field errors in the large dipole magnets. This translates into better dose uniformity to the patient and shorter treatment times. Magnetic field errors 10 to 20 times larger than previously acceptable, now leave beam position and direction virtually unchanged going into the nozzle. Fine tuning for beam positioning is now provided by small trim magnets on the gantry, which are far easier to control and regulate. Work currently is in progress to achieve angle-independent beam tunes on the gantry and to complete variable energy studies to allow the full range of energies between 70 and 250 MeV to be transmitted efficiently.

The PROLIT database of literature citations will not be available for a time, as work is done to make the database more interactive. The ultimate goal of PROLIT is to enable investigators in proton-beam-related research and practice, to help update the database by contributing information about their work or other information which they think should be included. When PROLIT is offered again, it likely will be via a computer network, to promote the interactive feature. *Particles* readers will be informed. *James Slater, Loma Linda University Medical Center, P. O. Box 2000, 11234 Anderson Street, Loma Linda CA 92354.*

Ion Beam Therapy at the **COoler SYnchrotron COSY Jülich**- Plans and Status:

The cooler synchrotron and storage ring COSY-Jülich is close to completion. On Sept. 10, the first proton beam was "funneled" through the 100 m long injection beam line and the entire 184 m-ring. The first 100 turns are foreseen for the very near future. Progress of commissioning of COSY is such that the physical programme can most likely begin, as planned, next spring.

COSY-Jülich will deliver protons at energies of 50 to 2500 MeV and has the option to accelerate He, C, O and Ne, as well. The fully developed machine (presumably April 1994) will provide a storage capacity of 2×10^{11} protons. 5×10^{9} protons/s should then be extractable at max. energy. For 250 MeV protons this number should be as high as 2×10^{10} particles/s. Other beam specifications of interest for therapy are the ultra slow extraction (≥5 s), an energy variation from pulse to pulse better than 10^{-3}, positioning of the beam better than ±0.5 mm, and a minimum spot size of about 2 mm.

As far as the medical program is concerned, things are going more slowly. Design and costing is still in the early phase, decisions on the major specifications and architecture of the therapy site have been postponed, partly because financing is still an unsolved problem and because the discussion on the functional optimization of the facility, in particular, the possible benefits of a gantry is still going on.

The extraction socket to the medical treatment site should be finished in spring. In early summer, beam should be available at the medical site and a physical dosimetry program already in preparation is to begin. Necessary constructional modifications of the treatment area are foreseen for early 1994. As minimum solution a horizontal beam line with a rastered pencil beam to treat head and neck tumors is anticipated. If a gantry will be approved, a higher room has to be attached to the present site. Even if no further delays occur, patient treatment is not expected before 1996/97.

There are at the moment three active programs associated with the therapy project:

I) An experimental and computational dosimetry program (IKP/IME) is prepared to describe the incident cooled proton beams with initial energies of 50-250 MeV and their way through the tissue. Measurements of beam profile and absolute dose in air, in-phantom measurements of the energy distribution, absolute dose at reference points and 3-d dose profiles are part of it. Monte Carlo simulations using the transport code HERMES (High Energy Radiation Monte Carlo Elaborate System) which considers e.g. nuclear interactions with secondary particle production and multiple Coulomb scattering complement the program.

II) At the electronics department (ZEL-EGS) of the KFA, a fiber optic dosimeter for in vivo dosimetry called FADOS is under development. The dosimeter can be permanently implanted in the patient, to stay for the whole irradiation period. Its detection sensitivity is approx. 0.1 Gy. So far, FADOS has only been designed for X-ray or gamma monitoring. However, as soon as the proton beam is available, tests will commence to extend the usage of FADOS to particle radiation, as well.

III) Another group at the electronics department cooperates with the diagnostics and PET group of the Institute of Medicine (IME) on improved tumor localization methods, e.g. by combined processing of data from various imaging techniques or new 3-d reconstruction algorithms. *Ute Linz, Forschungszentrum Jülich GmbH, IKP/COSY-Medizin, Postfach 1913, W-5170 Jülich, Germany*.

News from **TRIUMF, Vancouver, Canada:**

In December 1992 a grant of $500,000 was made to the British Columbia Cancer Agency by the Woodward's Foundation, a Vancouver based organization, for the equipment and treatment room modifications required to set up a proton therapy facility at TRIUMF for the treatment of eye tumours. The TRIUMF cyclotron is a unique particle accelerator for proton therapy offering variable energy and variable intensity proton beams in the ideal energy range.

The initial proposal was based on two specific treatments: tumours of the eye and orbit using the existing 2C beam line with an energy range of 70-120 MeV; and neuroradiosurgery of brain lesions, such as AVMs, using a new beamline 2B with energies between 150-250 MeV. This grant will enable the eye program to go ahead. The beam delivery and patient alignment system will follow the designs used at existing treatment centres. Beam tests of a range modulation and a passive scattering system have already been carried out. A local company is now working on the detailed design of the eye treatment chair which will have an extra degree of freedom to permit tilting of the head. This beam line has a maximum range of 8 cm so could be used for other tumours of the head and neck.

The present expectation is that the detailed design of the facility will be completed during the first half of 1993 so that hardware procurement can start. The goal will then be to treat the first patient by April 1994. *Ewart Blackmore, TRIUMF, 4004 Westbrook Mall, Vancouver B. B. V6T 2A3, Canada.*

News from **PSI, Villigen, Switzerland:**

A new beam line NA3 dedicated to proton therapy was installed in spring 1992 at PSI.

The beam has been available in the new medical area since May 1992 and has been used periodically (2 night shifts/ week) between June and September for test experiments for the development of the spot scanning technique. The results of this beam period are very encouraging and confirm our optimism in being able to treat patients at PSI with the voxel scanning method in the very near future.

The dynamic scanning method developed at PSI is based on the superposition of individual static dose applications deposited with a proton pencil beam focused at a given point (Bragg peak as a dose spot). The displacement of the spot position is performed (with beam switched off) preferentially with a sweeper magnet, secondly with a range shifter system and finally by translations of the patient table as the slowest and least frequent motion. The dosimetric results showed our ability to apply individual dose spots in space at a typical rate of 10,000 spots in a few minutes and to control the dose of each spot with a reaction time of about 0.1 ms (with a fast monitor system triggering a fast kicker magnet placed upstream of the patient in the beam line). The linearity with dose of the application system was found to be better than 2% and the reproducibility of dose measurements (performed with a small ionization chamber at different locations in a water phantom) was found to be better than 1%. This is despite the presence of beam instabilities of the order of 100% of the split (and subsequently degraded) beam from the main cyclotron of PSI.

The dose application system was steered according to a sequence of commands produced by our treatment planning system. The dose calculation is based on the weighted superposition of three dimensional dose calculations for each individual pencil beam (spot). A built-in optimization algorithm chooses the dosage of each spot, making total use of the flexibility of the dose application system. This permits the construction of arbitrarily shaped three-dimensional dose distributions in space. The whole system is designed to provide automated routine conformation therapy with minimal patient specific hardware.

We did not have enough beam time to investigate experimentally the effects of inhomogeneities on the dose distribution, with respect to the way they are presently calculated in our treatment planning system. Not all devices, which are planned to be included in the steering system to guarantee for the safety of the patient against inadvertent irradiations by the uncontrolled focused beam, were ready for this beam period. This work still has to be done before starting patients irradiations in 1994.

Some important progress has been achieved as well in the development of a proton radiography system.

At the end of September the experimental apparatus was completely removed from the horizontal beam line in the proton therapy room and the activities for the installation of the compact PSI gantry dedicated to voxel scanning were started. For this reason we will not have additional beam time in our area for most of 1993.

The PSI gantry spans a diameter of only 4 meters. Due to the large phase space of the degraded beam, the size of the magnets is large and the total weight of the gantry is expected to be around 100 tons. The beam optics of the gantry will provide a 1:1 image of the beam at coupling point at the isocenter, with complete achromaticity and parallel invariant sweeping of the focused beam. The patient table will permit 3 translational and 2 rotational degrees of freedom to be applied on the supine patient, thus allowing the beam to be incident on the patient from almost any direction.

The foundation of the gantry (a 1 meter deep pit) is almost completed. The rotating body of the gantry is being manufactured and will be installed in the area at the end of February. The magnets and quadrupoles will be delivered in late spring of 1993. The installation of the complete gantry including rotating beam line and patient table system is planned to be completed by the end of 1993.

A small building with the infrastructure needed for patient treatments (rooms for the preparation of the ambulatory patients before treatment and for the housing of the control system for the dynamic treatment) has been recently installed outside the experimental hall close to the proton therapy treatment room. The medical pavilion will be ready before the end of 1992.

The positioning of the patient will be performed outside of the treatment room. For this purpose a CT will be installed in the positioning room of the medical pavilion next spring. The patients will be transferred lying in their individual mould in the treatment room with a transporter system similar to the one used for pion treatments at PSI. We will also purchase a retractable X ray unit mounted directly on the gantry, which will be used to check directly on the gantry the correct positioning of the patient with respect to the beam.

Patient treatments with dynamic conformal beam scanning on the gantry are expected to be possible by mid 1994. *E. Pedroni, H. Blattmann, T. Böhringer, A. Coray, S. Lin, T. Lomax, G. Munkel, S. Scheib, U. Schneider, Paul Scherrer Institute, CH-5232 Villigen , PSI, Switzerland.*

Status of the **Indiana University Proton Radiation Therapy Project, USA:**

Presently, we are in the final stages of preparing to treat our first patient with a fixed horizontal beam line. Because of the height of the beam line (center 2 m from the floor) our design is for head and neck patients seated in a elevated chair. The treatment room has been cleaned and painted to be more comfortable for patients. The patient positioning system has been designed, constructed and installed in the treatment room. This system includes a chair with 3 degrees of translational freedom and 2 degrees of rotational freedom, and several alignment lasers. An x-ray machine and film processor have been added to allow port verifications.

We have installed a multi-wire ion chamber (MWIC) in the beam line preceding the treatment room, which allows us to evaluate the cyclotron and beam line stability before beginning a patient treatment. Any significant change that occurred during patient positioning would prevent the treatment for beginning, since the beam size and position as determined by that MWIC is part of the interlock for the final beam stop.

We have chosen to use the new IUCF control system for the proton therapy control system as well. This system is based on a VAX-based commercial software control package and a VME I/O interface. The VME crate holds several modules: ADCs, digital I/O boards, scalers, and an AEON rt300 VAX. The rt300 is connected by ethernet to a workstation and user I/O is done in an X-Window environment. Current signals from any of the beam monitors (MWIC, SEM, split ion chambers) are converted to a frequency pulse train (whose frequency is proportional to the current) in custom electronics modules. These pulses are counted by the scaler modules, with the number of counts being proportional to the charge collected. This gives us a fairly large dynamic range, high accuracy, and zero dead-time. The system will be completed and tested this winter, and the first patient treatment could occur as early as March of 1993. *Charles Bloch, Indiana University Cyclotron Facility, 2401 Milo B. Simpson Lane, Bloomington IN 47408.*

News from the **Harvard Cyclotron Laboratory:**

We are very grateful to Marge Diehl of Surfware Inc., a California software maker for the gift of Computer Aided Machining, (CAM) software to HCL. This gift is the result of an article “Making Weapons to Fight Cancer” which appeared in the January 1993 issue of MODERN MACHINE SHOP. This article described the making of patient apertures and boluses in our machine shop. Mrs Diehl was motivated to to give this gift by the story about the work done at HCL in the fight against cancer. The donation to HCL is made in memory of Ken Gettelman, MODERN MACHINE SHOP’s former Editor-In-Chief, and a fellow writer and friend of his, Ed Blackburn, who also died last year. *Elliot Hammerman, Machinist, Harvard Cyclotron Laboratory, 44 Oxford Street, Cambridge MA 02138.*

News from **ITEP, Moscow, Russia** (1):
Determination Of RBE Values At ITEP (Moscow) Medical Beam From Chinese Hamster Cells Survival

For a long period (since 1971) an absorbed dose of ITEP synchrotron medical beam has been interpreted as a dose of radiation with RBE being equal to 1.00. So, careful radiobiologic study with the objective to redetermine the RBE value for protons with high pulse dose rate characteristic of ITEP synchrotron was believed to be necessary primarily for the sake of unification of clinical results and comparability of the ITEP clinical data with those obtained at other proton therapy centres.
The preliminary study was carried out and RBE values were determined at the entry of the unmodulated 179 MeV beam and in the centre of spread out Bragg peak (SOBP), from measurements of the survival of Chinese hamster cells (clone 431).
Gamma-radiation of ^{60}Co was used as a reference source. The data obtained indicate that (i) the RBE values at the entry of the unmodulated beam and at the centre of the SOBP are in close agreement, with an average of about 1.10, (ii) protons are radiobiologically somewhat more effective than ^{60}Co gamma rays and (iii) high pulse dose rate of the ITEP medical beam does not affect significantly biological effects of the beam. *P.N. Yashkin, D. I. Silin, T.P. Feoktistova, R. S. Martirosov, Institute of Biophysics, Dzivopysnaya, 46, 123 182 Moscow Russia and V.A. Zolotov, V.I. Kostjuchenko, D.F. Nichiporov› Ye. I. Minakova, V.S. Khoroshkov, Medical Physics Department, ITEP, B. Cheremushkinskaya, 25, 117259 Moscow Russia.*

News from **ITEP, Moscow, Russia** (2):

The following has been completed for the Moscow PTF project by October 1:

- technical and economical foundation of PTF;
- draft plans of the accelerator and other equipment;
- technical specifications for the accelerator and treatment units;
- two prototypes of the accelerator magnets; measurements of magnetic field are completed;
- gantry prototype;
- accelerator chamber and ejection recharge target;
- gantry manufacturing was started.

The work on H^- particles acceleration in 10 GeV ITEP proton synchrotron and subsequent ejection of the proton beam started aimed to check conceptual design and to solve some technical problems experimentally.

The following was done by October 1: H^- source has been manufactured and installed and ITEP synchrotron linac injector. 1 mA H^- beam was accelerated up to 25 MeV.

Routine clinical work of ITEP proton beam was continued, resulting in total number of 3050 patients. *V.S. Khoroshkov, Medical Physics Department, ITEP, B. Cheremushkinskaya, 25, 117259 Moscow Russia.*

Update of the **Biomedical Cyclotron facility in Centre Antoine-Lacassagne, Nice:**

144 patients have been treated from June 17, 1991 to October 23, 1992: - 142 ocular melanomas (60 CGE/4 fractions), including 9 patients previously treated by surgery (3), plaque (5), protons (1); - 1 retinoblastoma (48 CGE/16 fractions/4 weeks) in a five year old boy, treated four years ago by left enucleation, and right eye 40 Gy photon irradiation; - 1 von Hippel-Lindau (48 CGE/12 fractions/3 weeks) in a 31 year old man, previously treated by plaque and photon irradiation.

The series of melanomas encompasses 65 males (mean age 56.2, 18 <-> 85), 77 females (mean age 56.3, 10 <-> 82). The mean values for these patients are: maximum range: 23.9 mm (9.7 <-> 30.3), modulation: 15.2 mm (7 <-> 25), tumor height: 6.2 mm (2 <-> 14.7), tumor volume 0.65 cc (0.07 <-> 2.9), tumor maximum diameter: 14.5 mm (7.1 <-> 23.4). The repartition by sites is 85 Posterior pole, 34 Equatorial, 20 Ciliary body. The mean tumor maximum diameter by sites is: Posterior pole: 13.6 mm (7.3 <-> 21.1), Equatorial: 15.02 mm (7.1 <-> 22.3), Ciliary body: 17.21 mm (10.7 <-> 23.4).

The Neutron beam has started by October 92, with an energy of 58 MeV for the proton beam and an intensity of 20 mA on the Beryllium target. Dosimetry is now beginning and the first measurements made for a 10 x 10 field at 5 cm depth in water are: entrance dose 55.2%, maximum dose at 2 cm, 50% dose at 17.4 cm. *P. Chauvel, N. Brassart, J. Hérault, JM. Gabillat, P. Mandrillon. Centre Antoine-Lacassagne, Biomedical Cyclotron, 227 avenue de la Lanterne - 06200 Nice - France.*

News from **GSI, Darmstadt and Dresden:**
Can the autoactivation of a stable light ion beam be employed for dose control in light ion tumour therapy?

We report here on postion emission tomography (PET) measurments of the spatial □ activity distribution which is generated by stopping high-energy ions of the stable nucleus ^{20}Ne in a thick target of polymethylmethacrylate ($C_5H_8O_2$). These experiments were carried out , since earlier data of Tobias et al (1) suggest that the □- radioactivity induced by projectile fragmentation is peaked near the range of the primary particles and therefore it might be used to monitor the beam stopping positions during the treatment.

To study the spatial distribution of □-emitters generated by a ^{20}Ne beam a limited angle positron camera of two large area (50 x 28 cm^2) high-density avalanche chambers (2) was installed at the beam of the heavy ion synchrotron at GSI. A 5 x 5 x 25 cm^3 block of Polymethylmethacrylate (PMMA) was centered in the field of view of the positron camera with the long edge parallel to the beam direction. It was exposed to a ^{20}Ne beam with an energy of 406 MeV/u and an intensity of about 2.5 x 10^7 particles/s. The repetition time of the beam was 3.5 s and the duration of the pulses was 0.5 s. In order to suppress the background, annihilation events were recorded only between the pulses. This technique allows the decay of short-lived positron emitters to be detected with high efficiencey. Longitudinal tomograms were constructed from the data by backprojection and iterative reconstruction (3). The tomogram of an 18 mm thick section through the PMMA block involving the beam axis (fig. 1) shows very clearly a radioactivity distribution with a prominent maximum at R ~ 148 mm which is close to the range of the primary particles of 145 mm as calculated using the code of Schwab (4).

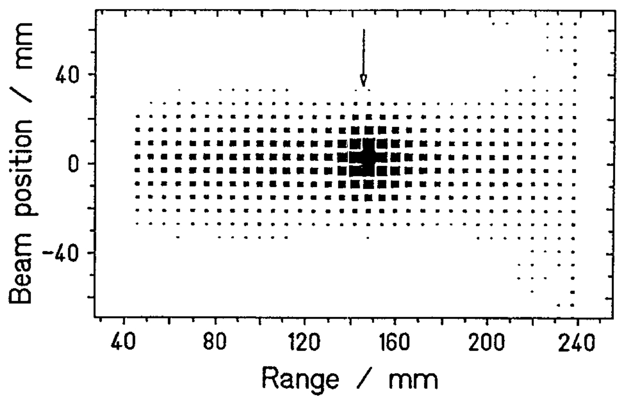

Fig 1: Tomogram of the distribution of β-activity induced by a ^{20}Ne beam of 406 MeV/u in a thick PMMA target. The activation time was 5 min. The range of ^{20}Ne calculated with the code of Schwab (4) is indicated by an arrow.

In fig. 2 the projection on the range axis of the two-dimensional distribution of fig. 1 is compared with the results of a simple Monte Carlo calculation (5) involving the transport and fragmentation of the primary beam as well as the stopping and decay processes of the first generation of β-radioactive fragments. This result indicates that the shape of the experimental distribution with a prominent maximum near the end of range of the primary particles can be qualitatively understood. After a considerable refinement this technique may offer the possibility of beam monitoring by means of PET during therapy with a light ion beam.

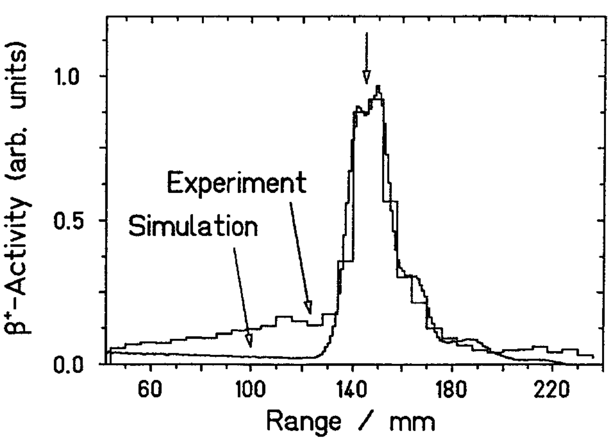

Fig. 2: Comparison of the experimental and simulated spatial distributions of β-activity induced by ^{20}Ne particles of 406 MeV/u in a PMMA phantom. The flat part of the spectra at low ranges results from target fragmentation. Projectile fragmentation causes the peak involving β-activity from Ne, F, and O and a long range tail of N and C isotopes.

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References: (1) C.A. Tobias, A. Chatterjee and A. R. Smith Phys Lett 37A (1971) 119; (2) P. Manfraß, W. Enghardt, W. D. Fromm, D. Wohlfarth and K. Hohmuth, Nucl. Instrum. Meth. in Phys. Res. A273,(1988) 904; (3) W. Enghardt, Physica Medica VII (1991) 119; (4) Th. Schwab, Report GSI-91-10

(Gesellschaft für Schwerionenforschung Darmstadt); (5) W. Enghardt, W.D. Fromm, H. Geissel, H. Keller, G. Kraft, A. Magel, P. Manfraß, G. Münzenberg, F. Nickel, J. Pawelke, D. Schardt, C. Scheidenberger and M. Sobiella, Phys. Med. Biol. 37 (1992) 2127.*W. Enghardt, W. D. Fromm, P. Manfraß, J. Pawelke, M. Sobiella, Forschungszentrum Rossendorf, Institut für Kern- und Handronenphysik, PF 19, DO-8051, Dresden, Germany and D. Schardt, H. Geissel, H. Keller, G. Kraft, A. Magel, G. Münzenberg, F. Nickel, C. Scheidenberger, Gesellschaft für Schwerionenforschung, Darmstadt, Planckstr. 1, PF 110552, DW-6100 Darmstadt, Germany*

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WORLD WIDE CHARGED PARTICLE PATIENT TOTALS

January 1 1993.

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	Jun-91
Uppsala	Sweden	p	1957	— 1976	73	
Harvard	MA. U.S.A.	p	1961		5742	Dec-92
Dubna	Russia	p	1964	— 1974	84	
Moscow	Russia	p	1969		2550	Oct-92
Los Alamos	NM. U.S.A.	π-	1974	— 1982	230	
St. Petersberg	Russia	p	1975		719	Jun-91
Berkeley	CA. U.S.A.	heavy	1975	— 1992	433	Jun-91
Chiba	Japan	p	1979		80	Jun-92
TRIUMF	Canada	π-	1979		304	Dec-92
PSI (SIN)	Switzerland	π-	1980		498	Dec-91
Tsukuba	Japan	p	1983		298	Jul-92
PSI (SIN)	Switzerland	p	1984		1246	May-92
Dubna	Russia	p	1987		24	Aug-92
Uppsala	Sweden	p	1989		27	Nov-92
Clatterbridge	England	p	1989		312	Dec-92
Loma Linda	CA. U.S.A	p	1990		369	Dec-92
Louvain-la-Neuve	Belgium	p	1991		14	Jun-92
Nice	France	p	1991		144	Oct-92
Orsay	France	p	1991		174	Dec-92
					1032	pion beams
					2487	ion beams
					11886	proton beams
				TOTAL	15405	all particle beams

Proposed NEW FACILITIES for PROTON & ION BEAM Therapy

INSTITUTION	PLACE	TYPE	DATE 1ST RX?	COMMENTS
Indiana Cyclotron	IN U.S.A	p	1993	200 MeV; other light ions possible.
N.A.C.	South Africa	p	1993	1st room ready & equipped for stereotactic radiosurgery.
P.S.I	Switzerland	p	1994	200 MeV, variable energy, dedicated beam line
Chiba	Japan	ion	1994	construction of HIMAC in progress.
TRIUMF	Canada	p	1994	adapt existing proton beam lines to therapy use.
A.P.D.C.	IL U.S.A	p	1994?	250 MeV accelerator; private facility.
Novosibirsk	Russia	p	1995?	180 - 200 MeV linear accelerator
ITEP Moscow	Russia	p	1996	6 treat. rms, 3 horiz. fixed beams, 2 gantry, 1 exp., H- accel.
NPTC (Harvard)	MA U.S.A.	p	1997	new accelerator & facility to be built at MGH
Jülich (KFA)	Germany	p	1997	Plan to develop a proton therapy beam line at COSY.
Sacramento	CA U.S.A	p	?	new proton therapy facility to be built at U.C. (at Davis) M.C.
G.S.I Darmstadt	Germany	ion	?	experiments for therapy and radiobiology in progress.
Clatterbridge	England	p	?	upgrade energy using booster linear accelerator.
Tsukuba	Japan	p	?	230 MeV accelerator; 2 treat. rooms; 2 vert+1 h beam; 2 vert.
Chicago	IL U.S.A	n,p	?	neutron, proton therapy; radioisotope production.
EULIMA	Europe	ion	?	European cooperative venture; future uncertain.