PARTICLES

sponsored by

PROTON THERAPY CO-OPERATIVE GROUP

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

Number 22 July Editor: Janet Sisterson Ph.D.,

Mailing Lists: I have completed updating the mailing list. I thank everyone who returned the forms to me.

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". We thank Dr. Steven Goetsch for his kind contribution.

Facility and Patient Statistics: I continue to collect information about all operating or proposed facilities. Please send me your information. My most recent published summary of the world wide patient statistics with detailed patient data through 1994 can be found in the following reference. "Proton therapy in 1996." J. M. Sisterson, CP392, Application of Accelerators in Research and Industry, eds. J.L. Duggan and I.L. Morgan, AIP Press, New York (1997), p1261-4.

Particles on the Internet: We have set up a home page for the Harvard Cyclotron Laboratory on the Internet with links to recent issues of Particles.

- The URL for the Harvard Cyclotron Laboratory is:-

http://neurosurgery.mgh.harvard.edu/hcl/ or http://brain.mgh.harvard.edu:100/hcl

Other proton therapy links:

- Northeast Proton Therapy Center: http://www.mgh.harvard.edu/depts/nptc/nptc.htm
- LLUMC, California: http://www.llu.edu/proton
- U of California, Davis: http://crocker.ucdavis.edu/cnl/research/eyet.htm
- Midwest Proton Radiation Institute: http://nike.iucf.indiana.edu/ptherapy/
- TRIUMF, Canada protons: http://www.triumf.ca/welcome/proton_thrpy.html
- TRIUMF, Canada pions: http://www.triumf.ca/welcome/pion_trtmt.html
- NAC, South Africa: http://www.nac.ac.za/~medrad/
- KVI, The Netherlands: http://www.kvi.nl/disk$1/protonlib/www/homepage.html
- PSI, Switzerland: http://www.psi.ch/

- Proton Oncological Therapy, Project of the ISS, Italy: http://top.iss.infn.it
- TERA foundation, Italy: http://www.tera.it
- Tsukuba, Japan: http://www-medical.kek.jp/index.html
- Tsukuba, Japan - new facility plans: http://www-medical.kek.jp/devnewfac.html
- HIMAC, Chiba, Japan: http://www.nirs.go.jp/ENG/particl.htm
- National Association for Proton Therapy: http://www.proton-therapy.org/
- Prolit - database of particle radiation therapy: http://proton.llu.edu
- GSI homepage: http://www.gsi.de

ARTICLES FOR PARTICLES 23

The **deadline for news for Particles 23,** the January 1999 issue, is **November 30 1999**. 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@radonc.mgh.harvard.edu

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 PTCOG e-mail address is PTCOG@radonc.mgh.harvard.edu

It is with regret that we accept Dr. Joe Castro's resignation from the Steering Committee. We are pleased that Dr. Herman Suit has agreed to take his place on this committee.

Steering Committee Members

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

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

PTCOG XXIX	Heidelberg, Germany	September 14- 16 1998
PTCOG XXX	NAC, Cape Town, South Africa	April 12 - 15 1999
PTCOG XXXI	Bloomington, IN, USA	October 11 - 13 1999

The proceedings for the PTCOG XXVII meeting held in Chiba, Japan in November 1997 should be available soon.

SECOND ANNOUNCEMENT:
PTCOG XXIX,
Heidelberg / Germany,
September 14 - 16, 1998.

Preliminary Program Outline

Sunday, 13th at the Renaissance Hotel, Heidelberg

18:00 - 20:00 Welcome Reception

Monday, 14th

9:00 -17:45 Sessions at the DKFZ, Heidelberg

19:00 - 22:00 Social Event

Tuesday, 15th.

7:30 - 8:20 Steering Committee Meeting breakfast

8:30 Transfer to GSI.

10:00 - 17:30 Sessions at GSI, Darmstadt

Barbecue at GSI, then transfer to hotels.

Wednesday, 16th
9:00 - 12:30 Sessions at the University Hospital, Heidelberg.
14:00-17:00 meeting of the ACT

DKFZ, The University Hospital and the Renaissance Hotel are all in Heidelberg. GSI, Darmstadt is about one hour away.

Registration/Presentations: A form is included in this mailing to register for the meeting and to request an oral or poster presentation. Oral presentations are limited to 10 minutes in length (unless specified otherwise), with additional time for discussion. The maximum space allocated for posters is 100 cm wide and 140 cm long, and material for mounting will be supplied. Papers on new or updated facilities should be presented as posters.

Presentations are solicited in the following areas: clinical results; treatment planning; beam application and safety; dosimetry; radiobiology; stereotactic proton therapy; new facilities (posters only).

All queries and the registration form included in this mailing should be sent to:

dkfz
PD Dr. Dr. Jürgen Debus
Im Neuenheimer Feld 280
69120 Heidelberg
Germany
Telephone: +49 6221 422516
Fax: +49 6221 422442
e-mail: j.debus@dkfz-heidelberg.de

Registration fee: The registration fee for the meeting has been set at DM 350 for those paying after August 15 1998 and DM 300 if paid before August 15th 1998. (DM 300.-- for those registered before June 30th 1998)

Please transfer the fee to one of the following accounts with the code **H 206**
Postscheckamt Karlsruhe (660 100 75) 452 75 - 752
Landeszentralbank Heidelberg (672 000 00) 672 / 01900
Deutsche Bank Heidelberg (672 700 03) 01 / 57008
Dresdner Bank Heidelberg (672 800 51) 4 688 491

Accommodation: Participants are expected to make their own reservations until August 10th 1998 at (please note space is limited):

RENAISSANCE HEIDELBERG HOTEL
Vangerwostr. 16
69115 Heidelberg
Tel: + 49 6221 908-0
Fax + 49 6221 908 508
(Please refer to the above meeting in order to obtain special rate of about 200 DM)

Information on other accommodations can be obtained from the Heidelberg tourist service:

Telephone + 49 6221 19433
+ 49 6221 142223 / 24
Fax + 49 6221 167318

Abstracts: Contributors are invited and strongly encouraged to submit an abstract of their presentation that will be published in the January 1999 issue of Particles. The abstract should be about one half page in length, and include a title, list of authors and their affiliations. Abstracts will be collected at the meeting or may be sent to Janet Sisterson by one of the means listed earlier in this newsletter. THE BEST METHOD is by e-mail to Sisterson@radonc.mgh.harvard.edu.

COMBINED MEETING - PTCOG XXX / EHTG / ECHED
12-15 April 1999

PTCOG Proton Therapy Co-Operative Group
EHTG European Hadron Therapy Group
ECHED European Clinical Heavy Particle Dosimetry Group

Date: 12-15 APRIL 1999

Venue: ARTHUR'S SEAT HOTEL
SEA POINT, CAPE TOWN
SOUTH AFRICA

Organisers: Medical Radiation Group
National Accelerator Centre
P O Box 72
Faure
7131 SOUTH AFRICA

Contact:
Dr. Dan Jones
Tel: +27-21-843-3820
Fax: +27-21-843-3382
e-mail: jones@nac.ac.za

Latest Information: http://www.nac.ac.za/~medrad/events.htm

The meeting will cover all aspects of neutron capture, fast neutron, proton and heavy ion therapy including

- Clinical results
- New treatment protocols
- Accelerators
- Beam delivery
- New facilities
- Dosimetry
- Quality Assurance
- Radiobiology
- Treatment Planning

Cape Town is regarded as one of the world's most beautiful cities and April is a very pleasant time of the year - the average maximum temperature is 23°C/73°F and the average minimum temperature is

12°C/54°F. The Arthur's Seat Hotel is conveniently located in the suburb of Sea Point and is one block from the seafront. Downtown is easily accessible as the hotel is on the main bus and taxi routes and there is also a shuttle bus to the Waterfront shopping, hospitality and entertainment complex. Cape Town is easily reached from all major cities, either on South African Airways or on other international carriers. Flights terminate in Cape Town or Johannesburg, which is a 2-hour flight from Cape Town.

For information on sightseeing and tours contact the nearest office of the South African Tourism Board (SATOUR) or:

Carol Swart
Talk Travel
P O Box 6878
Roggebaai
8012 SOUTH AFRICA

Tel: +27-21-797-1861
Fax: +27-21-797-7810

If you wish to receive further information please complete the form included in this mailing, and return it to the organisers.

BEAM SCANNING WORKSHOP
Rancho Mirage CA, 13-14 April 1998

Systems for scanning charged particle beams are complex, costly and demanding in terms of equipment, manpower and time. Several groups are presently interested in developing such systems while some expertise in this area is already available from other groups. The Beam Scanning Workshop brought together engineers, technical experts, medical physicists and other experienced persons from both sets of groups for discussions of all aspects of beam scanning.

This Workshop was arranged as a result of favourable responses received to the proposal in PARTICLES No. 20 (July 1997) regarding the formation of a beam scanning collaborative group and was attended by 26 participants. The proceedings were divided into several sessions covering different topics. Each topic was introduced by different speakers after which discussions took place. Apart from the main agenda topics, Dr. Y Futami of Chiba give a brief presentation of the C-11 radioactive beam spot scanning system under development at NIRS.

AGENDA

1. WELCOME [D Jones, NAC]
2. SPECIFICATIONS FOR BEAM SCANNING [M Goitein, NPTC]
3. PATIENT POSITIONING [N Schreuder, NAC]
4. BEAM DELIVERY [J Flanz, NPTC]
5. RADIOBIOLOGY [G Kraft, GSI]
6. TREATMENT PLANNING [E Pedroni, PSI]
7. CONTROL AND SAFETY [C Bloch, IUCF]
8. DOSE VERIFICATION [M Schippers, KVI]
9. ESTABLISHMENT OF COLLABORATIVE GROUPS [D Jones, NAC]

INTRODUCTION

The advantages of beam scanning systems in comparison with passive beam spreading systems are well known; perhaps the most important are:

1. Intensity modulation (and inverse planning) is possible.
2. There is negligible reduction in the range of the beam.
3. Integral dose is reduced as dose conformation to the proximal edge of the lesion is possible.
4. In principle no field-specific modifying devices are required.
5. Scanning systems are completely flexible.

The main disadvantages include:

1. Scanning systems are more complicated and therefore potentially less reliable and more dangerous.
2. The development of such systems is more demanding in terms of cost, time and manpower.
3. More stable beams are required.
4. Dose and beam position monitoring are more difficult.
5. The problems associated with patient and organ movement are more severe.

There are several techniques which can be used for scanning. For lateral beam spreading, circular scanning (wobbling) or linear scanning can be done. In the latter case the beam can be scanned continuously or in a discrete fashion (spot scanning). Another possibility is to undertake the fastest scan in one-dimension (strip scanning) and move the patient or the scanning magnet in the other dimension. Depth variation is achieved by interposing degraders in the beam (cyclotrons) or by changing the beam energy (synchrotrons).

The aim of beam scanning is to deliver a predetermined dose at any point in the body. Special care must be taken as scanning (because of high instantaneous dose rates) is potentially more dangerous than passive beam modification systems. The beam position and the dose delivered at each point must be accurately determined.

SUMMARY OF DISCUSSIONS

SOURCE-AXIS DISTANCE (SAD)

Cartesian scanning (i.e. with infinite SADs and therefore parallel beams) is most desirable as producing box-shaped fields and the patching together of adjacent fields (to treat larger areas) are in principle simpler.

With polar scanning (i.e. with short SADs and therefore divergent beams) these procedures are more difficult but can be done with proper treatment planning.

With short SADs there is also an increase in the entrance dose (inverse square law), but the impact of this effect is reduced *when multiple fields are used.*

FIELD SIZE

Up to 40 cm in 1 dimension.

The length of the other dimension depends on the scanning technique used. At least 40 cm is desirable.

The smallest field is determined by the elemental beam size.

DEPTH OF PENETRATION

A range of from near the skin surface (say, 1 or 2 cm.) to at least 32 cm.

RANGE MODULATION

For scanned beams, this concept doesn't apply. However, the range of depths over which Bragg Peaks are applied is unlikely to be more than 20 cm proximal to the deepest depth required. (This probably has little implication for design, given the previous specification.)

SPATIAL RESOLUTION (σ) AND PENCIL BEAM SIZE

This specification cannot exceed the physical limit set by multiple scattering within the patient - which is depth dependent. Typically, σ near the end of range is of the order of 3% of the range (e.g. 3 mm at 10 cm depth).

σ approx = 3 mm. at and near edge of field.

Within the field, a broader beam could be contemplated, say σ = 6 mm or even more.

The sharper resolution at the field edge can be achieved: with adjustable pencil beam profiles; with a collimator; by phase space trimming; or, to some extent, by a variable intensity near the field edge.

Changing the spot size between layers to preserve spacing should be considered, but this effect can be taken into account in the treatment planning.

DOSE DYNAMIC RANGE (PER FIELD)

Up to 8:1 within a depth "layer".

Up to 100:1 between layers.

DOSE FIDELITY

The delivered dose should everywhere be equal to the intended dose to within ± 2% - or a point receiving the intended dose should be found within a distance of ± 1 mm of any point of interest.

BEAM SPACING

Less than one third of the FWHM (full- width at half- maximum) of the pencil beam size.

NO. OF FIELDS PER FRACTION DELIVERED

From 7 to 30 (to simulate arc therapy) from any arbitrary direction.

TIME TO DELIVER ONE FIELD / FRACTION

The time to deliver a field should not exceed from 20 to 60 secs - depending on the field size and number of fields per fraction.

The more important specification is the time to deliver one fraction. Ideally, after patient set-up and localization, this should take no more than from 5 to 10 minutes.

POSITIONING AND IMMOBILIZATION

Patient positioning and immobilization are in principle no different for scanned beams than for conventional proton radiotherapy or radiosurgery, except that organ or patient motion pose more severe problems.

Patient set-up is also more difficult as no field-defining lights can be used for field shape and position confirmation. In practice x-ray verification of position is almost always done.

Typical set-up accuracies which are needed are <0.2 mm (extremities), 1-2 mm (head and neck) and 5-10 mm (abdomen).

ORGAN AND PATIENT MOTION

If the lesion being irradiated (or the patient) moves during treatment, hot and/or cold spots within the tumour and/or outside the tumour can be produced. These effects can be minimized by undertaking multiple scans, reducing the distance between spots or by using larger spots.

Gating the beam on and off at specific patient or organ positions can be done. Up to now this has usually been related to the breathing cycle. This requires real-time monitoring of the organ or patient position by means of motion detectors and transducers.

Other motion detector possibilities include the use of internal or external fiducial markers or anatomical landmarks in conjunction with x-radiography, ultrasound, neutron radiography or externally applied magnetic fields.

Patients can also be required to hold their breath or the areas of their bodies being irradiated can be compressed.

Because patient and organ motion usually takes place in a regular and predictable fashion the extent of movement can be anticipated and allowed for with reasonable accuracy.

The capability of repositioning from outside the treatment room is desirable to allow adjustment for small changes in patient or target position.

SCANNING MAGNETS

A long throw (distance from scanning magnets to patient) is desirable as this means that smaller magnets are required and faster scans are possible (for a given change in the magnetic field the spot will move a longer distance in the same time than with a short throw).

Long throws are possible with fixed beams but the throw is limited in a gantry.

It is desirable to sweep the beam by 20 cm in 30-100 msecs.

SHAPE OF BEAM SPOT

Planning is easier if the spot shape is always the same and for practical reasons it is assumed to be invariant.

A symmetrical shape is ideal.

Asymmetrical spots do not pose problems if the spot spacing is close enough.

SAFETY

It goes (almost) without saying that the safety of a scanning system (as with any part of a treatment apparatus) is of paramount concern.

For safety reasons, asymmetrical scanning is probably ideal i.e. the scanning magnet axes are offset from the treatment central axis.

Verification of the treatment pattern should take place as close to the patient as possible.

Redundant checks of the beam position must be done, preferably with different computers. e.g. the position can be checked by feedback of magnet current and of magnetic field strength.

Great care must be paid to restart procedures should interruption occur during irradiation in order to reproduce the required dose distribution.

BIOLOGICAL EFFECTS

The RBE depends on particle type, beam energy (depth), type of irradiated tissue and the integral dose (the latter is a result of the shape of the photon [reference] survival curves).

At the dose rates used in beam scanning there are no dose-rate effects.

Long treatment times are undesirable because they may approach the time scale of repair mechanisms.

With C-12 beams at GSI the RBE is changed for each irradiated elemental volume.

Although the RBE for proton beams does increase as a function of increasing depth (decreasing energy) this is not usually taken into account with any form of beam delivery.

A global RBE (usually 1.10) is assumed, but recent measurements at LLUMC, NAC and PSI done by the same group, using the same biological system in similar beams gave RBEs of 1.05, 1.15 and 1.25 respectively.

TREATMENT PLANNING

To date dedicated systems have been required. It has not been practical to modify commercial photon planning systems.

Intensity modulated beam delivery has been implemented at PSI only. Intensity modulated plans have been developed, and intensity modulated treatments are likely to be delivered in the near future.

A standard elemental beam shape is assumed for planning purposes. How often this shape should be checked is not clear (between fields, every day, ?)

A basic problem is that all dose distribution measurements are made in homogenous phantoms which do not reflect the situation in a patient.

Planning optimization is usually done at present by iterative techniques. At PSI, the treatment planning system produces a so-called "steering file" which specifies the scanning parameters for a particular field. For each spot the magnet currents, beam energy/degrader thickness, couch position (if applicable), RBE (if applicable) etc. are given).

In principle the RBE should be taken into account throughout the treated volume.

DOSE CALIBRATION AND VERIFICATION

The absolute dose must be determined at specific reference points in a phantom in order to calibrate the dose monitors.

The 3-D dose distribution must be verified.

Different detector systems can be used for simulations and for verification during treatment.

For simulation the following detectors can be used:

1-D: diodes, ionization chambers, TLDs, diamond detectors
2-D: "magic cube", radiographic film, scintillation screens
3-D: GEL (dose accuracy: 5%, spatial resolution: 1.5 mm
PET (2%, 4 mm)
CCD cameras with scintillation screens (0.5% , 0.5 mm)

During treatment multiwire ionization chambers, radiographic film (not real-time) and scintillation screens can be used.

REQUIREMENTS FOR QUALITY ASSURANCE

In order to undertake quality assurance procedures knowledge of the planned dose distributions are required.

The dose distributions must be checked with independent systems under exactly the same conditions as pertain to the treatment. It should be noted that for some detection systems this is not possible (e.g. radiochromic film requires higher doses, PET requires beam interruptions for data acquisition).

New dosimetry protocols will have to be developed for scanned beams.

WORKING GROUPS

At the end of the Workshop four specific topics were identified for further attention. It was proposed that Working Groups should be established to examine these topics in detail and report back at forthcoming PTCOG meetings.

The subjects to be addressed by the Working Groups, their Chairmen and e-mail addresses are given below:

	Working Group	**Chairman**	**e-mail address**
1	SPECIFICATIONS FOR IDEAL SCANNING SYSTEM	Michael Goitein	Goitein@hadron.mgh.harvard.edu Michael.Goitein@psi.ch
2	ONLINE CONTROL AND MONITORING OF SCANNED BEAMS	Jay Flanz	Flanz@hadron.mgh.harvard.edu
3	EFFECTS OF ORGAN MOTION	Dan Jones	Jones@nac.ac.za
4	DOSIMETRY OF SCANNED BEAMS	Marco Schippers	Schippers@kvi.nl

It is anticipated that additional informal discussions among interested people will take place at PTCOG XXIX (Heidelberg), while a second workshop will be held next at PTCOG XXX (Cape Town) which will give us more time to prepare the topics in more detail than can be done in the short period since the last workshop in Palm Springs.

Those interested in partaking in the activities of any of the above groups should contact the respective Chairmen as soon as possible.

Dan Jones, with help from Marco Schippers and Michael Goitein,
13 July, 1998

Clinical Protocol Working Group

At the 28th PTCOG meeting in Rancho Mirage, the Clinical Protocol Working Group had it's first session. The main objectives of this working group are:

- to provide participating members and all other interested parties with a continued update and status report of ongoing trials, including accrual rate, estimated time of protocol duration, and update of any foreseen or unforeseen difficulties.

- to discuss objectives and treatment rationales of potential future trials.

- to encourage international cooperation, specifically participation of institutions and facilities who agree with the principle treatment concept, and share similar technological equipment, etc.

This first session focused primarily on the status report of all currently existing proton protocols. Several potential future trial designs in the area of prostate cancer, CNS, sarcoma, and pediatric oncology. The reaction of participants was positive and encouraging. All relevant facts were summarized to the full PTCOG audience, on the last meeting day.

We plan to continue the working group at the upcoming meeting in Heidelberg, as well as future meetings, similar to other multi institutional and international cooperative groups.

Emphasis of the upcoming Fall meeting in Heidelberg will be to discuss participation, and future trials initiated by non U.S. institutions.

In keeping with PTCOG tradition, the clinical protocol working group is open to everyone interested. We plan again, to present a summary to the full PTCOG audience.

Many of us are unfamiliar with technical equipment, beam availability, patient availability, etc., of the various institutions. These and other variables are all factors influencing the choice of disease, site, and design of new trials, as well as opportunities to participate. Please consider a brief 5 - 8 min. presentation and outline of these parameters of your facility at the session in Heidelberg. Please keep in mind that this is not the forum to present any clinical data, which should always be presented at the regular clinical sessions.

Eugen B. Hug, M.D., Associate Professor, Radiation Medicine, Loma Linda University Medical Center, Loma Linda California. Phone: (909) 824-4280, Fax: (909) 824-4083, E-mail: Ehug@dominion.llumc.edu.

PROLIT: Culling The Heavy-Particle Radiation Therapy Literature

Prolit, a database of Medline abstracts related to particle radiation therapy, is now available on the Loma Linda Proton Treatment Center Web pages (http://proton.llu.edu). The database provides access to over 5000 particle therapy abstracts, enabling physicians, patients, and researchers to begin their search for information in one convenient site on the Web. A full description of Prolit is available on the Web site. The database will be updated regularly.

The first Prolit database was developed at LLUMC in the late 1980s; it was distributed to PTCOG members and others interested in particle radiation therapy via hard copy and diskettes. Prolit was discontinued in 1993, when it became apparent that the data-collection process was too labor-intensive and the mode of distribution limited. The current incarnation of Prolit can be updated quickly, and should reach a much larger audience via the Internet.

The Prolit development team anticipates refining the search engine and PubMed search strategy based on user feedback. Please direct any comments to Robert Kirby at rkirby@dominion.llumc.edu. *Robert Kirby, Dept. of Radiation Medicine, Loma Linda University Medical Center, 11234 Anderson Street, Loma Linda, CA 92354*.

PTCOG Information/News/Reports:

The following reports and articles were received by July 1998.

The National Association for Proton Therapy:

PROTON-THERAPY WEB SITE: now available on the internet

The National Association for Proton Therapy (NAPT) announced on March 18, 1998 the launching of its new web site --*http://www.proton-therapy.org* --to meet increasing demand for information on proton therapy for cancer treatment.

The web site focuses on the most frequently asked questions about the benefits of proton beam technology in the treatment of numerous cancer sites in the body -- including results of a recent study on men with prostate cancer. The web site includes sections on how protons work, proton facts, where to find proton therapy treatment, treatment center floor plan, testimonials from patients, and links to other proton therapy sites.

The NAPT is a non-profit organization providing education and awareness for the public, professional and governmental communities. Founded in 1990, it promotes the therapeutic benefits of proton therapy for cancer treatment in the U.S. and abroad.

Internet users are encouraged to visit the site and ask questions of their own by contacting lenarzt@proton-therapy.org. Contact: *Len Arzt, National Association for Proton Therapy, 7910 Woodmont Ave. #1303, Bethesda, MD 20814; 301-913-9360*.

Midwest Proton Radiation Institute, Bloomington, In, USA update:

Dr. Alejandro Mazal (CPO, Orsay) visited Indiana University for two months this spring to help us develop specifications for the new treatment rooms. While Ale was here, he also undertook to educate us on many aspects of proton therapy through informal talks on Stereotactic Irradiations, Dosimetry, Radioprotection, Treatment Planning, etc.

We have completed development and testing of the eye treatment facility and are now ready to treat patients, pending final approval from IU's Machine Produced Radiation Safety Committee. The testing process took somewhat longer than anticipated. The first AMD patients are scheduled to be treated in mid-July. These patients are participating in a clinical trial on choroidal neovascular membrane in age-related macular degeneration.

Design work for the new facility has been centered on energy selection and beam transport from the Cyclotron to the treatment rooms. An architectural firm is working on a conceptual design for the building addition required for patient care, treatment planning and preparation, and staff support. *Moira Wedekind, Indiana University Cyclotron Facility, 2401 Milo B Sampson Ln, Bloomington, IN 47408.*

News from **Moscow,** Russia:

The feasibility study of The Project of PTF at Moscow Oncologic Hospital #62 is completed by ITEP in collaboration with five physical and medical institutes in April, 1998. At the moment the facility cost estimated at $M23.3 and is being covered by Moscow Local Government. Hospital based PTF is being built around H^- synchrotron with the energy of 230 MeV and will be equipped with four treatment units - 2 gantries and 2 units for horizontal fixed beam.

Patient treatment has been carried out at ITEP PTF in 1997. 3039 patients were irradiated by January 1, 1998. *V.S. Khoroshkov, Inst. for Theor. & Exper. Physics, B. Cheremushkinskaya 25, Moscow 117259, Russia.*

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

After the successful treatment of the first two patients in December last year, the accelerator and the experimental area have been shut down because of service and upgrading work at the accelerator SIS and at the storage ring ESR and the installation of a new physics area that was planned long before .

The follow up of the two treated patients is very satisfying. In the CT-images a reduced uptake of contrast drug is observed and the T2 weighted MRI does not show any abnormality outside the target area. Therefore, it can be concluded that the treated volume coincides precisely with the target volume. This coincidence was also measured online during the treatment using PET techniques.

Because of the shut down period, the changes in the beam transport system and the installation of the heavy new physics cave, causing sedimentation problems to the building, a longer period of test and realignment is expected before patient treatment will be possible in order to obtain the same quality of performance that was reached last time.

At present the results of these first treatments are implemented in the control and safety system as well as in the treatment planning procedures. Next patient treatments are in preparation for late of August and early September. Then a maximum number of ten patients will be treated with twenty fractions in twenty consecutive days including weekends.

On September 14 -16 the next PTCOG meeting will be held at Heidelberg combined with the inauguration ceremonies for the GSI therapy.

More information is available on the web on the GSI homepage: http://www.gsi.de. *Gerhard Kraft, GSI, Planckstr. 1, Darmstadt D 64291, Germany.*

News from **NLHIAL**(National Laboratory of Heavy Ion Accelerator, Lanzhou), **Lanzhou**, **P.R. China**: HIRFL-CSR PROJECT IN LANZHOU

The Heavy Ion Research Facility in Lanzhou (HIRFL) has opened a new field of heavy ion physics and its application at intermediate energy domain in China. Meanwhile, important achievements have been obtained. Recently, it is proposed to upgrade the HIRFL with a multifuntional Cooling Storage Ring (CSR) forming a HIRFL-CSR accelerator system. This will greatly enhance the performances of

the HIRFL for the first decade of next century, particularly for studies by using Radioactive Ion Beams(RIBs), and to meet the arising nuclear physics needs.

CSR, a new accelerator planned at the Heavy Ion Research Facility in Lanzhou (HIRFL), is a multipurpose Cooling Storage Ring system, and consists of a main ring (CSRm) and an experimental ring (CSRe). The existing HIRFL will be used as its injector system. The heavy ion beams with energy range of 10-100 MeV/u from the HIRFL will be accumulated, cooled and accelerated to the higher energy range of 100-400 MeV/u in the main ring, and then extracted fast to produce radioactive ion beams (RIBs) or highly charged state heavy ions. After that, the secondary beams (RIBs or highly charged ions) can be accepted by the experimental ring for many internal target experiments with cooling.

Two electron coolers located in the long straight sections of the CSRm and CSRe respectively, will be used for beam accumulation, compensating for the growth of beam emittance during internal target experiment and providing high quality beams for special experiments.

The CSR system intends to provide internal and external target beams for many physics experiments. Two internal target in the long straight sections of CSRm and CSRe will be used for nuclear physics and highly charged atomic physics. Two external target of CSRm will be used for cancer therapy studies and the researches on the properties of nuclear matter under extreme condition.

The main parameters of the CSR are listed in Table 1. The lattices of the CSRm and CSRe are quite similar to each other. They consist of four arc sections and two long straight sections. The doublet and triplet quadruple are the essential options.

Table 1. Main parameters of the CSR

	CSRm	CSRe
Circumference(m)	161.20	128.96
Average radius(m)	25.66	20.56
Max. energy(MeV/u)	900($^{12}C^{6+}$)	400($^{12}C^{6+}$)
	400($^{238}U^{72+}$)	250($^{238}U^{90+}$)
Bpmax/Bpmin(T-m)	10.64/1.25	6.44/0.64
Bmax/Bmin(T)	1.40/0.16	1.40/0.13
Ramping rate(T/s)	~10	

The combination of multiturn injection and RF stacking will be used for the CSRm to accumulate heavy ions up to 10^{9-7} in a short duration of about four seconds. During the accumulation, both electron and stochastic cooling will be used for cooling of beam phase space in order to increase the accumulation ratio and efficiency. Table 2. is the accumulation parameters of several typical ions.

Table 2. Parameters of accumulation in CSRm

	$^{12}C^{6+}$	$^{129}Xe^{36+}$	$^{238}U^{37+}$
Energy(MeV/U)	50	20	10
Current(pps)	3.1×10^{12}	8.7×10^{10}	8.5×10^{9}
Stacking cycle(ms)	30	20	20
Injection period(s)	4	4	4
Particles of accum.	2.4×10^{9}	1.5×10^{8}	2.1×10^{7}

For the HIRFL-CSR plan, all optimising design and study are now in progress. The total budget of the CSR is about 300 million Chinese Yuan. The whole duration of it is intended to be seven years, two years for design and five years for construction. *Zengquan Wei, IMP, CAS, Nanchang Road 363, Lanzhou 730000, P.R. China*

News from **St. Petersburg**, Russia: Pulsed dose rate of high-energy proton beam as DNA structural damages modifier.

Two regimes of Gatchina's synchrocyclotron 1000 MeV proton beam generated with frequency of macropulses 4,5 s^{-1} accompanied by pulsed dose rate 25 Gy s^{-1} (regime I) and with frequency 45 s^{-1} accompanied by pulsed dose rate 2,5 Gy s^{-1} (regime II) were compared using normal rats, RL-67 adenocarcinoma bearing mice $(C57BLxCBA)F_1$ and DNA solution as a biological targets. Absorbed doses were monitored with ionising chamber and by yield of reaction C^{12}-p-p,n $\rightarrow C^{11}$ (β^+, E=0,511 MeV, ≅ 20 min.). The total absorbed doses and total elapsed time of exposes remained the same for both compared regimes.

The slight increasing of proton beam efficiency at regime I (RBE_I:RBE_{II} ≅ 1,1 ÷ 1,2) was established earlier in terms of lethality after total irradiation (6,9 and 12 Gy) of rats, the loss of their body weight, hematocrit, common protein level in plasma as well as raising free amino acids concentration in it (D. Karlin, B. Konov, 1989).

The size or calculated volume of carcinoma metastases in lungs of locally irradiated mice (10, 30 and 60 Gy) were more diminished at regime I, then at II one $\varnothing_{II} : \varnothing_I \cong 2$ or $V_I:V_{II} \cong 8$, p=0,03).

The intrinsic viscosity [η] of DNA, the yield of 3'OH-ends and malon aldehyde (MA)-like ends after irradiation at doses 30-90 Gy were estimated by means of magnetic ratator viscometer, liquid-spectrometer "Picker-Nuclear", DEAE-chromatography, labeling 3'OH kit N67 (Amersham) and reaction DNA-MA-like end +NH-labelled AdR* as well as NH-GdR* or NH-CdR* (TdR* for lack of NH-groups was employed as a control). Statistical analysis of complete data showed the significant increasing of 3'OH-and MA-like ends/mkg DNA after irradiation could be demonstrated with regime II only. Partial restoration of [η] value for double strand DNA as well as for melted single strand DNA both registered in time after exposure at regime I. Therefore it is concluded from this study that capability of irradiated DNA in solution to form the cross-links between its damaged deoxyribose moiety of one strands and undamaged base of another strand has depended just on the value of pulsed dose rate parameter. The proposed appraisal of radiochemical output of lethal structural damages of DNA like the cross-links seems to be the fruitful approach for elucidation the nature of radiobiological effects of fractionated high-energy particles. *A. Shoutko, D. Karlin, B. Konov, N. Chatinina, M. Vasilyeva, L. Ekimova, Central Research Institute of Roentgenology and Radiology, Leningradskaja str. 70/4. Pesochnij-2, St.-Petersburg, Russia, 186646.*

A very compact Protontherapy facility based on an extensive use of High Temperature Superconductors (HTS).

The present worldwide protontherapy development is slowed down by the volume and the general costs of the existing proton generators and delivery dose equipment. The use of High Temperature Superconducting cables recently available on the market (HTS), working around 30K modify completely the design of protontherapy equipment. At this temperature, independent cryocoolers able to work in any position can be extensively used. Added to a significant simplification of the associated cryothechnics, it becomes possible to gain what was promised by the use of superconductivity concerning the volume, the

weight, the general dimensions, the consumpted power. The complete facility is composed of a very compact isochronous Cyclotron 210 Mev p of only 88 tons 3.2 m in diameter equipped with an ECR ion source of infinite lifetime, followed by a superconducting voxel scanned isocentric gantry of 25 tons only, 5.2 meters in diameter. *C. Bieth, A. Laisne, Pantechnik 14 rue Alfred Kastler, 14000 Caen, France; P. Mandrillon, Centre Antoine Lacassagne, 168 Avenue de la lanterne, 6000 Nice, France; D. Ponvert, Institut Curie, 26 Rue d'Ulm 75248 Paris Cedex 05, France.*

Guest Commentary by M. R. Raju

Dear Friends,

As a graduate student in nuclear physics in India during the late 1950's, I was fascinated by and enjoyed reading about neutron capture theory and Bragg peak therapy in the proceedings of the First United Nations Conference on Peaceful Uses of Atomic Energy. I had the good fortune to pursue a research career in this field with the help of Prof. Gordon Brownell at the Massachusetts Institute of Technology and Massachusetts General Hospital in Boston and John Lawrence (brother of Ernest O. Lawrence) at the Radiation Laboratory in Berkeley.

I never expected that I would have the privilege of being part of the continuing development of particle therapy for more than three decades and my last two publications were invited review papers. The first in Radiation Research, "Particle therapy: Historical Developments and Current Status" 145, 391-407 (1996) and the second in Int. J. Rad. Biol., "Proton Radiobiology, Radiosurgery and Radiotherapy", 67, 237-259 (1995). I am happy that I can follow the progress in particle therapy through the Particles newsletter, which is an excellent informal journal. Over the years, I enjoyed my friendship with many of you, and I would like to take this opportunity to express my deep appreciation.

The purpose of this letter is to keep you all informed of my new venture and to seek your help and guidance, so that I can continue to interact with those of you who are interested in my new project. Nearly four years ago, I took voluntary retirement to spend most of my time developing a rural cancer center which will serve a mostly illiterate population in a rural area of Andhra Pradesh. The major emphasis of this cancer center will be on cancer awareness, prevention, early detection and treatment of the needy, who cannot afford to travel to big cities or pay the treatment costs. The appropriate technology needed, includes a Cobalt-60 treatment facility, a good pathology laboratory and a surgical theatre. I am already in the process of building the surgical theatre, but seek your help in finding resources to acquire a Cobalt-60 treatment facility.

This rural cancer center will be a small step in overcoming the gulf between sophisticated medical research, where there is a lot of effort to develop new ways of improving treatment, and the needs of most people in the world, who can gain enormous benefits from relatively simple medical measures. The "Mahatma Gandhi Memorial Medical Trust", founded nearly 20 years ago by my wife and occupying nearly 15000 square feet of buildings located on a five acre site in a rural area is making my work much easier. In the future, I would like to invite radiation oncologists and medical physicists to visit the Trust periodically to serve the poor, and personally experience the living conditions of most people in the world. We have already built a guest house our friends to stay in, when they come to participate in the services of the Trust and its efforts.

I have been very fortunate to have the enthusiastic support of some of the leading scientists and radiation oncologists from India. With a grant from the Indian Atomic Energy Regulatory Board for

Cancer for surveillance and the treatment of cervical cancer using intracavity brachytherapy, we have been able to treat 16 patients and complete a door-to-door survey of about 25000 families in this rural area. We found that nearly 10% of the deaths were due to cancer and that this percentage is increasing. We also found that most cervical cancer patients are illiterate. Only about 10% of the population seek qualified medical help, the rest are in the hands of quacks. More than 80% of the cancer patients seek treatment at advanced stages of the disease and this number is not increasing yet.

Recently, I was asked to be the Member Secretary for a District Cancer Control Program, under the National Cancer Control Program which has support from the World Health Organization. The major emphasis of this program is on cancer awareness, prevention and early detection. We are developing pamphlets in local language on cancer prevention and early symptoms including self examination of the breast. Cervical, oral and breast cancers together comprise nearly 75% of the cancer problem in India. Cervical cancer among women and oral cancer among men are the two most common cancers in India; both these tumors are preventable and can be detected at even precancerous stages. However, the incidence of breast cancer seems to be increasing. With the help of local doctors in villages, we are conducting cancer screening camps to detect early stages of cancer and then we help these patients to get the necessary treatment in cancer centers.

Some medical problems in India are due to illiteracy, but it still surprised me to learn that nearly 75% of children drop out during elementary school. Another pet project of mine is to develop preschools in villages to benefit children of illiterate parents. In collaboration with local people, we have established such a school in one village and it is quite successful. My wife and I are now building a model preschool in another village on a site that I inherited, and then I hope to see such schools in as many villages as possible. I am hoping that these preschools will reduce the drop out rate during elementary schools, and the State Government seems to be interested in partially funding such schools.

If you are interested in visiting us, please write to me. At this point I have neither fax or electronic mail. Also, if you happen to be traveling in India, you are welcome to come and visit us. My wish is that some of the people working in the forefront of radiotherapy developments will also take some time to address some of the basic problems, such as those I have outlined here. *M. R. Raju, Mahatma Memorial Medical Trust, Bhimavaram (AP) 534202, India. Telephone +91 8816 231 67.*

Editor's note: Dr. Raju came to the USA in 1961, worked at Massachusetts General Hospital from 1961 - 1963, and the Radiation Laboratory at Berkeley from 1963 - 1971. From 1971 to his retirement in 1993, he has been at Los Alamos National Laboratory (LANL) where he was appointed one of the first Fellows of LANL in 1981. In 1980, he wrote "Heavy Particle Radiotherapy" published by Academic Press summarizing the status of proton and ion therapy at that time. This book is a valuable resource for anyone interested in the history and development of proton and ion therapies.

Proposed NEW FACILITIES for PROTON & ION BEAM THERAPY
July 1998

INSTITUTION	PLACE	TYPE	1ST RX?	COMMENTS
NPTC (Harvard)	MA USA	p	1998	at MGH; 235 MeV cyclotron; 2 gantries + 3 horiz.
Kashiwa	Japan	p	1998	235MeV cyclotron;2gantries;1horiz; under construction
INFN-LNS, Catania	Italy	p	1999	70 MeV; 1 room, fixed horiz. beam
Bratislavia	Slovakia	p, ion	2000	75 MeV cyclotron; p; ions; +BNCT, isot prod.
CGMH, Northern Taiwan	Taiwan	p	2000	250 MeV synchrotron, 3 gantries, 1 fixed beam
Hyogo	Japan	p, ion	2001	2 gantries; 2 horiz; 1 vert; 1 45 deg;under construction
NAC, Faure	South Africa	p	2001	new treatment room with beam line 30^{o} off vertical.
Tsukuba	Japan	p	2001	270 MeV; 2 treat rooms with gantries; 1 research room
Wakasa Bay	Japan		2001?	multipurpose accelerator; building completed mid 1998
Shizuoka Cancer Center	Japan		2002?	synchrotron 230? MeV; 2 gantries; 1 horiz; funded.
CNAO, Milan & Pavia	Italy	p, ion	2002?	synchrotron; 1 gantry;2 fixed beam rooms;1 exp. room
AUSTRON	Austria	p, ion	?	2p gantry;1 ion gantry;1 fixed p;1 fixed ion;1 exp room
Beijing	China	p	?	250 MeV synchrotron.
Central Italy	Italy	p	?	cyclotron; 1 gantry; 1 fixed
Clatterbridge	England	p	?	upgrade using booster linear accelerator.
TOP project ISS Rome	Italy	p	?	200 MeV linac;1eye room; gantry?;under construction
3 projects in Moscow	Russia	p	?	
HIRFL,Lanzhou	PR China	C ion	?	
Jülich (KFA)	Germany	p	?	exp. beam line; ? plans for therapy.
Krakow	Poland	p	?	60 MeV proton beam.
KVI Groningen	The Netherlands	p	?	plan:- 200 MeV accel.; 2 rms; 1 gantry; 1 fix.
Moscow	Russia	p	?	320 MeV; compact, probably no gantry
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

WORLD WIDE CHARGED PARTICLE PATIENT TOTALS

July 1998

WHO	WHERE	WHAT	DATE FIRST RX	DATE LAST RX	RECENT PATIENT TOTAL	DATE OF TOTAL
Berkeley 184	CA. USA	p	1954	— 1957	30	
Berkeley	CA. USA	He	1957	— 1992	2054	June-91
Uppsala	Sweden	p	1957	— 1976	73	
Harvard	MA. USA	p	1961		7694	Jul-98
Dubna	Russia	p	1967	— 1974	84	
Moscow	Russia	p	1969		3039	Dec-97
Los Alamos	NM. USA	π-	1974	— 1982	230	
St. Petersburg	Russia	p	1975		1029	Jun-98
Berkeley	CA. USA	heavy ion	1975	— 1992	433	June-91
Chiba	Japan	p	1979		96	Oct-96
TRIUMF	Canada	π-	1979	— 1994	367	Dec-93
PSI (SIN)	Switzerland	π-	1980	— 1993	503	
PMRC, Tsukuba	Japan	p	1983		576	Mar-98
PSI (72 MeV)	Switzerland	p	1984		2487	Dec-97
Dubna	Russia	p	1987		40	May-98
Uppsala	Sweden	p	1989		147	Feb-98
Clatterbridge	England	p	1989		817	May-98
Loma Linda	CA. USA	p	1990		3433	Apr-98
Louvain-la-Neuve	Belgium	p	1991		21	Nov-93
Nice	France	p	1991		1010	Jan-98
Orsay	France	p	1991		956	May-97
N.A.C.	South Africa	p	1993		263	Jul-98
IUCF	IN USA	p	1993		1	Dec-97
UCSF - CNL	CA USA	p	1994		162	May-98
HIMAC, Chiba	Japan	heavy ion	1994		389	Feb-98
TRIUMF	Canada	p	1995		37	Jan-98
PSI (200 MeV)	Switzerland	p	1996		9	Dec-97
G.S.I Darmstadt	Germany	heavy ion	1997		2	Dec-97
Berlin	Germany	p	1998		3	Jul-98
					1100	pions
					2878	ions
					22007	protons
				TOTAL	25985	all particles

See Page 19.
For
The Proposed New Facilities Table