PROTON THERAPY CO-OPERATIVE GROUP

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FERMILAB III

MINUTES OF THE PTCOG MEETING HELD AT FERMILAB ON JAN 22nd and 23rd 1986

More than 40 people attended the PTCOG meeting kindly hosted by Fermilab. A copy of the agenda of the meeting is appended. At the start of the meeting brief announcements were made of a number of exciting recent developments: (1) Loma Linda University have decided to acquire a proton medical facility and are in the final stages of negotiating with Fermilab to design and build it; (2) Rush-Presbyterian and the university of Illinois have expresses an interest in obtaining a second machine from Fermilab; (3) R. R. Wilson has teamed up with Ray Kjellberg to form a company (MAC based in Boston) to develop a compact superconducting synchrotron: (4) there is a possibility that Hank Blosser will collaborate with physicists at SIN (Villagen, Switzerland) to design a superconducting synchrocyclotron which would be used for proton therapy at SIN.

The first afternoon was devoted to separate sessions of the three working groups – minutes of those meetings are appended. Aspects of the deliberations of these groups were brought to general attention during the second session of the second day.

Intensity

The first session of the second day was devoted to a discussion of the intensity needed for a clinical machine. This has emerged as a central and still not entirely resolved issue. As discussion proceeded it became clear that we badly need to agree on a common unit in which to express the intensity an it was agreed that we would use the unit of **protons per minute**. This is less ambiguous than a machine current, stated in nanoamperes, which can be (and was being) used with more than one meaning. The intensity needed depends on both clinical and technical considerations.

Clinically, one must define the sites of interest and the largest likely volume (properly stated in terms of field area and depth independently, since intensity is not linear with depth) as well as the dose rate desired. There was general agreement on the range of volumes of interest. The clinicians, somewhat to the consternation of some accelerator designers, were also rather clear on their desire to have dose rates available which would allow treatments to be delivered within, say, a breath hold – i. e. within 10 to 15 seconds. This is a higher dose rate than is available presently in most conventional

therapy machines or current heavy charge particle treatment beams, but was considered desirable in new modality which has the potential for very accurate and highly localized dose delivery.

Technically, the intensity of accelerated protons depends on the extractions efficiency and on details of the beam spreading techniques. In particular, there is a factor of about 4 better proton utilizations (and hence lower internal beam intensity requirement) if dynamic scanning is used to spread the beam as opposed to passive scattering.

Attached to the minutes is a memorandum entitled "Proton Beam Intensity" which includes a table of sites of interest and corresponding typical target volumes and the dose per fraction and dose rate specifications which were discussed at the meeting. The table also lists the corresponding implications for internally accelerated proton intensity – depending on the beam spreading technique used. The parameters used to develop these numbers are rough estimates made by your secretary.

There are some general considerations relating to the intensity issue. One could decide that a particular machine would be used for only a restricted number of clinical problems which might relax, perhaps substantially, the intensity requirement. There was general agreement that this would be rather short-sighted even for a specific facility since the clinical indications for proton therapy may change as clinical data accumulates and alternative therapies emerge – and would be even less sensible for the basic machine design since one would certainly hope that the effort in designing and building a machine would not have to duplicated for users with broader and more demanding needs. (The same arguments can be used in regard to providing machines with high enough energy for all likely uses.)

A second consideration relates to the wisdom of accepting a machine which could only provide the specified intensity by virtue of beam scanning. The positive experience with the "wobbler" at LBL appears to have made dynamic scanning more acceptable to many at the workshop. However, there was still some serious concern that one not be *required* to use dynamic beam scanning. Perhaps a compromise position would be to accept an intensity which would satisfy the requirements specified in the attached table with beam scanning, but which could provide scattered beams with a reduction of about 4 in the specified dose rate. However, high dose rate 3D scanned beam delivery is technically complex and its feasibility depends strongly on details of the beam time structure and extraction technique – so, if one must rely on scanning, one must confirm through a design study that it is possible for the particular accelerator being proposed.

Proton Medical Facility Designs

Several speakers outlined the current state of several of the design efforts presently underway. The speakers are indicated in the attached agenda and may be directly contacted for details of their programs (a mailing list for all PTCOG members is available from your secretary).

Rotating gantry design

Lynn Verhey (MGH) presented some interesting data (circulated at the meeting and available from him) concerning beam angles used in cancer treatments (other than ocular melanomas) at the Harvard Cyclotron Laboratory. He also presented an analysis of field sizes and beam directions used in the conventional treatments at MGH. In the HCL data, approximately 18% of fields were delivered from beam angles that are not close to (within $\pm 10^{o}$) of the four principal directions (AP, PA, left & right lateral). This, of course, is only one of the arguments for a rotating beam delivery system – the others

include: better immobilization for supine patients; greater ease and hence speed of set-up – leading to more accurate treatments and better throughput; more satisfactory delivery of combined photon and proton treaments and no need for the expensive CT scanner which can scan seated and standing patients.

Gantry designs were presented by Ken Thomas (Brobeck) and Bernie Gottschalk (HCL). The field size, the effective source-to-isocenter distance, and other specifications of the gantry are still unclear and a great deal of effort is needed before conceptual designs can be considered complete and the likely cost of a gantry is established – although it is clear that it is quite feasible to build one.

Shielding

Very informative shielding studies were presented by Bill Chu (LBL) and Miguel Awschalom (LBL) and reports are available from both of them. The shielding requirements are going to be a major concern in the design and cost of a facility and these documents will be very valuable as a first cut at these questions.

Next PTCOG meeting

It was agreed that a meeting before the summer would be useful – by that time the facilities group's specifications should bea at least in final draft form, and the rapid pace of the deign developments make it likely that there will be much else to discuss. There was also agreement that Fermilab is a convenient central location – and our hosts graciously offered their facilities once again. Some time towards the end of May of the beginning of June was proposed. An announcement of the final date will be made soon.