PLANS FOR THE FUTURE

OUTLOOK FOR 1985

SIN is in the course of upgrading the accelerator facility. 1984 the injector II has been successfully tested. Starting with the next high energy period it will be gradually taking over the injection into the ring cyclotron. Due to this second preaccelerator there will be no interruption of the production of 590 MeV protons anymore for low energy operation. The consequence of this is a continuous beam period starting in may, when the present shutdown for reconstruction of the thin target area will end, till the end of the year. On the other hand the ring accelerator cannot be run for such a long period without regular service periods. Three days are planned for regular service every four weeks and a longer service of five days will be necessary approximately every three months. The longest acceptable interruption in any treatment course is assumed to be 5 days and such a gap should not happen more than once for any patient. To keep deviations from the present treatment scheme minimal the plans are to treat on weekends before and after the long service interruptions. The overall treatment time for a treatment with 20 fractions will still be 33 days but the treatment days, never more than 4 in a sequence will not be distributed with the same regularity over time. For the pion project the disadvantage of the irregular treatment schedules is believed to be more than compensated by the fact that a continuous patient accrual can be offered. Patient preparation for the next beam period is planned to start mid April 1985.

200 MeV PROTON THERAPY PROJECT

Two important differences distinguish the pion treatment at SIN from conventional radiotherapy. One is the physical characteristics of the pion beam, low ionization density of the pions in flight, capture of the pion at the end of its path with a wide spectrum of particles, some of them with high ionization density. The other one is the shaping of the treatment volume in three dimensions to fit the target volume as close as possible. The second characteristic is not limited to pion treatment, with an appropriate technique it could be performed with protons for example. A proton treatment facility at SIN would therefore allow a direct determination of the importance of the high LET component in the pion treatment. In addition to serving as a control irradiation for the pion therapy a proton beam would have many other applications in radiotherapy.

Protons have been applied for radiotherapy of deep seated tumors since many years at several centers around the world with success. A particularly suited area being small tumors close to very sensitive vital structures for example in the brain or near the spinal cord. These irradiations have all been performed with static beams equiped with collimators and range shifters. At SIN a study is underway to build a beam line for proton radiotherapy which would be suitable for static beam therapy and in addition for pencil beam scanning with an isocentric gantry for large deep seated tumors.

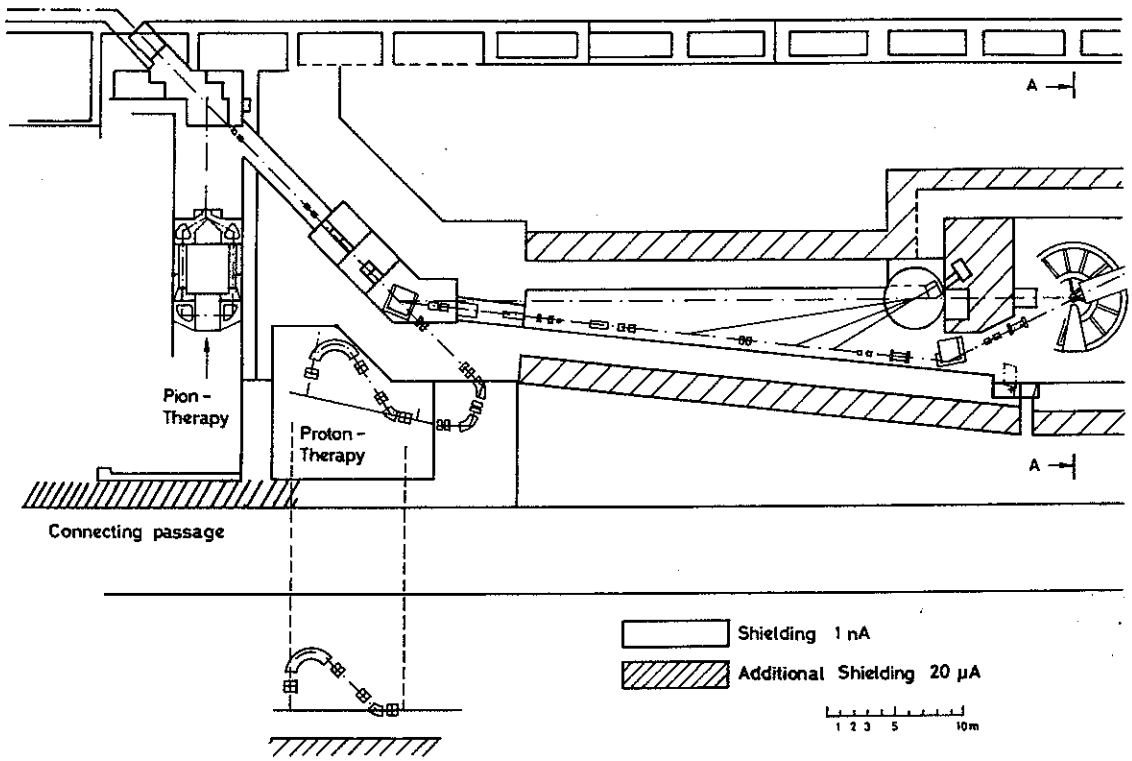

Fig. 1

Adjacent to the present pion treatment room a physics area (NA1) is under construction (Fig. 1). The beam line of this area can be used for proton therapy. With an energy degrader the energy of the protons from the ring accelerator has to be reduced to between 150 MeV and 250 MeV, ideal to treat deep seated tumors with multiport irradiation. It is possible to place the proton therapy treatment room side by side with the pion therapy room and to link it with a connecting passage to the preparation room of the pion project. This way the two radiotherapy projects are using the same medical infrastructure. The use of the beam line of NA1 for proton therapy makes a truly simultaneous operation of the Piotron and the proton treatment facility impossible. A time sharing is necessary where the switching time for the proton beam as well as the proton irradiation time are approximately two minutes each. Beam time losses of six minutes at the most and only once per patient can be tolerated and would not significantly reduce the number of patients for the pion project but at the same time allow for an equal number of patients to be treated with protons.

The major goal of the project is the evaluation of the feasibility of proton treatment in a hospital. A dedicated proton accelerator for radiotherapy and isotope production could well be within the financial scope of a large hospital. To investigate the optimal characteristics of the treatment facility, a set up with a high flexibility at a physics institute is ideal. An isocentric beamline is therefore planned which would at least cover a sector of 90^{o} including a vertical position from top and a horizontal position. Pencil beam scanning will be developped to shape the treatment volume together with variable range shifting in three dimensions. The patient couch will be moved computer controlled in three axis and will rotate around the vertical axis through the isocenter. The development will make use of the experience of the dynamic treatment with the Piotron.

Special effort is being made to get cooperation nationally and internationally for this project already from the beginning.