

## The PTC in Prague and R&D perspectives

*Wednesday, 7 September 2016 16:05 (25 minutes)*

Radiotherapy is one of three main approaches for cancer treatment. First application of ionization radiation in human medicine was done before almost 110 years. Since that time different types of particles were used for treatment. Even though most of the time photon radiation was used other particles have also very suitable properties for treatment.

From very beginning radioactive isotopes were used as a source of radiation for therapy, later first accelerator –x-ray tube –was used as source of photons. But energies of such produced photon were quite low and with unfavorable mechanism of energy transfer from particle to tissue so those sources were quite unsuitable for treatment of deeply seated tumor. In fifties of twentieth century large development was done in reaching of higher energies, accelerators were started to be built. Basically at the same time accelerators for electrons and for heavier particles were introduced, it was in the middle of fifties. At the same time their exploitation for medical purposes was suggested. Due to more simple and cheaper design electron accelerators (which producing both electron and bremsstrahlung radiation) started to dominate and accelerators for heavier particles were inaccessible from the clinical point of view. Nowadays situation is changing. Because of modern computers and material technology advances, particle accelerators are starting to be very good option for more and more clinical sites. The most pronounced particle for treating patients in future is proton. There are several reasons for this like its accessibility, depth dose distribution properties (Bragg peak shape of depth dose curve), no fragmentation of projectile particles, RBE close to photons so only slight adaptation of treatment protocols is needed. Proton has also favorable ratio of mass and charge, so relatively compact accelerators may be built.

Construction works at Prague started in the beginning of 2009 close to hospital Na Bulovce. The goal of the project was to create top technology radiotherapy center for treating with proton beam. Accelerator was placed into the building in autumn 2011 and first patient was treated in December 2012. From very beginning PTC decided to work with pencil beam scanning dose delivery system. It was recognized as best solution from several points of view –treatment delivery is fast, no patient specific hardware is needed, adaptive treatment approach is more feasible and number of treated patients can be higher.

Even that PTC facility was built for treatment already in the early stage of construction the thought of using proton beam also for research was introduced and site plan was changed accordingly. In the plans PTC included room which is somehow separated away from ordinary clinical work, with separate control room. Right now PTC reached its full patient load, patient treatment is running for 12 hours a day, so next step is to put into live also research part of the center.

Above mentioned does not mean, that no research is done in PTC facility. At the very beginning, colleagues from NPL provided dose measurement which resulted in publication in Medical Physics (“Experimental and Monte Carlo studies of fluence corrections for graphite calorimetry in low- and high-energy clinical proton beams”, main author Ana Lourenco). Also neutron dosimetry and angular distribution of neutrons was examined and results were also published in Radiation Protection and Dosimetry journal (“Angular distribution of neutron spectral fluence around phantom irradiated with high energy protons”, main author Zdenek Vykydal). In PC we actively collaborate with radiobiology group in Department of Dosimetry of Czech Academy of Science, providing irradiation of different cell lines in order to estimate RBE in proton pencil beam radiotherapy.

PTC also closely collaborates with Department of Dosimetry and Application of Ionisation Radiation at Czech Technical university. Students of medical physics are working on their master or PhD thesis in PTC.

Above mentioned experiments were integrated into patient flow in time when there was ramp up period of number of daily treatments. Preparation of experimental equipment in patient treatment rooms is time demanding and for more time consuming experiments on the edge of possible.

The perspective of PTC in the field of research and development is to find a partner with strong scientific background and create long-term partnership for scientific collaboration. For this purpose PTC can offer very well defined and stable beam of protons with energies up to 235 MeV and beam currents up to 300 nA. This beam may be modified by equipment installed in the experimental room according to agreed purpose. PTC may also offer experienced staff in proton dose measurement and with excellent knowledge of medical physics

topics –from treatment planning to treatment delivery and clinical dosimetry.

**Presenter:** Dr VONDRACEK, V. (PTC)

**Session Classification:** New generation Ion Acceleration Beamlines