Contribution ID: **68** Type: **Invited**

Simultaneous cancer treatment and online imaging with radioactive ion beams at FAIR

Wednesday, 1 May 2019 11:35 (30 minutes)

Radiotherapy using accelerated heavy ions has the potential to overhaul cancer treatment and replace invasive techniques (surgery, catheter ablation) for selected noncancer diseases. However, particle therapy is hampered by the range uncertainty and requires more precision to fully leverage its physical advantages and expand the applications to noncancer diseases such as heart arrhythmia. The best way to visualize online the beam in vivo would be the use of ⊠+ emitters for treatment. Radioactive ion beams (RIB) with positron emitting isotopes can in fact be visualized by PET. Compared to PET monitoring of stable particles [1], RIB improve the count rate by orders of magnitude, eliminate the shift between the peaks of measured activity and dose, and reduce the impact of washout using short-lived isotopes and acquisition times. The use of RIB as a pre-treatment range probe had been already proposed many years ago, but therapeutic use was hampered by the low intensity achievable at conventional accelerators [2]. The RIB intensity will be increased x10,000 at FAIR compared to the current beams [3]. This means that currents around 107-108 pps will be reached. We will will especially concentrate on isotopes with short half-life t1/2, such as 10C, which have obviously the greatest potential for online beam monitoring. At FAIR, RIB are produced using the in-flight technique and are separated in an electromagnetic separator: the FRS. From SIS18, using the FRS, the beam can be directed to the Cave M, where we can exploit the medical equipment including the online BASTEI PET. We will then perform physical beam dosimetry in a water phantom and biological dosimetry in a cellular phantom to assess the biological effectiveness of the RIB. Finally, the system will be tested in an animal model. The goal of the project is to achieve a resolution <0.3 mm during the treatment.

[1] K. Parodi, Vision 20/20: Positron emission tomography in radiation therapy planning, delivery, and monitoring. Med Phys (2015) 42:7153–7168.
[2] M. Kanazawa et al., Application of an RI-beam for cancer therapy: In-vivo verification of the ion-beam range by means of positron imaging. Nucl Phys A (2002) 701:244–252.
[3] M. Durante et al., Applied nuclear physics at the new high-energy particle accelerator facilities. Phys. Rep. (2019). DOI: 10.1016/j.physrep.2019.01.004

Primary author: Prof. DURANTE, Marco (1GSI Helmholtzzentrum für Schwerionenforschung, Biophysics Department, Darmstadt, Germany)

Presenter: Prof. DURANTE, Marco (1GSI Helmholtzzentrum für Schwerionenforschung, Biophysics Department, Darmstadt, Germany)

Session Classification: Radioisotope beams in hadron therapy

Track Classification: Radioisotope beams in hadron therapy