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Charge breeding investigations for a future ^{11}C treatment facility

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Within work-package 2 of the MEDICIS-Promed ITN we study the possibilities of using a radioactive therapy beam in hadron therapy. In particular, ^{11}C (β^+ emitter, $t_{1/2}=20.3$ min) is investigated as it has excellent properties for both on-line and off-line PET imaging, which can be used for dose verification. While ions are produced abundantly in conventional hadron therapy with stable carbon, it is highly challenging to provide a radioactive beam of adequate intensity for treatment. The main challenge of this work lies in linking the production of a continuous, molecular CO^+ beam from an ISOL-target with a low repetition-rate medical accelerator. The concept of accumulation, breeding and post-acceleration of radioactive carbon beams was tested at REX-ISOLDE.

Different possibilities of using a charge breeding stage as a CO beam preparation tool for hadron therapy with a synchrotron are laid out and investigated with regard to their feasibility and technical limitations. Measurement data taken at ISOLDE is presented that quantifies the behaviour and limitations of the Penning trap and EBIS under the extreme conditions of high-intensity, low repetition-rate beams. Thereby, various injection scenarios that correspond to different design options for a hadron therapy beam preparation stage are compared. Finally, a green field approach is presented, that discusses possibilities of matching the radioactive beam with future medical accelerators, in particular with a fast all-linac system.

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