COMPACT HADRON DRIVERFOR CANCER THERAPIES USING CONTINUOUS ENRGY SWEEP SCANNING

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A design of a compact hadron driver for future cancer therapies based on the induction synchrotron that has been recently published is previewed. To realize a slow extraction in a fast-cycling synchrotron, which allows energy-sweep beam-scanning, a zero momentum-dispersion region and a high flat region are necessary. The proposed design meets both requirements, which has two-fold symmetry with a circumference of 52.8 m, a 2m-long dispersion-free section, and a 3m-long large dispersion flat section. The ring can deliver heavy ions (200 MeV/au) at 10 Hz. A beam fraction is dropped from the barrier bucket at the desired timing, and the increasing negative momentum deviation of this beam fraction becomes large enough for the fraction to fall in the electrostatic septum extraction gap, which is placed at the large dispersion region. The programmed energy sweep extraction enables scanning beam irradiation on a cancer site in depth. Details of the lattice parameters and computer simulations for slow extraction are discussed.

It is emphasized that the proposed hadron driver allows us to explore a novel 3D or 4D spot scanning on moving organs because of the continuous extraction with energy sweep from the fast cycling accelerator in an extremely shorter time period of 10-20 msec than a typical moving time period of a few seconds This suggests that any gantry will be not required for a patient who can endure forced rotation of his body. Modification or move of his organ due to the gravitation can be tracked by the pencil beam.