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Democratization of Particles Therapy: Design of The Most Compact Multiroom Particle Therapy Facility

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Particle therapy has advantages over conventional radiotherapy, but is not so widespread because of significant facility costs. In this work, we developed a compact, low-cost, expandable and high-performance beamline for a multi-room particle therapy facility. The accelerator is located at a lower level (underground) and the beamline guides the particles to treatment rooms located on the upper level of the floor. Such a compact beamline can rotate 360o about the vertical axis to deliver beams to the treatment delivery rooms, which are then designed in a circular arrangement. The rotating beamline can then deliver beam to each treatment room, where the patient is treated in an upright position and rotated in front of a static treatment beam. The beamline characteristics have been calculated with BDSIM Monte Carlo simulations code. Simulation indicates that our beamline can transport full momentum spread (±5%) up to patient location allowing to have broadened Bragg peaks and ultra-high dose rates (>1000 Gy/s) to limit the field delivery time within a single breath-hold (5 second field delivery) even for large tumors. With this design, we can fit a single-room proton facility within an existing LINAC vault and a four-room facility within the area of a tennis court. We believe that such a high throughput and low investment cost facility could eventually allow to treat patients with particles at costs approaching that of conventional radiation therapy.

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Footnotes

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