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**Design Challenges of a Rapid Cycling Synchrotron for Carbon/Proton Therapy**[1] NATHAN COOK, Stony Brook University — The growing interest in radiation therapy with protons and light ions has driven demand for new methods of ion acceleration and the delivery of ion beams. One exciting new platform for ion beam acceleration and delivery is the rapid cycling synchrotron. Operating at 15Hz, rapid cycling achieves faster treatment times by making beam extraction possible at any energy during the cycle. Moreover, risk to the patient is reduced by requiring fewer particles in the beam line at a given time, thus eliminating the need for passive filtering and reducing the consequences of a malfunction. Lastly, the ability to switch between carbon ion and proton beam therapy provides the machine with an unmatched flexibility. However, these features do stipulate challenges in accelerator design. Maintaining a compact lattice requires careful tuning of lattice functions, tight focusing combined function magnets, and fast injection and extraction systems. Providing the necessary acceleration over a short cycle time also necessitates a five-fold frequency swing for carbon ions, further burdening the design requirements of ferrite-driven radiofrequency cavities. We will consider these challenges as well as some solutions selected for our current design.

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