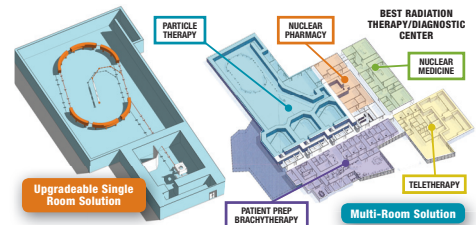


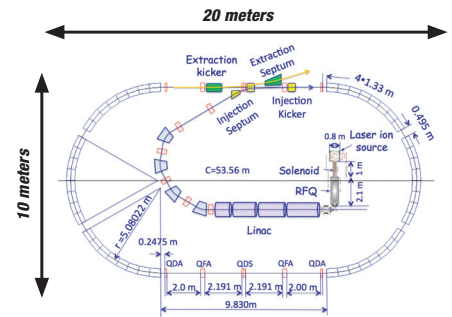
## ION RAPID CYCLING MEDICAL SYNCHROTRON (IRCMS)

The iRCMS is a state-of-the-art synchrotron designed for future cancer therapy facilities that foresee the need to deliver clinical or pre-clinical beams heavier than typical protons. We have optimized an accelerator design under the CRADA funded by BMI specifically for the generation of carbon ions with a maximum energy of 400MeV/u in addition to protons of typical clinical energies. The accelerator is optimized to cycle with a frequency of 15 Hz to the top energy required to deliver treatment at a maximum depth of 27 cm. The iRCMS uniquely combines advanced spot scanning with rapid energy modulation thereby eliminating the contamination associated with patient specific hardware. Extremely small beam emittances are also associated with rapid cycling, which facilitates the generation of particle beams with unprecedented precision. The iRCMS was conceived to include highly efficient single turn injection and extraction and shall utilize a linac to inject carbon ions and protons at a kinetic energy of 8 MeV/u.

### Single & Multi-Room Solutions



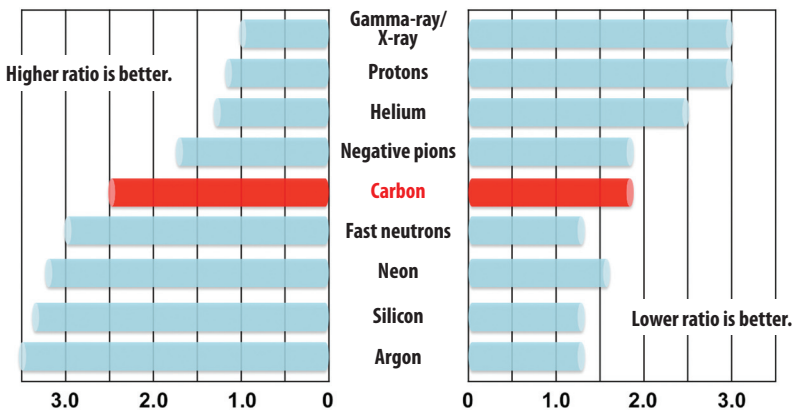
### Racetrack Smaller Area Footprint



Accelerator Comparison Table					
	Energy Maximum (MeV)	Avg. Current Delivered (nA)	Charge Accelerated (nC/s)	Maximum Credible Incidence (MCI)	
				Risk Ratio MCI/Delivered	Shielding (50 mSv/yr Concrete @10.00 m (m))
<b>Protons (206 MeV)</b>					
Isochronous Cyclotron (NC)	230	2	1250	625	2.89
Isochronous Cyclotron (SC)	250	2	313	156	2.44
Synchro Cyclotron (SC)	250	2	1	0.50	0.54
Slow Cycling Synchrotron	250	2	20	10	1.53
<b>Best ion Rapid Cycling Medical Synchrotron (iRCMS)</b>	<b>1200</b>	<b>2</b>	<b>0.133</b>	<b>0.067</b>	<b>0.13</b>

Best iRCMS is under development and not available for sale currently.

### RBE: Relative Biological Effectiveness OER: Oxygen Enhancement Ratio

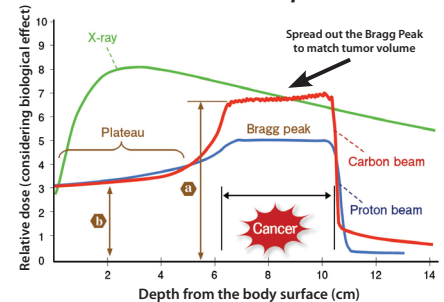


RBE represents the biological effectiveness of radiation in the living body. The larger the RBE, the greater the therapeutic effect on the cancer lesion.

OER represents the degree of sensitivity of hypoxic cancer cells to radiation. The smaller the OER, the more effective the therapy for intractable cancer cells with low oxygen concentration.

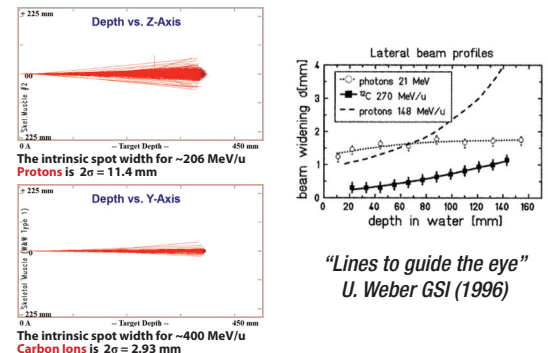
### Clinical Comparison: X-rays, Protons & Carbon Ions

Peak-to-Plateau ratio of the RBE (a/b) is larger in carbon ion beams than for proton beams.



Protons - Base/Peak = 60% Carbon Ions - Base/Peak = 45%

### Carbon Ions more precise than Protons



"Lines to guide the eye"  
 U. Weber GSI (1996)

Adapted from M. Subramanian, S.G. Peggs, J.P. Lidestri, J.K. Kandaswamy, K.Suthanthiran • PTCOG 55, Prague, CZ, May 2016.