

Best Medical International signs a Memorandum of Understanding with University of Wisconsin Medical Radiation Research Center (UWMRRC) to develop Revolutionary New Carbon Therapy

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Best Medical International and Best Particle Therapy of TeamBest Companies, have recently entered into a Memorandum of Understanding (MOU) with the University of Wisconsin Medical Radiation Research Center (UWMRRC).

Best Particle Therapy will be introducing their unique 400 MeV ion Rapid Cycling Medical Synchrotron (iRCMS) with Variable Energy, Heavy Ion Treatment Technologies, offering Proton-to-Carbon Heavy Ion, for Highly Precise, Conformal and Hypo-Fractionated Radiation Therapy. This will be the most advanced new technology for Cancer Therapy, enhancing the cure for many millions of Cancer patients, who do not have this option currently.

The advantages of the Best 400 MeV iRCMS are:

- Intrinsically small beams – facilitating beam delivery with precision for the most conformal radiation therapy
- Hypo-fractionated radiation therapy
- Small beam size – small magnets, light gantries – smaller footprint
- Highly efficient single turn extraction – less shielding
- Flexibility – heavy ion beam therapy (protons and/or carbon), beam delivery modalities.

In partnership with Best Cure Foundation (BCF), TeamBest Companies will set up a Hub-and-Spoke Model of Healthcare Delivery System, using Express and Mobile Clinics, linked to General and Multi-Specialty Medical Centers, using all of TeamBest's new and advanced technologies globally.

University of Wisconsin and Best Medical are excited about the collaboration, as this brings much needed carbon ion therapy to Midwestern states such as Illinois, Wisconsin, Indiana, etc.

For more information, please visit: www.teambest.com and www.bestcure.md.

For more information about Krishnan Suthanthiran, please visit his bio page at: http://www.teambest.com/about_bio.html.

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BestTM Particle Therapy

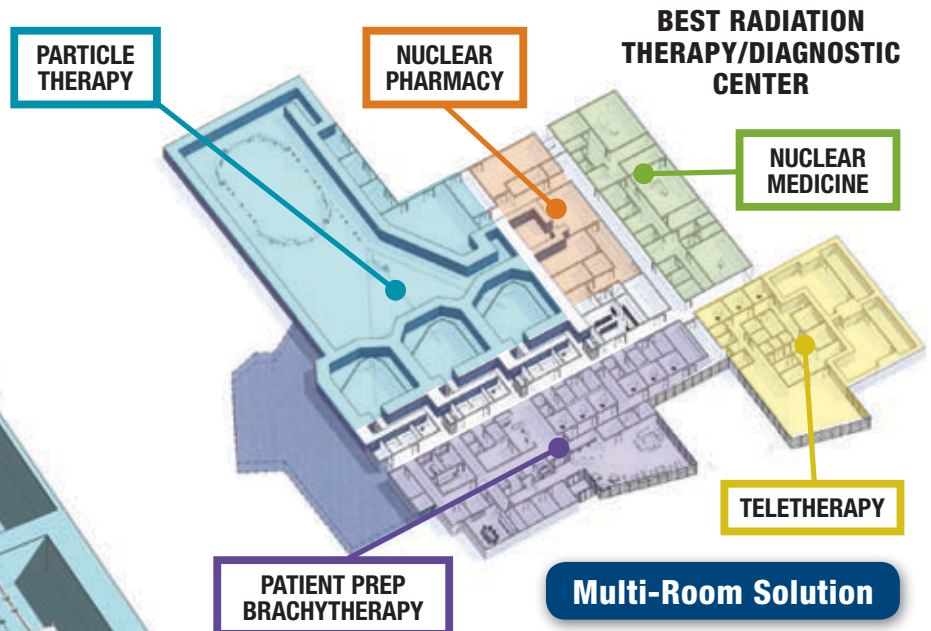


Upgradeable Single Room Solution

Best Particle Therapy is developing a Proton-to-Carbon therapy system to deliver energetic particle beams of protons and carbon ions, achieving a high level of precision to treat deep-seated as well as radiation-resistant tumors.

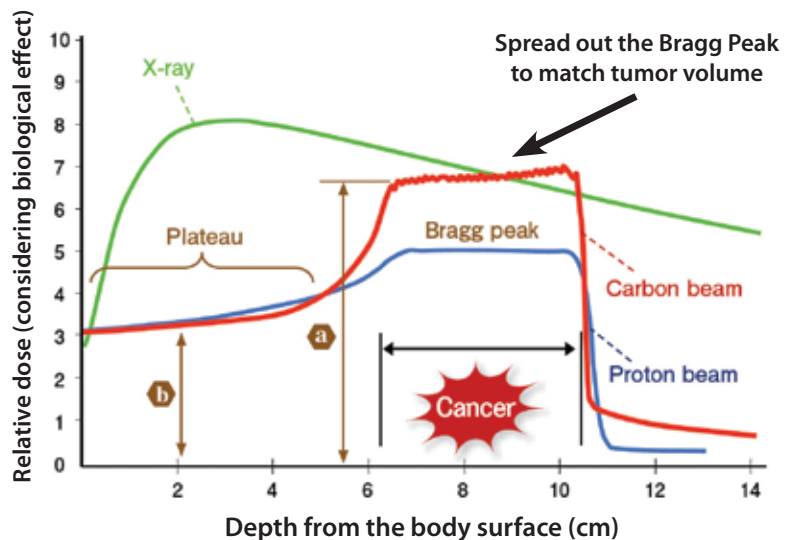
400 MeV Rapid Cycling Medical Synchrotron for Proton-to-Carbon Heavy Ion Therapy:

- A unique combination of advanced spot scanning with rapid energy modulation
- Elimination of neutron contamination associated with patient specific hardware
- Intrinsically small beams facilitating beam delivery with precision
- Small beam sizes – small magnets, light gantries – smaller footprint
- Highly efficient single turn extraction
- Efficient extraction – less shielding
- Flexibility – heavy ion beam therapy (proton and/or carbon), beam delivery modalities



Prototype iCMS Combined Function Magnet

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

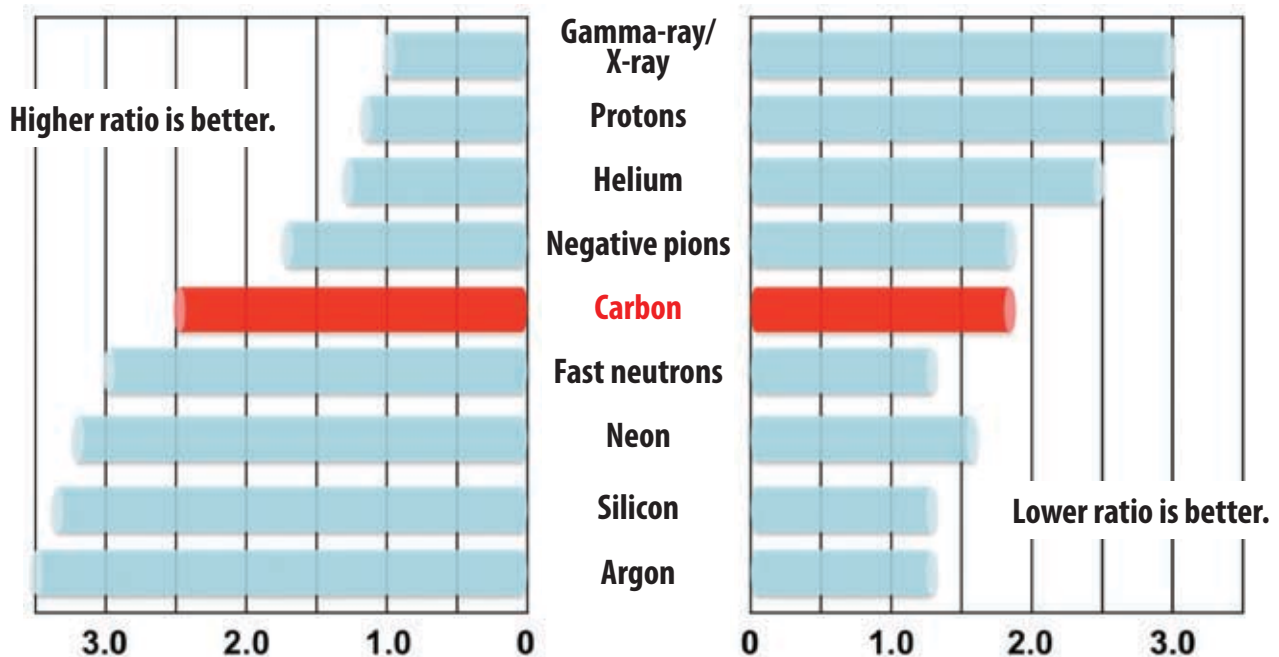


Graph courtesy of Hirohiko Tsujii et al., Radiological Sciences, 50(7), 4, 2007

Accelerator Comparison Table

				Maximum Credible Incidence (MCI)	
	Energy Maximum (MeV)	Avg. Current Delivered (nA)	Charge Accelerated (nC/s)	Risk Ratio MCI/ Delivered	Shielding (50 mSv/yr) Concrete @10.00 m (m)
Protons (206 MeV)					
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
Best ion Rapid Cycling Medical Synchrotron (iRCMS)	1200	2	0.133	0.067	0.13

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.

* Specifications are subject to change. Product shown not available for sale currently.

BestTM Particle Therapy

ION RAPID CYCLING MEDICAL SYNCHROTRON (IRCMS) STATUS AND FUTURE PLANS

Manny Subramanian¹, Stephen G Peggs², Joseph P. Lidestri³, JK Kandaswamy¹, Krishnan Suthanthiran¹

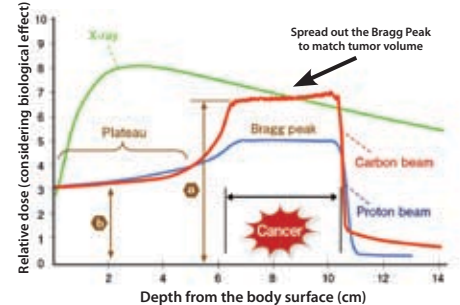
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PTCOG 55 • PROTON THERAPY CENTER • PRAGUE, CZECH REPUBLIC • MAY 22–28, 2016

Best Medical International (BMI) entered a Cooperative Research and Development Agreement (CRADA) with Brookhaven National Laboratory to advance the design of the 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. The Collider Accelerator Department (CAD) at Brookhaven National Laboratory (BNL) has 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 lattice design is a racetrack with two zero dispersion parallel straight sections ideal for injection, extraction and RF systems. The racetrack is 12 meters wide and 23 meters long with the two arcs having a bending radius of ~5 meters. These arcs are made up of 24 combined function magnets with a maximum magnetic field of $B_{max} \sim 1.3$ Tesla. 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.

Clinical Comparison: X-rays, Protons & Carbon Ions

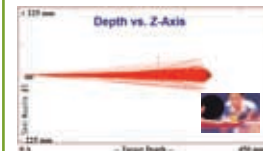
Peak-to-Plateau ratio of the RBE (a/b) is larger in carbon ion beams than for proton beams.



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

Graph courtesy of Hirohiko Tsuji et al., Radiological Sciences, 50(7), 4, 2007

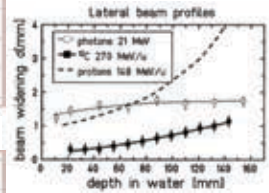
Carbon Ions are more precise than Protons



The intrinsic spot width for ~206 MeV/u Protons is $2\sigma = 11.4$ mm

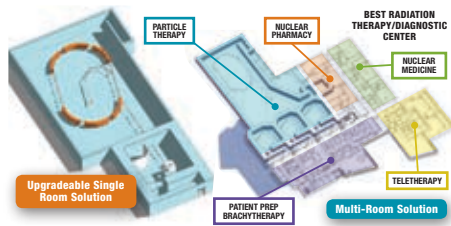


The intrinsic spot width for ~400 MeV/u Carbon ions is $2\sigma = 2.93$ mm



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

Best Particle Therapy Rapid Cycling Synchrotron



Best Medical Synchrotrons with Variable Energy from Proton to Carbon, in Single or Multi-Room Solutions, with or without Gantry



Advanced Beam Delivery – Less Shielding



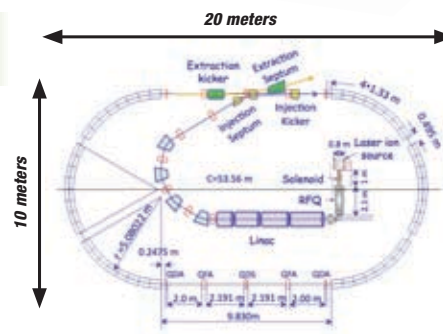
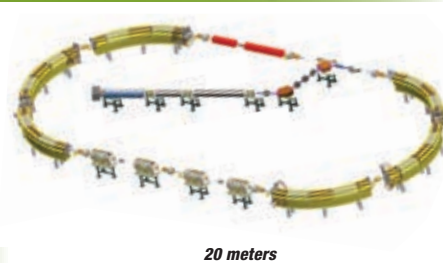
Shielding Estimate Comparisons

	Accelerator Comparison Table				
	Energy Maximum (MeV)	Avg. Current Delivered (nA)	Charge Accelerated (nC/s)	Risk Ratio MCV Delivered	Shielding (50 mSv/yr) Concrete @10.00 m (m)
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Slow Cycle Synchrotron	250	2	20	10	1.53
Rapid Cycle Synchrotron	1200	2	0.133	0.067	0.13

Estimates above were calculated using the Moyer Model
Neutron source terms for 177 MeV protons
Neutron transmission factors
Neutron attenuation length in concrete (SLAC PUB 130339)

Final shielding calculations use a full scale Monte Carlo method (MCNPX, GEANT, FLUKA)

Racetrack Synchrotron – Smaller Area Footprint



Prototype iRCMS Combined Function Magnet



Summary

BMI & BNL have jointly developed a rapid cycling proton/carbon synchrotron that enables advanced features including:

- A unique combination of advanced spot scanning with rapid energy modulation
- Elimination of neutron contamination associated with patient specific hardware

Rapid cycling technology has several natural advantages:

- Intrinsically small beam emittances facilitating beam delivery with unprecedented precision
- Small beam sizes – small magnets, light gantries – smaller footprint
- Highly efficient single turn extraction
- Efficient extraction, less charge per bunch – less shielding
- Flexibility – protons and or carbon, future beam delivery modalities

BestTM Cyclotron Systems

Best Cyclotron Systems provides 1–3 MeV Deuteron Cyclotrons (NEW Patent Pending), 70–150 MeV Proton Therapy Cyclotrons (NEW Patent Pending), 3–90 MeV High Current Neutron Production Cyclotrons (NEW Patent Pending) as well as 15/20u/25/30u/35/70 MeV Proton Cyclotrons & 35/70 MeV Multi-Particle Alpha/Deuteron/Proton Cyclotrons

- Currents from 100uA to 1000uA (or higher) depending on the particle beam are available on all Best Cyclotron Systems
- Best 20u to 25 MeV and 30u to 35 MeV are fully upgradeable on site

NEW Best Cyclotrons	1–3 MeV	Deuterons for materials analysis (Patent Pending)
	70–150 MeV	For Proton Therapy (Patent Pending)
	3–90 MeV	High current proton beams for neutron production and delivery (Patent Pending)
Best 15p Cyclotron	15 MeV	Proton only, capable of high current up to 1000 Micro Amps, for medical radioisotopes
Best 20u/25p Cyclotrons	20, 25–15 MeV	Proton only, capable of high current up to 1000 Micro Amps, for medical radioisotopes
Best 30u/35p Cyclotrons	30, 35–15 MeV	Proton only, capable of high current up to 1000 Micro Amps, for medical radioisotopes
Best 70p Cyclotron	70–35 MeV	Proton only, capable of high current up to 1000 Micro Amps, for medical radioisotopes
Best 150p Cyclotron	From 70 MeV up to 150 MeV (non-variable)	For all Medical Treatments including Benign and Malignant Tumors for Neurological, Eye, Head/Neck, Pediatric, Lung Cancers, Vascular/Cardiac/Stenosis/Ablation, etc. (Patent Pending)

Best 15



15 MeV
100–1000 μA

Best 20u/25



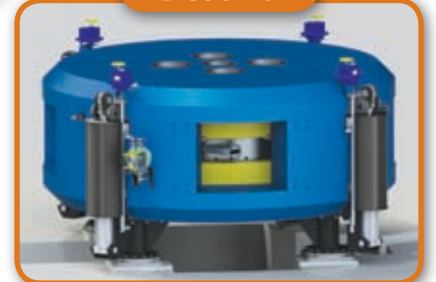
20, 25–15 MeV
200–1000 μA

Best 30u/35

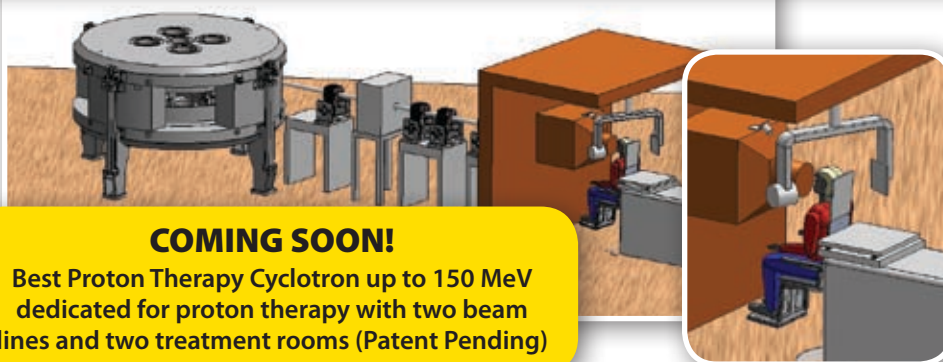


30, 35–15 MeV
400–1000 μA

Best 70



70–35 MeV
700–1000 μA



COMING SOON!

Best Proton Therapy Cyclotron up to 150 MeV dedicated for proton therapy with two beam lines and two treatment rooms (Patent Pending)

Installation of Best 70 MeV Cyclotron at Italian National Laboratories (INFN), Legnaro, Padua, Italy





Introducing...Exciting new products under development from TeamBest® Companies!

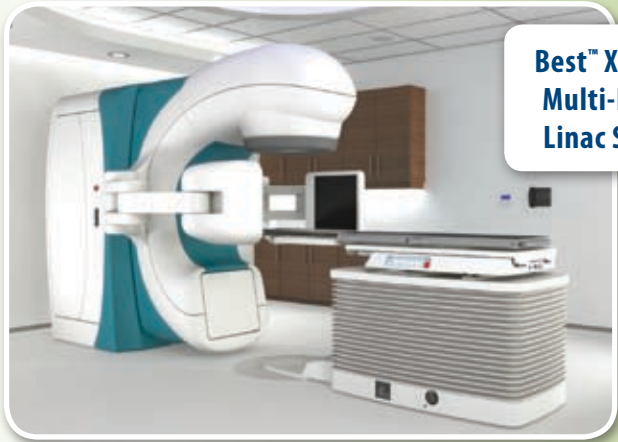
Best™ E-Beam™ Robotic IORT Linac System



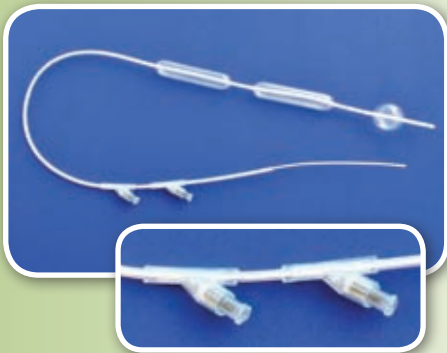
Best™ X-Beam™ Robotic Radiosurgery System



Best™ X-Beam™ Multi-Energy Linac System



Best™ Intra Luminal Balloon Applicator (Esophageal)



Best™ HDR Afterloader



Best™ Double-Balloon Breast Brachytherapy Applicator



* Certain products shown are not available for sale currently.

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