UWMCF Quick Facts

Original equipment cost: $4 million

Original building cost: $3 million

History

The UW Medical Cyclotron Facility was built in 1979 as part of a National Cancer Institute grant that funded multiple fast neutron therapy (FNT) centers around the country. The UWMCF is currently the only fully operational, hospital-based clinical fast neutron therapy facility in the country.

Original principal investigators: Tom Griffin and Peter Wootton.
Accelerator and beam transport built by: Scanditronix (Uppsala Sweden)
Gantry and therapy system built by: Elven (Crawley England).
First patient treated: October 1984.

Until 2012, the facility was referred to as the Clinical Neutron Therapy Facility (CNTS). While we still continue to treat patients with FNT, our facility has diversified over the years and has expanded to include many emerging areas of medical research.

UWMCF Technical Support Group

Robert Emery, M.S., director

Jon Jacky, Ph.D., computer systems, control systems
Tobin Weber, Ph.D., physics, engineering, controls
Eric Dorman, B.S., physics, engineering, operations
Stefani Banerian, M.S., computer systems, control systems
Dave Argento, Ph.D., engineering, operations
Greg Moffitt, M.S., engineering, oeprations

Accelerator:

BEAM CAPABILITIES OF THE UW MC-50 CYCLOTRON

Particle	Ion	Energy Range [MeV]	Comments
Proton	H+ H2+	28.0 to 50.5 6.8 to 12.0	75 uA at 50.5 MeV
Deuteron	D+	13.6 to 23.8	50 uA (during acceptances tests)

3He	3He+ 3He++ 3He++	9.5 to 15.5 9.5. to 15.5 20.3 to 35.7	Not tried Not tried
Alpha	4He++	27.0 to 47.3	50 uA at 28.0 MeV, 70 uA at 47.3 MeV

In addition to the energies directly available out of the accelerator, we can achieve any energy below the max available energy using degraders.

Accelerator: Scanditronix MC50, compact room temperature design. Final commissioning in 1984. 3 Spiral sector design. 90% Extraction efficiency for protons at 50.5 MeV.

Cyclotron Magnet	1.7 T
Power consumption	500 kW
Extraction radius	59 cm
Pole Diameter of main magnet	155 cm
RF Cavity Frequency Range	19.6-25.9 Mhz

FAST Neutron Therapy:

Materials In Beam path
Starting at Target:

Target	10.5 mm Beryllium
Target Housing	3.0 mm Copper
Target Cooling	2.0 mm Water
Target End cap	2.0 mm Phosphor Bronze CDA 510
X-Ray Drawer / Primary Collimator	Electrolytically pure Iron
Flattening Filters	Mild Steel
Ion Chamber Entrance and Exit	1.0 mm Graphite
Ion Chamber HV Disks	3.0 mm A150 Plastic (2x)
Beam Defining Light Mirror	1.0 mm Titanium (at 45 degree angle)
Wedges - 30°, 45°, 60°	Heavy Metal (95% W,1.5% Fe, 3.5% Ni)
Collimator Leaves	Pure Iron with Polyethylene Inserts
Collimator Exit Window	2 mm Plexiglas

Target:	Beryllium cylinder 10.5mm long, 12.7mm diameter. Half of the proton energy deposited here to create fast neutrons. Remaining proton energy is deposited in 3mm copper backing. Beryllium is not fully stopping to reduce number of low energy neutrons generated. Target life = 7000 fields at 3.5 kW beam power.
Average Neutron Energy:	22 MeV
Onboard Ion Chamber:	PTW 3404 transmission chamber with four “half moon” segments. The up/down and left/right segments are operated as independent chambers providing dual chamber redundancy. RTD sensor for automatic temperature correction. The chamber charge signals are processed by Scanditronix recirculating type integrators. The dose monitor controller operates independently from the rest of the control system.
Dose rate:	A servo system keeps the dose rate at 60 MU/min. This is the standard dose rate and is the maximum we can run without constant operator attention. Average dose rate during a standard run is 5% to 10% lower because of intensity ramping at start-up and occasional RF sparks.
Dose/Monitor Unit:	1.00 cGy/MU
Beam Flattening Filter:	Iron flattening filter, no beam hardening filter
Wedges:	3 internal wedges, which can be oriented in all four cardinal positions with respect to the collimator leaves. Wedges are made from “Heavy Metal”, 95% W, 1.5% Fe, 3.5% Ni)
X-Ray Tube:	kV tube is inserted in beam path for port films
Source-Axis Distance:	150 cm
Depth of Maximum Dose:	d-Max=1.5 cm-1.7cm
Collimation:	Motorized 40 Leaf - Multi-leaf Collimator. Leaf edges are focused to beryllium target in X and Y directions.
Collimator length:	65 cm
Collimator composition:	Iron/polyethylene (plastic)

Distance to Isocenter:	Downstream end of collimator 44 cm from isocenter. Collimator accessory ring is 34 cm from isocenter.
Field Sizes:	At Isocenter: X-Direction 0-28.5 cm Continuously variable Y-Direction 0-32.5 cm Variable in increments of: 1.5 cm (0-15 cm) 2.0 cm (15-35 cm)
Weight of collimator:	1.7 t
Gantry Weight:	37 t
Gantry arm/head/collimator:	11 t
Isocentric Gantry Rotation:	± 185 deg
Collimator Rotation:	77 - 284 deg
Treatment Planning System:	Prism 1994-2012 Pinnacle 2012-
Patients:	First treatment: 19-OCT-84 3000+ Patients treated from 84-Present 311 Patients Treated in Last 5 years 32% Major Salivary Glands 32% Minor Salivary Glands 13% Secondary Malignancies 5% Bones and Joints

Isotope Production:

Isotope	Beam	Energy	Status
Sn-117m	Alpha	47.3 MeV	Regular Production
At-211	Alpha	29.0 MeV	Regular Production
Re-186	Deuteron	???	Investigating
Np-236	Deuteron	???	Investigating

Operating Schedule:

Available for fast neutron therapy (FNT) patient treatment: Tues-Fri, 8am-6pm.
Available for research: Tues-Fri, 5am-7:30am, 6pm-11pm, Sat/Sun on request.
Mondays generally reserved for maintenance unless otherwise requested.

Current Research Programs Supported:

Radionuclide production: Scott Wilbur, Ph.D.

Precision Proton Radiotherapy Platform: Eric Ford, Ph.D.

Monte Carlo modeling of neutron dose profile and biological effects: Rob Stewart Ph.D.

Absolute dose measurements of proton beam using laser interferometery:
Juergen Meyer, Ph.D.

Neutron activation PET imaging: Rob Stewart, Ph.D., Robert Miyaoka

Radiation effects testing: Rob Emery, M.S.

Neutron IMRT: Rob Emery, M.S., Rob Stewart Ph.D.