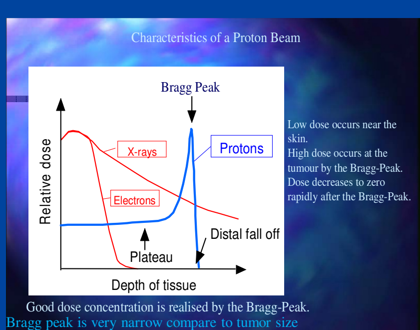
Will the High Cost of Proton Therapy Facilities Limit the Availability of Proton Therapy Treatment?

Richard L. Maughan
University of Pennsylvania

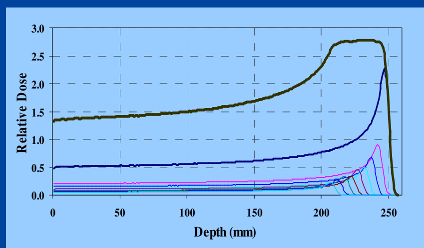
Disclaimer: University of Pennsylvania has a Proton Therapy Facility

The Rationale

The Bragg Peak



Spread-Out Bragg Peak



Adding together Bragg peaks from multiple beam energies with independent weights can generate a flat region at the tumor at the expense of increasing the entrance dose

4

The Proton Beam Delivery System

5

Scattered or Scanned Beam?

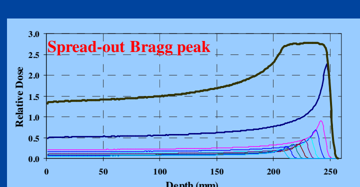
To use the proton beam for treatments it must be spread-out in the lateral and depth directions. There are several ways to do this:

Depth

- **Passive using Modulator wheels or Ridge filters**
- **Active by bringing in different energy protons**

Transverse

- **Passive using double scatterers**
- **Active by magnetically steering the protons across the target**

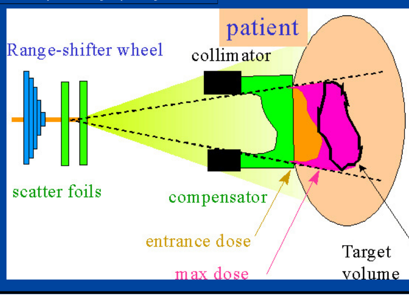


6

Double-Scattering

A set of scatterers and modulators spread the beam in the transverse and depth directions and field specific apertures and compensators are used to conform to the target.

http://radmed.webntry/scan/n_scattering.html.psi.ch/asm/ga



7

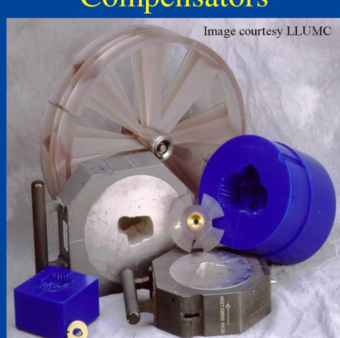
Proton Beam Delivery Options

Uniform Scanning (aka Wobbling)

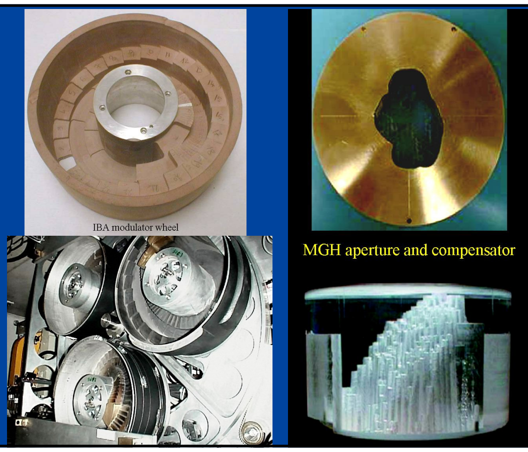
- Large spot (~ 5 cm diameter FWHM)
- Lateral Field Shaping – Aperture or MLC
- SOBP – Modulator wheel
- Distal Edge Shaping – Patient Specific Compensator
- Allows for much larger field sizes – up to 30 cm x 40 cm

8

Modulator Wheel, Apertures and Compensators



9



IBA modulator wheel

MGH aperture and compensator

MLC for Double Scattering

Proton Beam Delivery Options

Modulated Scanning (aka Pencil Beam Scanning)

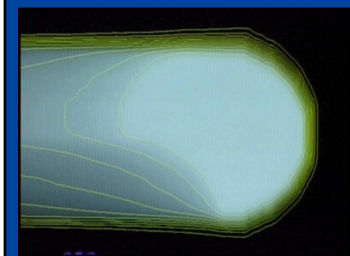
Energy selection outside treatment room – selects depth of penetration of beam spot.

X and Y magnet scanning to provide lateral beam shaping
Beam spot Gaussian determines beam penumbra characteristics.

12

Spot Scanning - The Principle

The dynamic application of scanned and modulated proton pencil beams



A full set, with a homogenous dose conformed distally *and* proximally

13

Images courtesy of E Pedroni and T Lomax, PSI

New Technology for Capital Cost Reductions

14

Reducing Capital Costs Of Proton Therapy System

- To date all operational systems have multiple treatment rooms with beams supplied by a single accelerator, with high patient throughput to recover the large capital costs.
- As the accelerator and beam transport systems are expensive items, one room solutions combined with less expensive compact accelerator solutions have been advocated.

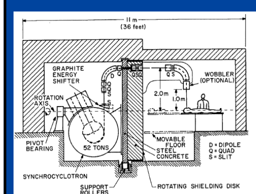
15

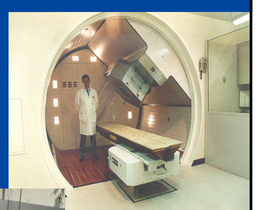
Compact Accelerators

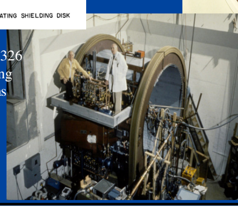
1. A gantry mounted Superconducting Synchrocyclotron. Built by Mevion originally installed at Washington University, St Louis.
2. A gantry mounted Dielectric Wall Accelerator (DWA). Under development by Compact Particle Accelerator Corporation (CPAC).
3. A gantry mounted Laser Accelerator. Basic research in many laboratories around the world.

16

Superconducting Synchrocyclotron



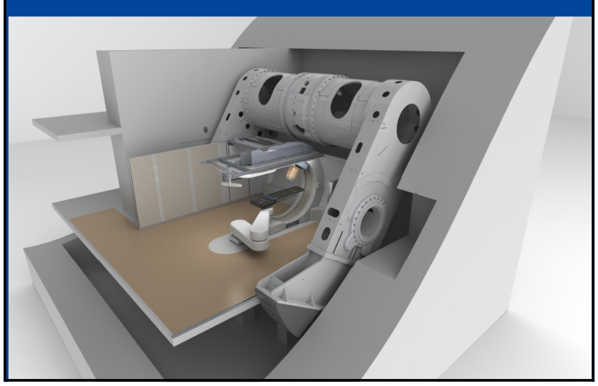




Blosser, NIM 1989, **41**, 1326 "Compact Superconducting Synchrocyclotron Systems for Proton Therapy."

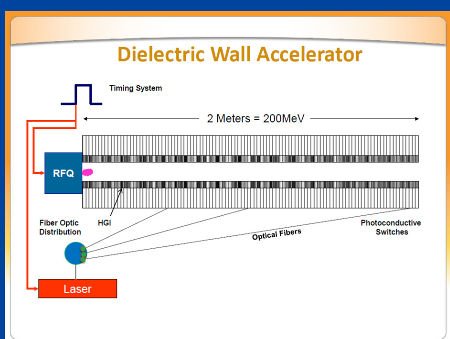
17

Mevion Superconducting Synchrocyclotron



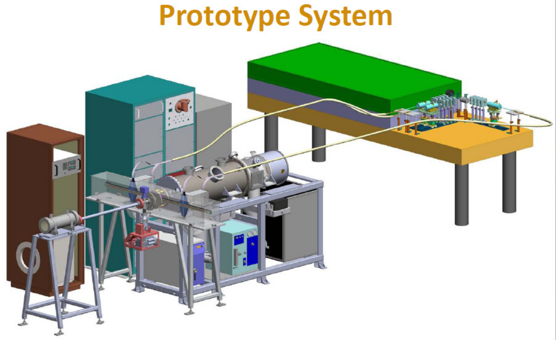
Mevion Superconducting Synchrocyclotron

CPAC Dielectric Wall Accelerator



20

Prototype System

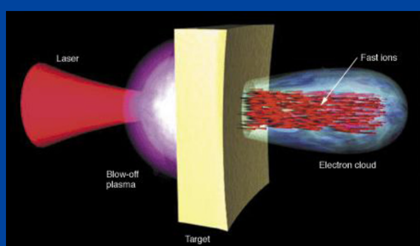


Objective

- Deliver a 50-200MeV, 3-30 pC per pulse, fixed beam, compact (~5 m length) proton accelerator
  - Current target completion date: 2015

22

Laser Acceleration

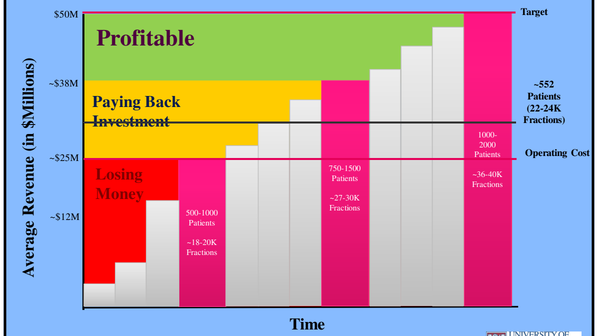


23

The Business Plan

24

2000 Patients Per Year



Source:The National Accociation for Proton Therapy, Proton News, Catching the Proton Wave,Charlotte Huff

UNIVERSITY OF PENNSYLVANIA Abramson Cancer Center

25

The Financial Challenge of PT

"according to the Advisory Board analysis. M.D. Anderson's Latinkic, predicts that it could be as long as 10 years before investors start turning a profit" *

It can be quicker if you plan for it.

**Source:The National Accociation for Proton Therapy, Proton News, Catching the Proton Wave,Charlotte Huff*

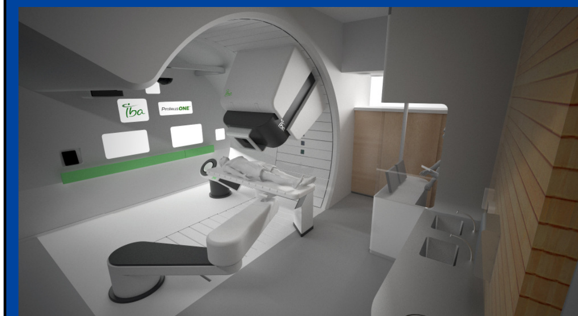
26

Role of Single Room Systems

- Reduced capital costs, start-up, training and staffing costs make the technology accessible to many smaller institutions.
- Business plan may not be as attractive.
- Cost per room relative to large facility – is it lower?
- The established vendors are offering one accelerator, one gantry system on a limited foot print to compete

27

One Room Solution Based on Established Technology



The Business Plan

- Currently in the USA high capital costs are compensated by high reimbursement.
- Therefore, business plans remain attractive.

Professional Symposium,
Thursday 1:00 pm – 1:55 pm
"Economics of Light Ion Therapy"
Michael Moyers

29

Project Plan

30

Formal Project Plan

- Major milestones established with vendor
- Timeline established for installation, acceptance, commissioning and first treatment
- Financial incentives to vendors for "on time delivery"
- Biweekly formalized review of progress at Proton Steering Committee Meetings
- Ramp up plan
- Annual budget for personnel, travel, software development/IT infrastructure, ramp up plan

31

31

Formal Project Plan Challenges

- Must be prepared to be flexible; highly probable that revision will be needed.
- For a large multi-room system, time sharing for continuing system validation, acceptance, commissioning and patient treatment is a particularly challenging as the program ramps-up.

32

Project Implementation and Ramp-Up

33

Form a Core Team

- 3 Medical Physicists - preferably one with accelerator expertise and all with extensive clinical experience
- 3 Physicians - active clinicians who understand the clinic/work flow
- Departmental Chief Operating Officer
- 1 Senior level Health System Administrator
- 1 Project Manager

34

Implementation Challenges

- Vendor cooperation & collaboration
- Identify and recruit required human resources
- Constant attention to the project plan
- Focus on the goals & principles – with flexibility

35

Credentialing & Training

- Hire physicists and technical staff with proton experience
- Send physicists & physicians to other proton therapy centers for training
- Use existing Training Centers
- Formal educational program for staff with associated assessment of competencies
- Proton planning is different need to have/gain in depth understnding of range uncrtainty.

36

Project Implementation and Ramp-up Involves Time and Money

- Project Management (Physicians, Physicists and Administration)
- Start-up/Ramp-up Staffing
- Training (Physicians, Physicists, Dosimetrists and Therapists).
- The time and expense involved is much greater than for starting-up a new conventional therapy facility.

37

Beyond Implementation: On-going Challenges

38

Ongoing Challenges

- Operational Efficiency
  - people and processes: a local issue
  - equipment and option choices
- Continuing Credentialing & Training
- Maximizing system relaability/up-time: generally the Vendor's responsibility
- External Forces: such as reimbursement

39

Team in Proton Therapy at Full Capacity Operation

Personnel	1 Room	Multi-Room 2	Multi-Room 5
Physicians	2-3	4-5	10-12
Physicists	2-3	4-5	10-12
Dosimetrists	2-3	4-6	10-15
Therapists	7-8	12-14	35
Nurses	2	4	10
Admin. Support	1-2	2-3	5-7

Summary Slides

41

What Are the Cost?

ITEM	1 Room	Multi-Room 2	Multi-Room 5
Equipment + Building	$30 M	$60 M	$140 M
Start-up/Ramp-up period Personnel Maintenance (start-up)	1 year $3-4M $0.3M	2 years $6-8M $0.5 M	3 years $15-20M $1.5 M
TOTAL (thro' start-up)	$3.3-4.3M	$6.5-8.5M	$16.5-21.5M
Annual Running Costs Personnel Maintenance	 $3-4M $1 M	 $6-8M $2 M	 $15-20M $4 M
TOTAL (Annual running)	$4-5M	$8-10M	$19-24M

42

How Can Costs be Minimized?

- Reduce costs by limiting scope:
  – less rooms saves capital costs on equipment and building
  – less running costs for maintenance and personnel
- Reduce costs by limiting available modality options – modulated scanning only (PBS)
  - Less capital cost on treatment nozzle
  - TPS costs reduced for less treatment planning options.
  - Planning less time consuming, fewer dosimetrists

43

Critical Success Factors for Proton Therapy in the USA

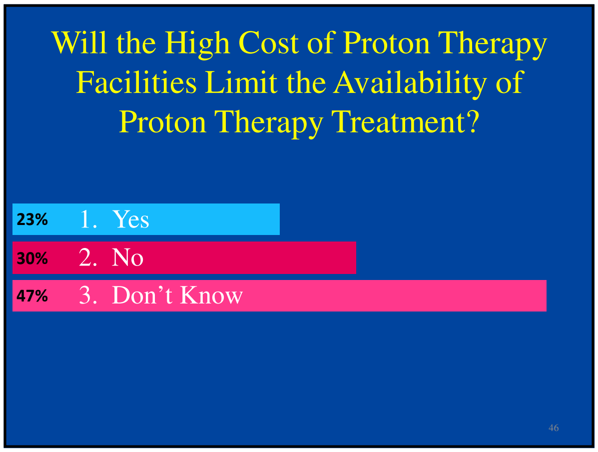
- Successful deployment of one room systems.
- Reimbursement rates remain higher than for photon therapy – Key issue.
- This requires more evidence that proton therapy is superior to photon across a range of disease sites.
  Cost-benefit evidence.
- Capital costs and start-up costs are not an issue provided reimbursement is maintained, since current business plans are feasible.

44

Conclusion

The Conclusion is yours - time to vote!

45


Will the High Cost of Proton Therapy Facilities Limit the Availability of Proton Therapy Treatment?
23% 1. Yes
30% 2. No
47% 3. Don't Know
46