Novel Technologies for Cancer Therapy and Research

HAMPTON UNIVERSITY
PROTON THERAPY INSTITUTE
FIGHTING CANCER, SAVING LIVES

BIOMEDICAL TECHNOLOGY FORUM

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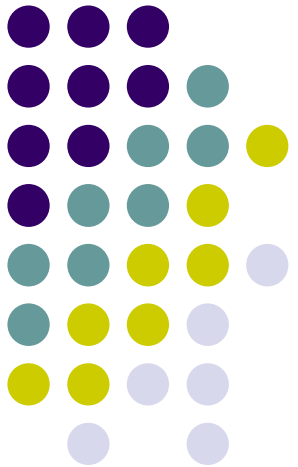
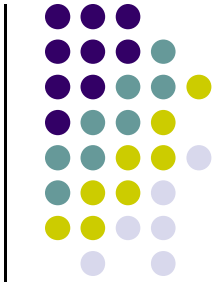


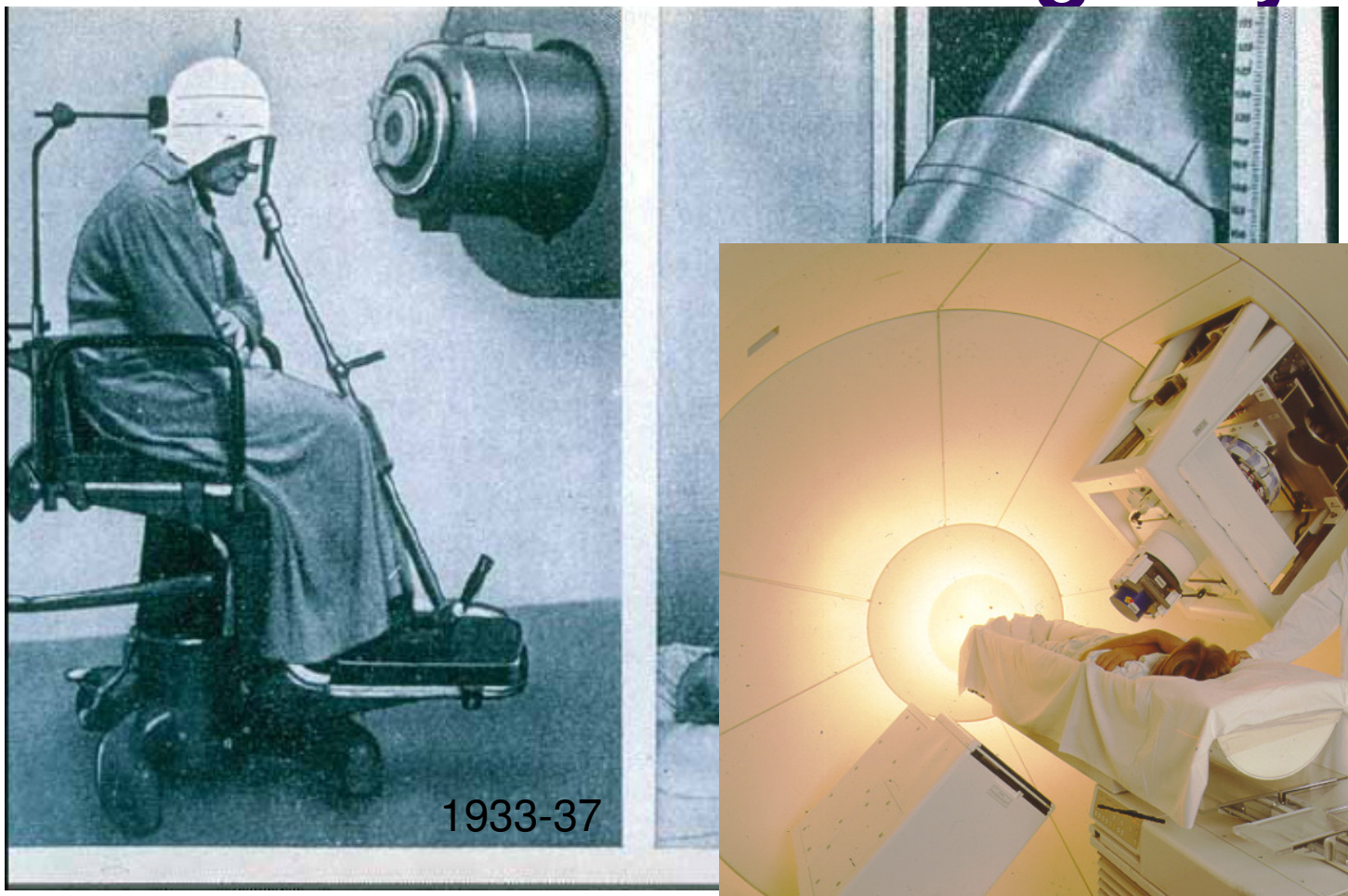
JLab, June 15, 2010

Outline



- Introduction to proton therapy
  - Dosimetric Advantages
  - Unique Challenges
  - Delivery Techniques
- HUPTI
- Research

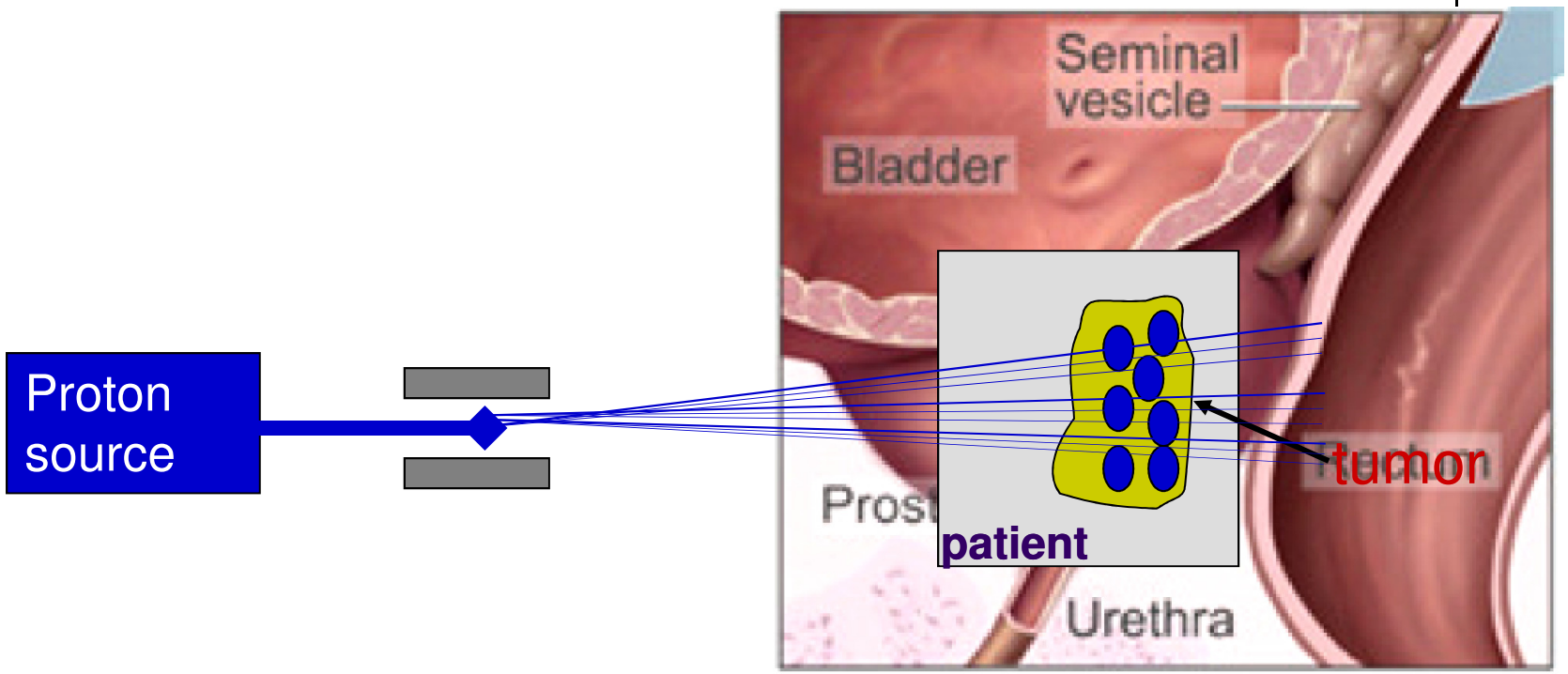
We have come a long way…



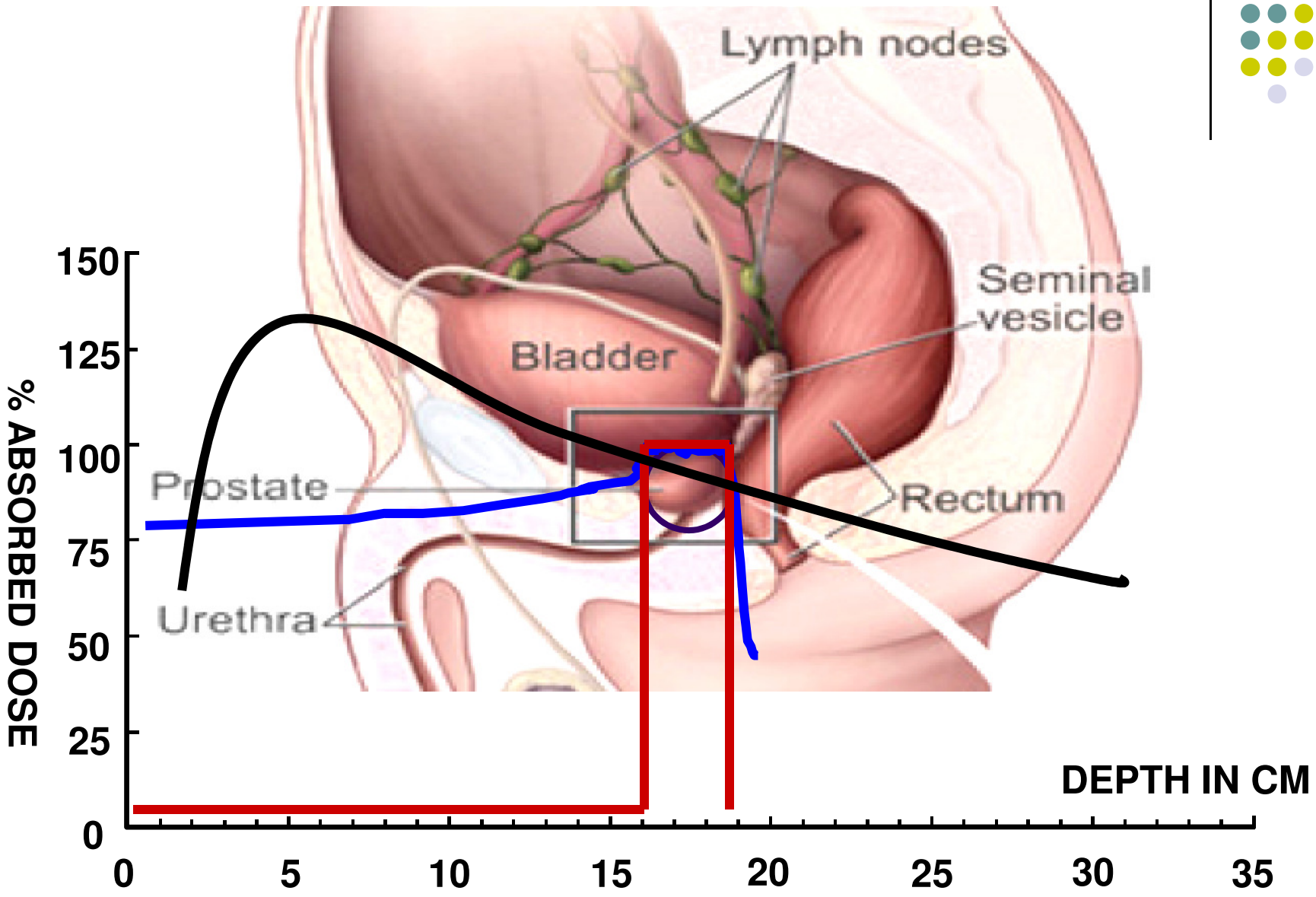
Radiation Therapy

- The goal
  - deliver lethal doses of radiation to the tumor killing cancer
  - minimize or eliminate healthy tissue injury.

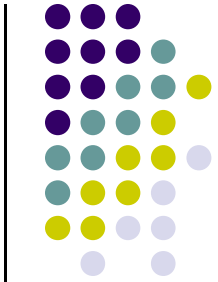
Treatment Delivery



Treatment Delivery protons vs. x-rays

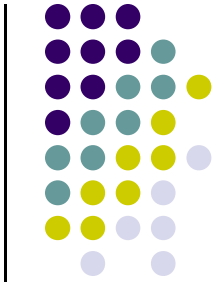


Advantages of irradiation with Protons



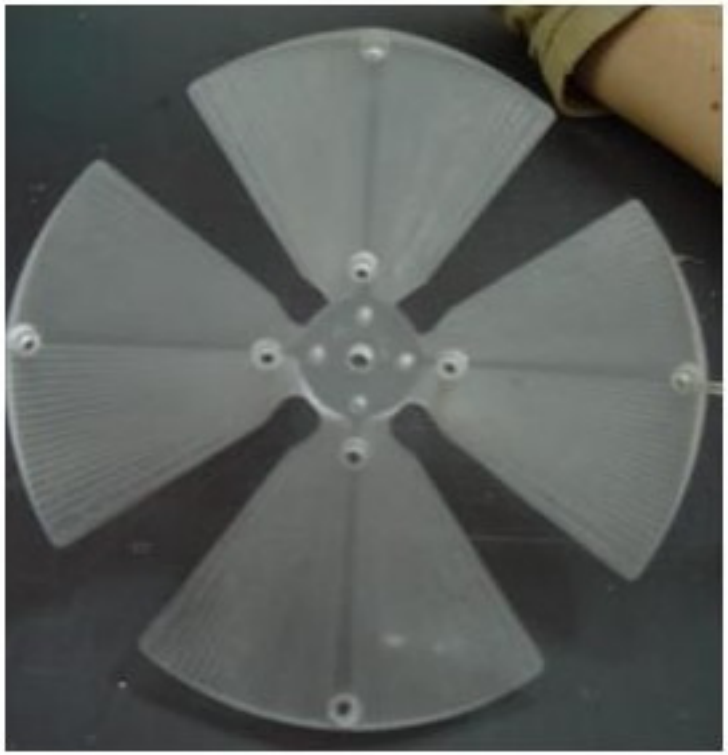
- Deliver *less* dose *in front* of the tumor
- *Deliver maximum dose* to the *tumor region*
- *NO DOSE behind* the tumor
- **Protons destroy tumor more effectively** than x-rays or electrons – protons are ~*2000 times* heavier than electrons

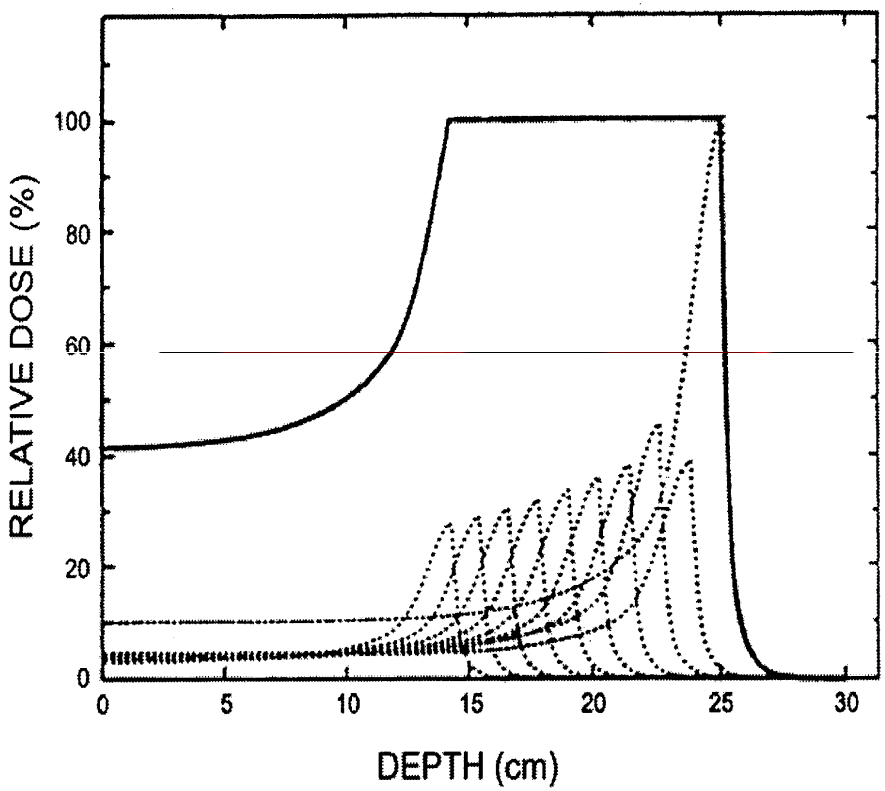
Beam Delivery Techniques



- Scattering
  - Double Scattering
  - Single Scattering
- Uniform Scanning
- Modulated Scanning

Spread-out Bragg Peak





Beam Delivery - Scattering

Figure 3-2 Ridge Filter

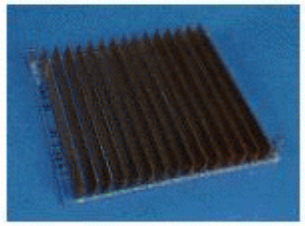


Figure 3-3 Bolus

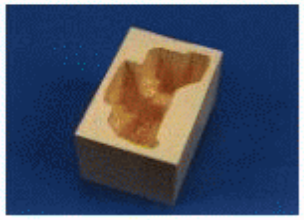
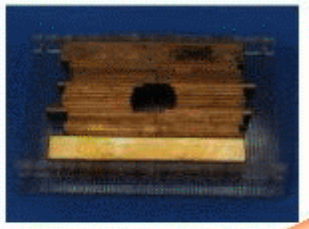
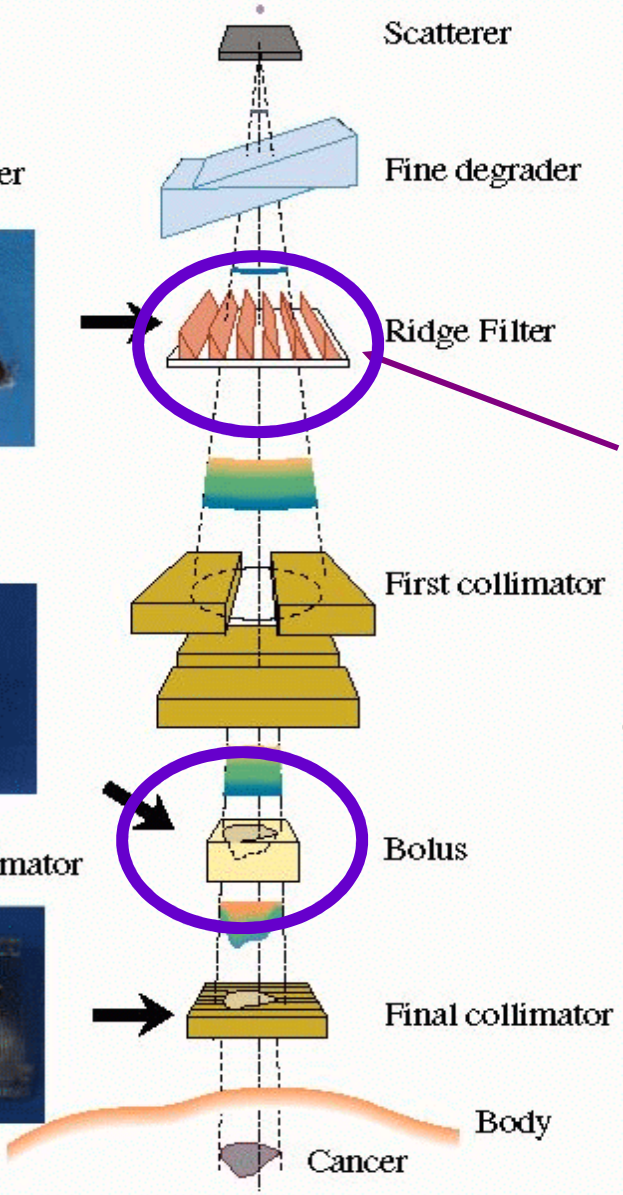


Figure 3-4 Final collimator



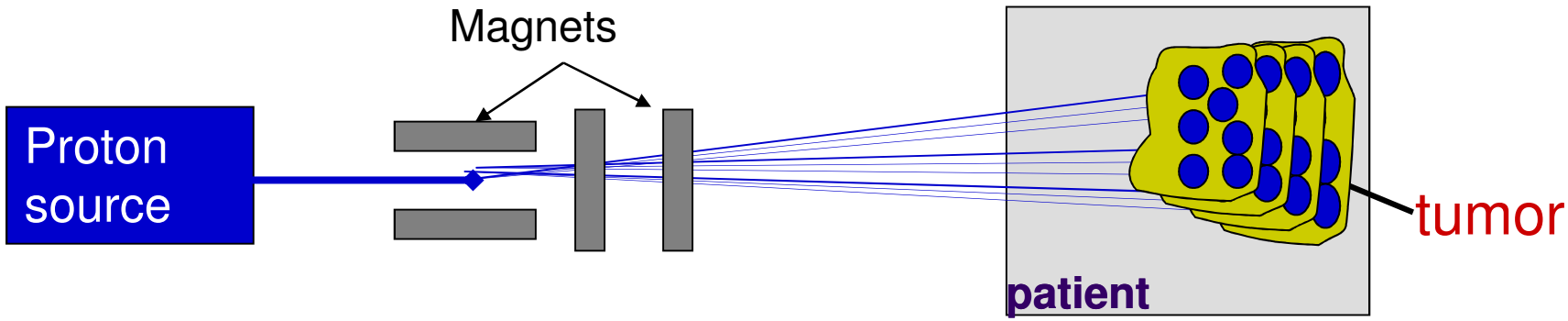


Range modulator, provides spread out Bragg peak (uniform 3D dose)

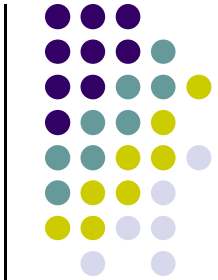
Uniform Scanning

- Narrow proton beam is scanned laterally by scanning magnets for each energy layer

•Scanning area cover full field
•Dose delivered layer by layer
•Beam shaping by
• Block in lateral direction
• Compensator in range



Cure vs. Complications



For x-rays

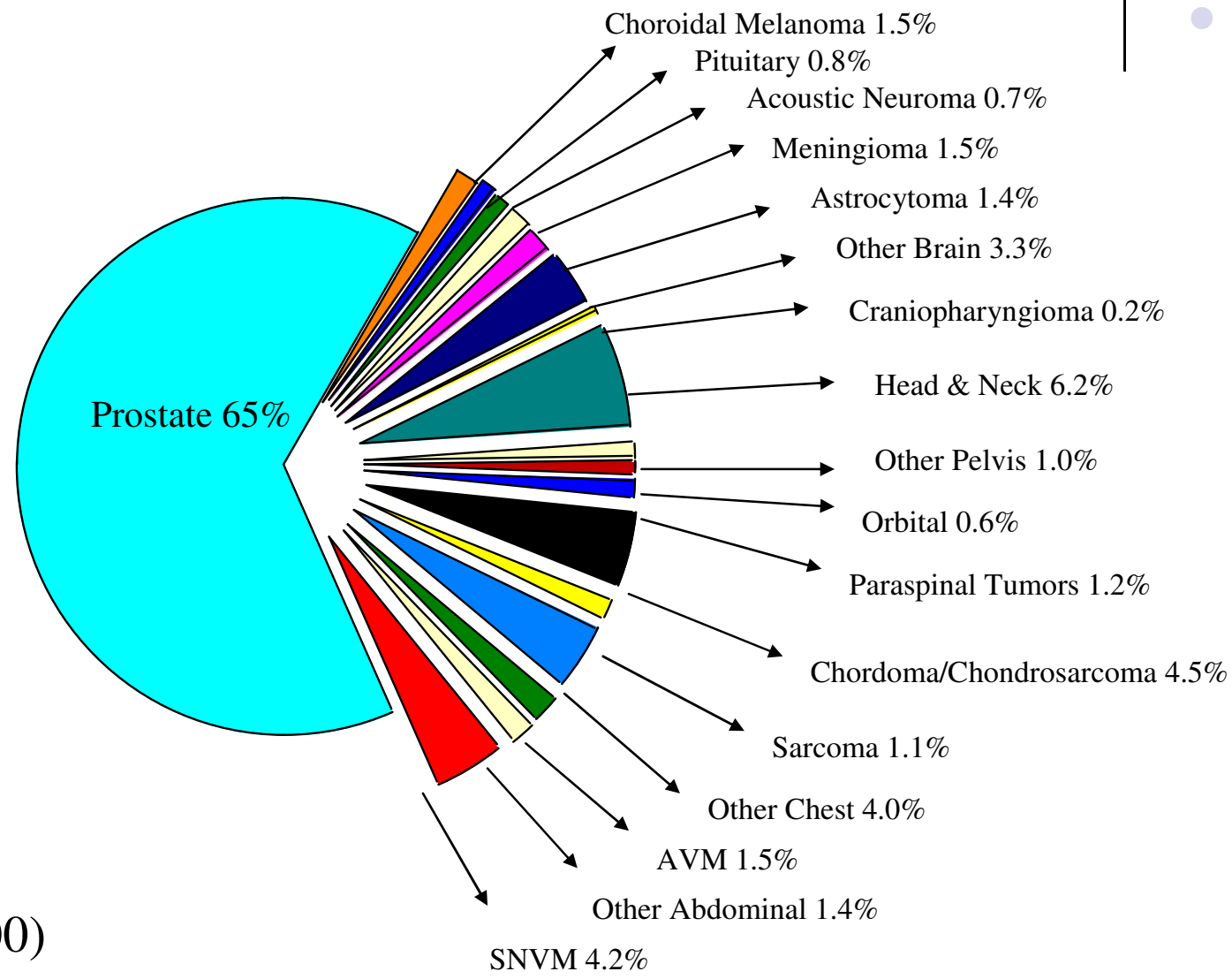
- A reduction of dose by 5% lowers the chances of cure significantly, from *65% to 15%*

- On the other hand an increase of dose by 5% may kill all the cancer but increases the risk of complications from *10% to 80%.*

Due to excellent healthy tissue sparing protons allow to increase the dose without such high risks of complications

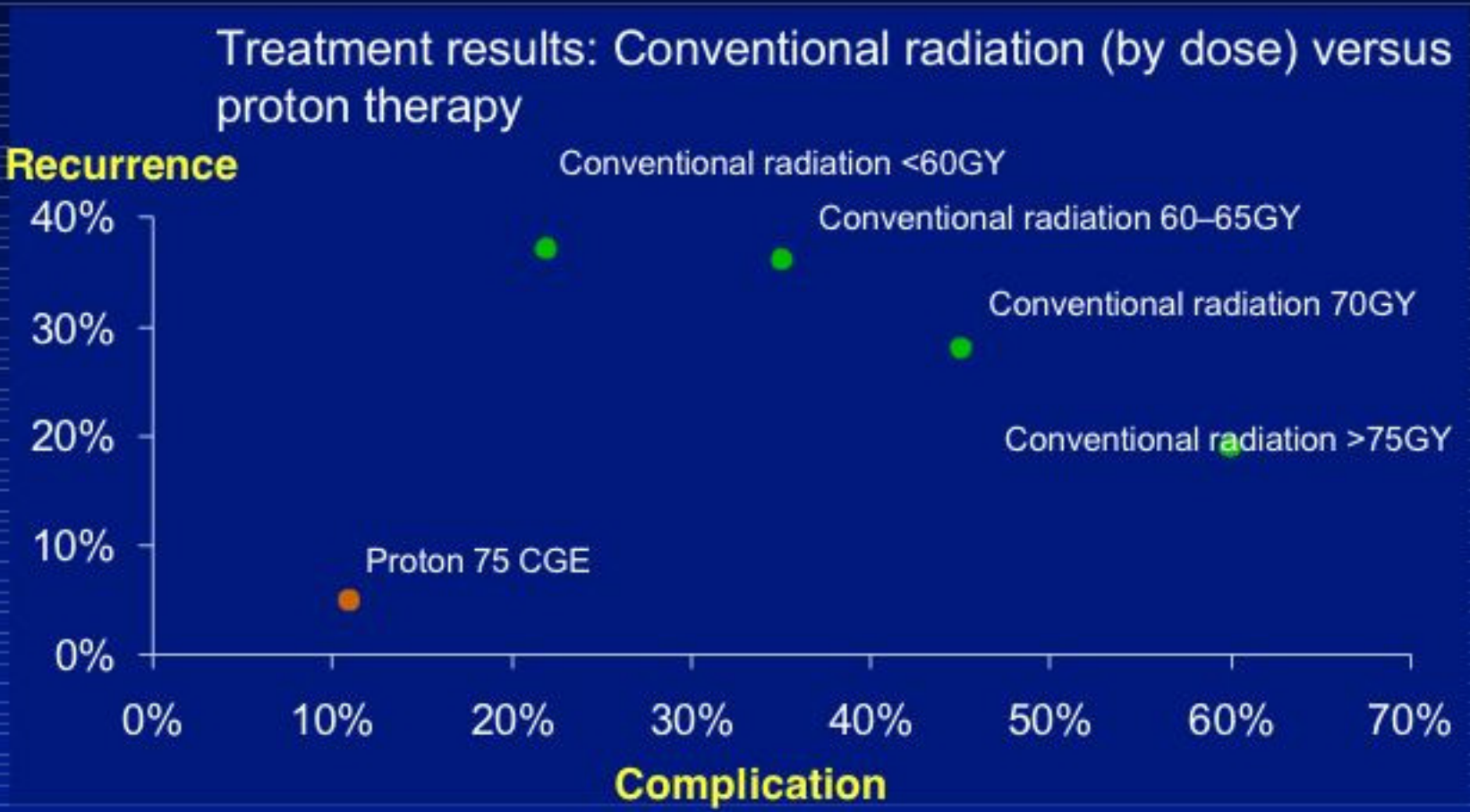
COMPLETED PROTON PATIENTS BY DIAGNOSIS

From Inception to December 2004



(100% = 10,300)

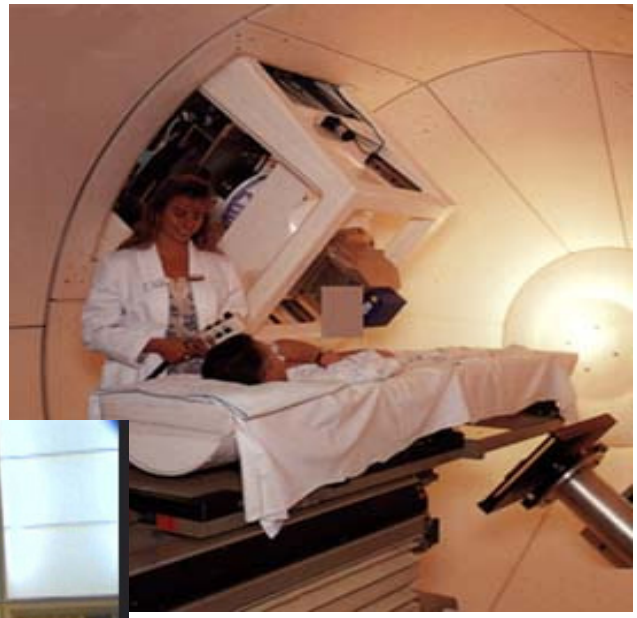
Loma Linda University Medical Center clinical results

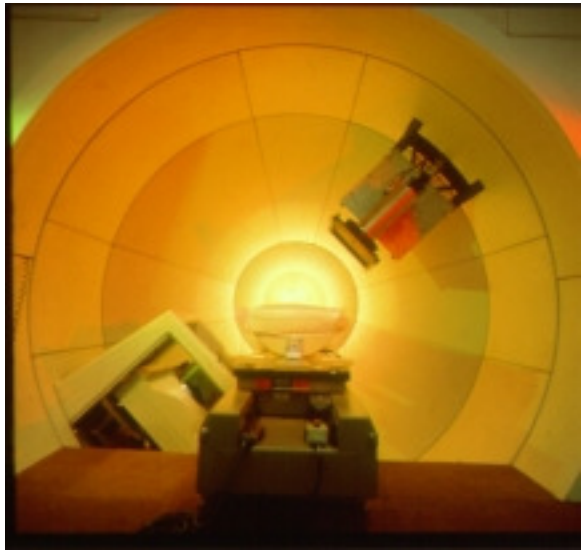


f. presentation Dr. N. Mendenhall, University of Florida

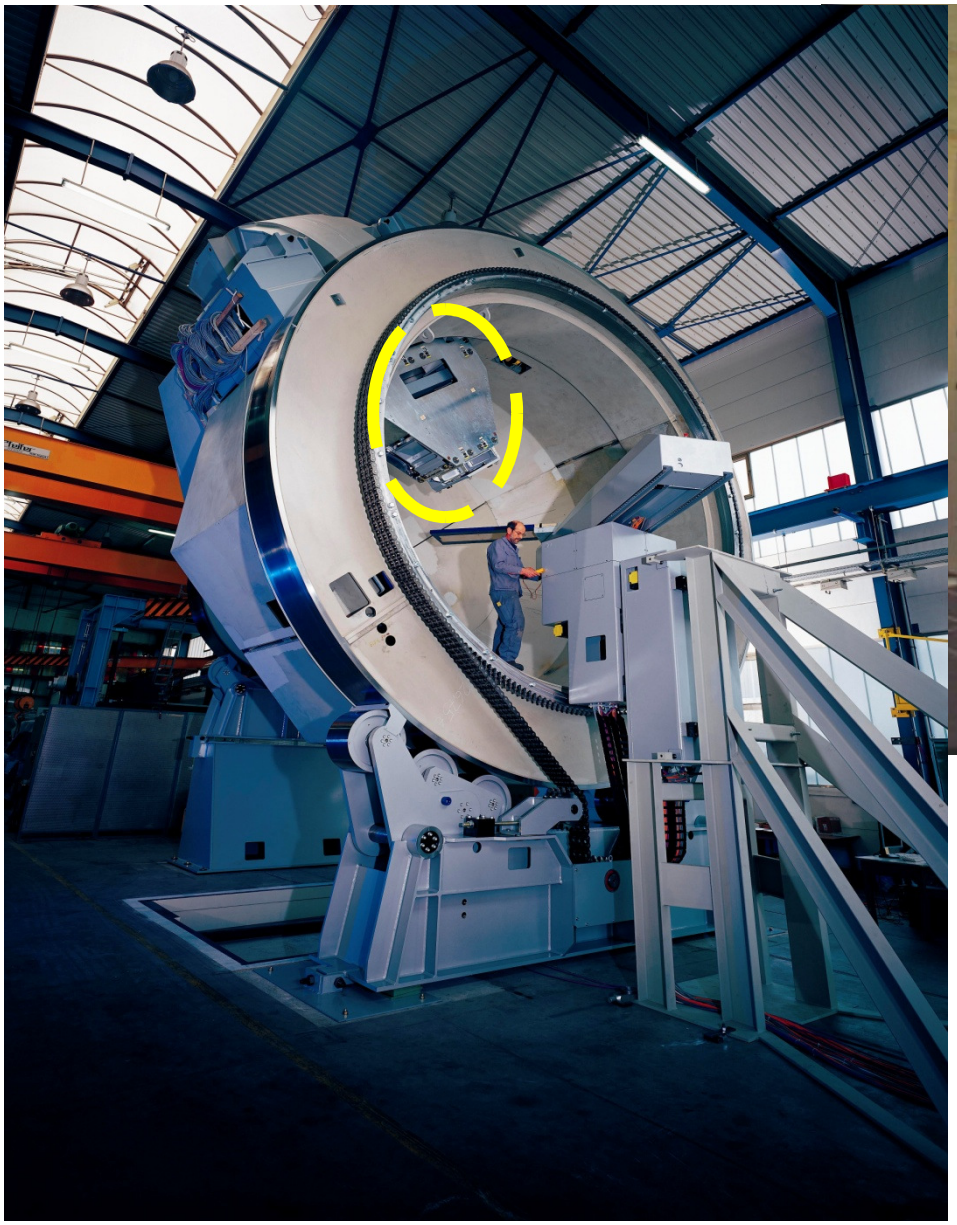
A brief tour of the treatment process (courtesy of Loma Linda) …

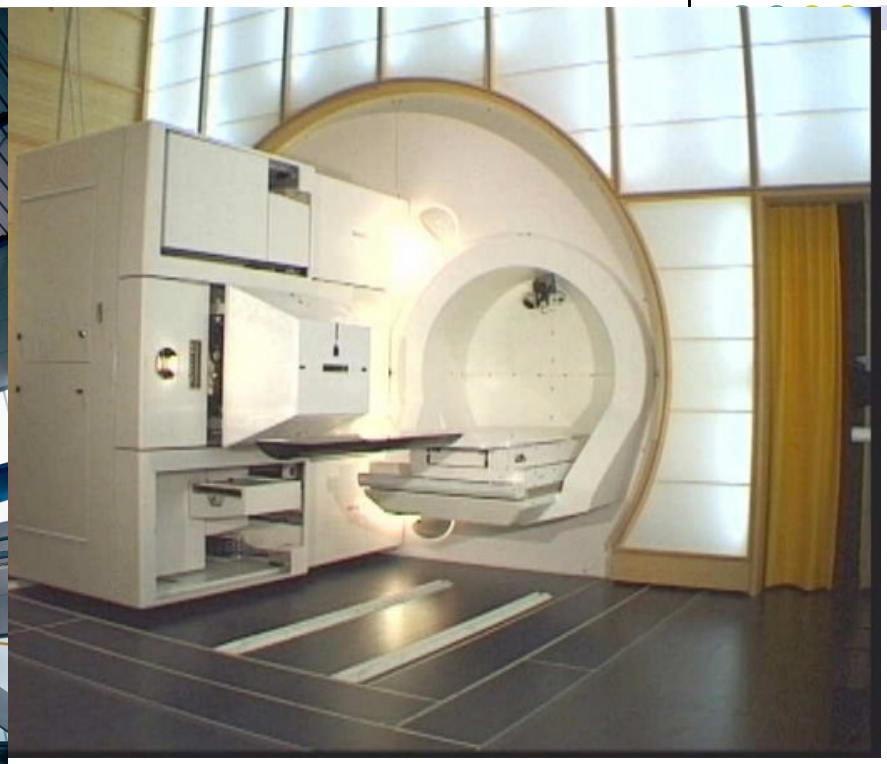
- Treatment rooms use gantries to deliver the proton beam. The 90-ton, three-story gantries can be rotated 360 degrees to deliver the beam at the precise angle prescribed by the physician.





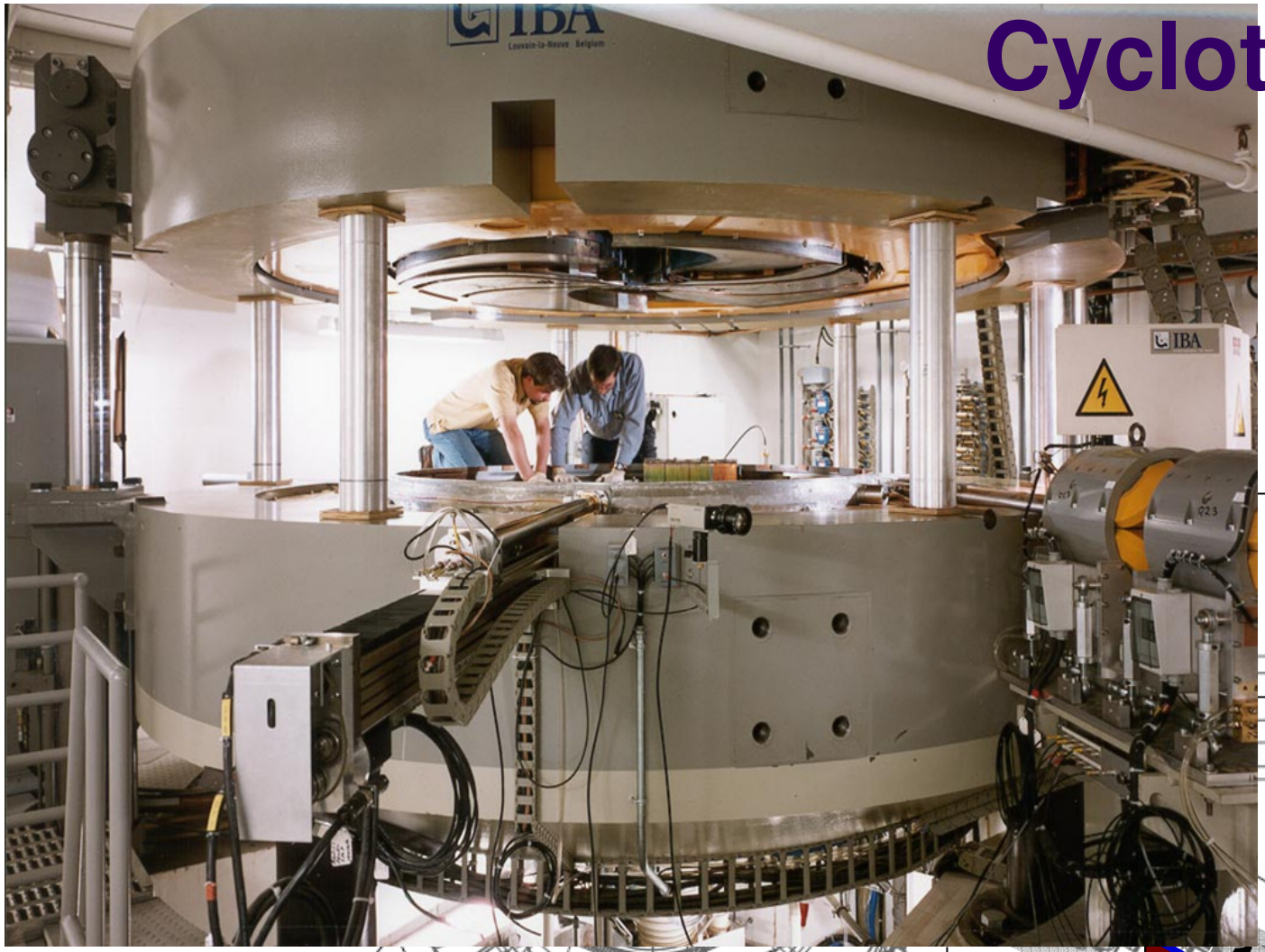
Simulating therapy machines

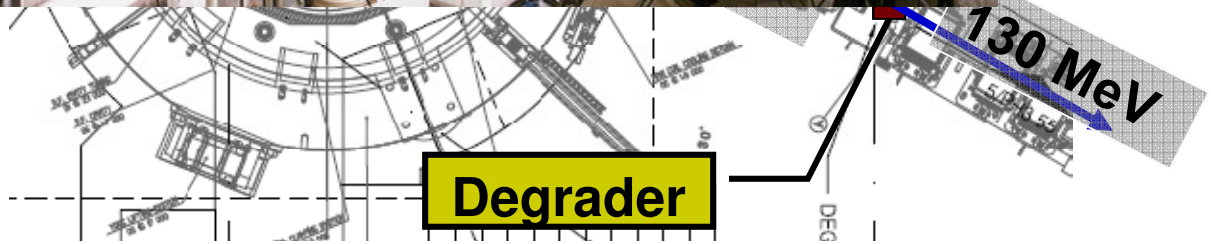




- Most of the ~40 ft. tall, 90 ton, gantry is concealed by the walls and floor of the treatment room--the patient only sees the front of the proton nozzle rotating prior to treatment

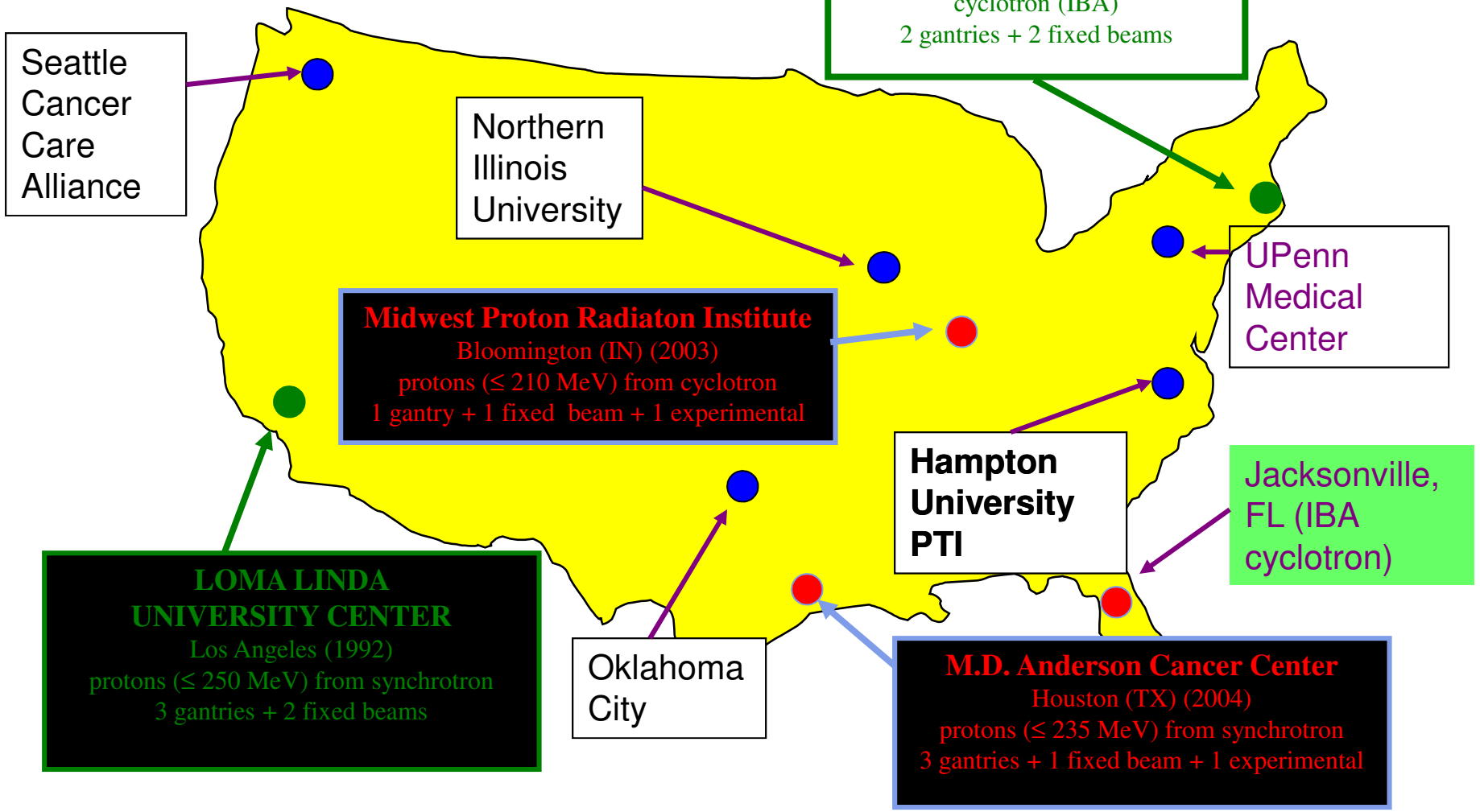
Cyclotrons



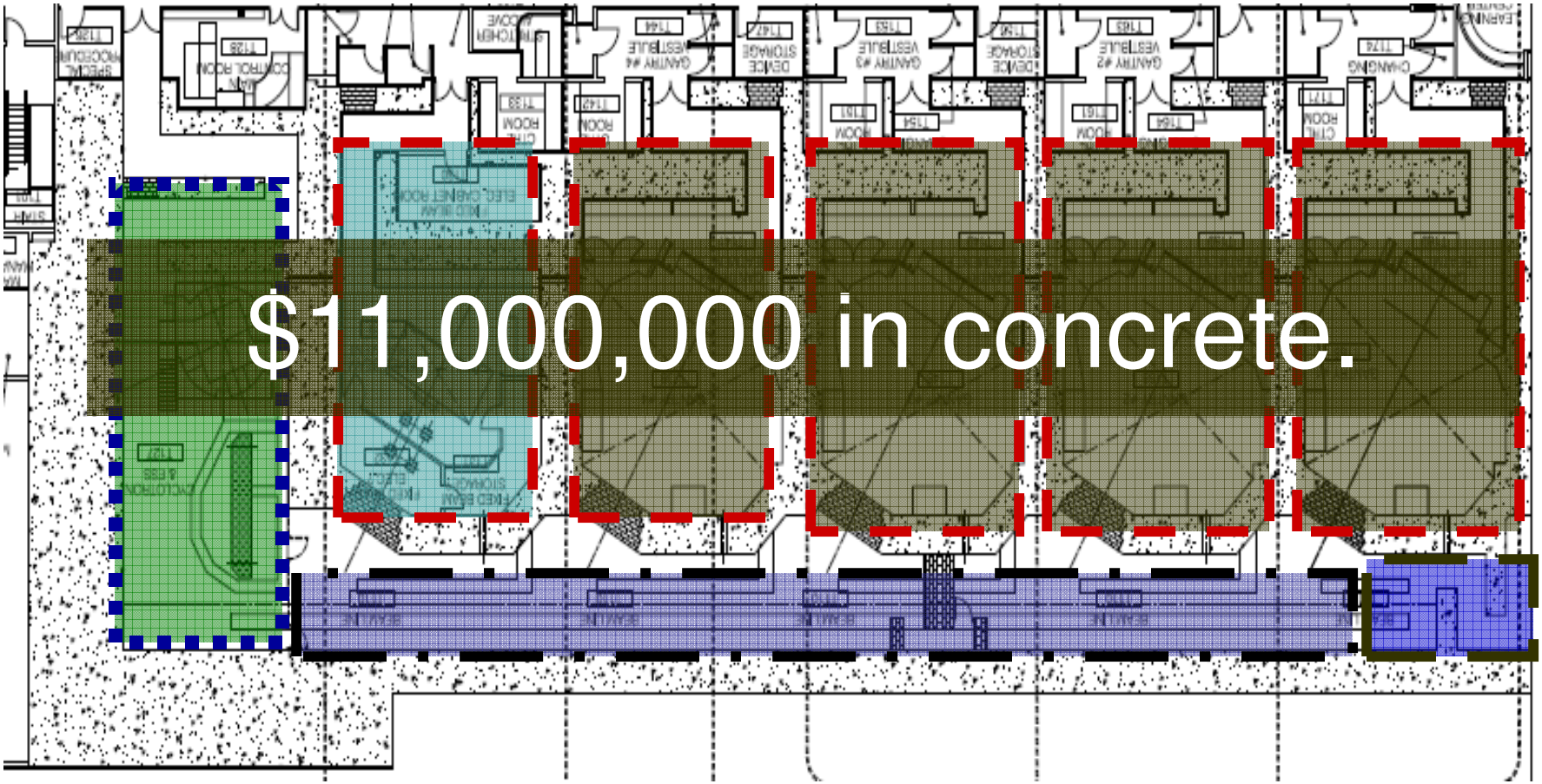


Proton Therapy in the USA (5 centers)

9 new projects have been announced (●)



What will the Hampton center look like?
Inside…..



Hampton University Proton Therapy Institute

~$200M project

Construction started 7/2007,
First patient expected 8/2010

Largest and most advanced in the nation / world

At maximum capacity, will treat >150 patients / day

4 gantries, fixed beam room, *dedicated research line*

Hampton University Proton Therapy Institute

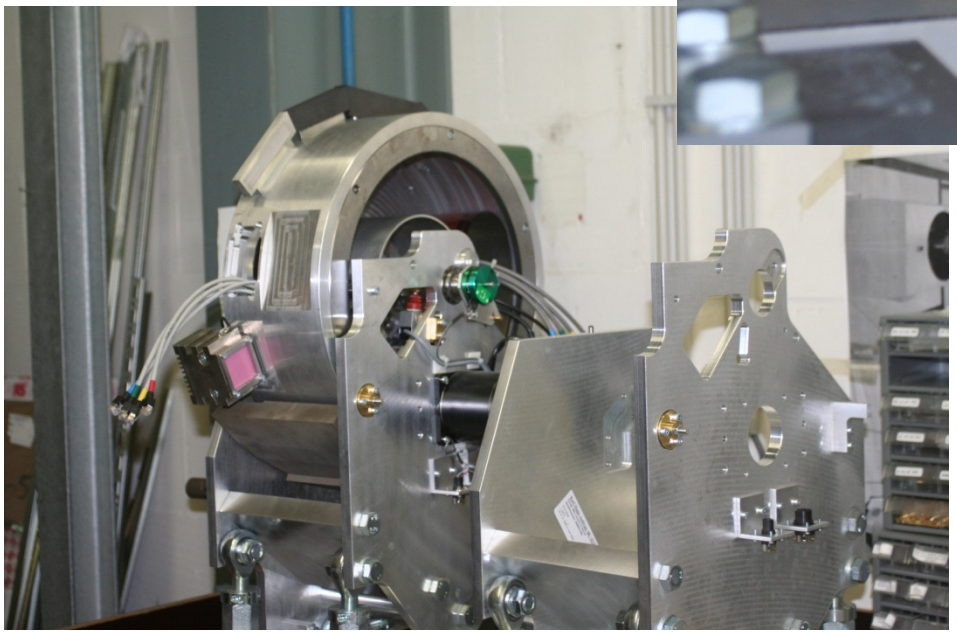
99% equipment on site for all 5 treatment rooms

Beam line installation complete

Gantry superstructures complete

First beam delivered from cyclotron March 2009

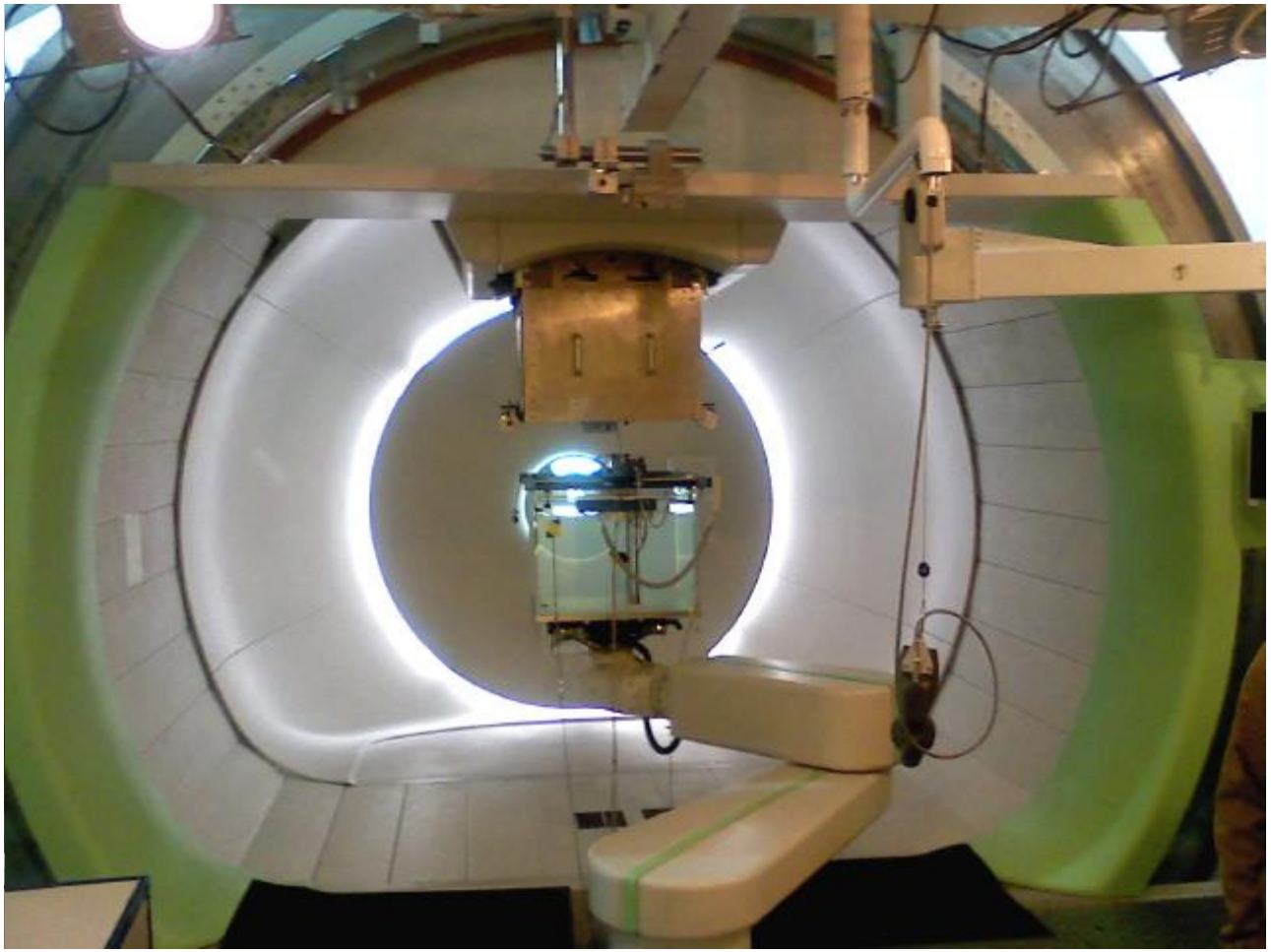
Currently delivering test beam to treatment rooms



•HUPTI has accepted the fitst treatment room in February

•On track to treat patients in August 2010

A brief tour –
Currently Commissioning First Room



A brief tour –
Imaging System

PET/CT imaging unit from Philips is being installed.

Collaboration Opportunities – **Applied Research**

- **Radiation Biology** (*in collaboration with EVMS, NASA*)
- **Proton Tomography**
- **Neutron Shielding Materials Research** (*in collaboration with Veritas Medical Solutions*)
  - Hybrid and Light-weight solutions
- **Radiobiologicaly Optimized Therapy Simulations** (in collaboration with Varian Medical Systems)

Collaboration Opportunities – **Instrumentation**

- Dedicated Imager for Proton Radiotherapy Guidance and Monitoring (*in collaboration with TJNAF*)
- Respiration Gating Technologies (*in collaboration with Philips Healthcare*)
- Development of QA Tools (*in collaboration with CIRS*)

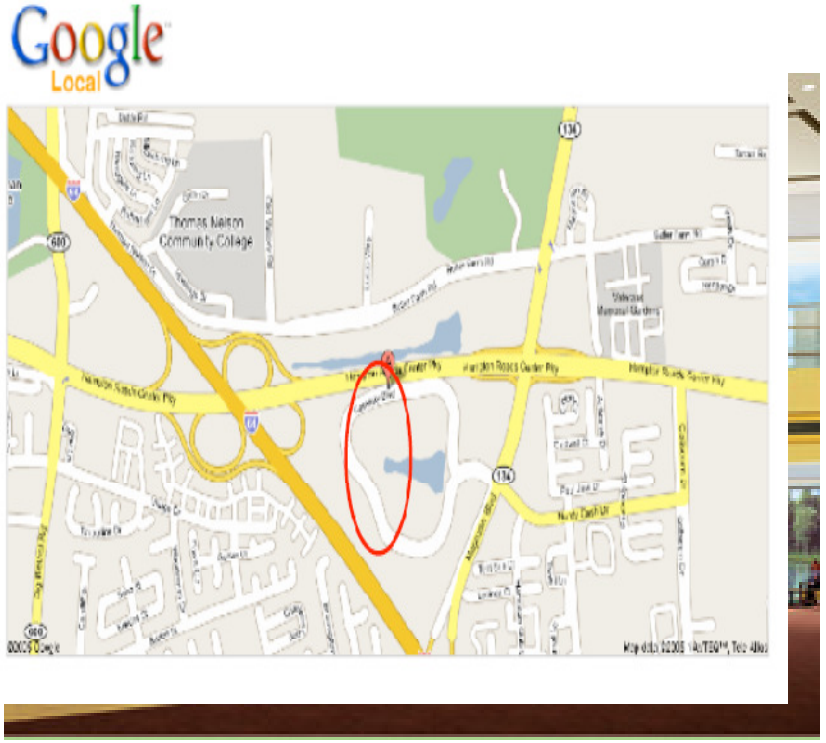
Current Status …

❖The facility is a $225 million, state-of-the-art treatment and research center.

❖Nation's 7th proton therapy facility, **the largest in the world** (98,000 sq.ft) also a hotel and conference center

❖HUPTI will treat over 2,000 patients per year, including 65% prostate cancer treatments. The remaining 35% includes breast, lung, pediatric, and other cancers.

❖ First patient – August 2010



- ***Put Hampton Roads "on the map" as a high-end medical destination.***

Where to get more information…..

- **HUPTI website** **http://www.hamptonproton.org/**
- Scientific and Technical Director **Cynthia Keppel, keppel@jlab.org**
- **Vahagn.Nazaryan@hamptonproton.org**
- **The National Association for Proton Therapy**; **http://Proton-therapy.org**
- **Loma Linda University Medical Center** **http://www.llu.edu/proton/**
- **Particle Therapy Co-Operative Group; http://ptcog.web.psi.ch/**

Thank You!

Questions?