Clinical Trials with Protons

Non-small Cell Lung Cancer

Head and Neck Cancer
(Oropharynx)

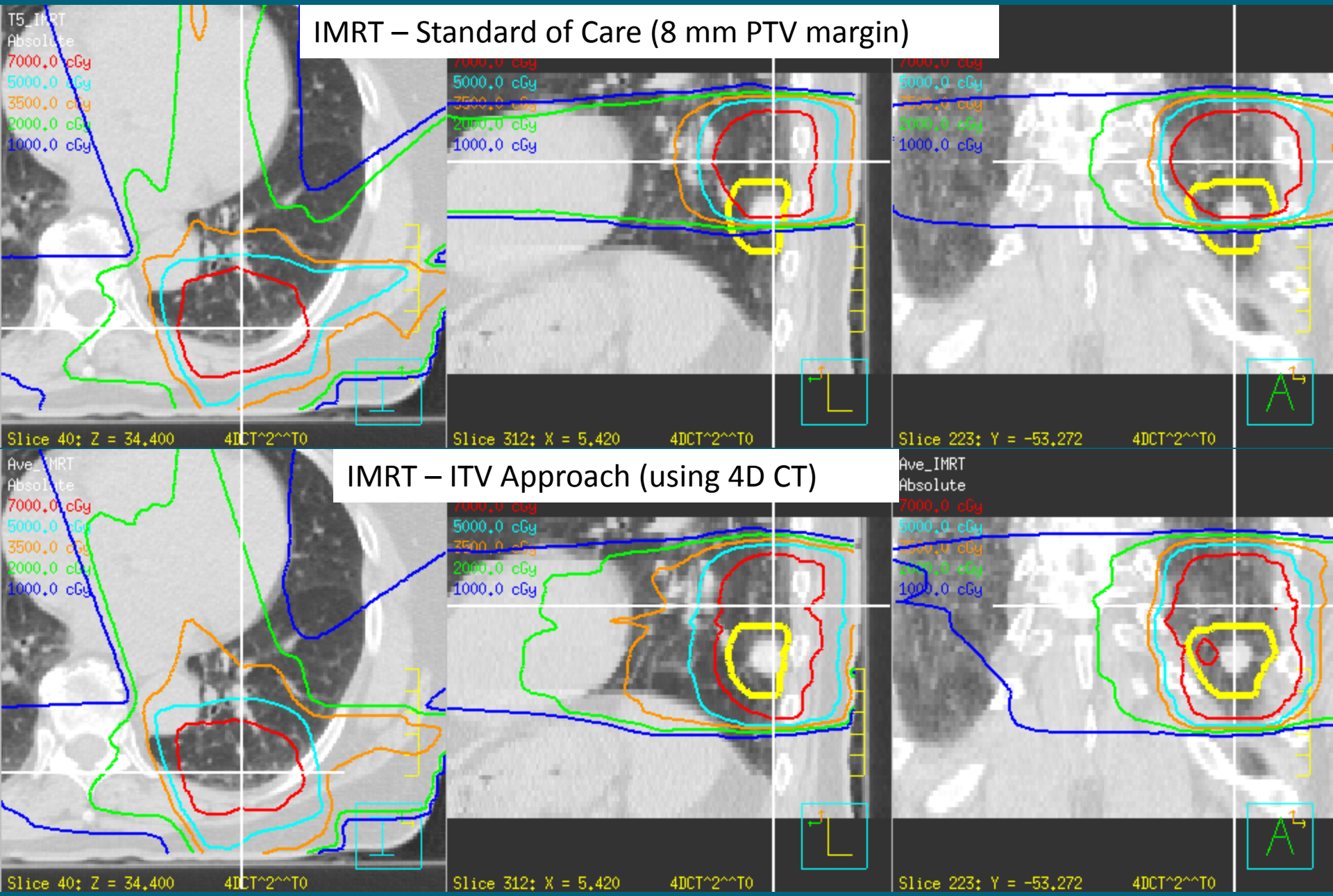
Cancer Deaths 2014

• Lung and bronchus		159,260
• Colon/rectum	50,310}	
• Breast	40,430}	159,810
• Pancreas	39,590}	
• Prostate	48,029}	

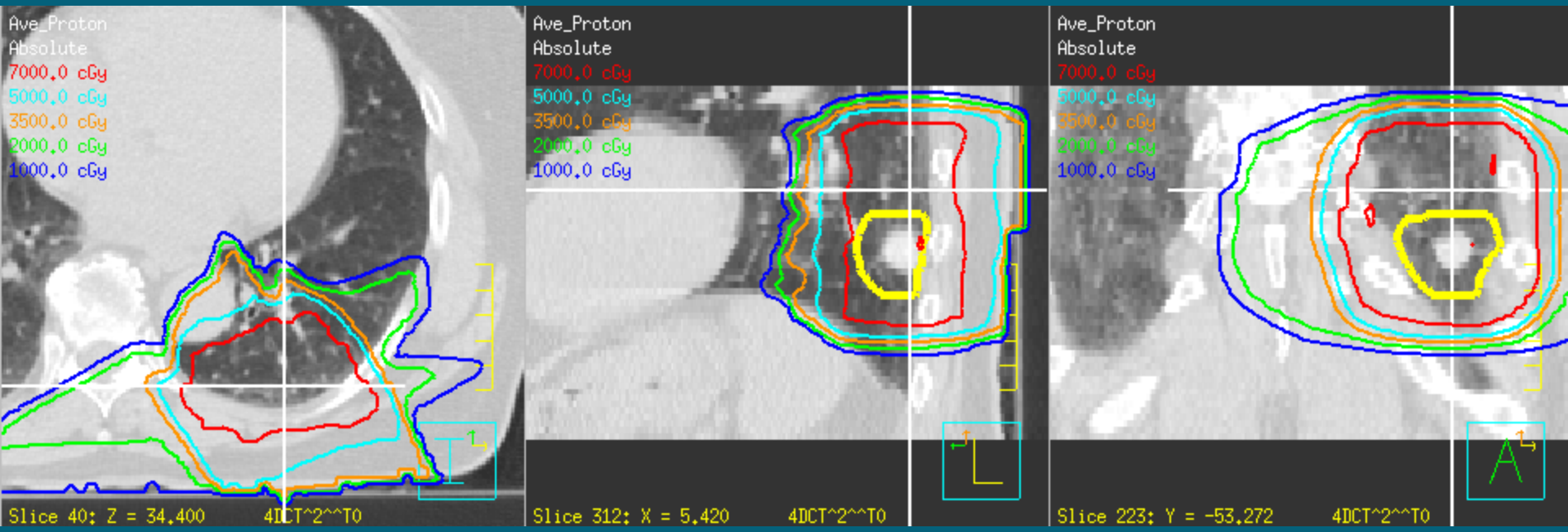
Treatment of Locally Advanced NSCLC

- Concurrent chemotherapy

- Management of tumor motion
  - 4D CT simulation and planning
  - Active breath holding
  - Gating


IMRT – Standard of Care (8 mm PTV margin)
T5_IMRT
Absolute
7000.0 cGy
5000.0 cGy
3500.0 cGy
2000.0 cGy
1000.0 cGy
Slice 40: Z = 34.400
4DCT^2^^T0
Slice 312: X = 5.420
4DCT^2^^T0
Slice 223: Y = -53.272
4DCT^2^^T0
IMRT – ITV Approach (using 4D CT)
Ave_IMRT
Absolute
7000.0 cGy
5000.0 cGy
3500.0 cGy
2000.0 cGy
1000.0 cGy
Slice 40: Z = 34.400
4DCT^2^^T0
Slice 312: X = 5.420
4DCT^2^^T0
Slice 223: Y = -53.272
4DCT^2^^T0
10 Gy
20 Gy
35 Gy
50 Gy
70 Gy

Proton – ITV Approach



10 Gy 20 Gy 35 Gy 50 Gy 70 Gy

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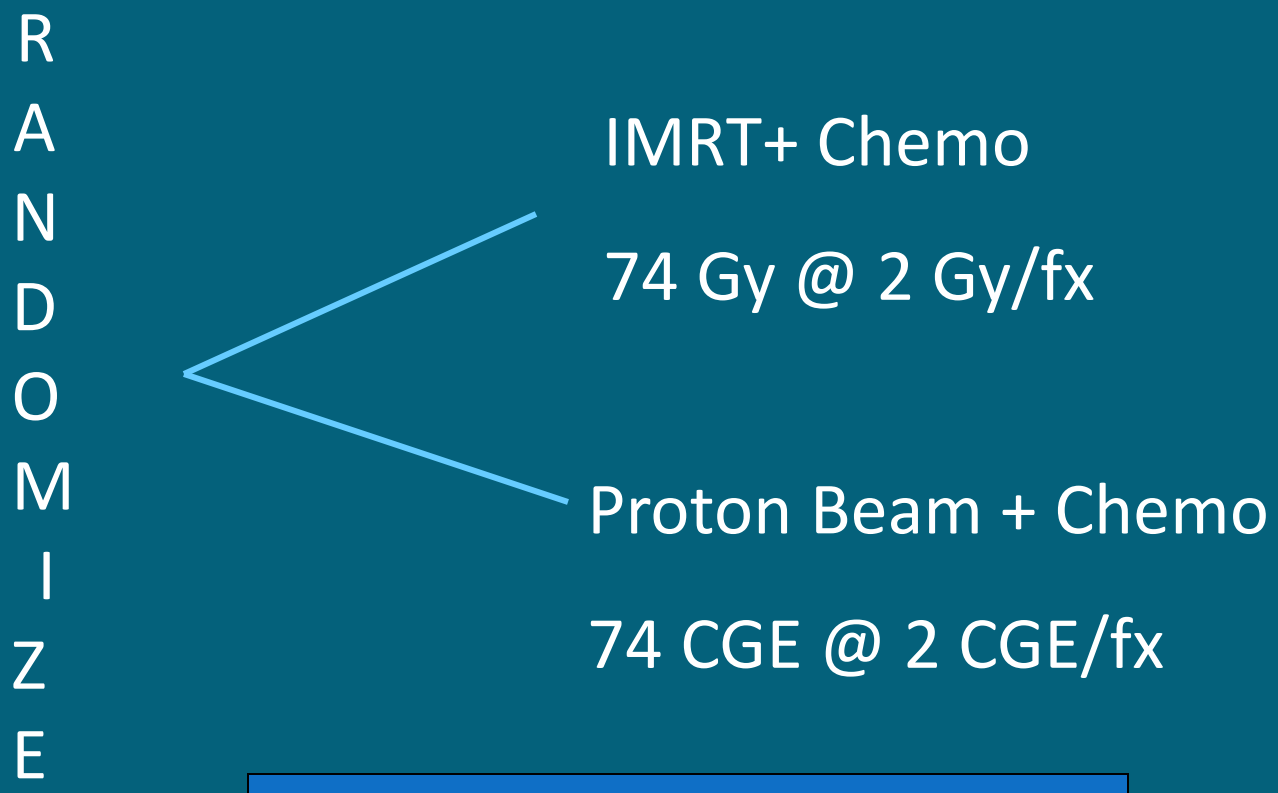
Grade 3+ Esophagitis

- IMRT (N=66) 40%
- Proton Therapy (N=62) 6%

Treatment Related Pneumonitis Grade 3+

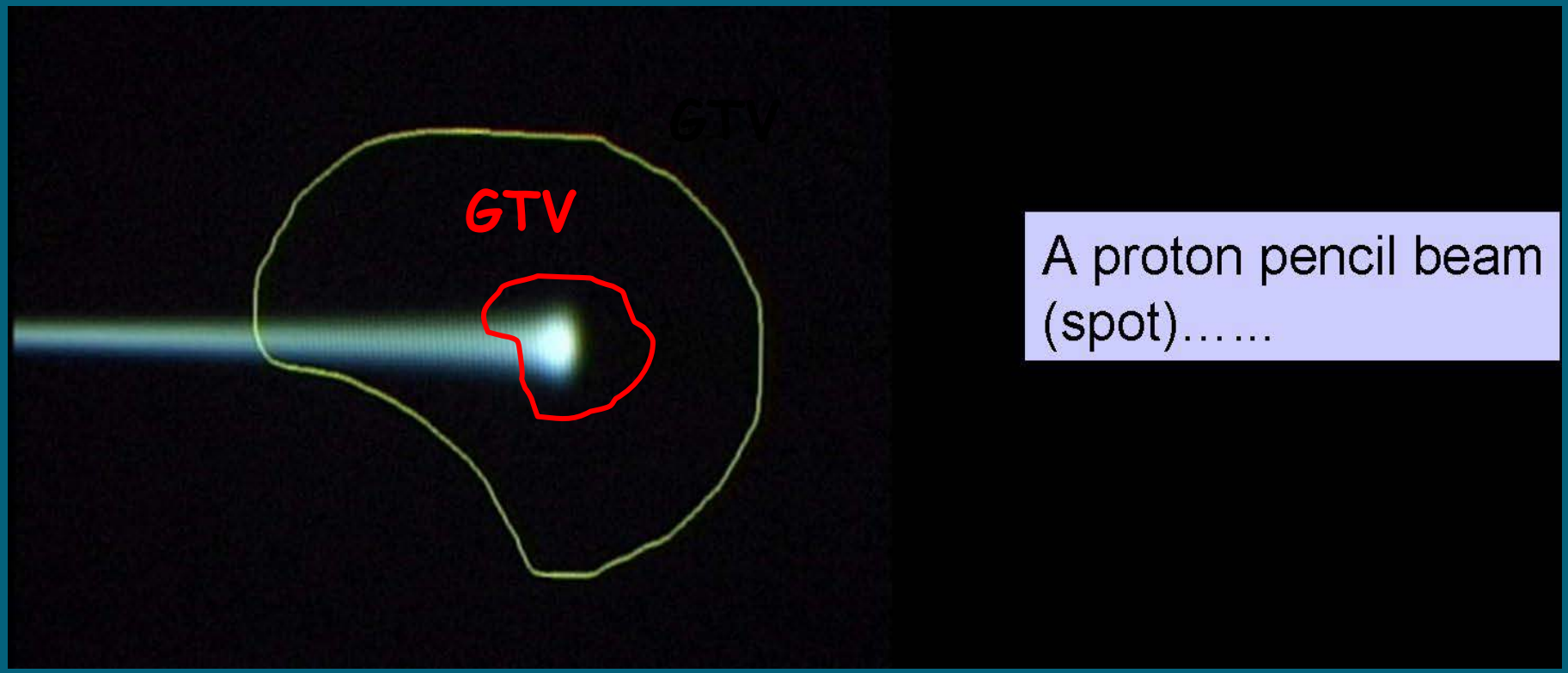
- IMRT 9%
- Proton Therapy 2 %

Randomized Trial of Photons vs Protons for NSCLC Stage II/III



Adaptive planning; Bayesian statistics

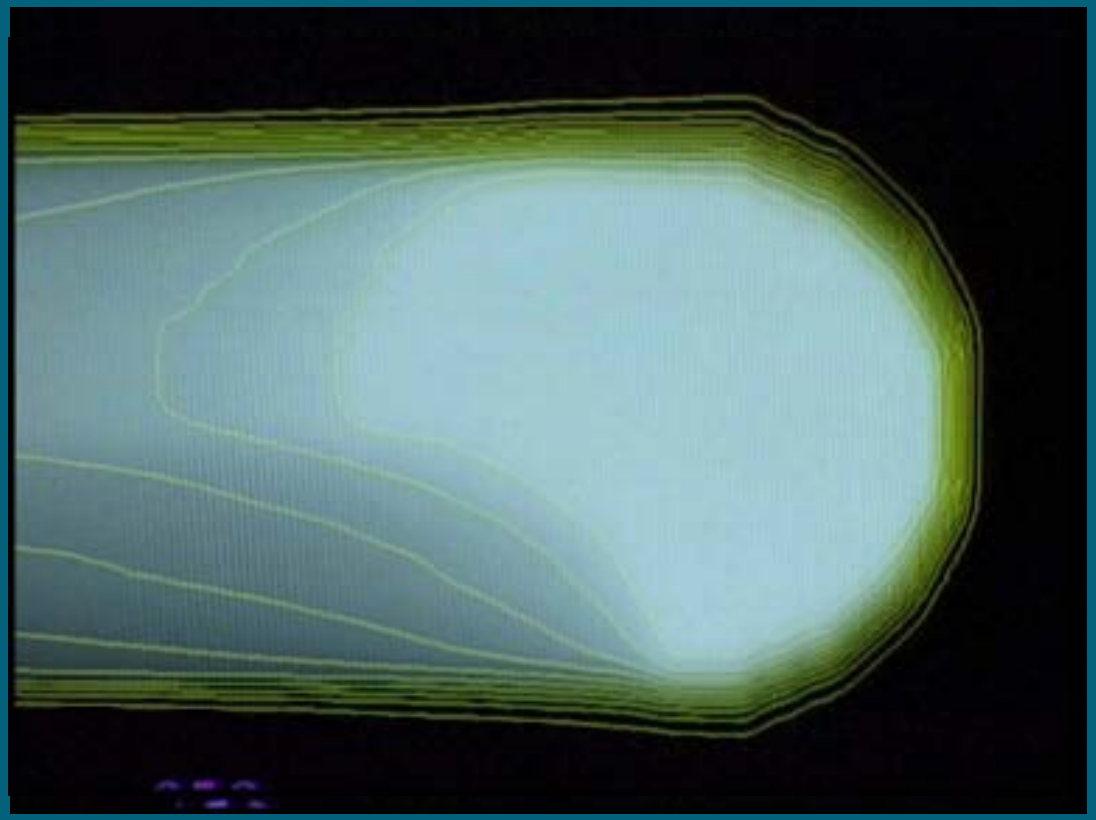
Intensity Modulated Proton Therapy (IMPT)



Modified from Eros Pedroni-PSI
Courtesy of Cliff Chao

Beam Scanning

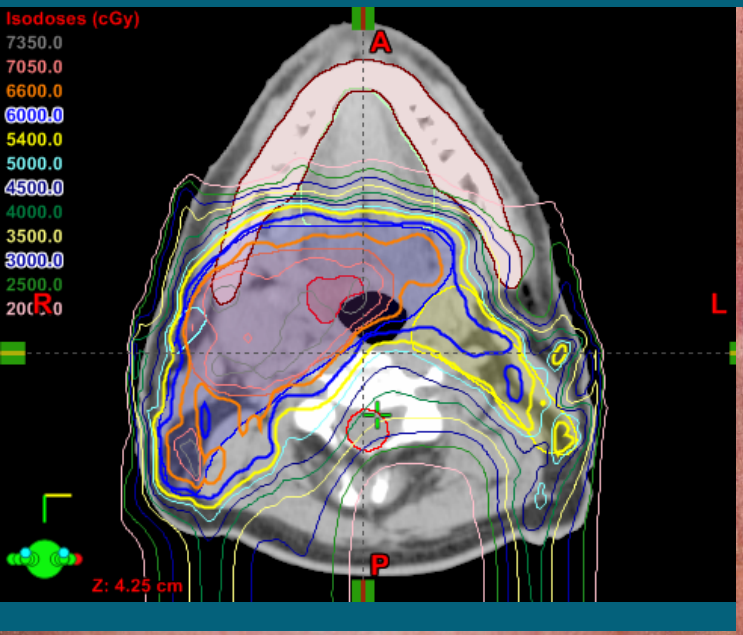
- Deliver many small beams to a tumor using magnetic beam deflection.
- Energy is changed in accelerator to scan each successive layer.



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

Pedroni, PSI

Oropharynx - BOT
Concurrent Chemoradiation



1. Decrease Mucositis
2. Decrease odynophagia
3. Decrease N/V
4. Decrease weight loss
5. No PEG tube
6. Decrease xerostomia
7. Maintain taste
8. Decrease dysphagia

Comparative Trials
Protons vs. X-rays
(double scattering or IMPT)

- NSCLC : Double scatter protons vs. IMRT (phase II) with Mass General Hospital
- NSCLC: Double scatter protons vs. IMRT (Randomized phase II) with RTOG
- Carcinoma of Oropharynx: IMRT vs. IMPT