Radiation Therapy for Cancers of the Esophagus and Stomach

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Surgery

- Surgery is the mainstay of curative treatment for:
  - Esophageal Carcinoma:
    - Squamous cell carcinoma
    - Adenocarcinoma
  - Gastric Cancer:
    - Adenocarcinoma
  - Less of a role in other subtypes (lymphoma)

Radiation Therapy (RT): Who Is it For?

- Can play a role in all stages of disease
  - Localized:
    - Before surgery (Pre-Operative)
    - After surgery (Post-Operative)
    - Alternative to surgery
  - Metastatic:
    - Treating the esophagus/stomach for local symptoms
    - Other sites to relieve pain or other symptoms

Radiation Therapy: How Does It Work?

- High energy radiation - 1,000 times more energy than x-rays used in Radiology for chest x-rays, CAT scans, etc.
- Radiation damages DNA (genetic code) of cancer cells
- This DNA damage will cause cells to die when they try to divide before properly repairing the damage
- Cancer cells are directly targeted while the normal organs are spared as much as possible
- Cancer cells divide more often than healthy normal cells → that's what makes cancer bad
- Cancer cells not as good at repairing DNA as normal cells

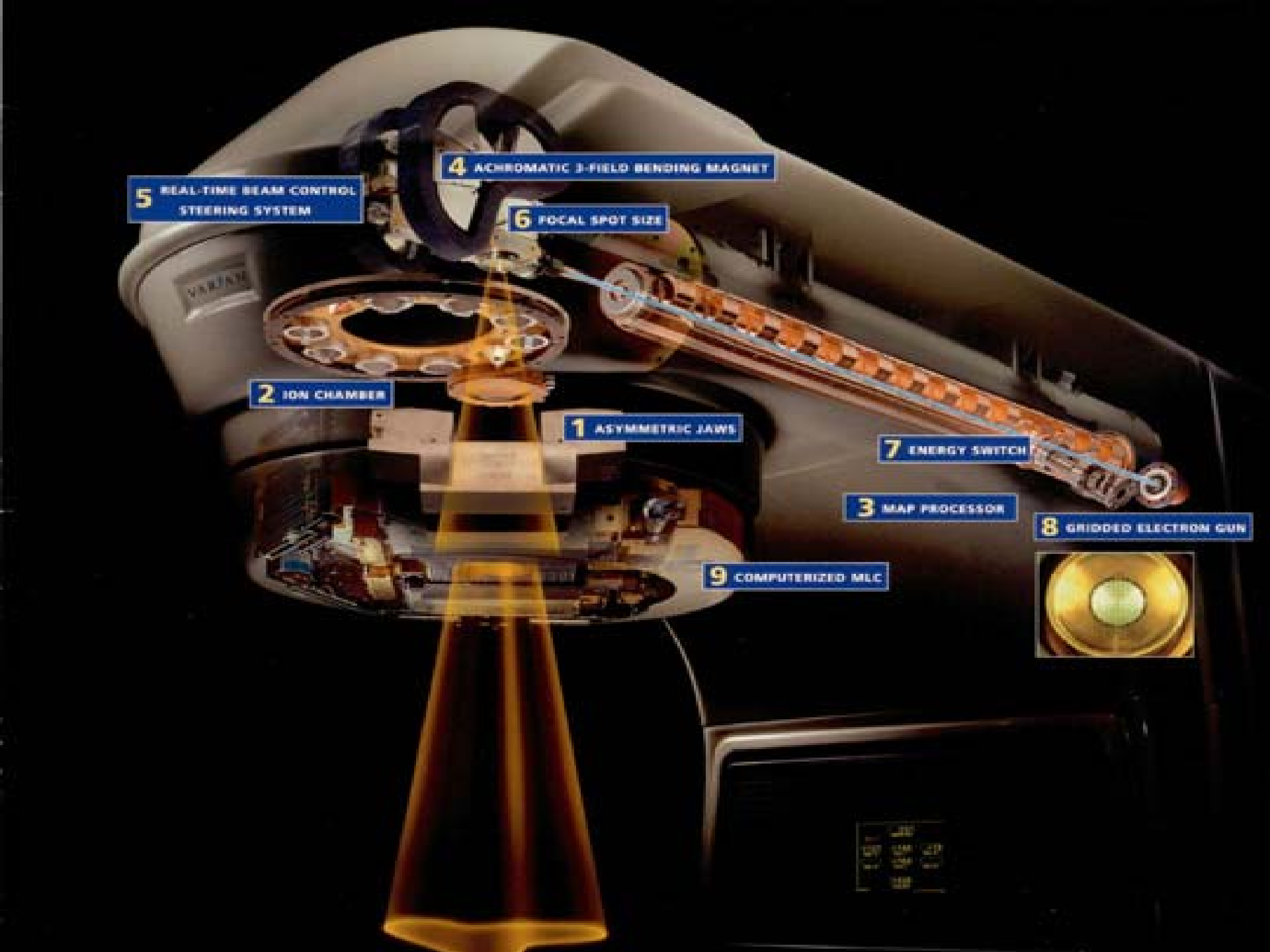
➢ Cancer cells more vulnerable to RT than normal cells

Radiation Therapy: What are the Types?

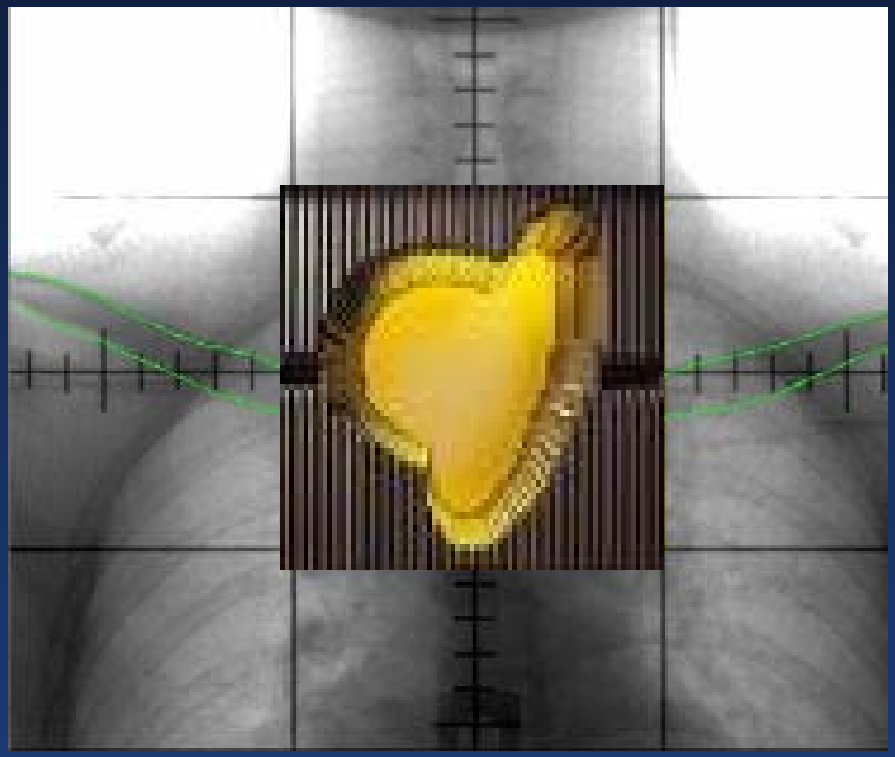
- External Beam Radiation with Photons (X-rays)
  - 3-D Conformal RT
  - IMRT (**I**ntensity **M**odulated **R**adiation **T**herapy)
- External Beam Radiation with Protons
- Brachytherapy (i.e. "internal radiation", using naturally occurring radioactive substances)
  - High-dose rate, temporary catheters

How Can Radiation Help the Surgeon?

- Before surgery:
  - To help make otherwise difficult resections easier
  - Treat surrounding tissues and lymph nodes where tumors cells may have seeded
- After surgery:
  - “Clean up” any tumor cells that may have seeded the surrounding tissues or lymph nodes
  - Treat “positive margins” of resection

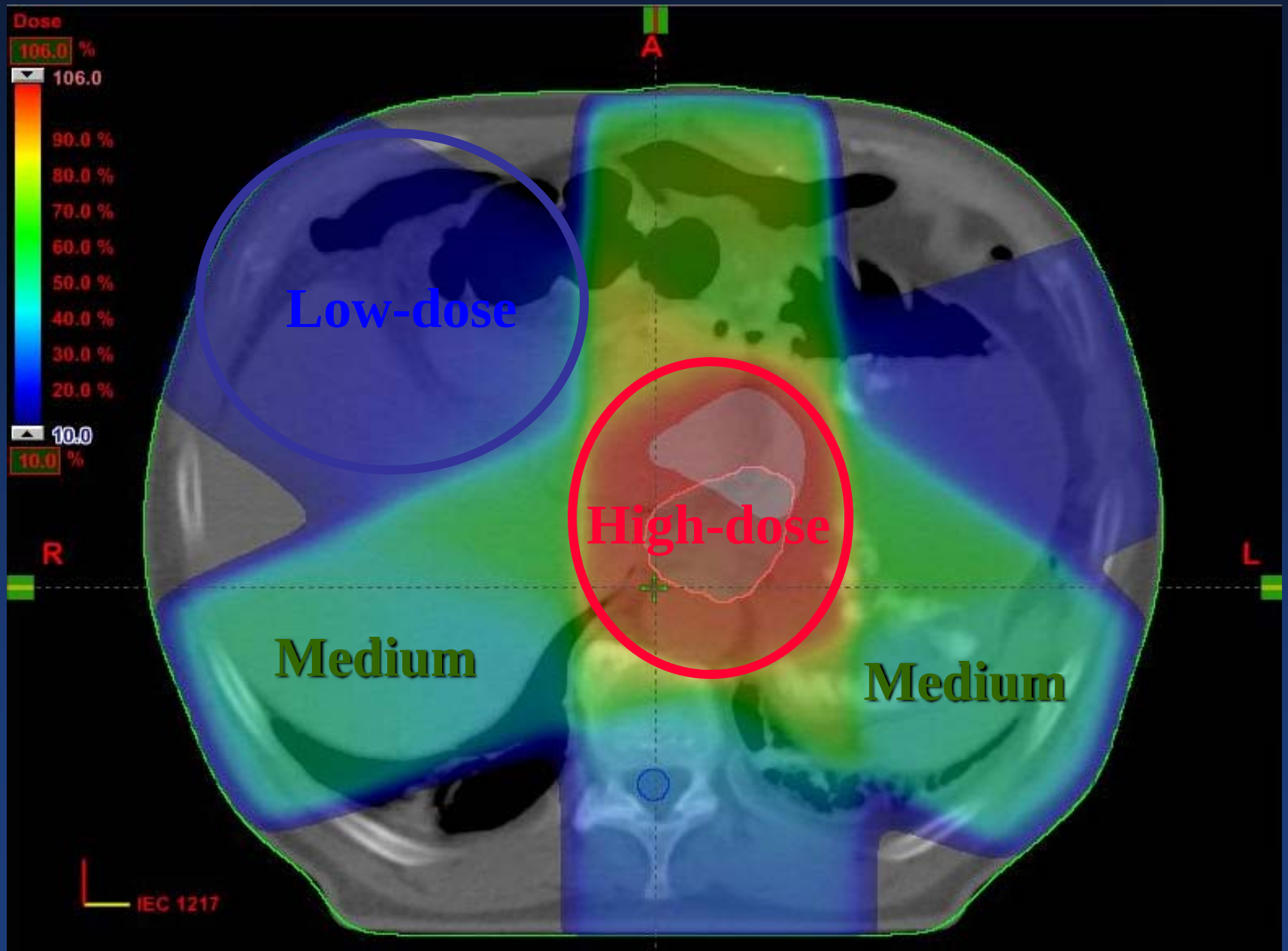

4 ACHROMATIC 3-FIELD BENDING MAGNET
5 REAL-TIME BEAM CONTROL STEERING SYSTEM
6 FOCAL SPOT SIZE
2 ION CHAMBER
1 ASYMMETRIC JAWS
7 ENERGY SWITCH
3 MAP PROCESSOR
8 GRIDDED ELECTRON GUN
9 COMPUTERIZED MLC

Conformal Radiation Therapy

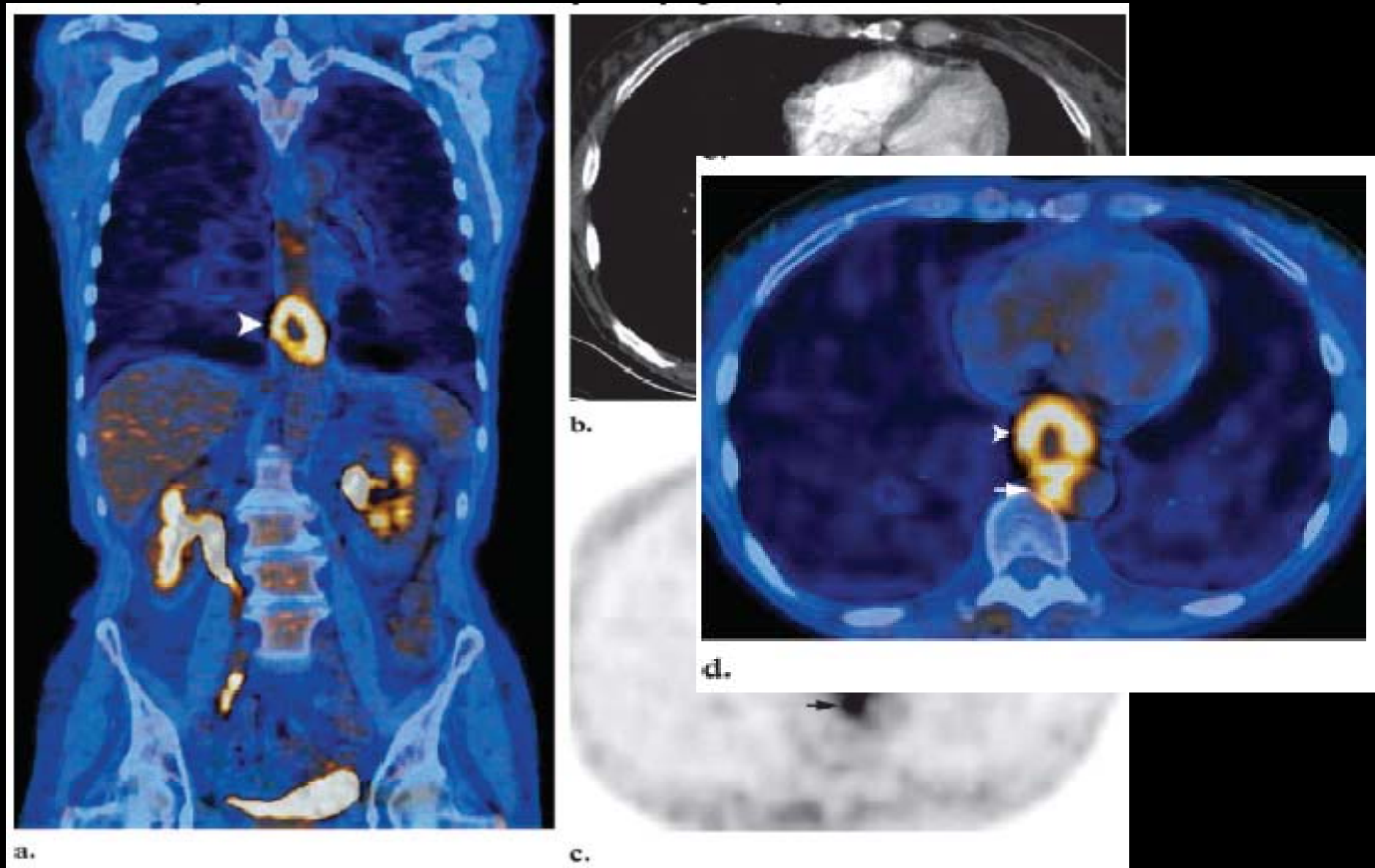


- Square or rectangular beams sculpted with computer controlled blocks
- "Multileaf Collminator"

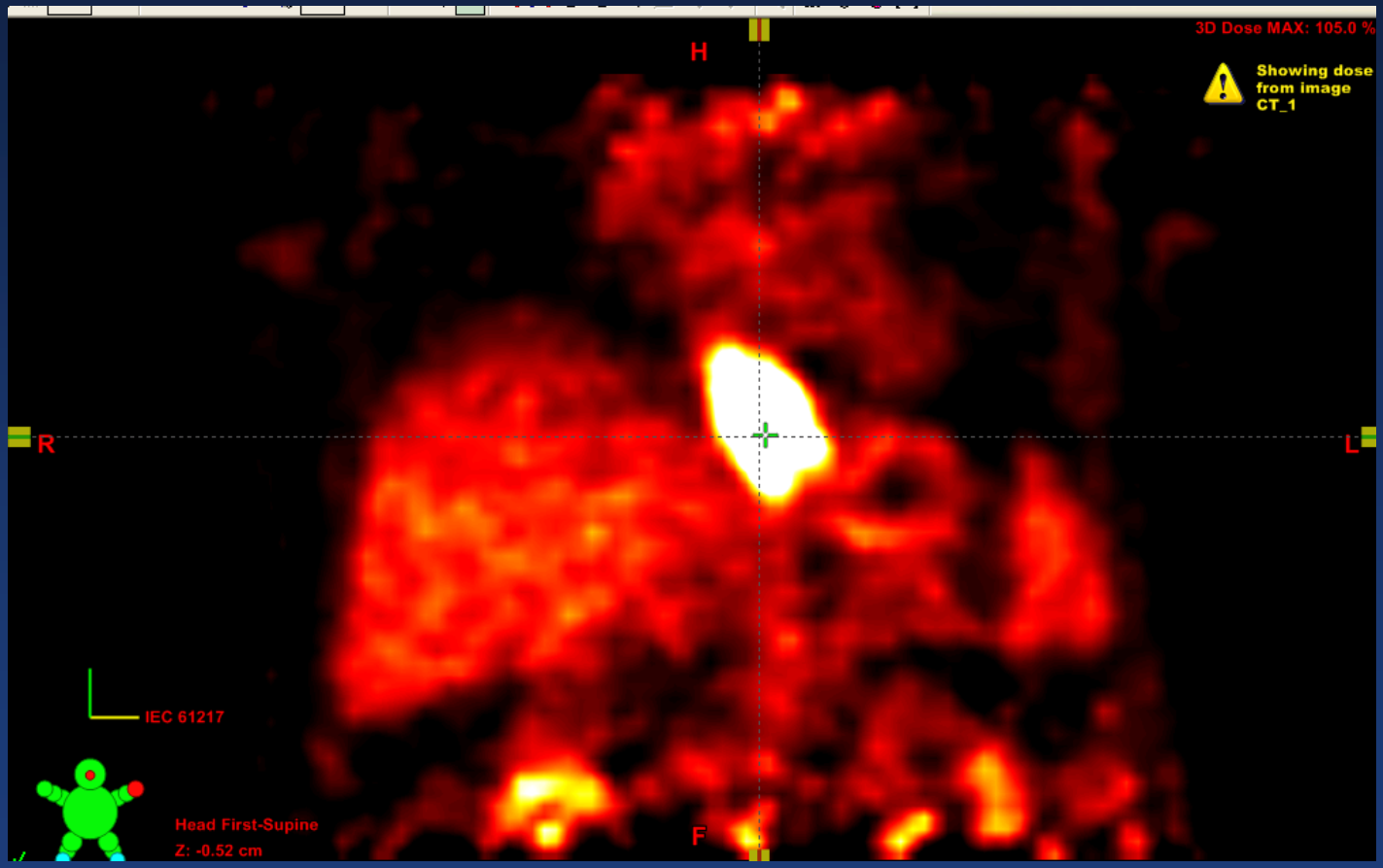
3-D Conformal Plan: 4 fields



PET/CT for Treatment Planning



4D PET/CT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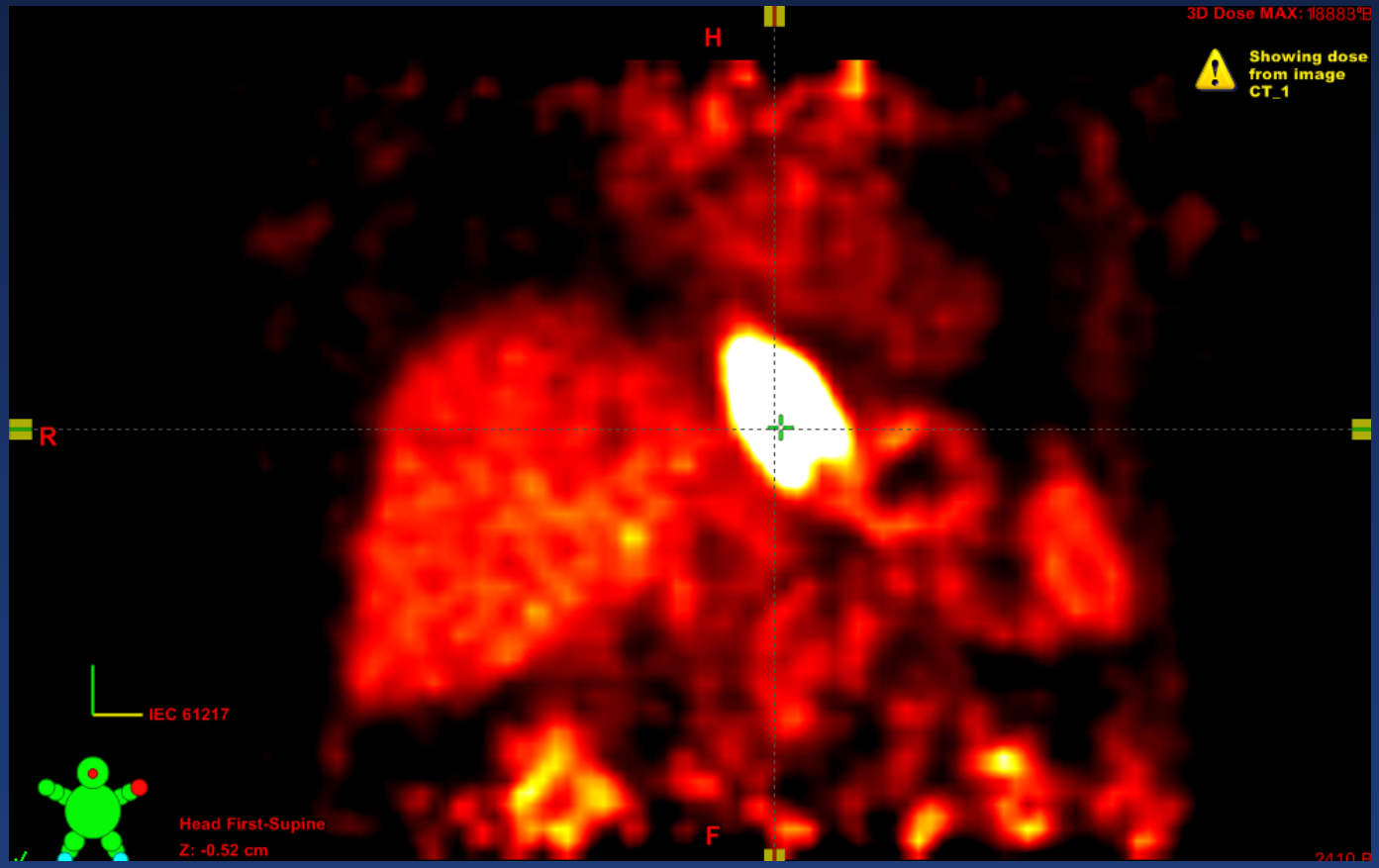
Head First-Supine
Z: -0.52 cm

4D PET/CT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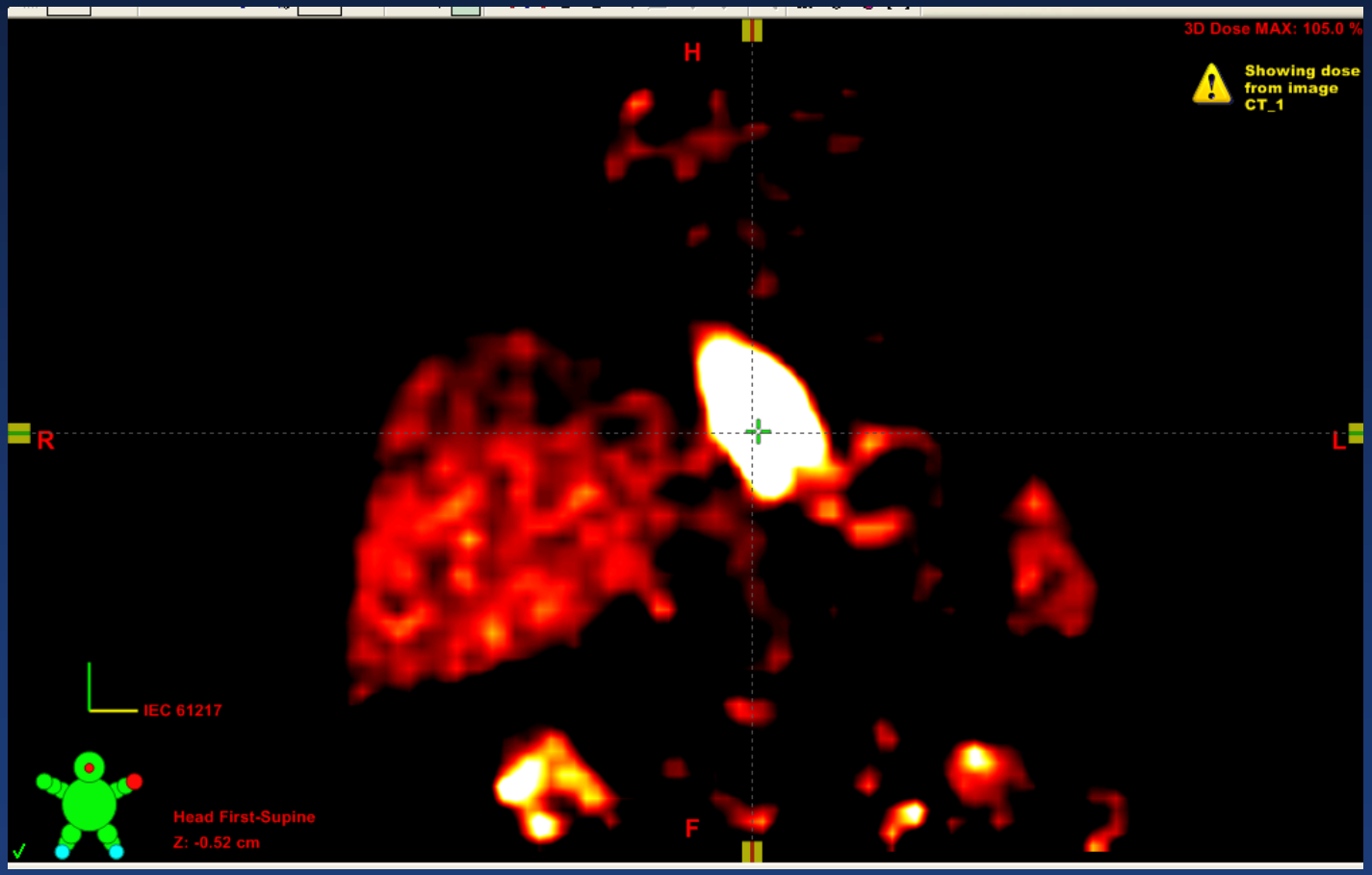
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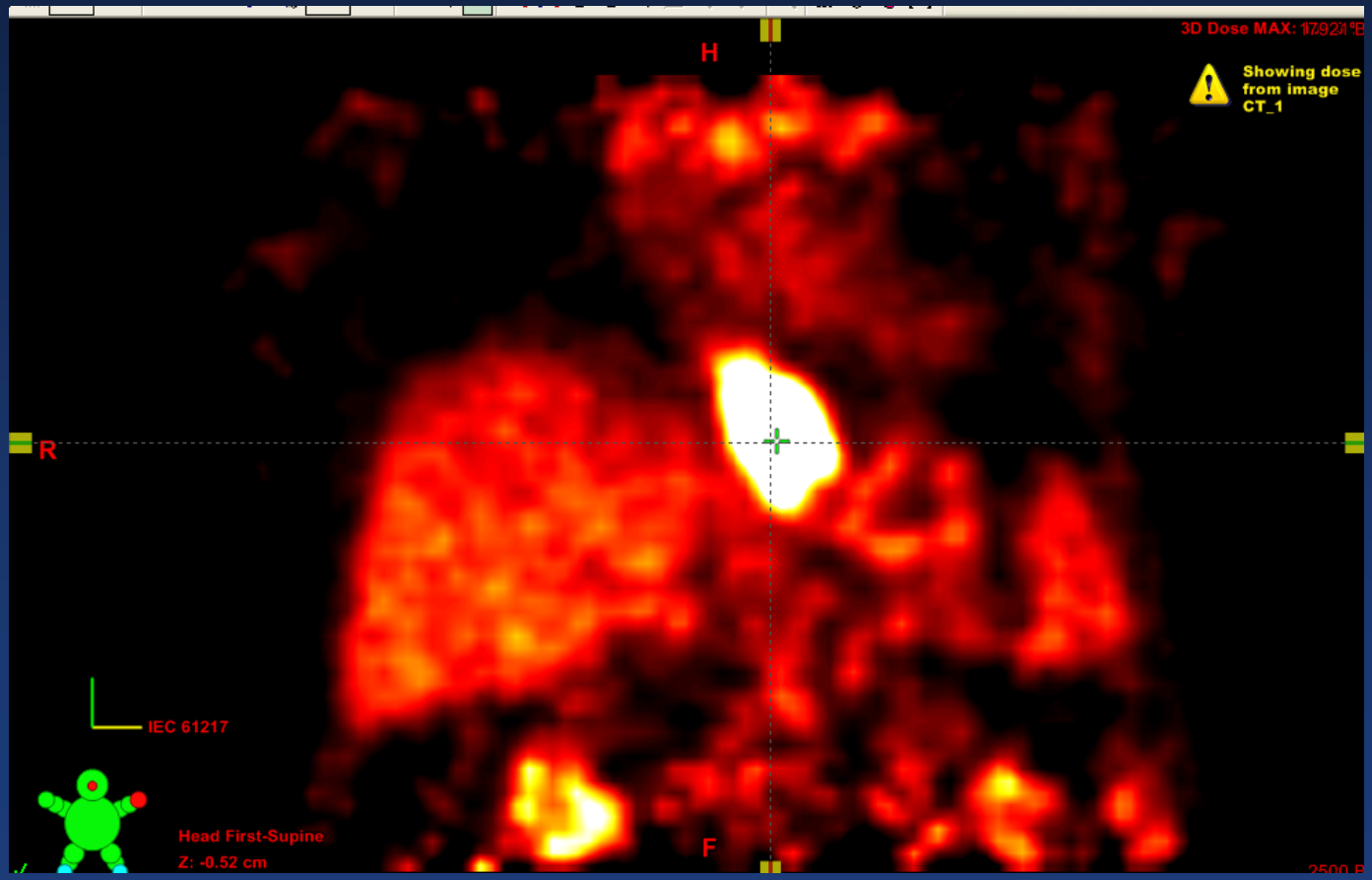
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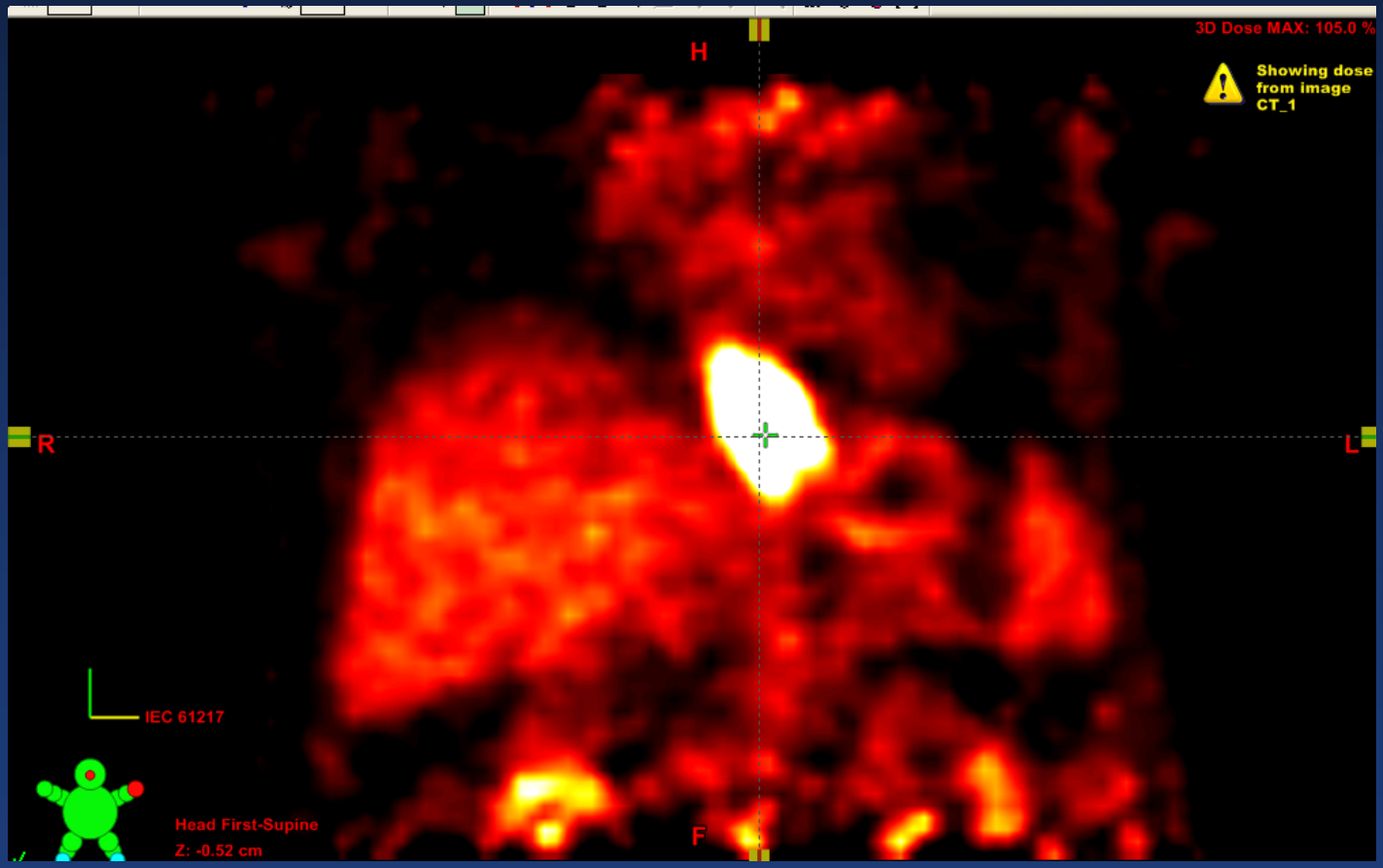
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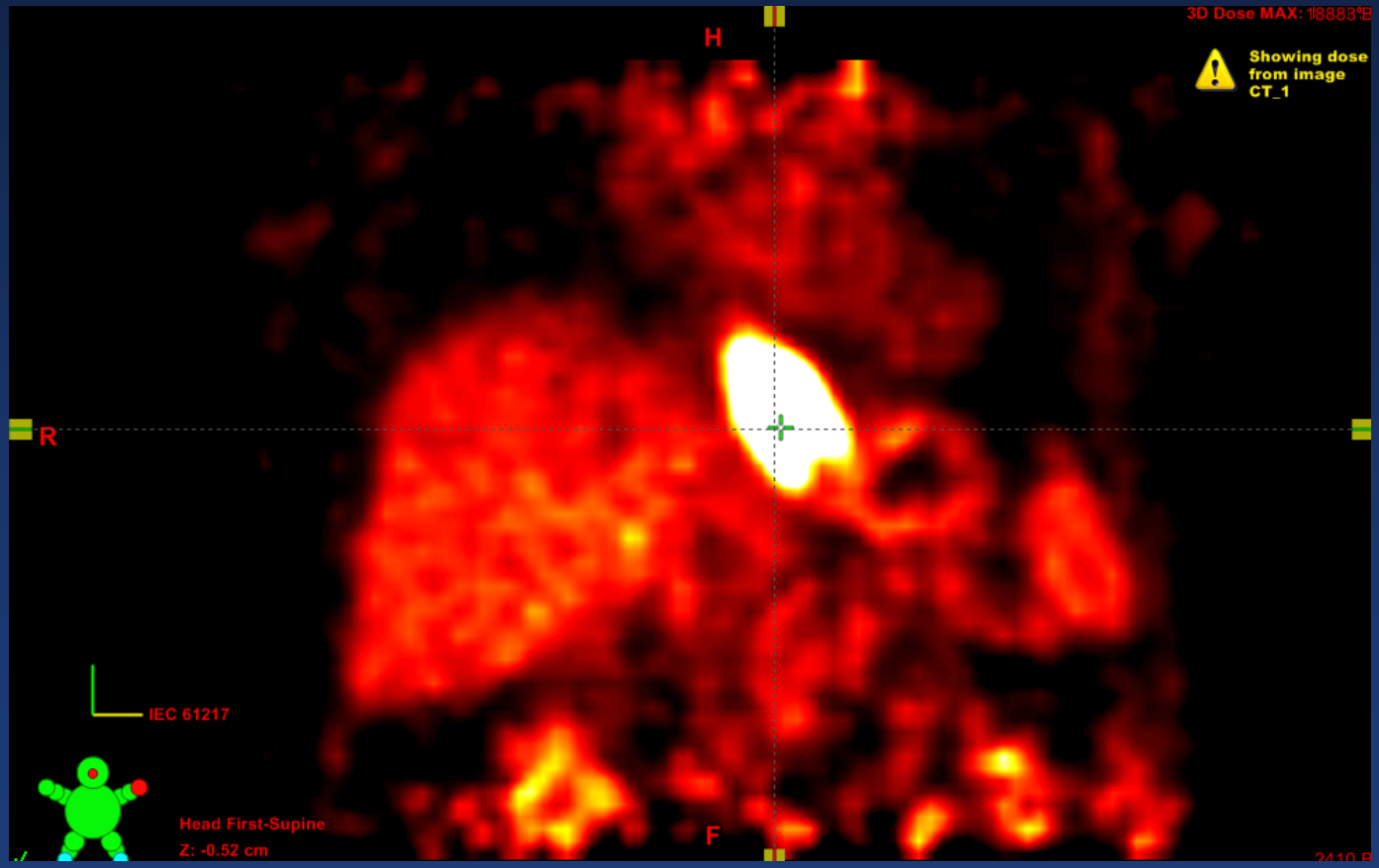
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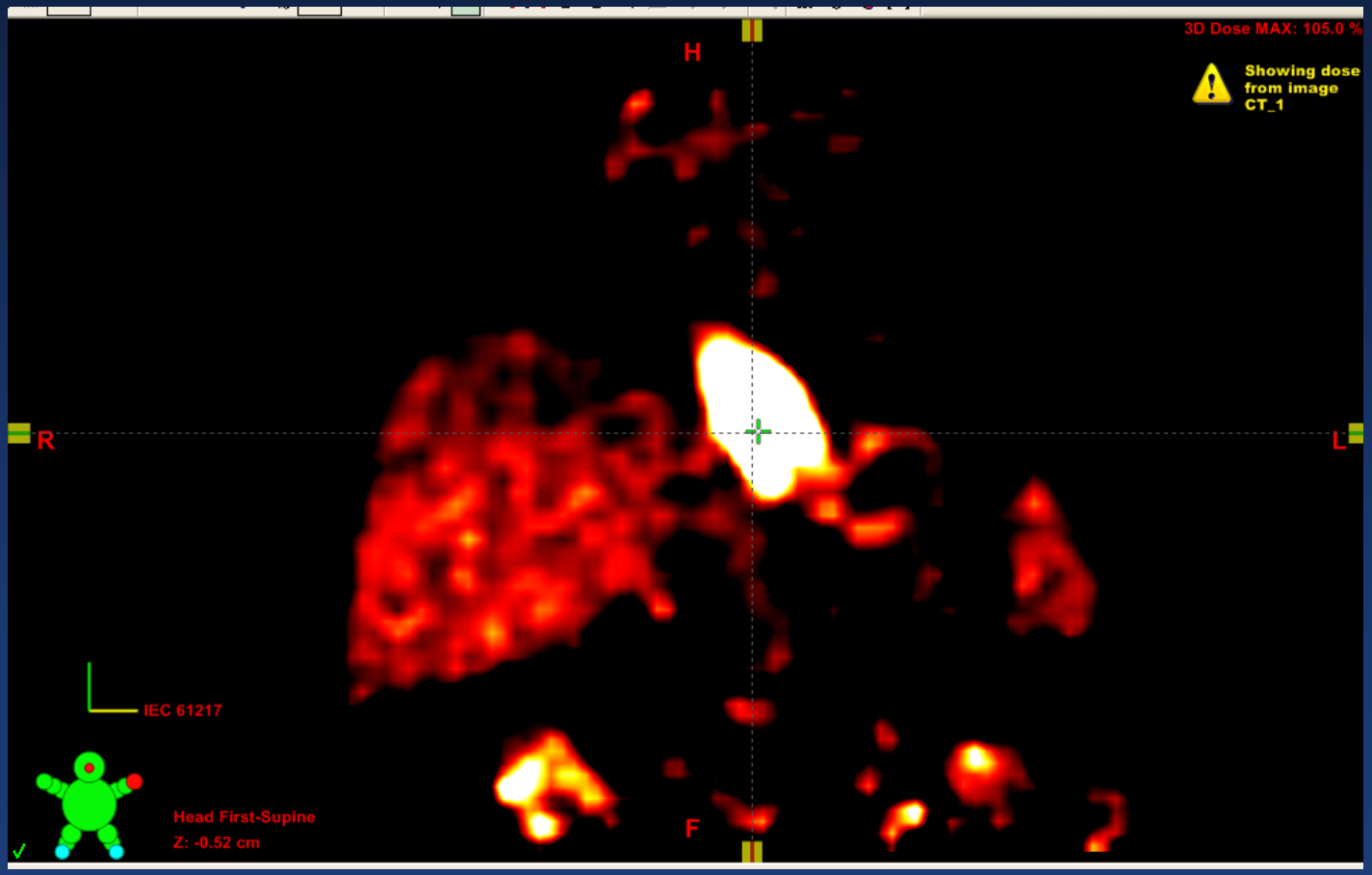
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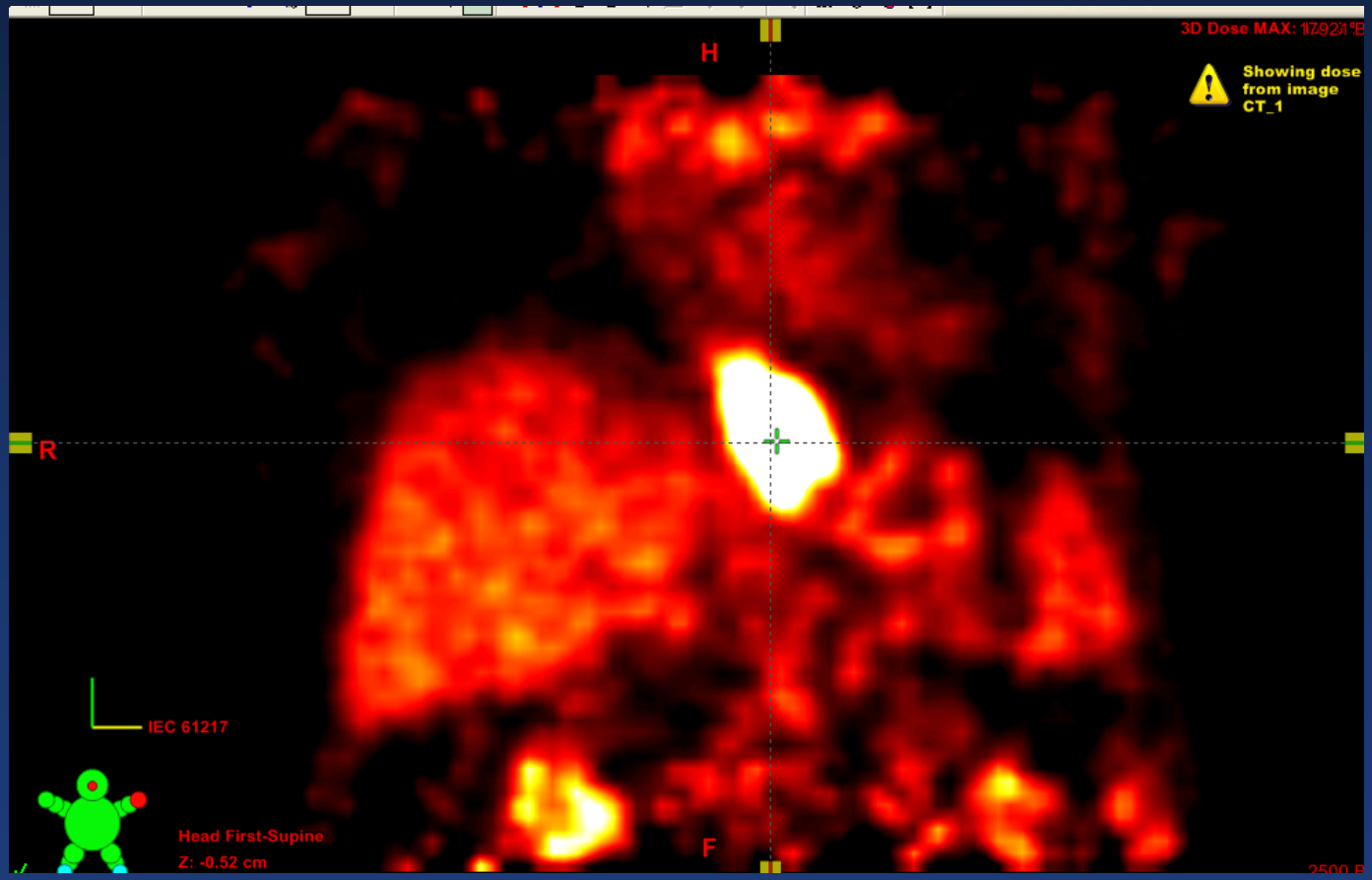
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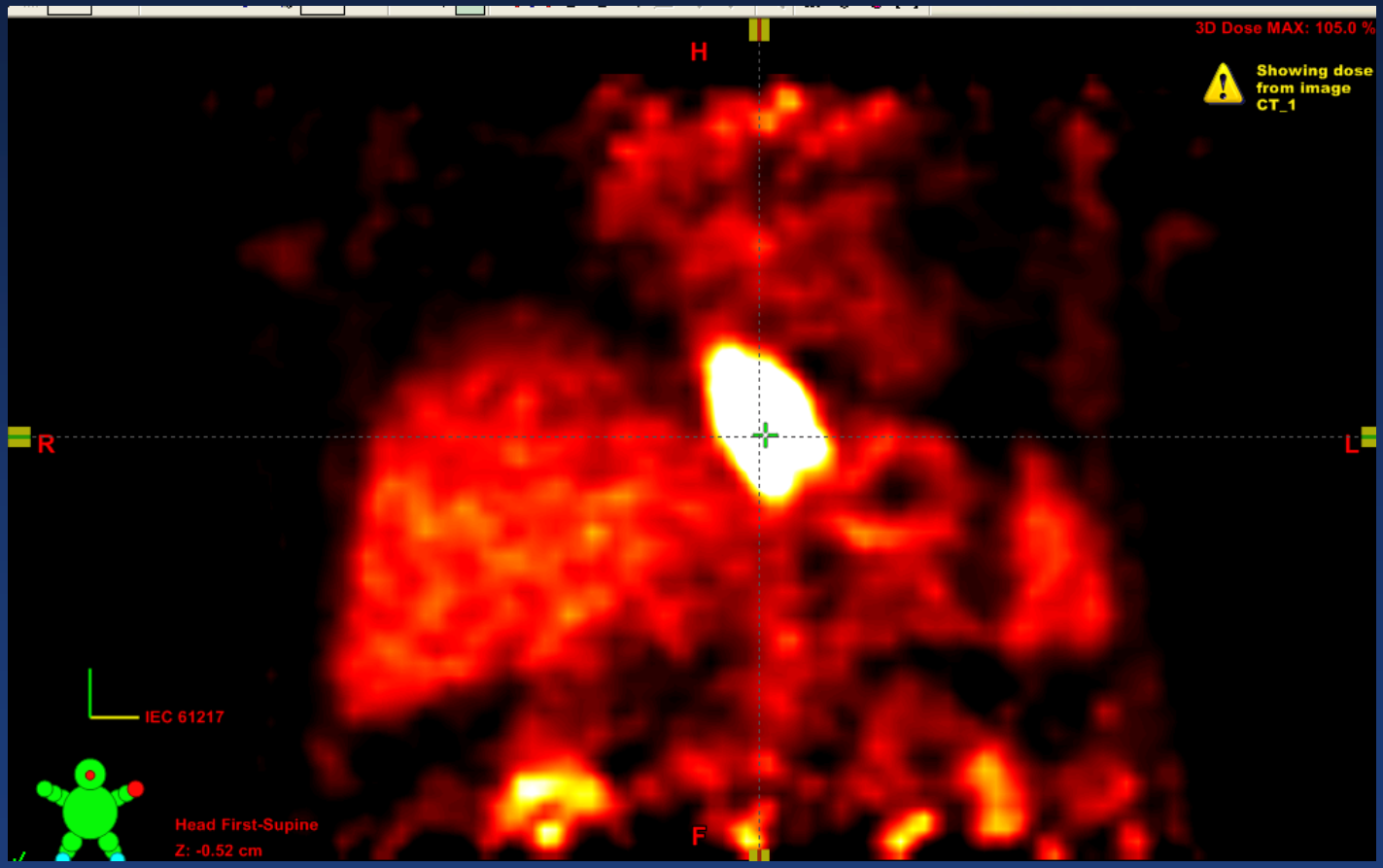
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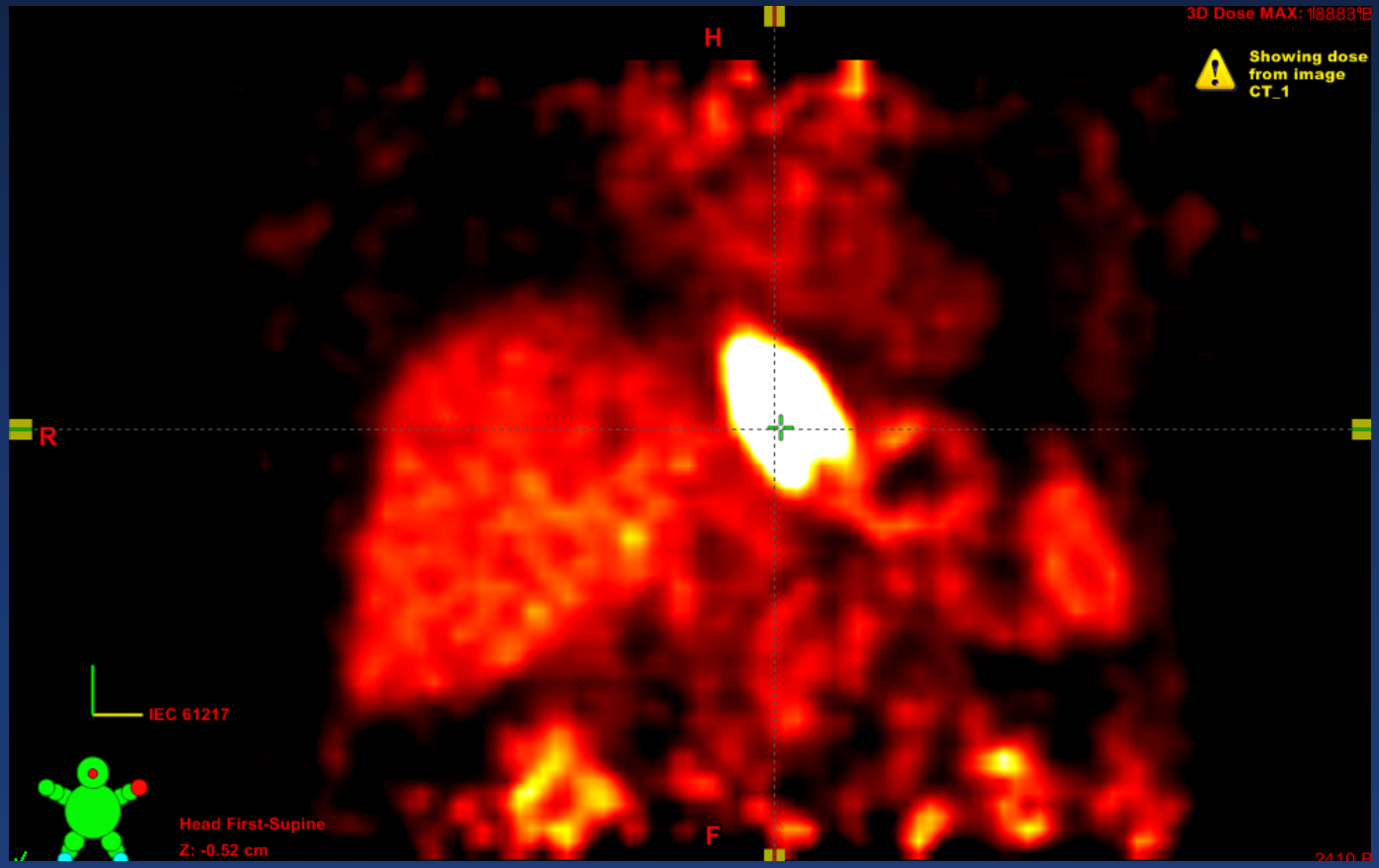
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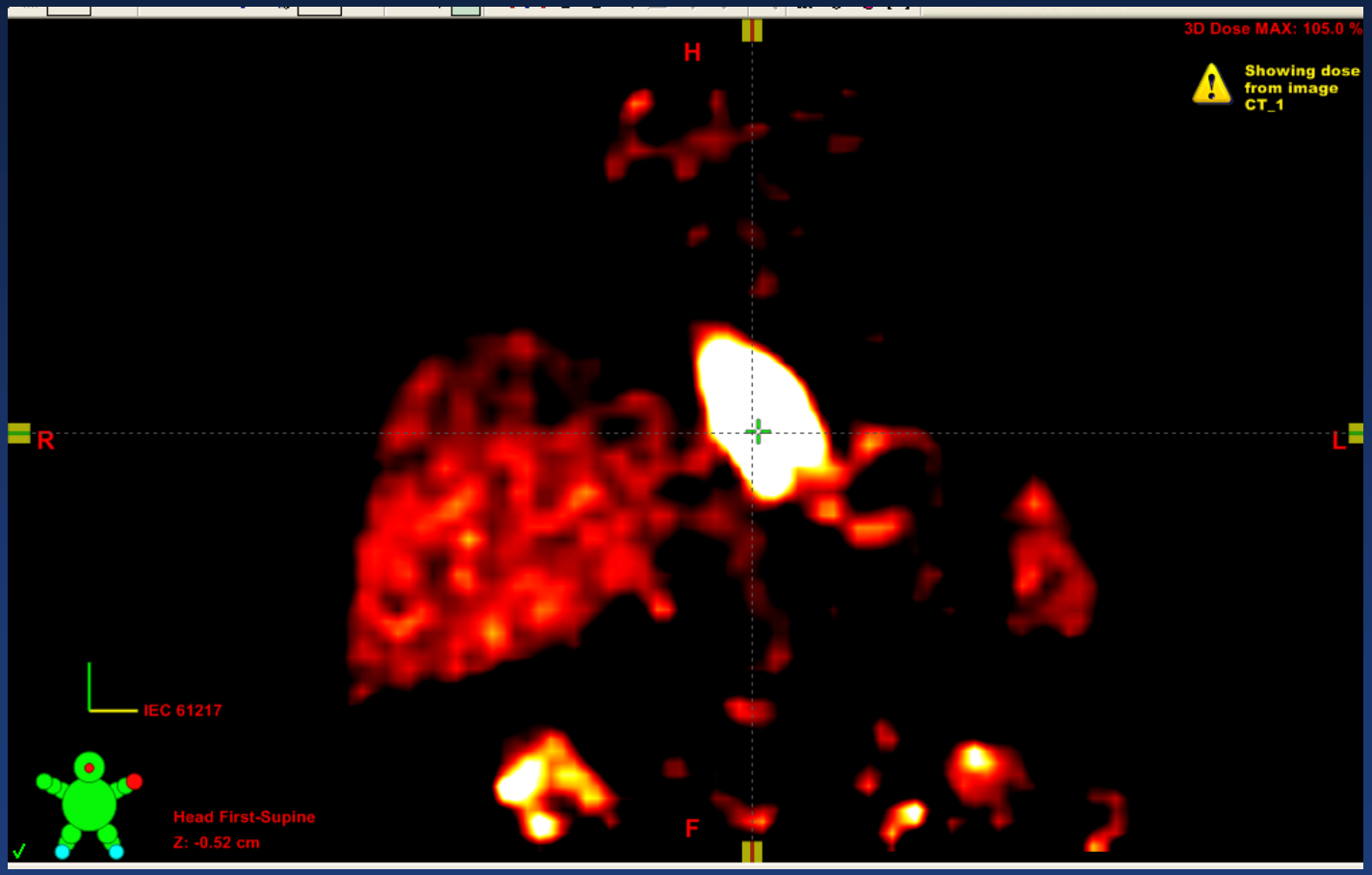
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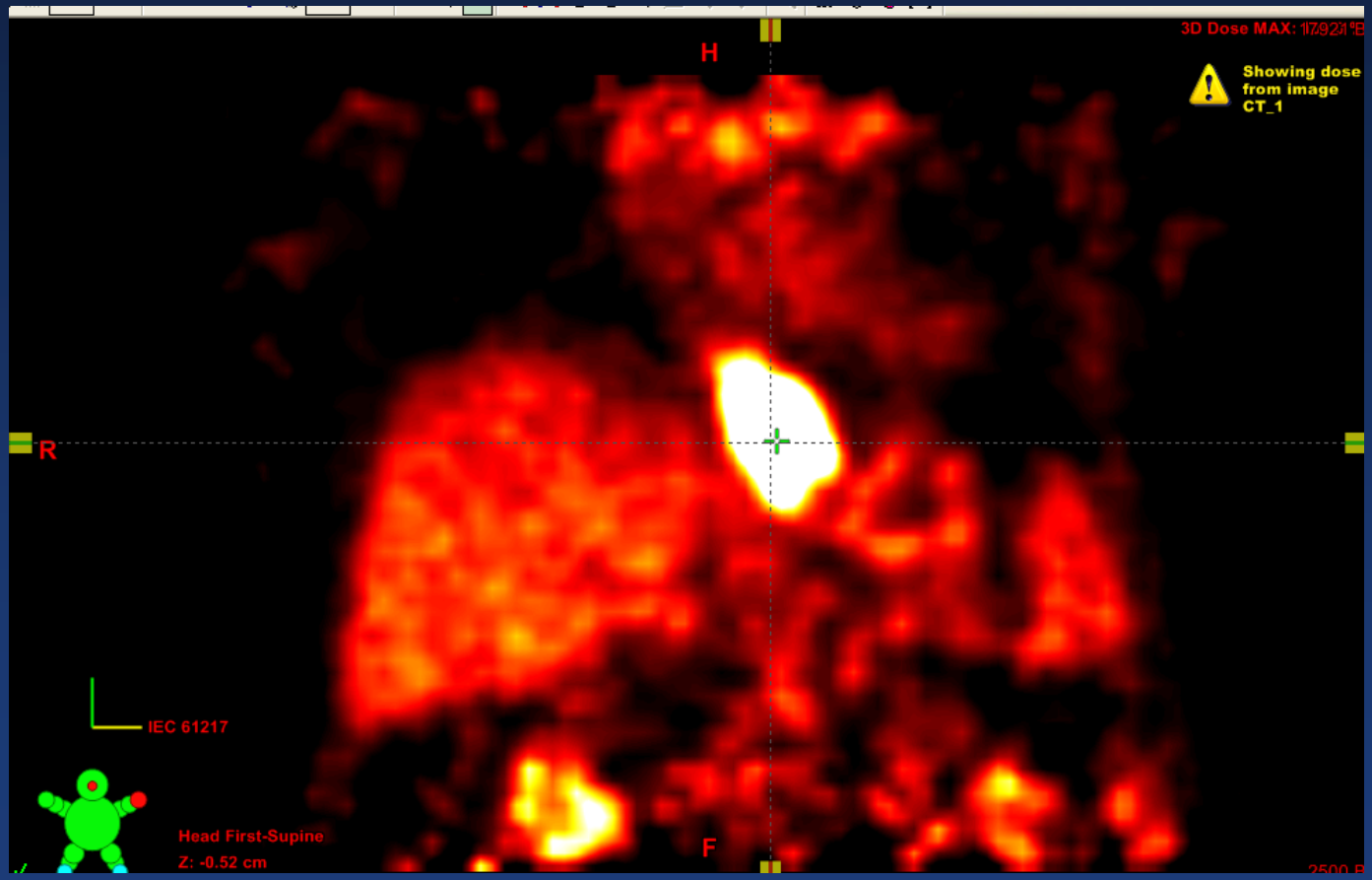
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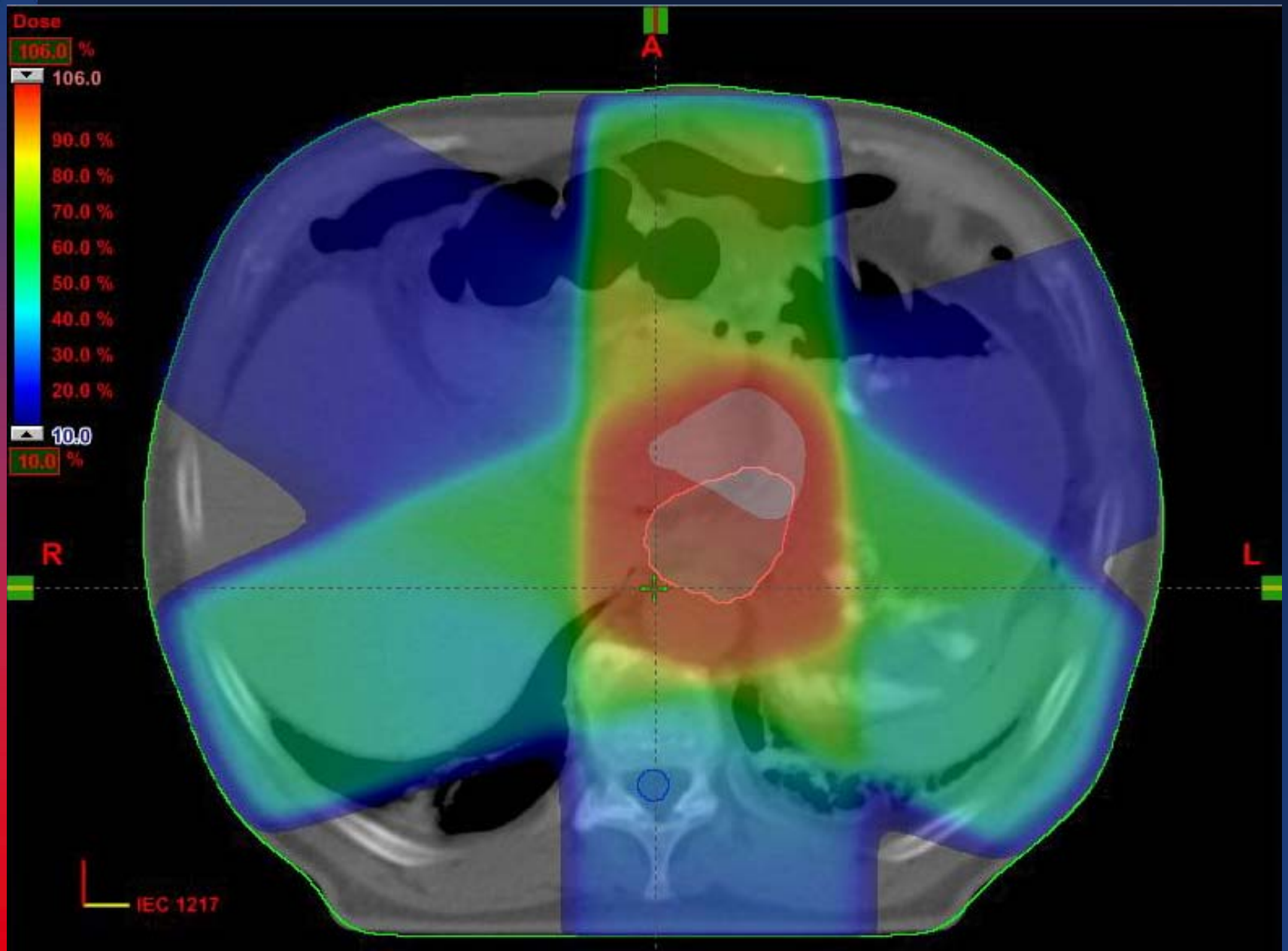
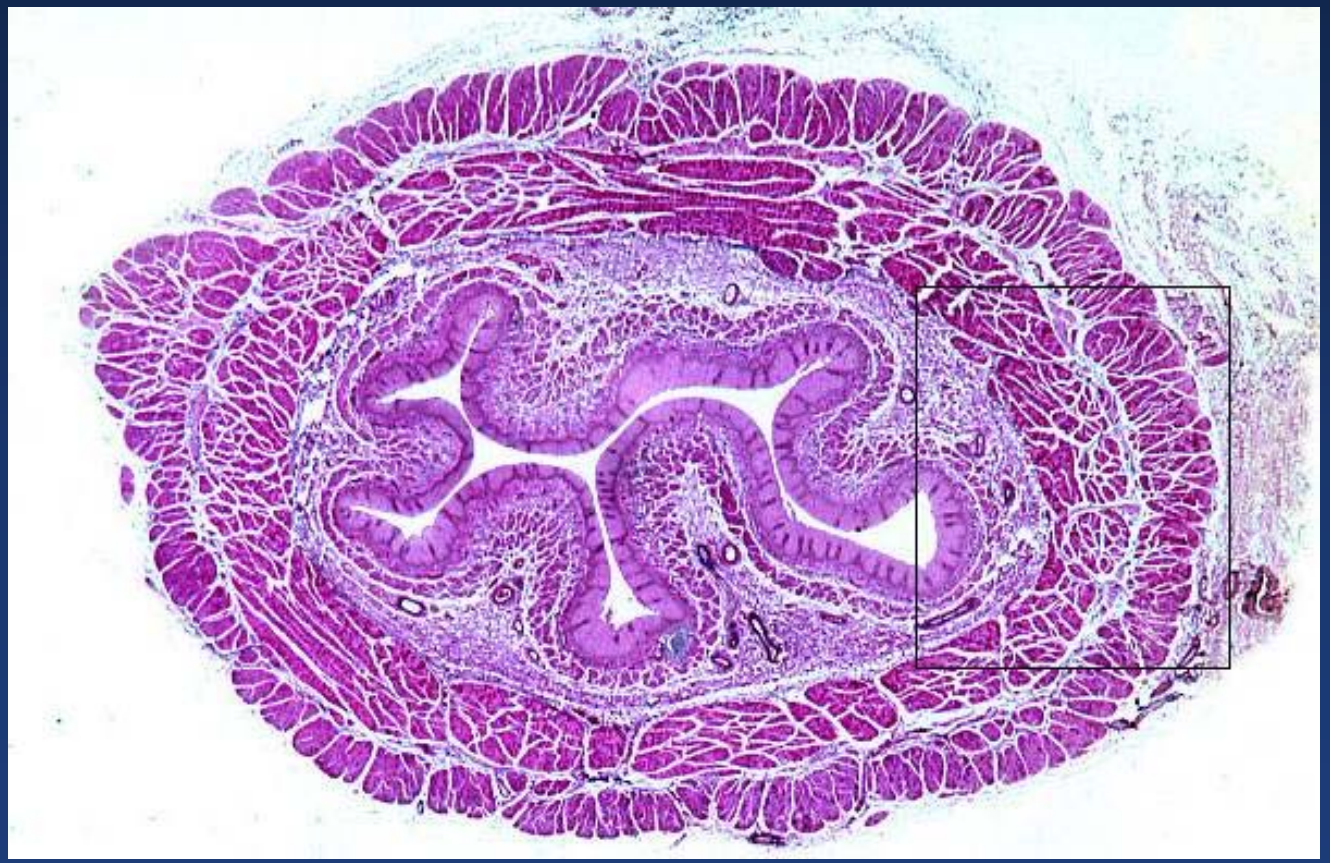


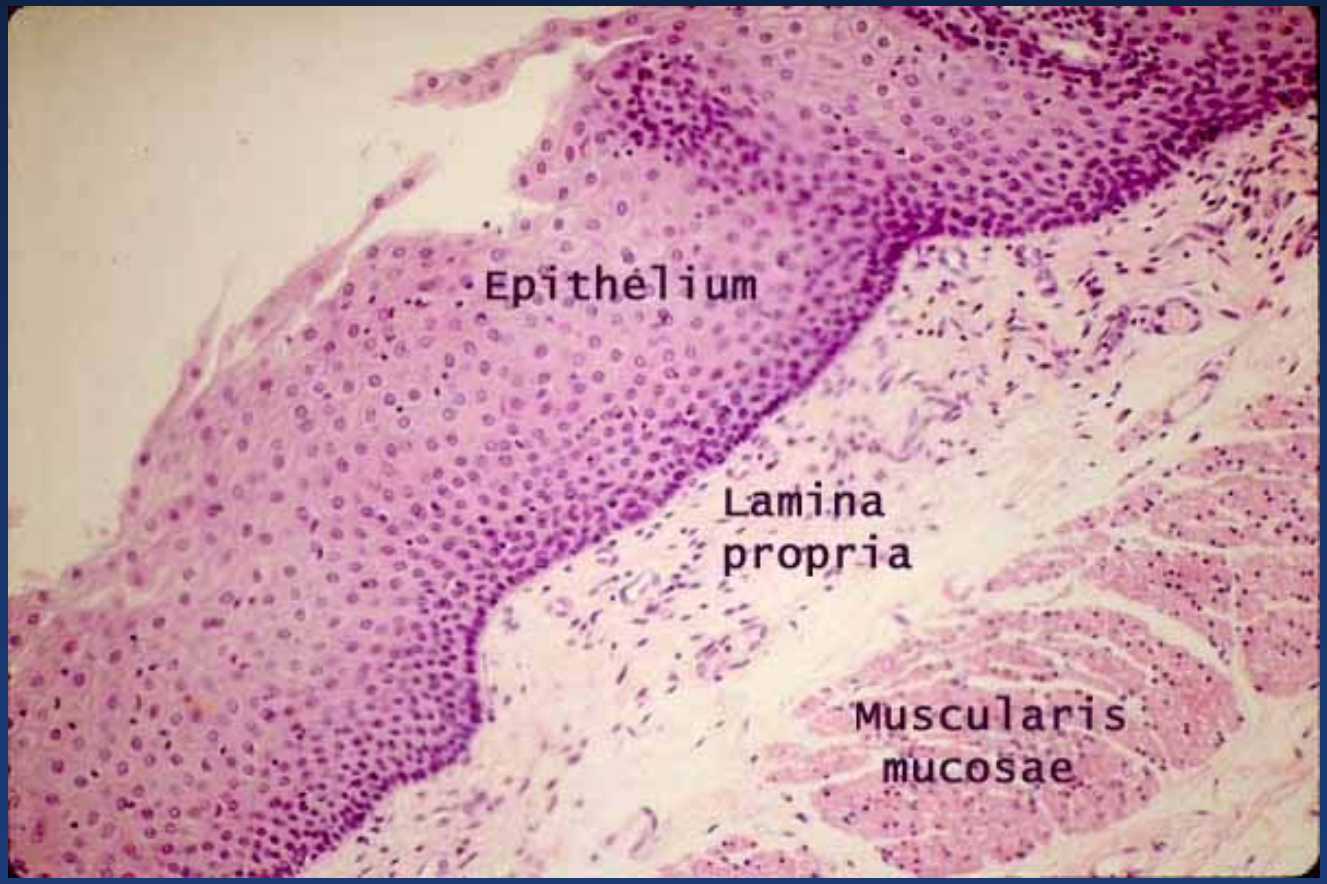
Radiation and Normal Tissues

- Cross section of the esophagus.
  - The innermost layer replenishes itself, similar to skin



Radiation and Normal Tissues

- Radiation stops the replenishing cells from dividing



Side Effects

- Short term side effects (during and months after)
  - Fatigue
  - Nausea/Vomiting/Heartburn
  - Painful swallowing
  - Loss of appetite/Weight Loss
  - Diarrhea/Bloating/Cramping
  - Skin redness
  - Lowered blood counts
- Long term risks (months to years after)
  - Scarring of swallowing tube (stricture)
  - Indigestion, pain, bleeding, ulcer, bowel obstruction
  - Risk of damage to lungs, heart, spinal cord, kidney, liver.

Nutrition

- Nutritional support
  - Evaluation and follow-up by a Nutritionist
  - Tubes
    - "G-tube" – tube to the stomach
    - "J-tube" – tube into the small intestine
    - Feeding the gut has fewer complications than IV nutrition
  - Monitoring
    - Caloric intake
    - Weight, blood pressure, heart rate
    - Blood tests for how nourished you are (albumin, preabumin)
  - Intervention
    - Appetite stimulants, nutritional supplements, IV fluids

Nutrition

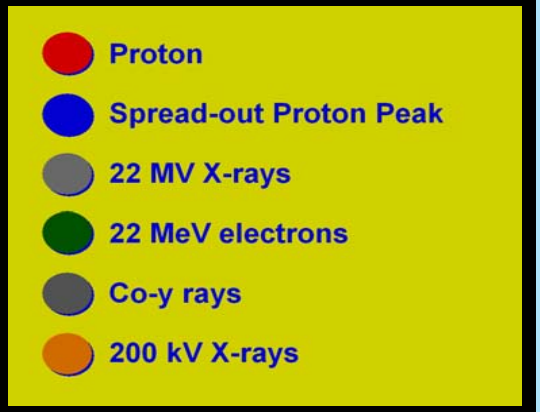
- Chart review study in patients with pancreas cancer:
  - Patients who had intensive nutritional support were less likely to miss radiation treatments
  - Nutritional intervention may improve outcomes
- Similar study in 132 patients with cancer of the esophagus: >80% had nutritional counseling
  - The less weight you lose during radiation, the better the outcome
  - Goal: Get through radiation treatments without interruption, and get to surgery in the best shape as possible

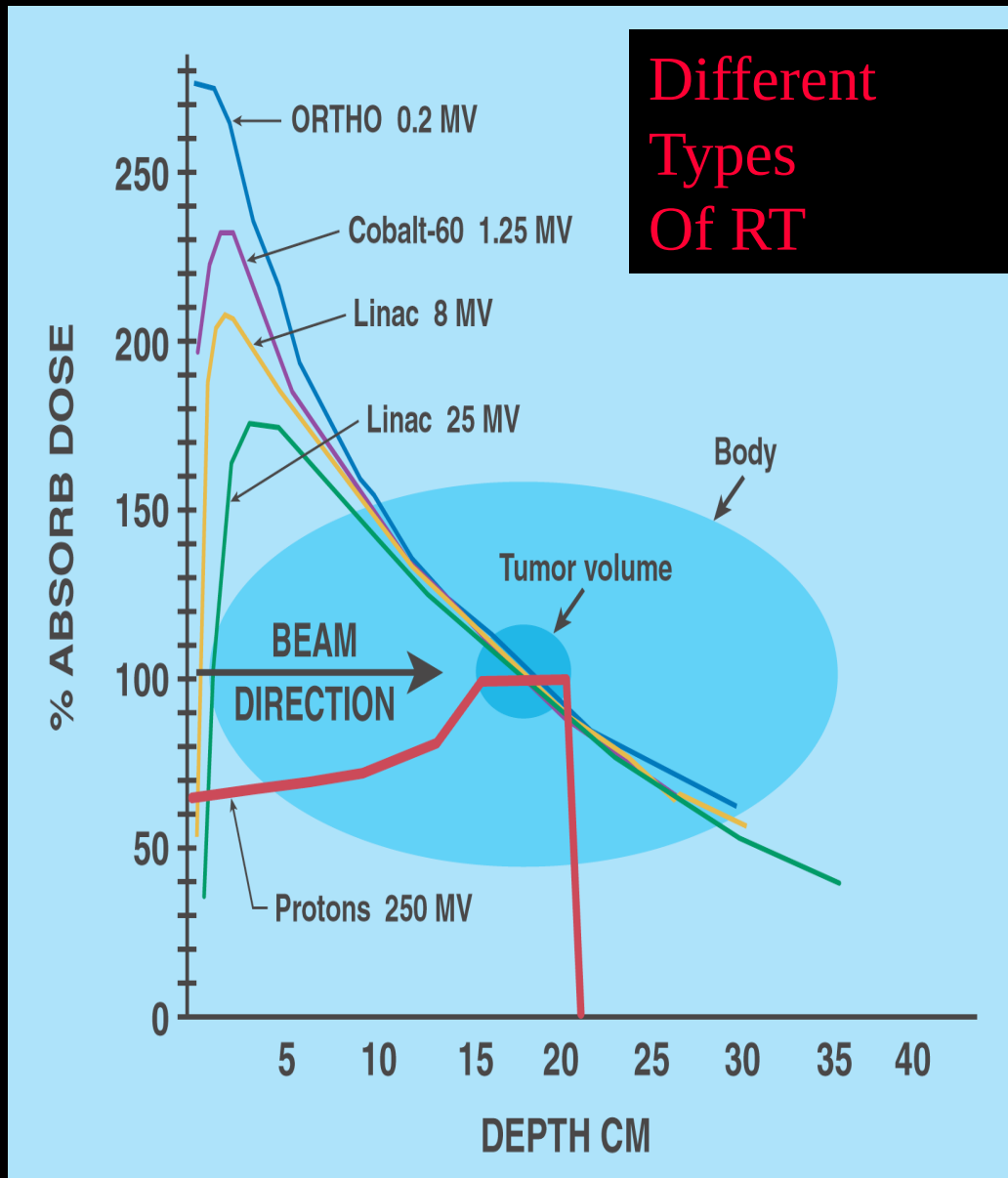
And Last But Not Least…

THE PROTONS ARE HERE!

What are Protons, Anyway?

- Protons are radiation, too, but they are heavy charged particles
- Unlike x-rays (photons), which are waves
- OK, but so what?
- Bragg Peak Effect

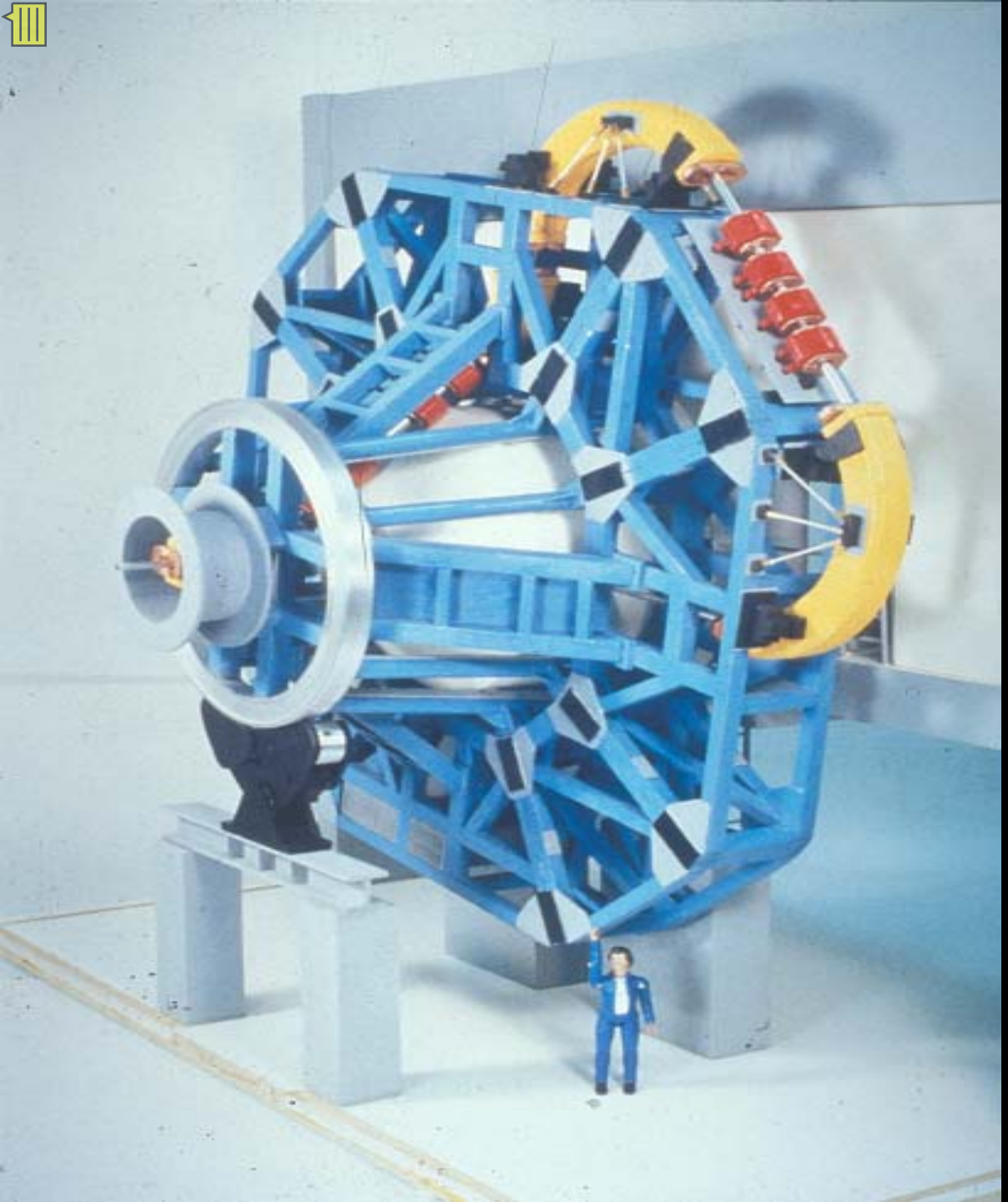




How Are Protons Made?

And This Is How It Looks on the Inside

Cyclotron is a circular particle accelerator consisting of high-powered magnets – it weighs over 200 tons!



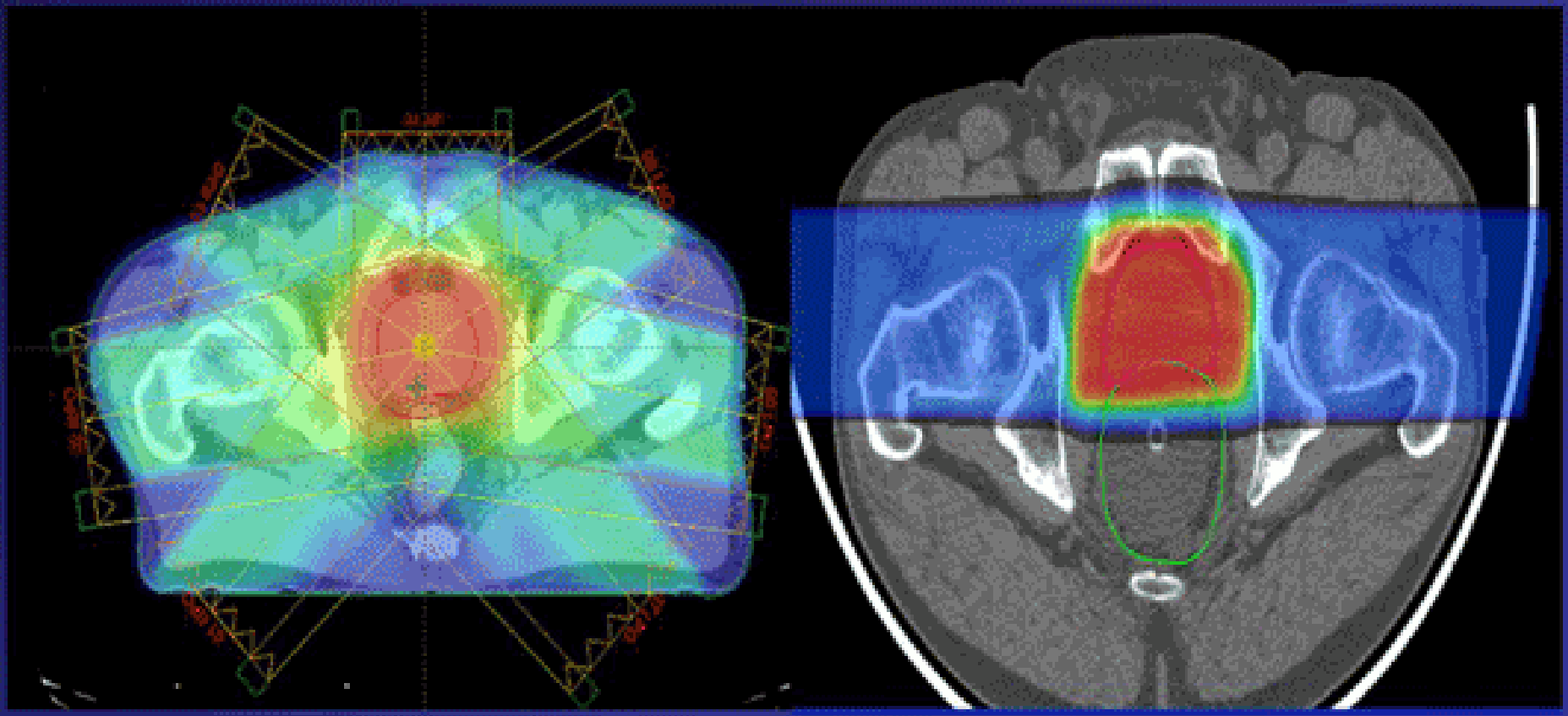
Proton Gantry, portion of the cyclotron that directs the proton beam as it enters into the actual patient treatment room

This is What the Patient Sees

What Advantages May Protons Have for Cancer Treatment ?

- Protons have the same tumor killing biologic properties that photons have, *but with*
  - Less dose to normal tissues (by 50-70%!)
  - Therefore potentially fewer side-effects
  - And the ability to increase radiation dose without increasing side effects
- So possibly better long-term outcomes with the same or fewer side effects

Prostate Cancer-80 Gy

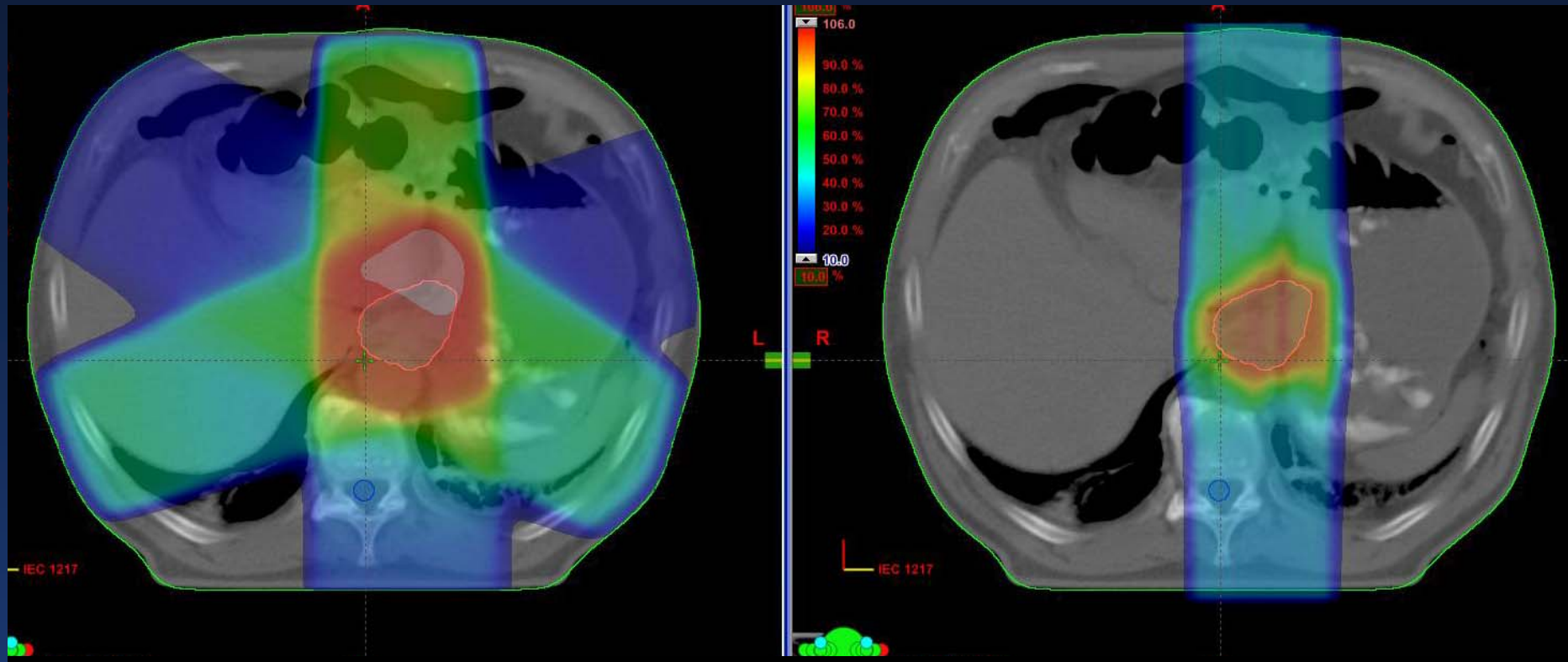


IMRT

PROTONS

Red = High dose Green = Medium dose Blue = Low dose

Photon vs. Proton



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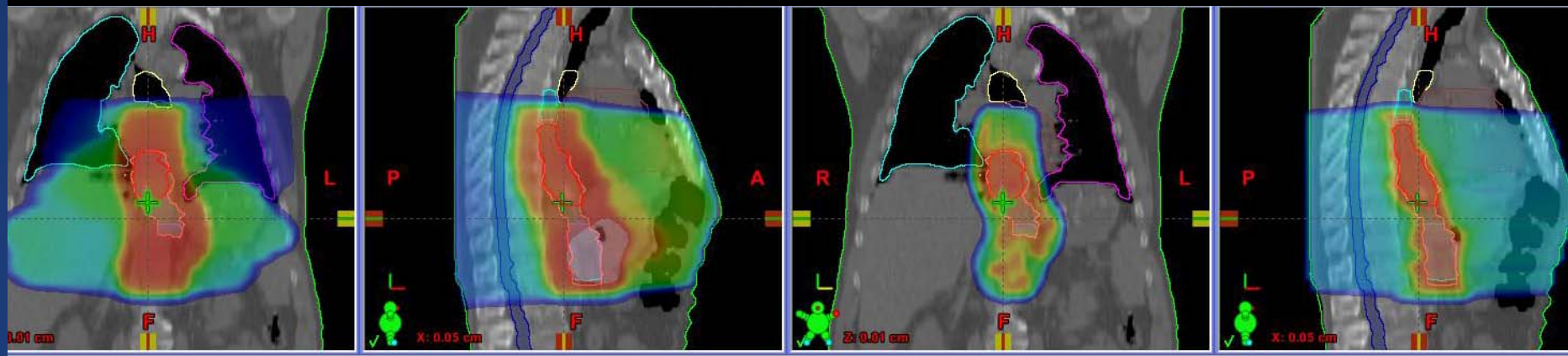

General Comments

- Get all the information you can from trusted and reliable sources
- Once you (& your loved ones) feel well- informed and make a decision, there is no wrong answer, just what is right for you
- High-volume, academic, NCI-designated cancer centers like Penn have the clinical experience, technological resources, and cutting edge advances that are vital for optimal cancer management

The Future of Penn Radiation Oncology

Thank you for your attention!