DB06-12: Teaching Medical Imaging with Analogies

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Other Collaborators

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Student Audience

- University
- Prior to entering medical studies
- One year of physics
  - Algebra-based
  - Only physics course
- Change parts of this course
  - Not replacing the course

Goals

- Conduct research on student reasoning and mental models related to application of physics to contemporary medicine,
- Develop active engagement instructional materials on applications of physics to contemporary medical diagnosis and procedures, and
- Integrate physics and contemporary medical applications throughout the physics course for medical students

Approach to the science

- Focus on the physics not the medicine
  - That's what I know
  - Students could not analyze a PET scan but could describe the underlying principles
- Qualitative problem solving
- Use visualization frequently

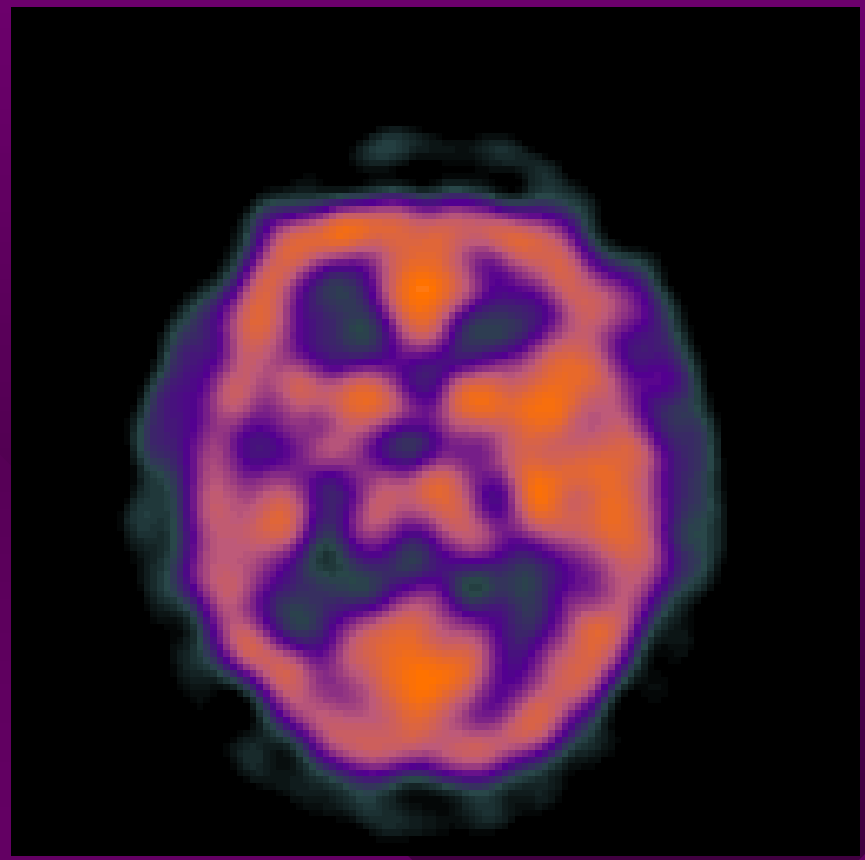
Physics applications to medical diagnosis & treatment such as

- X-rays & CT Scans
- Ultrasonic Imaging
- Positron Emission Tomography
- Magnetic Resonance Imaging
- Lasers in diagnosis & surgery

Research on Learning

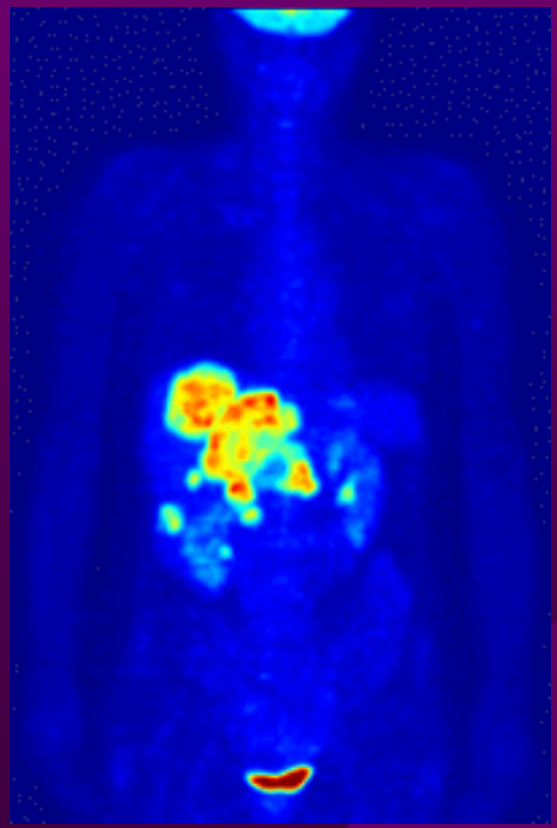
- Clinical Semi-structured Interviews
  - One-on-one (interviewer & student)
  - Elicit student reasoning & mental models
- *Teaching Interviews*
  - Small groups of students
  - Do the best we can to teach a limited topic

Positron Emission Tomography (PET)



Positron Emission Tomography (PET)

- Positron emitter injected into body
- Positrons annihilate with electrons
- Detection of 2 gamma rays determines the location of the annihilation
- Watch body functions as they occur



From Wikimedia Commons

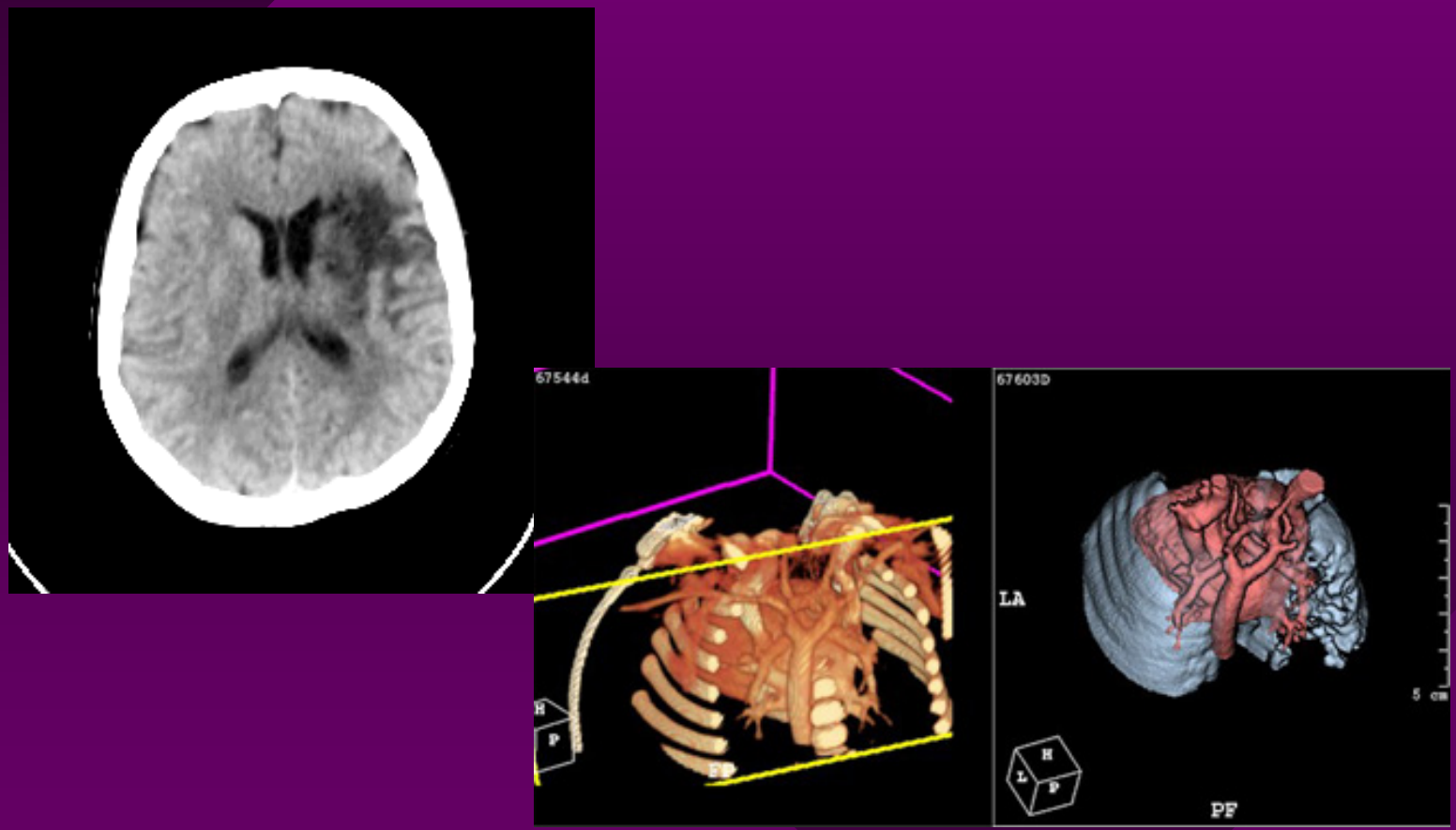
PET Coincidence Analogy 1

- Focus on coincidence & what it tells us
- Hidden collision carts
- One student releases the carts
- Another student sees the carts only at the end of the track
- Determine where the carts started

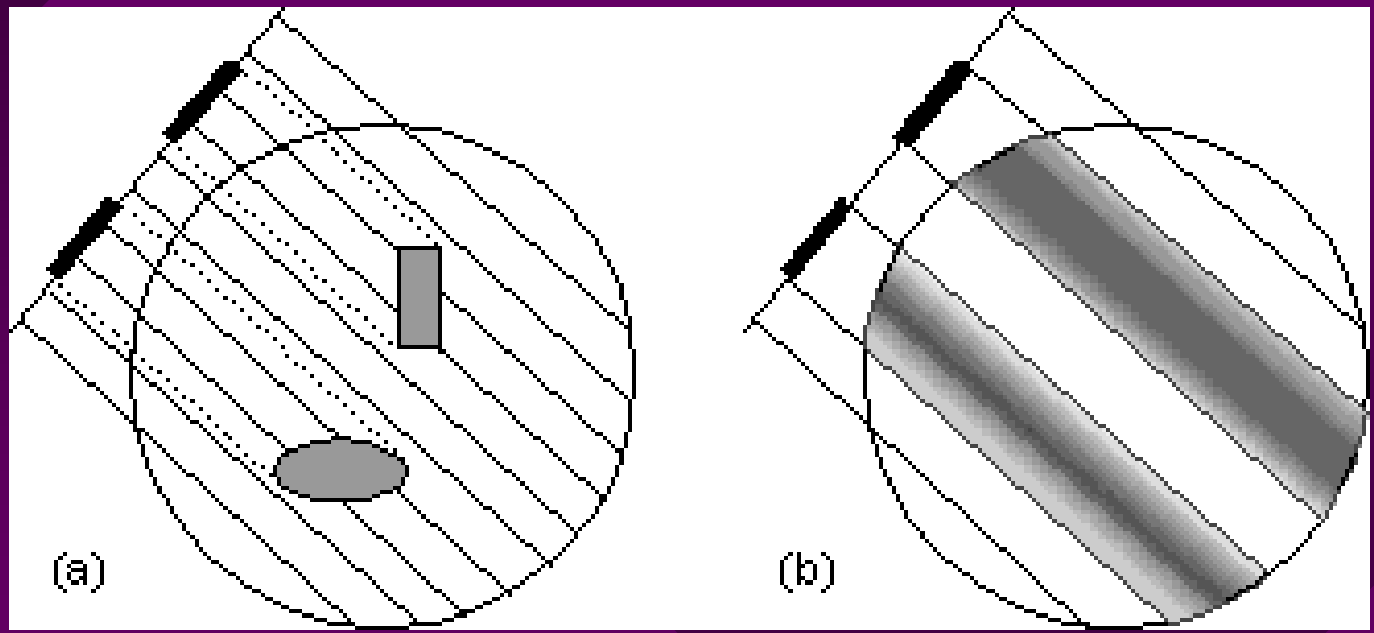
PET Coincidence Analogy 2

- LEDs hidden inside a cake carrier
- For each “annihilation” two lights flash
- Student determine the “location” of the group of annihilations.

Computer Tomography



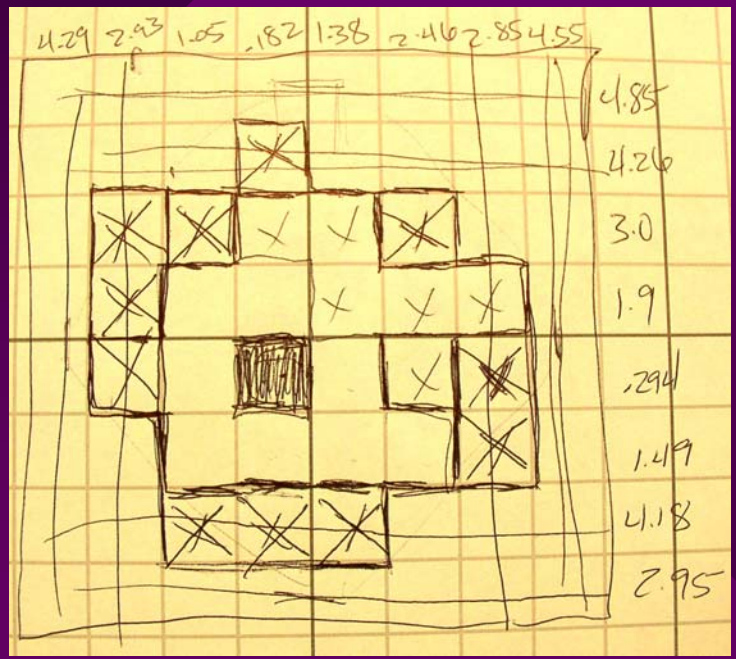
Back Projection used in CT Scans

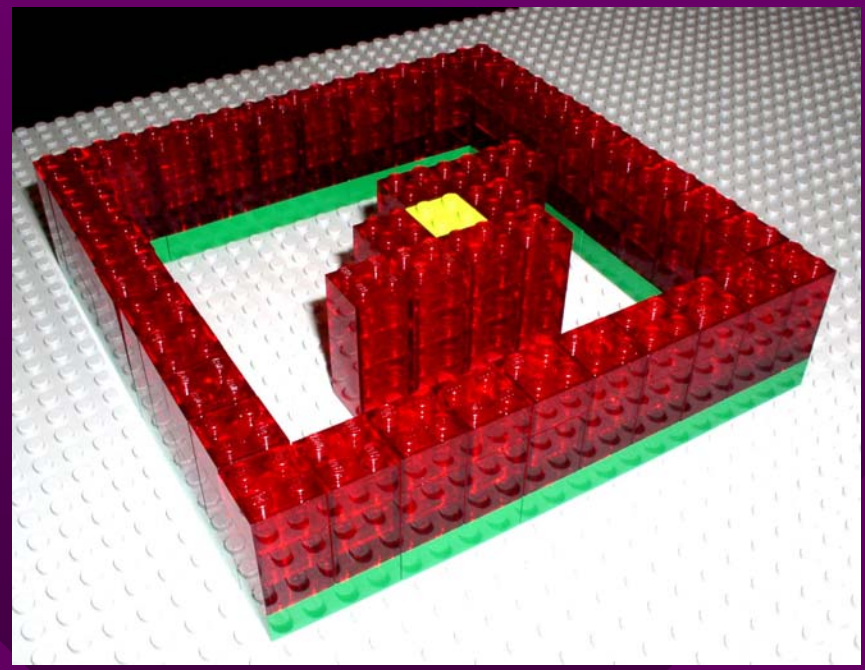


Back Projection with Legos

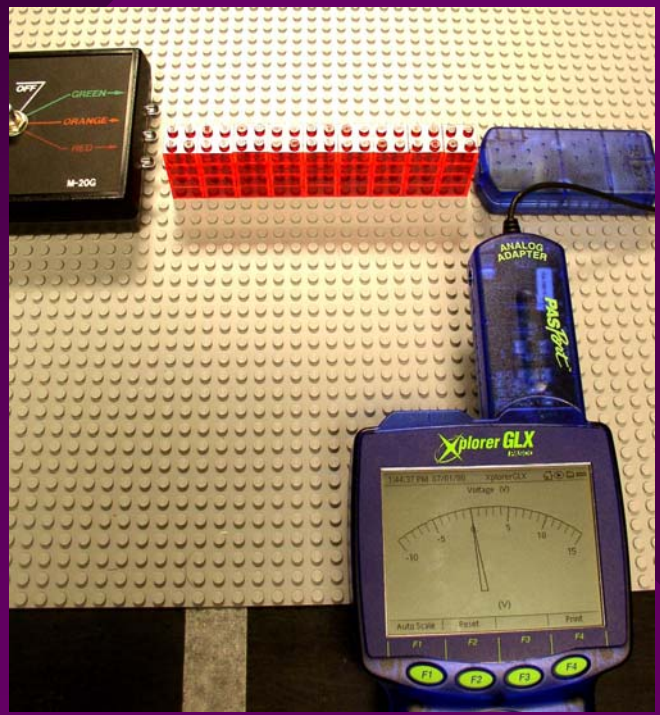
- LED source; Photodector
- Configuration of translucent Lego blocks hidden from view
- Determine the configuration from the light absorption data

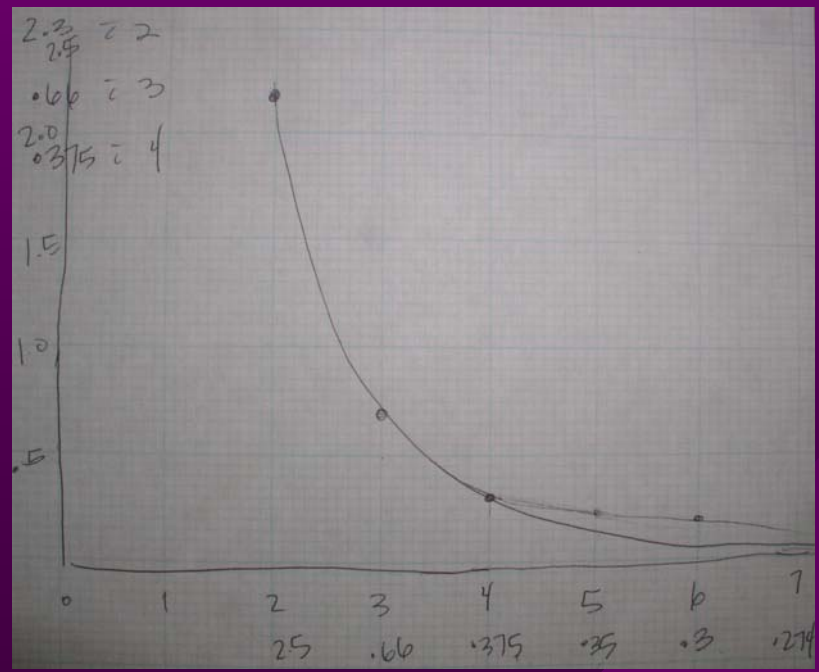
Example



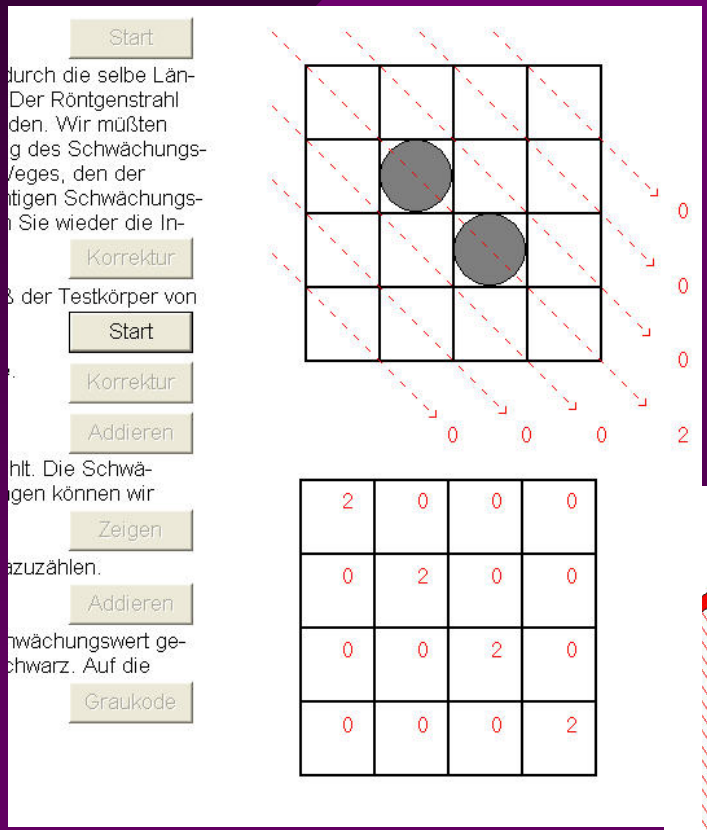


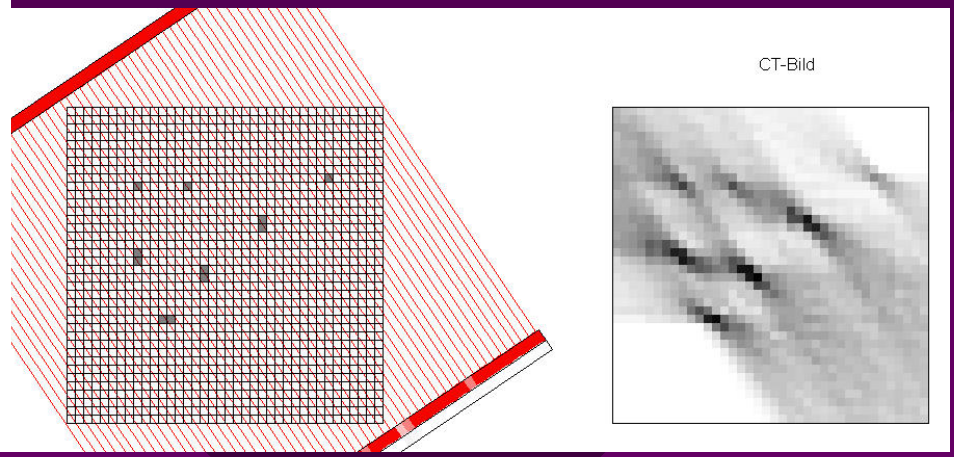
Attentuation of Light adds additional information





Interactive Simulations for CT





Didaktik der Physik

Ludwig Maximilian University, Munich

Physics Education Research Group

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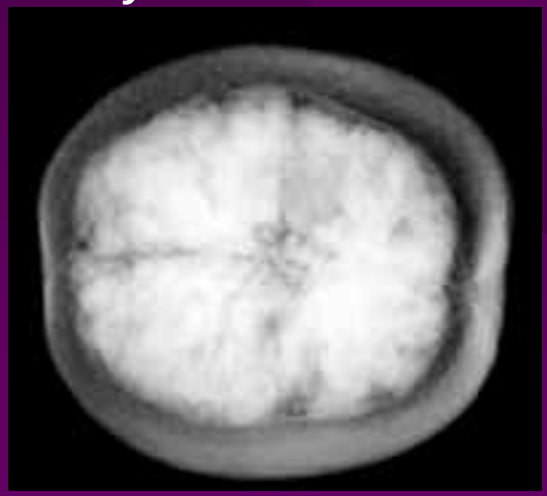
More sophisticated method of signal analysis leads to better results

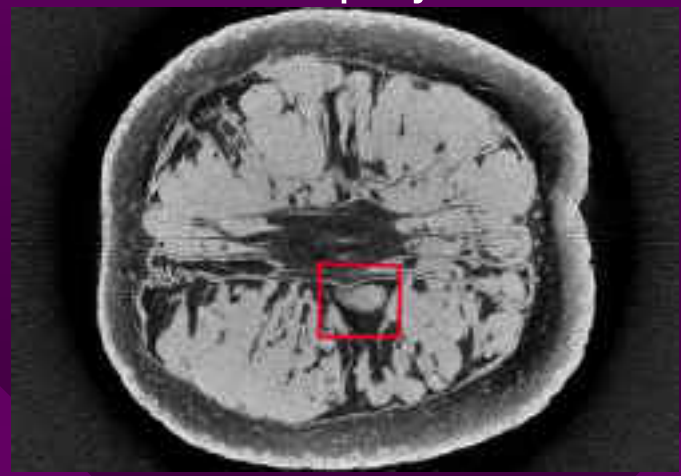
Images of an orange

x-ray



Brandeis University Detector Group

CT with back projection



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