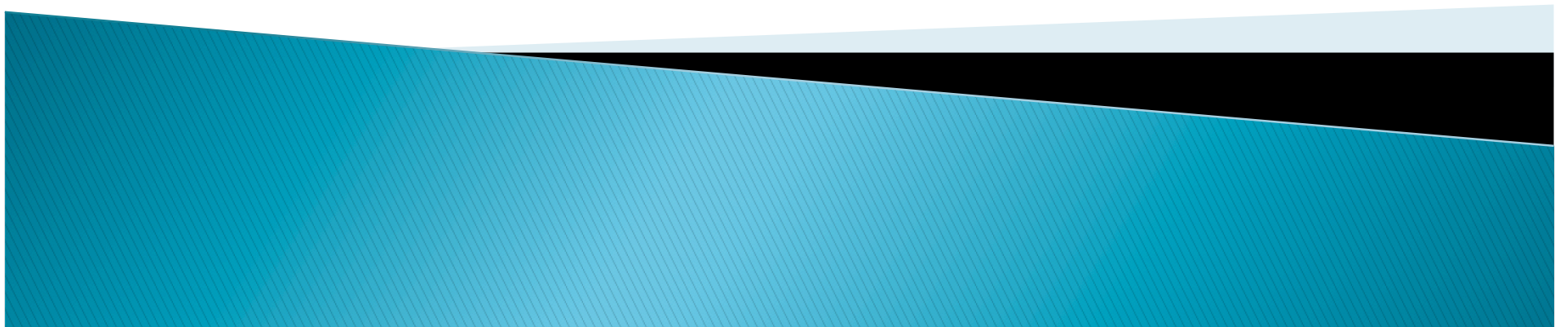


An Open Source Platform for Small Animal Imaging & Therapy

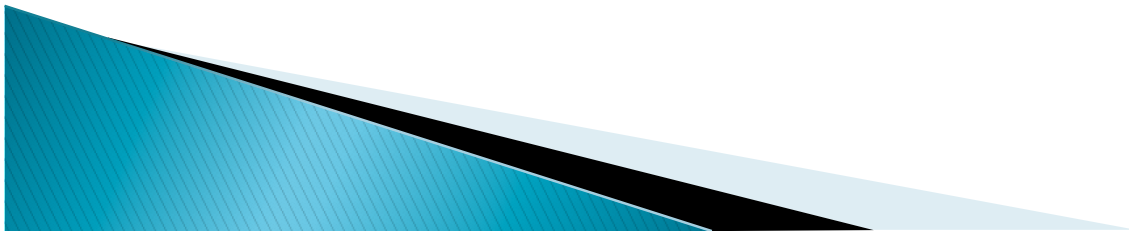
Client: Robert Jeraj; Rock Mackie; Surendra Prajapati
Advisor: Prof. Willis Tompkins

Jay Sekhon (Leader)
Jon Seaton (Communicator)
Whitney Johnson (BSAC)
Sarah Springborn (BWIG)



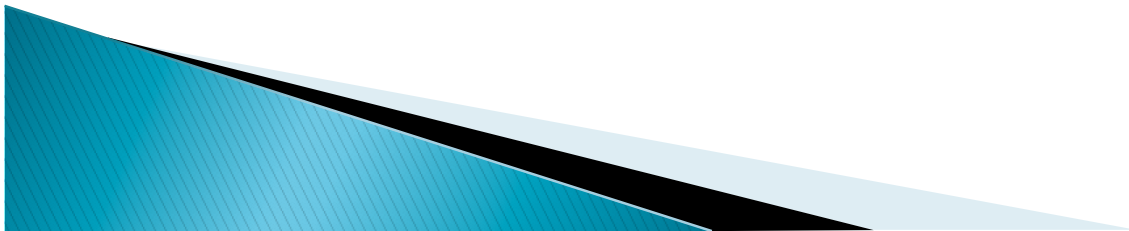
Presentation Overview

- ▶ Problem Statement
- ▶ Client Background & Open Sourcing
- ▶ Current Systems
- ▶ CT, PET, RT & Specs for each
- ▶ Combined Systems
- ▶ Future Work



Problem Statement

- ▶ Project Aim: Develop an open source small animal imaging and therapy platform
- ▶ Integrates imaging (CT, PET) and therapy (radiotherapy)
- ▶ Designed to enable researchers to build their own system by their needs.



Client Background & Open Sourcing

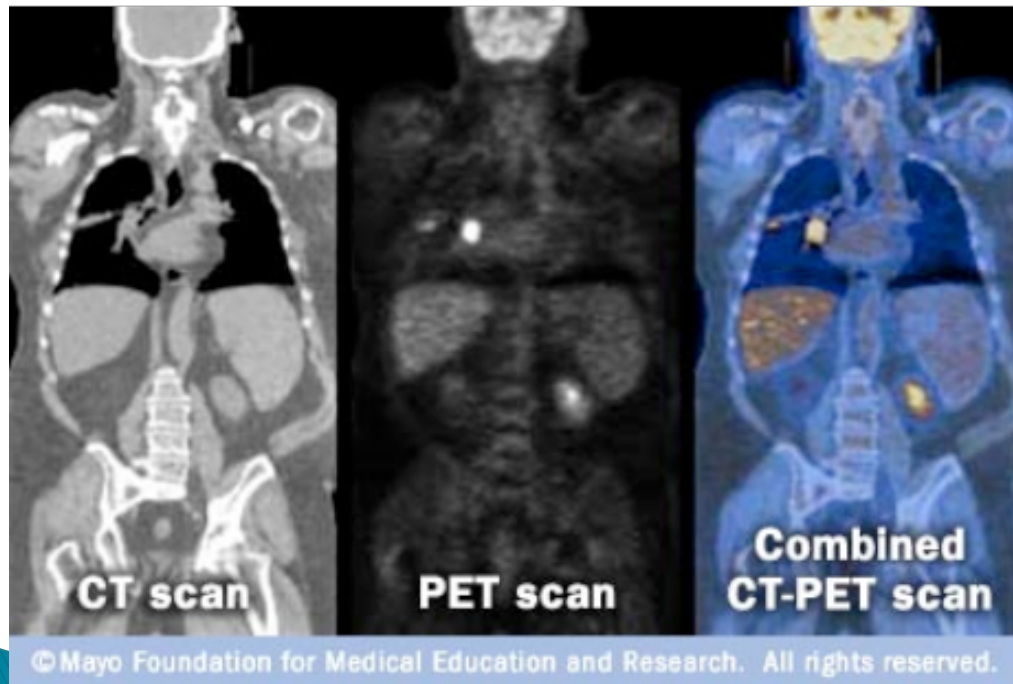
- ▶ OMSD Project – UW in cooperation with Morgridge Institute for Research
- ▶ Promote medical research and collaboration
- ▶ Open access to design and development
- ▶ Expensive technology available to groups with limited funding



<http://www.rebeccavyduna.com/collaborative.htm>

Current Systems

- Combined CT/PET and CT/RT human systems available

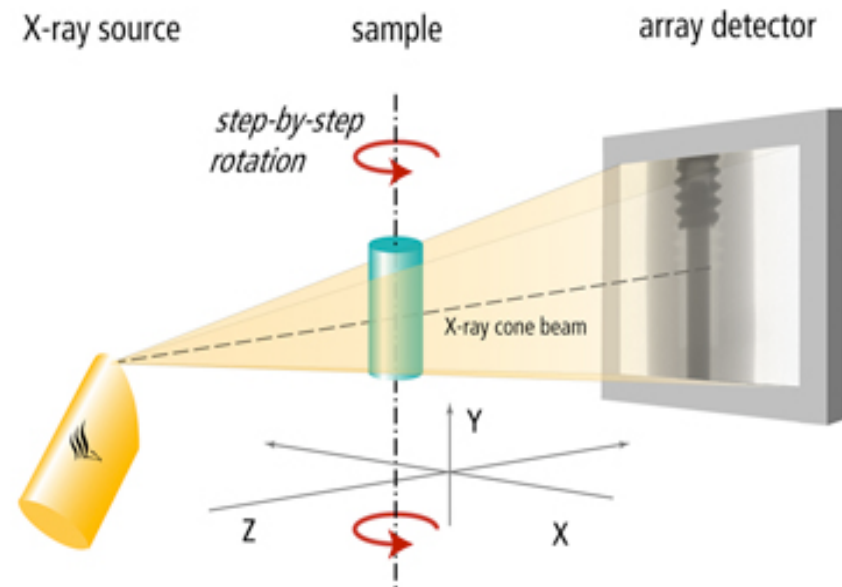


Small Animal System

- Fewer regulatory obstacles
- Prototype for human medicine

Computed Tomography (CT)

- ▶ Multiple X-rays at different angles
- ▶ Computer reconstructs image



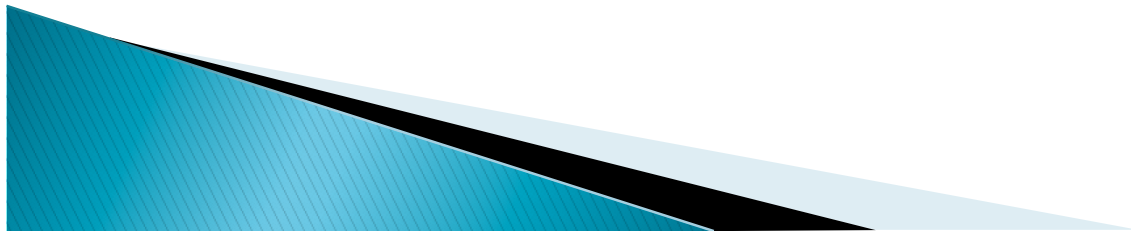
http://www.phoenix-xray.com/images/principles_of_operation/tomography_e.jpg

- Used to show anatomy

http://www.ispub.com/ispub/ijsvolume_13_number_2/foreign_body_erosion_of_duodenum/fig2.jpg

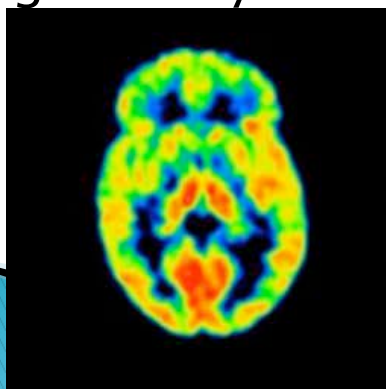
CT Specifications

Item	Details
X-ray Source Energy	50-100 kVp
Focal Spot	< 10 microns
Filters	0.5 mm Cu and 1 mm Al
Acquisition Geometry	Fan Beam
Detector	Silicon Photodiodes
Detector Resolution	20-40 micron, 0.25 mm ³ voxel resolution

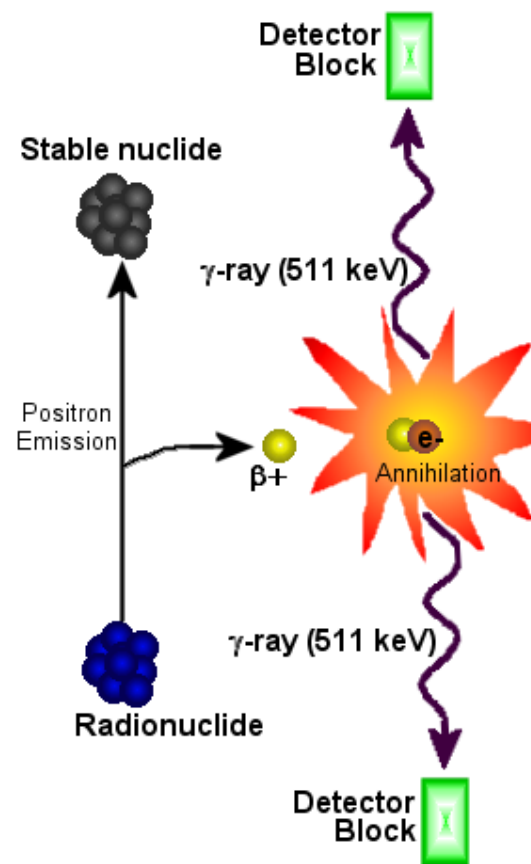


Positron Emission Tomography (PET)

- Radioactive tracer injected into the body
- Positron emission: collides with electron; annihilation event
- Gamma ray emission at 180° , picked up by detector blocks.
- Use timing difference to pinpoint location
- Can image activity vs. geometry

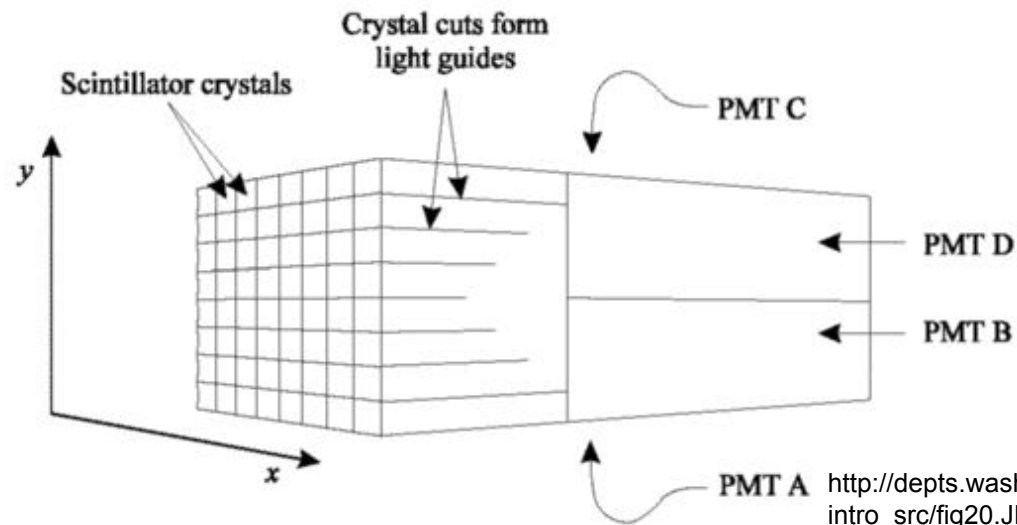


http://www.camh.net/Research/Studies_and_recruitment/38344brain_scan.jpg



PET Specifications

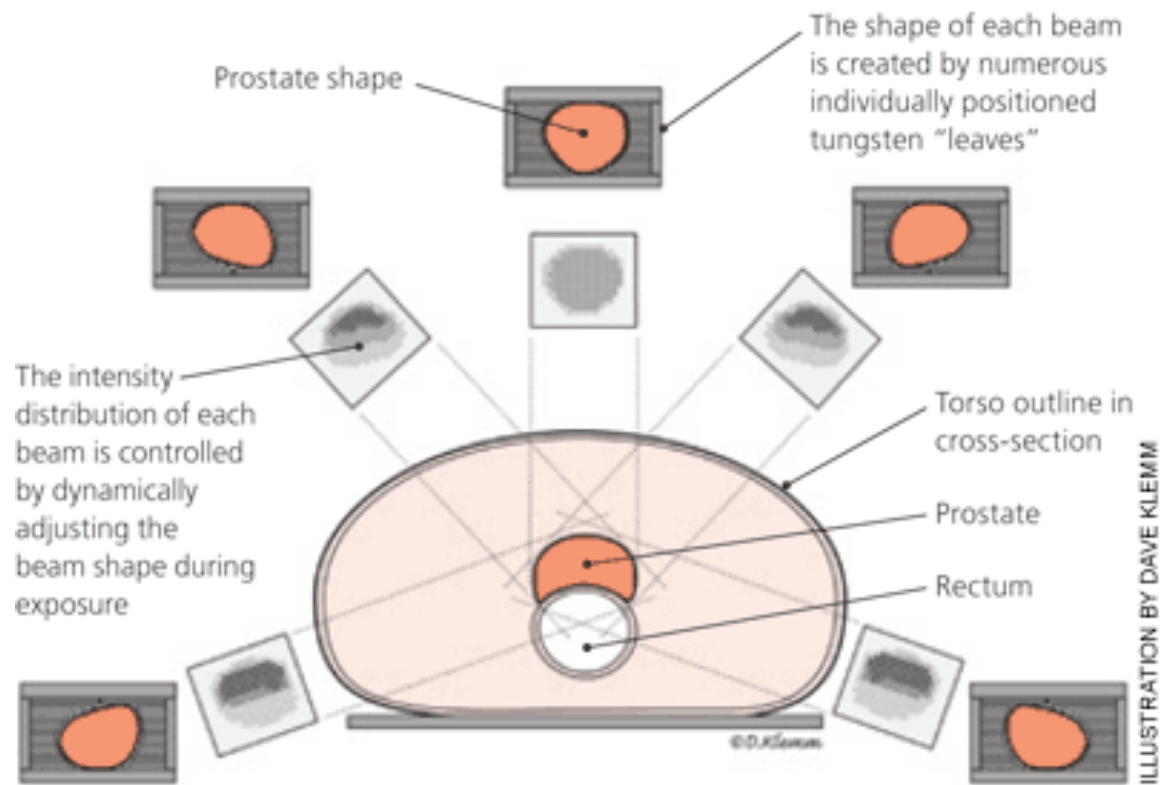
Item	Details
Scintillation Crystals	LSO; 10mm thick
Photomultiplier Tube (PMT)	Gain: 1.7E6; 19mm diameter
Timing Resolution	312 ps
Image Reconstruction	Filter-back projection
Radioisotopes	Co-57



http://depts.washington.edu/nucmed/IRL/pet_intro/intro_src/fig20.JPG

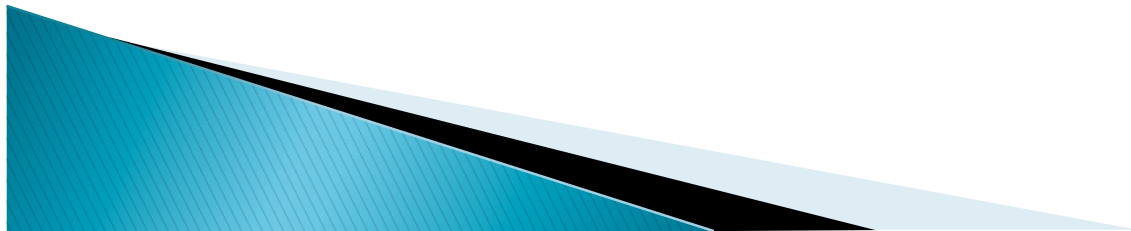
Radiation Therapy

- High intensity X-rays radiated into the body to destroy certain cells (usually malignant tumors)
- This is done from many locations
- Intensity and shape can be modulated (IMRT and MLC)



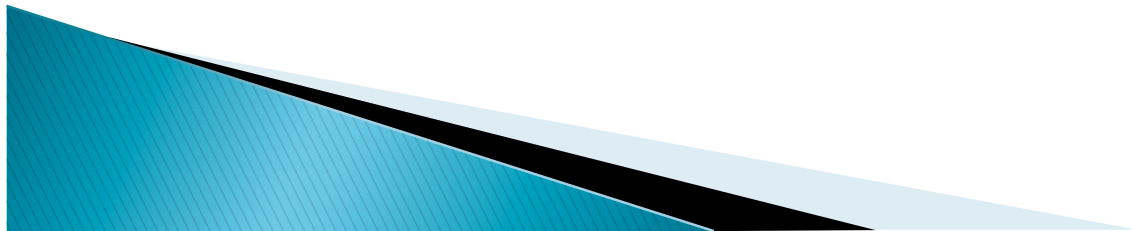
RT Specifications

Item	Details
Orthovoltage Tube	250 kVp max
Focal Spots	0.4 mm
Dosimeter (ion chamber)	3 mm radius; 317 x 107 Gy/C
Collimator	2 mm thick; 120 leaves
Cooling System	



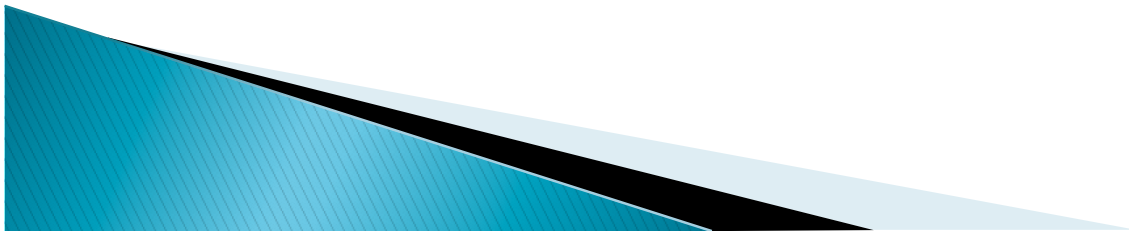
Combined Systems

Item	Details
Couch System	0.125 mm; 0.05° rotational
Bore Diameter	12 cm
Motor	
Data Acquisition/ Management	
Beam Shielding System	Pb shielding
Power Control System	



Future Work

- ▶ Finish Specifications Sheet
- ▶ Find Vendors for Individual Components
- ▶ Solid Works Modeling
- ▶ Radiation Simulations
- ▶ Software Design and RT Treatment System
- ▶ Rapid Prototyping Custom Parts
- ▶ Purchase Items and Complete Production



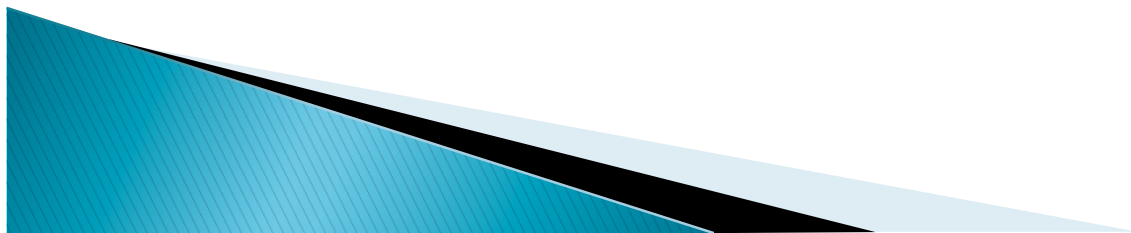
Selected References

Abate, A, M C Pressello, M Benassi and L Strigari. "Comparison of IMRT planning with two-step and one-step optimization: a strategy for improving therapeutic gain and reducing the integral dose." *Phys. Med. Biol.* 54:7183–7198. 2009.

Geurts, M, J Gonzalez, and P Serrano-Ojeda. "Longitudinal Study using a Diode Phantom for Helical Tomotherapy IMRT QA." *Med. Phys.* 36(11):4977–4983. 2009.

Gossman, M S, A R Graves-Calhoun and J D Wiklinson. "Establishing radiation therapy treatment planning effects involving implantable pacemakers and implantable cardioverter-defibrillators." *Journal of Applied Clinical Medical Physics*, 11(1):33–45. 2010.

Prajapati, S, T Mackie, R Jeraj and M Rodriguez. "Initiation of open source medical devices (OSMD) with the development and design of small animal imaging and therapy system." Unpublished Data. 2010.



Questions

