

NAVISCAN INC.

Nick Disher and Abhishek Kumar

INTRODUCTION

ABOUT NAVISCAN

Naviscan is the leader in organ-specific molecular testing. The company designs, manufactures, and distributes high-resolution Positron Emission Tomography (PET) scanners.

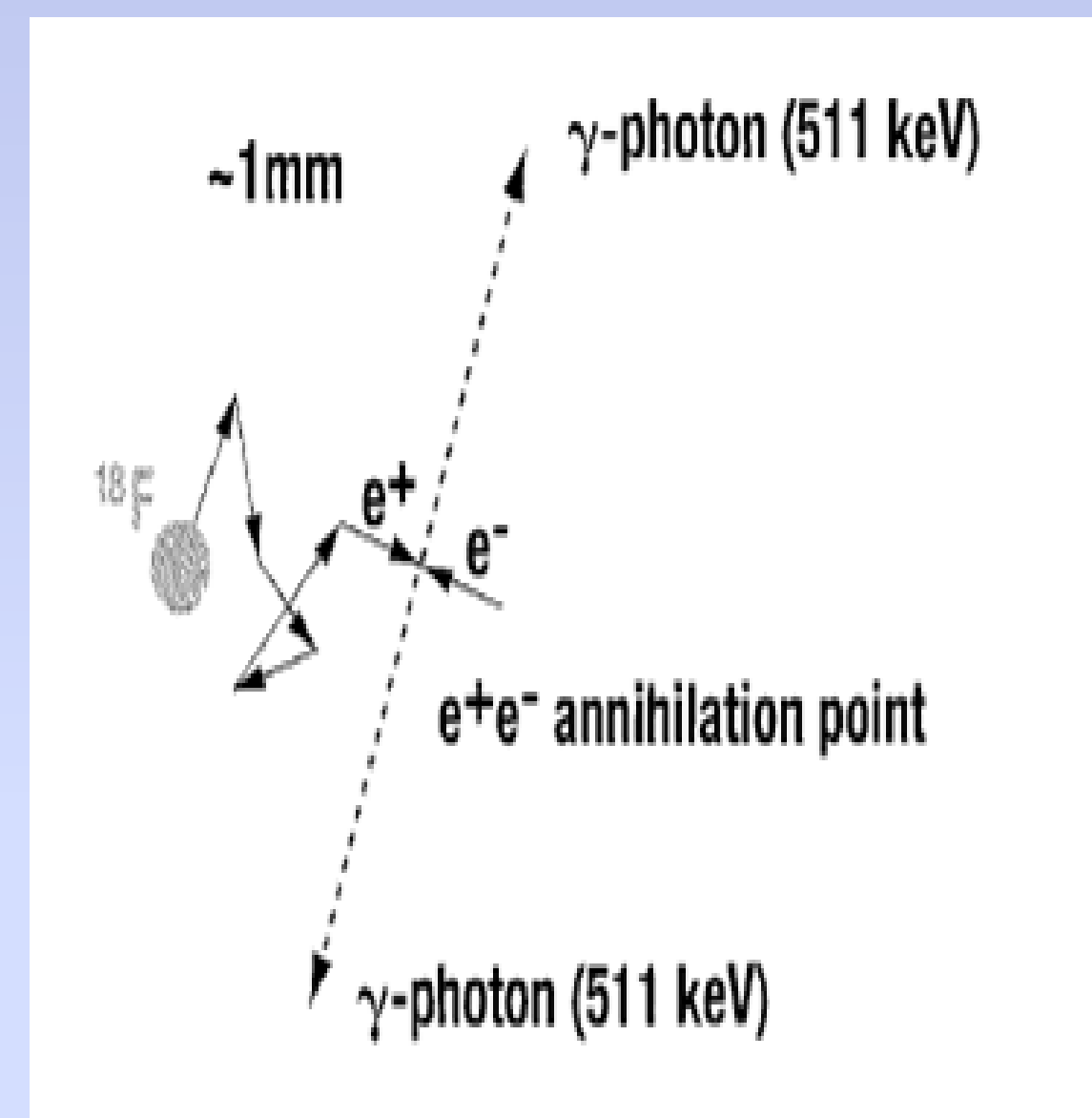
WHAT IS A PET SCANNER?

A PET scanner is used to detect lesions that could be potentially cancerous in virtually any part of the body that can fit between the two paddles. The PET scanner developed by Naviscan is used specifically to detect breast cancer.

PHYSICS

CANCER DETECTION

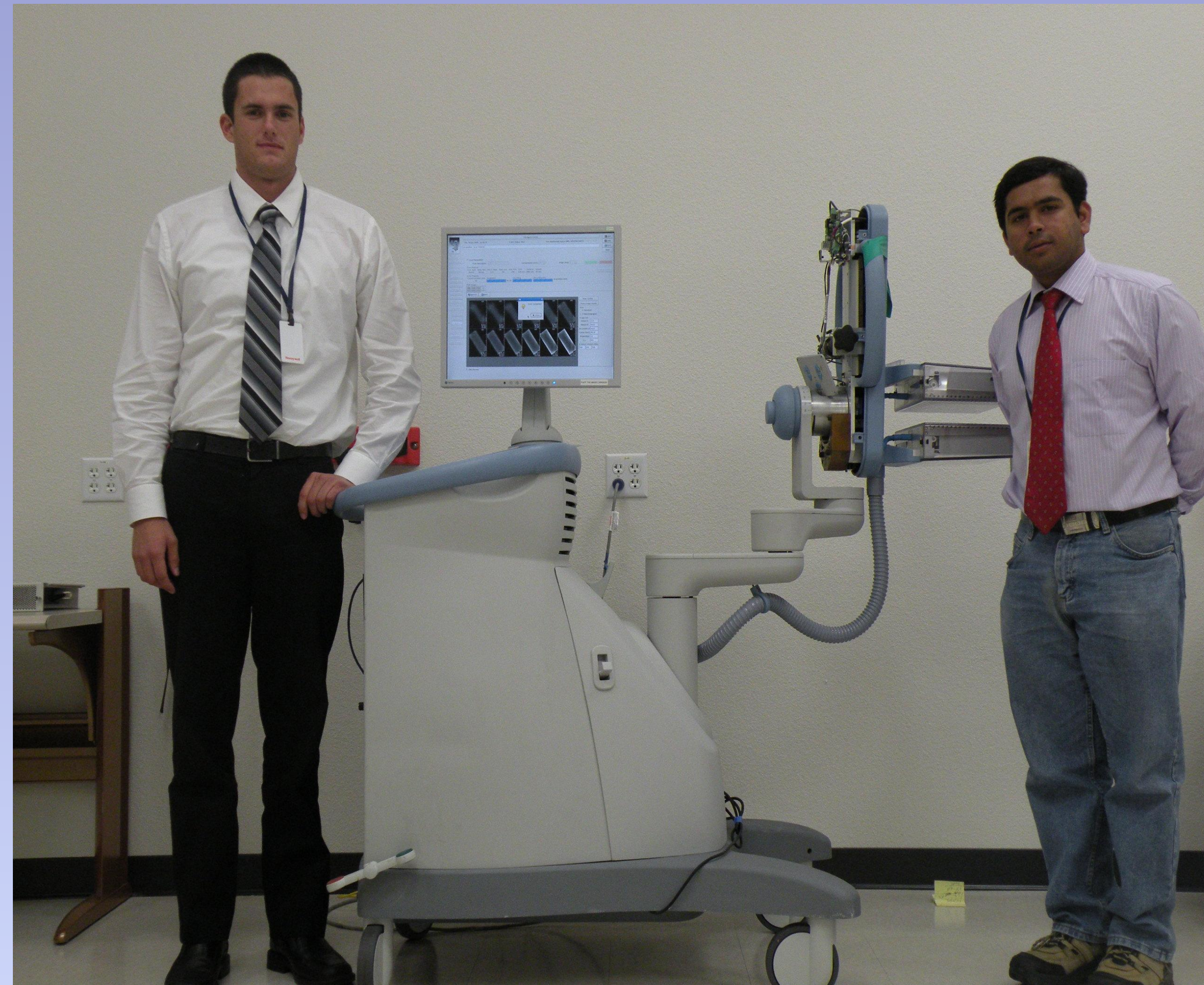
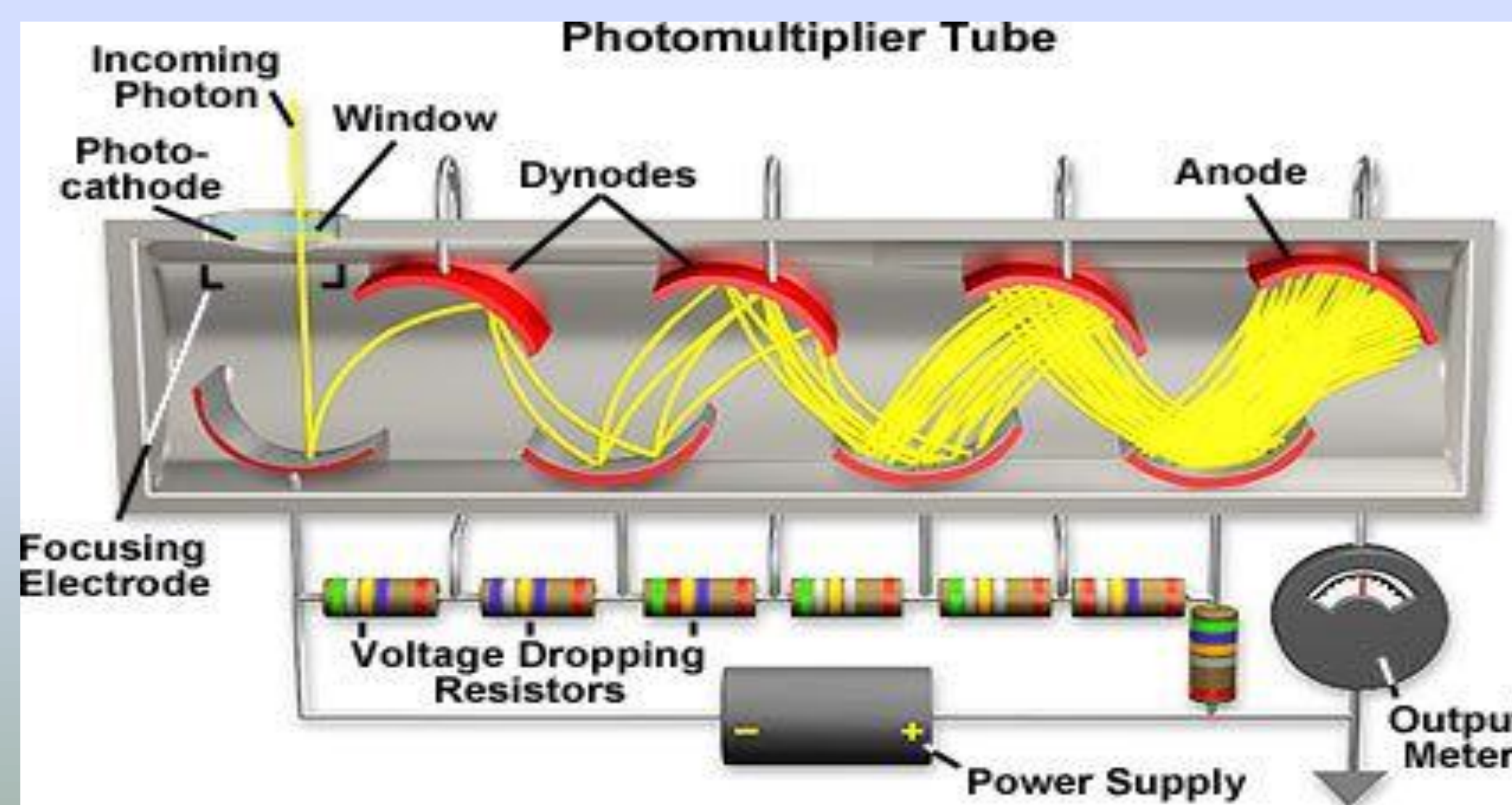
Cancer cells have a higher metabolic rate than ordinary cells and therefore require more sugar intake. Fludeoxyglucose (FDG) is a proton rich radionuclide that is easily absorbed into the cancer cells. When FDG decays, it will emit a positron (B^+) into the surrounding tissue. The positron will then annihilate and emit two gamma rays of about 511keV, exactly 180 degree from each other.



PHOTOMULTIPLIER TUBE

A photomultiplier tube (PMT) is a vacuum seal tube and consists of a crystal scintillator (CS), a photocathode, dynodes, and anodes. When the gamma ray comes into contact with the CS, multiple light photons are emitted in all directions. A few of these photons are passed through a photocathode, a reaction occurs, and photoelectrons are shot into the tube.

Inside the tube are multiple dynodes that are electrically charged with successively higher voltages through the tube. When the photoelectron hits the dynode, the difference in energy levels causes more electrons to be released, hence the multiplier effect. The electrons finally reach the end of the tube and collide with the anode, causing a current pulse.



ELECTRONICS

FRONT END ELECTRONICS

The pulse given off from the anode in the PMT is passed into the front end electronics. Because of the sensitivity of the PMT, many waves are picked up by the sensors causing background noise and false readings. A trigger board is used to sort through the given pulses and pick only those which are suitable for analysis. This board consists of a Pulse Height Analyzer, or comparators, and an field programmable gate array (FPGA). The given pulse is first compared to two threshold values and the peak of the pulse must lie between them. In this condition, the digital signal from the comparator is given to the FPGA for timing analysis. The trigger is specifically looking for coincident events, or two pulses in a given time period. If there is a coincidence, the trigger opens up a gate to the Analog to Digital Converter (ADC) for processing. The trigger dramatically decreases dead time between scans.

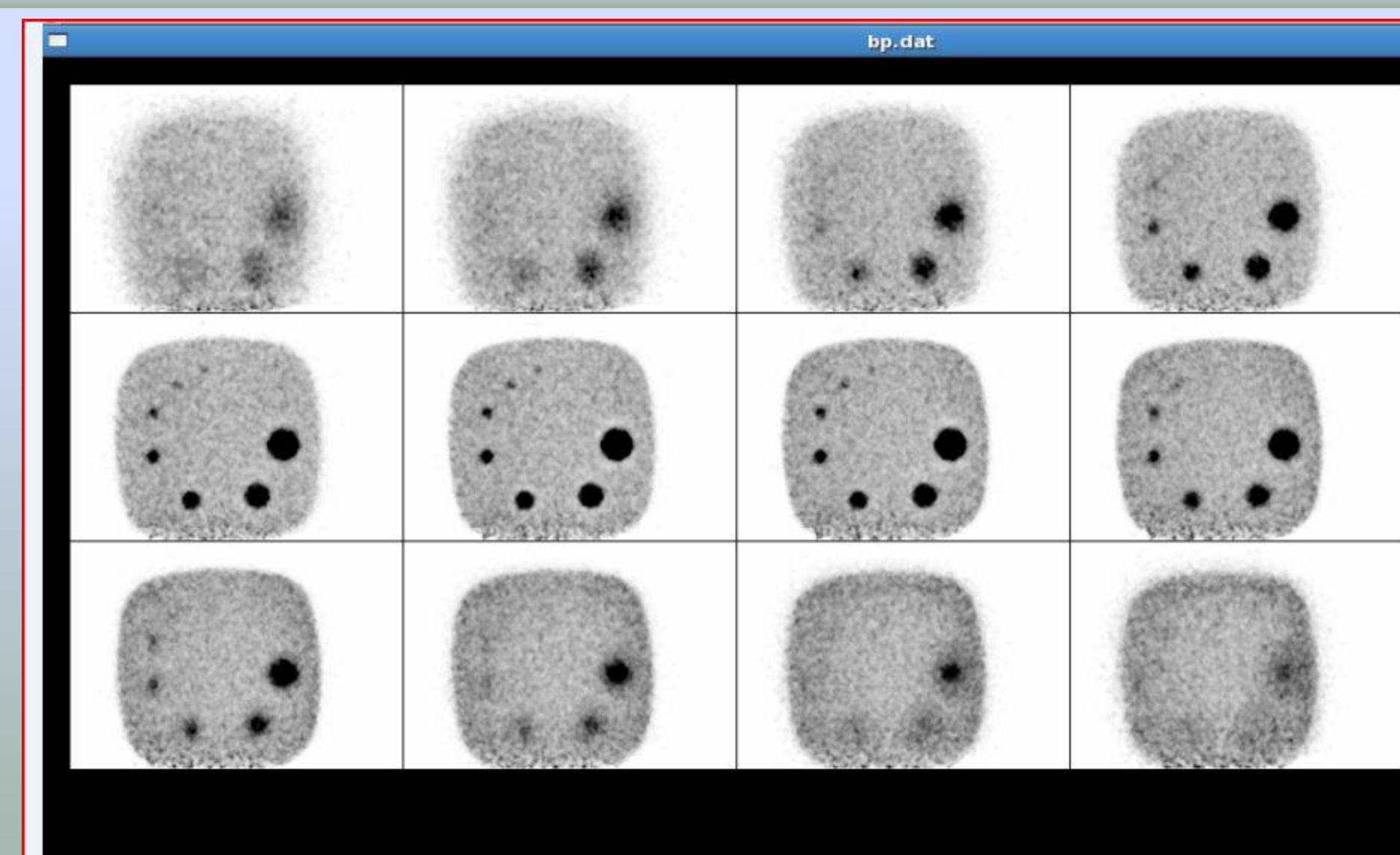
TASKS

Nick was given the task to go through the FPGA code for the trigger and report back interpretation. After writing a report of his interpretation of the AHDL code, he used a logic analyzer to see when specific signals went to a high state and the timing of certain coincident events. From this, we were able to find the coincident window and also the throughput time.

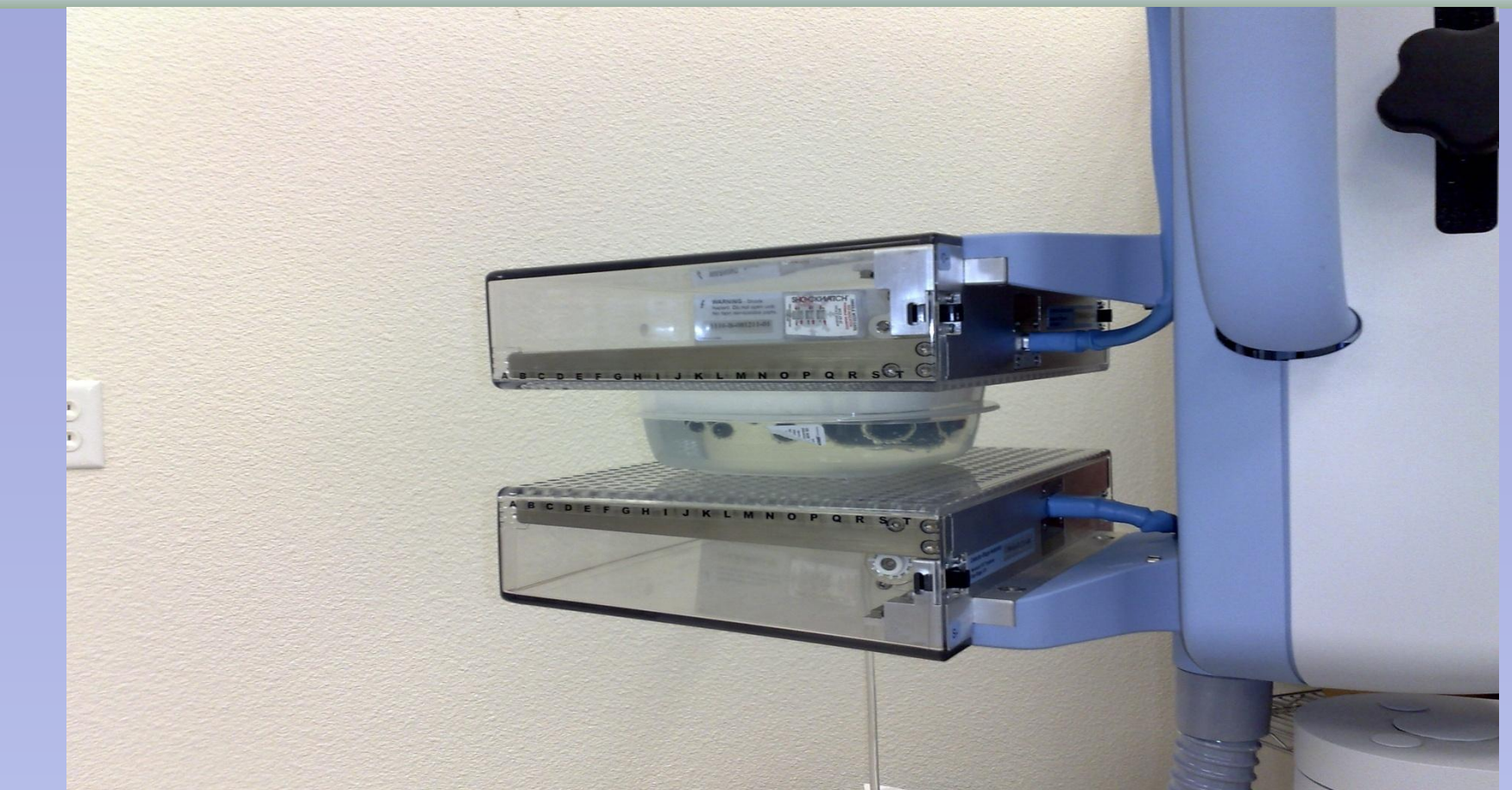
Abhishek designed and documented engineering drawings using SolidWorks. An example of which is shown in the poster. Besides this, he also worked on experiments done to create image processing.

IMAGE PROCESSING

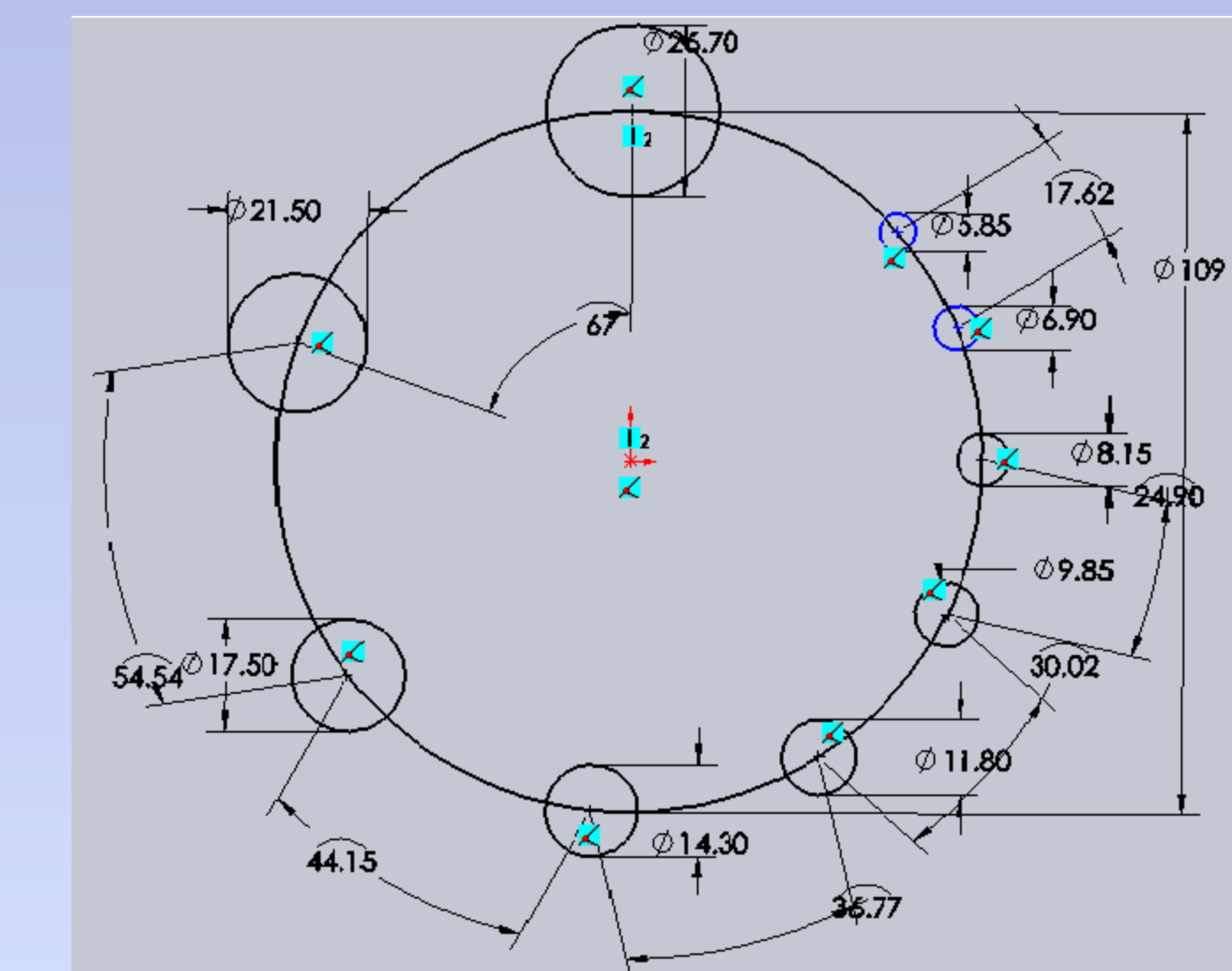
The adjacent figure shows the Lesion Detection of a PEM system with a Proposed Breast Image Quality Phantom. The task in this experiment was to design the phantoms in a circular formation, for which we used SolidWorks. Once the experiment was performed, we used MATLAB to generate the image. The dark spots indicate the phantom size.



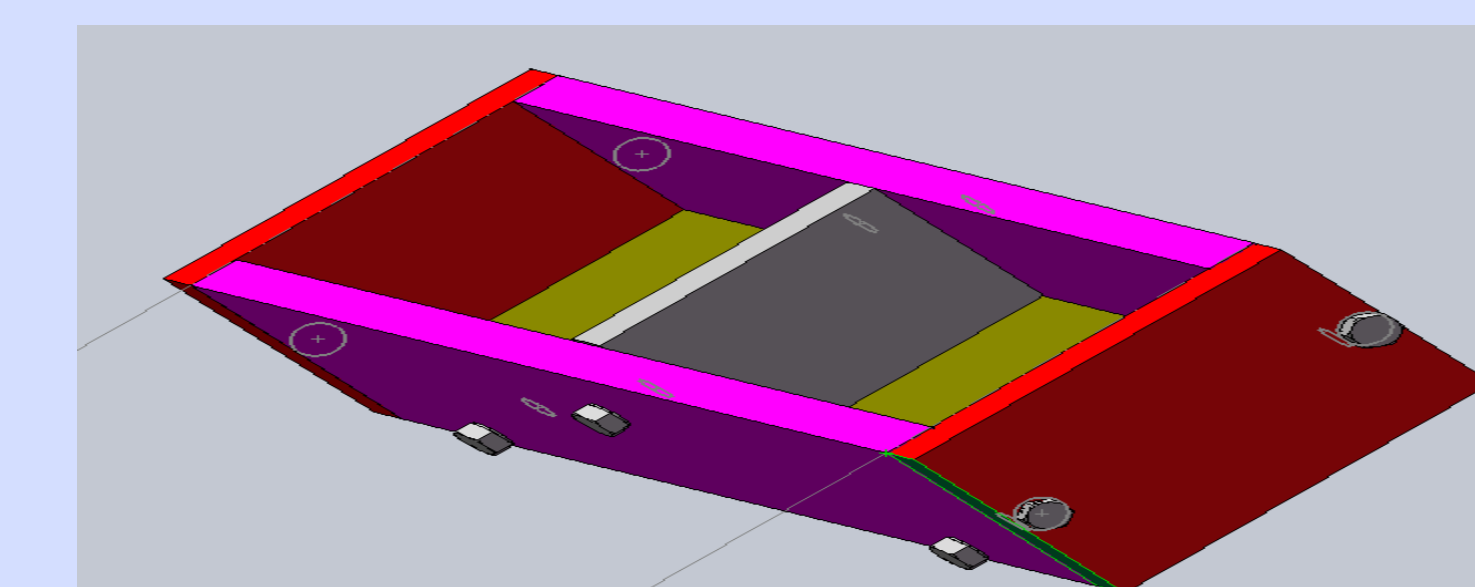
MECHANICS



The Test set-up. This is where women's breast is held for cancer detect ability.



The design built for the successful experiment of Lesion Detection of a PEM System with a proposed image quality phantom.



The mold box was one of the many designs documented using SolidWorks.

CONCLUSION

NICK DISHER

I am junior at San Diego State University and I'm currently pursuing a Bachelor of Science in Electrical Engineering. At Naviscan, I was able to get some hands on experience with logic analyzers and multi-meters. I was also given a first hand look at what studying existing designs for efficiency enhancement really was. I would not have been able to get this kind of experience in school.

ABHISHEK KUMAR

I am in my senior year at San Diego State University pursuing BS in Mechanical Engineering. Interning at Naviscan was my first interface with the engineering world. Assisting engineers in their projects helped me get good hands on experience with SolidWorks and MATLAB. I am sure that this experience will foster my growth as an engineer.

ACKNOWLEDGEMENTS

We would like to thank Naviscan and all their employees for giving us this opportunity to work with them this summer. Special thanks to Ron Moore, Timothy Nguyen, Weidong Luo, Dirk Gilbert, Scott Campbell, and Linda Young. We would also like to thank the National Science Foundation sponsoring us for this internship.