

A STRATEGIC PARTNERSHIP



Jesse Garant Metrology exclusively uses Volume Graphics for all our CT machines for both reconstruction and analysis. We have a variety of CT machines ranging from the smallest at 80KeV to the largest at 3MeV.



TABLE OF CONTENTS

What is Jesse Garant Metrology Center?
Construction of our additional Facility with vault
Custom Large Format DDA Panel
Linac Testing
Real World Results



WHO IS JESSE GARANT METROLOGY CENTER



JESSE GARANT METROLOGY CENTER

Jesse Garant Metrology Center provides solutions that help create meaningful advancements in industry. By focusing on advanced imaging solutions such as Industrial Computed Tomography with the support of production x-ray and 3d scanning services, we deliver critical insights into inspection projects that are difficult to measure. With over 10,000 parts CT scanned, spanning seven years in ten different industries, we continue to invest in our Industrial CT Scanning Services and have the proper infrastructure in place to operate efficiently. We are a service only based company, we do not sell machines but will modify or manufacture them to meet our customers needs.



New Facility



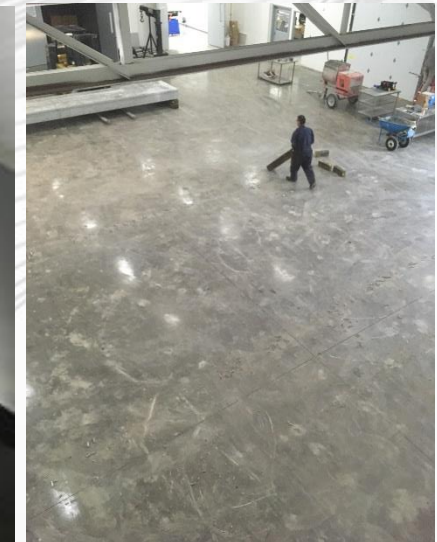
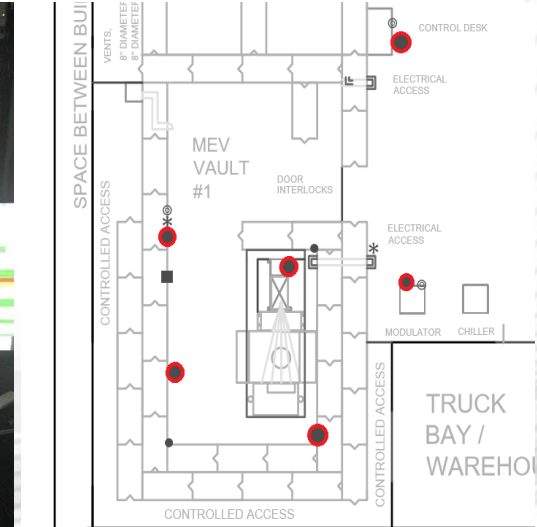
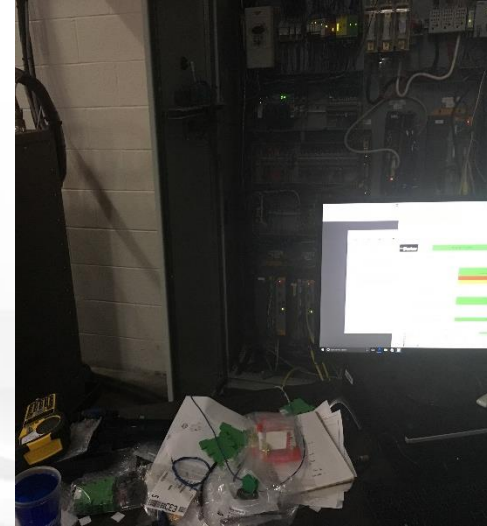
BRAND NEW LAB FACILITY

- Started Construction of a new facility in August of 2016 to house our new MeV system. 15000 ft² facility complete with temperature control and tractor trailer loading bays.
- Our lab only facility currently has 8 analysts to scan and process data. We use Volume Graphics exclusively to reconstruct and analyze all our data including data from our Structured light scanners to the laser CMM.



VAULT CONSTRUCTION

- The base vault construction took just over 6 months to assemble and complete.
- Vault takes up 4000 sqft
- The weight of the vault topped out at 1.8 million lbs.
- 4" thick solid steel door weighing 14000 lbs.
- 8 Axis system built to handle parts up to 5000lbs
- In house designed, wired and built!



Custom Built DDA Panel



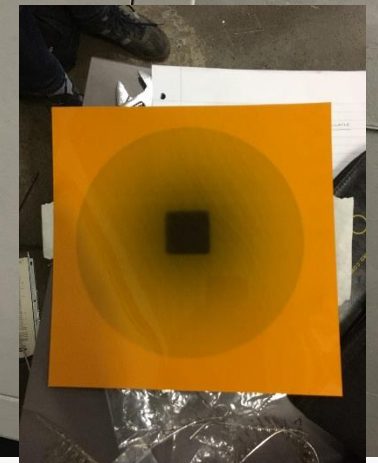
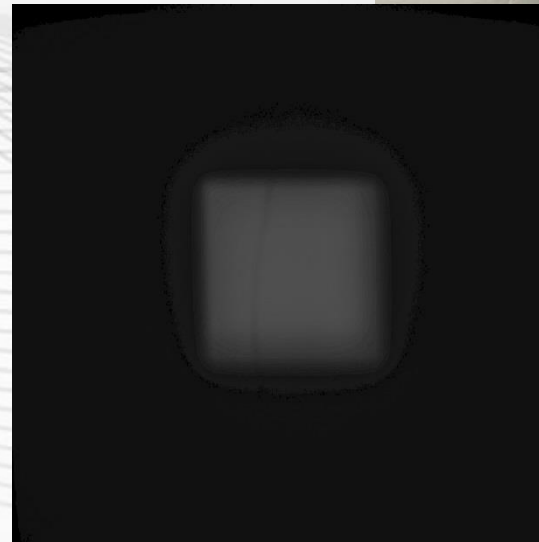
CUSTOM BUILT PANEL

- The panel is a custom built 1 meter by 1 meter panel
- 2048x2048
- 16bit
- Multiple Binning Modes available (1,2,4,8)
- Capable of withstanding up to 6MeV or 8 Gy/min
- Mountable to either an actuator or dowel stands.
- Fast integration time: 10ms
- Cadmium Tungstate Scintillator (CdWO_4) backed to 4mm steel plate



TESTING THE PANEL

- On initial exposure we noticed something wasn't quite right, the image that was being acquired was in the shape of a square and only several cm wide. There also was what looked to be a wire in the middle of the image.
- To help diagnose the problem we used self exposing xray film to confirm our suspicions. Curiously there was no wire in the image, but confirmed the shape.



LINAC CUSTOM COLLIMATOR?

- An incorrect collimator was installed from the manufacturer. It came with the wrong shape and angle. The collimator that came with the unit was a 1.25"x1.25" Square with a 3° angle.
- A new collimator with the proper angle (15°) to dose 1 meter x 1 meter panel at 2.72 meters away was found and swapped out.
- When removing the collimators we noticed that there was no obstruction against the ion chamber and there was no wires in the way of the beam path. The problem must lie else where.



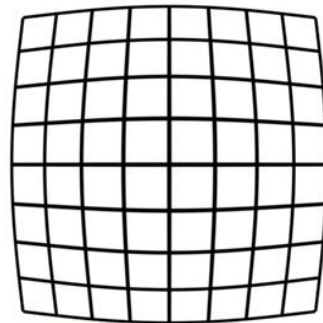
STILL ISSUES

- Internal defect, separation between the steel plate and the scintillation material was un-detectable with the naked eye.
- Extremely Difficult to manufacture a 1mx1m cadmium tungstate scintillator backed to 4mm steel plate. May have been damaged during shipping.

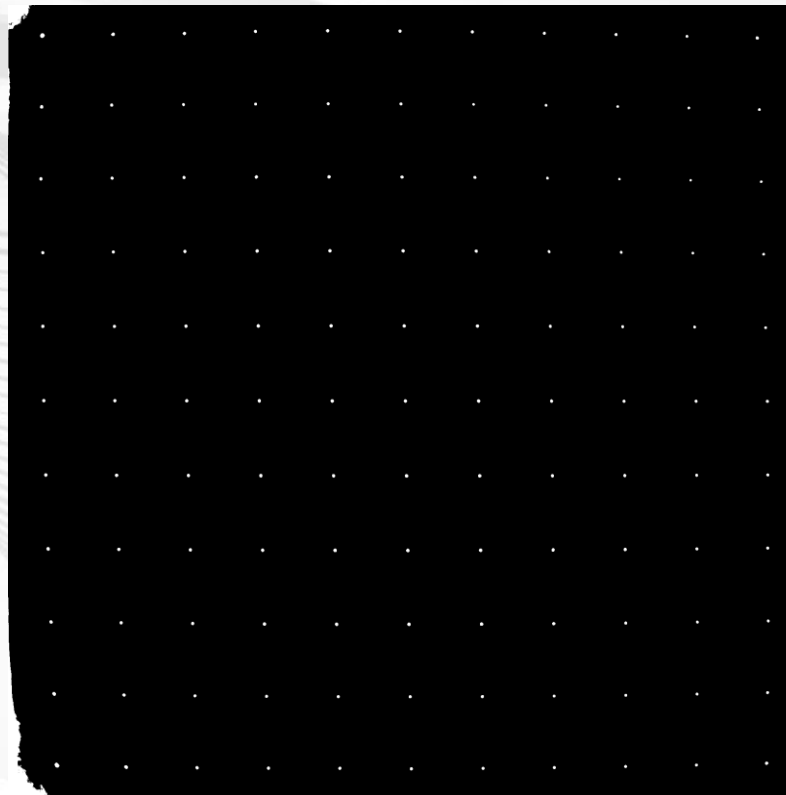
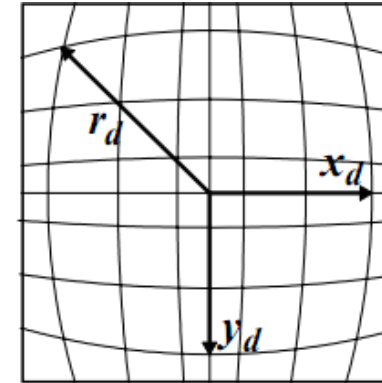
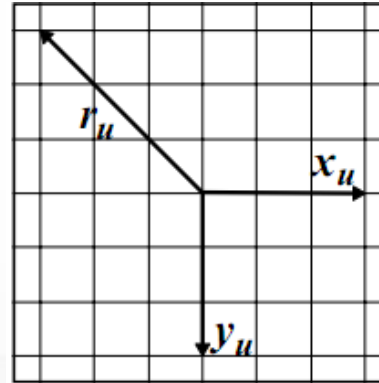


TESTING THE PANEL

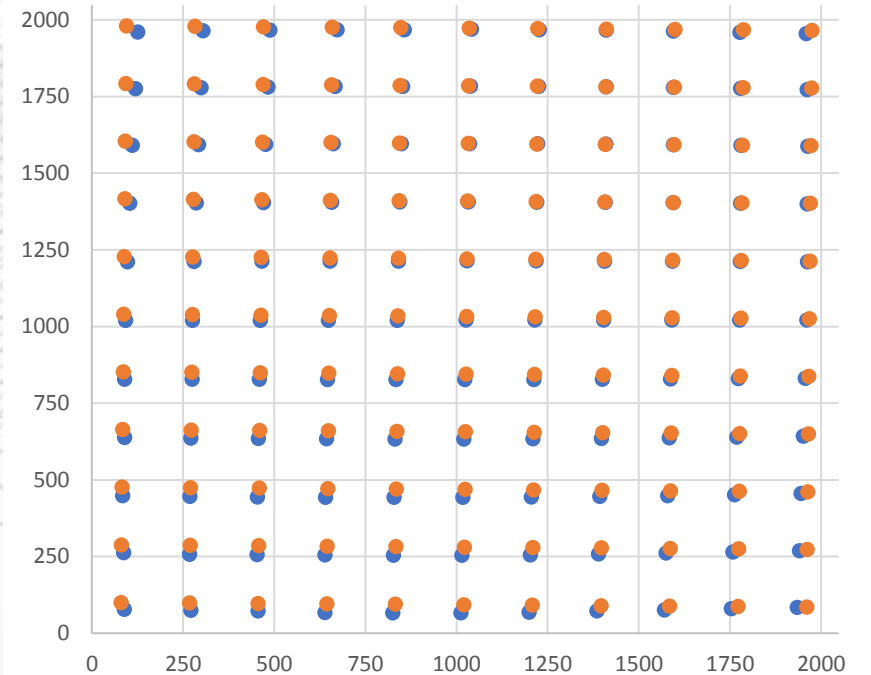
- Due to the size and the construction of the detector it is subject to Negative Optical Distortion (barrel distortion).
- The barrel distortion is caused from the distance of the point source to the detector from an unflattened beam.
- We took a precision hole patten which we first binarized and used a special algorithm to correct for the optical distortion.



Barrel Distortion



Barrel Distortion Correction Plot

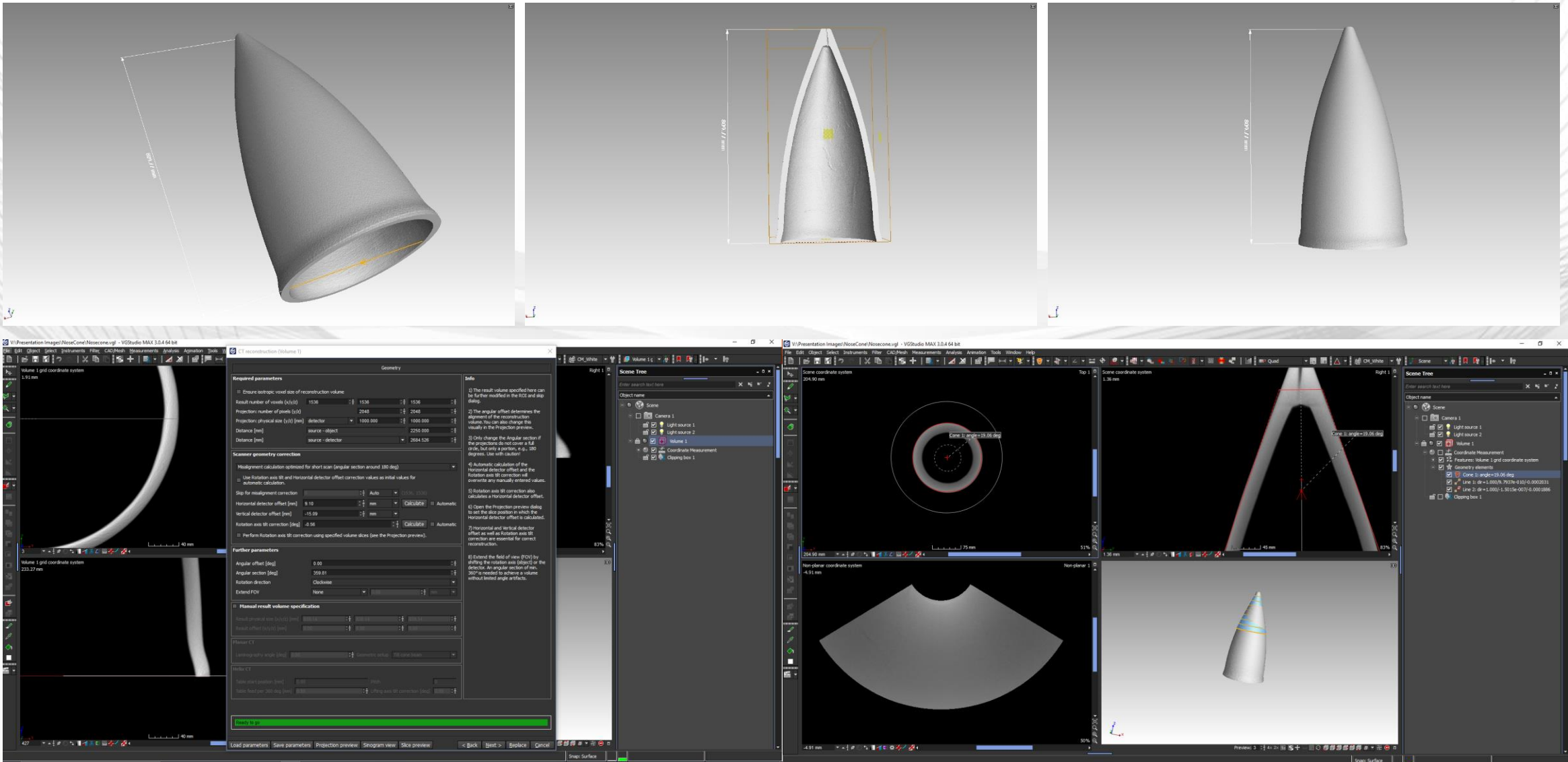




Linac Testing

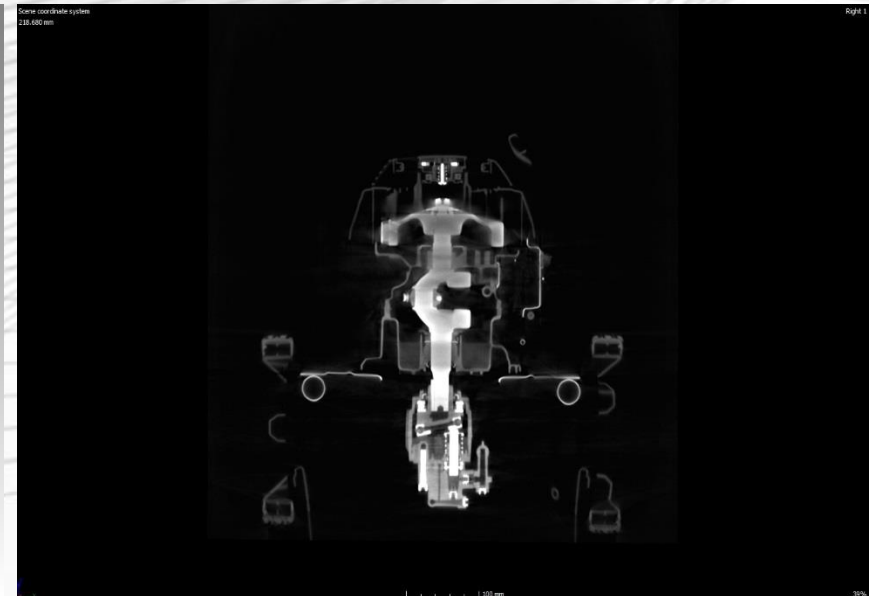
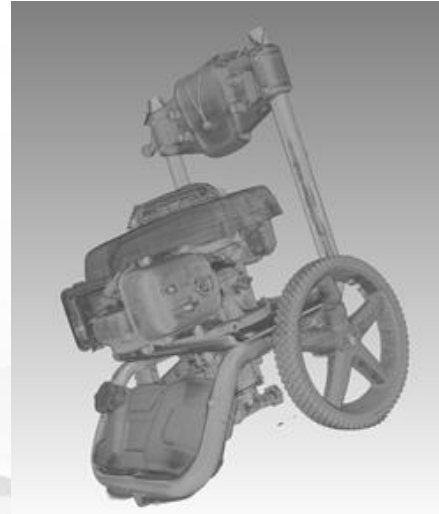


USING VOLUME GRAPHICS TO RECONSTRUCT ALL DATA

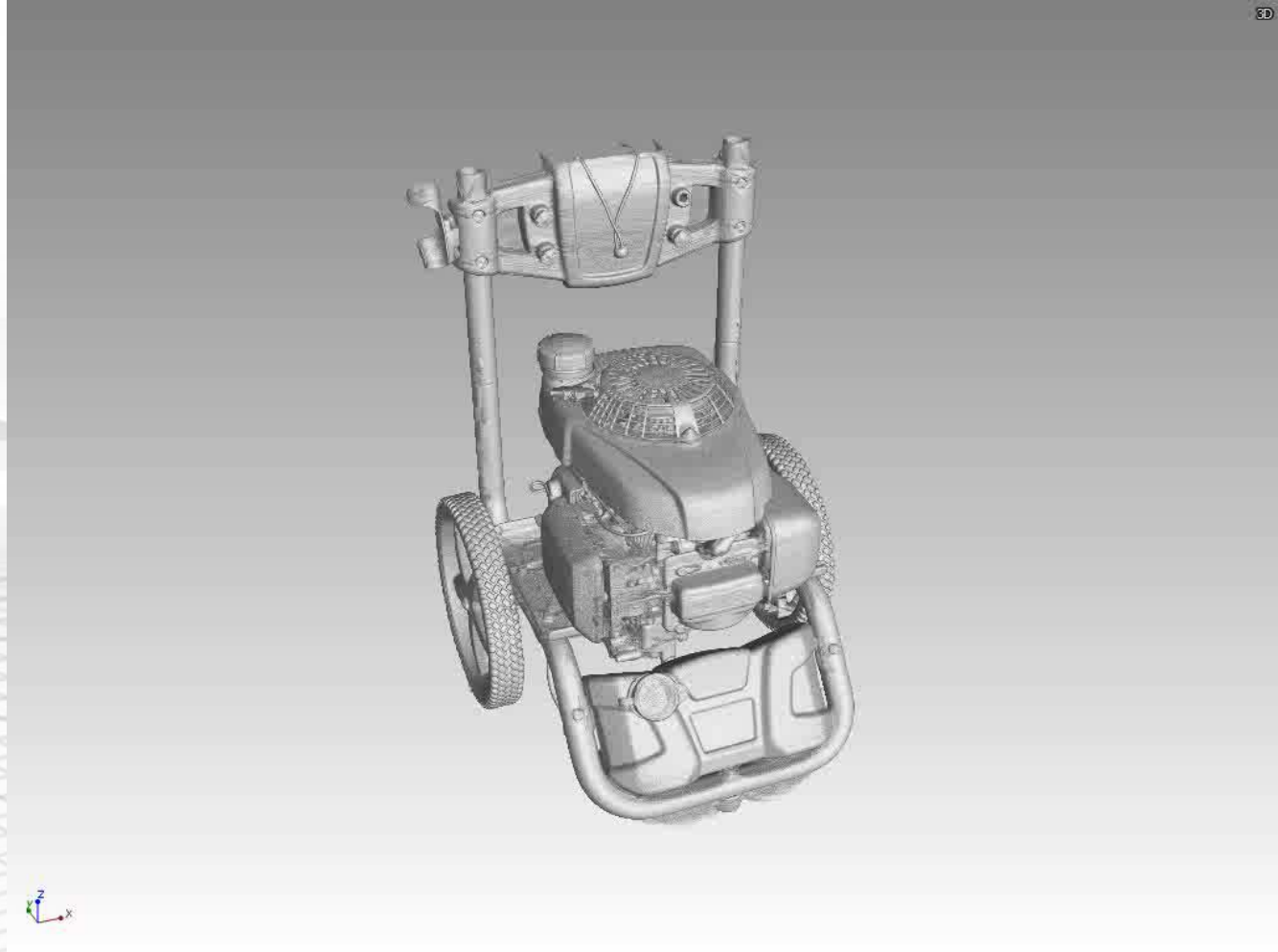
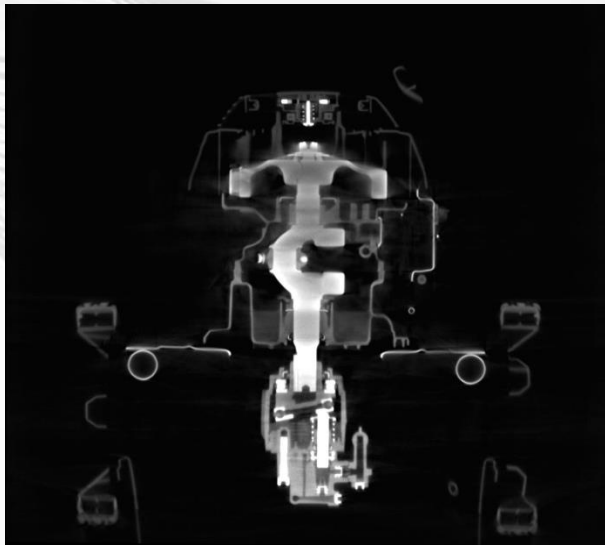
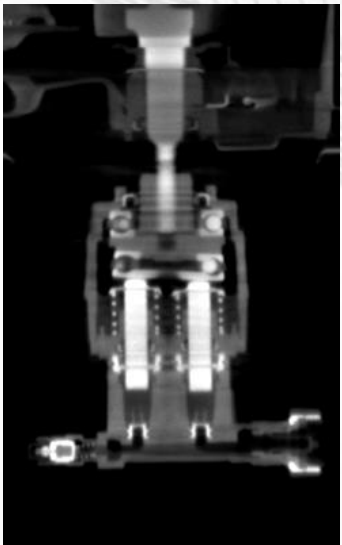


3 MeV VARIAN LINAC TESTING PHASE

- With the reconstruction tools in VG this allowed us to apply different scanning techniques (Field of View Enlargement, HELIX, ROI, etc)
- Our scans using the large format panel yielded little to no scatter from materials of different densities.
- Connections and welds can be seen quite clearly between dissimilar materials and as accurate as 500 microns

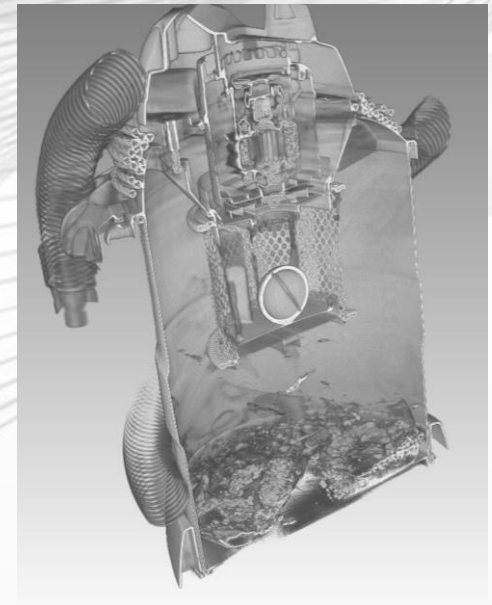
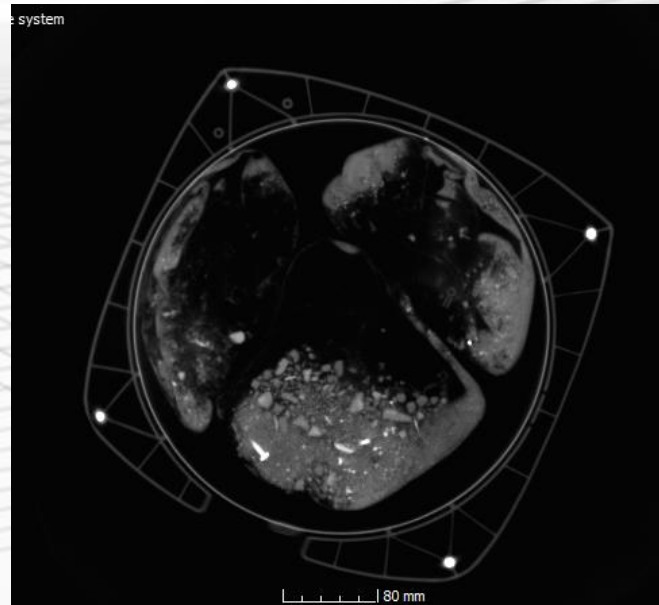
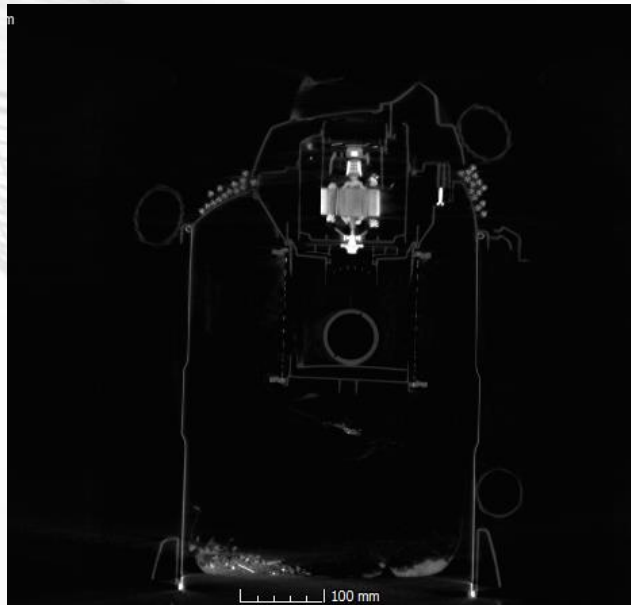


TESTING PHASE



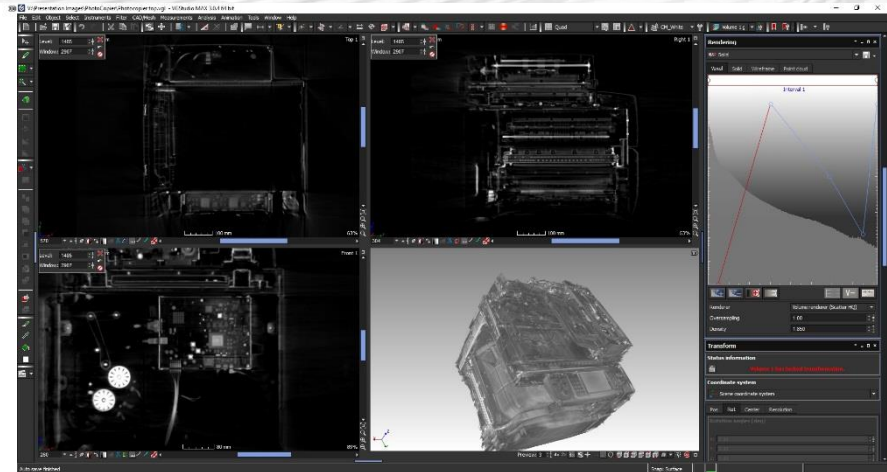
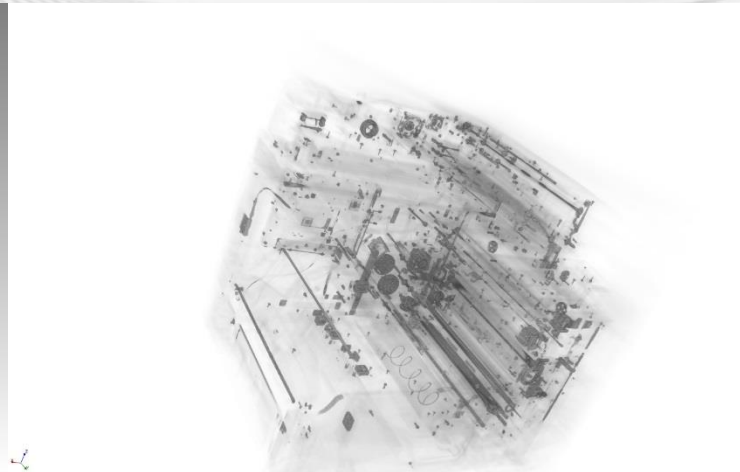
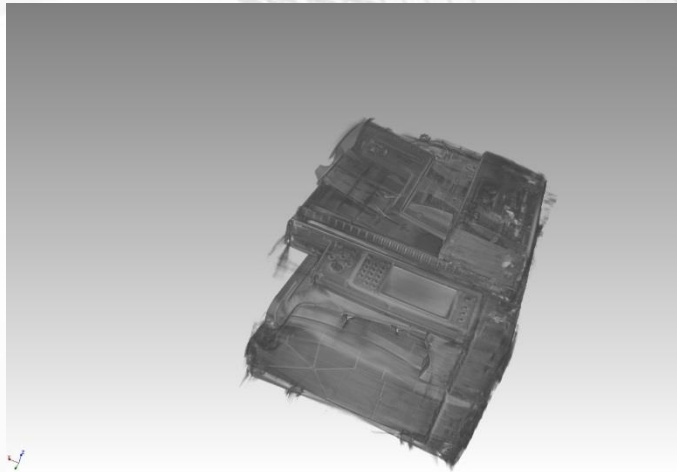
TESTING PHASE

Ever wonder how full your ShopVac is without opening it?



TESTING PHASE

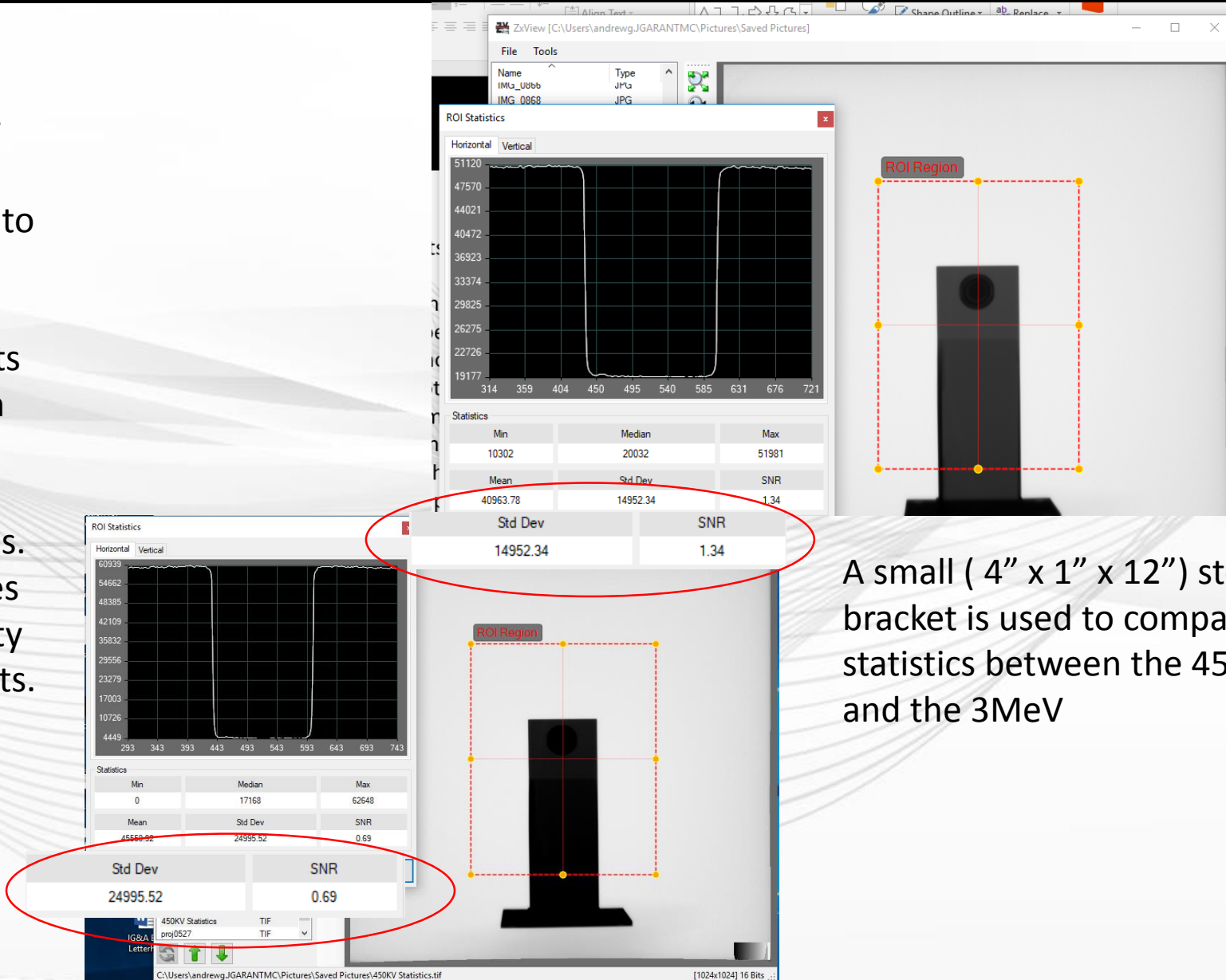
I was once asked what was in our office photocopier. Well here you go.



SO WHY USE A LINAC?

Benefits of using a Linear Accelerator for CT:

- High energy radiation is less likely to be scattered due to the energy removed by the scattering of the photon. In short basically means its more likely to continue to travel in the direction intended.
- As the energy of photons increase the probability of interaction drops.
- The imaging quality great increases due to the high signal homogeneity and lower beam hardening artifacts.

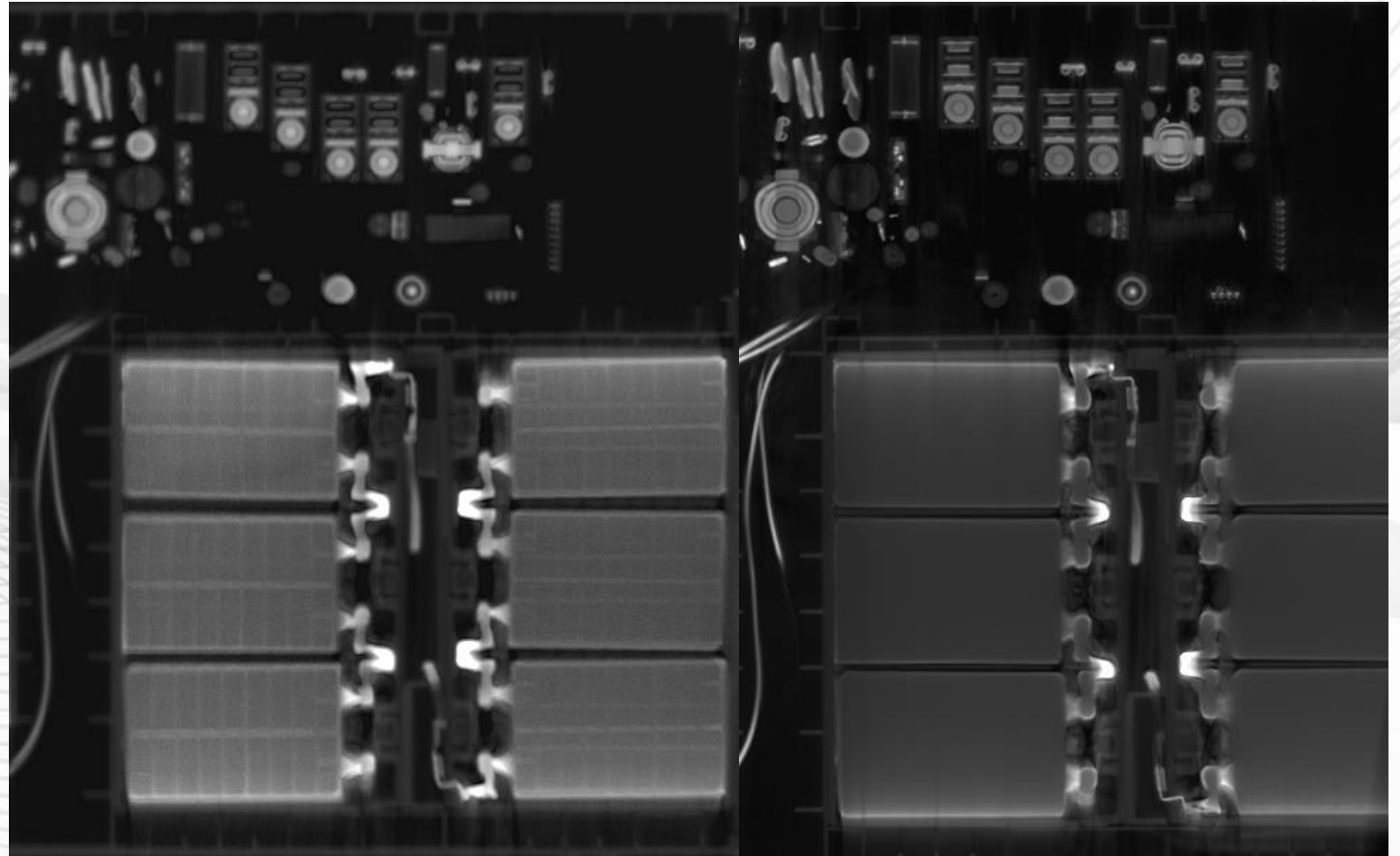


A small (4" x 1" x 12") steel bracket is used to compare the statistics between the 450KeV and the 3MeV

SO WHY USE A LINAC?

Benefits of using a Linear Accelerator for CT:

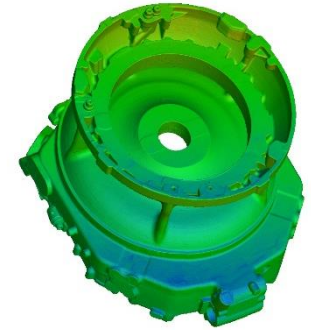
- The ability to see clean interfaces between low and high density material.
- The grayscale of the low energy scan (450KeV) doesn't correspond accurately to the real material as shown in the MeV scan data.



A UPS Power Supply Scanned on 3MeV (Left) & 450KeV (Right)

WHY USE A LINAC WITH A DDA? TIME=MONEY!

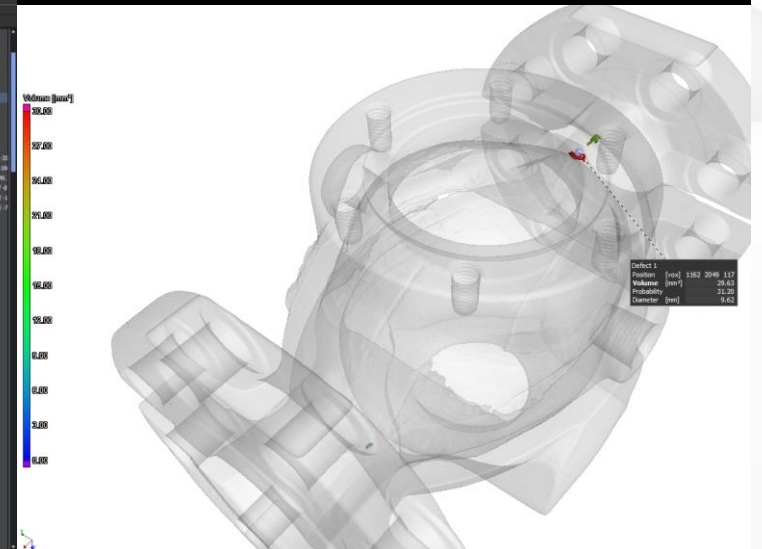
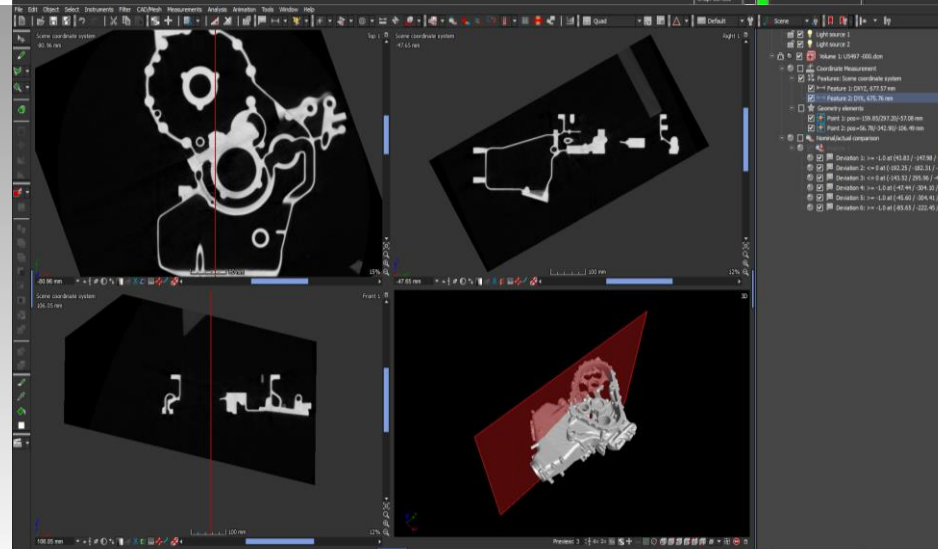
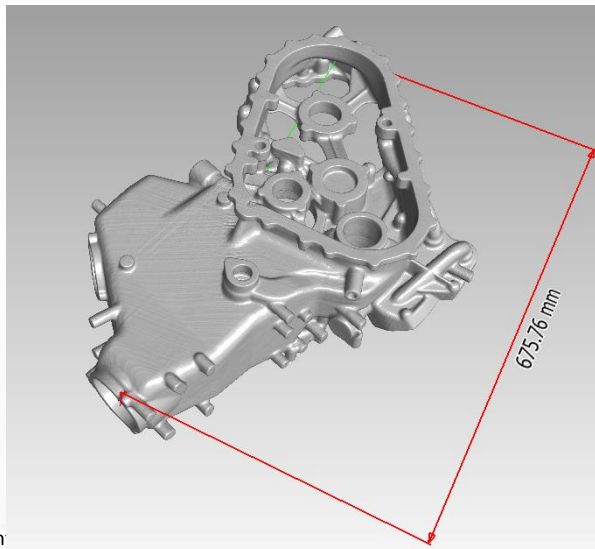
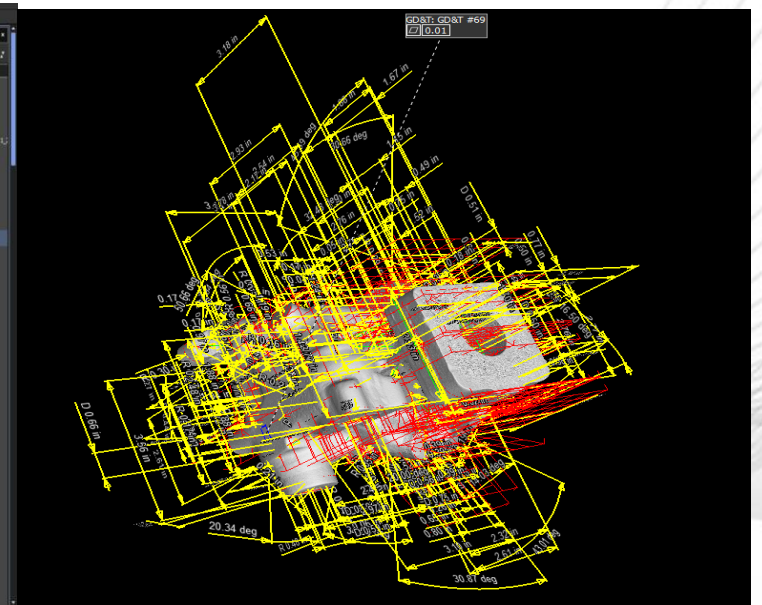
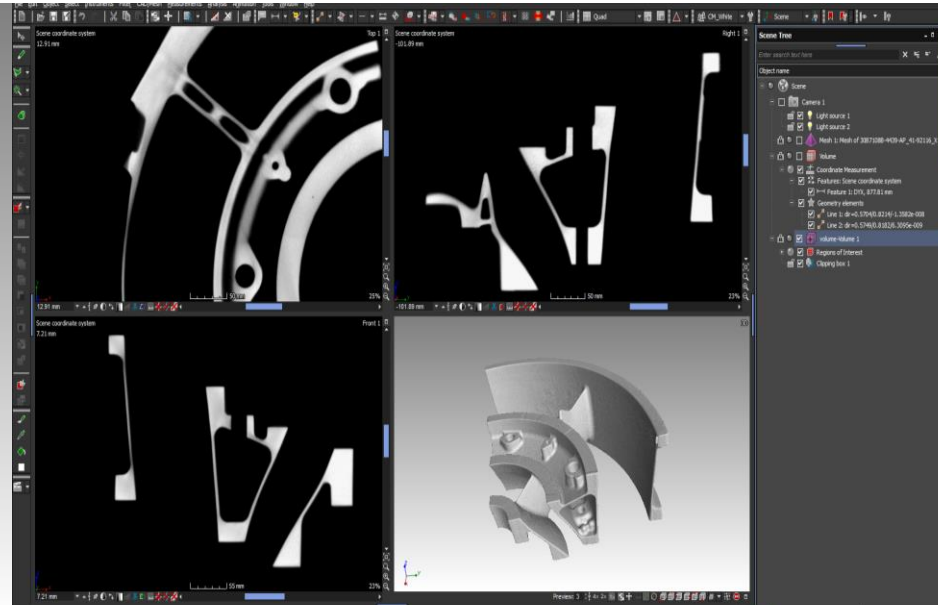
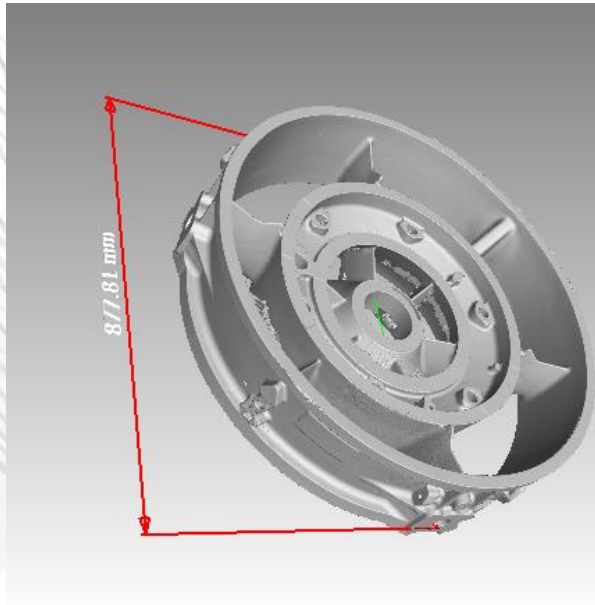
- Going to a large format flat panel has drastically improved the acquisition time at little to no reduction in image quality.
- If using a 2048 pixel horizontal line, Nyquist states that we should be using 3201 frames for proper acquisition.
- Typical LDA run time at 3201 projections per slice @ 90 seconds per slice at .5mm increments for a total of 915 slices for the casting. This in turn equates to **22 hours!**
- With the large format DDA panel we are down to 27 minutes for 3201 frames for the same 2K matrix.
- There is little to no discernable loss of quality and no more missed defects on the Z axis
- As the old adage says: Time = Money!



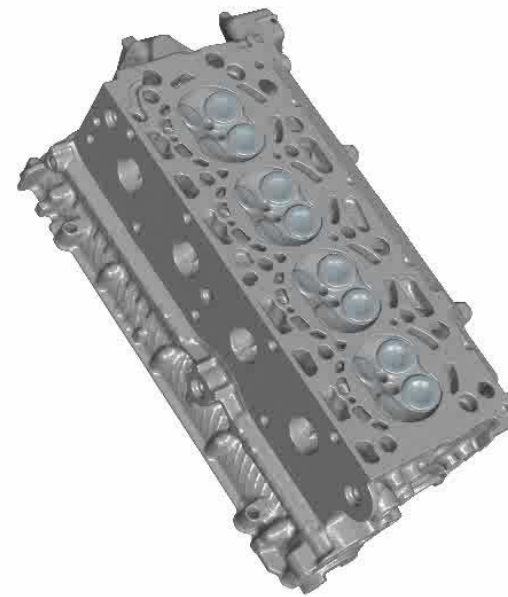
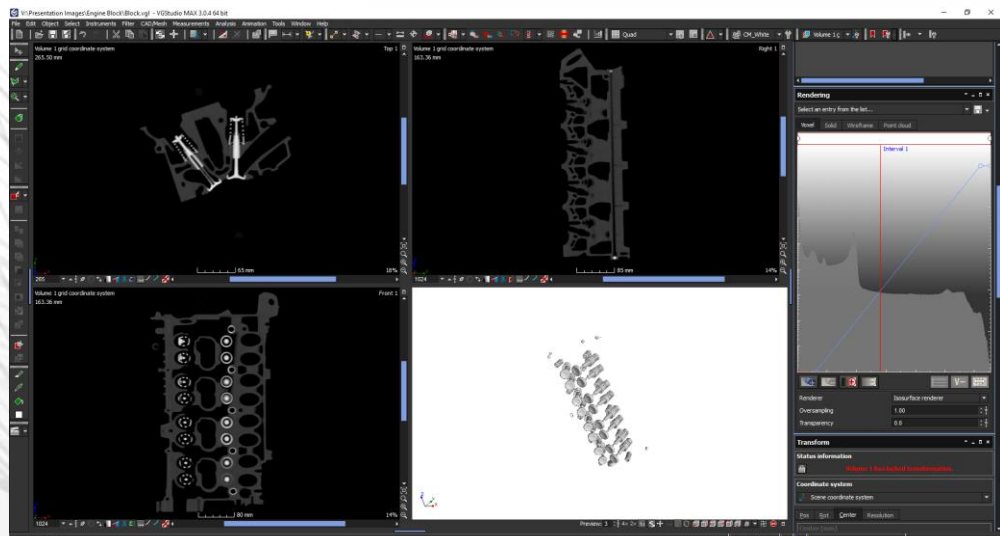
Real World Results



Large Format Castings



MIXED MATERIAL CASTINGS



SUMMARY

Until now accelerator based CT was mainly reserved for national labs. With our new DDA based Linear Accelerator we will be able to offer scanning services never before available to the general public at a reasonable cost and timing.

Advantage of using a linear accelerator with a flat panel DDA:

- Fast acquisition which equates to faster scan times for most applications.
- Large field of view for single or multiple part scans
- Shorter scan times equals less wear and tear on expensive equipment
- More versatility in scanning techniques versus standard LDAs
- Clean differentiation between mixed materials and complex assemblies.
- High level of resolution and accuracy
- Real Time X-ray capable with frame rates up to 30fps
- Large higher density and low density materials that cannot be scanned using traditional tubes <1MeV

Special thanks to Tony Melton from Industrial Imaging Solutions and his ZxAcquire DDA Software.

Something for Roger Wende

