

# EFFECT OF FILTER MATERIAL ON QUALITY OF X-RAY COMPUTED TOMOGRAPHY MEASUREMENT OF COMPLEX SPECIMENS



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# Outline

- ▣ What are we doing
- ▣ How are we getting the results
- ▣ Why the results are important

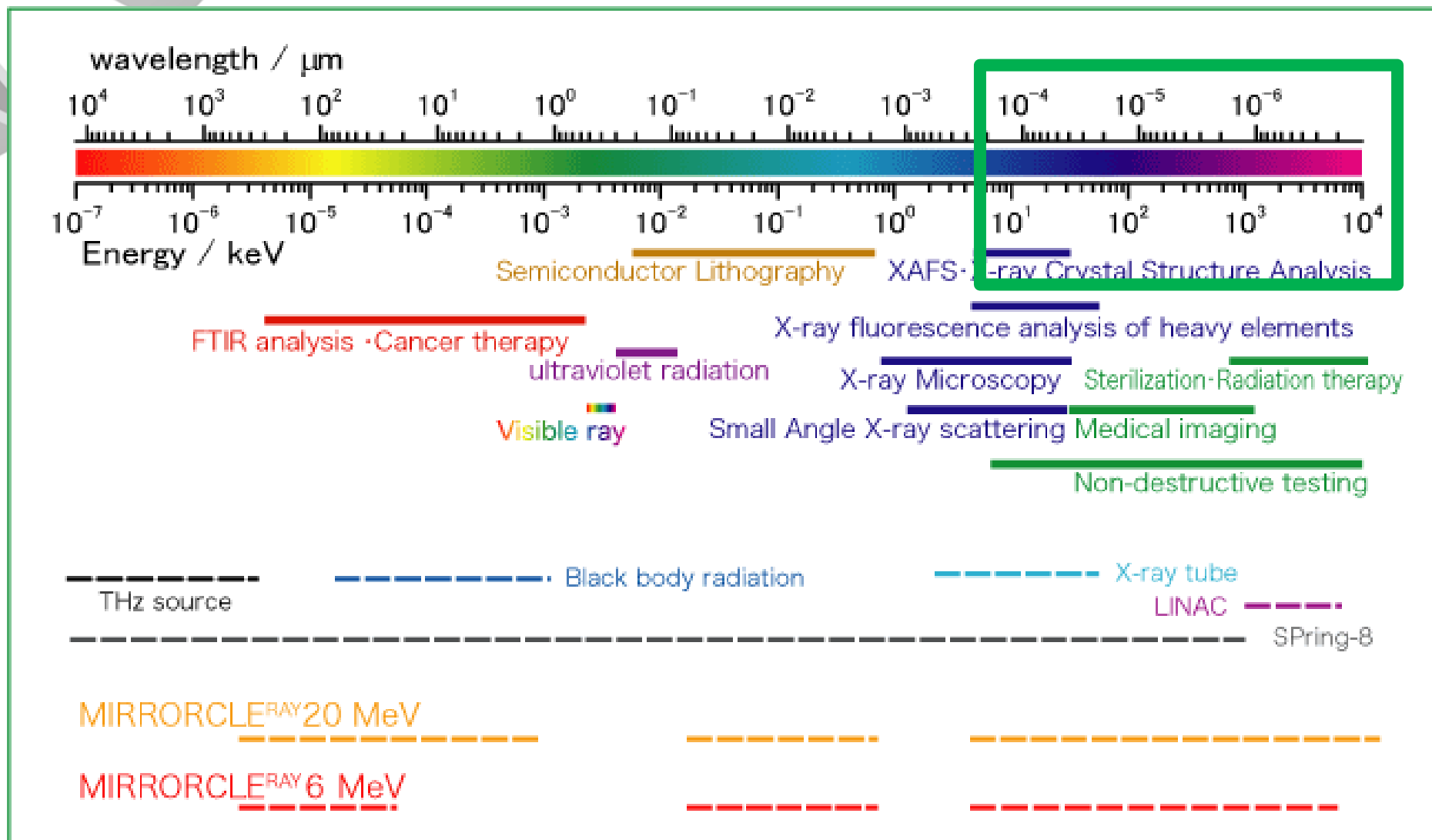


# Introduction

Nexus Metrology, a division of Trikon Technologies Inc., is dedicated to providing Micro-Computed Tomography (CT) and Material Characterization Simulation Services to Industry Application areas, Science and Academia. Most notably, we work in the fields of:

- ▣ - **ENGINEERING & NDT**
  - ▣ - **GEOSCIENCE**
- ▣ - **MATERIAL SCIENCE**
- ▣ - **LIFE SCIENCE**



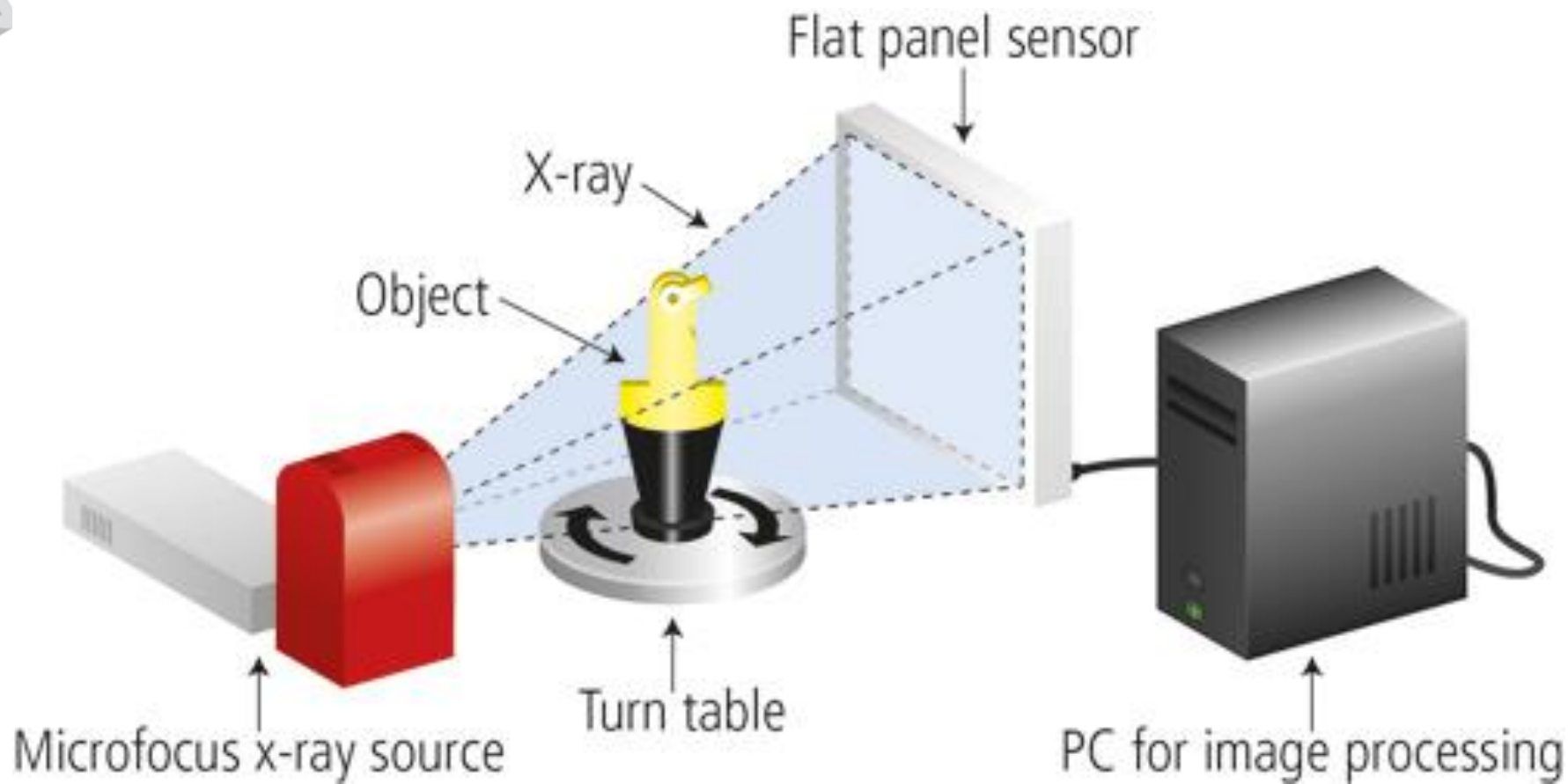


range





# Method



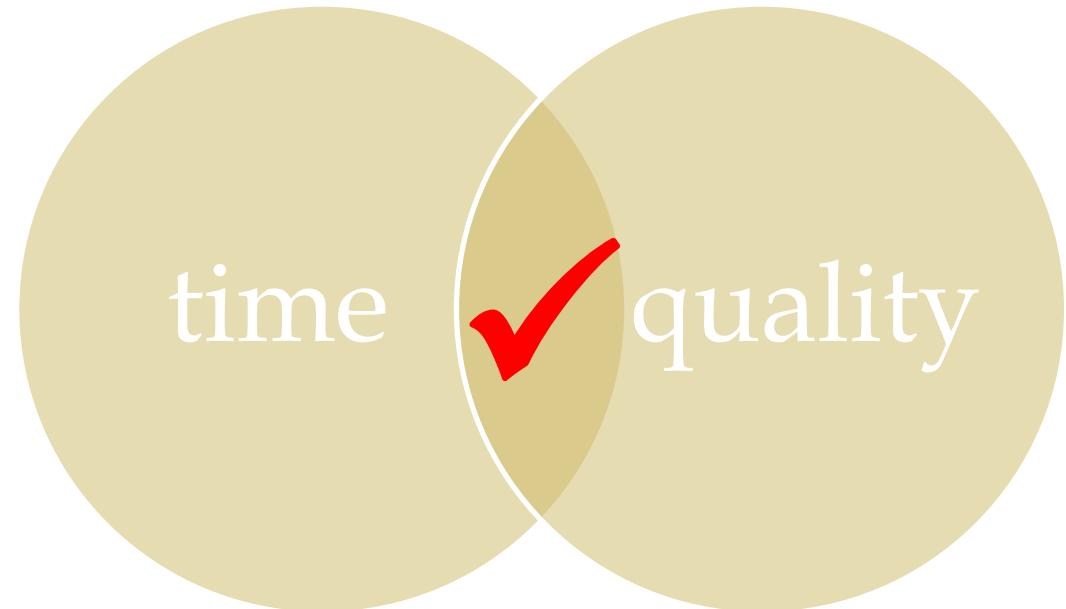
# Instrumentation

- samples up to 50 kg and 30cmx30cm
- Spatial resolution 3  $\mu\text{m}$
- advanced flat panel detector with 40x40 cm field of view



# Important Parameters

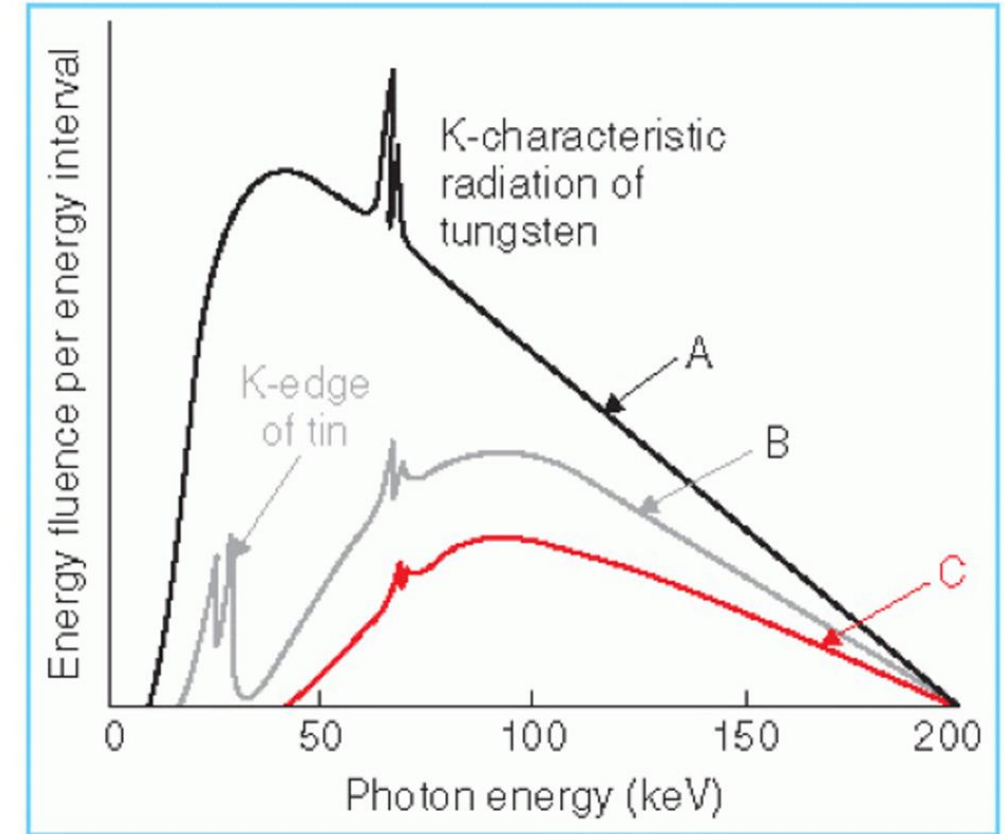
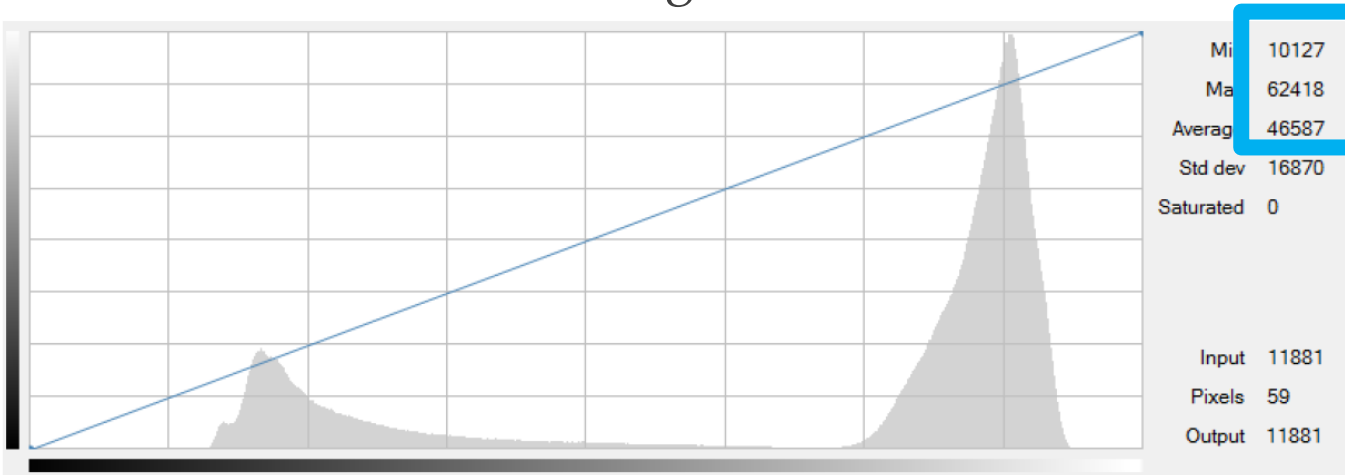
- Material
- Time
- Quality
- Resolution
  - *energy*
  - *power*
  - *frame averaging*
  - *number of projections*



# Objective

## Filtering Materials

- Aluminium** - pinches bremsstrahlung & removes 3rd generation peaks.
- Silver** - same as Al, but to greater extent.
- Copper** - same as Al, leaving only 1st Generation Peaks.
- Tin** - same as Cu, but to greater extent.



Schematic graph showing changes in spectral distribution of a 200-kVp x-ray beam with various filters. Curve A is for Al, curve B is for Sn + Al, and curve C is for Sn + Cu + Al

<https://radiologykey.com/quality-of-x-ray-beams/>





# Sample Description



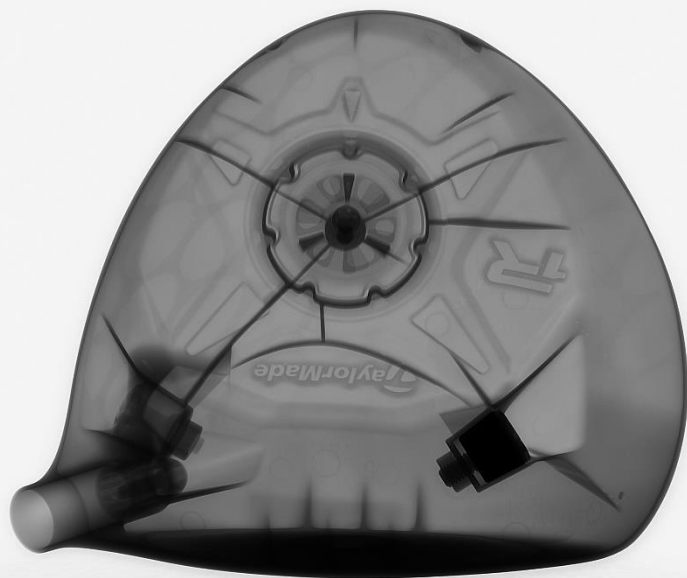
Taylor Made R1 driver

NDT in Canada 2017 Conference (June 6-8, 2017)



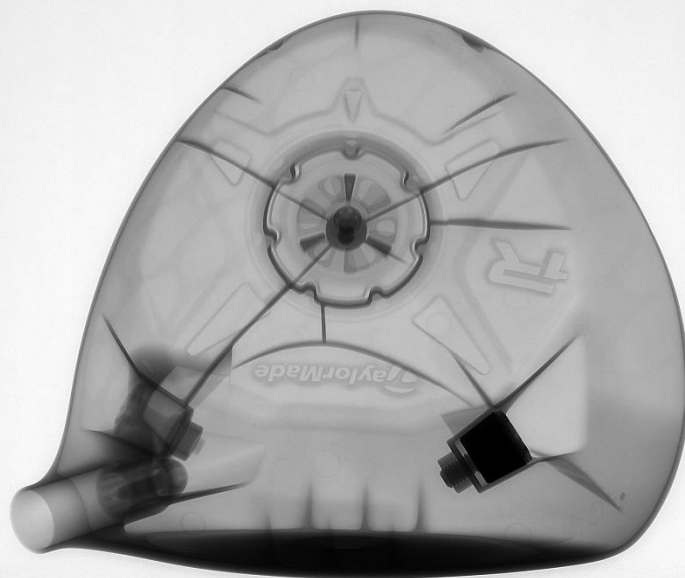
# Results

165kV  
61uA  
no filter  
354 ms  
2.82 fps



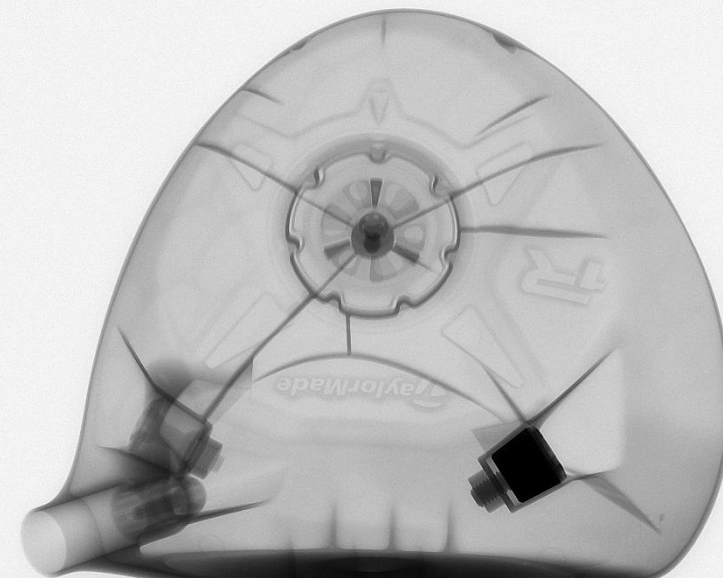
6k-35k grey levels

165kV  
61uA  
1mm Cu  
354 ms  
2.82 fps



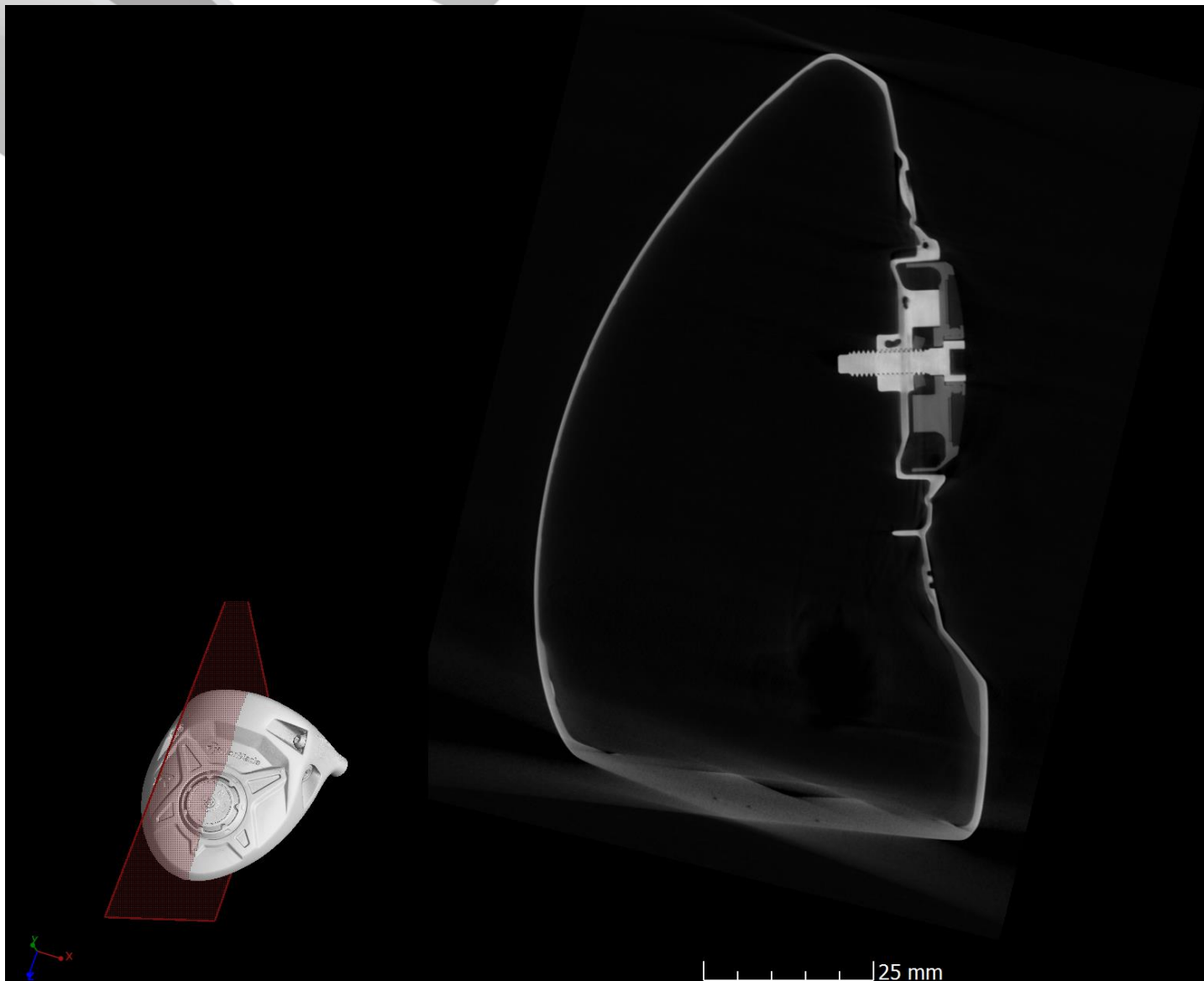
0k-20k grey levels

165kV  
61uA  
0.8mm Sn  
2.83 s  
0.353 fps



0k-65k grey levels

# Results



**G1 -Cu,1mm**

220 kV

66 uA

14W

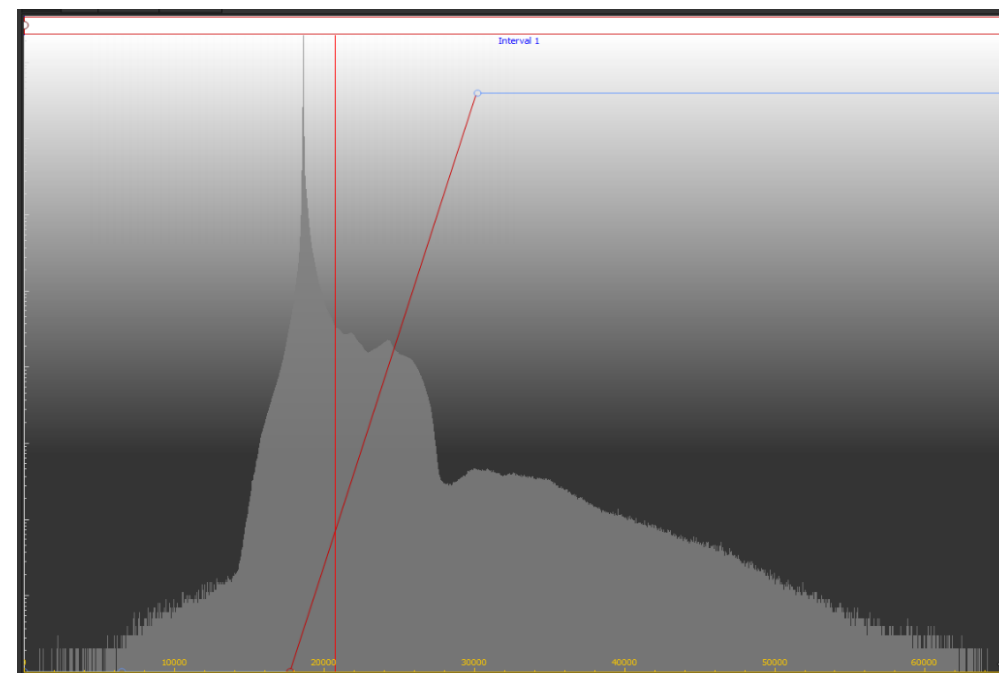
Grey levels range: 9.7k-61k

Time: 1hr 15 min 11 sec

Exposure: 708 ms (1.41 fps)

3141 frames

2 frames per projection



# Results

**G3 -Al, 2.5 mm**

220 kV

66 uA

14.5 W

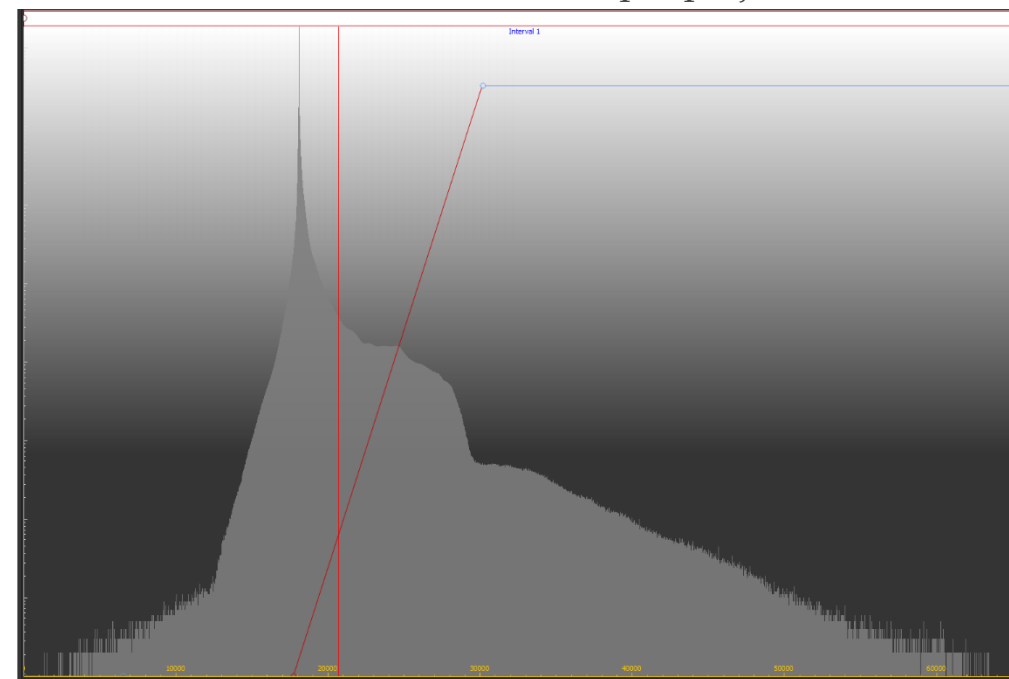
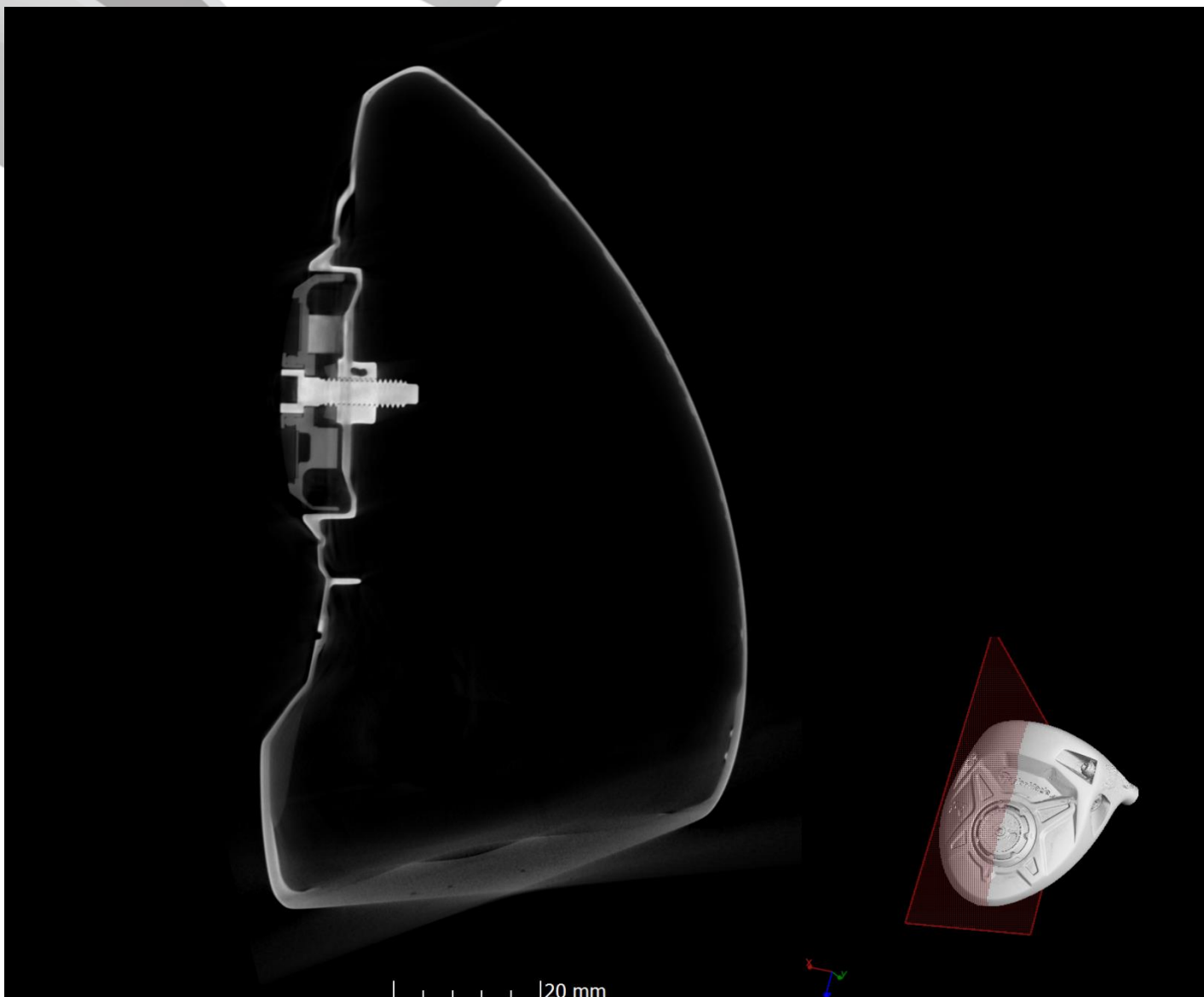
Grey levels range: 6.8k-62k

Time: 25 min

Exposure: 250 ms (1.41 fps)

3141 frames

2 frames per projection





# Results

**G2 -Sn,0.5 mm**

220 kV

66 uA

14.5 W

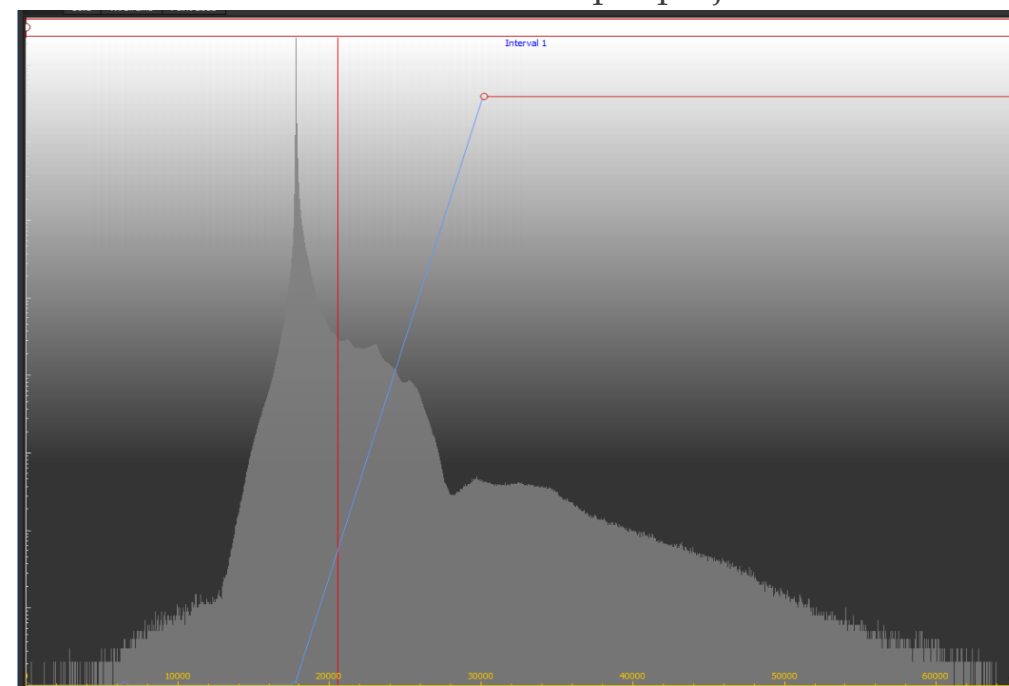
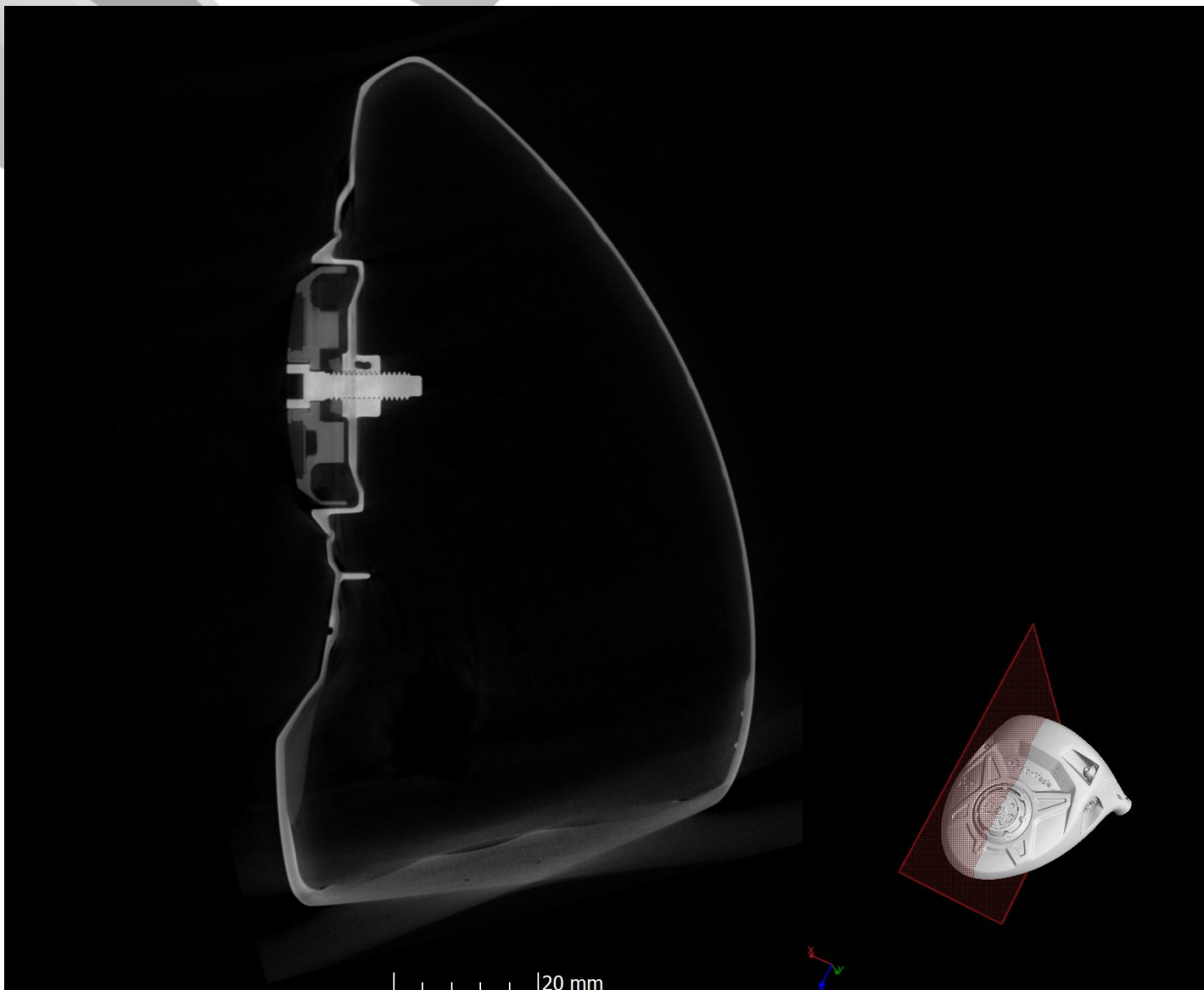
Grey levels range: 10.4k-60k

Time: 1hr 15 min 11 sec

Exposure: 708 ms (1.41 fps)

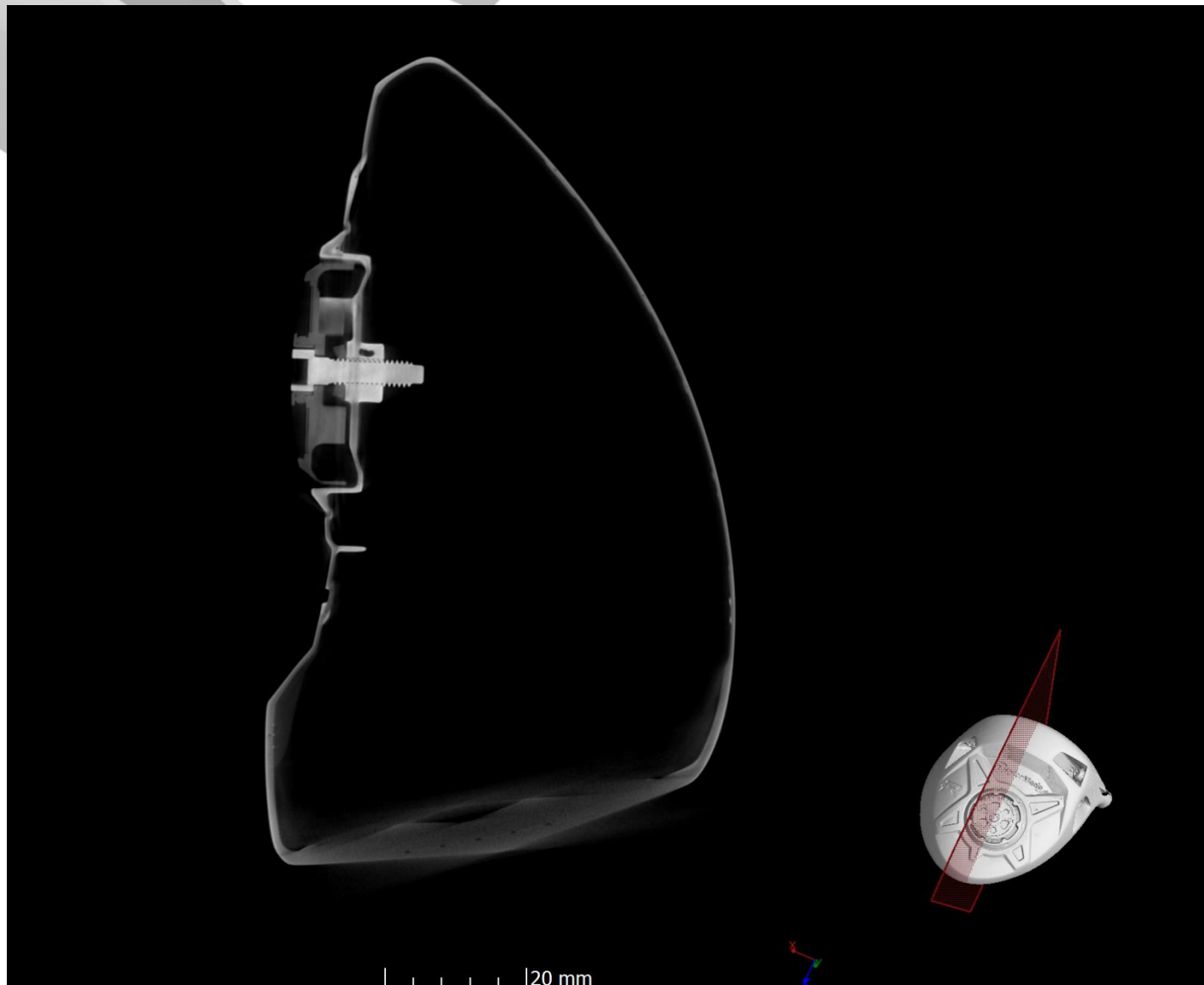
3141 frames

2 frames per projection





# Results



**G4 -Al, 19.5 mm**

220 kV

66 uA

14.5 W

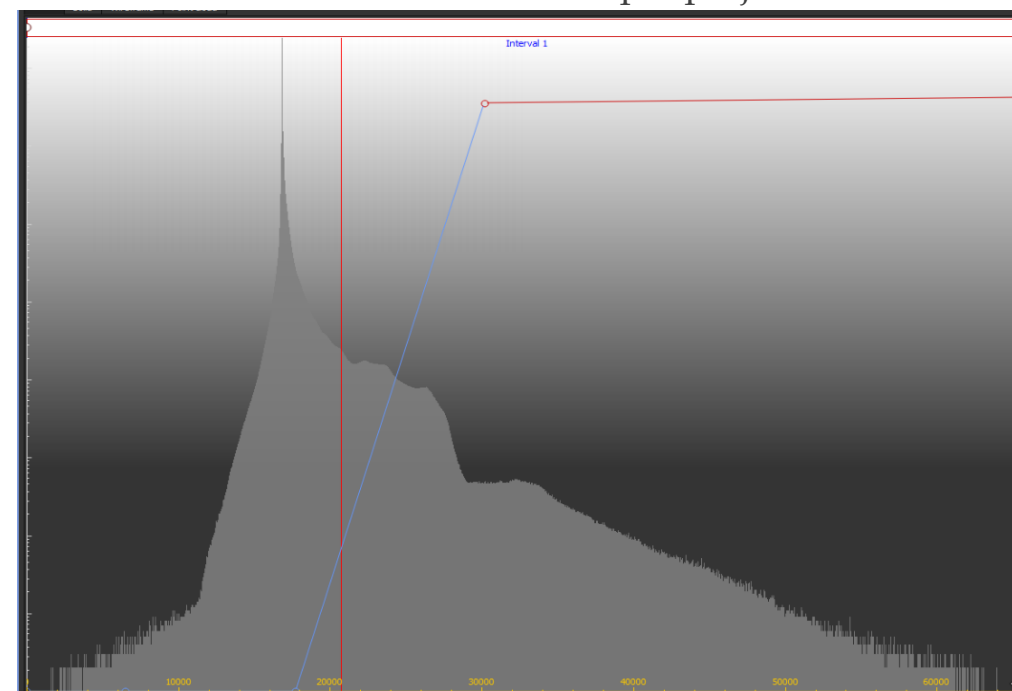
Grey levels range: 6.8k-62k

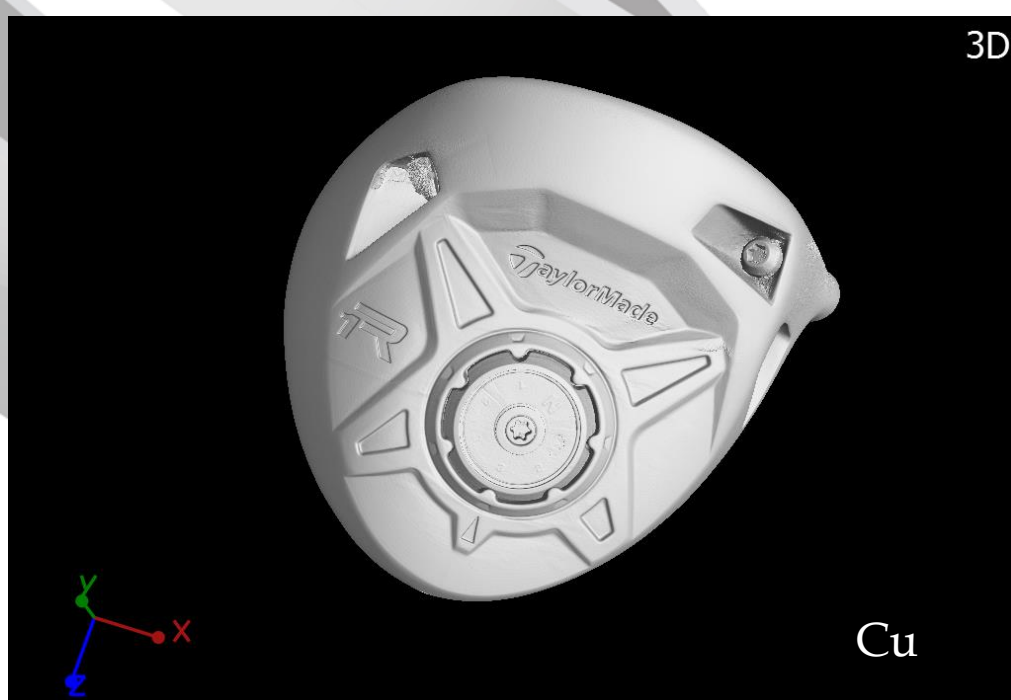
Time: 1hr 15 min 11 sec

Exposure: 708 ms (1.41 fps)

3141 frames

2 frames per projection





# Conclusions

- ▣ Al, Cu, Sn and Ag were evaluated as filter material used in industrial Radiography and CT
- ▣ Due to material properties of metals, thickness of the filter varied from 0.5 mm to 19 mm
- ▣ Cu and Sn have showed the best ability to filter low energy x-rays
- ▣ At the same conditions lowest noise level and artifacts were observed for the CT scan using Sn filter



# Thank you for Attention