# Nanox Technology Overview

February 2023

# Introduction

### Market and Industry Data and Customer Information

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This presentation may contain forward-looking statements that are subject to risks and uncertainties. All statements that are not historical facts contained in this presentation are forward-looking statements. Such statements include, but are not limited to, any statements relating to the initiation, timing, progress and results of the Company's research and development, manufacturing and commercialization activities with respect to its X-ray source technology and the Nanox.Arc, the ability to realize the expected benefits of its recent acquisitions and the projected business prospects of the Company and the acquired companies. In some cases, you can identify forward-looking statements by terminology such as "can," "might," "believe," "may," "estimate," "continue," "anticipate," "intend," "should," "plan," "should," "could," "expect," "predict," "potential," or the negative of these terms or other similar expressions. Forward -looking statements are based on information the Company has when those statements are made or management's good faith belief as of that time with respect to future events and are subject to risks and uncertainties that could cause actual performance or results to differ materially from those expressed in or suggested by the forward-looking statements. Factors that could cause actual results to differ materially from those currently anticipated include: risks related to (i) Nanox's ability to complete development of the Nanox System; (ii) Nanox's ability to successfully demonstrate the feasibility of its technology for commercial applications; (iii) Nanox's expectations regarding the necessity of, timing of filing for, and receipt and maintenance of, regulatory clearances or approvals regarding its technology, the Nanox.Arc and Nanox.CLOUD from regulatory agencies worldwide and its ongoing compliance with applicable quality standards and regulatory requirements; (iv) Nanox's ability to realize the anticipated benefits of the recent acquisitions, which may be affected by, among other things, competition, brand recognition, the ability of the acquired companies to grow and manage growth profitably and retain their key employees; (v) Nanox's ability to enter into and maintain commercially reasonable arrangements with third-party manufacturers and suppliers to manufacture the Nanox.Arc; (vi) the market acceptance of the Nanox System and the proposed pay-per-scan business model; (vii) Nanox's expectations regarding collaborations with third-parties and their potential benefits; and (viii) Nanox's ability to conduct business globally; (ix) changes in global, political, economic, business, competitive, market and regulatory forces; and (x) risks related to business interruptions resulting from the COVID-19 pandemic or similar public health crises, among other things.

For a discussion of other risks and uncertainties, and other important factors, any of which could cause Nanox's actual results to differ from those contained in the forward-looking statements, see the section titled "Risk Factors" in Nanox's Annual Report on Form 20-F for the year ended December 31, 2021, and subsequent filings with the U.S. Securities and Exchange Commission. The reader should not place undue reliance on any forward-looking statements included in this presentation

Except as required by law, Nanox undertakes no obligation to update publicly any forward-looking statements after the date of this presentation to conform these statements to actual results or to changes in the Company's expectations.

NANOX

# Together for better health.

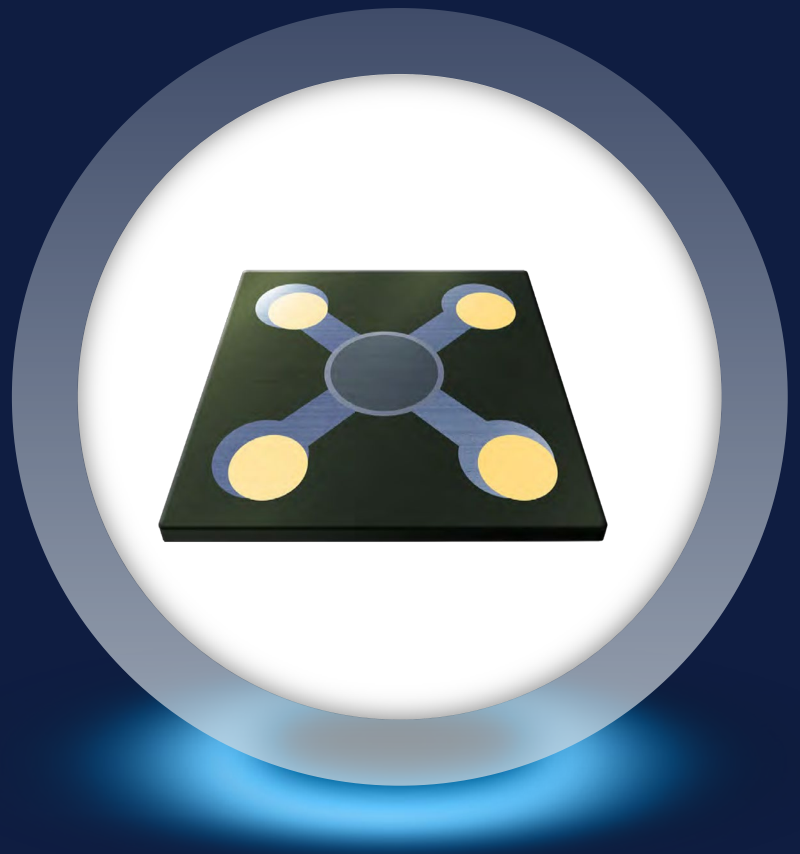
# 2/3

of the world's population has no meaningful **access** to medical imaging

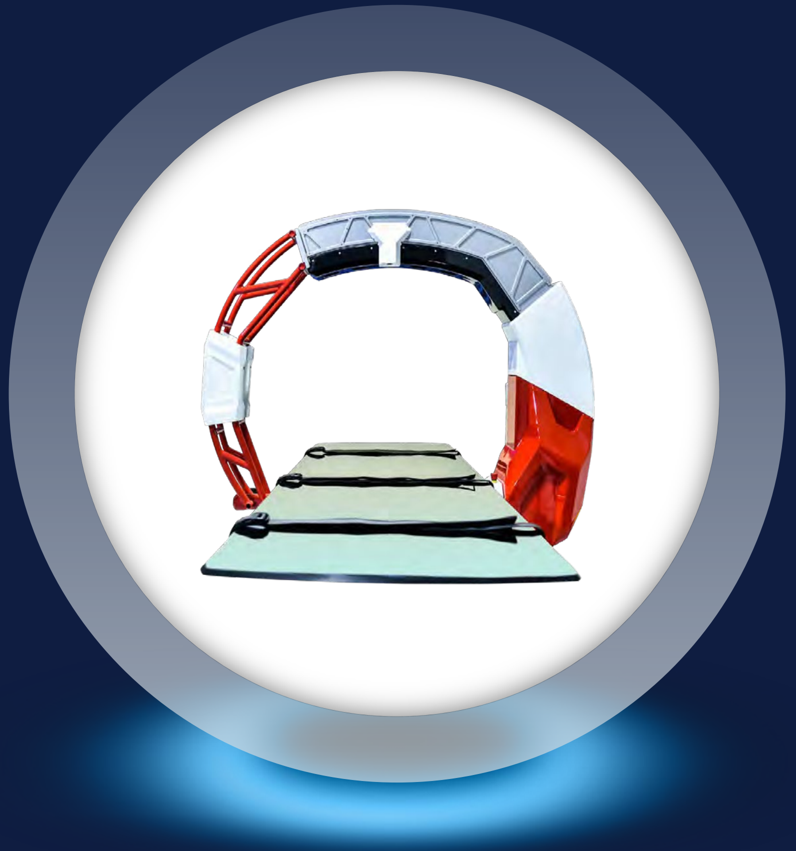
NANOX

## Hardware Solution

# INCREASE ACCESSIBILITY



Nanox.SOURCE



Nanox.ARC

Future Products

Device pending US FDA 510k clearance

NANOX

# NANOX
# ECO - SYSTEM

## AI solution
Medical AI systems would provide first response and decision assistive information

NANOXAI

## Teleradiology
Radiology specialists would provide diagnostics online

USARAD

## Marketplace
The platform would employ a matching engine to match scans to radiologists
Hospitals and doctors would get real-time global access

NANOX Market Place

NANOX

## Devices*


Nanox would transmit all imaging data from Nanox.ARC and future devises to the cloud SaaS platform

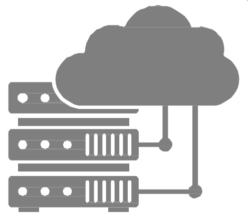
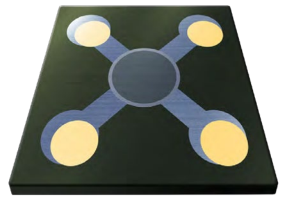
## Cloud


Image Reconstruction and SaaS billing

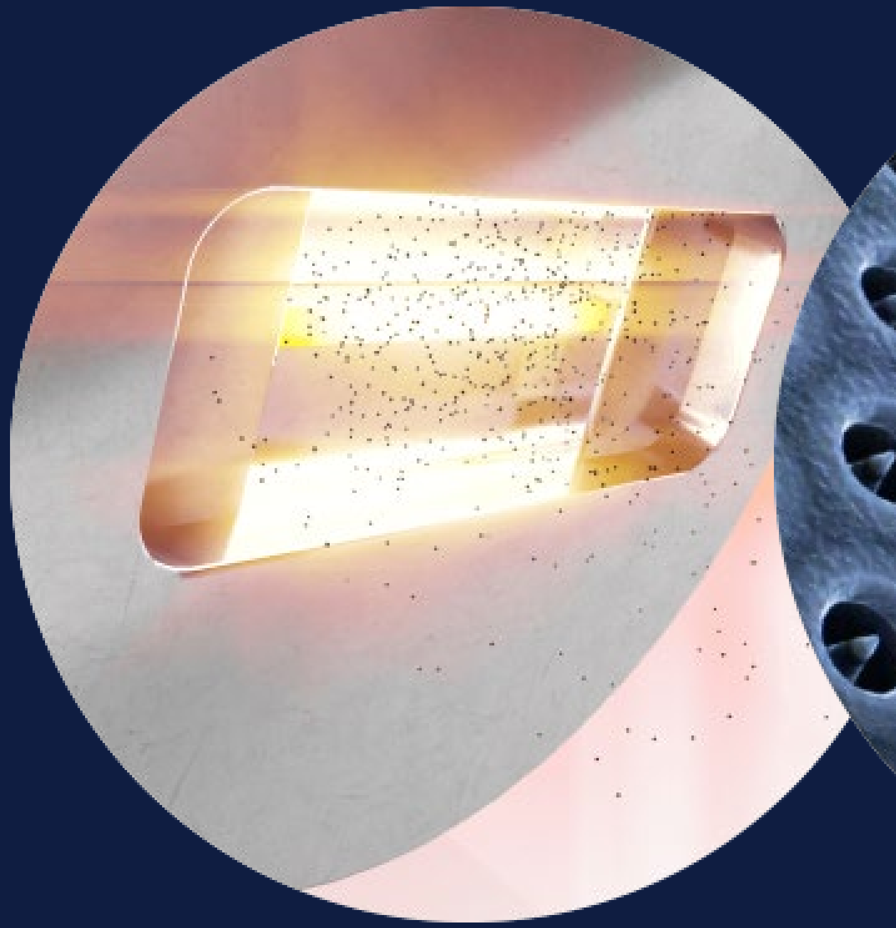
## OEM


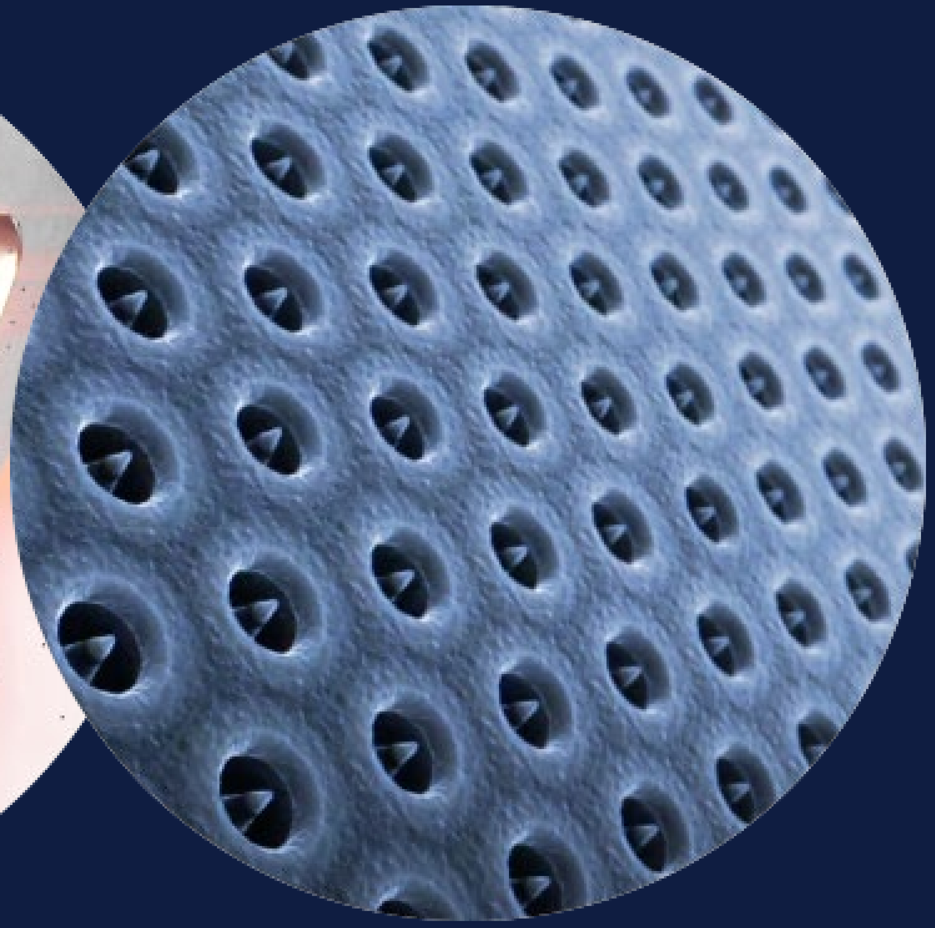
Tailor our X-Ray source technology to third party imaging systems

*Concept Device. For Educational Purposes Only.
Device pending US FDA 510k clearance

# Technology Hardware

# Technology update





From one metal filament heated to 2.000° Celsius, requiring special cooling and rotation mechanics

To a field of 100 Million nano-cones on a silicon chip, emitting digitally controlled electron streams under low voltage

# Technology
# MEM & Tubes

NANOX

# Introduction to Digital X-Ray Technology & Nanox Status

IU Kim

Chairman of Nanox Korea

# Market overview: Development Status of Digital X-Ray Sources

| Type | Institute | Status |
|---|---|---|
| In-chamber type<br> | U. North Carolina (Xintek, Xinray, XinVivo, Nuray) (USA, China) | - CNT emitters<br>- Development of FE x-ray source for medical imaging and therapy |
| | Nagoya Ins. Tech. | - CNT emitters<br>- Demonstration of x-ray generation |
| | Other Univ. | - Various emitters<br>- For demonstration of x-ray generation |
| Vacuum-sealed tube type<br> | **AIST** (Japan) | - Nano carbon emitters<br>- Development of portable ceramic sealed x-ray tubes for industrial inspections |
| | **NANOX** (Israel) | - Nano Spindt tip |
| | **ERI** (Taiwan) | - CNT emitters<br>- Portable glass sealed x-ray tube for dental |
| | **ETRI** (Korea) | - CNT emitters<br>- Development of ceramic sealed x-ray tubes for medical and industrial imaging |
| | **Vatech, VSI, PicoPacfi** (Korea) | - CNT emitters<br>- **Commercialization of ceramic sealed x-ray tube through ETRI's technology** |

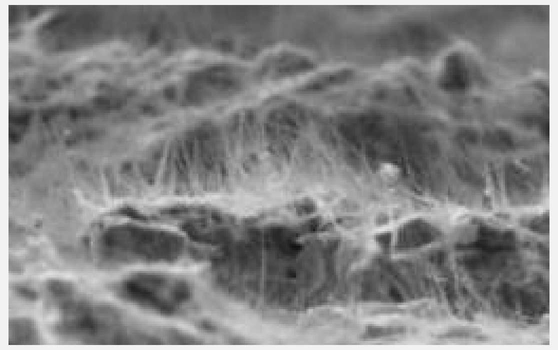
Source: Trends on the Development of Carbon Nanotube-Based Digital X-ray Tube, 2016, Journal of Information Display, Volume 19, 2018

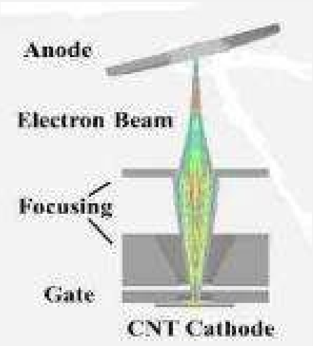
# Market overview: Development Status of Digital X-Ray Sources

## U. North Carolina :

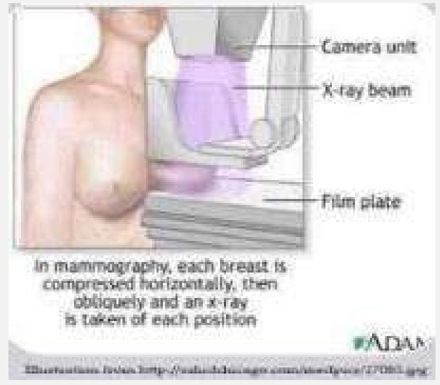
Xintek (Xinray Systems, XinVivo, XinNanoMaterials, Nuray, Micro-X (Carestream)

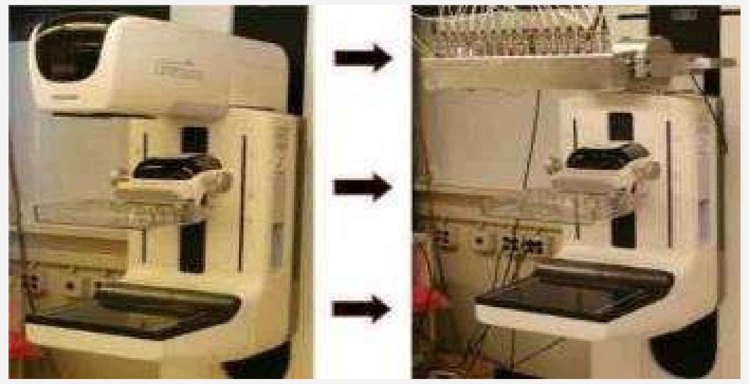
►CNT X-ray sources in a vacuum chamber (not sealed tube type)



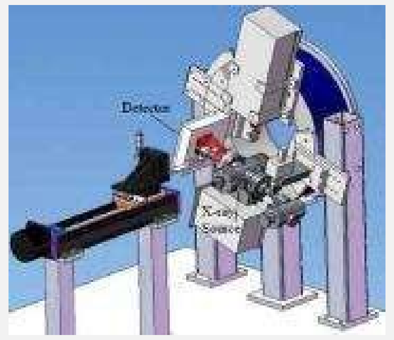


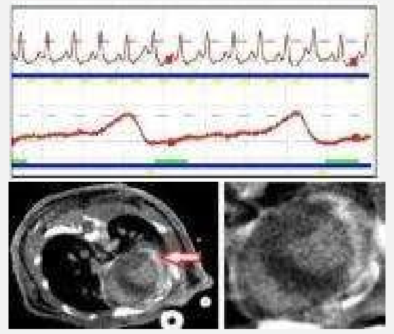

►Stationary Digital Breast Tomosynthesis (sDBT) clinical trial at UNC hospitals



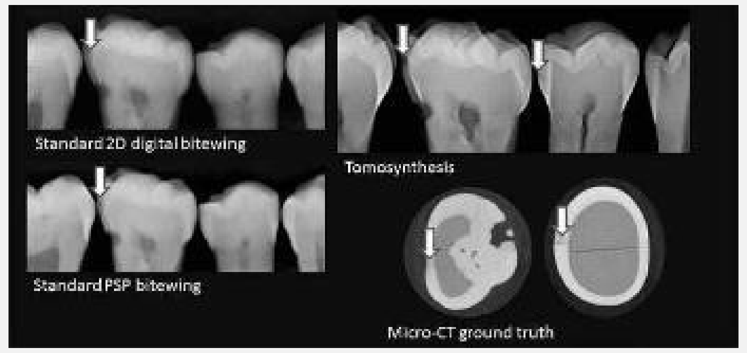



►**Gated Micro-CT**



►**TomoD system for 3D intraoral imaging**



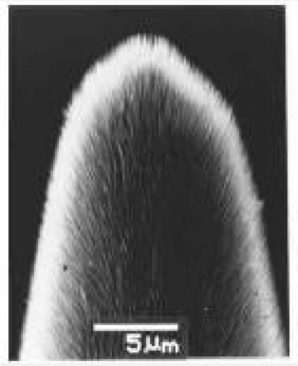

Source: Yahachi Saito, Nanostructured Carbon Electron Emitters and their Applications, 2022

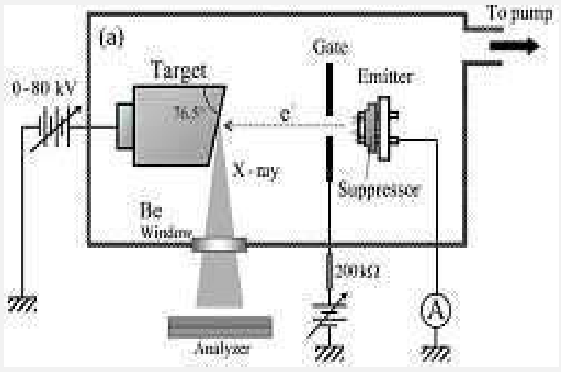
# Market overview: Development Status of Digital X-Ray Sources

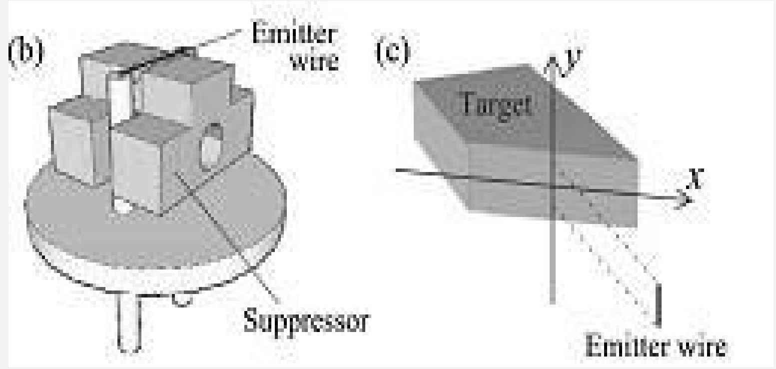
## Nagoya Institute of Technology

(Prof. Okuyama, Japan)

►miniature x-ray source in a vacuum chamber (not sealed tube type)




## AIST, Onizfia Glass

(Japan)

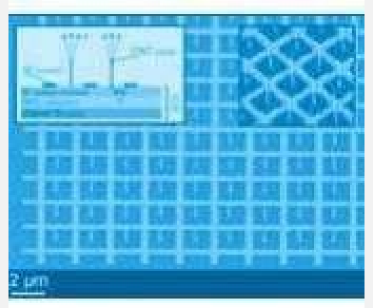
►portable x-ray tube in a sealed tube type, with diode mode (triode?)

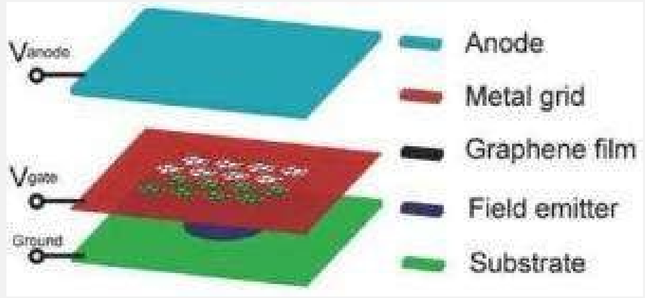
ed carbon emitters

## Cambridge XRAY SYSTEMS

(Spin-off from Cambridge U.)

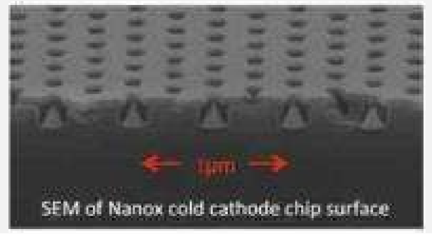
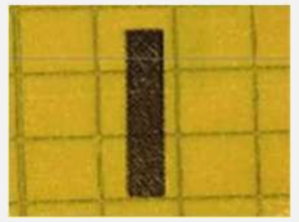
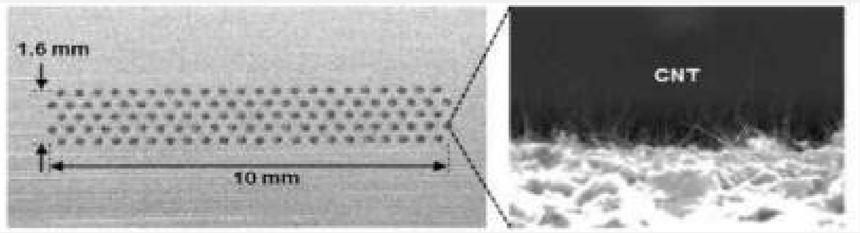
►novel CNT emitters, graphene gate no x-ray sources



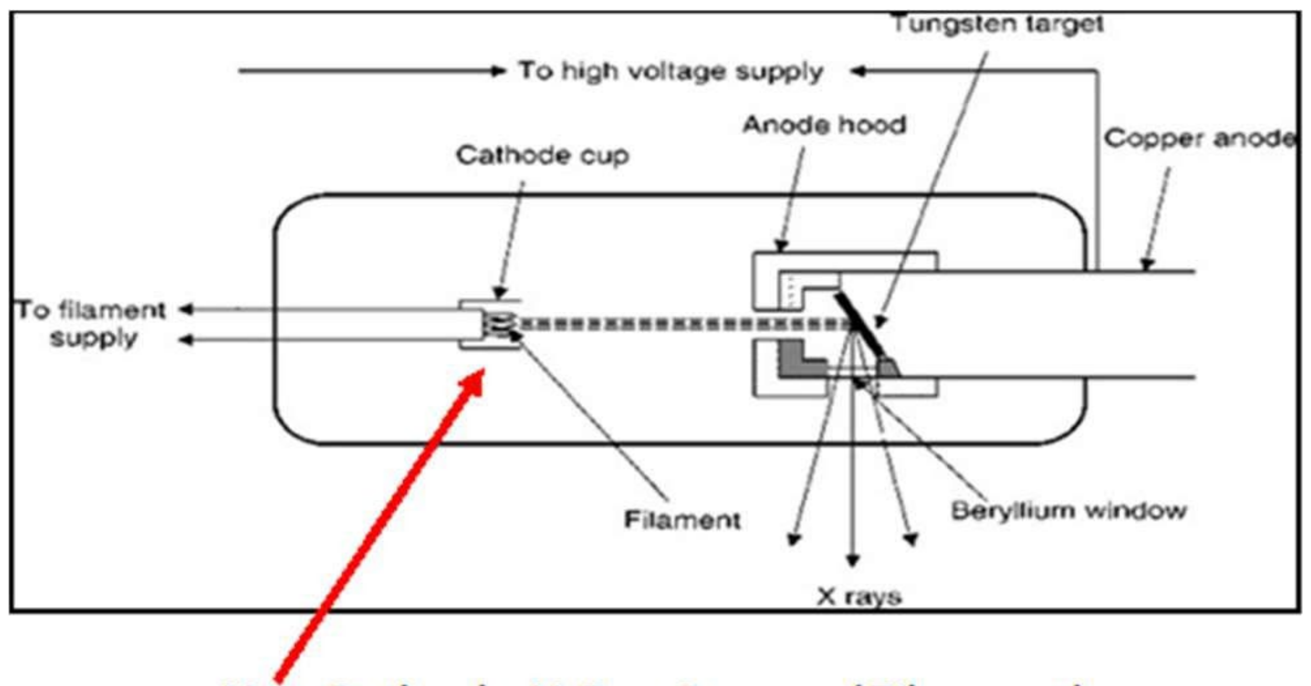

Source: Trends on the Development of Carbon Nanotube-Based Digital X-ray Tube, 2016, Journal of Information Display, Volume 19, 2018

# Market overview: Development Status of Digital X-Ray Sources

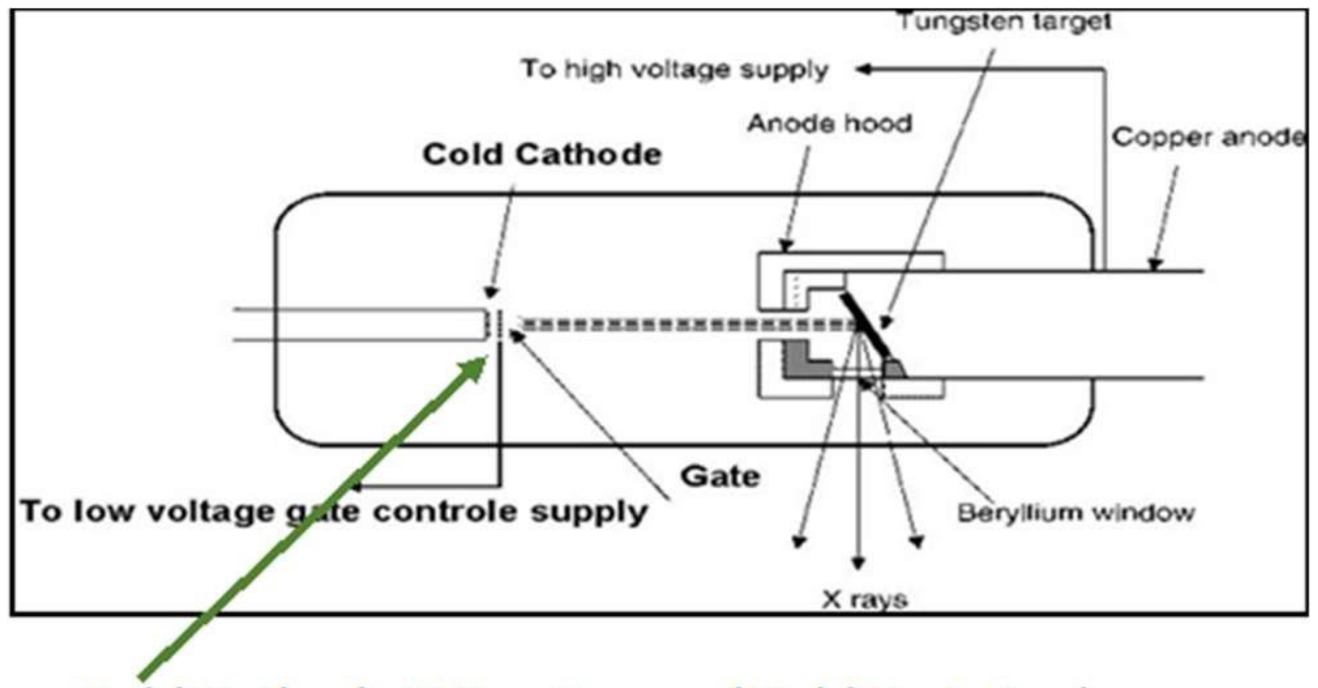
| | |
|---|---|
| NANOX | ▶ **MEMS Spindt tips**   |
| ERI<br><br>(Taiwan) | ▶ in a sealed tube type, with diode mode     |
| Nanoray<br><br>(with several Univ. in Korea) | ▶ grown CNT emitters, no x-ray tubes   |
| VEC GmbH<br><br>(Varex-Cetteen Joint Venture) | ▶ **CNT multi-beam X-ray sources (not sealed tube type)**   |
| ETRI<br><br>(VSI, Vatech,Picopack) | ▶ sealed CNT x-ray tubes with a commercial lifetime     |

Source: Trends on the Development of Carbon Nanotube-Based Digital X-ray Tube, 2016, Journal of Information Display, Volume 19, 2018

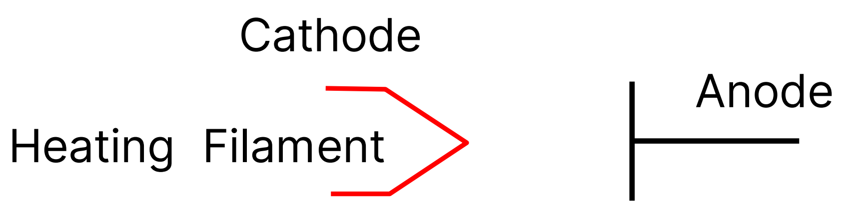
# Hot Cathode vs. Cold Cathode Explained

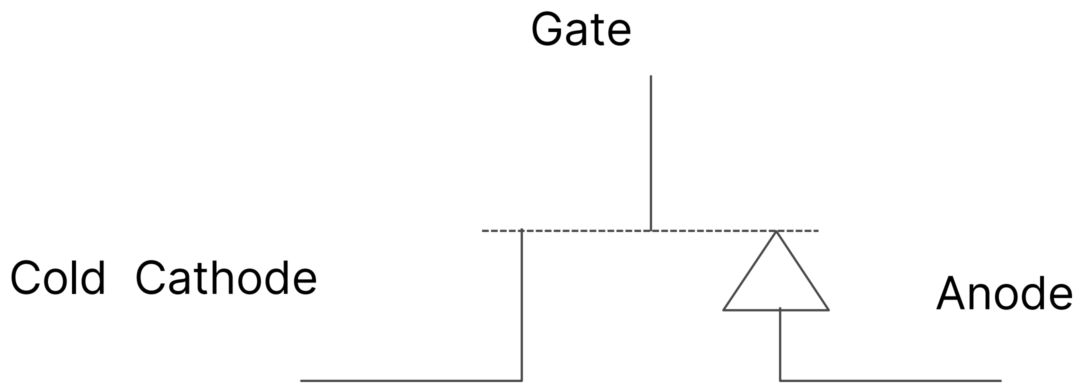



Hot Cathode X-Ray Source (Filament)




Cold Cathode X-Ray Source (Field Emission)



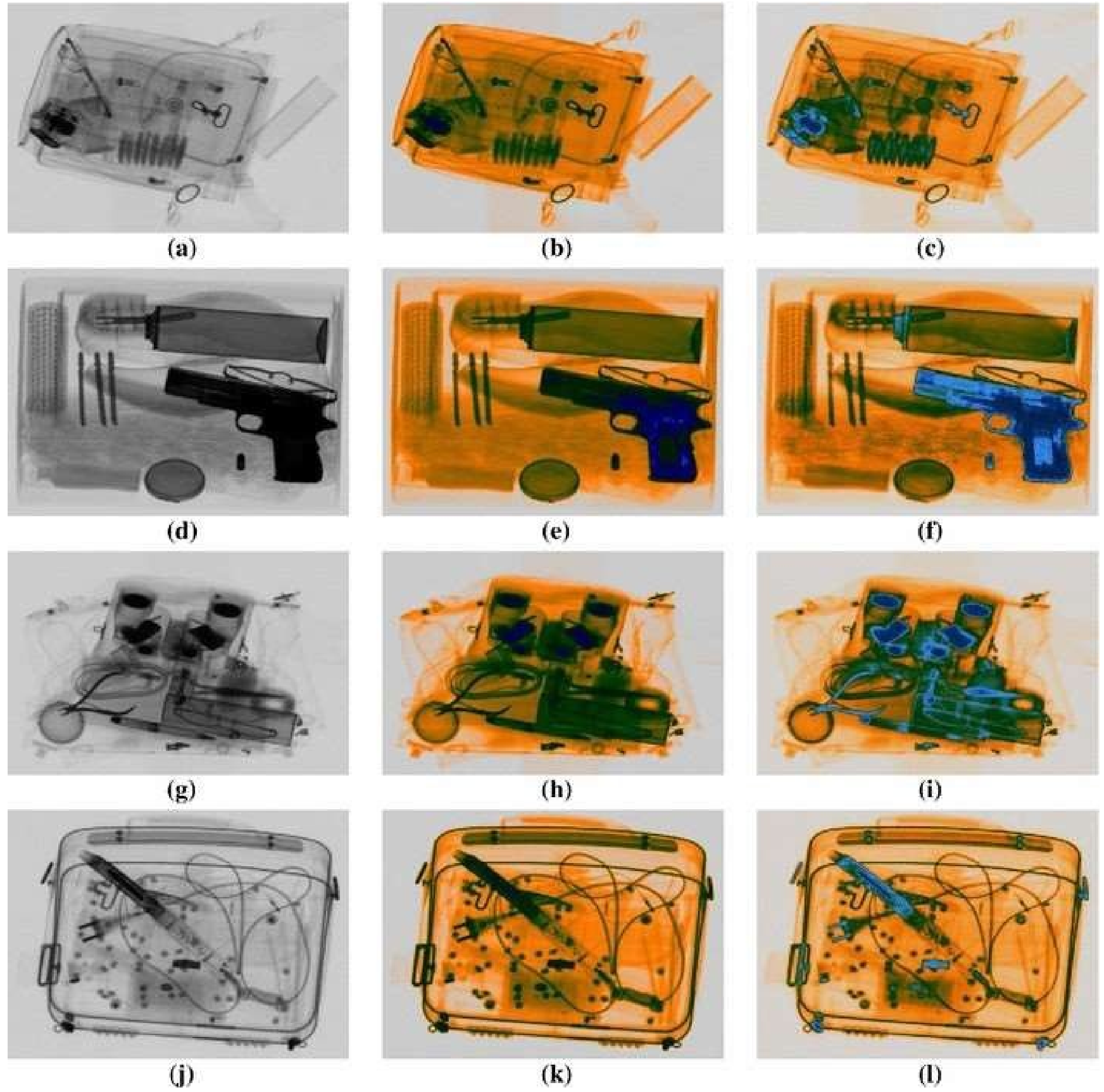



# Technology –Digital X-ray Source (2), possible future usage and implementation

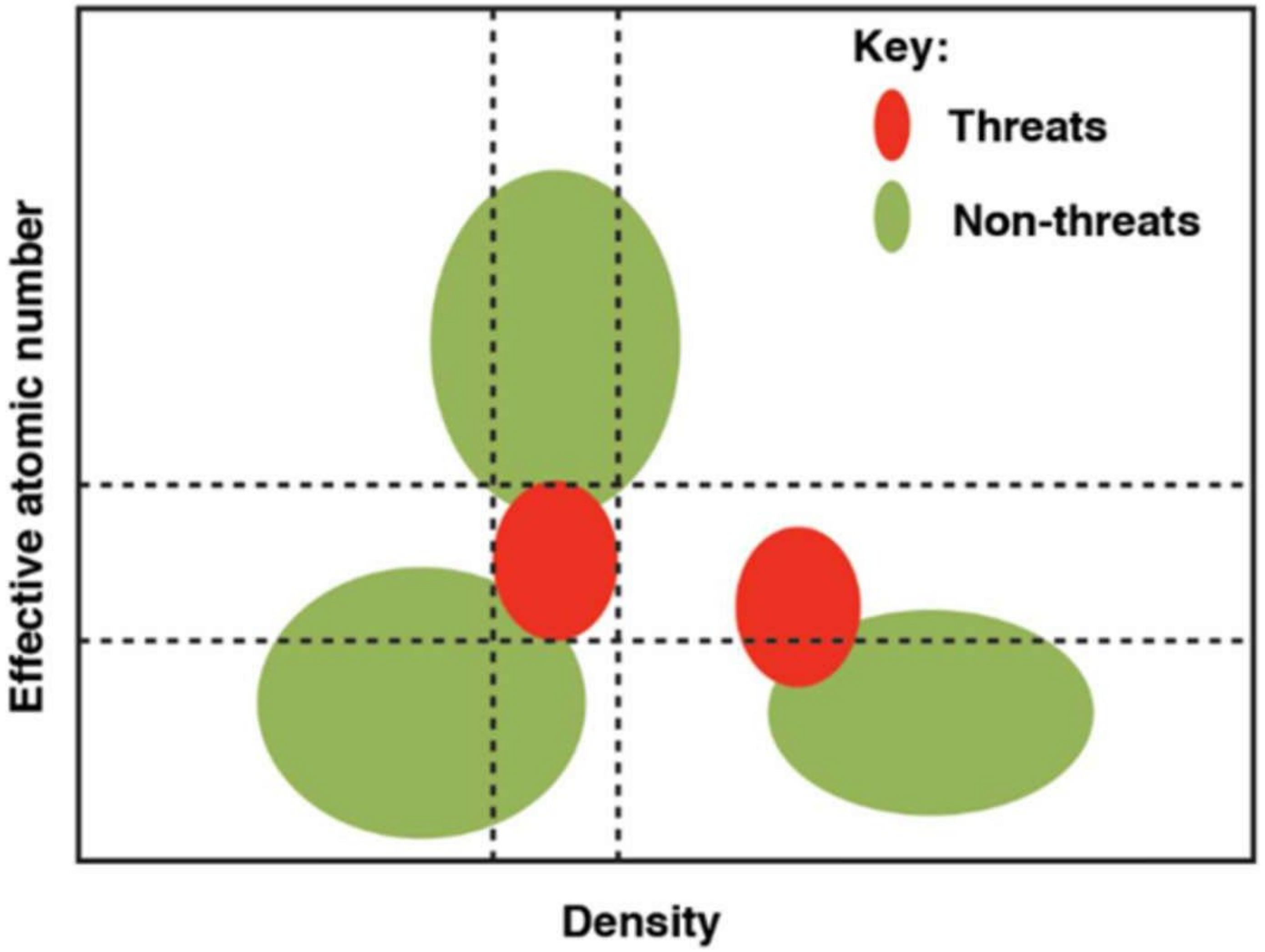
## Thermionic vs. Cold Cathode X-ray tube

| | Thermionic | Cold Cathode(Nano-X Tube) |
|---|---|---|
| X-ray power vs. KV | Fixed kV (lose emission at low kV) | Anode voltage independent emission 40-200kV freedom |
| Pulsed operation | Limited | < micro second time resolution<br>≣ Fit for low dose C-arm applications |
| Multiple X-ray source | Practically impossible | Unlimited<br>≣ Enables Stationary CT |
| CT strategy | Fast spinning single heavy X-ray source<br>Bulky, heavy and expensive construct<br>Large Space / Immobile | Light distributed X-ray source array<br>Light and simple construct<br>Small space / Mobile |

# Dual energy scan for identifying high Z materials

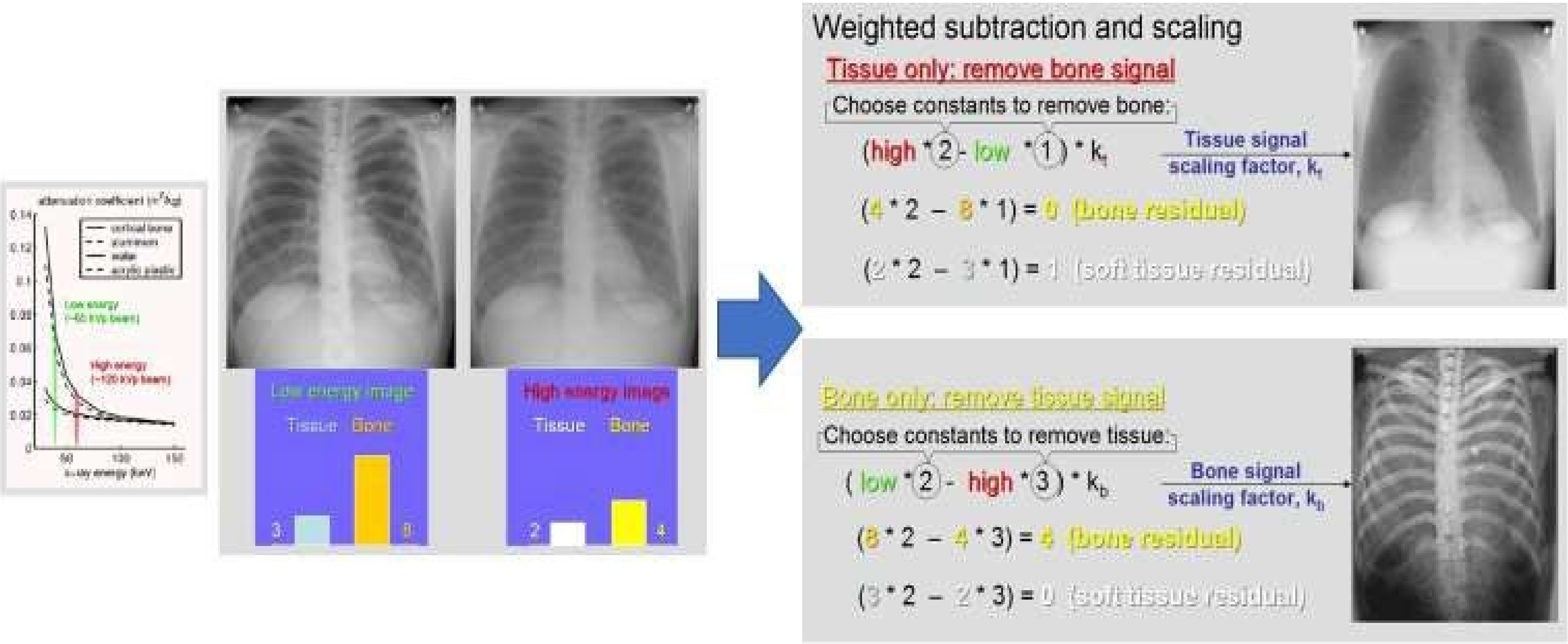



Source: Sharpening filter for false color imaging of dual-energy X-ray scans, 2016



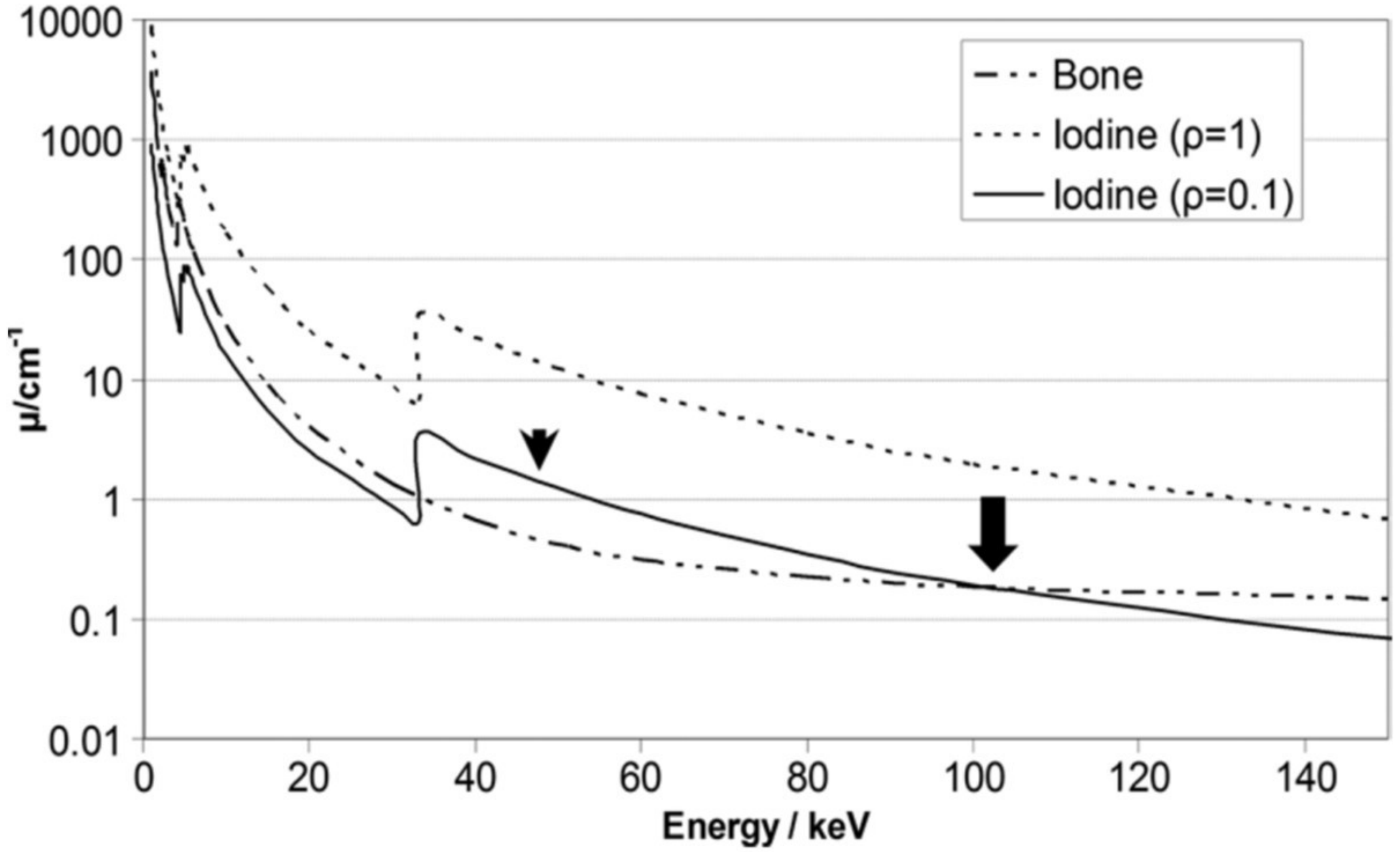

Source: Dual-Energy X-ray Radiography and Computed Tomography, 2018

# Separation of soft tissues and bones in dual energy chest X-ray



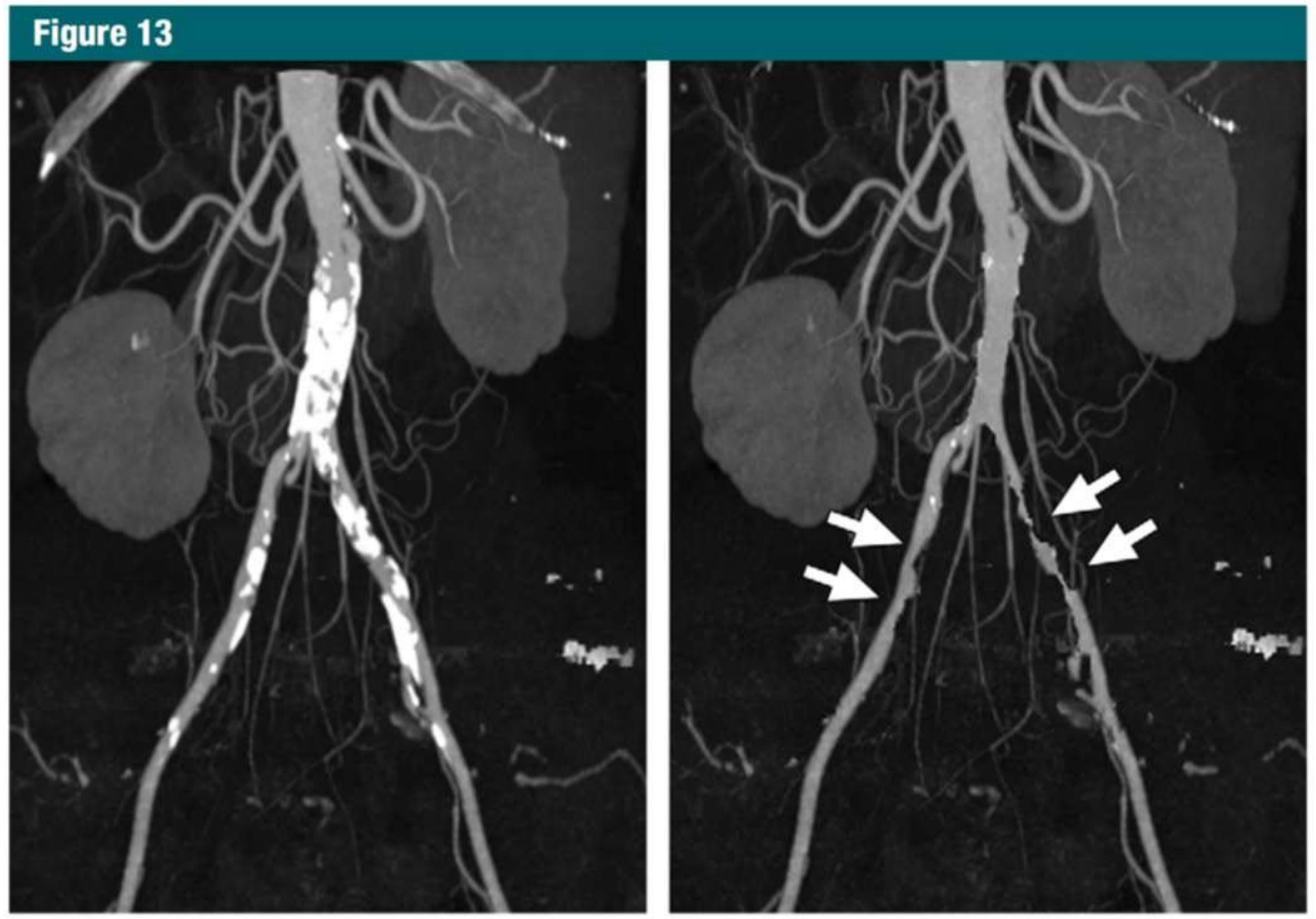

Source: https://www.upstate.edu/radiology/education/rsna/radiography/dual.php

# Dual energy scan in medical applications




Linear attenuation coefficients for bone and iodine. The iodine with density 0.1 happens t o have the same $\mu$ at 100kV. Only chromatic scan can separate those.

Source: "Dual- and Multi-Energy CT: Principles, Technical Approac hes, and Clinical Applications", 2015




Coronal maximum intensity projection images fro m CT angiographic study of the aortic bifurcatio n in a 70-year-old man. (left) Calcified plaque ob scures the vessel lumen. (right) By using dual-en ergy material decomposition, the calcified plaqu e is identified and subtracted, giving a clear indic ation of vessel patency and areas of stenoses (a rrows).

Source: https://www.upstate.edu/radiology/education/rsna/radiography/dual.php

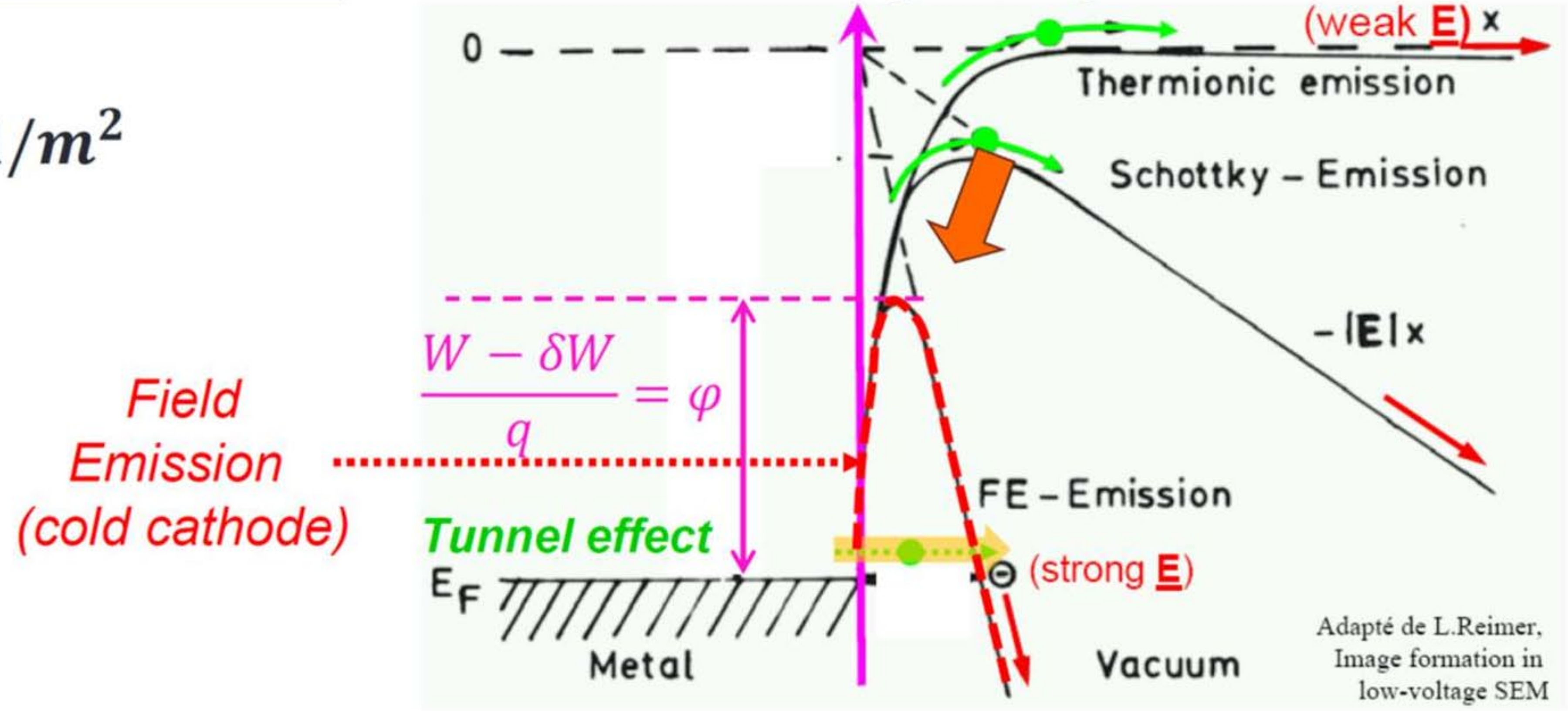
# Technology –Digital X-ray Source (3)

## Thermionic vs. Field Emission

| Thermionic Emission | Electric Field Emission |
| --- | --- |
| $J = AT^2 e^{-\frac{(W-\eth W)}{kT}}$ | $J = \frac{k_1 E^2}{\varphi} e^{-(\frac{k_2 \varphi^{\frac{3}{2}}}{E})}$ |
| • Temperature driven (T)<br>• Electrons gain energy from heat – high temperature filament evaporates over time<br>• Schottky effect (W- $\delta W$) requires strong external electric field – emission diminishes at lower anode bias | • Electric field driven (E)<br>• Electrons escapes cathode by quantum tunneling<br>• Emission is independent of anode bias, and only controlled by gate<br>    • Spectral scan<br>    • Addressable multi-source X-ray array enabling stationary CT<br>    • Fast switching pulse mode operation |

# Electron Field Emission

- In the presence of a very strong electric field (E>10 MV/cm) , the working barrier is thin enough to allow electron emission through **Tunnel Effect**
- The associated emission is ruled by the Fowler-Nordheim theory (quantum physics)
- It is a **cold cathode emission** => no metal heating is required
- $J \approx \frac{k_1 E^2}{\varphi} e^{-\left(\frac{k_2 \varphi^{3/2}}{E}\right)} A/m^2$
  - $k_1 = 1.4\ 10^{-6} (SI)$
  - $k_2 = 6.87\ 10^{7} (SI)$
- *J~1 MA/cm² !*

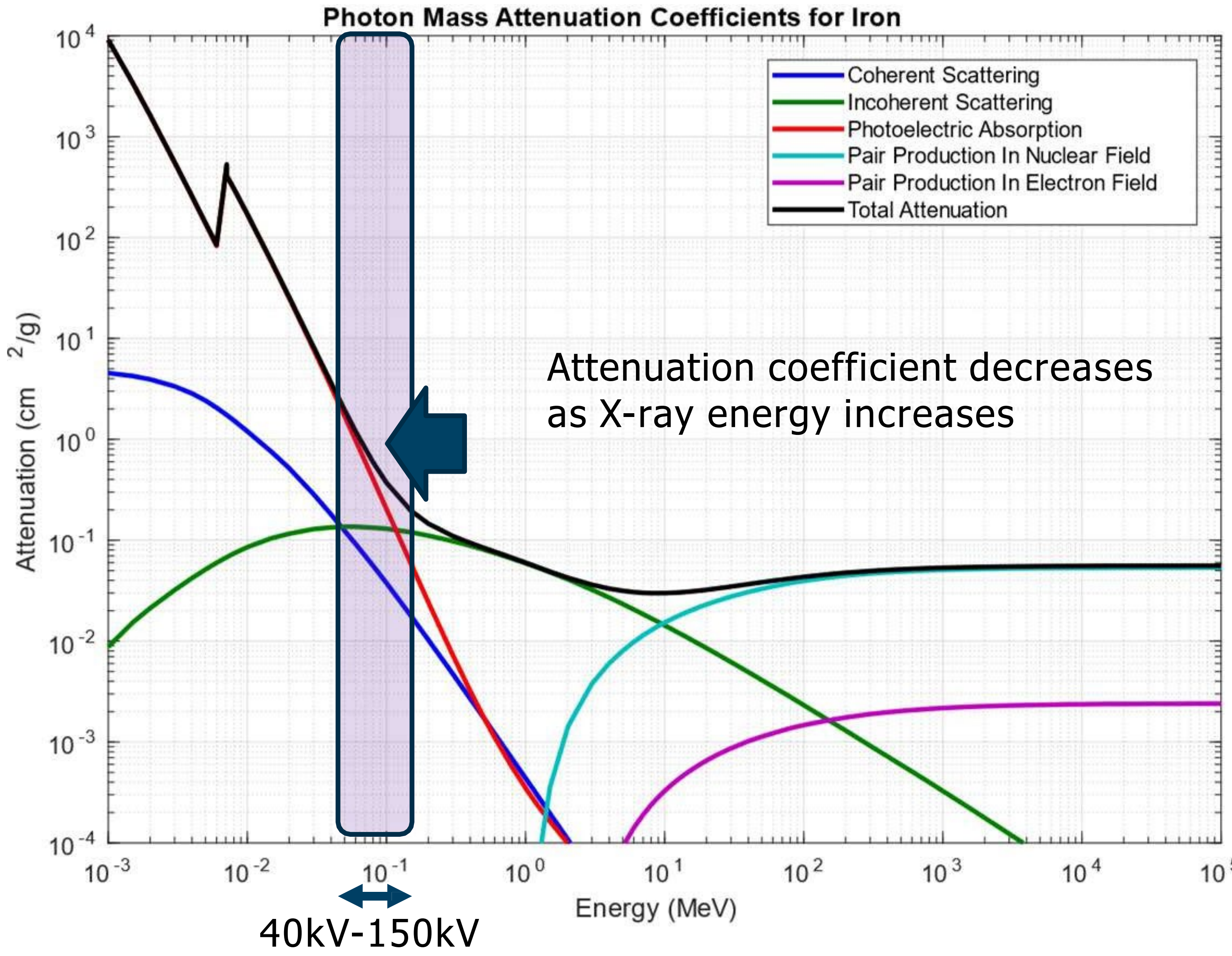


# X-ray mass attenuation coefficient

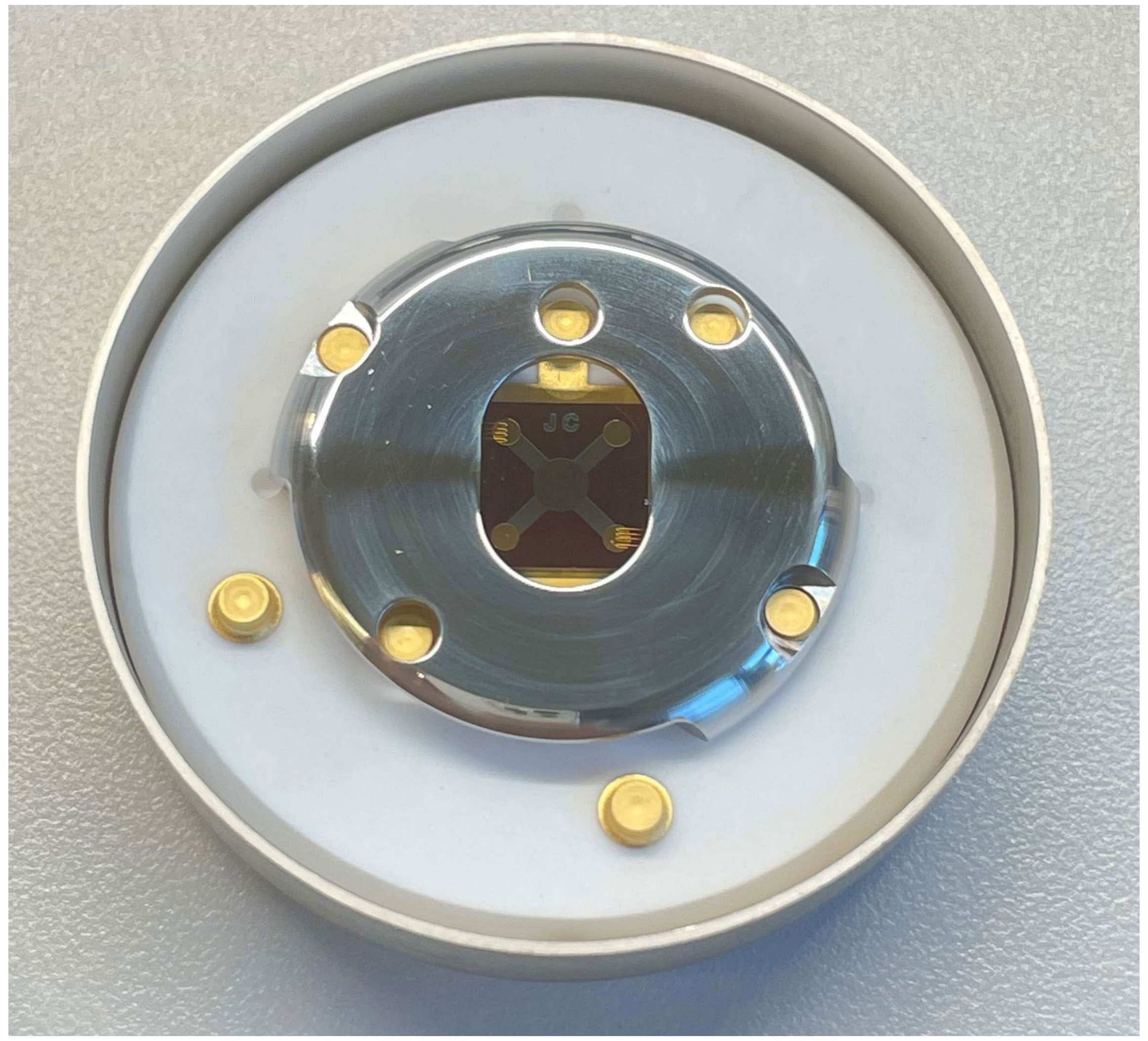
$$I = I_0 e^{-(\frac{\mu}{\rho})\lambda}$$

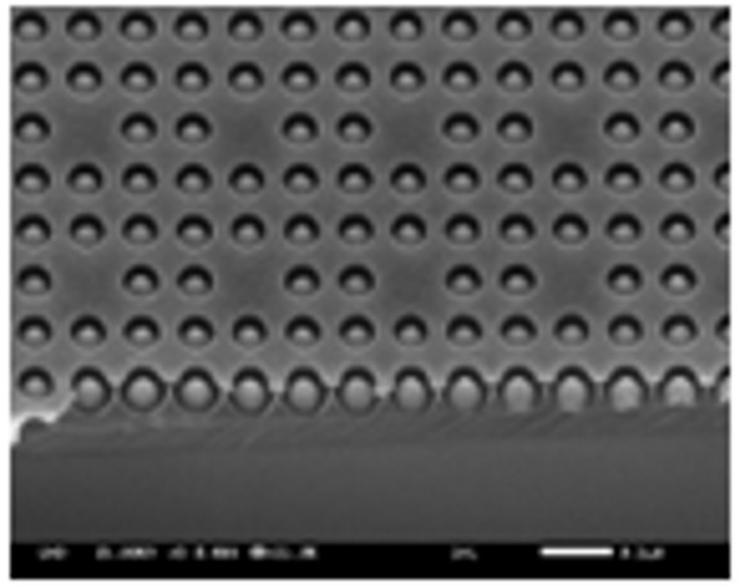
$\mu$: Mass Attenuation Coefficie
nt
$\rho$: Mass density
$\lambda$: $\rho$l, area density

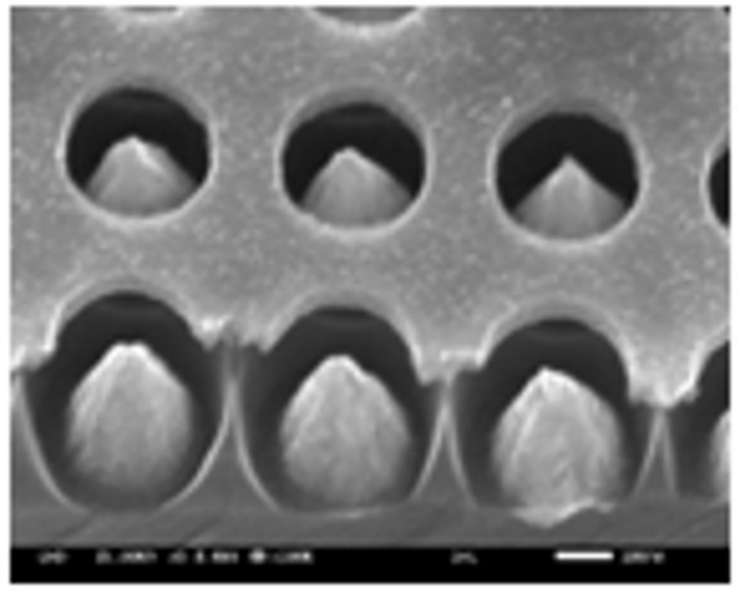
Purpose of CT imaging is finding CT numb
er which is a representation of $\mu$ at each
voxel



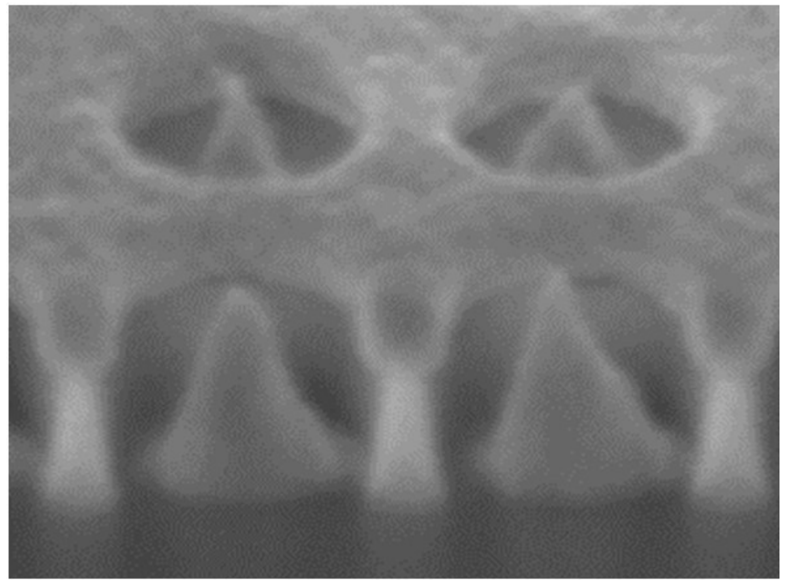
# Actual Picture of the Nanox Emitter

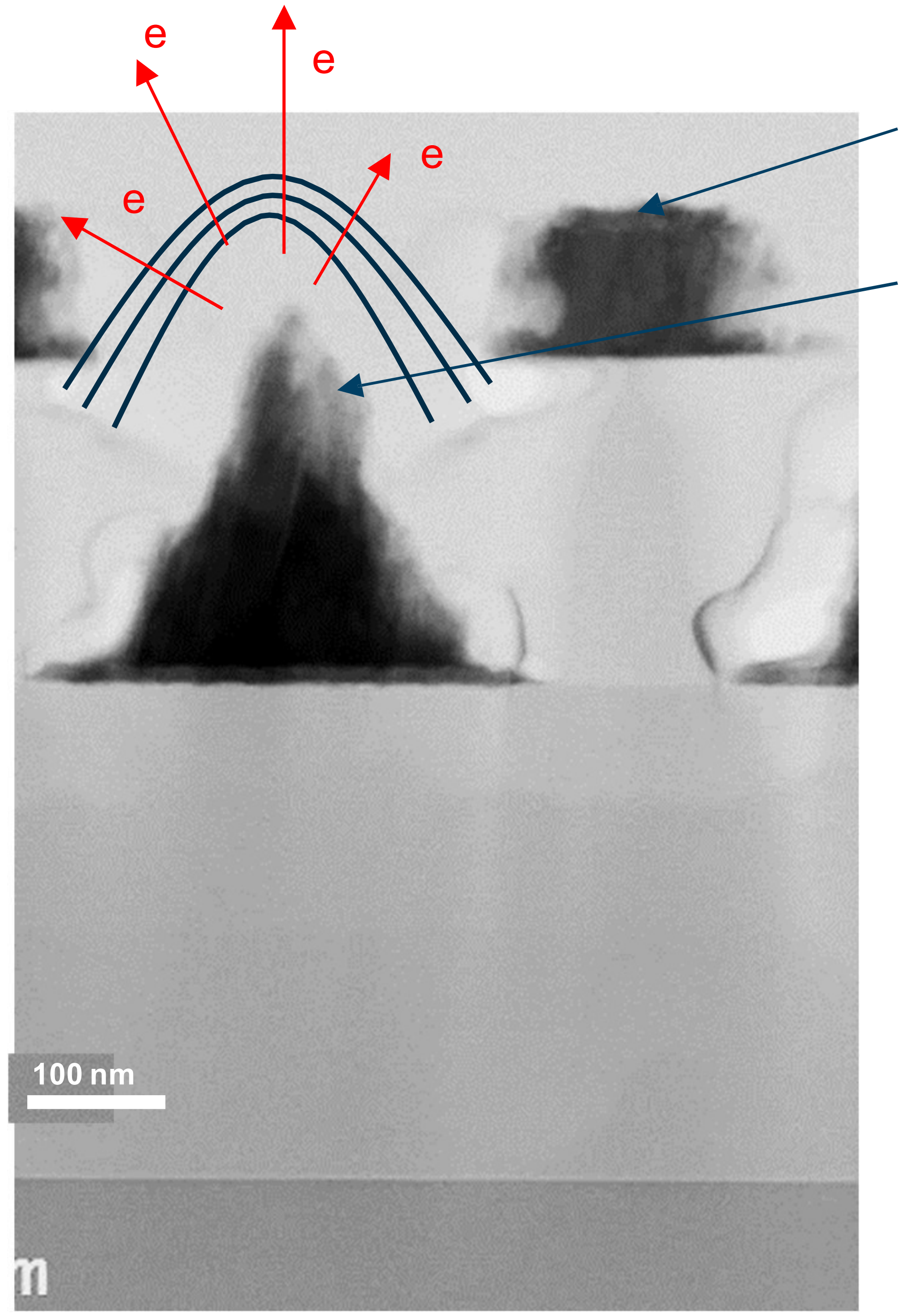






# Nanox Field Emitter Array





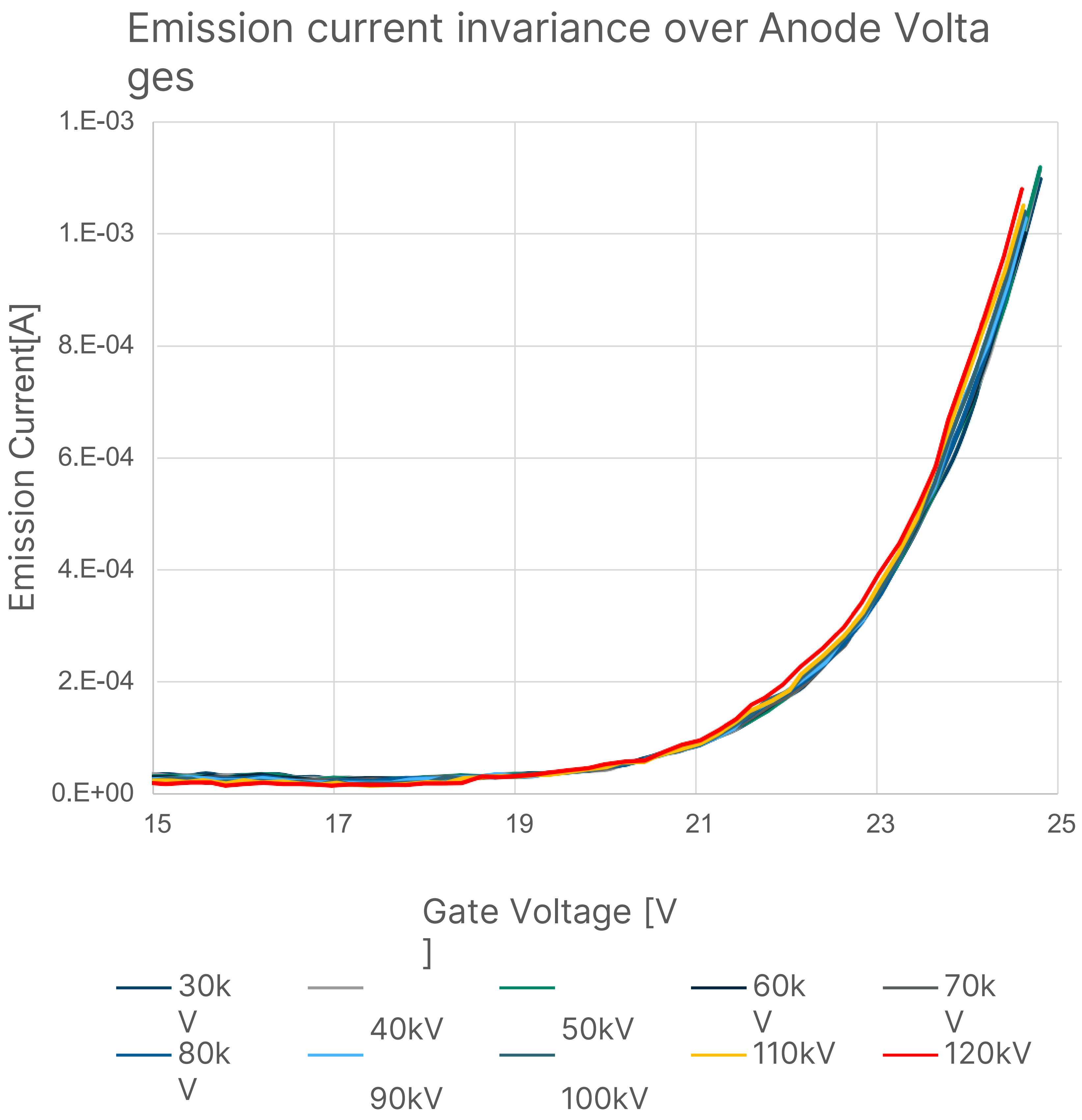

Gate: 0-40V, 30V typical

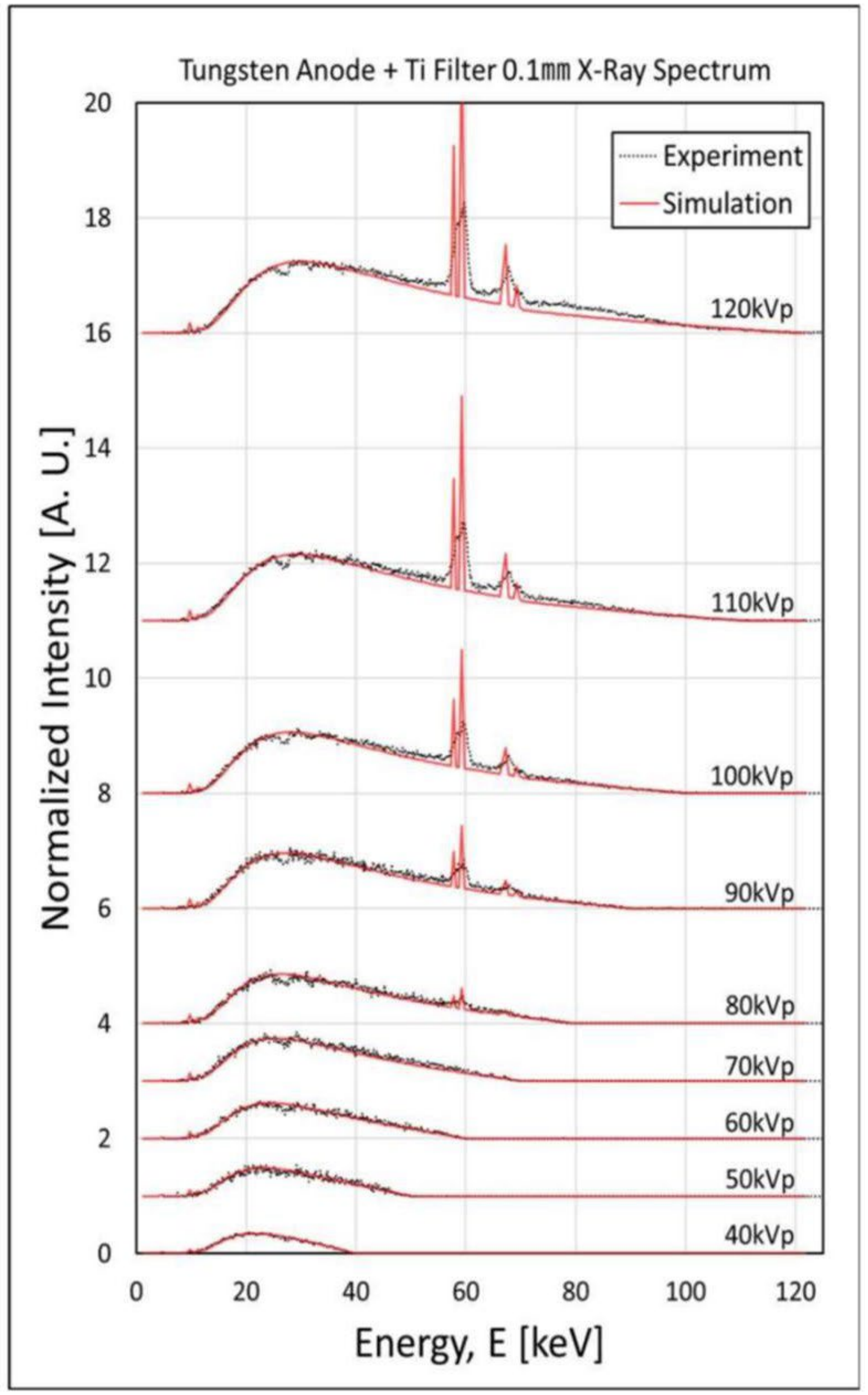
Spindt cathode: 0 V

$$|E| = \frac{V}{d}$$

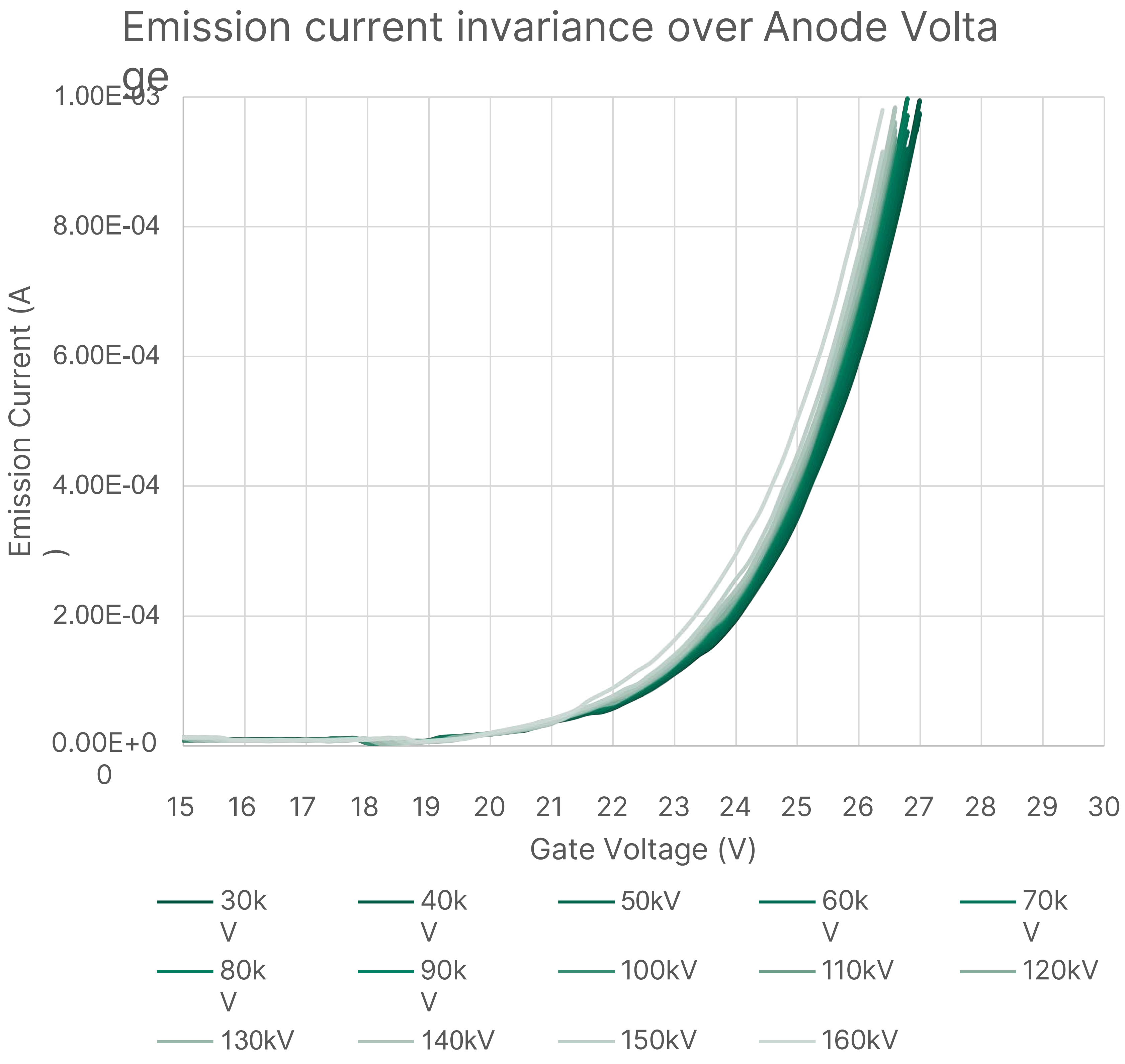
$E > 30V/100nm = 3x10^8 V/m$

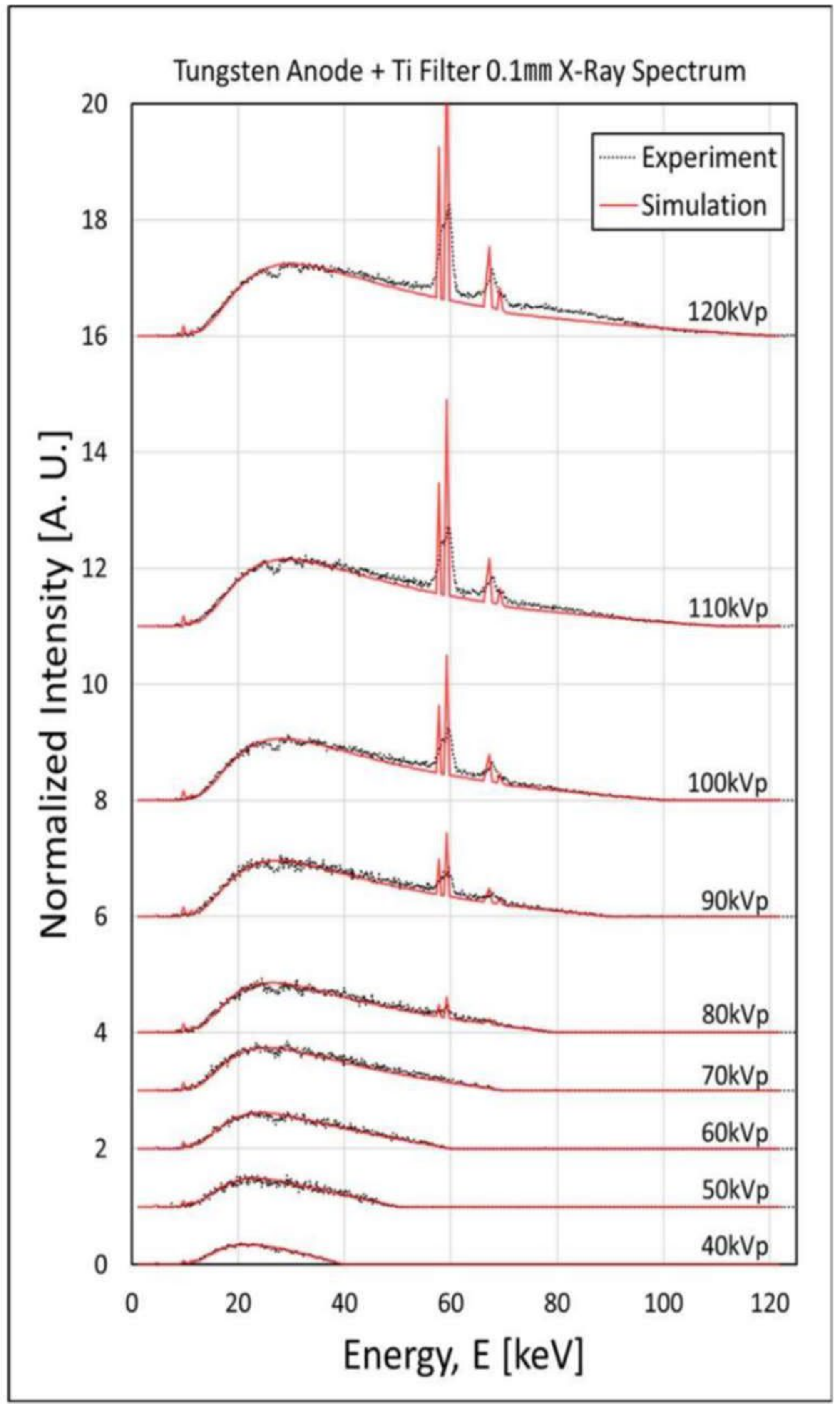
# Emission Current Invariance and Spectral Scan Capability of Nano-X tube within specification(40-120KV)



# Emission Current Invariance and Spectral Scan Capability of Randomly selected tubes in R&D line(30-160KV)

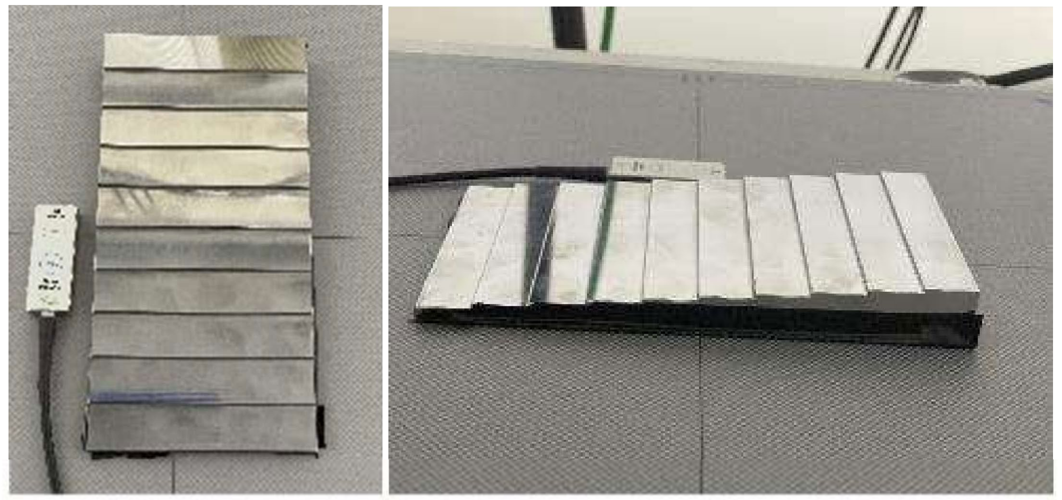


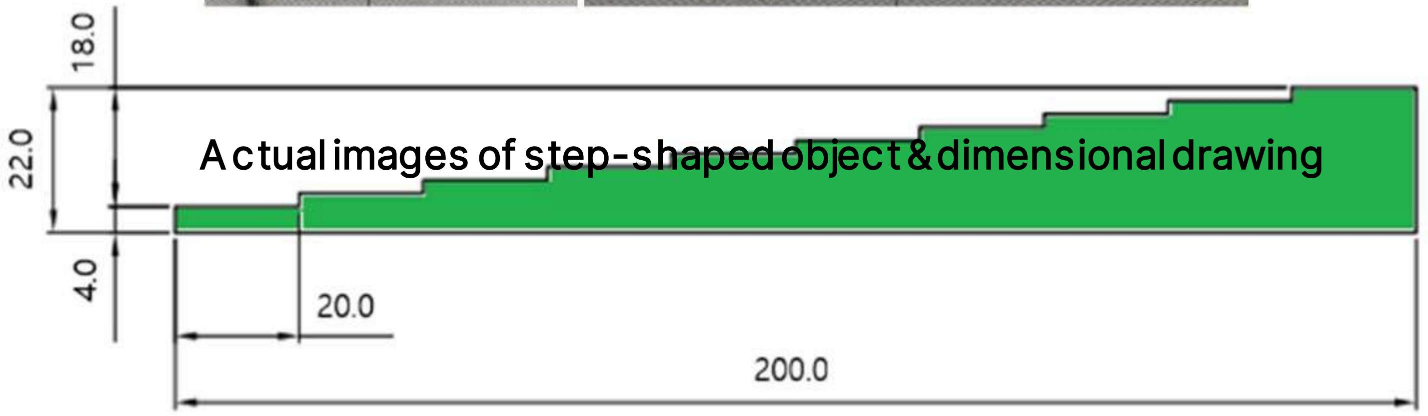



# X-ray images from 60kV to 160kV by Nanox Tube*

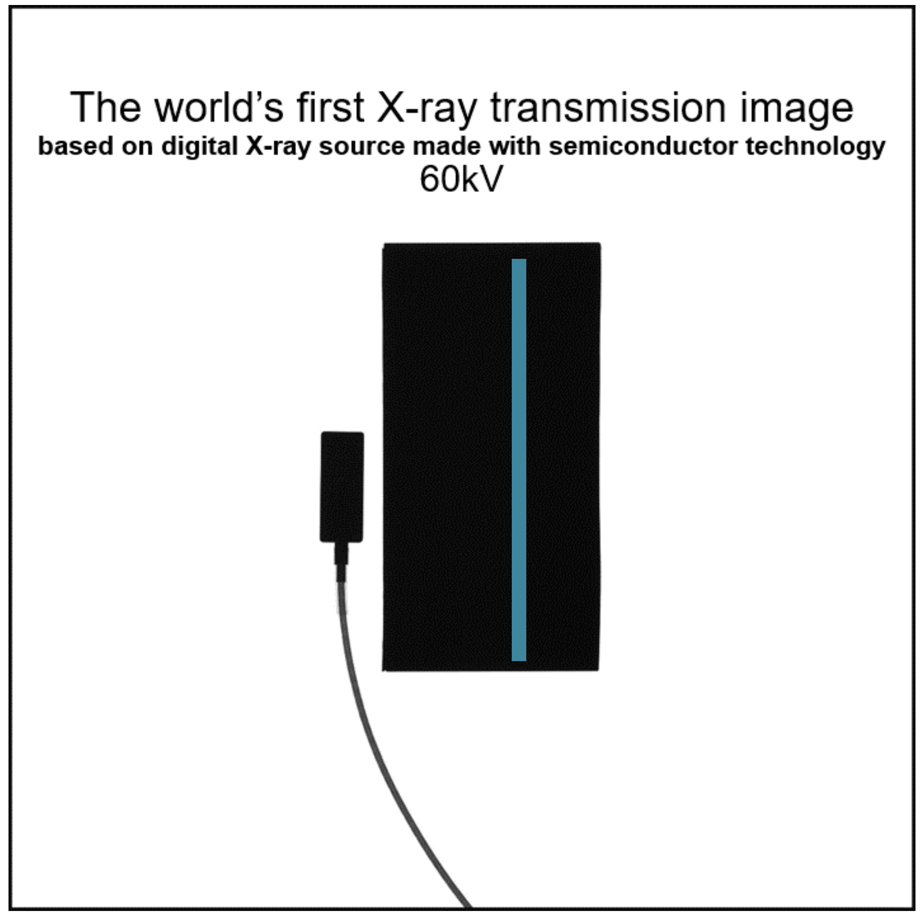
Steel step-phantom with the step thickness from 4mm to 22mm (10 steps). 11 shots of this phantom with chromatic scan 60kV-160kV with incremental 10kV each step

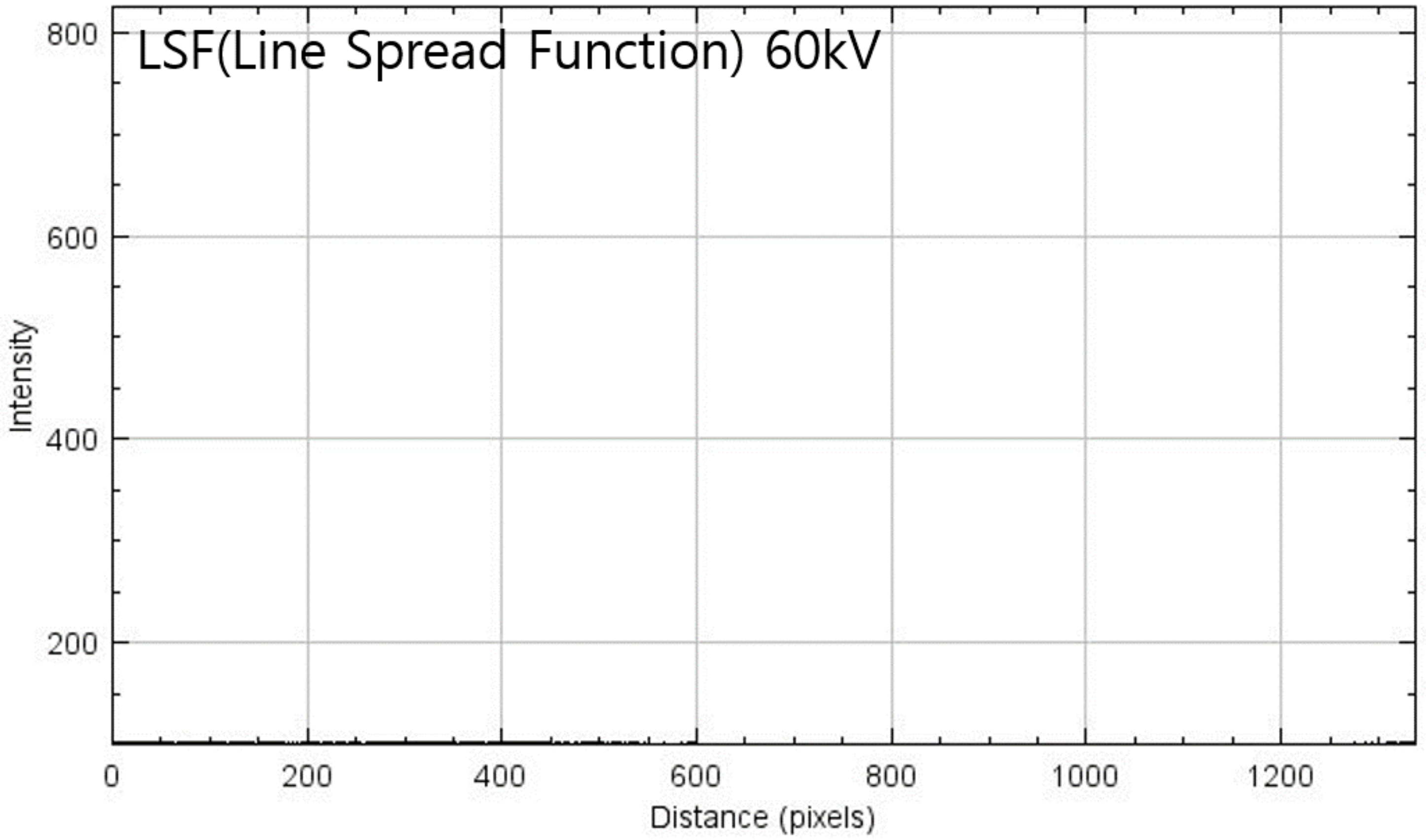
It is believed the world first transmission image based on Digital X-ray source made with semiconductor technology.





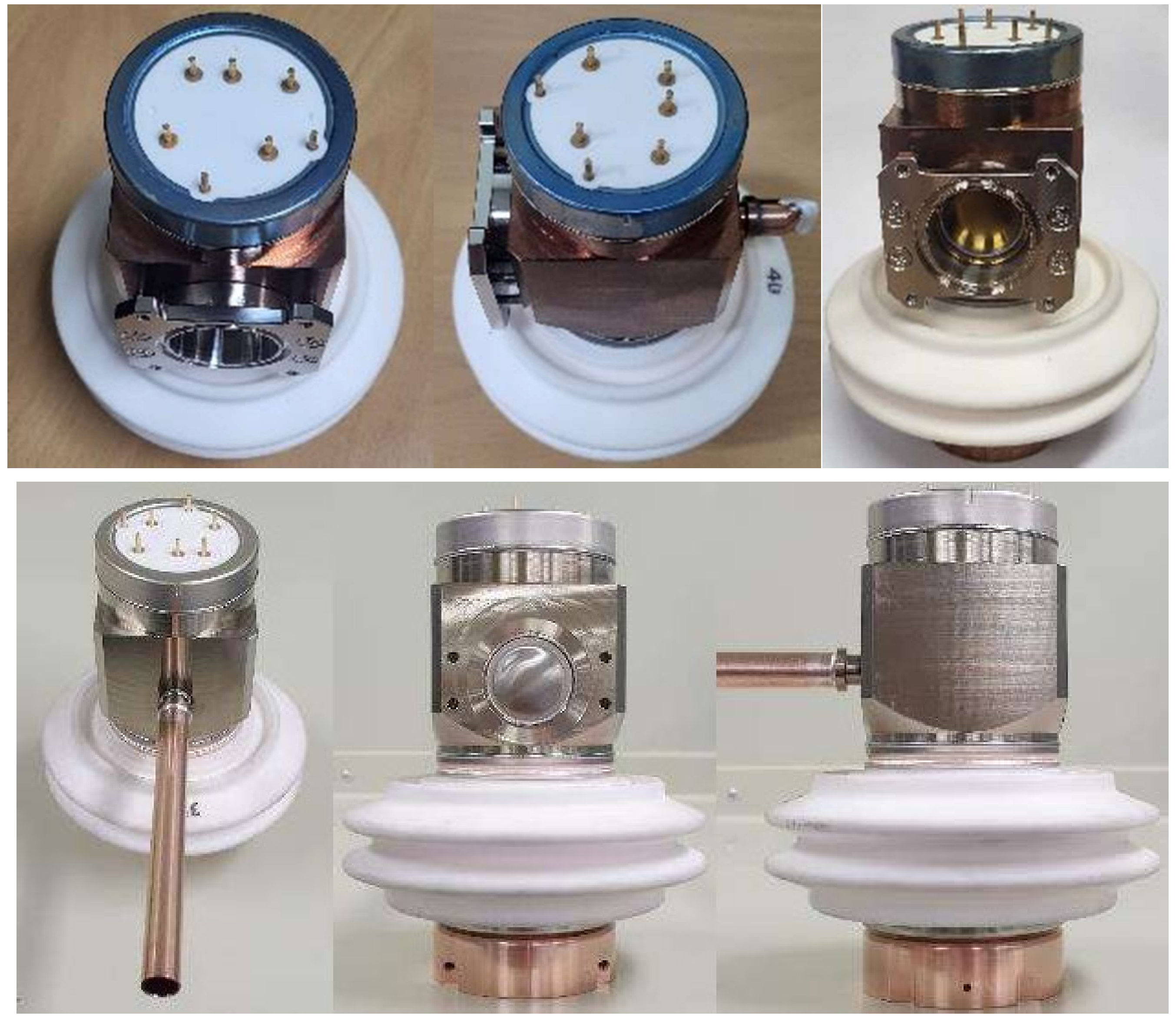

Actual images of step-shaped object & dimensional drawing




* under lab conditions

# Nanox Tube



Real images of Nanox-tu
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Anti-electrostatic coveri
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# Thank You!

# Technology
# ARC

# The Nanox.ARC workflow & demo

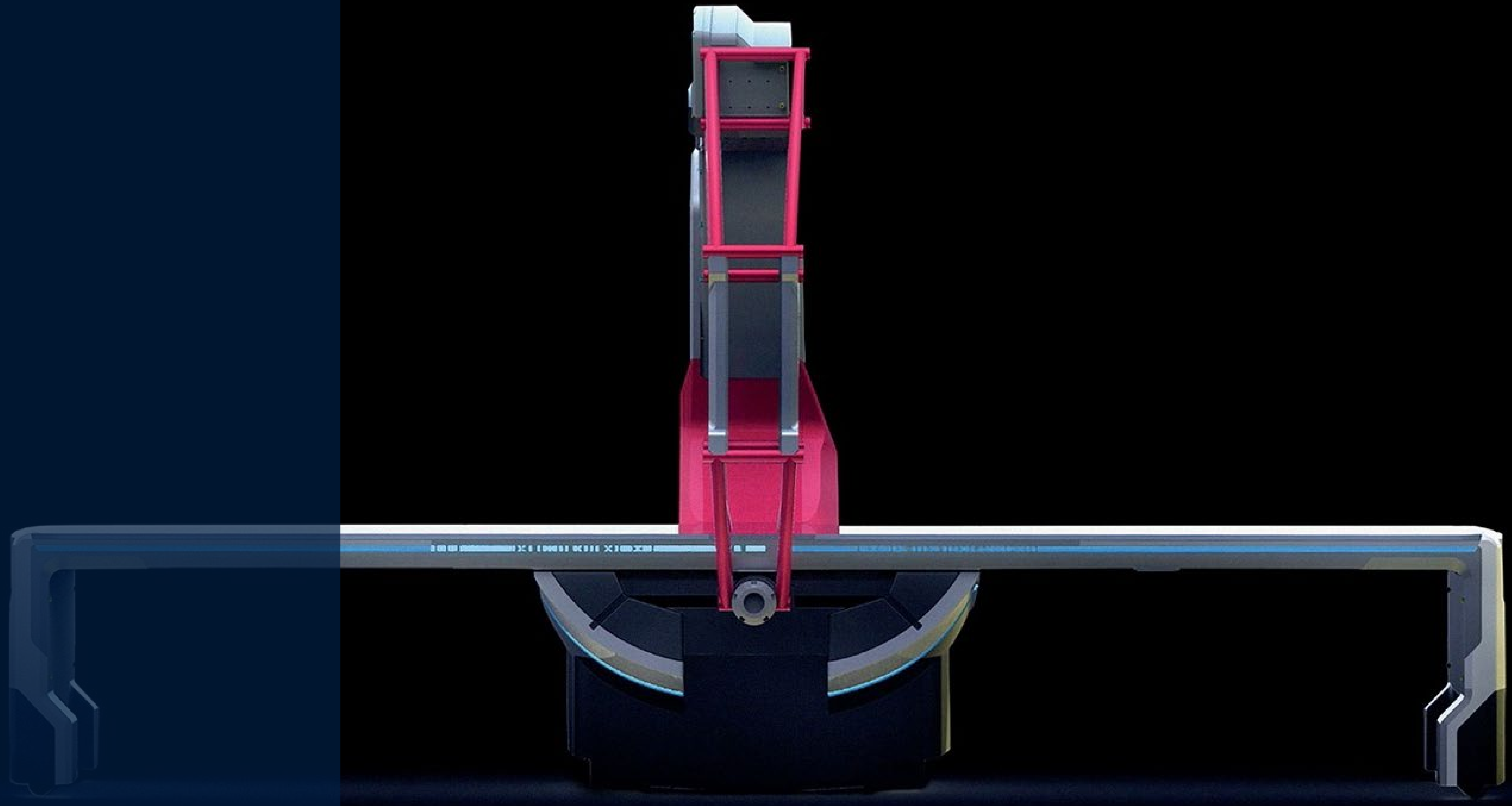
Ofir Koren

General Manager, ARC Division

Device pending US FDA 510k clearance

# The ARC 3D digital Multi Source

- Digital tomosynthesis
- Multi-source
- Small footprint
- Cost is substantially lower than existing market alternative
- Enables simple architecture
- Stationary sources
- Energy-efficient duty-cycle
- Connect to Nanox.Cloud

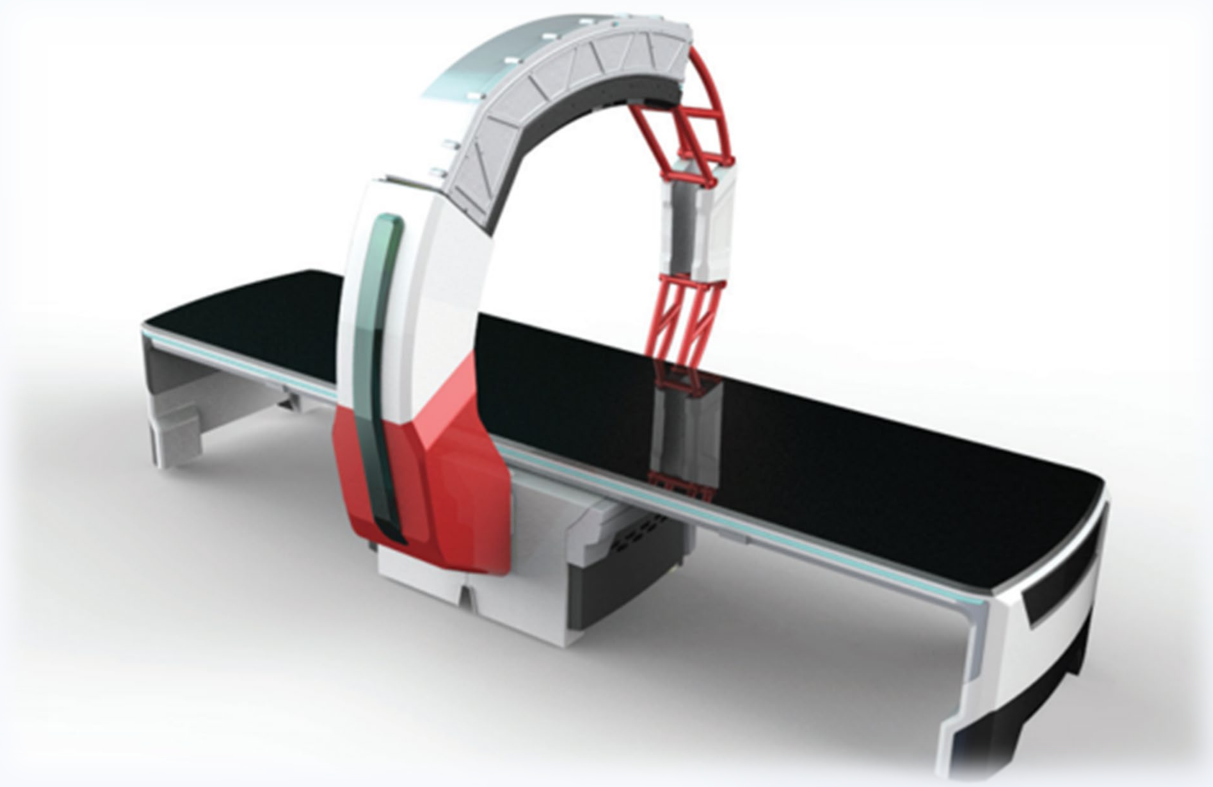


# Technical Overview

# So how we scan?

Nanox.ARC can use up to 5 tubes:

- Each tube is activated **separately** and **sequentially**
- The total radiation dose is contributed to by the sum of projections (each projection done by a single tube)
- Pre-defined protocols define the number, sequence, angle, and energy of the tubes
- User (radiographer) selects a protocol
- All scanned data is uploaded to the Nanox.Cloud and then to Marketplace, AI, Teleradiology



| Name | kV | mAs | Start Theta | End Theta | N of projections | Tubes |
|---|---|---|---|---|---|---|
| Pelvis_1T | 80 | 0.62 | 12 | -12 | 30 | 3 |
| Skull_1T | 85 | 0.66 | 12 | -12 | 30 | 3 |
| Hand_1T | 50 | 0.29 | 12 | -12 | 30 | 3 |
| Elbow_1T | 60 | 0.4 | 12 | -12 | 30 | 3 |
| Knee_1T | 65 | 0.38 | 12 | -12 | 30 | 3 |
| Abdomen_1T | 80 | 0.8 | 12 | -12 | 30 | 3 |
| Abdomen_5T | 80 | 0.8 | 12 | 12 | 30 | 12345 |
| Chest_5T | 110 | 0.24 | 7.5 | -7.5 | 30 | 12345 |
| Foot_1T | 60 | 0.4 | 12 | 12 | 30 | 3 |
| Shoulder_1T | 65 | 0.5 | 12 | 12 | 30 | 3 |

Protocol example for educational purposes only

# Nanox.ARC Scan process

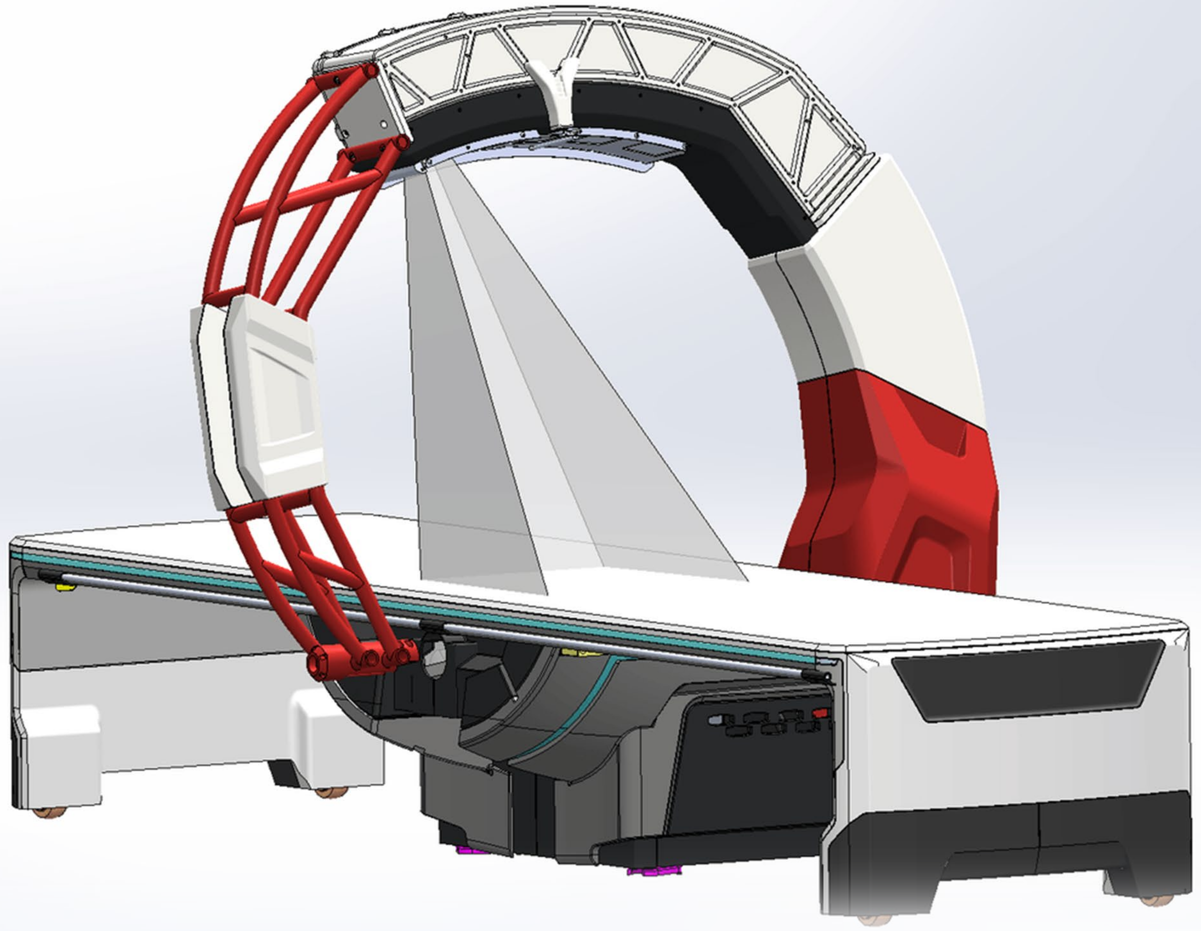
For example, MSK -

Use of a single, central tube only

and

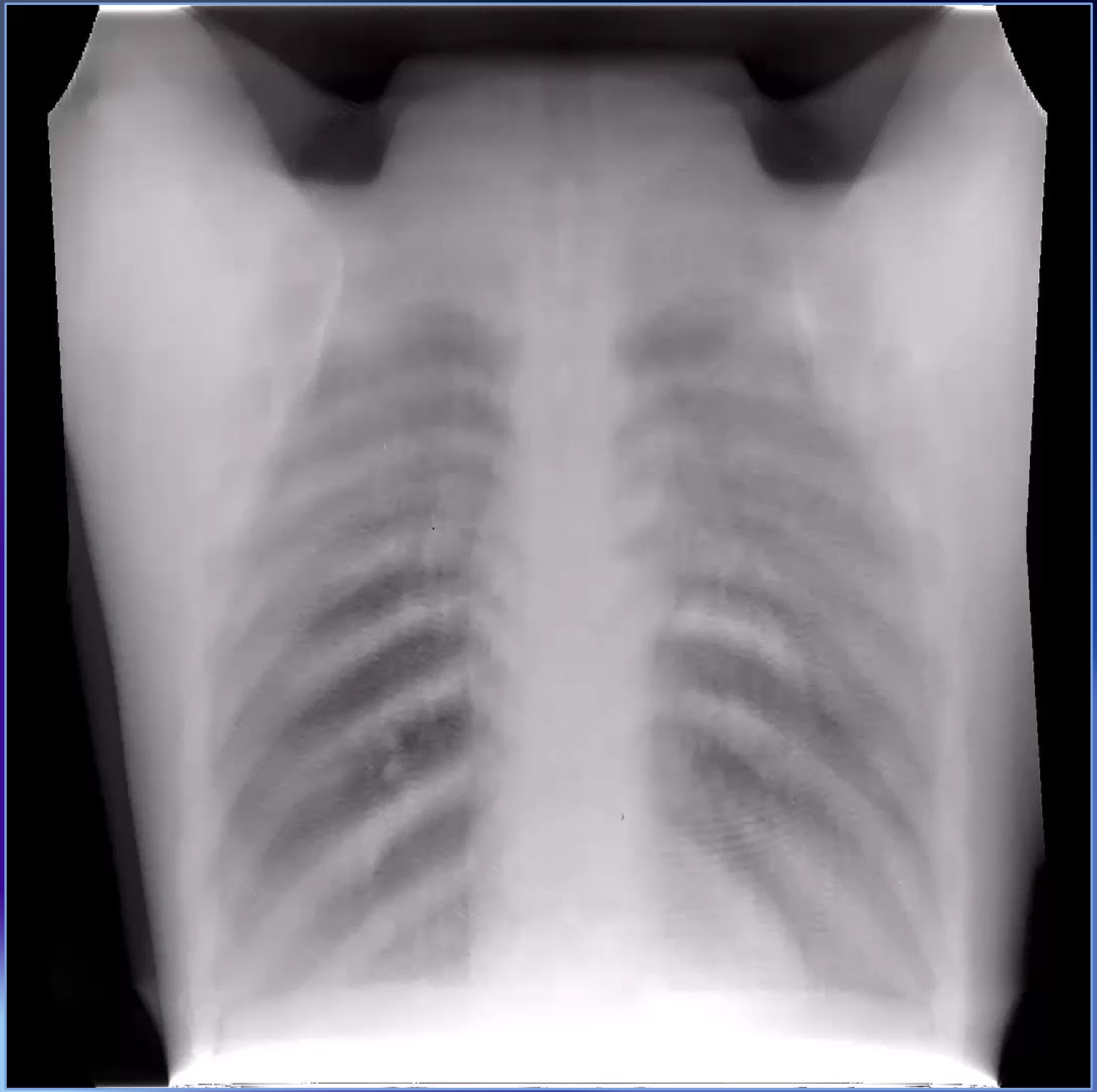
Chest and abdomen -

Use of <up to> 5 tubes



Radiographic image of an anthropomorphic phantom

Tomosynthesis image of an anthropomorphic phantom
Images Produced by Nanox.ARC, 2021



# Tomosynthesis: place in medical imaging

## X-ray

1 – 2 images

Reading time: 110±30 sec

Dose – 0.04-0.1 mSv

## Tomosynthesis

30-60 Images

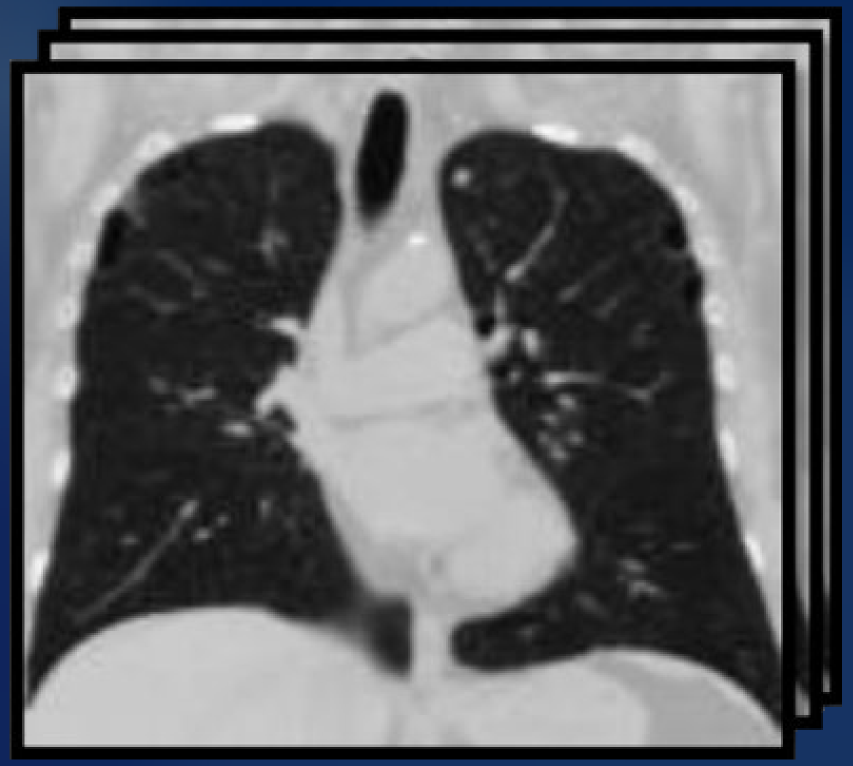
220±40 sec

0.1-0.2 mSv

## CT

Hundreds of images

600±150 sec



CT >2mSv LDCT 1-1.5mSv


## Nanox.ARC

Transmits imaging data to its cloud MSaaS platform

NANOX
MARKET PLACE

## Market Place

A unique solution, built by radiologists, for the imaging industry

NANOX AI

## Robodiologist

Medical AI System Provide Decision Assistive Information

NANOX USA RAD

## Teleradiology

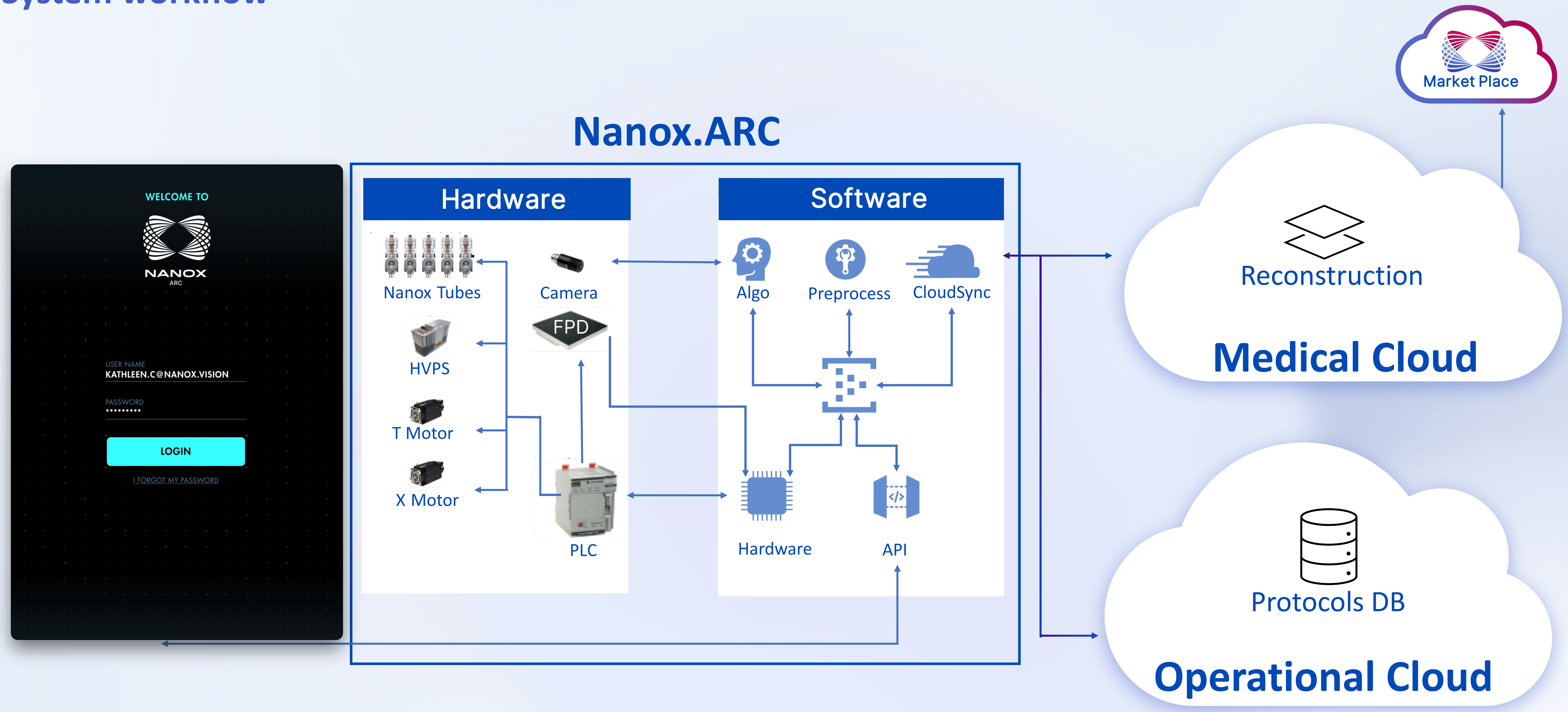
Specialists Provide Timely Online Diagnostics

NANOX AI

## Population Health

AI empowered CT solutions

# System workflow



NANOX

# Thank You!