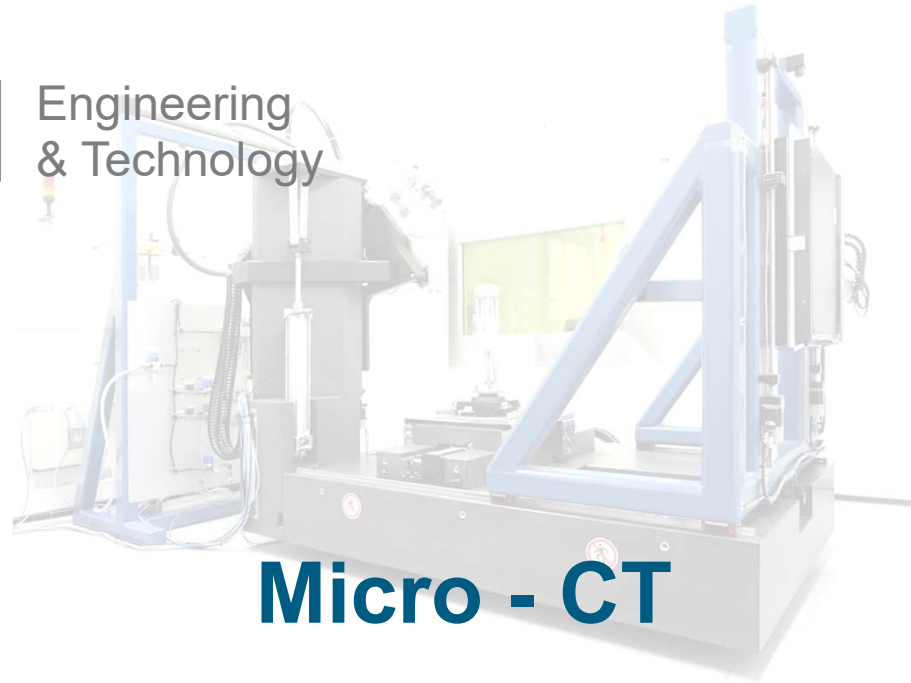


**ZEA-1** | Engineering  
& Technology



**Micro - CT**

## Basics and Applications

FRED PAULY

FORSCHUNGSZENTRUM JÜLICH GMBH

CENTRAL INSTITUTE FOR ENGINEERING, ELECTRONICS AND ANALYTICS (ZEA)

**ENGINEERING UND TECHNOLOGY (ZEA-1)**

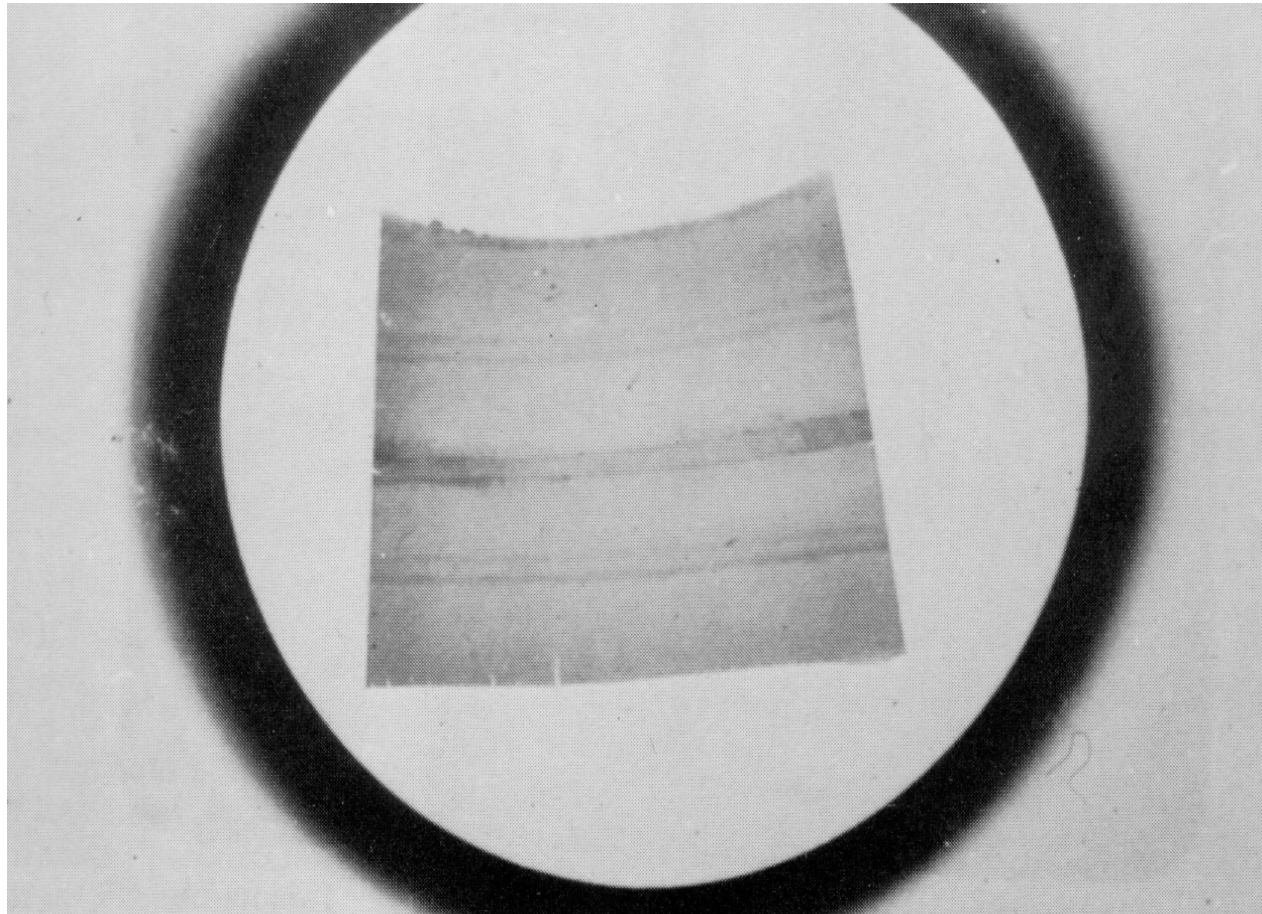
Mitglied der Helmholtz-Gemeinschaft

# **MICRO–CT**

## **BASICS AND APPLICATIONS**

- **History / Basics**
- **Micro- / Nanofocus – X-Ray - Technology**
- **Detectors**
- **Computed Tomography - CT**
- **Examples**
- **Outlook**

# HISTORY



•

•

•

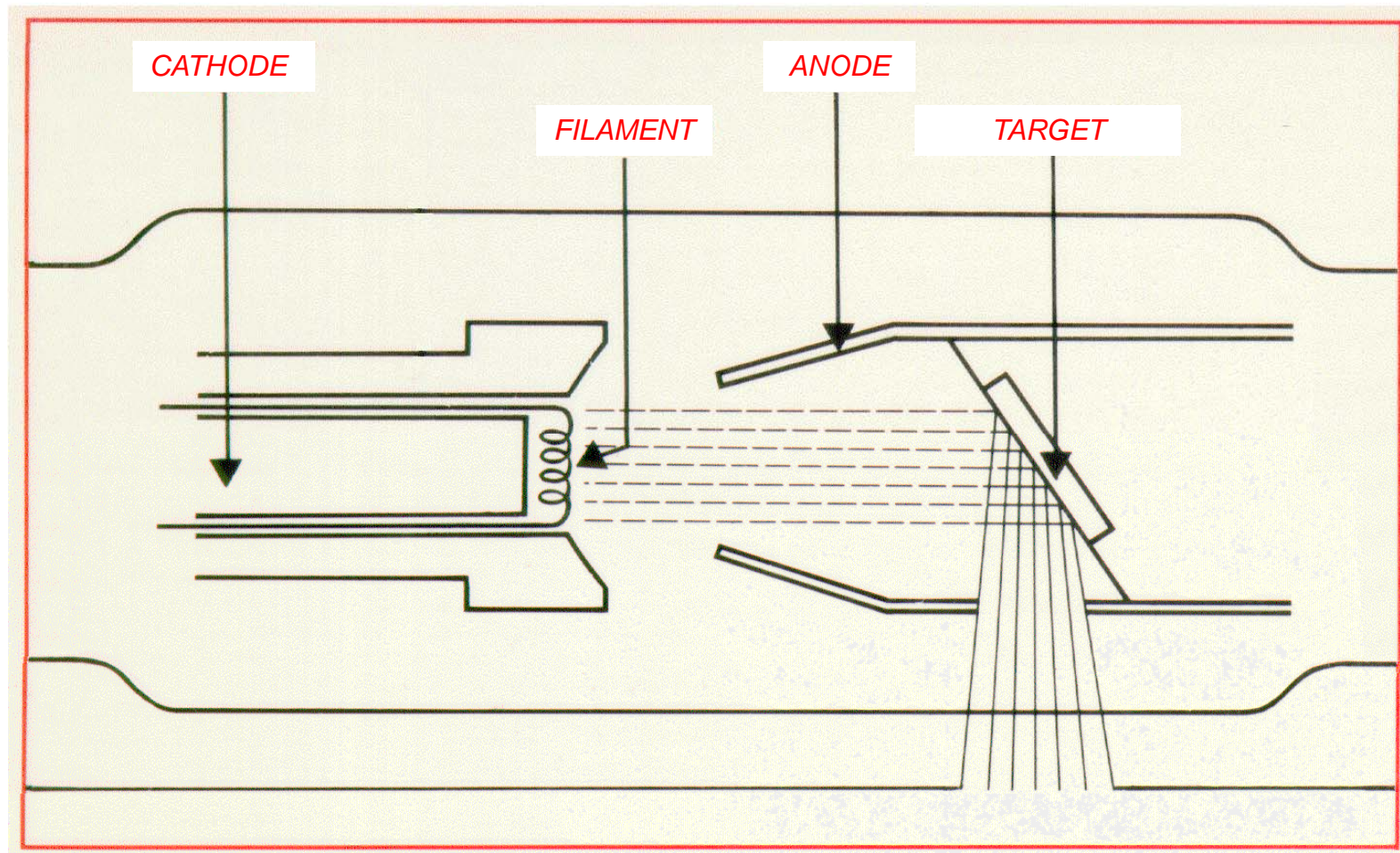
# HISTORY



Mitglied der Helmholtz-Gemeinschaft

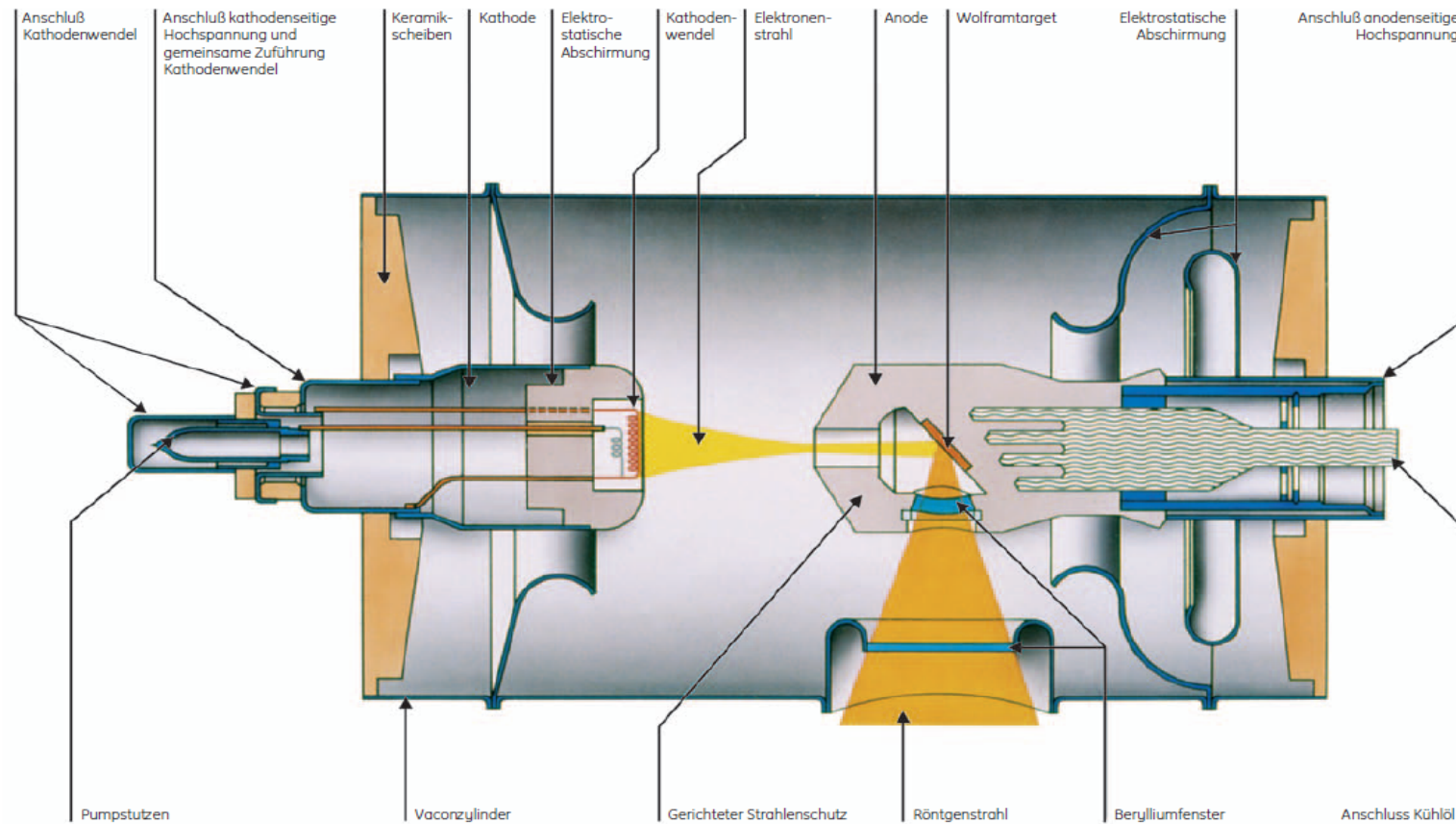


# CONVENTIONAL X-RAY TECHNOLOGY

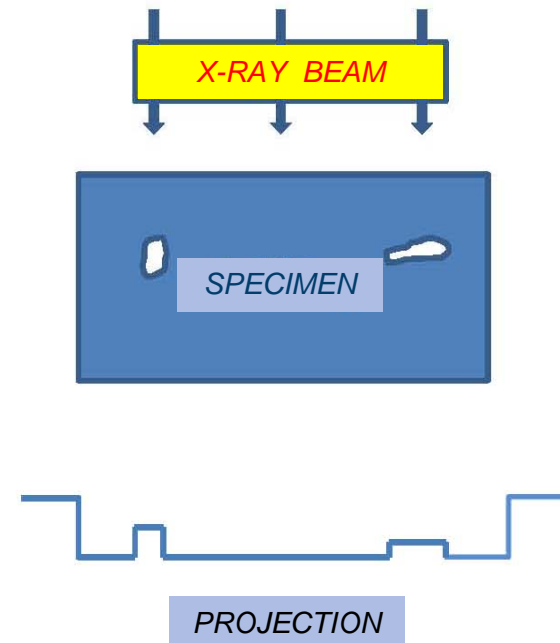
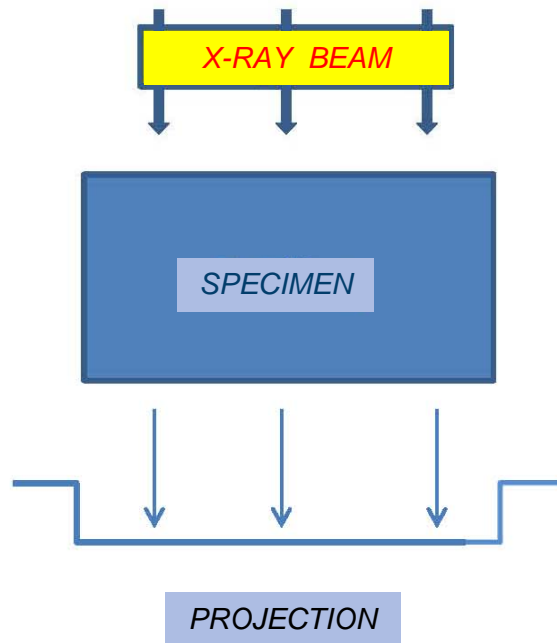


*Schematic representation of conventional X-Ray tube*

# CONVENTIONAL X-RAY TECHNOLOGY



# CONVENTIONAL X-RAY TECHNOLOGY



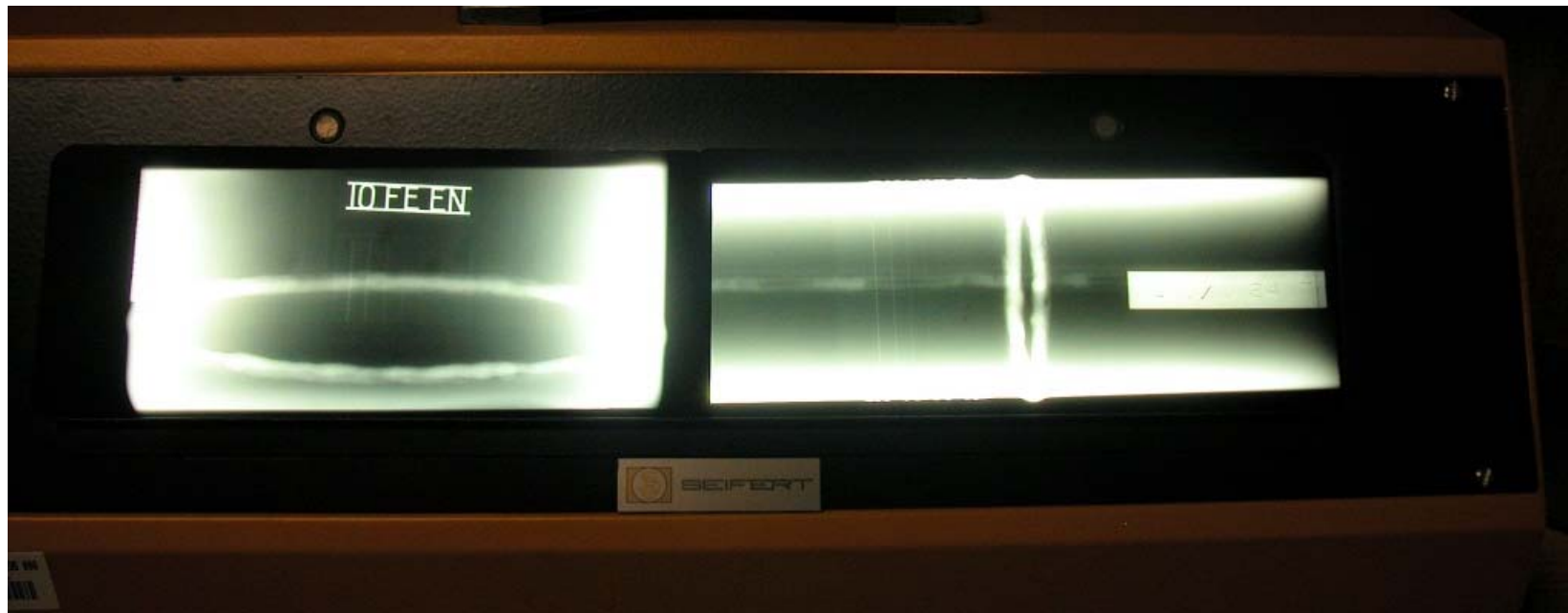


# CONVENTIONAL X-RAY TECHNOLOGY

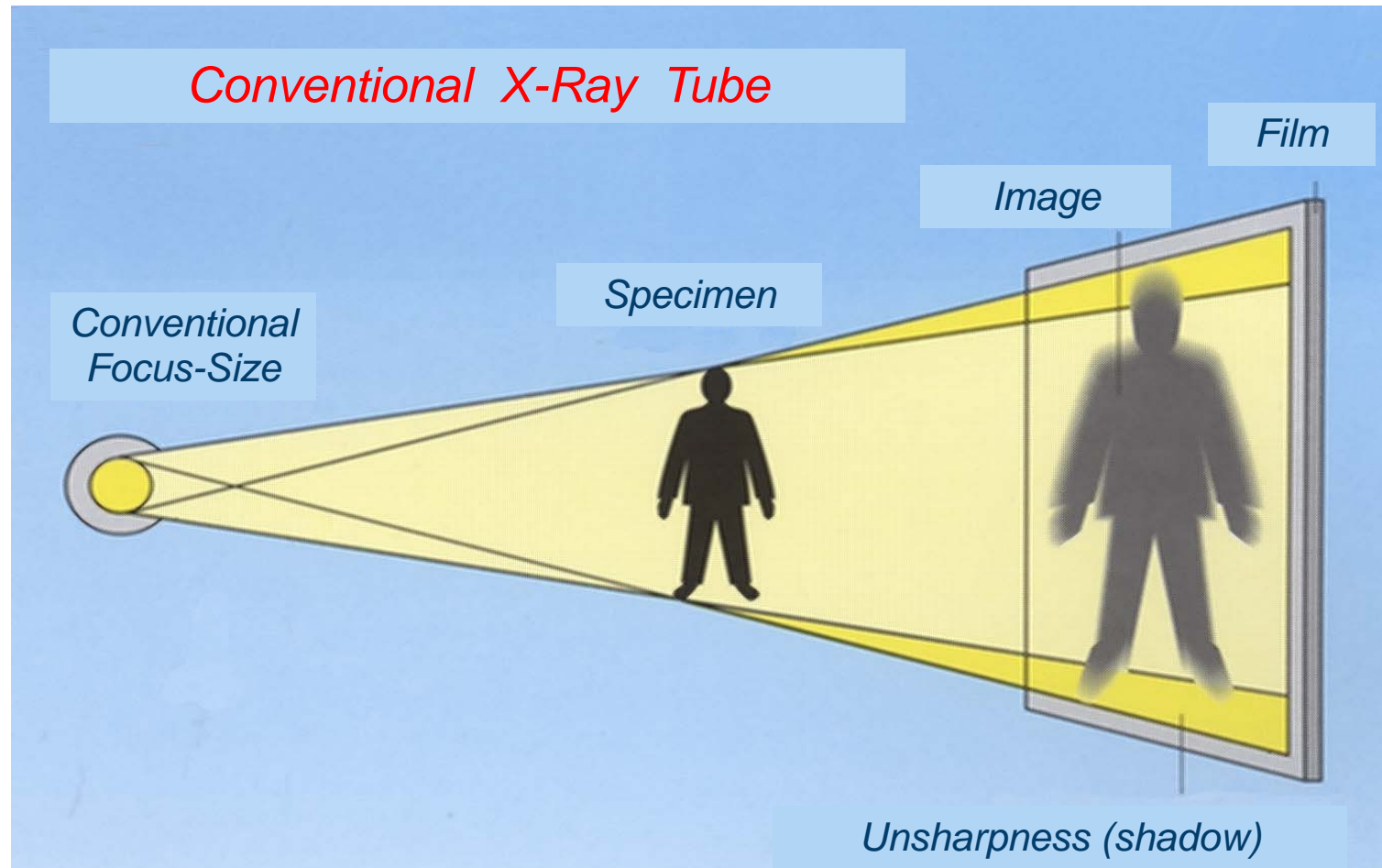




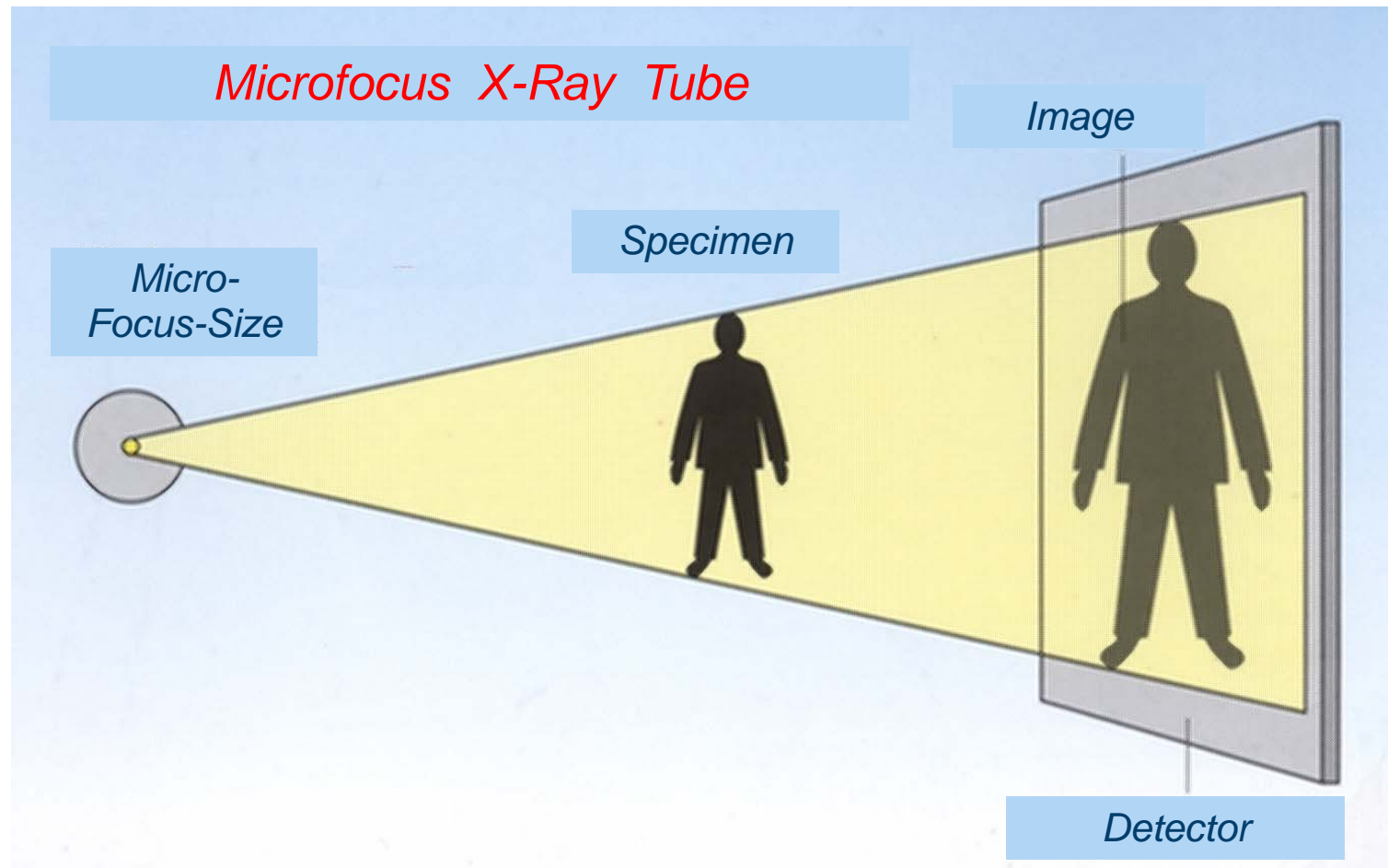
# CONVENTIONAL X-RAY TECHNOLOGY



# CONVENTIONAL X-RAY TECHNOLOGY



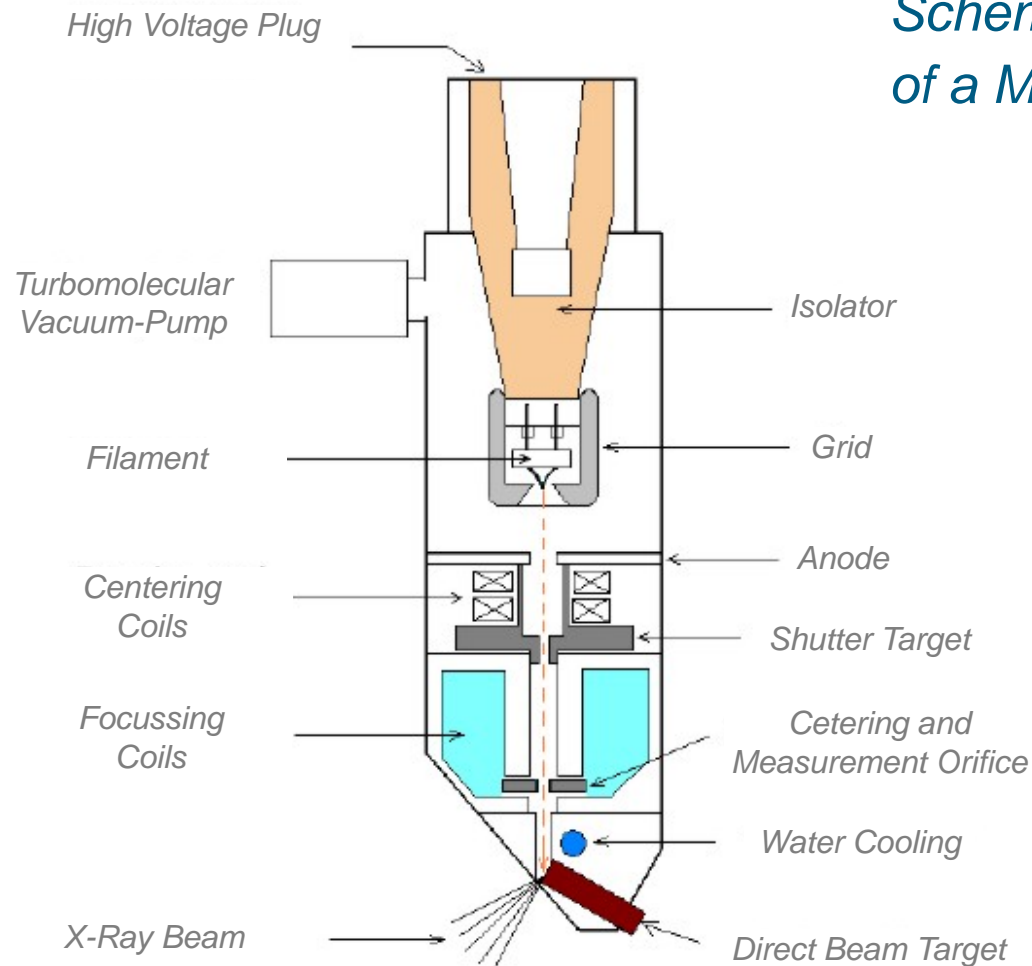
# MICROFOCUS – X-RAY TECHNOLOGY





# MICROFOCUS – X-RAY TECHNOLOGY

*Schematic representation  
of a Microfocus-Ray tube*



# MICROFOCUS – X-RAY TECHNOLOGY



VISCOM XT 9225

DED (Direct-Beam)

225 kV / 3 mA / 320 W

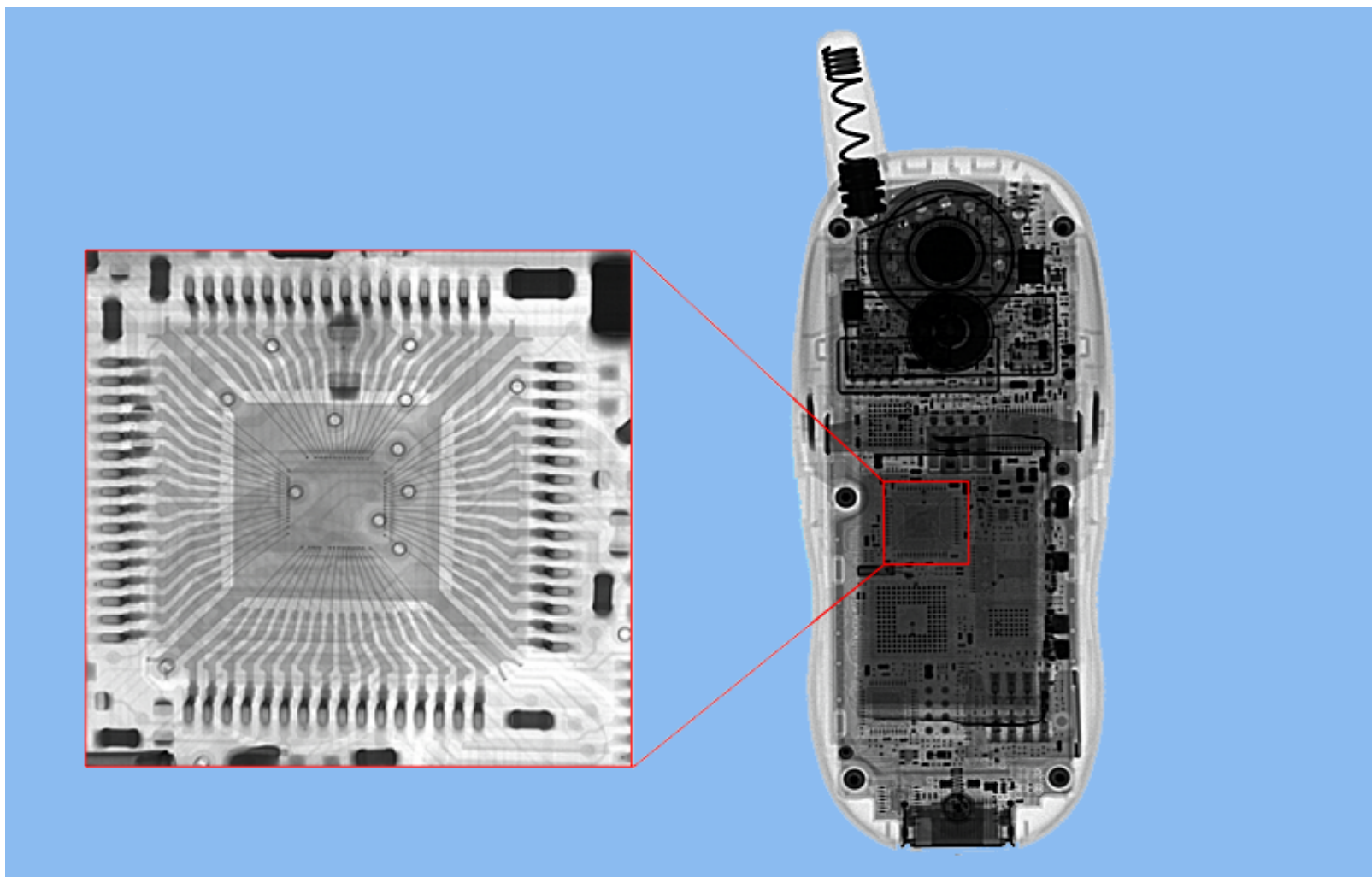
Focus: 2 - 10  $\mu\text{m}$  (Microfocus)

TXD (Transmission-Beam)

160 kV / 1 mA / 40 W

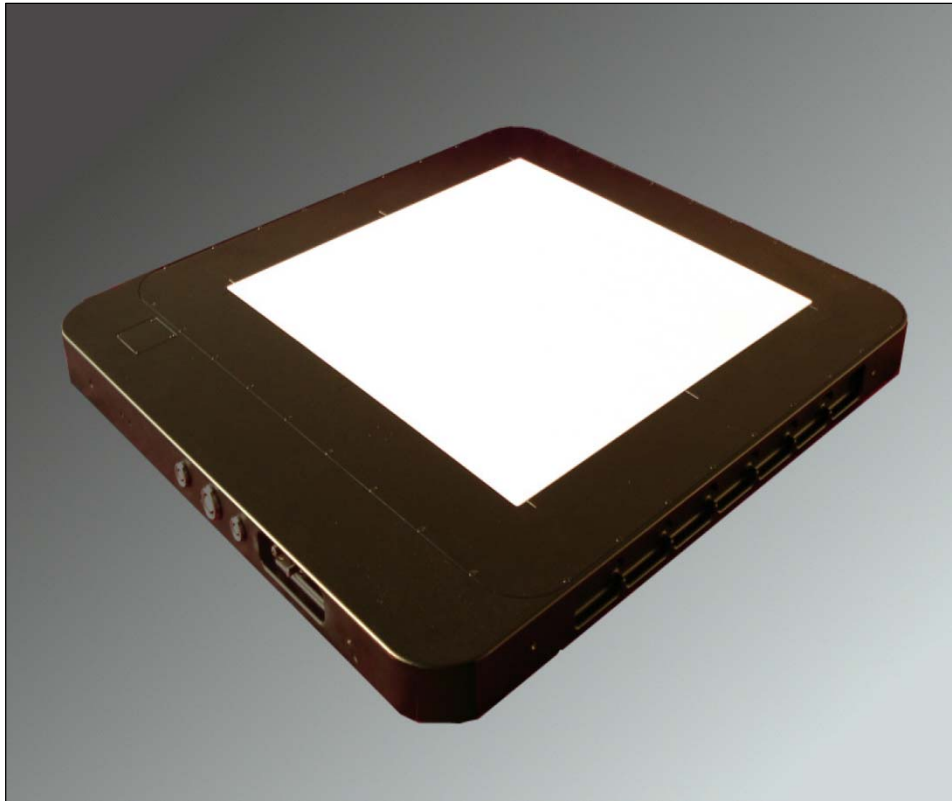
Focus: < 900 nm (Nanofocus)

# MICROFOCUS – X-RAY TECHNOLOGY



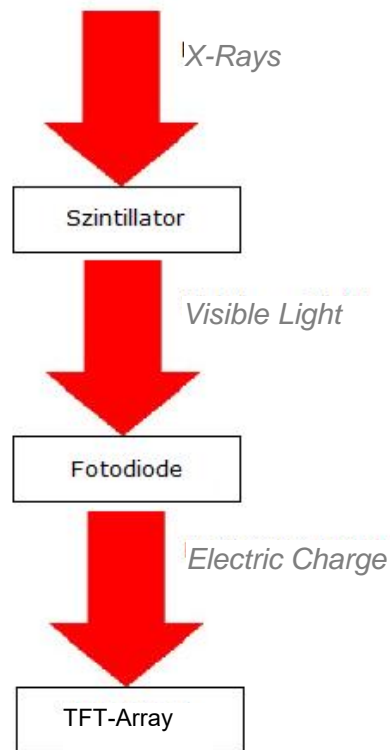


# DETECTORS



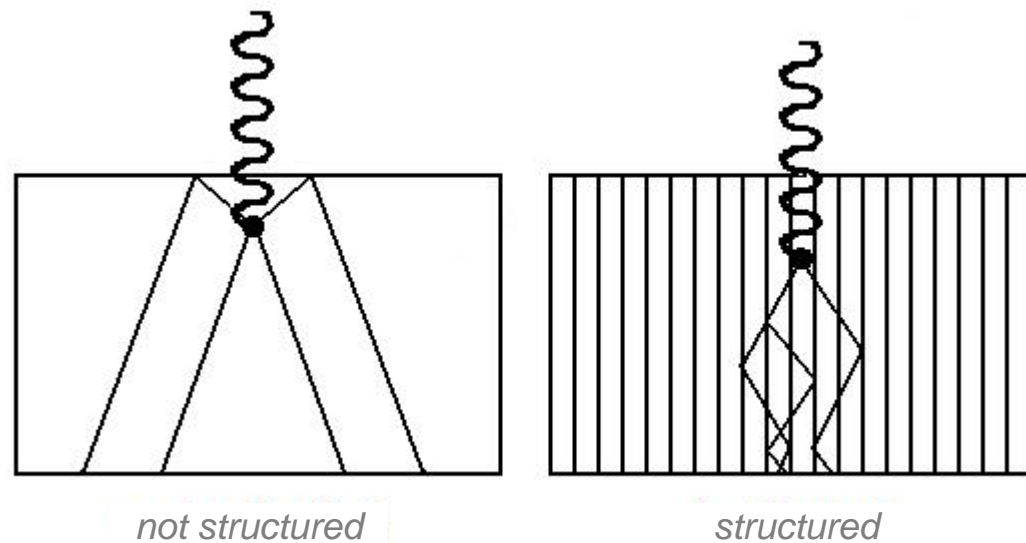
# DETECTORS

## Principle of operation of Flat Panel Detektors

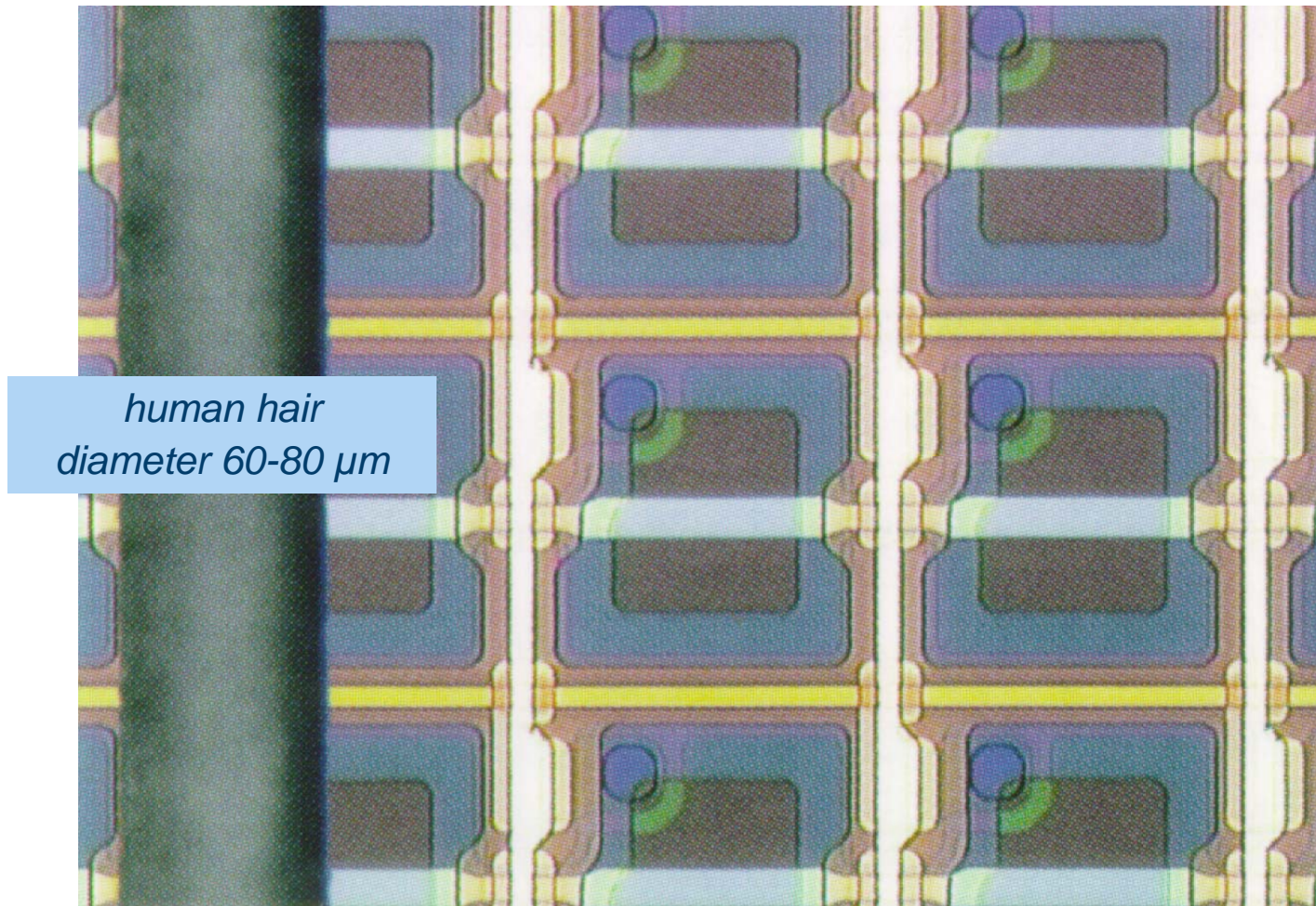


Source: Wikipedia

*Schematic representation of  
structured Szintillators  
for reduction of scattering*



# DETECTORS



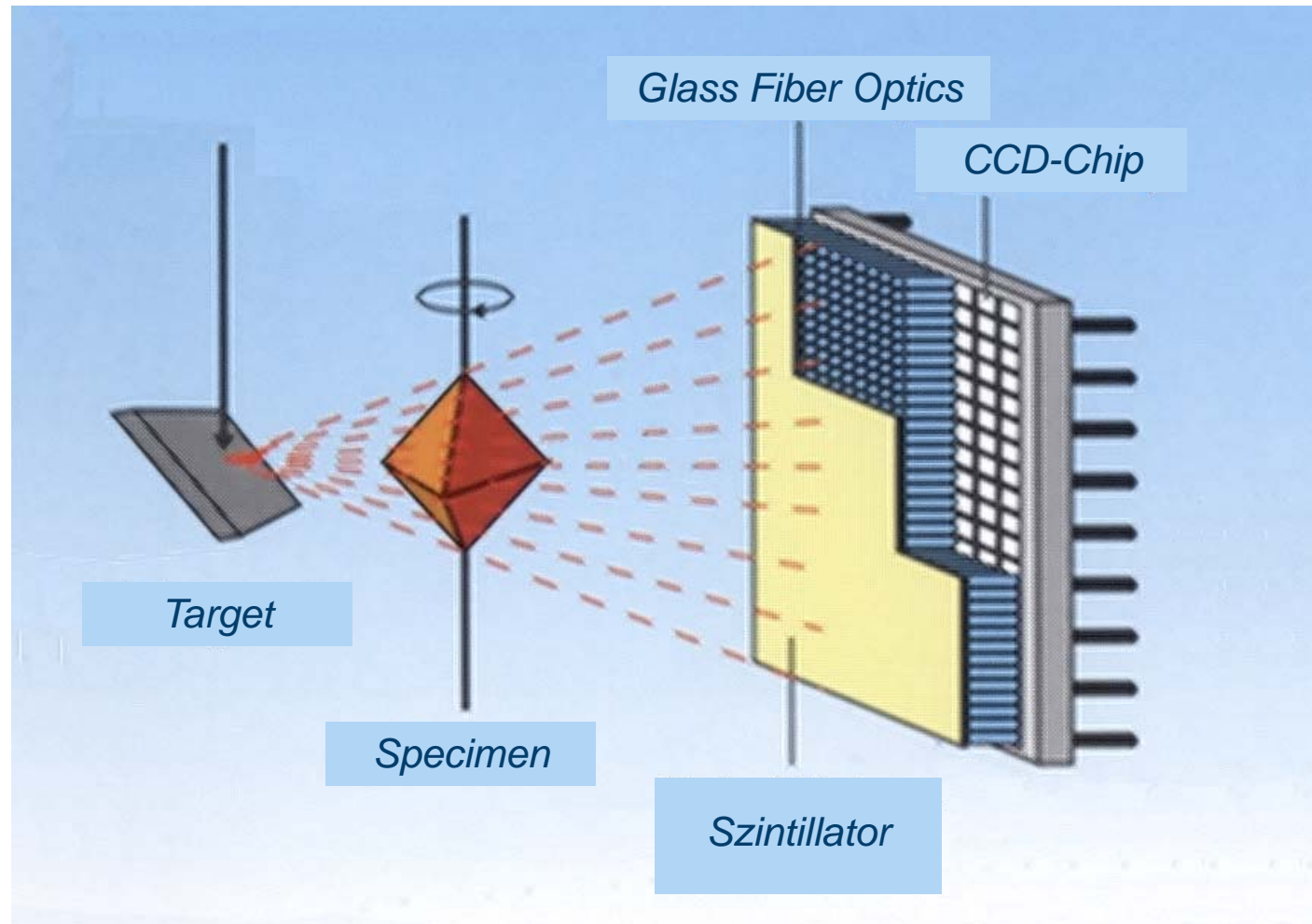


# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)

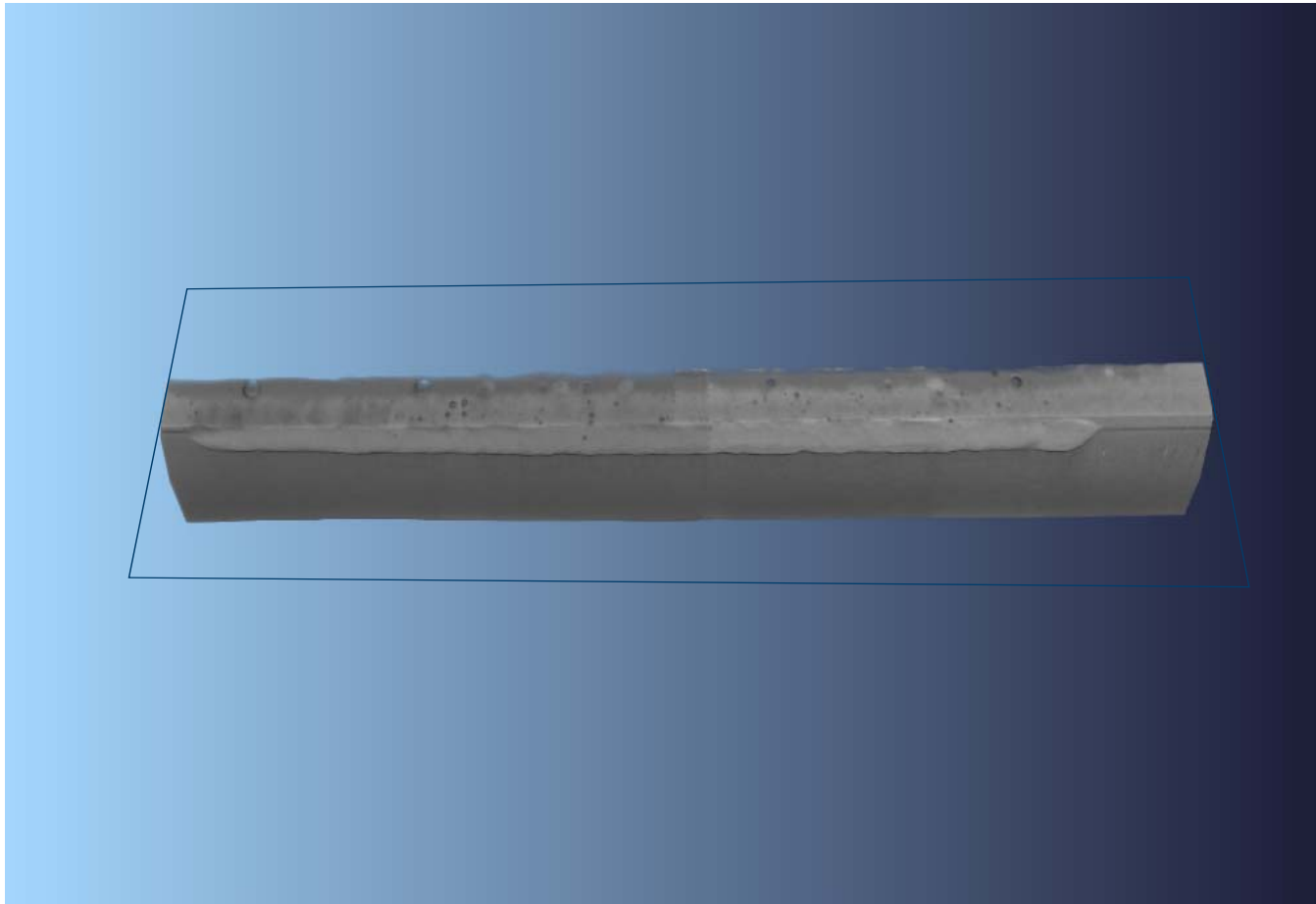


Mitglied der Helmholtz-Gemeinschaft

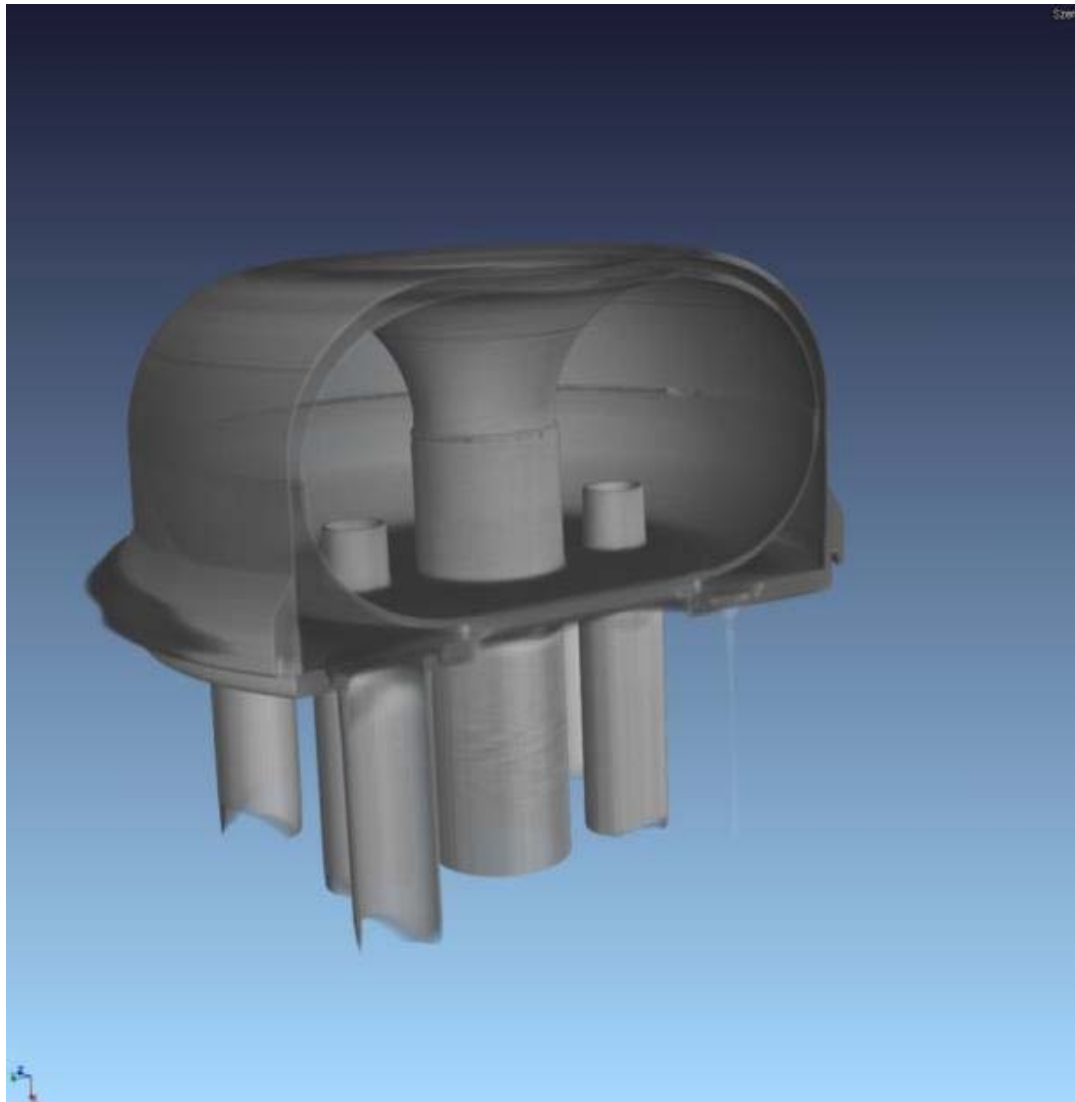
# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)



# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)



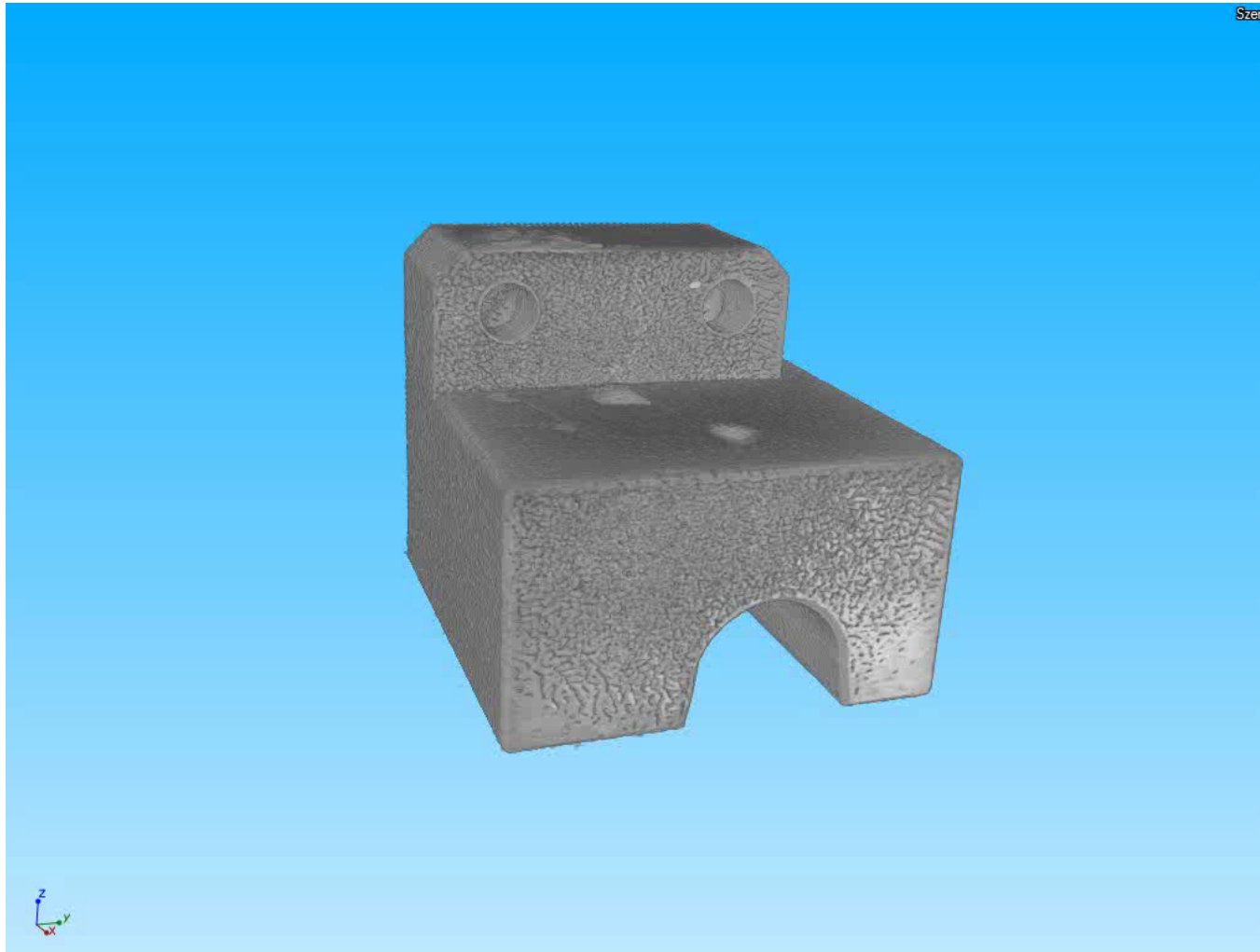
# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)



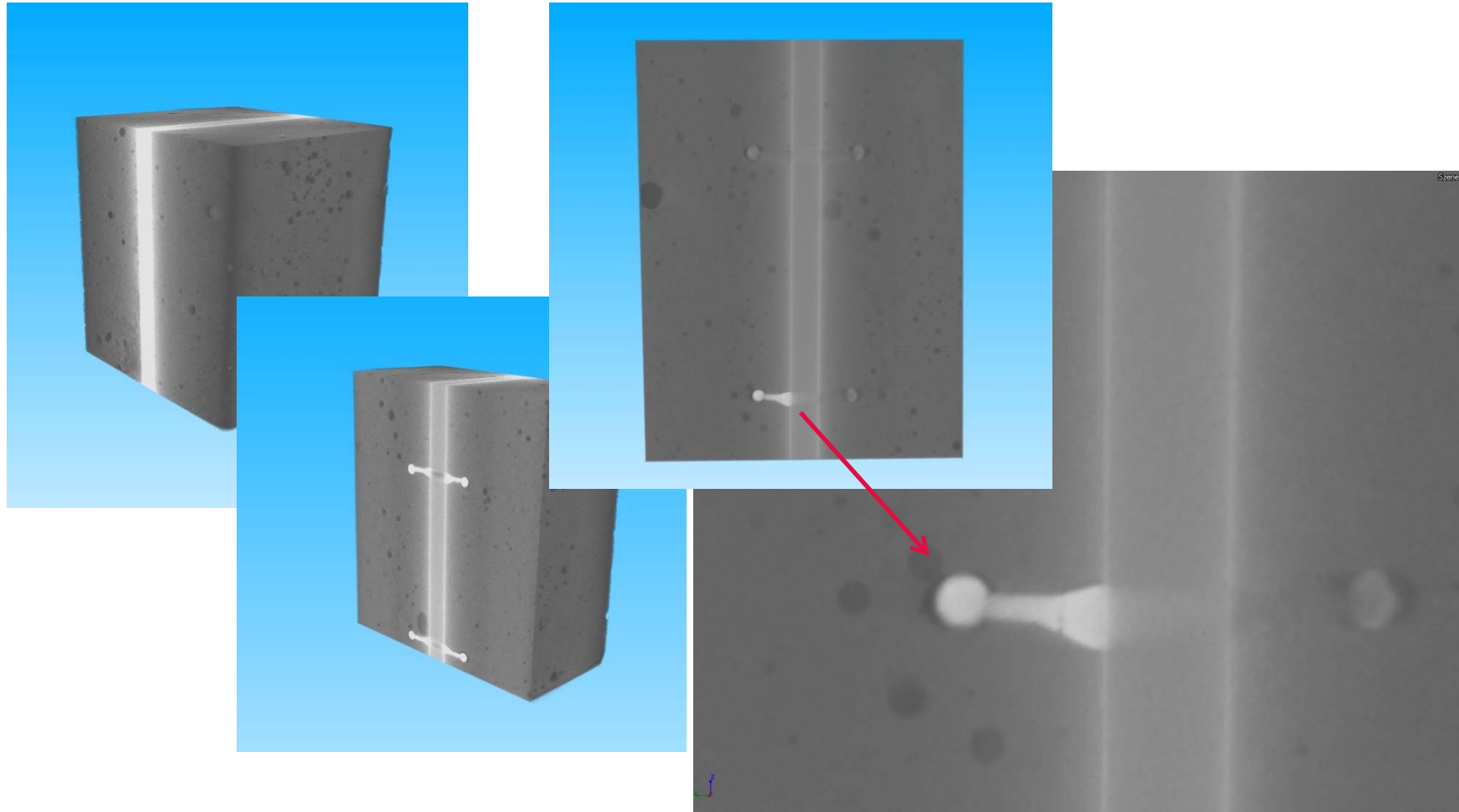
Mitglied der Helmholtz-Gemeinschaft



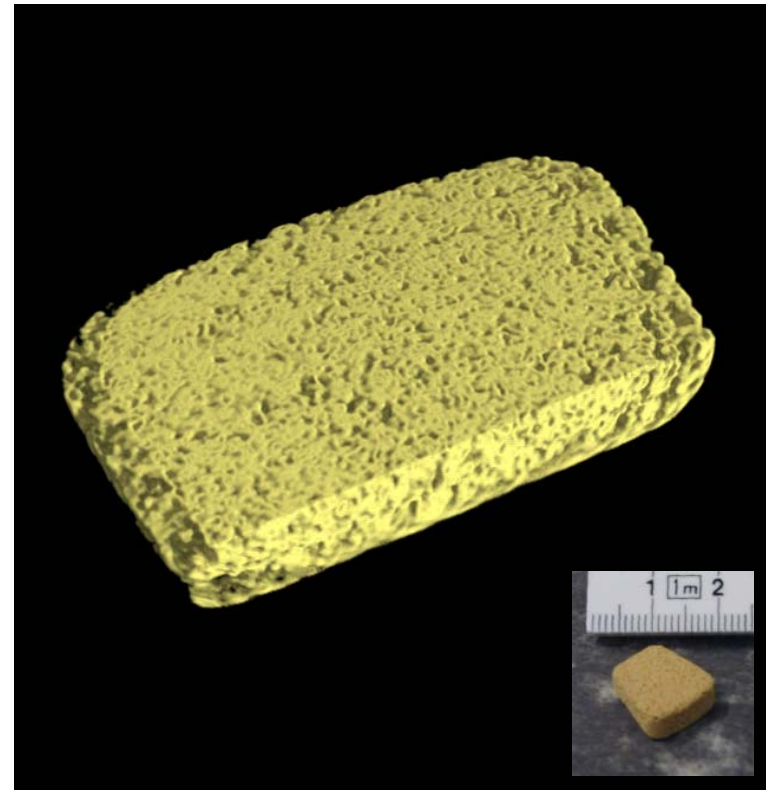
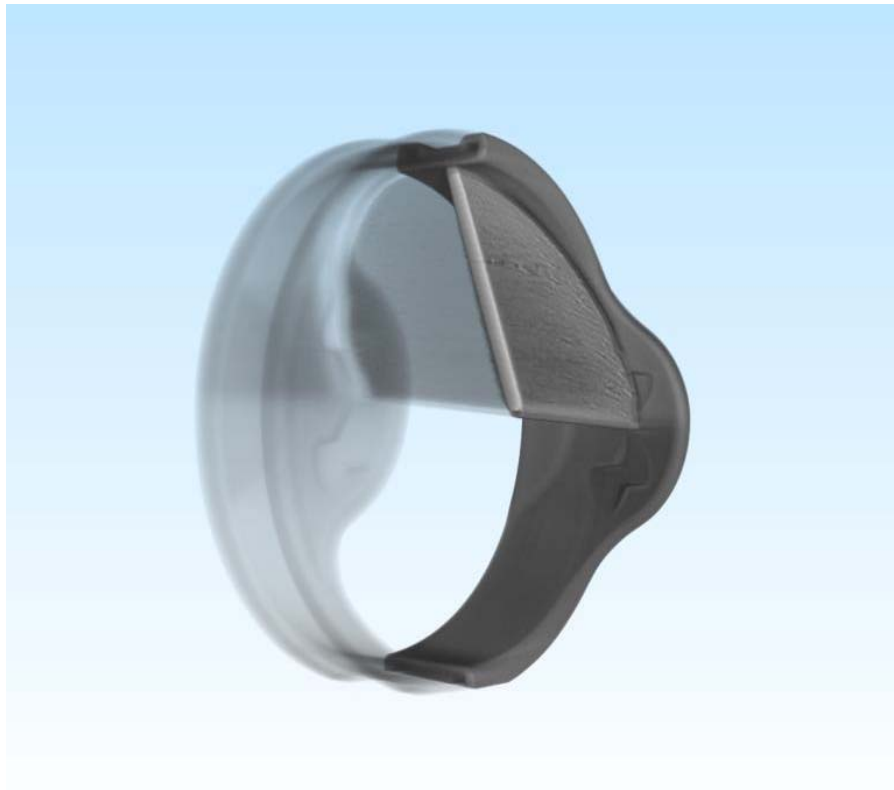
# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)



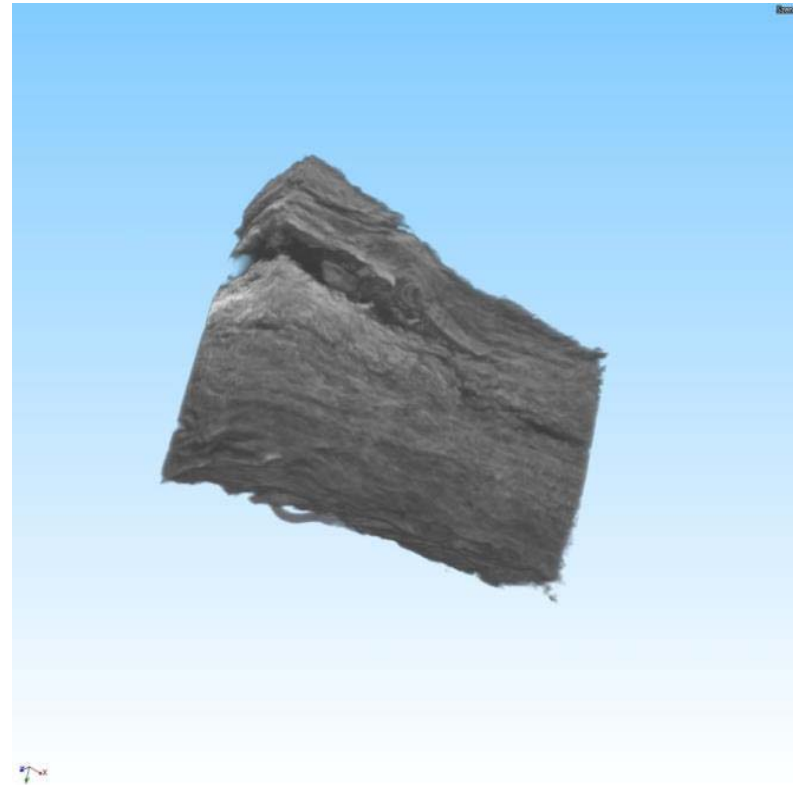
# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)



# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)

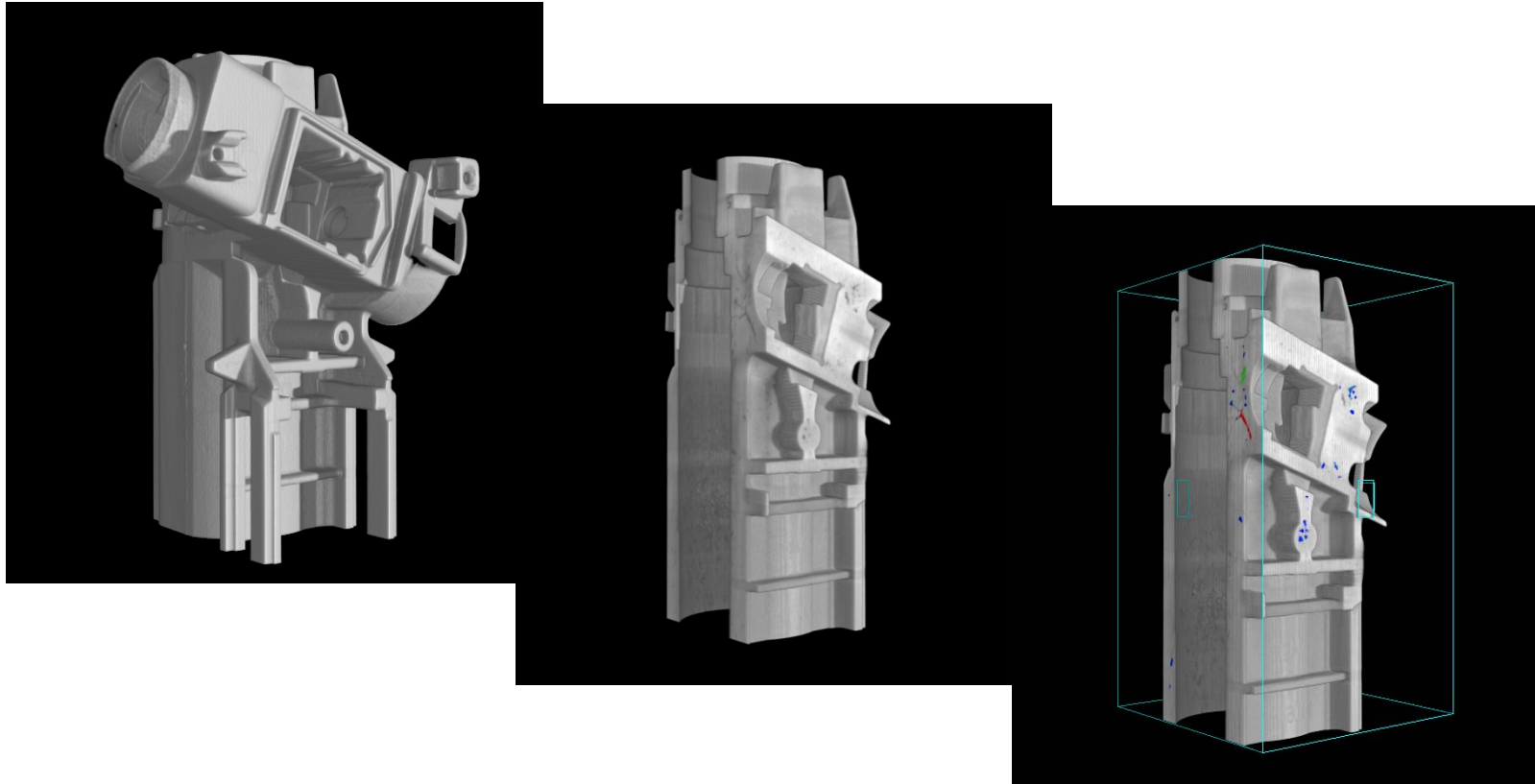


# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)





# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)



# COMPUTED TOMOGRAPHY (3D - $\mu$ CT)

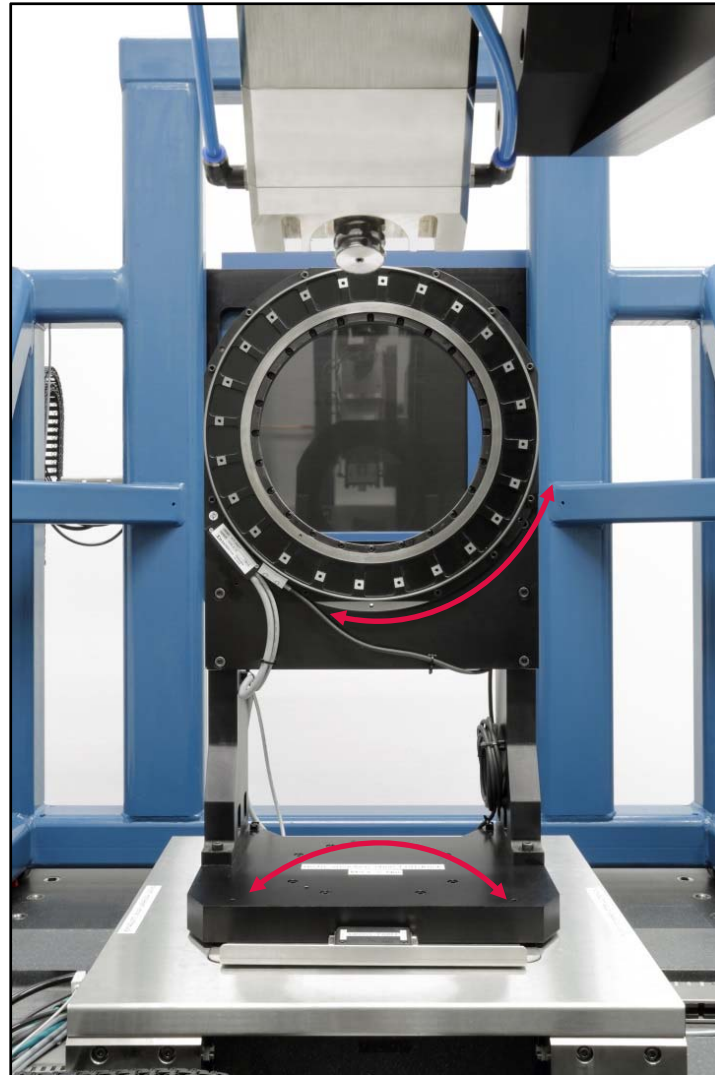
possibility and limits		
power	penetration	object-resolution
225 kV, 3000 $\mu$ A	Al: ca. 40 mm	theoretical: 1 $\mu$ m
focus	Fe: ca. 20 mm	practical: > 5 $\mu$ m
normal: 2 - 10 $\mu$ m nano: < 1 $\mu$ m	Cu: ca. 10 mm	strongly dependent on material and contrast

# OUTLOOK

- **Online Radioscopy**  
visualisation of dynamic processes
- **(Rotation-) Laminography**  
alternative to Computed Tomography, especially for flat objects

# COMPUTED LAMINOGRAPHY

## Rotation Laminography





# MICRO-CT

***QUESTIONS ?***

***IDEAS ?***

***NEW APPLICATIONS ?***





***Thank you very much for  
your interest and attention!***