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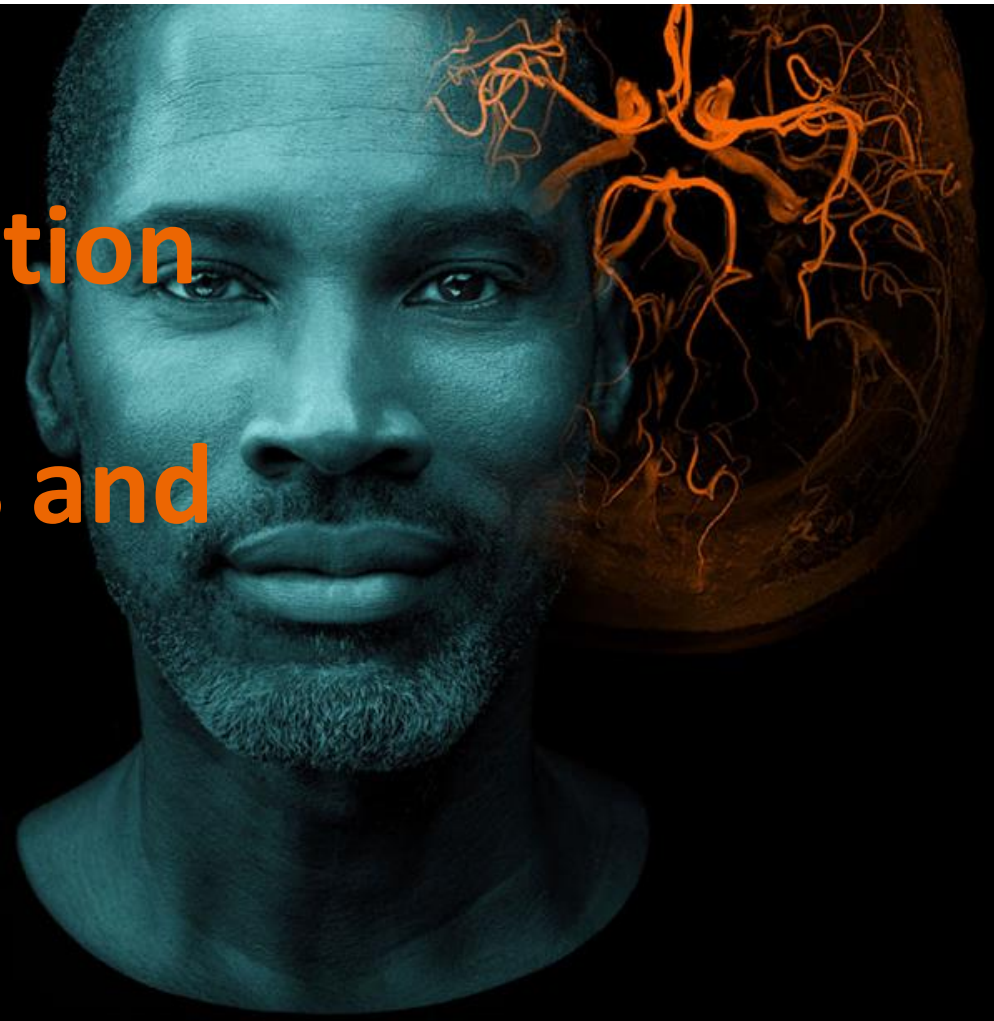
Dual Energy CT for Radiation Therapy: Technical Considerations and Clinical Applications



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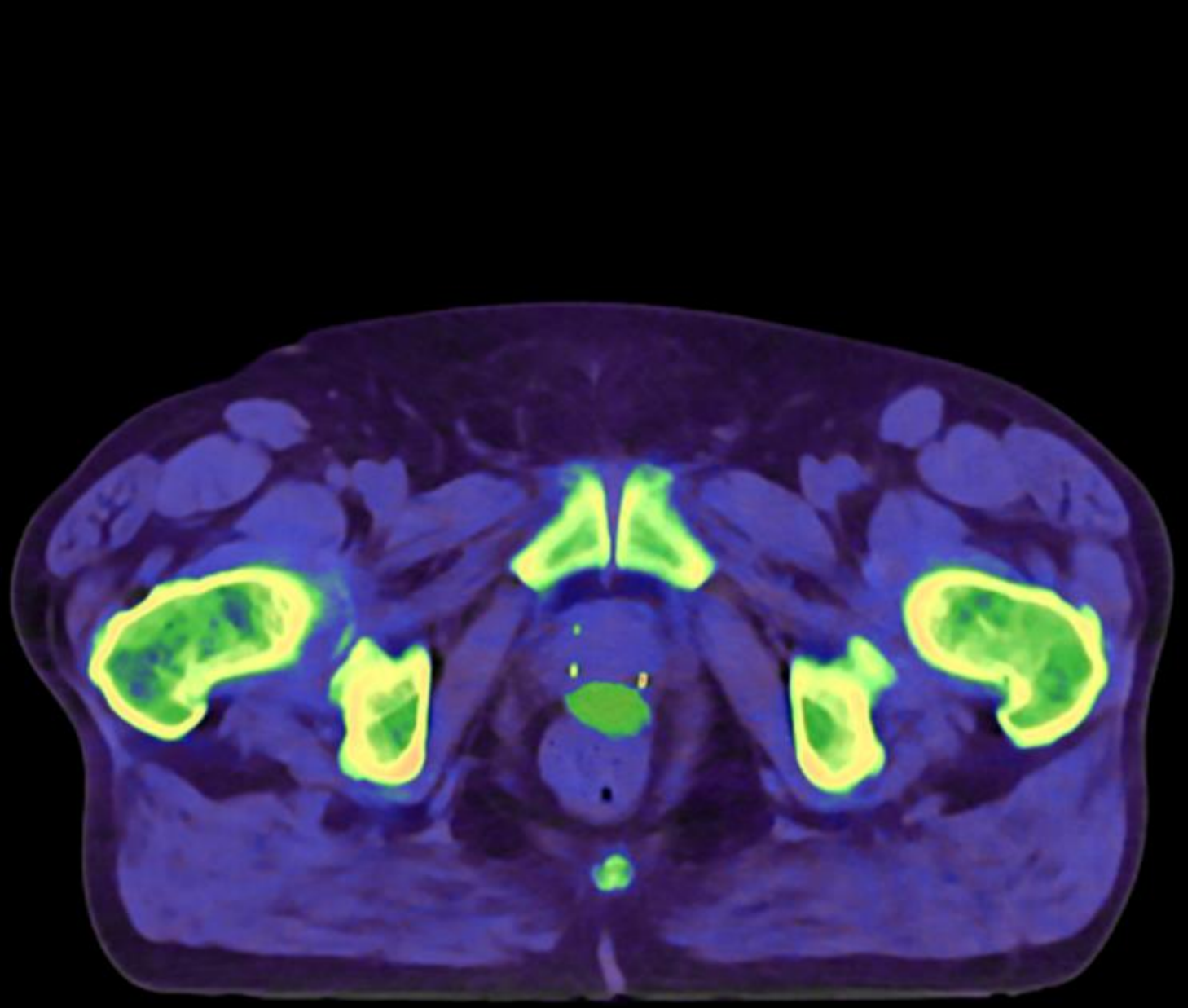

Courtesy of MAASTRO Clinic, The Netherlands

Clinical Applications

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What makes Dual Energy stand out?

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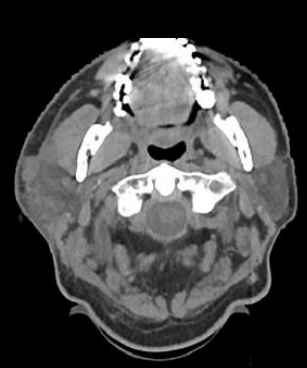
Improved tumor visualization

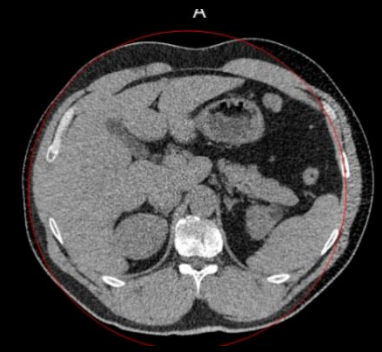
Increased confidence in tumor contouring with the use of monoenergetic energies acquired with Dual Energy technologies tailored to each scanner.

Artifact reduction



Increased process efficiency and potentially improved clinical outcomes using Dual Energy for metal artifact reduction.

Tissue characterization



Increase the competitiveness of your institution – use Rho and Z as the new foundation for dosimetric calculations and tissue differentiation to put yourself at the forefront of innovation.

Left: Courtesy of: Universitätsspital Basel / Basel, Switzerland
Middle left: Courtesy of: Radiologische Allianz Hamburg
Middle right: Courtesy of: Clinique CIMOP Bizet / Paris, France
Right: Courtesy of: Khoo Teck Puat Hospital / Singapore

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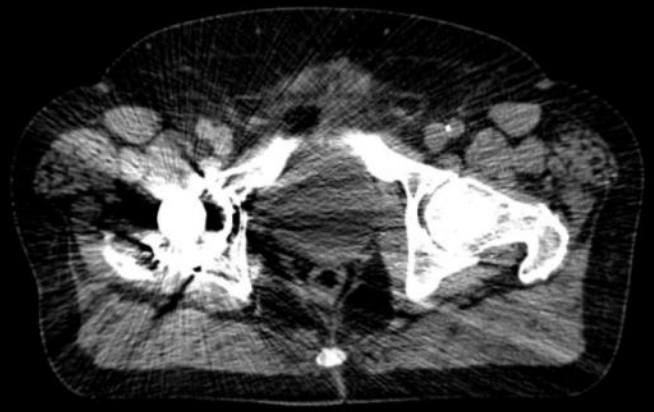
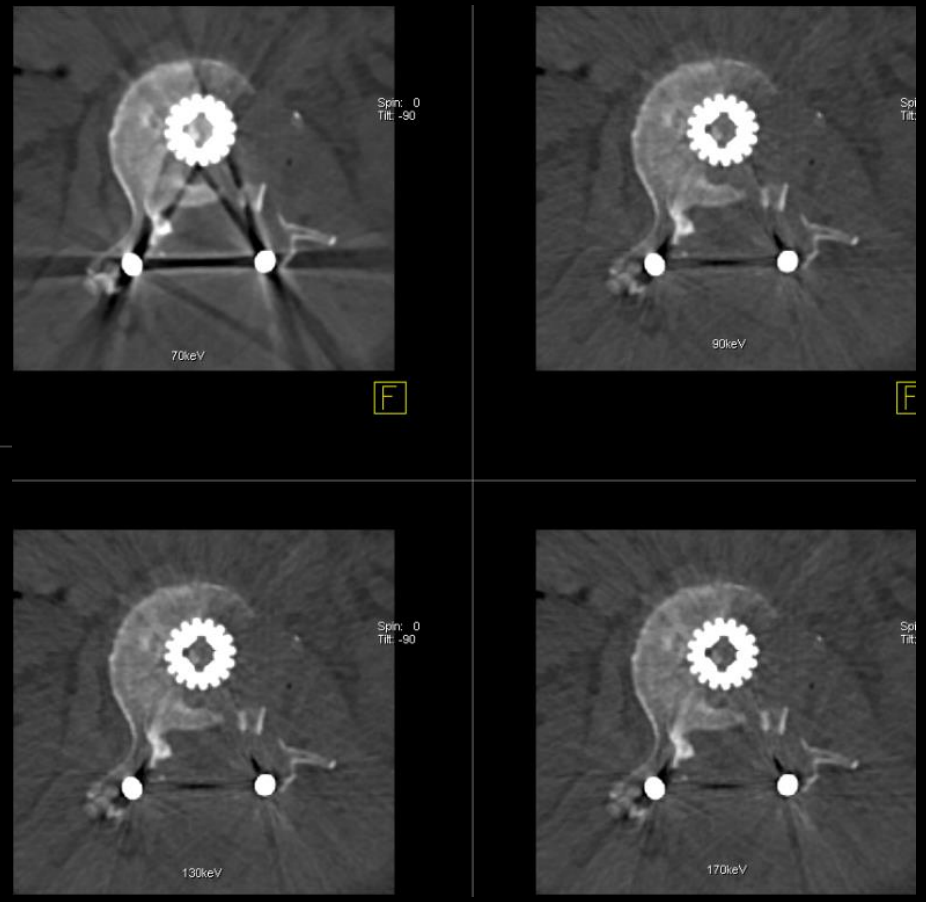
Metal artefact reduction



Conventional CT

Dual Energy CT



Pelvis images courtesy of Courtesy of :Radiologische Allianz Hamburg
Spine images courtesy of Clinique CIMOP Bizet / Paris, France

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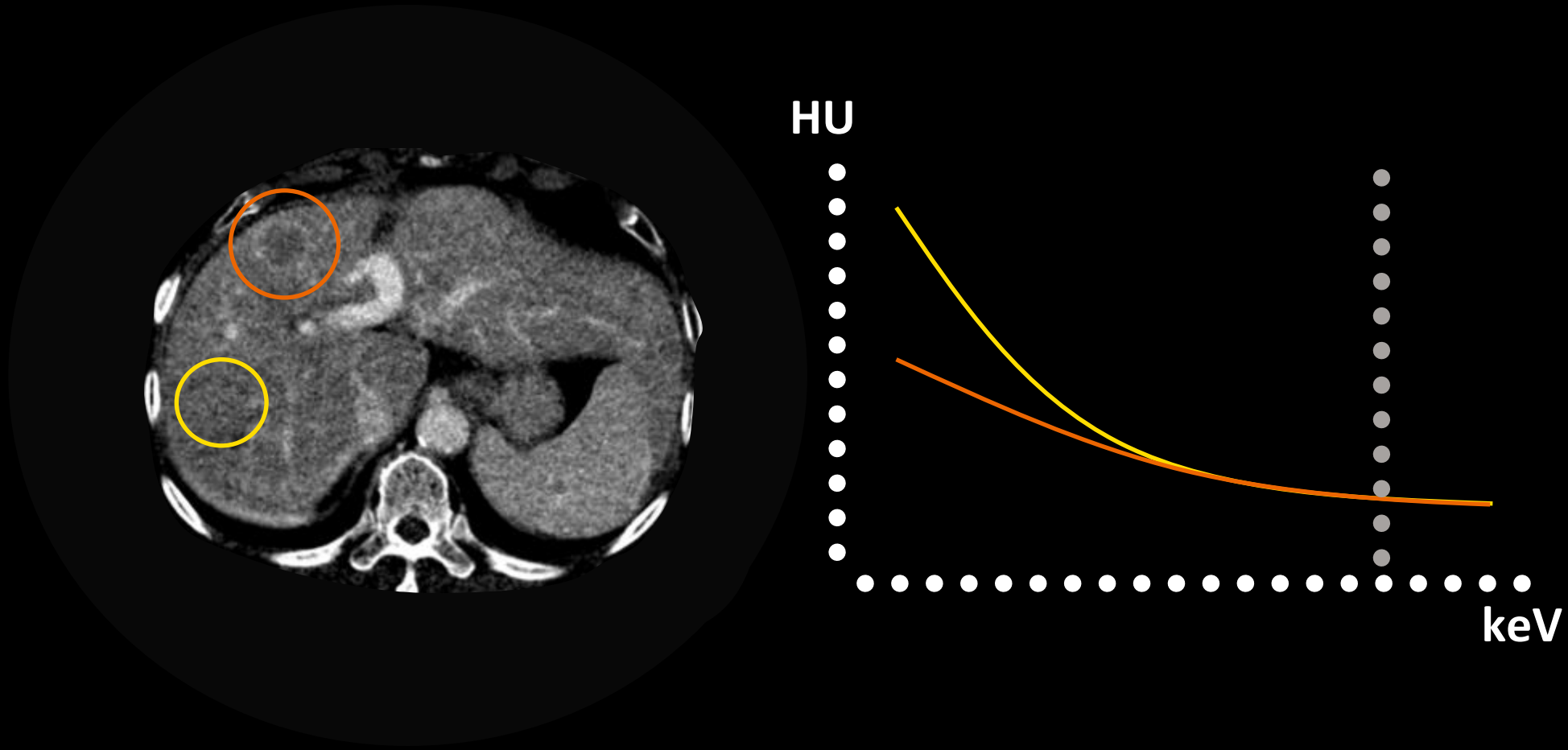
Dual Enegery Monoenergy +
Different keV lead to different image impressions



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syngo.CT DE Monoenergetic Plus[1)] – Enhances soft tissue contrast

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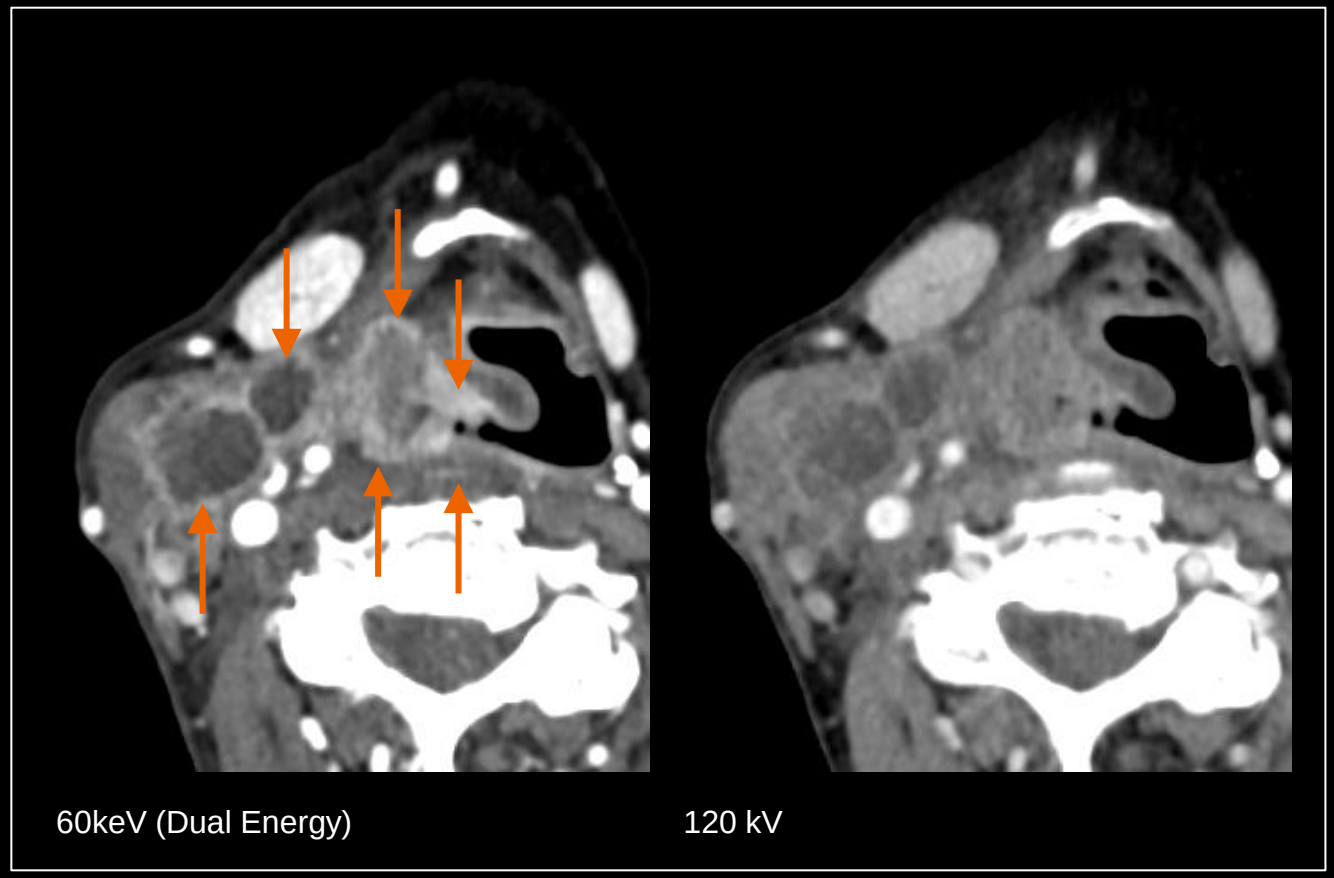
***syngo*.CT DE Monoenergetic Plus[2)]**

"Monoenergetic reconstructions at **60 keV** of DECT imaging of head and neck SCC result in a significantly improved overall image quality[1)]"



Courtesy of Erasmus MC. Rotterdam, Netherland ; 1) Julian L. Wichmann, MD,et al, Virtual Monoenergetic Dual-Energy Computed Tomography; Optimization of Kiloelectron Volt Settings in Head and Neck Cancer; 2) Optional

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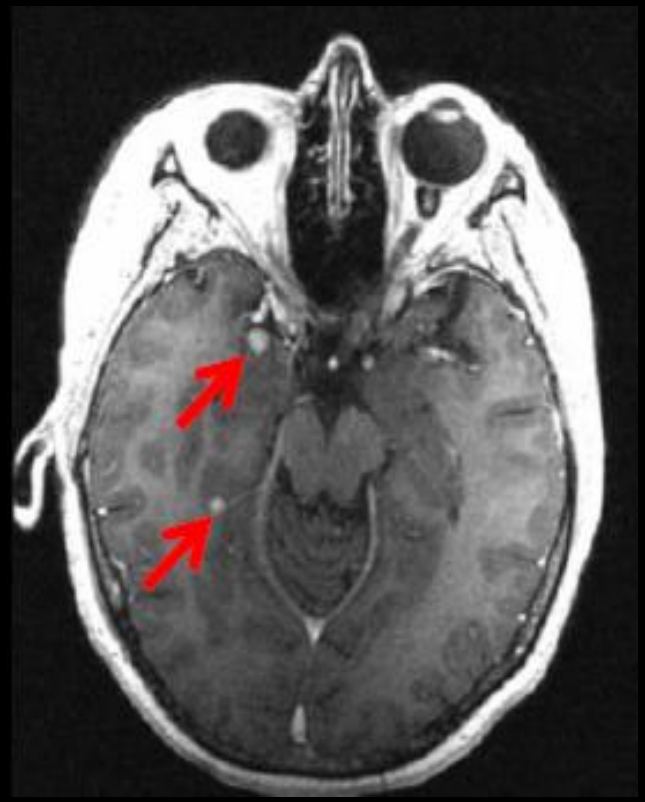
Dual Energy Monoenergy + Brain metastases

120 kV



T1 WI MRI with Contrast

Courtesy of Fox Chase Cancer Center, Philadelphia PA

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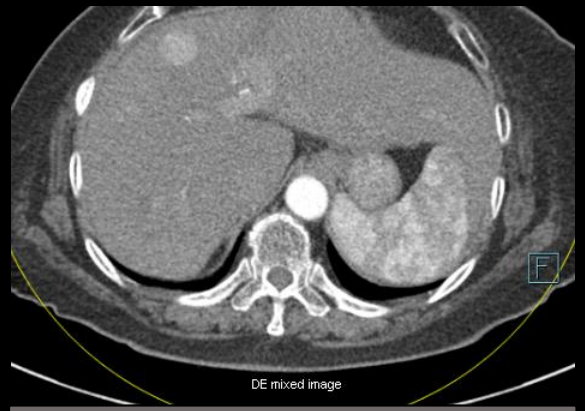
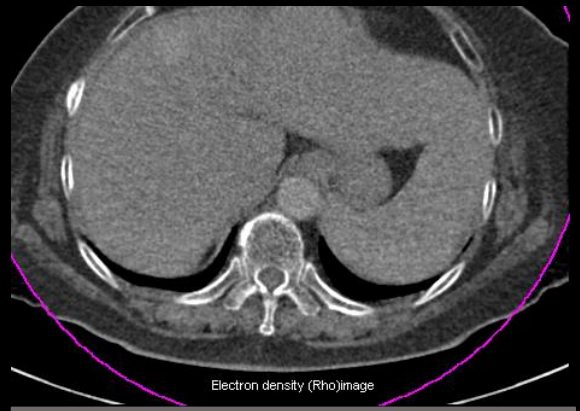
Electron Density and Effective Atomic Number – Proton Therapy



DE mixed image



Electron density (Rho) image

Effective atomic number (Z) image

Rho/Z image

- Access to electron density and effective atomic number maps in one examination
- Interactive adjustment of material decomposition parameters for immediate optimization of the results
- Separate windowing of low and high kV datasets

Courtesy of: Khoo Teck Puat Hospital/Singapore

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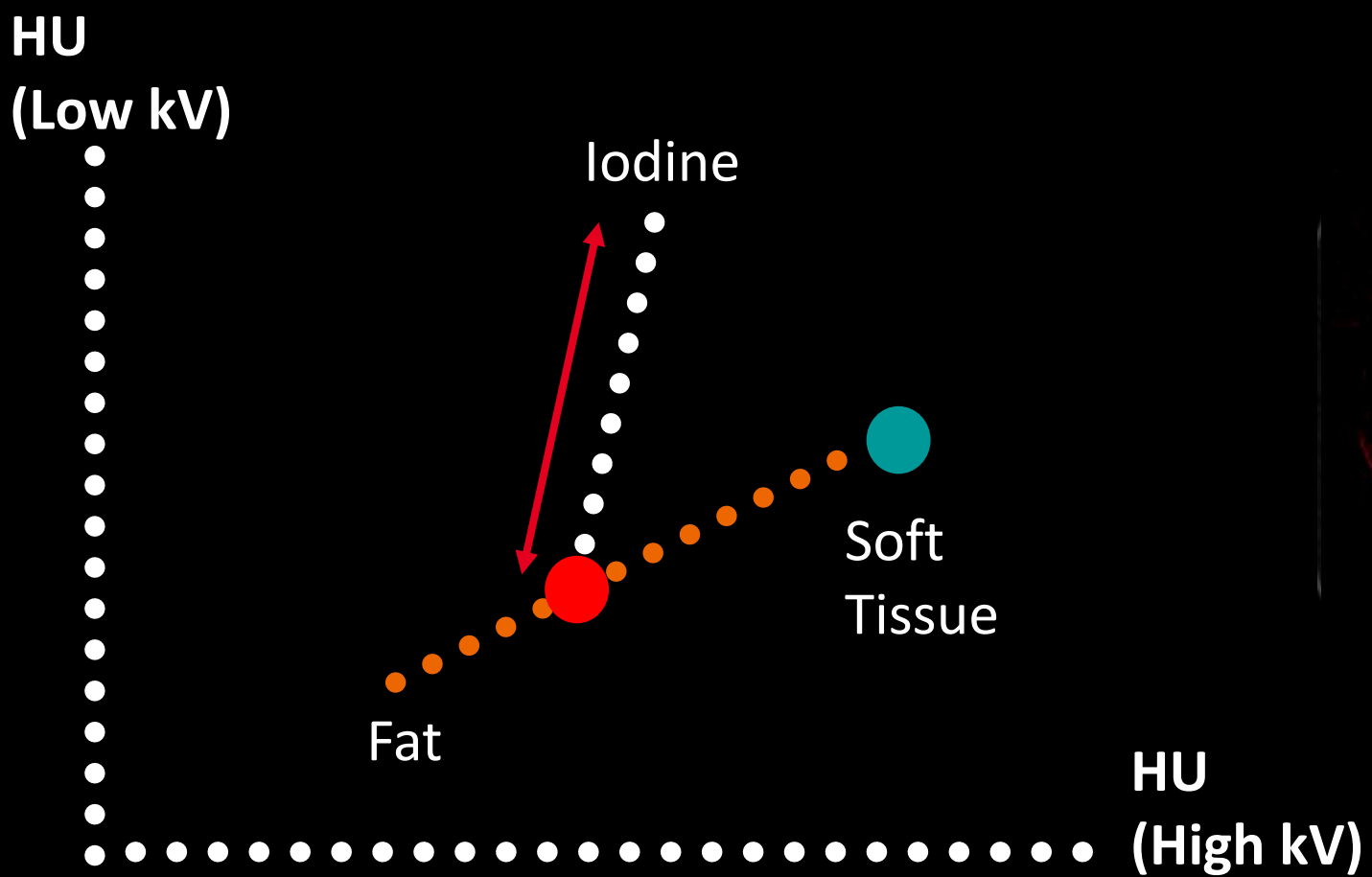
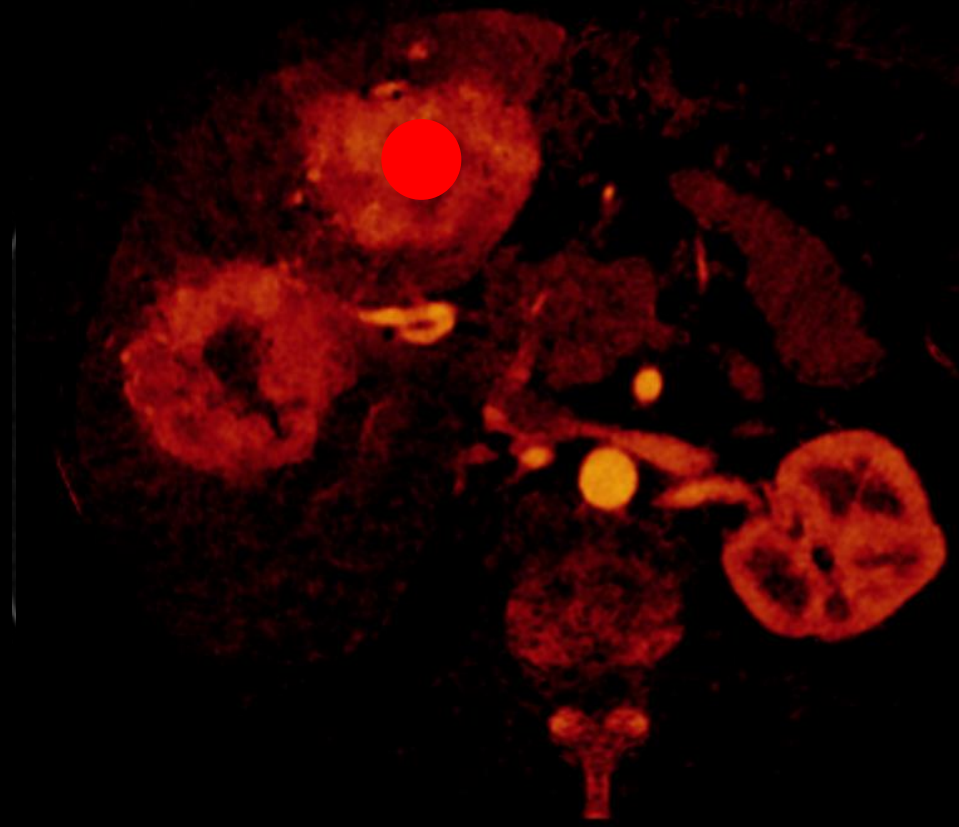
What is Iodine Map?
Liver VNC /Lung PBV/ Brain Hemorrhage /Virtual Unenhanced





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True and Virtual Non-contrast Images (VNC)

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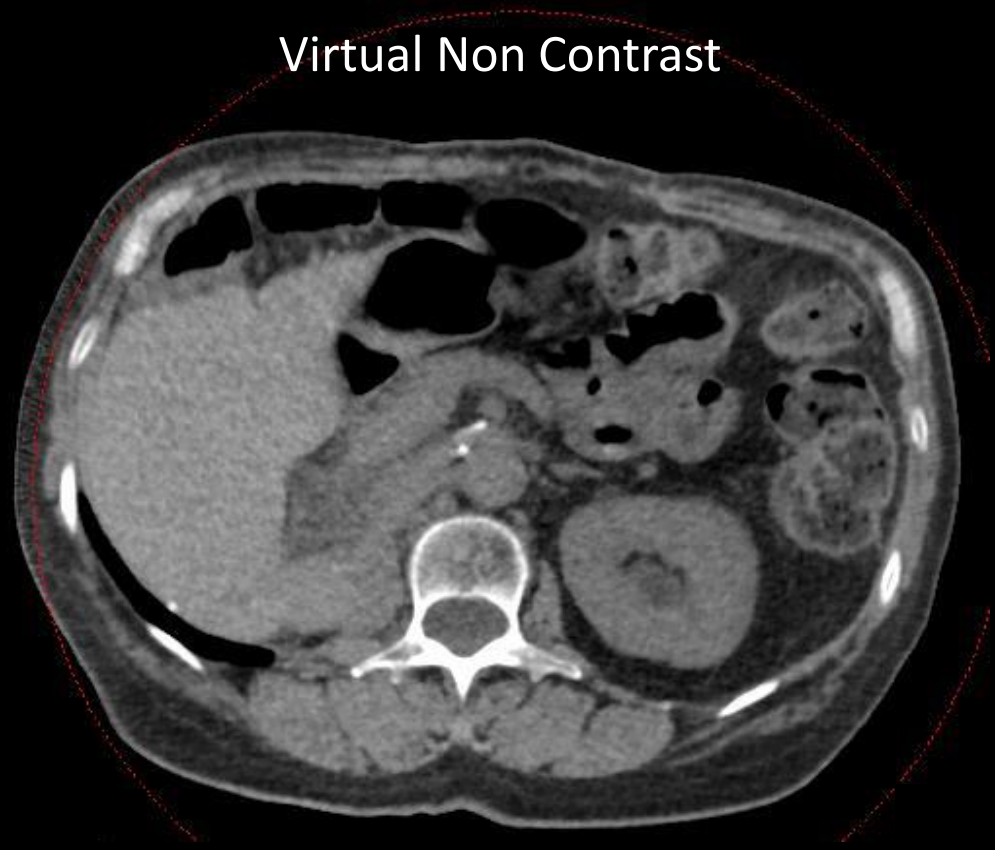
True Non Contrast

Virtual Non Contrast



Courtesy of Ludwig-Maximilians-Universität, Klinikum Großhadern, Munich, Germany

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Lung perfused blood volume -
Potentially Sparing Lung IMRT and SBRT planning

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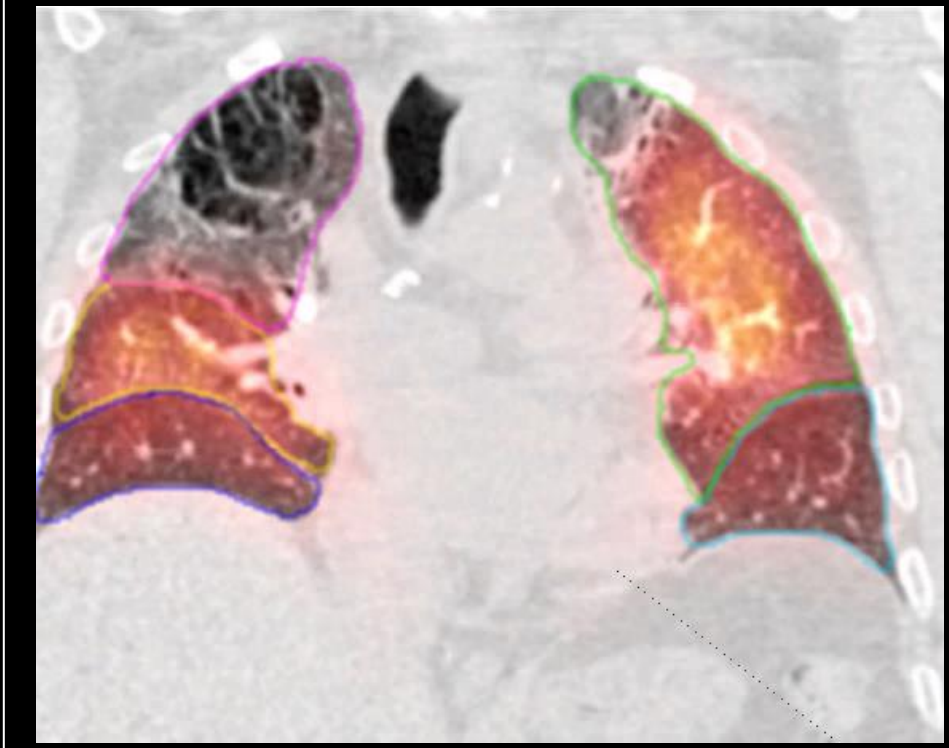
"DECT Iodine maps **strongly correlate** with standard **SPECT/CT** for evaluation of differential lung function"

"The use of functional imaging reveals significant variation in **functional dosimetric** parameters as compared to standard anatomical dosimetry in **SABR** and **IMRT** plans[1)]"



Courtesy of Centre Hospitalier de l'Université de Montréal; 1) Houda et al, Phase I-II Study of Dual Energy Computed Tomography (DECT) for Assessment of Pulmonary Function in Radiotherapy Planning, Journal of Radiation Oncology. vol 120, p17, (Sep 2017)

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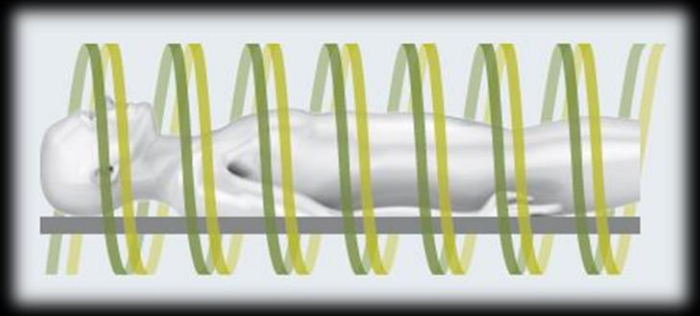

Technical considerations

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Dual Energy CT – Various approaches

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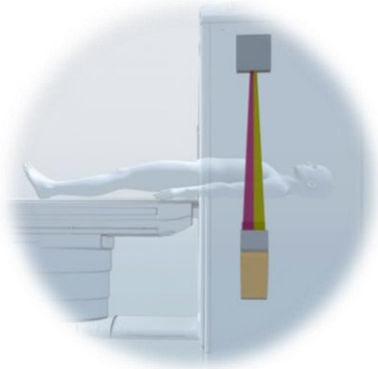
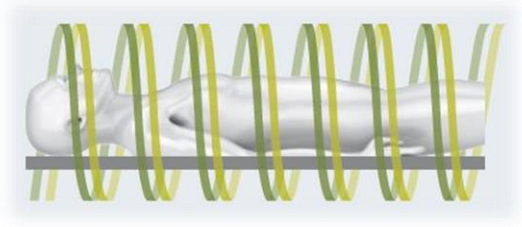
Dual Source

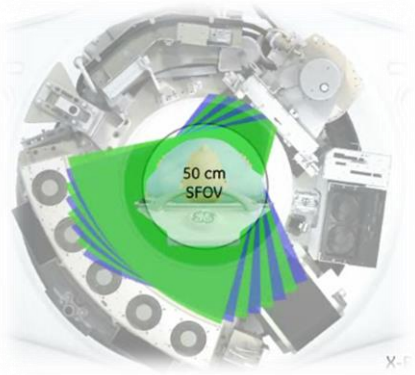
TwinBeam



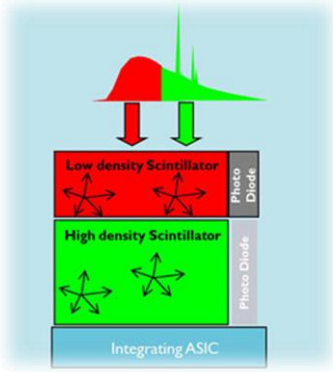
Dual Spiral



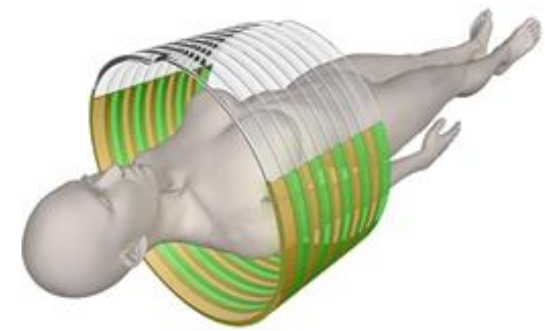
Fast kV Switching



Dual Layer



Slow kV switching



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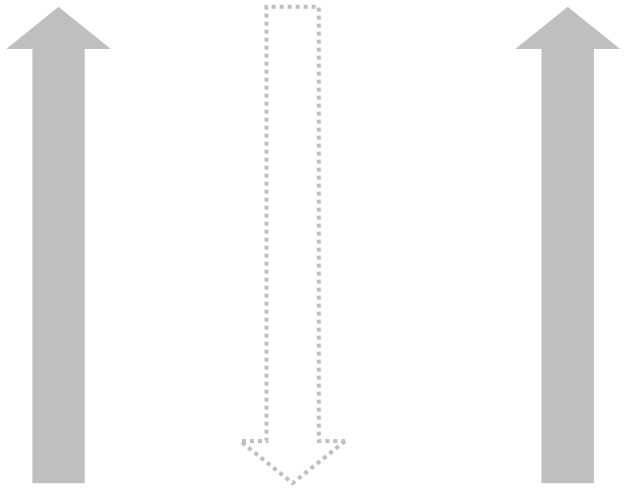
Dual Spiral Dual Energy

1st spiral
@ **low kV**

2nd spiral
@ **high kV**



- Full number of projections
- Full routine ready
- All dose reduction features available

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TwinBeam Dual Energy

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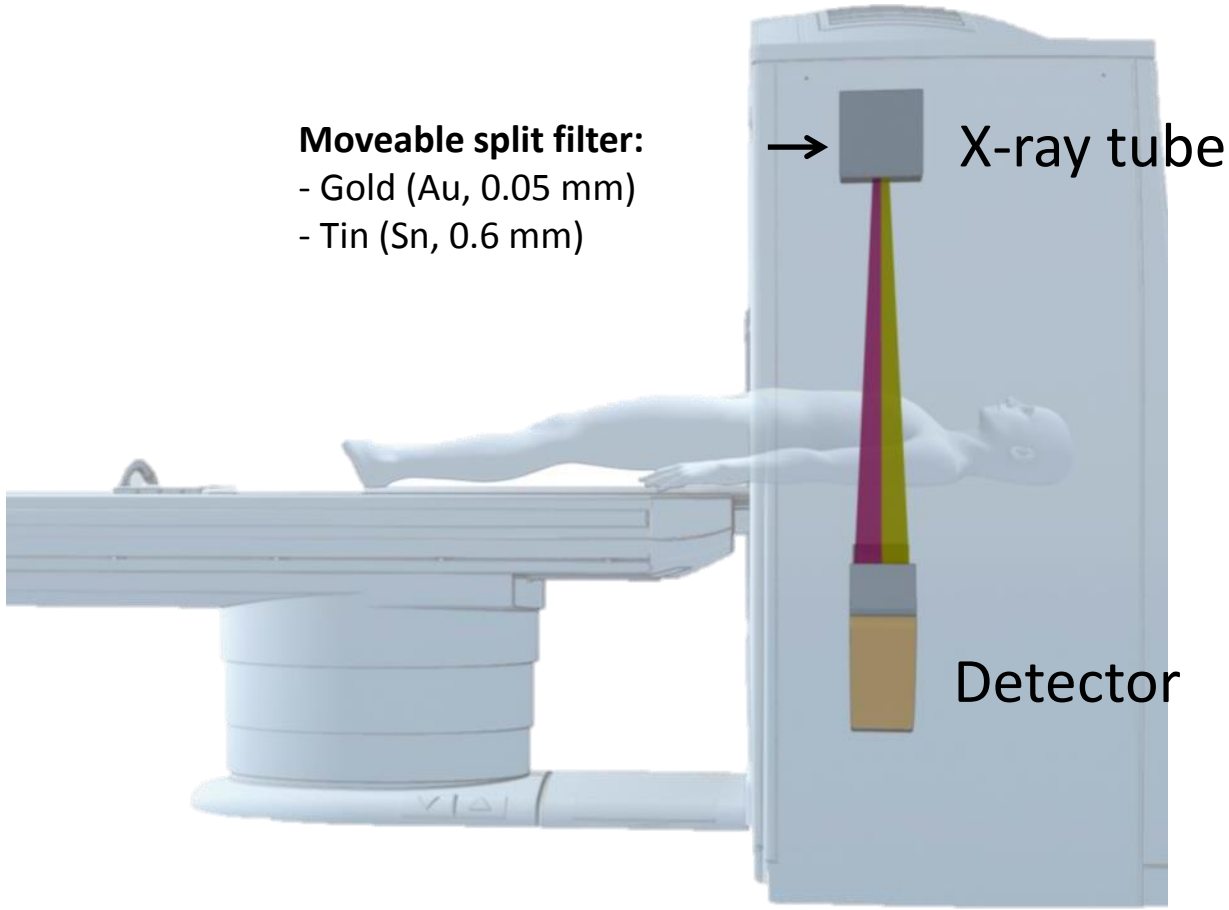
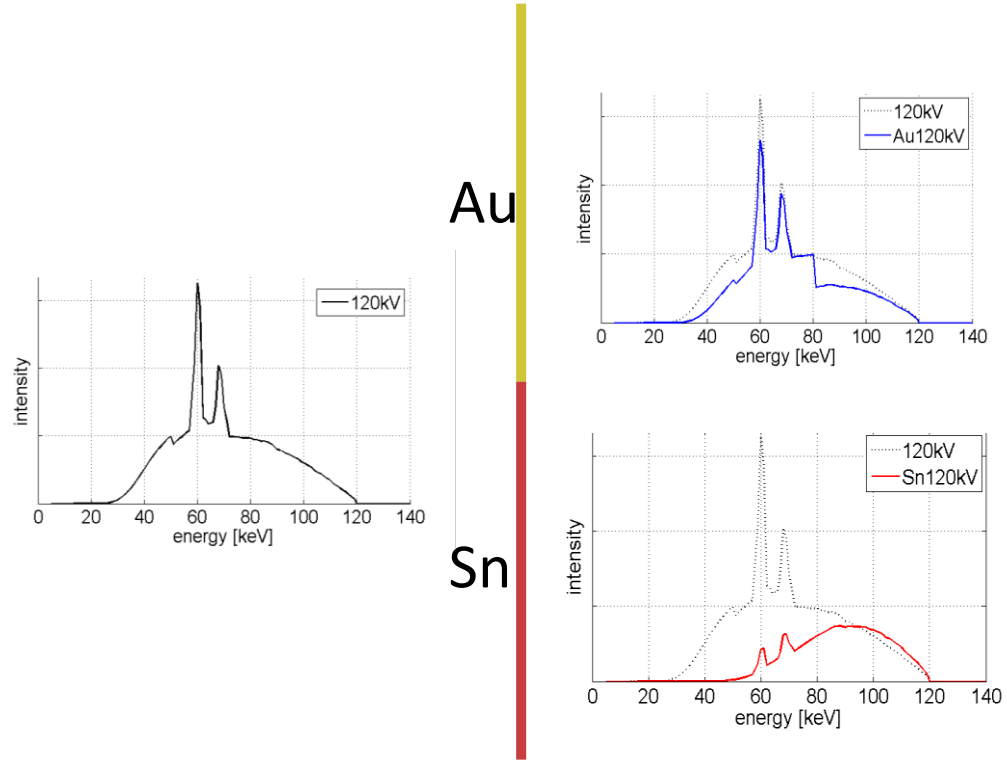
Moveable split filter:
- Gold (Au, 0.05 mm)
- Tin (Sn, 0.6 mm)





Split filter

Simultaneous acquisition of low and high energy spectra

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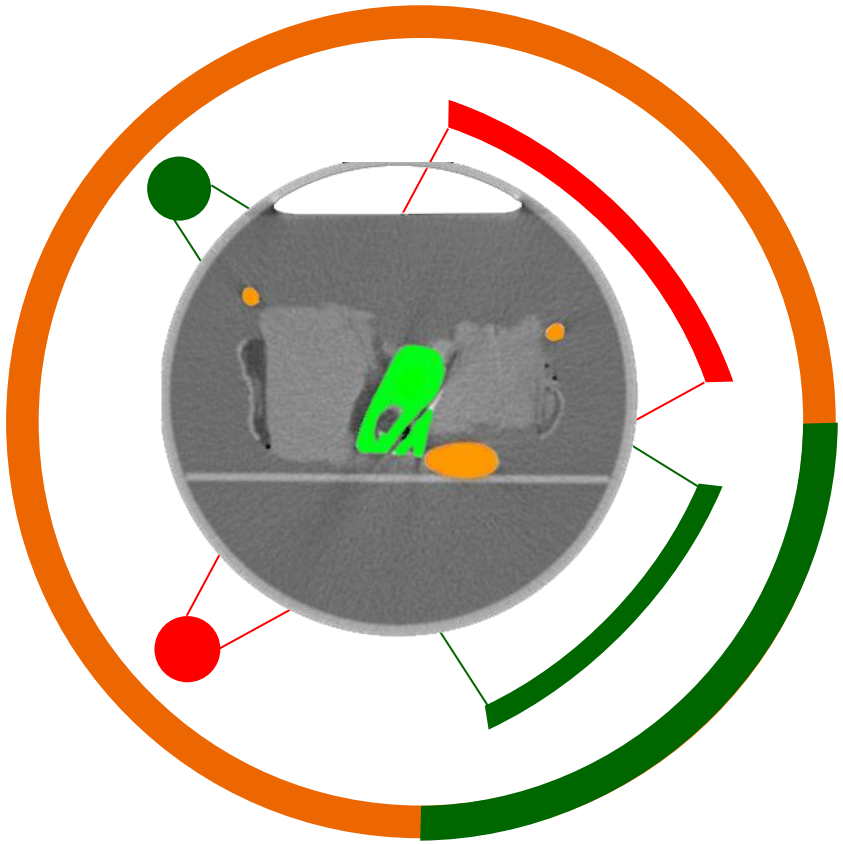
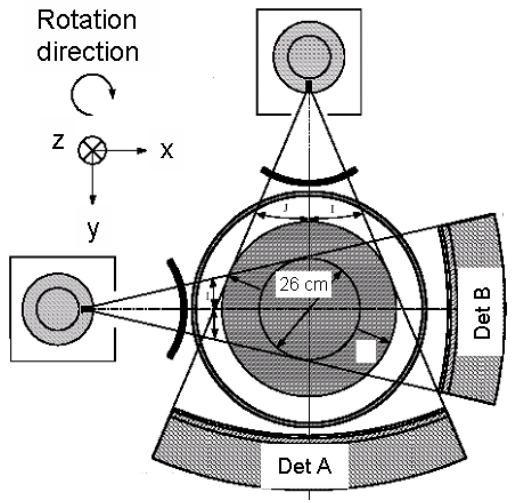
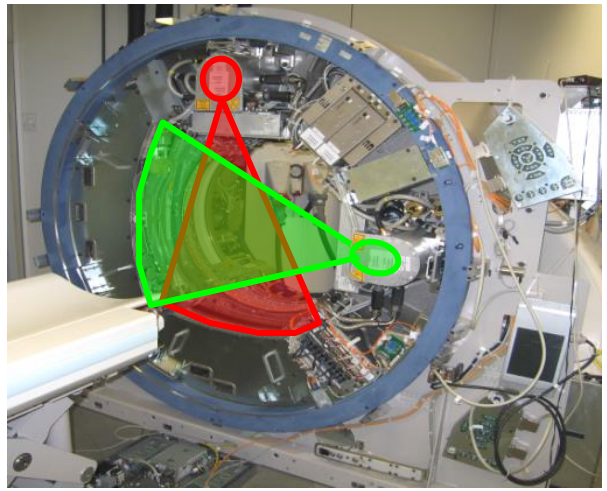
Dual Source CT Dual Energy



DSCT System Design

- **Two X-ray tubes at 95°**
  each with 100 or 120 kW
- **Two detectors at 95°**
  each with 0.6mm collimation and double z-sampling (z-flying focal spot)
- **0.25s/0.28 s gantry rotation time[1]**





1. Actual gantry rotation time depends on dual source scanner model

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Dual Energy CT – Various approaches

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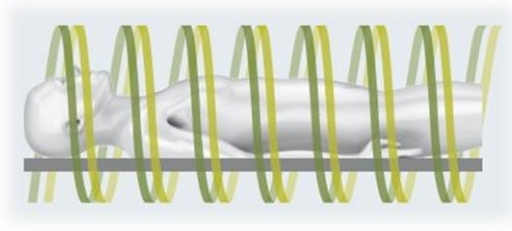
Dual Source	TwinBeam	Dual Spiral
		
• Simultaneous acquisition • Best energy separation • Limited DE field of view	• “Simultaneous” acquisition • Decent energy separation • 50 cm DE field of view	• Sequential acquisition • Good energy separation • 50 cm DE field of view

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Thank you!

Guillaume Grousset – guillaume.grousset@siemens-healthineers.com
Booth #906
July, 2019

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