

***IMAGES in RADIOTHERAPY  
CT, PET-CT***

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*IFMP Workshop*

# *INTRODUCTION*

- *Radiotherapy treatment goal*
  - *deliver as high as possible dose to the volume of interest*
  - *spar the surrounding healthy tissues as much as possible*

# *INTRODUCTION*

- *procedure*

- *treatment simulation*
- *arrange the treatment fields*
- *treatment verification*
- *treatment evaluation*

# *INTRODUCTION*

*the delivered dose should be the same as  
the predicted one  
that dose should be delivered on the certain  
volume (PTV)*

## ***Questions:***

*How we are sure that the delivered dose is the same as the predicted one?*

*How we are sure that the dose is delivered at the right place?*

*How we are sure that the delivered dose is the same as the predicted one?*

Delivered dose accuracy depends on:

- machine functionality,
- beam calibration errors
- calculation algorithm uncertainty

*How we are sure that the dose is delivered at the right place?*

Delivered dose accuracy depends on:

- patient position errors
- volume of interest delineation precision

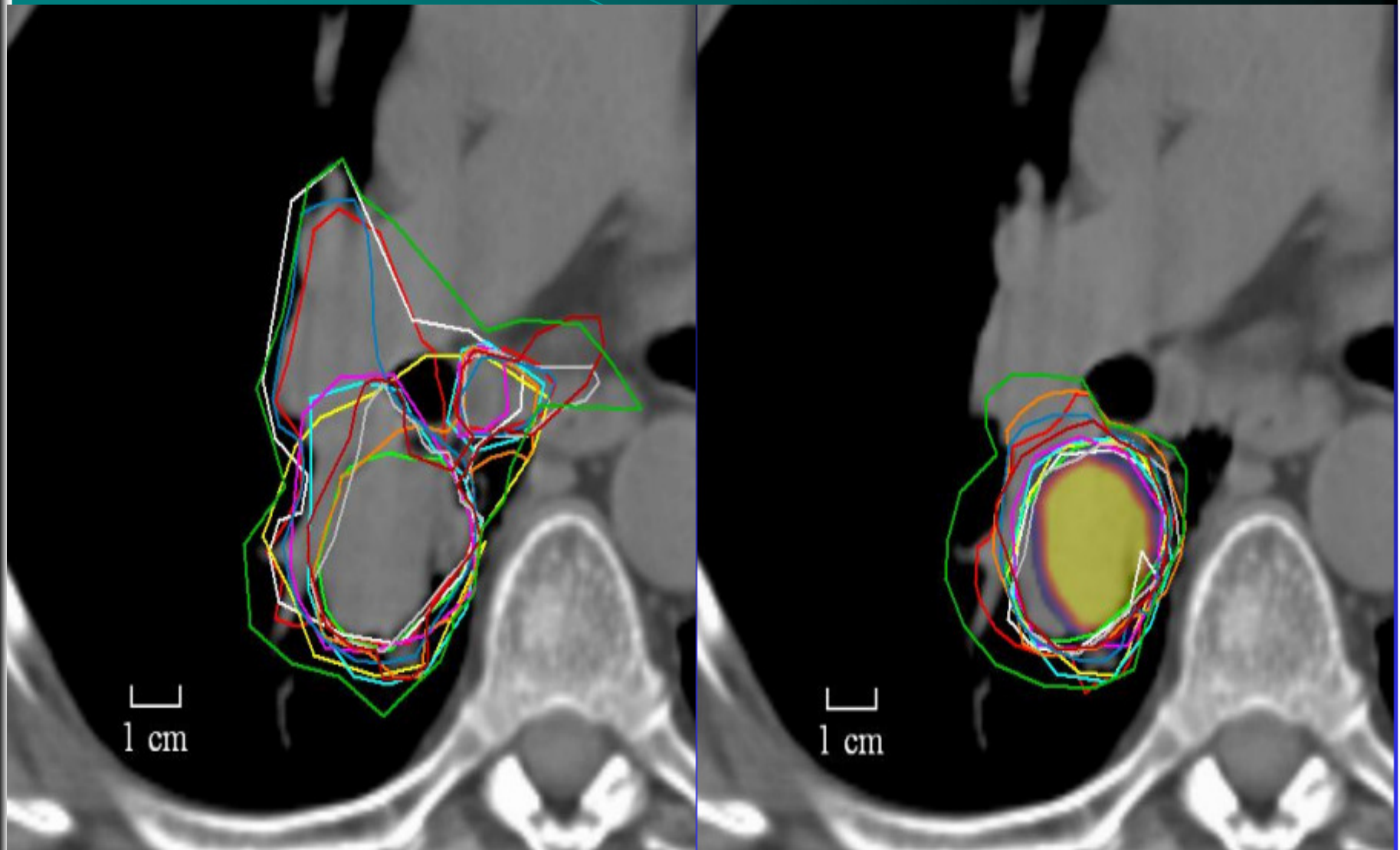
*How we are sure that the delineation is correct?*

Delineation accuracy depends on:

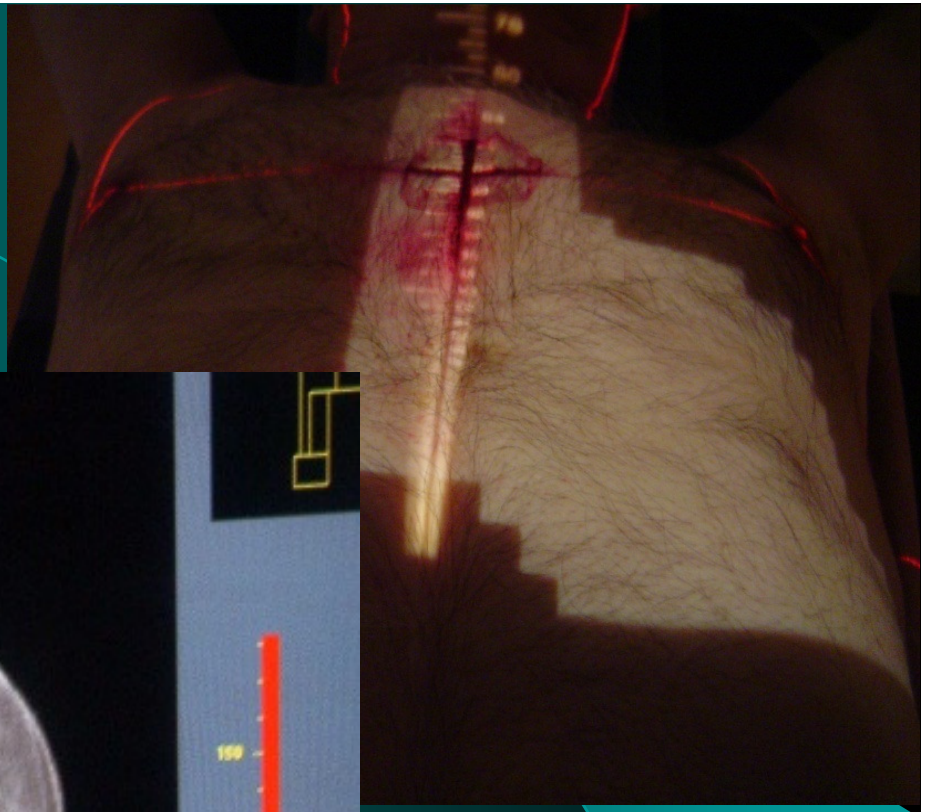
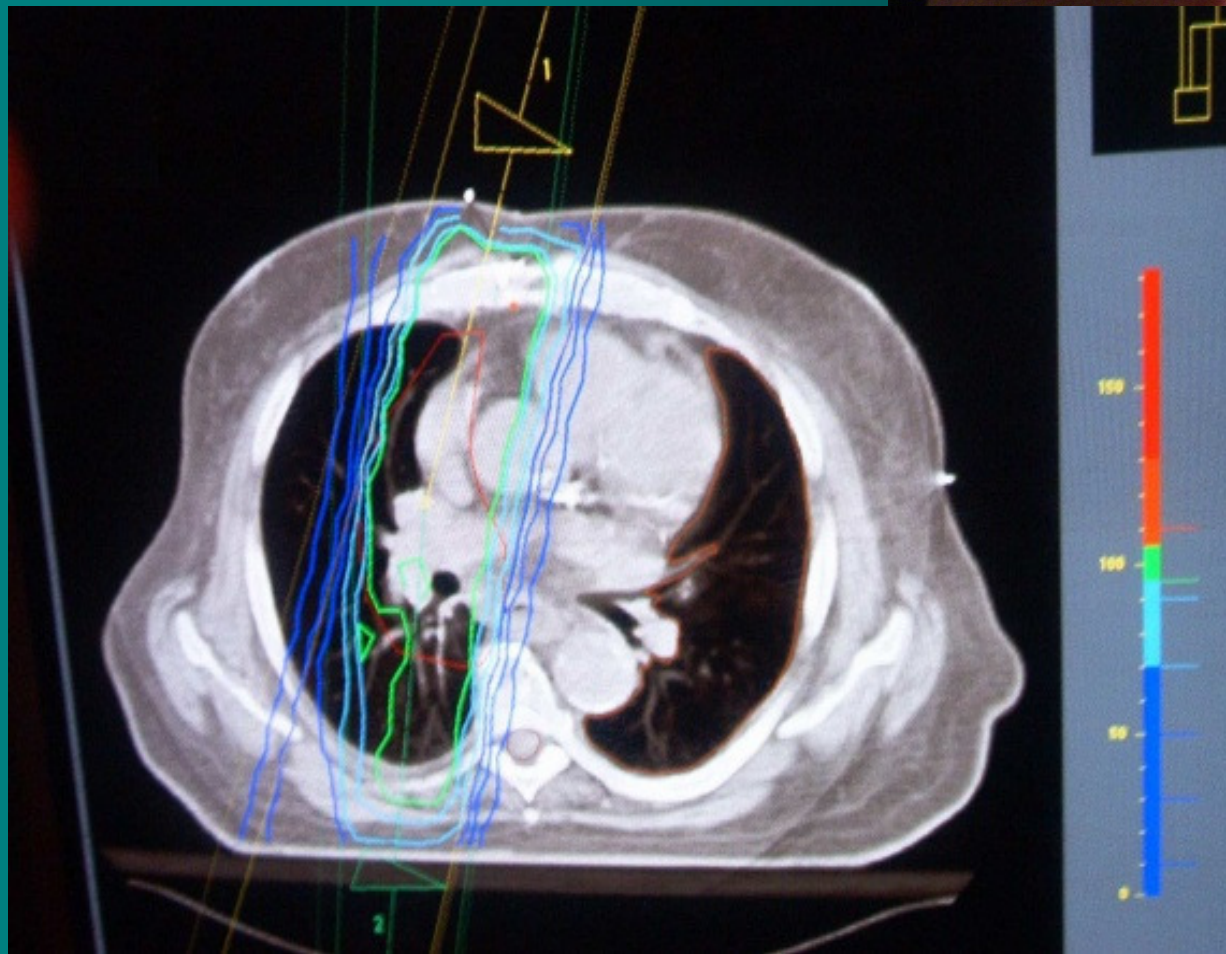
- tumor tissue visibility
- radiation oncologist experience



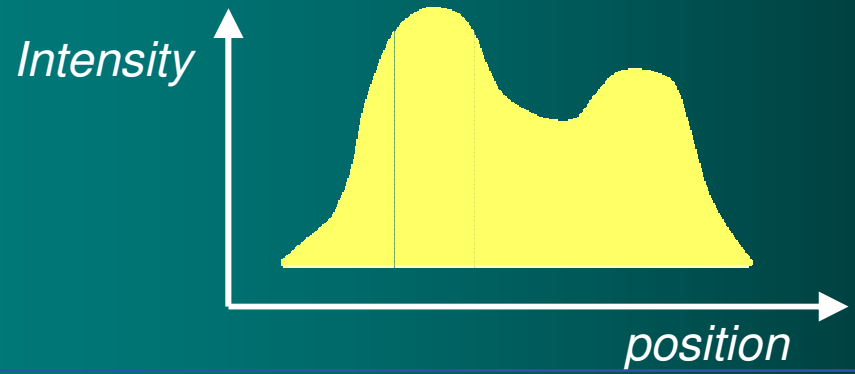
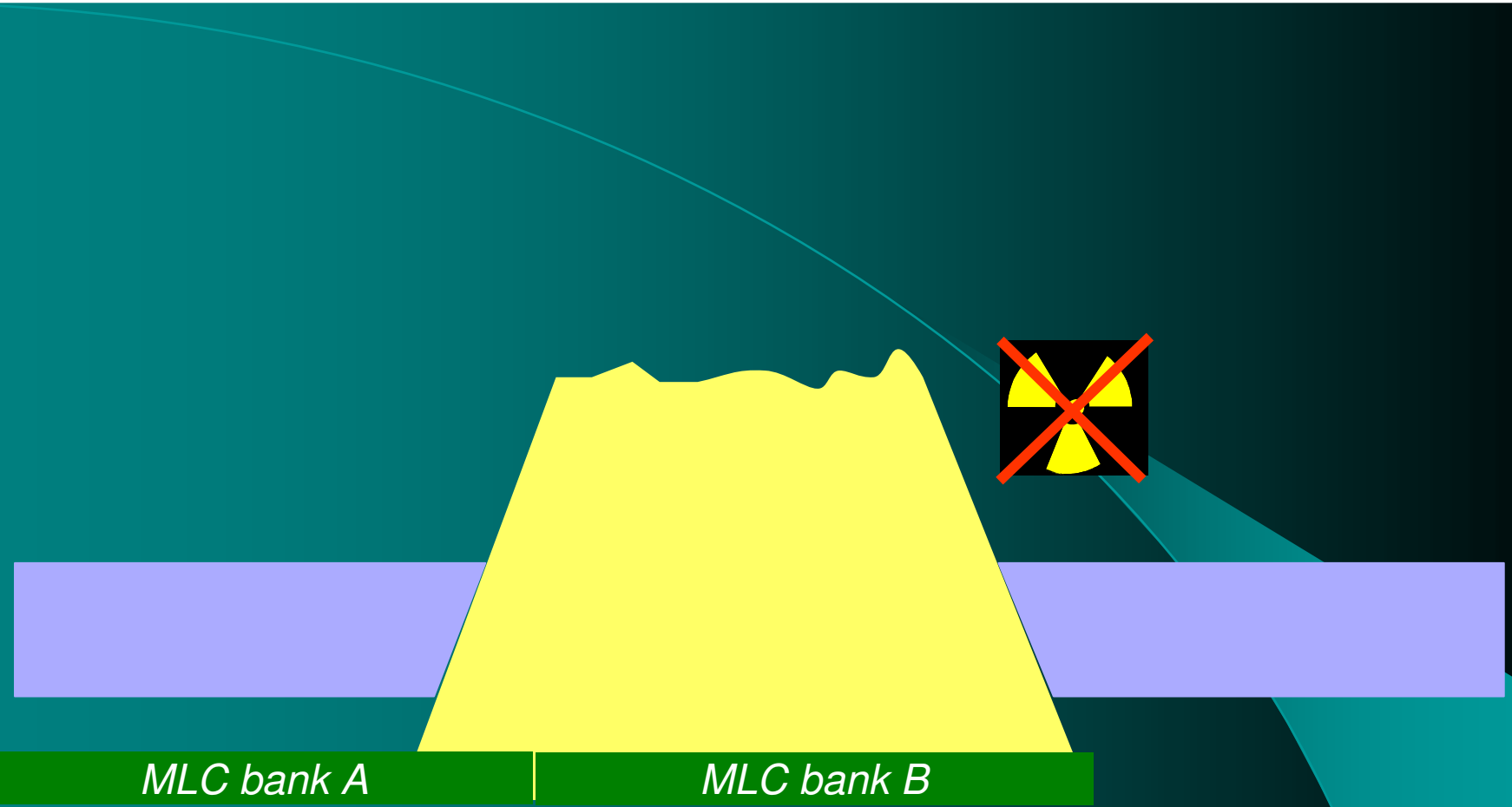
# *imaging*



# *imaging*





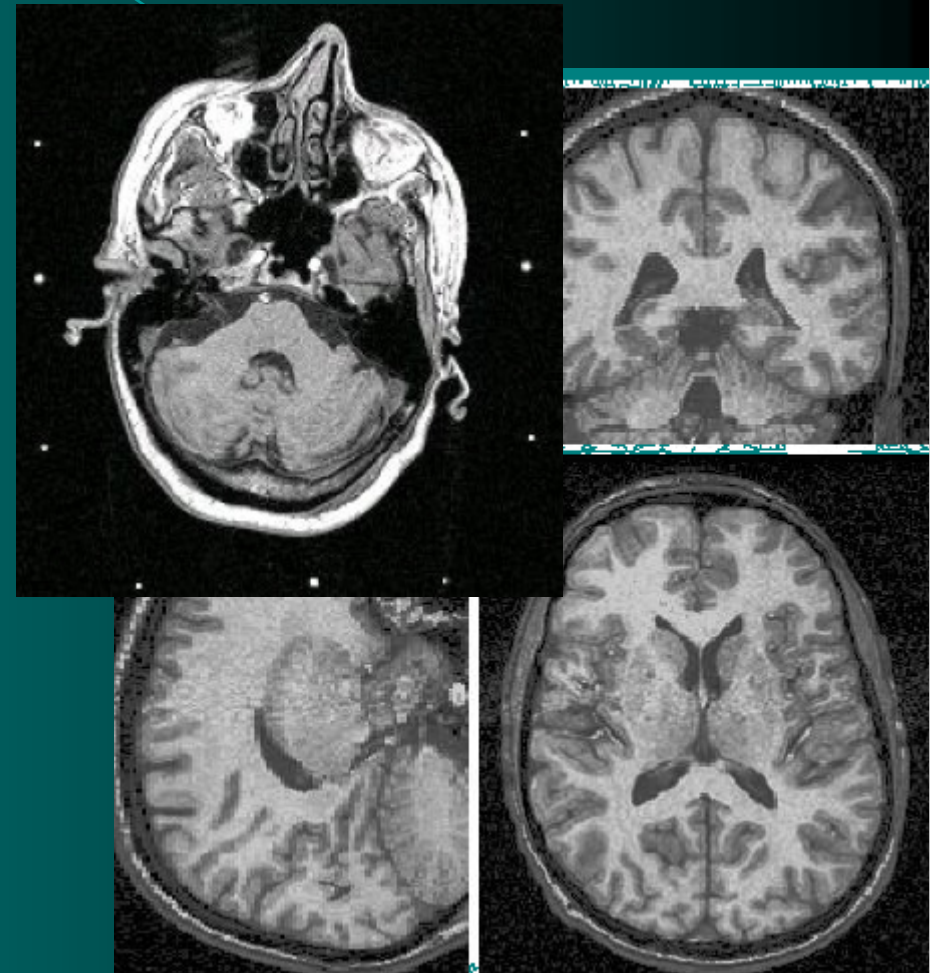
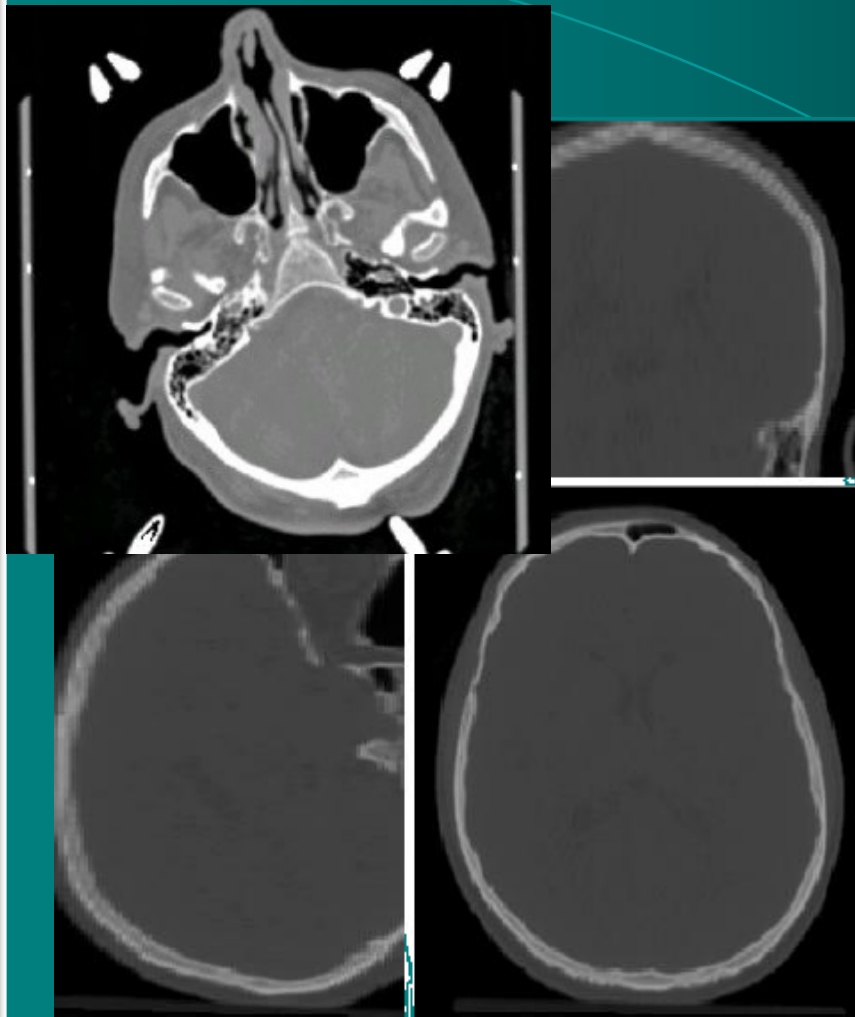


## *imaging*

Integration of multimodality imaging data for radiotherapy treatment planning is beneficial and indispensable for perfect delineation.

- *CT*      *for planning*
- *MRI*  
*for registration*
- *PET-CT*

# Why MRI?



# Why MRI?

Transversal - CT\_25.04.2014 - MR\_2mm - 4/24/2014 15:35

Sagittal - CT\_25.04.2014 - MR\_2mm - 4/24/2014 15:35

REGISTRATION

CT Image CT\_25.04.2014 4/24/2014

MR Image MR\_2mm 4/24/2014

3/7/2014 CT

3/28/2014 MRI

3/28/2014 MRI

3/28/2014 MRI

4/24/2014 CT

4/24/2014 CT

4/24/2014 MRI

4/24/2014 MRI

4/24/2014 MRI

The interface displays three main views of a brain scan: Transversal (axial), Frontal (coronal), and Sagittal (sagittal). Each view shows a CT scan (grayscale) and an MRI scan (color) overlaid for registration. A registration toolbar at the top shows a sequence of image types and dates: CT (3/7/2014), MRI (3/28/2014), MRI (3/28/2014), MRI (3/28/2014), CT (4/24/2014), CT (4/24/2014), MRI (4/24/2014), MRI (4/24/2014), and MRI (4/24/2014). The CT images from 4/24/2014 are highlighted with a dashed orange box. A small 3D coordinate system is visible in the bottom left of the Transversal view, showing a Z-axis value of 15.15 cm. In the Sagittal view, a coordinate system shows an X-axis value of 0.00 cm and a Y-axis value of -21.10 cm. The interface also includes a 'Both' button and a 100% zoom indicator.

Z: 15.15 cm

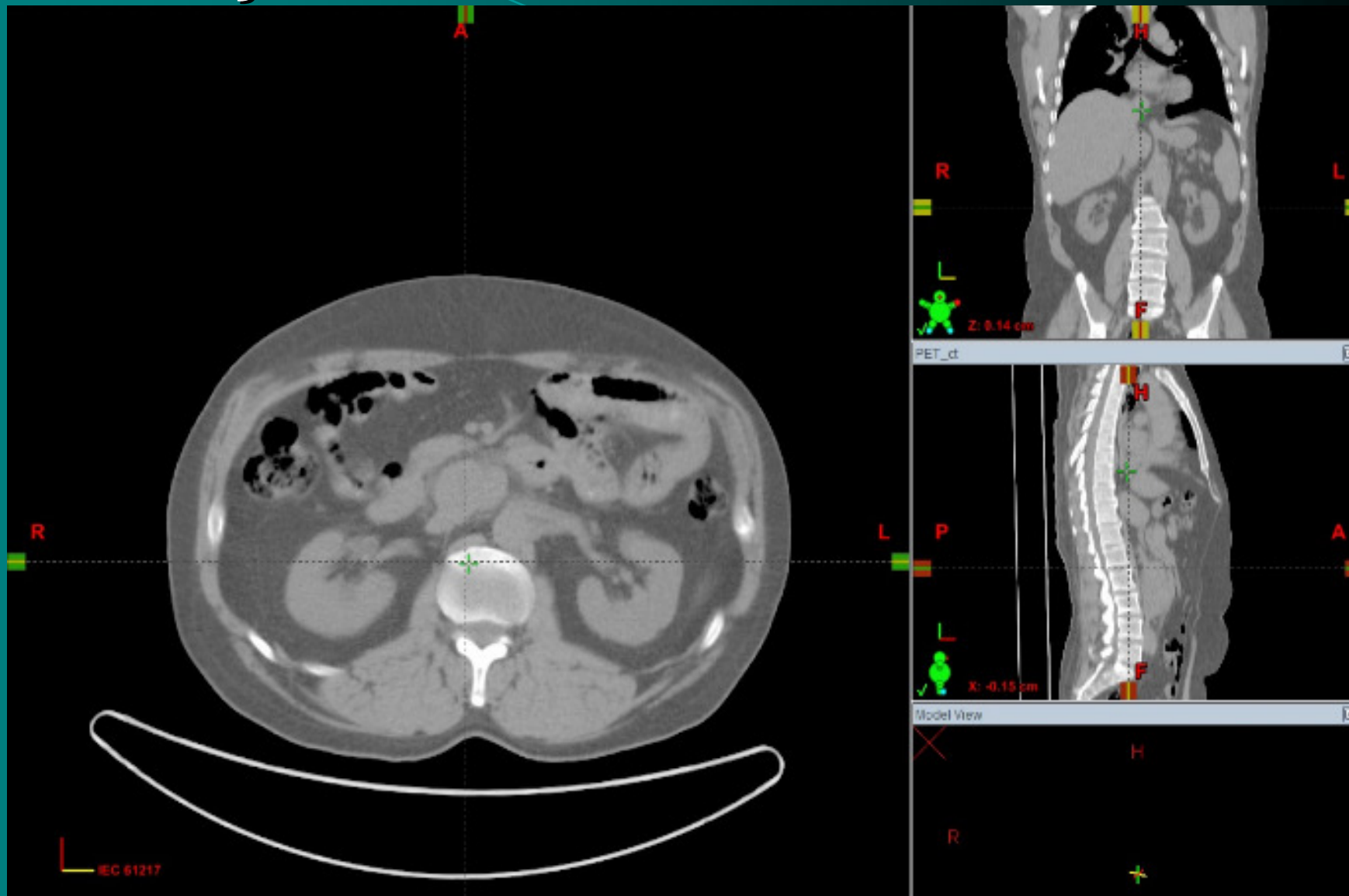
X: 0.00 cm

Y: -21.10 cm

Both

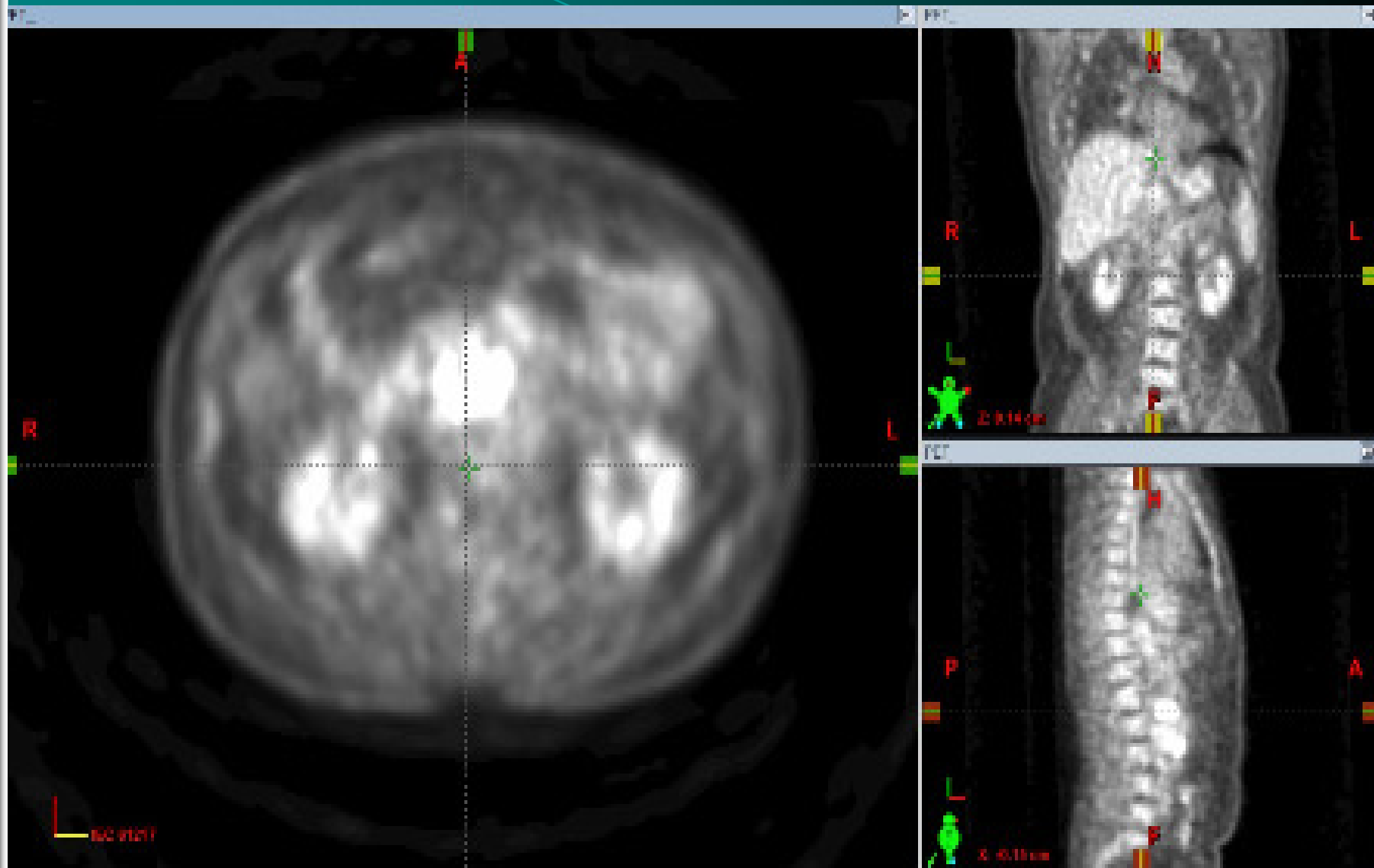
100 %

# Why PET/CT?

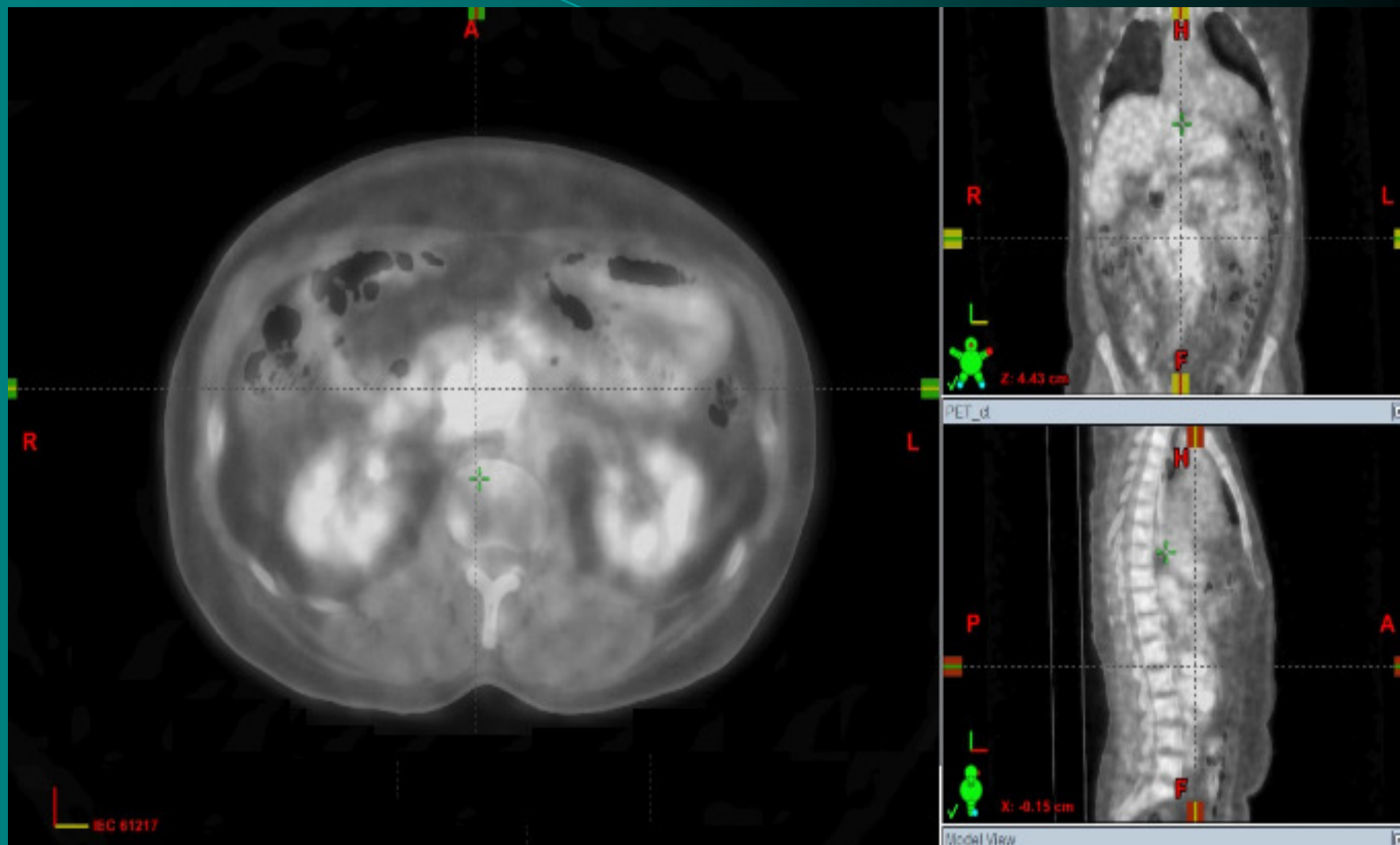




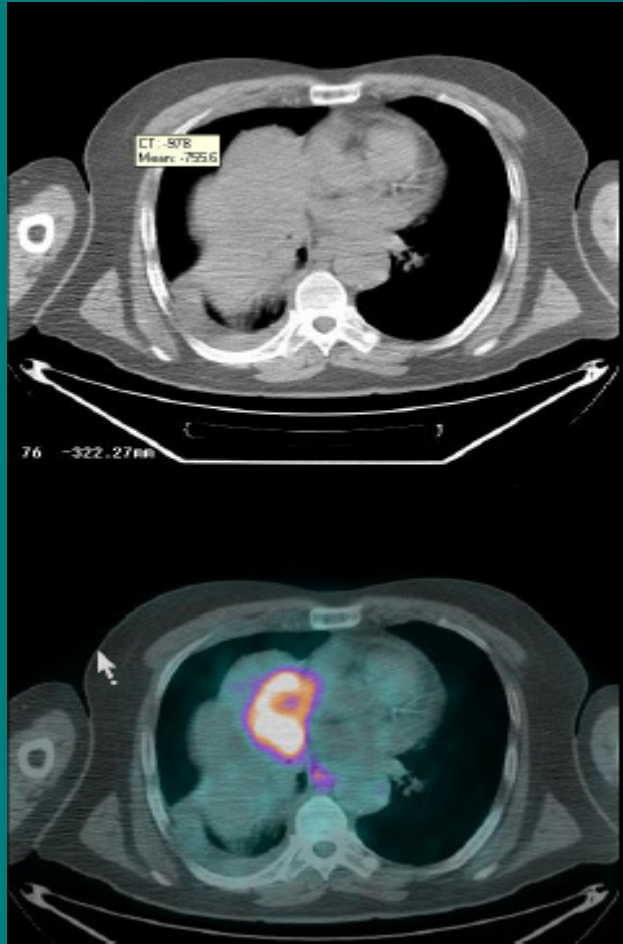
# Why PET/CT?



# Why PET/CT?



# Why PET/CT?

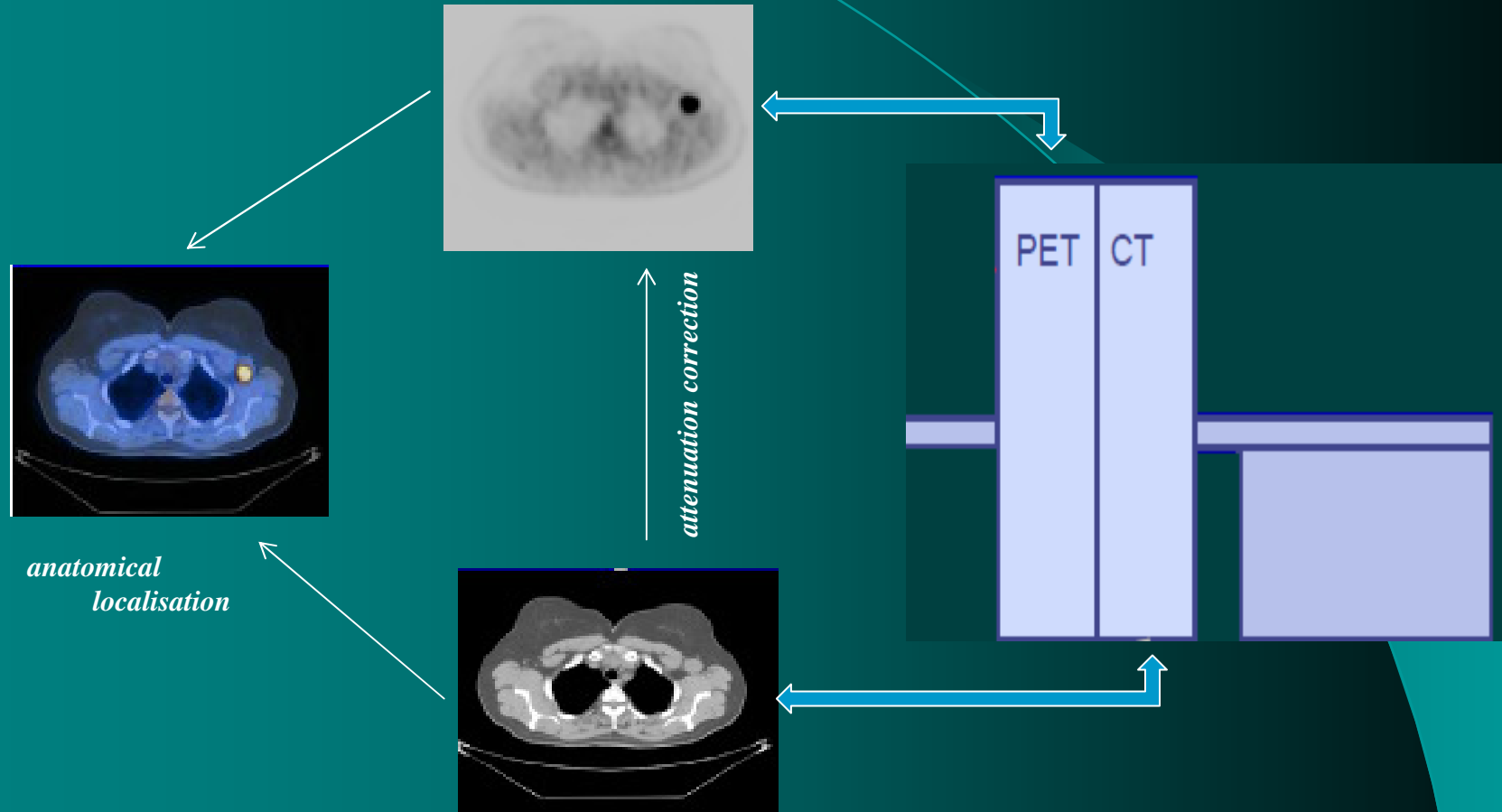


*66 years male patient*

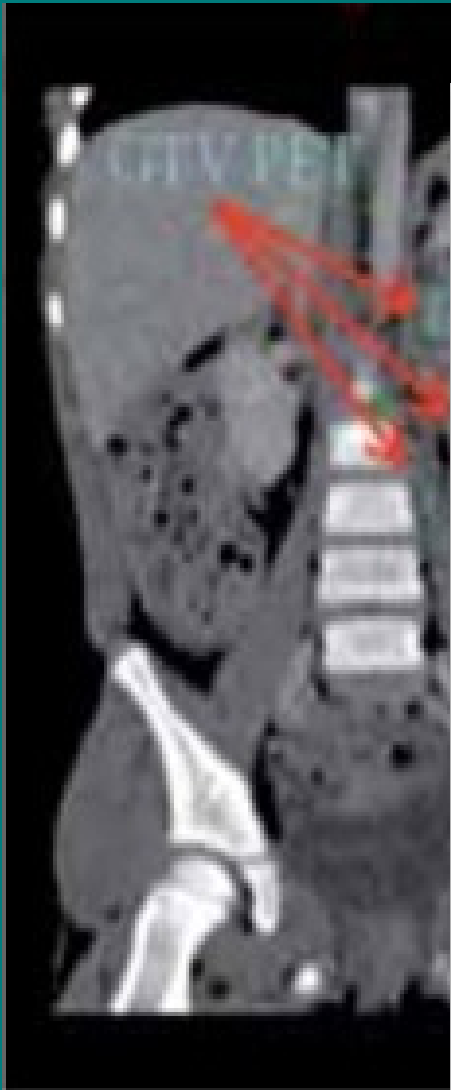
- *Primary: lung Ca with atelectasis*
- *Right hilar mass*

# Integrated PET/CT Imaging System

## *BENEFITS of COMBINED TECHNIQUE*

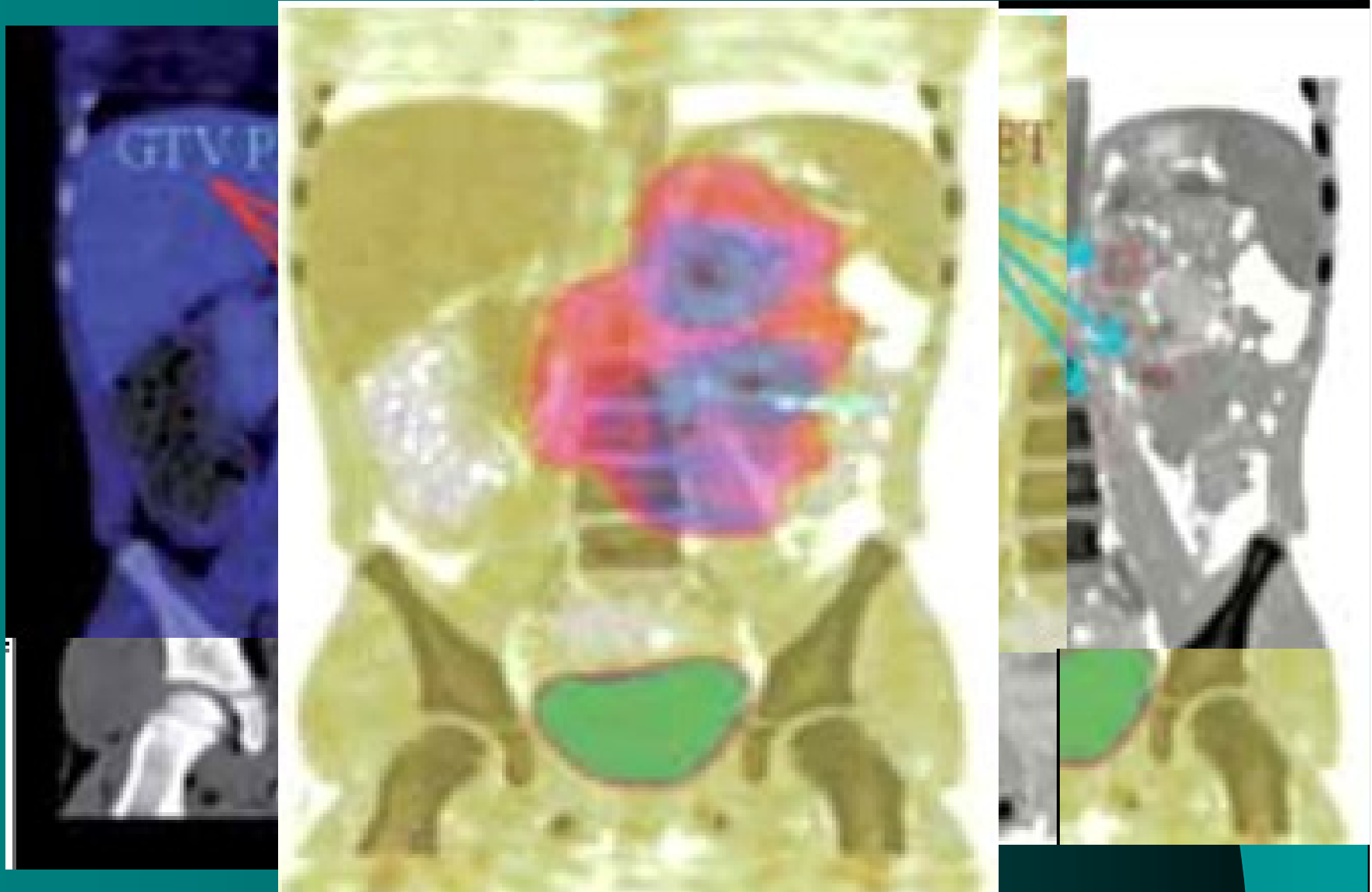


# Pre - treatment imaging



- *lung on CT*
- *lung on PET*

# *images registration*



# *Imaging for treatment verification*

- *geometry verification*

- *Patient position during the treatment which affect intra-fraction dose distribution*
-

# Imagin

- **LUNG**
- **kV**
- **CB**

Plan Tree Image Gallery Transversal - CT\_1 - CBCT\_1 - 3/12/2014 13:35 3D/3D Match

Reference: setupCBC...

Head First, Supine  
Z: 5.80 cm

Couch Position (IEC 61217 Scale) and Shift

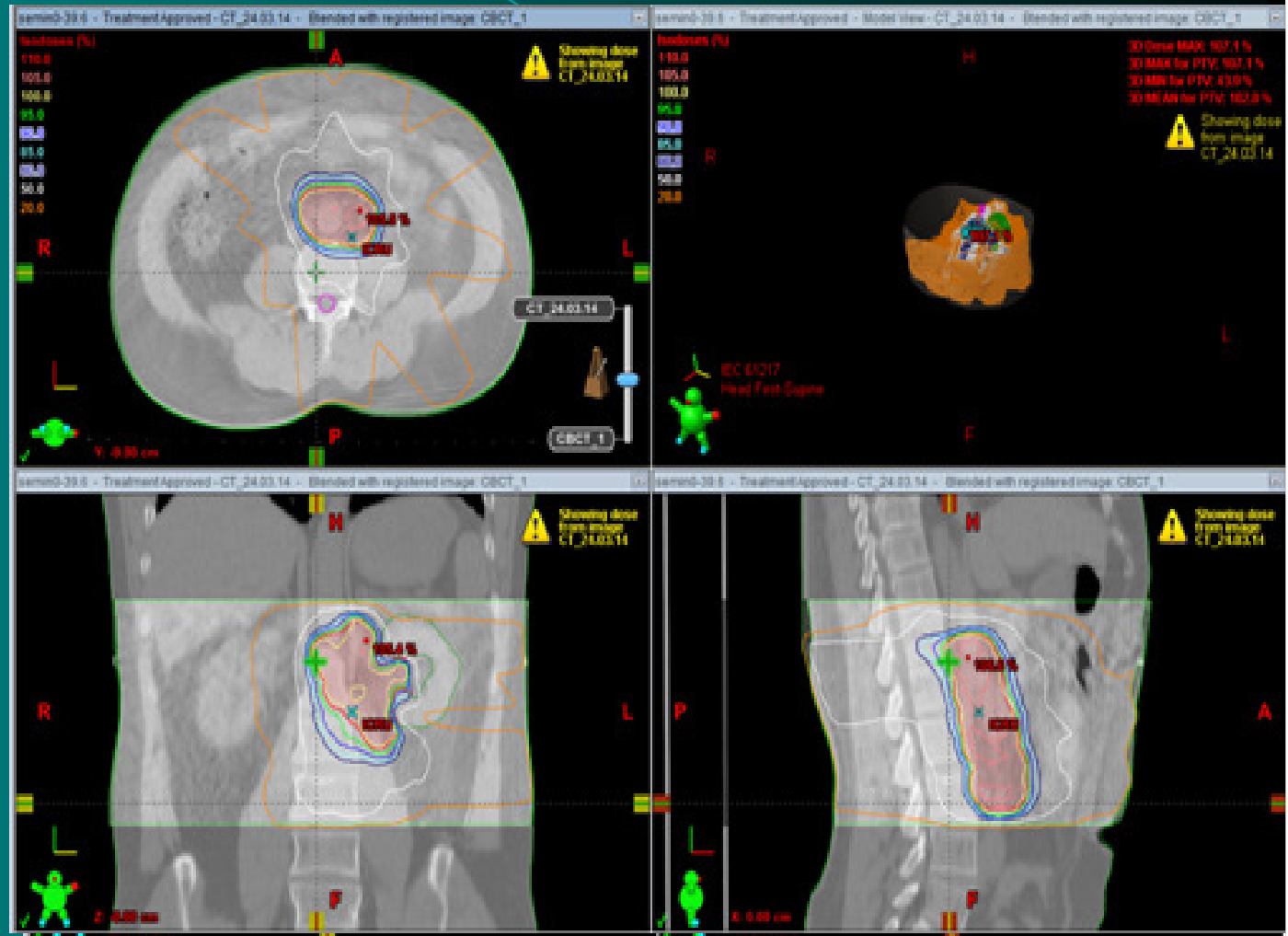
	TARGET	ACTUAL	SHIFT		TARGET	ACTUAL	SHIFT	
Couch Vrt	-8.5	-8.9	+0.4	<input checked="" type="checkbox"/> Include	Couch Lat	+4.3	+4.2	+0.1 <input checked="" type="checkbox"/> Include
Couch Lng	131.9	131.8	+0.1	<input checked="" type="checkbox"/> Include	Couch Rtn	359.9	359.9	0.0 <input type="checkbox"/> Include

Reset Shift  
Save Match  
Apply Shift



# Imaging for treatment evaluation

- *CBCT verification plan*



## ***Conclusion:***

PET scan is revolution on tumor tissue recognizing

PET- CT scan is even more

The imaging of biologic inhomogeneities within sub volumes of the tumor may offer the possibility to adapt doses to local differences in radiosensitivity.

## ***Conclusion:***

All set-up and patient positioning tools currently used in the radiation oncology department on simulators and linear accelerators should be equally conscientiously used in the PET suite when images are acquired for treatment planning.

All quality controls required in the radiation therapy process, particularly those for geometrical alignment between all parts of the radiotherapy chain, must also include the PET scanner.



