Surgical Planning Laboratory
Brigham and Women's Hospital
Boston, Massachusetts USA

a teaching affiliate of
Harvard Medical School

3D VISUALIZATION OF DICOM IMAGES FOR RADIOLOGICAL APPLICATIONS

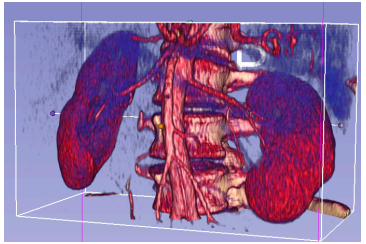
Sonia Pujol, PhD
Brigham and Women's Hospital, Harvard Medical School

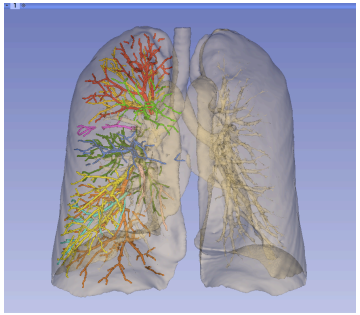
Kitt Shaffer, MD, PhD
Boston University School of Medicine

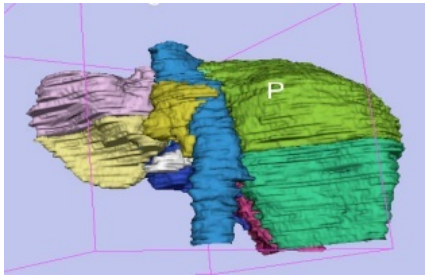
Ron Kikinis, MD,
Brigham and Women's Hospital, Harvard Medical School

3D Visualization of DICOM images for Radiological applications

Following this tutorial, you will be able to load and visualize DICOM volumes with 3D Slicer, and to interact in 3D with structural images and models of the anatomy.

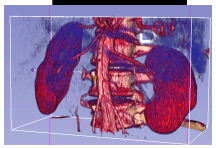






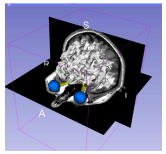
Overview

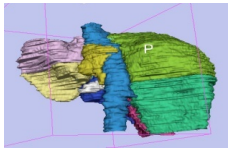
Part I: Introduction to the 3D Slicer software



Part II: 3D Data Loading and visualization of DICOM images

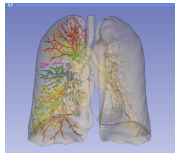
- Volume Rendering of thoraco-abdominal CT data
- Surface Rendering of MR head data





Part III: 3D interactive exploration of the anatomy

- Exploration of the Segments of the liver
- Exploration of the Segments of the lung



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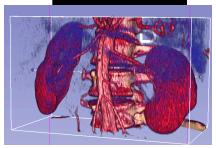

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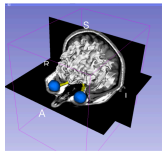

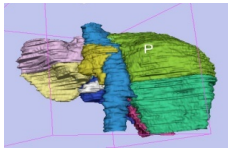

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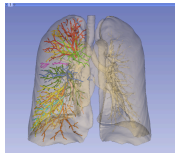
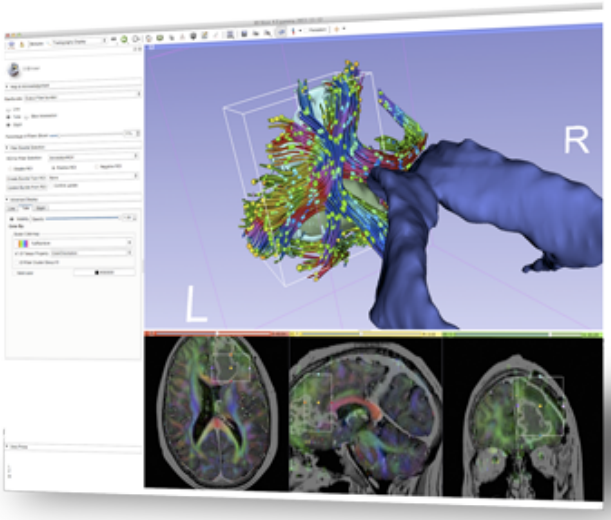
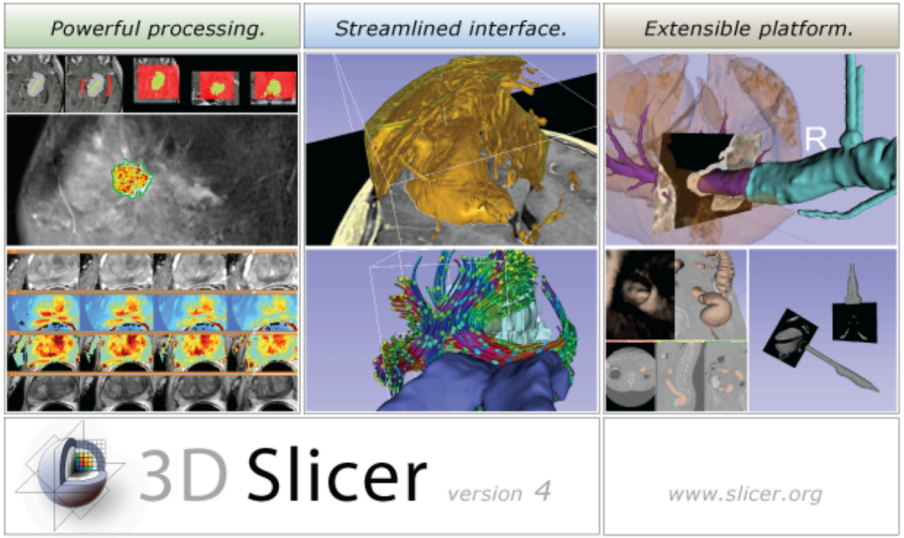


Introduction to the 3D Slicer software



3D Slicer



3D Slicer is a freely available open-source platform for segmentation, registration and 3D visualization of medical imaging data.

3D Slicer is a multi-institutional effort supported by the National Institute of Health.

3D Slicer History

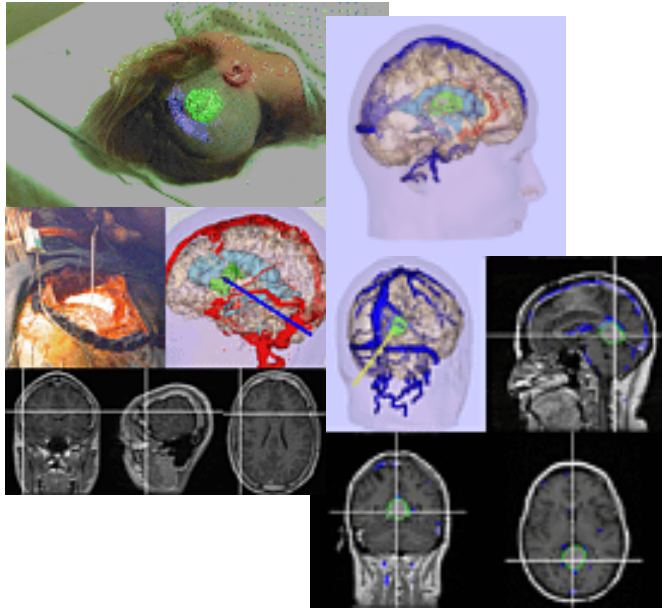
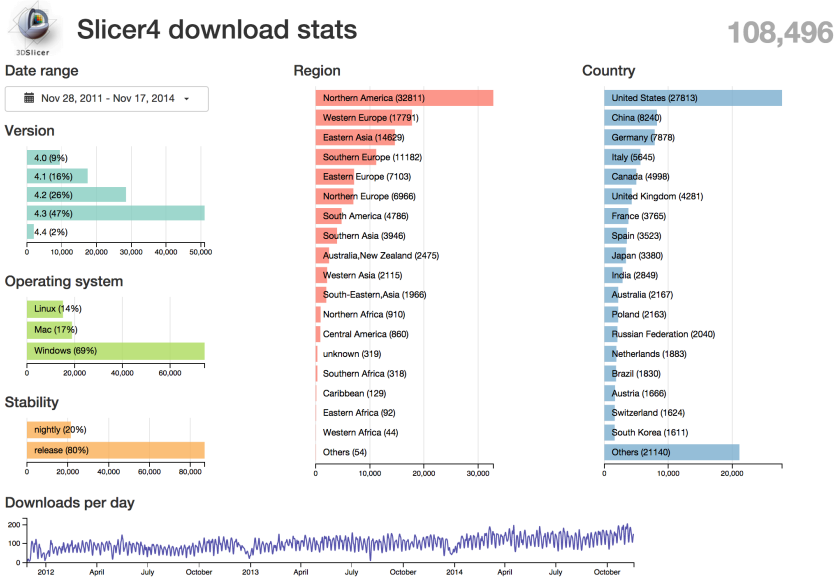


Image Courtesy of the CSAIL, MIT

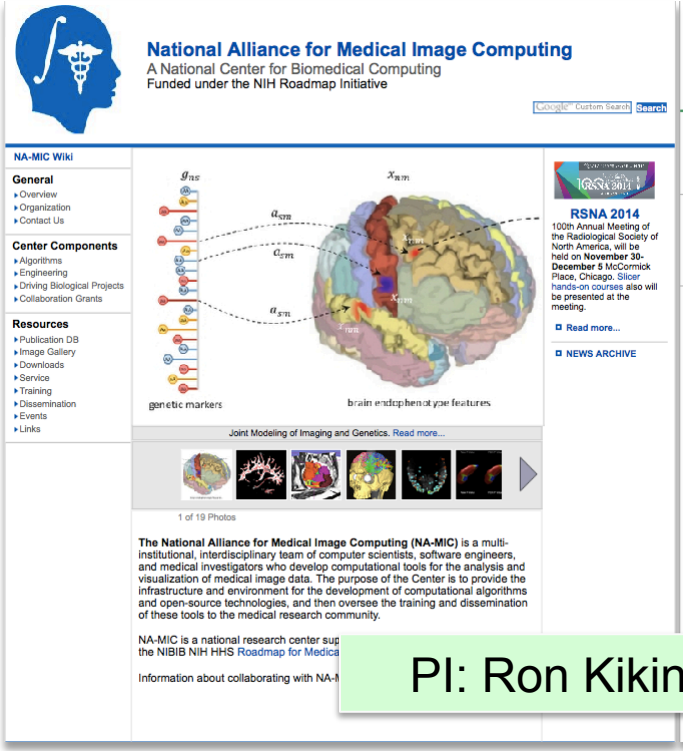
- 1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)

3D Slicer History

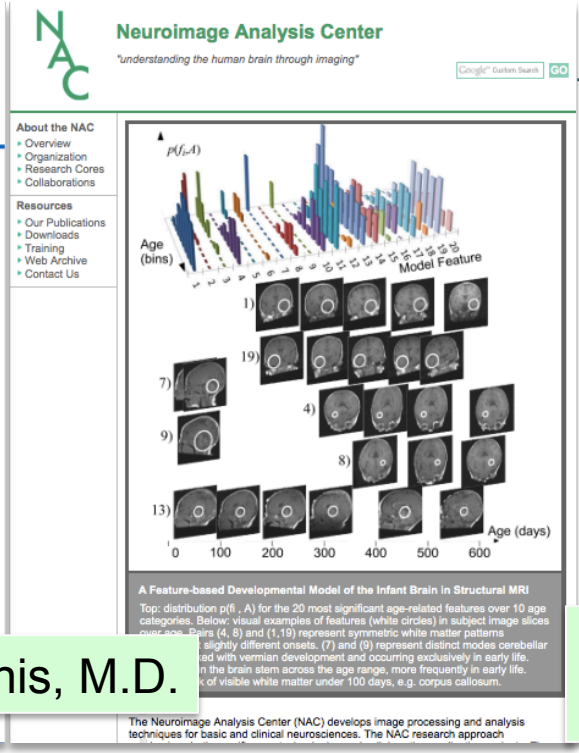


- 1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)
- 2014: Slicer is a multi-institution effort to share the latest advances in image analysis with the clinical & scientific community

A multi-institution: NA-MIC, NAC, NCIGT



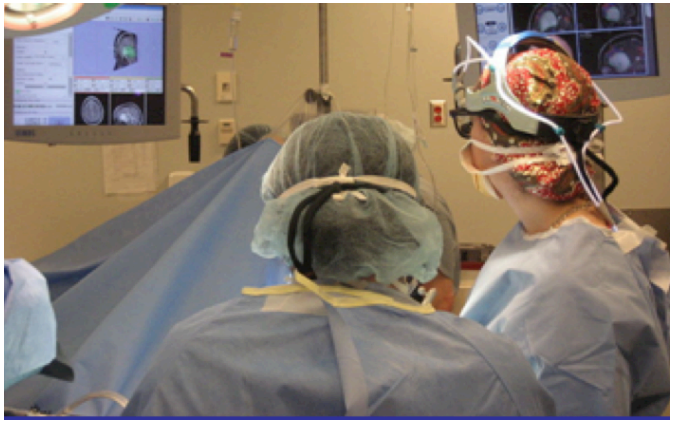
PI: Ron Kikinis, M.D.



PIs: Ferenc Jolesz, M.D., Clare Tempany, M.D.

An interdisciplinary platform

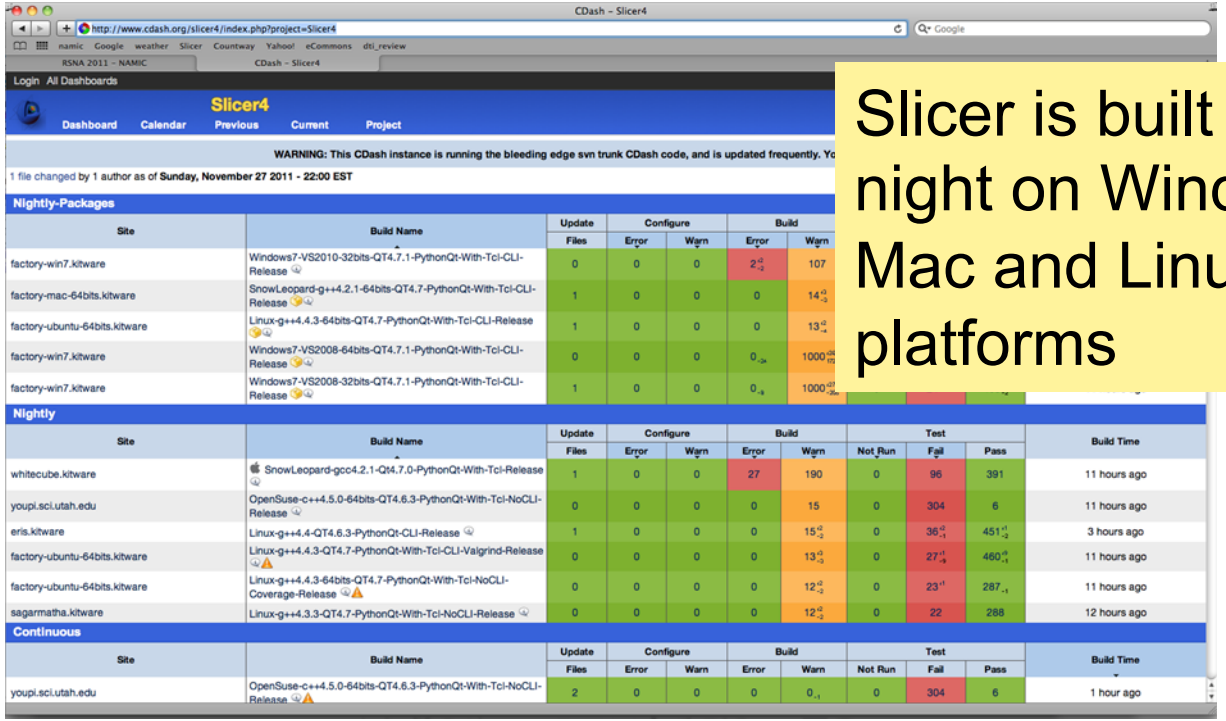
An open-source environment for software developers



An end-user application for clinical investigators and scientists

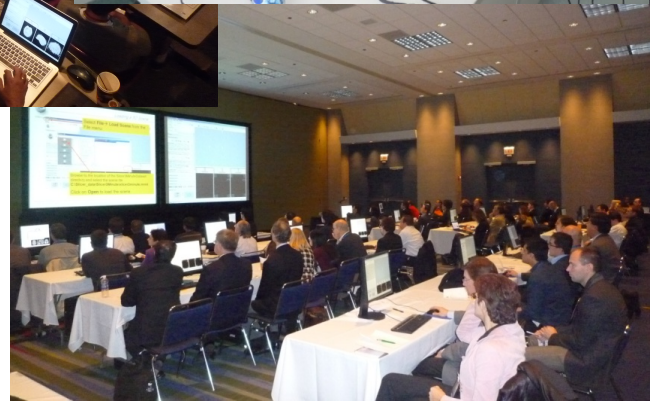
A software platform that is both easy to use for clinical researchers and easy to extend for programmers

Slicer: Behind the scenes



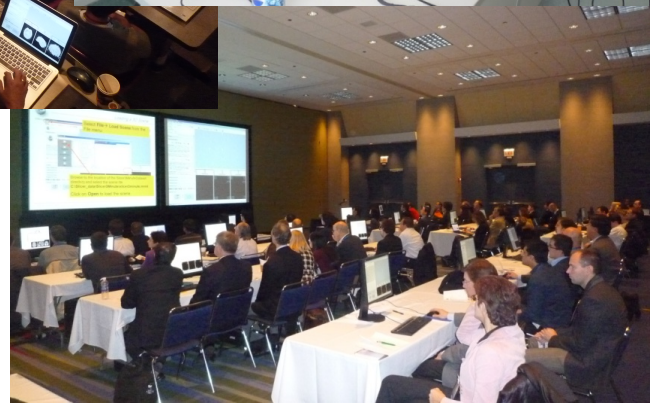
Slicer is built every night on Windows, Mac and Linux platforms

Slicer Training events



- Hands-on training workshops at national and international venues
- More than 3,500 clinicians, clinical researchers and scientists trained since 2005

Slicer Training events



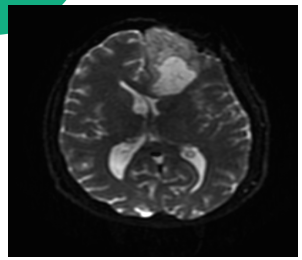
Major international conferences

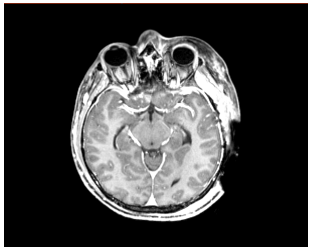
- **RSNA** 2008, 2009, 2010, 2011, 2012, 2013, 2014
- **MICCAI** 2008, 2009, 2011, 2012, 2013, 2014
- **SfN** 2009, 2011
- **SPIE** 2012, 2013
- **CAOS** 2010
- **CARS** 2010, 2012, 2013

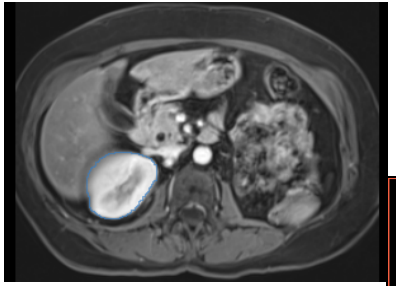
An extensible platform

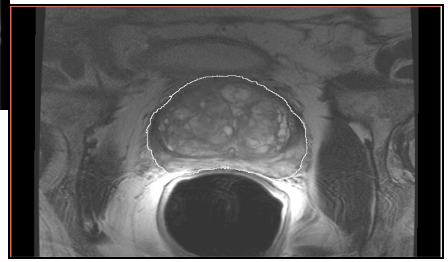
- 3D Slicer supports plug-ins called Slicer extensions available from the Extension Manager
- Allows end-users to select extensions useful to them, without having to download the entire extension archive.
- Built Nightly with Slicer

Slicer clinical applications



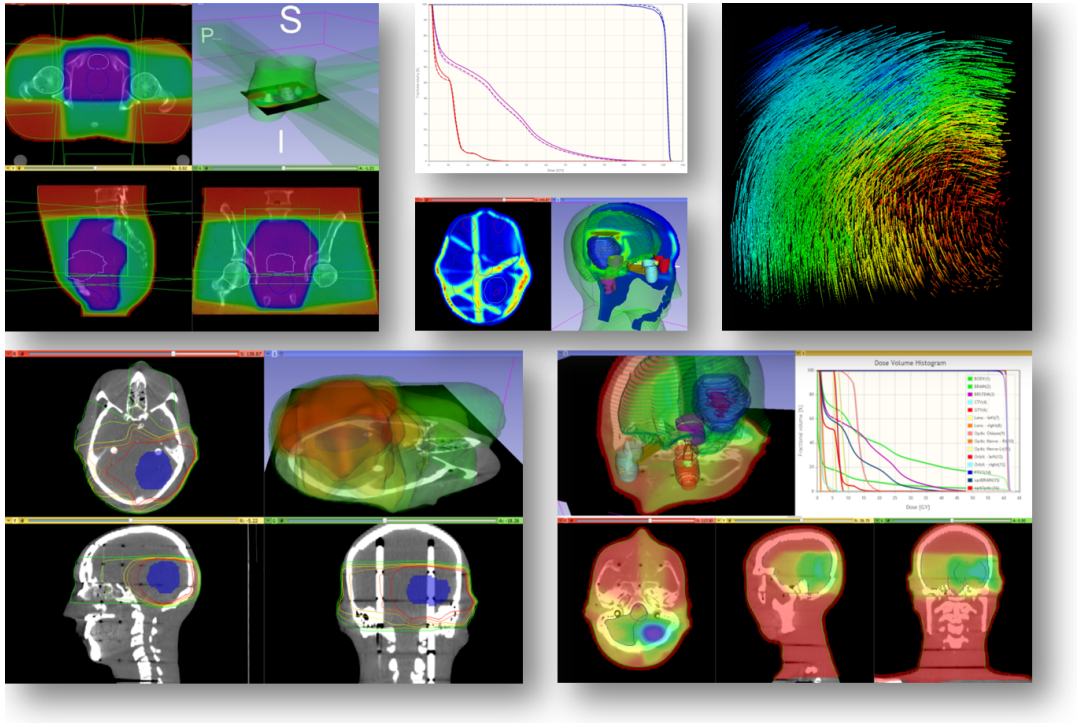






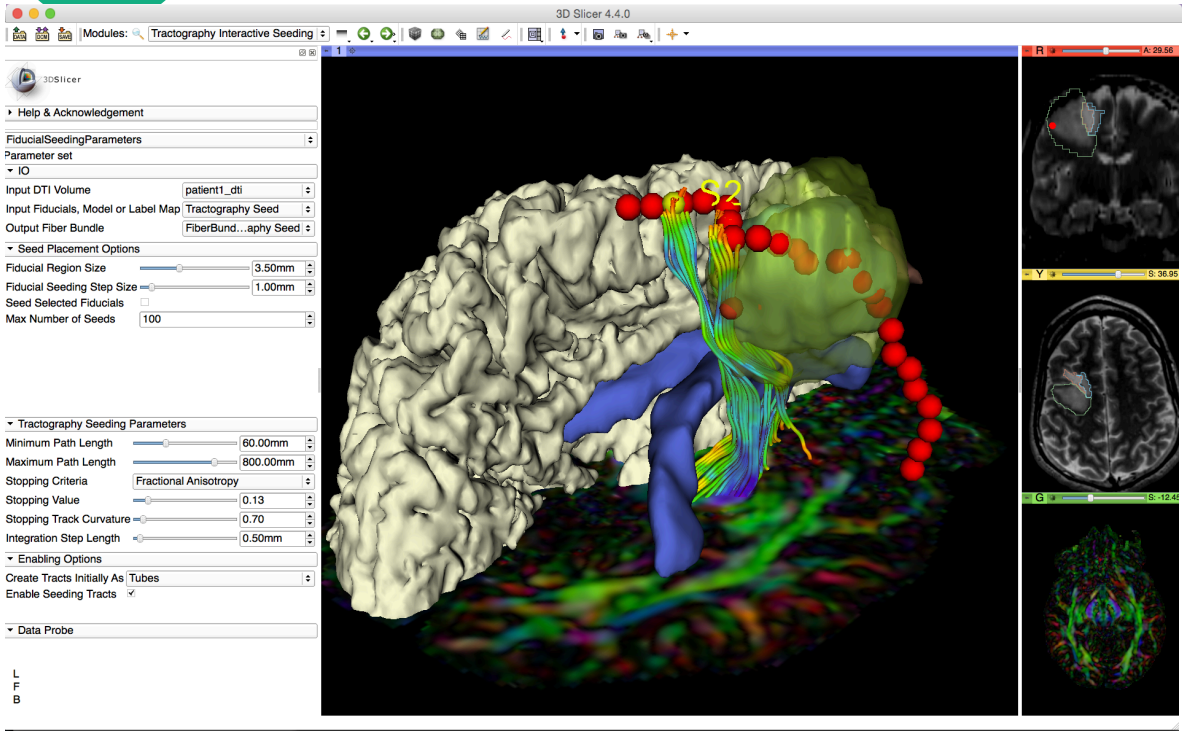
- Applied science oriented toward patient-specific analysis in the presence of pathology
- Driving Biological Projects leading to the development of new tools

Examples of clinical applications



- Radiotherapy: RT-specific analysis dose accumulation and dose comparison (G.Fichtinger et al. Queen's University, Canada)

Examples of clinical applications



- Diffusion Tensor Imaging tractography for neurosurgical planning

Overview

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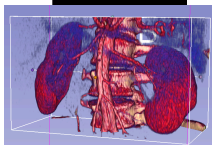

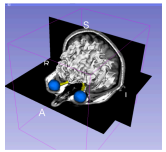

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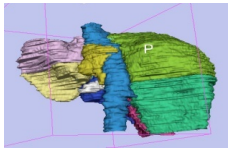

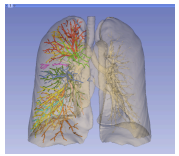

Part III: 3D interactive exploration of the anatomy

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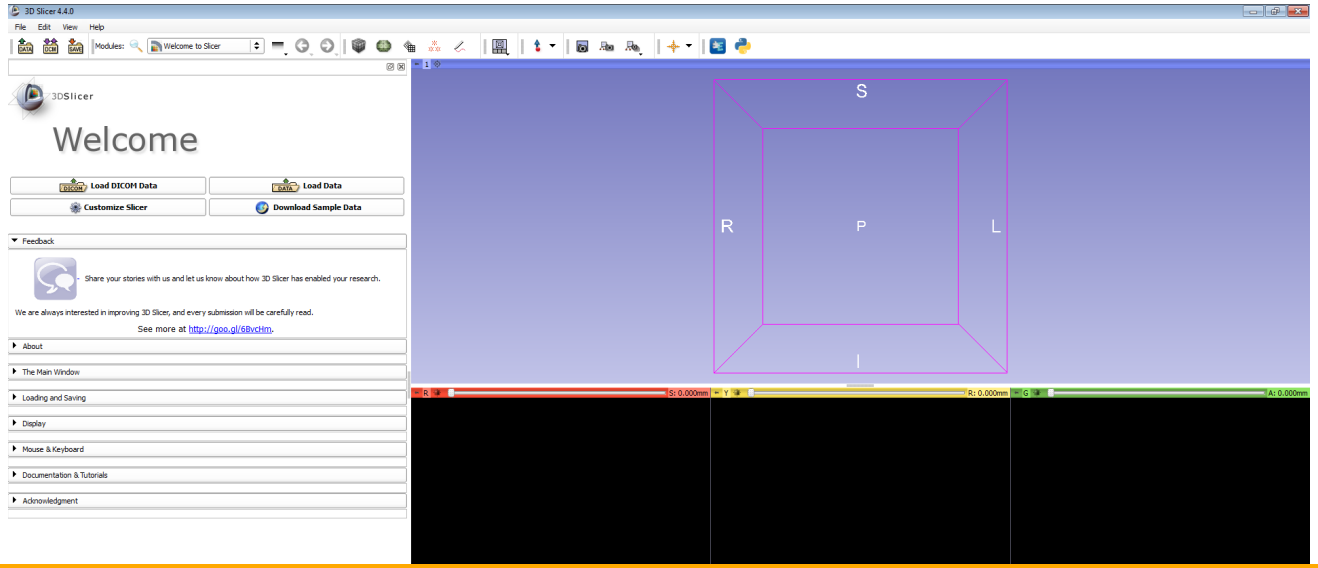
Welcome to Slicer4

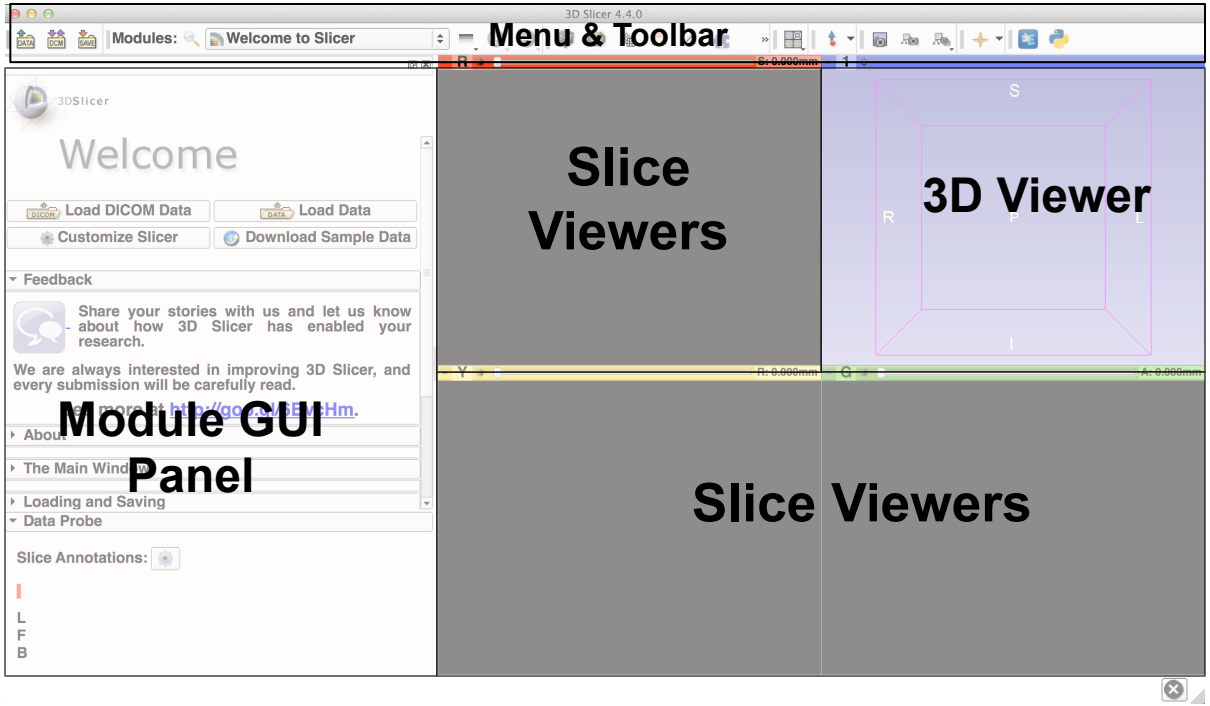


To start Slicer, double-click on the **Slicer-shortcut** icon on the Desktop (bottom left)

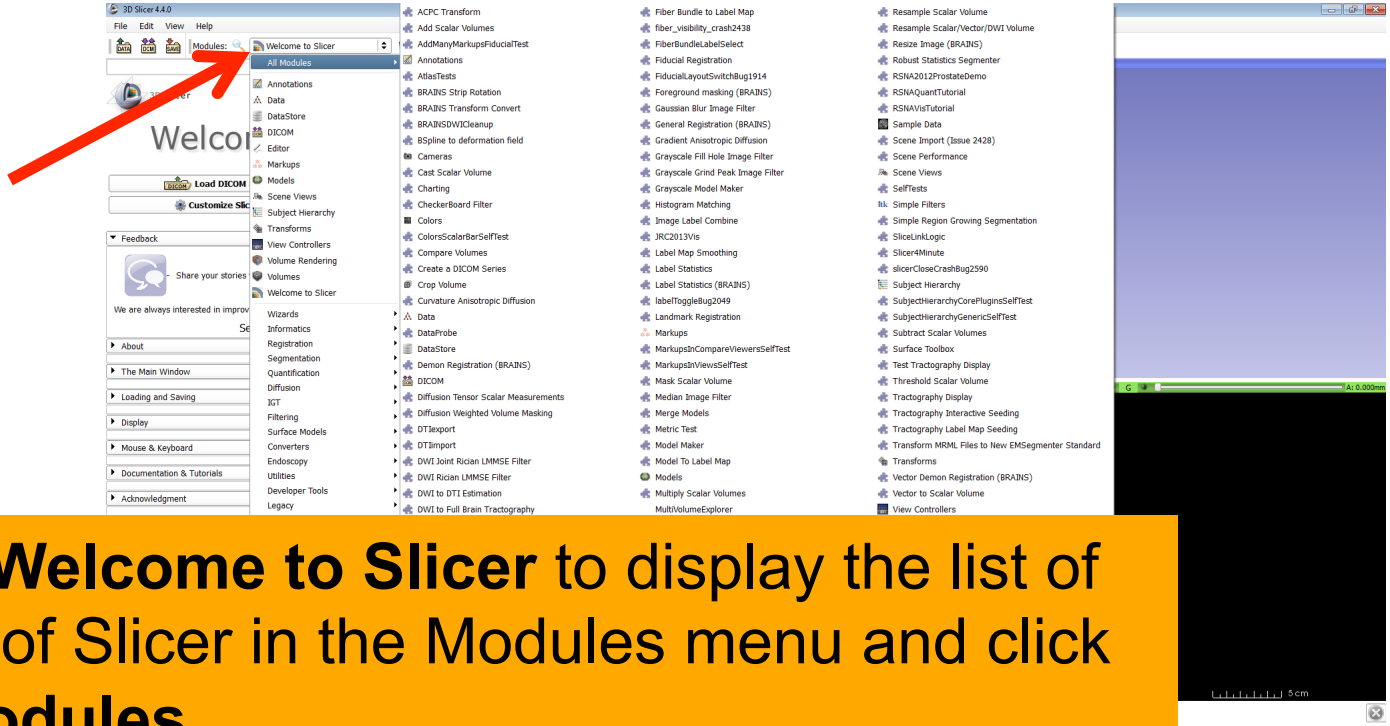
Navigating the Application GUI

The Graphic User Interface (GUI) of Slicer4 integrates **four components:**

- the Menu & Toolbar
- the Module GUI Panel
- the 3D Viewer
- the Slice Viewers

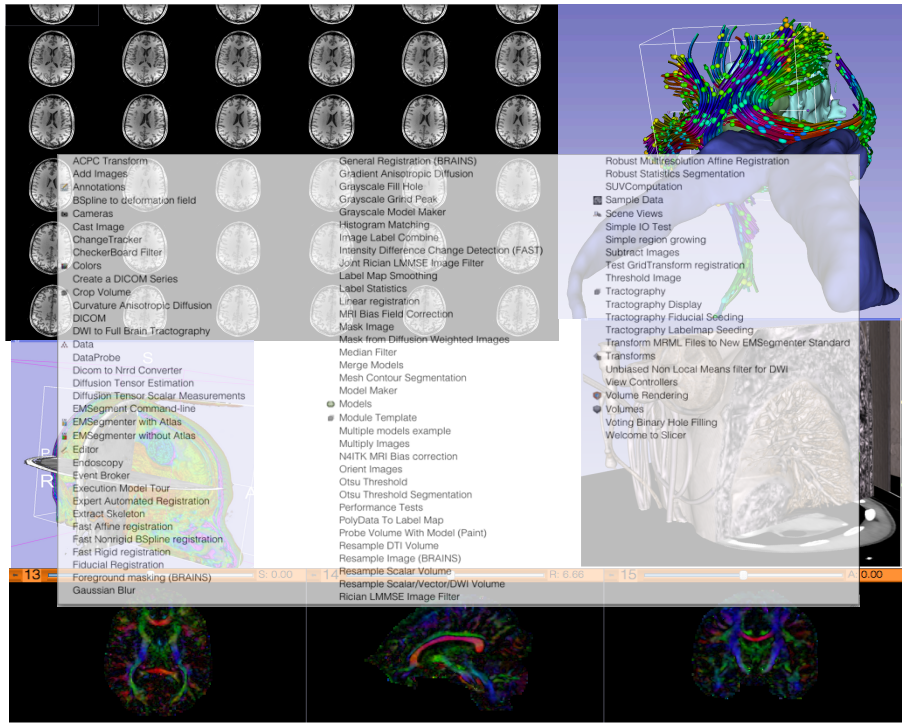


Welcome to Slicer4.4



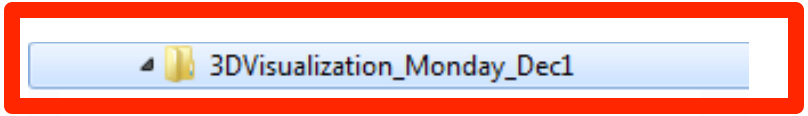
Click on **Welcome to Slicer** to display the list of modules of Slicer in the Modules menu and click on **All Modules**

Welcome to Slicer4.4



Slicer4.4 contains more than 100 modules for image segmentation, registration and 3D visualization of medical imaging data

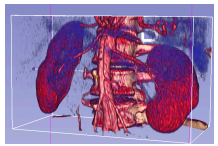
Tutorial datasets

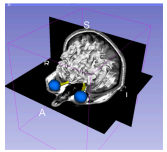


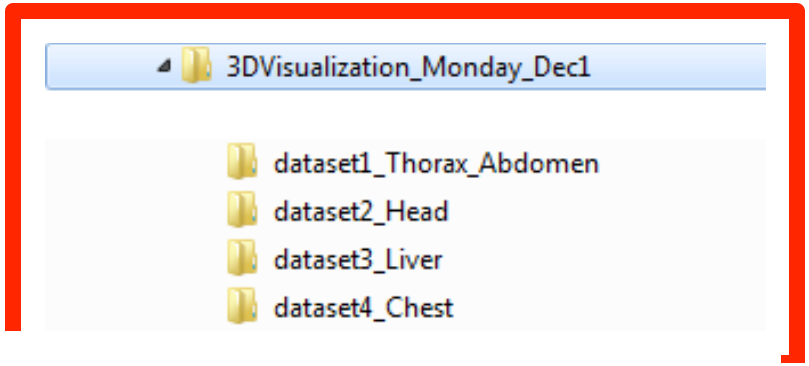
The tutorial datasets are located on the directory **3DVisualization_Monday_Dec1** on the desktop

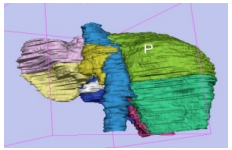
Double-click on the directory to expand it

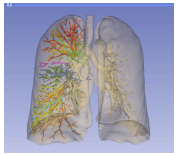
Tutorial datasets



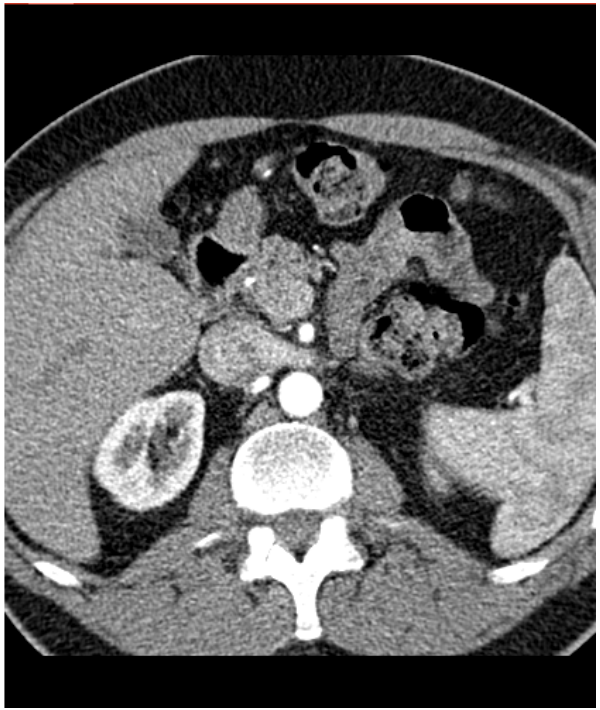








The directory contains 4 datasets that we prepared for this course.

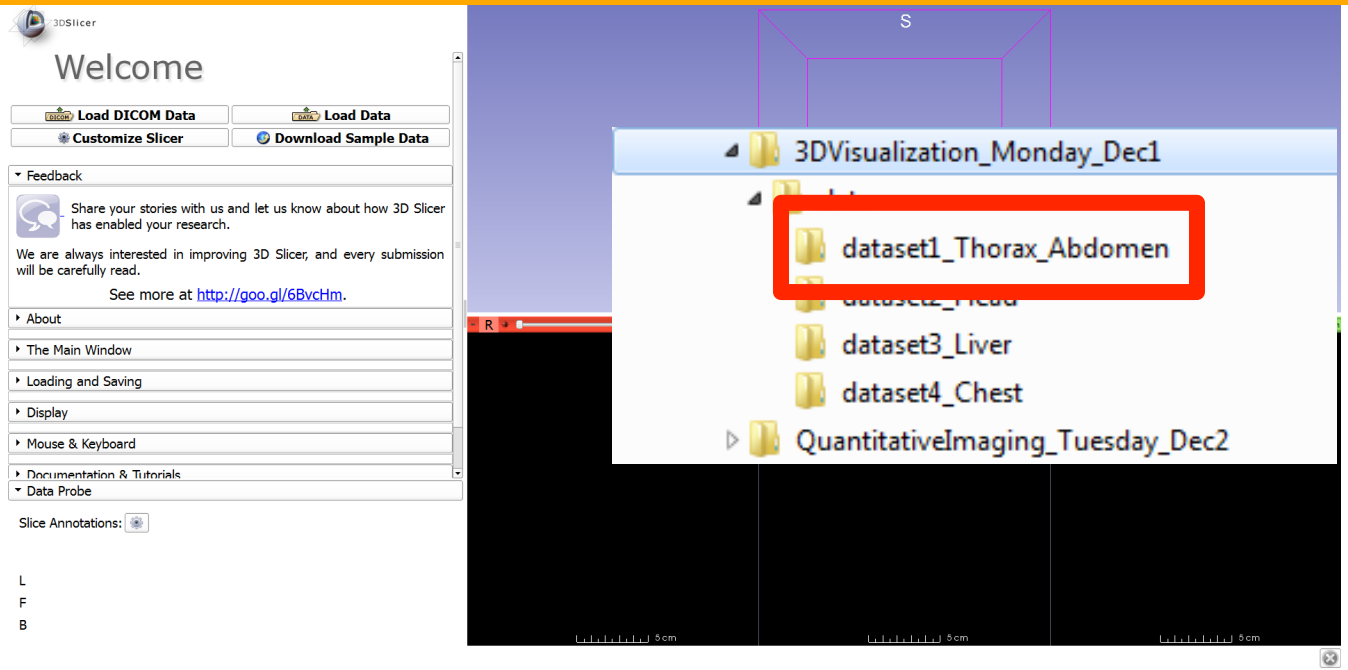


Part 1:

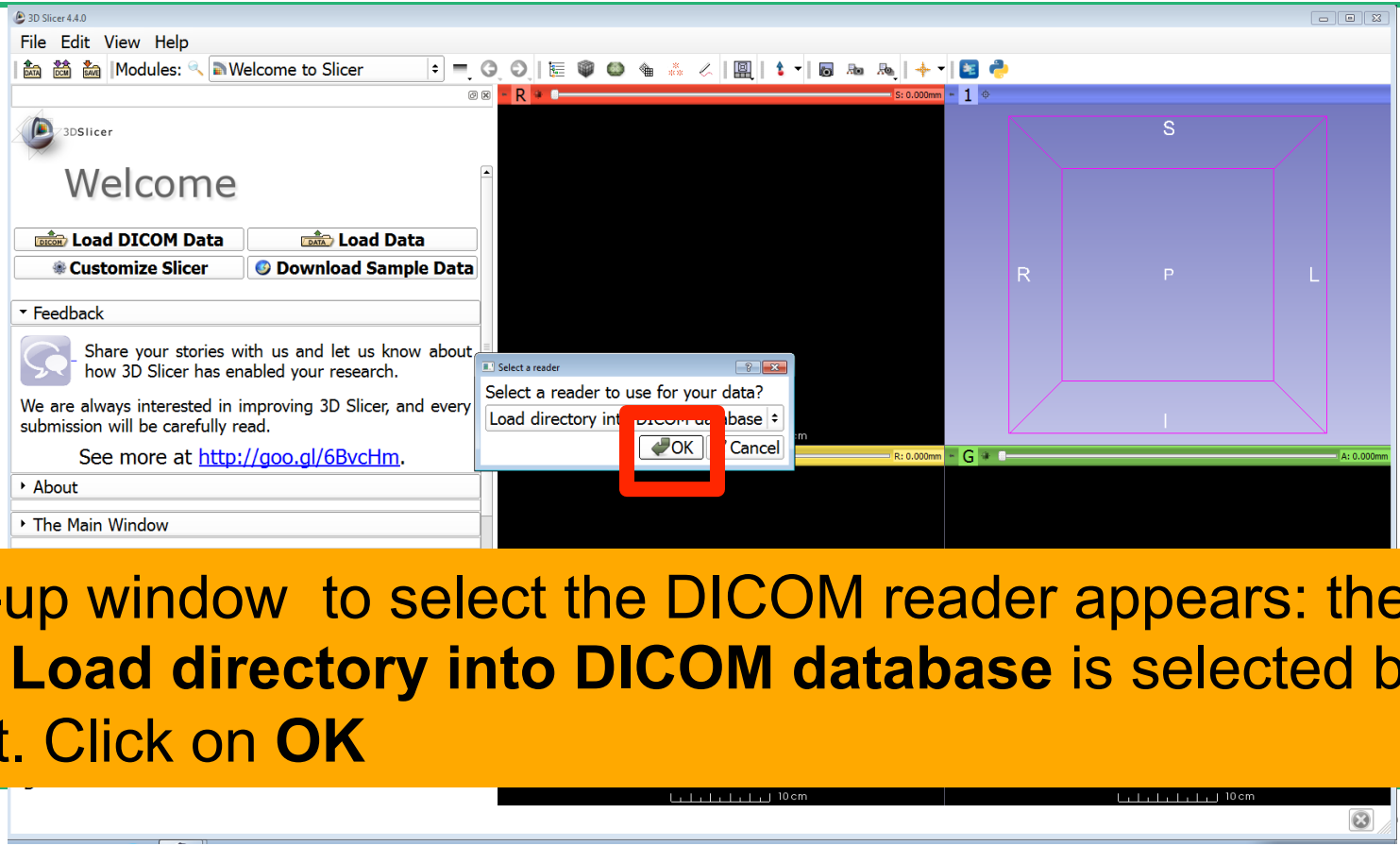
Loading a DICOM Volume

Loading a DICOM volume

Drag and drop the directory **‘dataset1_Thorax_Abdomen’** into Slicer

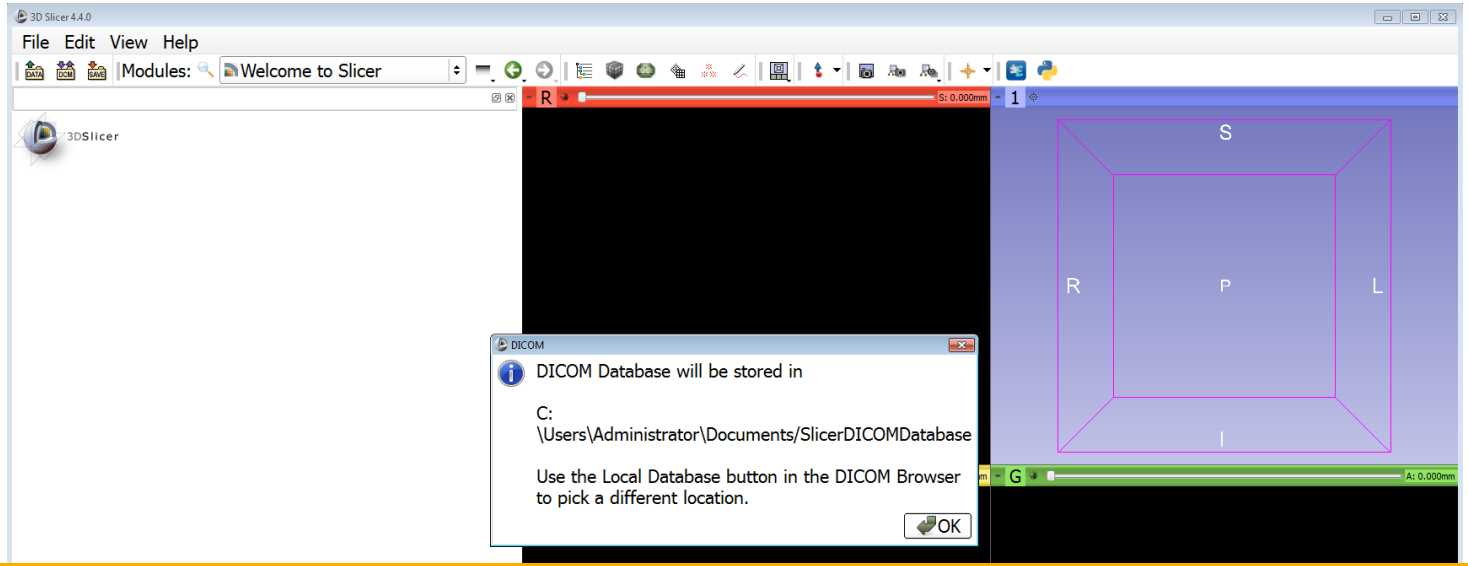


Loading a DICOM volume



A pop-up window to select the DICOM reader appears: the option **Load directory into DICOM database** is selected by default. Click on **OK**

Loading a DICOM volume



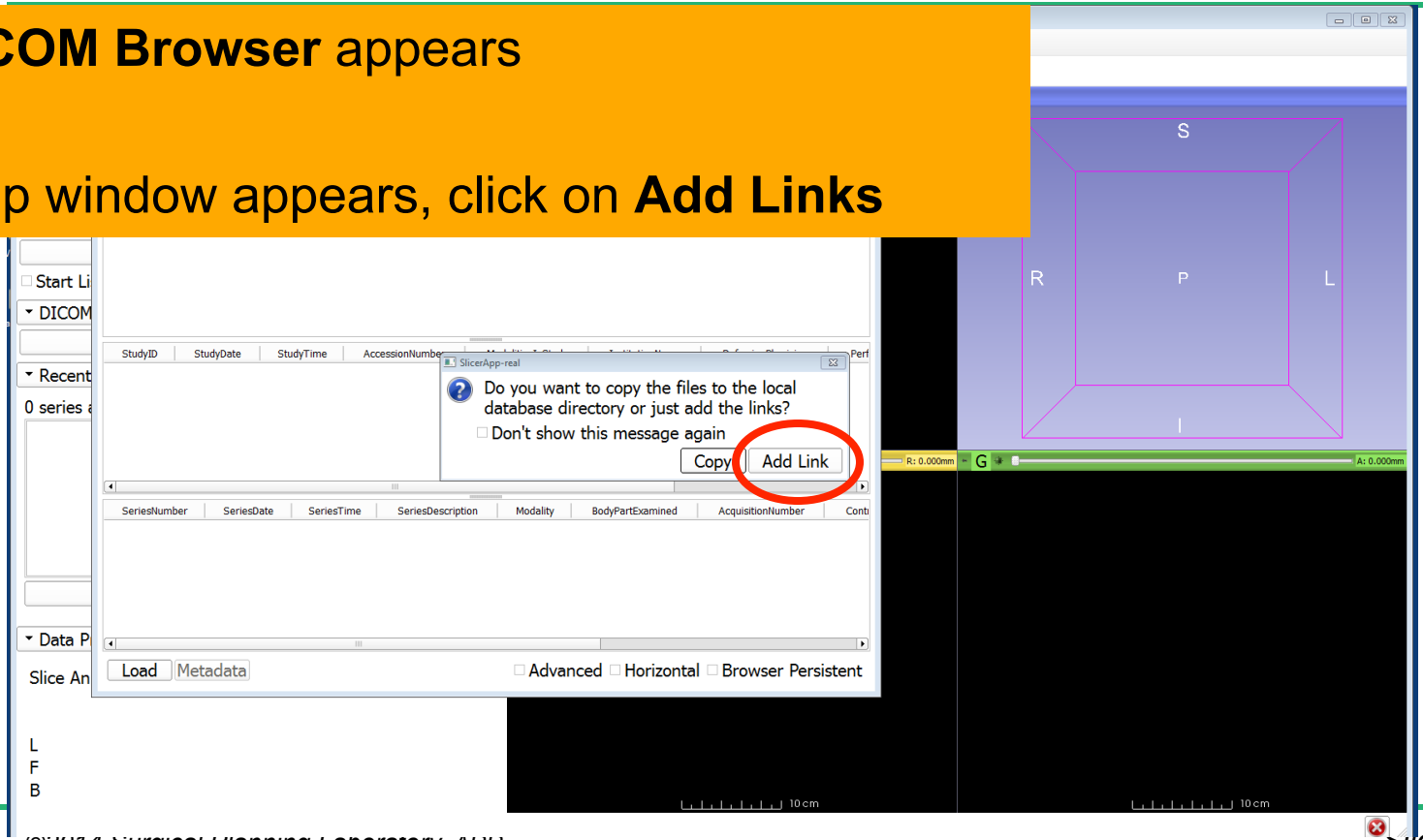
A DICOM pop-up window appears to inform the user where Slicer will store the DICOM Database.

Click on **OK**

Loading a DICOM volume

The **DICOM Browser** appears

A pop-up window appears, click on **Add Links**



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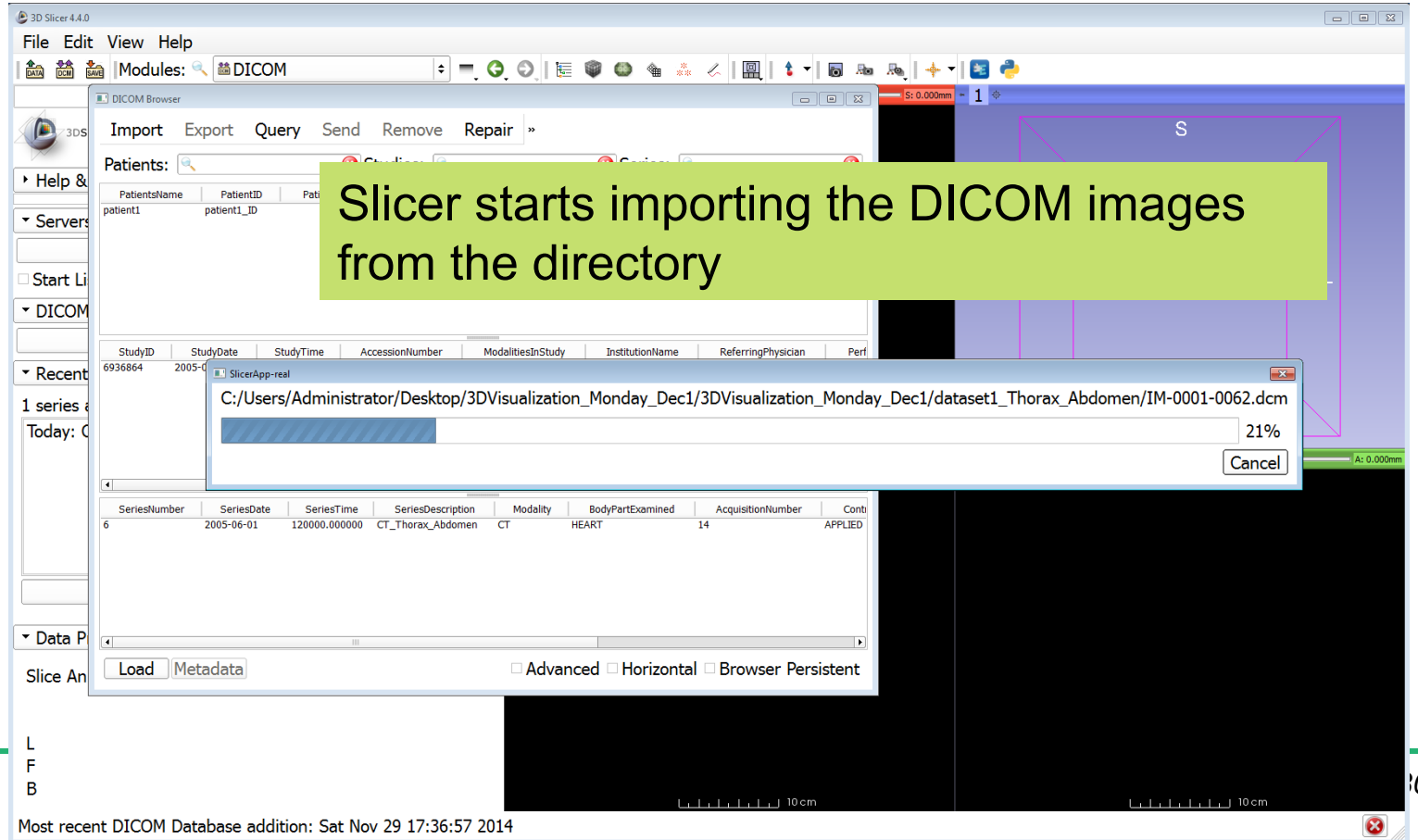

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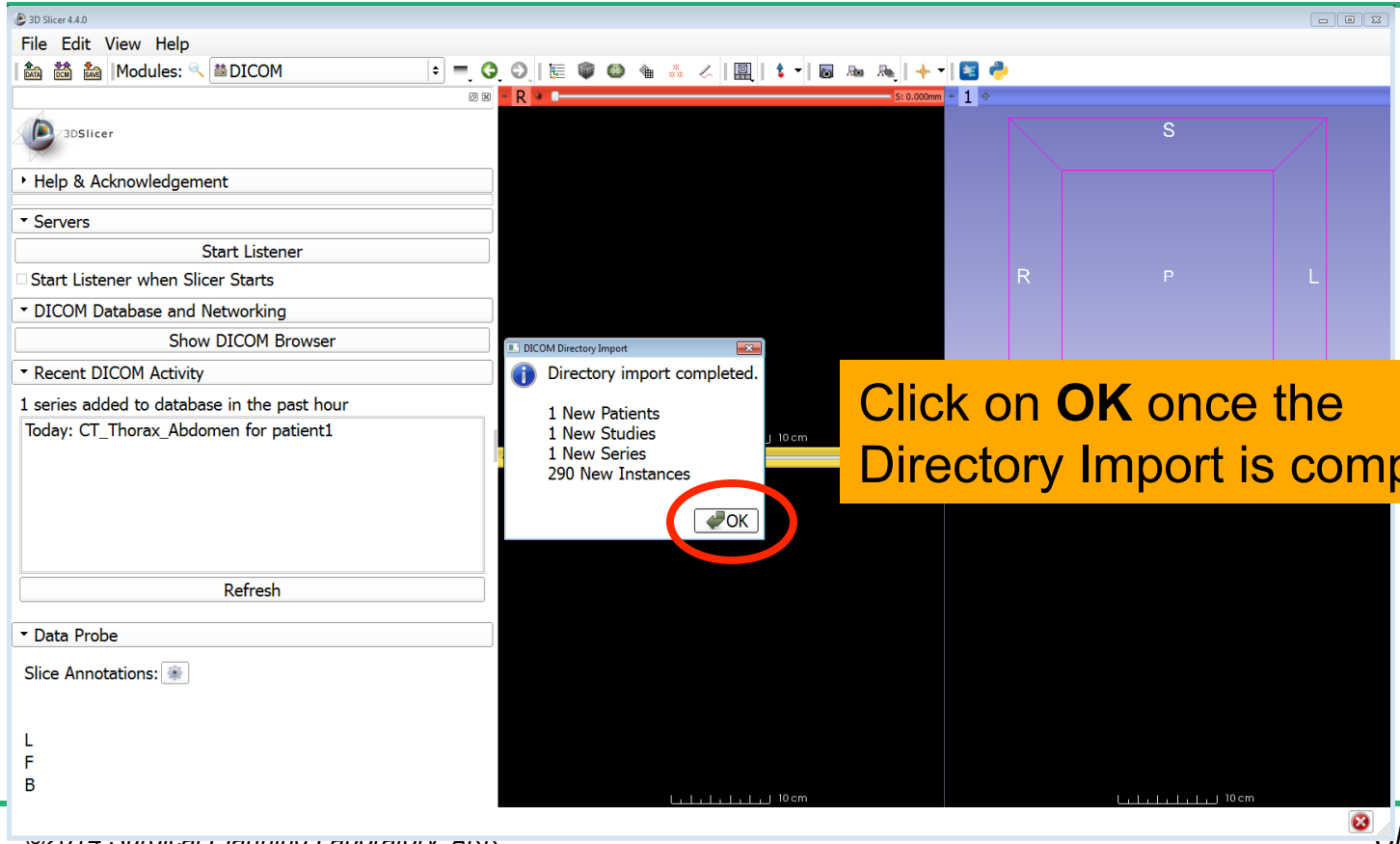
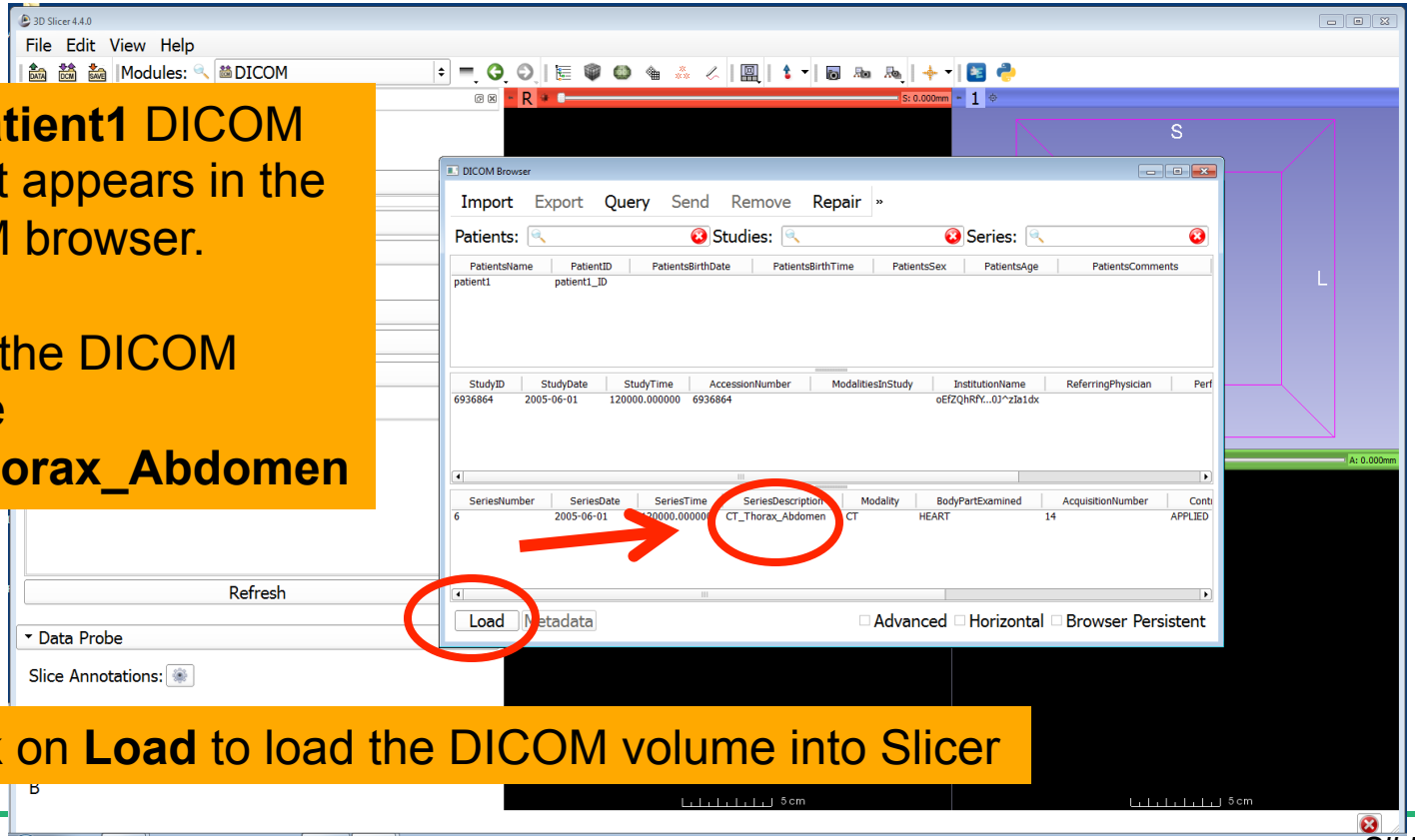


Click on **OK** once the Directory Import is completed

Loading a DICOM volume

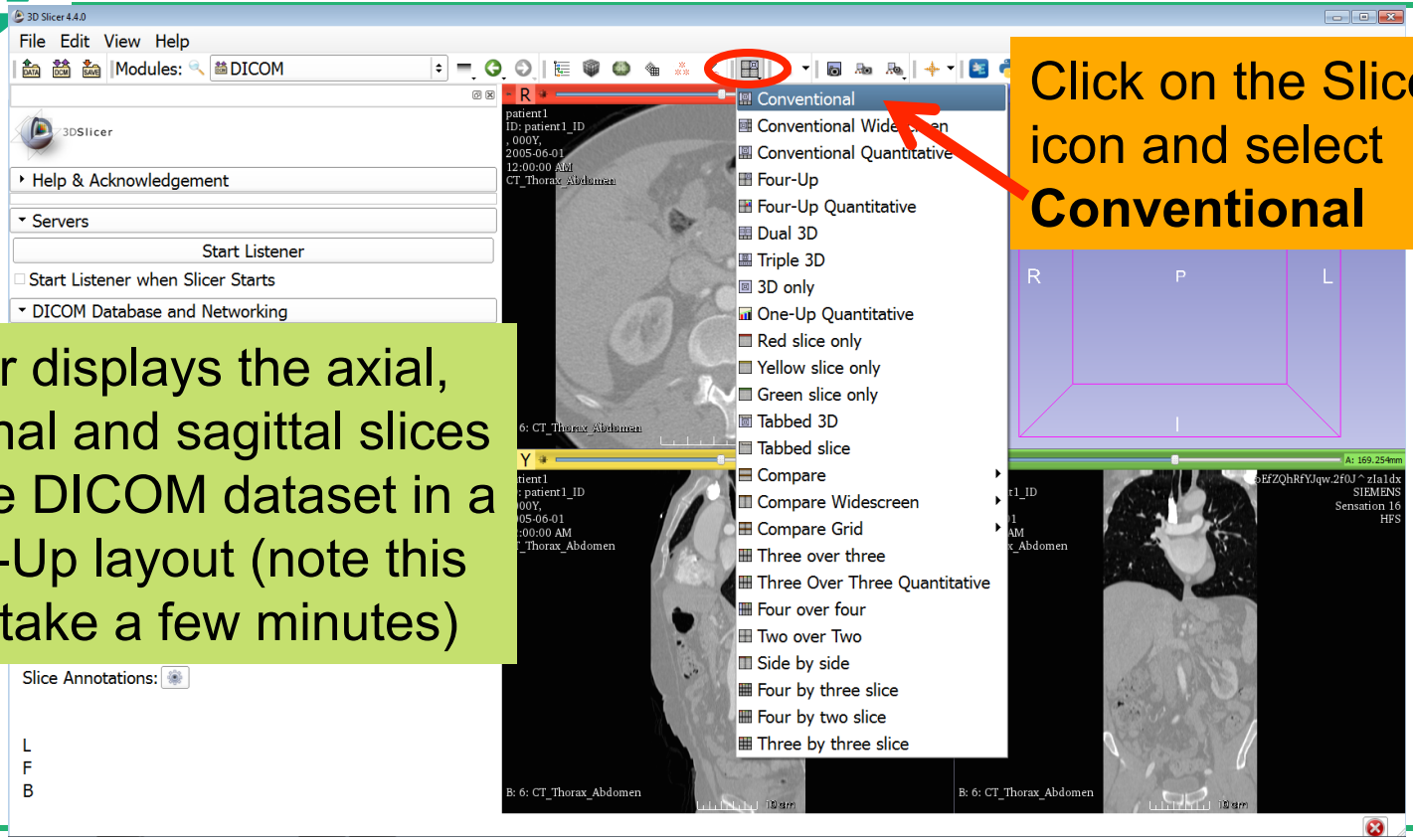
The **patient1** DICOM dataset appears in the DICOM browser.

Select the DICOM volume **CT_Thorax_Abdomen**

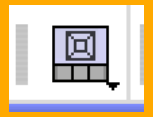


Click on **Load** to load the DICOM volume into Slicer

Loading a DICOM volume

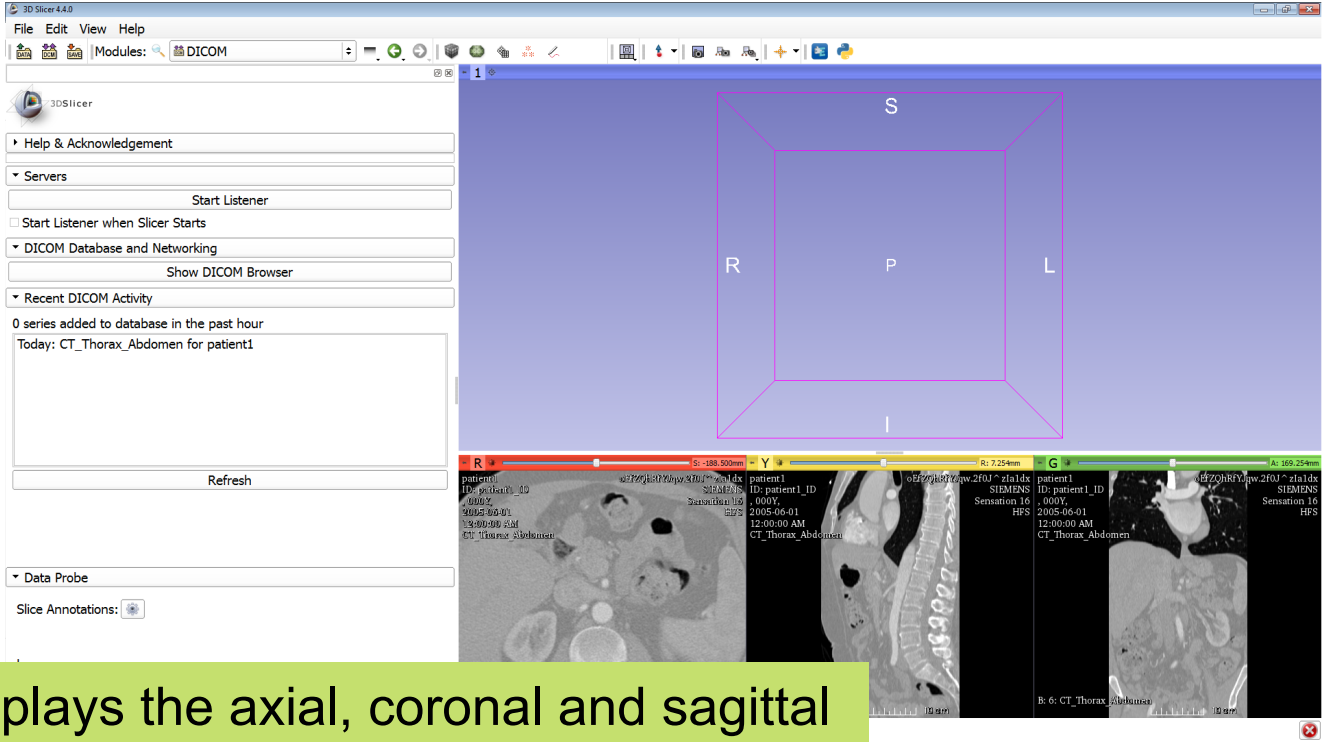


Click on the Slicer layout icon and select **Conventional**



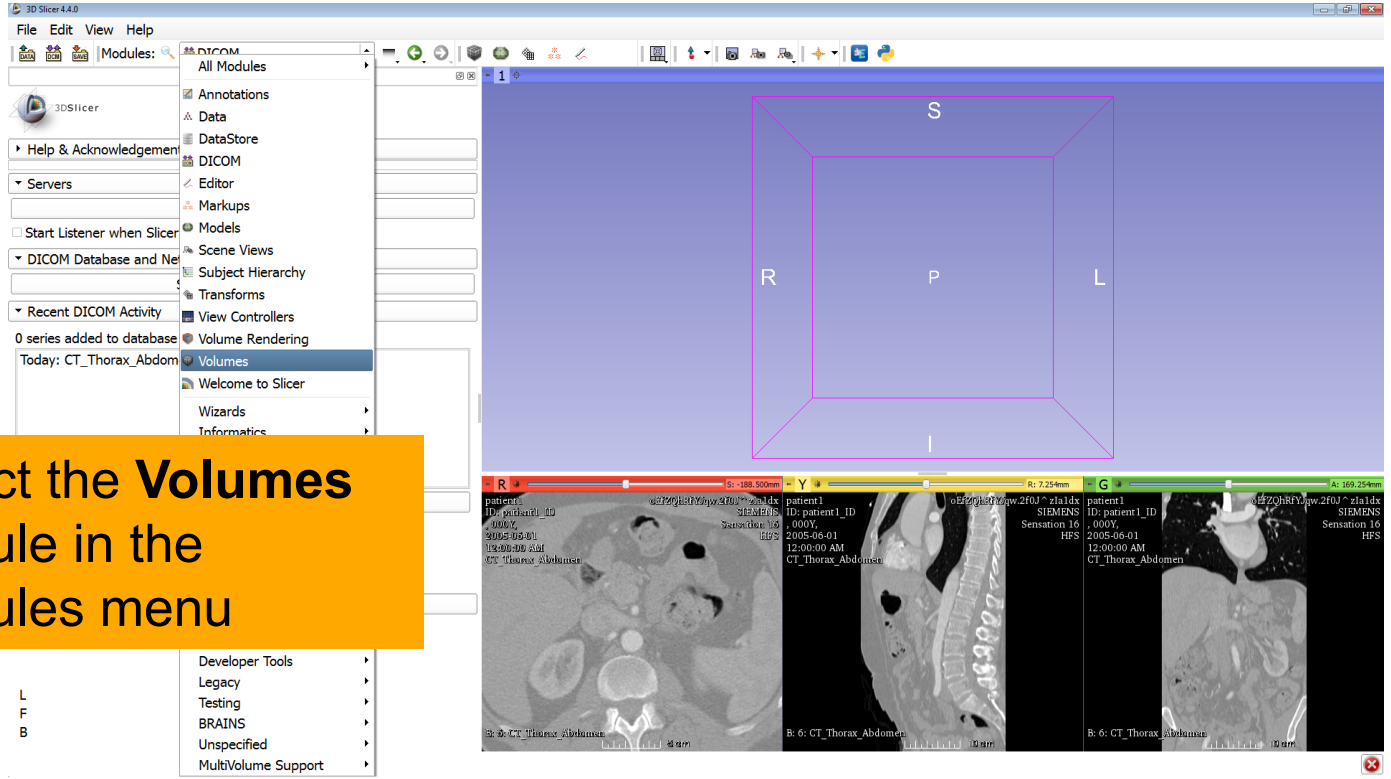
Slicer displays the axial, coronal and sagittal slices of the DICOM dataset in a Four-Up layout (note this may take a few minutes)

Loading a DICOM volume



Slicer displays the axial, coronal and sagittal slices in conventional viewer mode

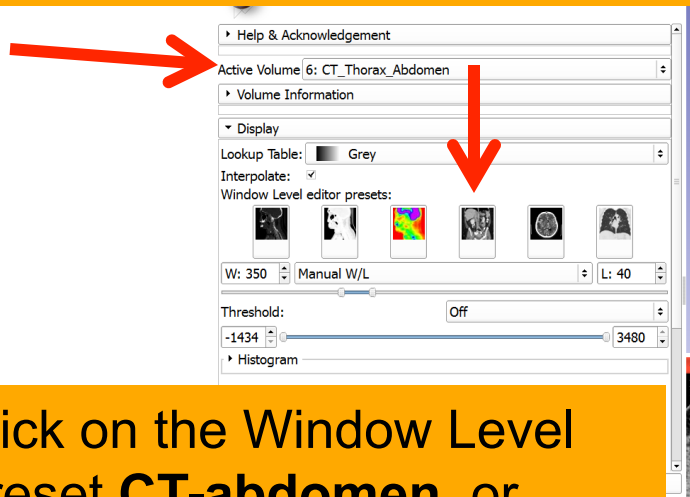
Loading a DICOM volume



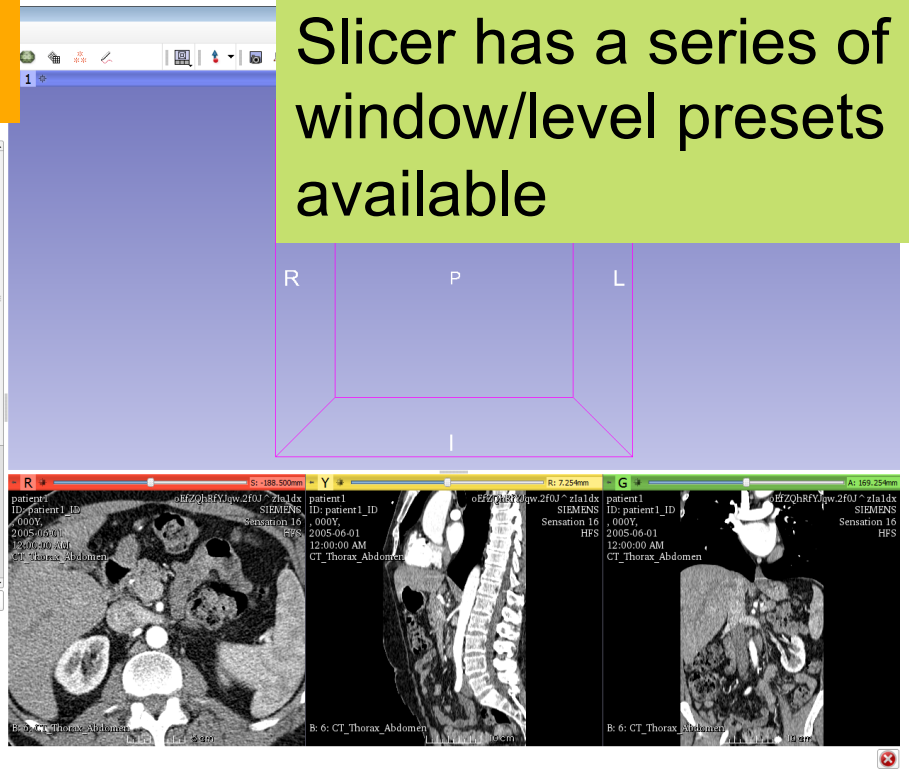
Select the **Volumes** module in the modules menu

Loading a DICOM volume

Select the Active Volume **6:CT_Thorax_Abdomen**



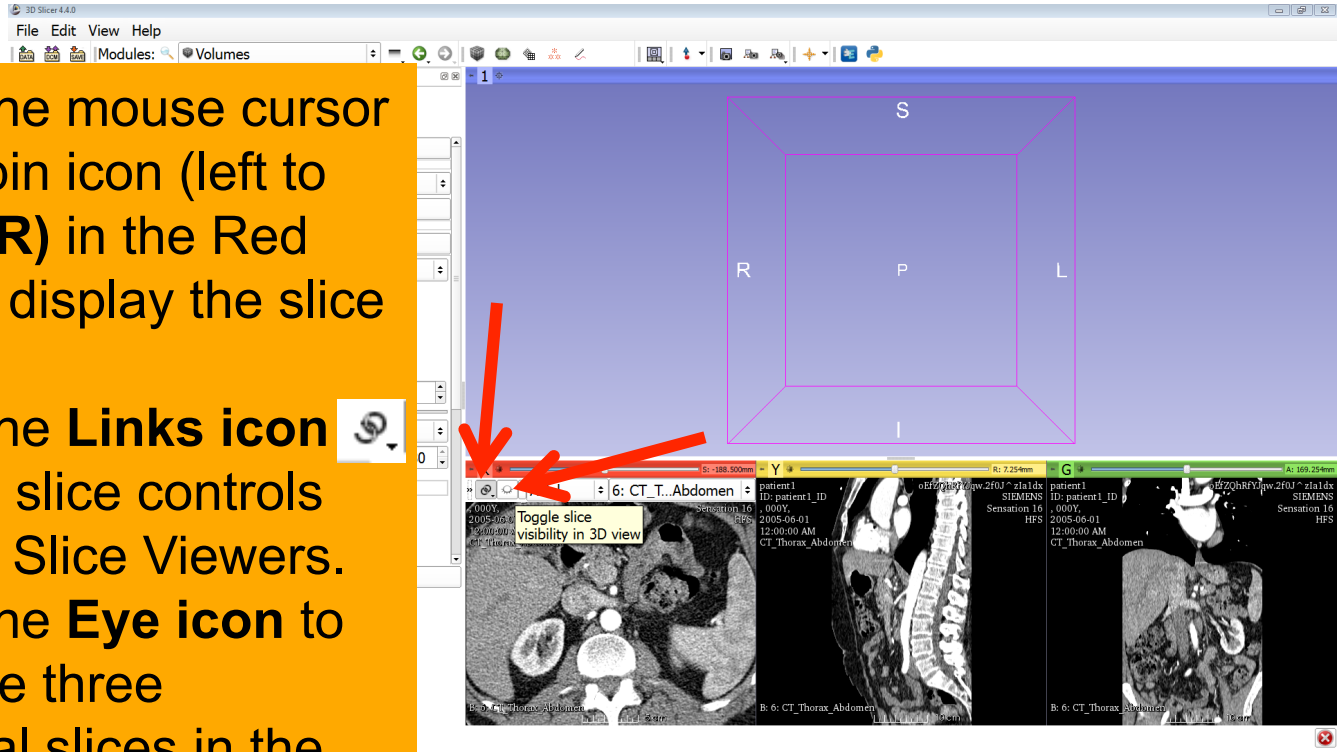
Slicer has a series of window/level presets available



Click on the Window Level Preset **CT-abdomen,** or adjust manually the Window and Level using the Manual W/L slider

Loading a DICOM volume

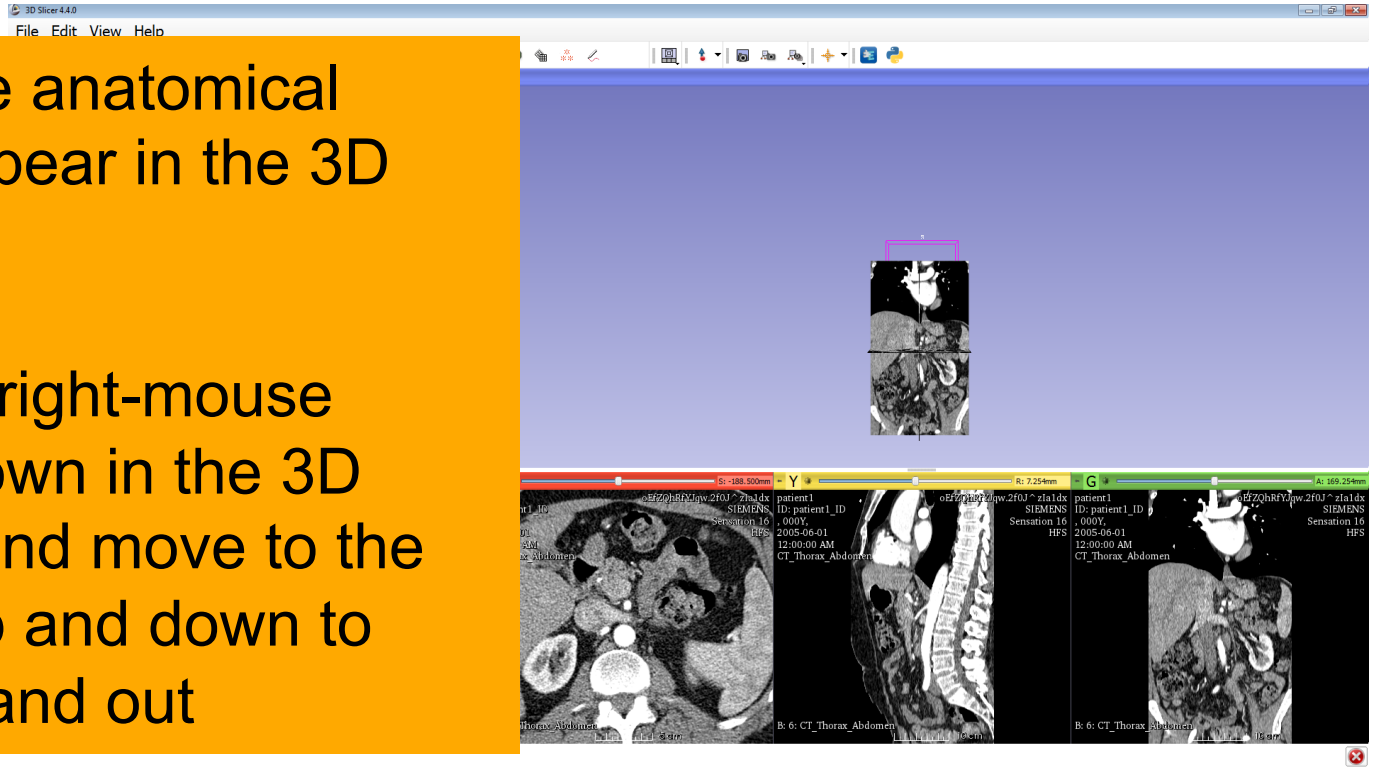
- Position the mouse cursor over the pin icon (left to the letter **R)** in the Red Viewer to display the slice menu.
- Click on the **Links icon** to link the slice controls across all Slice Viewers.
- Click on the **Eye icon** to display the three anatomical slices in the 3D Viewer



Loading a DICOM volume

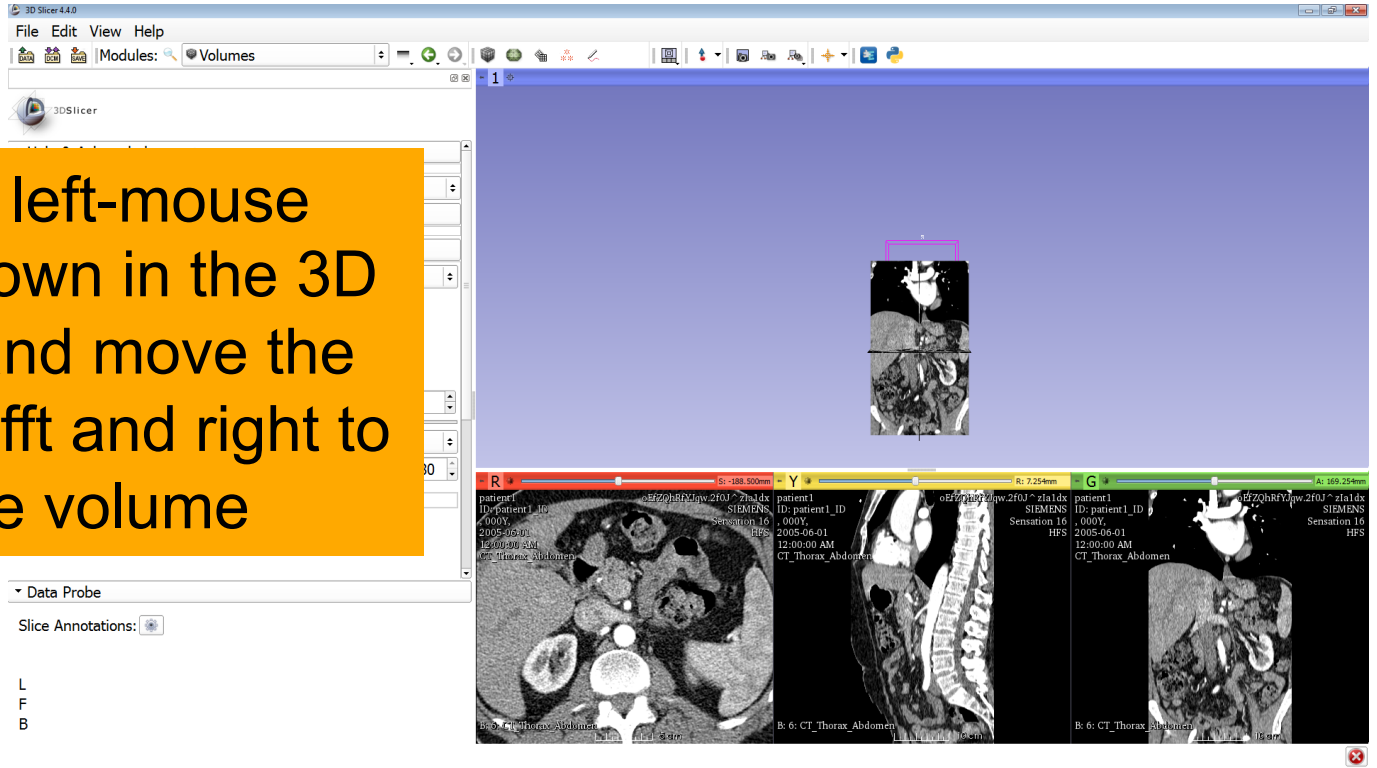
The three anatomical slices appear in the 3D viewer.

Hold the right-mouse button down in the 3D Viewer, and move to the cursor up and down to zoom in and out

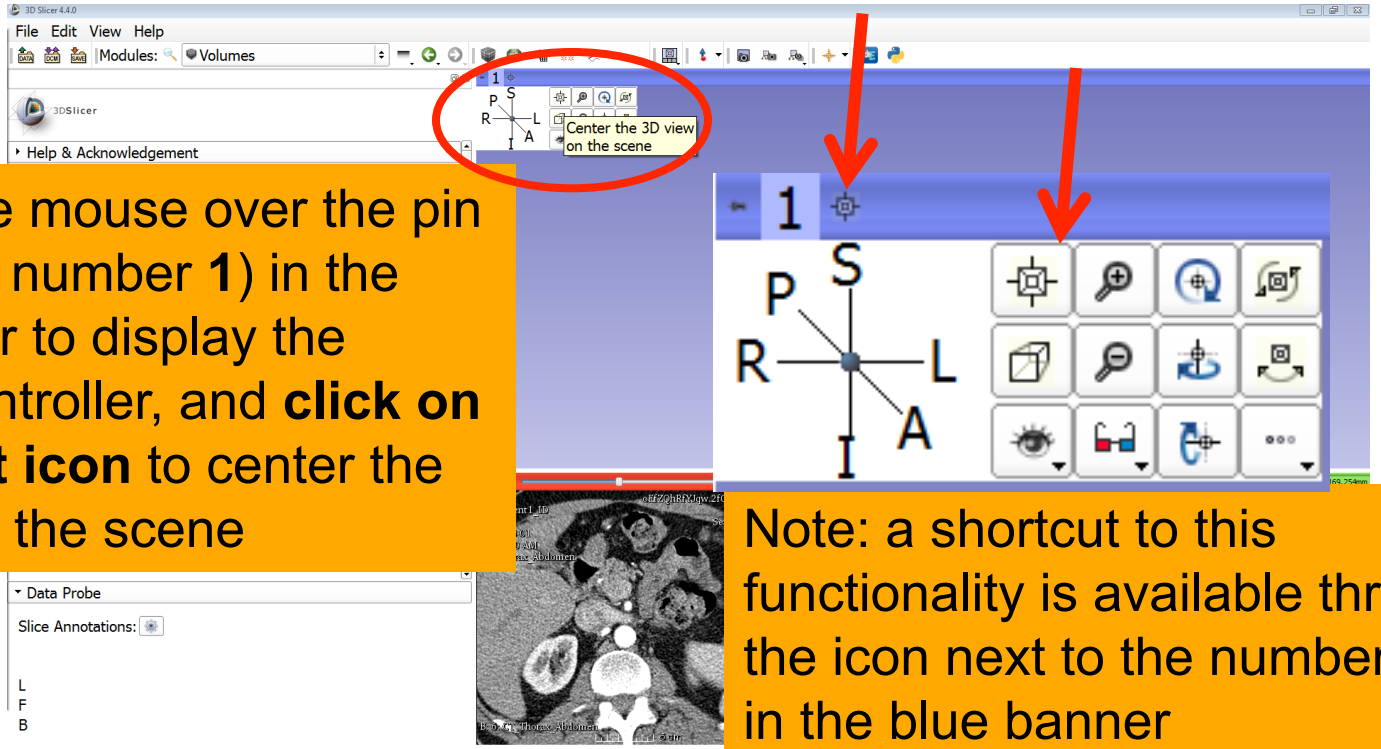


Loading a DICOM volume

Hold the left-mouse button down in the 3D Viewer and move the cursor lefft and right to rotate the volume



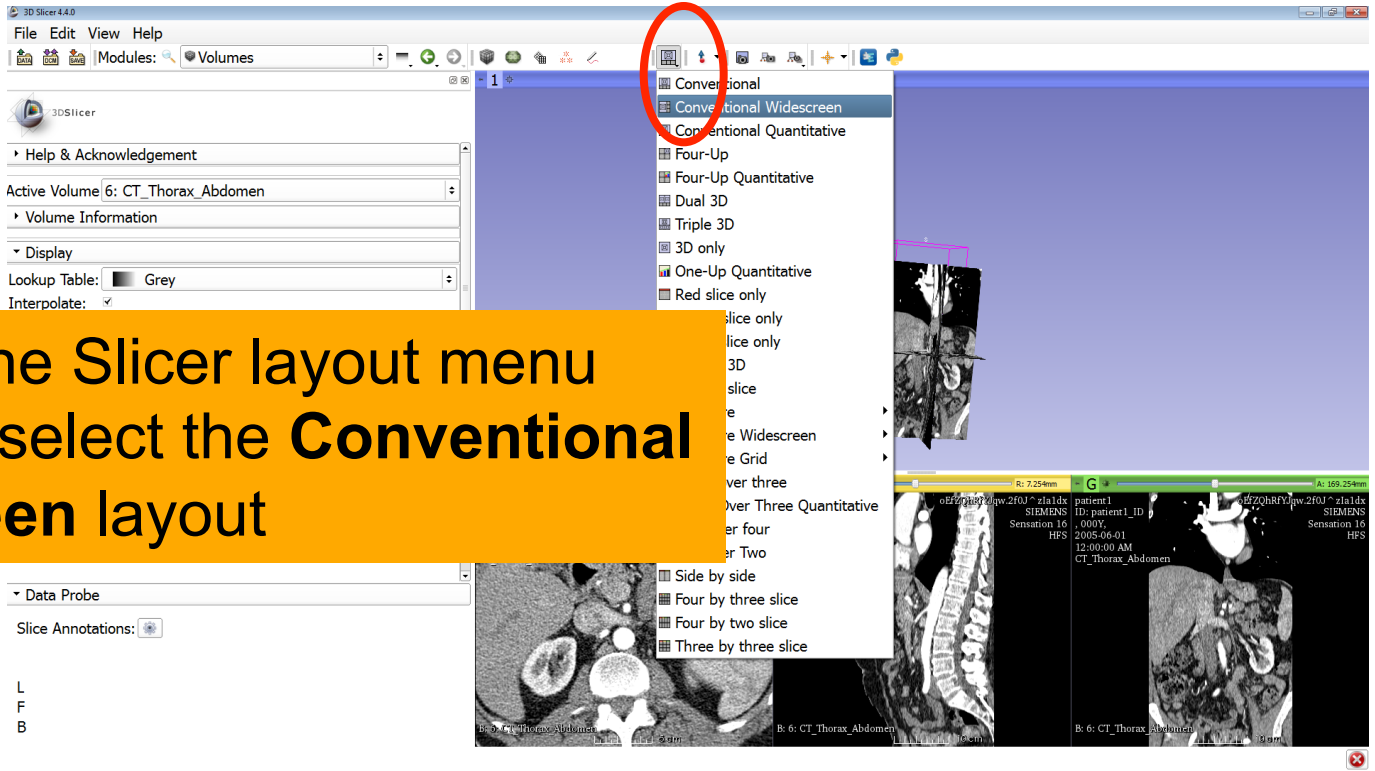
Loading a DICOM volume



Position the mouse over the pin icon (left to number **1**) in the blue banner to display the 3DView controller, and **click on the top left icon** to center the 3D view on the scene

Note: a shortcut to this functionality is available through the icon next to the number ‘1’ in the blue banner

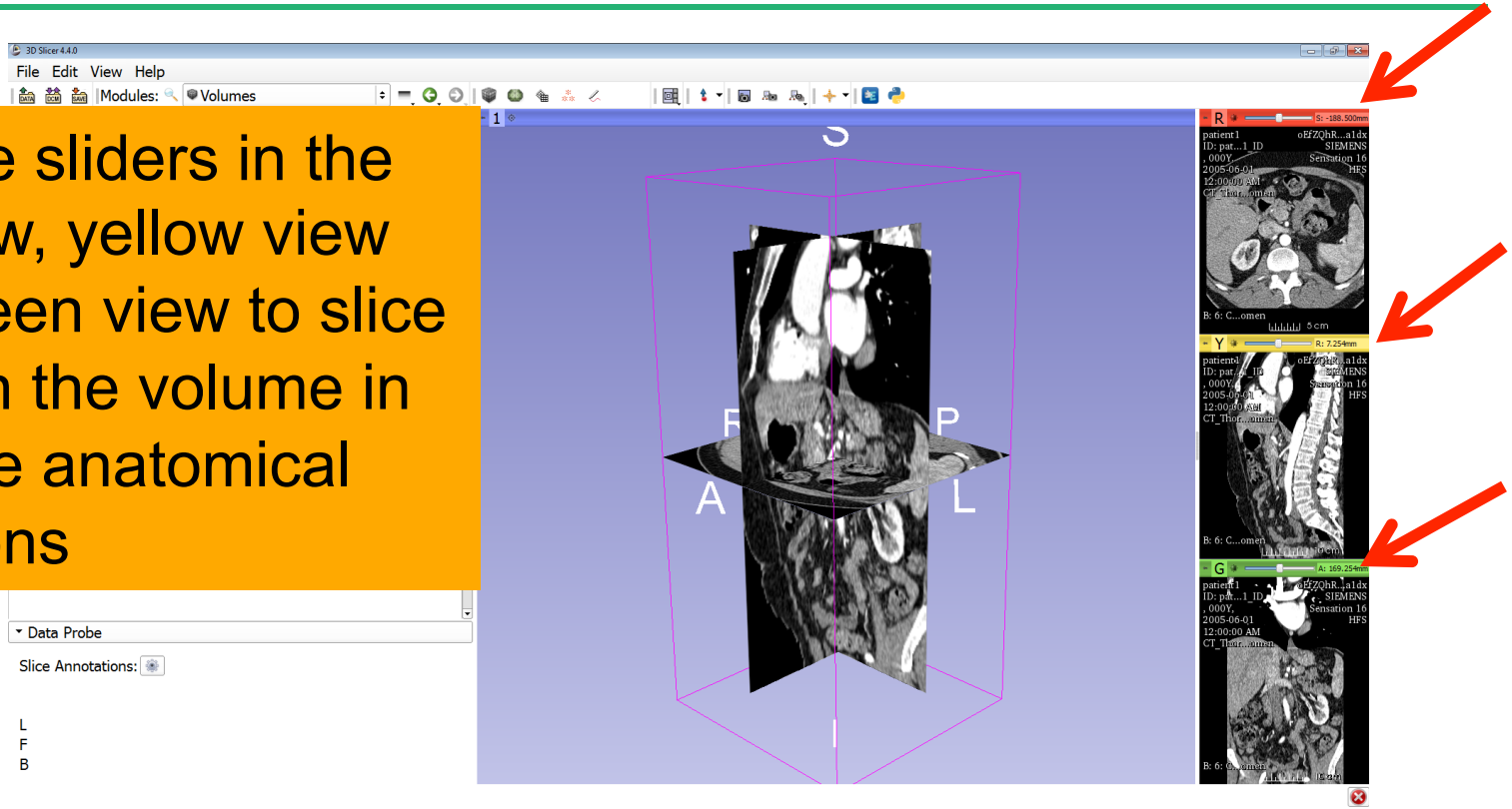
Loading a DICOM volume

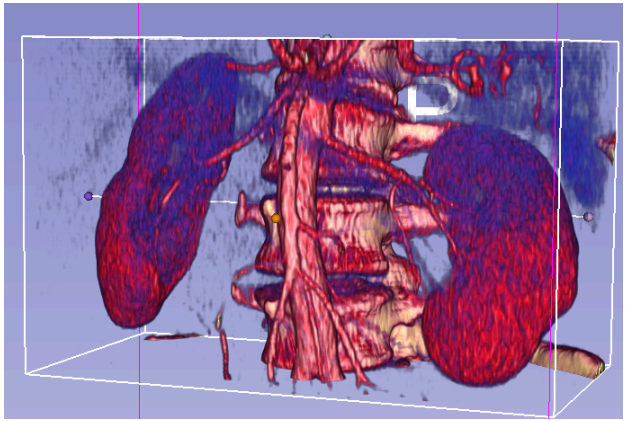


Click on the Slicer layout menu icon, and select the **Conventional Widescreen** layout

Loading a DICOM volume

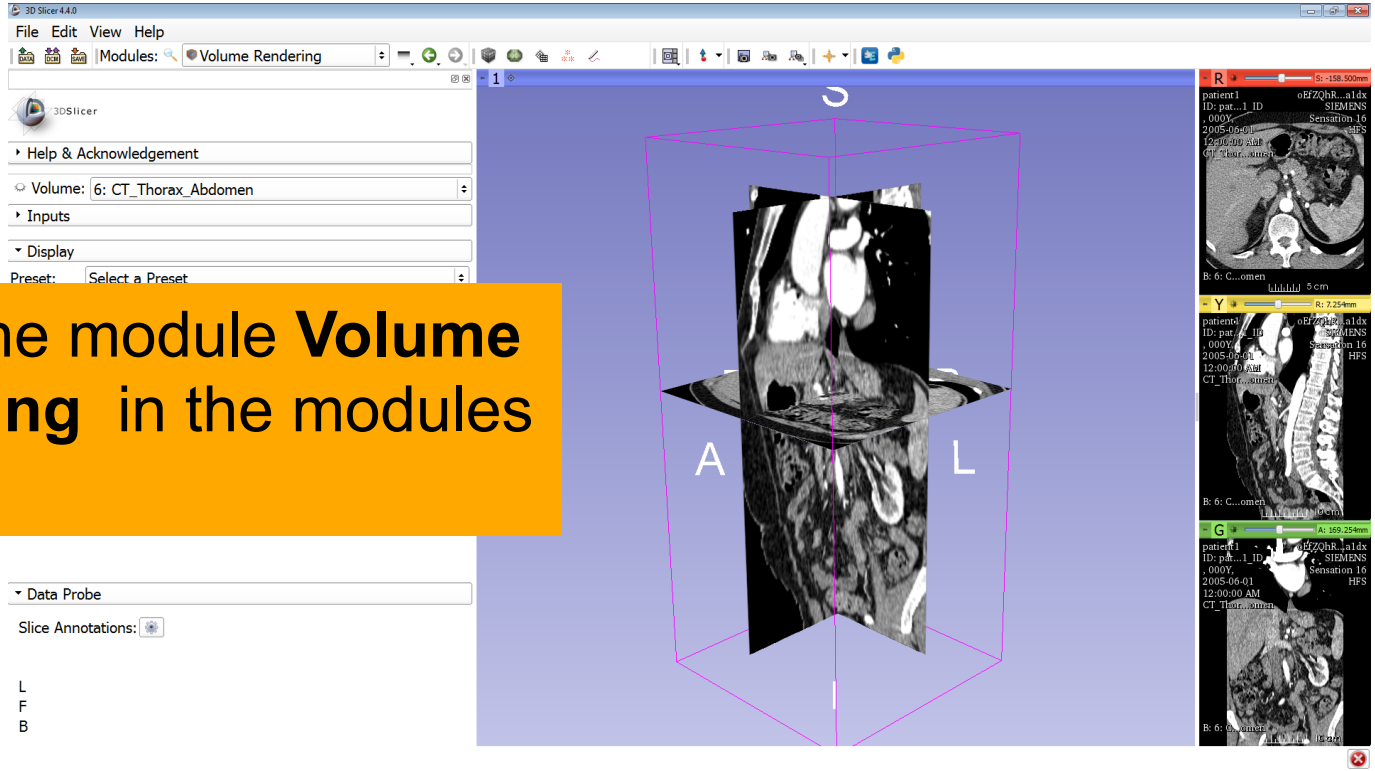
Use the sliders in the red view, yellow view and green view to slice through the volume in all three anatomical directions





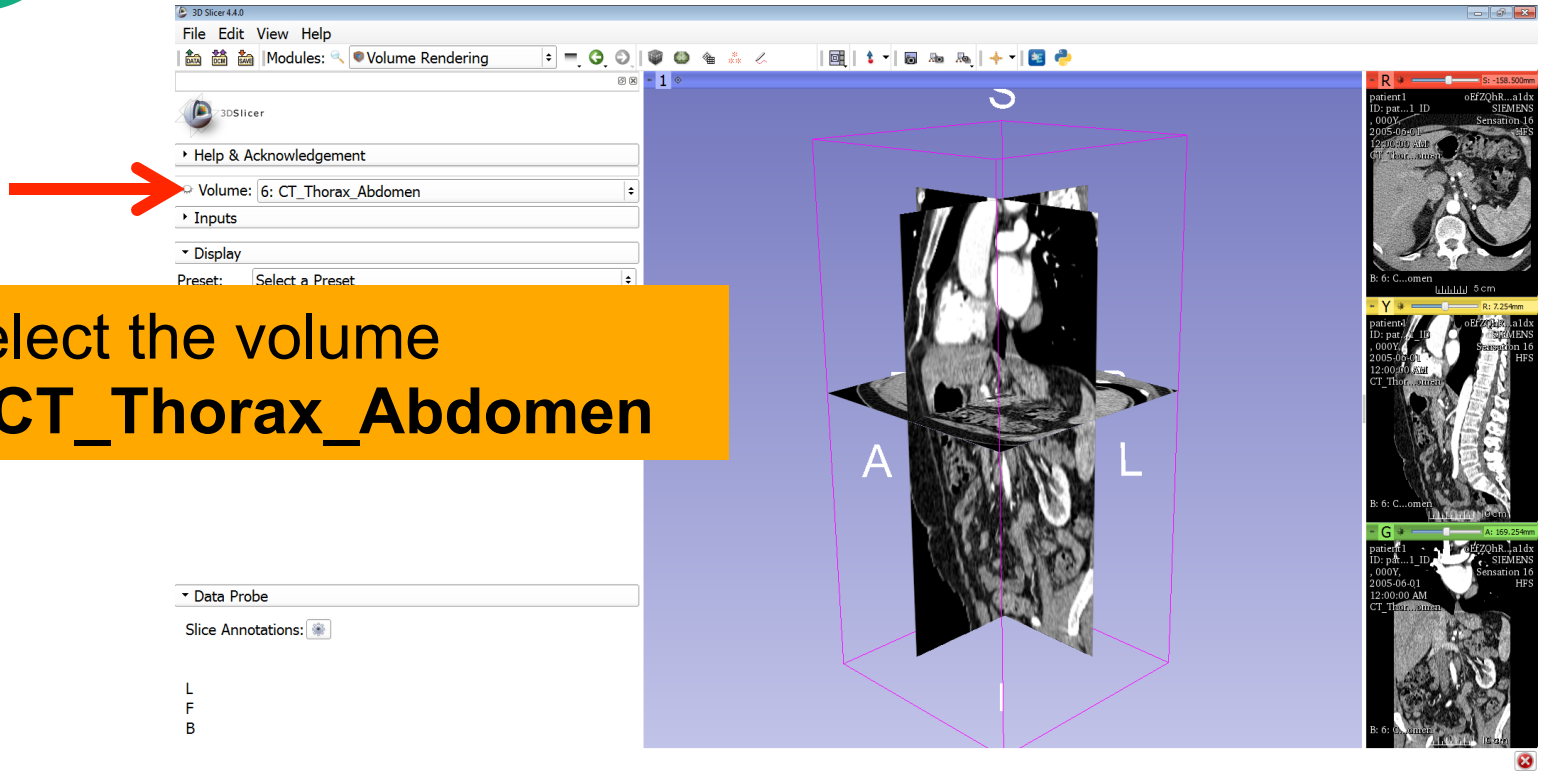
3D Interactive exploration of thoraco-abdominal CT data using Volume Rendering

Volume Rendering



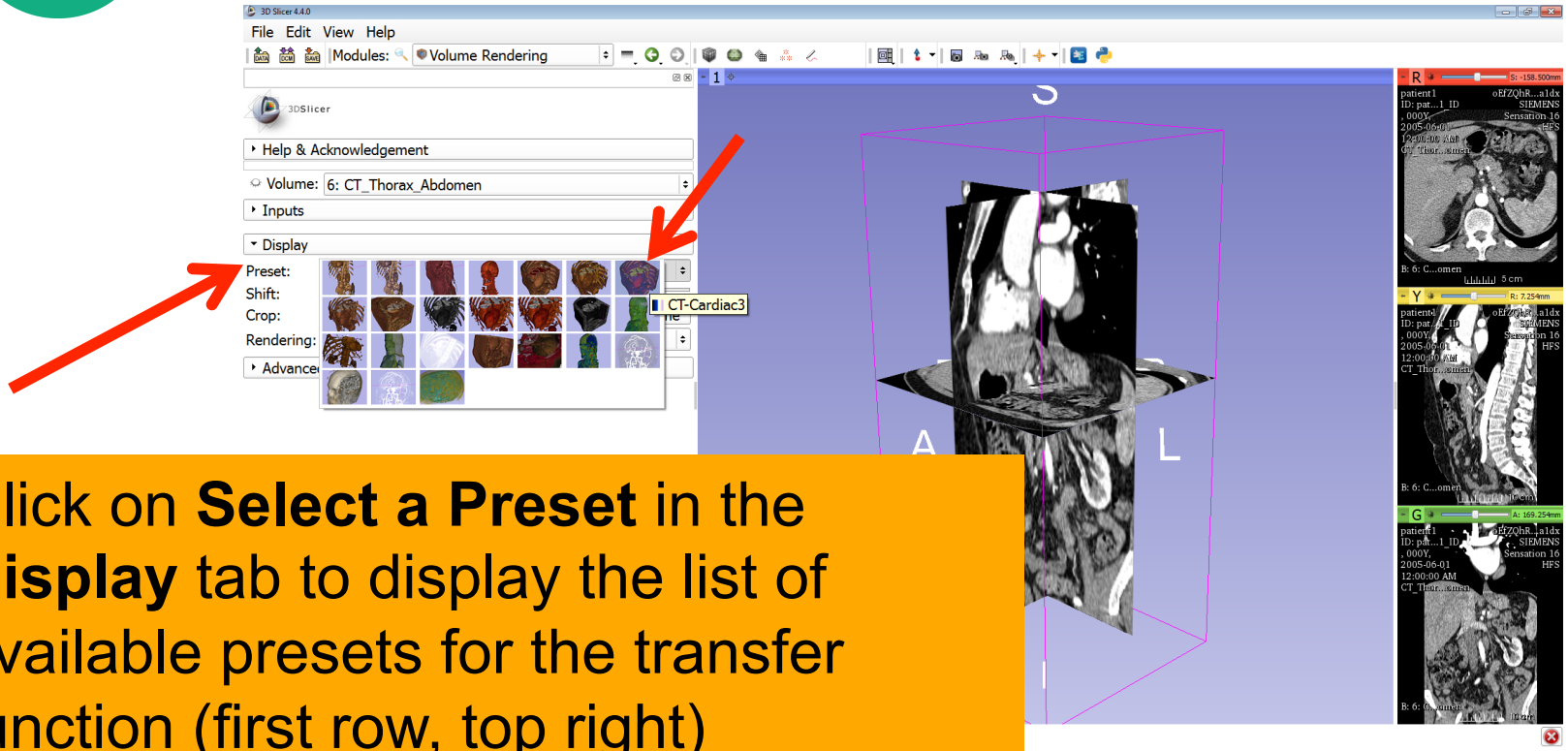
Select the module **Volume Rendering** in the modules menu

Volume Rendering



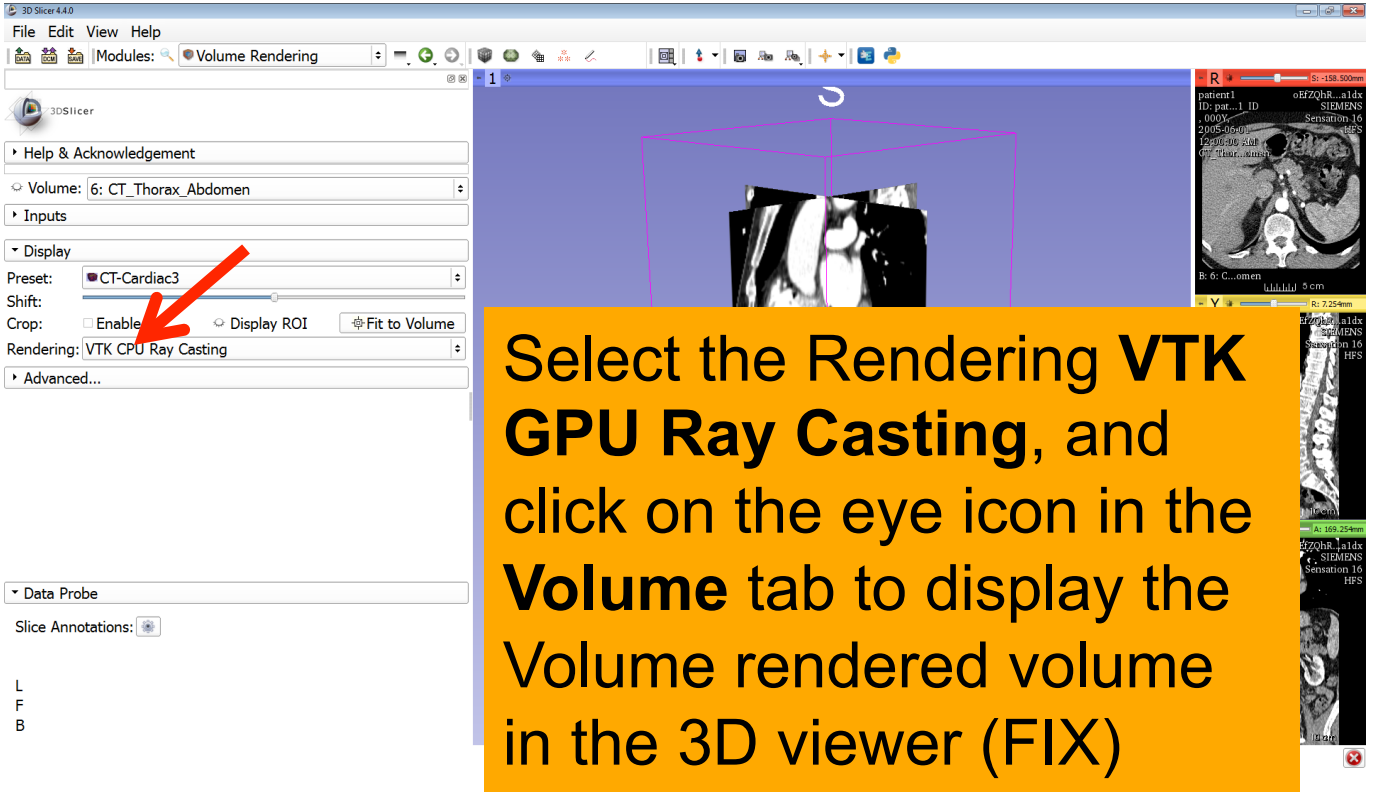
Select the volume
6:CT_Thorax_Abdomen

Volume Rendering



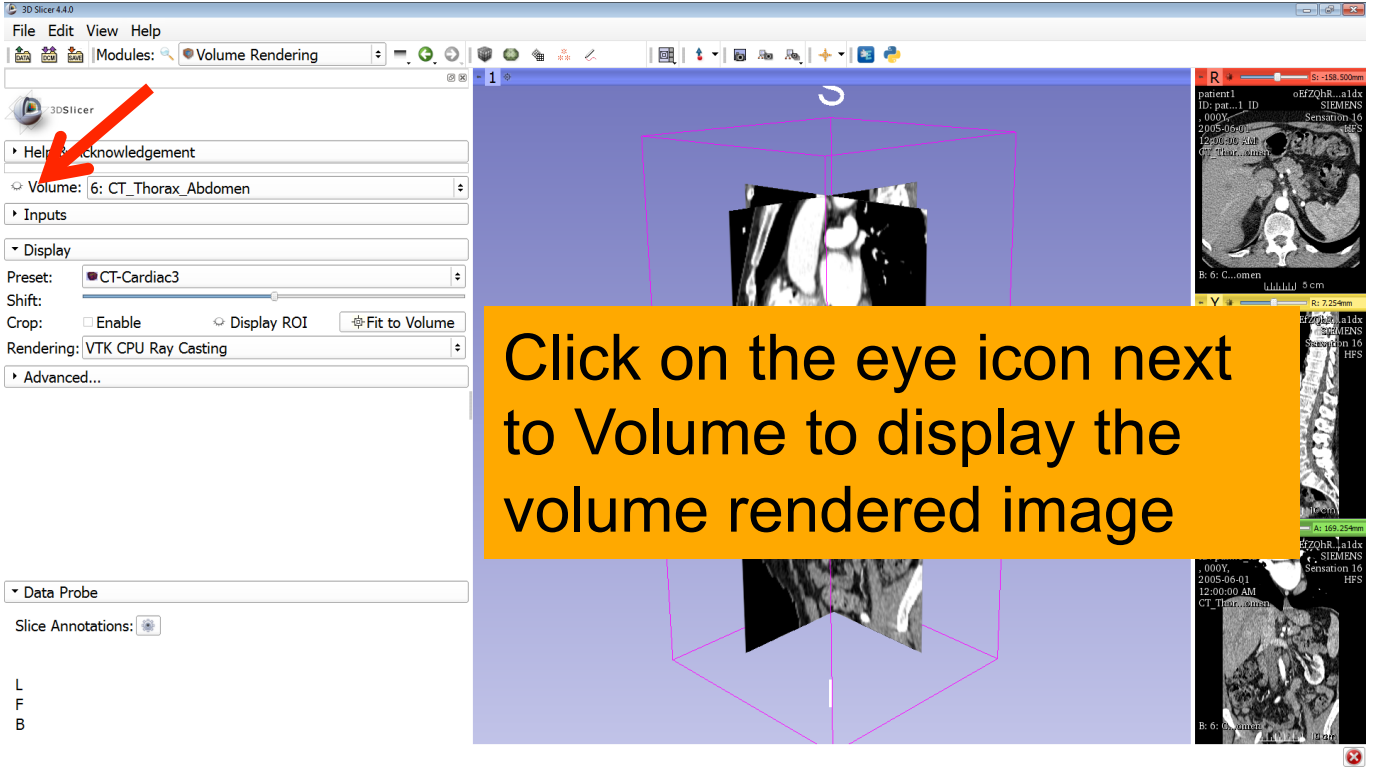
Click on **Select a Preset** in the **Display** tab to display the list of available presets for the transfer function (first row, top right)
Select the Preset **CT-Cardiac3**

Volume Rendering

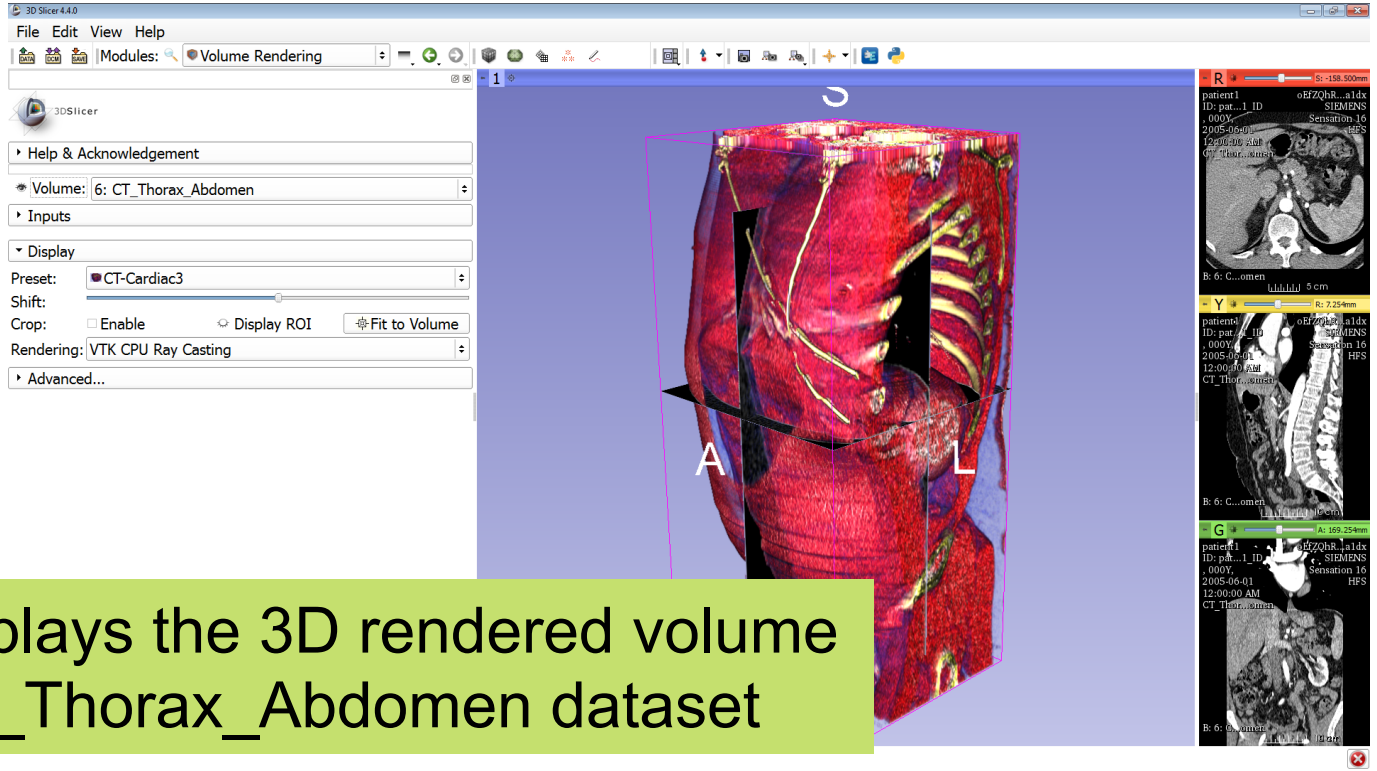


Select the Rendering **VTK GPU Ray Casting**, and click on the eye icon in the **Volume** tab to display the Volume rendered volume in the 3D viewer (FIX)

Volume Rendering

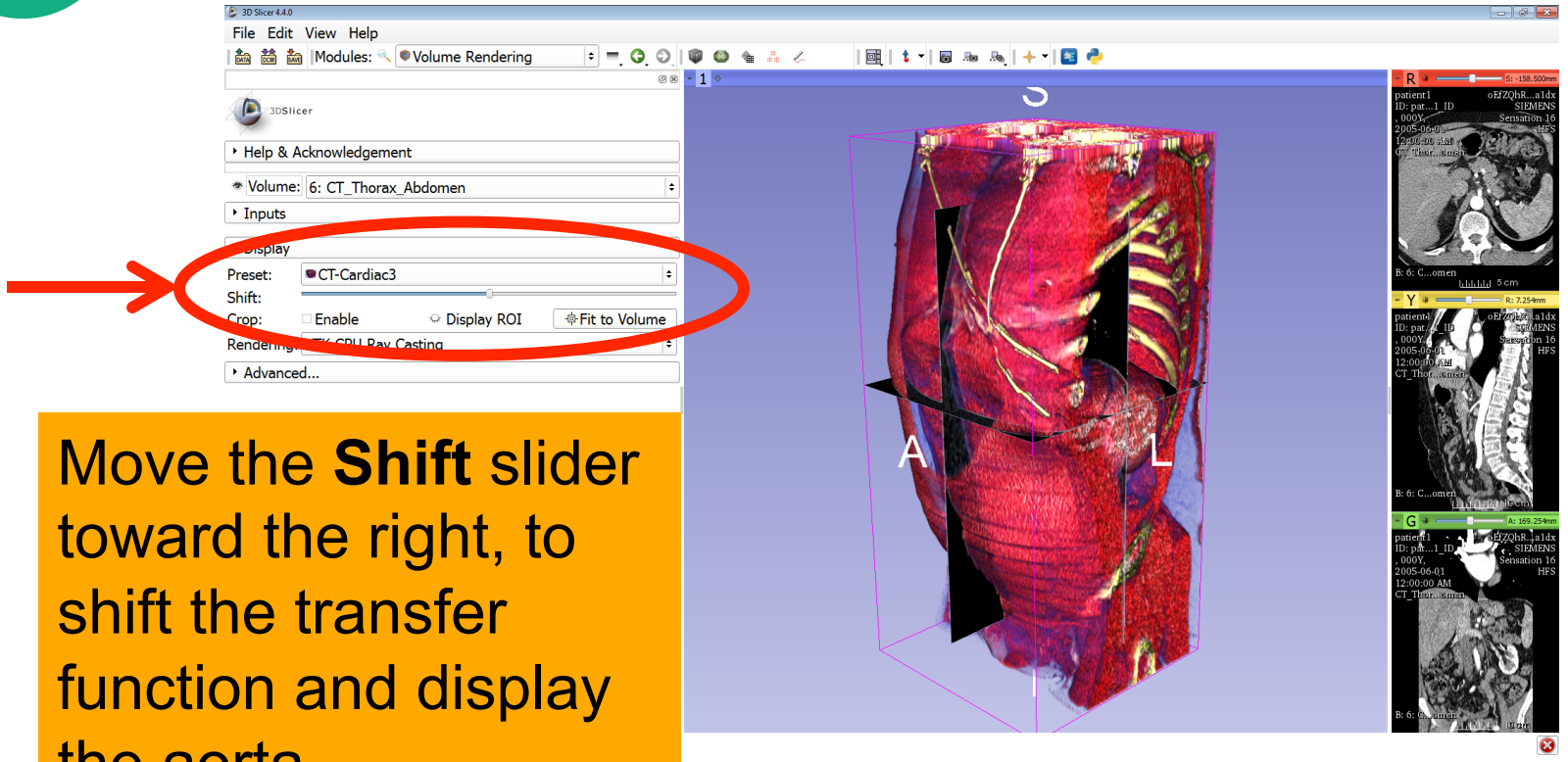


Volume Rendering



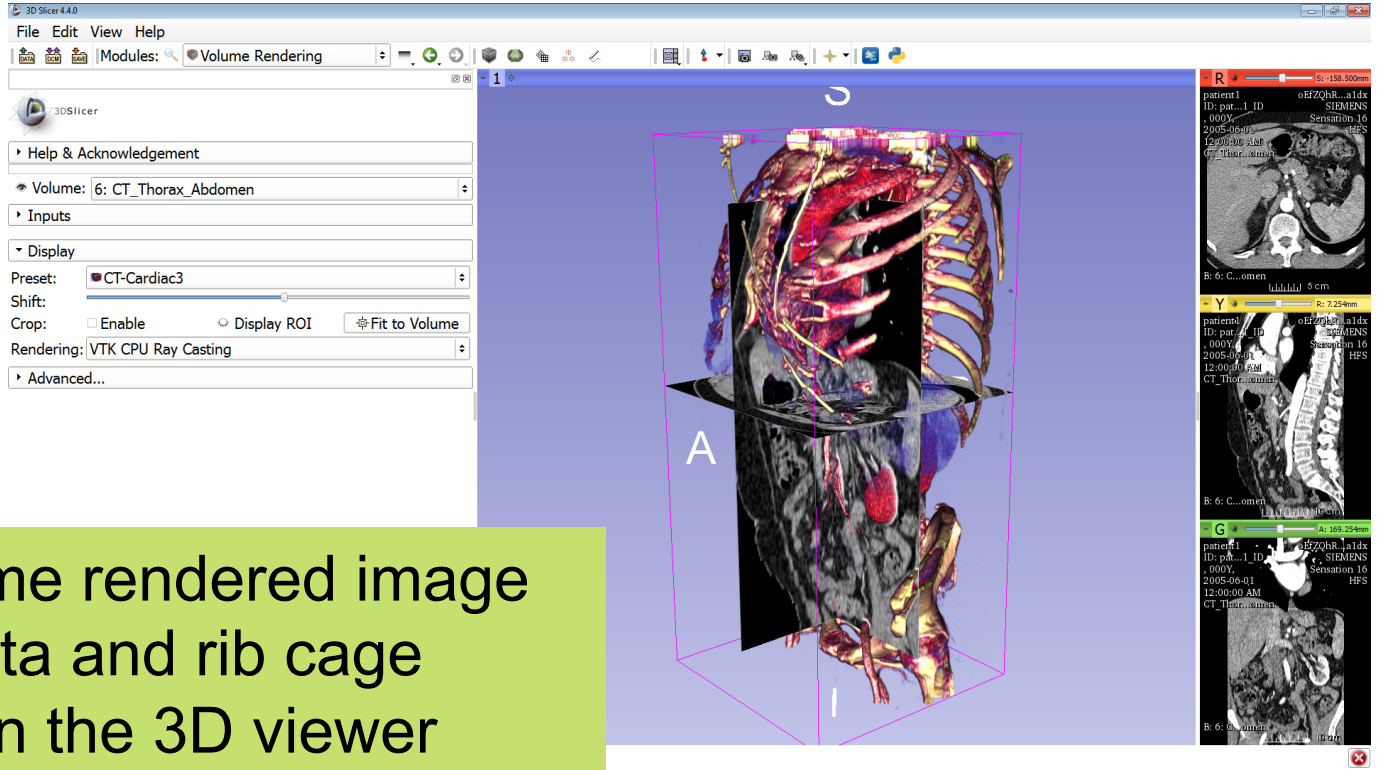
Slicer displays the 3D rendered volume of the CT_Thorax_Abdomen dataset

Volume Rendering



Move the **Shift** slider toward the right, to shift the transfer function and display the aorta

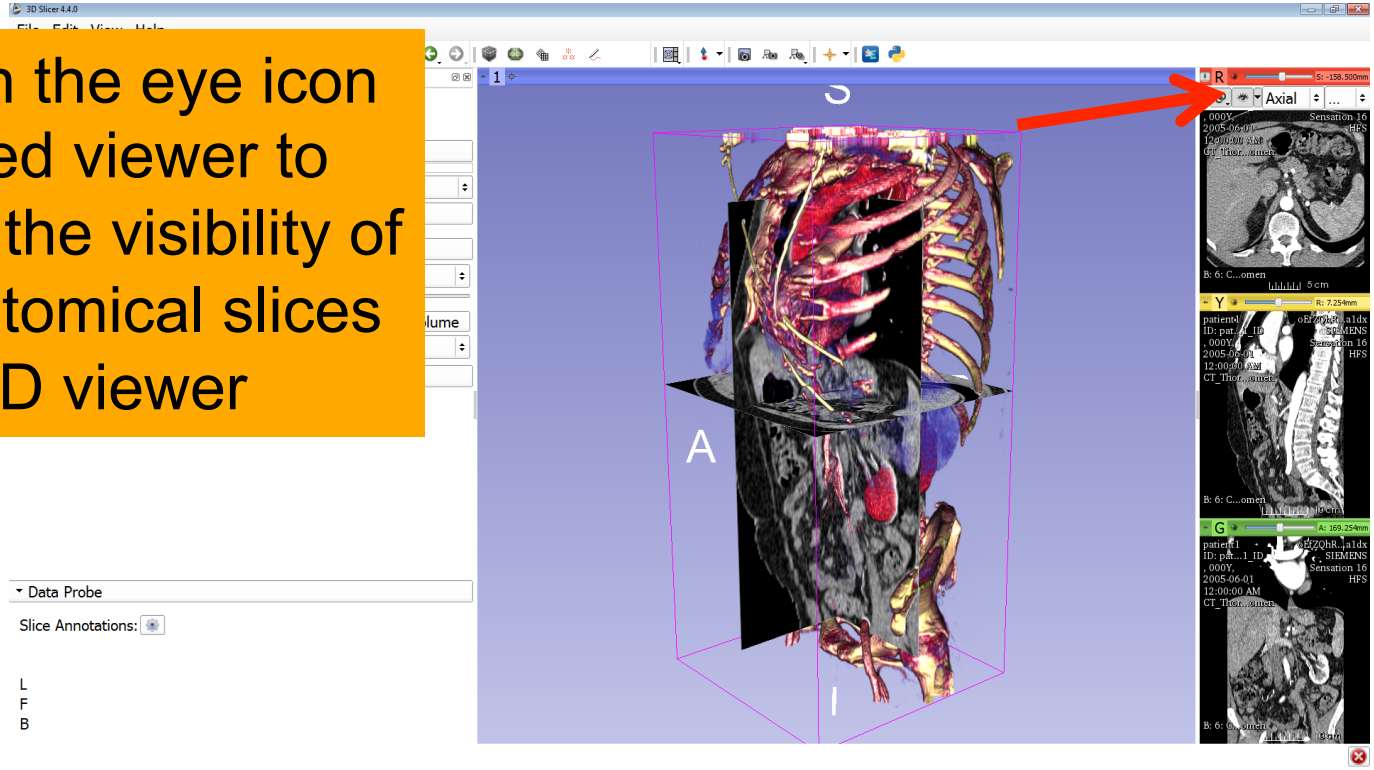
Volume Rendering



The volume rendered image of the aorta and rib cage appears in the 3D viewer

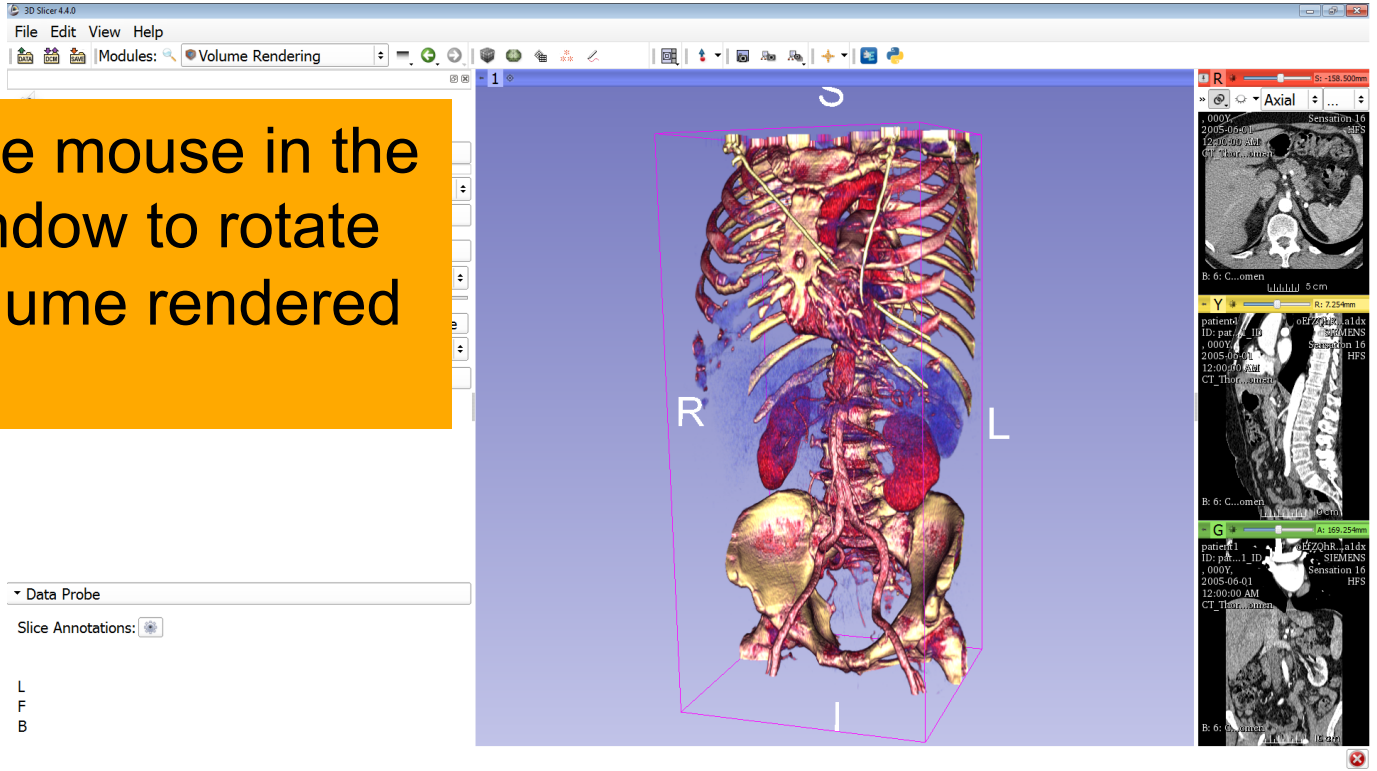
Volume Rendering

Click on the eye icon in the red viewer to turn off the visibility of the anatomical slices in the 3D viewer

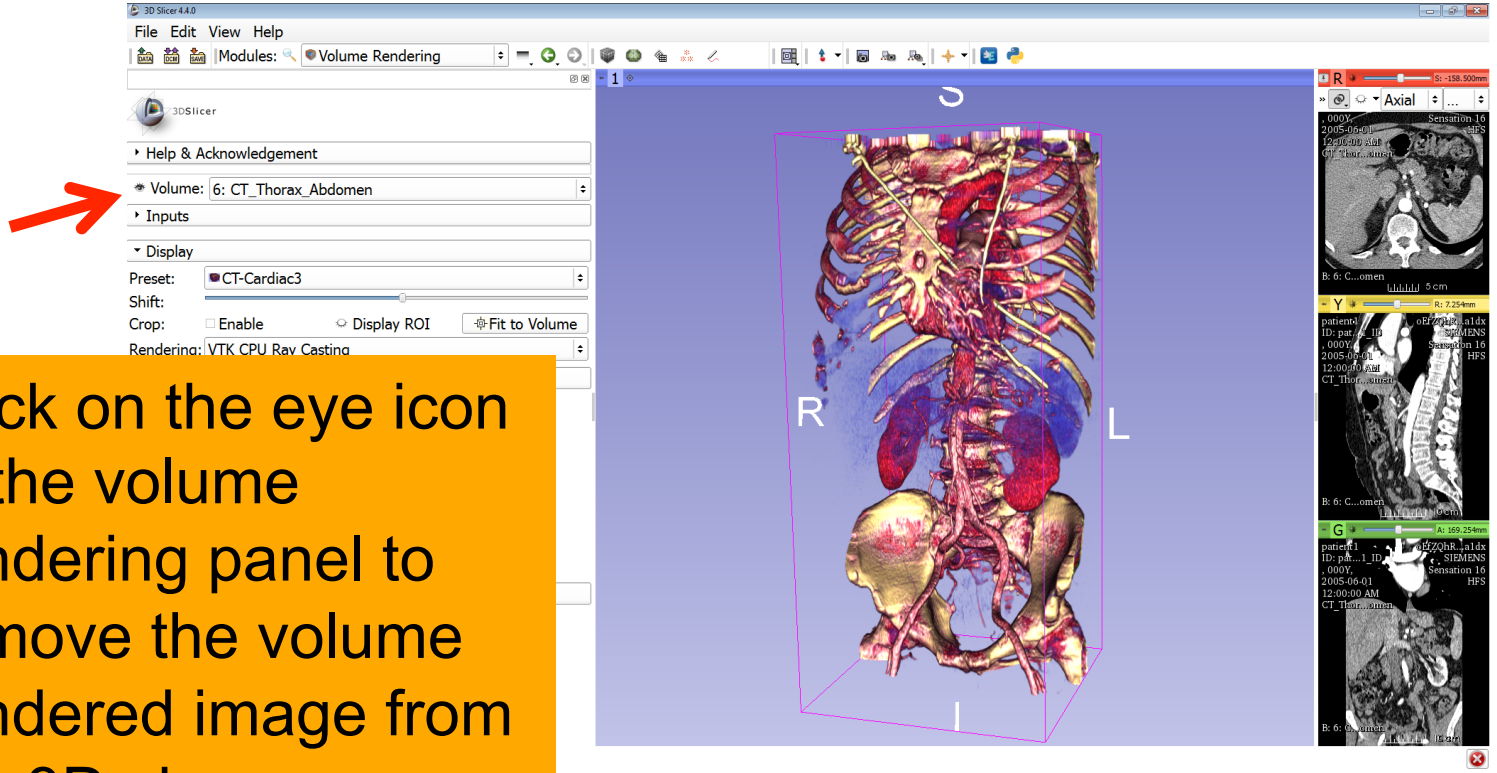


Volume Rendering

Use the mouse in the 3D window to rotate the volume rendered image

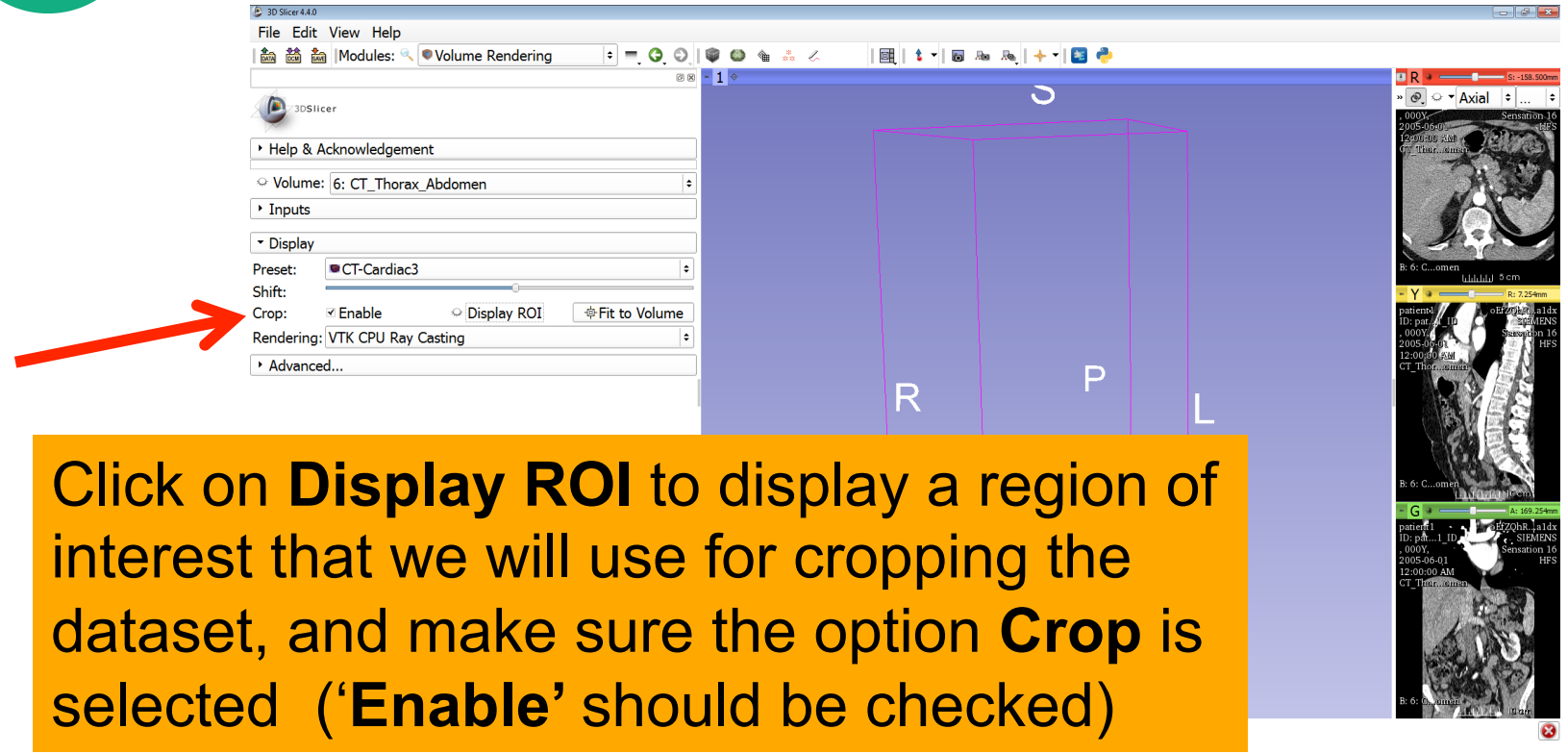


Volume Rendering



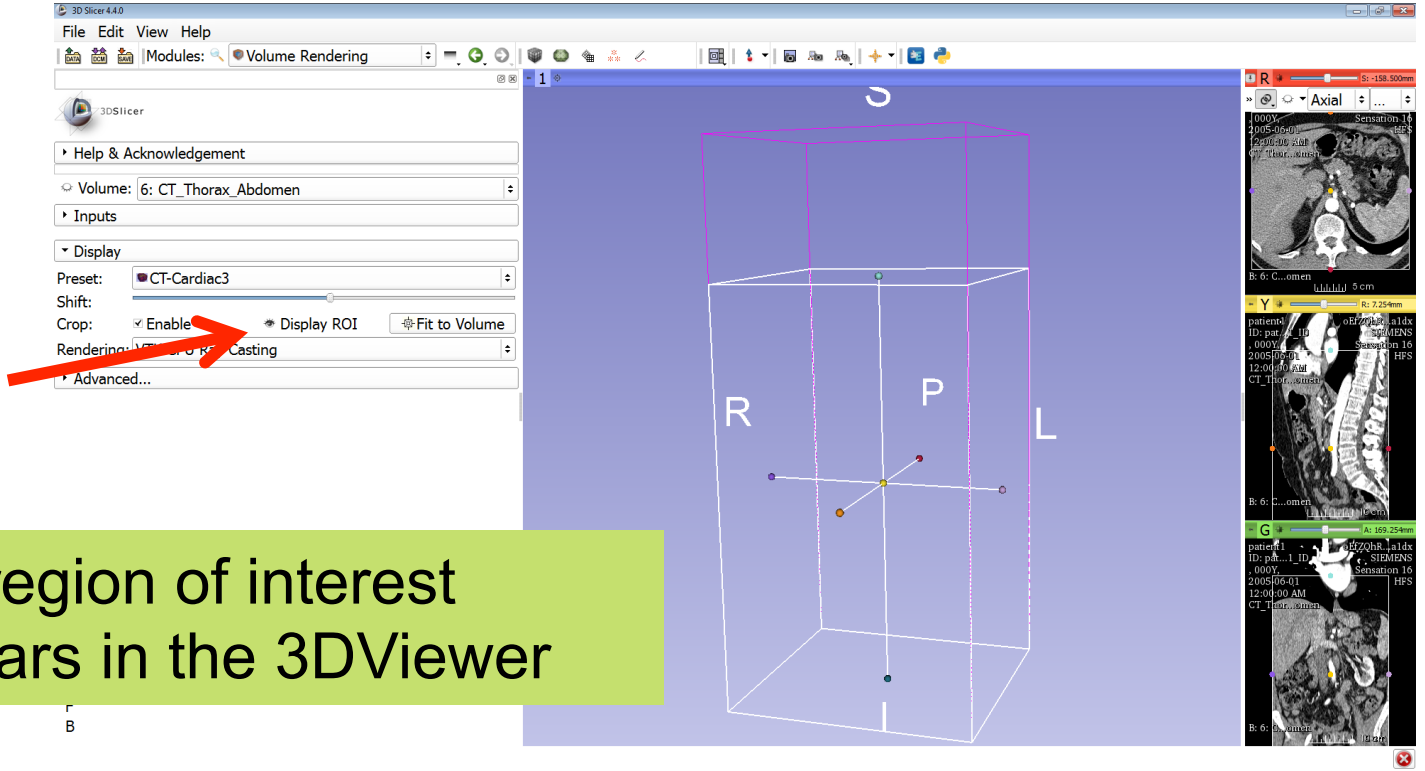
Click on the eye icon in the volume rendering panel to remove the volume rendered image from the 3D viewer

Volume Rendering



Click on **Display ROI** to display a region of interest that we will use for cropping the dataset, and make sure the option **Crop** is selected (‘**Enable**’ should be checked)

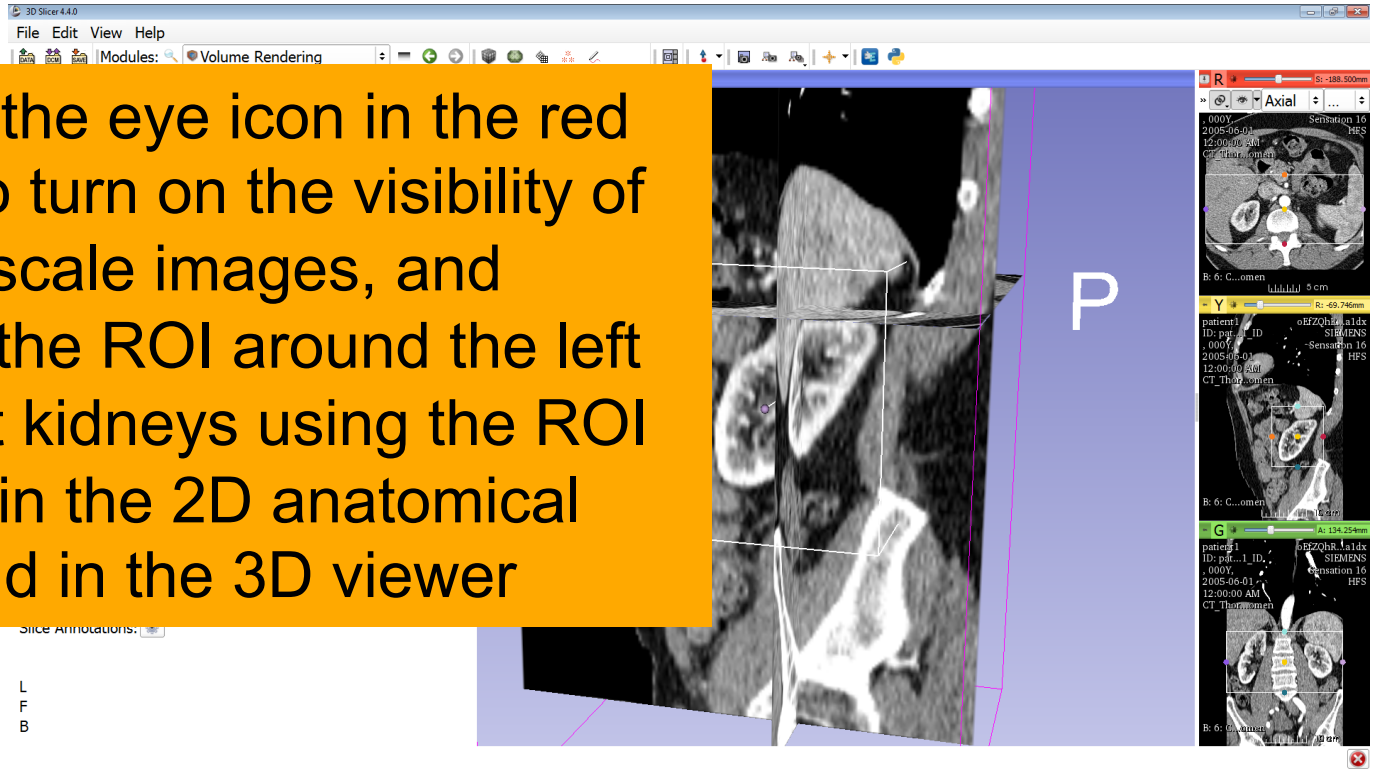
Volume Rendering



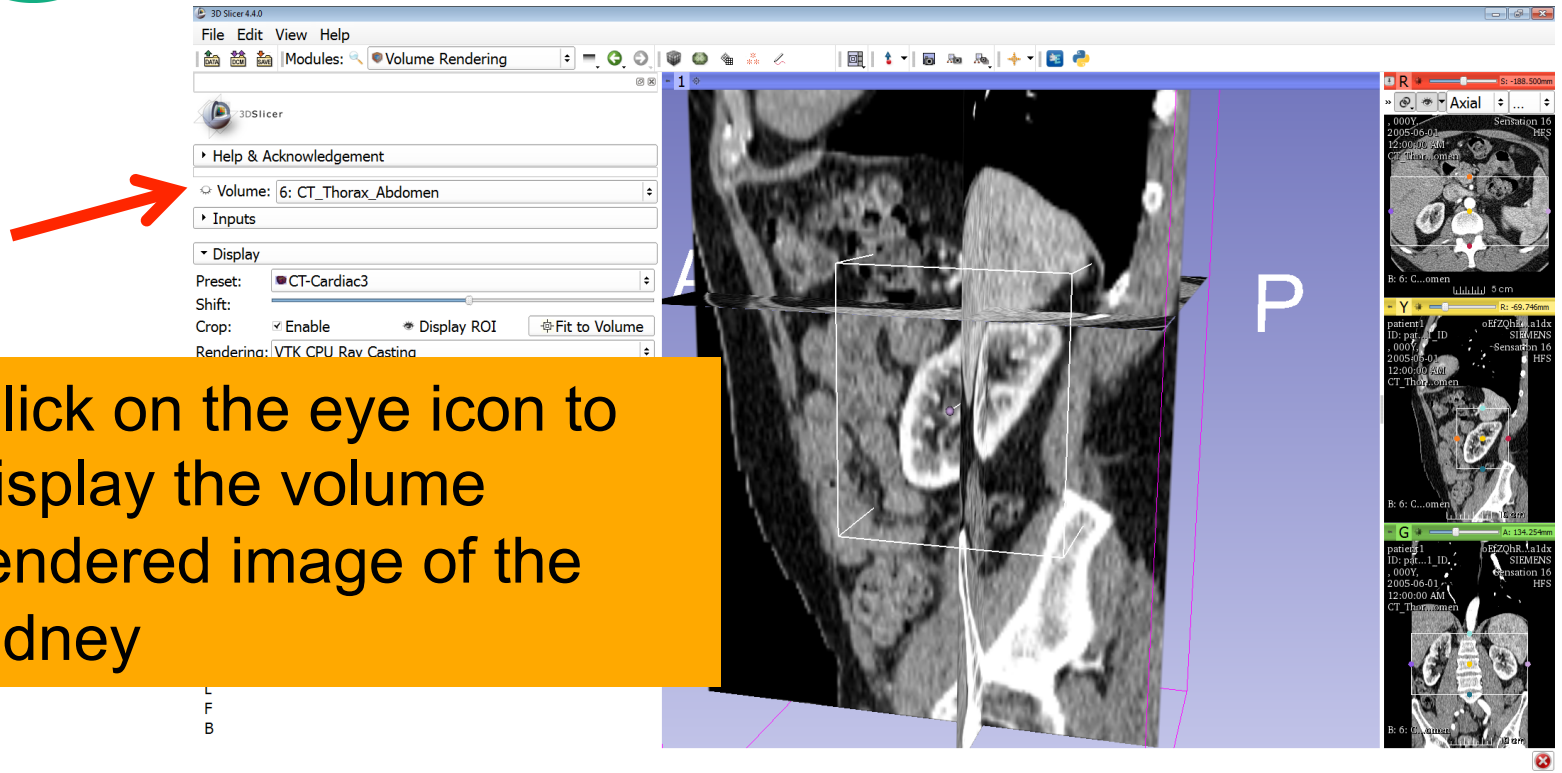
The region of interest appears in the 3DViewer

Volume Rendering

Click on the eye icon in the red viewer to turn on the visibility of the grayscale images, and position the ROI around the left and right kidneys using the ROI controls in the 2D anatomical views and in the 3D viewer

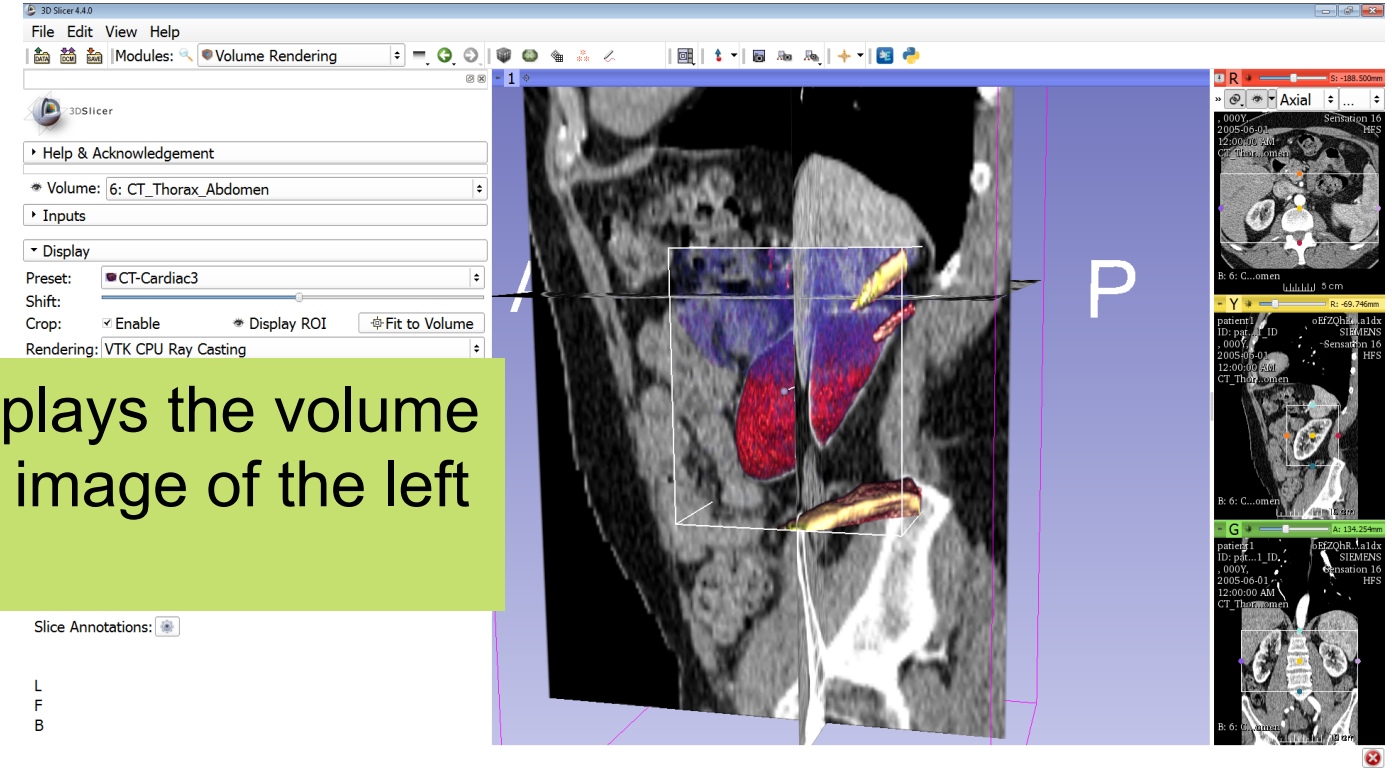


Volume Rendering



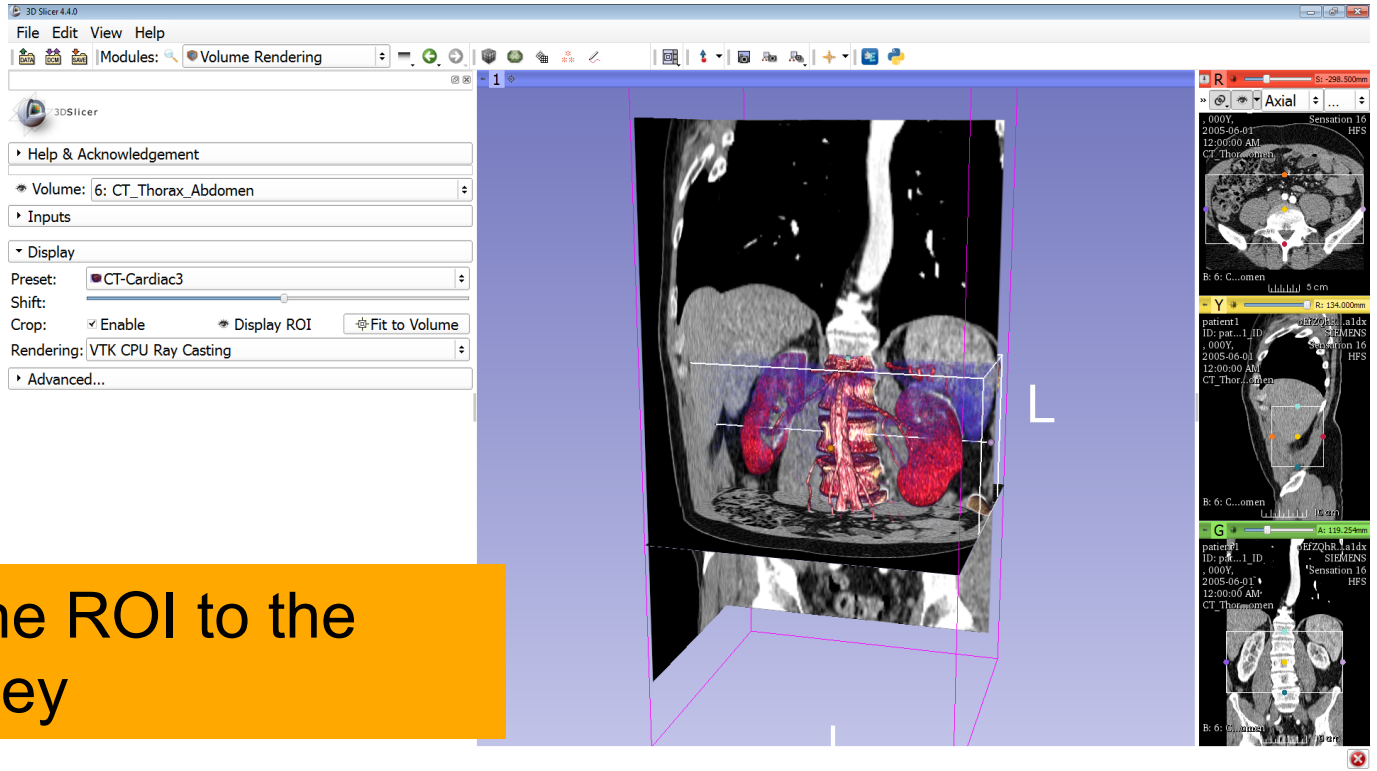
Click on the eye icon to display the volume rendered image of the kidney

Volume Rendering



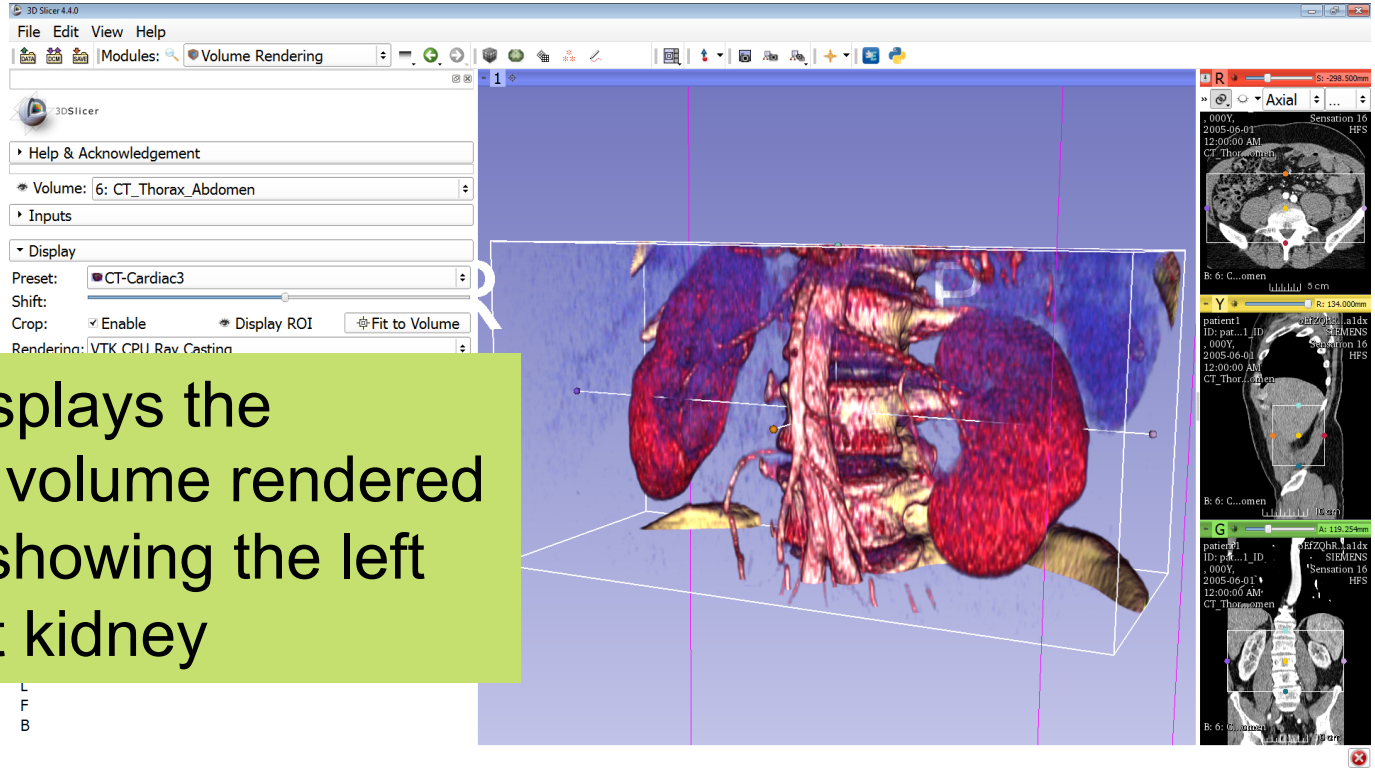
Slicer displays the volume rendered image of the left kidney

Volume Rendering



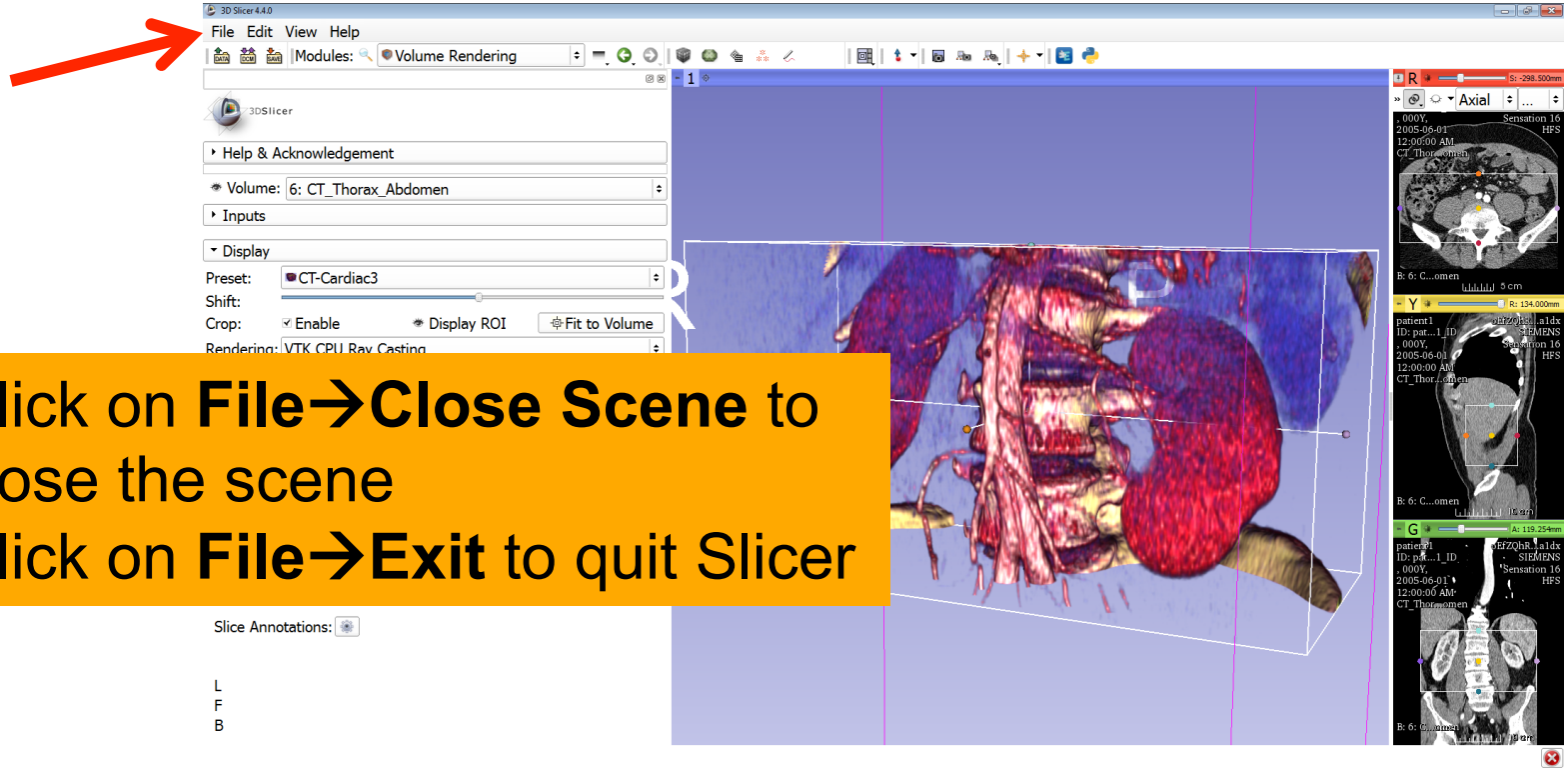
Extend the ROI to the right kidney

Volume Rendering



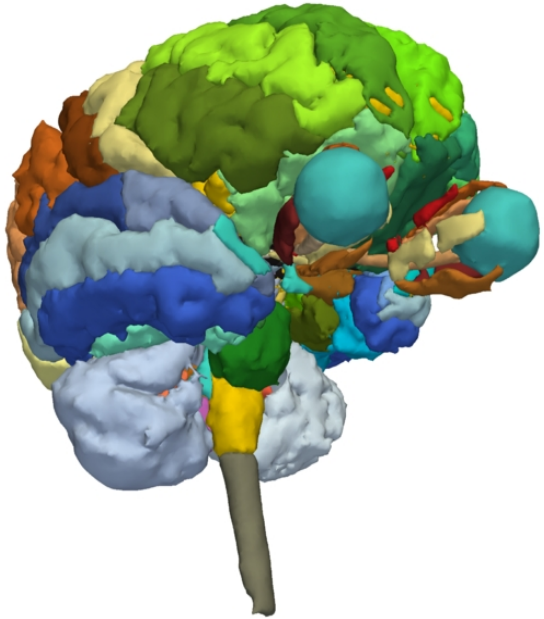
Slicer displays the cropped volume rendered images showing the left and right kidney

Volume Rendering



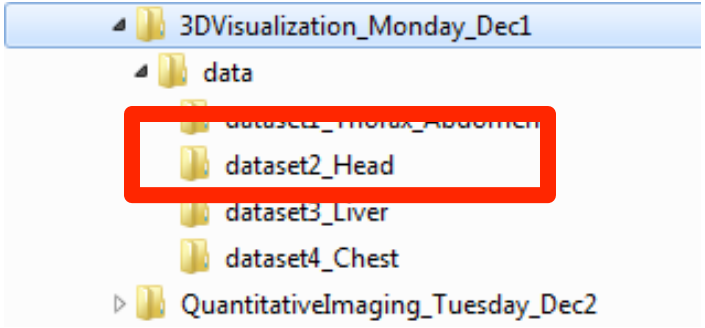
Click on **File→Close Scene** to close the scene

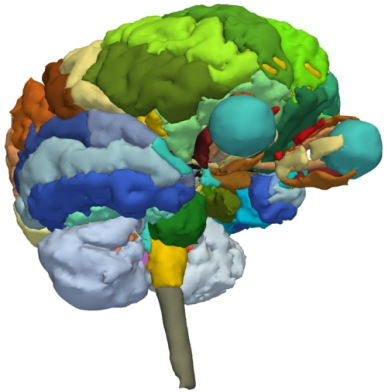
Click on **File→Exit** to quit Slicer



Part 2:
3D visualization of surface models of the brain

3D Data Loading and Visualization





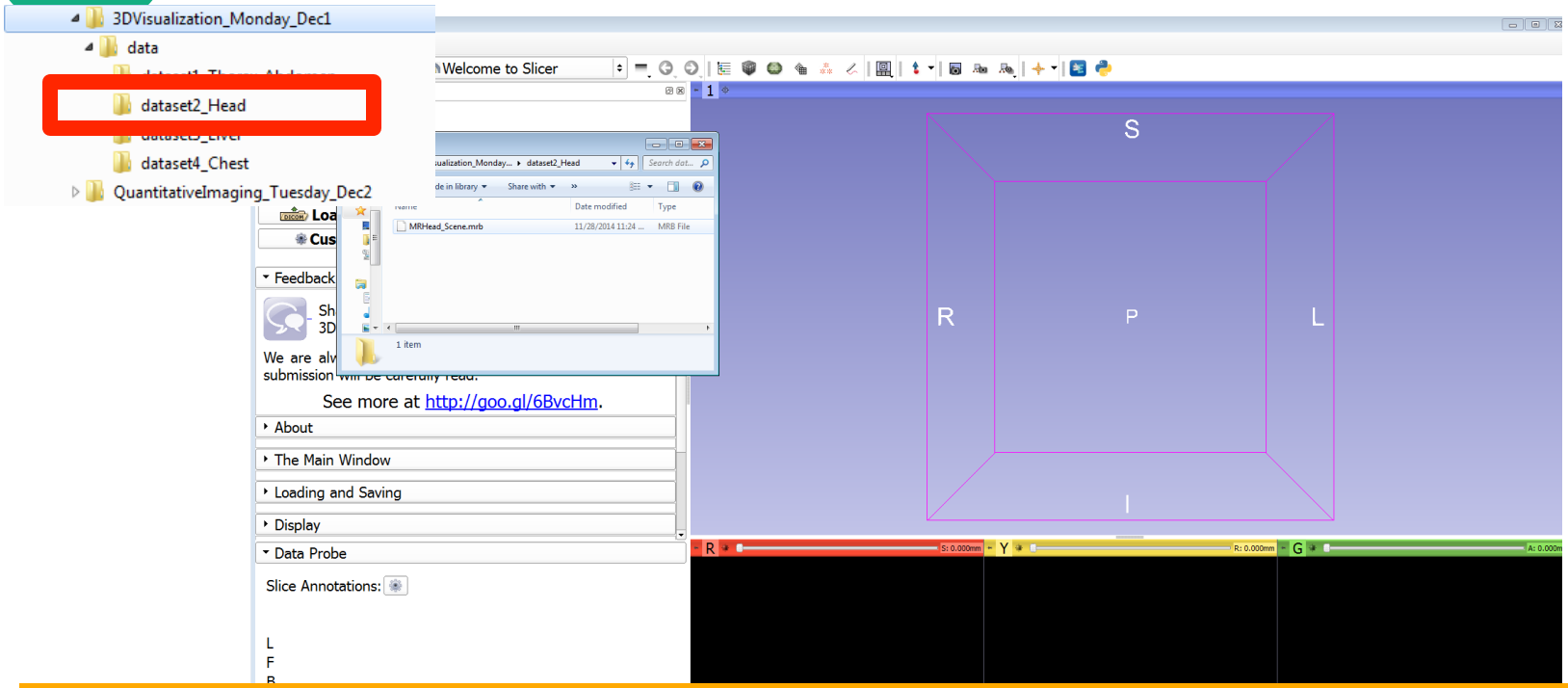
- Open the directory **3DVisualization_Monday_Dec1** on the Desktop
- Select the directory **dataset2_Head**
- Select the file **MRHead_Scene.mrb**

This file is composed of an MR scan of the brain and 3D surface reconstructions of anatomical structures.

The data are part of the SPL-PNL Brain Atlas developed by Talos, Jakab, Kikinis et al. The atlas is freely available for download at:

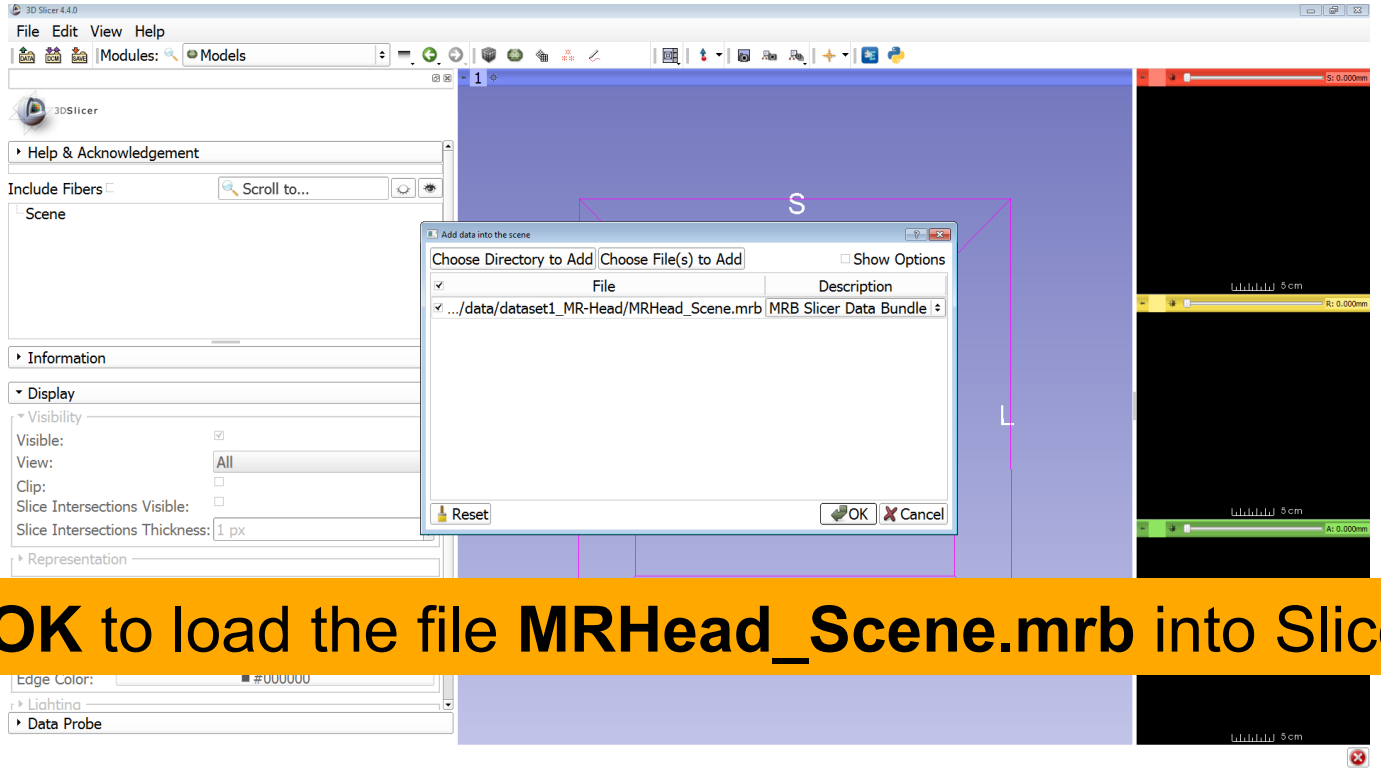
http://www.spl.harvard.edu/publications/item/view/2037

3D visualization of surface models of the brain



Drag and drop the file **Head_Scene.mrb** into Slicer

3D visualization of surface models of the brain

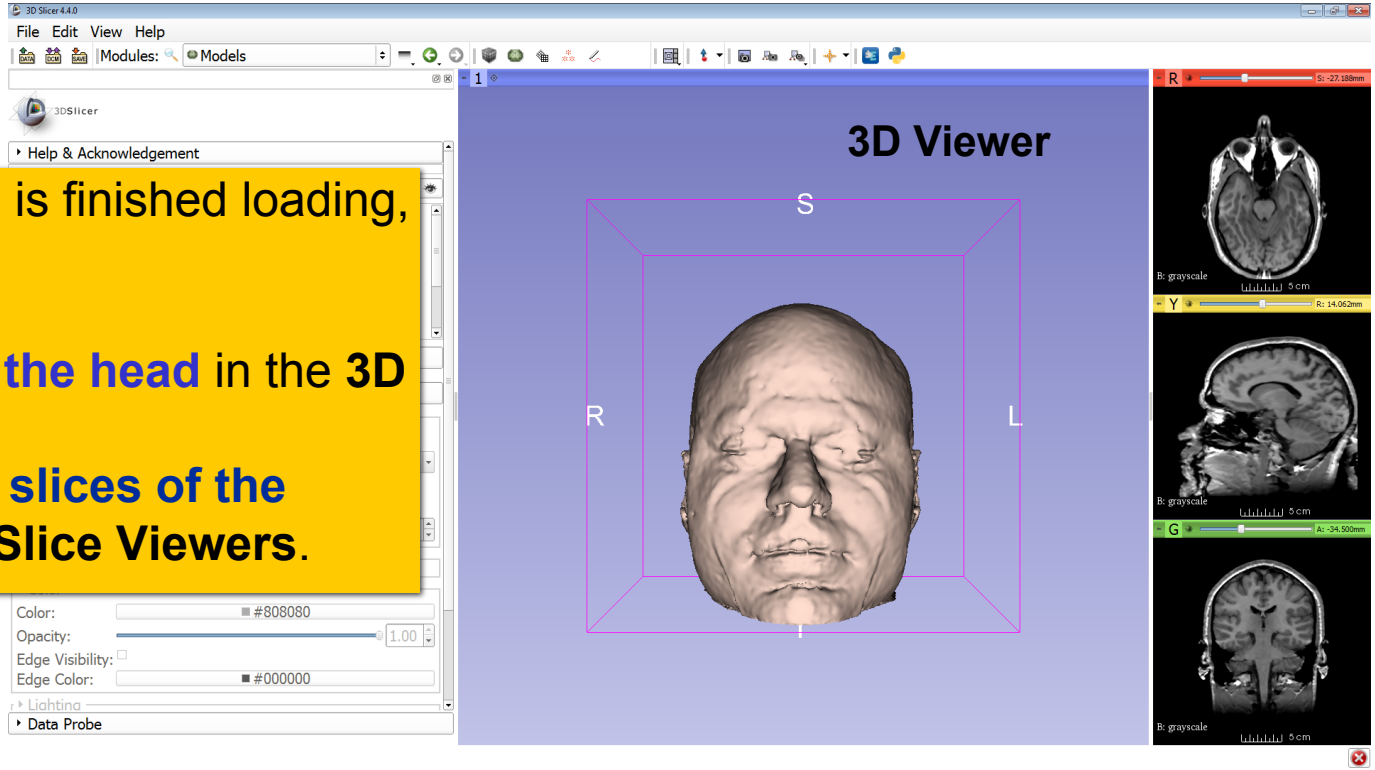


Click on **OK** to load the file **MRHead_Scene.mrb** into Slicer

3D visualization of surface models of the brain : Viewing the Scene

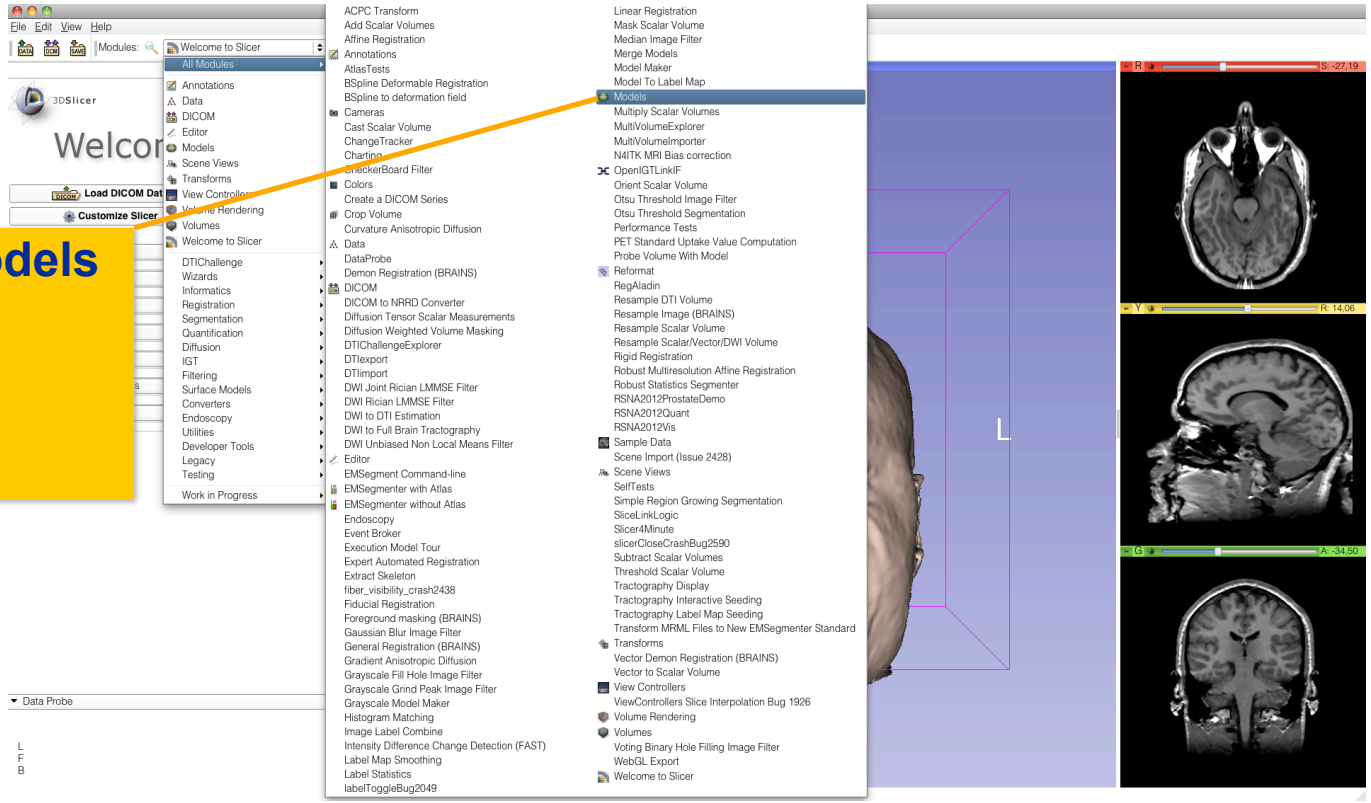
When the scene is finished loading, Slicer displays:

- a **3D model of the head** in the **3D Viewer**, and
- anatomical **MR slices of the brain** in the **2D Slice Viewers**.

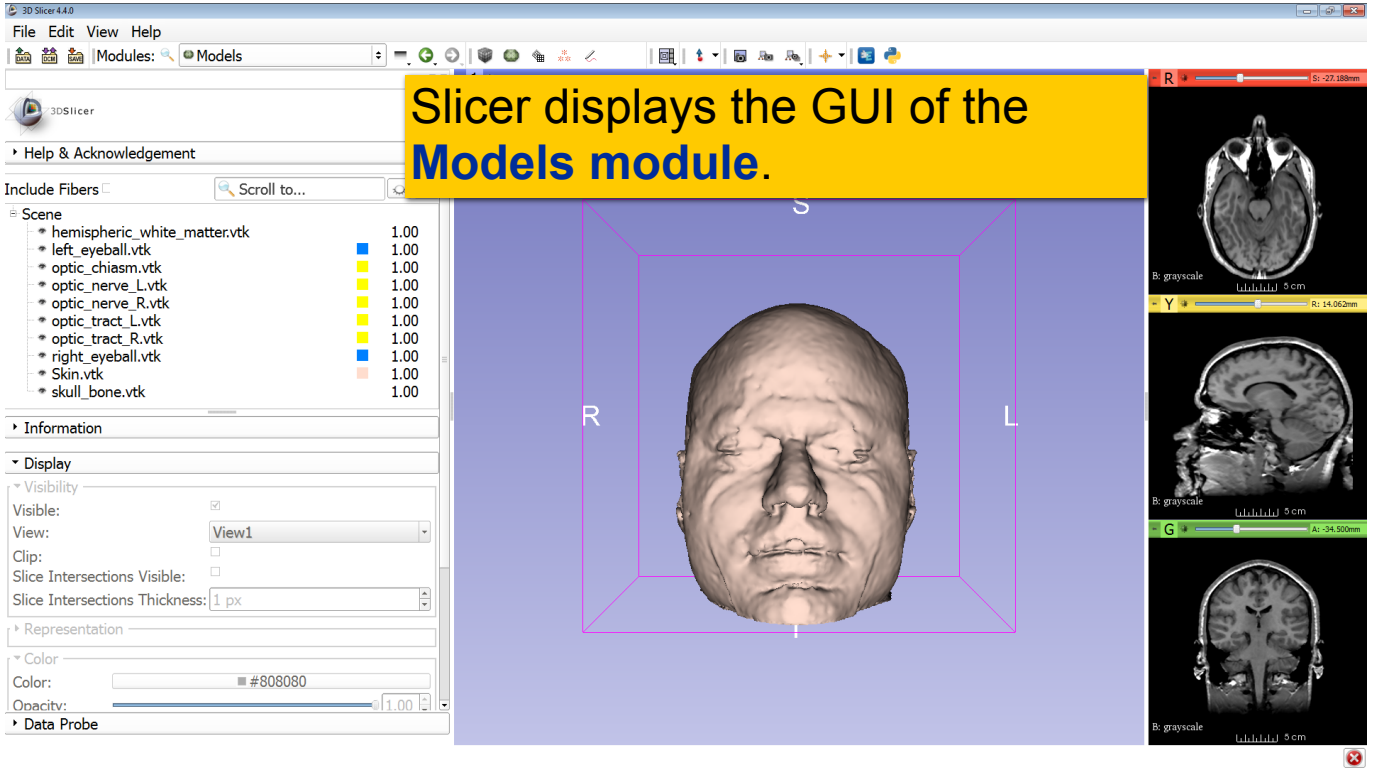


3D visualization of surface models of the brain : Exploring Slicer's functionality

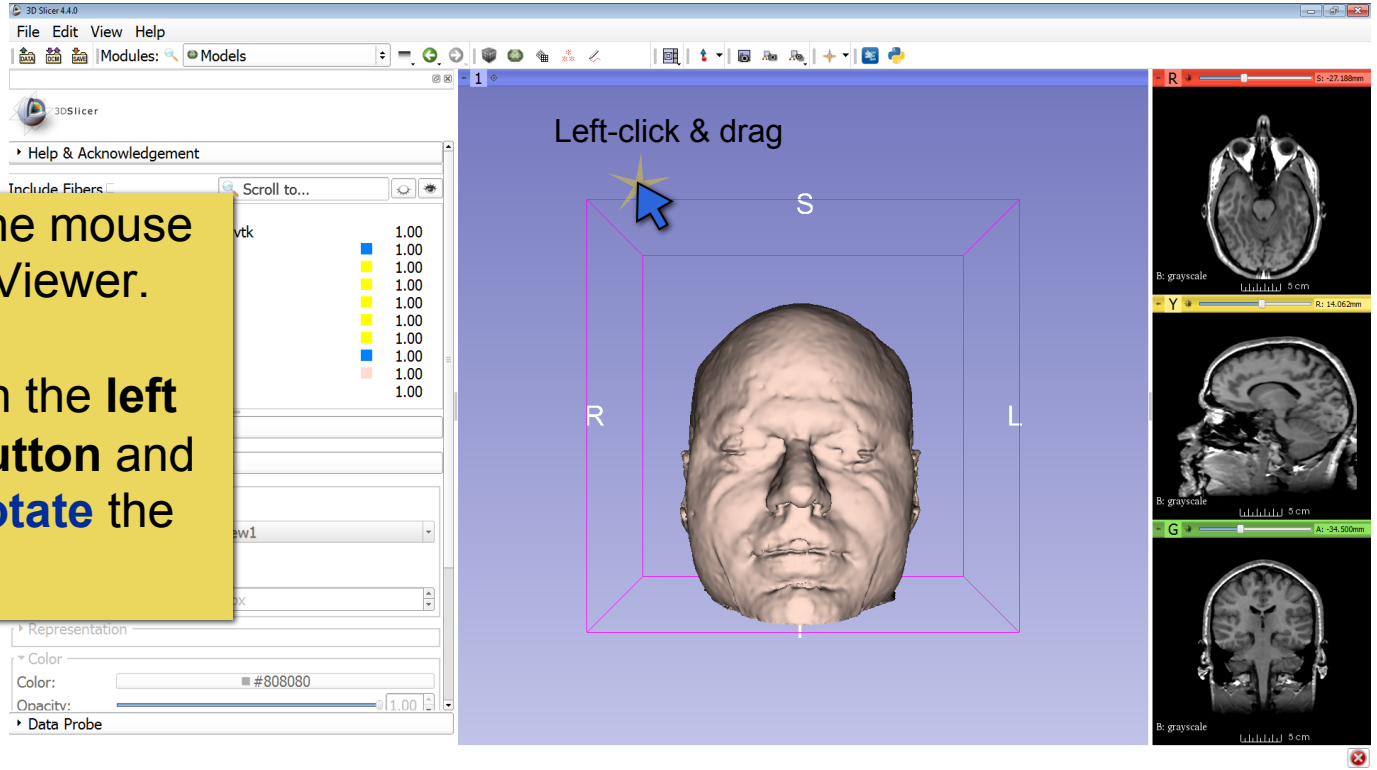
To access the **Models module**, browse through the list of modules.



3D visualization of surface models of the brain : Switching to the Models Module



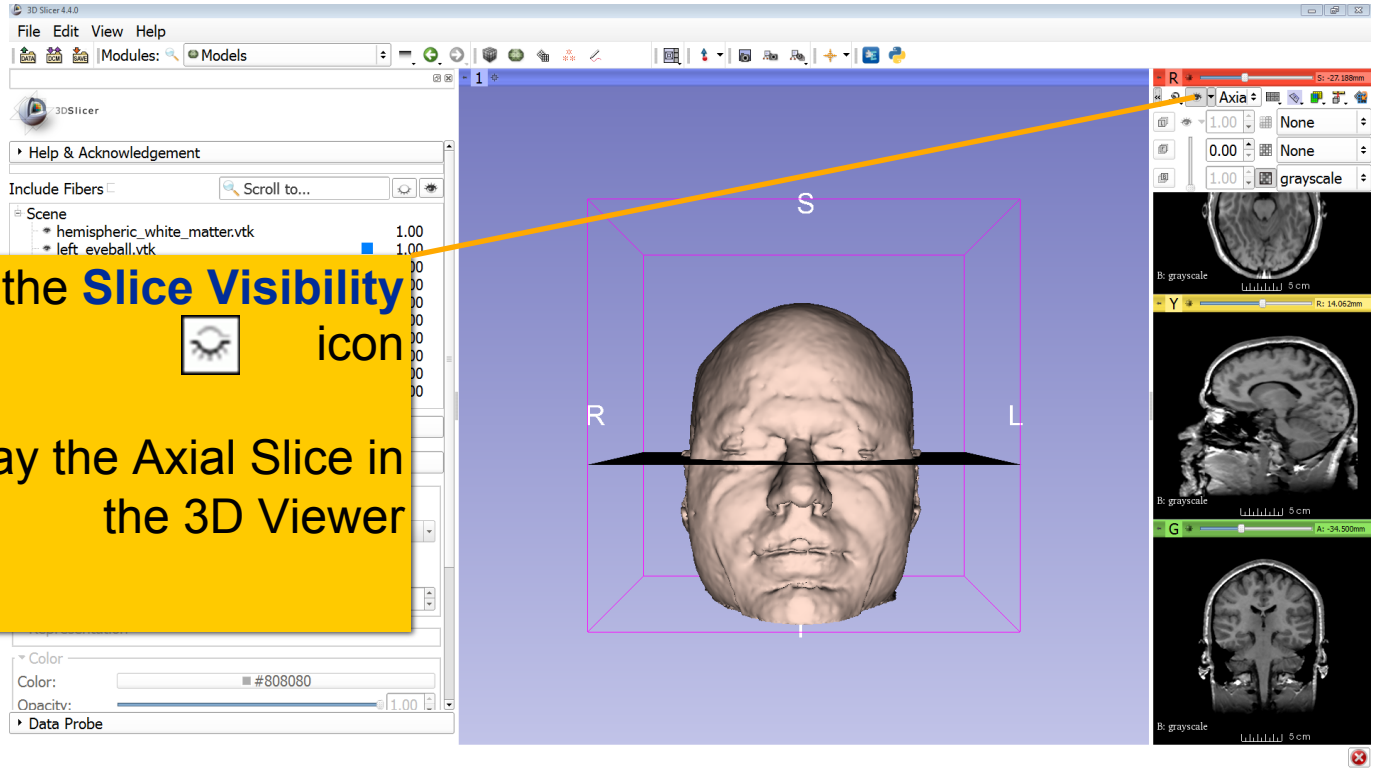
3D visualization of surface models of the brain : Basic 3D Interaction



Position the mouse in the 3D Viewer.

Hold down the **left mouse button** and **drag to rotate** the model.

3D visualization of surface models of the brain : Viewing Slices in the 3D Viewer

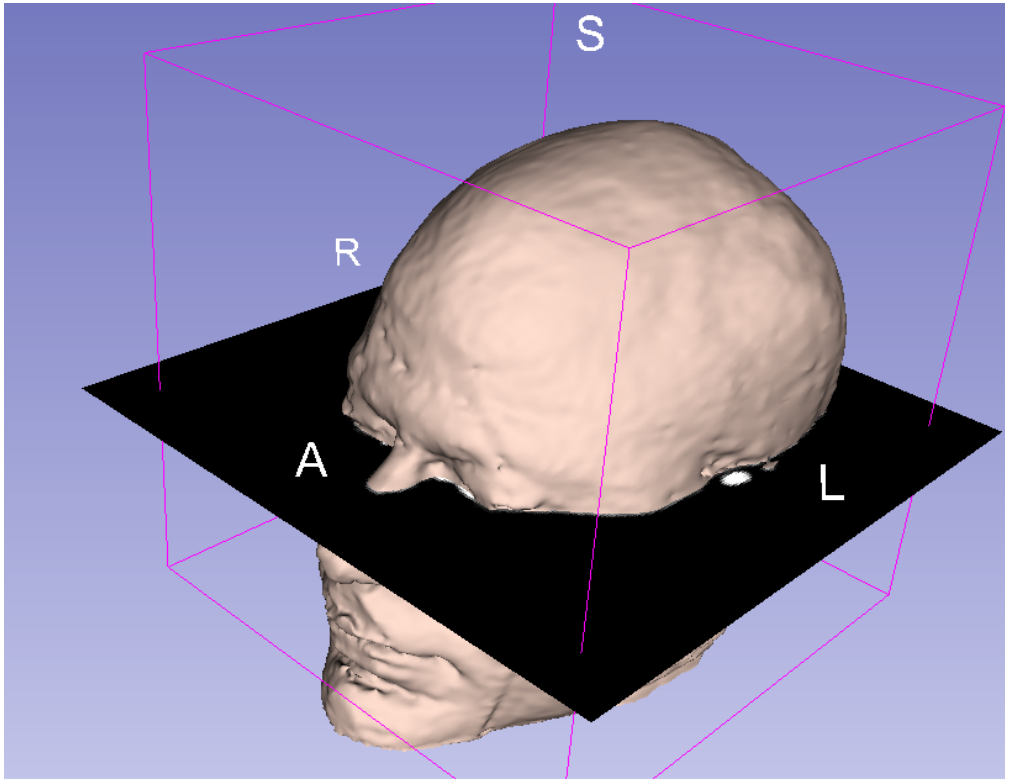


Click on the **Slice Visibility** icon

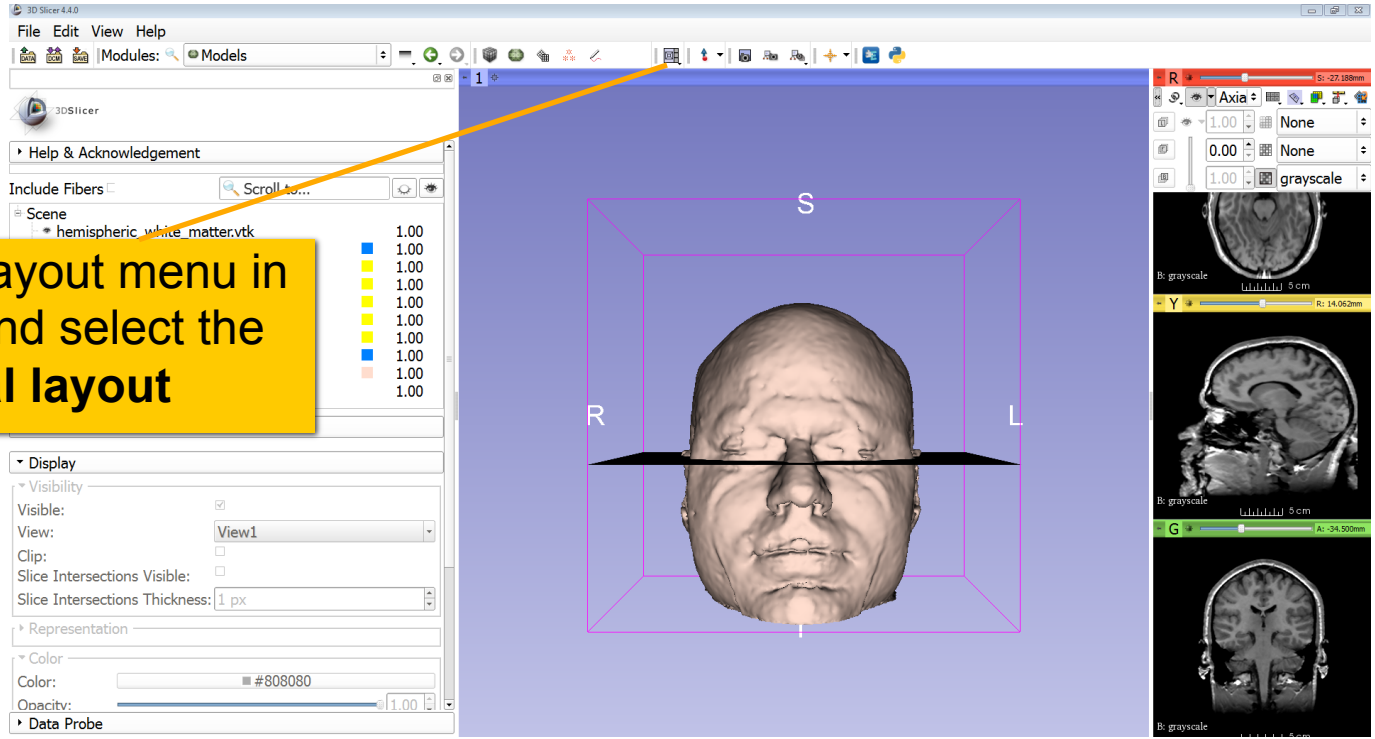
to display the Axial Slice in the 3D Viewer

3D visualization of surface models of the brain

Slicer adds a view of the **Axial slice** in the 3D View.



3D visualization of surface models of the brain : Viewing Slices in the 3D Viewer



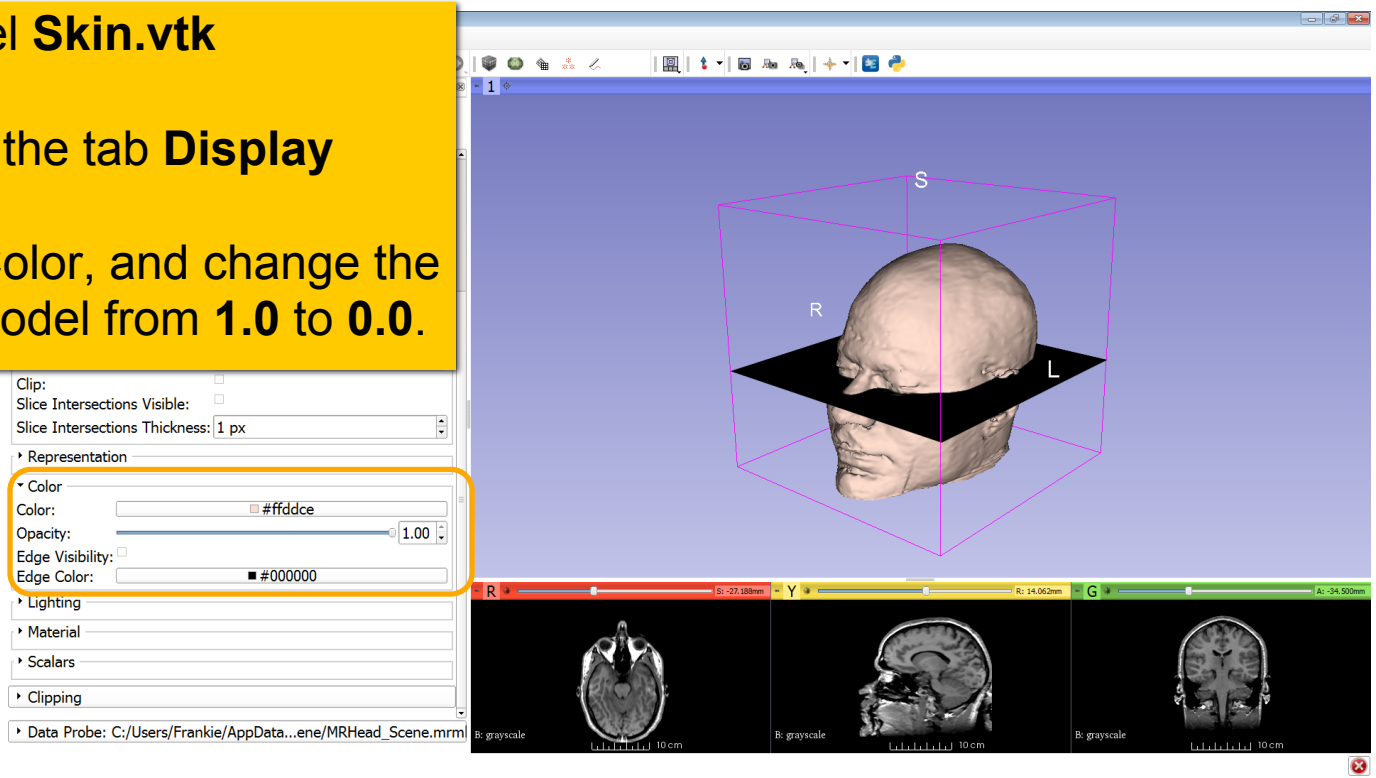
Click on the layout menu in the toolbar, and select the **Conventional layout**

3D visualization of surface models of the brain

Select the model **Skin.vtk**

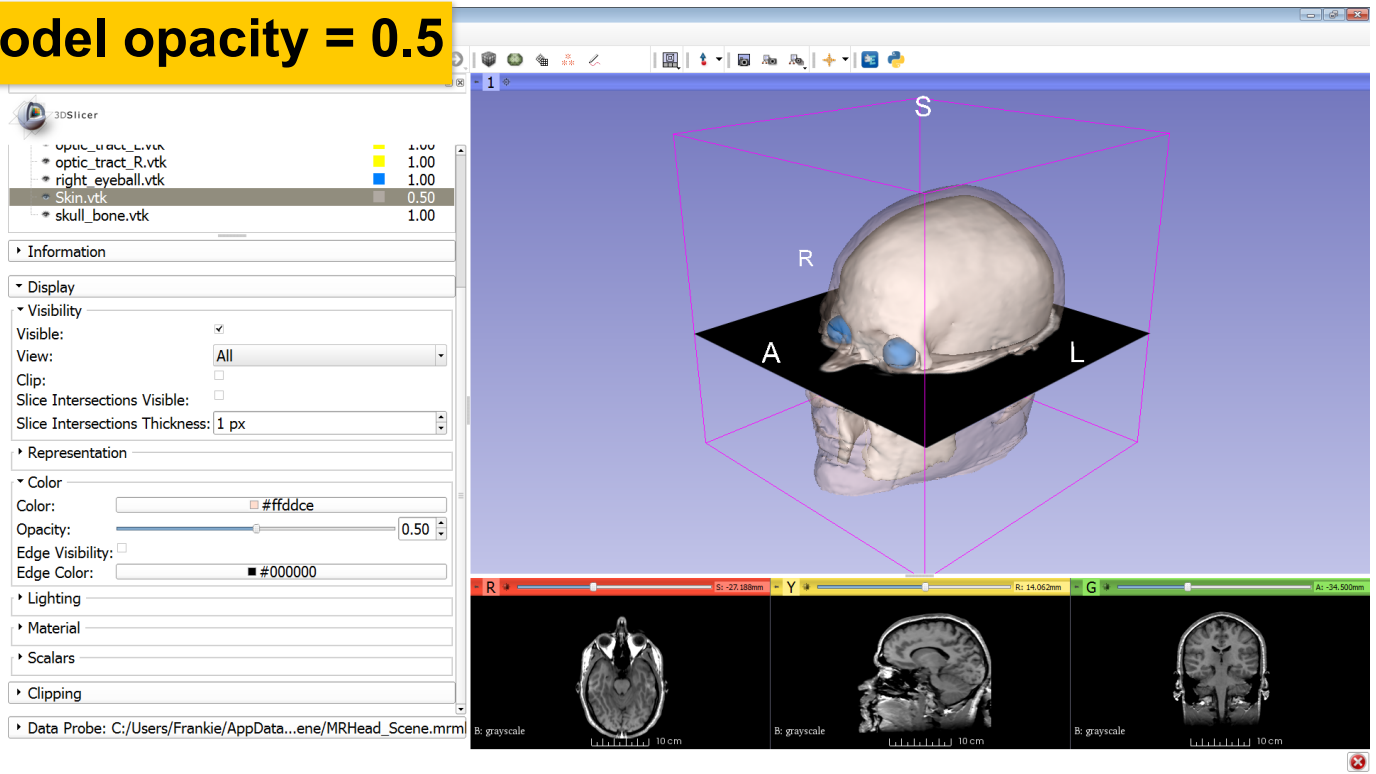
Click to expand the tab **Display**

Select the tab Color, and change the opacity of the model from **1.0** to **0.0**.



3D visualization of surface models of the brain

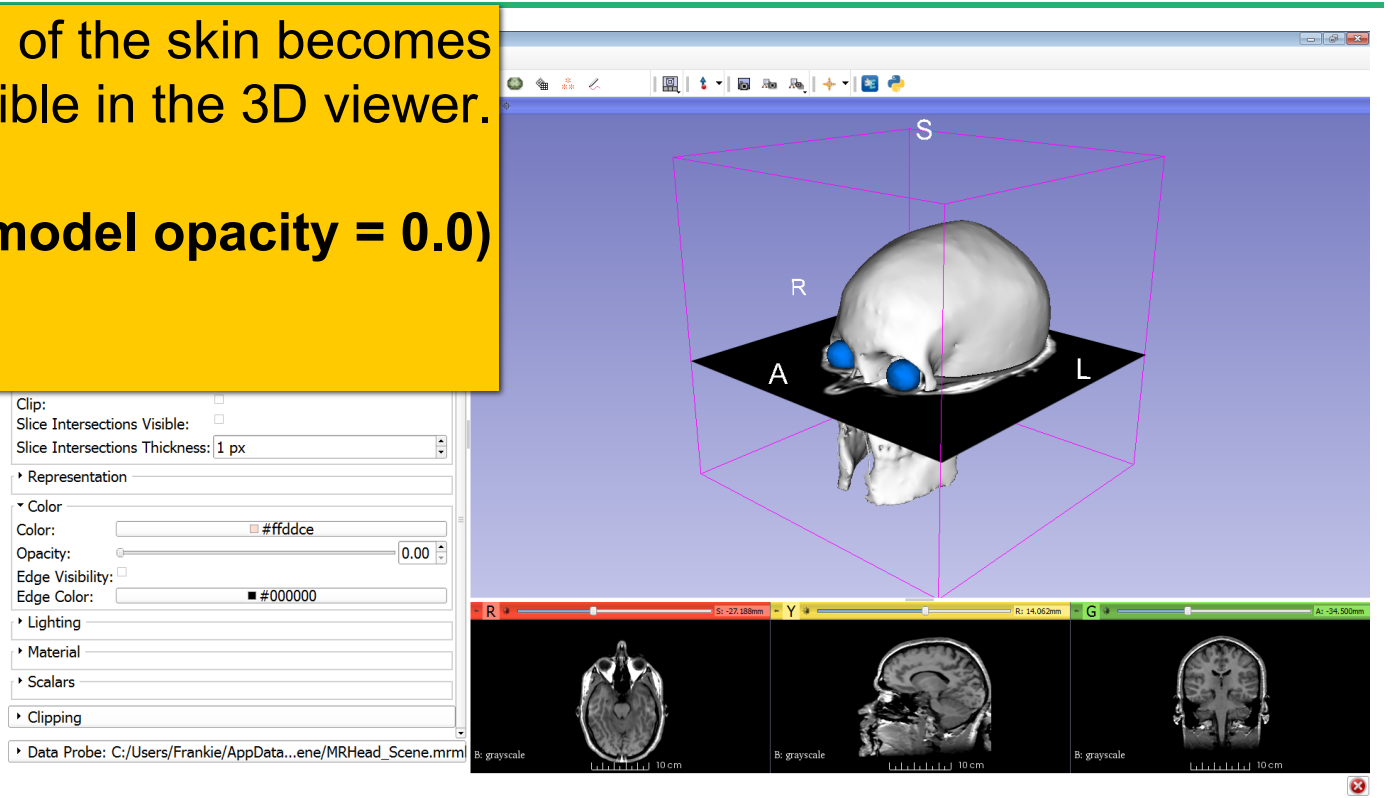
skin model opacity = 0.5



3D visualization of surface models of the brain

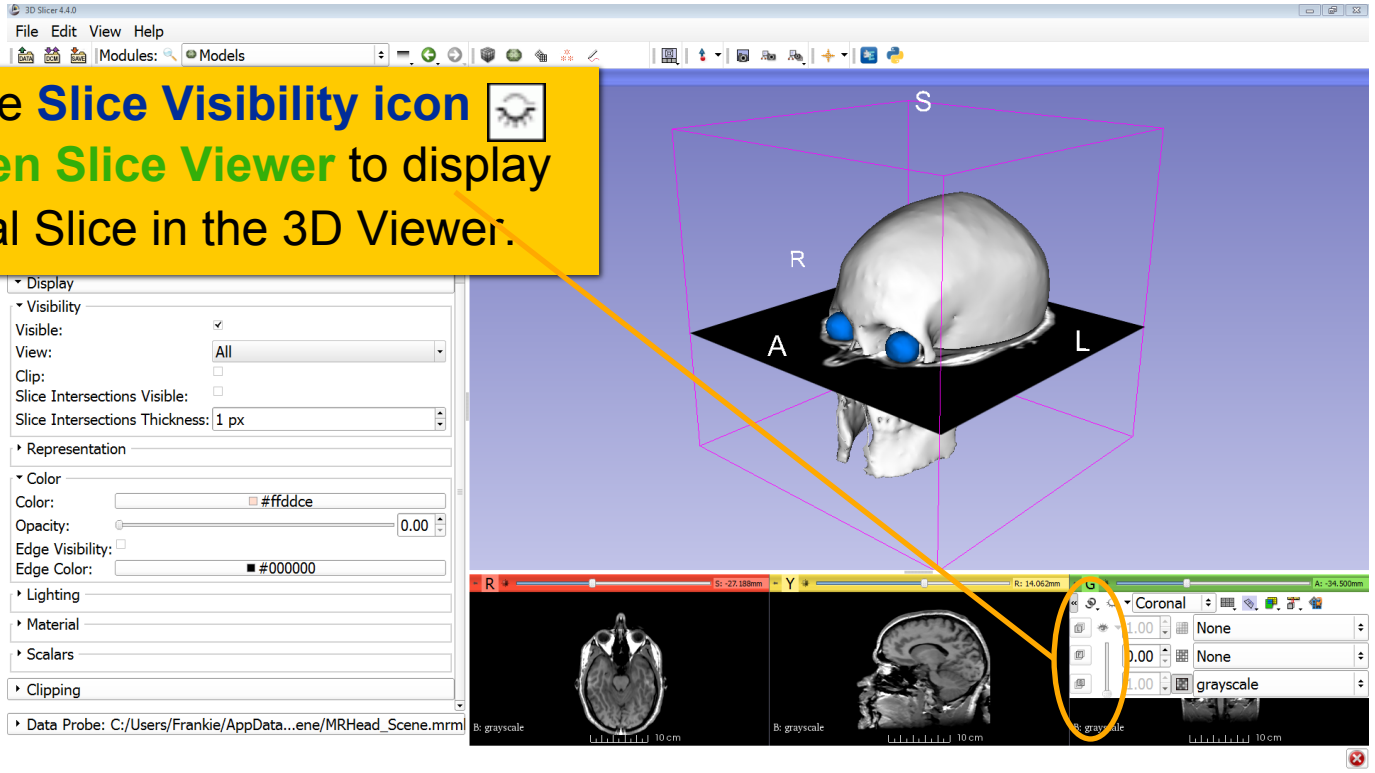
The model of the skin becomes invisible in the 3D viewer.

(skin model opacity = 0.0)



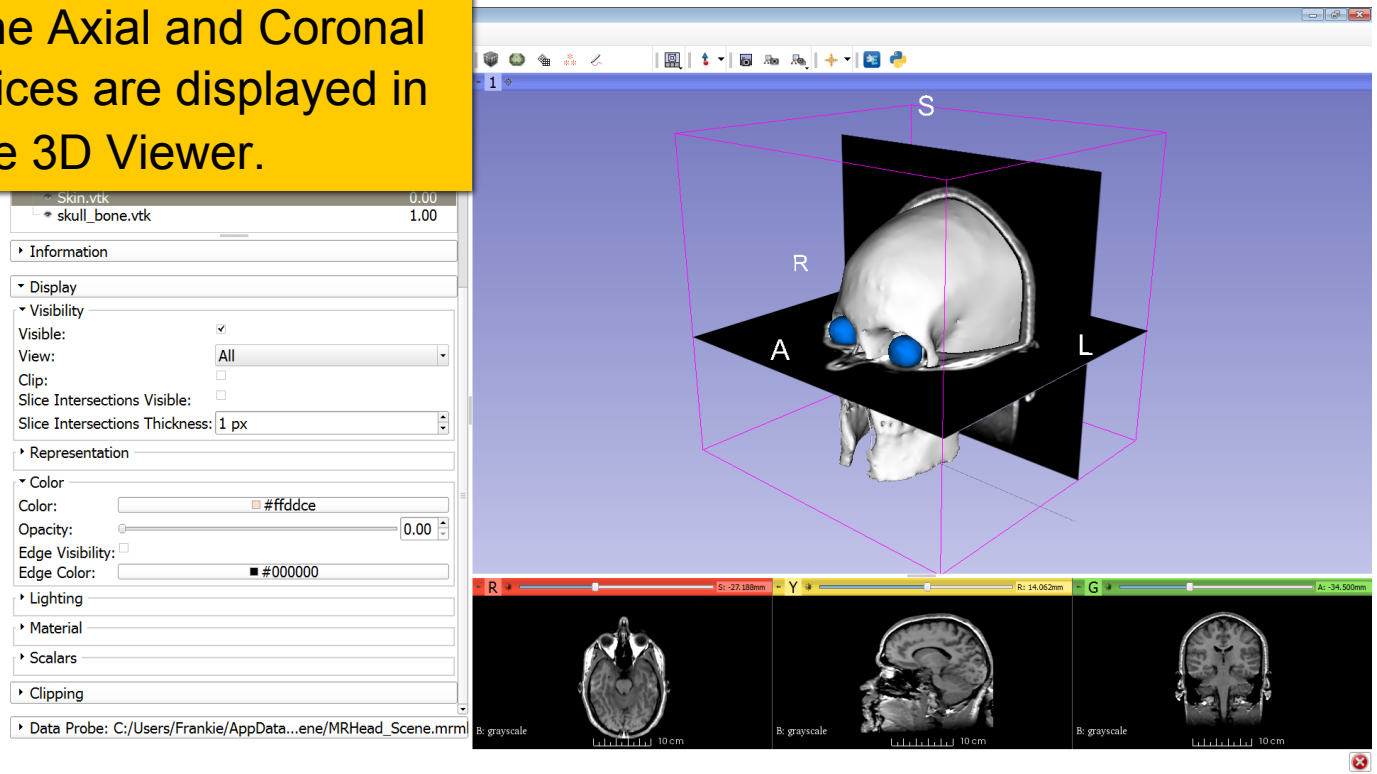
3D visualization of surface models of the brain

Click on the **Slice Visibility icon** in the **Green Slice Viewer** to display the Coronal Slice in the 3D Viewer.

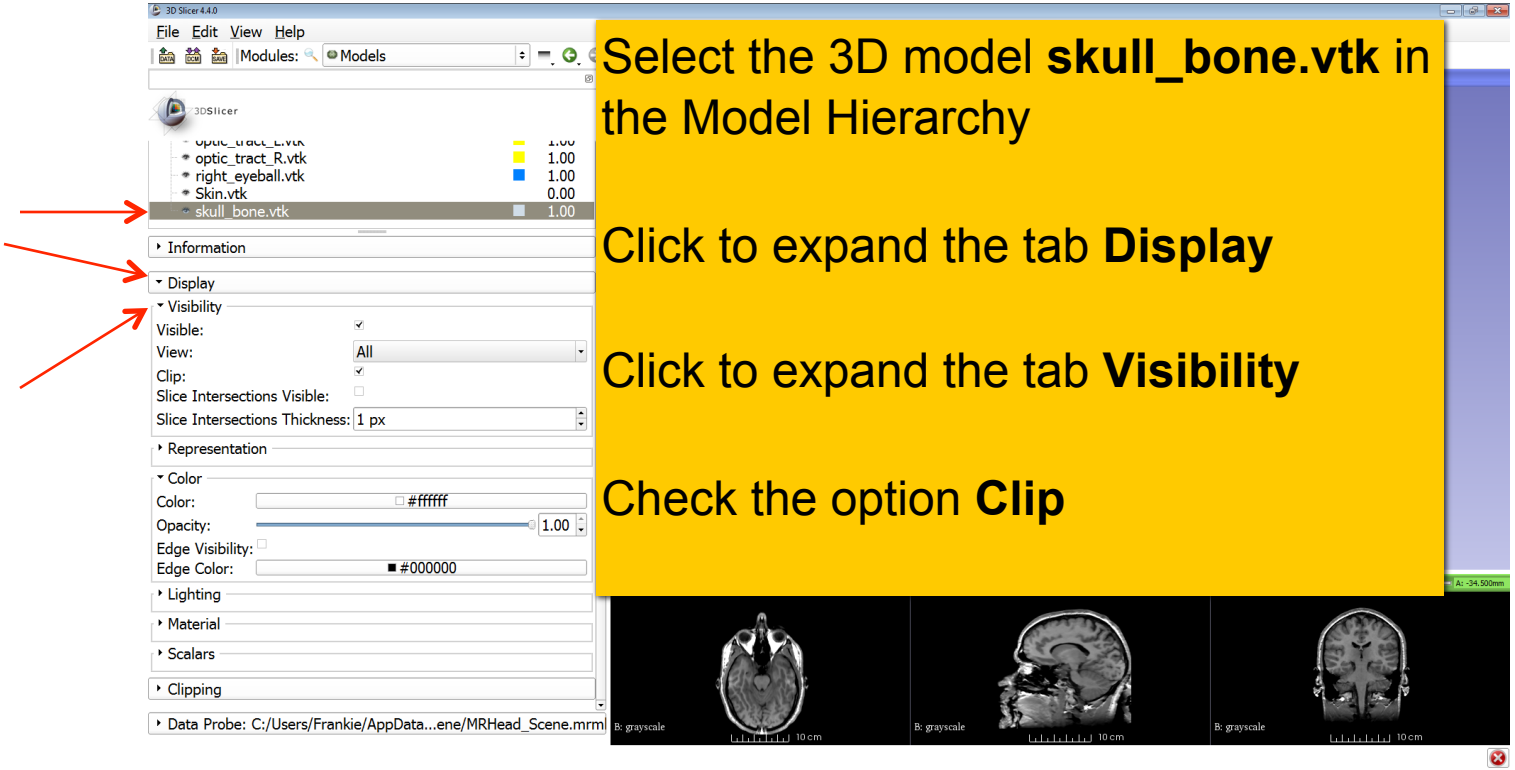


3D visualization of surface models of the brain

The Axial and Coronal Slices are displayed in the 3D Viewer.

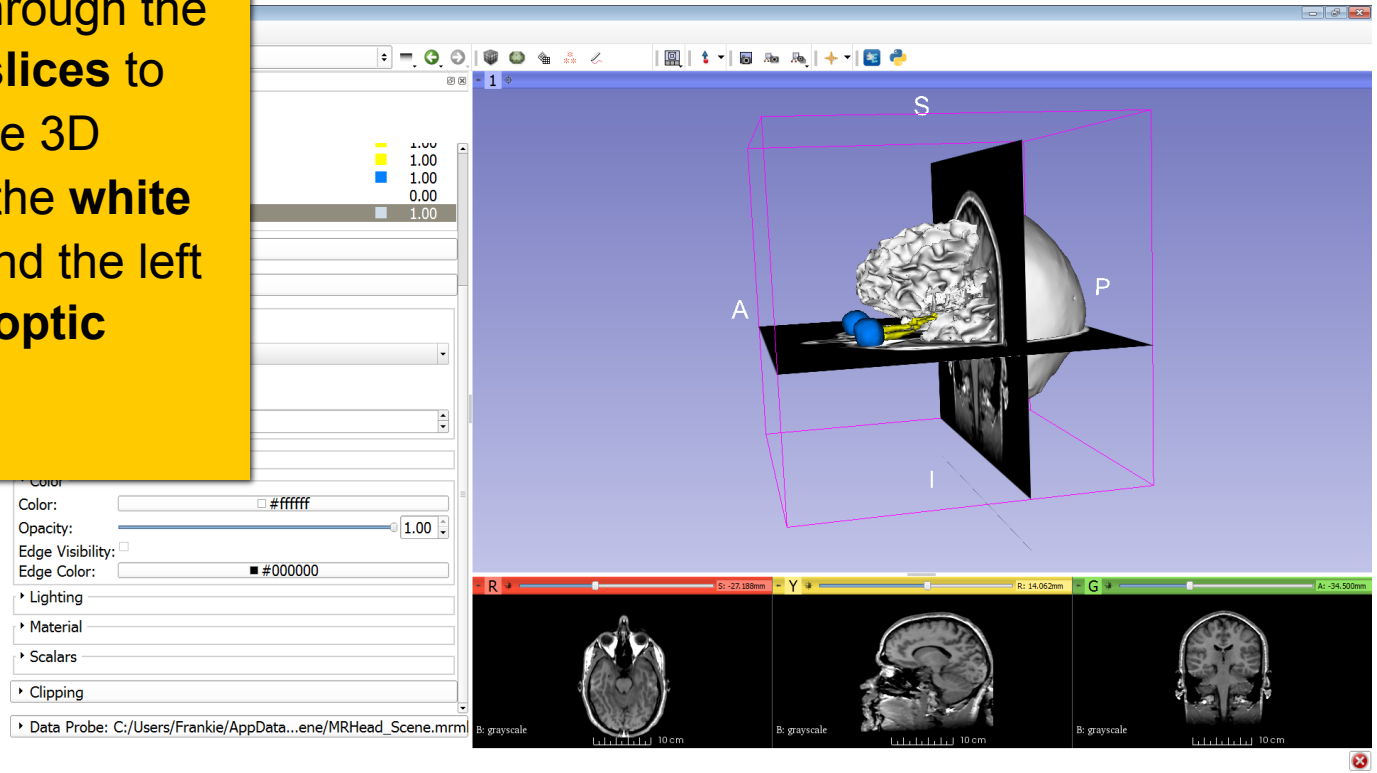


3D visualization of surface models of the brain



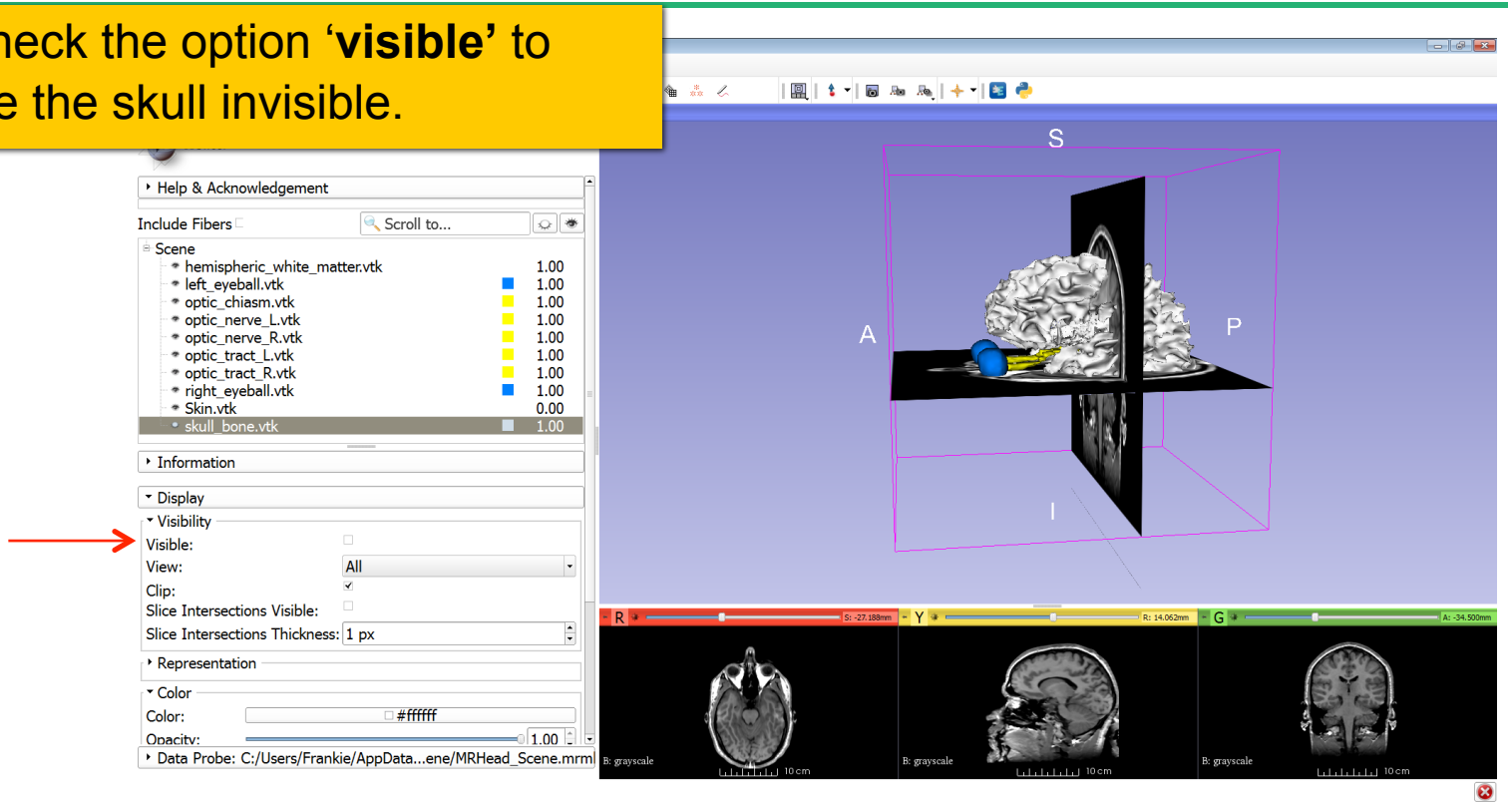
3D visualization of surface models of the brain

Browse through the **coronal slices** to expose the 3D model of the **white matter**, and the left and right **optic nerves**.



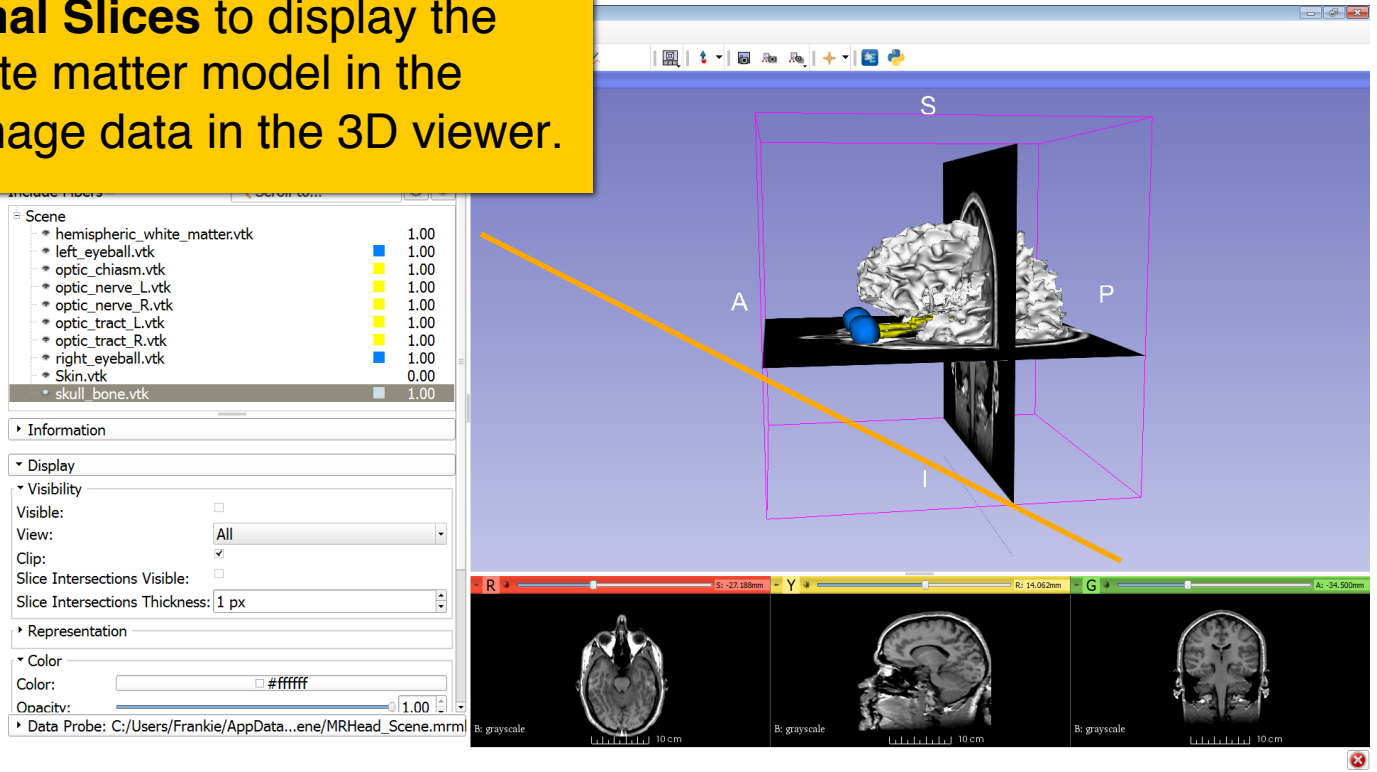
3D visualization of surface models of the brain

Uncheck the option '**visible**' to make the skull invisible.



3D visualization of surface models of the brain

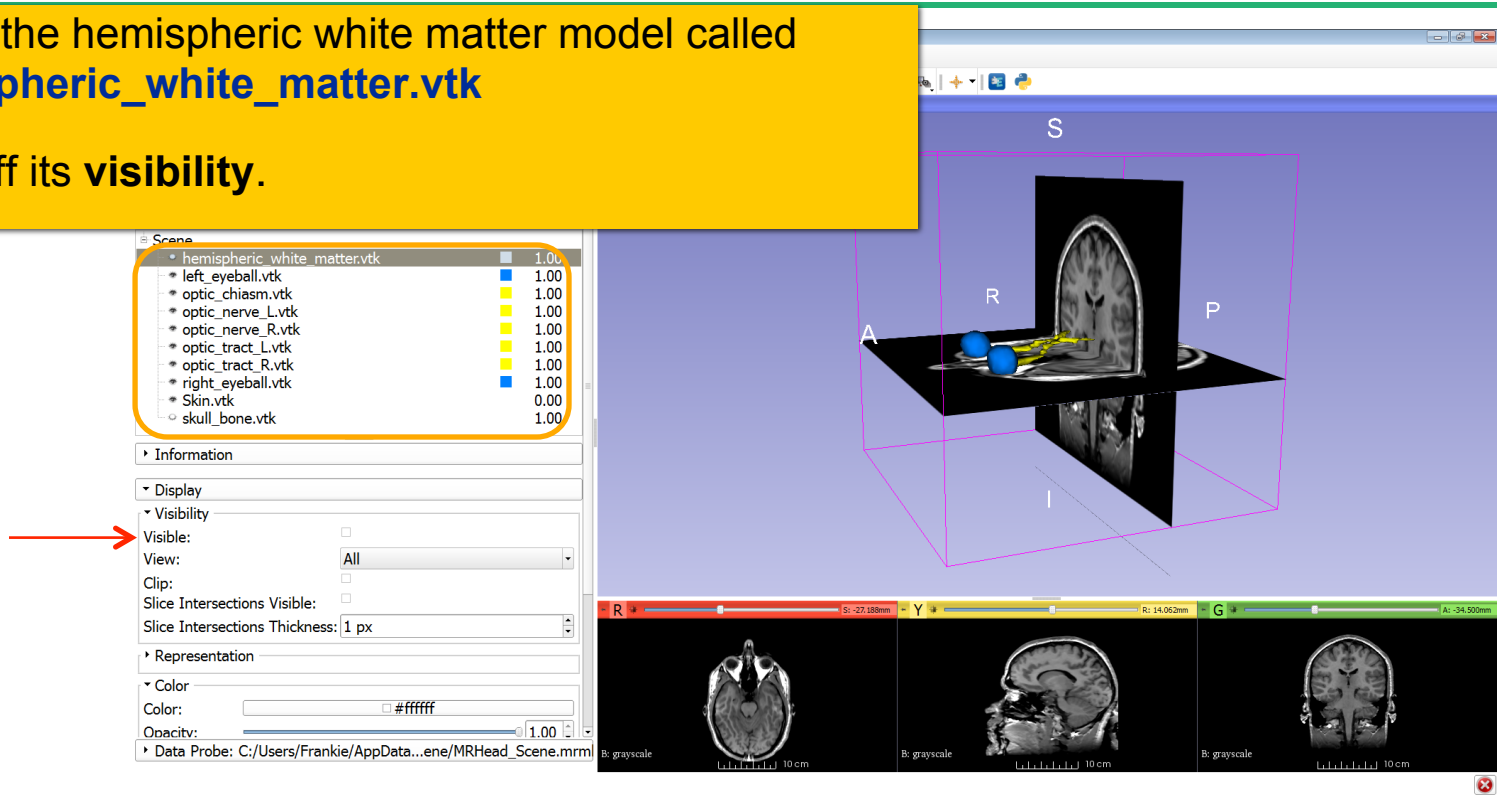
Scroll the **Coronal Slices** to display the hemispheric white matter model in the context of the image data in the 3D viewer.



3D visualization of surface models of the brain

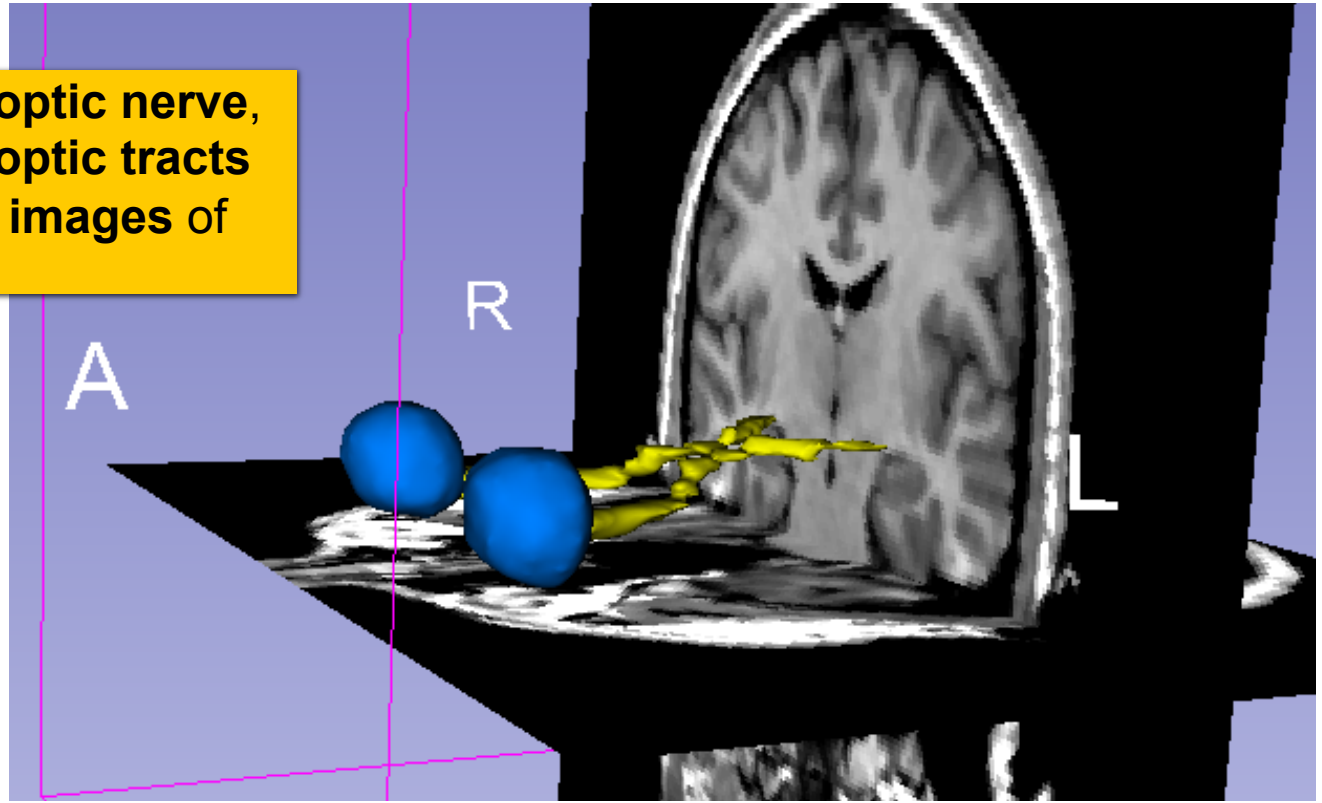
Select the hemispheric white matter model called **hemispheric_white_matter.vtk**

Turn off its **visibility**.



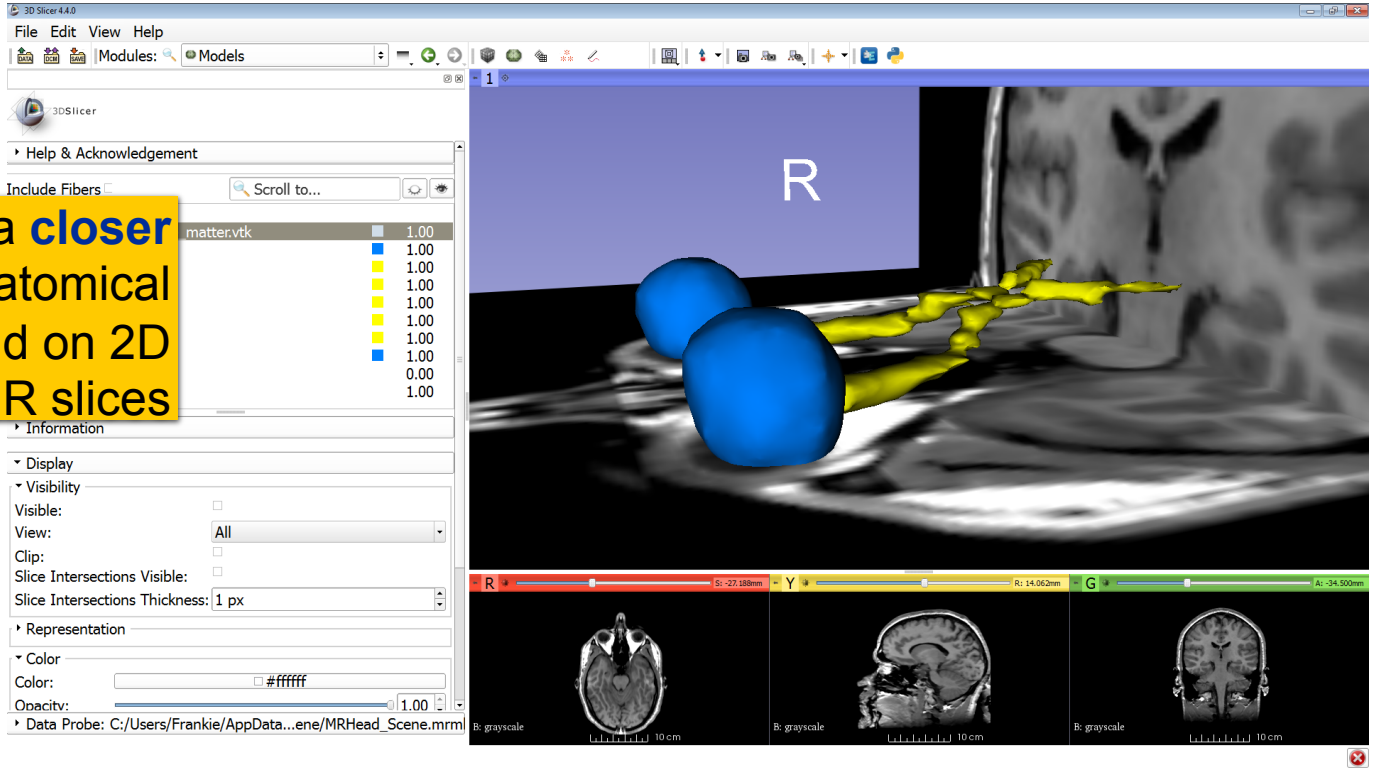
3D visualization of surface models of the brain

Slicer displays the **optic nerve**, **optic chiasm** and **optic tracts** overlaid on the **MR images** of the brain.



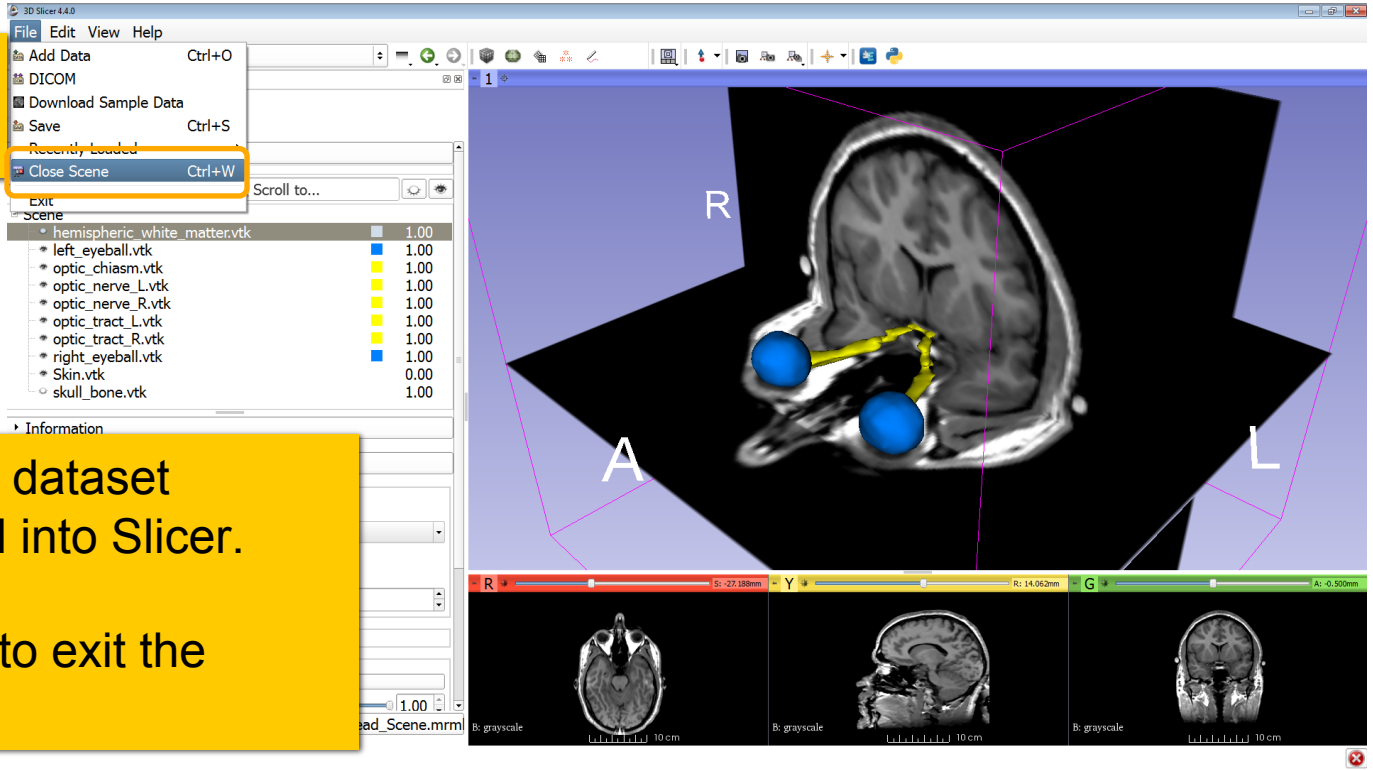
3D visualization of surface models of the brain

Slicer displays a **closer view** of 3D anatomical structures overlaid on 2D MR slices



Close the existing scene and all its data

Select **File->Close Scene**

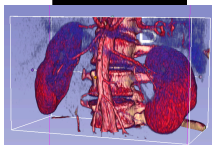


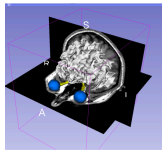
This removes any dataset previously loaded into Slicer.

Select **File→Exit** to exit the software

Overview

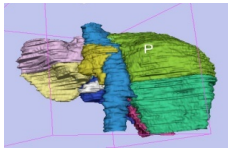
Part I: Introduction to the 3DSlicer software

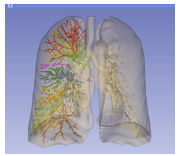




Part II: 3D Data Loading and visualization of DICOM images

- Volume Rendering of thoraco-abdominal CT data
- Surface Rendering of MR head data

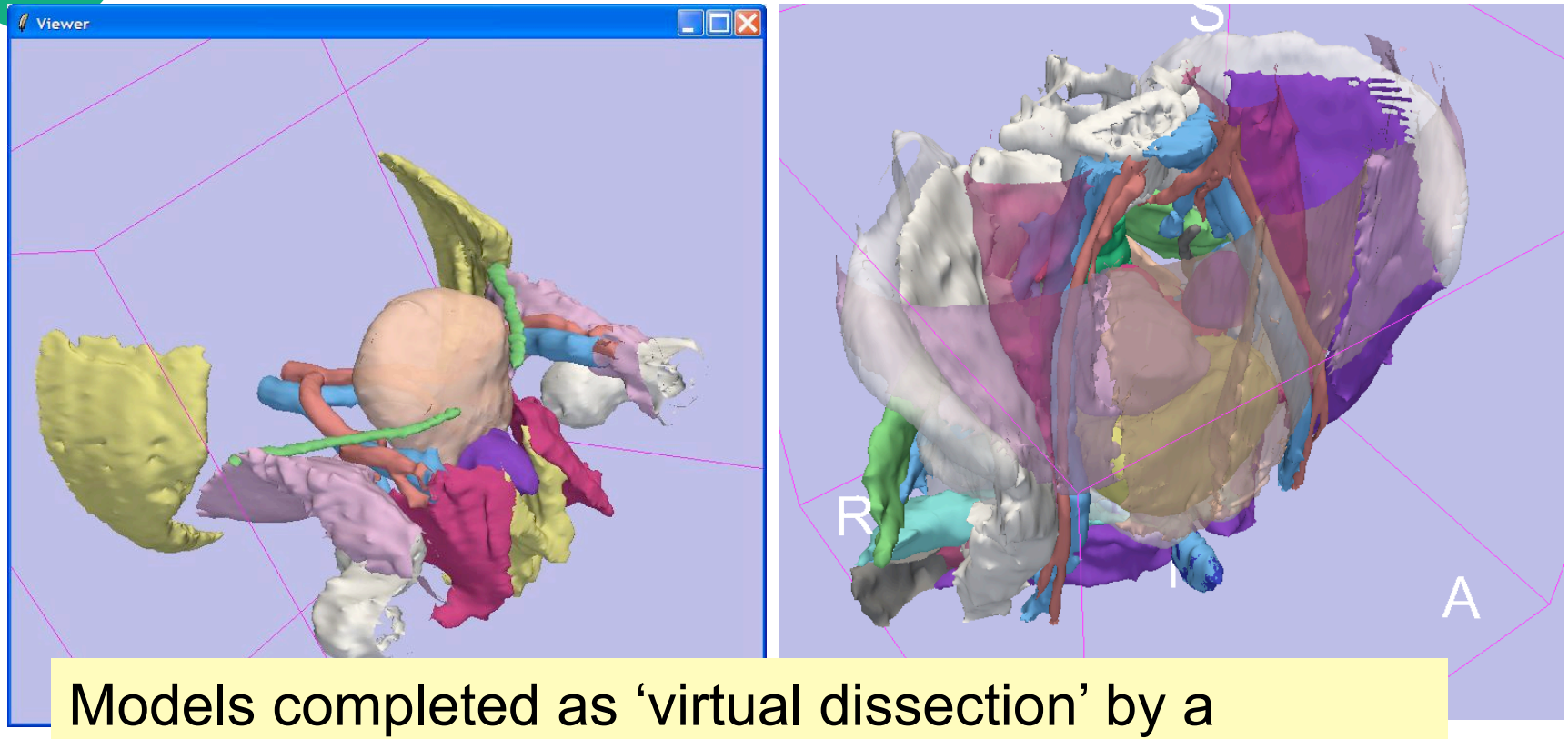




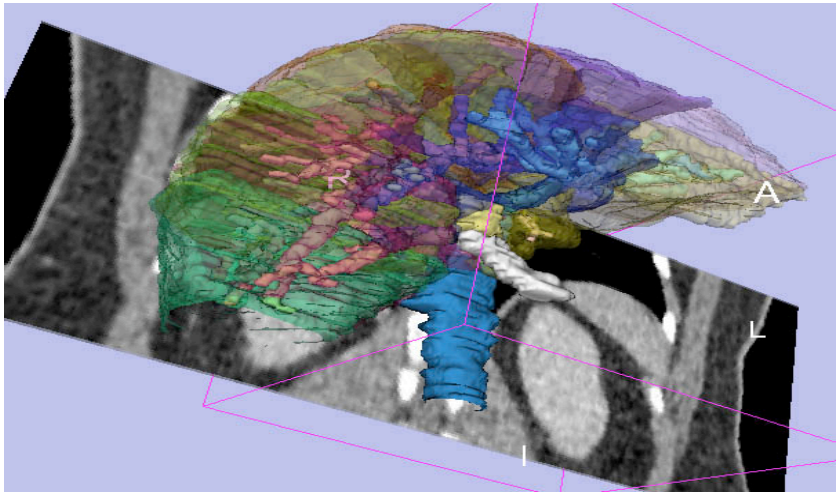
Part III: 3D interactive exploration of the anatomy

- Exploration of the Segments of the liver
- Exploration of the Segments of the lung

Slicer for Radiology Education



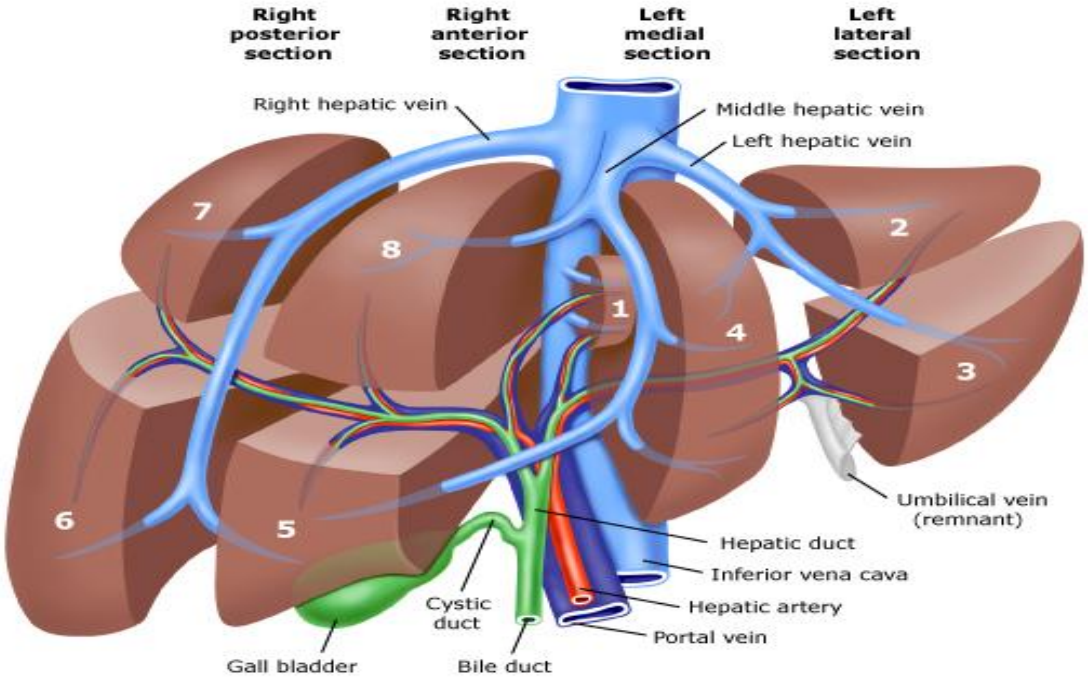
Models completed as ‘virtual dissection’ by a medical student who is now a radiology resident



Part IIIa:

Interactive 3D Visualization of the segments of the liver

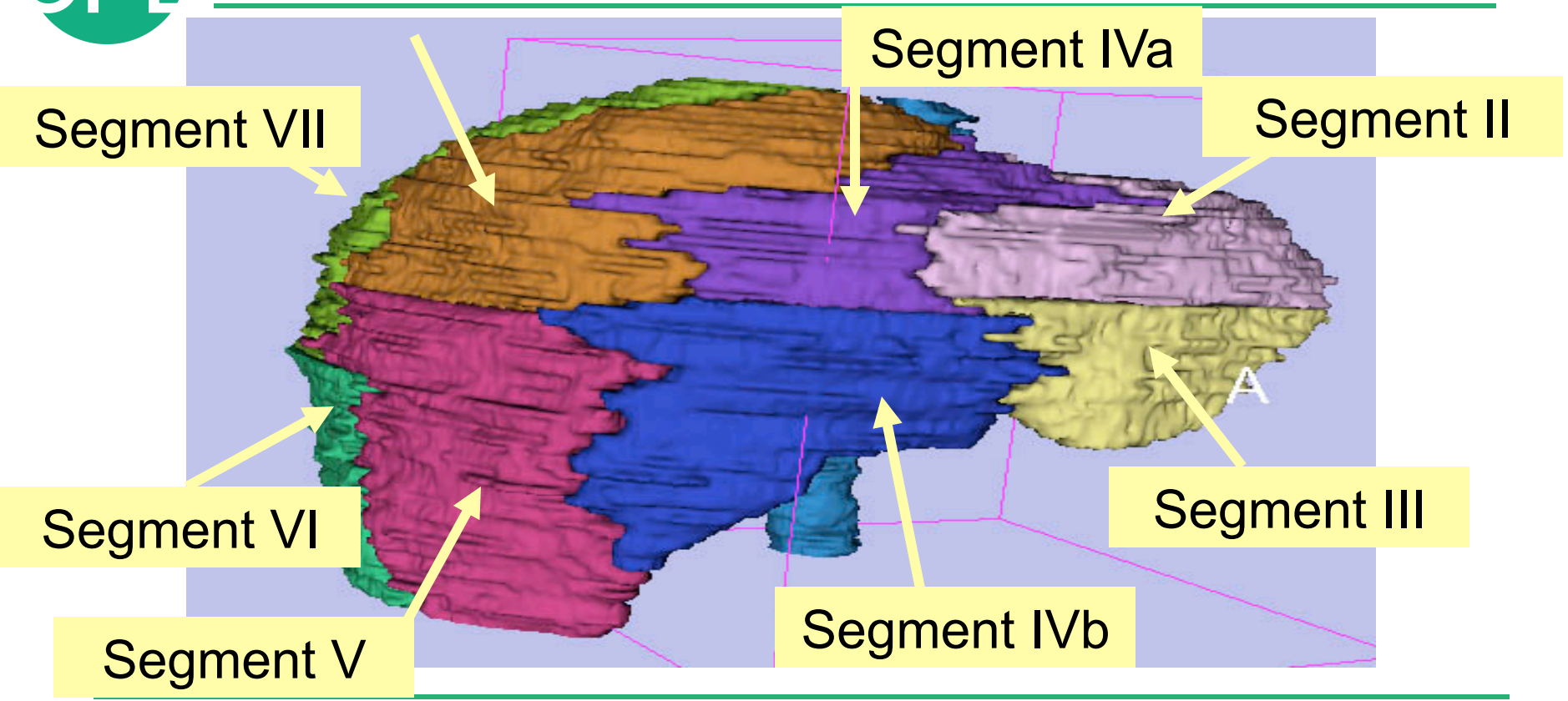
Anatomy of the liver



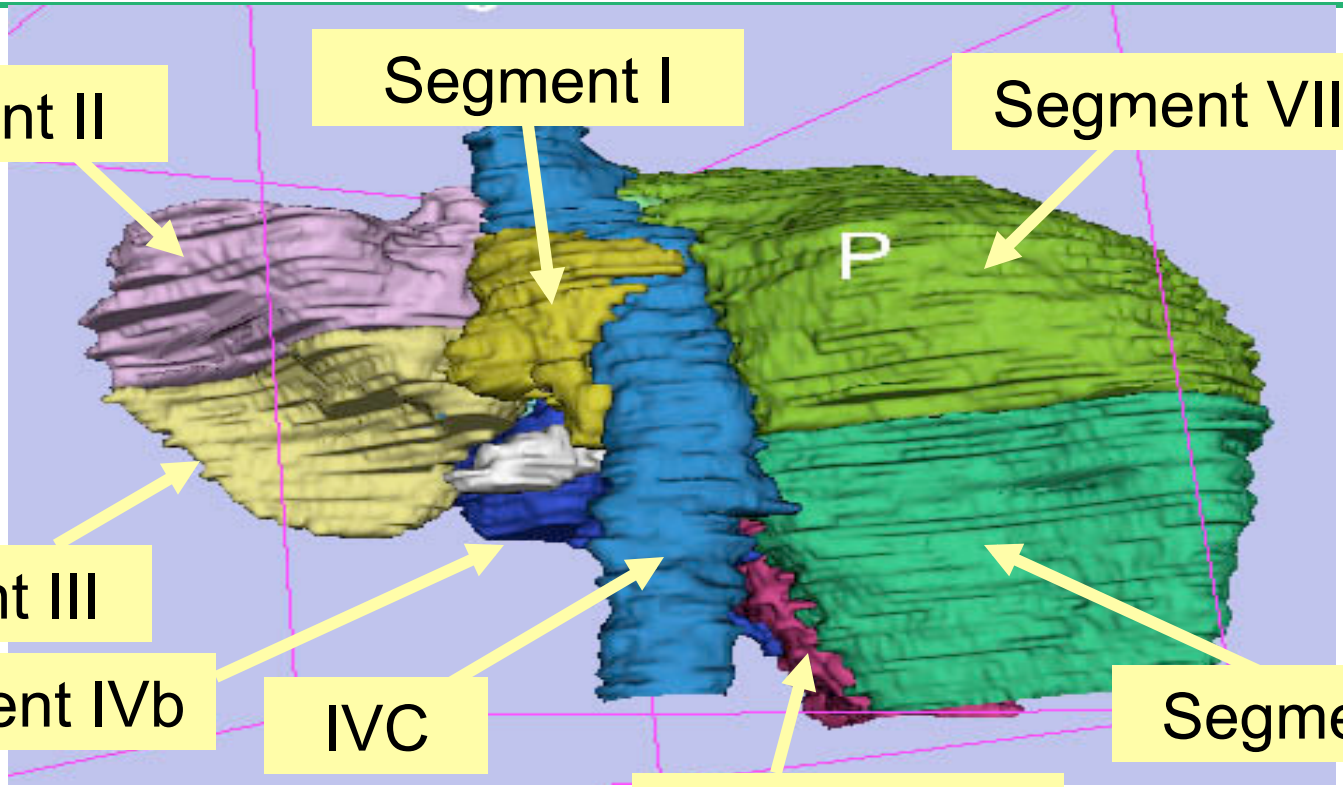
Liver dataset

The liver dataset is a contrast-enhanced CT abdominal scan of a healthy 36 year-old male.

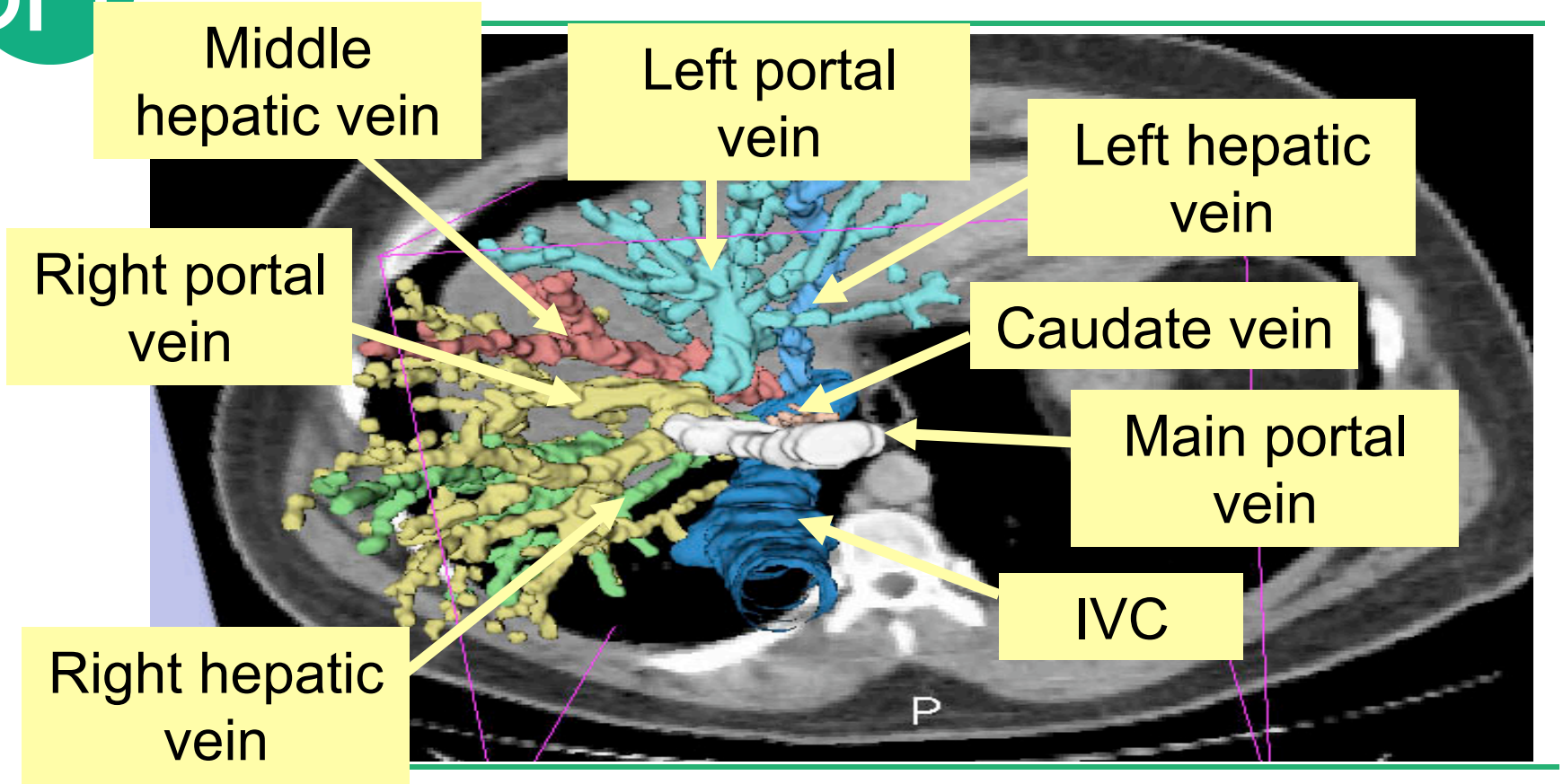
3D segments of the liver



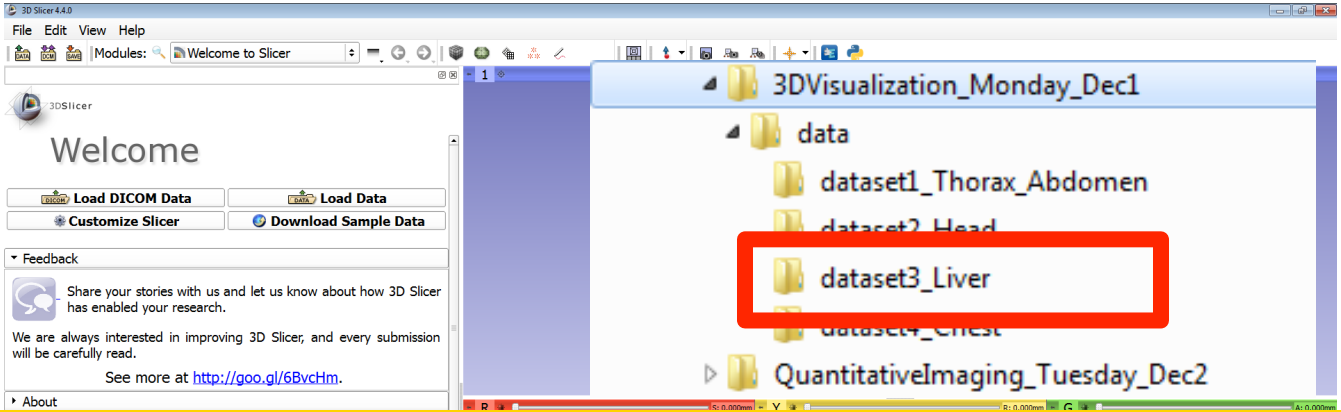
3D segments of the liver



Liver vasculature



Loading the Liver Scene



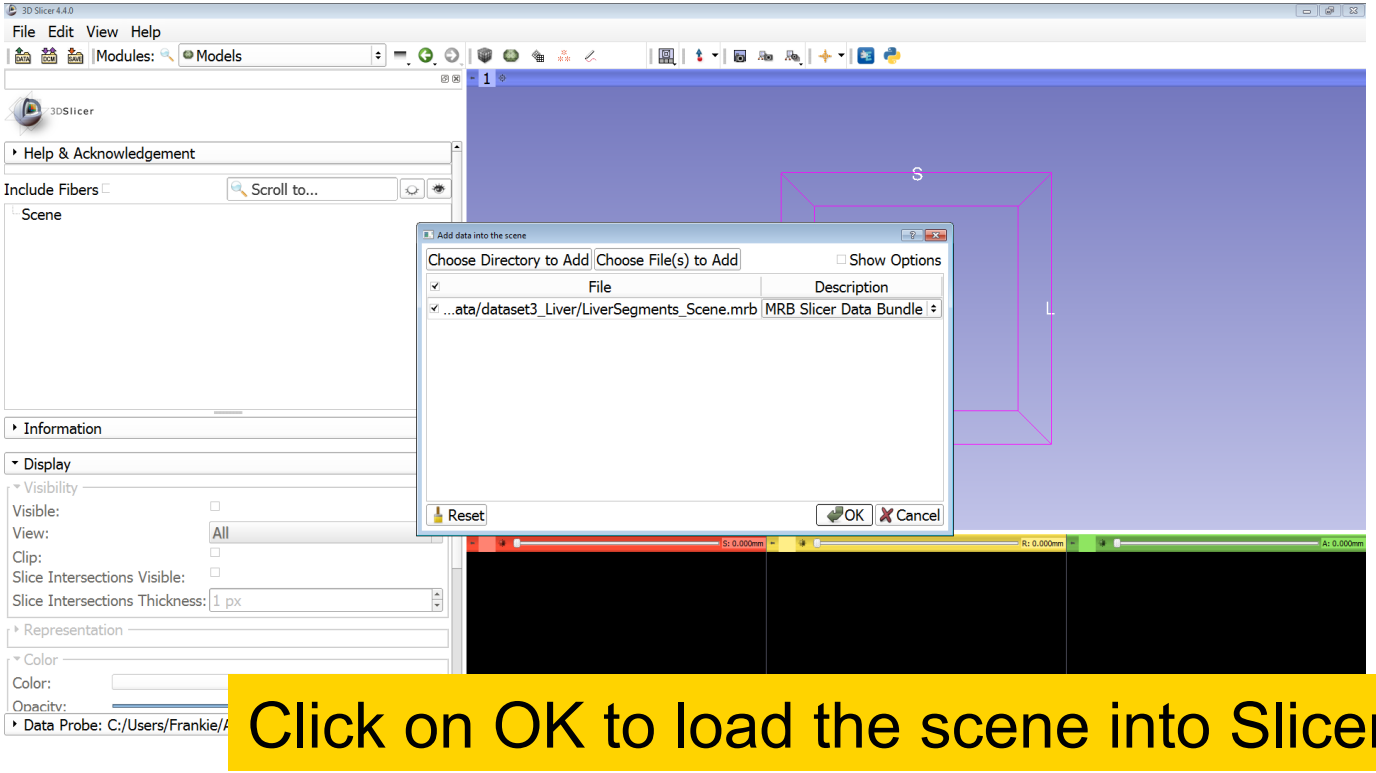
Browse to the directory **3DVisualization_Monday_Dec1**

Select the directory **dataset3_Liver**

Drag and drop the file **LiverSegments_Scene.mrb** into Slicer

Click on OK to load the scene into Slicer

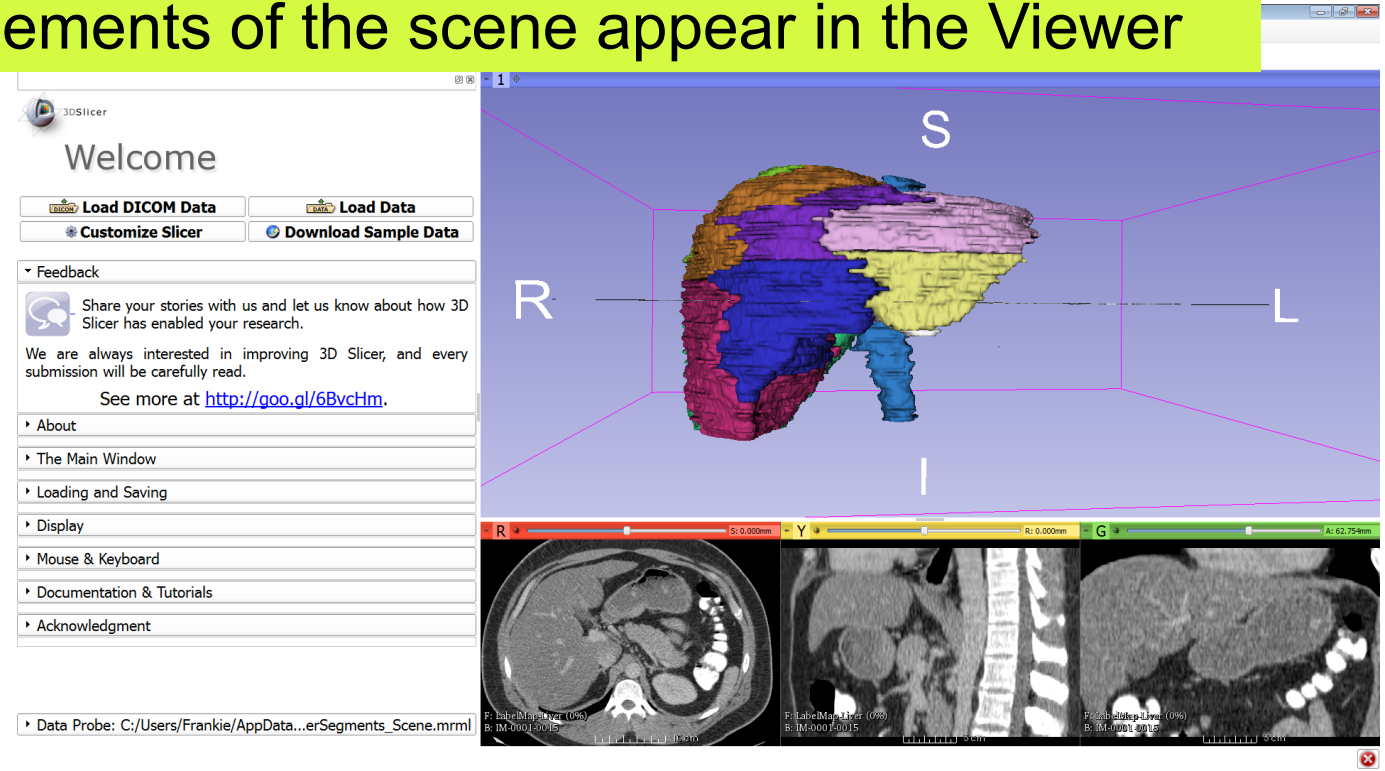
Loading the Liver Scene



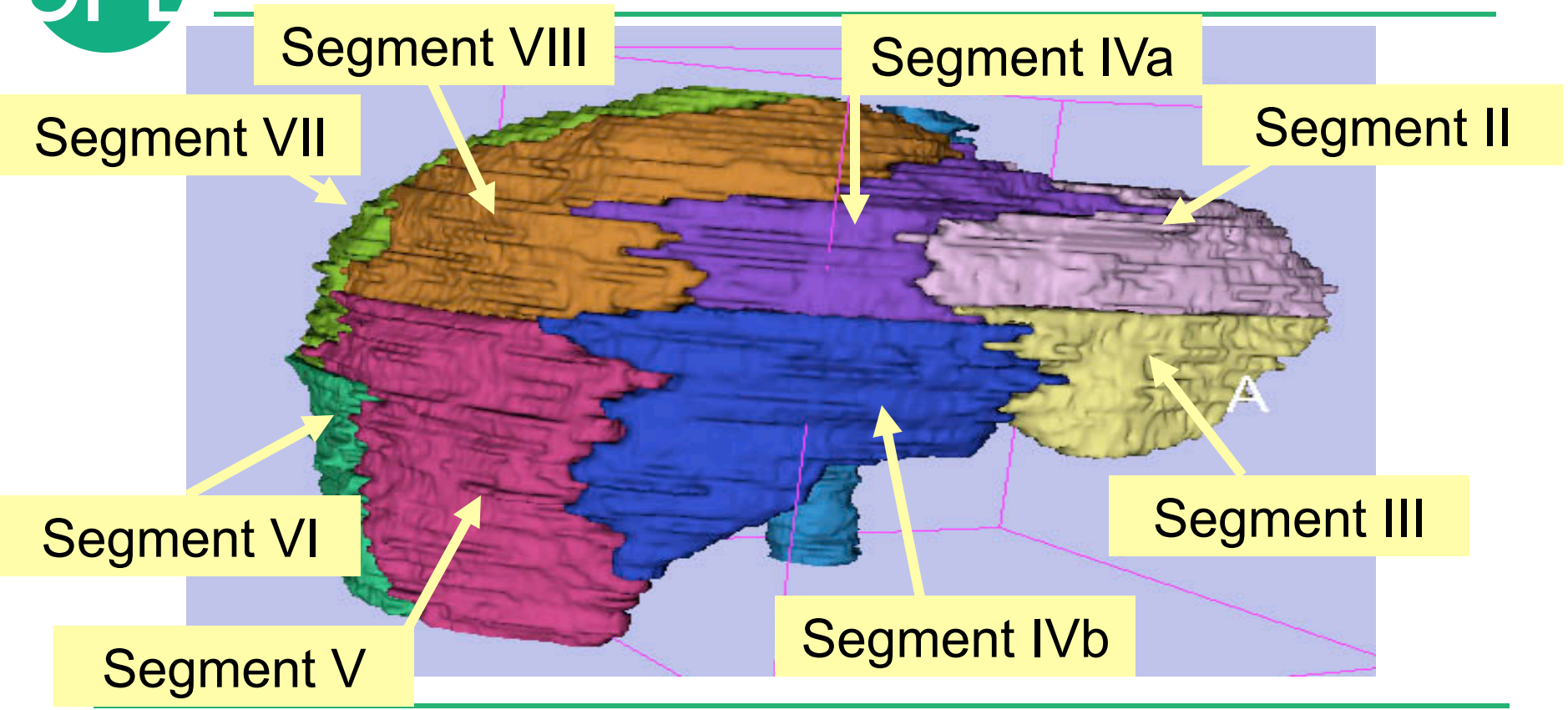
Click on OK to load the scene into Slicer

Liver Segments Scene

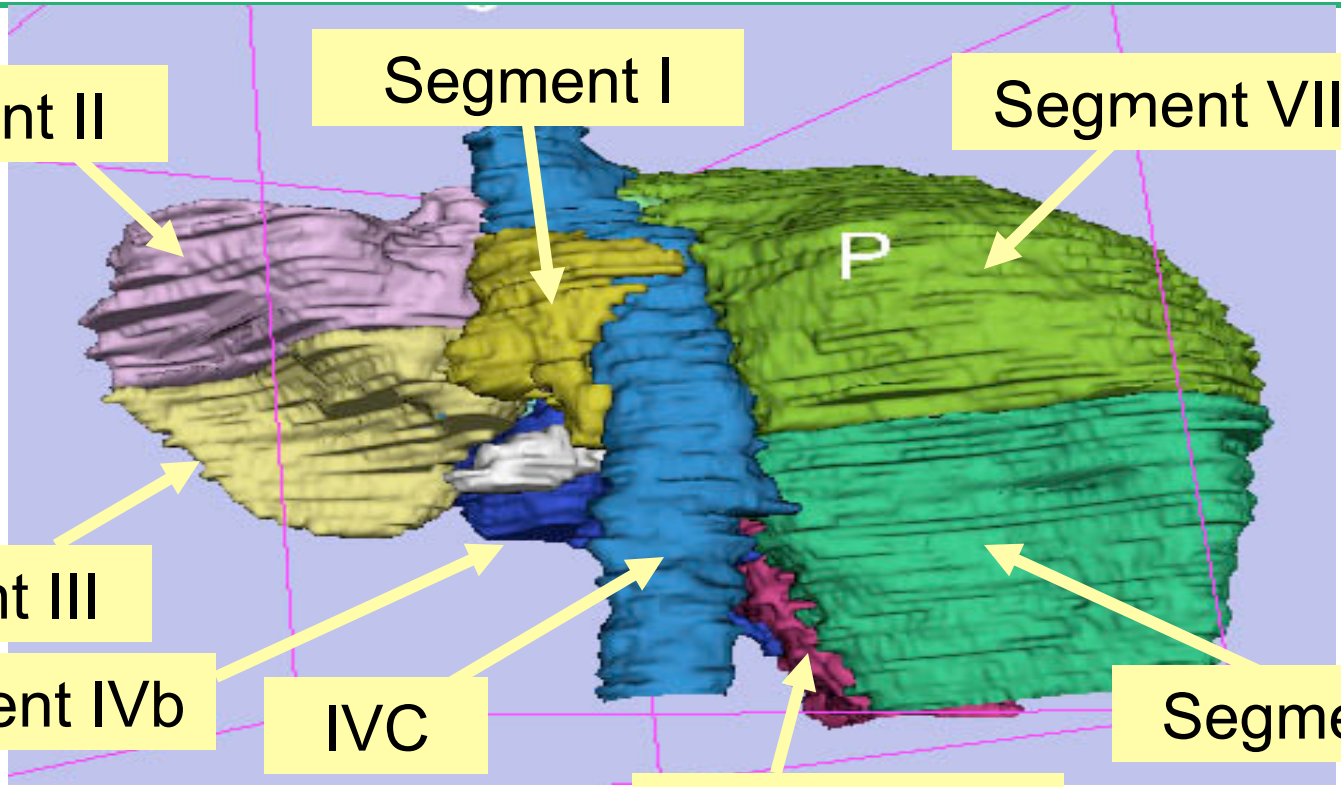
The elements of the scene appear in the Viewer



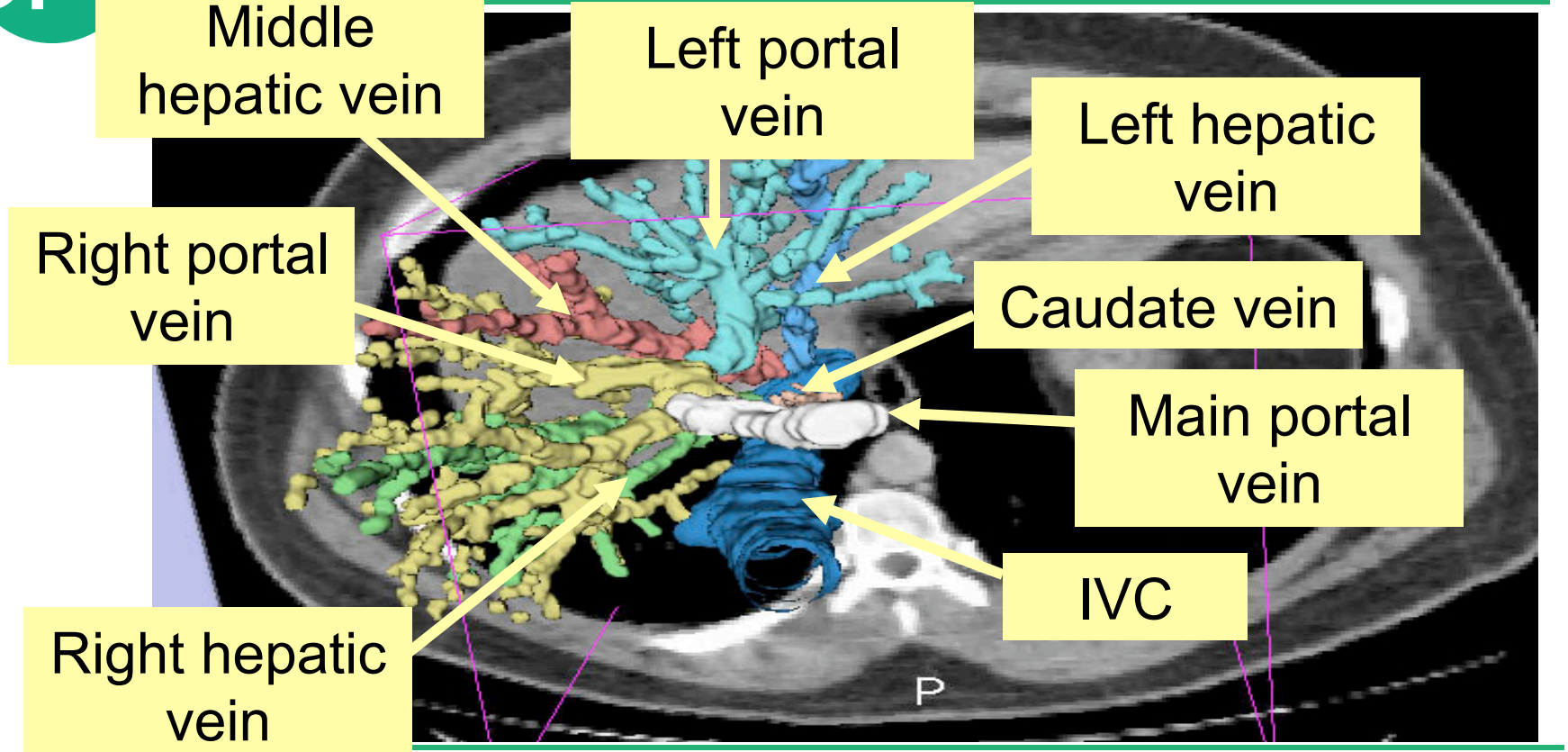
3D models of the liver



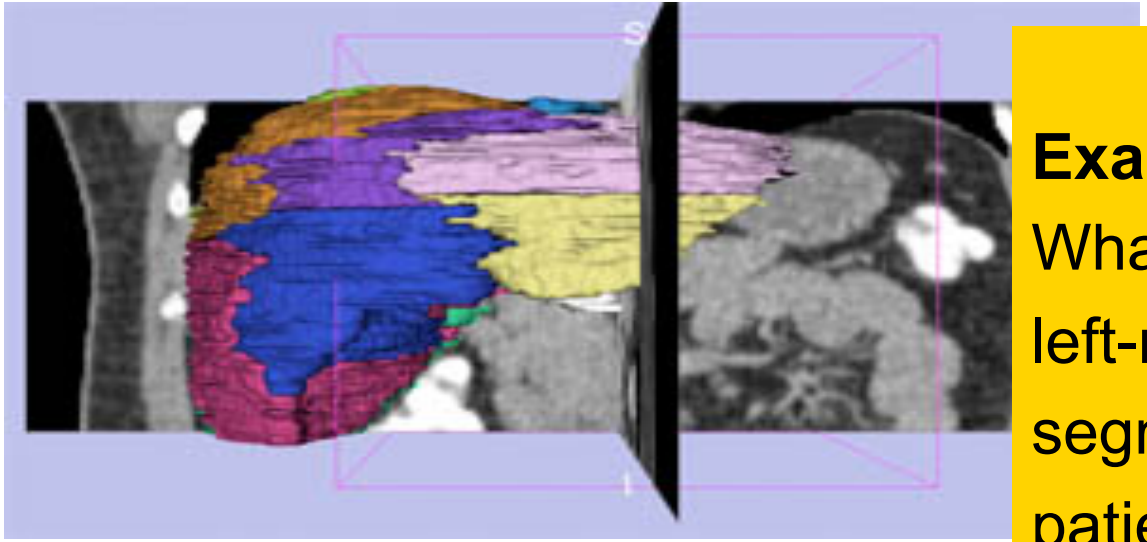
3D models of the liver



3D models of the liver



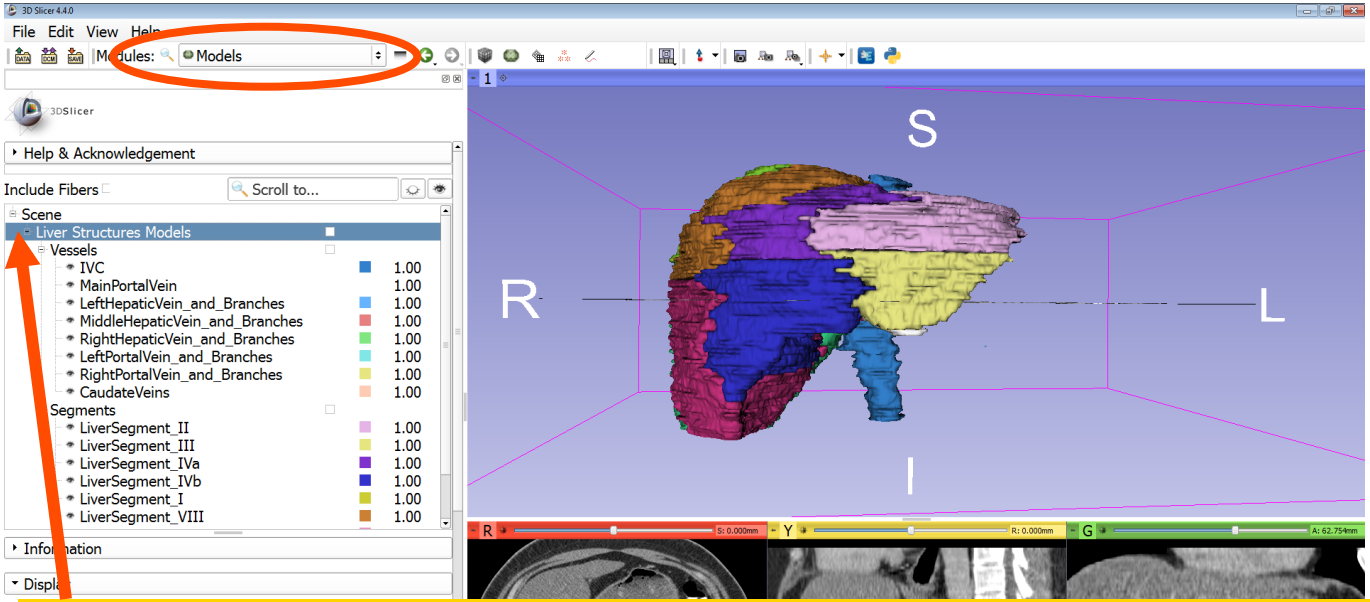
3D Exploration of Liver Segments



Example:

What organ abuts the left-most margin of segment II in this patient ?

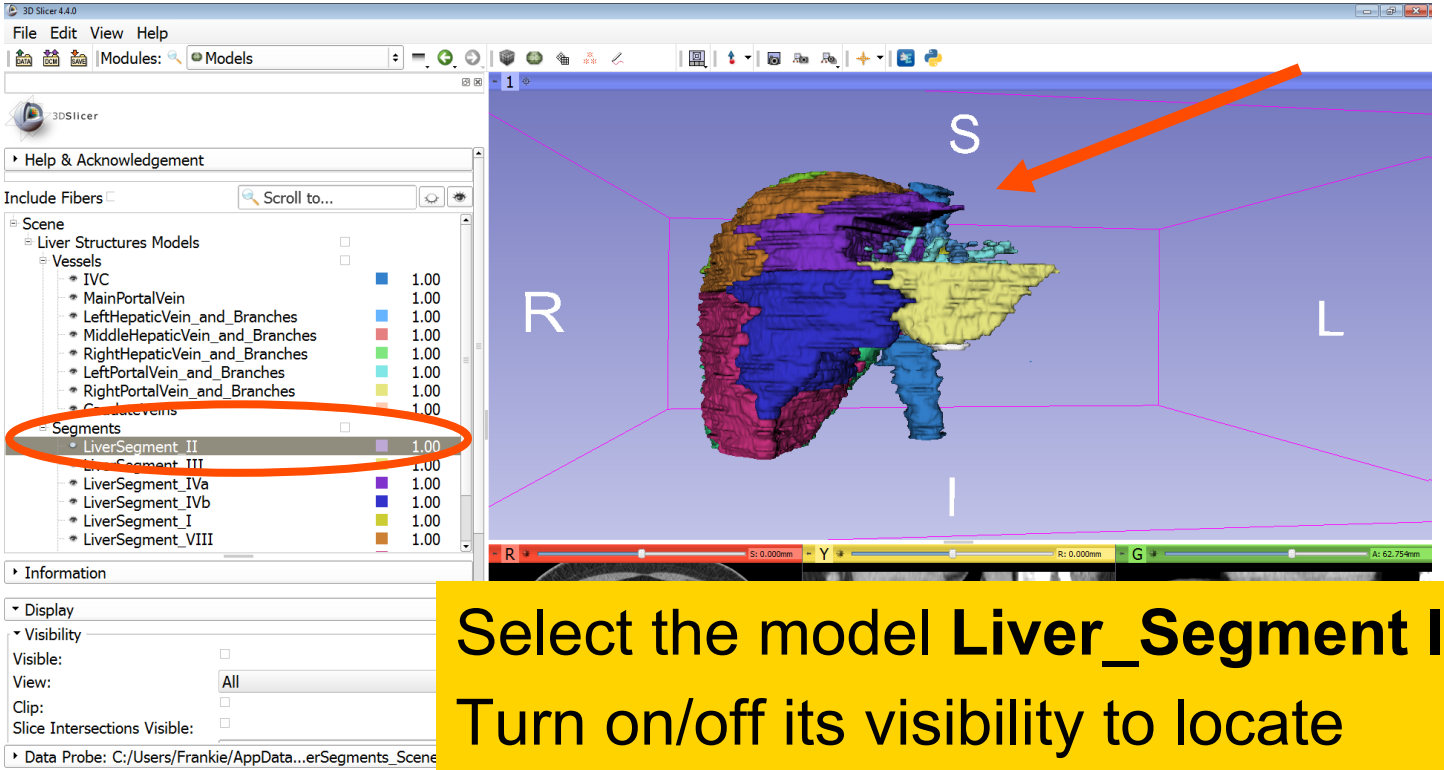
3D Exploration of Liver Segments



Select the module **Models**

Click on the **Liver Structures Models** Hierarchy

3D Exploration of Liver Segments



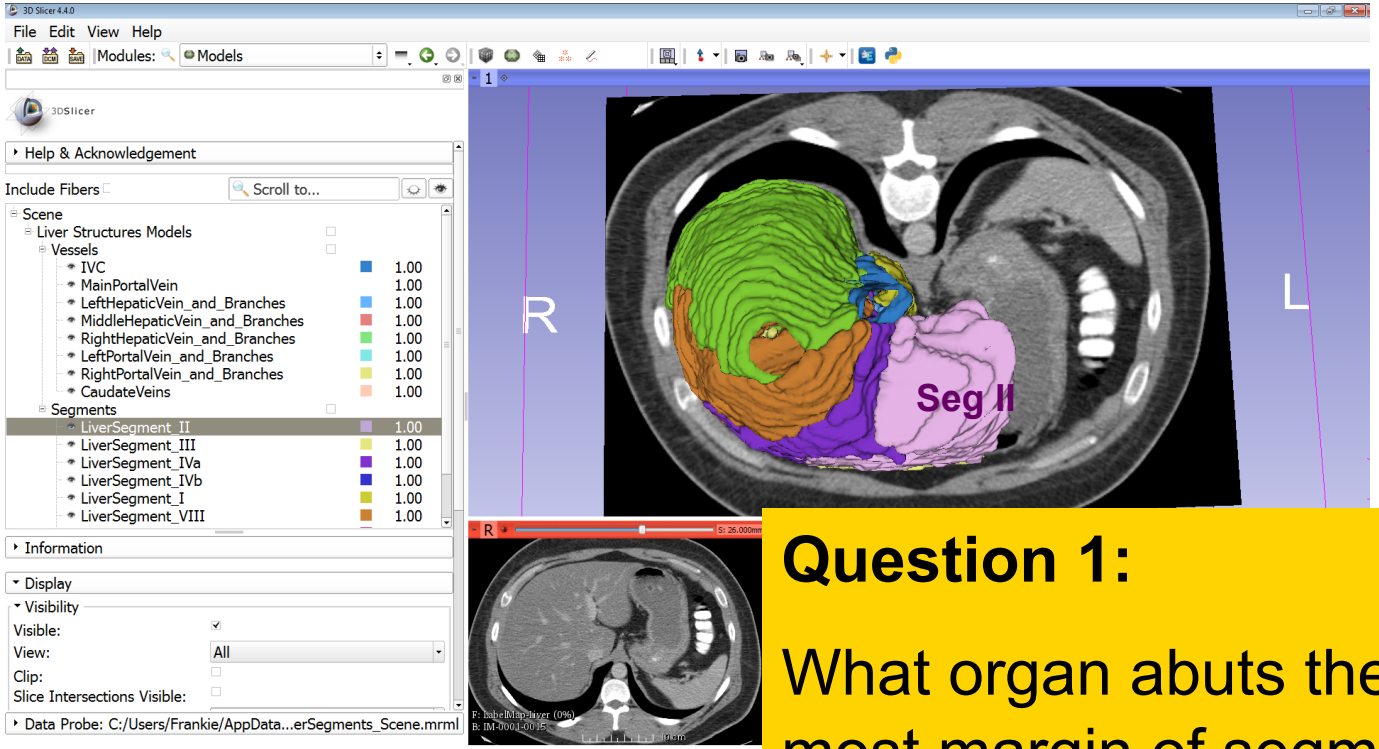
Select the model **Liver_Segment II**

Turn on/off its visibility to locate it in the 3D viewer.

3D Exploration of Liver Segments

Position the mouse in the 3D Viewer, hold down the left mouse button and drag to orient the 3D model to a superior view.

3D Exploration of Liver Segments



Question 1:

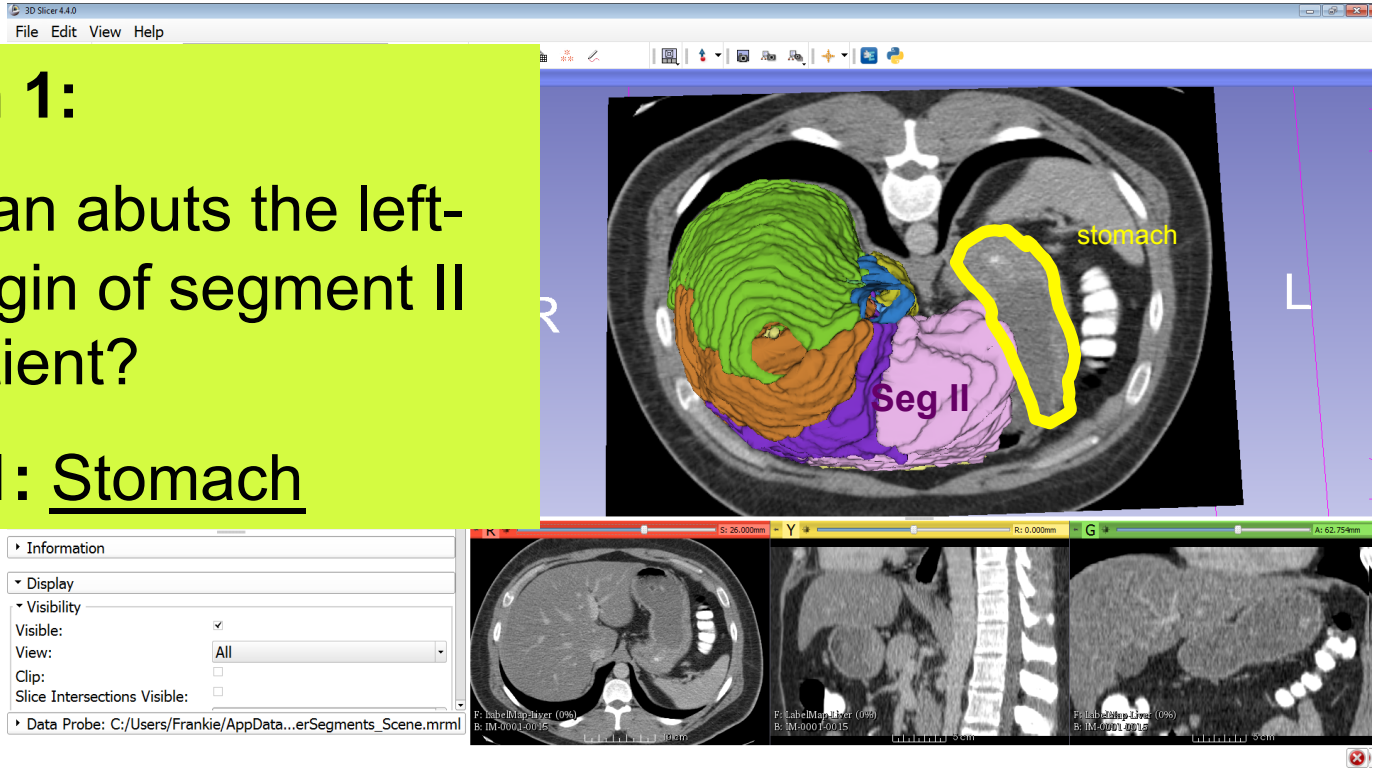
What organ abuts the left-most margin of segment II in Patient 1?

3D Exploration of Liver Segments

Question 1:

What organ abuts the left-most margin of segment II in this patient?

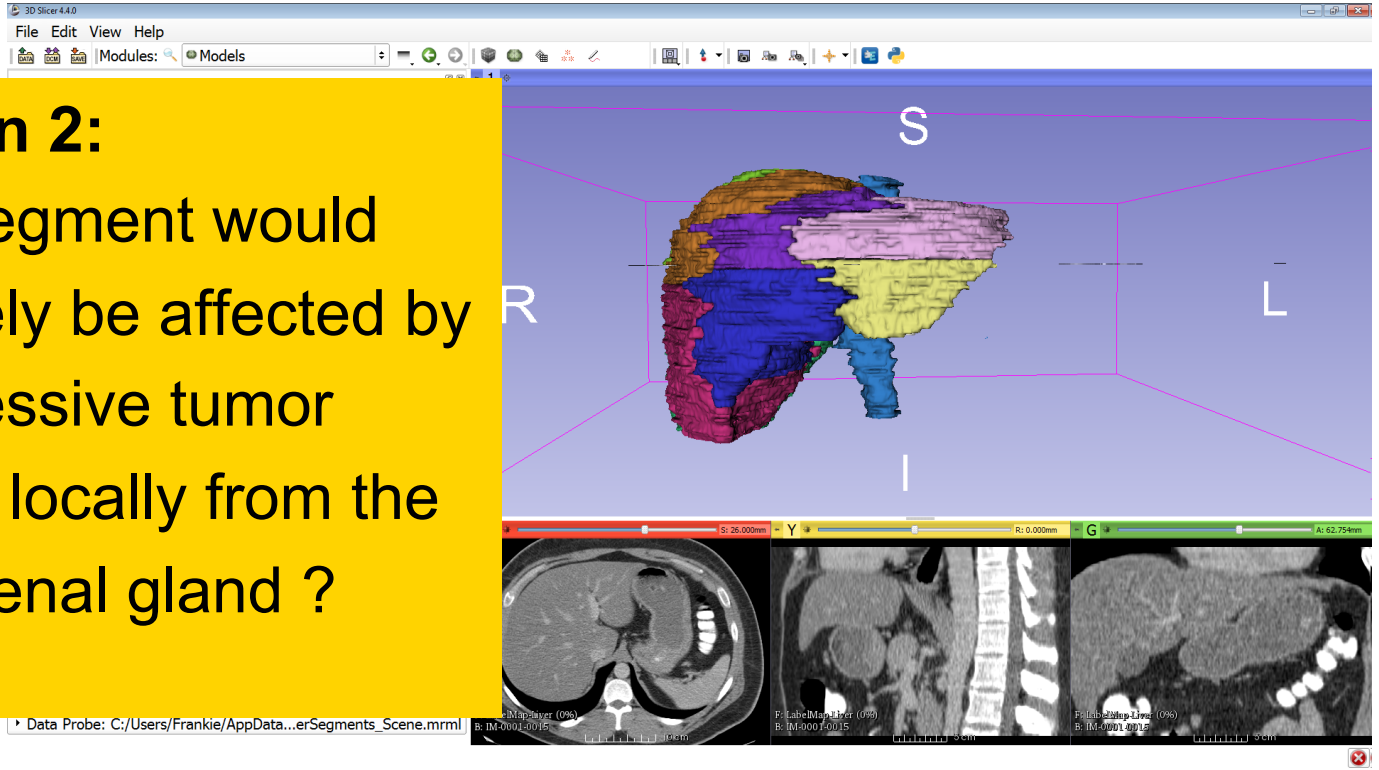
Answer 1: Stomach



3D Exploration of Liver Segments

Question 2:

Which segment would most likely be affected by an aggressive tumor invading locally from the right adrenal gland ?



3D Exploration of Liver Segments

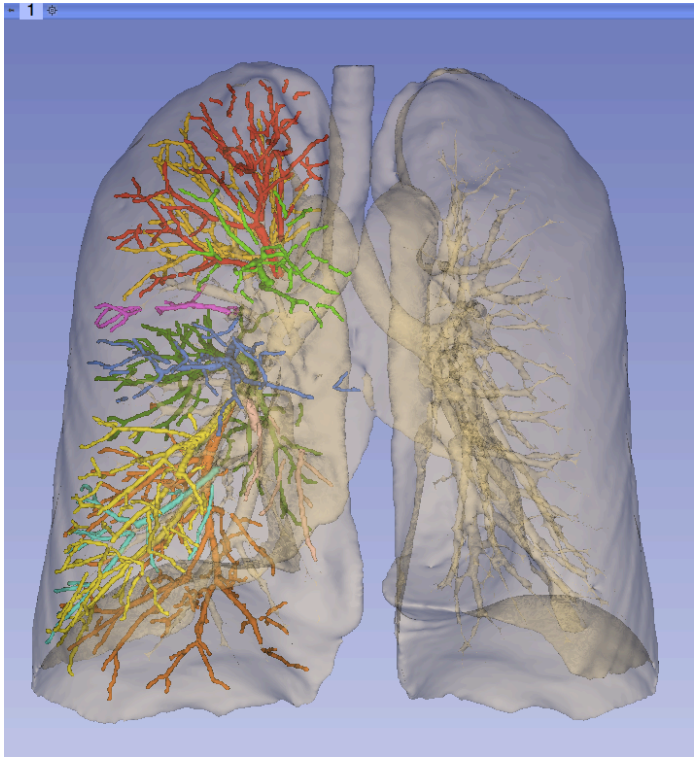
Question 2:

Which segment would most likely be affected by an aggressive tumor invading locally from the right adrenal gland ?

Answer 2: Segment VII

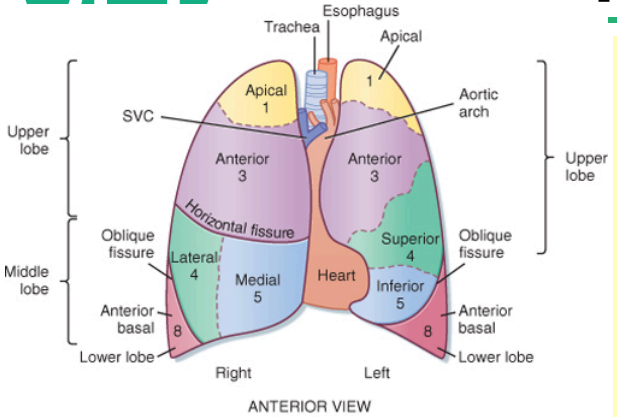
Closing the Liver Scene

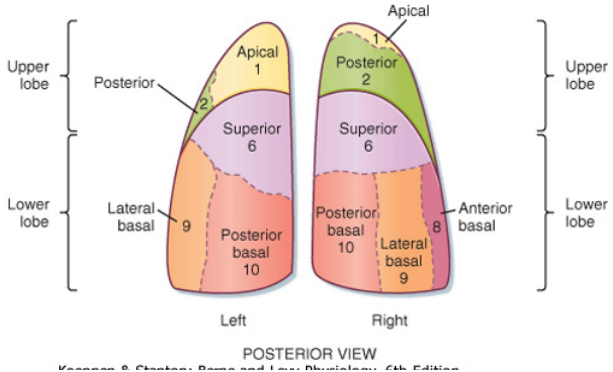
Select **File → Close Scene and File→Exit**



Part IIIb: Interactive 3D Visualization of the segments of the lungs

Bronchopulmonary Segments





Right Lung (10 segments)

Right Upper Lobe (RUL)
- RUL Apical
- RUL Posterior
- RUL Anterior

Right Middle Lobe (RML)
- RML Lateral
- RML Medial

Right Lower Lobe (RLL)
- RLL Superior
- RLL Medial Basal
- RLL Anterior Basal
- RLL Lateral Basal
- RLL Posterior Basal

Left Lung (8 segments):

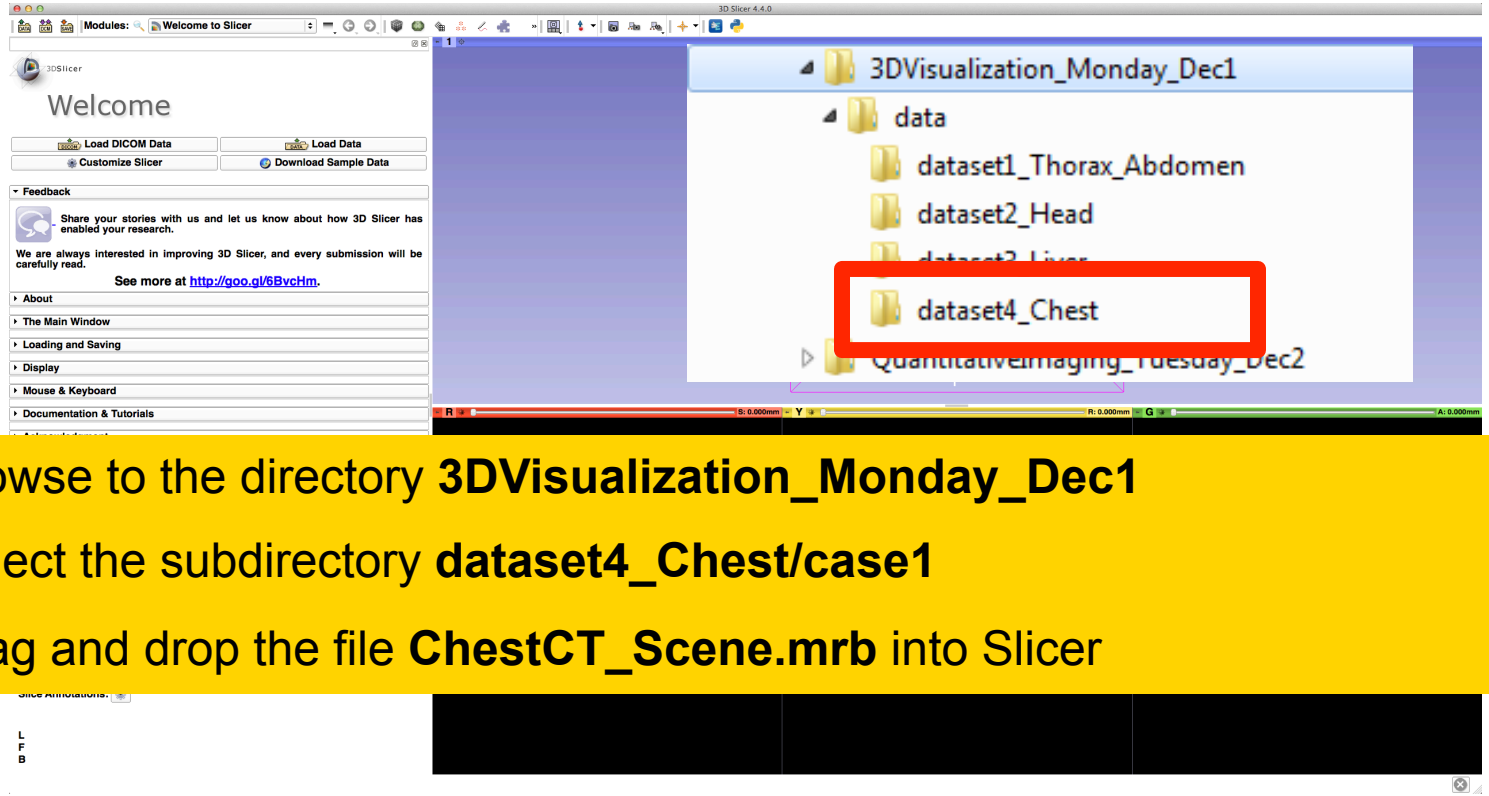
Left Upper Lobe (LUL)
- LUL Apical Posterior
- LUL Anterior

Left Upper Lobe Lingula (LUL Lingula)
- LUL Superior Lingula
- LUL Inferior Lingula

Left Lower Lobe (LLL)
- LLL Superior
- LLL Anteromedial Basal
- LLL Lateral Basal
- LLL Posterior Basal

Source: Koeppen & Stanton: Berne and Levy Physiology, 6th edition

Lung Segments: Case 1

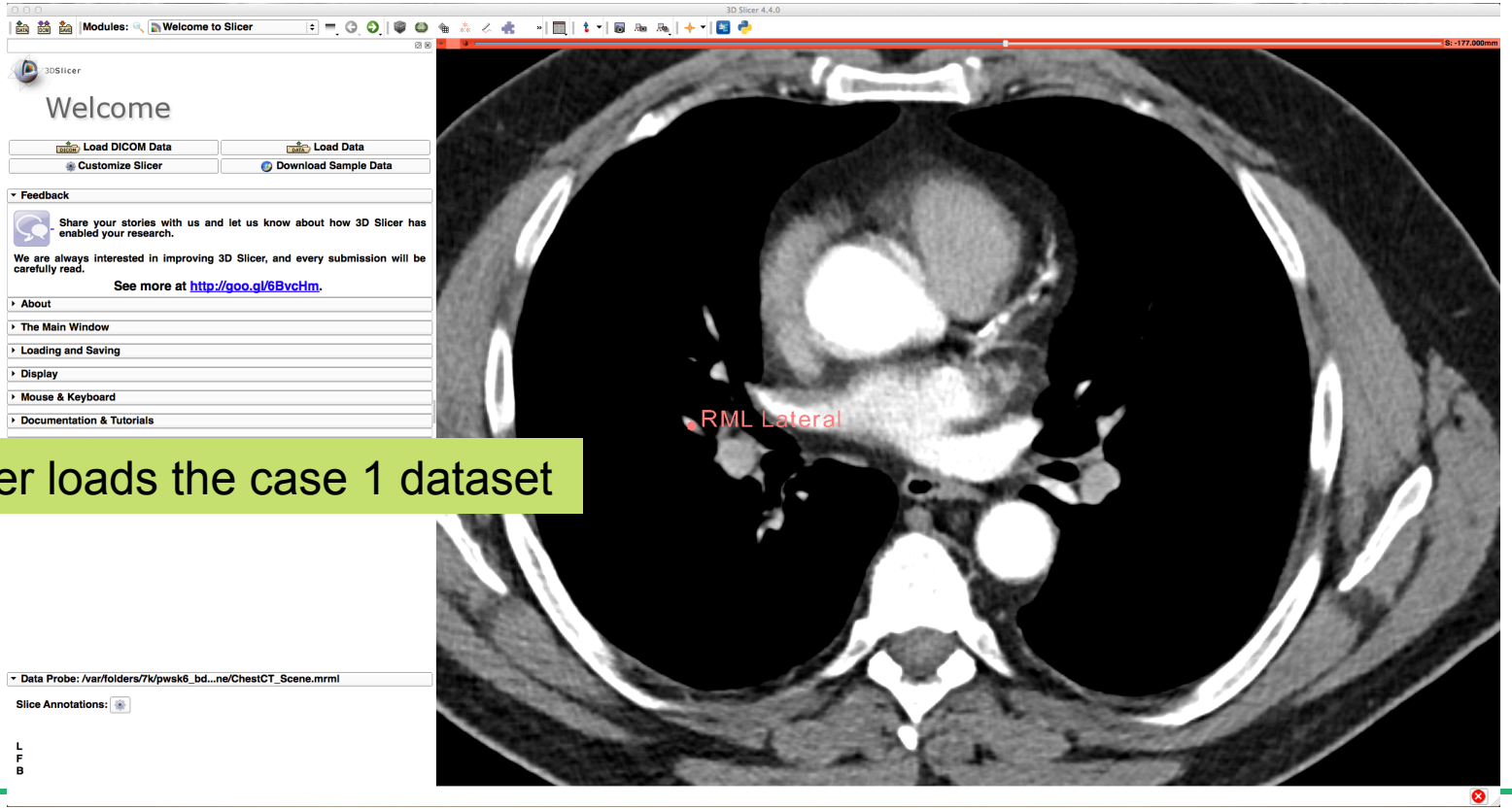


Browse to the directory **3DVisualization_Monday_Dec1**

Select the subdirectory **dataset4_Chest/case1**

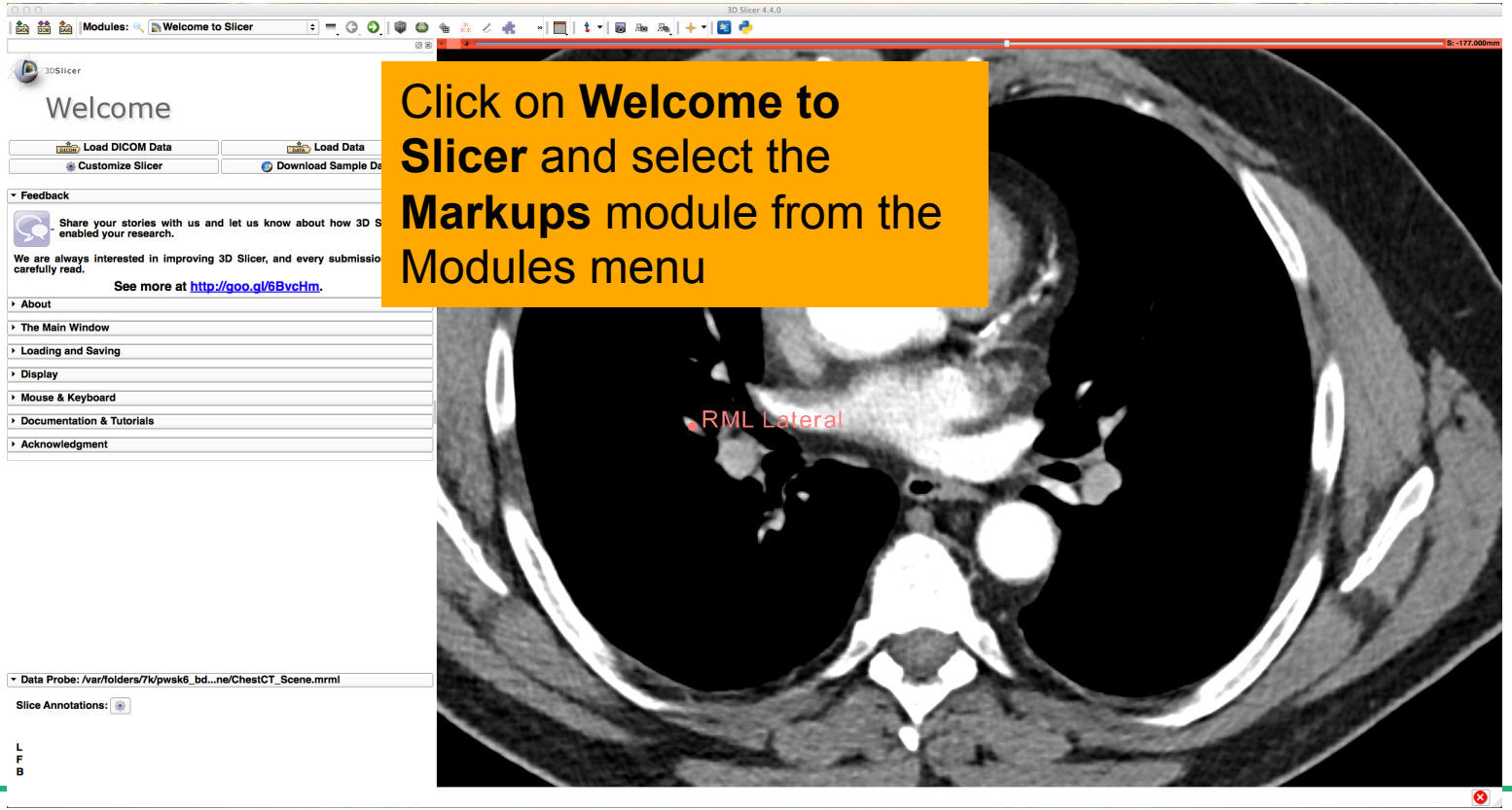
Drag and drop the file **ChestCT_Scene.mrb** into Slicer

Lung Segments: Case 1



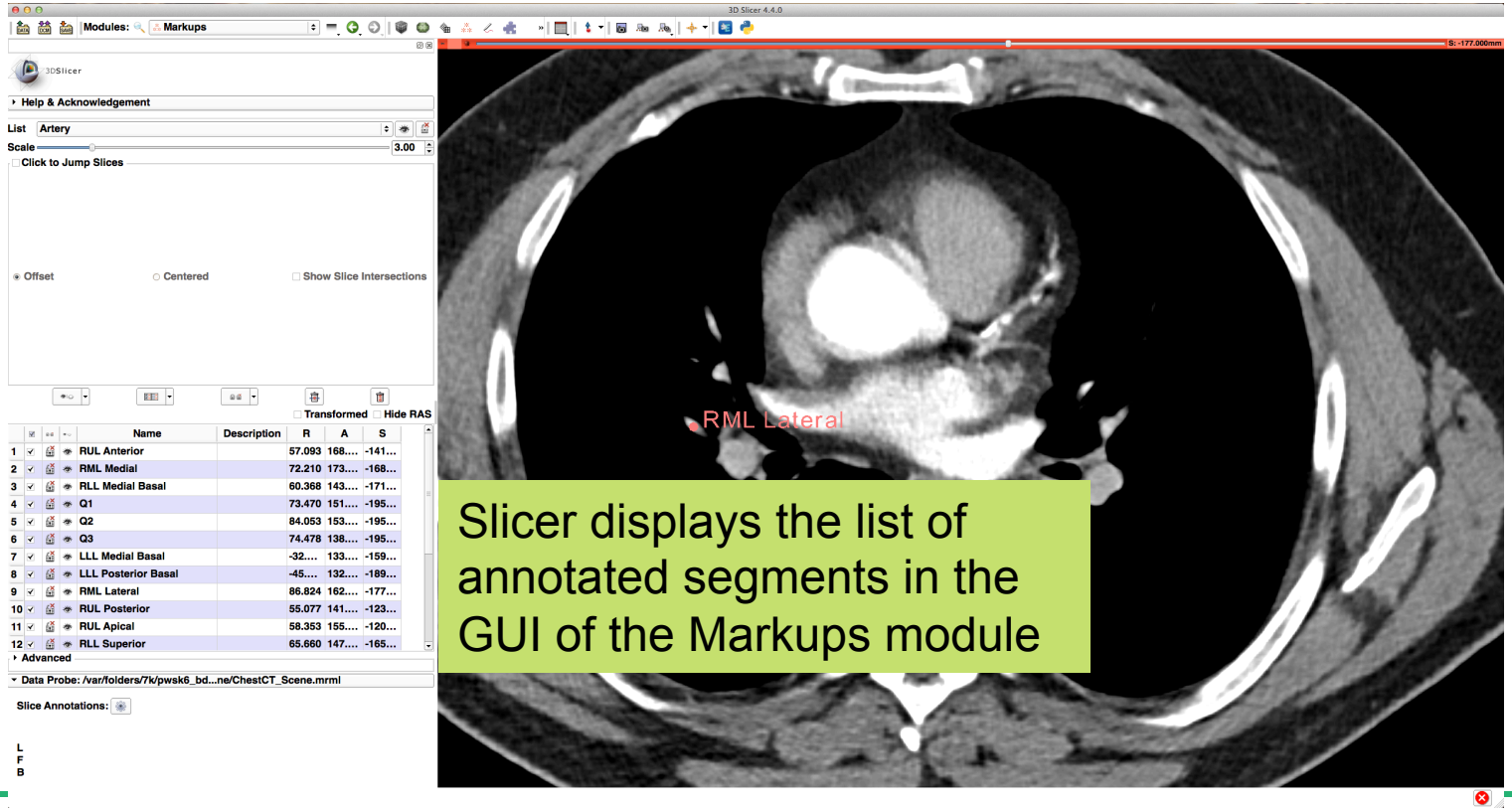
Slicer loads the case 1 dataset

Lung Segments: Case 1

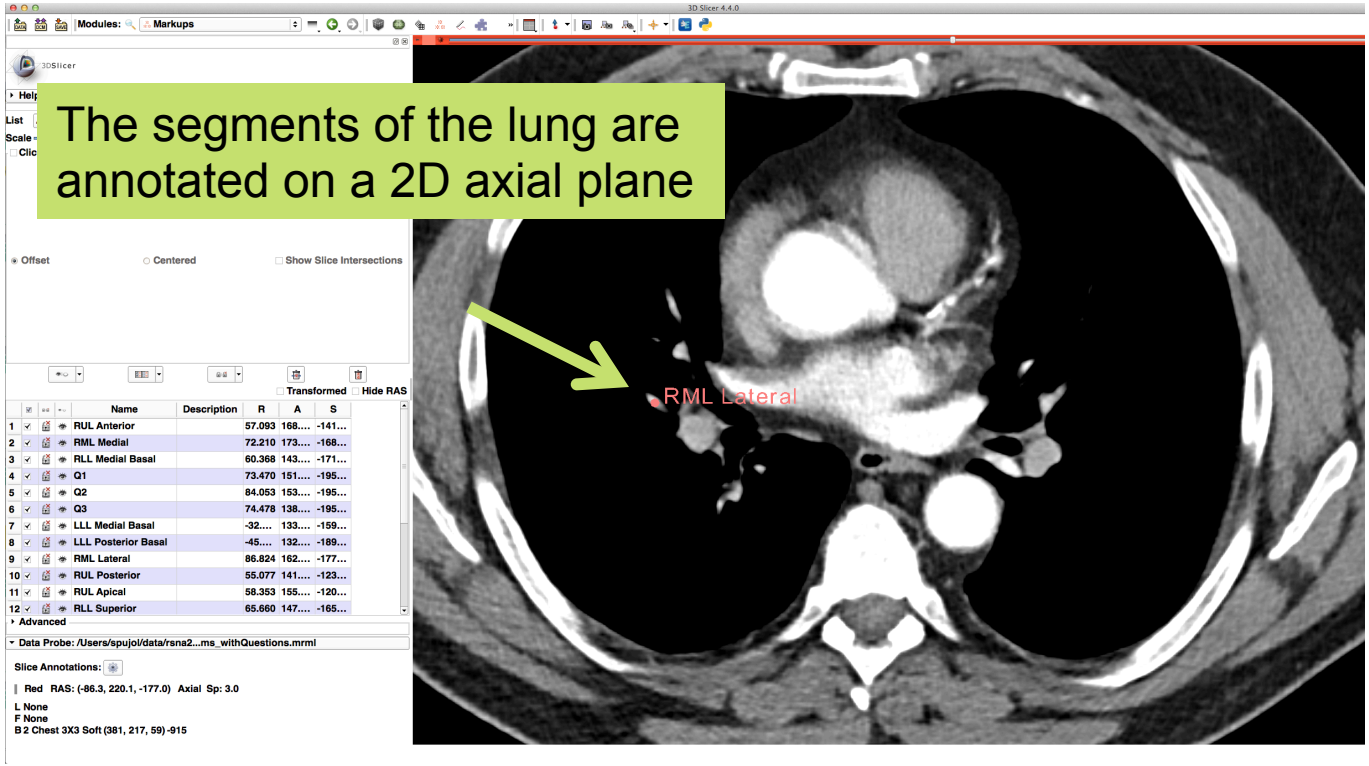


Click on **Welcome to Slicer** and select the **Markups** module from the Modules menu

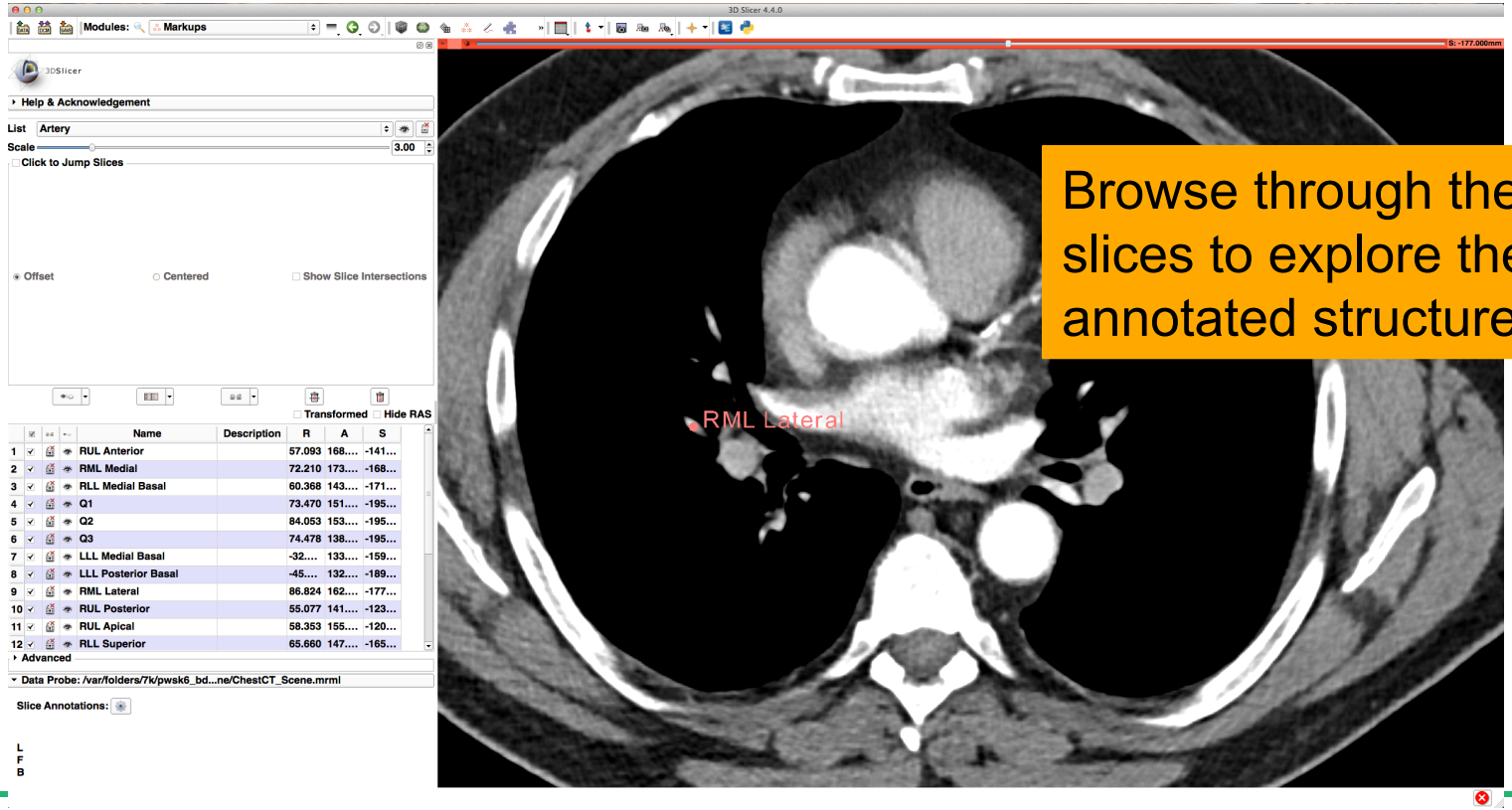
Lung Segments: Case 1



Lung Segments: Case 1

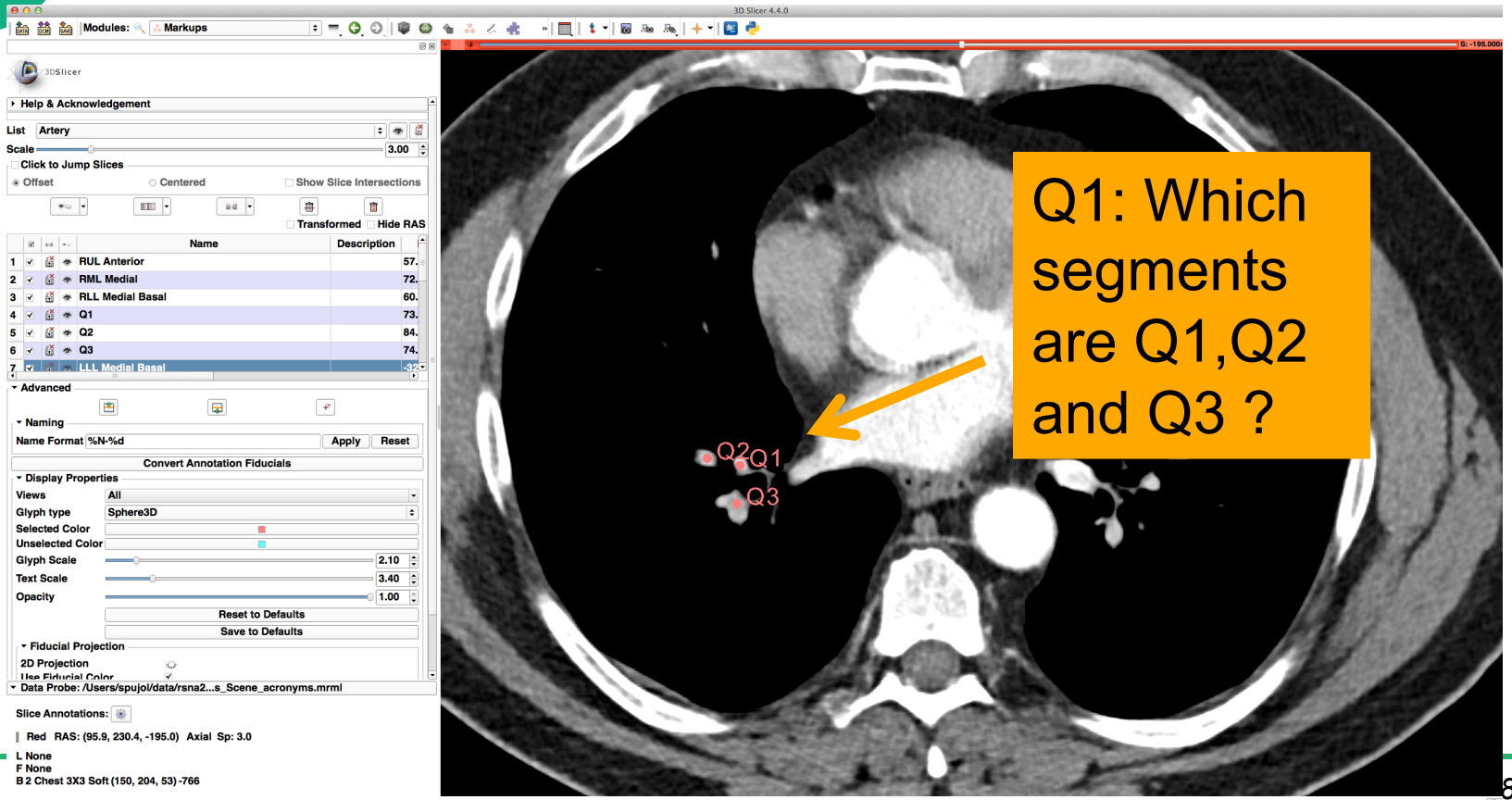


Lung Segments: Case 1

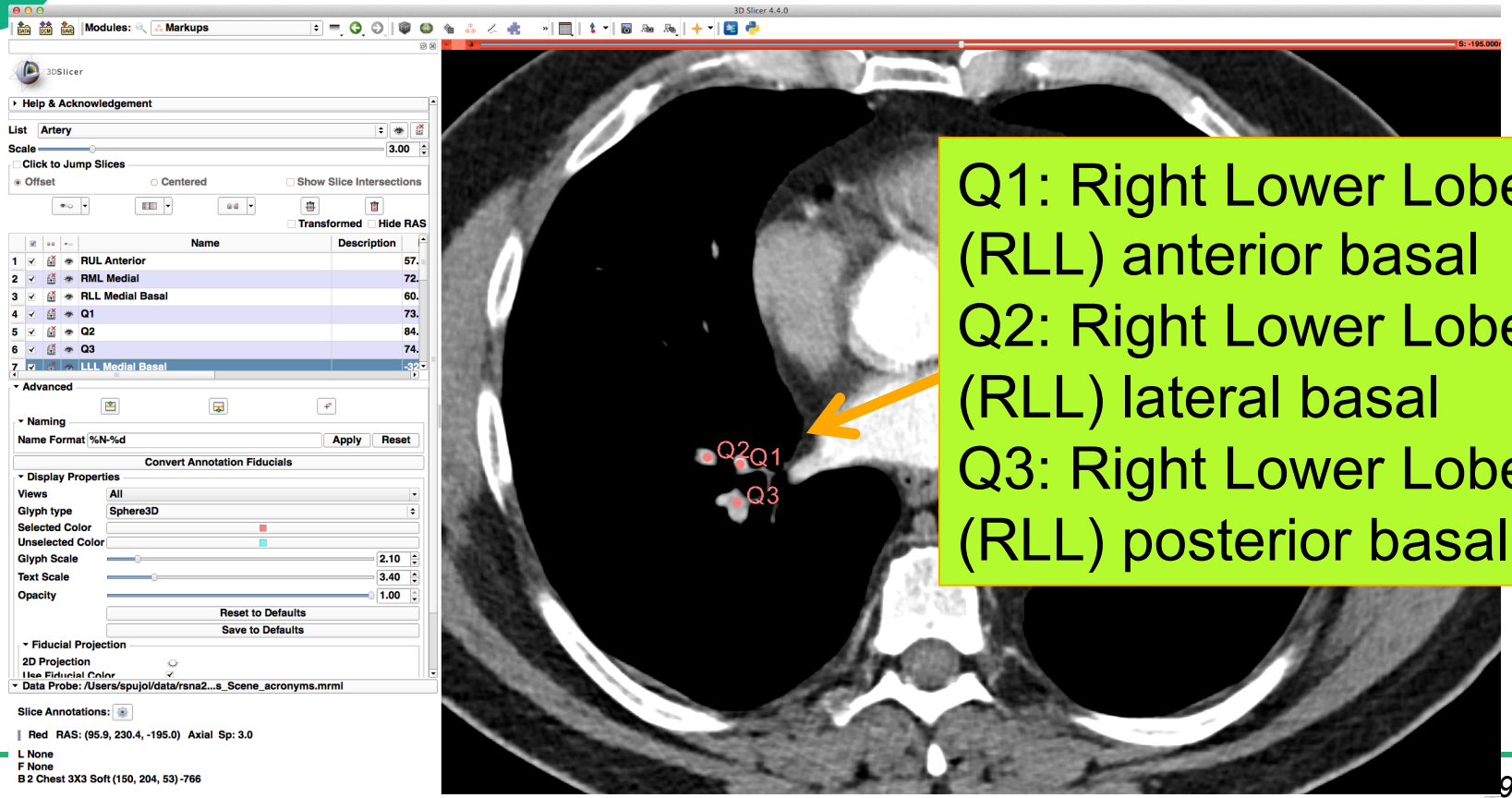


Browse through the slices to explore the annotated structures

Lung Segments: Question 1

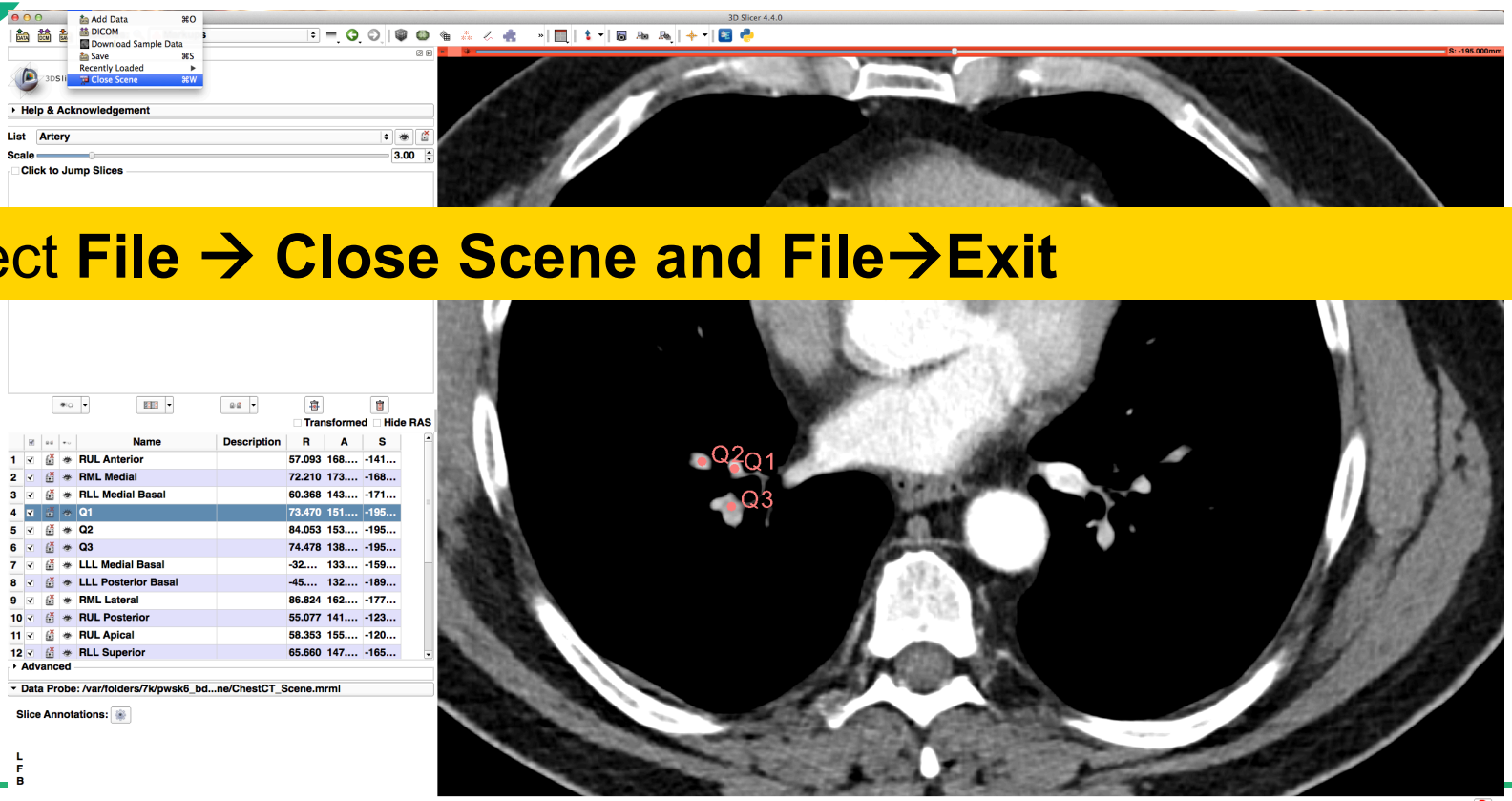


Lung Segments: Answer 1



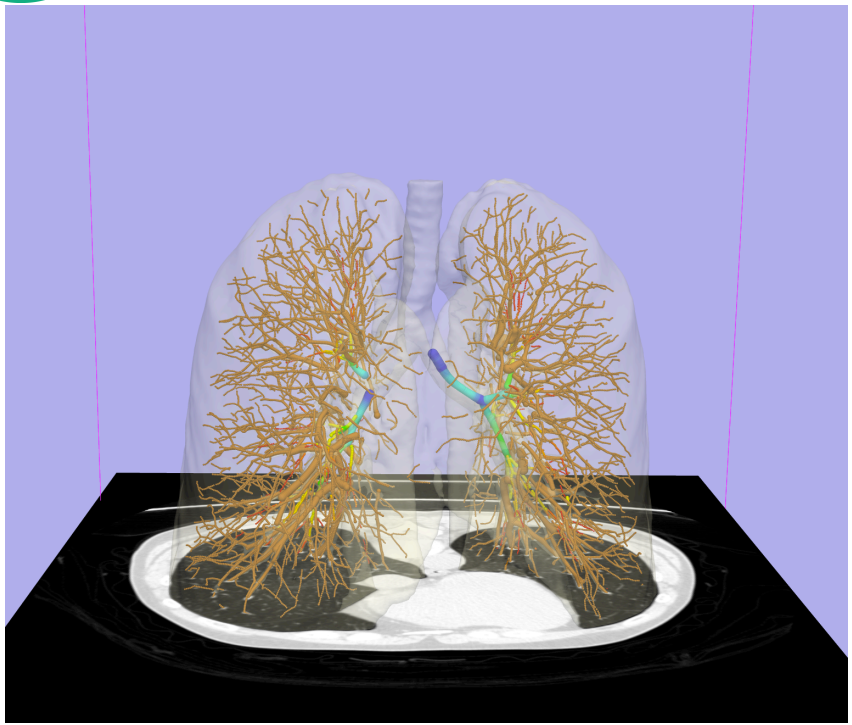
Q1: Right Lower Lobe (RLL) anterior basal
Q2: Right Lower Lobe (RLL) lateral basal
Q3: Right Lower Lobe (RLL) posterior basal

Lung Segments: Case 1



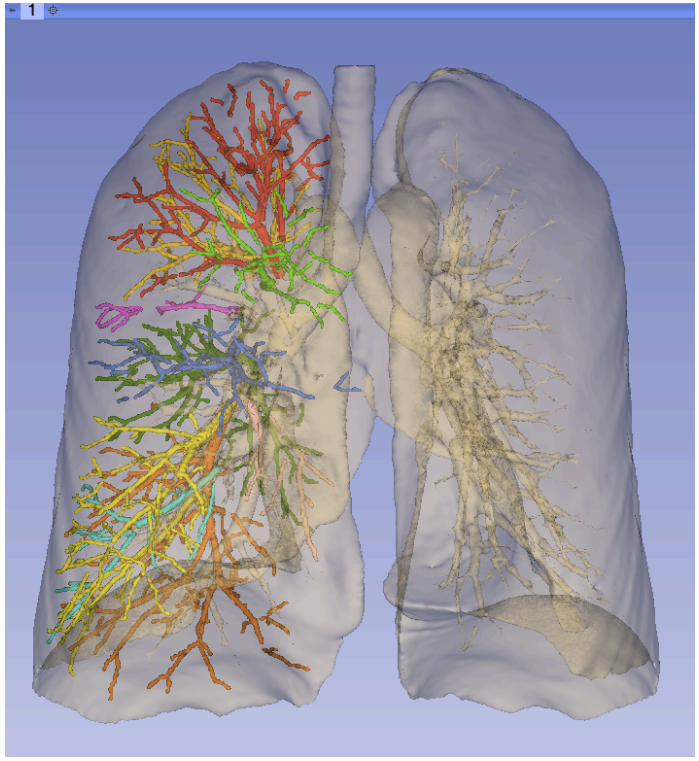
Select **File → Close Scene and File→Exit**

From 2D to 3D



Segmentation and 3D surface reconstruction of the lung and pulmonary vessels from a Chest CT dataset

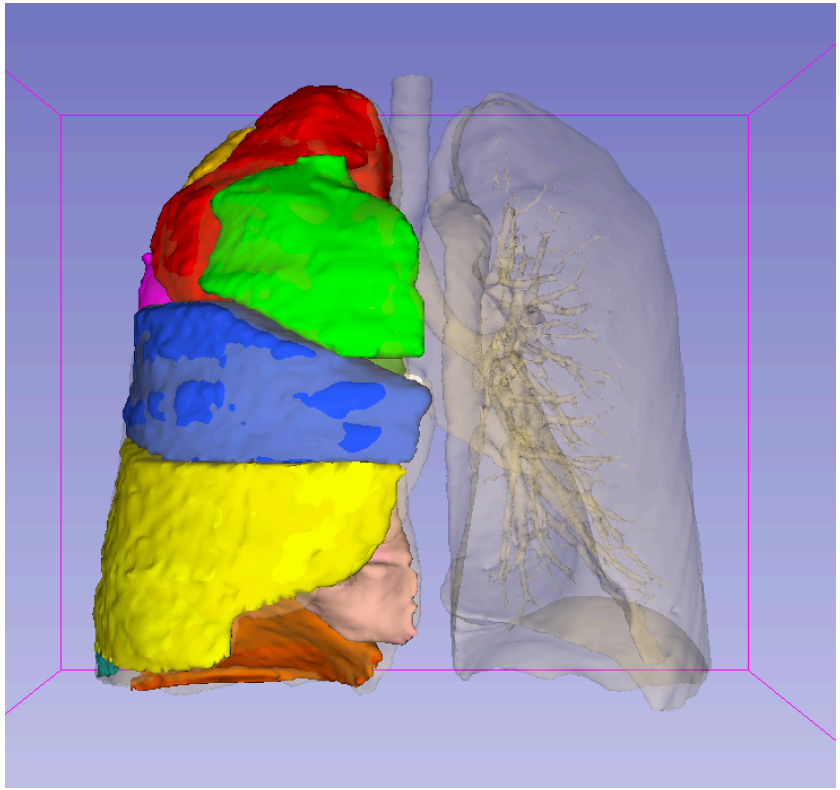
3D Segments of the lung



3D parcellation of arteries and veins from original model of pulmonary vessels (Right Lobe)

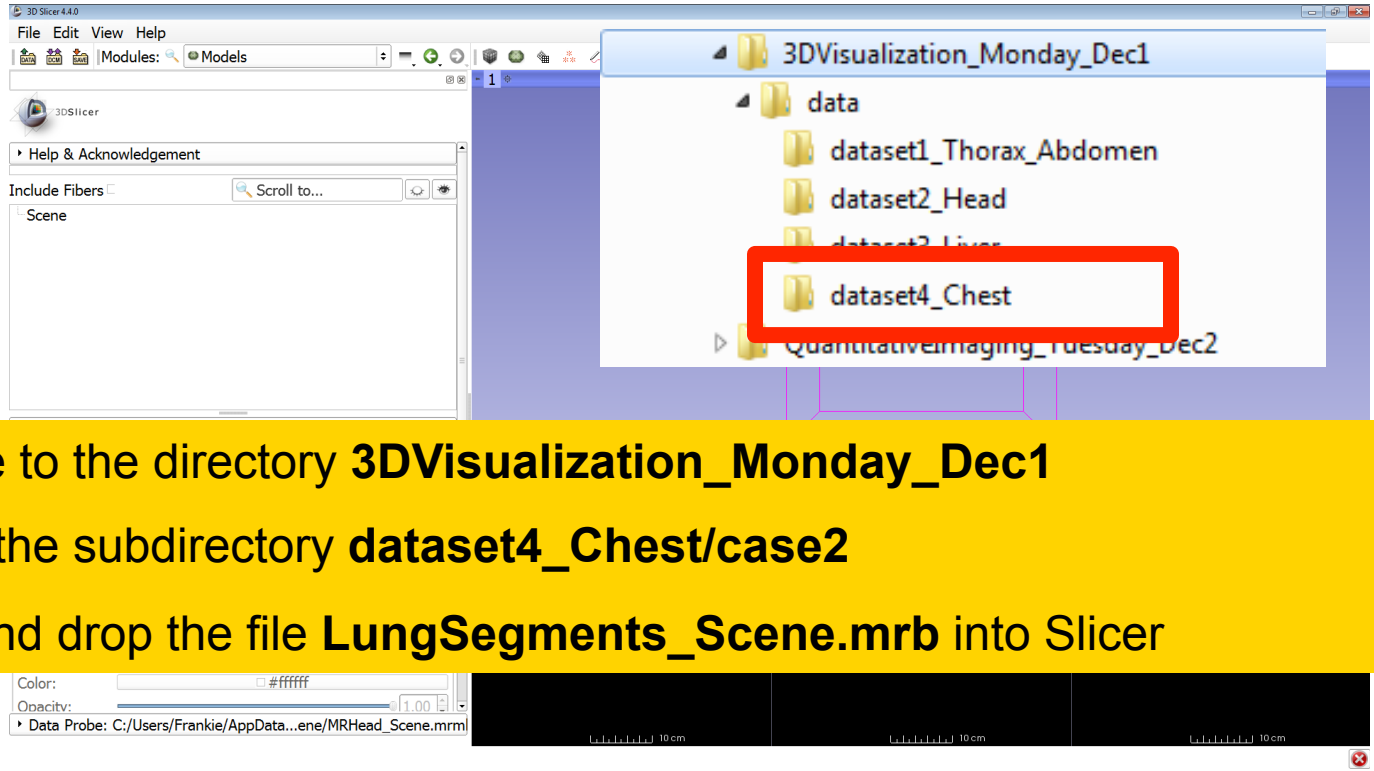
- Upper Lobe (RUL)
  - RUL Pulmonary Vein
  - RUL Anterior Segment
  - RUL Apical Segment
  - RUL Posterior Segment
- Middle Lobe (RML)
  - RML Pulmonary Vein 1 & 2
  - RML Lateral Segment
  - RML Medial Segment
- Lower Lobe (RLL)
  - RLL Pulmonary Vein 1,2,3
  - RLL Anterior Basal Segment
  - RLL Medial Basal Segment
  - RLL Lateral Basal Segment
  - RLL Posterior Basal Segment

3D Segments of the lung



Educational research project supported by the RSNA Research & Education Foundation, through the Education Scholar Grant program

Lung Segments: Case 2

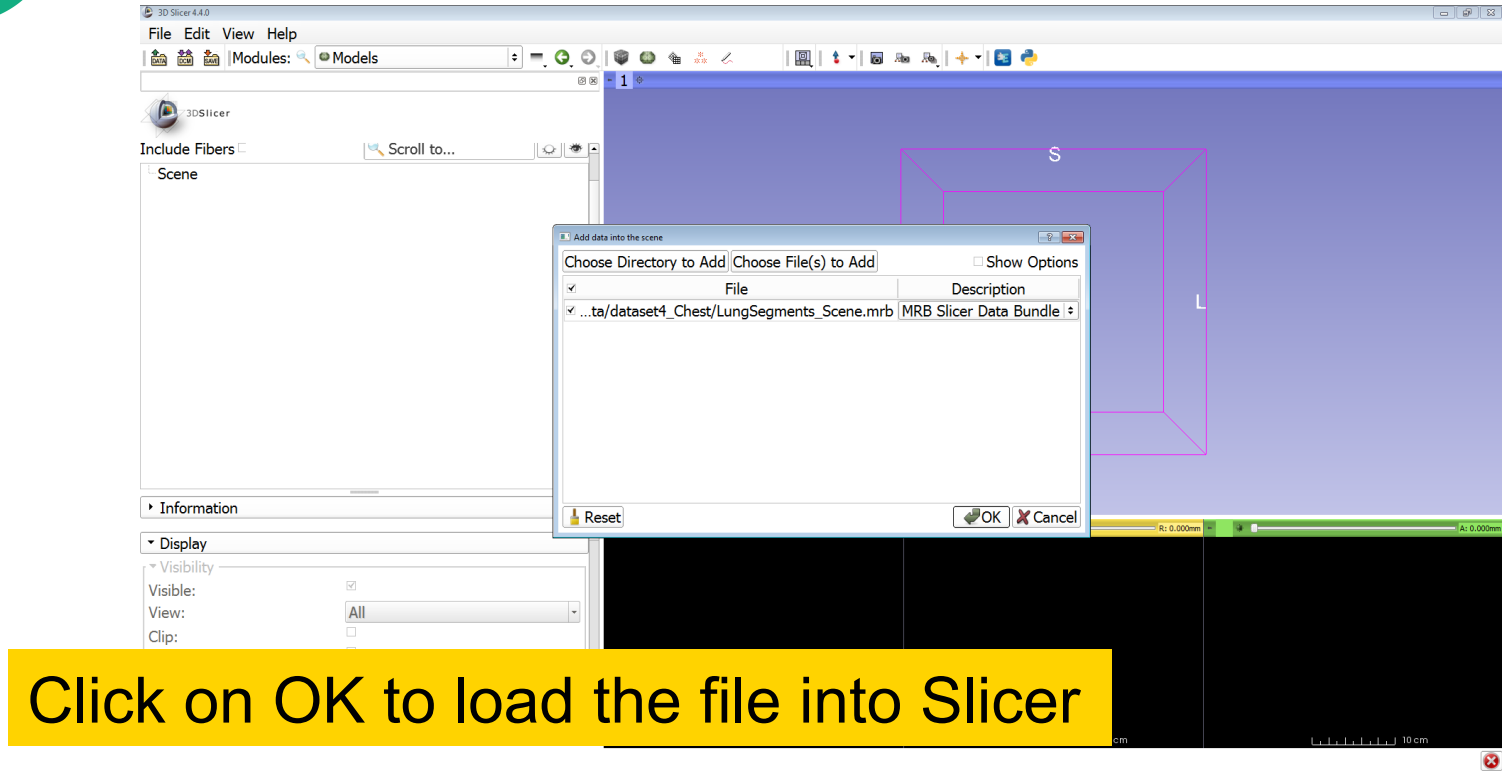


Browse to the directory **3DVisualization_Monday_Dec1**

Select the subdirectory **dataset4_Chest/case2**

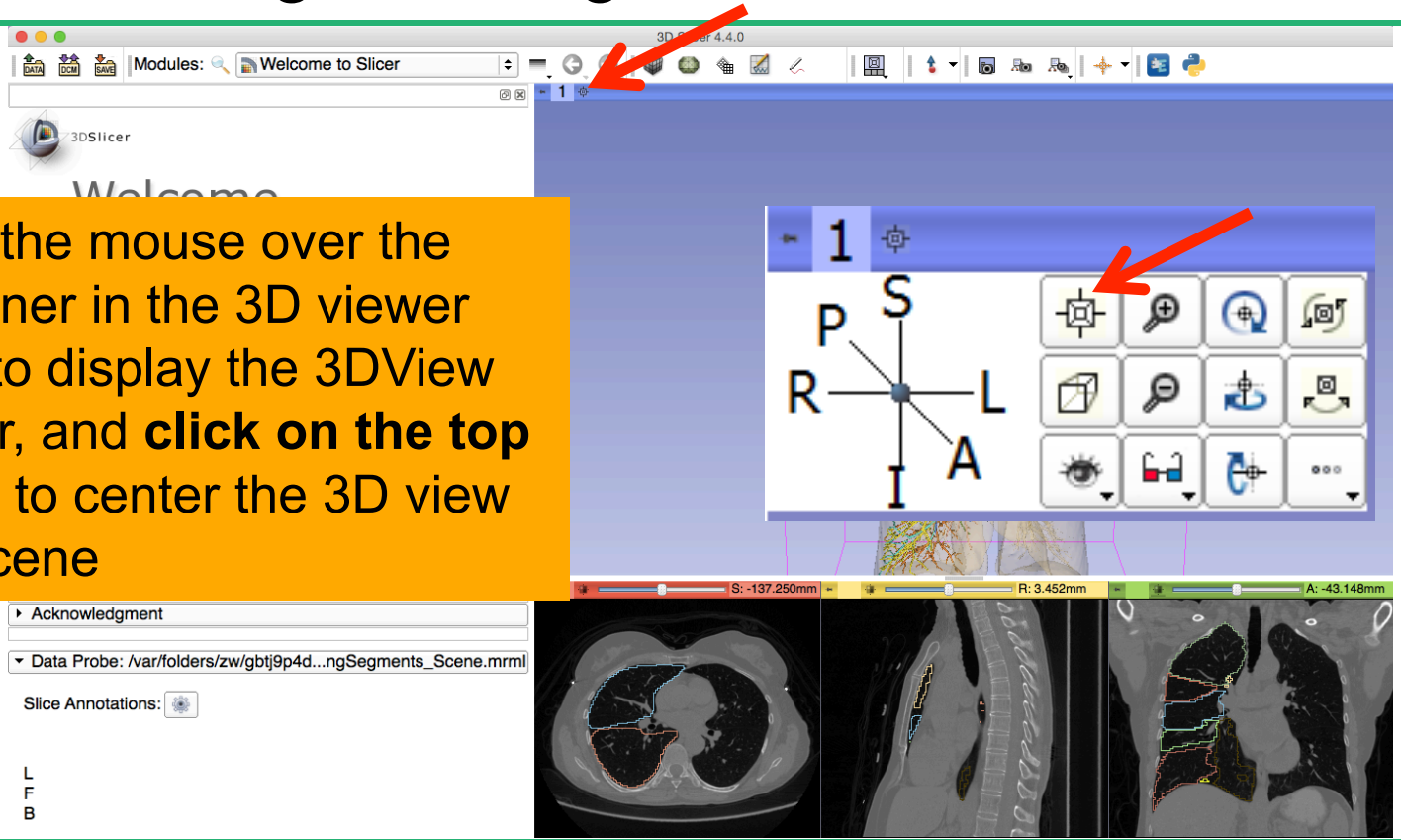
Drag and drop the file **LungSegments_Scene.mrb** into Slicer

Loading the Lung Scene



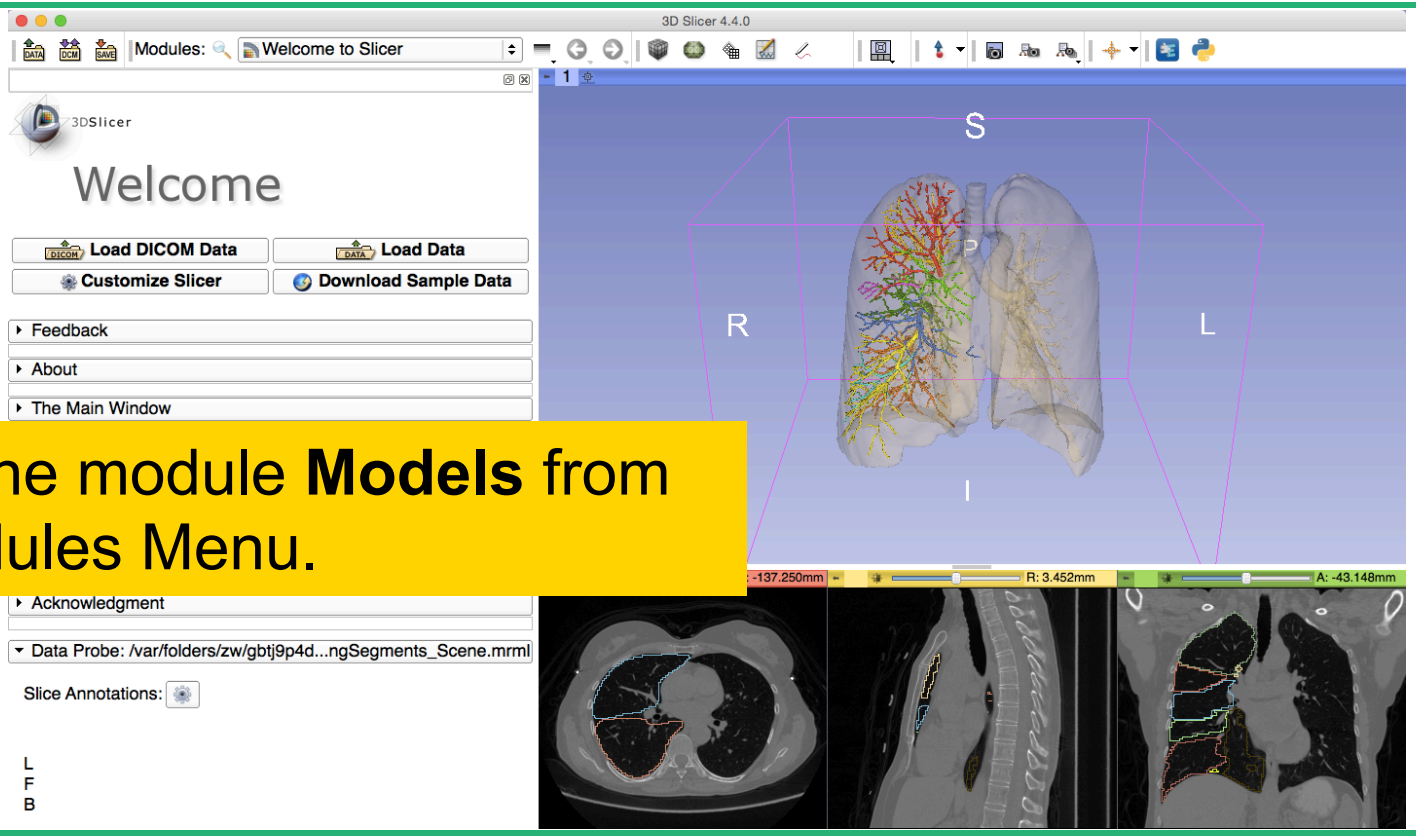
Click on OK to load the file into Slicer

Loading the Lung Scene



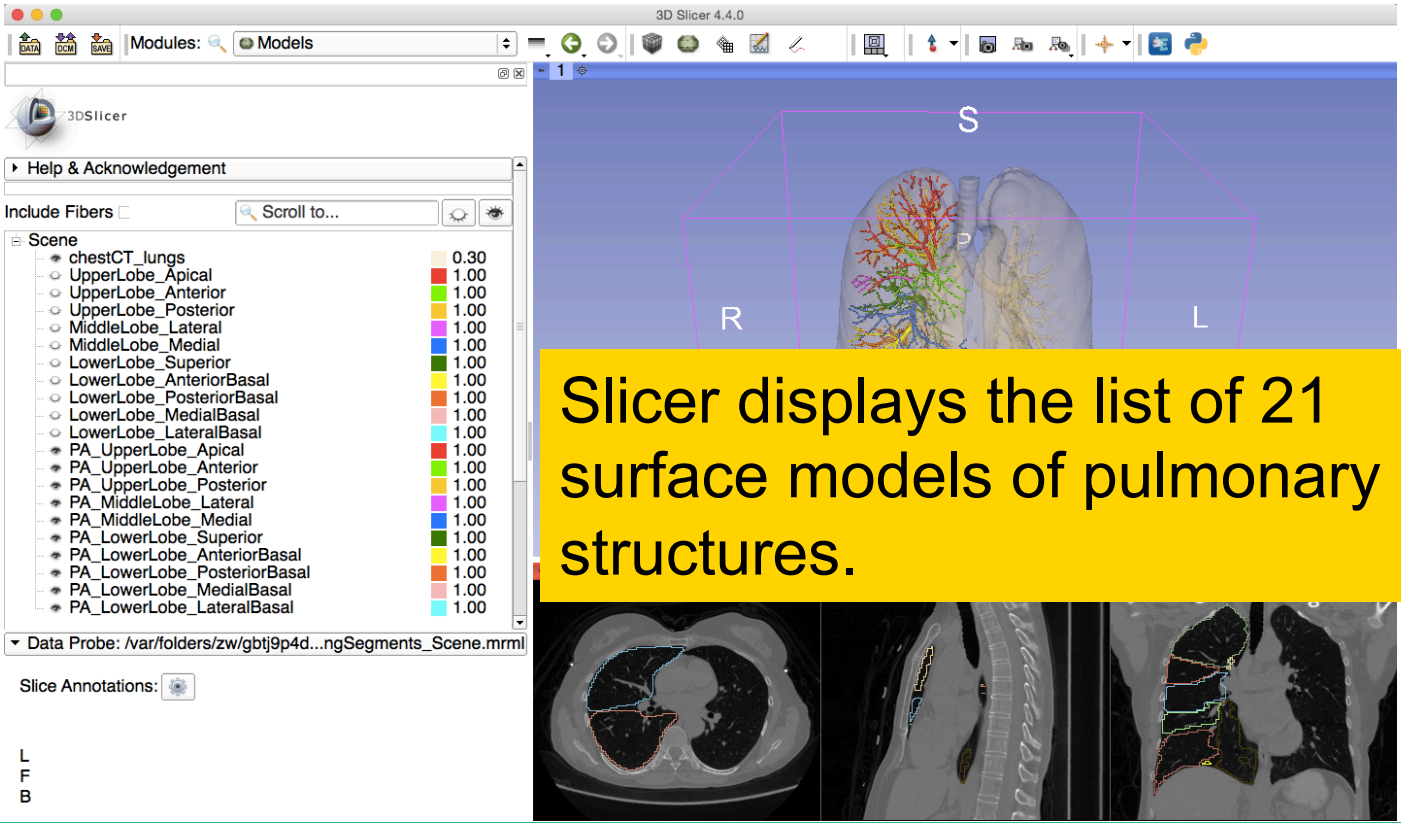
Position the mouse over the blue banner in the 3D viewer window to display the 3DView controller, and **click on the top left icon** to center the 3D view on the scene

Loading the Lung Scene



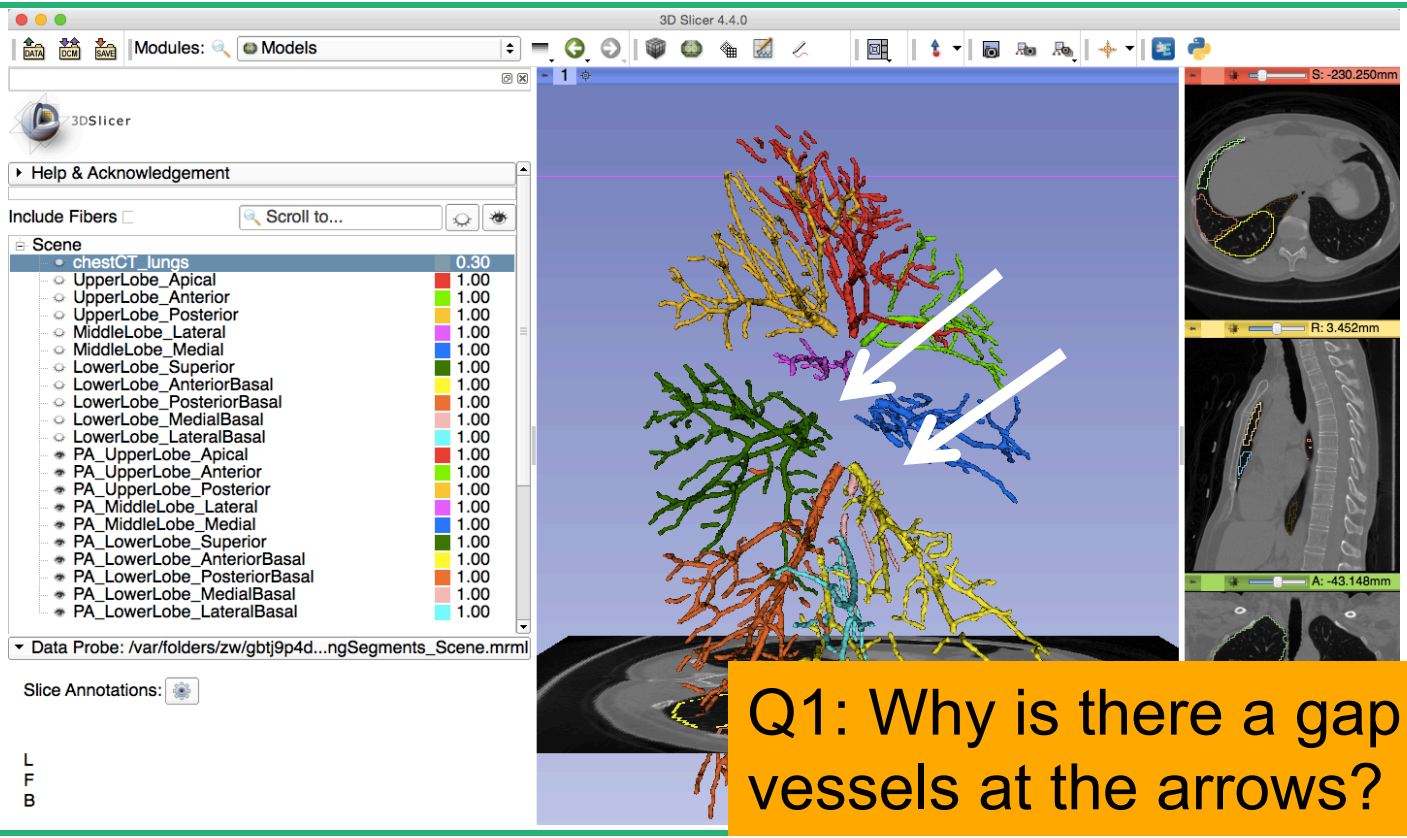
Select the module **Models** from the modules Menu.

Lung Segments: Case 2



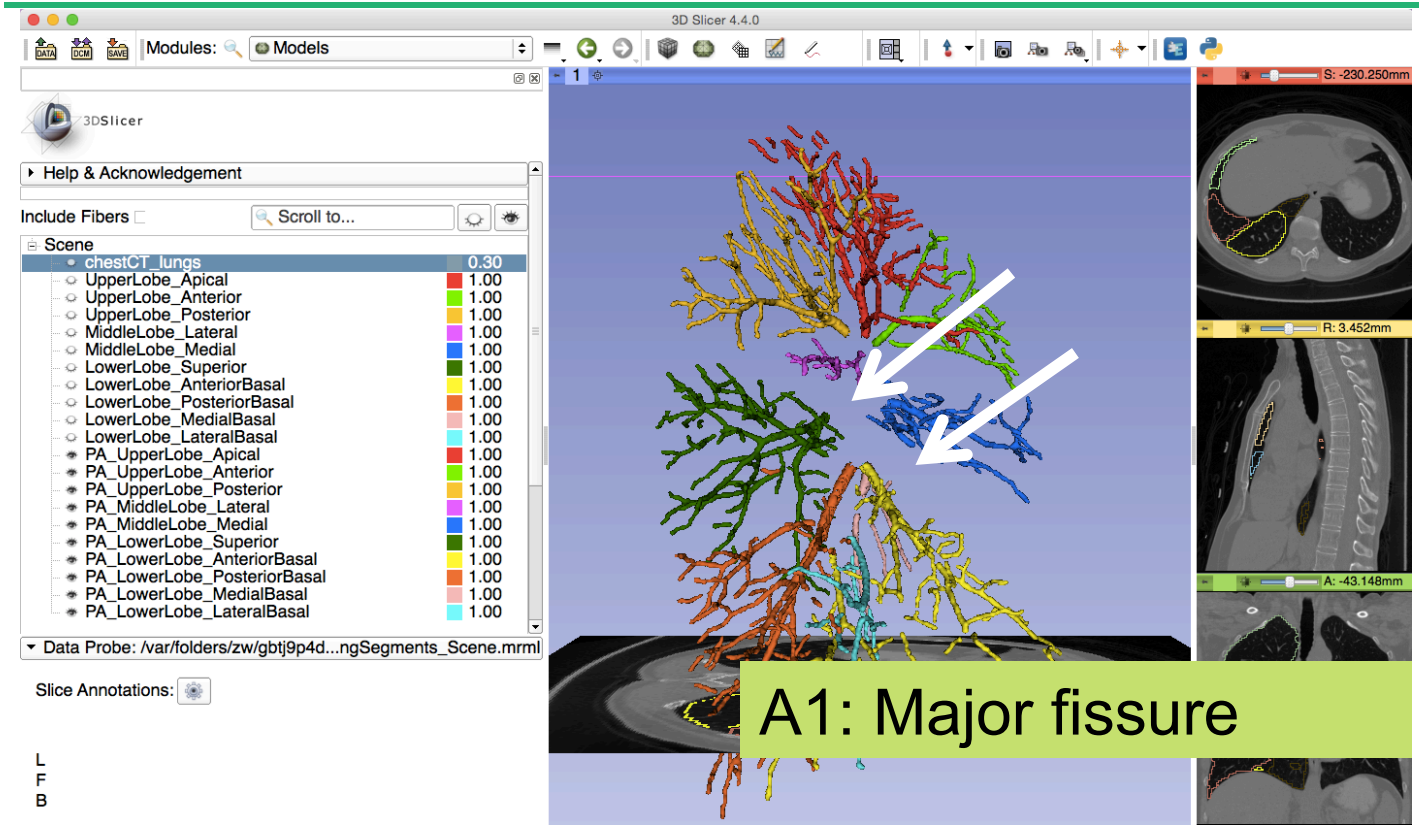
Slicer displays the list of 21 surface models of pulmonary structures.

Lung Segments – Case 2: Question 1

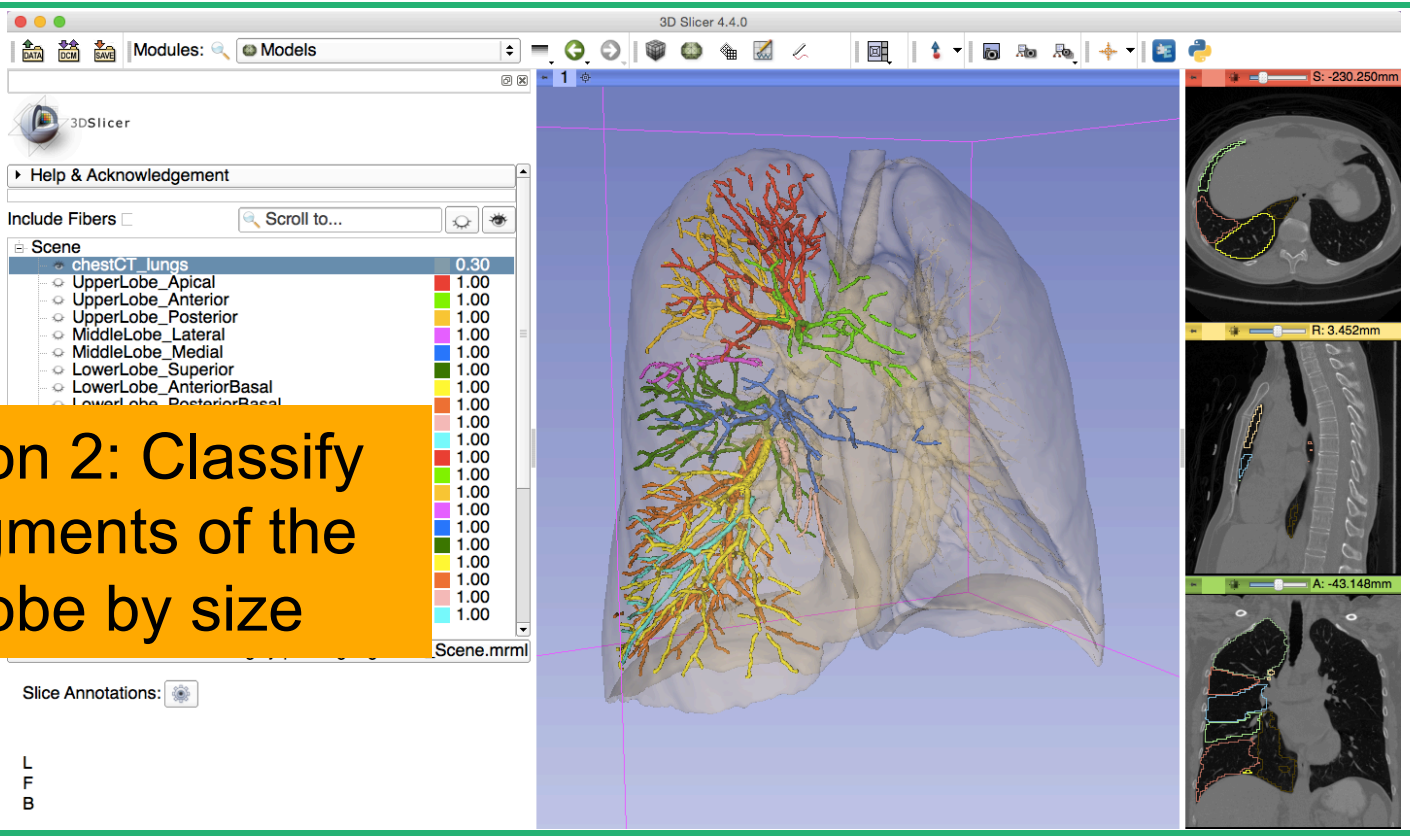


Q1: Why is there a gap in the vessels at the arrows?

Lung Segments – Answer 1

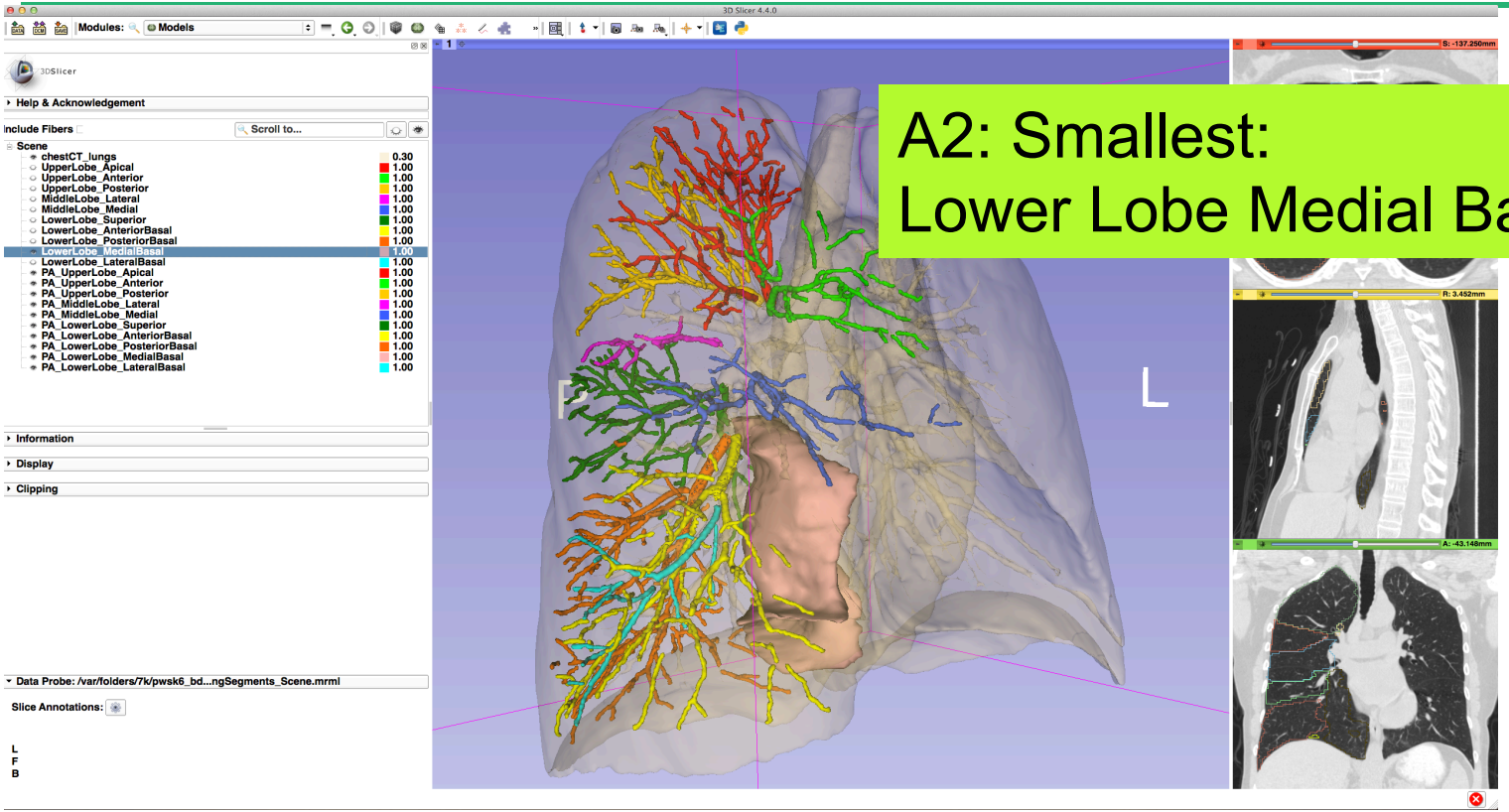


Lung Segments – Case 2: Question 2

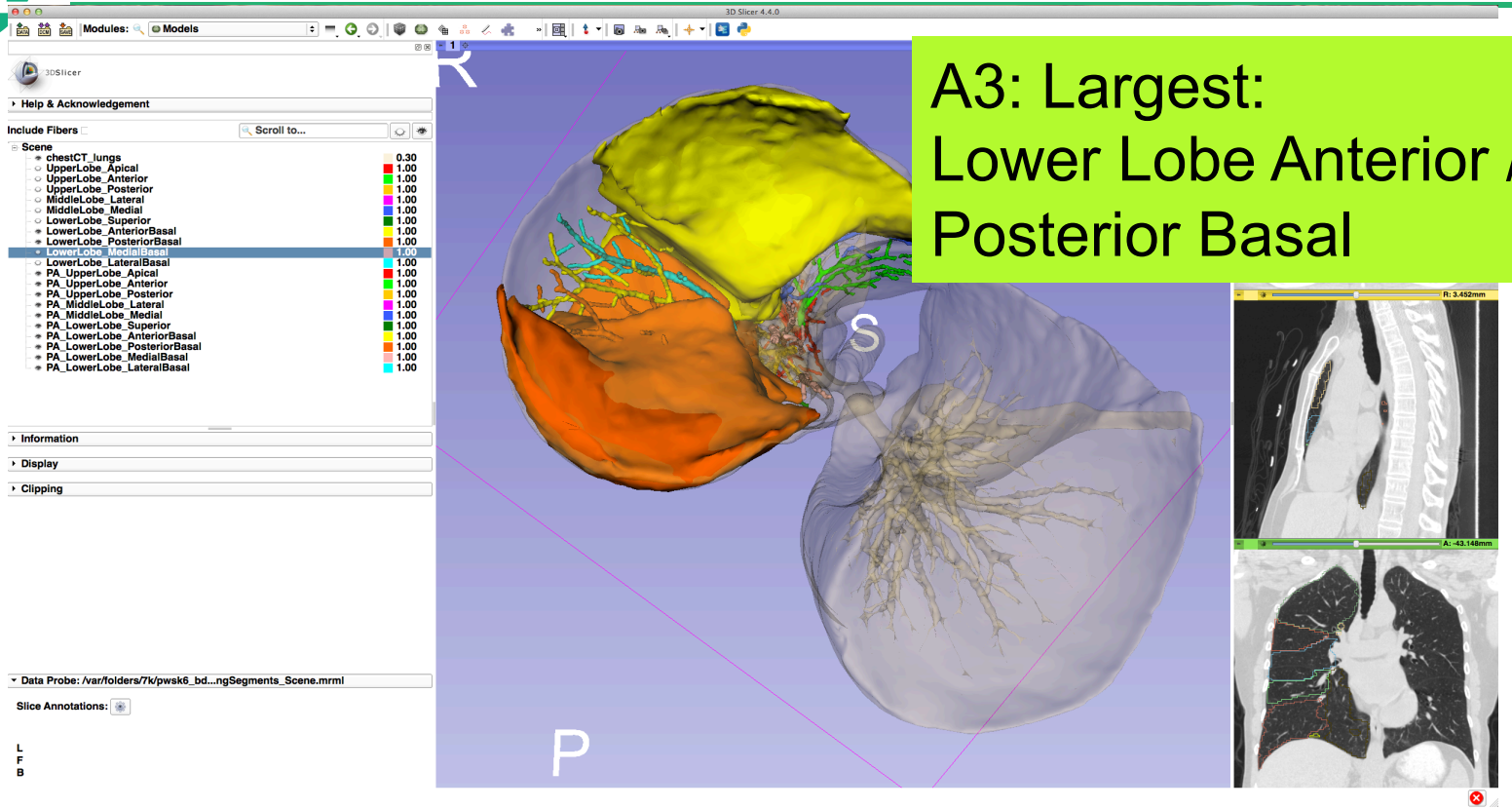


Question 2: Classify the segments of the lower lobe by size

Lung Segments – Answer 2

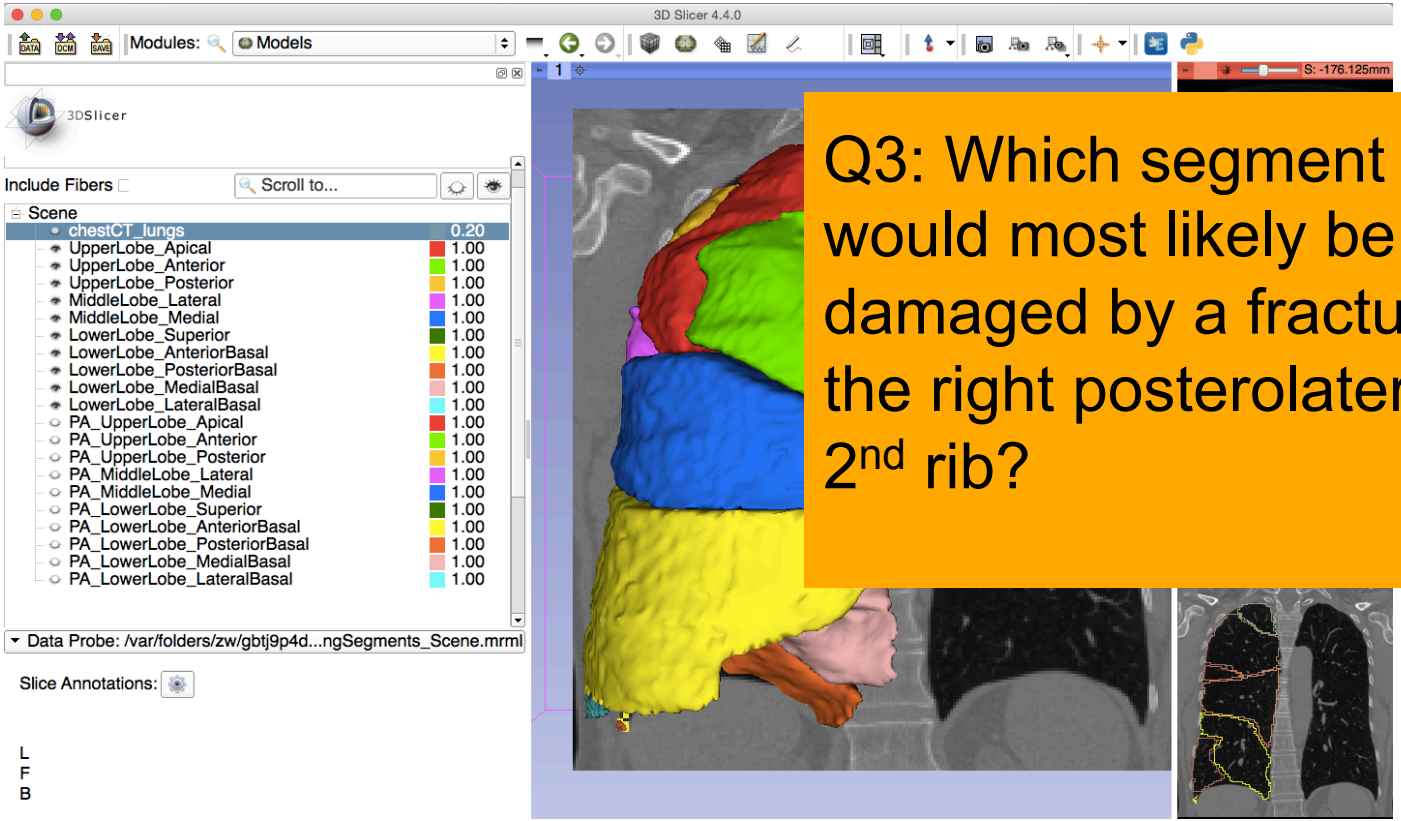


Lung Segments – Answer 3



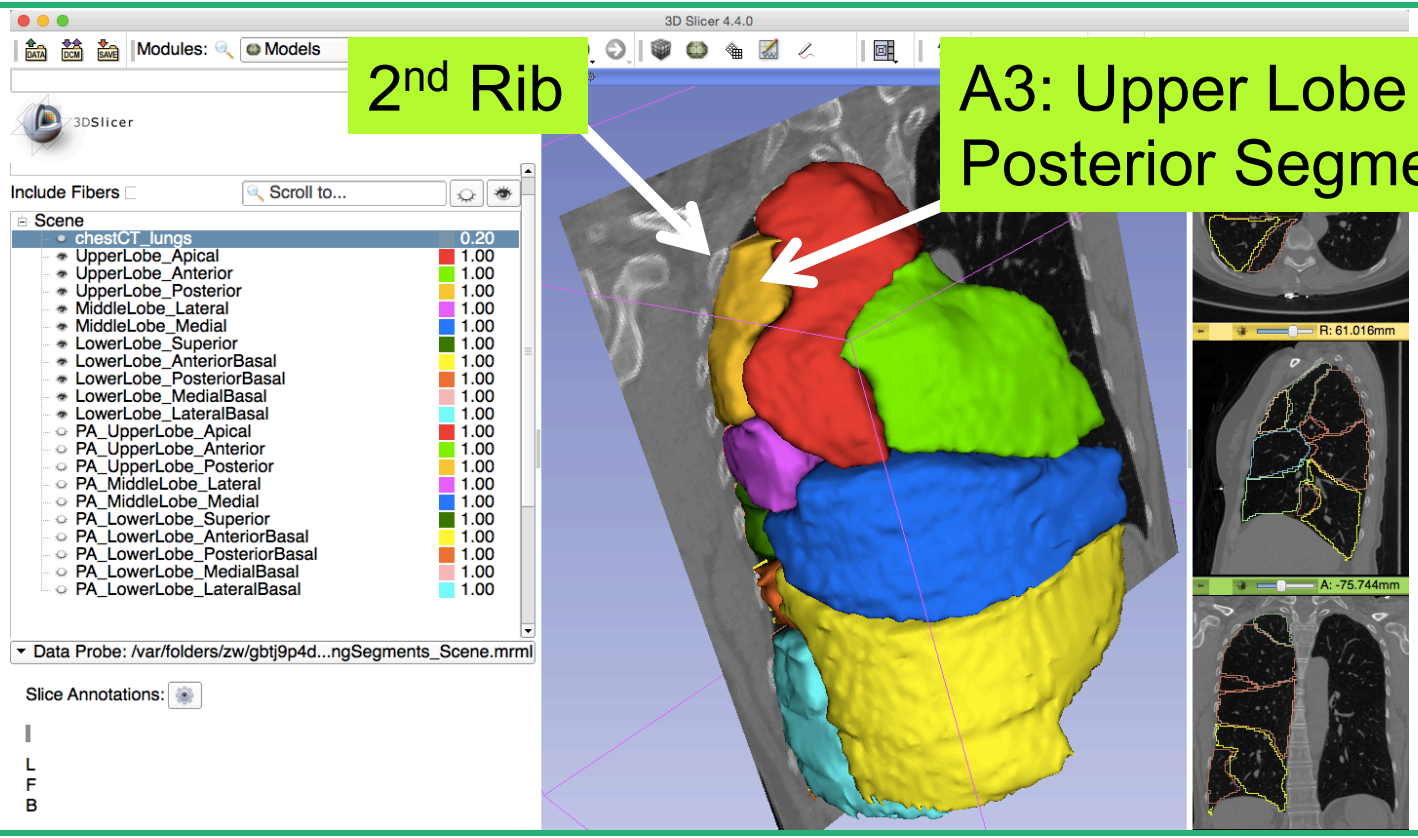
A3: Largest:
Lower Lobe Anterior / Posterior Basal

Lung Segments – Question 3

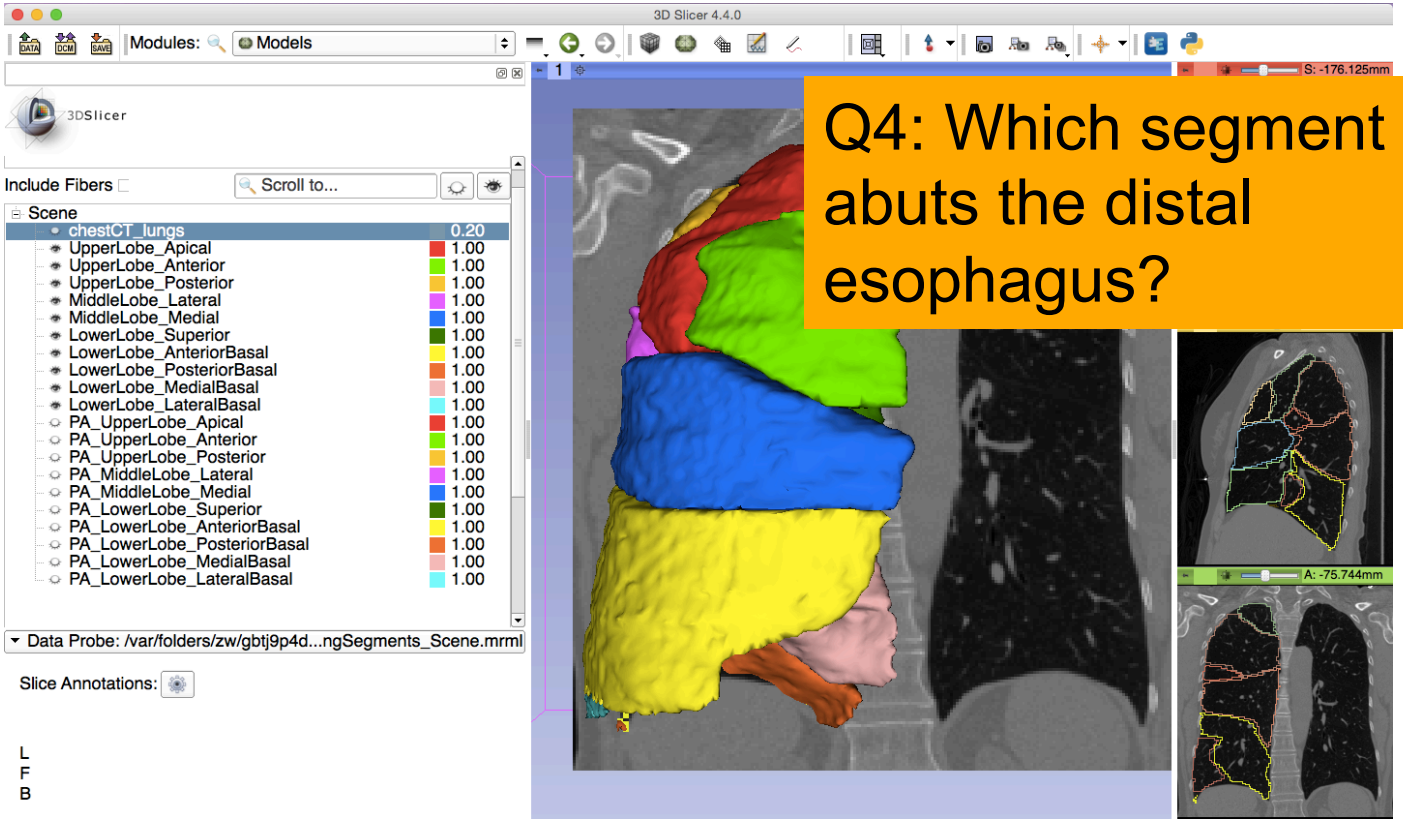


Q3: Which segment would most likely be damaged by a fracture of the right posterolateral 2nd rib?

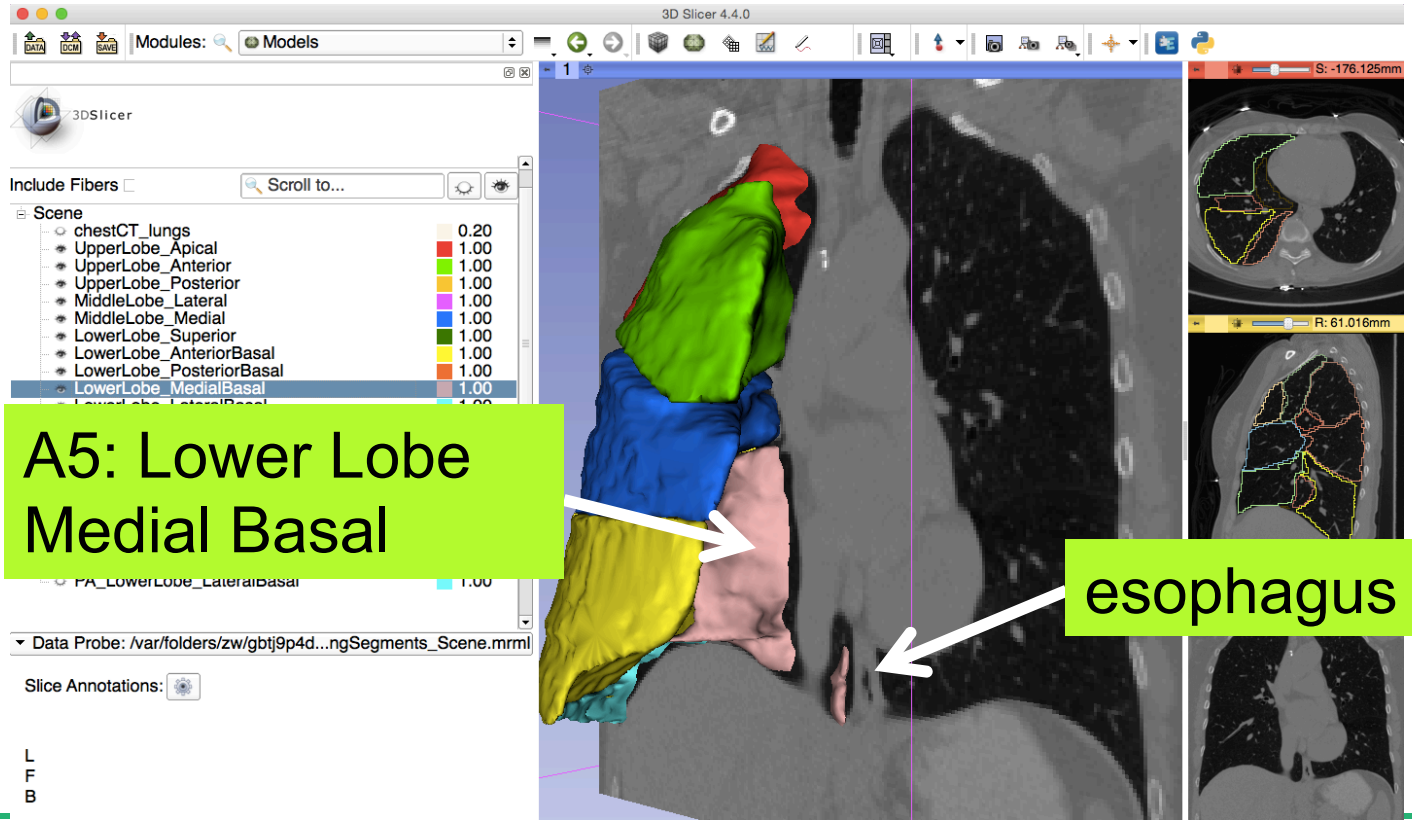
Lung Segments – Answer 3



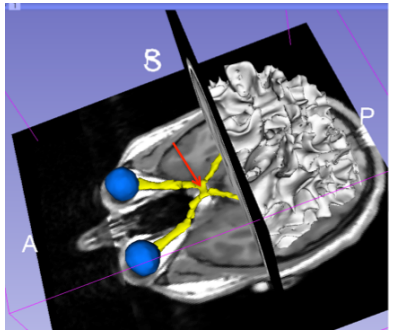
Lung Segments – Question 4

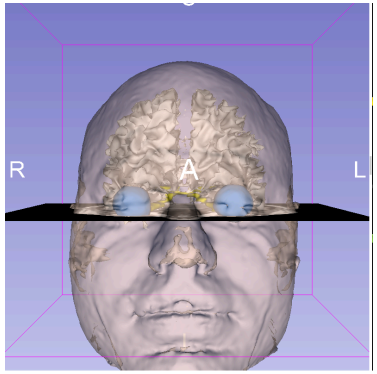


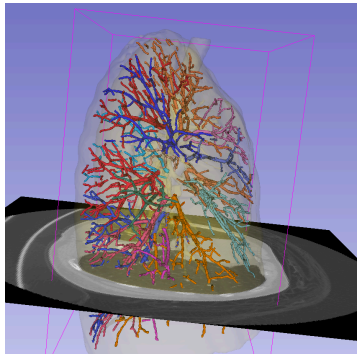
Lung Segments – Answer 5

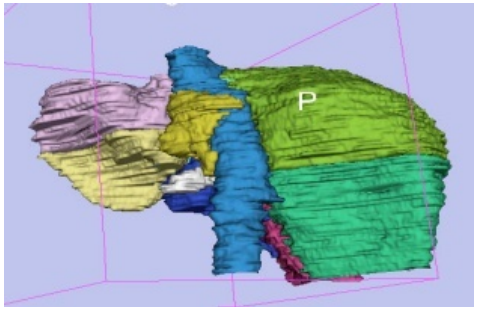


3D Visualization of DICOM images









- Interactive user-interface to load and manipulate DICOM volumes, labelmaps and 3D models
- User-defined 3D view of the anatomy

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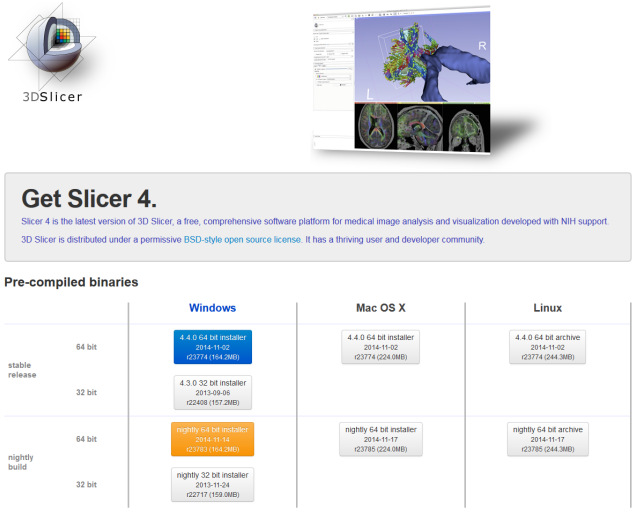

3D Slicer at RSNA 2014

Quantitative Imaging Reading Room, Exhibit LL-QRR002

- Daily meet the experts session, 12:15-1:15 pm
- 3D Slicer: An Open Source Platform for Segmentation, Registration, Quantitative Imaging, and 3D Visualization of Multi-Modal Image Data.

Sonia Pujol, PhD

Steve Pieper, PhD

Andriy Fedorov, PhD

Ron Kikinis, MD

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Franklin King, Queen's University, Kingston, Ontario
Sidong Liu, University of Sydney Australia/BWH
Ye Li, PLA General Hospital, Beijing/BHW

3DSlicer at RSNA

Sunday, November 30	Monday, December 1	Tuesday, December 2	Wednesday, December 3	Thursday, December 4	Friday, December 5
8:00am-12:30pm: 3D Slicer Exhibit:Quantitative Imaging Reading Room. Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	**8:00am-11:00am:** 3D Slicer Exhibit: Quantitative Imaging Reading Room. Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	**8:00am-12:15pm:** 3D Slicer Exhibit: Quantitative Imaging Reading Room. Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	--- 8:00am-12:15pm: **3D Slicer Exhibit:** Quantitative Imaging Reading Room. **Lakeside Learning Center Hall E, Exhibit LL-QRR3007.**	**8:00am-12:15pm:** 3D Slicer Exhibit: **Quantitative Imaging Reading Room.** Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	**8:00am-12:45pm:** 3D Slicer Exhibit: **Quantitative Imaging Reading Room.** Lakeside Learning Center Hall E, Exhibit LL-QRR3007.
12:30pm-1:30pm: Meet-The-Experts Session, 3D Slicer Exhibit: Quantitative Imaging Reading Room. Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	**12:15pm-1:15pm:** Meet-The-Experts Session, 3D Slicer Exhibit: Quantitative Imaging Reading Room. Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	**8:30am-10:00am:** RSNA Refresher Course: **"Quantitative Medical Imaging for Clinical Research and Practice: Hands-on Workshop."** **Sonia Pujol, Katarzyna Macura, Ron Kikinis** Room S401CD.	**12:15pm-1:15pm:** Meet-The-Experts Session, 3D Slicer Exhibit: **Quantitative Imaging Reading Room.** Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	**12:15pm-1:15pm:** 3D Slicer Exhibit: **Quantitative Imaging Reading Room.** Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	
1:30pm-6:00pm: 3D Slicer Exhibit: Quantitative Imaging Reading Room. Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	**12:30pm-2:00pm:** RSNA Refresher Course: **"3D Interactive Visualization of DICOM Images for Radiology Applications: Hands-on Workshop."** **Sonia Pujol, Kitt Shaffer, Ron Kikinis** Room S401CD.	**12:15pm-1:15pm:** Meet-The-Experts Session, 3D Slicer Exhibit: **Quantitative Imaging Reading Room.** Lakeside Learning Center Hall E, Exhibit LL-QRR3007. --- **1:15pm-6:00pm:** 3D Slicer Exhibit: **Quantitative Imaging Reading Room.** Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	**1:15pm-6:00pm:** 3D Slicer Exhibit: **Quantitative Imaging Reading Room.** Lakeside Learning Center, Hall E, Exhibit LL-QRR3007.	**1:15pm-6:00pm:** 3D Slicer Exhibit: **Quantitative Imaging Reading Room.** Lakeside Learning Center Hall E, Exhibit LL-QRR3007.	
	1:15pm-6:00pm: 3D Slicer Exhibit: **Quantitative Imaging Reading Room.** Lakeside Learning Center Hall E, Exhibit LL-QRR3007.				

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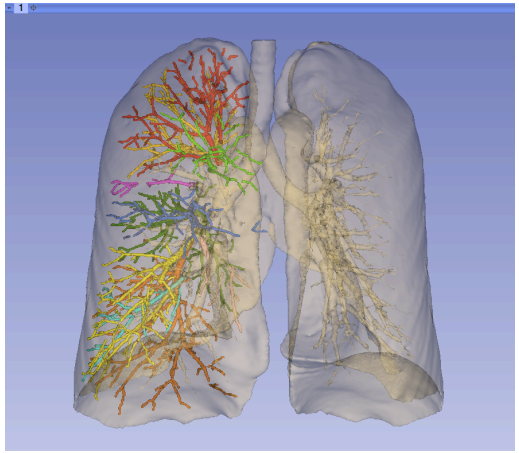

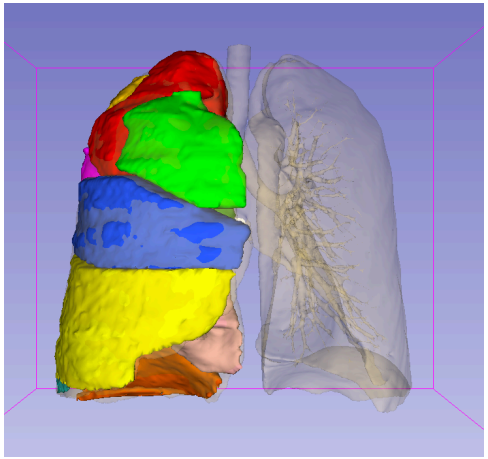

Questions and comments: Sonia Pujol, Ph.D
spujol@bwh.harvard.edu