



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, Harvard Medical School
Surgical Planning Laboratory, Brigham and Women's Hospital

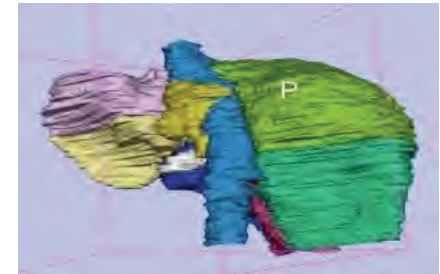
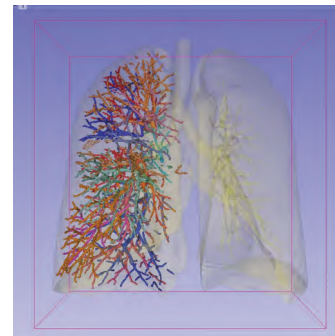
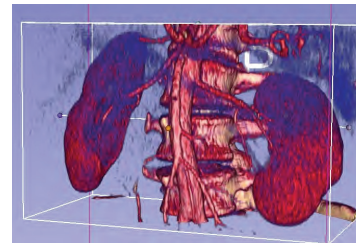
Kitt Shaffer, MD, PhD, Boston University
Vice-Chairman for Education, Boston University School of Medicine

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



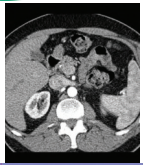
3D Visualization of DICOM images for Radiological applications

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.**

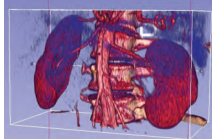




Overview

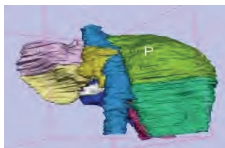


Part I: Introduction to the 3DSlicer software



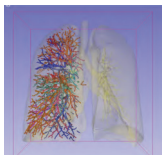
Part II: 3D Data Loading and visualization of DICOM images

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



Part III: 3D interactive exploration of the anatomy

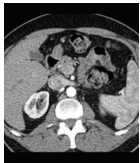
- Exploration of the Segments of the liver
- Exploration of the Segments of the lung





Tutorial Datasets

The tutorial data include 4 datasets:



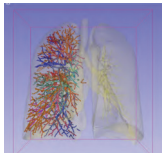
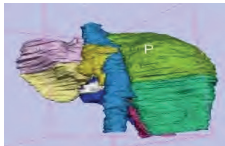
3D Visualization DICOM images part 1:

- dataset1_Thorax_Abdomen
- dataset2_Head



3D Visualization DICOM images part 2:

- dataset3_Liver
- dataset4_Chest

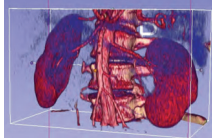




Overview

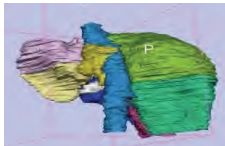


Part I: Introduction to the 3DSlicer software



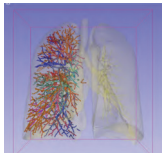
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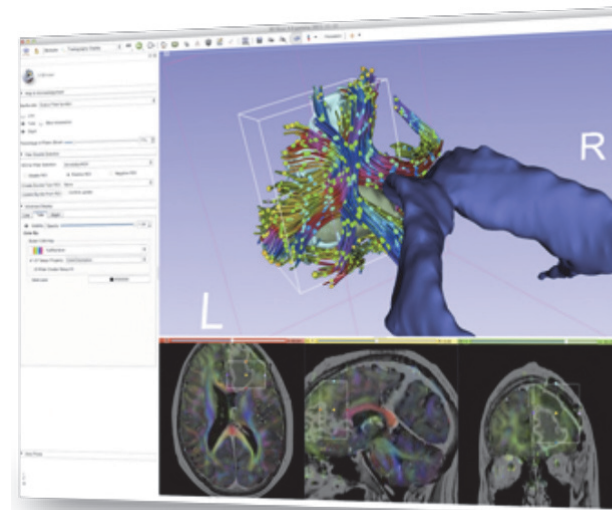
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- Exploration of the Segments of the liver
- Exploration of the Segments of the lung



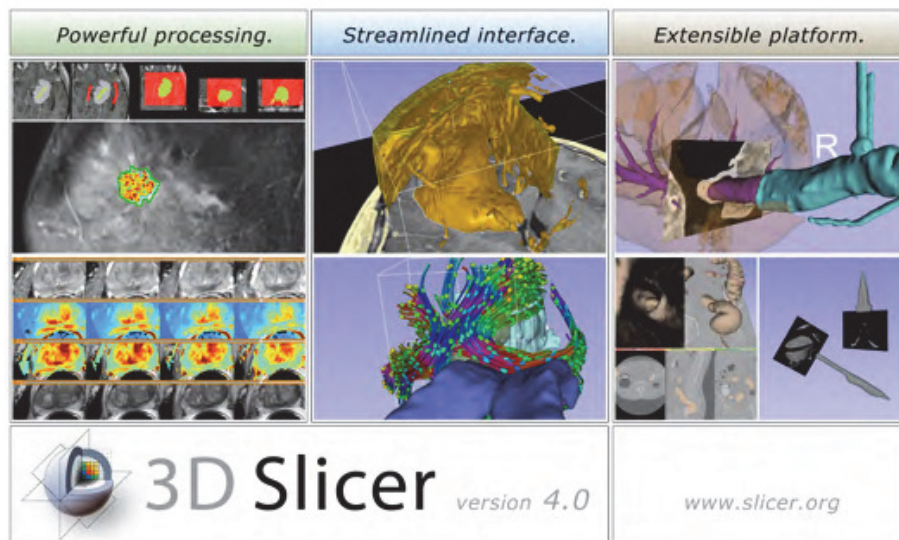


Introduction to the 3DSlicer software





3DSlicer

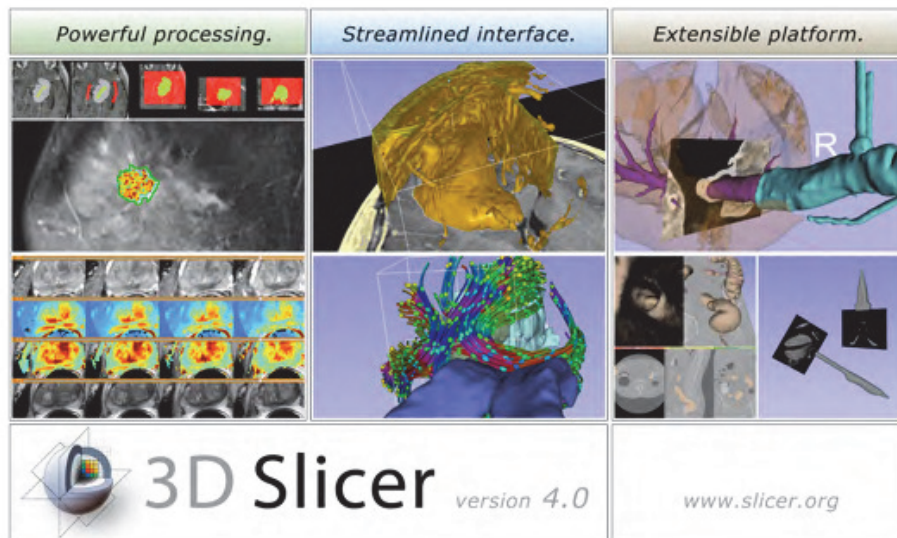


3D Slicer is a freely available **open-source** platform for segmentation, registration and 3D visualization of medical imaging data.

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



3DSlicer



- 3DSlicer version 4.3 is a **multi-platform software** running on Windows, Linux, and Mac OSX
- Slicer is distributed under a **BSD license** with no restriction on use
- Slicer is a tool for research, and is **not FDA** approved

Disclaimer

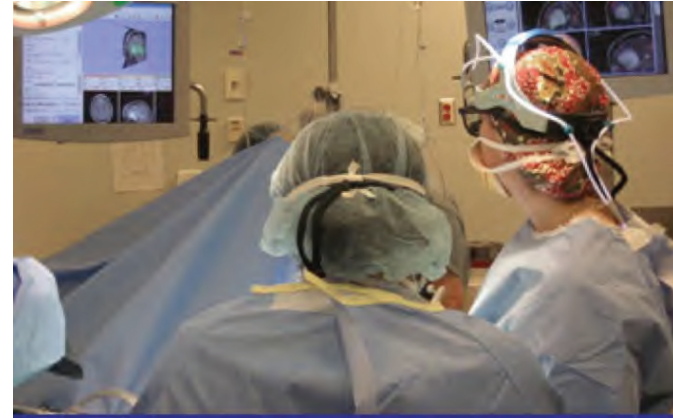
It is the responsibility of the user of 3DSlicer to comply with both the terms of the license and with the applicable laws, regulations and rules.



An interdisciplinary platform



An open-source environment for software developers

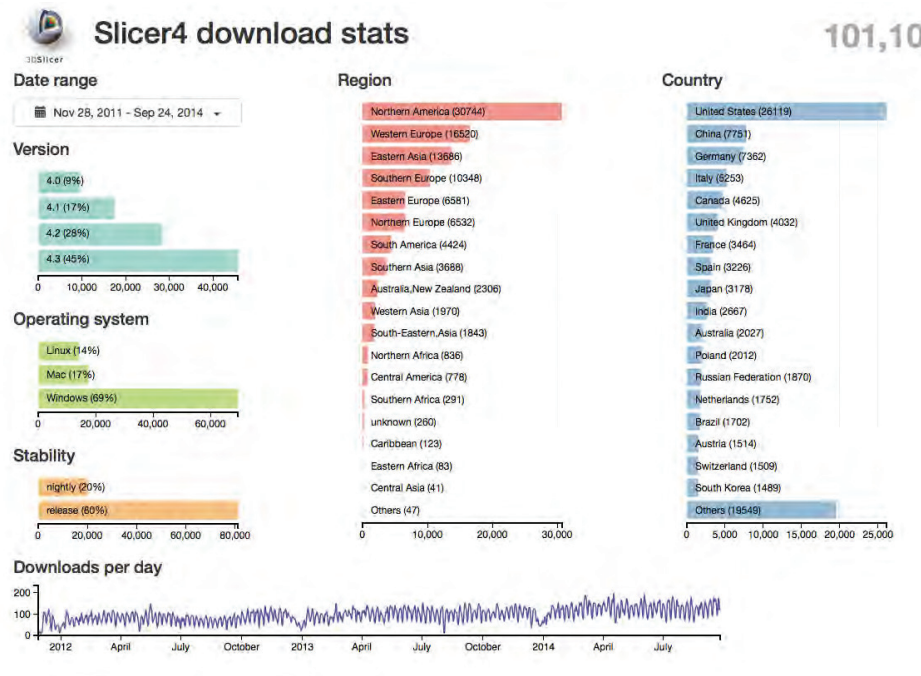


An end-user application for clinical investigators and scientists

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




3DSlicer History



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



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



National Alliance for Medical Image Computing
A National Center for Biomedical Computing
Funded under the NIH Roadmap Initiative

Google Custom Search **Search**

NA-MIC Wiki

General

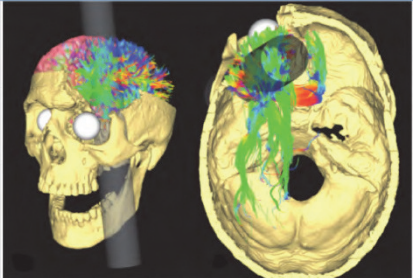
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Center Components

- Algorithms
- Engineering
- Driving Biological Projects
- Collaboration Grants

Resources

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RSNA 2012

The 98th Annual Meeting of the Radiological Society of North America will be held on November 25-30, 2012 at McCormick Place, in Chicago, IL. RSNA is an international society of radiologists, medical physicists and other medical professionals with more than 50,000 members across the globe.

[Read more...](#)

[NEWS ARCHIVE](#)

Modeling the path of the tamping iron through the Gage skull and its effects on white matter structure [Read more...](#)

1 of 24 Photos

The National Alliance for Medical Image Computing (NA-MIC) is a multi-institutional, interdisciplinary team of computer scientists, software engineers, and medical investigators who develop computational tools for the analysis and visualization of medical image data. The purpose of the Center is to provide the infrastructure and environment for the development of computational algorithms and open-source technologies, and then oversee the training and dissemination of these tools to the medical research community.

Supported by the National Institutes of Health (NIH) under the NIH Roadmap Initiative.

Information about collaborating with NA-MIC

PI: Ron Kikinis, M.D.



Neuroimage Analysis Center
"understanding the human brain through imaging"

Google Custom Search **GO**

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- Collaborators

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fMRI-DTI Modeling via Landmark Distance Atlases for Prediction and Detection of Fiber Tracts

Leave-one-out prediction of tract location according to the landmark distance atlas (LDA). Each subject's MRI acquisition yields two anatomical landmarks, plus the leave-one-out LDA from the other subjects, were used to predict the location of the AF, left CST, and right CST. The true structures for each subject are shown in dark blue, and the 80% confidence interval for the predicted trajectory is shown in transparent cyan. These results provide an alternative visualization of the data in the learned landmark distance model and they demonstrate reasonable model generalization to novel subjects.

[More...](#)

[Featured Image Archive](#)

The Neuroimage Analysis Center (NAC) develops image processing and analysis techniques for basic and clinical neurosciences. The NAC research approach emphasizes both specific core technologies and collaborative application projects. The activities of the NAC are centered at the Harvard Medical School and the Surgical Planning Laboratory at the Brigham and Women's Hospital, with collaborators throughout the United States and the rest of the world.

Of research center supported by the National Center for Research Resources (NCRR) (P30 RR0211) and the Institute of Biomedical Imaging and Bioengineering (NIBIB), (P41 EB005539) National Institutes of Health.



National Center for Image-Guided Therapy

NCIGT Wiki

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Advanced Multimodality Image Guided Operating (AMIGO) Suite

The Advanced Multimodality Image Guided Operating (AMIGO) Suite is an innovative surgical and interventional environment that is the clinical translational test bed of the National Center for Image-Guided Therapy (NCIGT) at the Brigham and Women's Hospital (BWH) and Harvard Medical School. The AMIGO is an integrated, 5,700 square foot area divided into three sterile procedure rooms in which a multidisciplinary team will treat patients with the benefit of intra-operative imaging using multiple modalities. More...

[Featured Image Archive](#)

The National Center for Image Guided Therapy (NCIGT) is a Biomedical Technology Resource Center supported by the NCRR and NIBIB institutes

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



Slicer: Behind the scenes

CDash - Slicer4

WARNING: This CDash instance is running the bleeding edge svn trunk CDash code, and is updated frequently. You have 1 file changed by 1 author as of Sunday, November 27 2011 - 22:00 EST

Site	Build Name	Update			Configure			Build		
		Files	Error	Warn	Error	Warn	Error	Warn		
factory-win7.kitware	Windows7-VS2010-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0	0	0	0	0	107	
factory-mac-64bits.kitware	SnowLeopard-g++4.2.1-64bits-QT4.7-PythonQt-With-Tcl-CLI-Release	1	0	0	0	0	0	0	14	
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-64bits-QT4.7-PythonQt-With-Tcl-CLI-Release	1	0	0	0	0	0	0	13	
factory-win7.kitware	Windows7-VS2008-64bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0	0	0	0	0	1000	
factory-win7.kitware	Windows7-VS2008-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	1	0	0	0	0	0	0	1000	

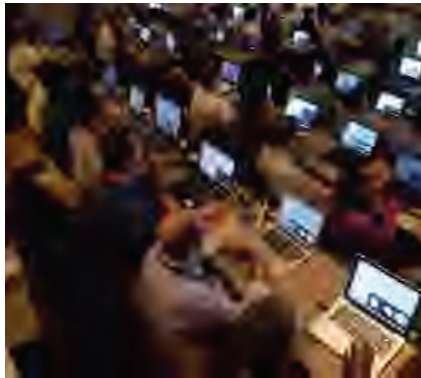
Site	Build Name	Update			Configure			Build			Test			Build Time
		Files	Error	Warn	Error	Warn	Error	Warn	Not Run	Fail	Pass			
whitecube.kitware	SnowLeopard-gcc4.2.1-QT4.7.0-PythonQt-With-Tcl-Release	7	0	0	0	0	27	190	0	26	331	11 hours ago		
youpiaci.utah.edu	OpenSuse-c++4.5.0-64bits-QT4.6.3-PythonQt-With-Tcl-NoCLI-Release	0	0	0	0	0	0	15	0	0	6	11 hours ago		
eris.kitware	Linux-g++4.4-QT4.6.3-PythonQt-CLI-Release	1	0	0	0	0	0	15	0	39	151	3 hours ago		
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-QT4.7-PythonQt-With-Tcl-CLI-Valgrind-Release	0	0	0	0	0	0	13	0	27	160	11 hours ago		
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-64bits-QT4.7-PythonQt-With-Tcl-NoCLI-Coverage-Release	0	0	0	0	0	0	12	0	0	267	11 hours ago		
sagarmatha.kitware	Linux-g++4.3.3-QT4.7-PythonQt-With-Tcl-NoCLI-Release	0	0	0	0	0	0	12	0	29	289	12 hours ago		

Site	Build Name	Update			Configure			Build			Test			Build Time
		Files	Error	Warn	Error	Warn	Error	Warn	Not Run	Fail	Pass			
youpiaci.utah.edu	OpenSuse-c++4.5.0-64bits-QT4.6.3-PythonQt-With-Tcl-NoCLI-Release	2	0	0	0	0	0	0	0	0	6	1 hour ago		

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



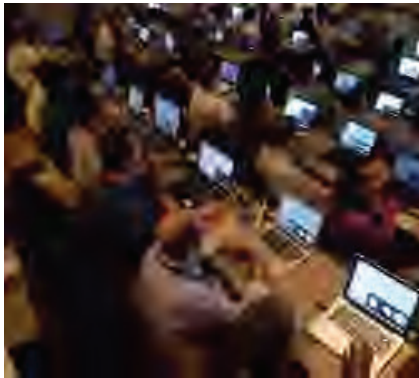
Slicer Training events



- Hands-on training workshops at national and international venues
- More than 2,700 clinicians, clinical researchers and scientists trained since 2005



Slicer Training events



RSNA 2011

Major international conferences

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



RSNA Activities

Hands-on refresher courses

- 3D Visualization of DICOM images for Radiology Applications
- Quantitative Imaging for Clinical Research and Practice

Quantitative Imaging Reading Room Exhibit

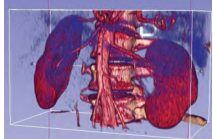
- 3DSlicer: An Open Source Platform for Segmentation, Registration, Quantitative Imaging, and 3D Visualization of Multi-Modal Image Data.



Overview

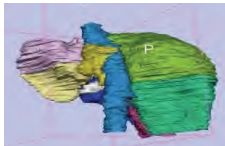


Part I: Introduction to the 3DSlicer software



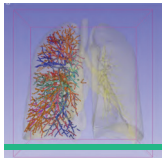
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- Surface Rendering of MR head data



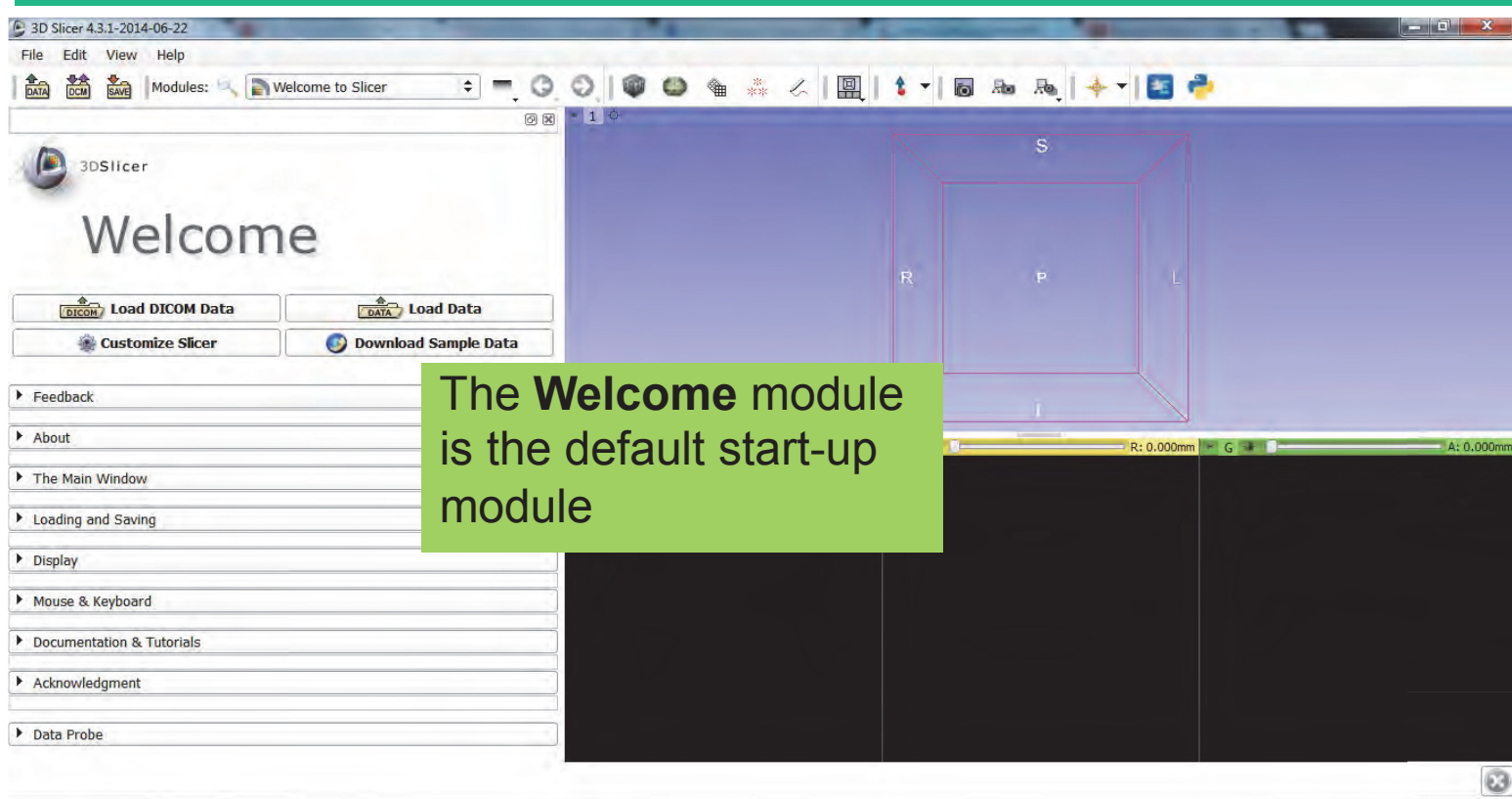
Part III: 3D interactive exploration of the anatomy

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



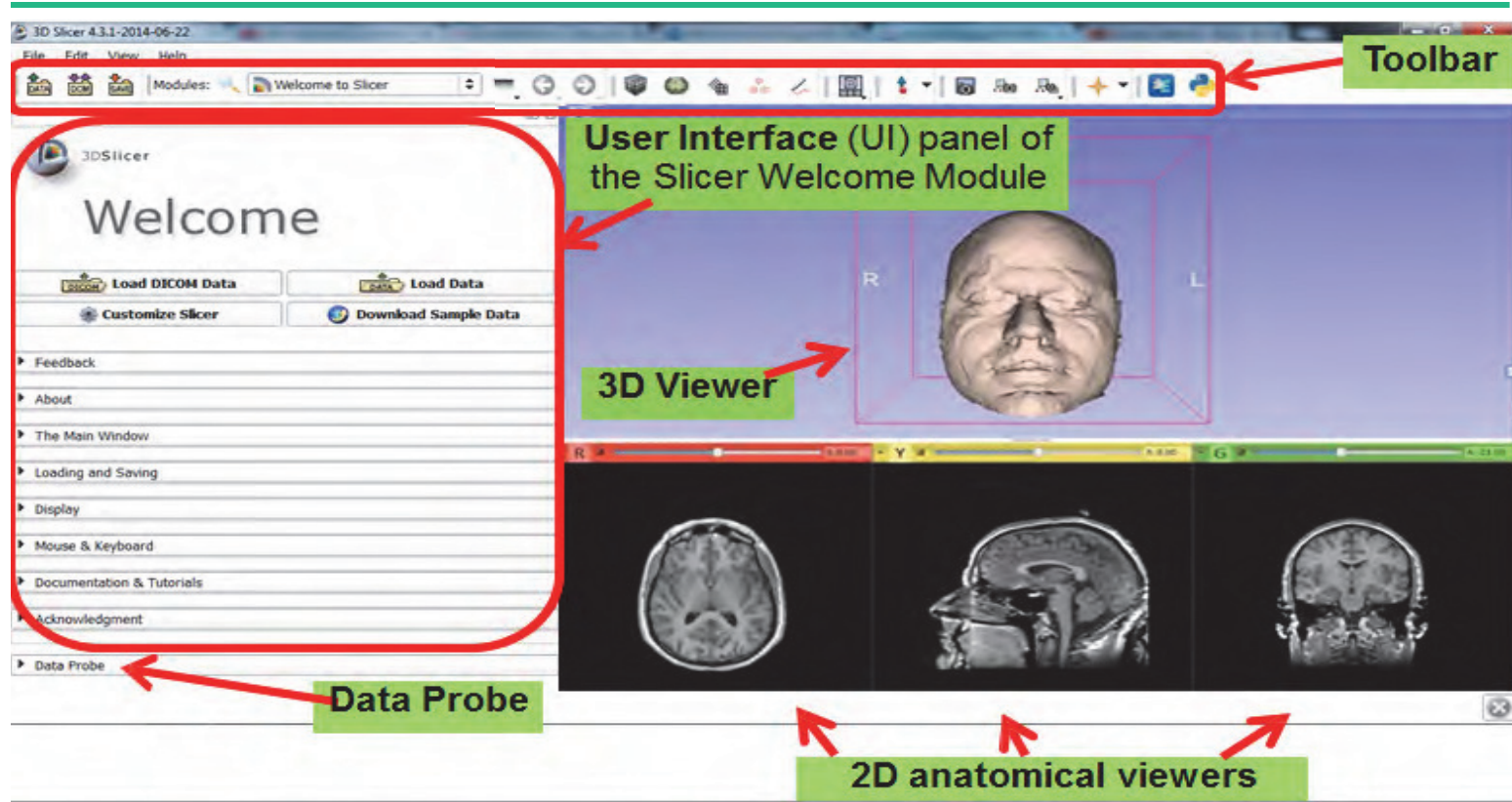


Welcome to Slicer4





Navigating the Application GUI

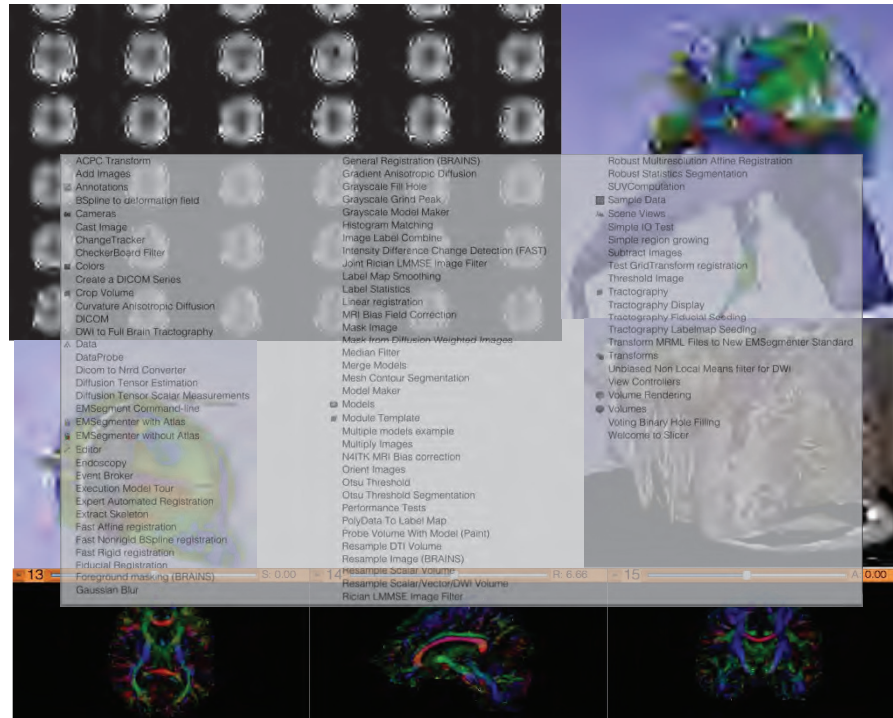




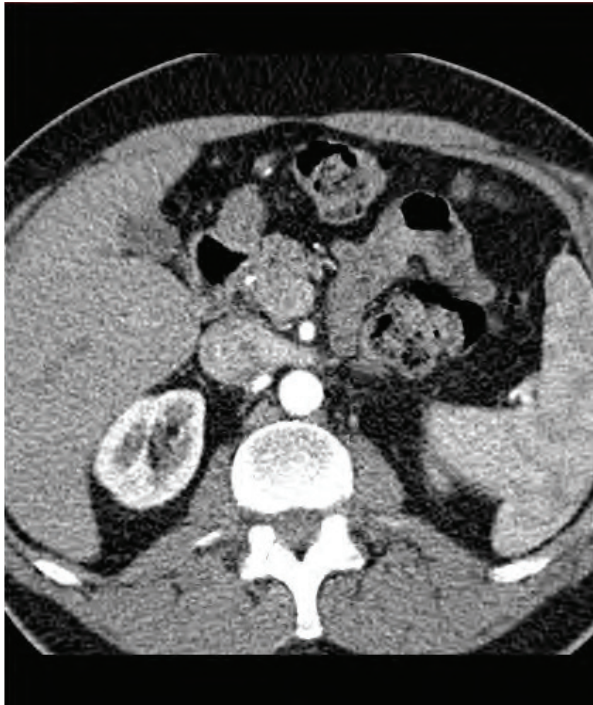
Welcome to Slicer4.3.1.1



Welcome to Slicer4



Slicer4.3.1 contains more than 100 modules for image segmentation, registration and 3D visualization of medical imaging data



Part 1:

Loading a DICOM Volume

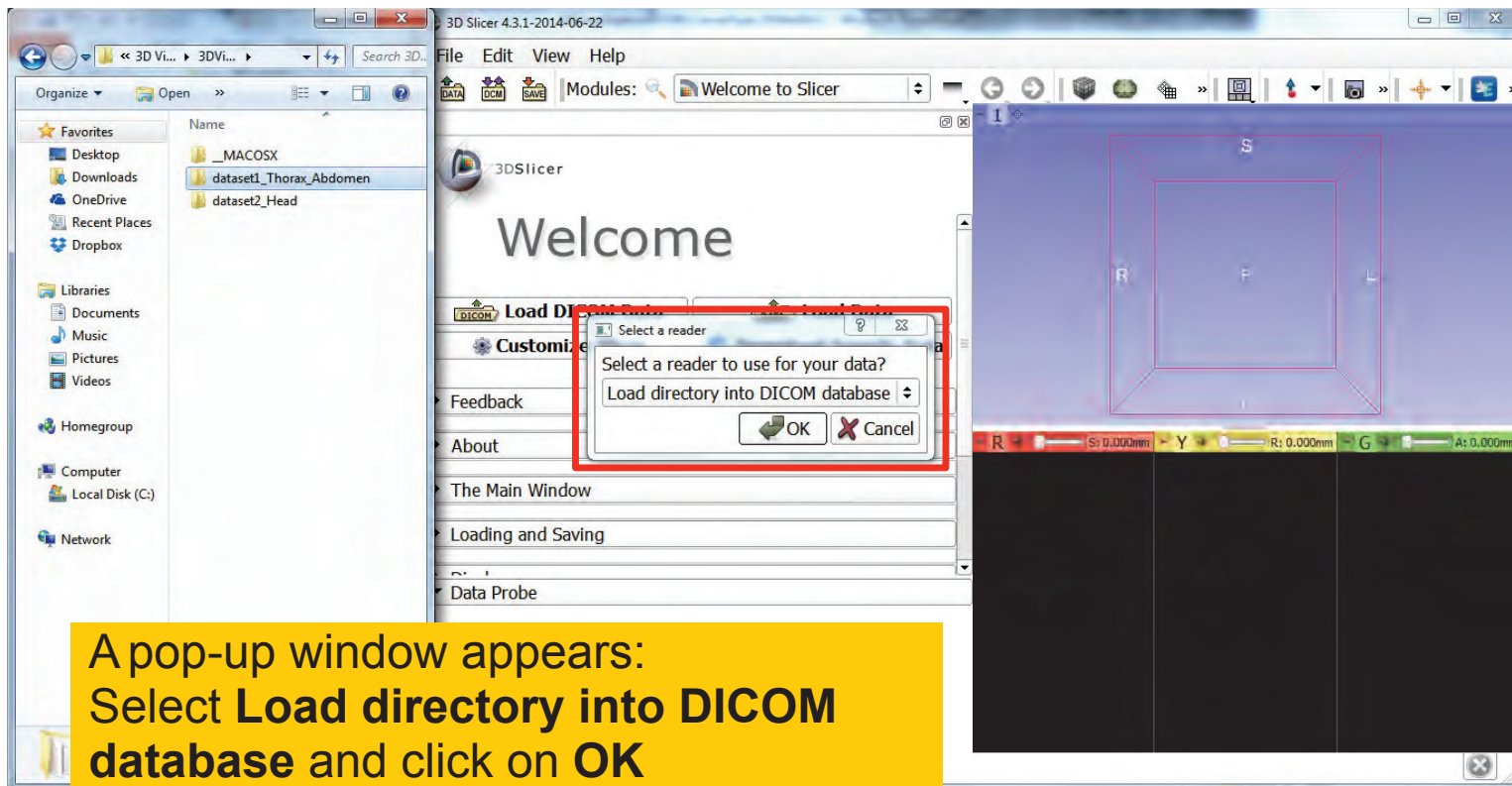


Loading a DICOM volume

Drag and drop the “dataset1_Thorax_Abdomen” file into slicer



Loading a DICOM volume



A pop-up window appears:
Select Load directory into DICOM database and click on **OK**



Loading a DICOM volume

The screenshot shows the 3D Slicer 4.3.1-2014-06-22 interface. The DICOM Browser window is open, displaying a table of DICOM data. A progress dialog box is overlaid on the browser, showing the file path and a progress bar at 17%. The progress dialog box contains the following text:

C:/Users/F/Desktop/Slicer 4.3.1-2014-06-22/3D Visualization Dicom/3DVisualization_DICOM_images_part1/dataset1_Thorax_Abdomen/IM-0001-0051.dcm
17%
Cancel

The DICOM Browser window shows the following table:

PatientsName	PatientID	PatientsBirthDate	PatientsBirthTime	PatientsSex	PatientsAge	PatientsComments
patient1	patient1_ID					
DTI_32ch_test	1234	1900-01-01		F		

Below the DICOM Browser window, a table of DICOM series is visible:

SeriesNumber	SeriesDate	SeriesTime	SeriesDescriptor	Modality	BodyPartExamined	AcquisitionNumber	ContrastAgent
6	2005-06-01	120000.000000	CT_Thorax_Abdomen	CT	HEART	14	APPLIED

Slicer starts loading the DICOM images



Loading a DICOM volume

3D Slicer 4.3.1-2014-06-22

File Edit View Help

DATA DCM SAVE Modules: DICOM

3DSlicer

Help & Acknowledgement

Servers

Start Listener when

DICOM Database an

Recent DICOM Activ

0 series added to data

Past Month: CT_Tho

Past Month: ep2d_di

Data Probe

DICOM Directory Import

Directory import completed.

1 New Patients

266 New Studies

266 New Series

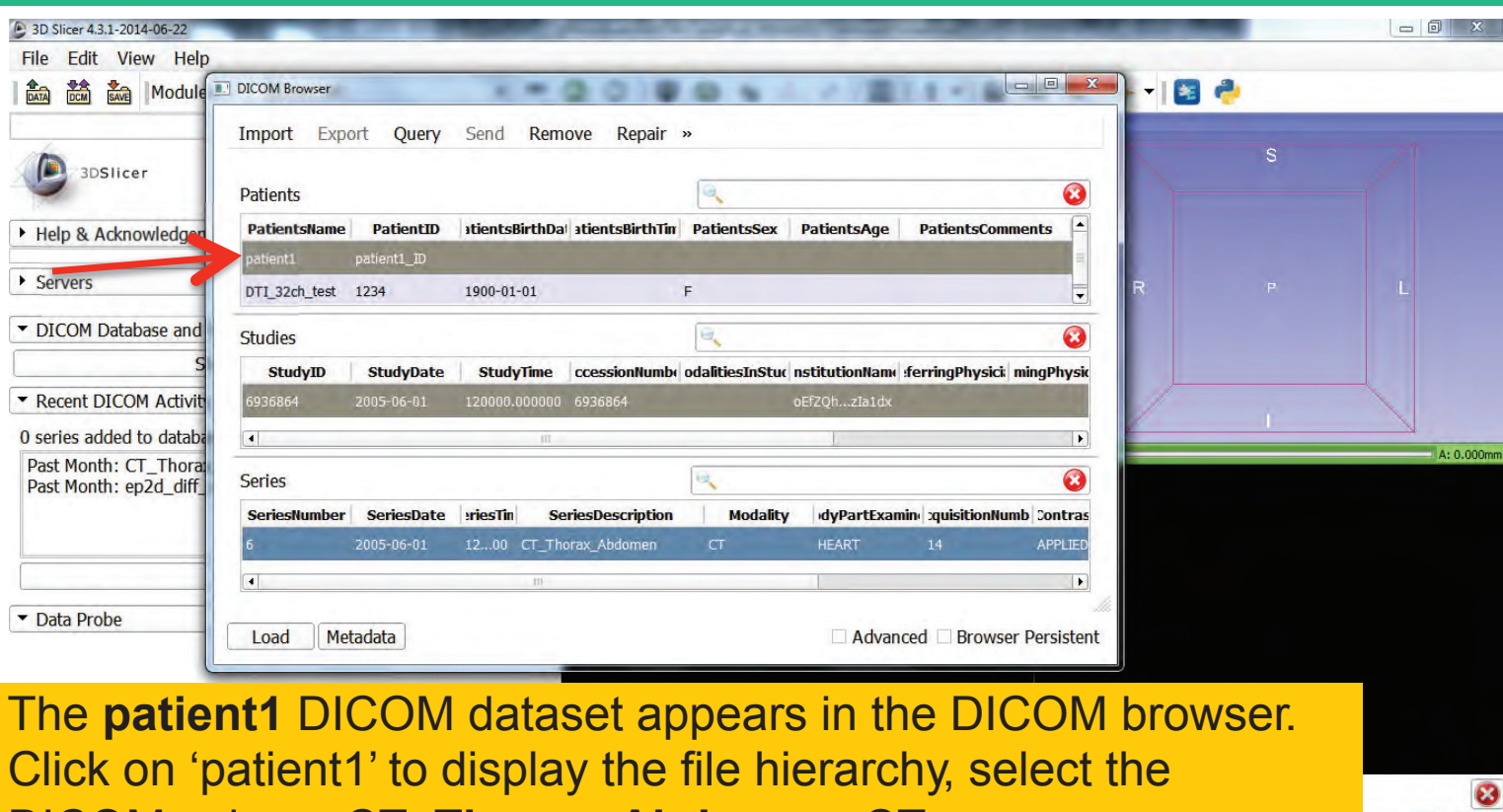
266 New Instances

OK

Click on **OK** once the directory import is completed



Loading a DICOM volume



The **patient1** DICOM dataset appears in the DICOM browser. Click on 'patient1' to display the file hierarchy, select the DICOM volume **CT_Thorax_Abdomen_CT**



Loading a DICOM volume

The screenshot shows the DICOM Browser window in 3D Slicer. It contains three tables: Patients, Studies, and Series. The 'Load' button is highlighted with a red box.

PatientsName	PatientID	PatientsBirthDate	PatientsBirthTime	PatientsSex	PatientsAge	PatientsComments
patient1	patient1_ID					
DTI_32ch_test	1234	1900-01-01		F		

StudyID	StudyDate	StudyTime	AccessionNumber	ModalitiesInStudy	InstitutionName	ReferringPhysician	OrderingPhysician
6936864	2005-06-01	120000.000000	6936864		oEFZQh...zIa1dx		

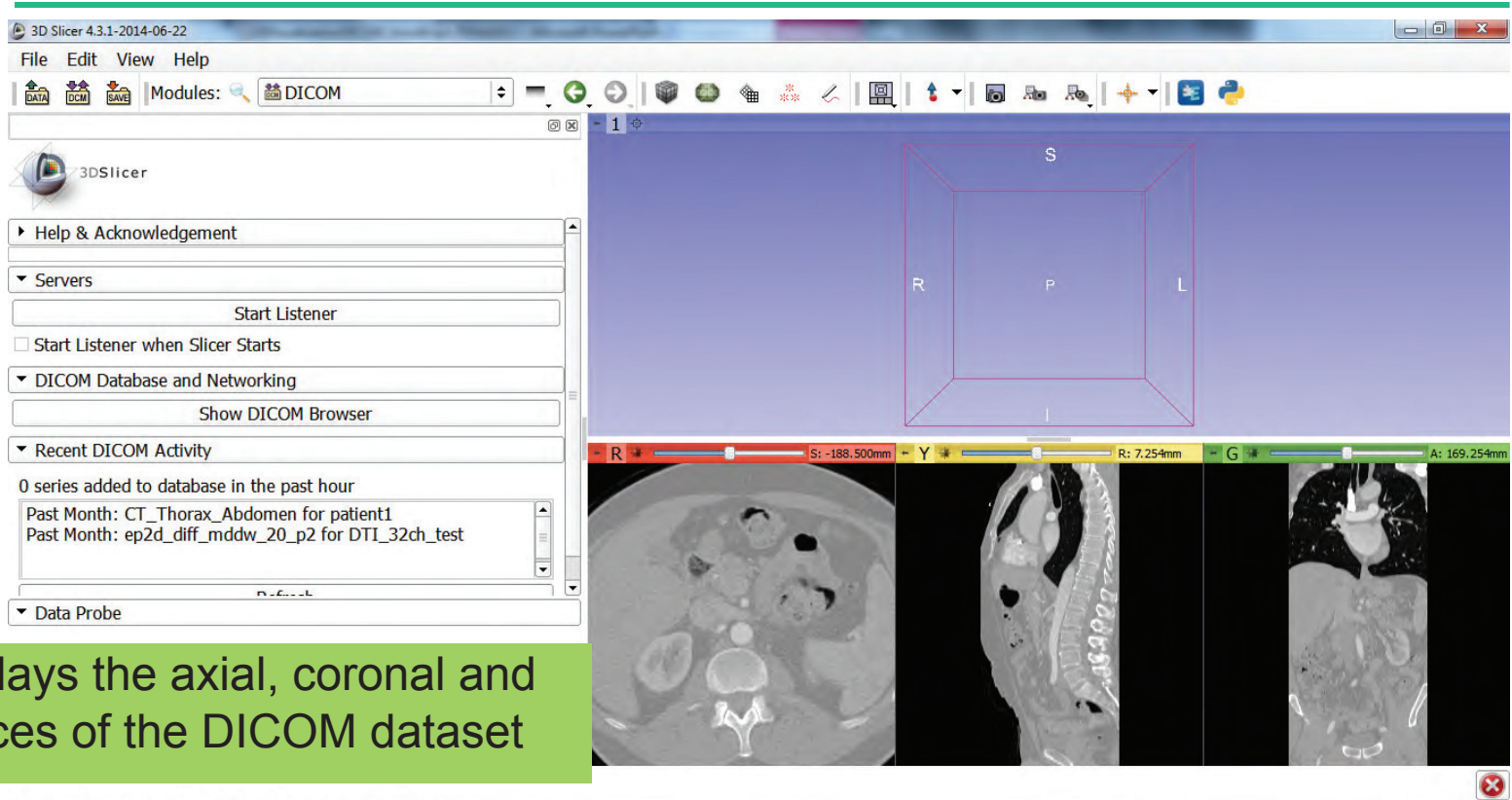
SeriesNumber	SeriesDate	SeriesTime	SeriesDescription	Modality	BodyPartExamined	AcquisitionNumber	Contrast
6	2005-06-01	12...00	CT_Thorax_Abdomen	CT	HEART	14	APPLIED

Advanced Browser Persistent

Click on **Load Selection to Slicer** to load the DICOM volume into Slicer (note: this may take a few minutes)



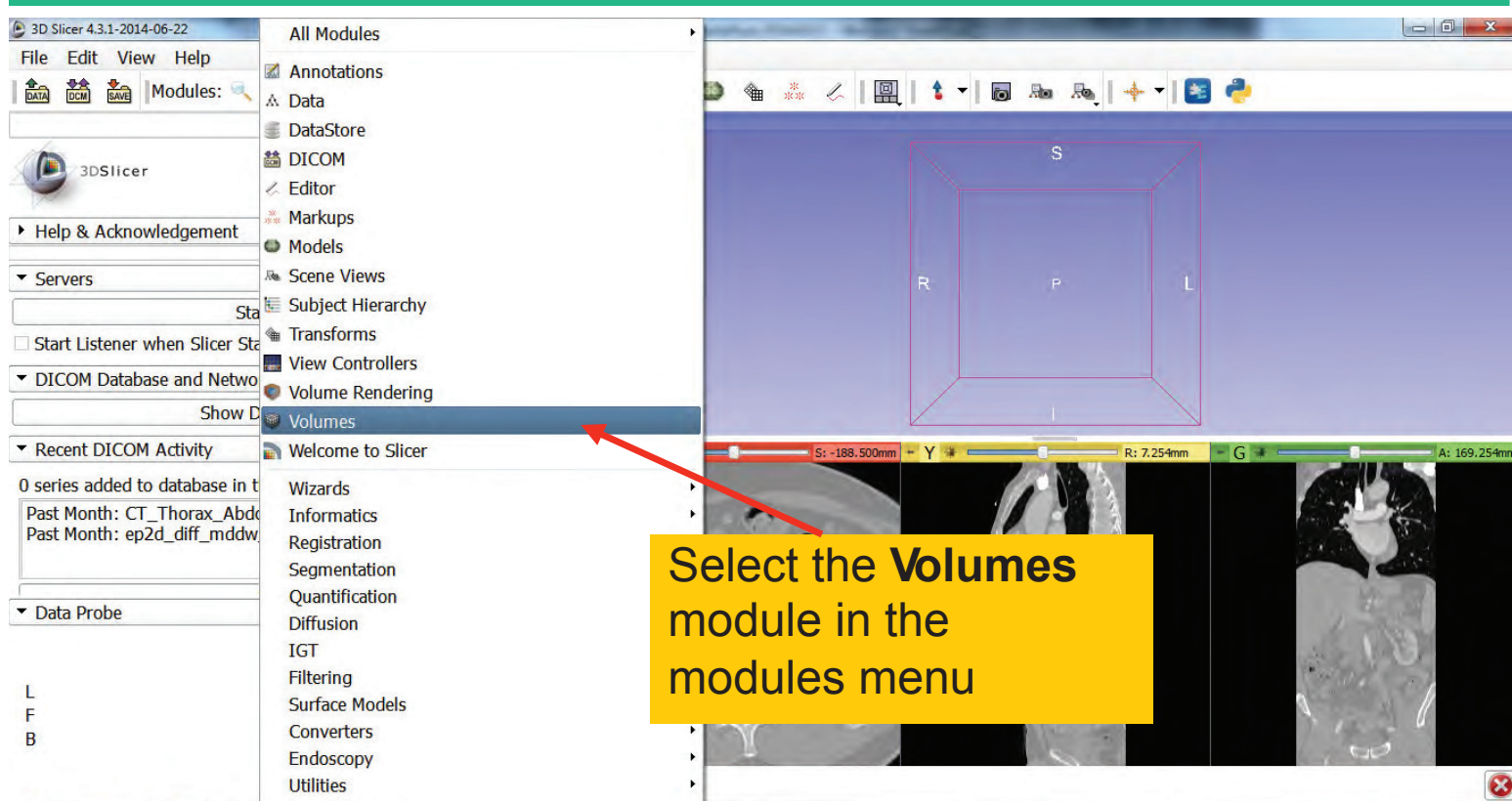
Loading a DICOM volume



Slicer displays the axial, coronal and sagittal slices of the DICOM dataset



Loading a DICOM volume

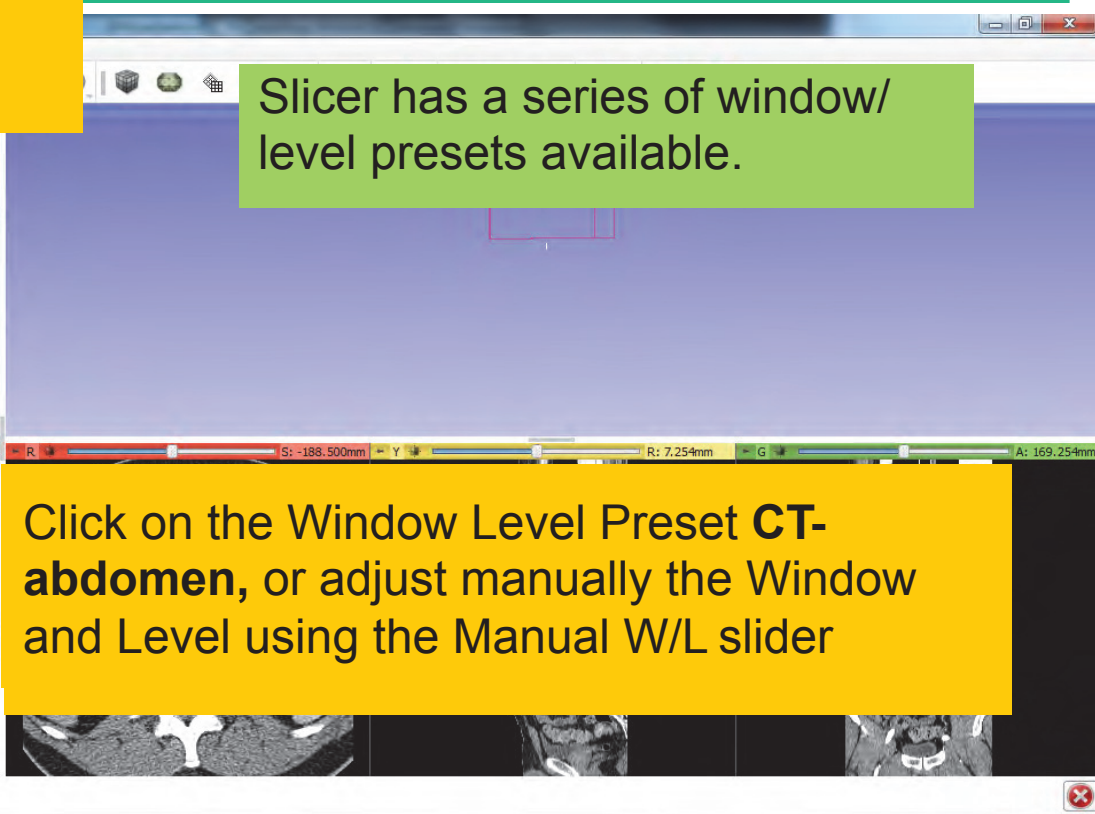
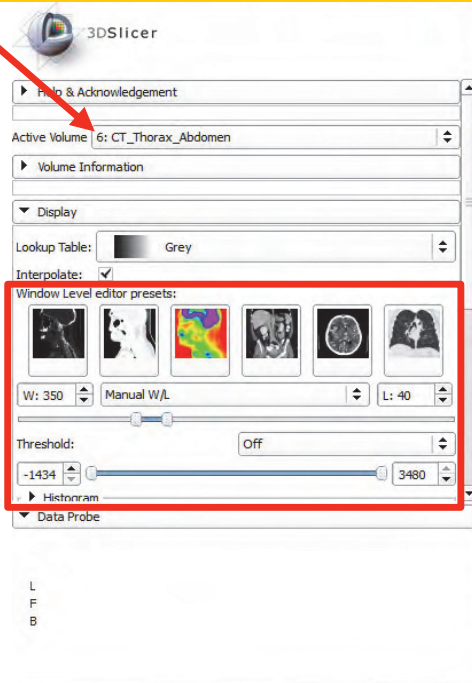




Loading a DICOM volume

Select the Active Volume
6:CT_Thorax_Abdomen

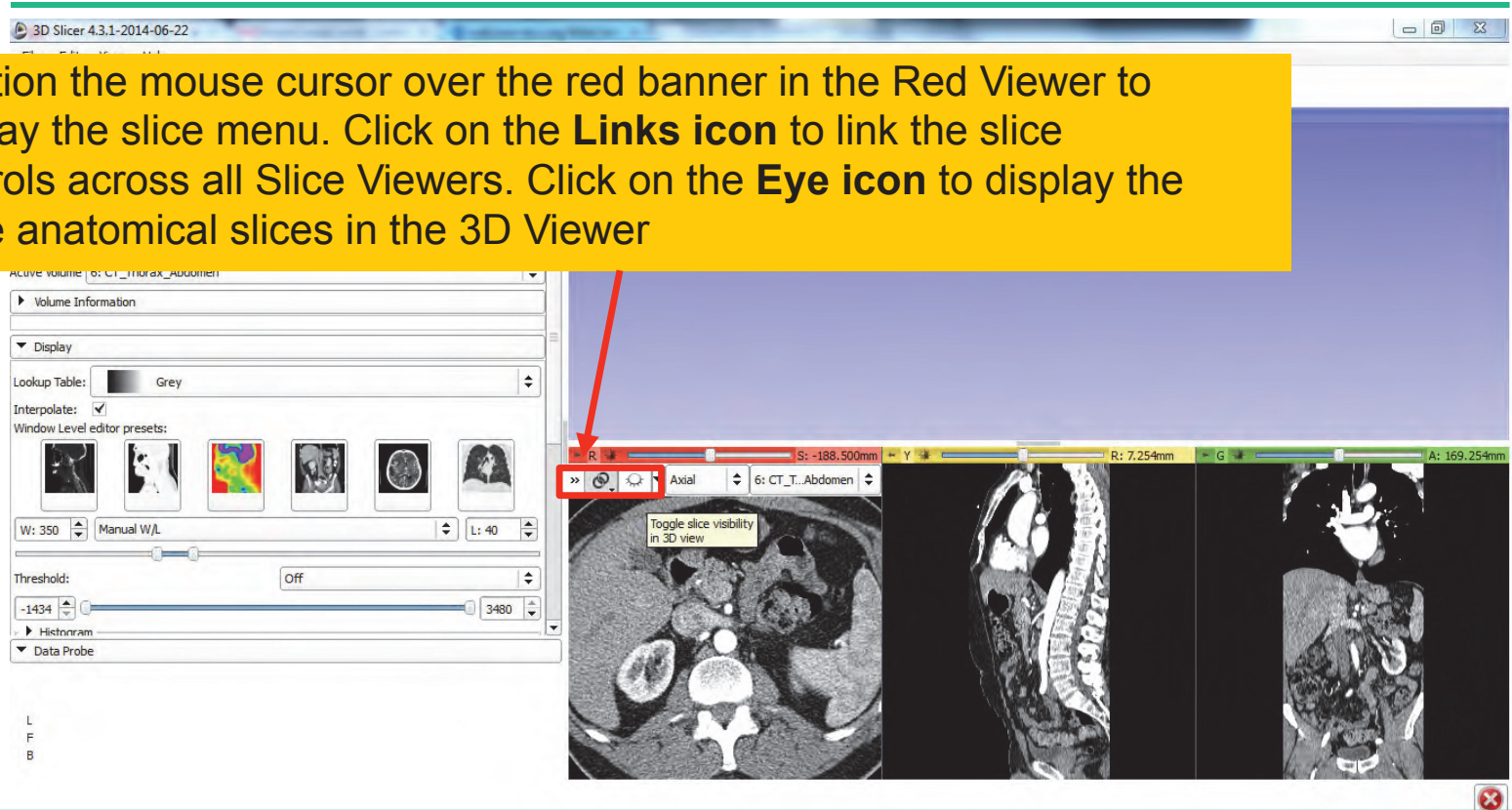
Slicer has a series of window/
level presets available.





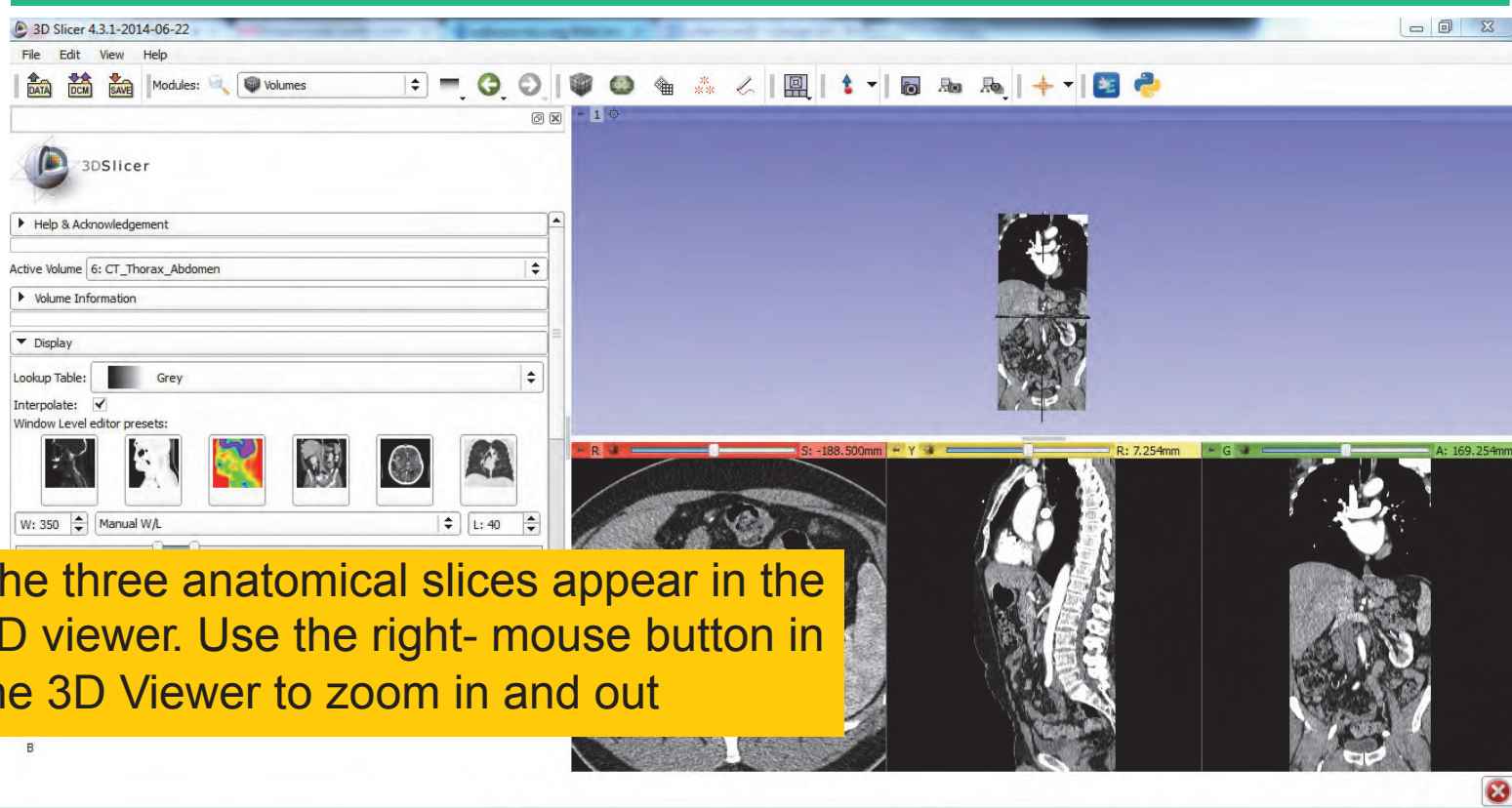
Loading a DICOM volume

Position the mouse cursor over the red banner 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





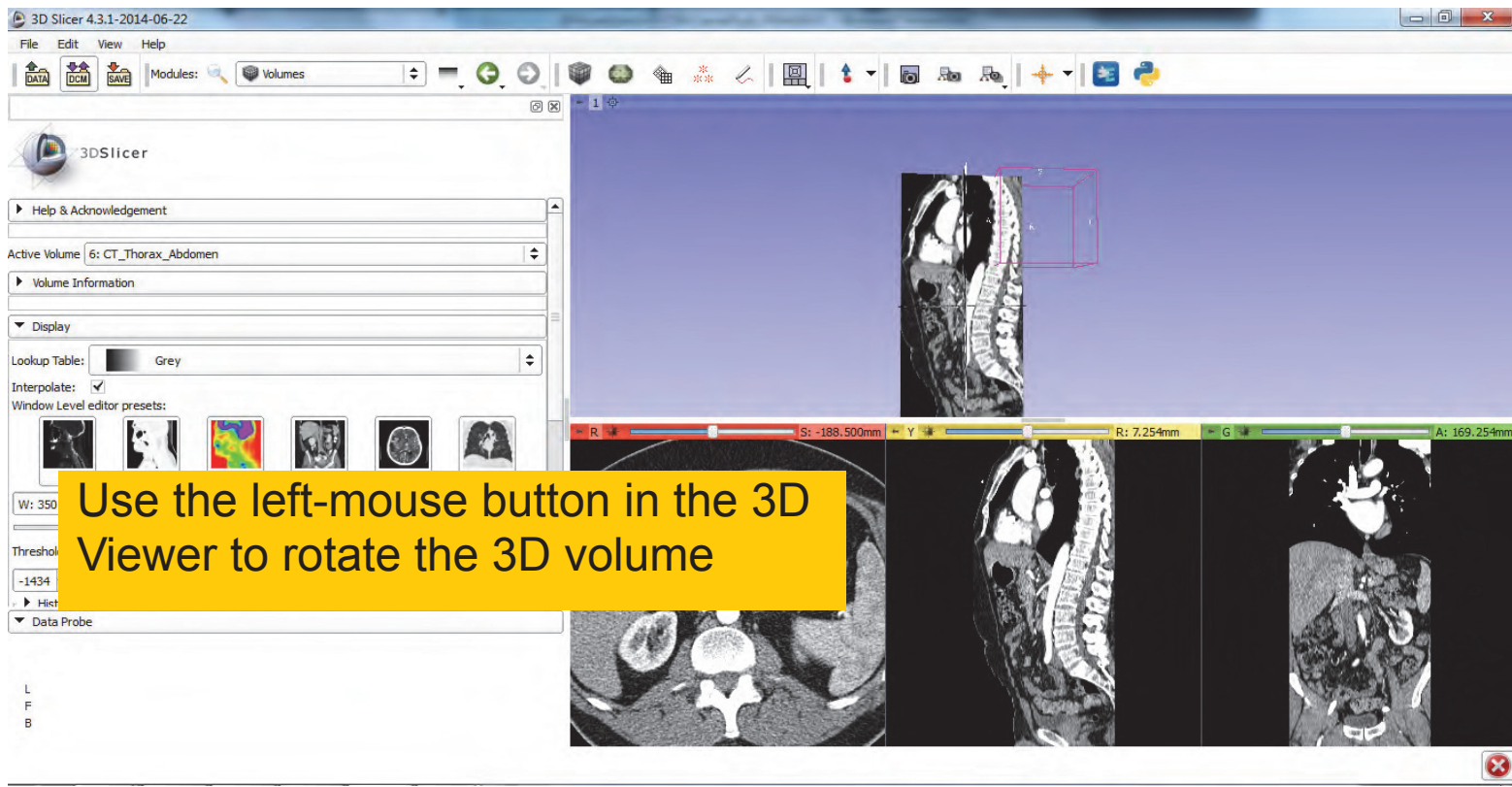
Loading a DICOM volume



The three anatomical slices appear in the 3D viewer. Use the right- mouse button in the 3D Viewer to zoom in and out

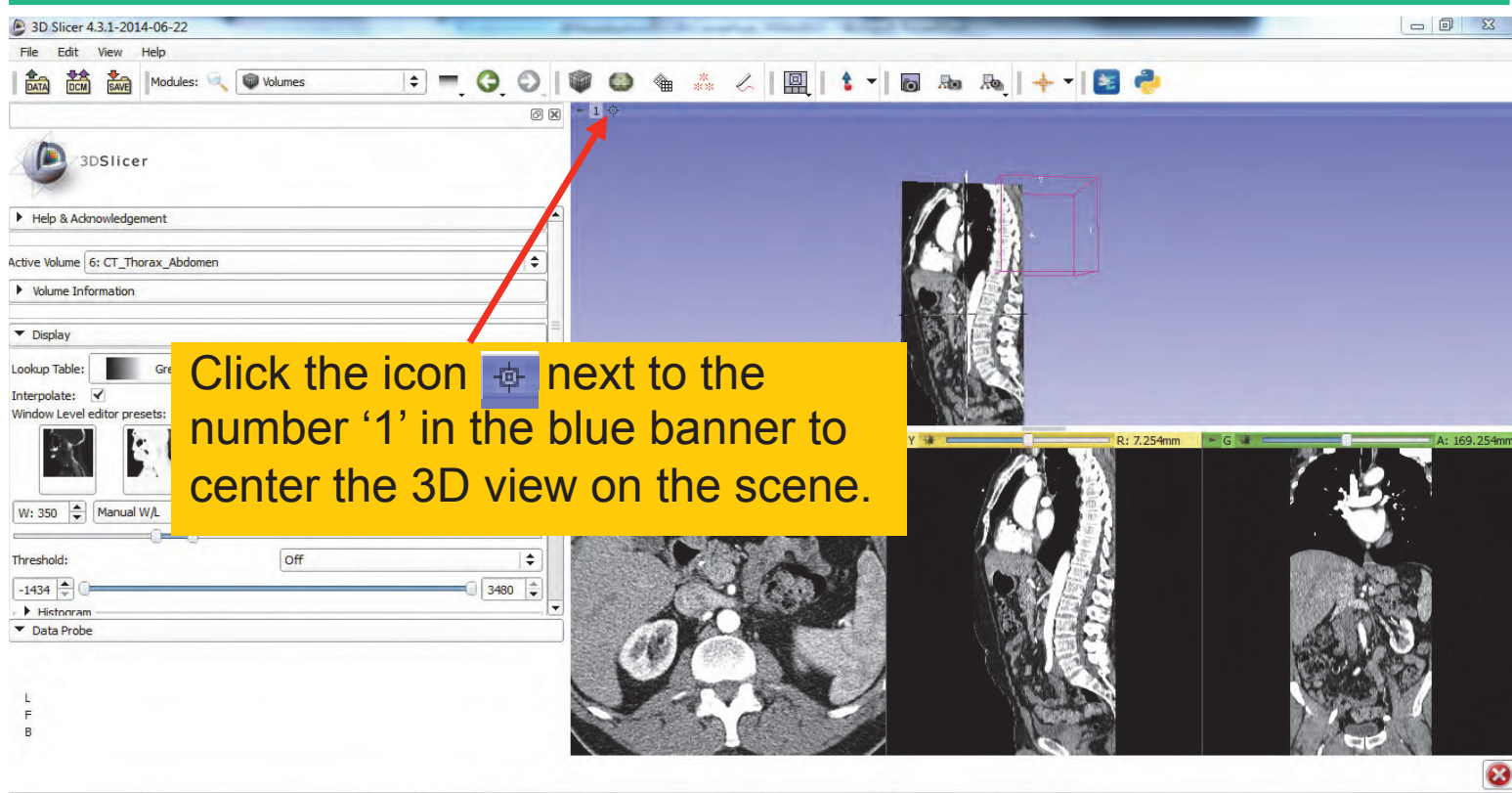


Loading a DICOM volume



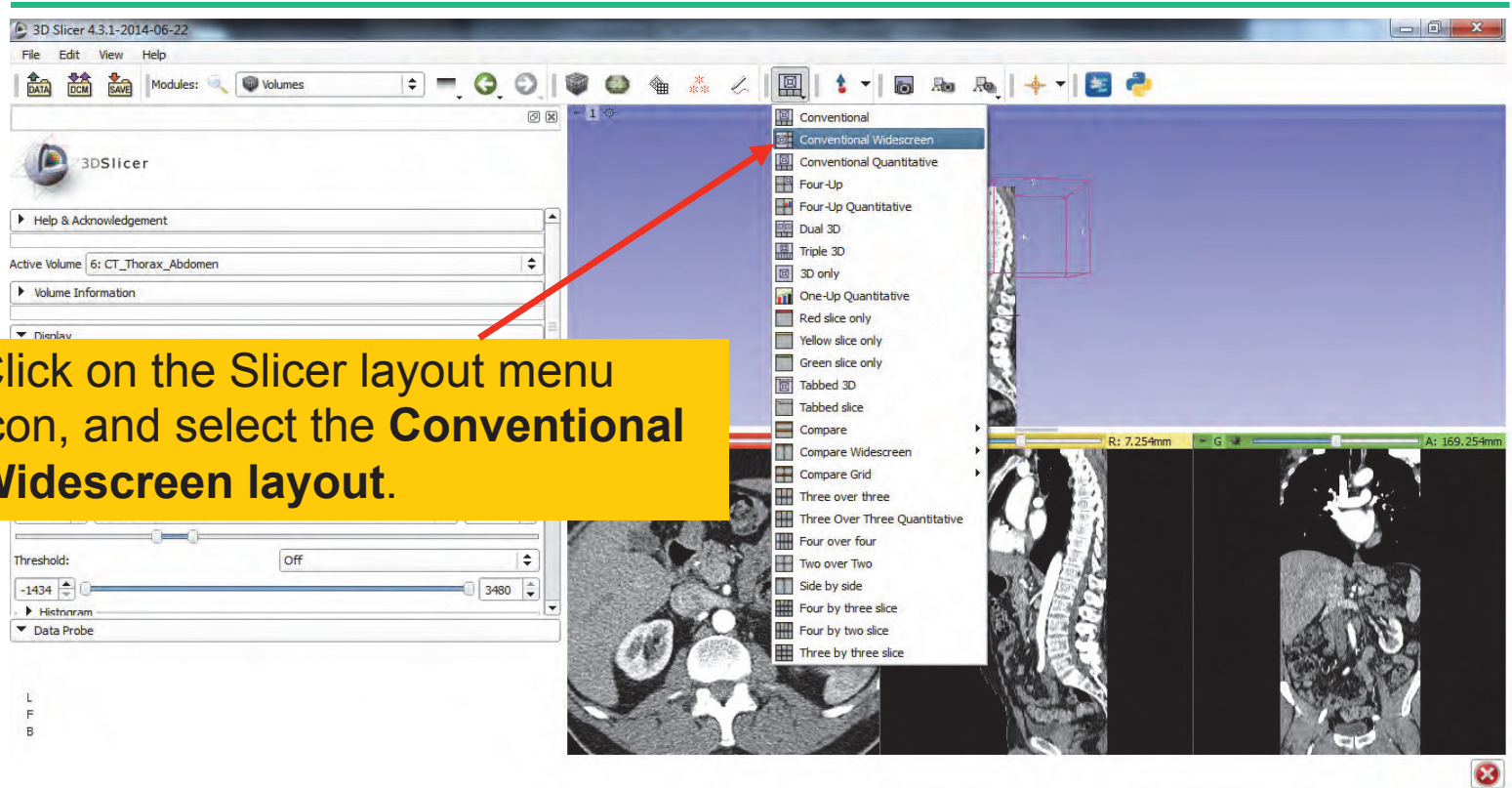


Loading a DICOM volume



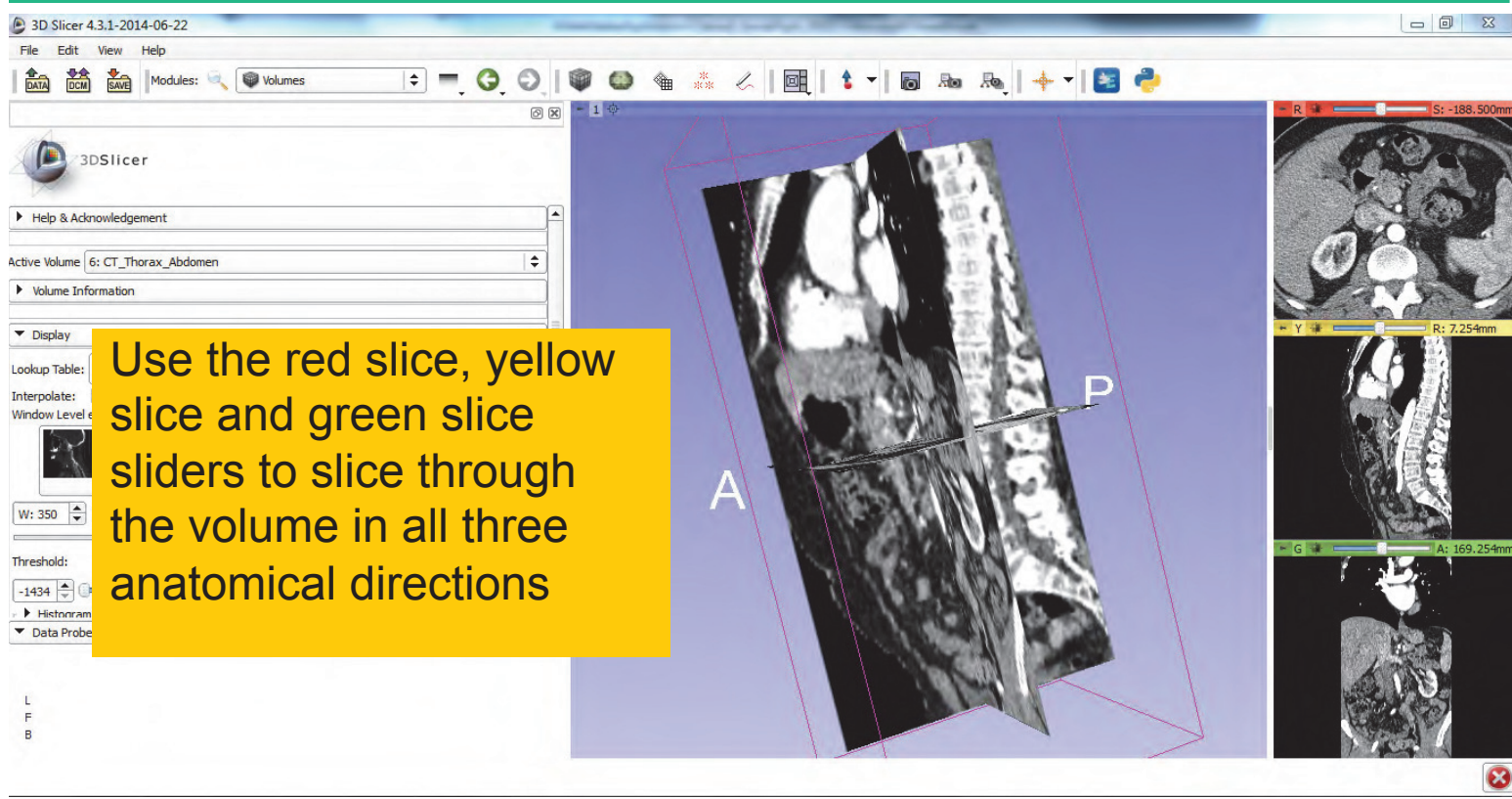


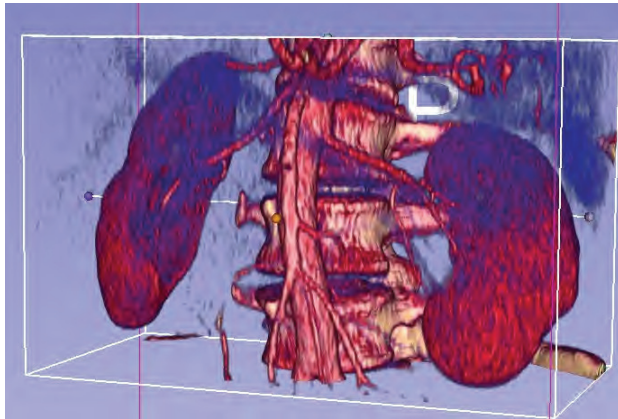
Loading a DICOM volume





Loading a DICOM volume

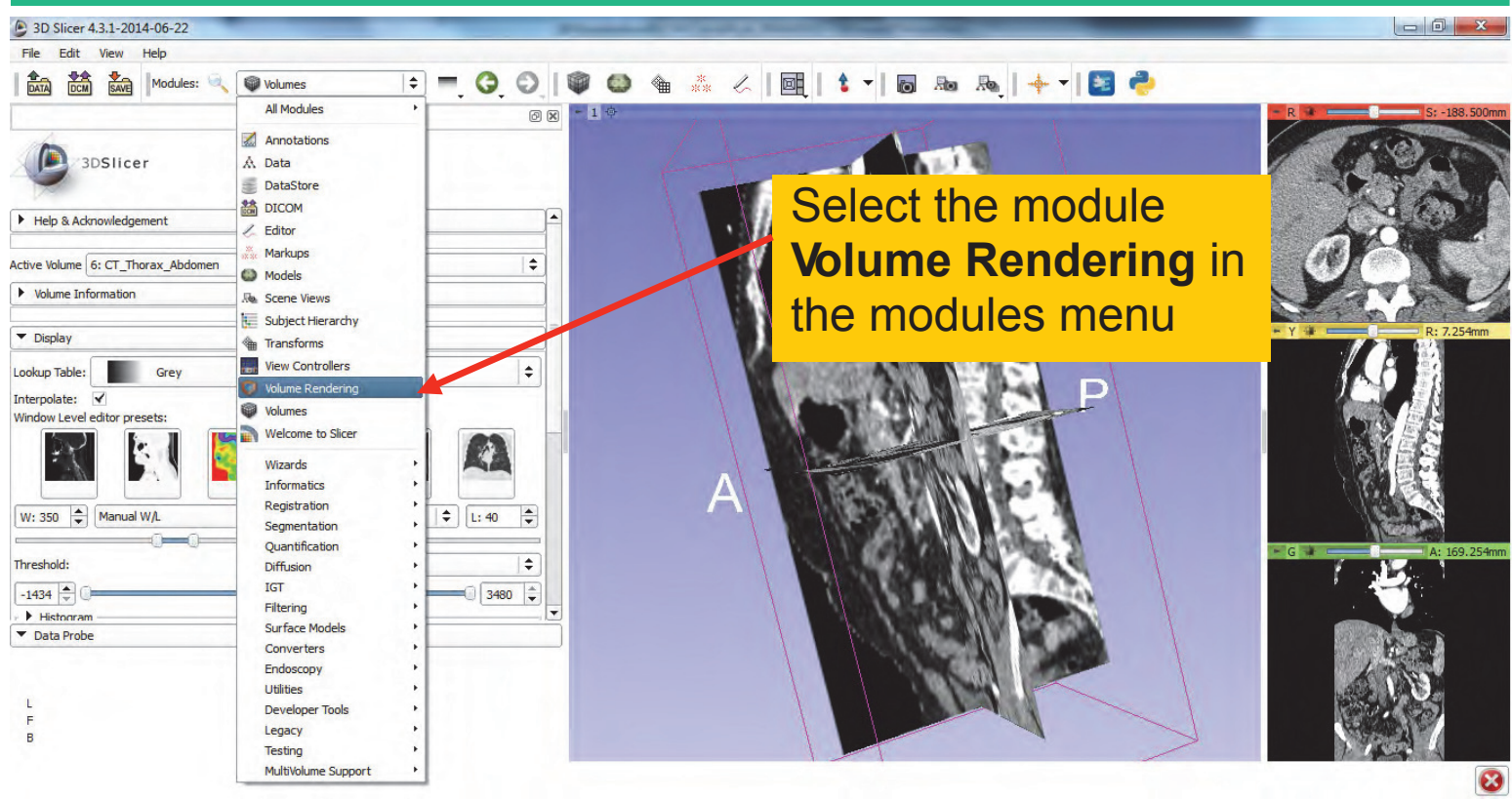




3D Interactive exploration of
thoraco-abdominal CT data
using Volume Rendering

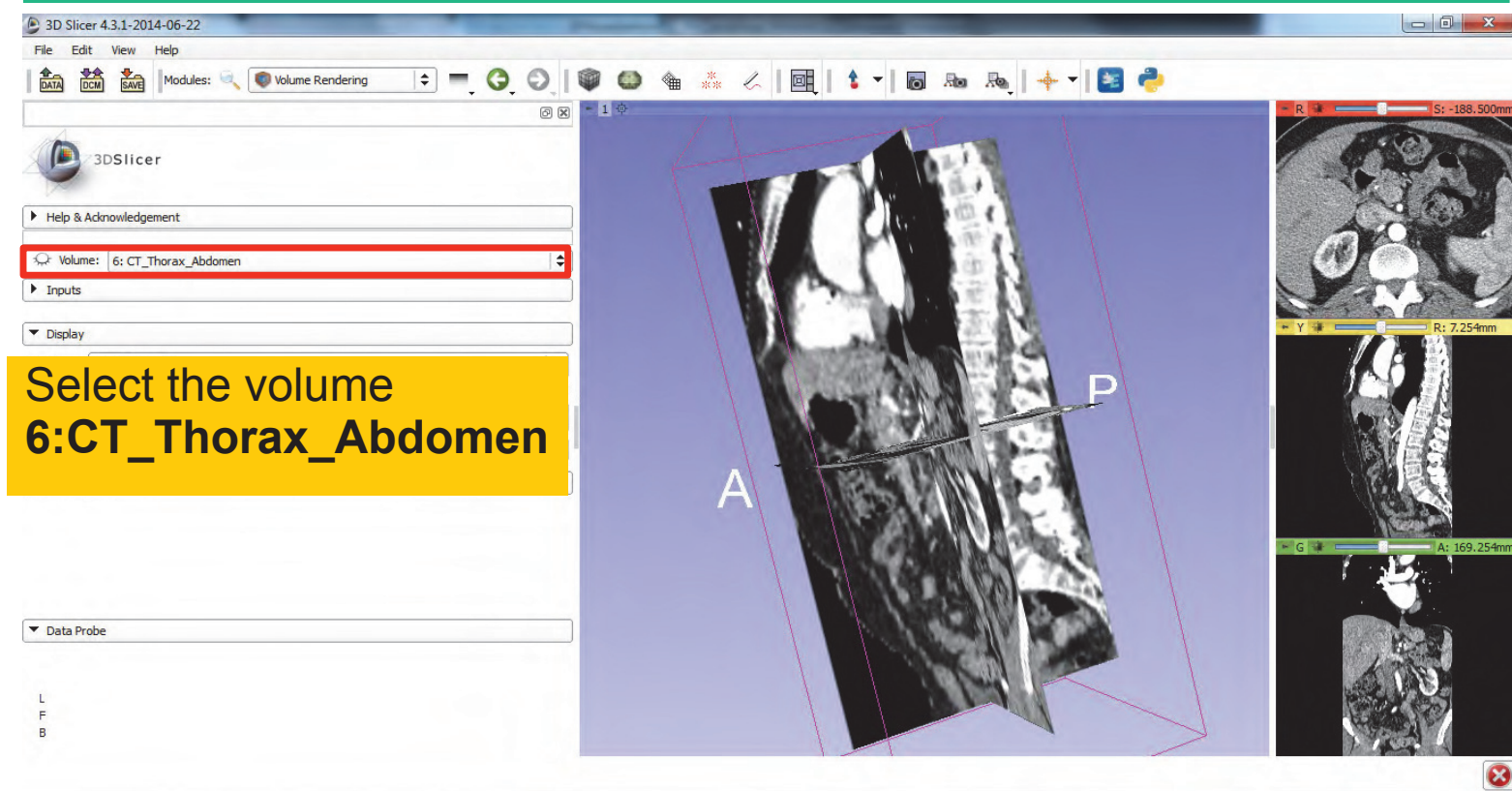


Volume Rendering



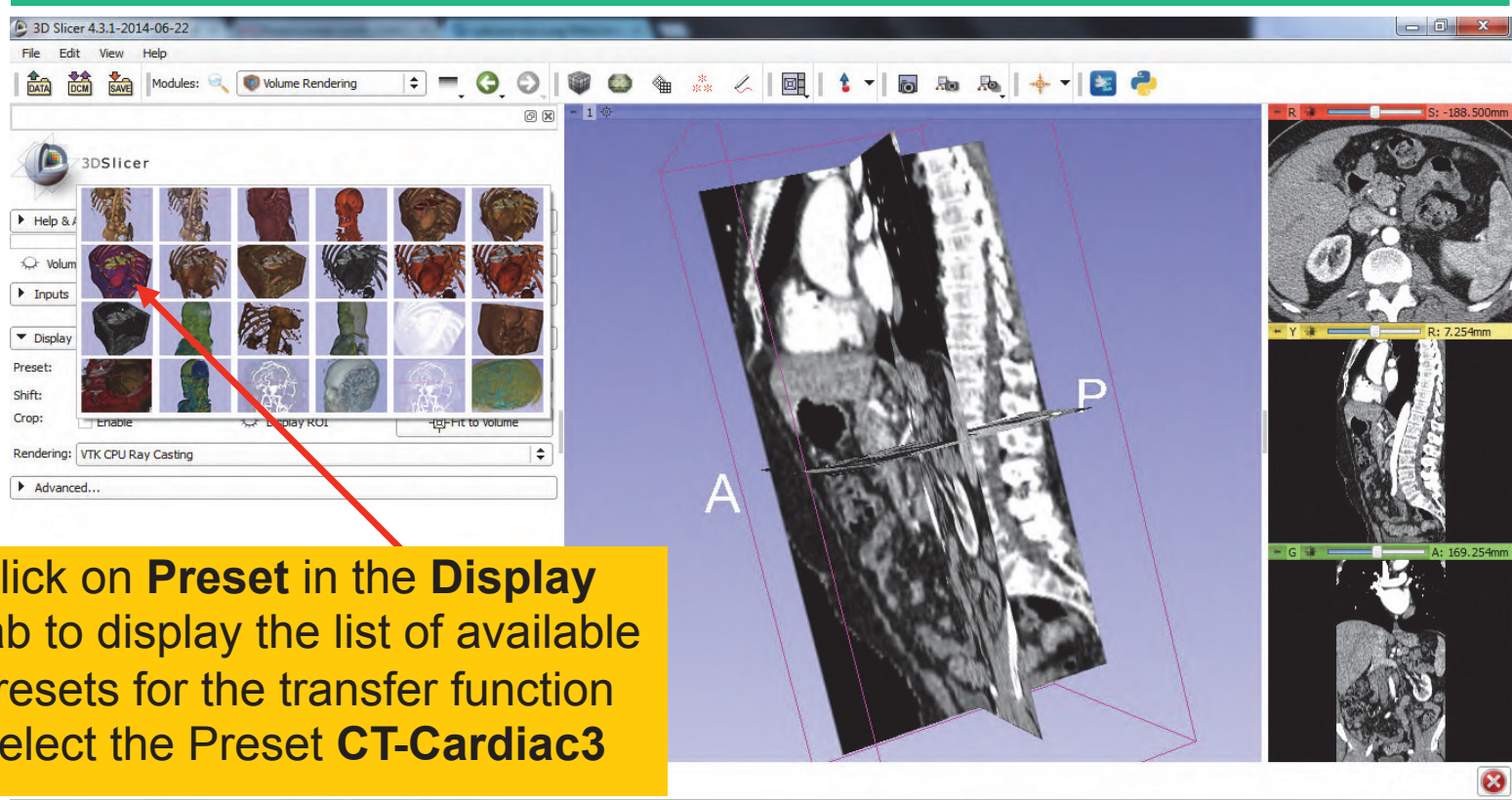


Volume Rendering





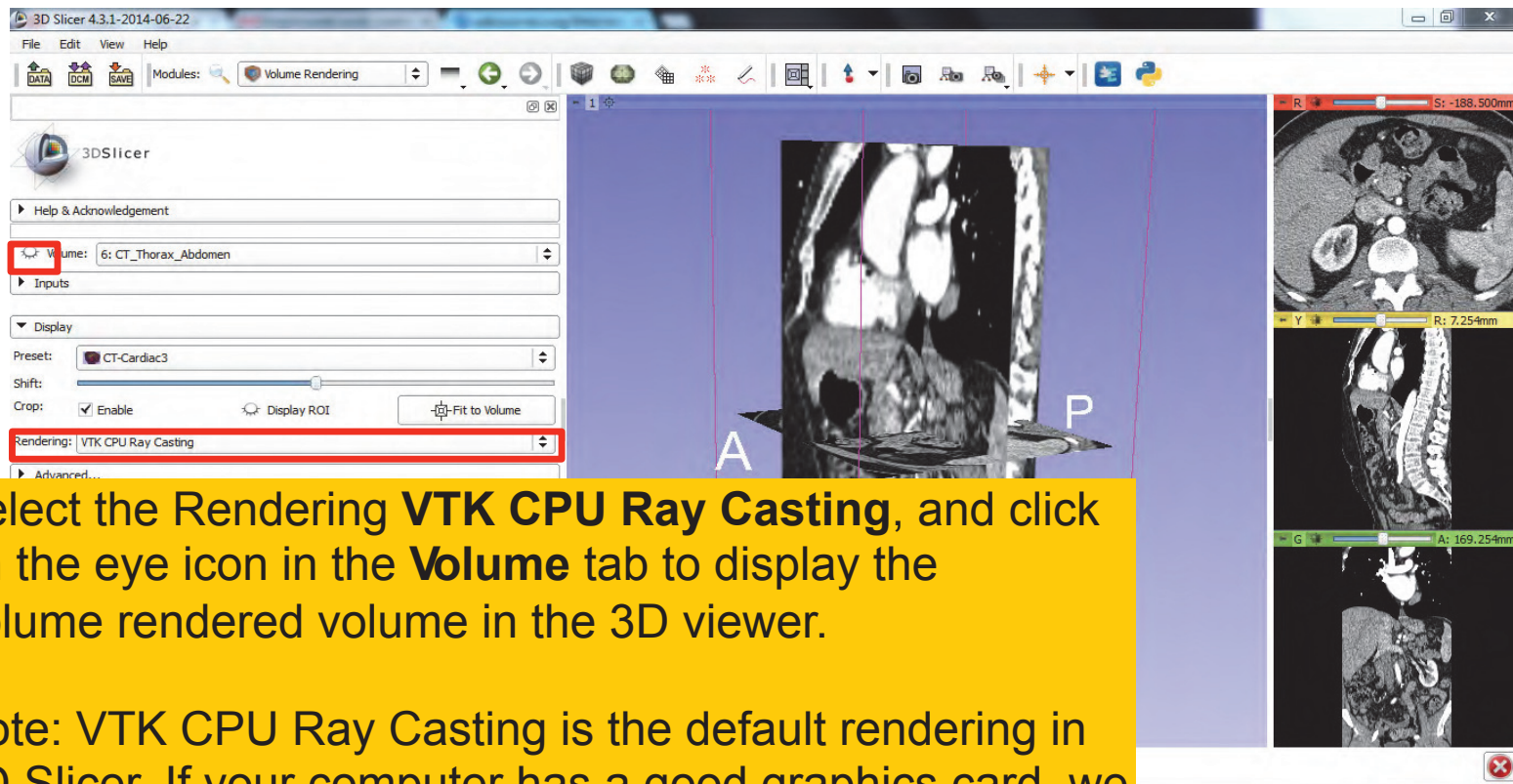
Volume Rendering



Click on **Preset** in the **Display** tab to display the list of available presets for the transfer function
Select the Preset **CT-Cardiac3**



Volume Rendering

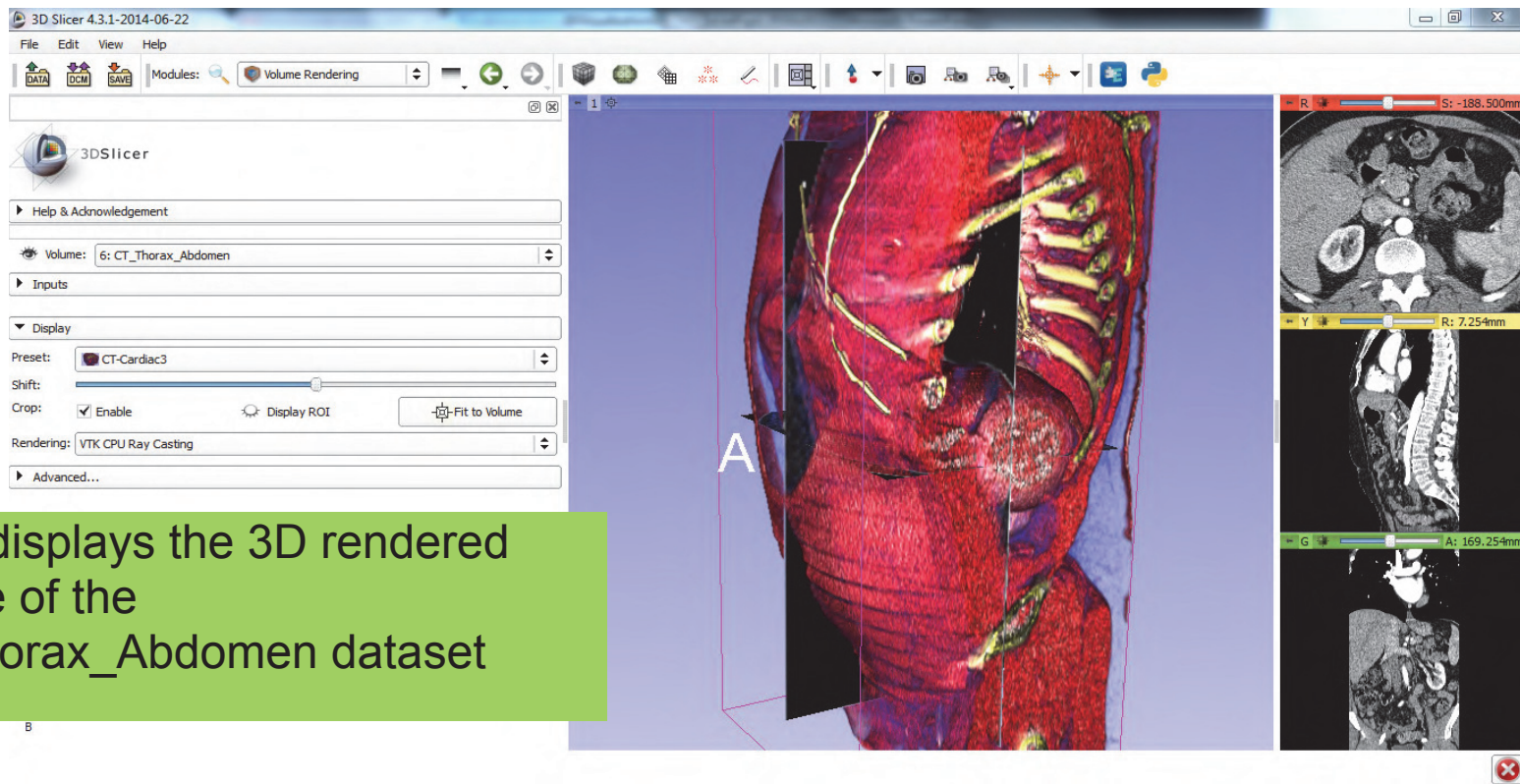


Select the Rendering **VTK CPU Ray Casting**, and click on the eye icon in the **Volume** tab to display the Volume rendered volume in the 3D viewer.

Note: VTK CPU Ray Casting is the default rendering in 3D Slicer. If your computer has a good graphics card, we recommend the **VTK GPU Ray Casting**

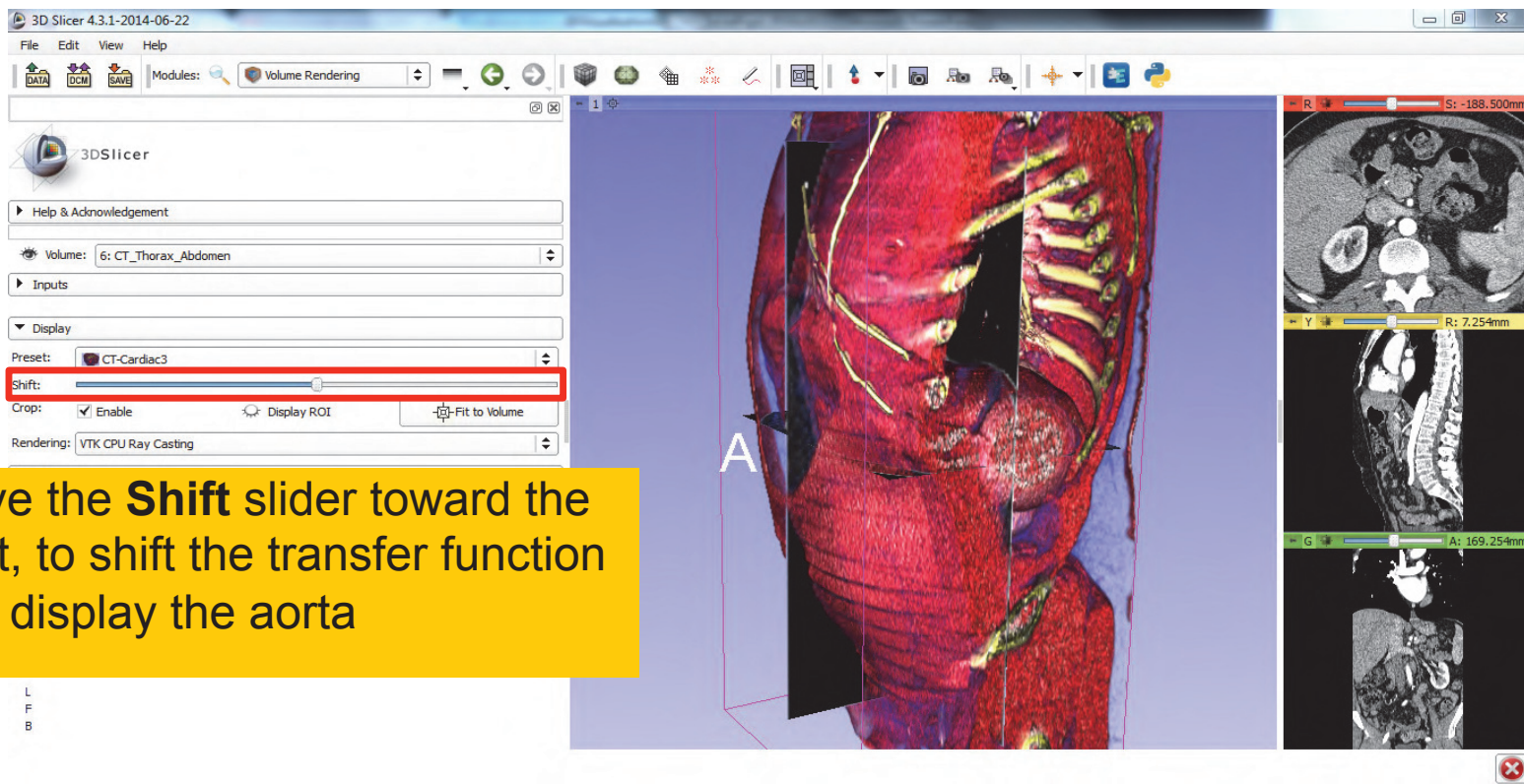


Volume Rendering





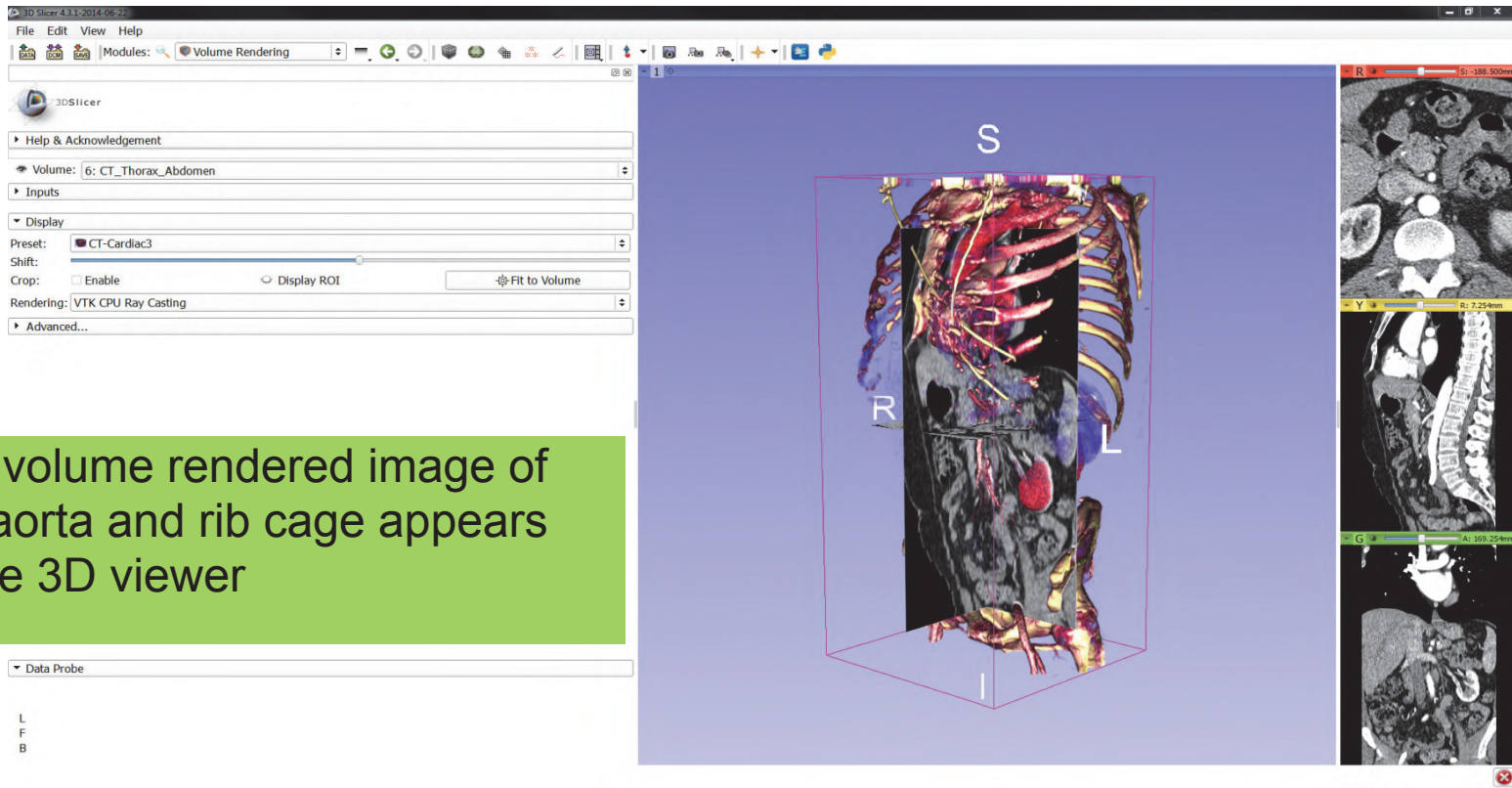
Volume Rendering



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



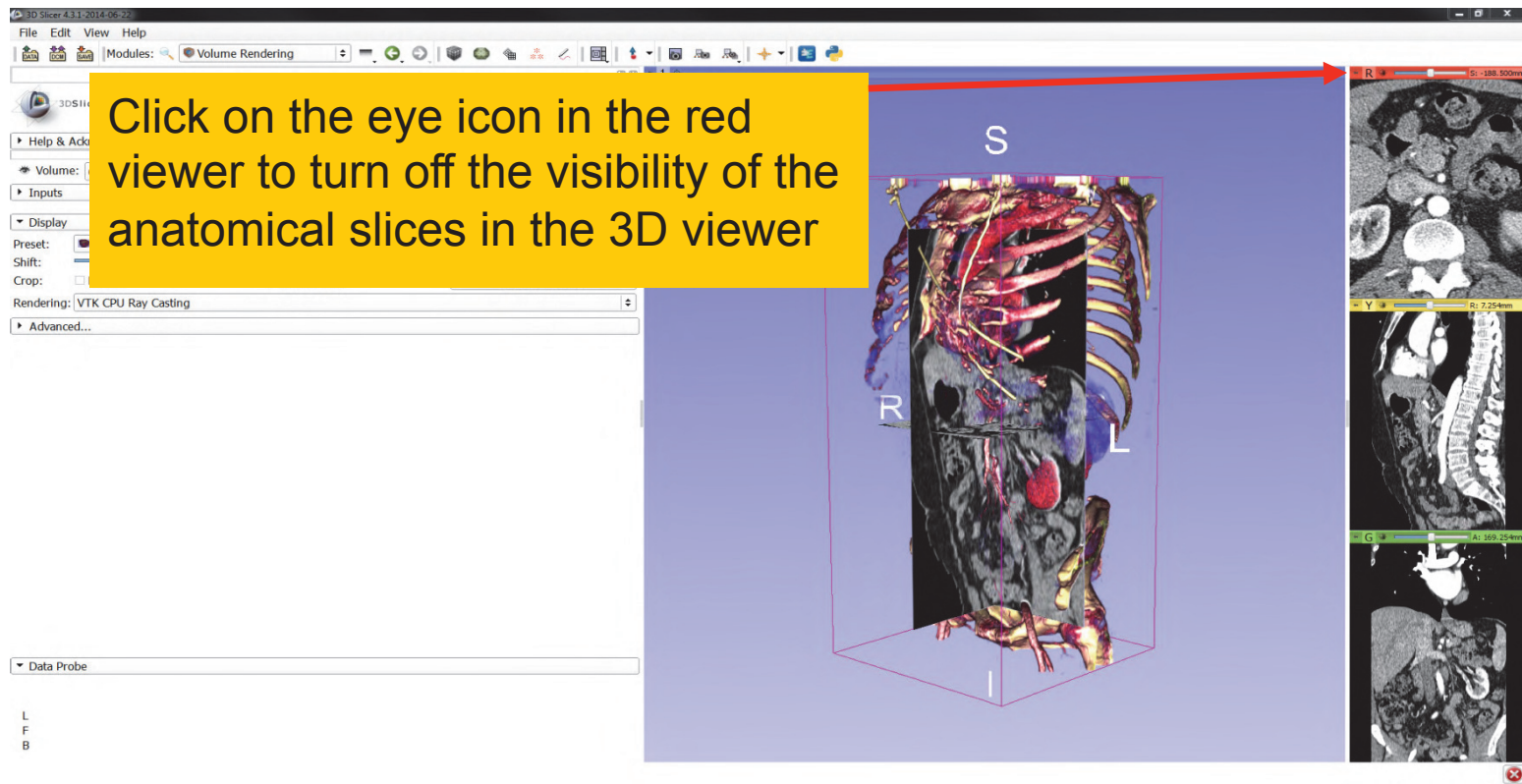
Volume Rendering



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

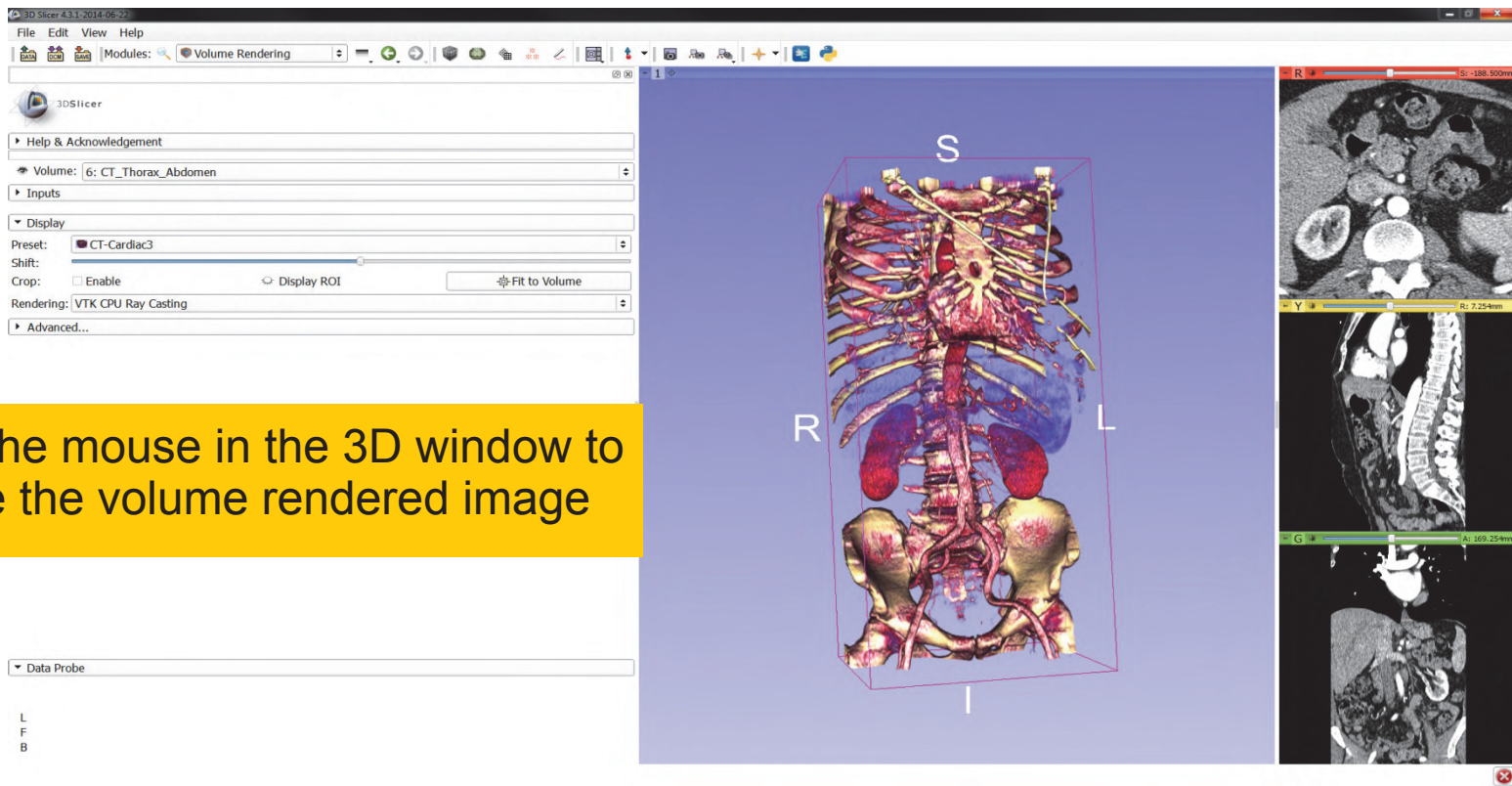


Volume Rendering



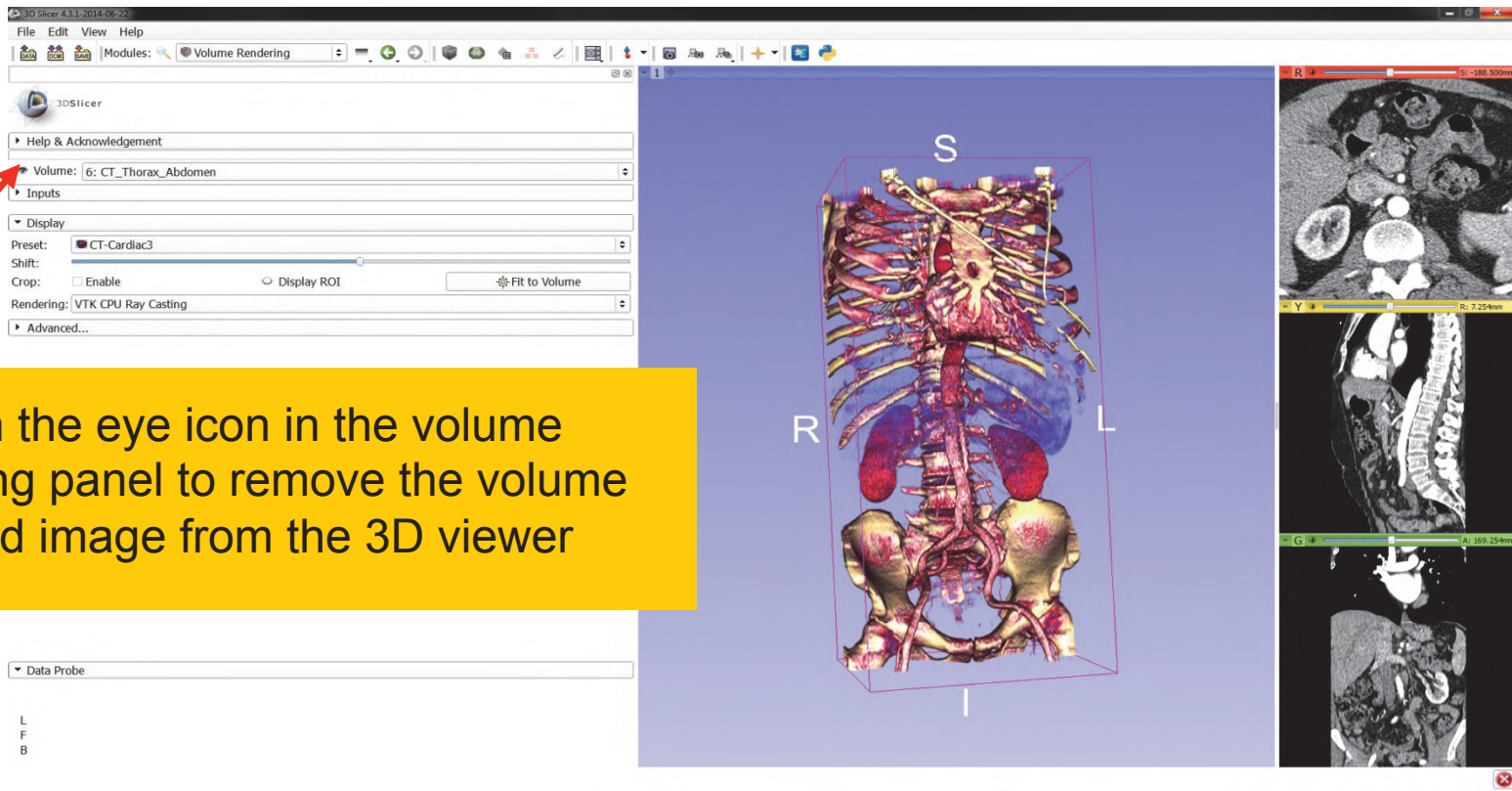


Volume Rendering





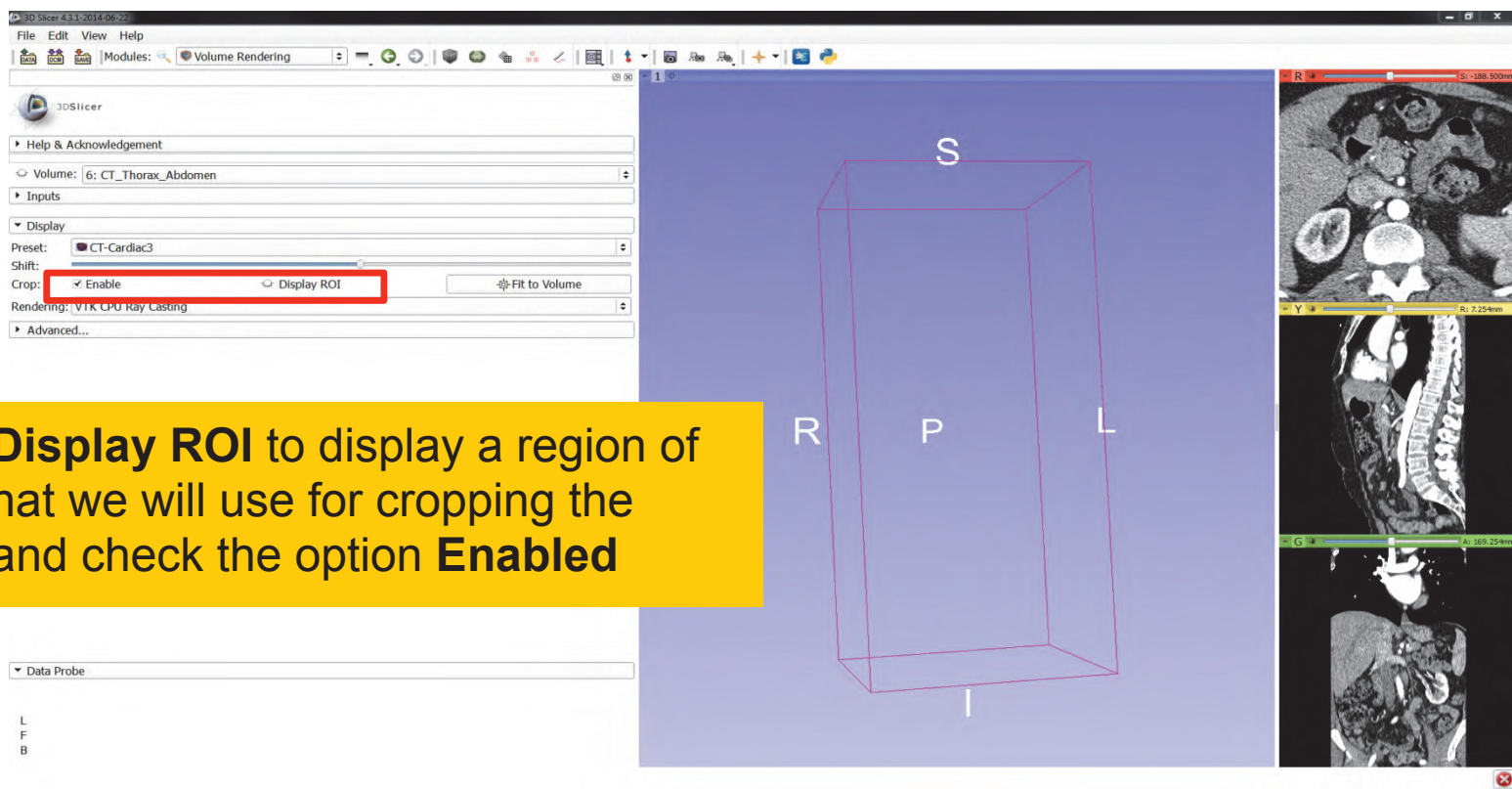
Volume Rendering



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



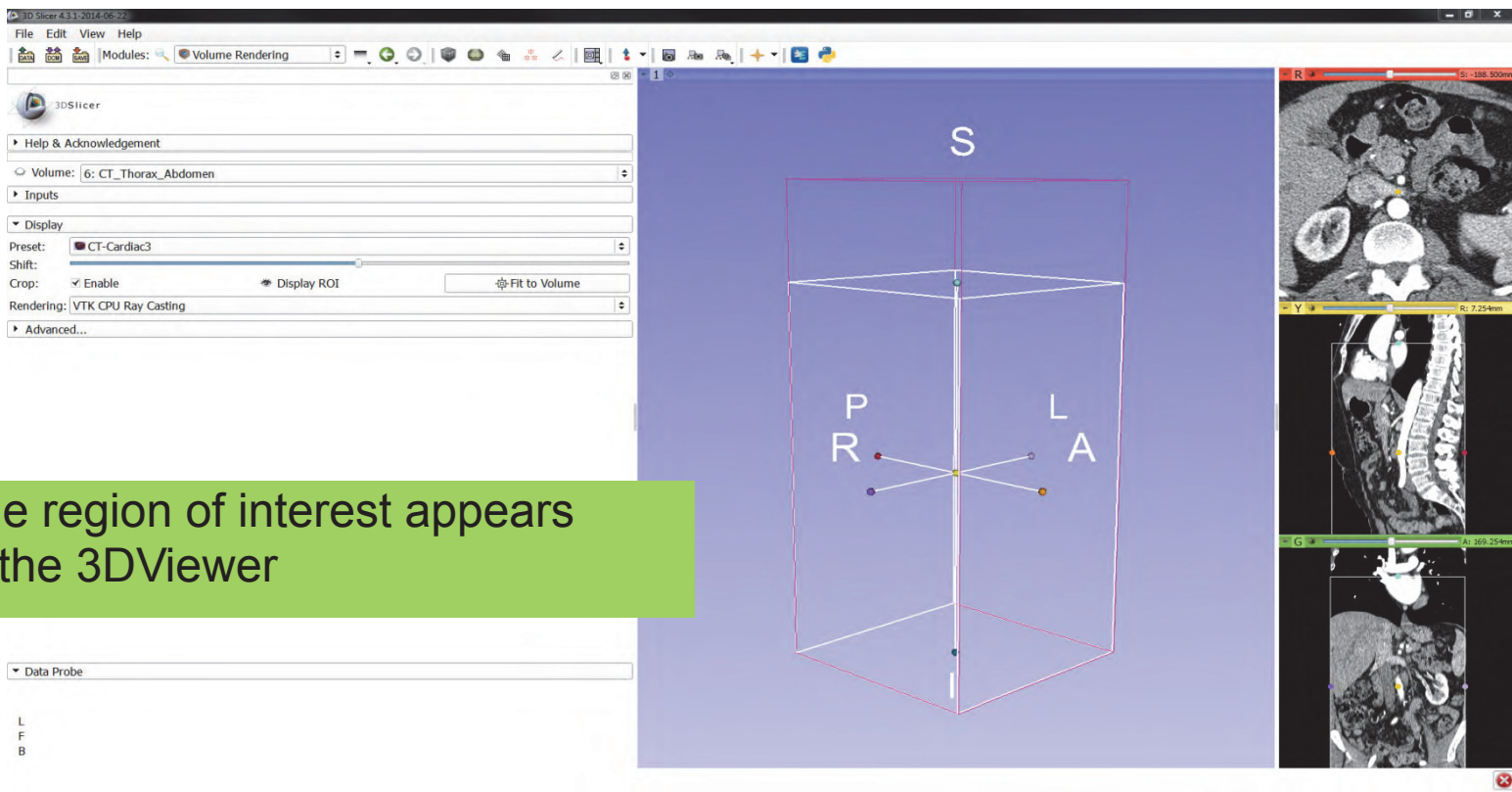
Volume Rendering



Click on **Display ROI** to display a region of interest that we will use for cropping the dataset, and check the option **Enabled**

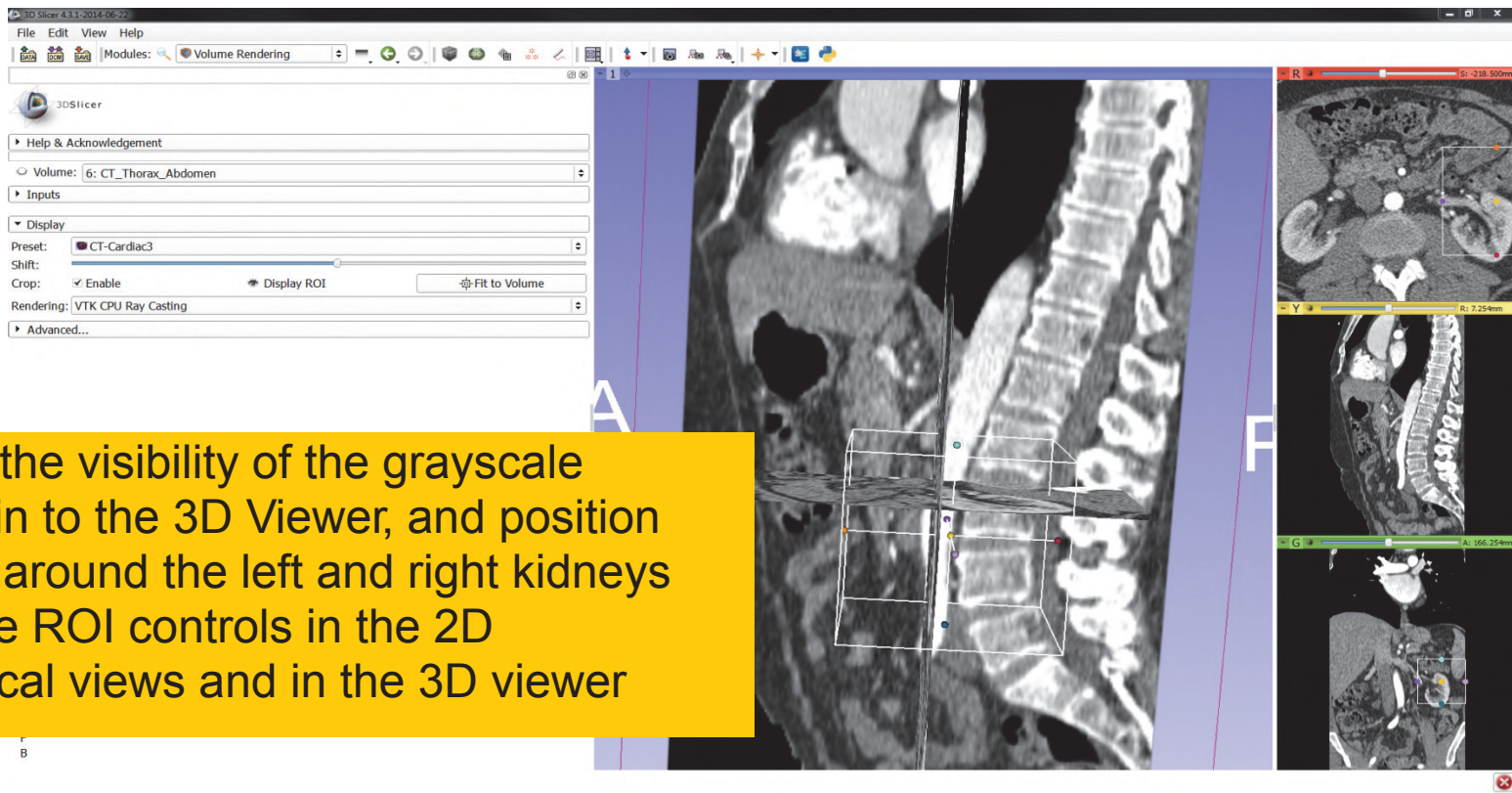


Volume Rendering





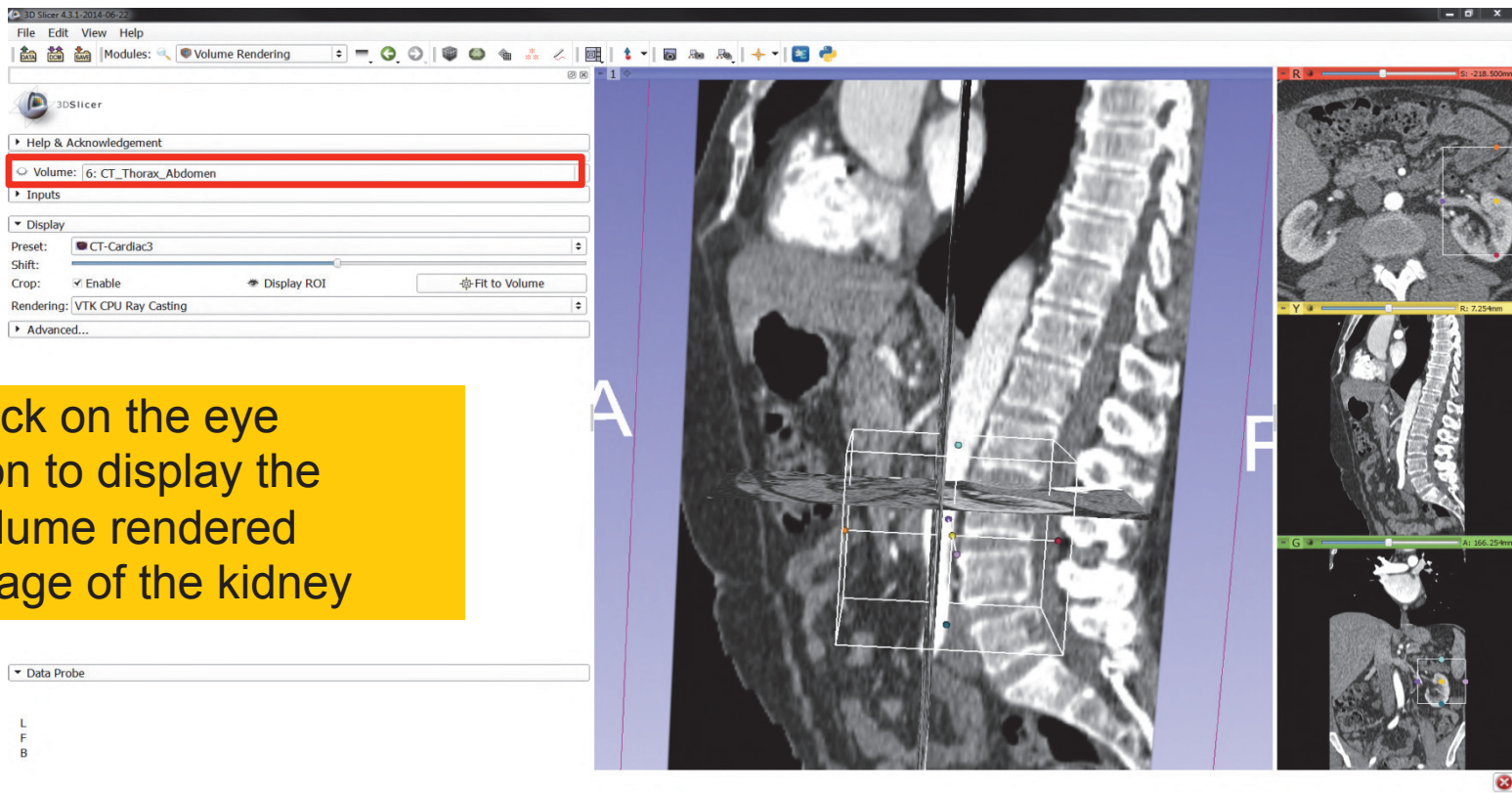
Volume Rendering



Turn on the visibility of the grayscale images in to the 3D Viewer, and position the ROI around the left and right kidneys using the ROI controls in the 2D anatomical views and in the 3D viewer



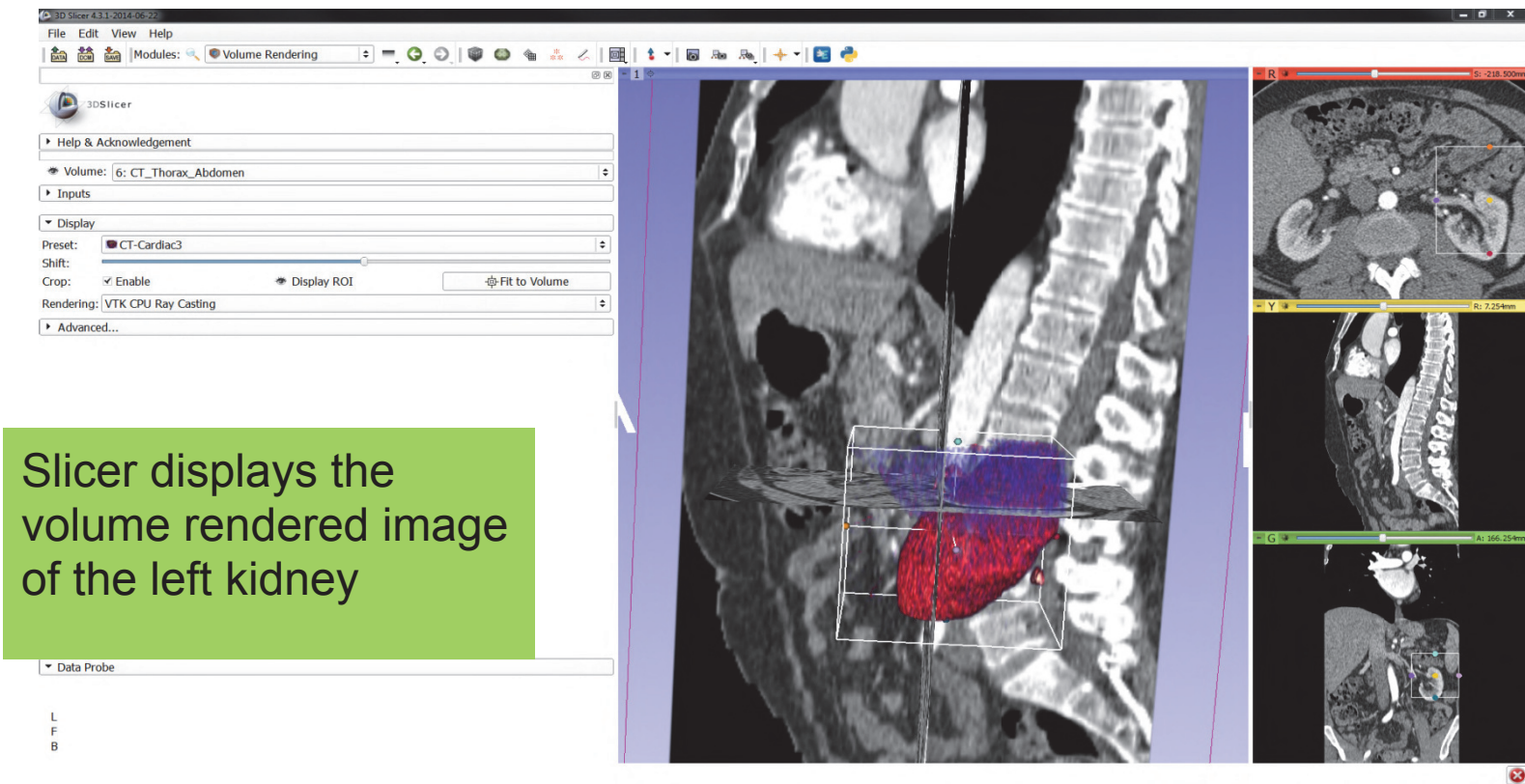
Volume Rendering



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

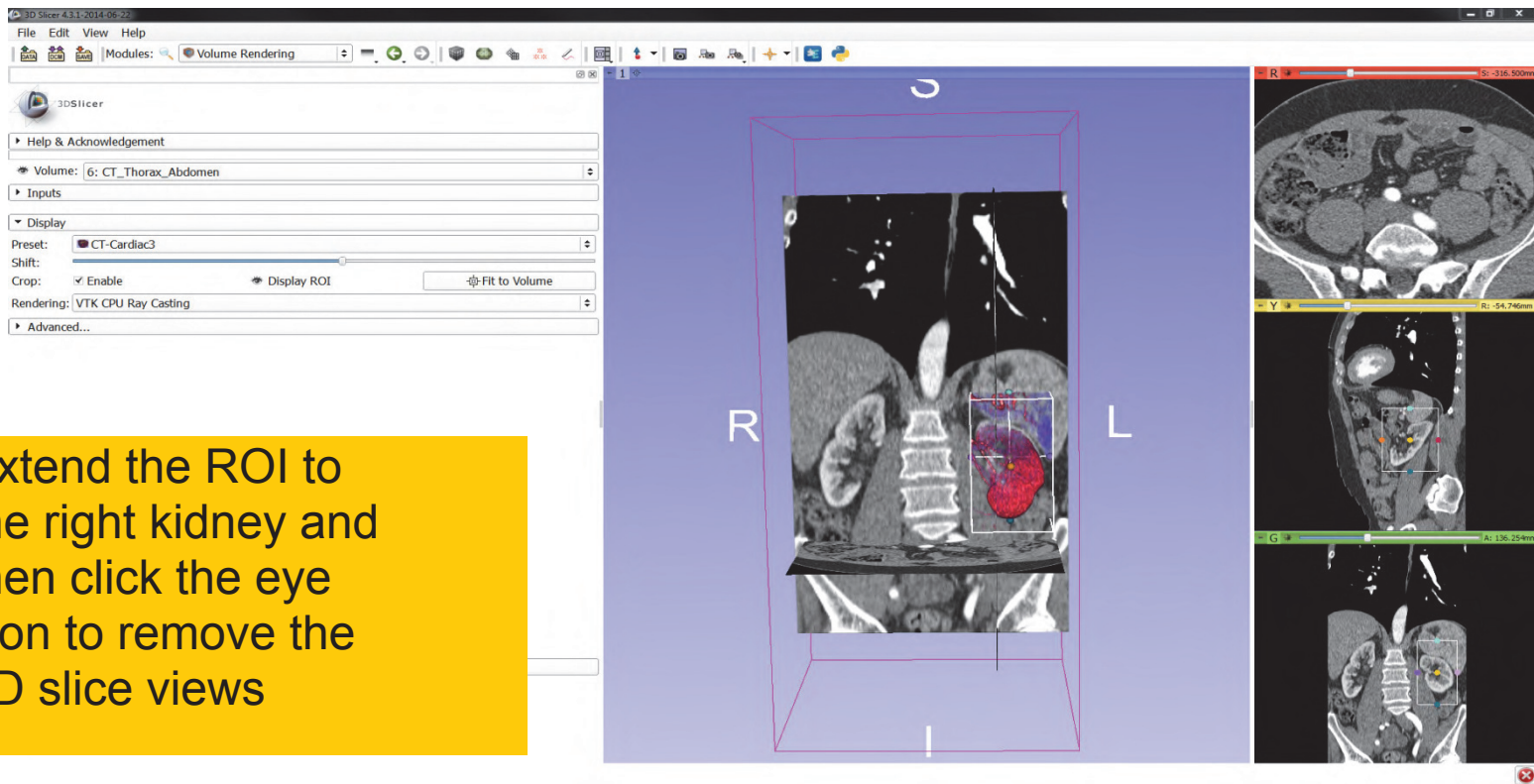


Volume Rendering





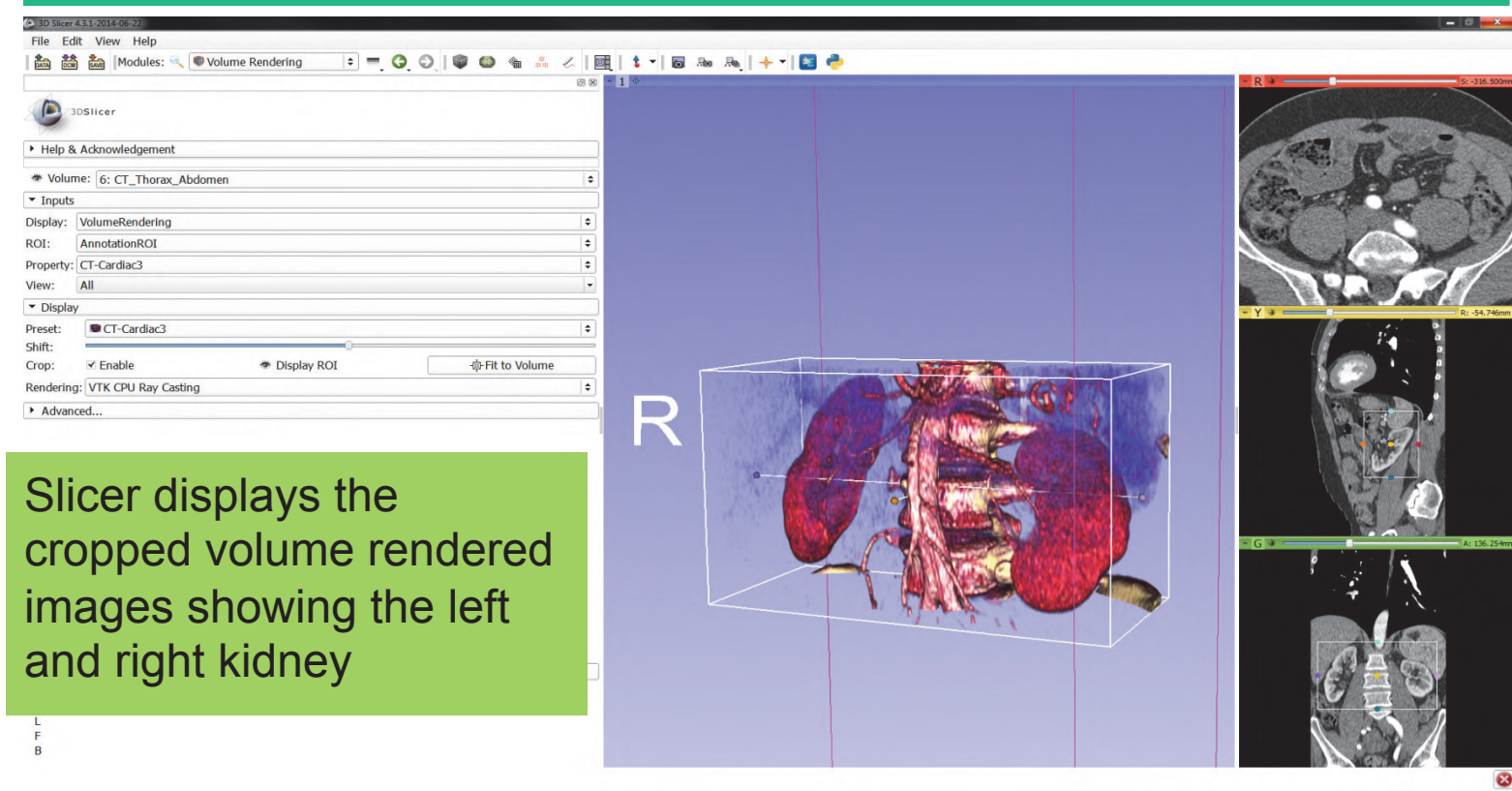
Volume Rendering



Extend the ROI to the right kidney and then click the eye icon to remove the 2D slice views

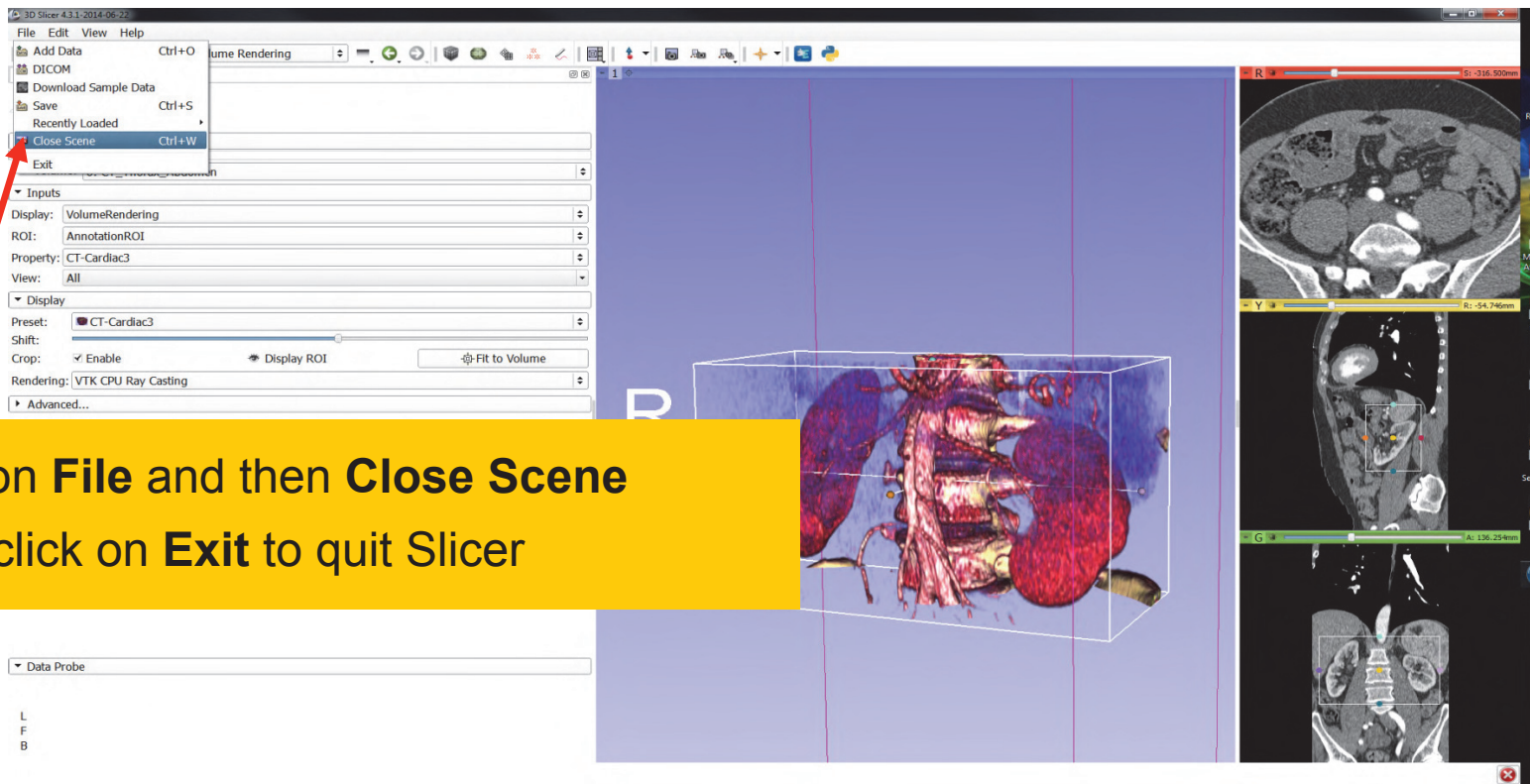


Volume Rendering



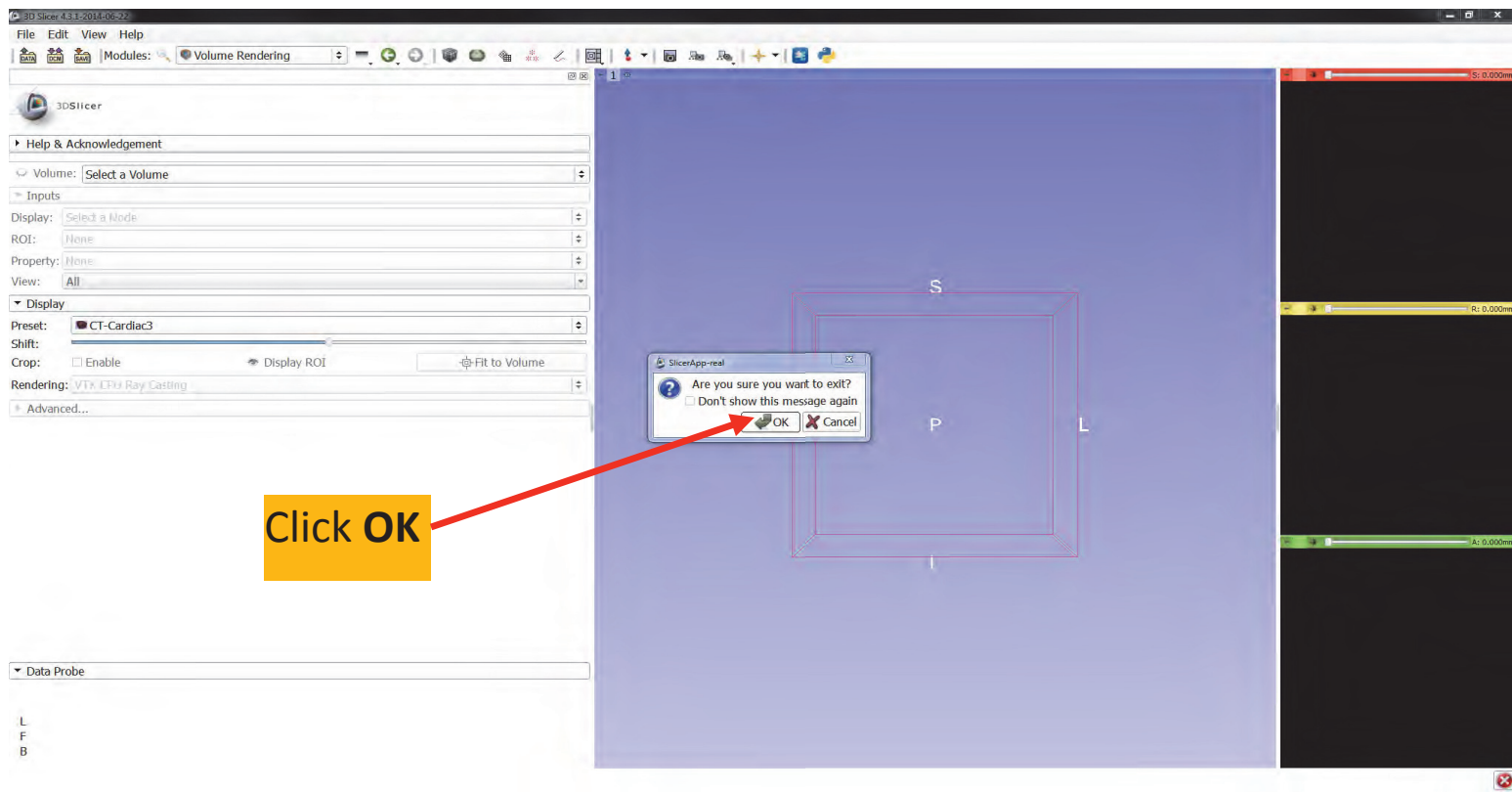


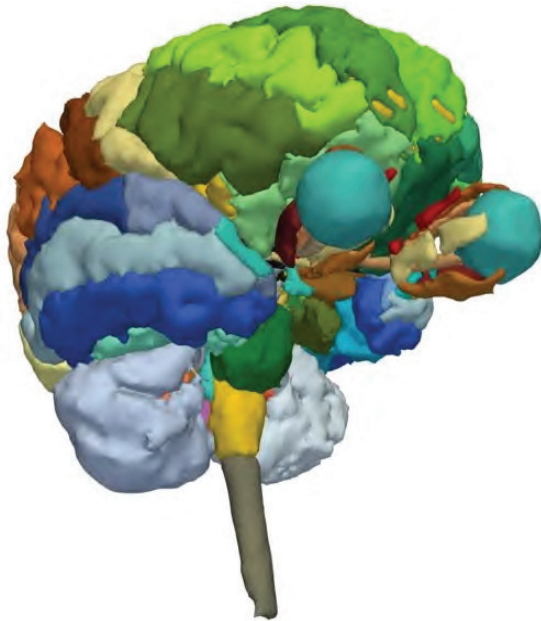
Volume Rendering





Volume Rendering

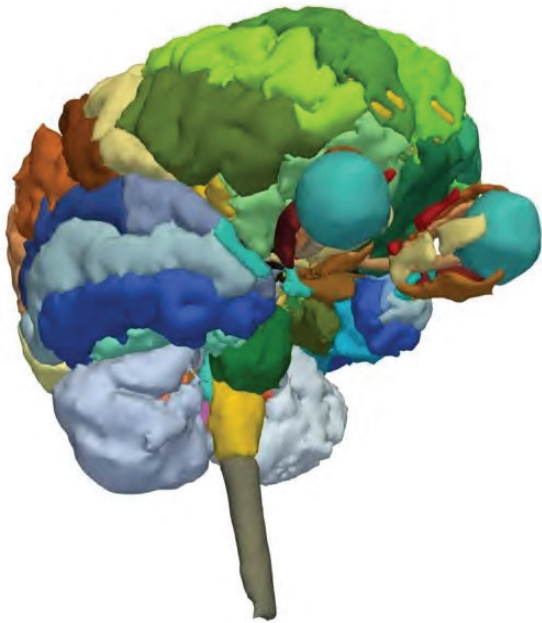




3D visualization of surface models of the brain



3D Data Loading and Visualization

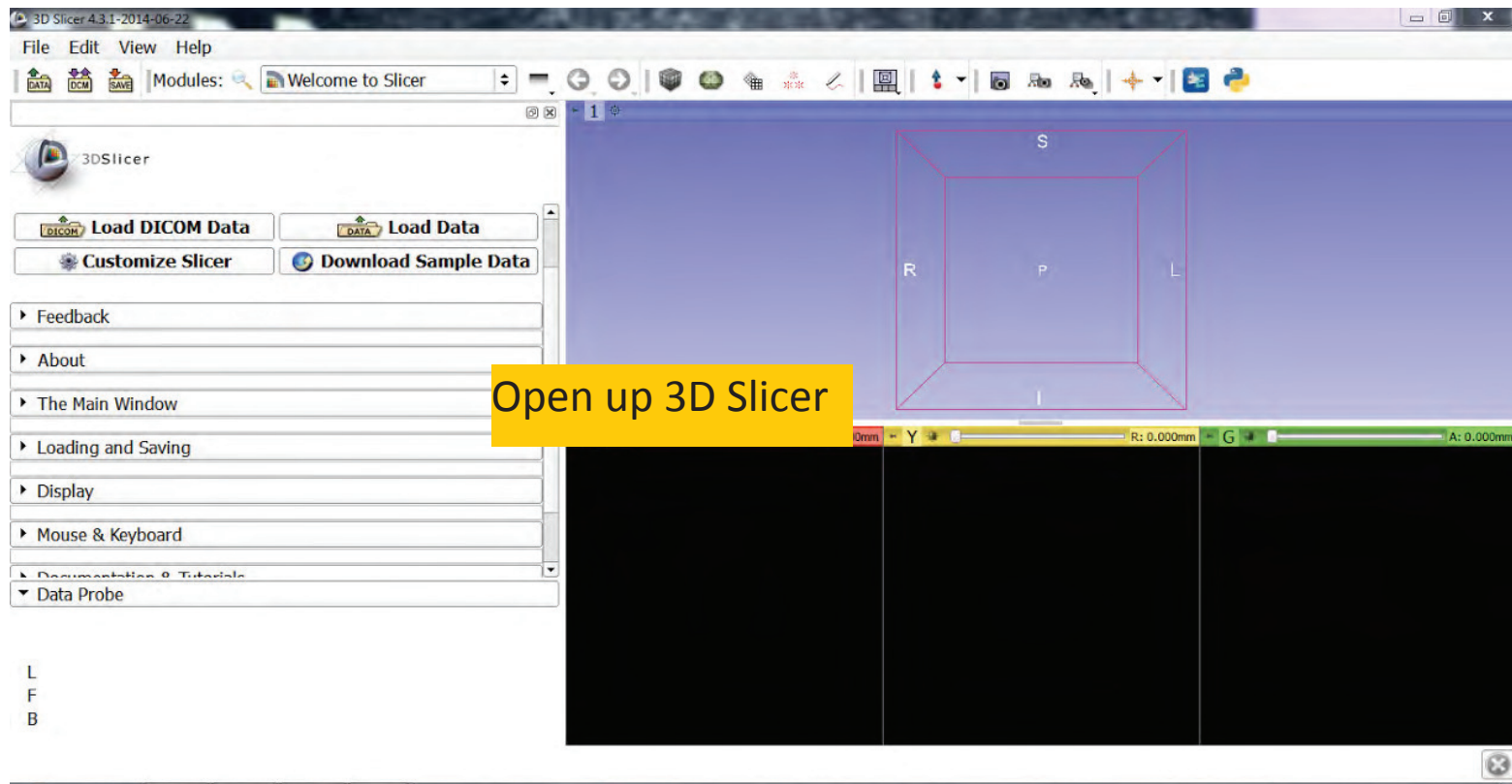


- This tutorial is a short introduction to the advanced **3D visualization capabilities Slicer**
- The Slicer4 Minute dataset is composed of an MR scan of the brain and 3D surface reconstructions of anatomical structures.
- The data are part of the **SPL Multi-modality MRI-based atlas of the brain** by Halle et al. The atlas is available at:

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

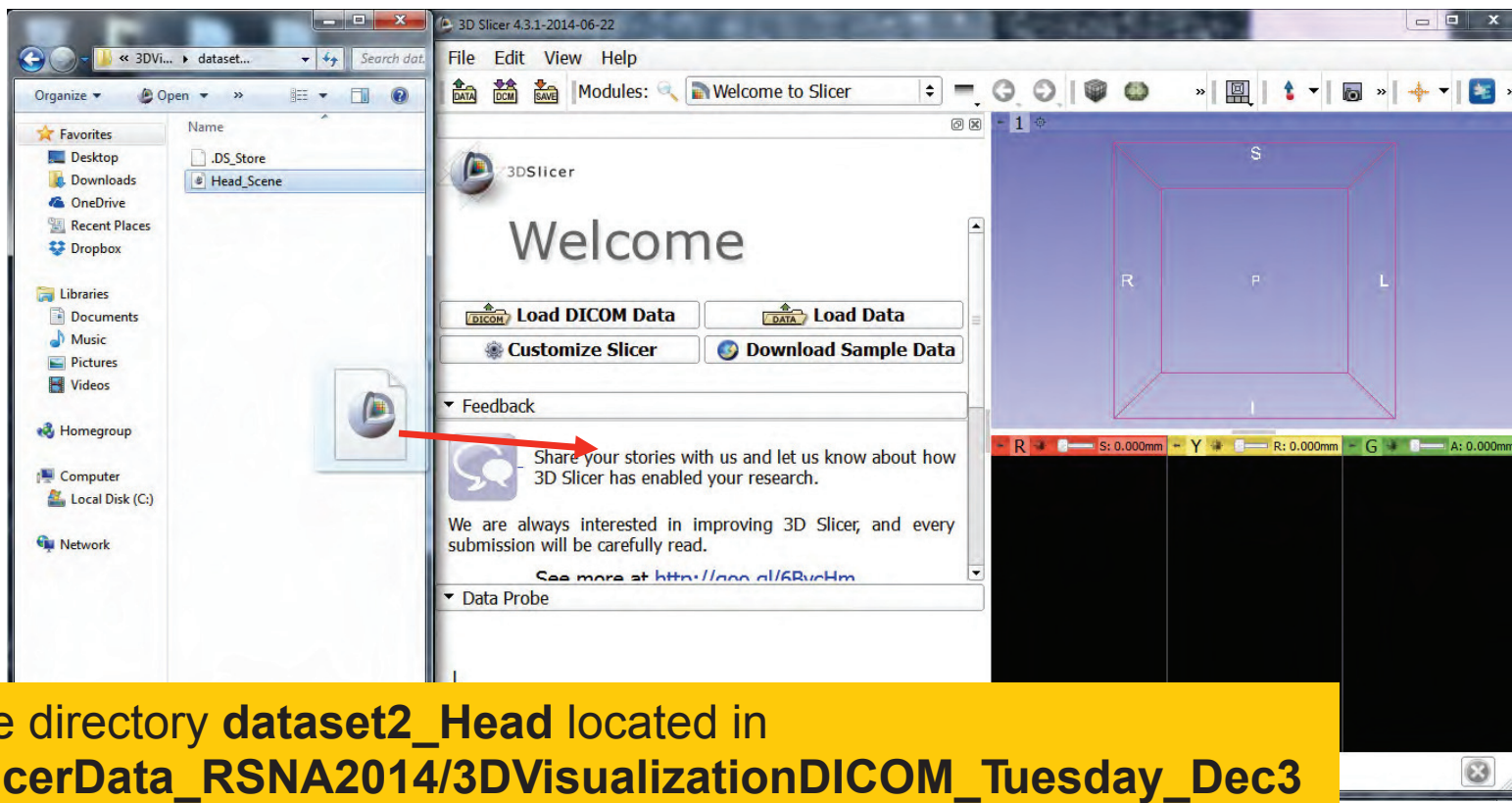


Welcome to Slicer4





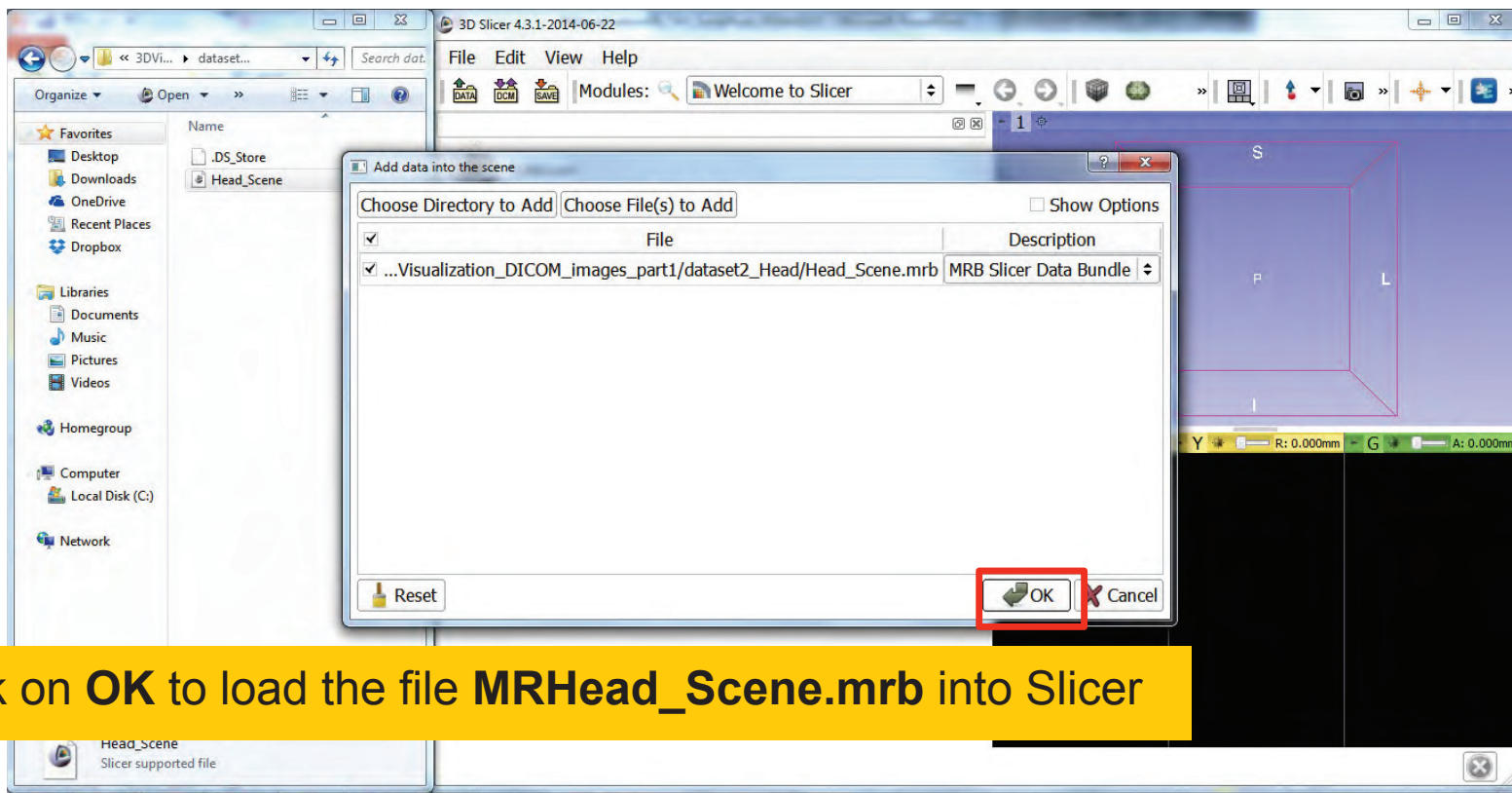
Slicer4 Minute Tutorial: Viewing the Scene



Open the directory **dataset2_Head** located in **C:/3DSlicerData_RSNA2014/3DVisualizationDICOM_Tuesday_Dec3** and drop the file **Head_Scene.mrb** into Slicer



Slicer4 Minute Tutorial: Viewing the Scene



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

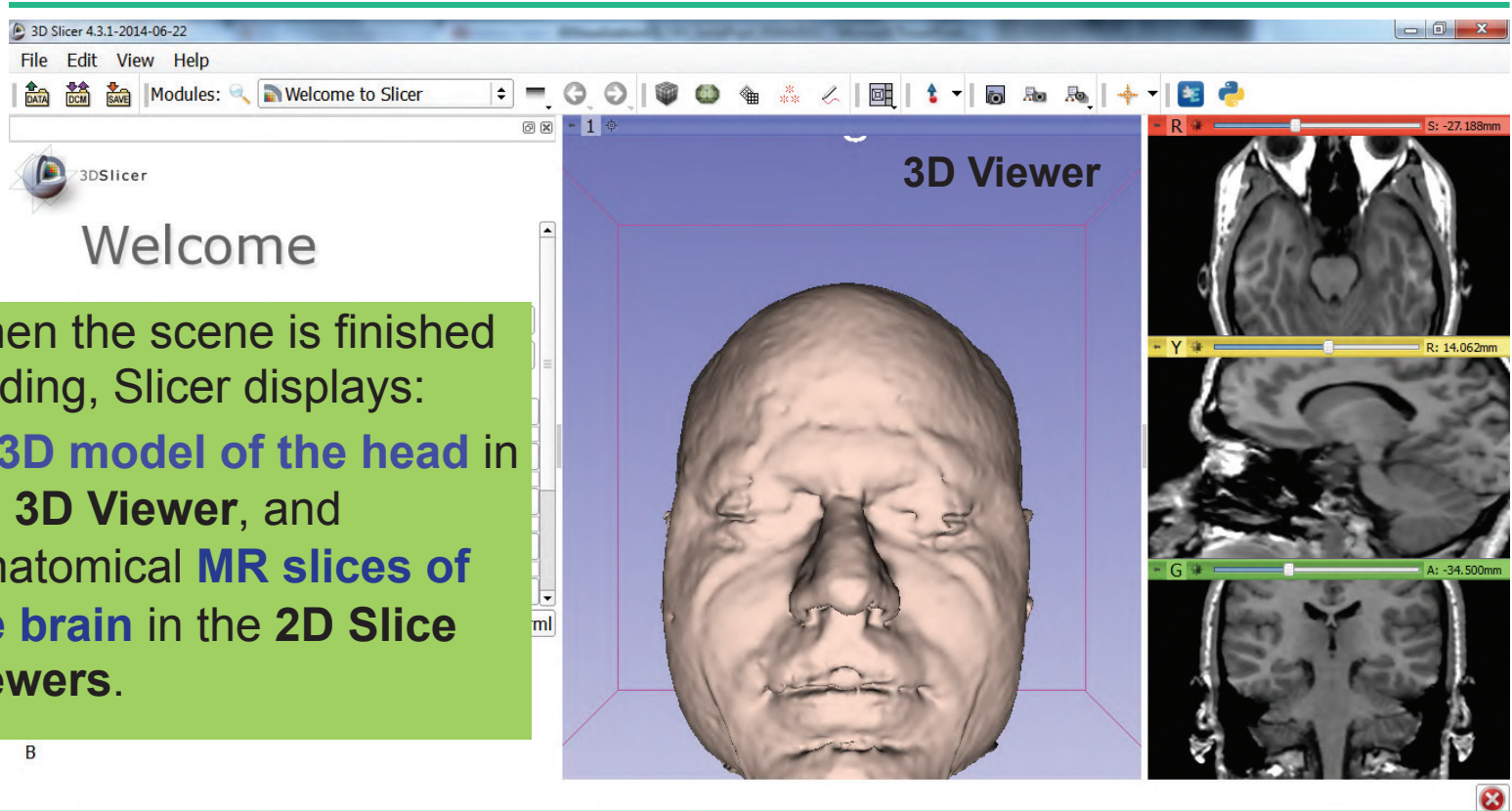


Slicer4 Minute Tutorial: Viewing the Scene

When the scene is finished loading, Slicer displays:

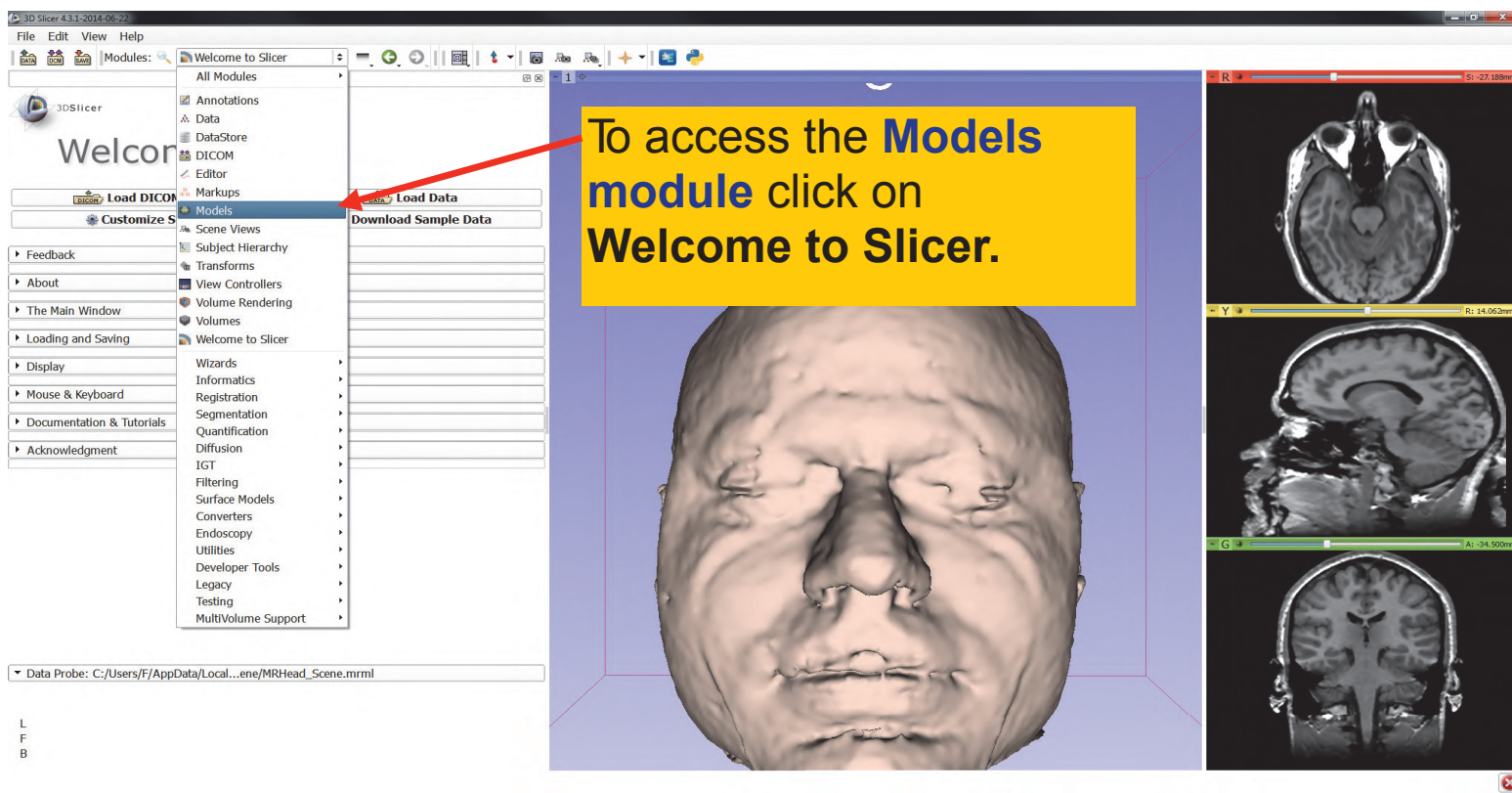
- a **3D model of the head** in the **3D Viewer**, and
- anatomical **MR slices of the brain** in the **2D Slice Viewers**.

B



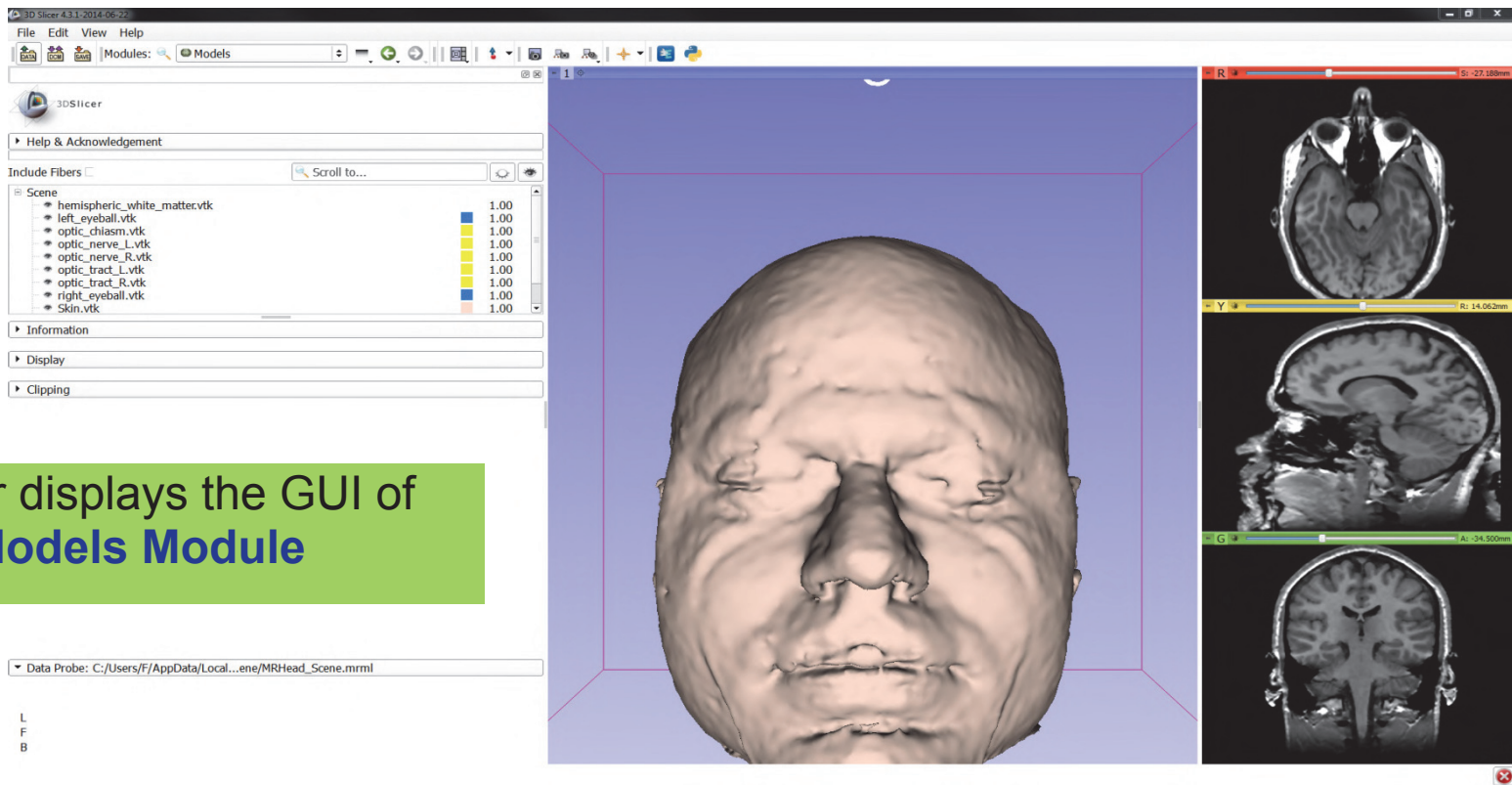


Slicer4 Minute Tutorial: Exploring Slicer's functionality





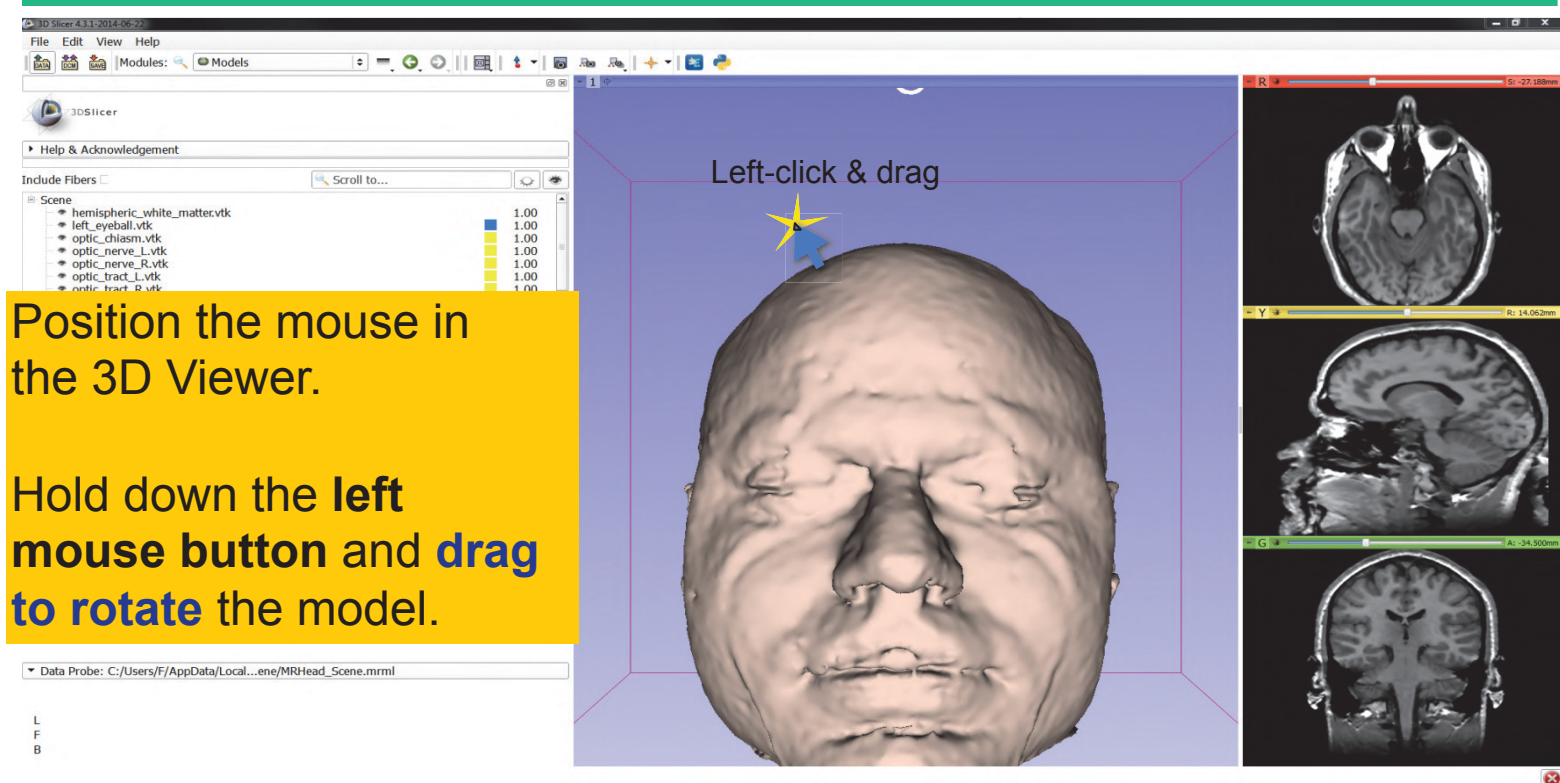
Slicer4 Minute Tutorial: Switching to the Models Module



Slicer displays the GUI of the **Models Module**

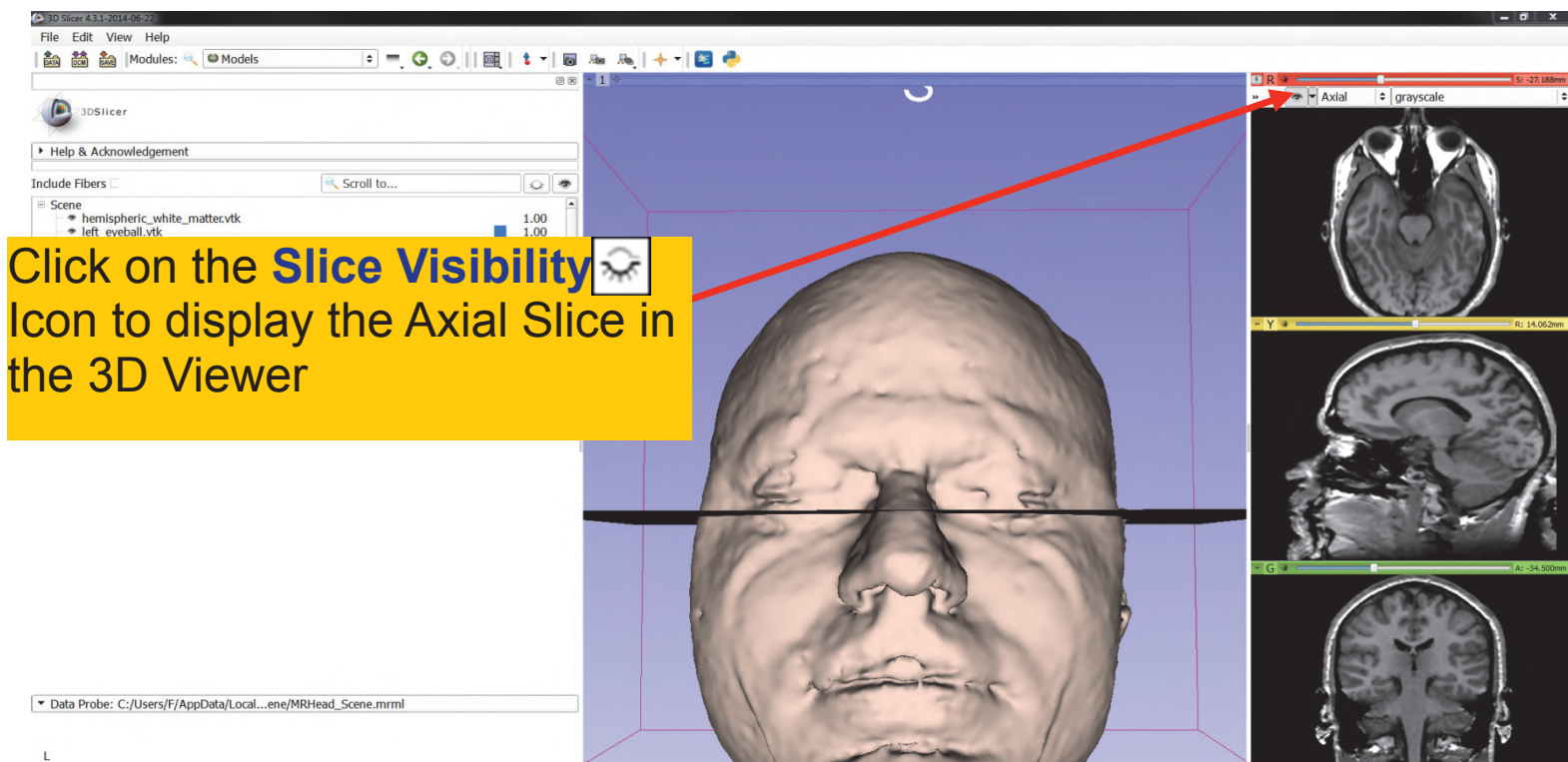


Slicer4 Minute Tutorial: Basic 3D Interaction





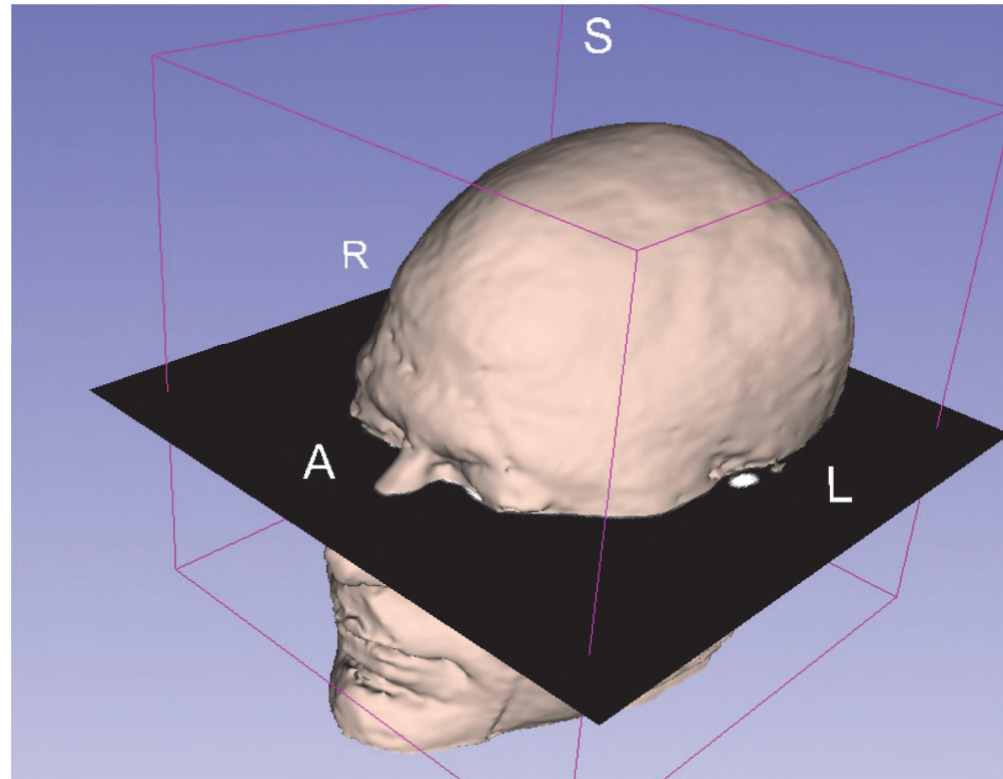
Slicer4 Minute Tutorial: Viewing Slices in the 3D Viewer





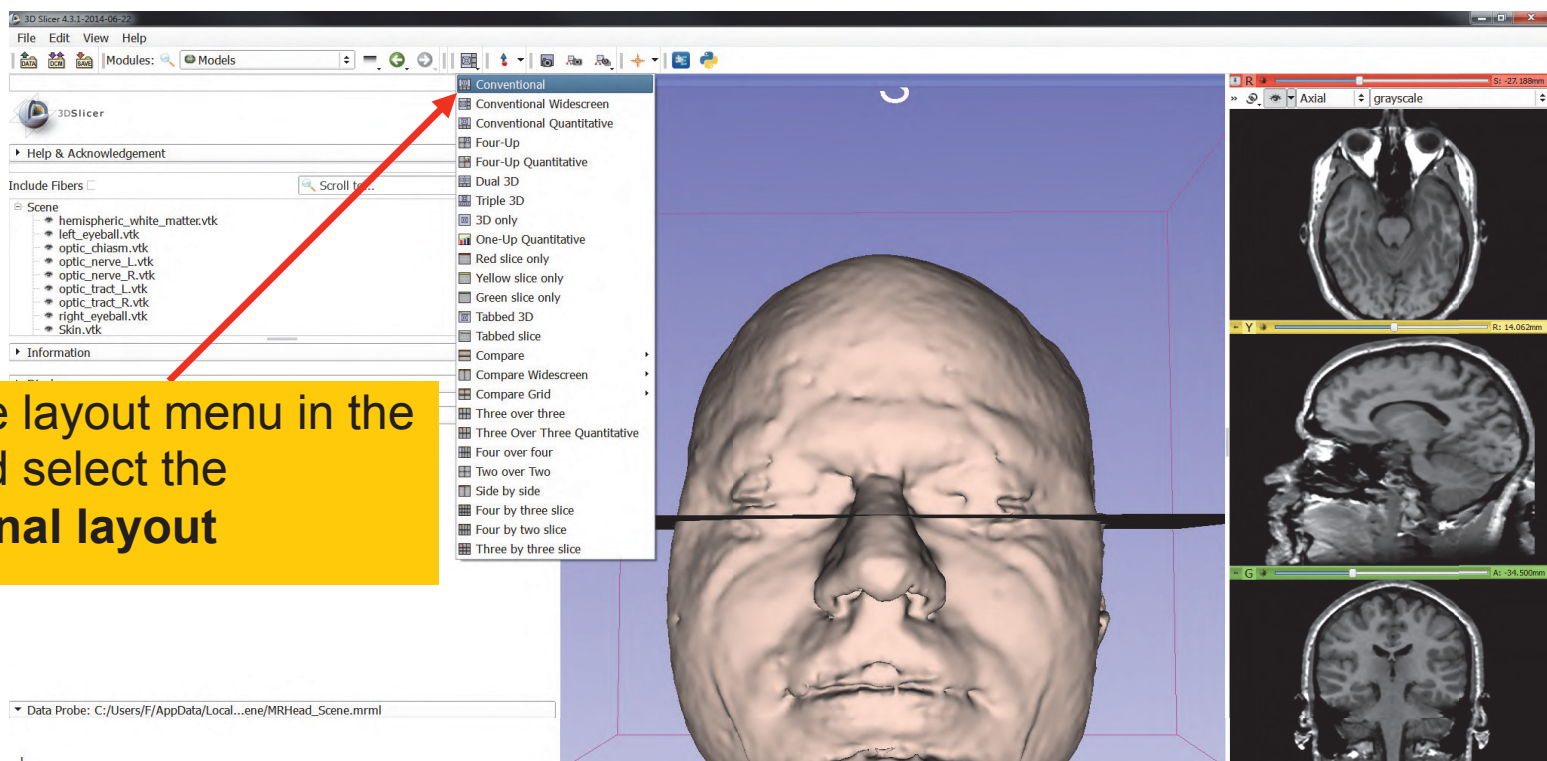
Slicer4 Minute Tutorial: 3D Visualization

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





Slicer4 Minute Tutorial: Viewing Slices in the 3D Viewer

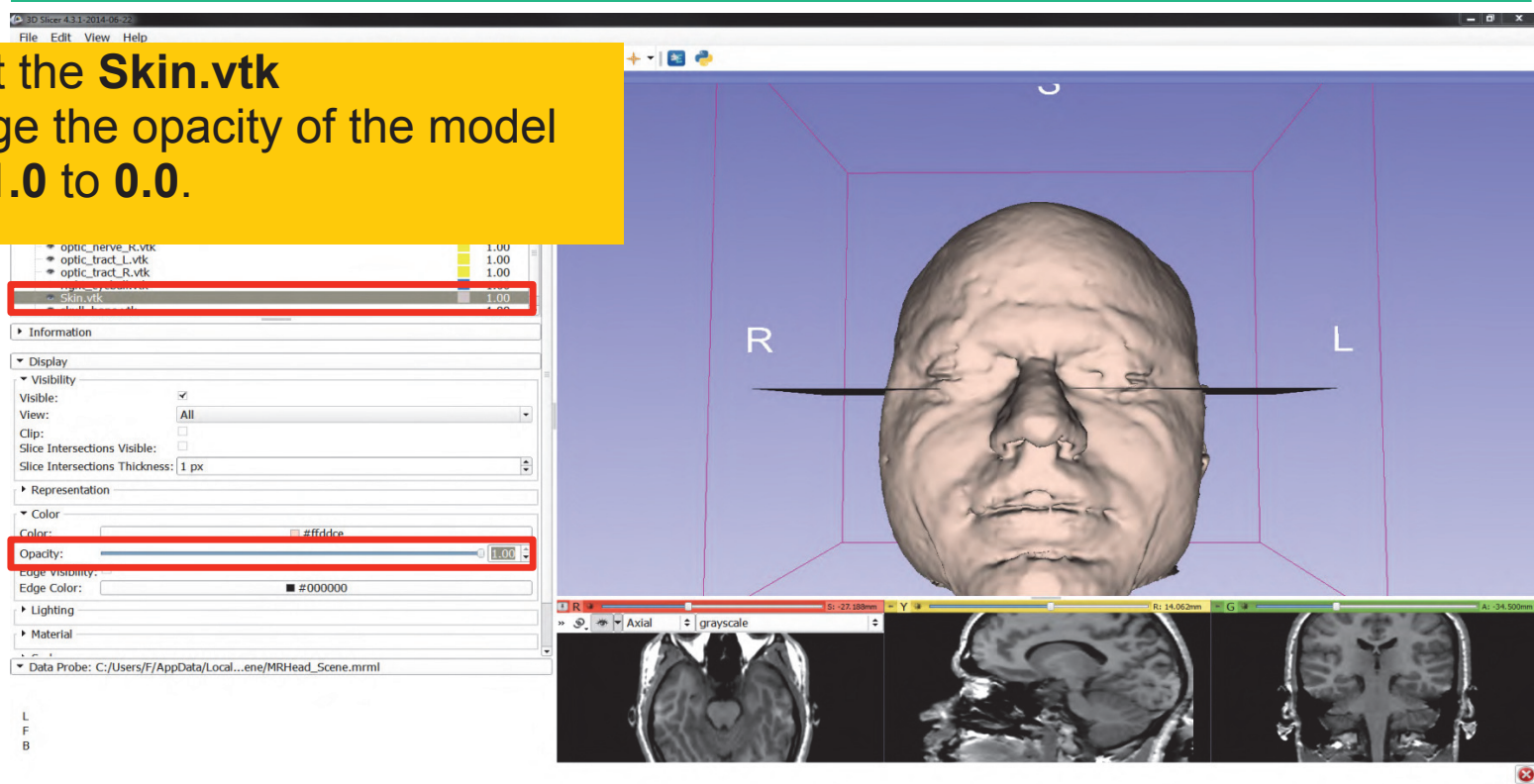


Click on the layout menu in the toolbar, and select the **Conventional layout**



Slicer4 Minute Tutorial: 3D Visualization

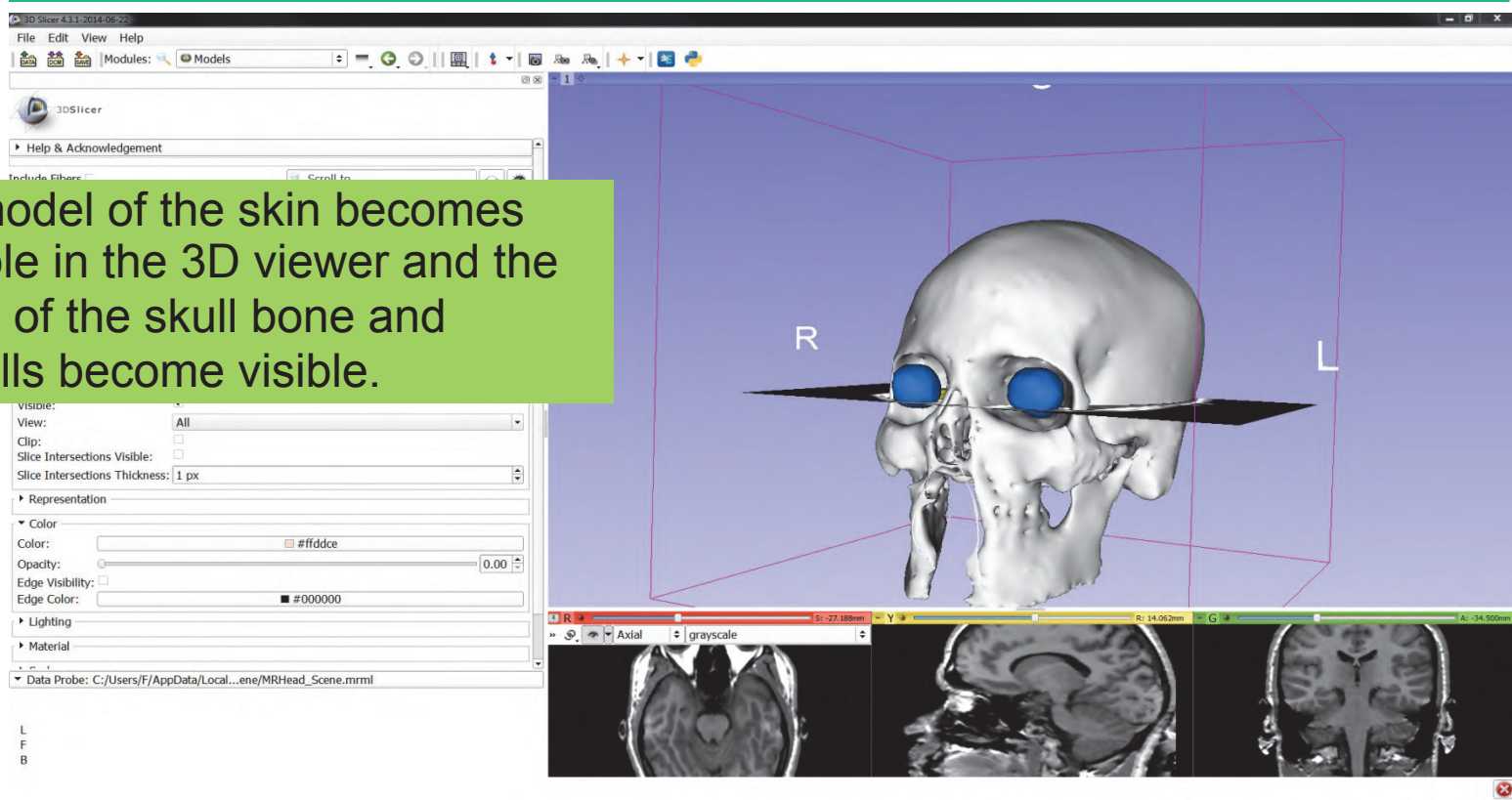
Select the **Skin.vtk**
Change the opacity of the model
from **1.0** to **0.0**.





Slicer4 Minute Tutorial: 3D Visualization

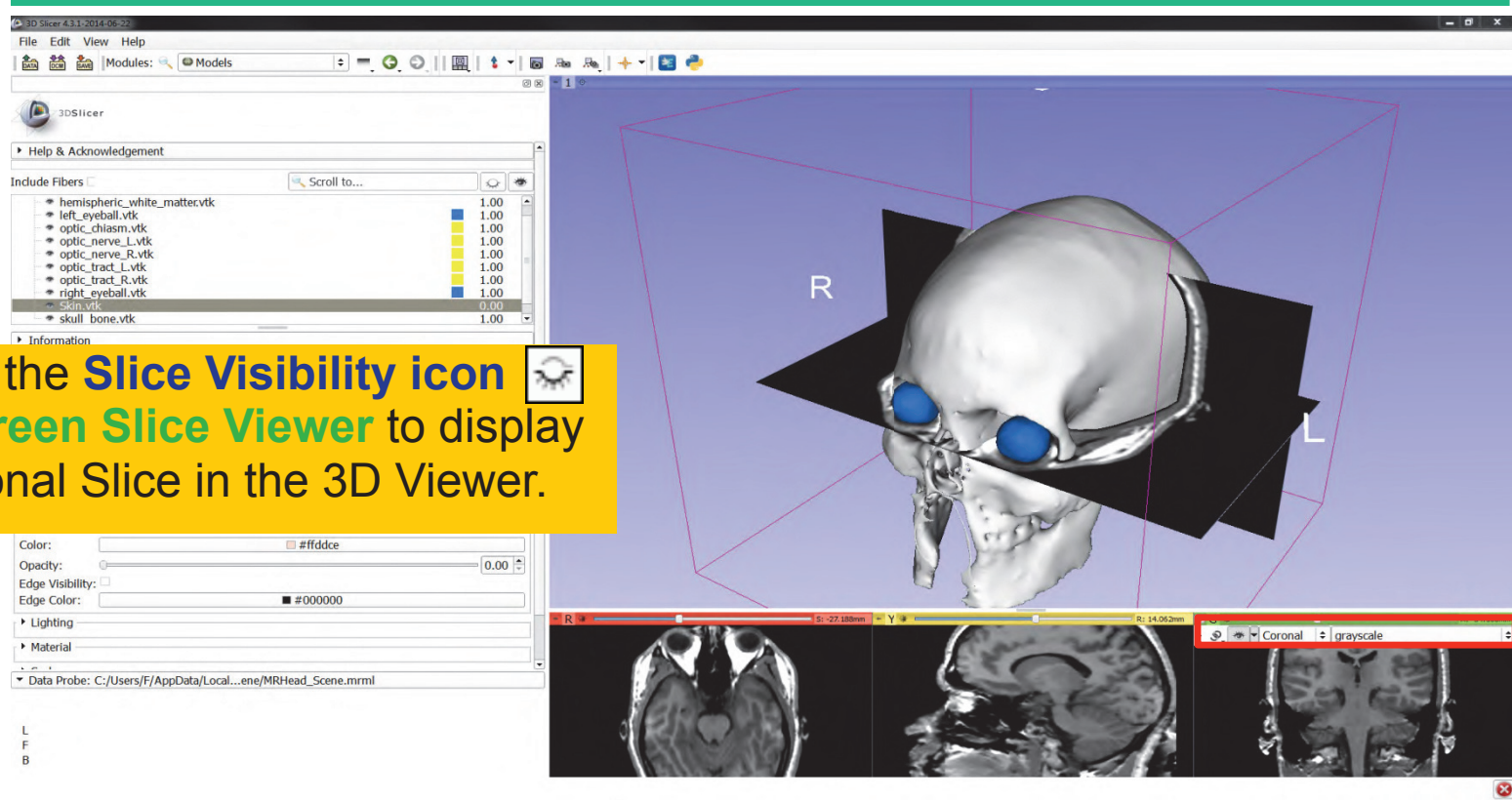
The model of the skin becomes invisible in the 3D viewer and the model of the skull bone and eyeballs become visible.





Slicer4 Minute Tutorial: 3D Visualization

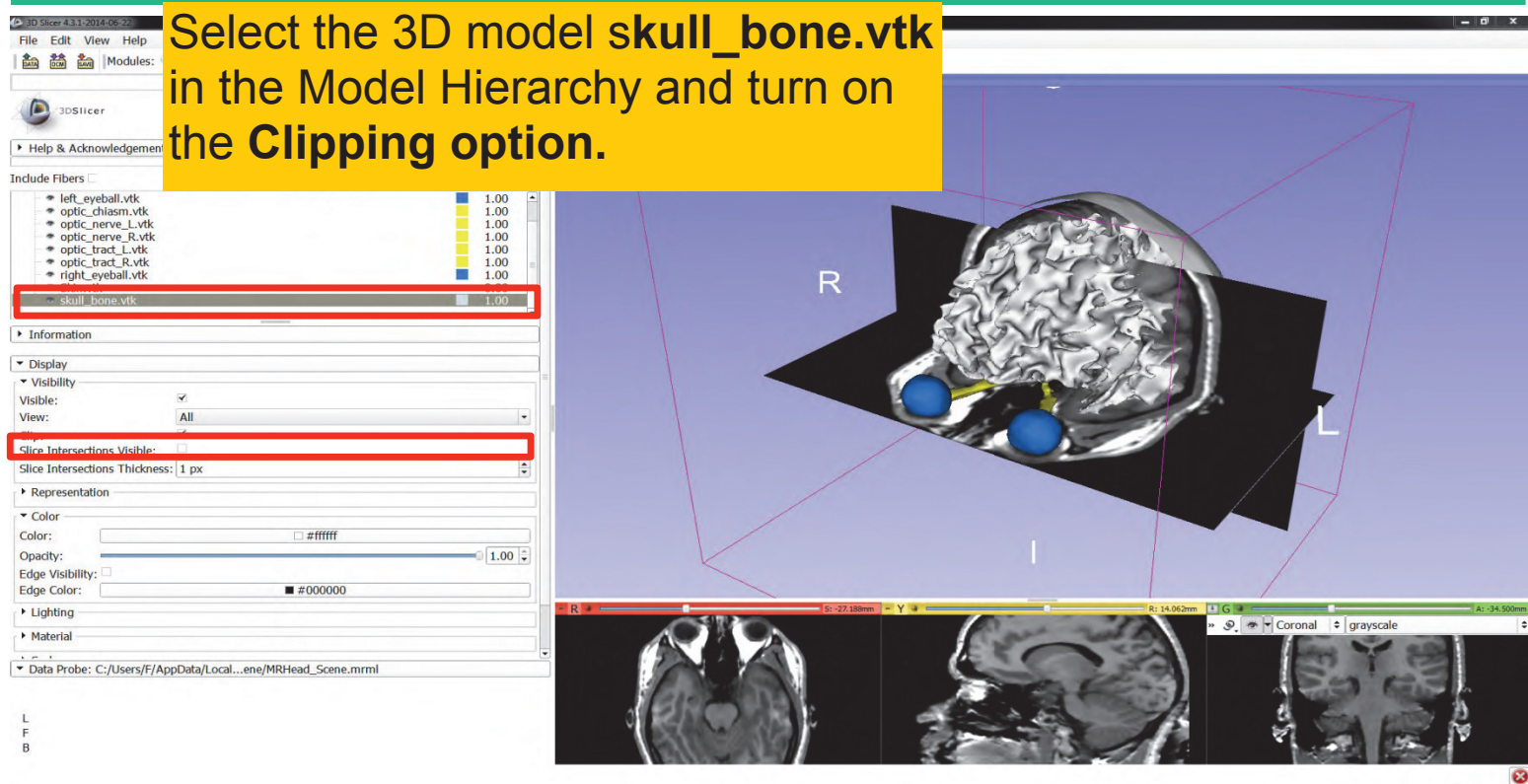
Click on the **Slice Visibility** icon  in the **Green Slice Viewer** to display the Coronal Slice in the 3D Viewer.





Slicer4 Minute Tutorial: 3D Visualization

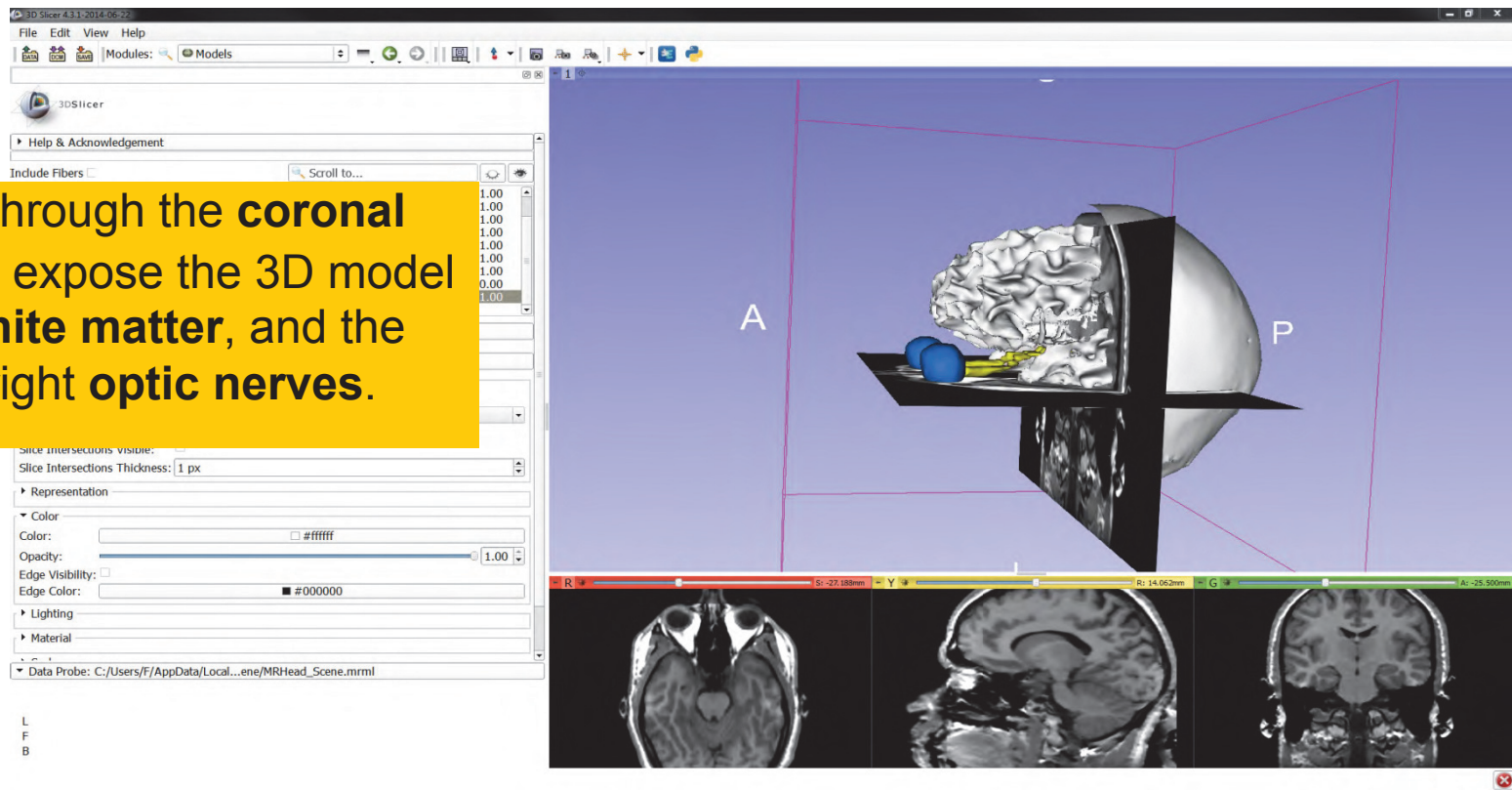
Select the 3D model **skull_bone.vtk** in the Model Hierarchy and turn on the **Clipping** option.





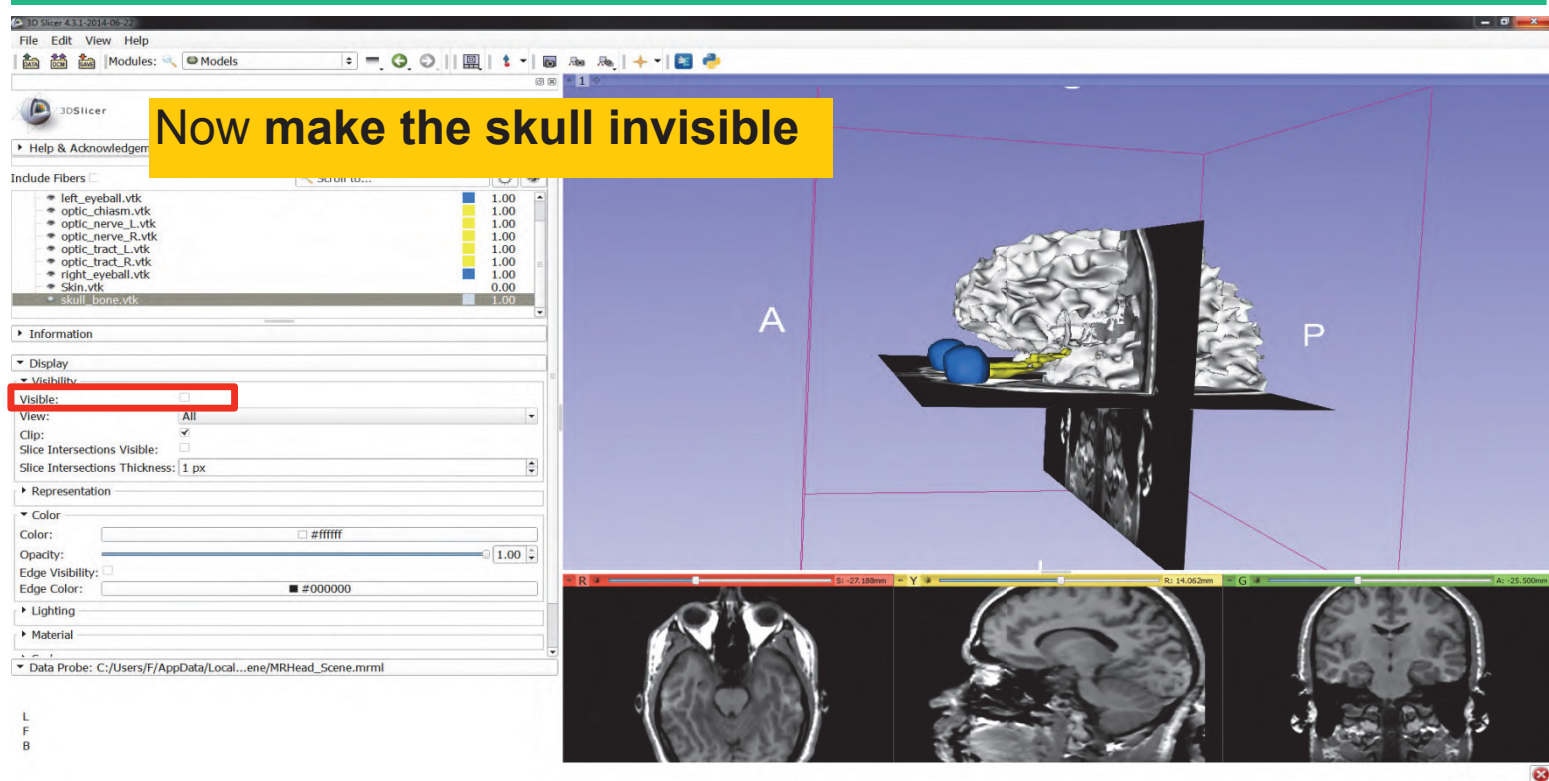
Slicer4 Minute Tutorial: 3D Visualization

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





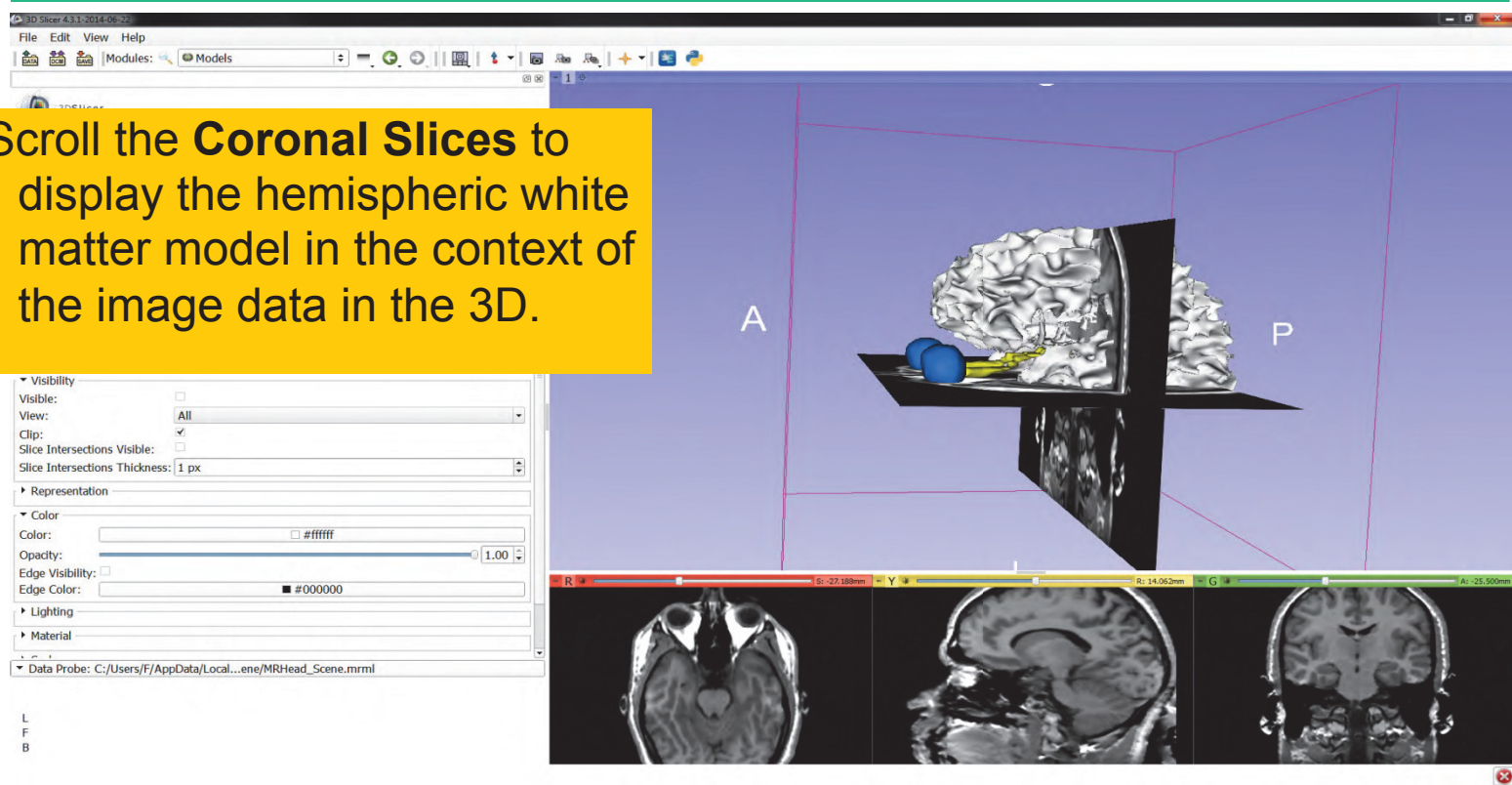
Slicer4 Minute Tutorial: 3D Visualization





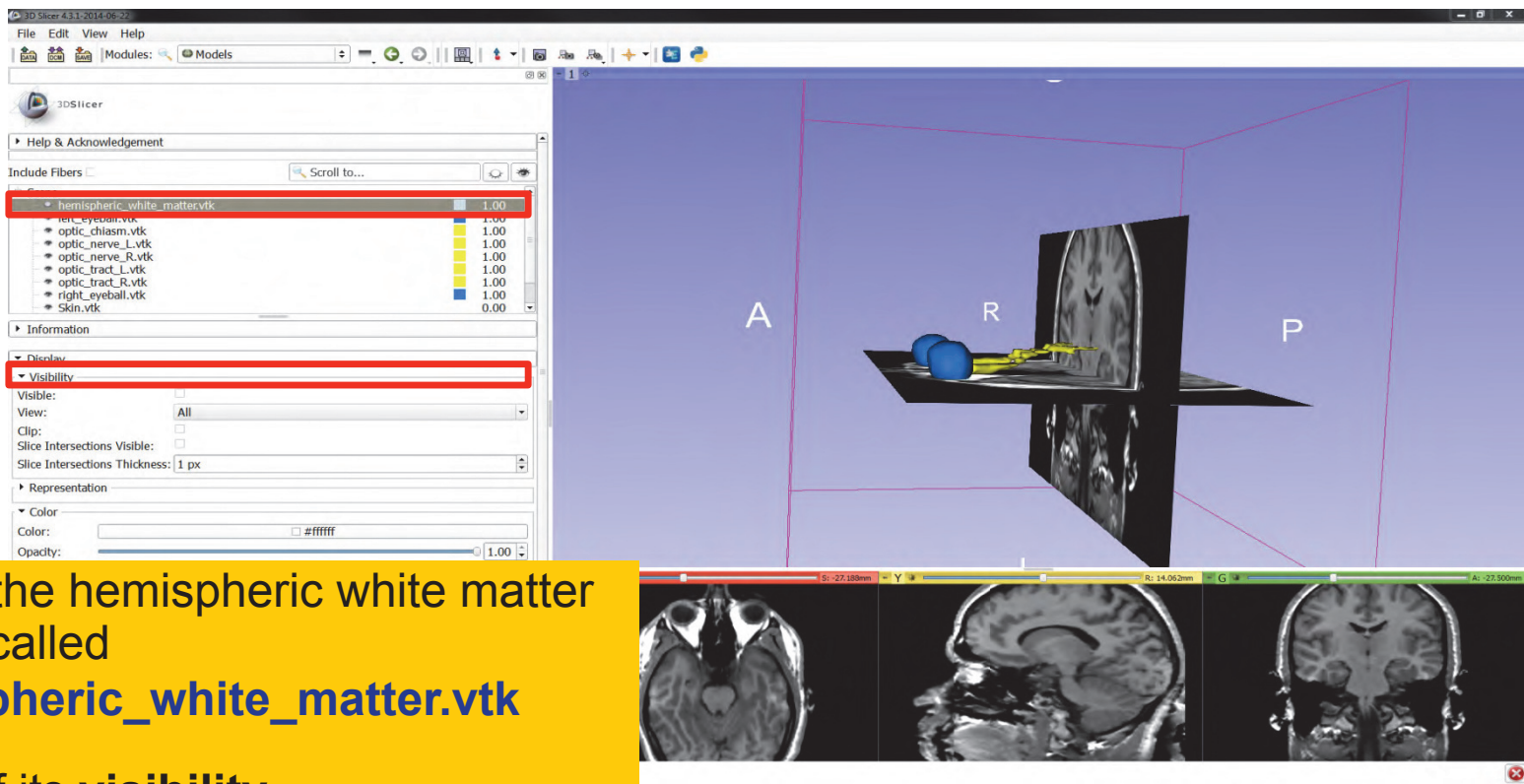
Slicer4 Minute Tutorial: 3D Visualization

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





Slicer4 Minute Tutorial: 3D Visualization



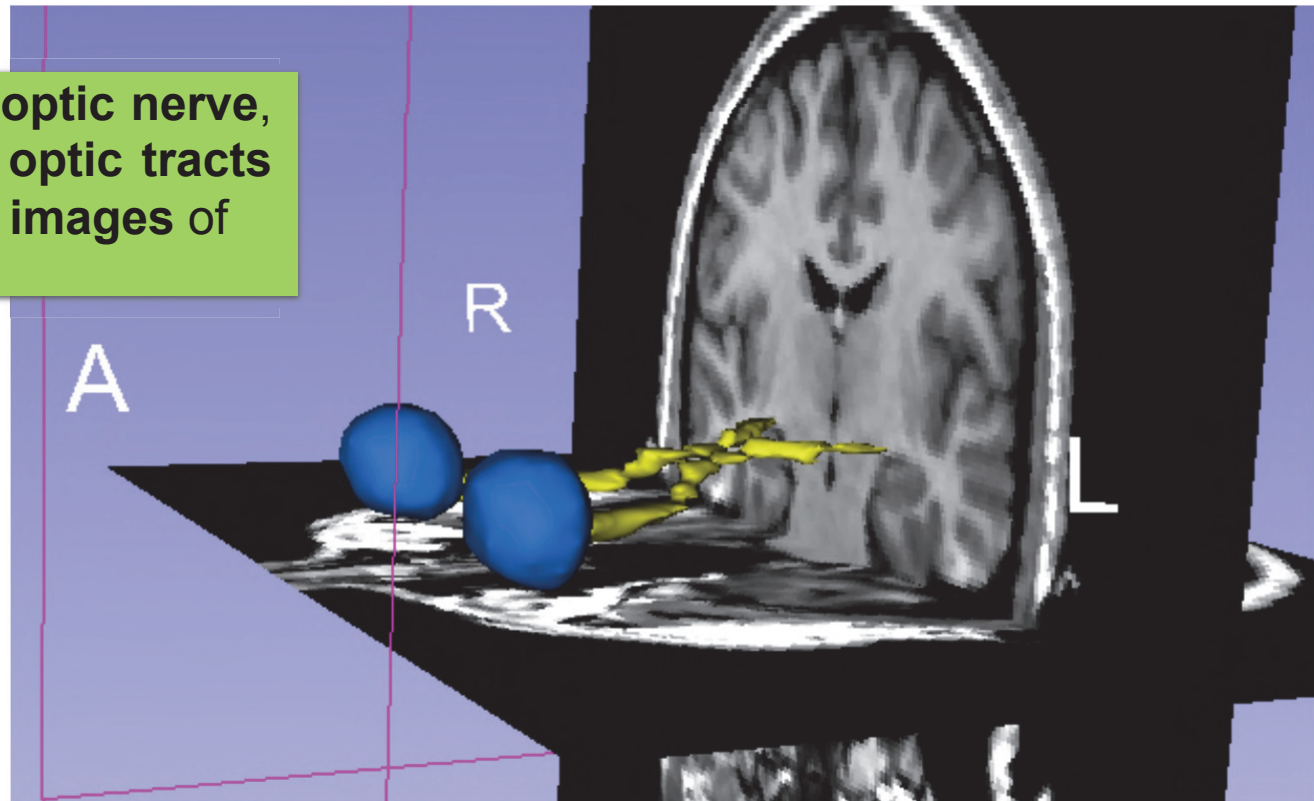
Select the hemispheric white matter model called **hemispheric_white_matter.vtk**

Turn off its **visibility**.



Slicer4 Minute Tutorial: 3D Visualization

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

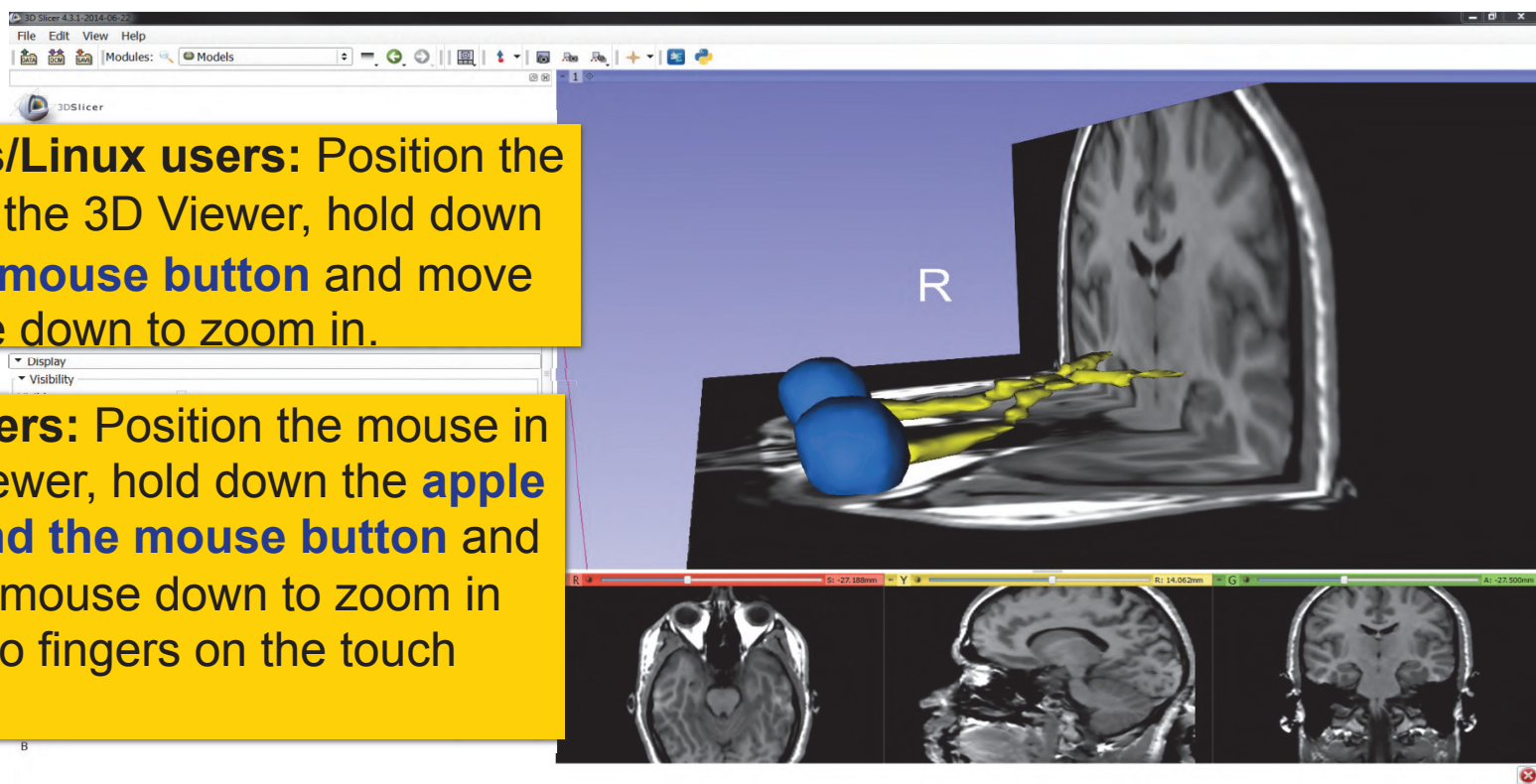




Slicer4 Minute Tutorial: 3D Visualization: Zoom the view

Windows/Linux users: Position the mouse in the 3D Viewer, hold down the **right mouse button** and move the mouse down to zoom in.

Mac users: Position the mouse in the 3D Viewer, hold down the **apple button and the mouse button** and move the mouse down to zoom in (or use two fingers on the touch pad).





Close the existing scene and all its data

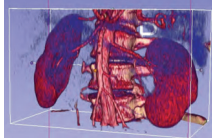
The screenshot shows the 3D Slicer application window. The 'File' menu is open, and the 'Close Scene' option is highlighted with a red arrow. A yellow text box over the menu says 'Select File->Close Scene This removes any dataset previously loaded into slicer.' Another yellow text box over the 'Exit' option says 'Click on Exit to exit Slicer'. The main 3D view shows a brain scan with two blue spheres and yellow lines. The bottom of the window shows three orthogonal views (axial, sagittal, coronal) and a coordinate system with axes labeled R, S, Y, G, and A.



Overview

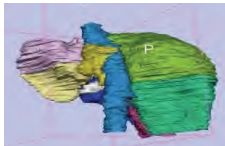


Part I: Introduction to the 3DSlicer software



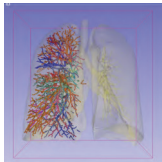
Part II: 3D Data Loading and visualization of DICOM images

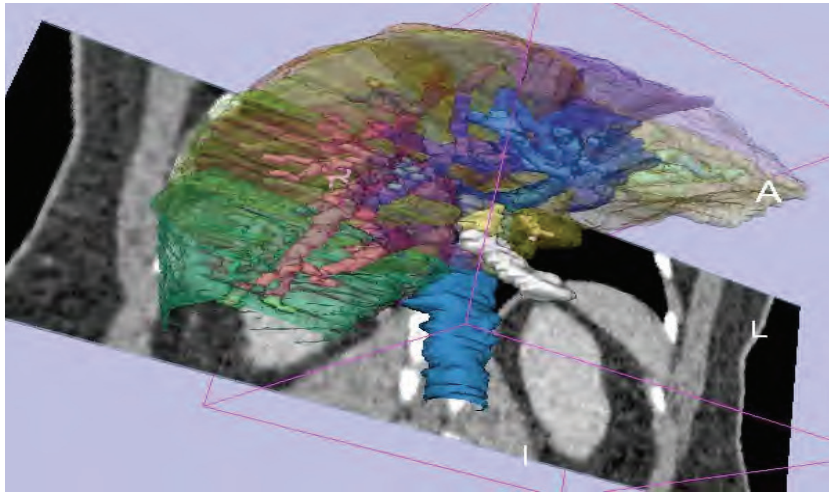
- Volume Rendering of thoraco-abdominal CT data
- Surface Rendering of MR head data



Part III: 3D interactive exploration of the anatomy

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



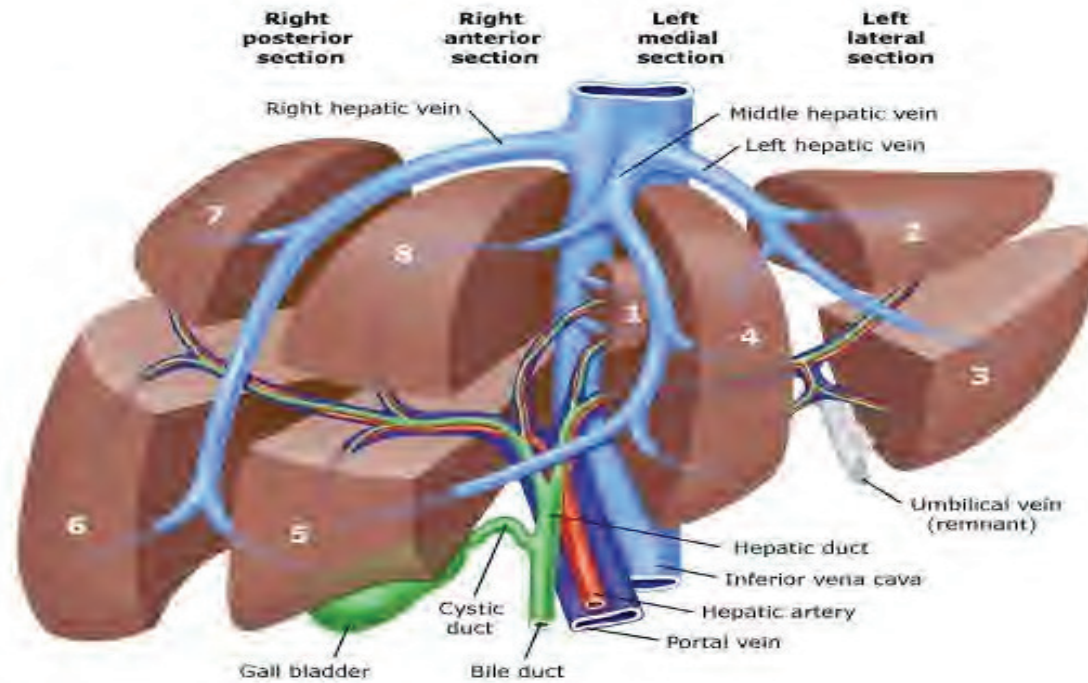


Part II:

Interactive 3D Visualization
of the segments of the liver

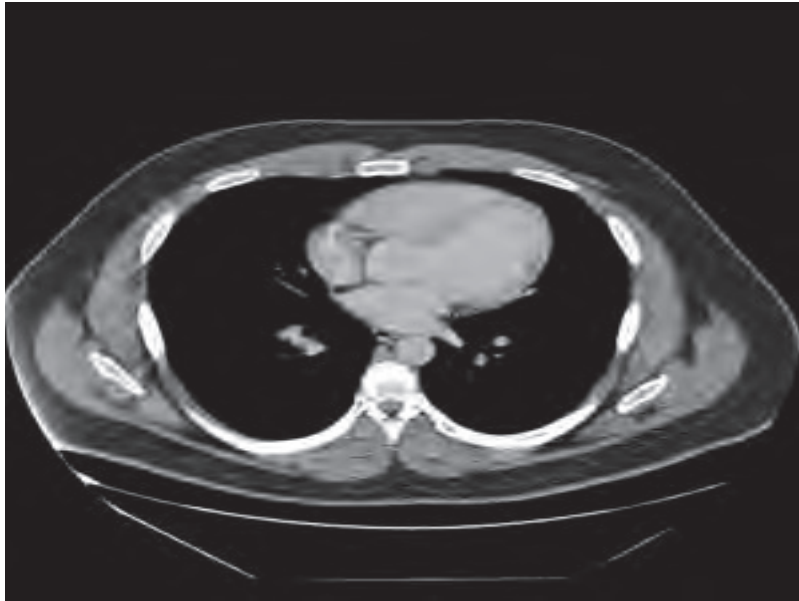


Anatomy of the liver





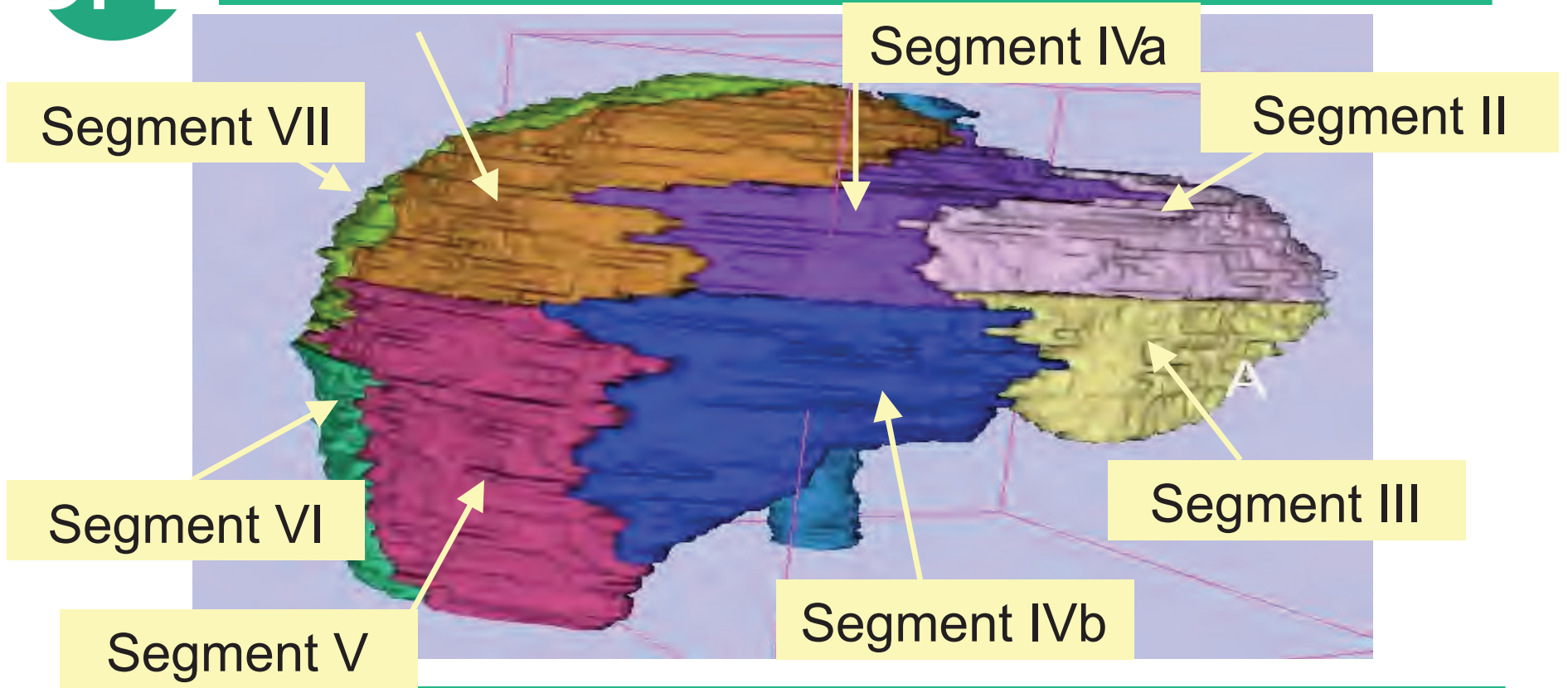
Liver dataset



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

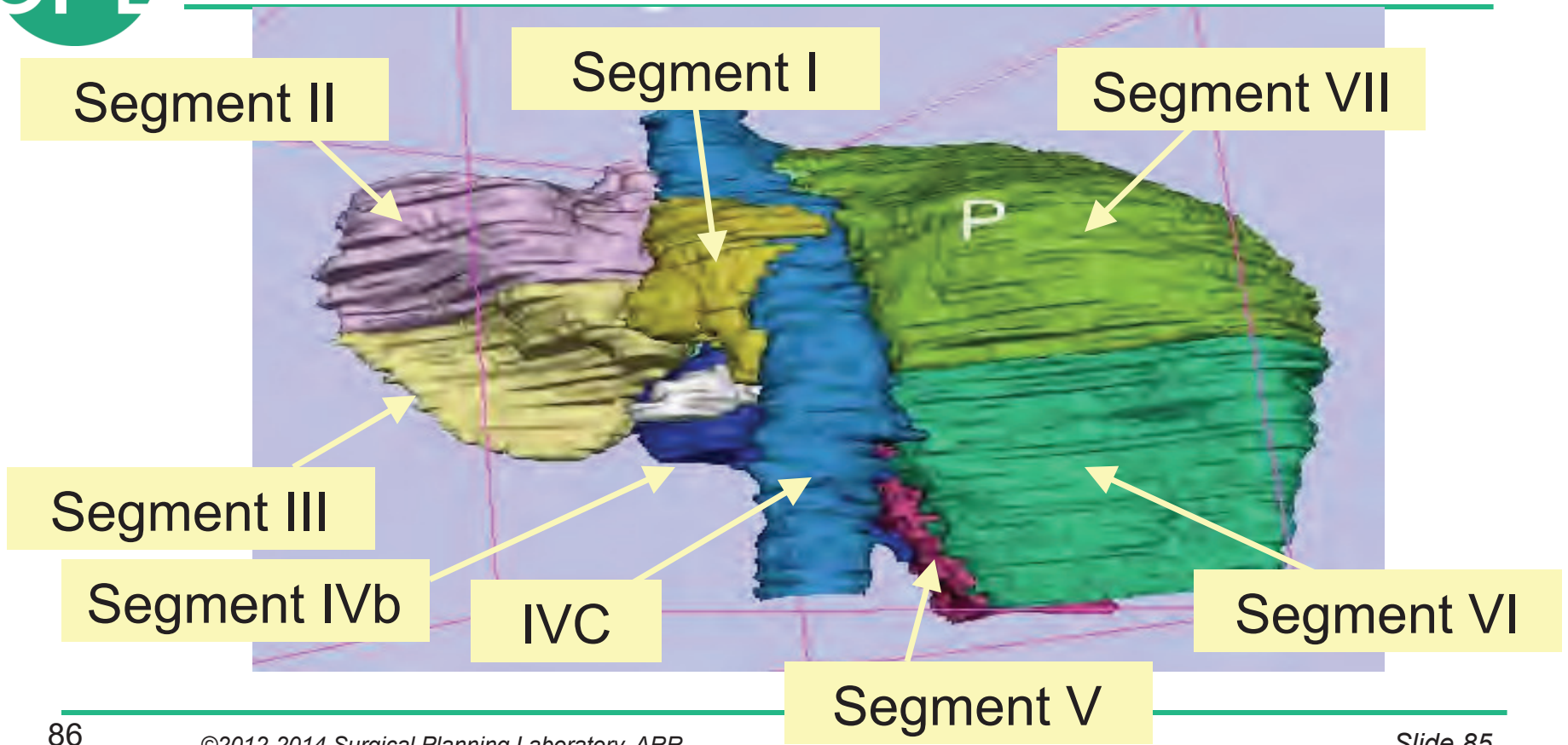


3D segments of the liver



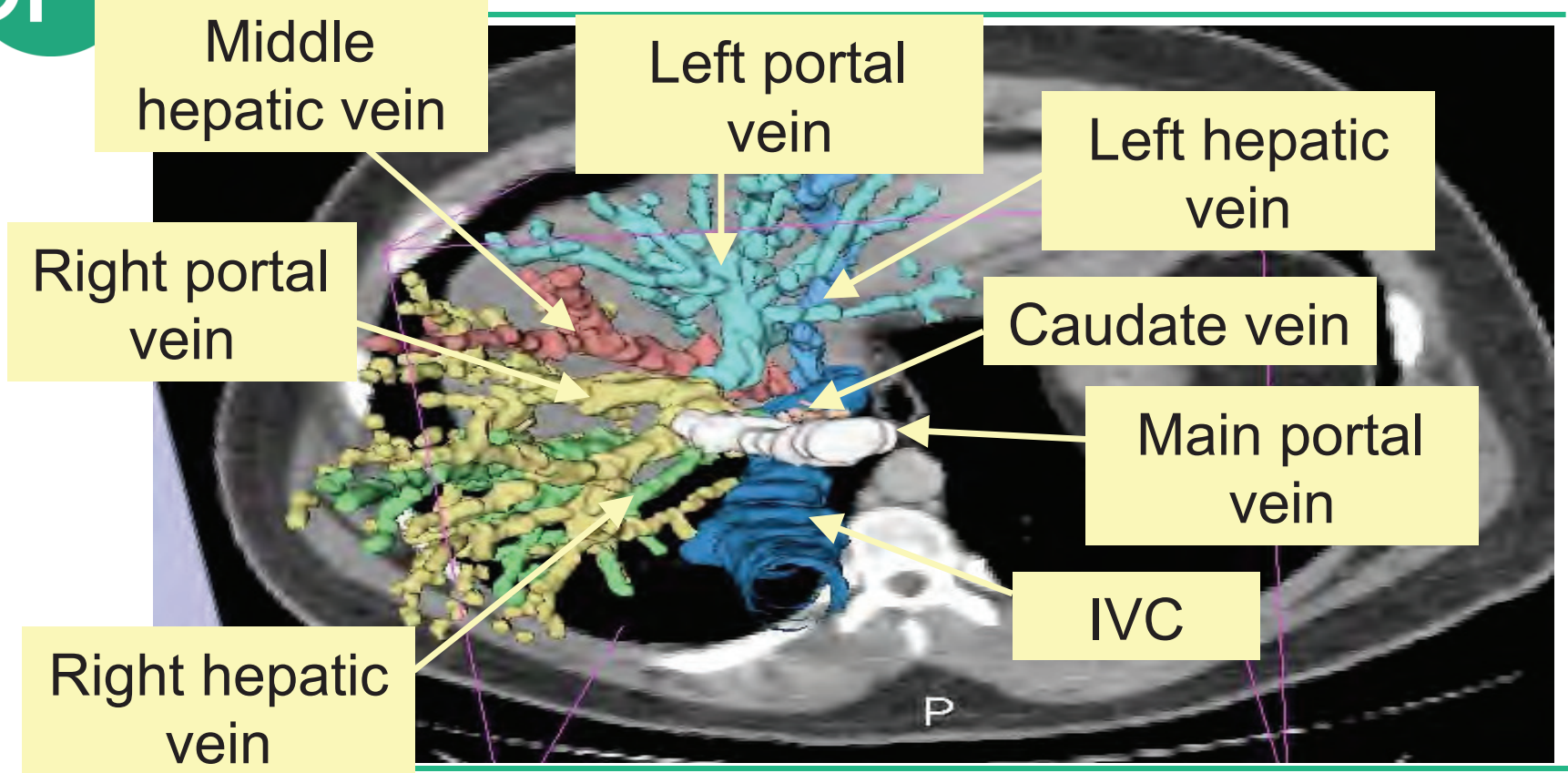


3D segments of the liver



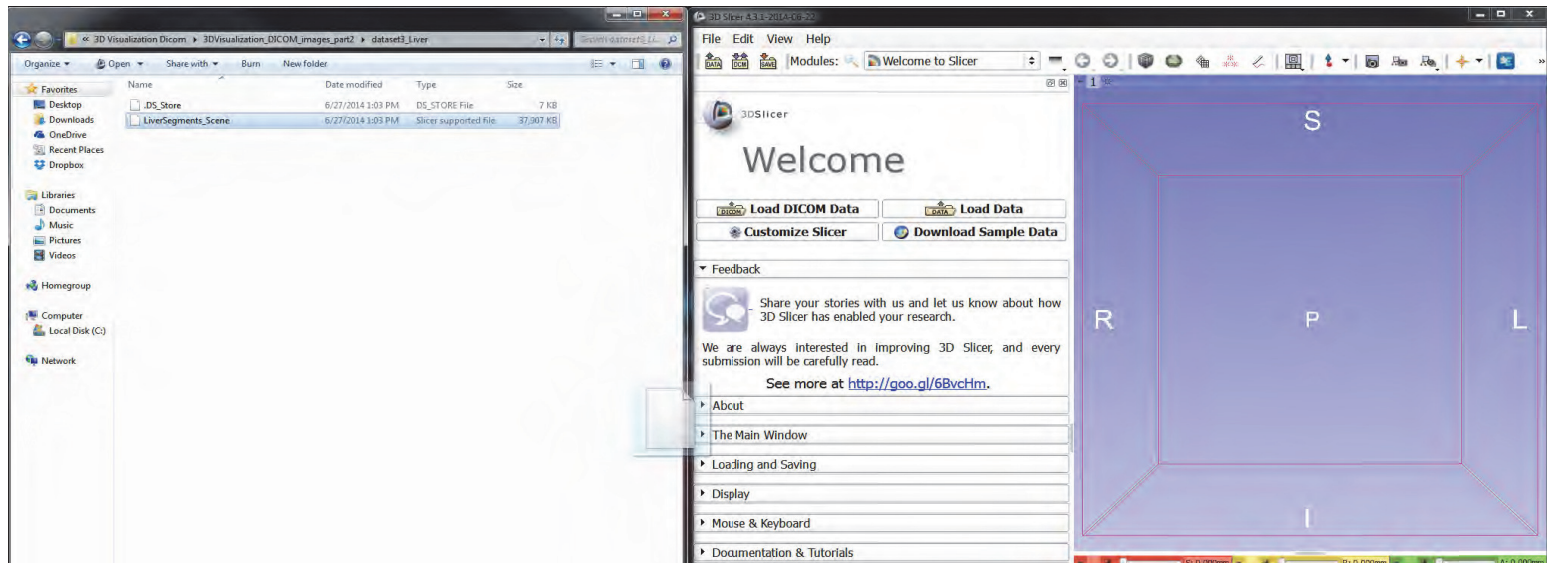


Liver vasculature





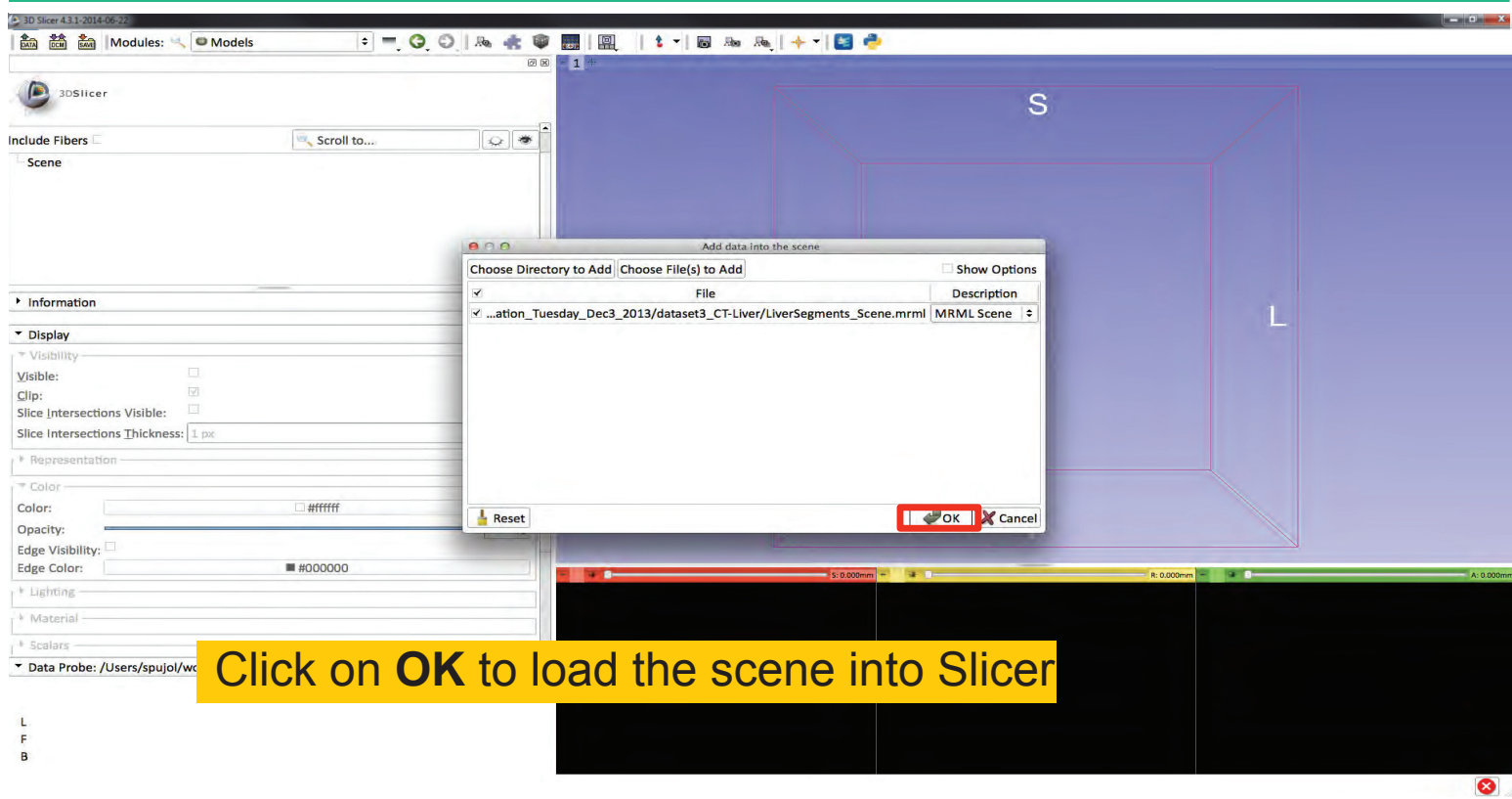
Loading the Liver Scene



Browse to the directory
C:\3DSlicerData_RSNA2014\3DVisualizationDICOM_Monday_Dec1
Select the directory **dataset3_Liver**
Drag and drop the file **LiverSegments_Scene.mrb** into Slicer



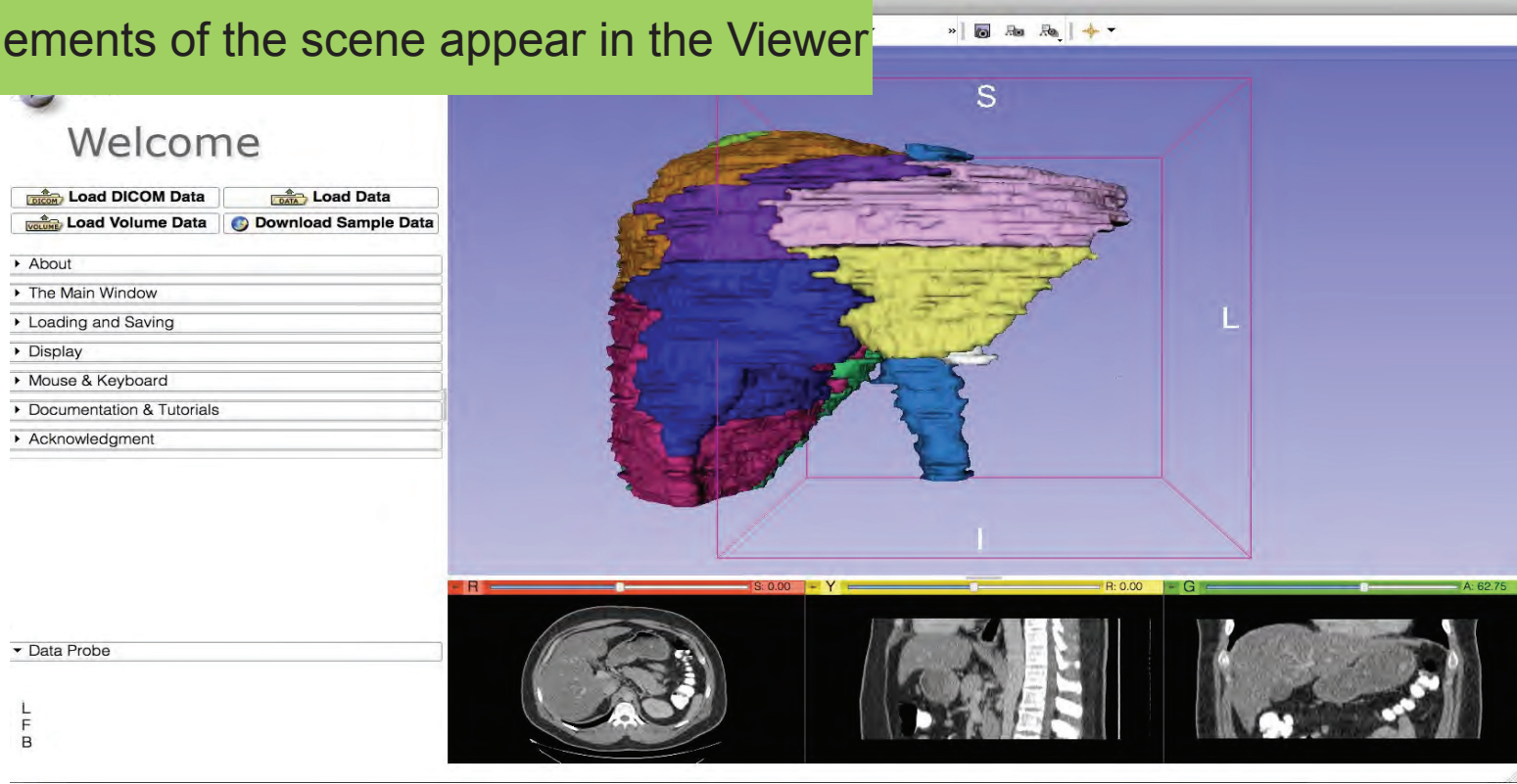
Loading the Liver Scene





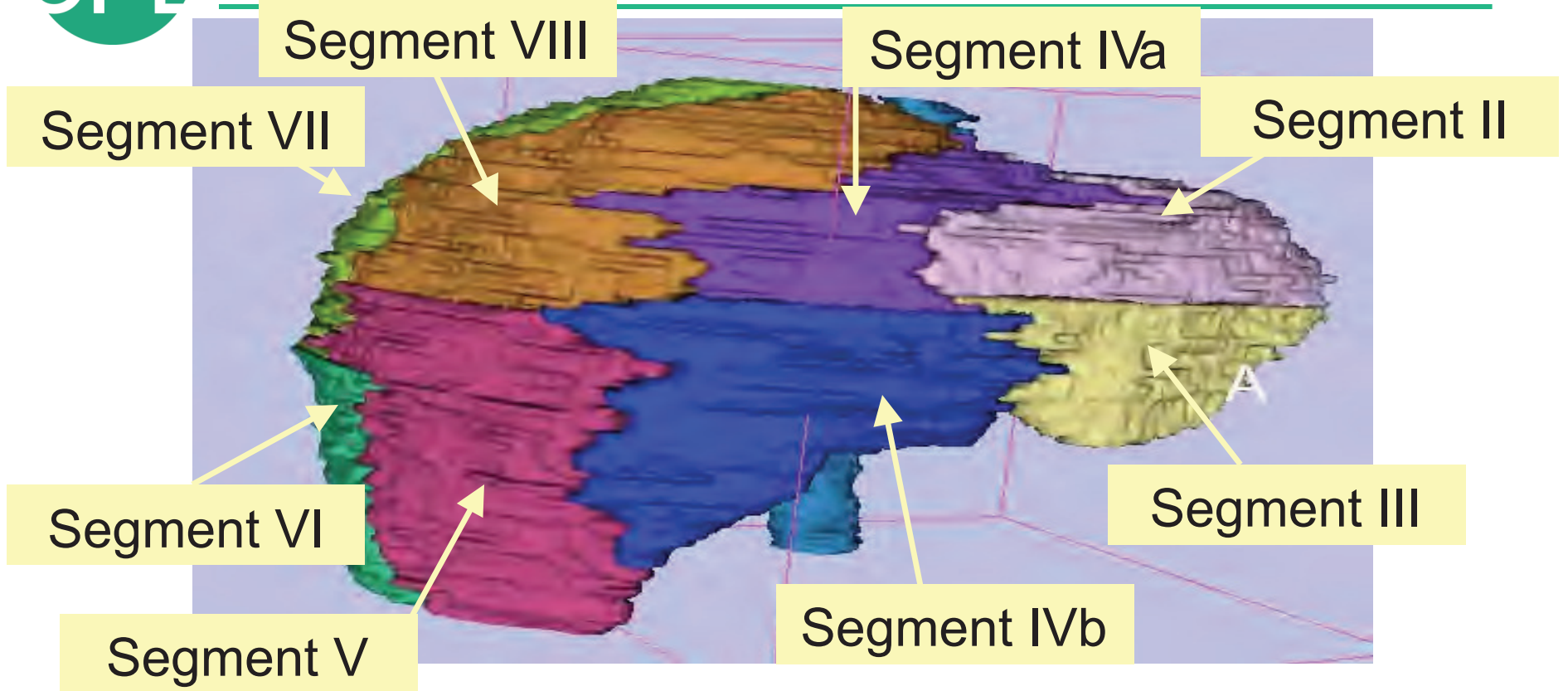
Liver Segments Scene

The elements of the scene appear in the Viewer



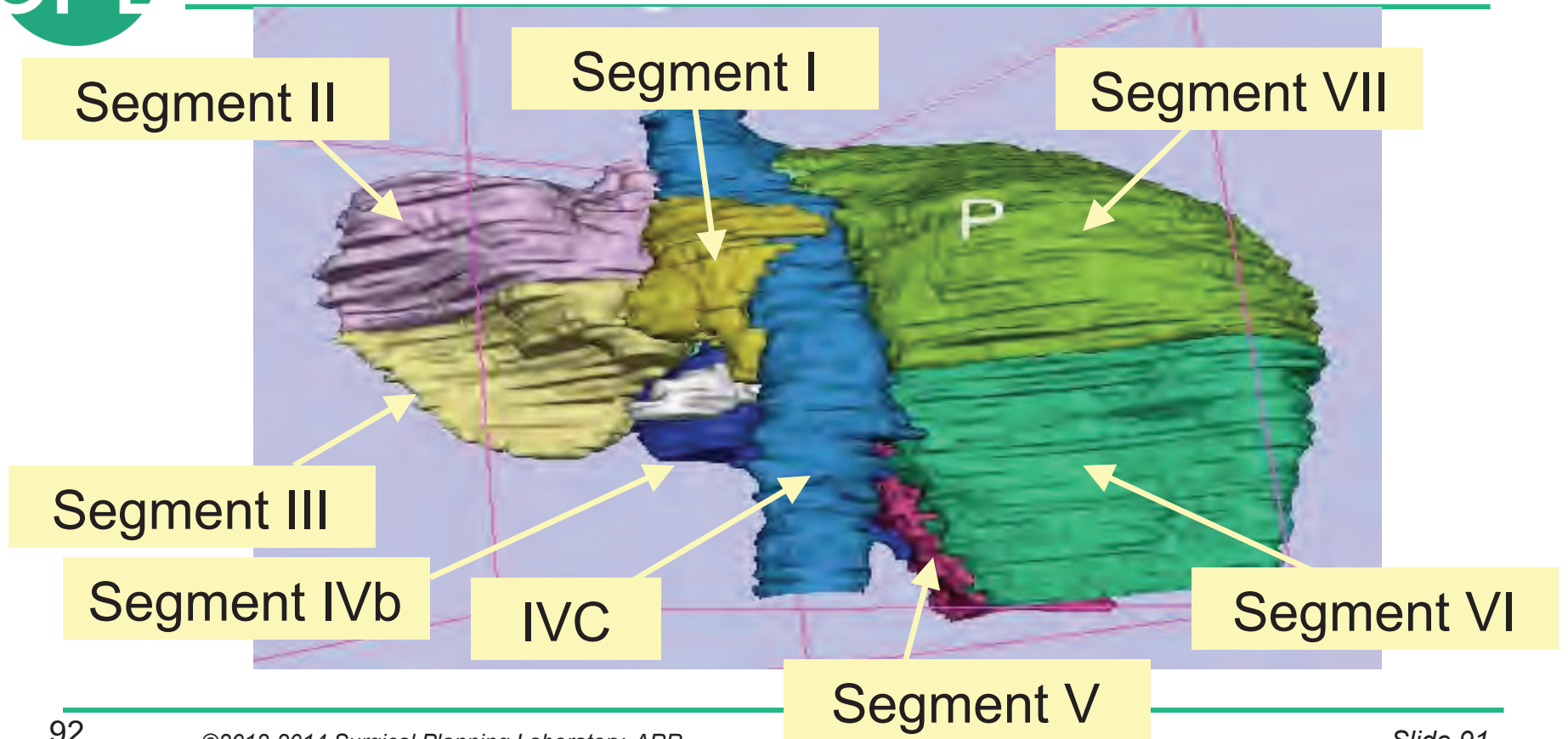


3D models of the liver



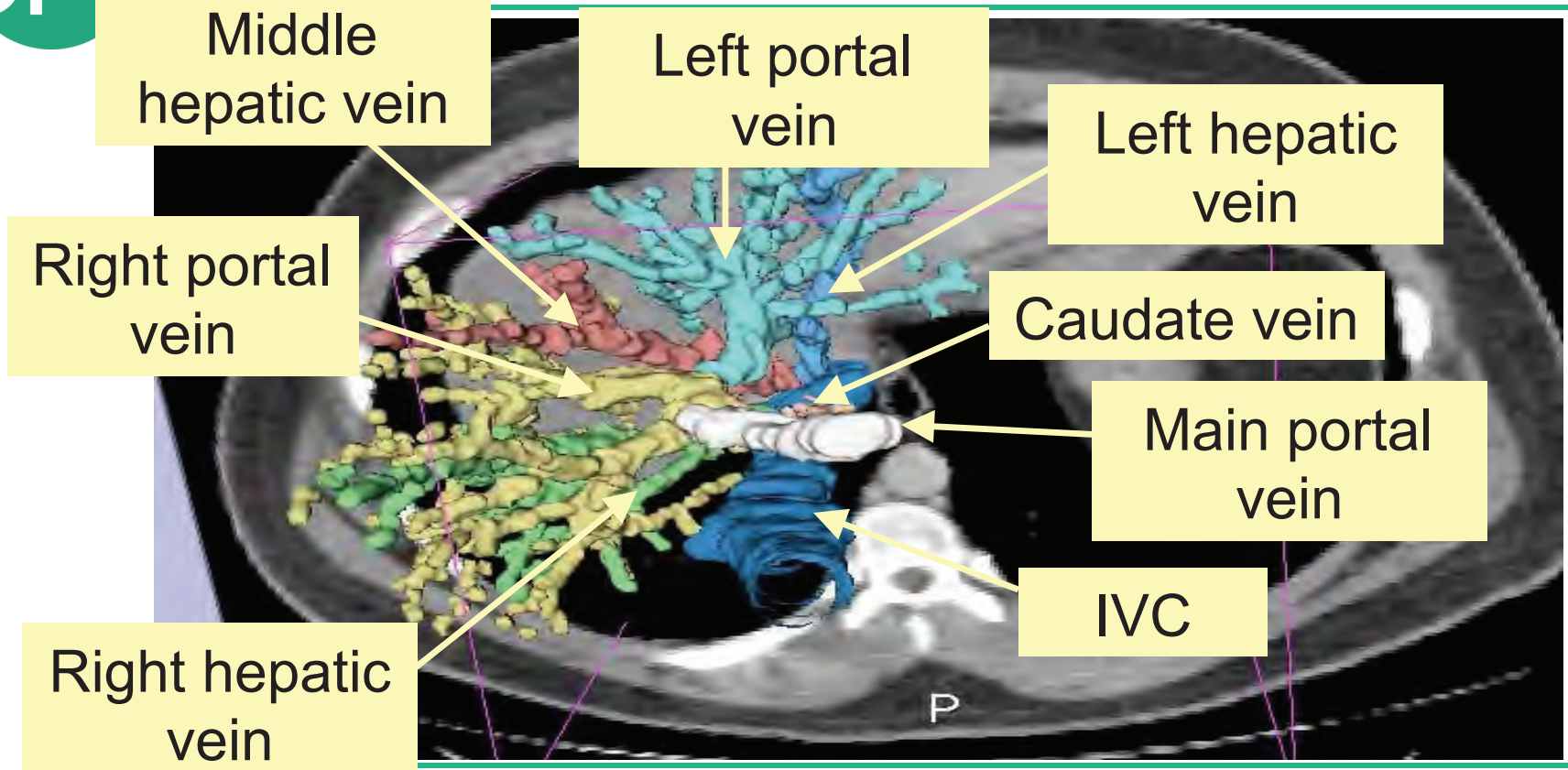


3D models of the liver



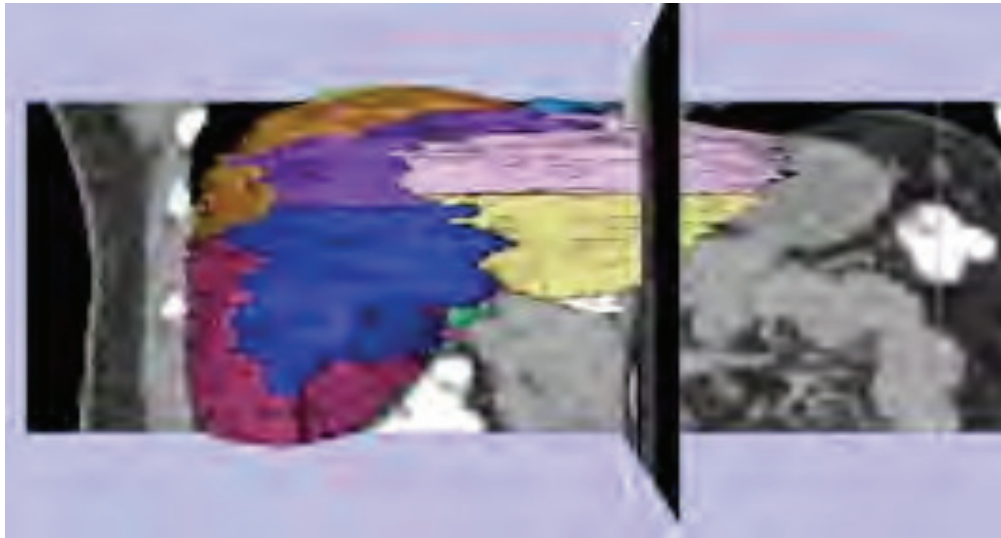


3D models of the liver





3D Exploration of Liver Segments

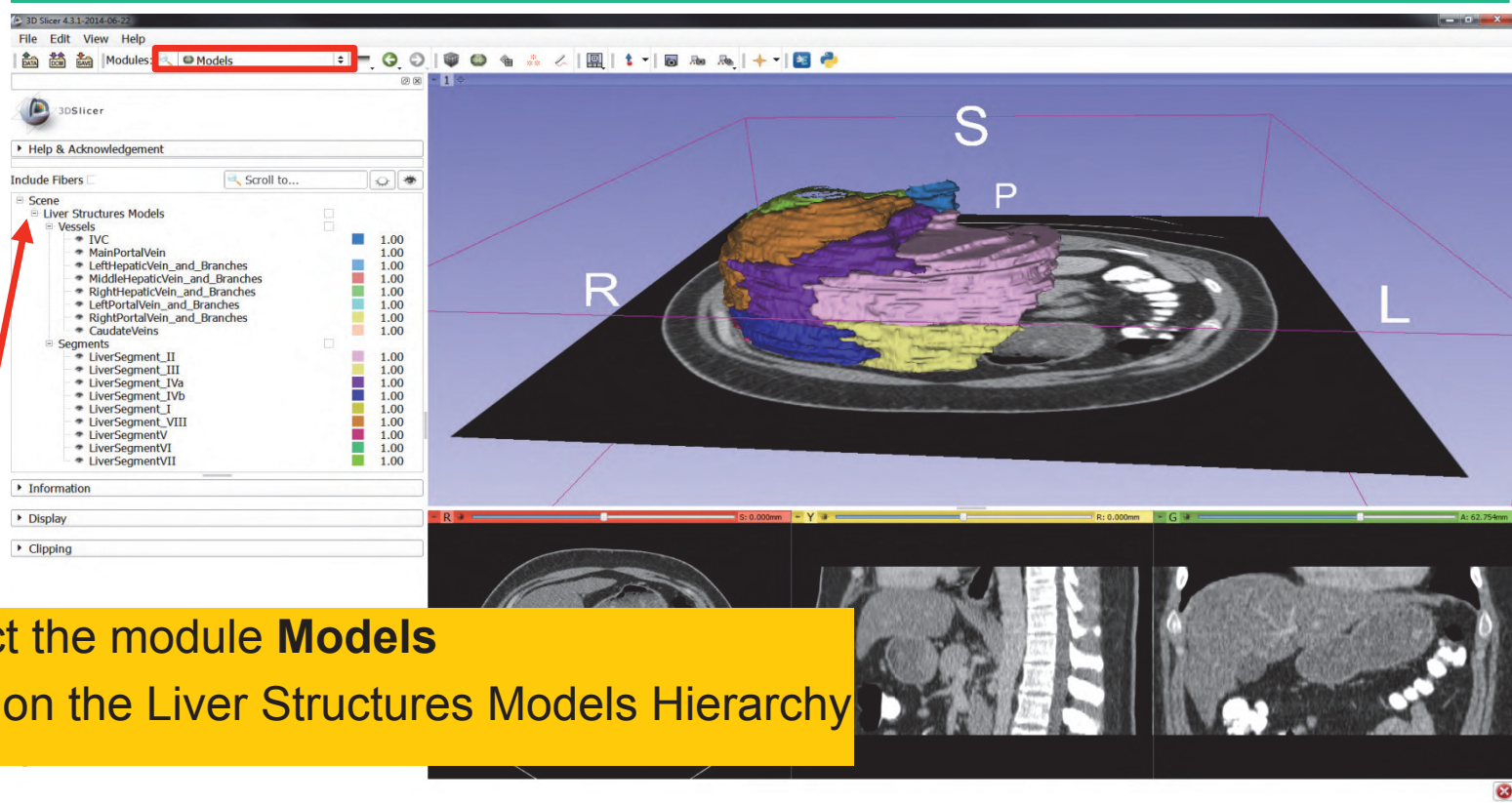


Example:

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



3D Exploration of Liver Segments





3D Exploration of Liver Segments

3D Slicer 4.8.0 (2014-06-22)

File Edit View Help

Modules: Models

3DSlicer

Help & Acknowledgement

Include Fibers

Scene

- Liver Structures Models
 - Vessels
 - IVC 1.00
 - MainPortalVein 1.00
 - LeftHepaticVein_and_Branches 1.00
 - MiddleHepaticVein_and_Branches 1.00
 - RightHepaticVein_and_Branches 1.00
 - LeftPortalVein_and_Branches 1.00
 - RightPortalVein_and_Branches 1.00
 - CaudateVeins 1.00
 - LiverSegment_II 1.00**
 - LiverSegment_III 1.00
 - LiverSegment_IVa 1.00
 - LiverSegment_IVb 1.00
 - LiverSegment_I 1.00
 - LiverSegment_VIII 1.00
 - LiverSegment_V 1.00
 - LiverSegment_VI 1.00
 - LiverSegment_VII 1.00

Information

Display

Visibility

Visible:

View: All

Clip:

Slice Intersections Visible:

Slice Intersections Thickness: 1 px

Representation

Data Probe: C:/Users/F/AppData/Local...erSegments_Scene.mrml

L
F
B

R S L

0.000mm Y 0.000mm R 0.000mm G 62.754mm A

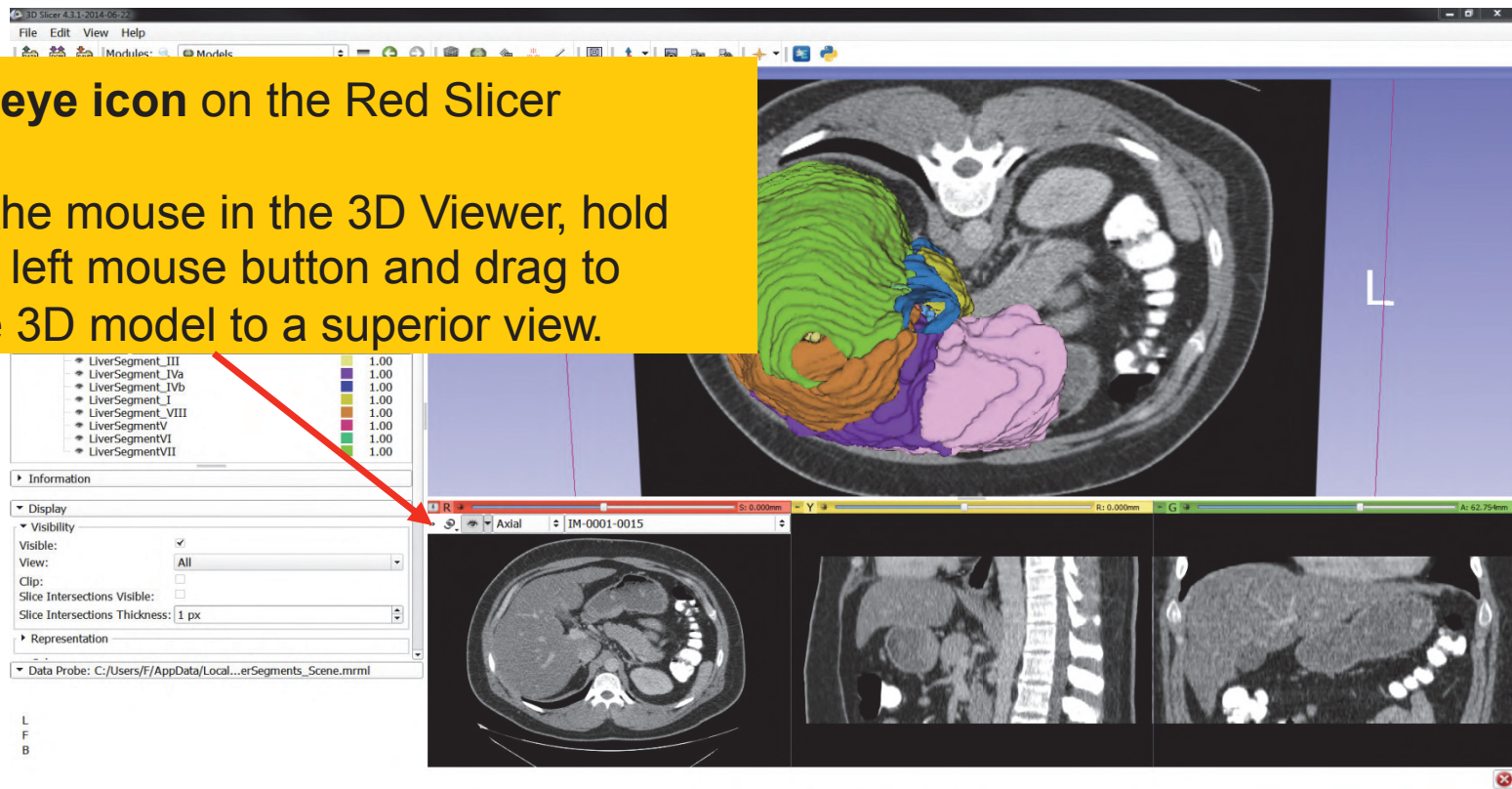
Select the model **Liver_Segment II**
Turn on/off its visibility to locate it in the 3D viewer.



3D Exploration of Liver Segments

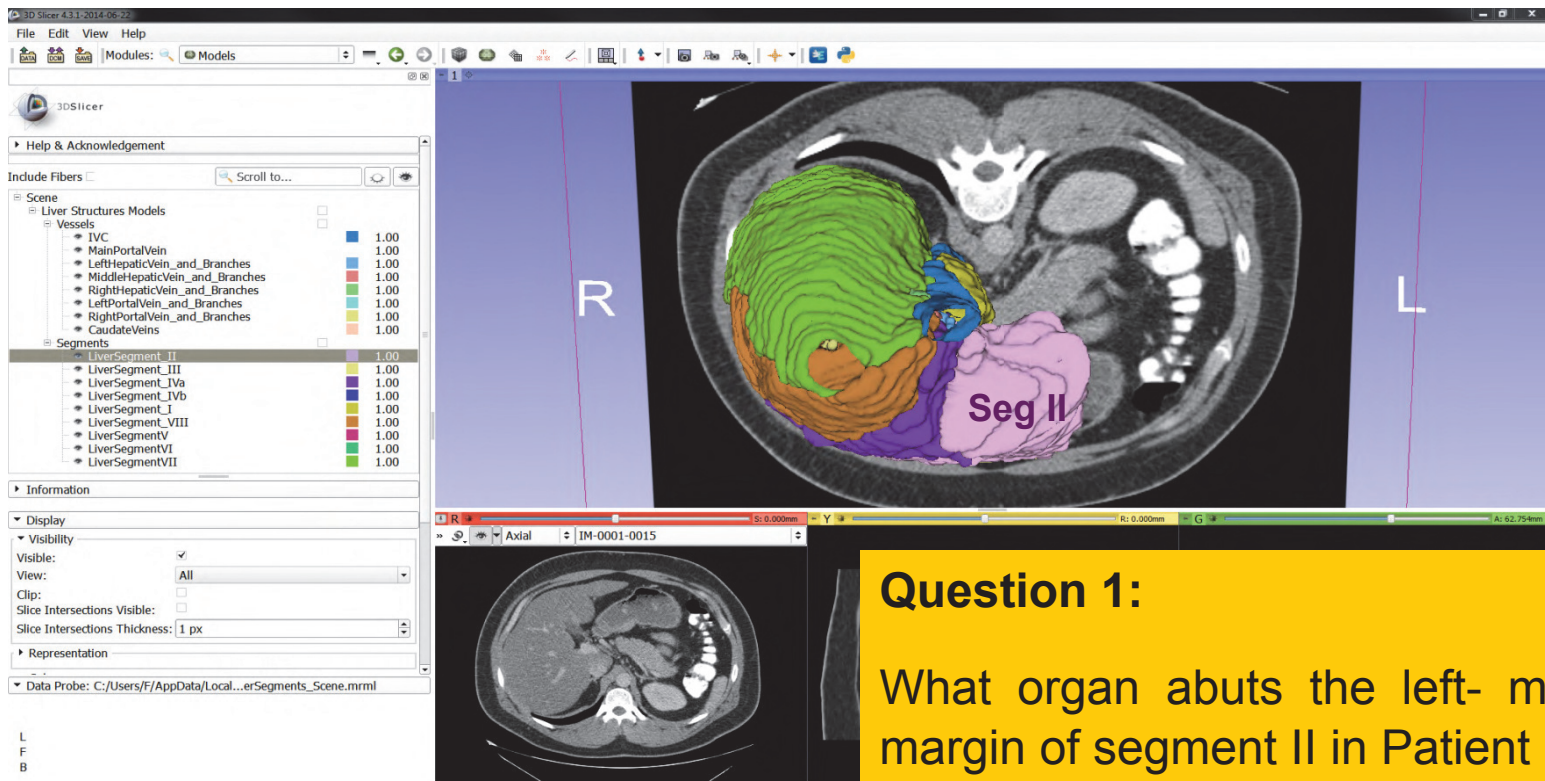
Click the **eye icon** on the Red Slicer

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



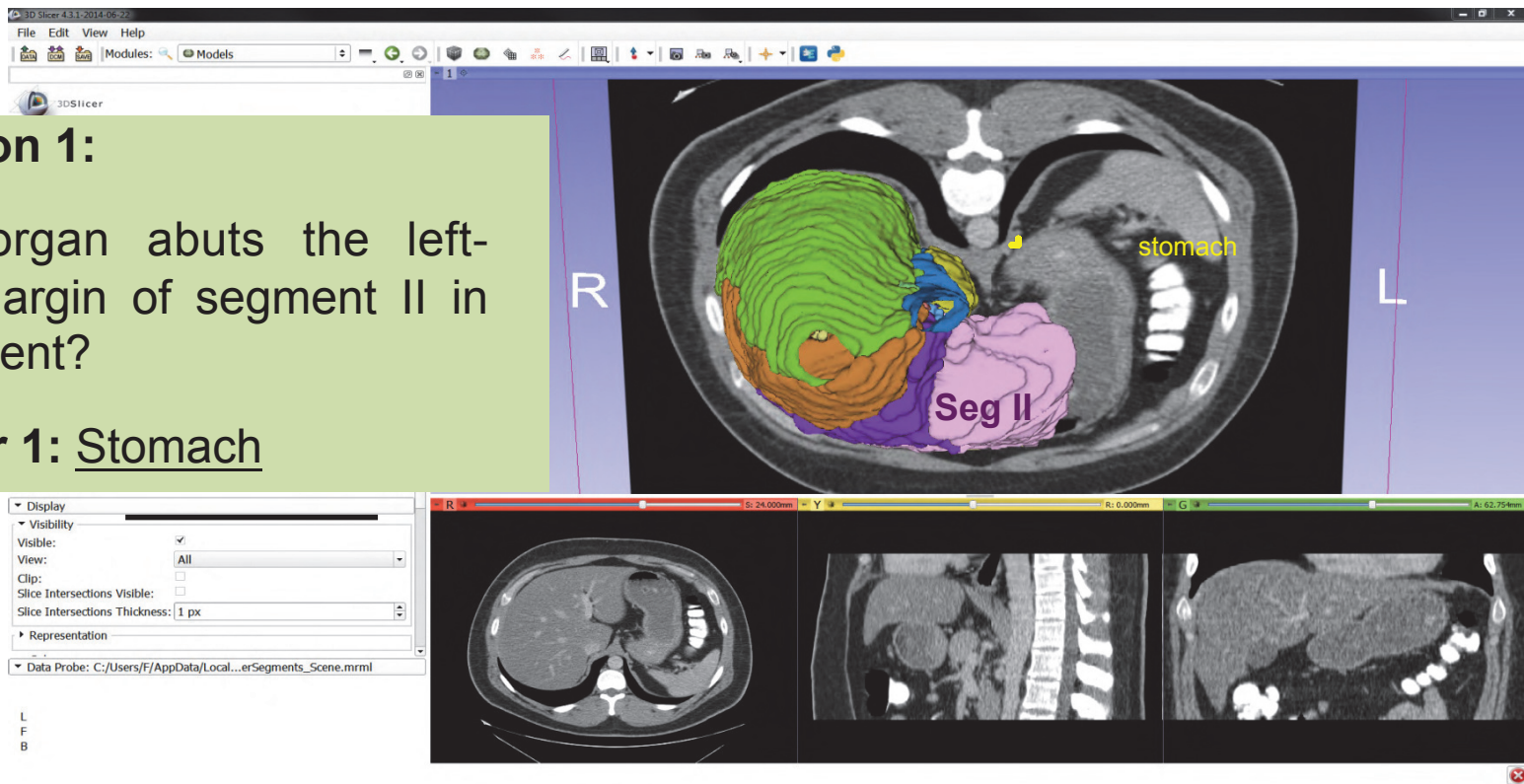


3D Exploration of Liver Segments

Question 1:

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

Answer 1: Stomach

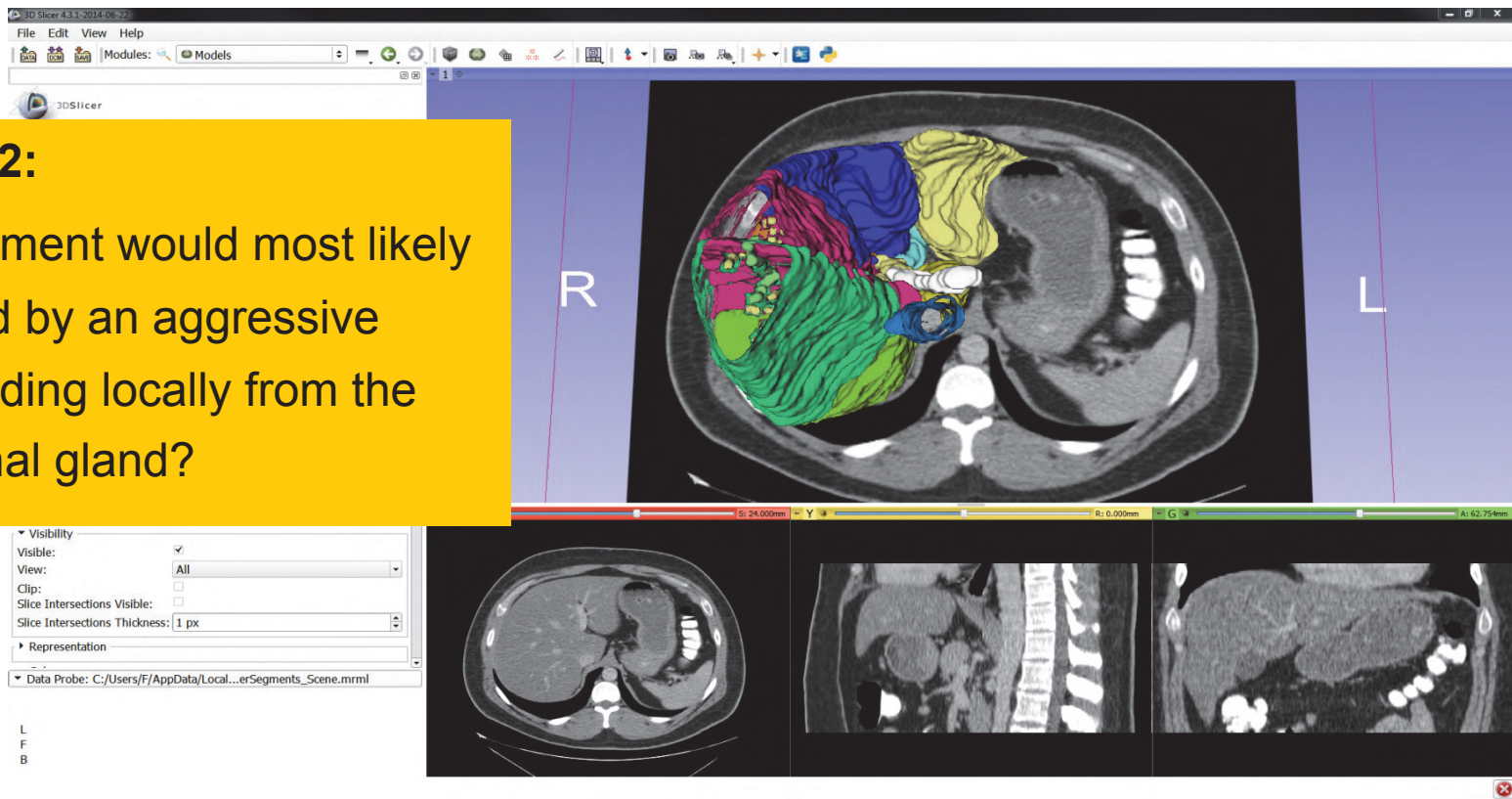




3D Exploration of Liver Segments

Question 2:

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



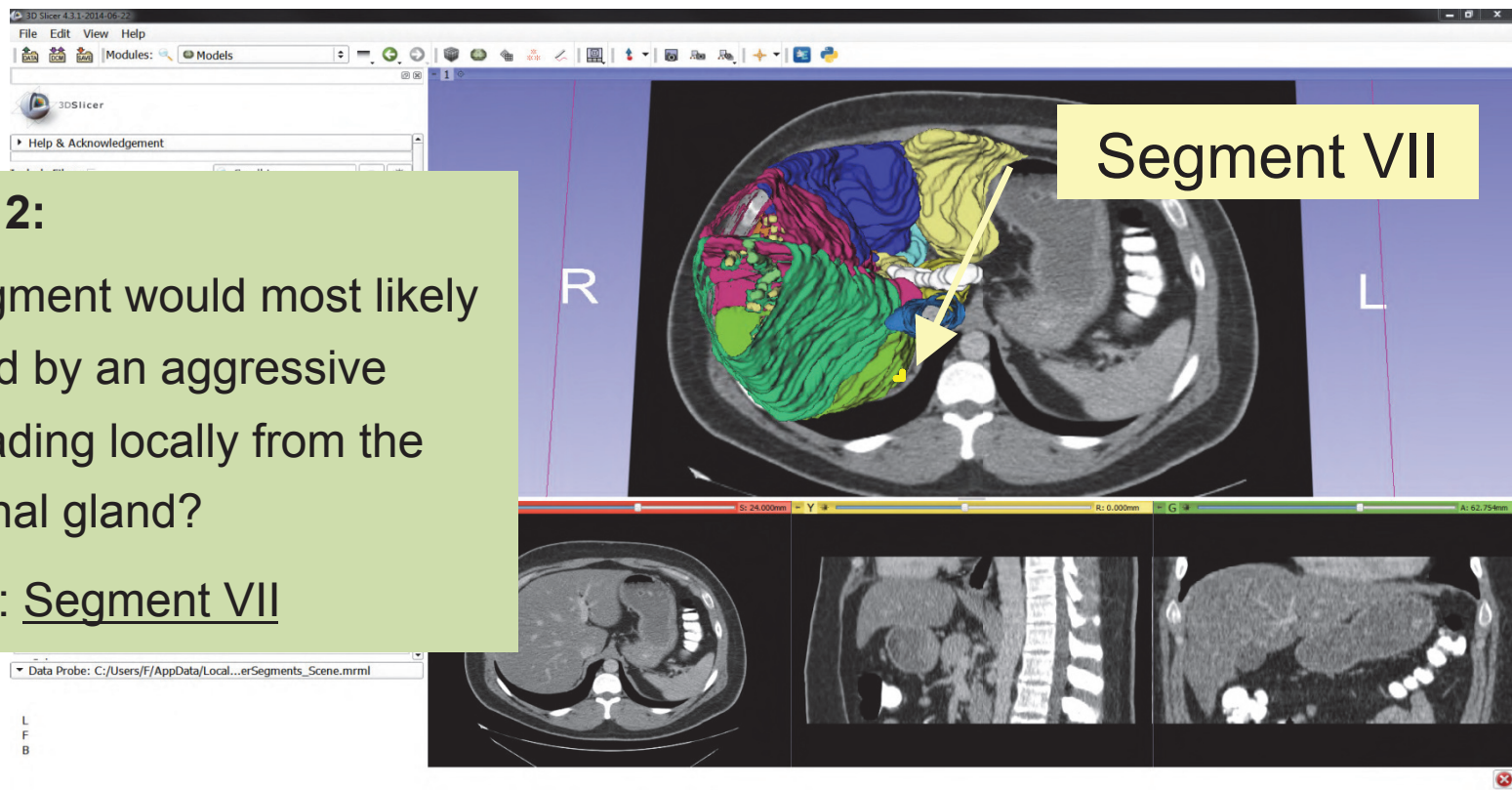


3D Exploration of Liver Segments

Question 2:

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

Answer 2: Segment VII





3D Exploration of Liver Segments

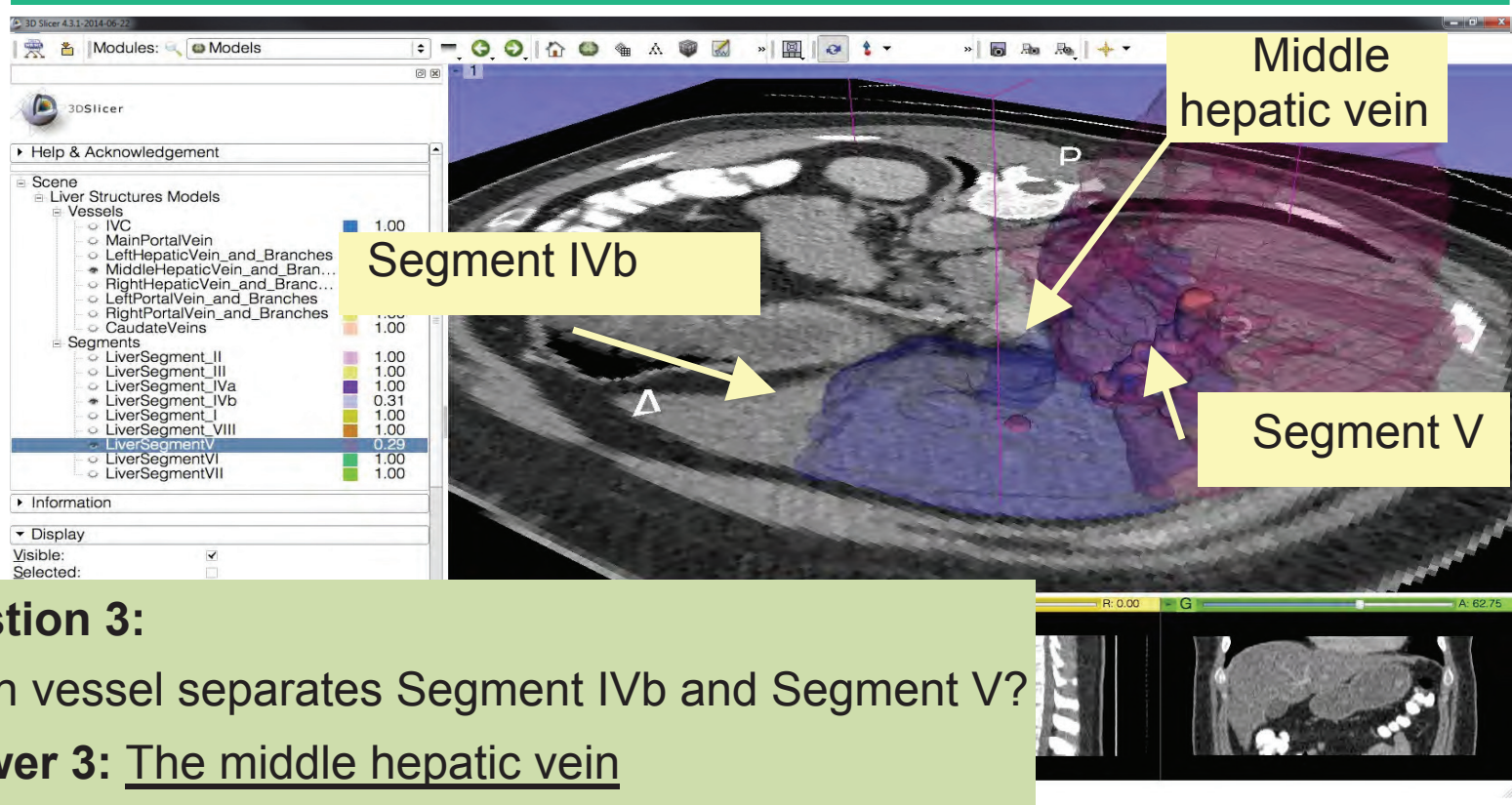


Question 3:

Which vessel separates Segment IVb and Segment V?

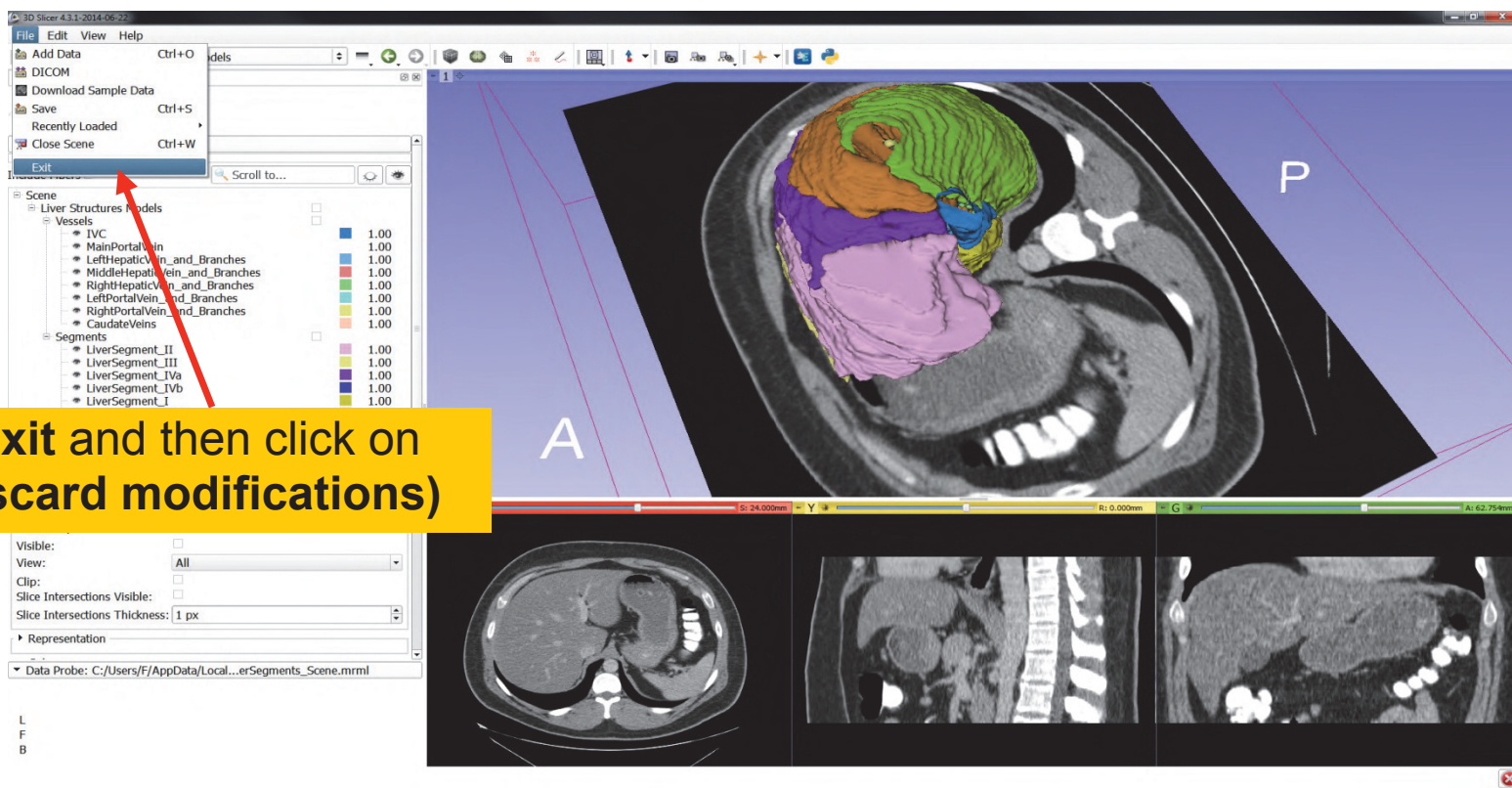


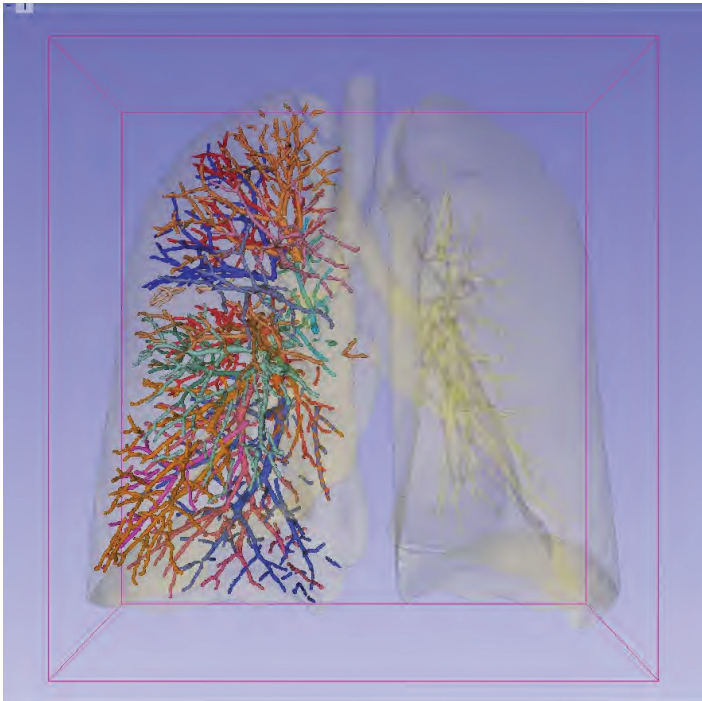
Middle Hepatic Vein





Closing the Liver Scene

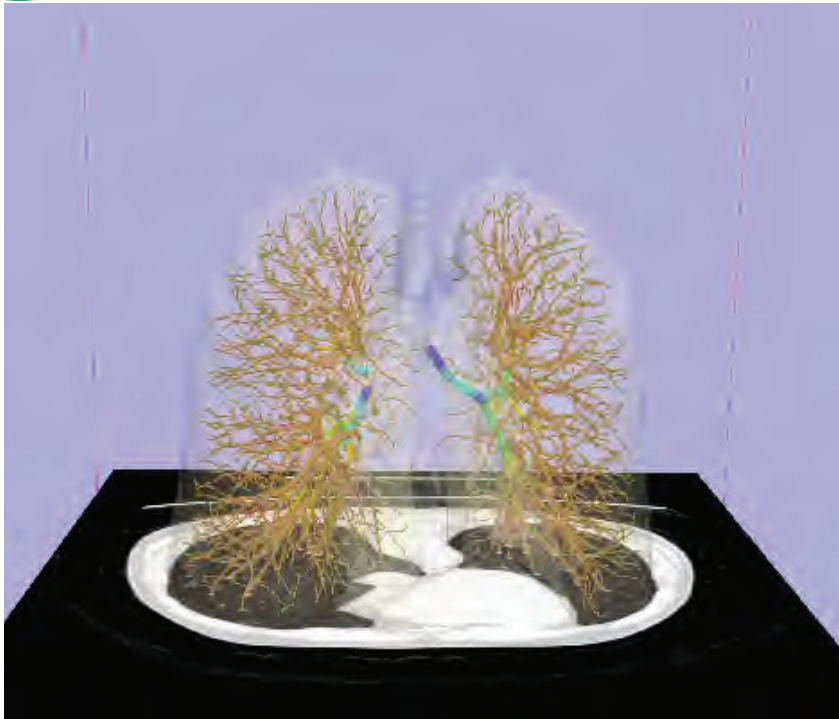




Interactive 3D Visualization of the segments of the lungs



Segments of the lung



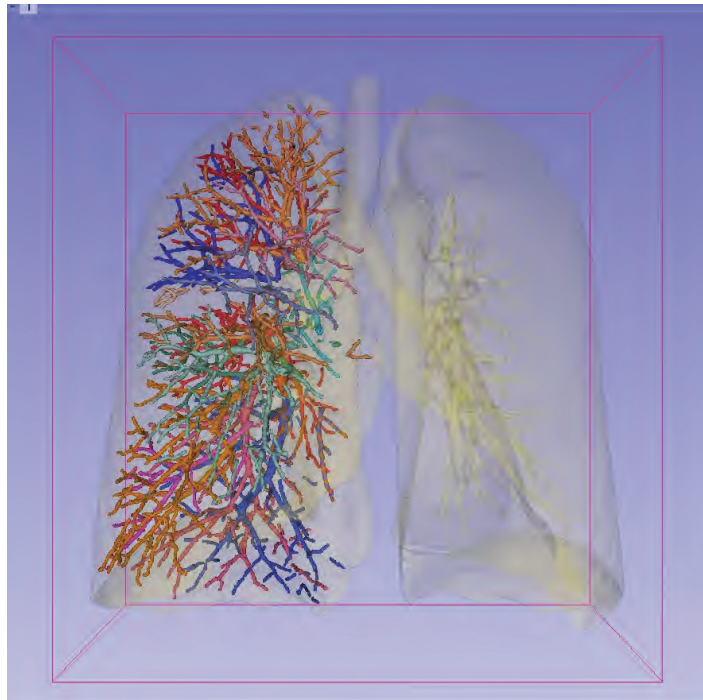
Segmentation and 3D surface reconstruction of the lung and pulmonary vessels

Acknowledgment:

Segmentation of the lung surface and vasculature: Raul San Jose Estepar, Ph.D., George Washko, M.D., Ed Silverman, M.D. and James Ross, MSc. Brigham and Women's Hospital (K25 HL104085) and COPDGene (01 HL089897 and U01 HL089856)



Segments of the lung

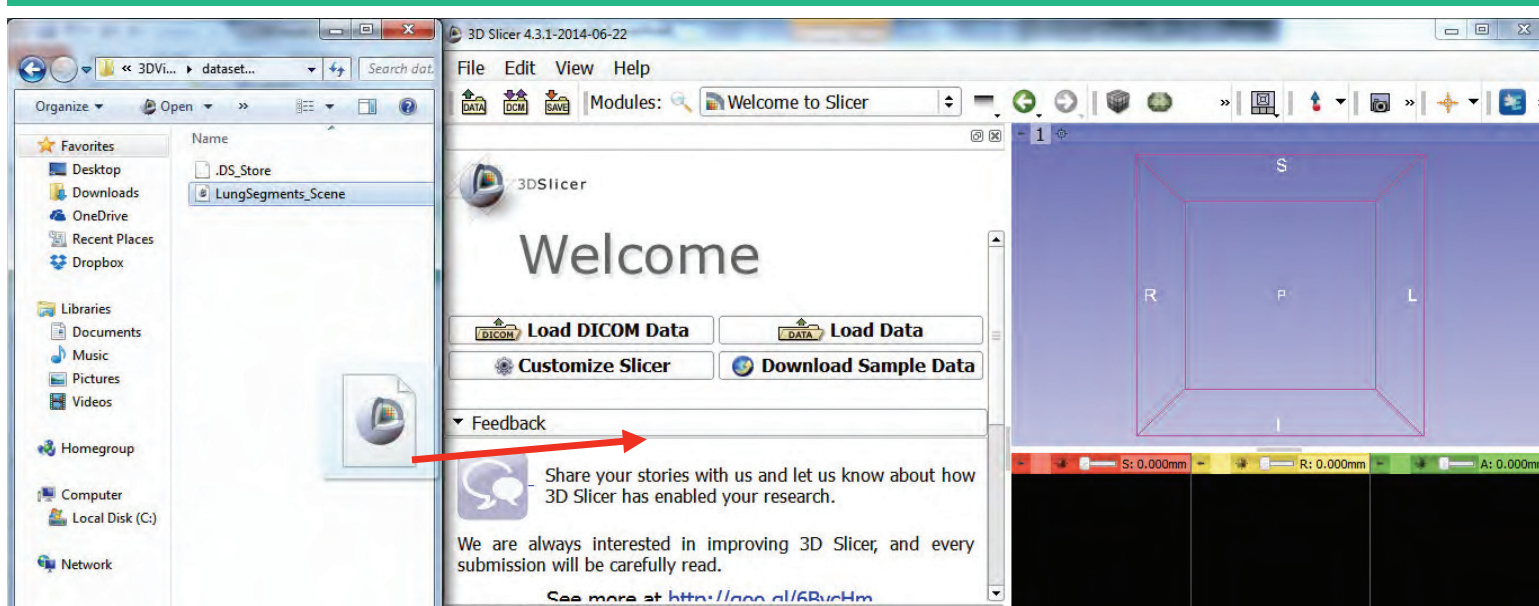


3D parcellation of arteries and veins from original model of pulmonary vessels
(Kitt Shaffer, M.D., Ph.D. - Sonia Pujol, Ph.D.)

- Right Upper Lobe (RUL)
 - RUL Pulmonary Vein
 - RUL Anterior Segment
 - RUL Apical Segment
 - RUL Posterior Segment
- Right Middle Lobe (RML)
 - RML Pulmonary Vein 1 & 2
 - RML Lateral Segment
 - RML Medial Segment
- Right 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



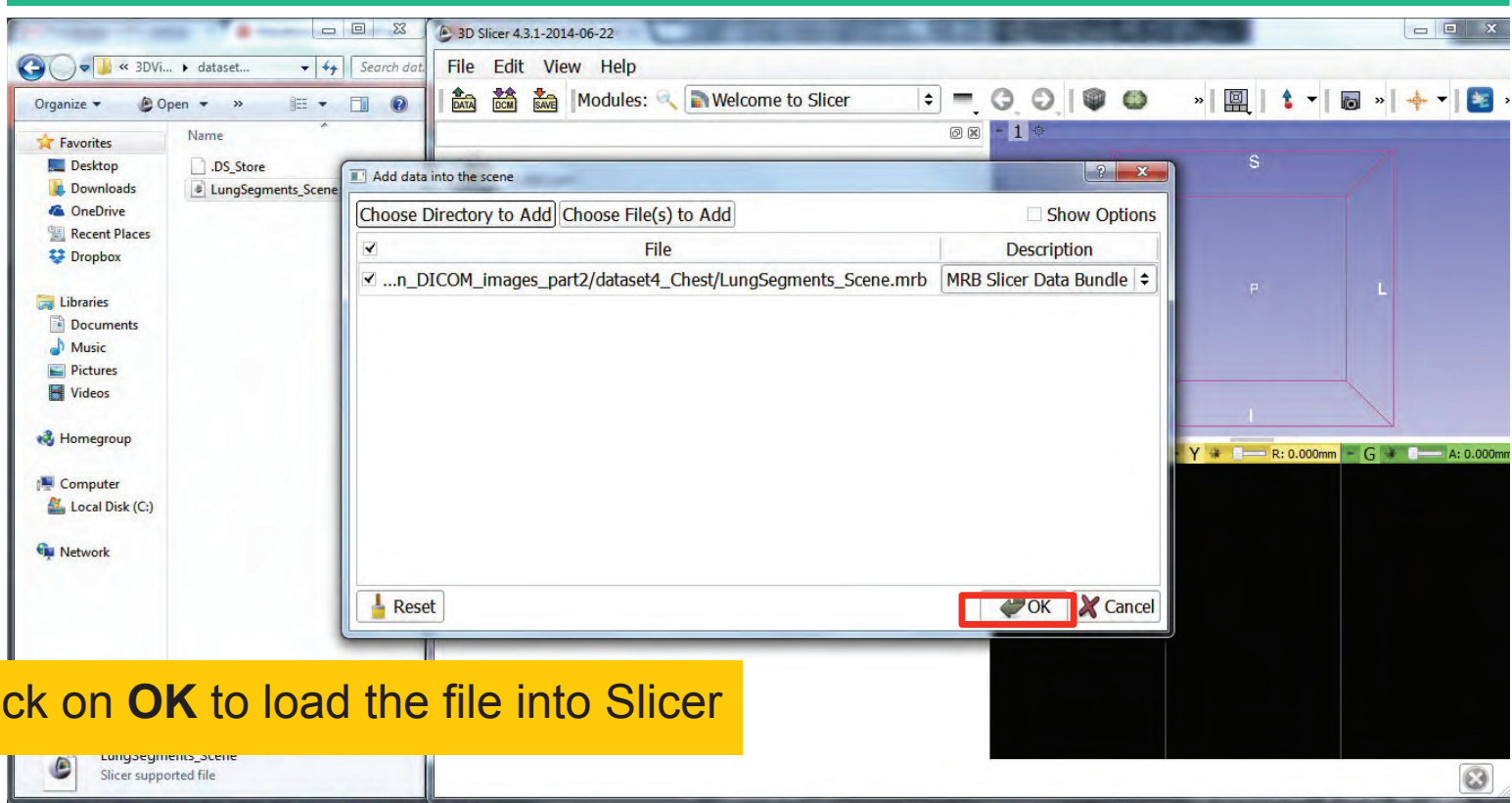
Loading the Chest Data Scene



Open the directory `C:\3DSlicerData_RSNA2014\3DVisualizationDICOM_Monday_Dec1`
Select the subdirectory `dataset4_Chest`
Drag and drop the file `LungSegments_Scene.mrb` into Slicer

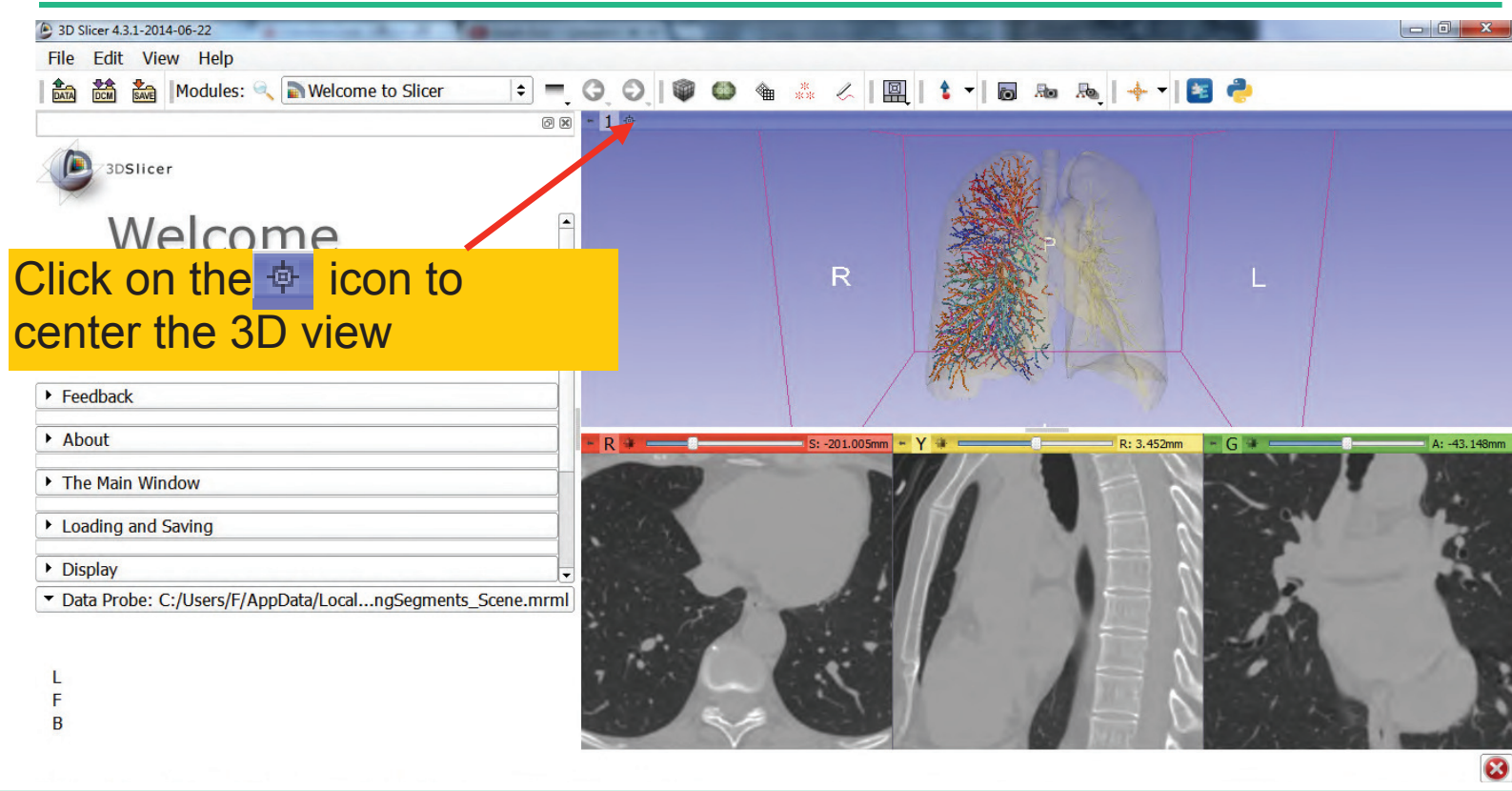


Loading the Lung Scene



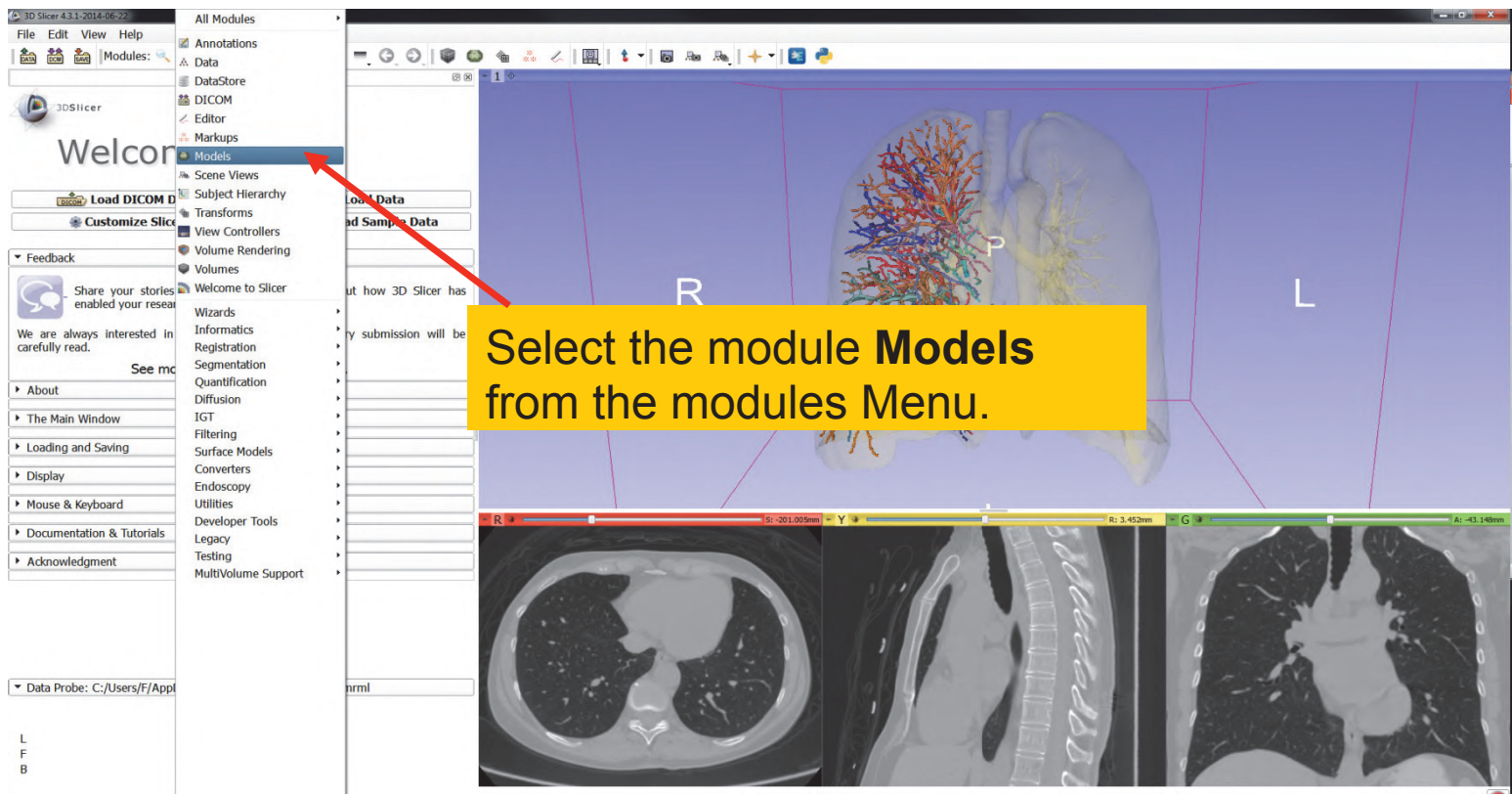


Loading the Lung Scene



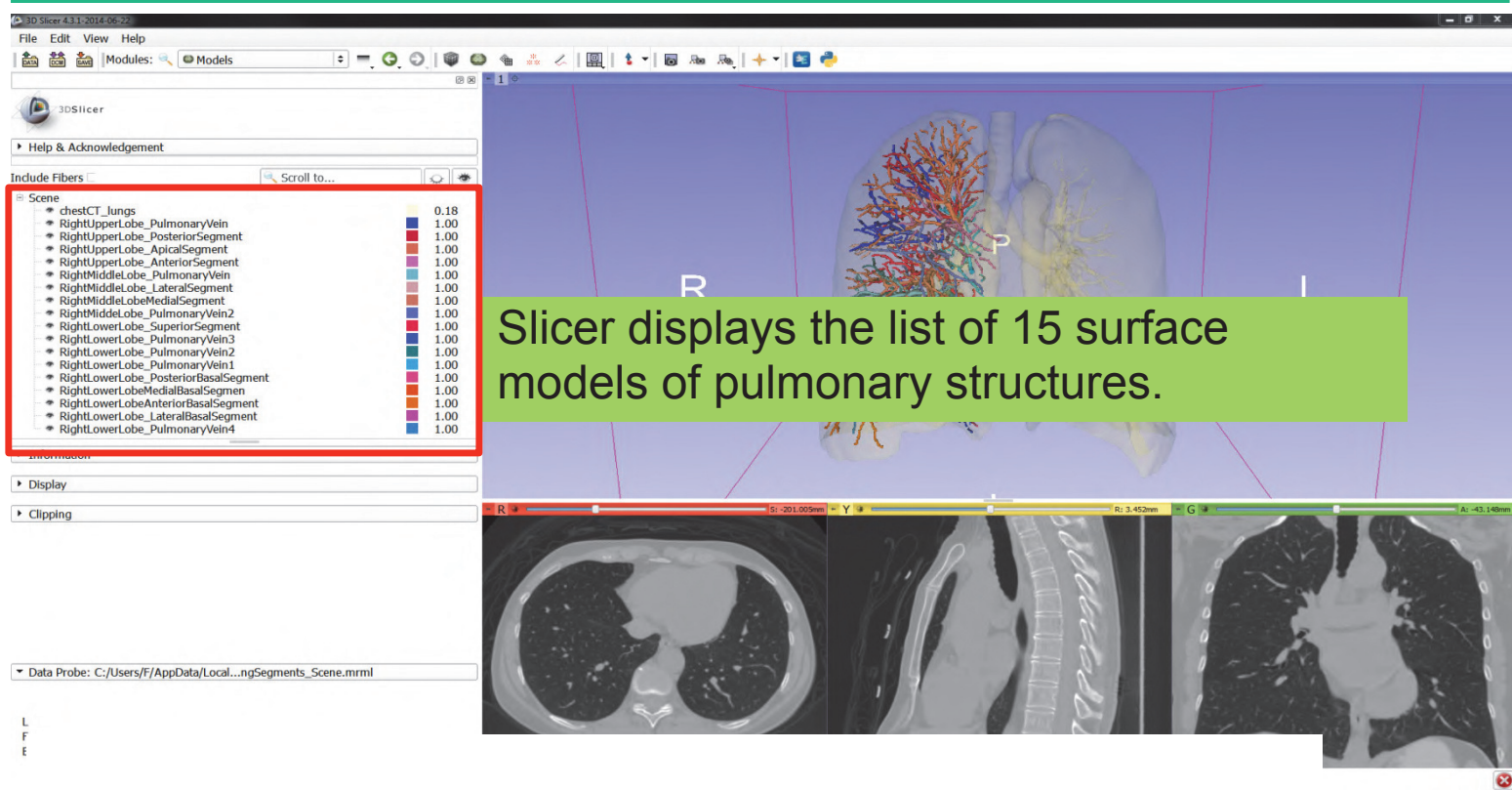


Loading the Lung Scene





Lung Segments





Lung Segments – Question 1

The screenshot shows the 3D Slicer interface with a 3D model of lung segments. The 'Include Fibers' list on the left contains the following items:

Segment Name	Value
RightUpperLobe_AnteriorSegment	1.00
RightMiddleLobe_PulmonaryVen1	1.00
RightMiddleLobe_LateralSegment	1.00
RightMiddleLobeMedialSegment	1.00
RightLowerLobe_PulmonaryVen2	1.00
RightLowerLobe_SuperiorSegment	1.00
RightLowerLobe_PulmonaryVen3	1.00
RightLowerLobe_PulmonaryVen2	1.00
RightLowerLobe_PulmonaryVen1	1.00
RightLowerLobe_PosteriorBasalSegment	1.00
RightLowerLobeMedialBasalSegment	1.00
RightLowerLobeAnteriorBasalSegment	1.00
RightLowerLobe_LateralBasalSegment	1.00
RightLowerLobe_PulmonaryVen4	1.00

Two white arrows point to a gap in the vessels. A yellow box contains the question: **Q1: Why is there a gap in the vessels at the arrows?**



Lung Segments – Question 2

The screenshot shows the 3D Slicer interface with a 3D model of lung segments. A red arrow labeled 'S' points to a specific segment. The sidebar on the left lists the segments and their visibility settings:

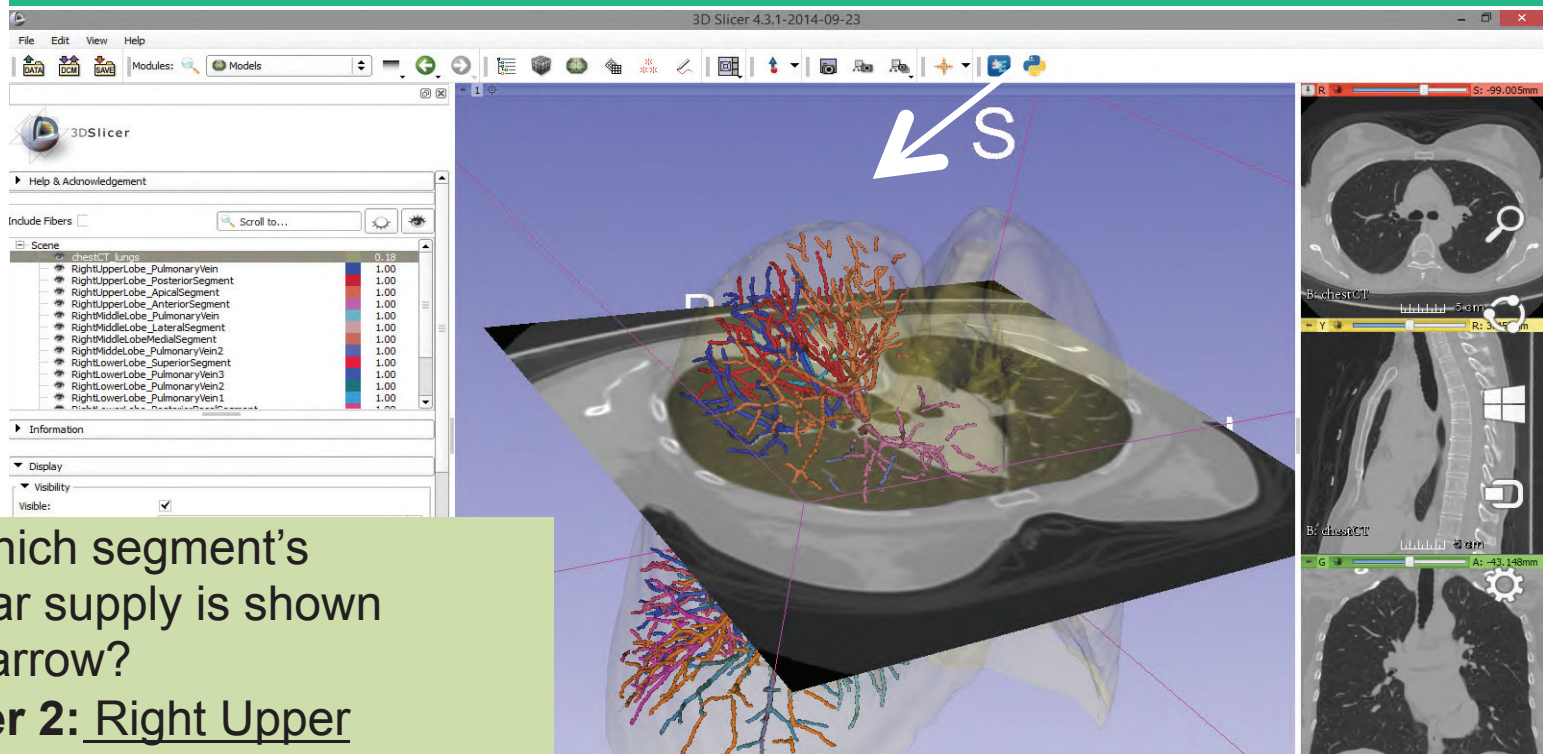
Segment Name	Visibility
RightUpperLobe_PulmonaryVein	1.00
RightUpperLobe_PosteriorSegment	1.00
RightUpperLobe_ApicalSegment	1.00
RightUpperLobe_AnteriorSegment	1.00
RightMiddleLobe_PulmonaryVein	1.00
RightMiddleLobe_LateralSegment	1.00
RightMiddleLobe_MedialSegment	1.00
RightMiddleLobe_SuperiorVein2	1.00
RightMiddleLobe_SuperiorSegment	1.00
RightLowerLobe_PulmonaryVein3	1.00
RightLowerLobe_PulmonaryVein2	1.00
RightLowerLobe_PulmonaryVein1	1.00

The main 3D view shows the lung segments with a red arrow labeled 'S' pointing to a segment. The interface also includes a sidebar with 'Include Fibers' and 'Information' sections, and a main 3D view area with a red arrow labeled 'S' pointing to a segment.

Q2: Which segment's vascular supply is shown at the arrow?



Lung Segments – Question 2

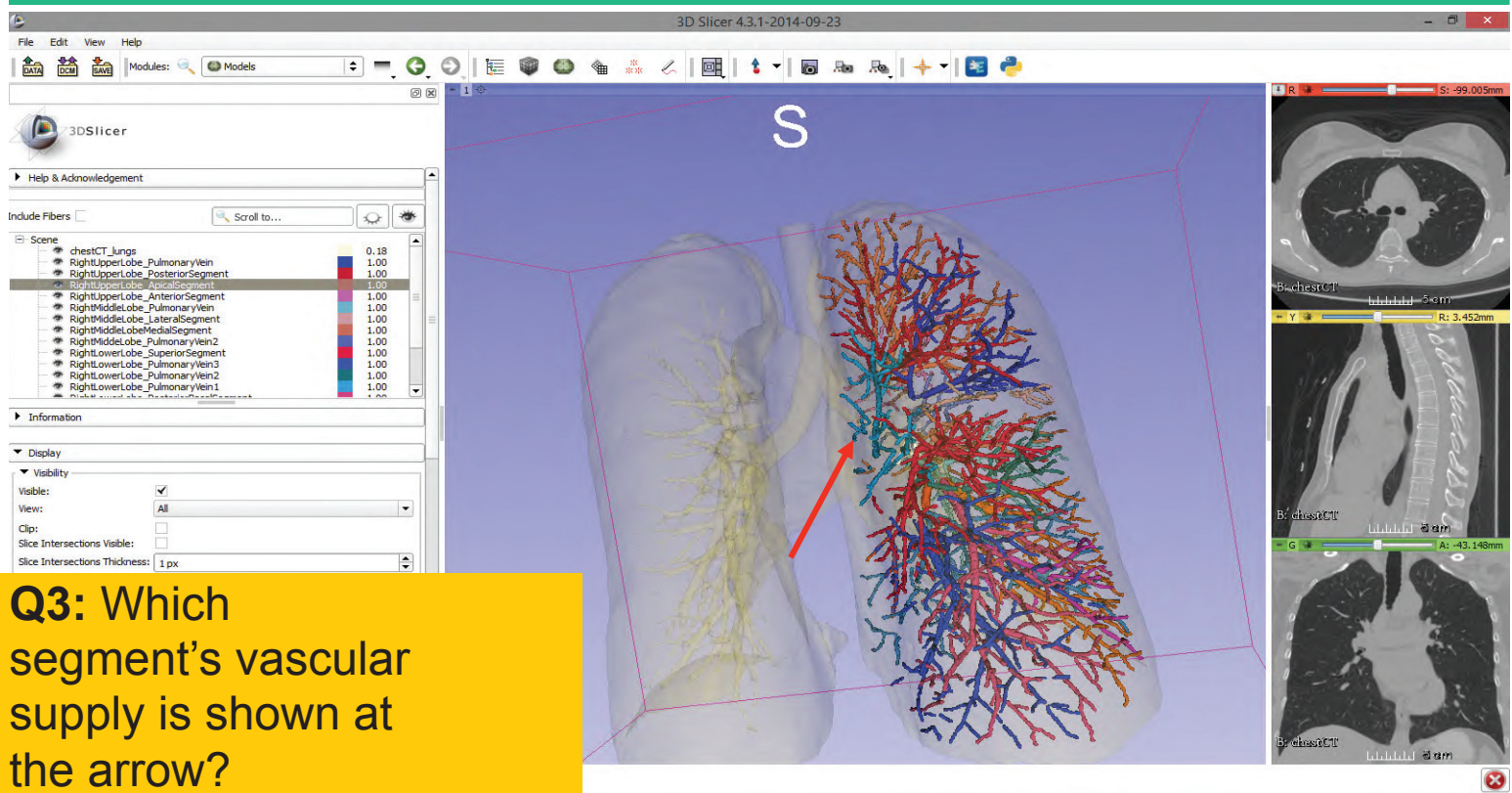


Q2: Which segment's vascular supply is shown at the arrow?

Answer 2: Right Upper Lobe Apical Segment



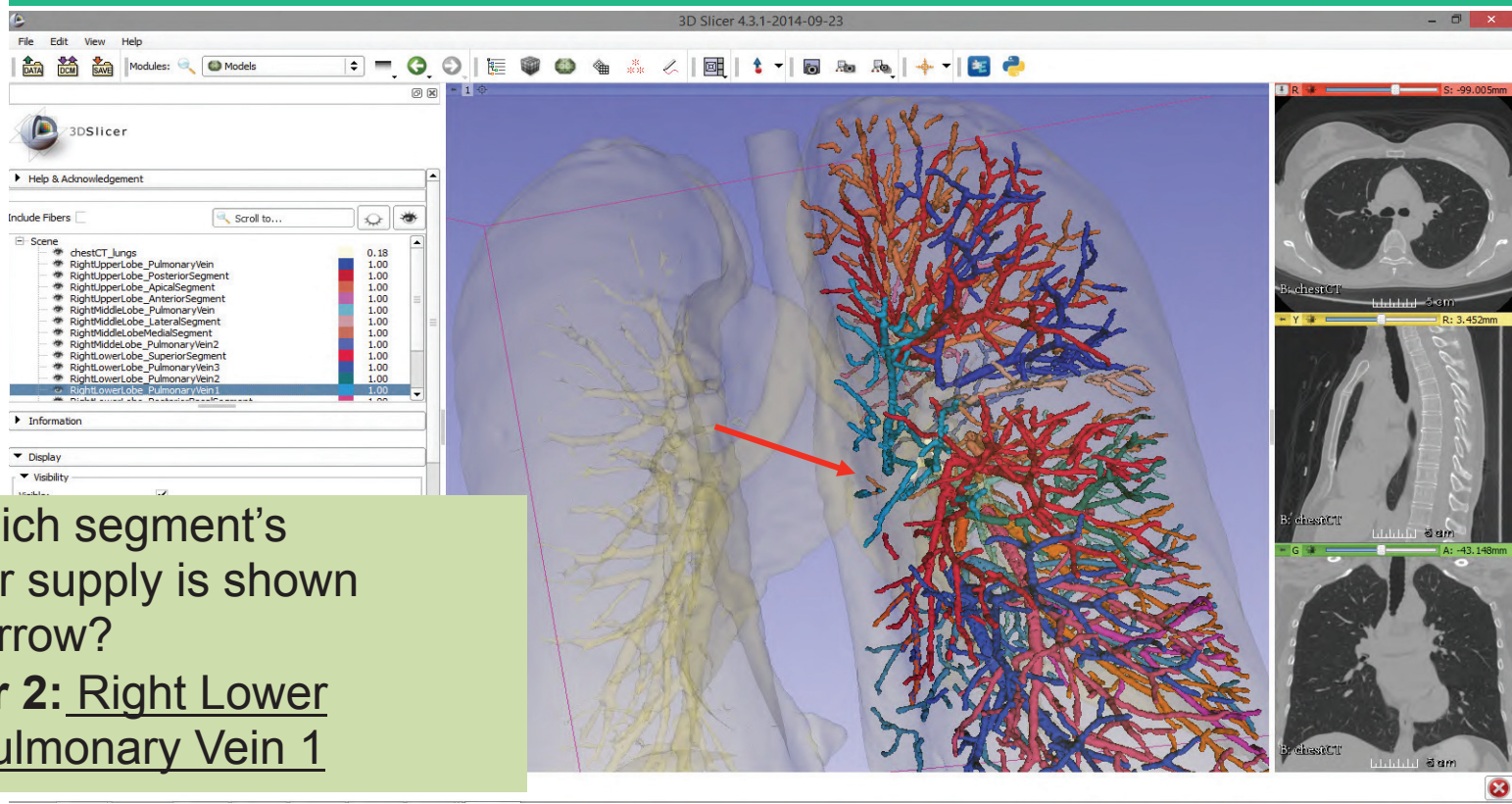
Lung Segments – Question 3



Q3: Which segment's vascular supply is shown at the arrow?



Lung Segments – Question 3



Q3: Which segment's vascular supply is shown at the arrow?
Answer 2: Right Lower Lobe Pulmonary Vein 1

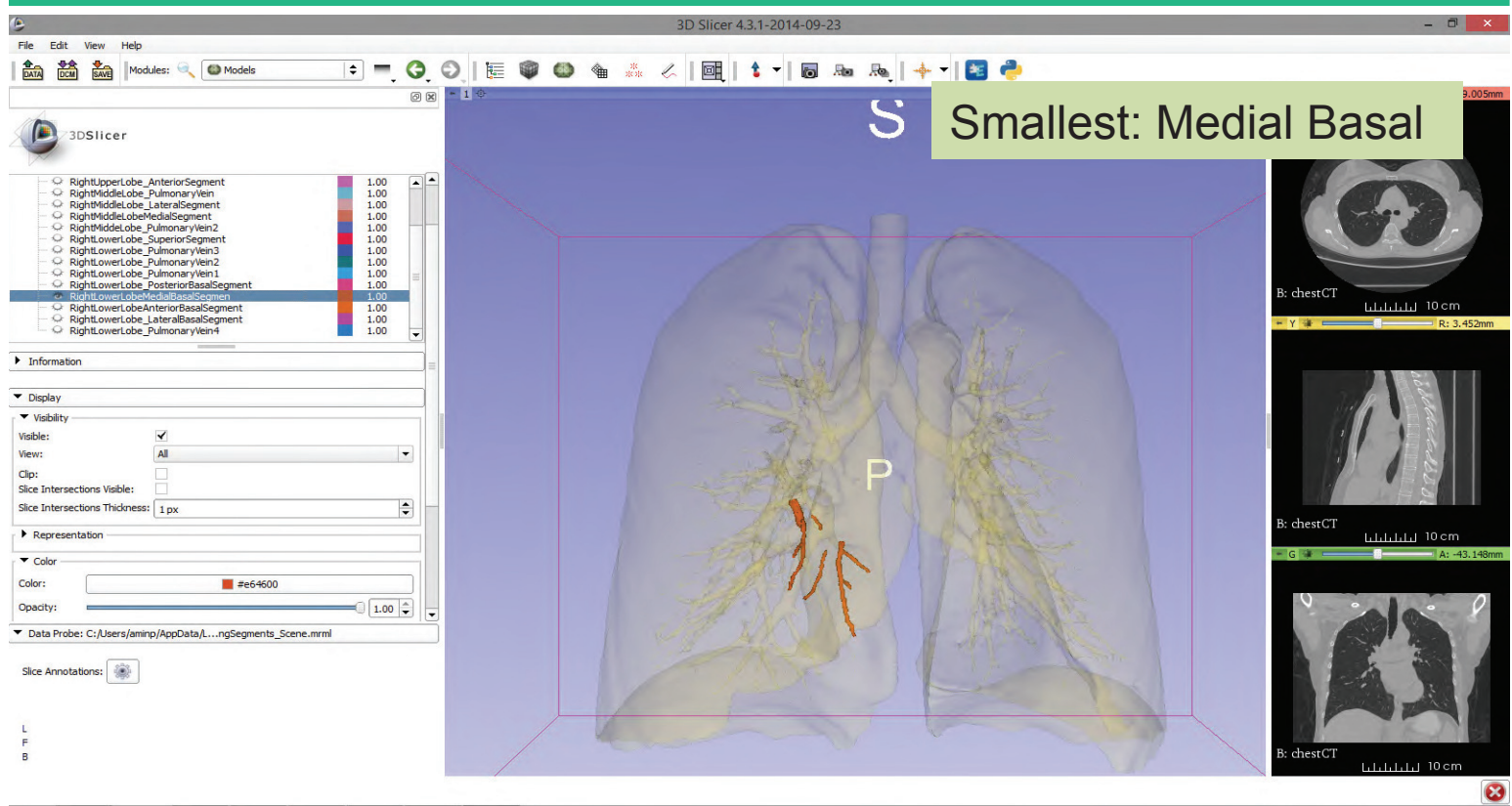


Lung Segments – Question 4

Q4: Classify the segments of the lower lobe by size.

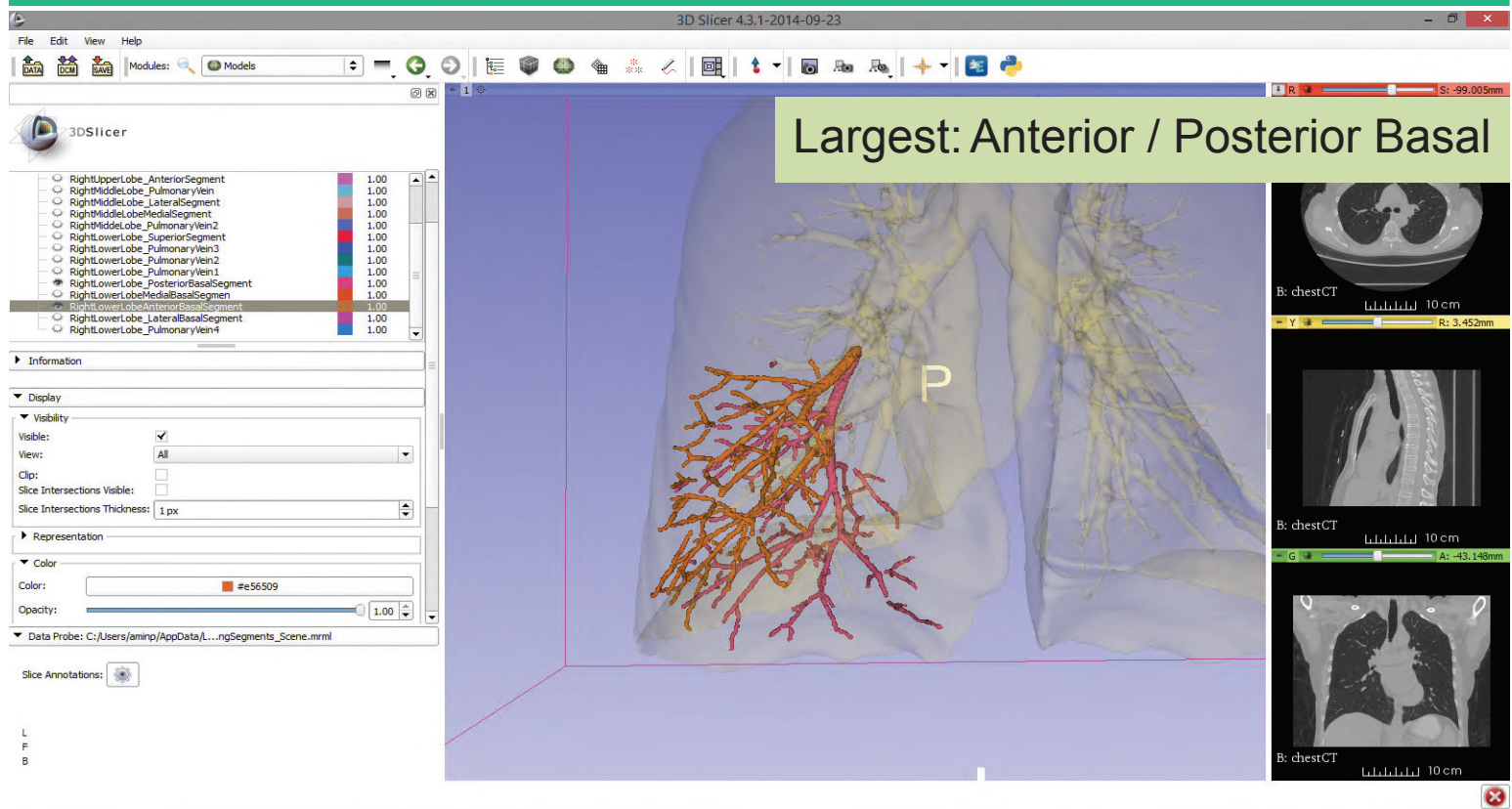


Lung Segments – Question 4



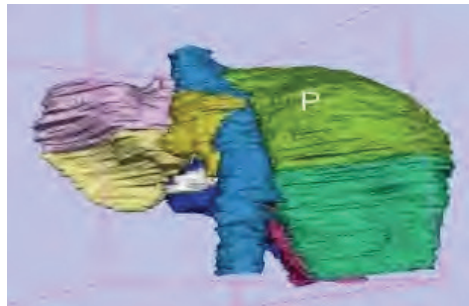
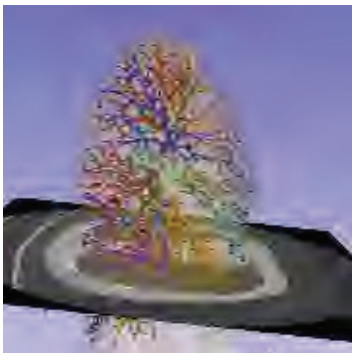
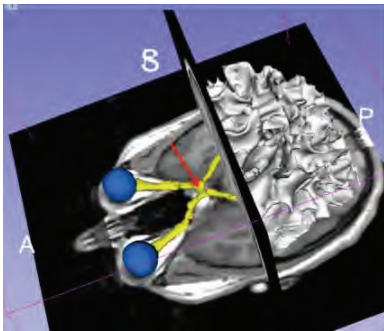


Lung Segments – Question 4





3D Visualization of DICOM images



- Interactive user-interface to load and manipulate greyscale volumes, labelmaps and 3D models.
- User-defined 3D view of the anatomy
- 3D Open-source platform for Linux, Mac and Windows



3DSlicer website





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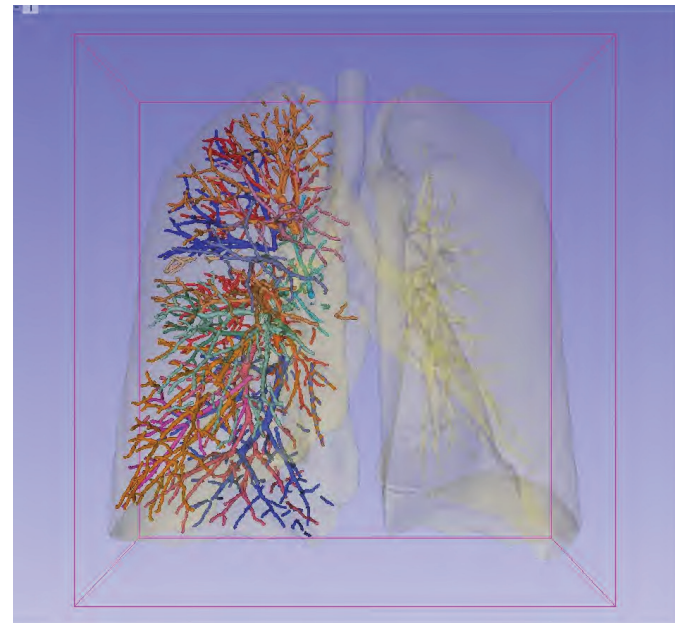
• Parth Amin, WIT '16



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www.slicer.org
www.na-mic.org



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