



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

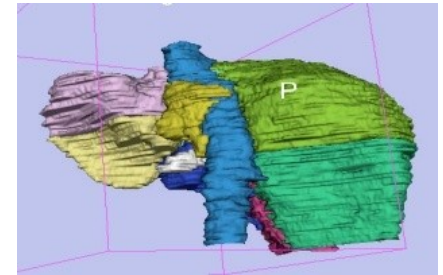
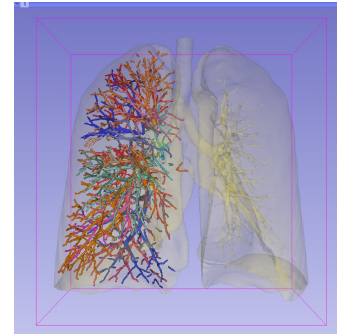
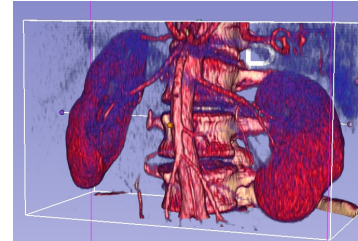
Kitt Shaffer, MD, PhD, Boston University
Vice-Chairman for Education, Boston University School of Medicine

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



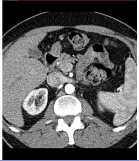
3D Visualization of DICOM images for Radiological applications

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.**

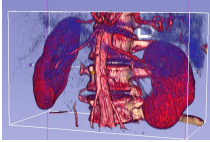




Overview

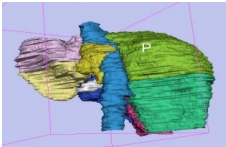
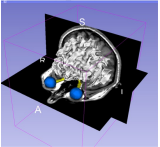


Part I: Introduction to the 3DSlicer software



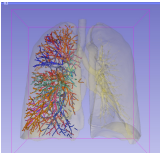
Part II: 3D Data Loading and visualization of DICOM images

- 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





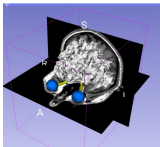
Tutorial Datasets

The tutorial data include 4 datasets:



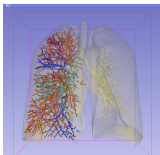
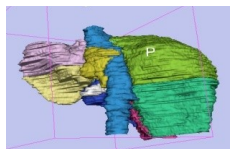
3D Visualization DICOM images part 1:

- dataset1_Thorax_Abdomen
- dataset2_Head



3D Visualization DICOM images part 2

- dataset3_Liver
- dataset4_Chest

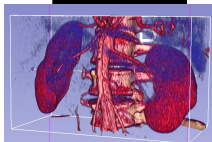




Overview

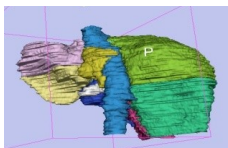
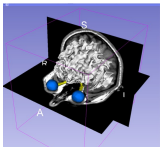


Part I: Introduction to the 3DSlicer software



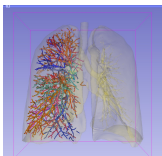
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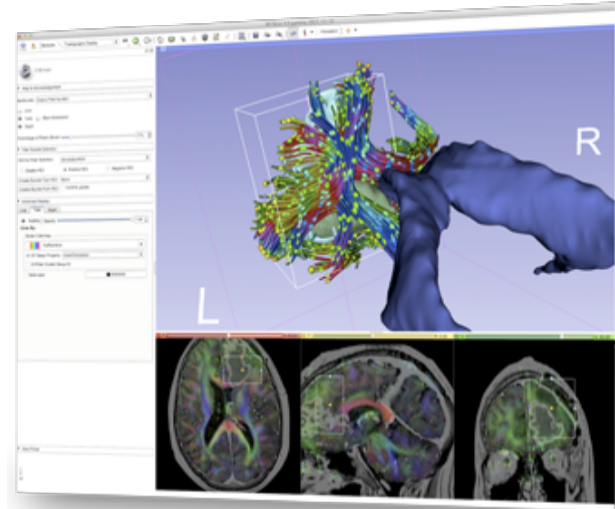
Part III: 3D interactive exploration of the anatomy

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



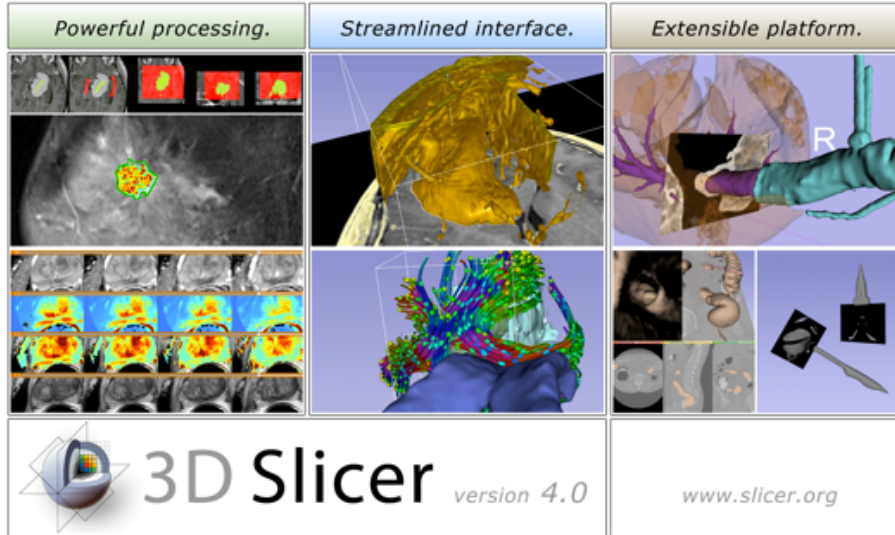


Introduction to the 3DSlicer software





3DSlicer

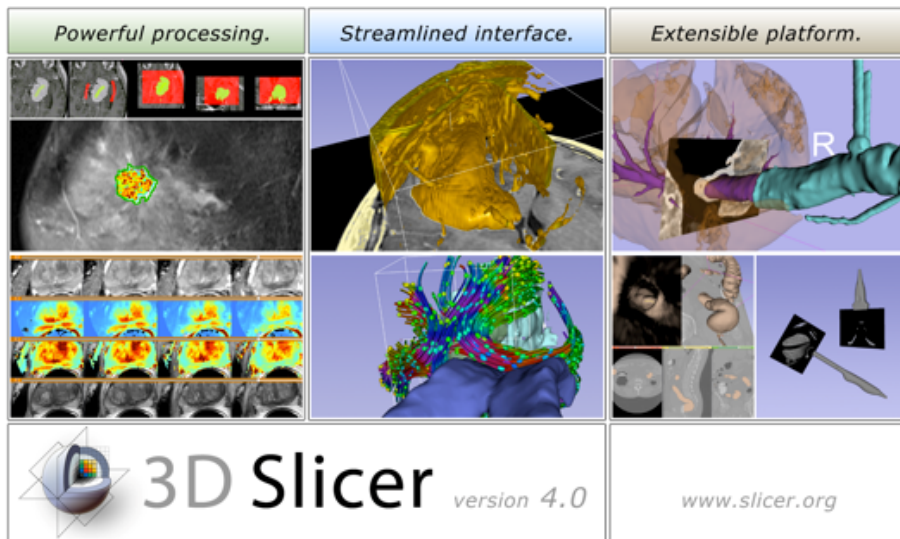


3D Slicer is a freely available **open-source** platform for segmentation, registration and 3D visualization of medical imaging data.

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

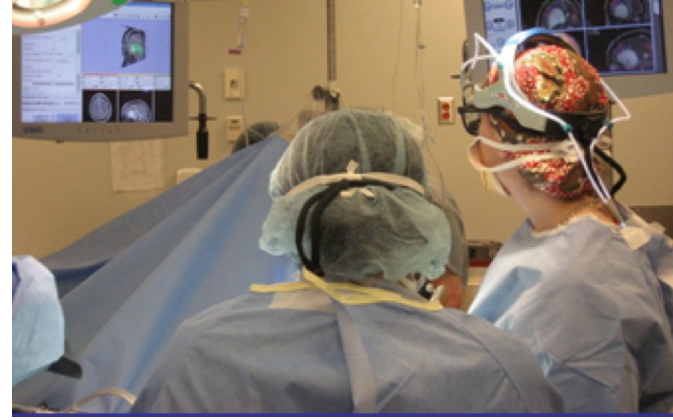
It is the responsibility of the user of 3DSlicer to comply with both the terms of the license and with the applicable laws, regulations and rules.



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)

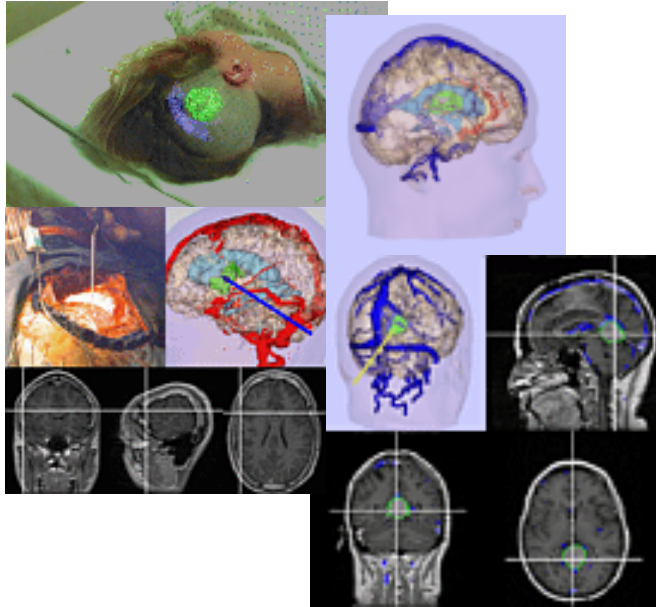


Image Courtesy of the CSAIL, MIT



3DSlicer History

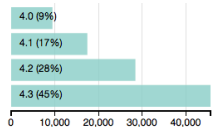


Slicer4 download stats

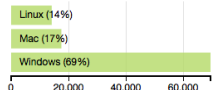
Date range

Nov 28, 2011 - Sep 24, 2014

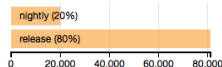
Version



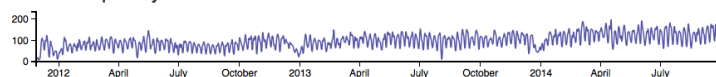
Operating system



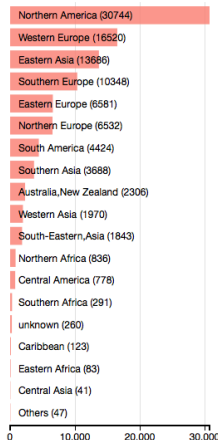
Stability



Downloads per day



Region



Country



101,101

- 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

NA-MIC Wiki

General

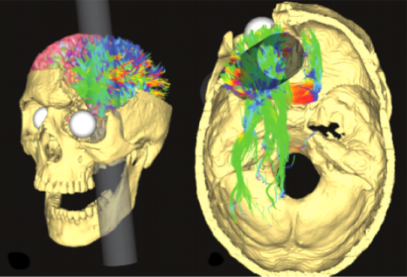
- Overview
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Center Components

- Algorithms
- Engineering
- Driving Biological Projects
- Collaboration Grants

Resources

- Publication DB
- Image Gallery
- Downloads
- Service
- Training
- Dissemination
- Events
- Links



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 research community.

Supported by the National Institutes of Health (NIH) and the National Science Foundation (NSF).

Information about collaborating with NA-MIC



Neuroimage Analysis Center

"understanding the human brain through imaging"

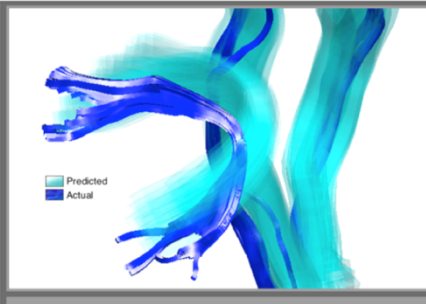
Google Custom Search

About the NAC

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- Collaborations

Resources

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- Image Gallery
- Downloads
- Training
- Web Archive



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 fMRI activation peaks and 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 dissections 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.

Research supported by the National Center for Research Resources (NCRR) (P30 RR021311) and the Institute of Biomedical Imaging and Bioengineering (NIH) (P41 EB005547).



National Center for Image-Guided Therapy


NCIGT Wiki

About Us

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- Research Projects
- DBPs
- People

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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.

PI: Ron Kikinis, M.D.

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



Slicer: Behind the scenes

CDash - Slicer4

http://www.cdash.org/slicer4/index.php?project=Slicer4

RSNA 2011 - NAMIC | CDash - Slicer4

Login | All Dashboards

Slicer4

Dashboard | Calendar | Previous | Current | Project

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

Nightly-Packages

Site	Build Name	Update	Configure			Build	
		Files	Error	Warn		Error	Warn
factory-win7.kitware	Windows7-VS2010-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0		2	107
factory-mac-64bits.kitware	SnowLeopard-g++4.2.1-64bits-QT4.7-PythonQt-With-Tcl-CLI-Release	1	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	13
factory-win7.kitware	Windows7-VS2008-64bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0		0	1000
factory-win7.kitware	Windows7-VS2008-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	1	0	0		0	1000

Nightly

Site	Build Name	Update	Configure			Build			Test			Build Time
		Files	Error	Warn		Error	Warn		Not Run	Fail	Pass	
whitecube.kitware	SnowLeopard-gcc4.2.1-QT4.7.0-PythonQt-With-Tcl-Release	1	0	0		27	190		0	96	391	11 hours ago
youpi.sci.utah.edu	OpenSuse-c++4.5.0-64bits-QT4.6.3-PythonQt-With-Tcl-NoCLI-Release	0	0	0		0	15		0	304	6	11 hours ago
eris.kitware	Linux-g++4.4-QT4.6.3-PythonQt-CLI-Release	1	0	0		0	15		0	36	451	3 hours ago
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-QT4.7-PythonQt-With-Tcl-CLI-Vaigrind-Release	0	0	0		0	13		0	27	460	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	12		0	23	287	11 hours ago
sagarmatha.kitware	Linux-g++4.3.3-QT4.7-PythonQt-With-Tcl-NoCLI-Release	0	0	0		0	12		0	22	288	12 hours ago

Continuous

Site	Build Name	Update	Configure			Build			Test			Build Time
		Files	Error	Warn		Error	Warn		Not Run	Fail	Pass	
youpi.sci.utah.edu	OpenSuse-c++4.5.0-64bits-QT4.6.3-PythonQt-With-Tcl-NoCLI-Release	2	0	0		0	0		0	304	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

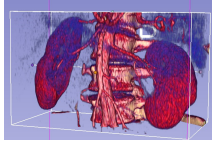
- 3DSlicer: An Open Source Platform for Segmentation, Registration, Quantitative Imaging, and 3D Visualization of Multi-Modal Image Data.



Overview

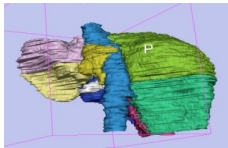
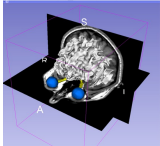


Part I: Introduction to the 3DSlicer software



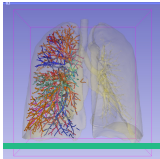
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- Surface Rendering of MR head data



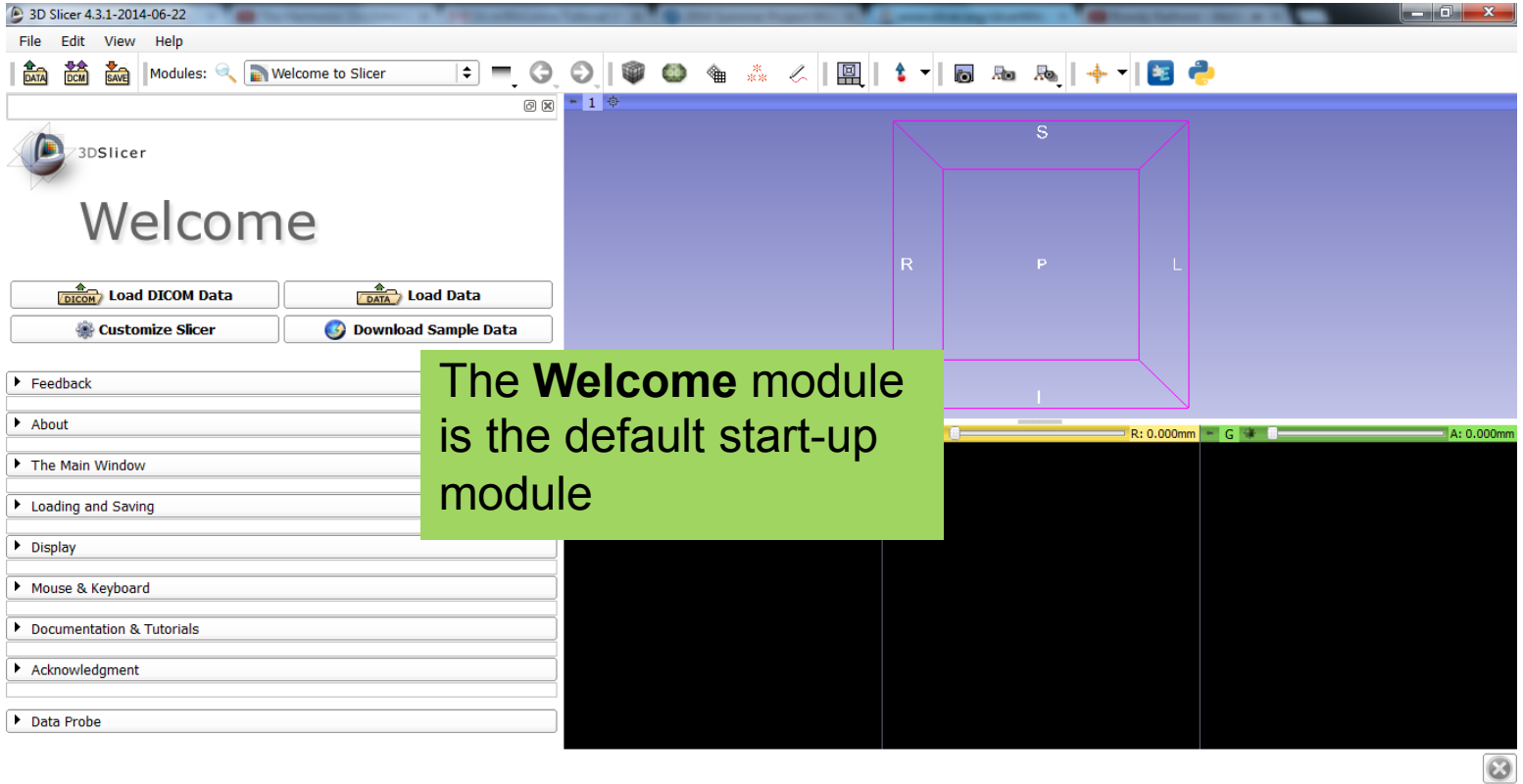
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- Exploration of the Segments of the lung





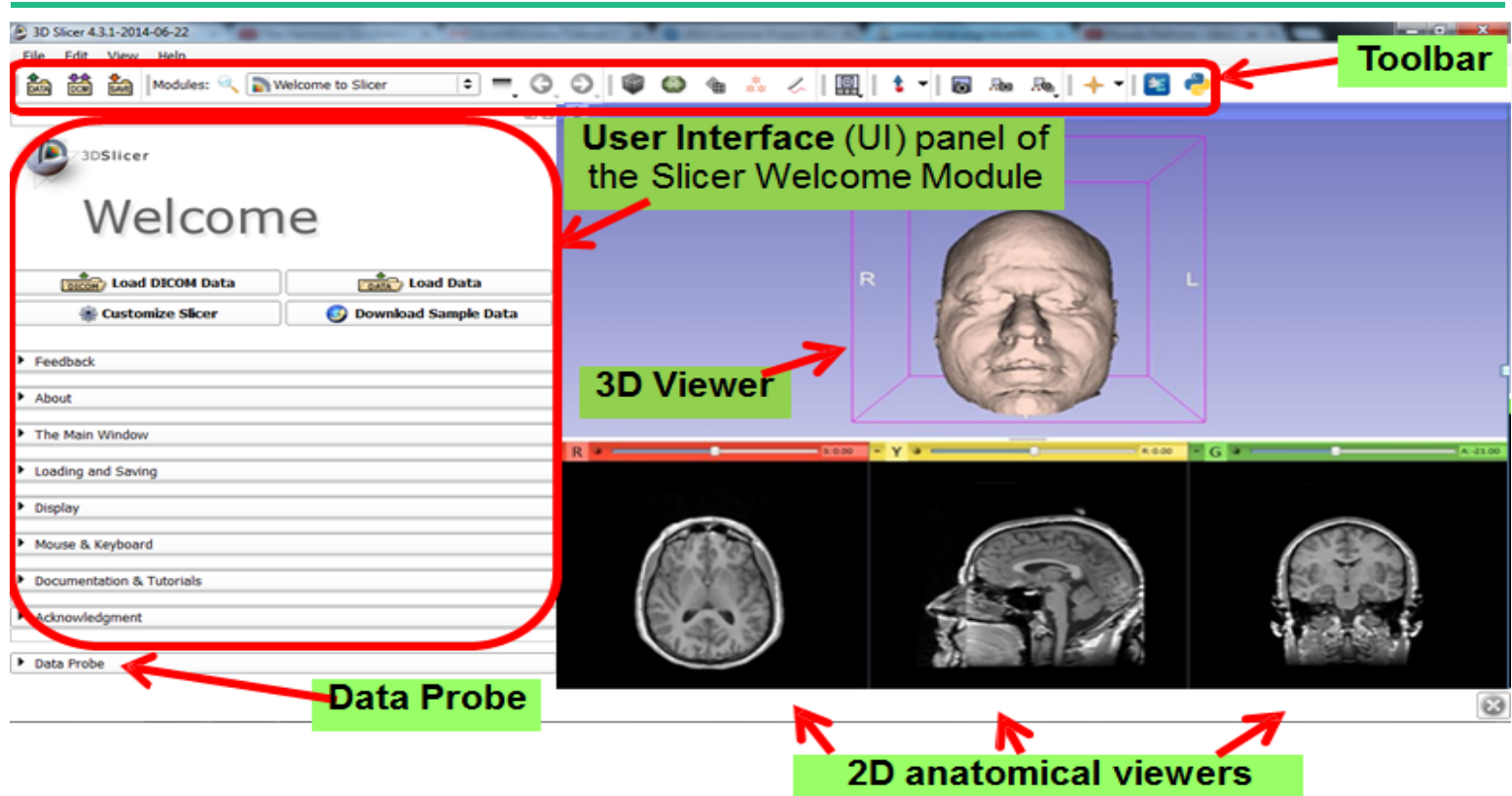
Welcome to Slicer4



The **Welcome** module is the default start-up module



Navigating the Application GUI





Welcome to Slicer4.3.1.1

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

The screenshot shows the Slicer4.3.1.1 application. The 'Modules' menu is open, displaying a list of modules. A red arrow points to the 'Welcome to Slicer' option at the top of the list. The background shows the main Slicer window with a 'Welcome' dialog box.

Modules:

- Welcome to Slicer
- All Modules
- Annotations
- Data
 - DICOM
- Editor
- Models
- Scene Views
- Transforms
- View Controllers
- Volume Rendering
- Volumes
- Welcome to Slicer
- Wizards
 - Informatics
 - Registration
 - Segmentation
 - Quantification
 - Diffusion
 - IGT
 - Filtering
 - Surface Models
 - Converters
 - Endoscopy
 - Utilities
 - Developer Tools
 - Legacy
 - Testing
- Work in Progress

ACPC Transform

Add Scalar Volumes

Affine Registration

Annotations

AtlasTests

BSpline Deformable Registration

BSpline to deformation field

Cameras

Cast Scalar Volume

ChangeTracker

Charting

CheckerBoard Filter

Colors

Create a DICOM Series

Crop Volume

Curvature Anisotropic Diffusion

Data

- DataProbe
- Demon Registration (BRAINS)

DICOM

DICOM to NRRD Converter

Diffusion Tensor Scalar Measurements

Diffusion Weighted Volume Masking

DTIexport

DTIimport

DWI Joint Rician LMMSE Filter

DWI Rician LMMSE Filter

DWI to DTI Estimation

DWI to Full Brain Tractography

DWI Unbiased Non Local Means Filter

Editor

EMSegment Command-line

EMSegmenter with Atlas

EMSegmenter without Atlas

Endoscopy

Event Broker

Gradient Anisotropic Diffusion

Grayscale Fill Hole Image Filter

Grayscale Grind Peak Image Filter

Grayscale Model Maker

Histogram Matching

Image Label Combine

Intensity Difference Change Detection (FAST)

Label Map Smoothing

Label Statistics

labelToggleBug2049

Linear Registration

Mask Scalar Volume

Median Image Filter

Merge Models

Model Maker

Model To Label Map

Models

Multiply Scalar Volumes

MultiVolumeExplorer

MultiVolumeImporter

N4ITK MRI Bias correction

OpenIGTLinkIF

Orient Scalar Volume

Otsu Threshold Image Filter

Otsu Threshold Segmentation

Performance Tests

PET Standard Uptake Value Computation

Probe Volume With Model

Reformat

Resample DTI Volume

Resample Image (BRAINS)

Resample Scalar Volume

Resample Scalar/Vector/DWI Volume

Rigid Registration

Robust Multiresolution Affine Registration

Robust Statistics Segmenter

RSNA2012Quant

RSNA2012Vis

Sample Data

Scene Import (Issue 2428)

Scene Views

Tests

Tractography Display

Tractography Interactive Seeding

Tractography Label Map Seeding

Transform MRML Files to New EMSegmenter Standard

Transforms

Vector Demon Registration (BRAINS)

Vector to Scalar Volume

View Controllers

ViewControllers Slice Interpolation Bug 1926

Volume Rendering

Volumes

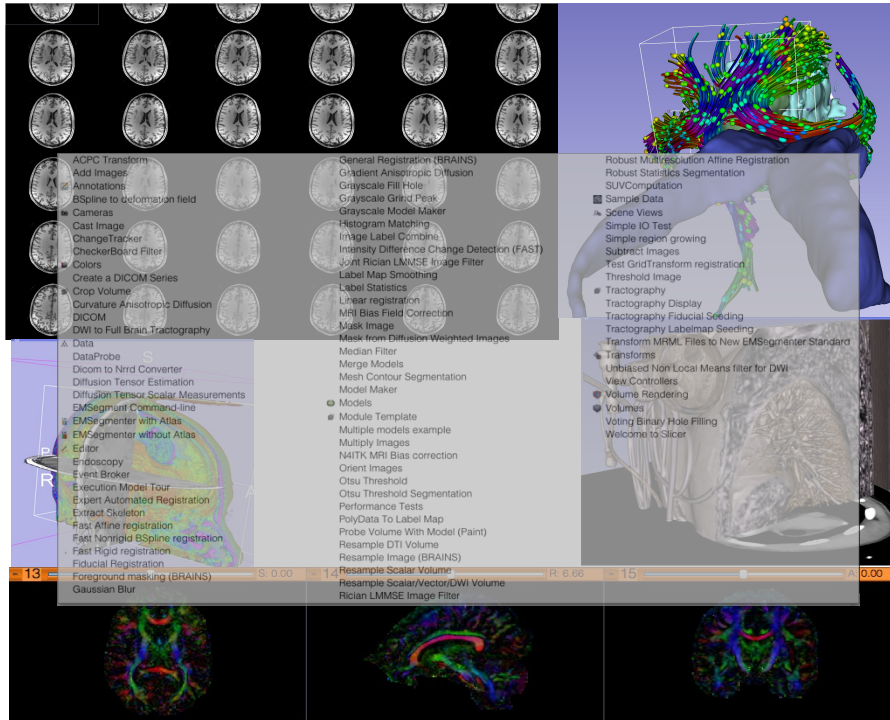
Voting Binary Hole Filling Image Filter

WebGL Export

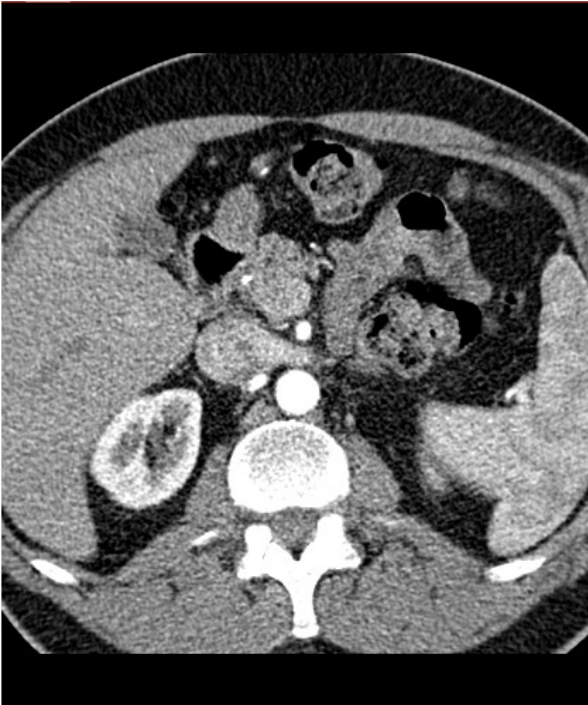
Welcome to Slicer



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



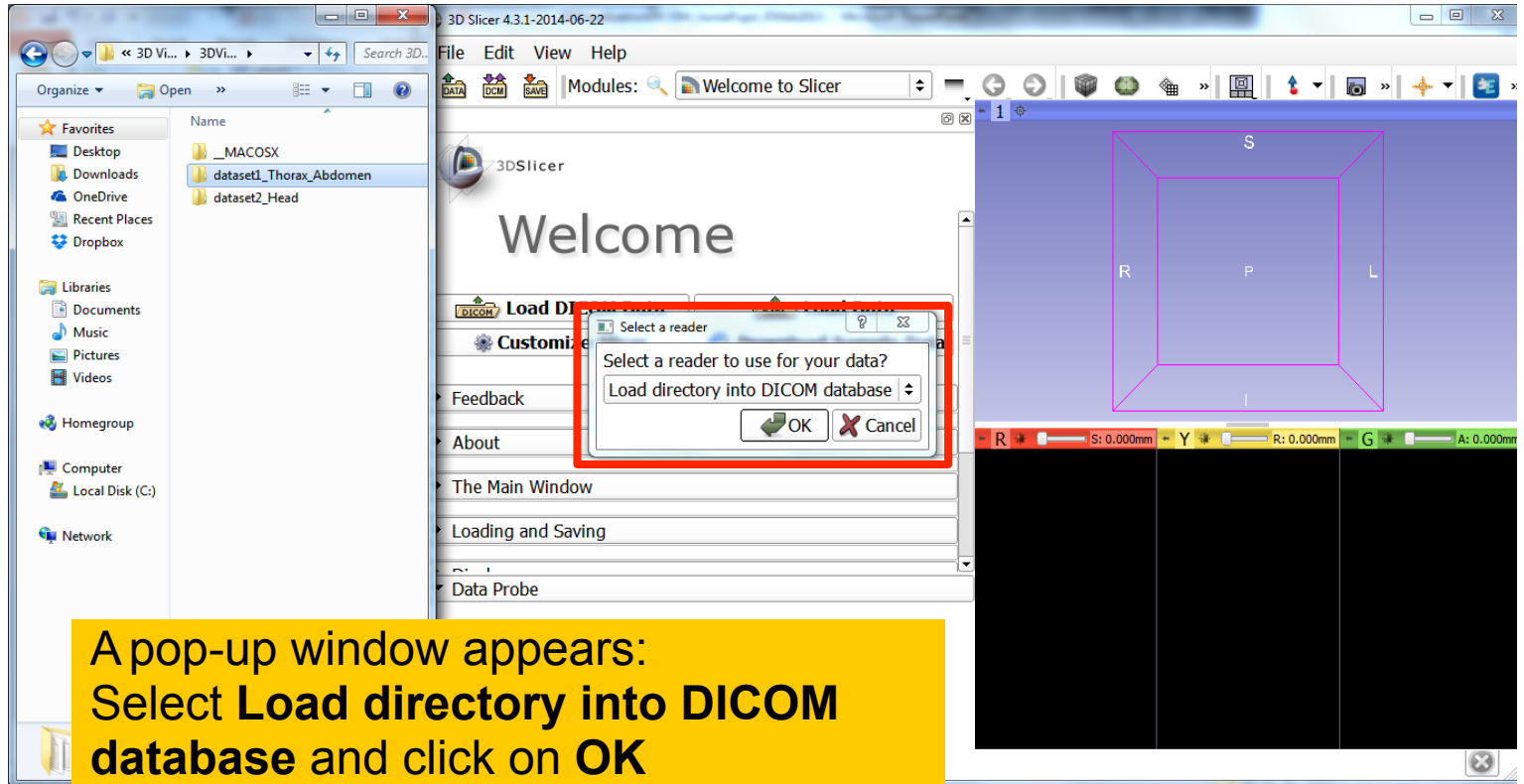
Loading a DICOM volume

The screenshot shows the 3D Slicer application interface. On the left, a file explorer window is open, displaying a list of files including 'dataset1_Thorax_Abdomen'. A red arrow points from this file name to the 'Load DICOM Data' button in the 3D Slicer interface. The 3D Slicer window shows the 'File' menu, 'Load DICOM Data' button, and a 3D view area with a purple wireframe box labeled 'S', 'R', 'P', 'L', and 'I'. Below the 3D view, there are three panels: 'R' (red), 'Y' (yellow), and 'G' (green), each with a scale bar indicating 0.000mm.

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 interface with the DICOM Browser and SlicerApp-real windows open. The DICOM Browser displays a table of patients and studies. The SlicerApp-real window shows the file path for loading a DICOM volume.

DICOM Browser - Patients Table

PatientsName	PatientID	PatientsBirthDate	PatientsBirthTime	PatientsSex	PatientsAge	PatientsComments
patient1	patient1_ID					
DT1_32ch_test	1234	1900-01-01		F		

DICOM Browser - Studies Table

SeriesNumber	SeriesDate	SeriesTime	SeriesDescription	Modality	BodyPartExamine	AcquisitionNumber	ContrastAgent
6	2005-06-01	120000.000000	CT_Thorax...	CT	HEART	14	APPLIED

SlicerApp-real - File Path

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

Slicer starts loading the DICOM images



Loading a DICOM volume

3D Slicer 4.3.1-2014-06-22

File Edit View Help

Modules: DICOM

3DSlicer

Help & Acknowledgement

Servers

DICOM Database and

Recent DICOM Activ

0 series added to data

Past Month: CT_Thor

Past Month: ep2d_di

Data Probe

dataset1_Thorax_Abdomen
File folder

DICOM Directory Import

Directory import completed.

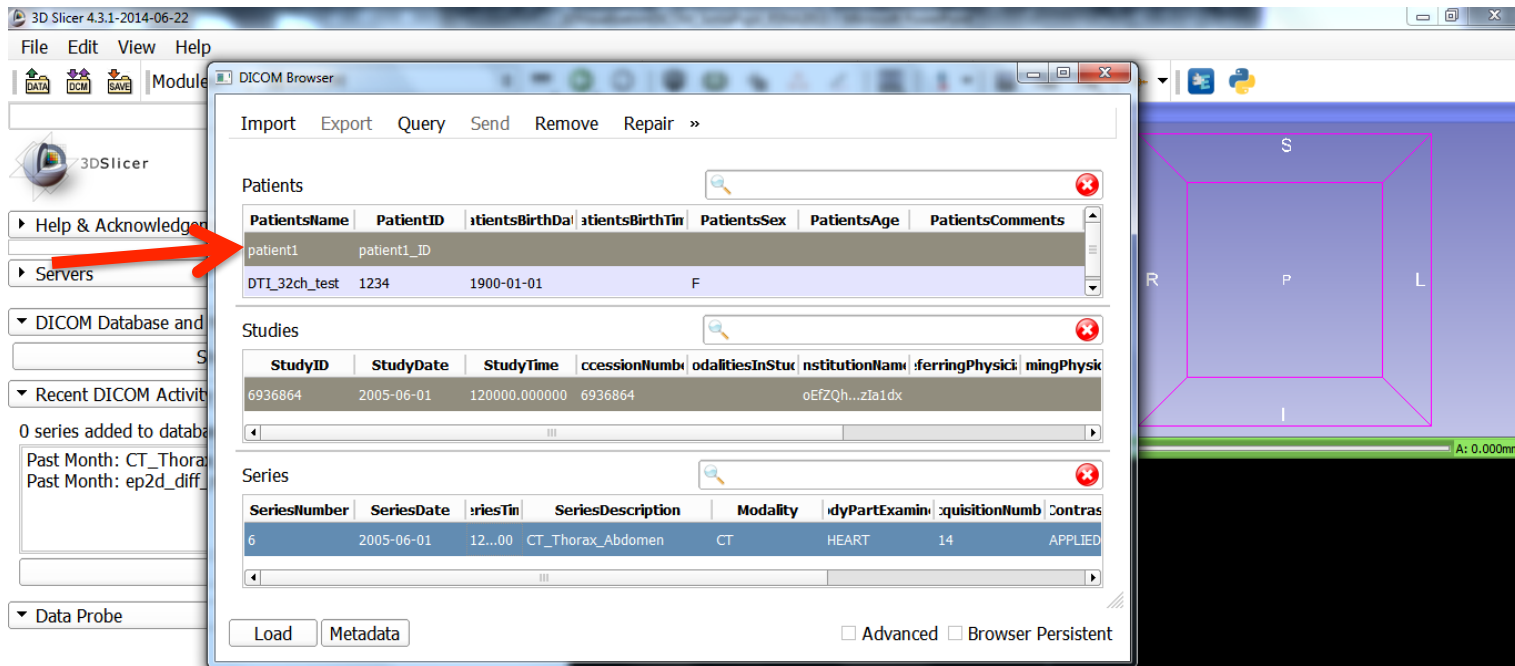
- 1 New Patients
- 266 New Studies
- 266 New Series
- 266 New Instances

OK

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



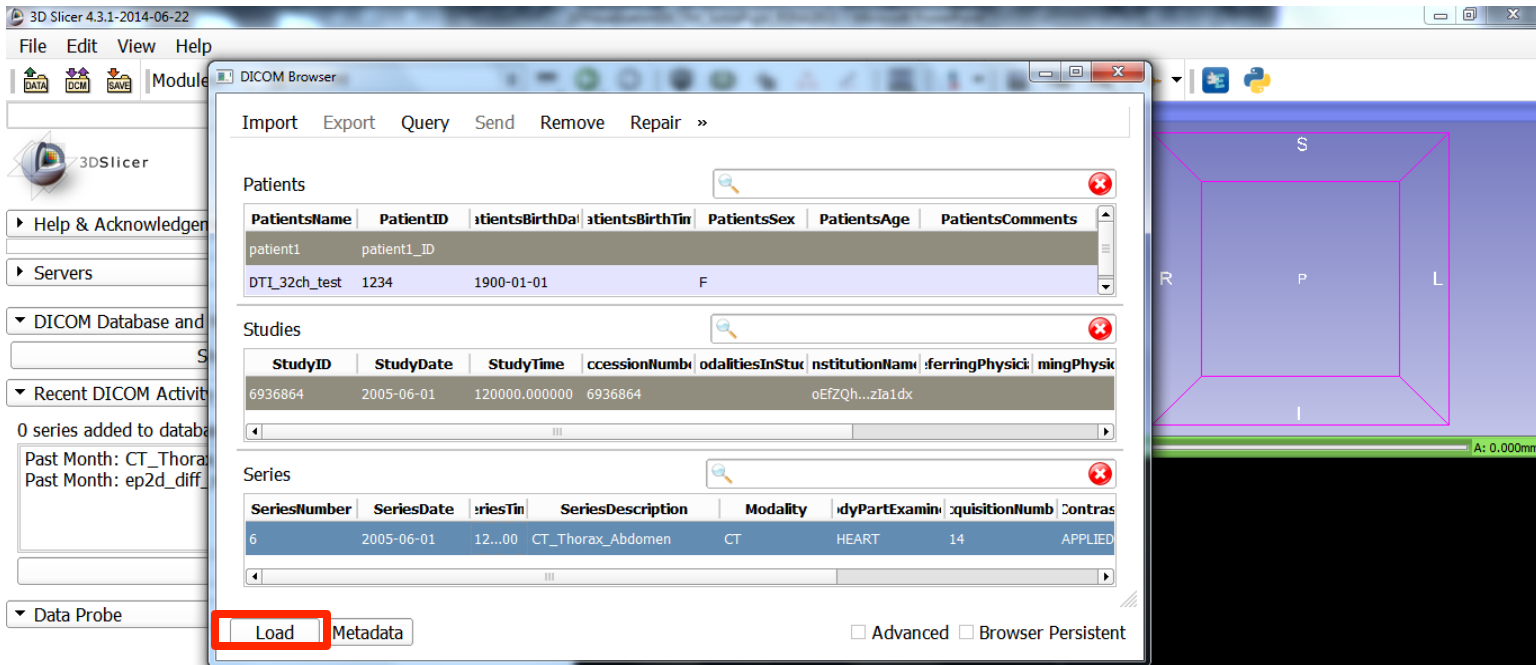
Loading a DICOM volume



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**



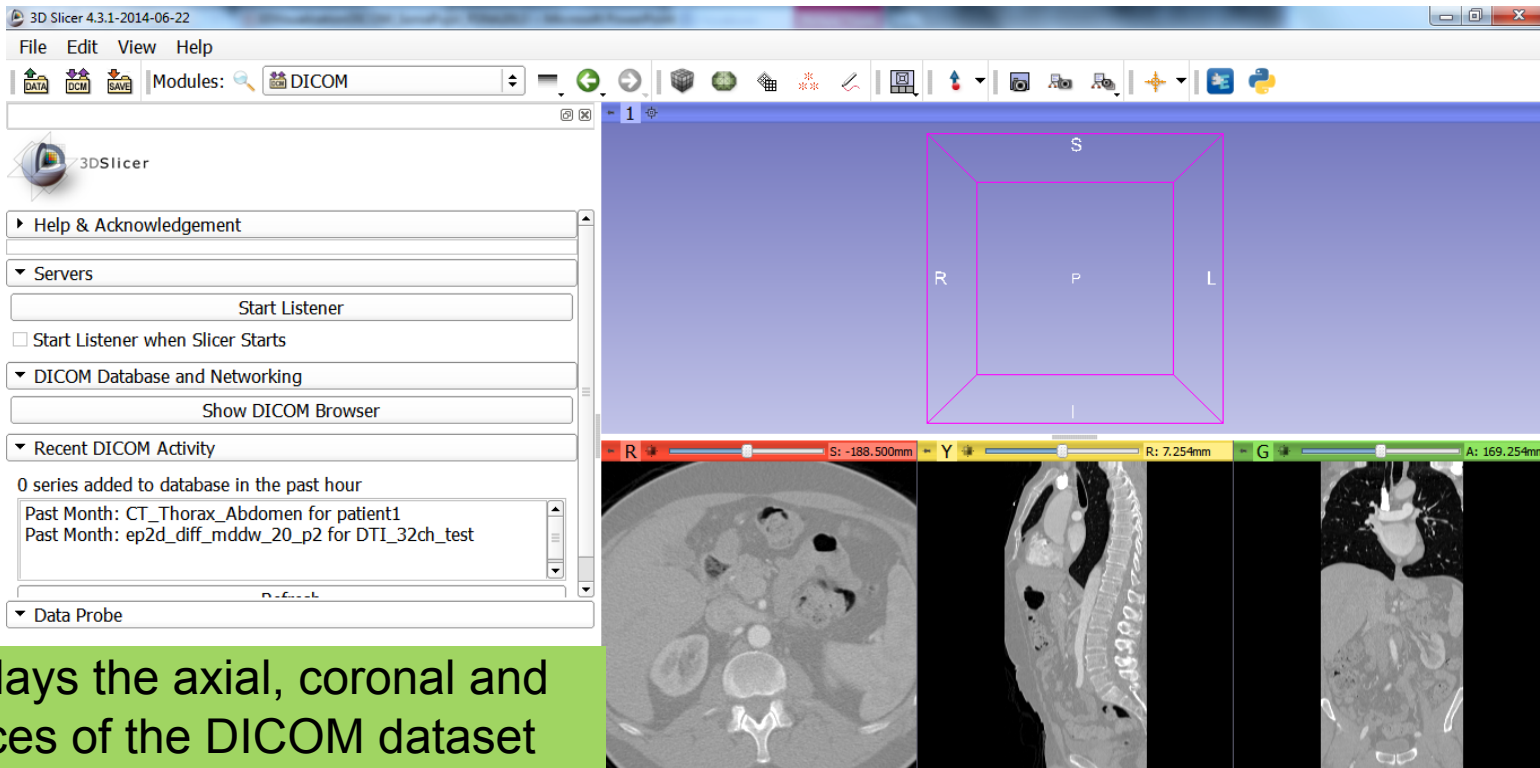
Loading a DICOM volume



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



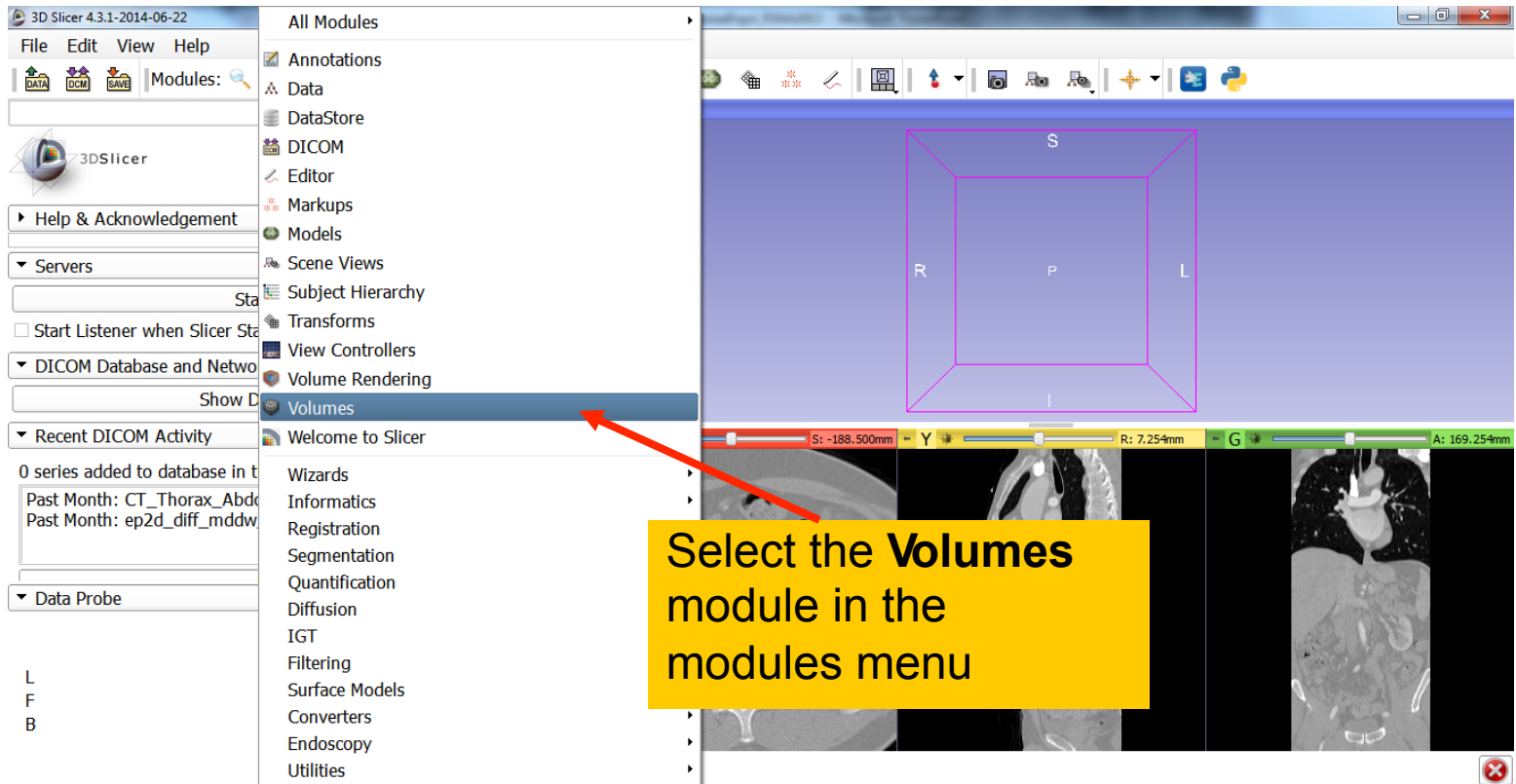
Loading a DICOM volume



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



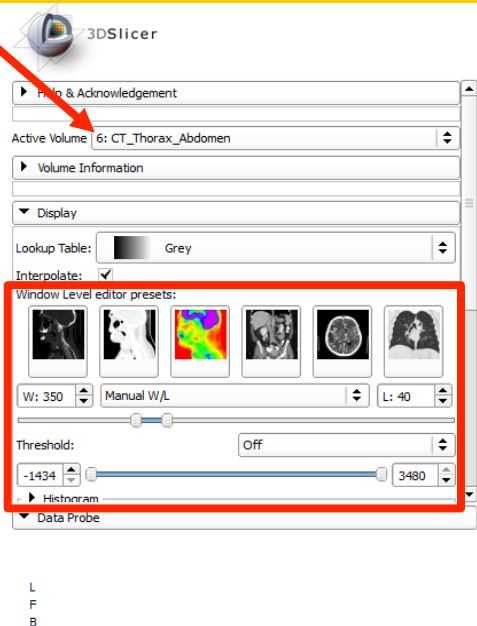
Loading a DICOM volume





Loading a DICOM volume

Select the Active Volume
6:CT_Thorax_Abdomen



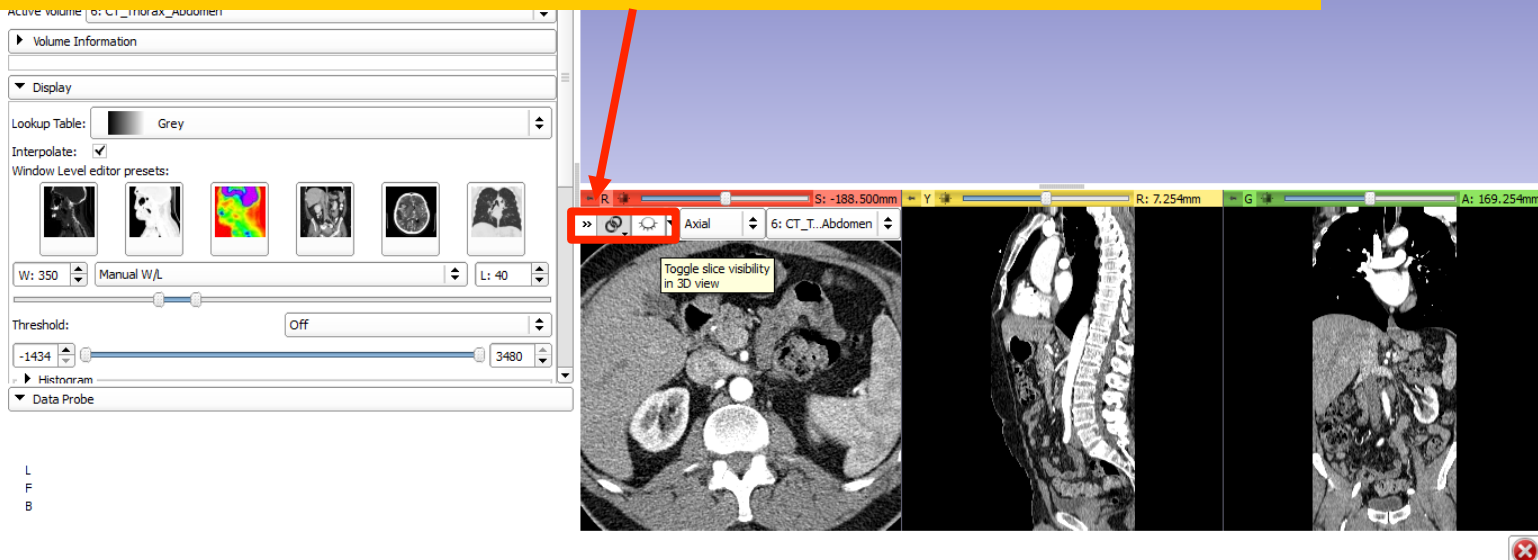
Slicer has a series of window/
level presets available.

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



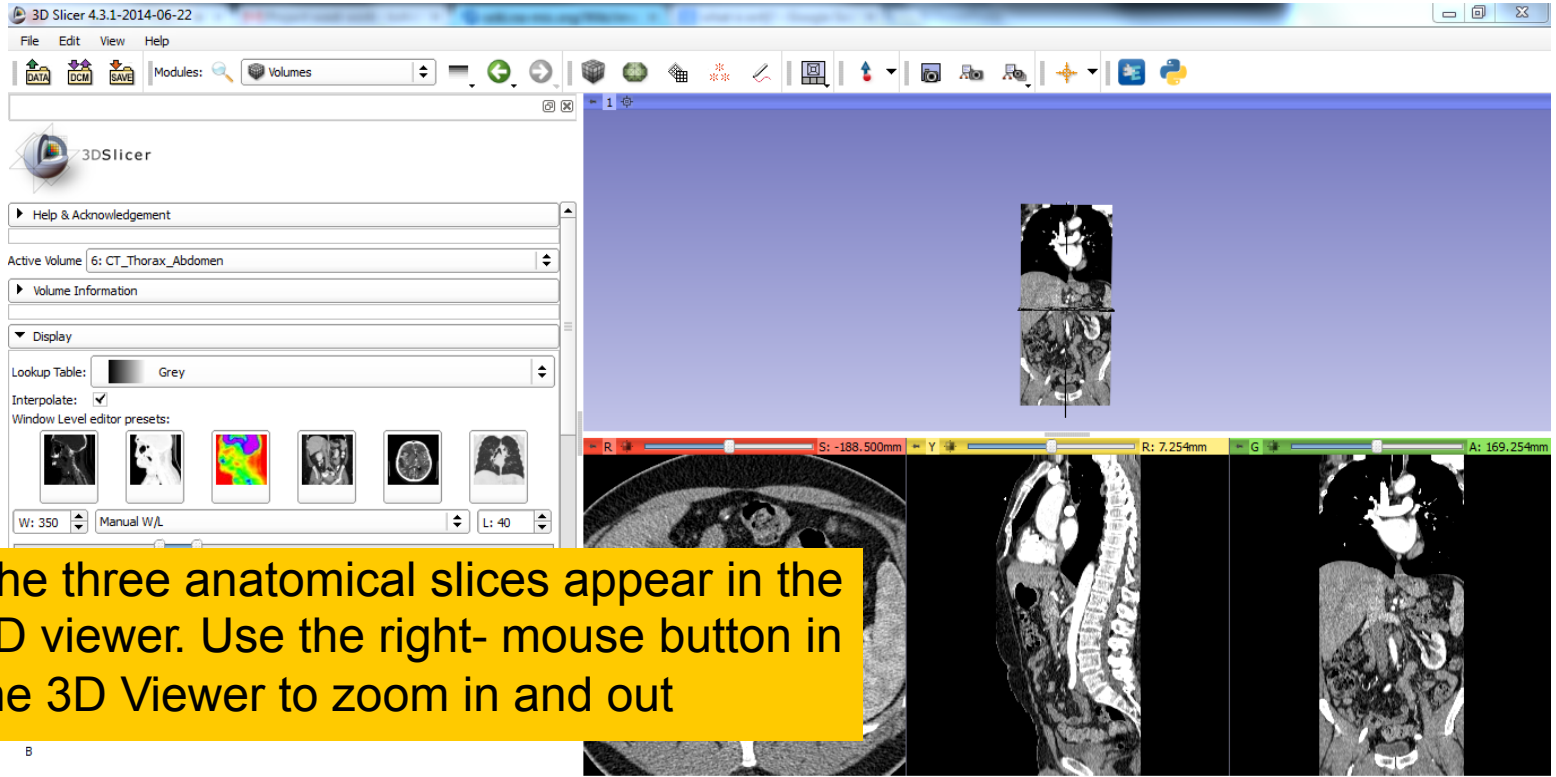
Loading a DICOM volume

Position the mouse cursor over the 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



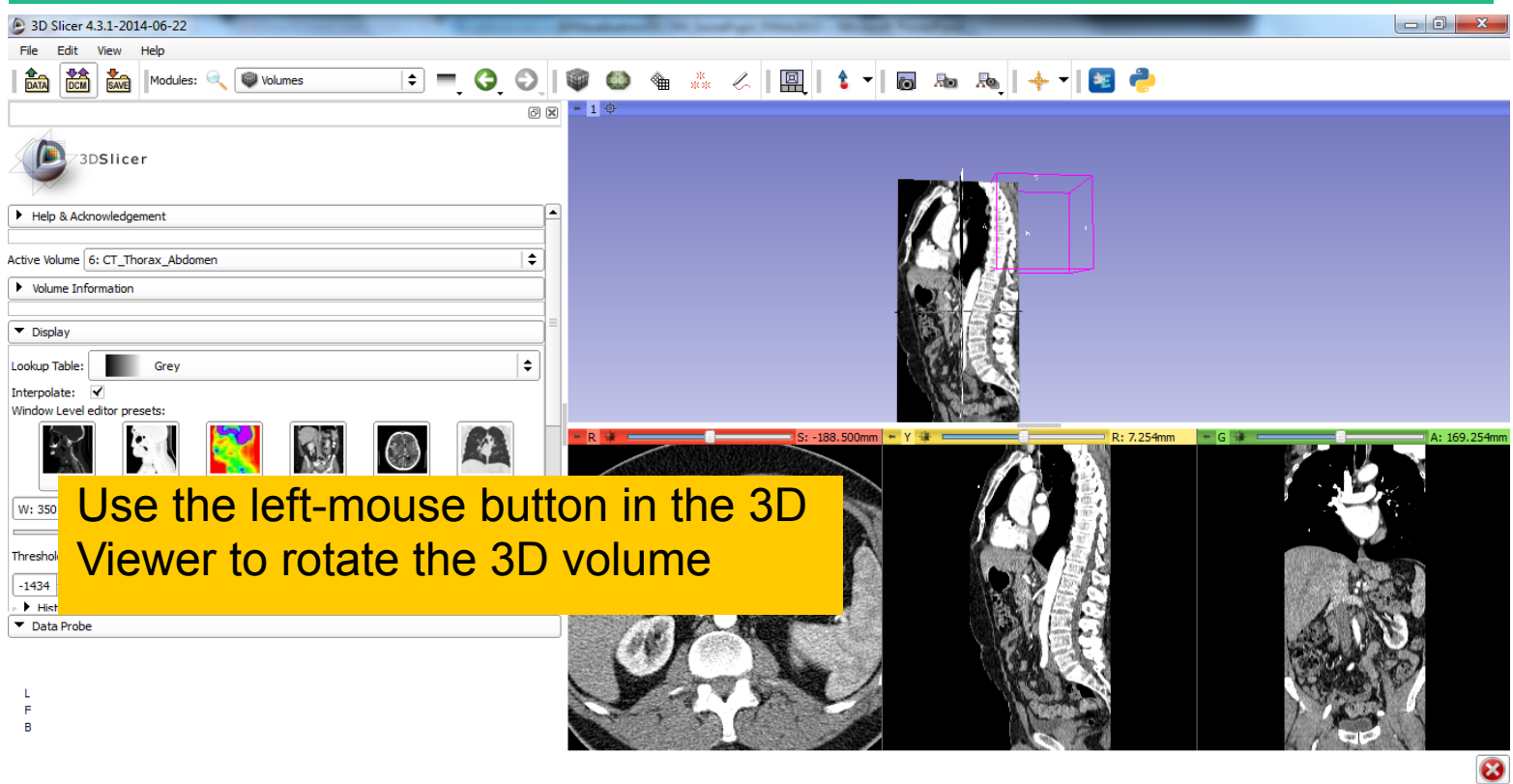


Loading a DICOM volume



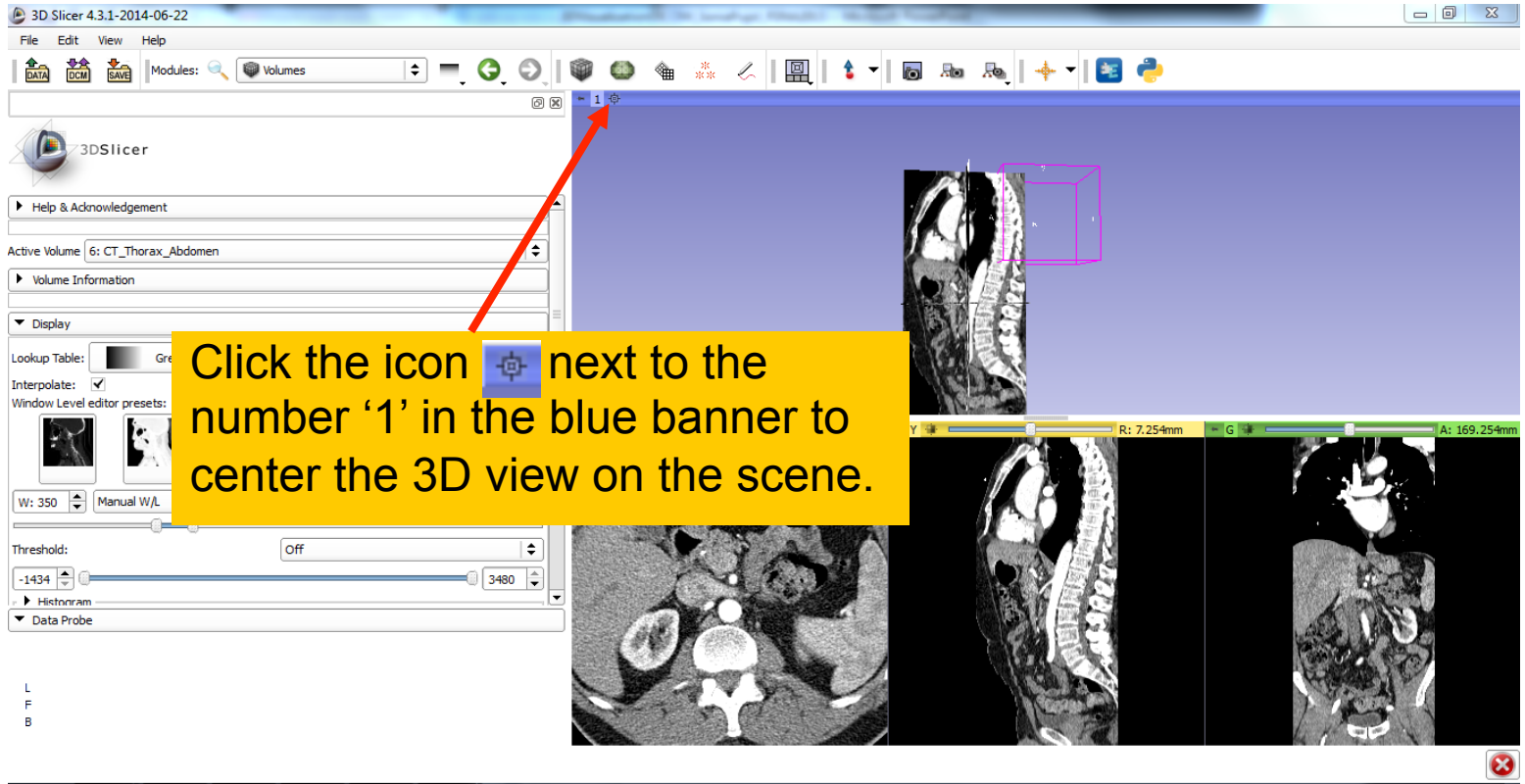


Loading a DICOM volume



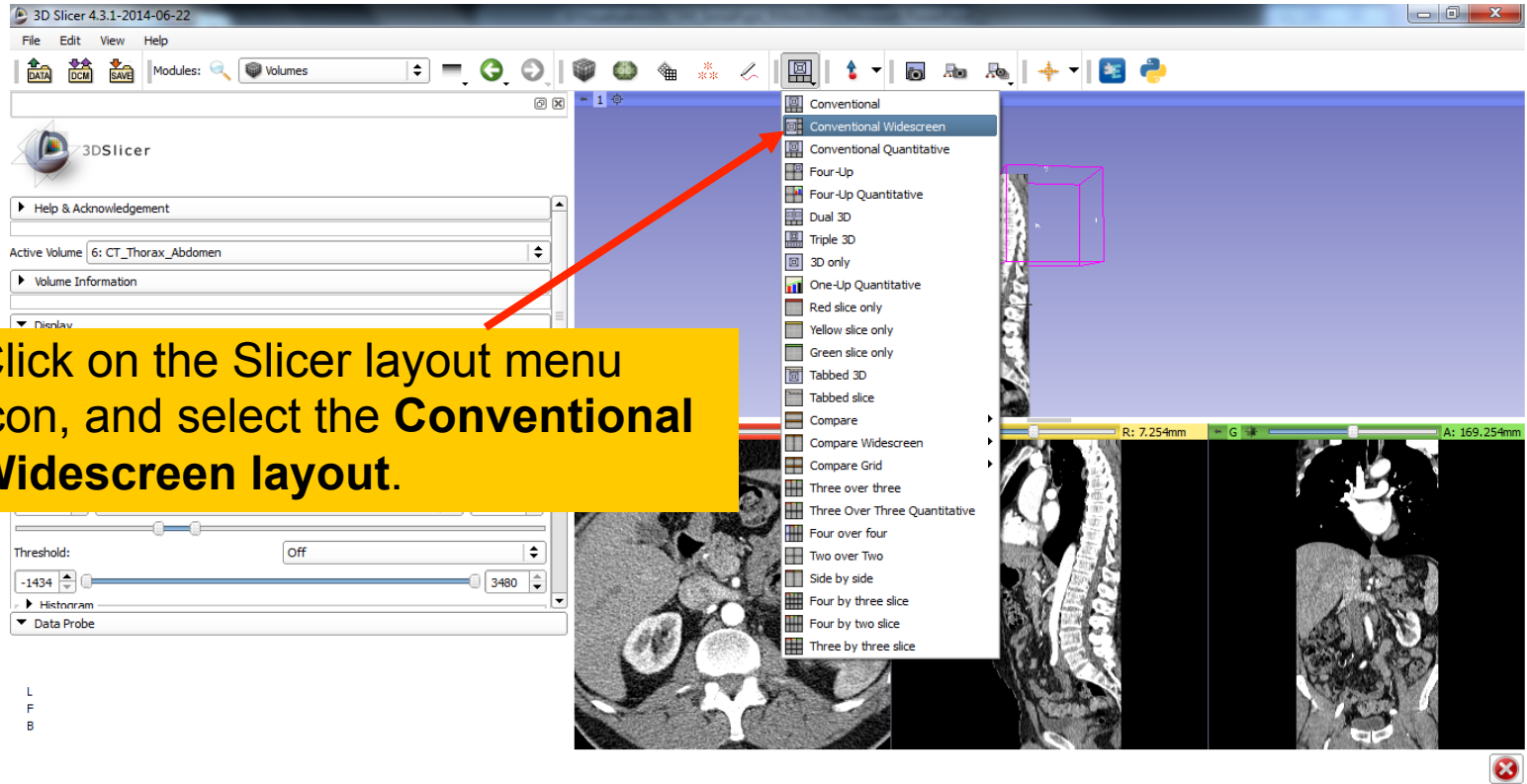


Loading a DICOM volume



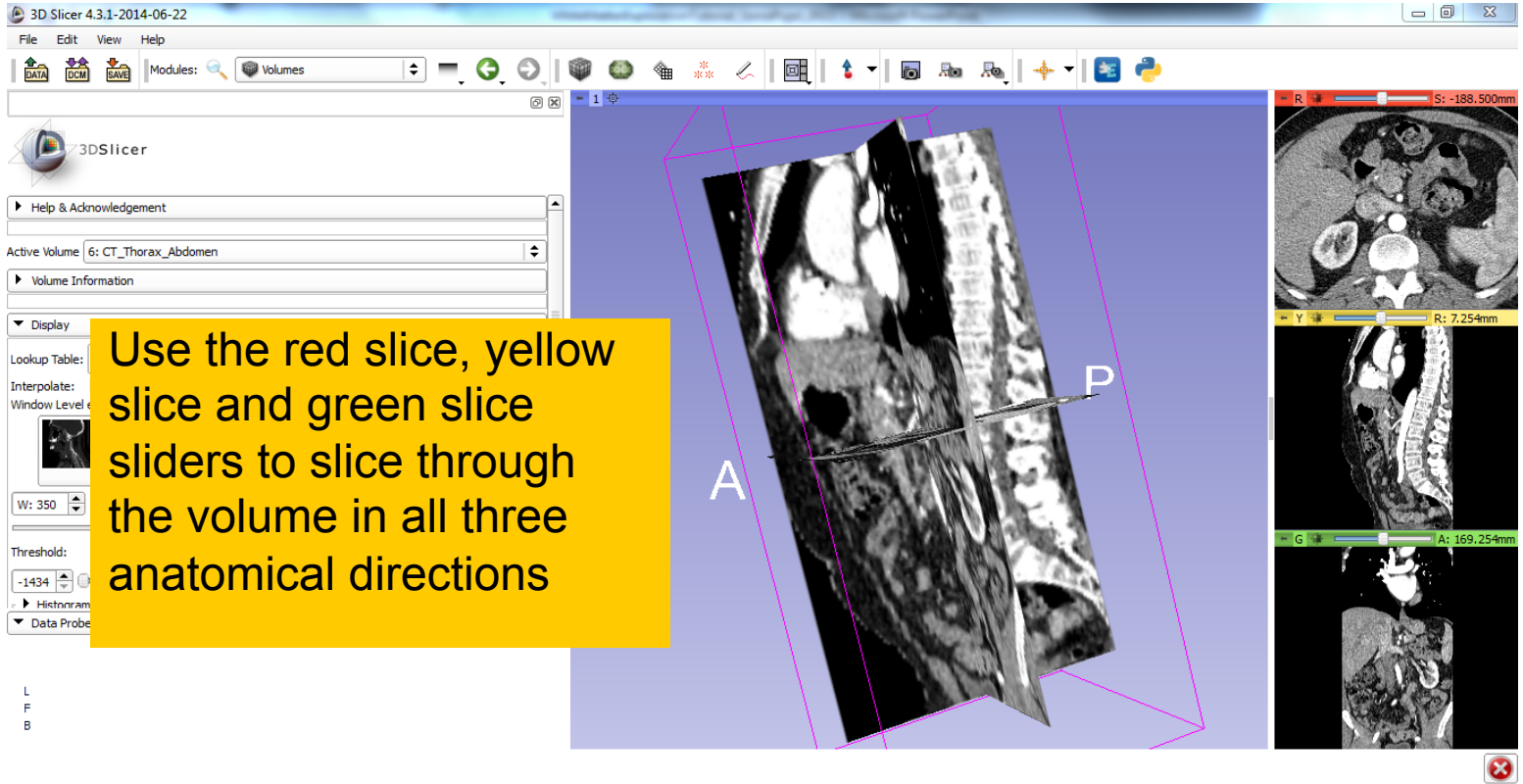


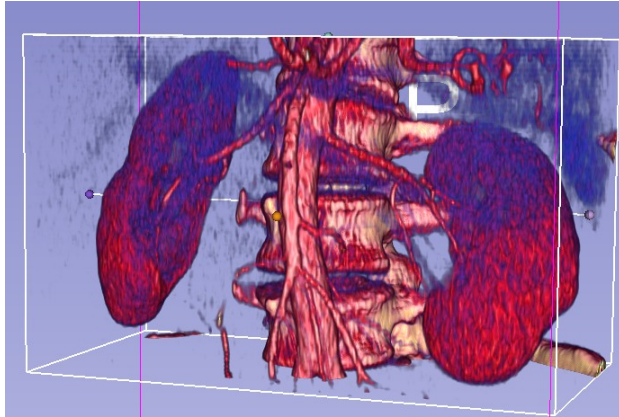
Loading a DICOM volume





Loading a DICOM volume

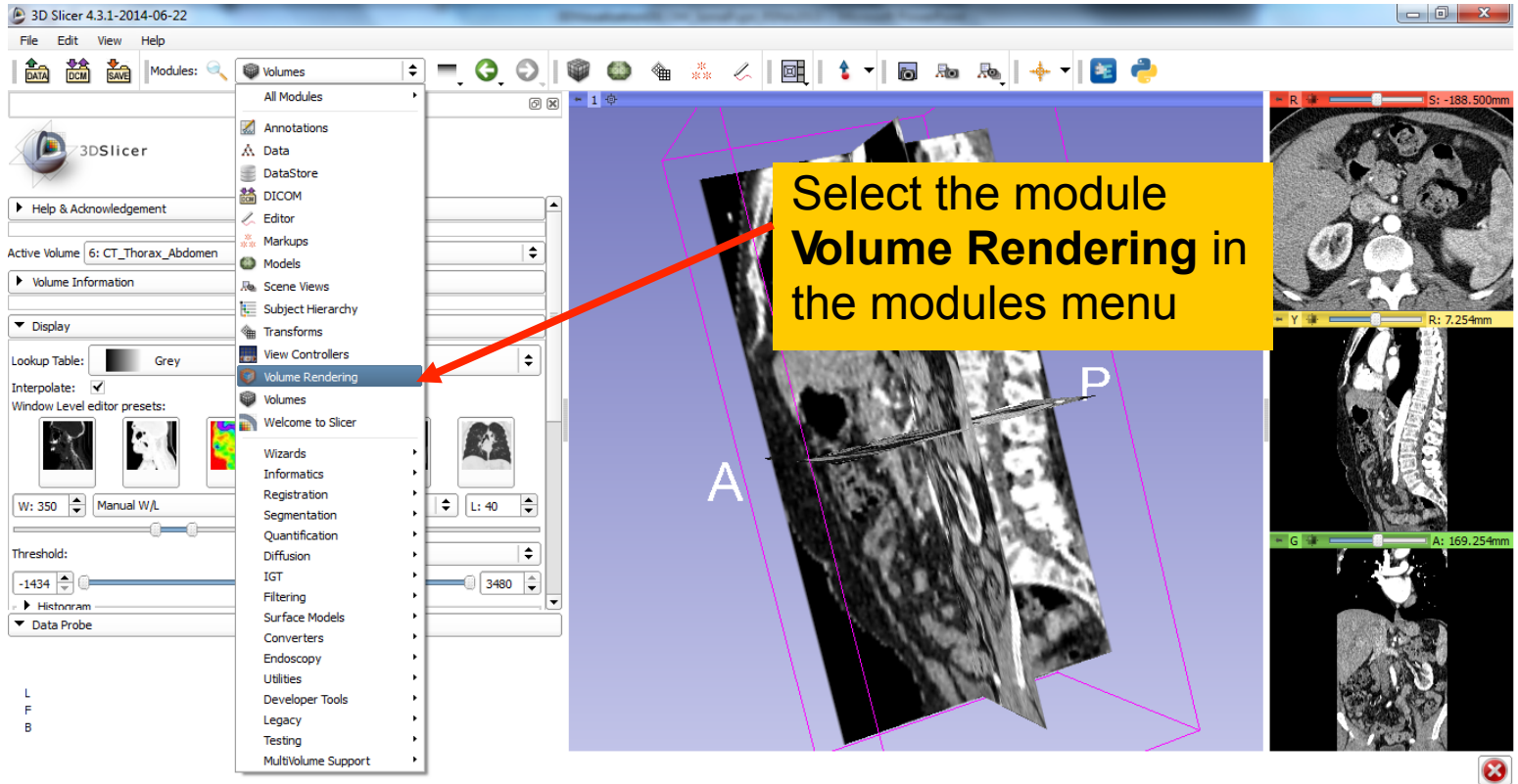




3D Interactive exploration of
thoraco-abdominal CT data
using Volume Rendering

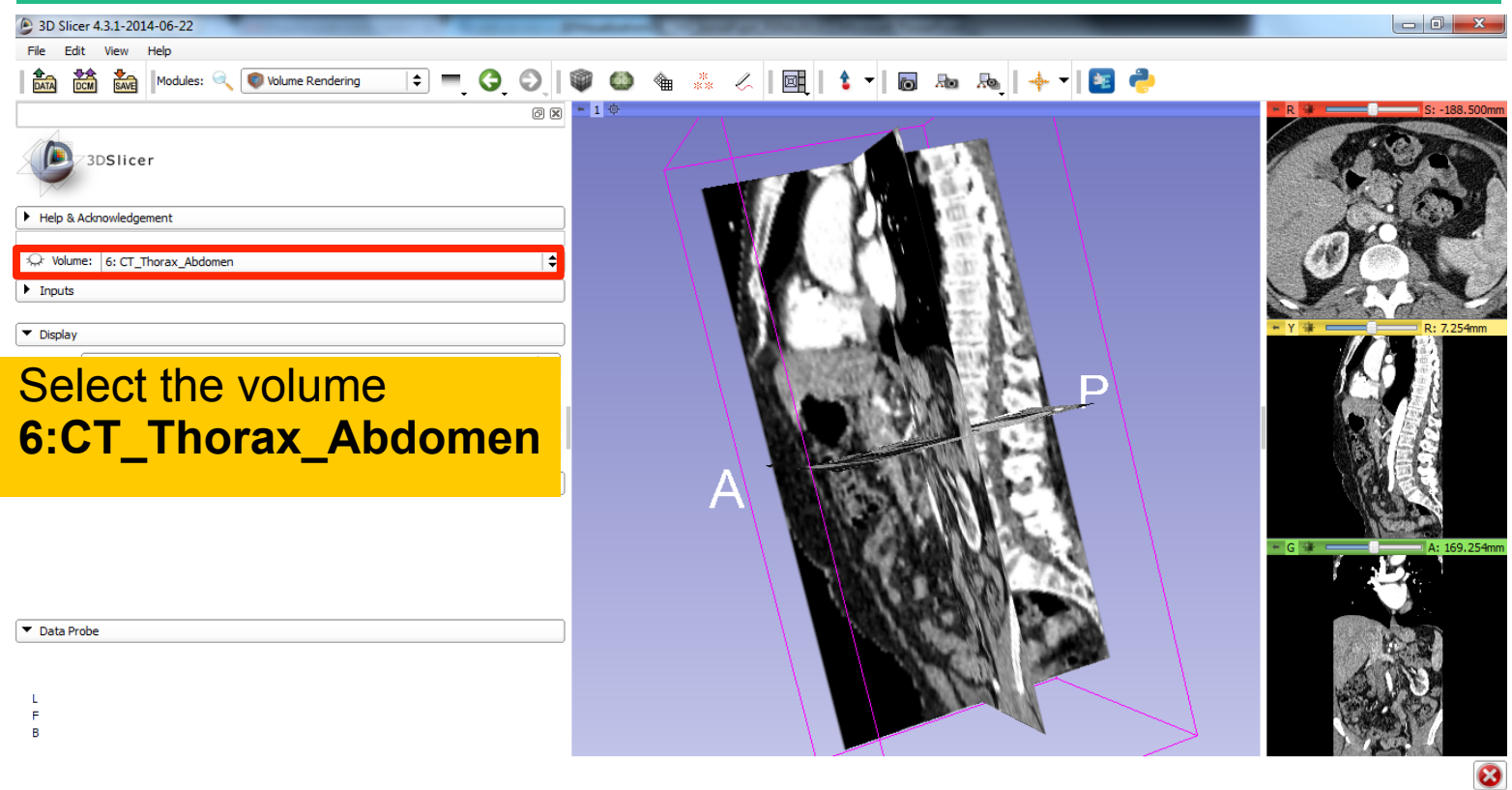


Volume Rendering



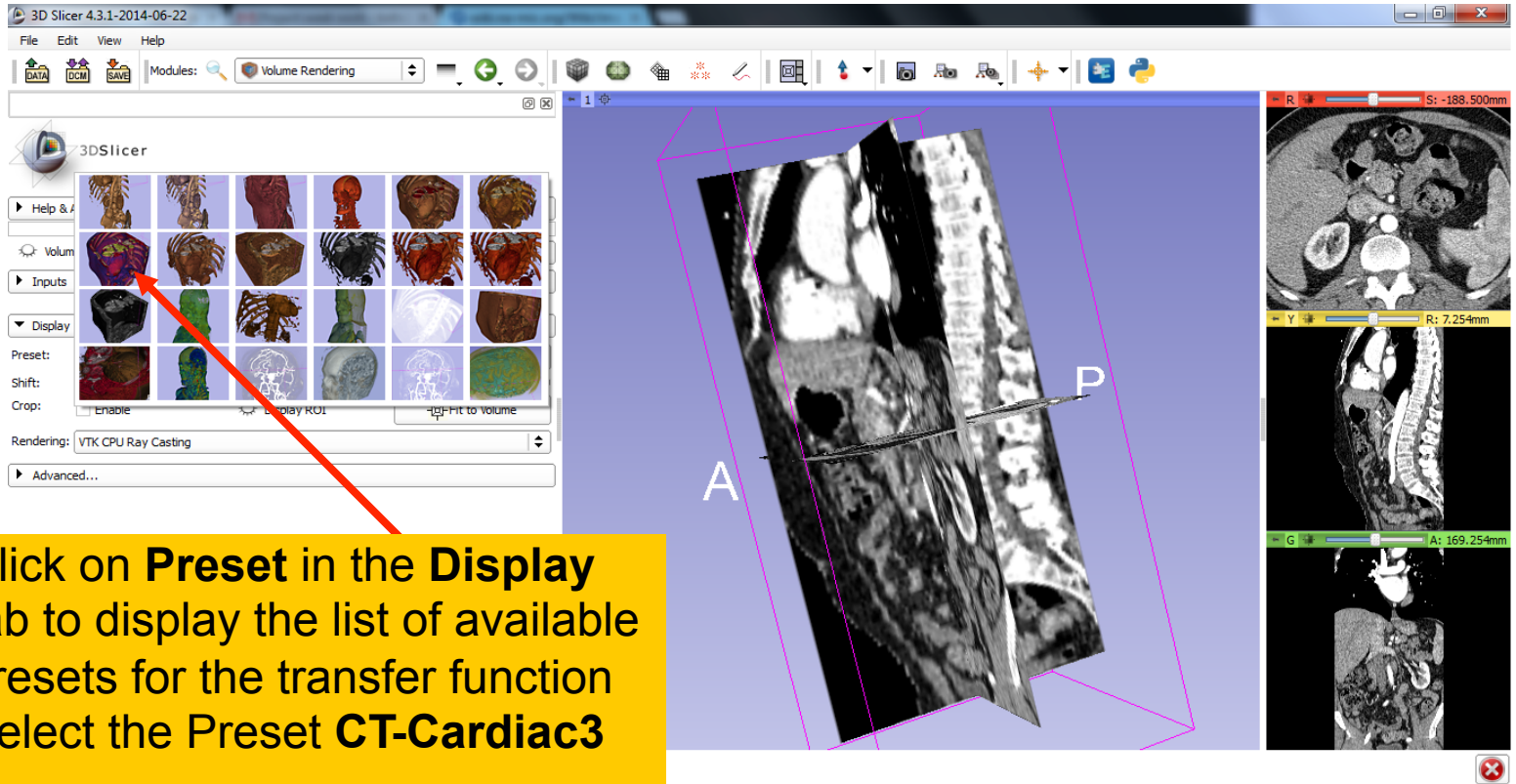


Volume Rendering





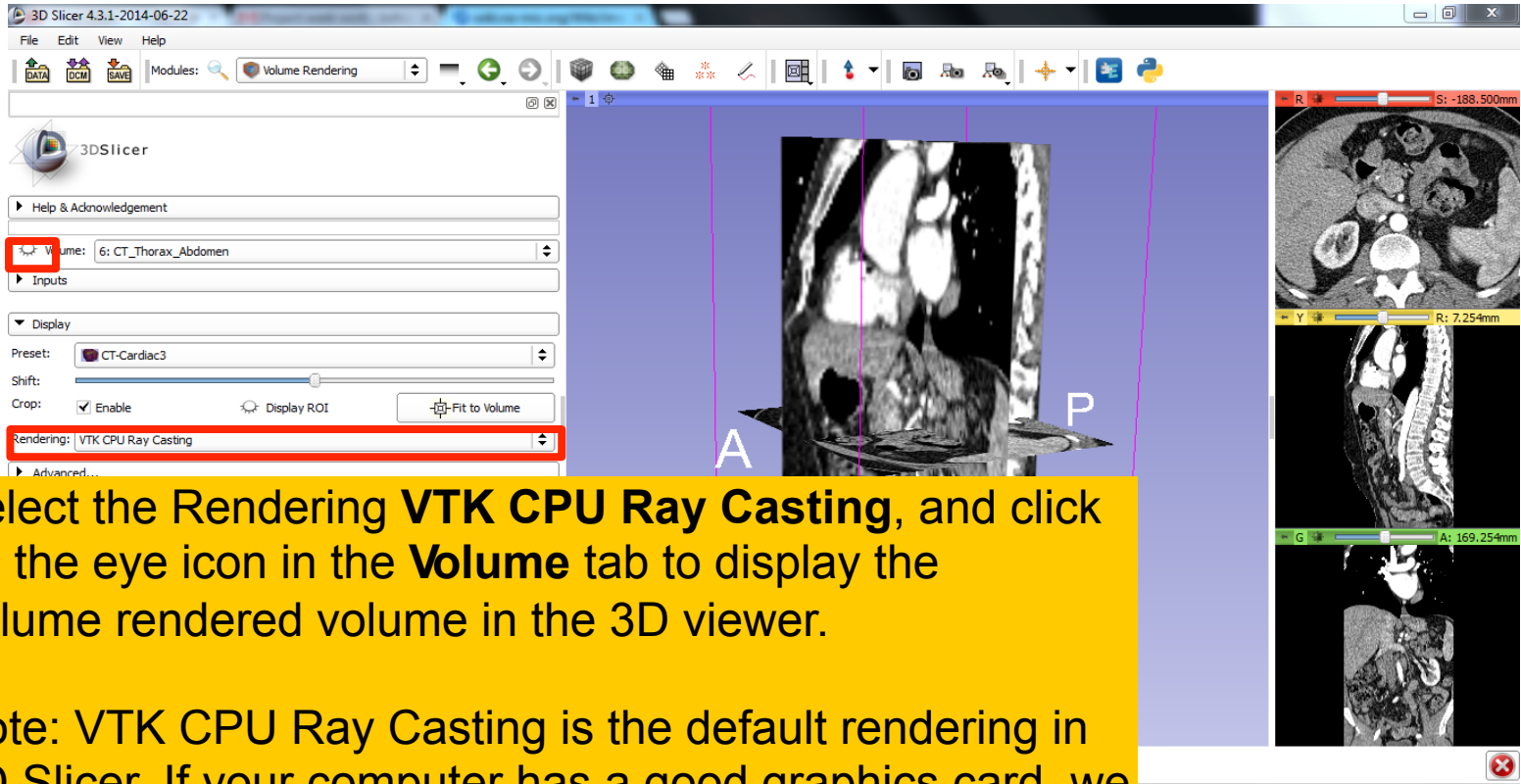
Volume Rendering



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

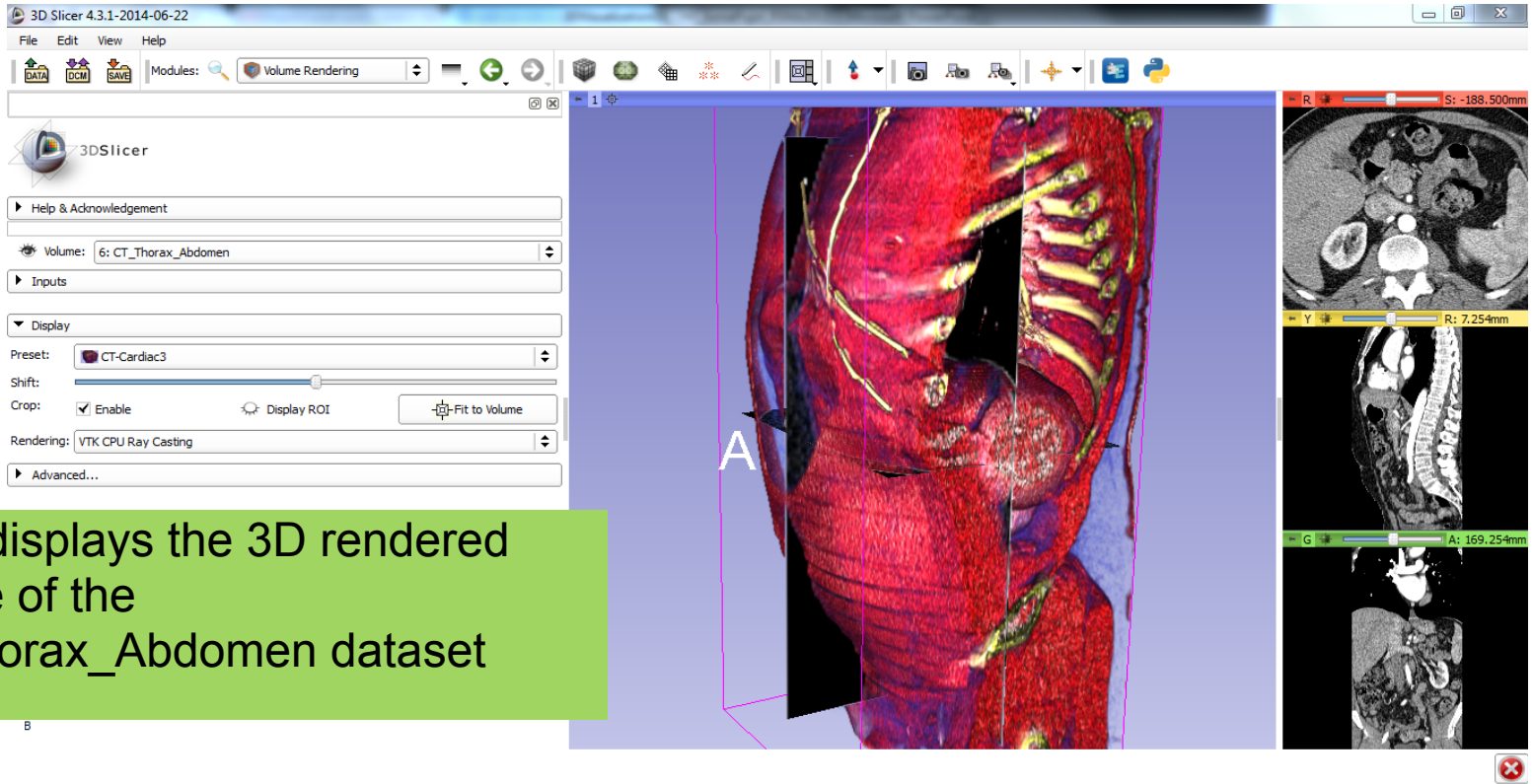


Select the Rendering **VTK CPU Ray Casting**, and click on the eye icon in the **Volume** tab to display the Volume rendered volume in the 3D viewer.

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**



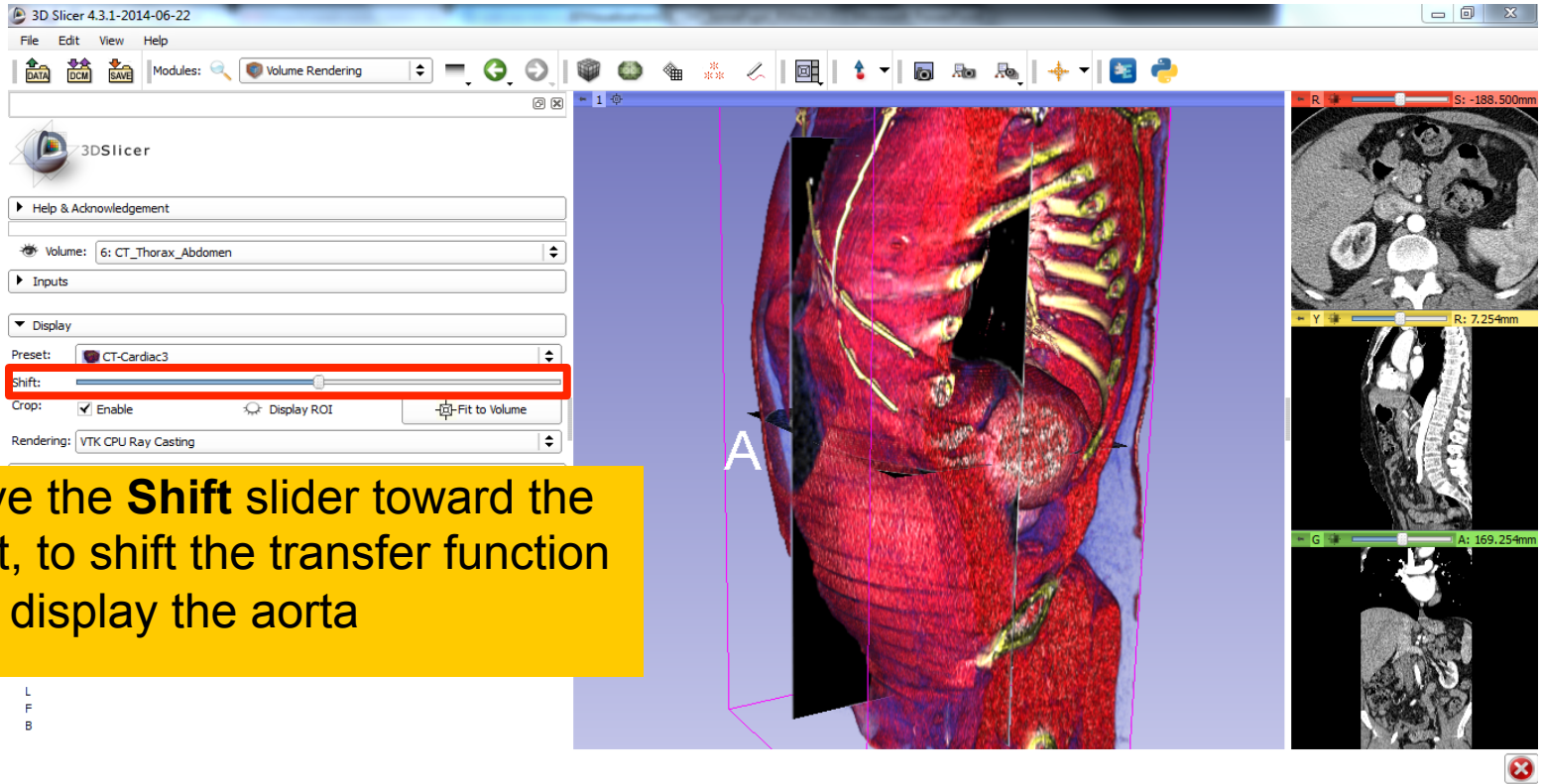
Volume Rendering



Slicer displays the 3D rendered volume of the CT_Thorax_Abdomen dataset



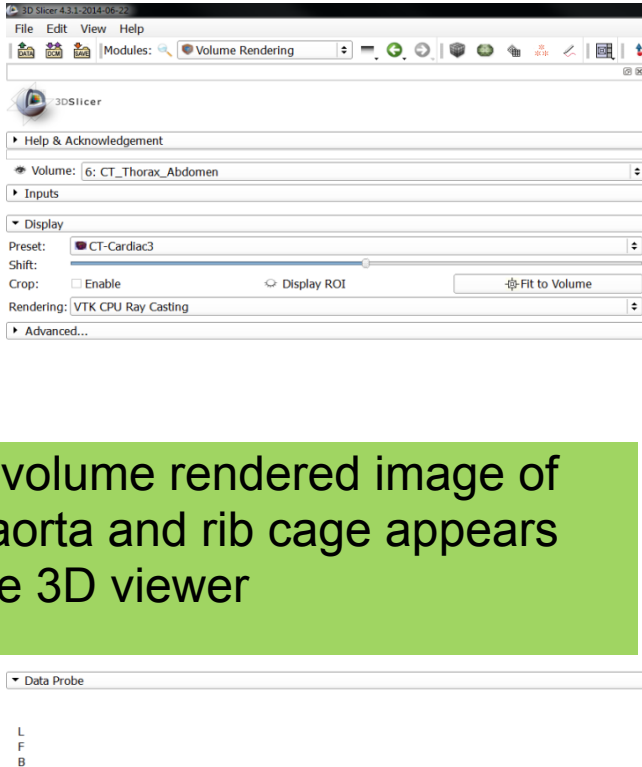
Volume Rendering



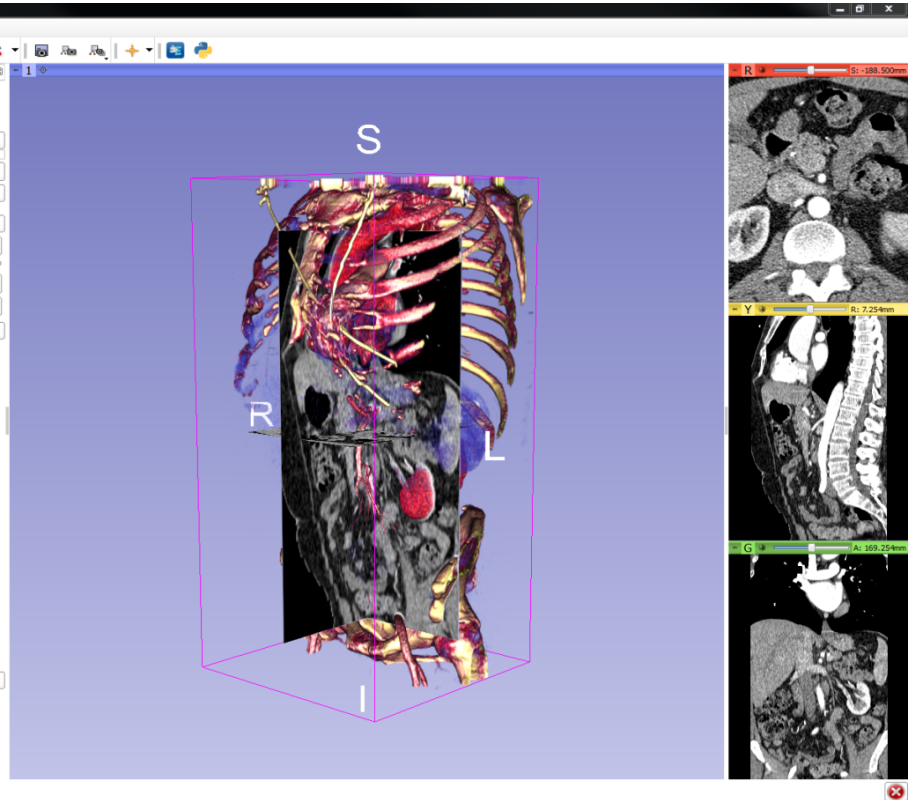
Move the **Shift** slider toward the right, to shift the transfer function and display the aorta



Volume Rendering

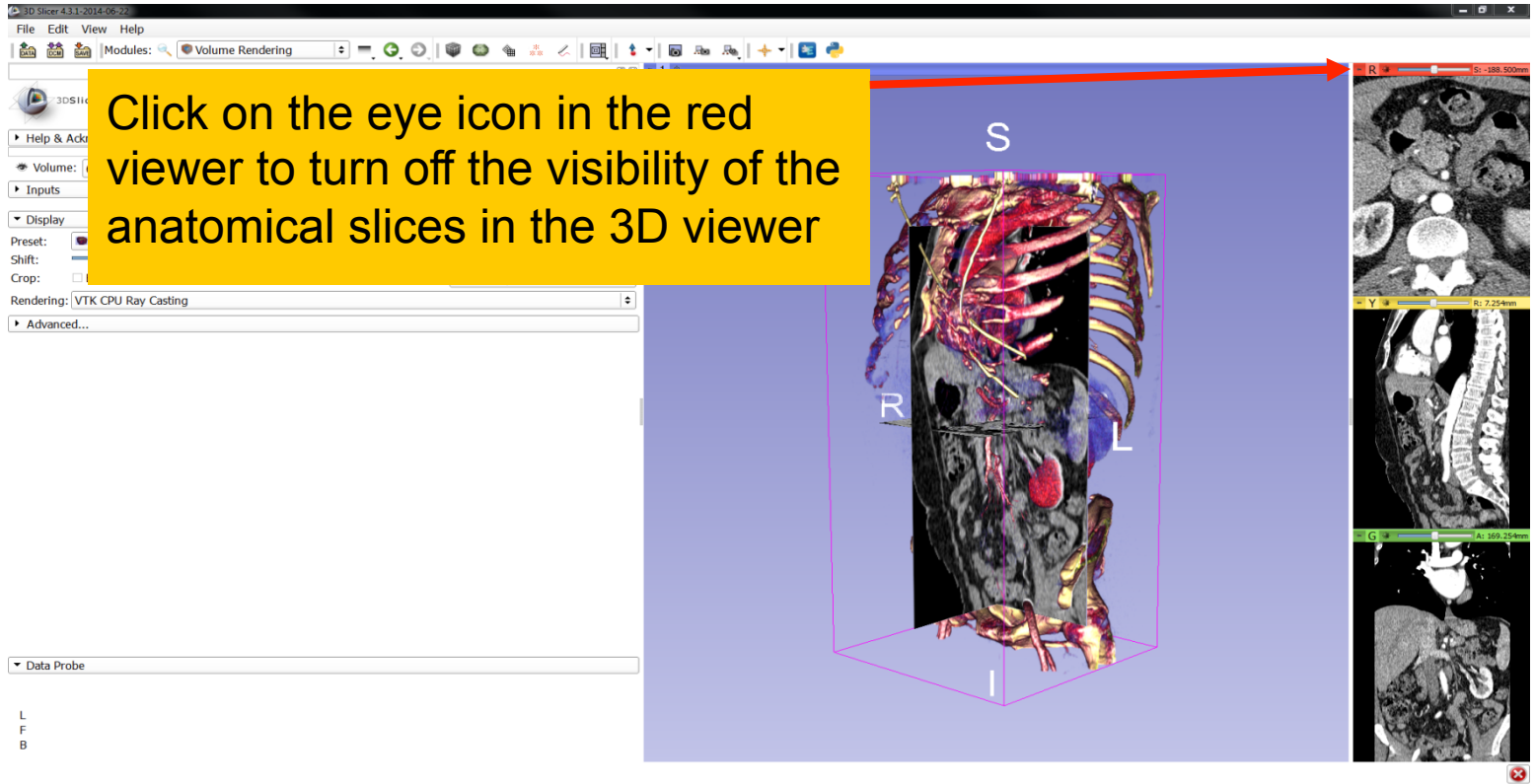


The volume rendered image of the aorta and rib cage appears in the 3D viewer



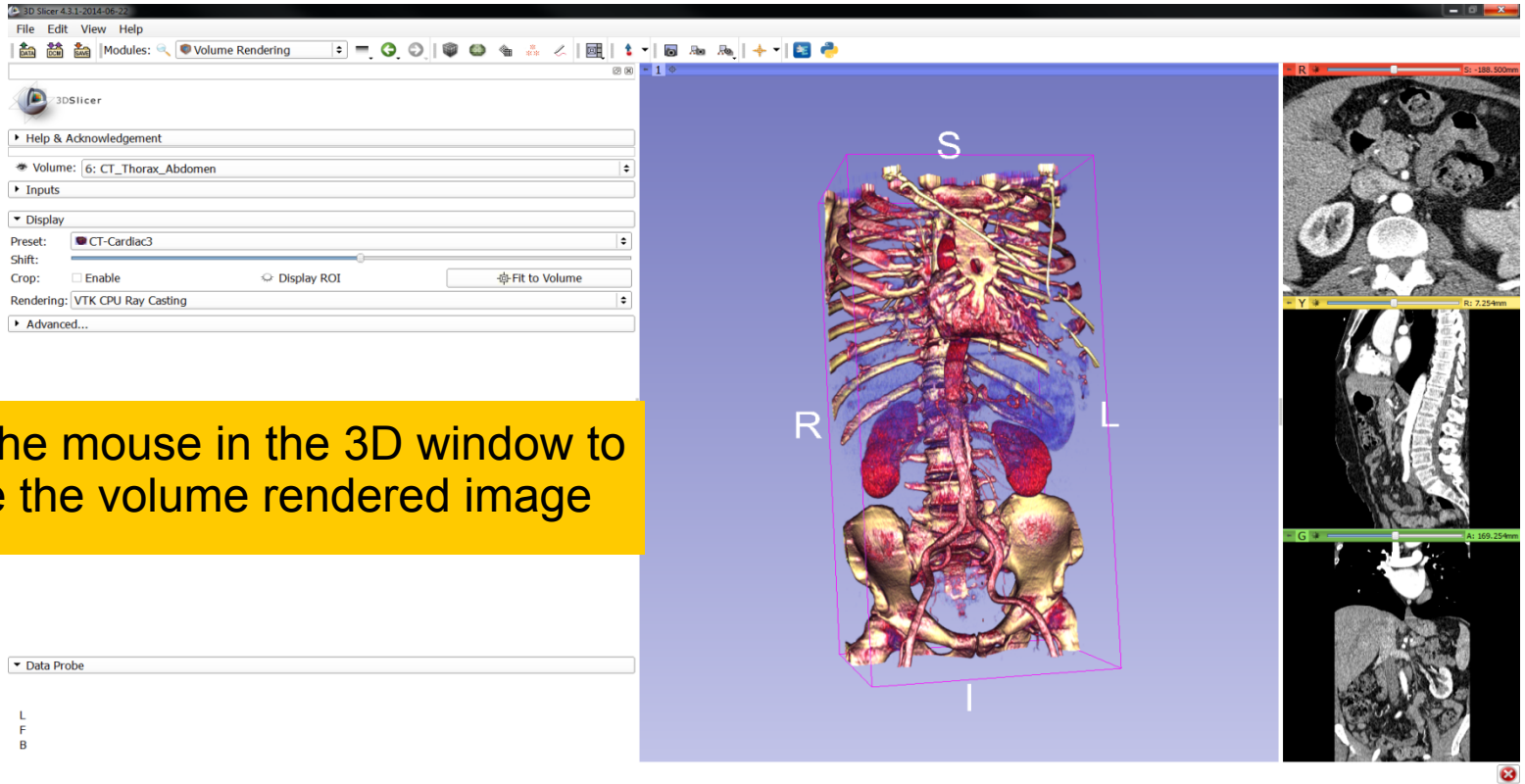


Volume Rendering





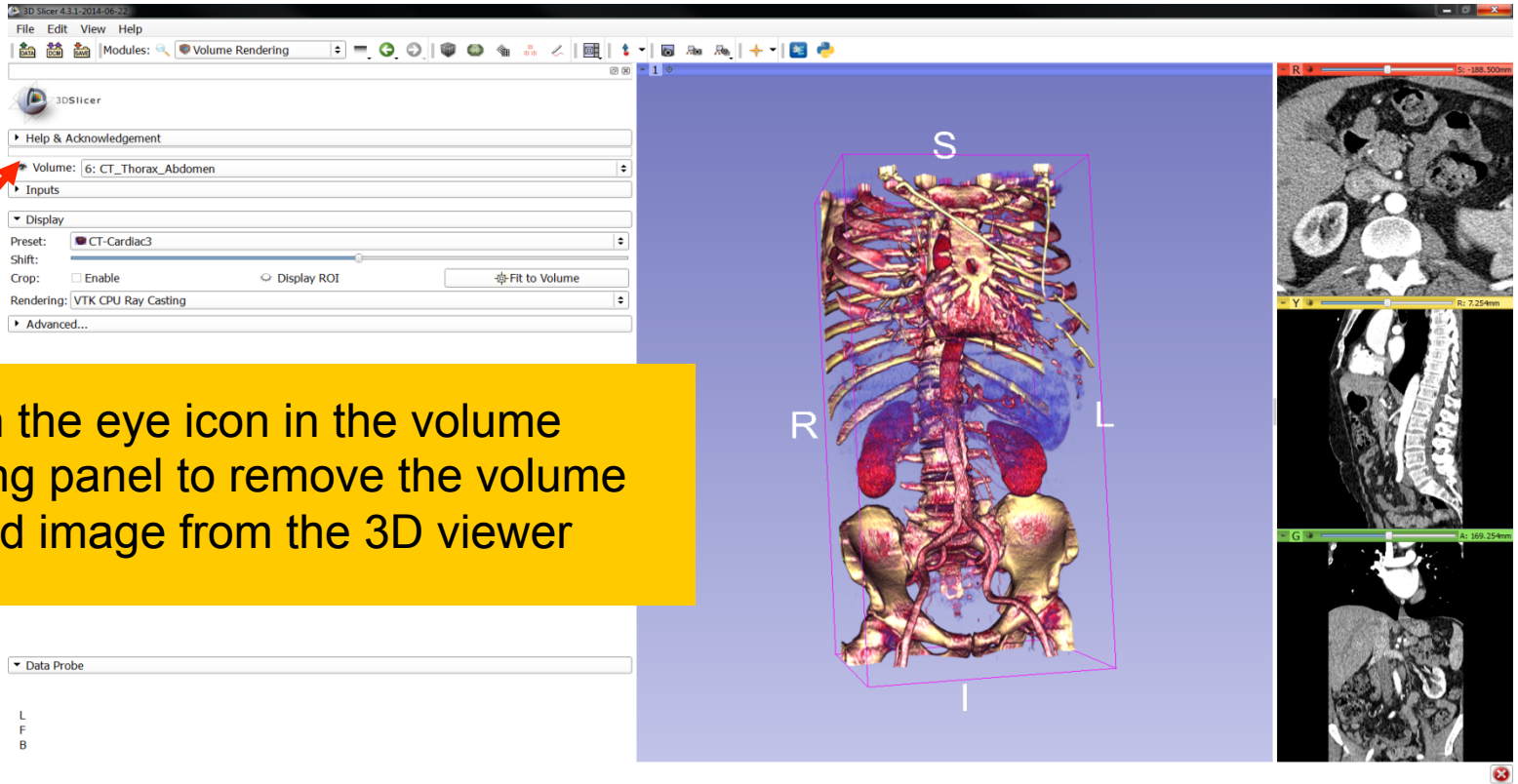
Volume Rendering



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



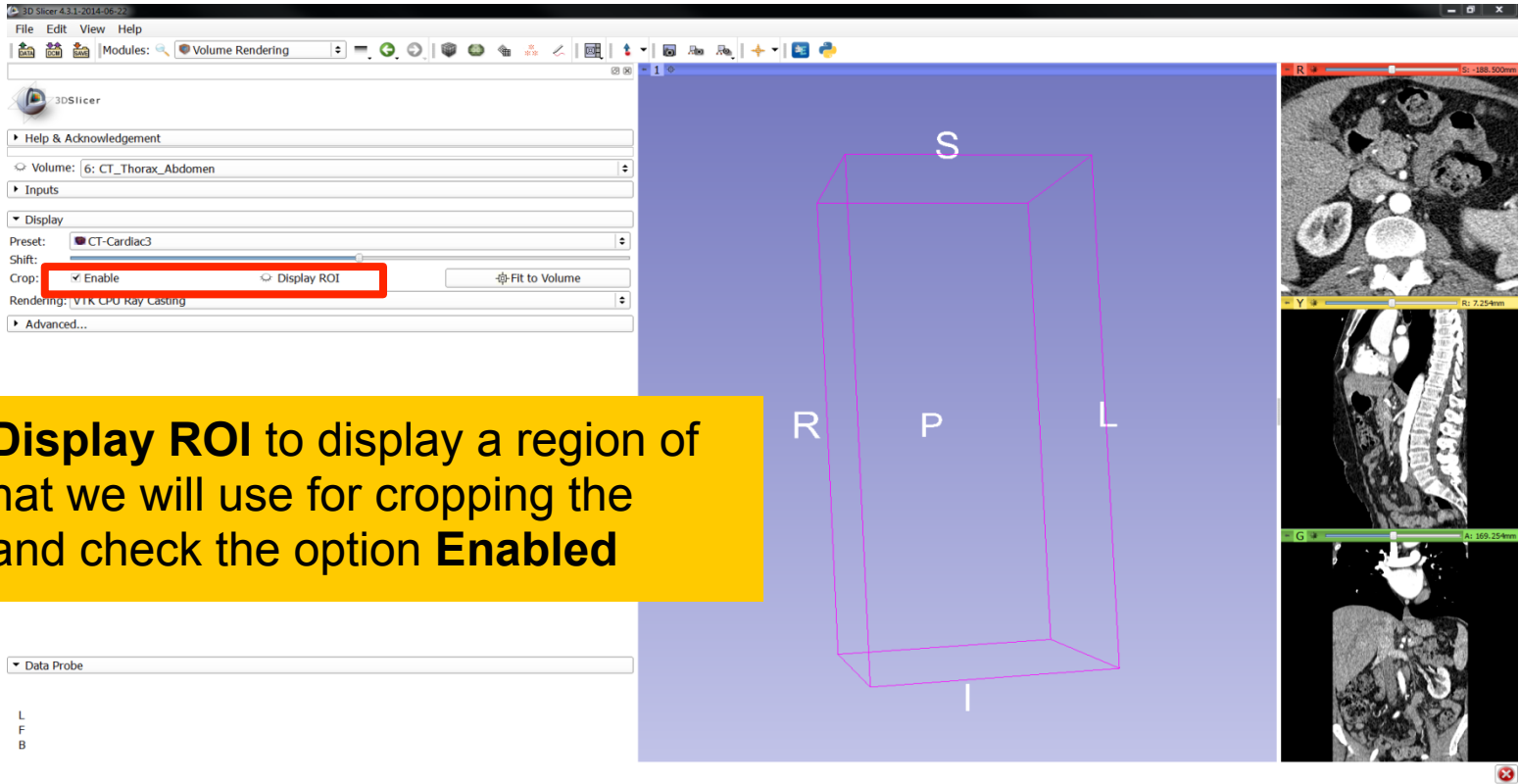
Volume Rendering



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



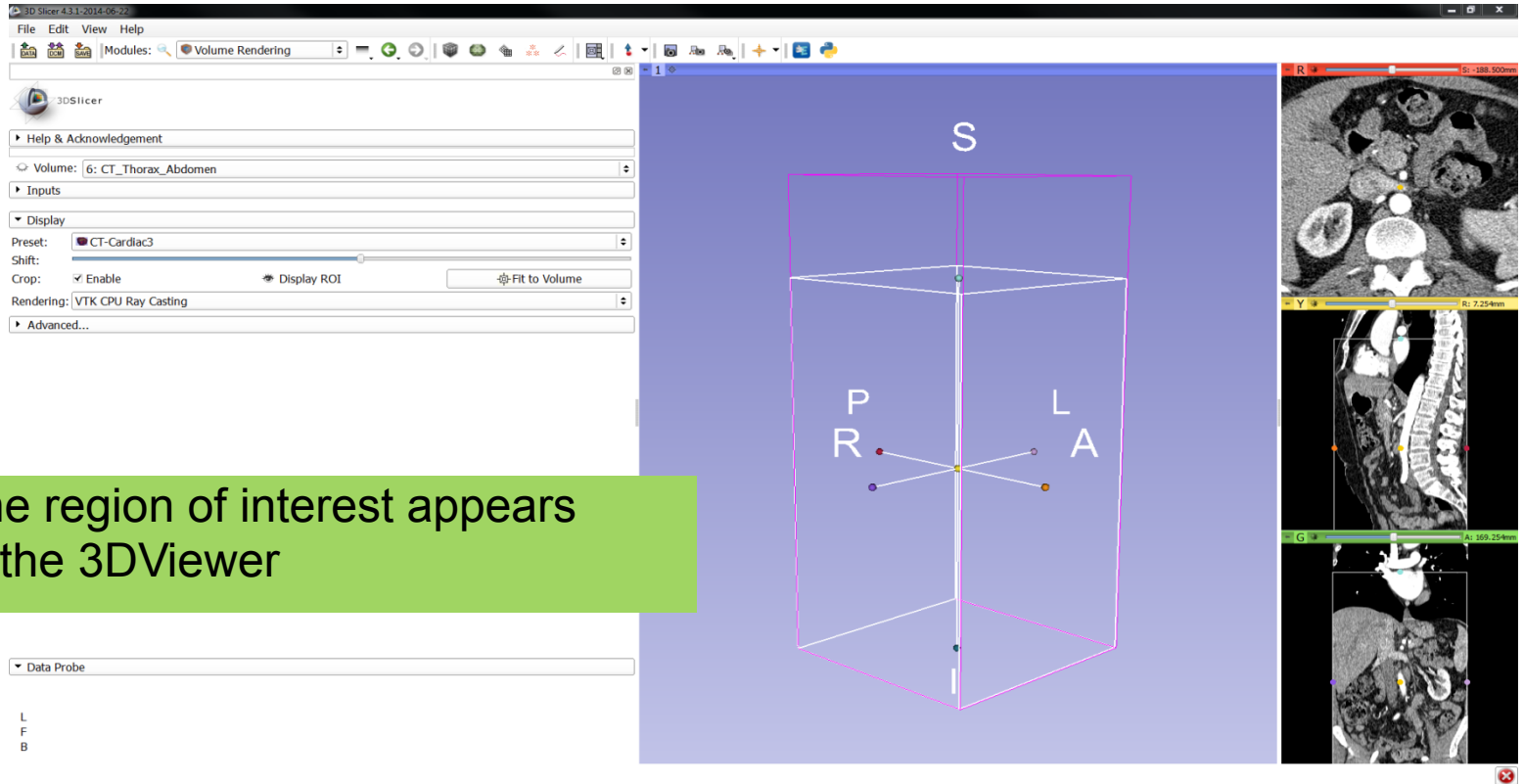
Volume Rendering



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



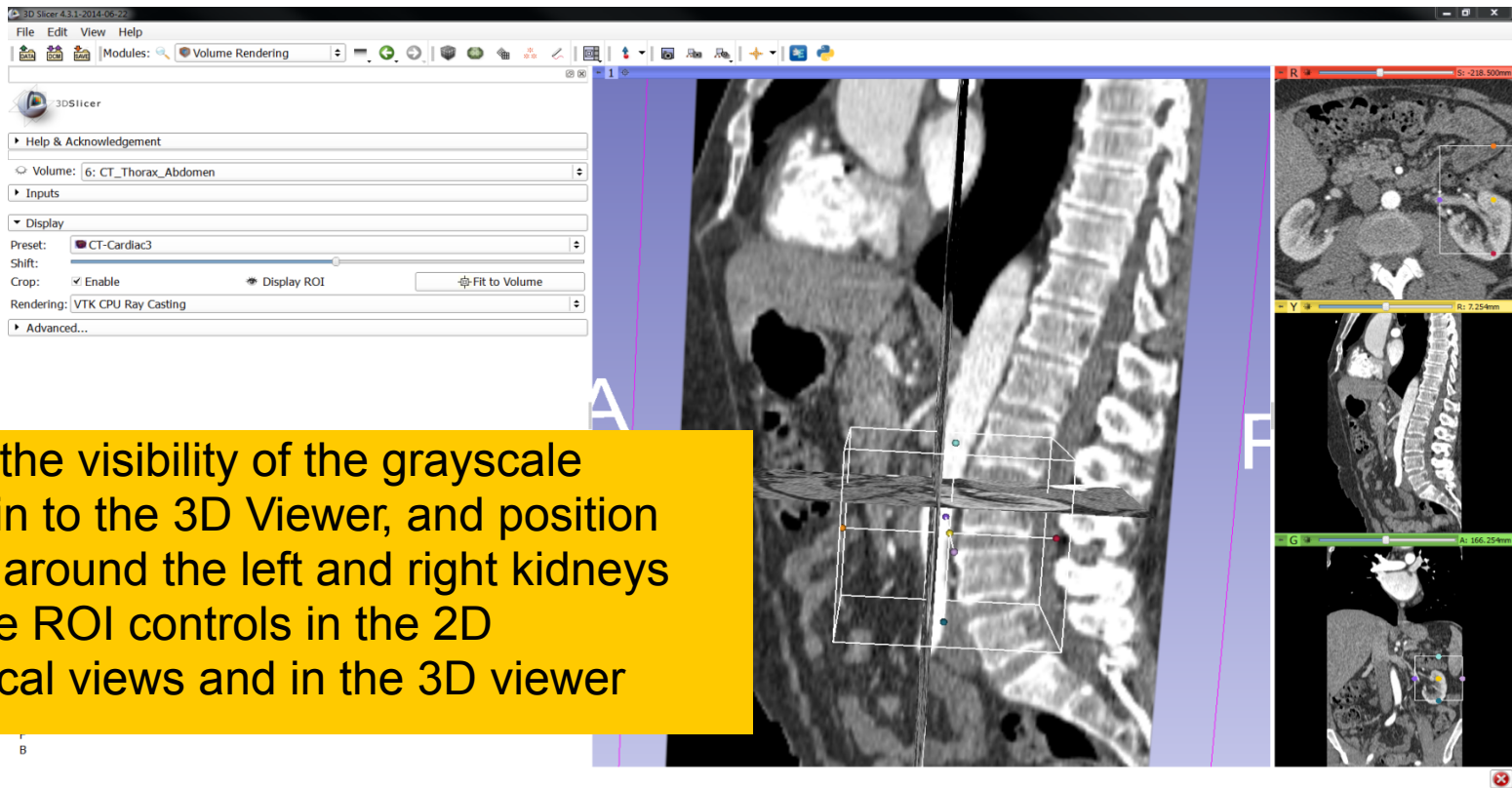
Volume Rendering



The region of interest appears in the 3DViewer



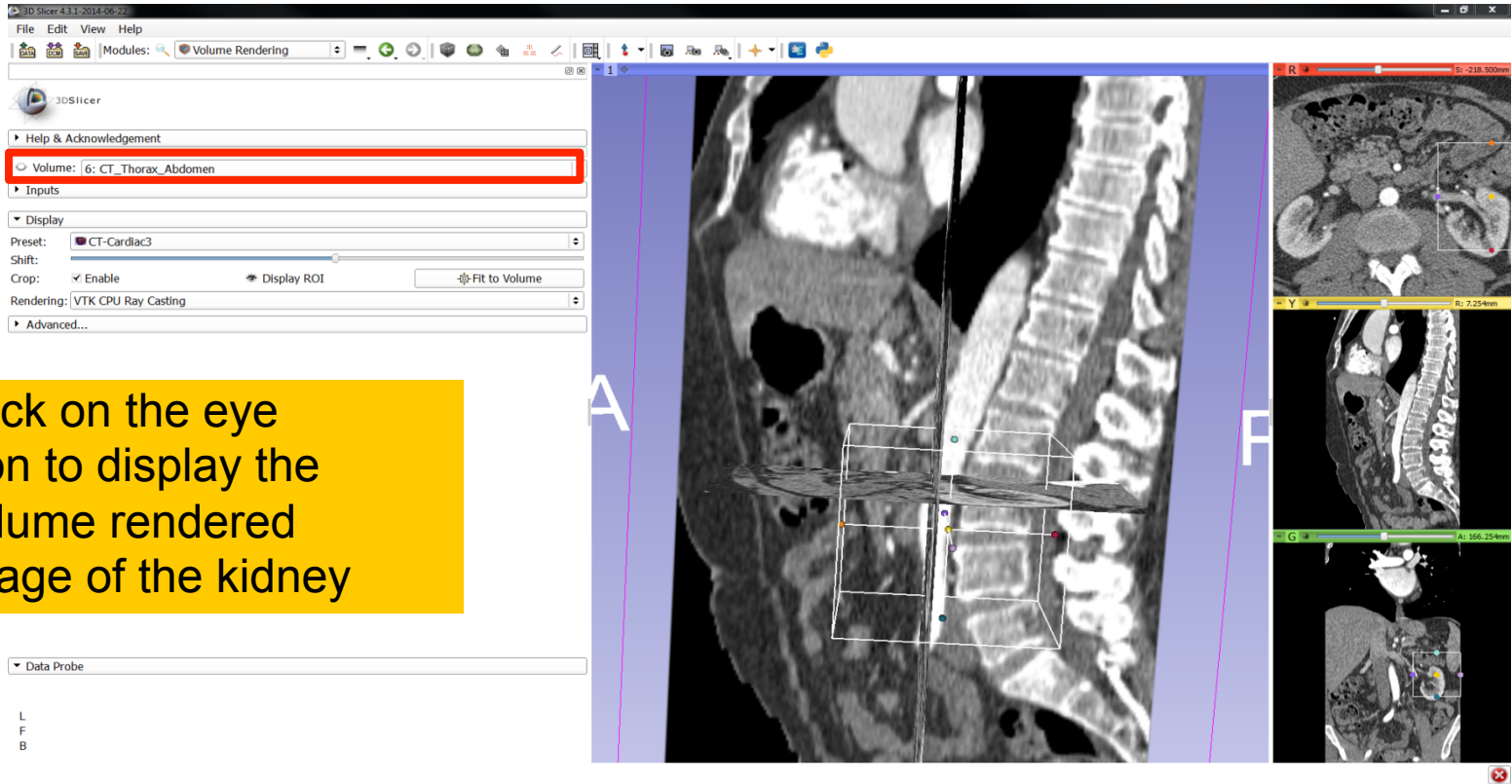
Volume Rendering



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

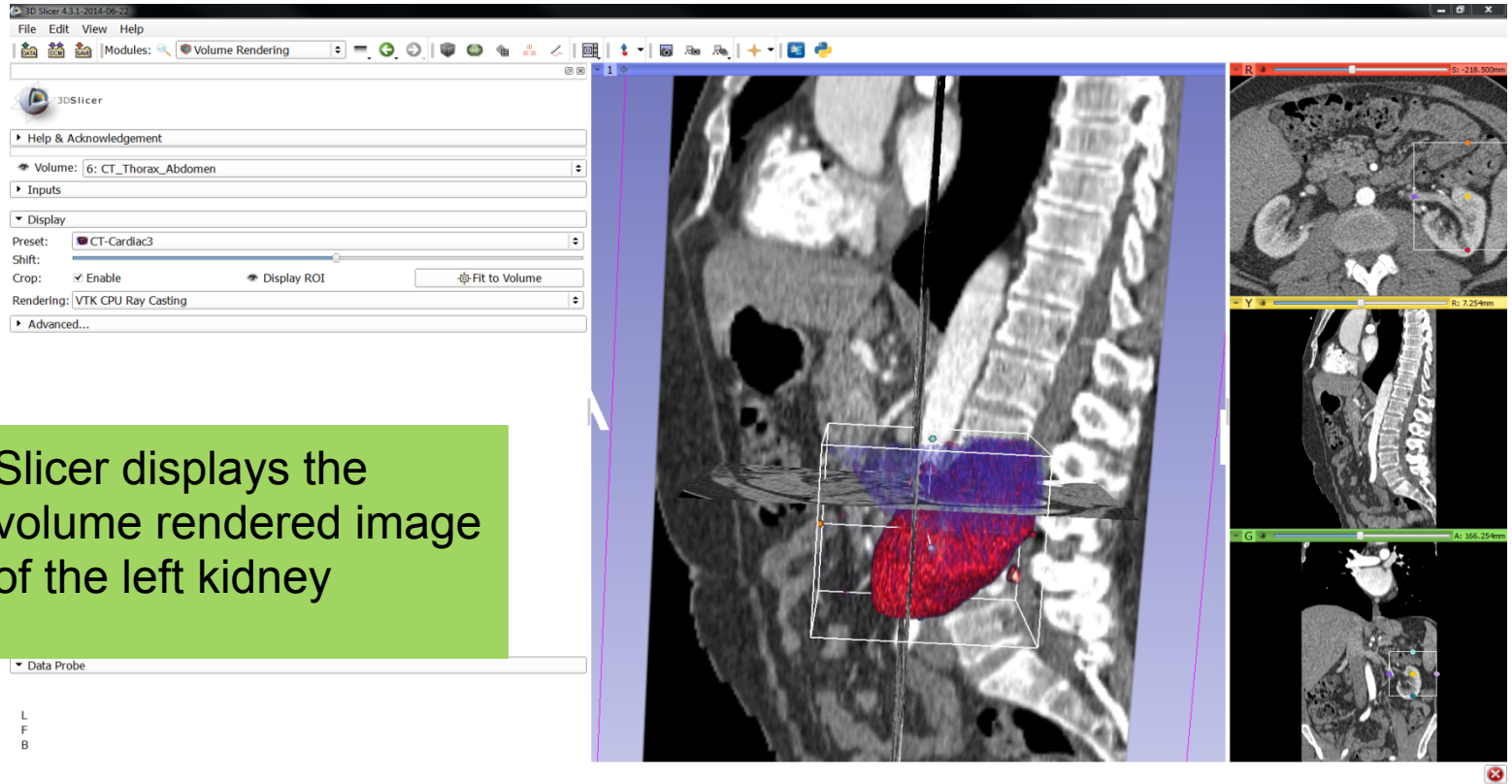


Volume Rendering





Volume Rendering

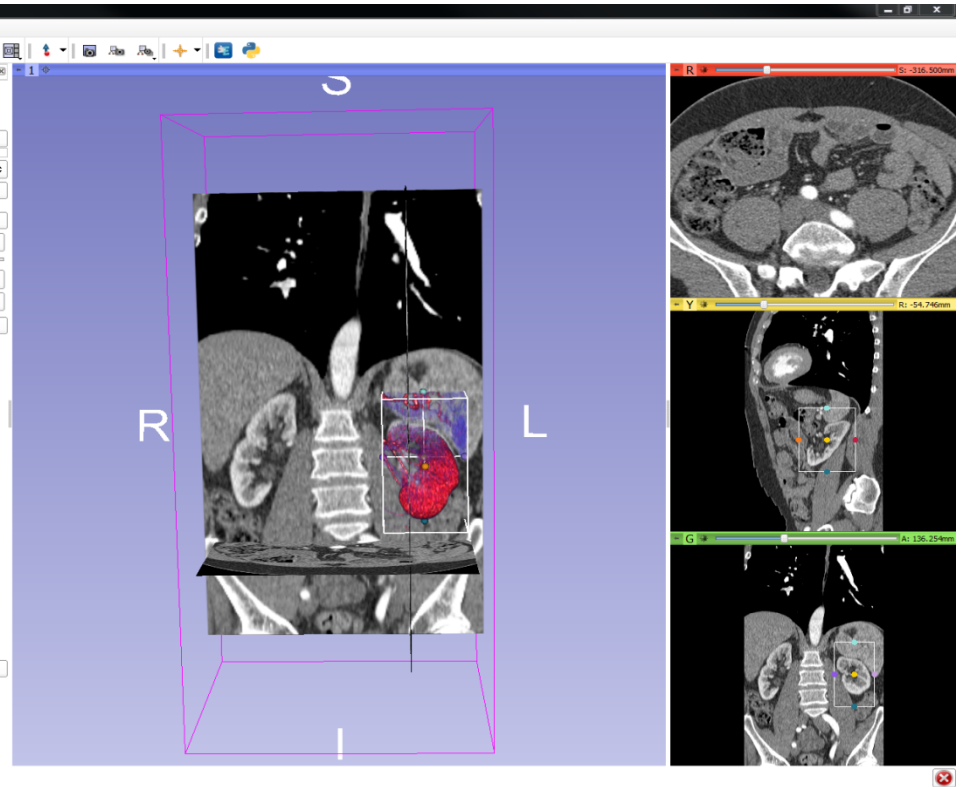


Slicer displays the volume rendered image of the left kidney



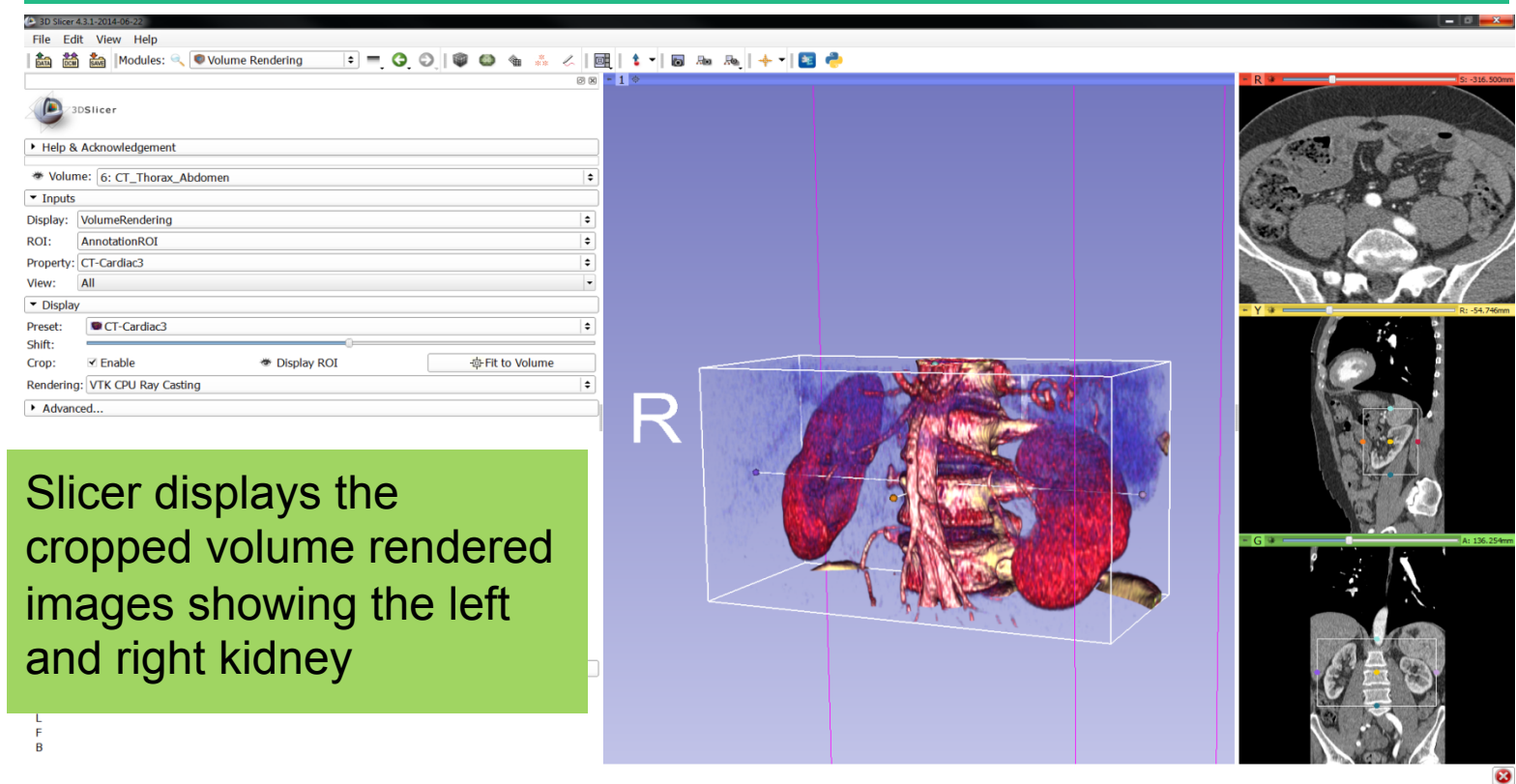
Volume Rendering

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





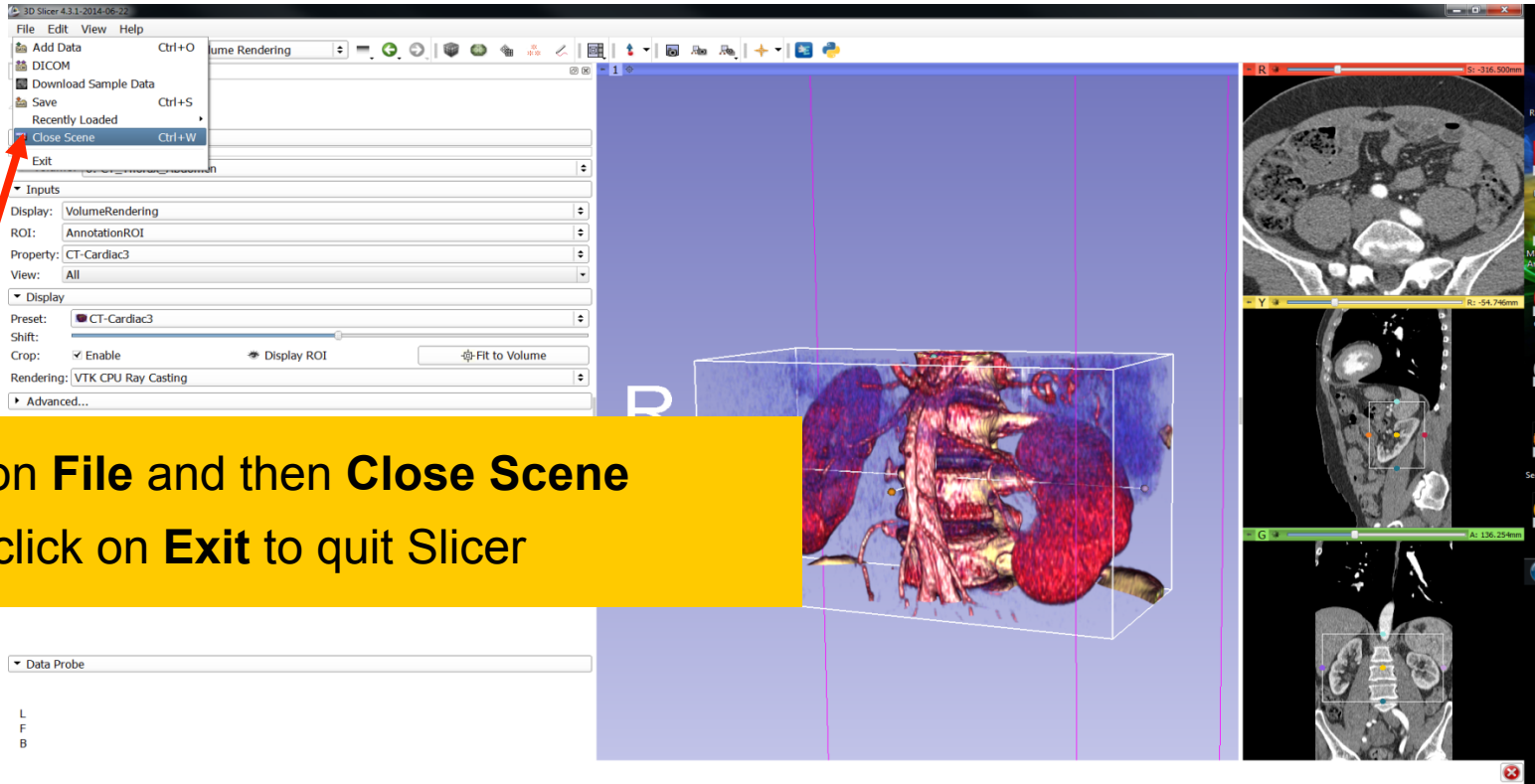
Volume Rendering



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



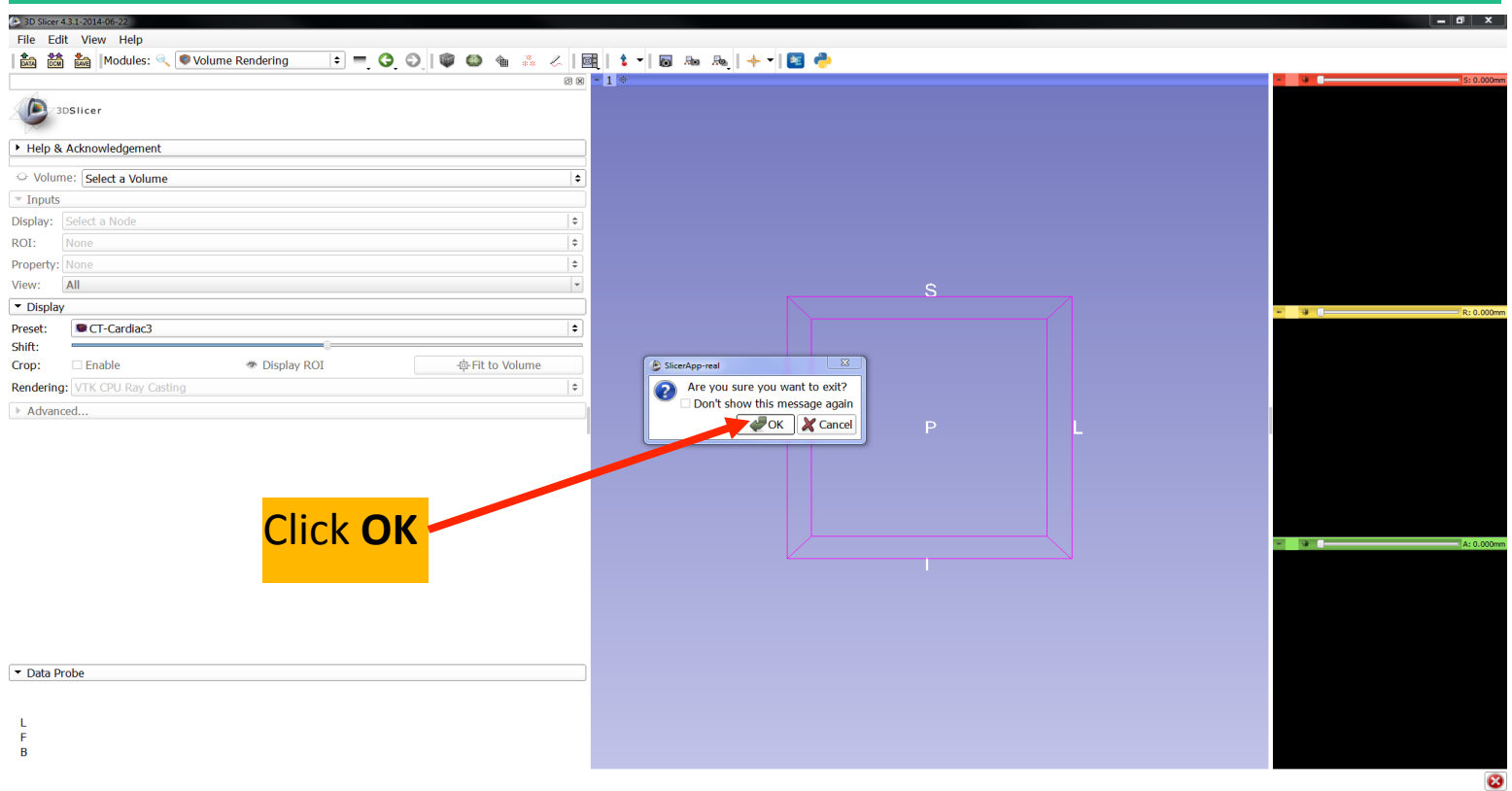
Volume Rendering

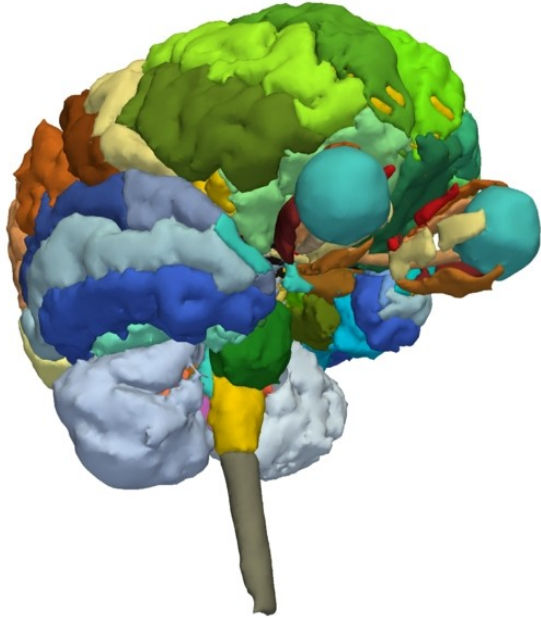


Click on **File** and then **Close Scene**
Then click on **Exit** to quit Slicer



Volume Rendering





3D visualization of surface models of the brain



3D Data Loading and Visualization

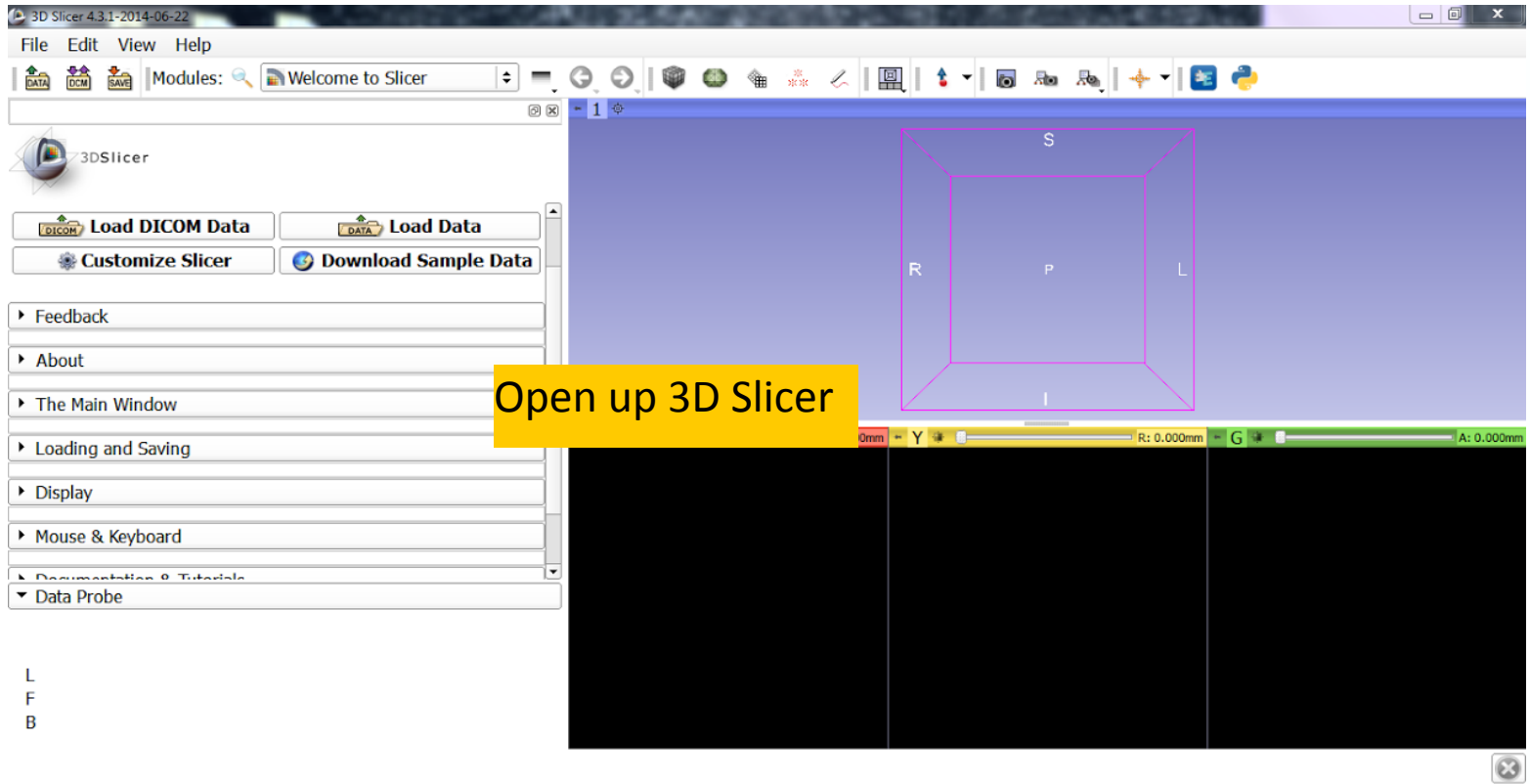


- This tutorial is a short introduction to the advanced **3D visualization capabilities Slicer**
- The Slicer4 Minute dataset is composed of an MR scan of the brain and 3D surface reconstructions of anatomical structures.
- The data are part of the **SPL Multi-modality MRI-based atlas of the brain**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

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

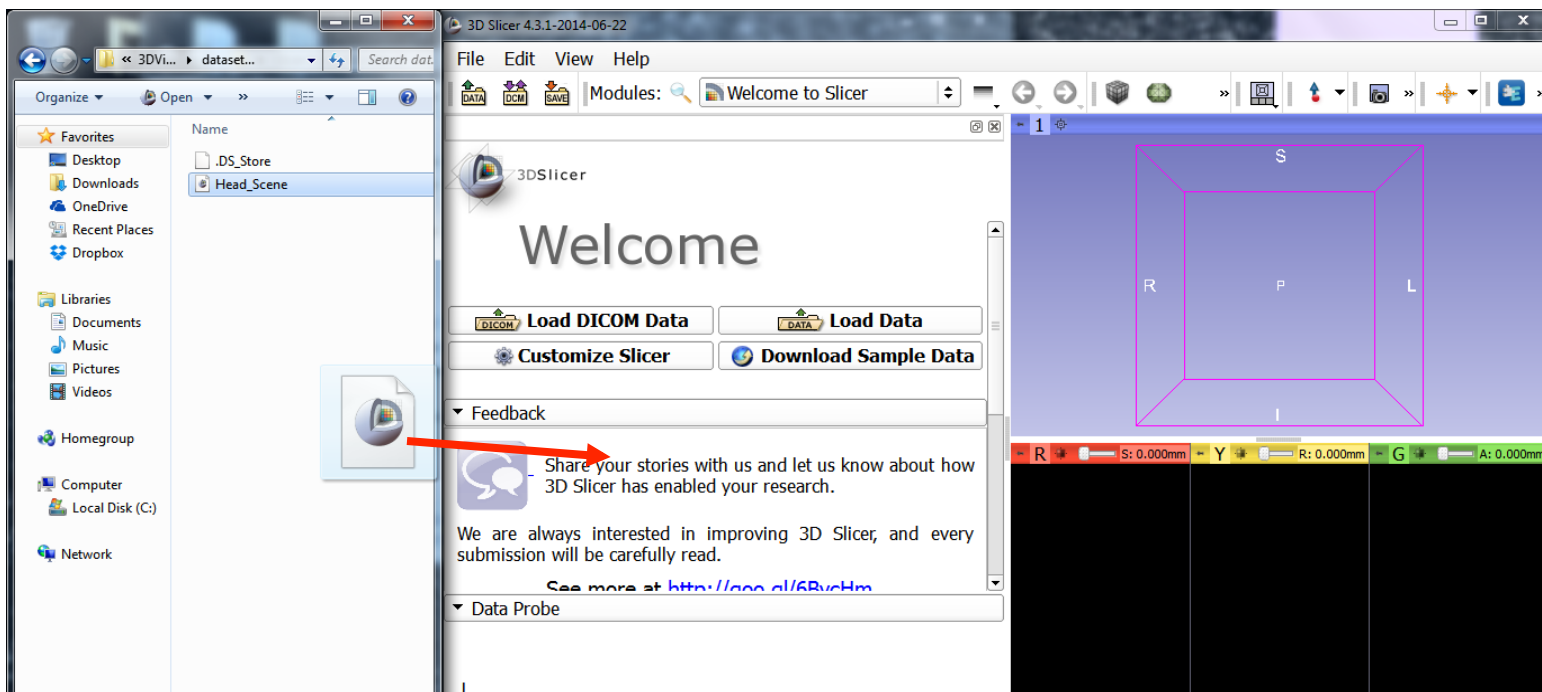


Welcome to Slicer4





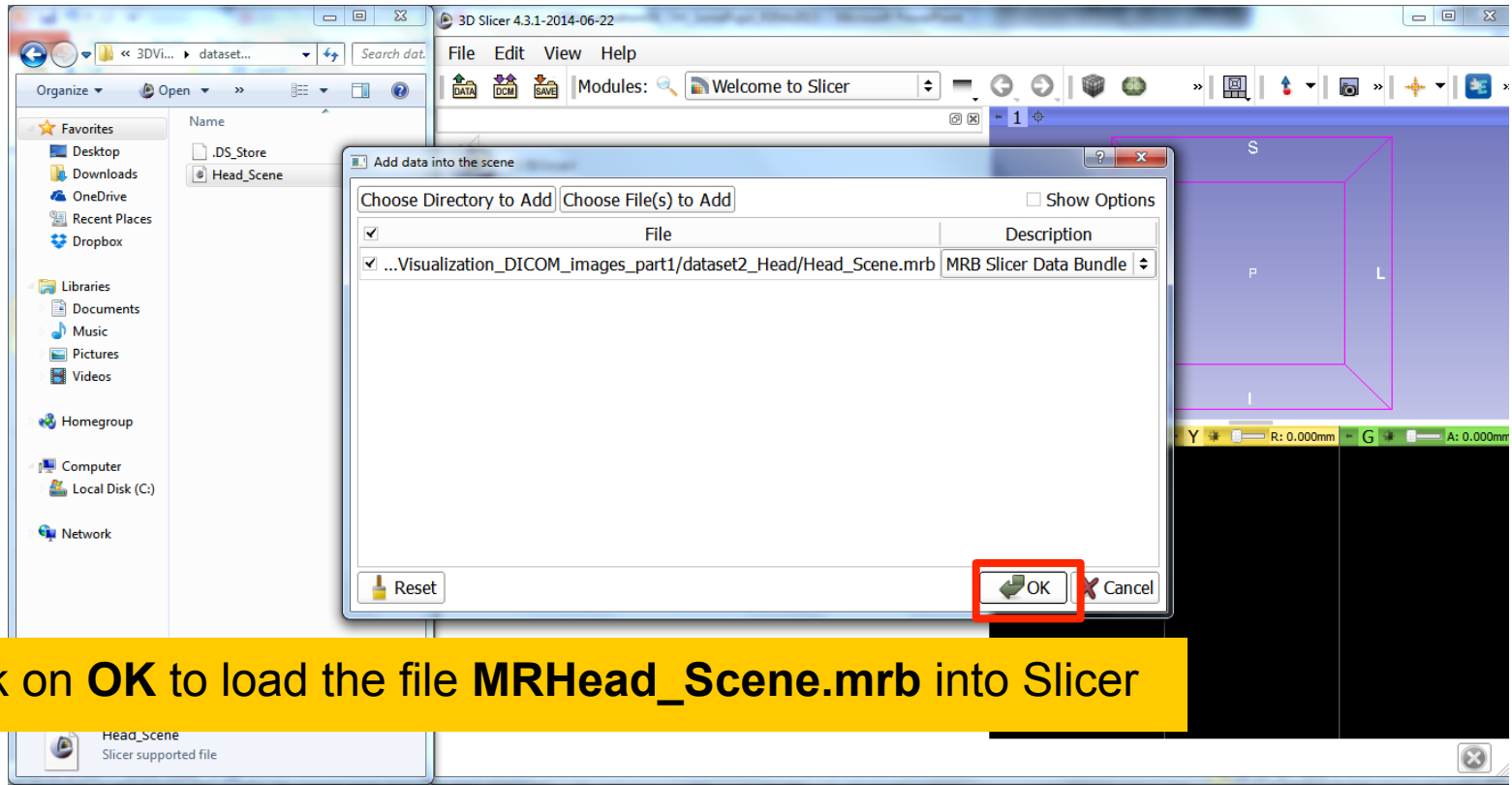
Slicer4 Minute Tutorial: Viewing the Scene



Open the directory **dataset2_Head** located in
C:/3DSlicerData_RSNA2014/3DVisualizationDICOM_Tuesday_Dec3
Drag 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

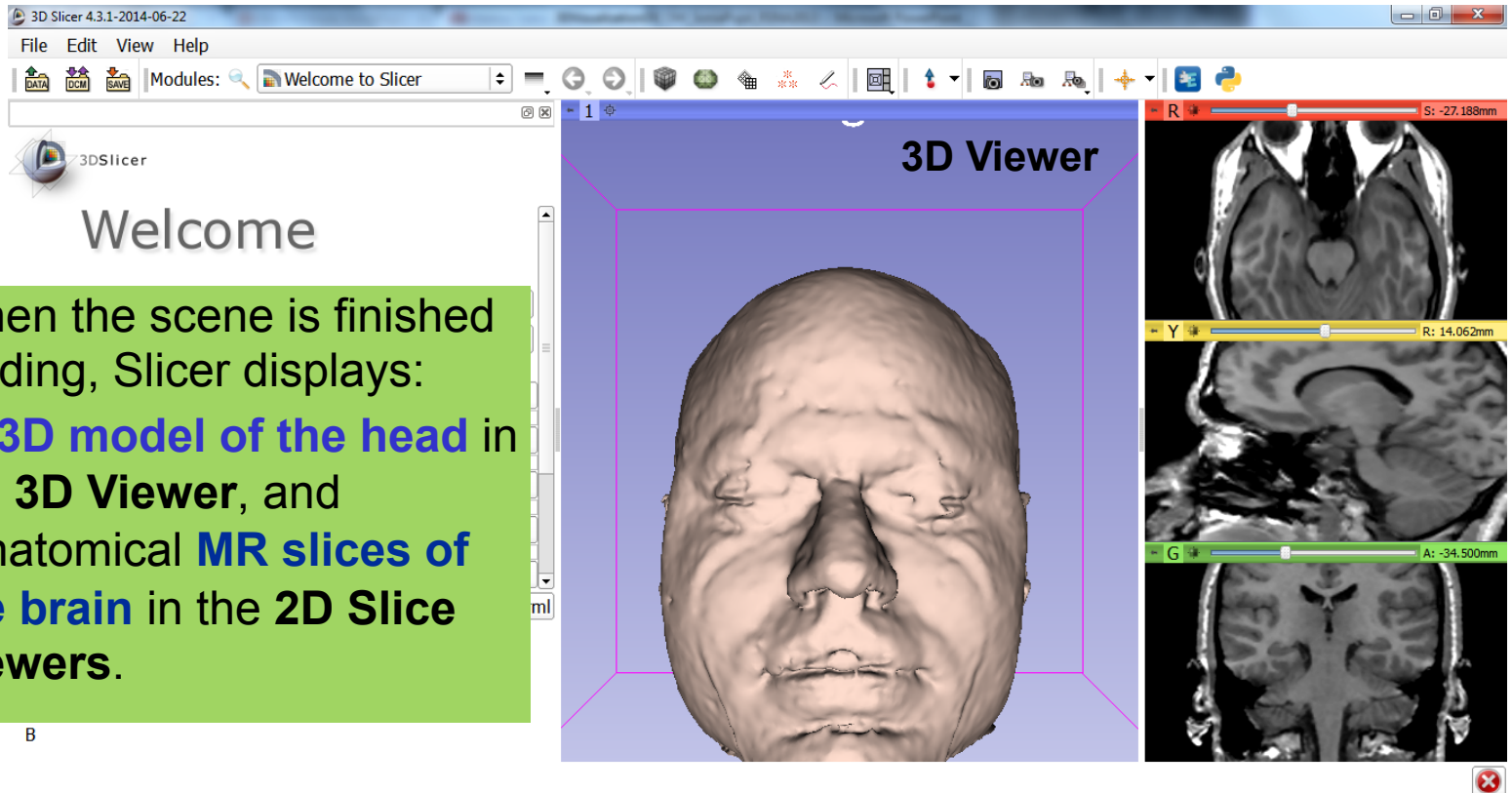


Slicer4 Minute Tutorial: Viewing the Scene

When the scene is finished loading, Slicer displays:

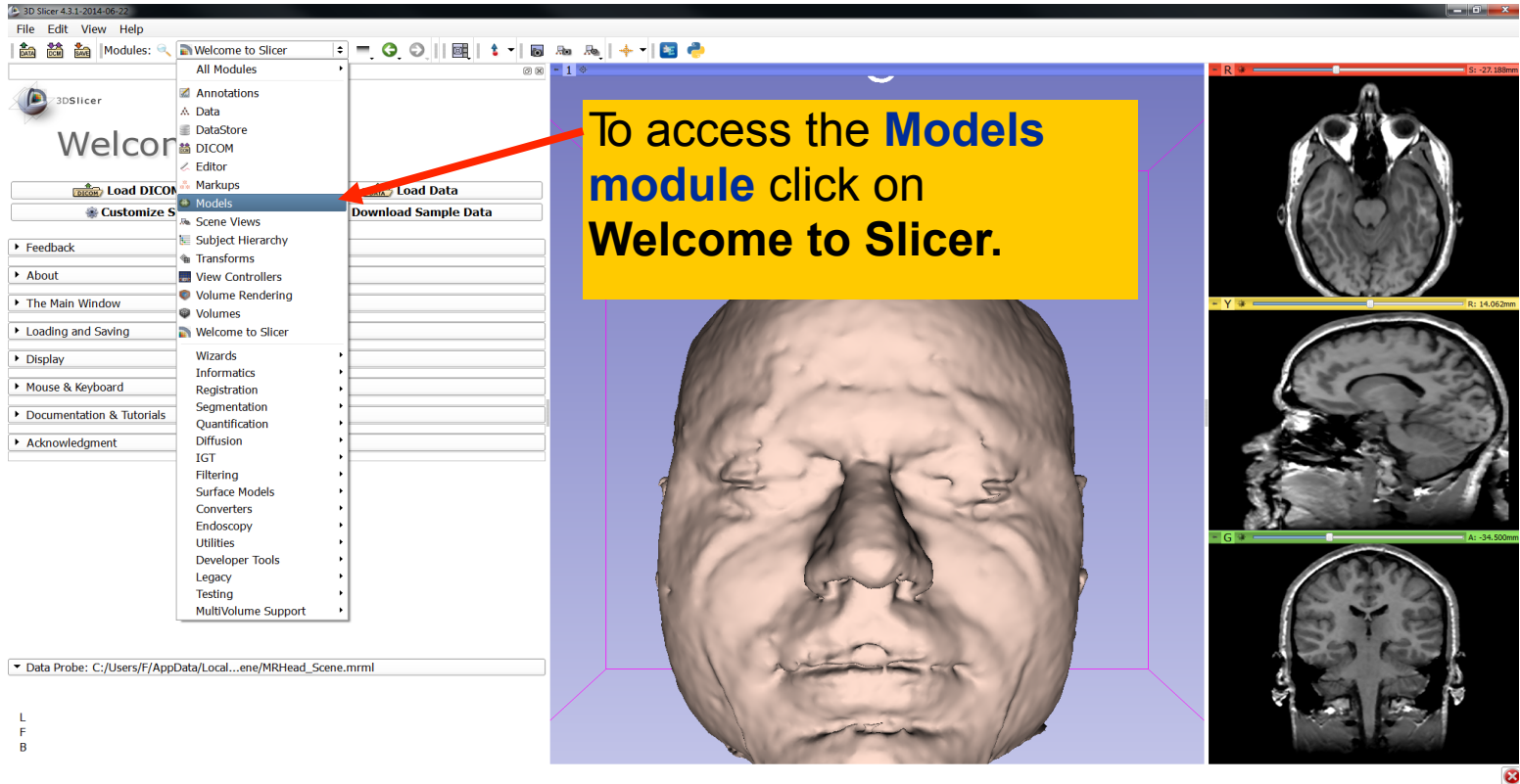
- a **3D model of the head** in the **3D Viewer**, and
- anatomical **MR slices of the brain** in the **2D Slice Viewers**.

B



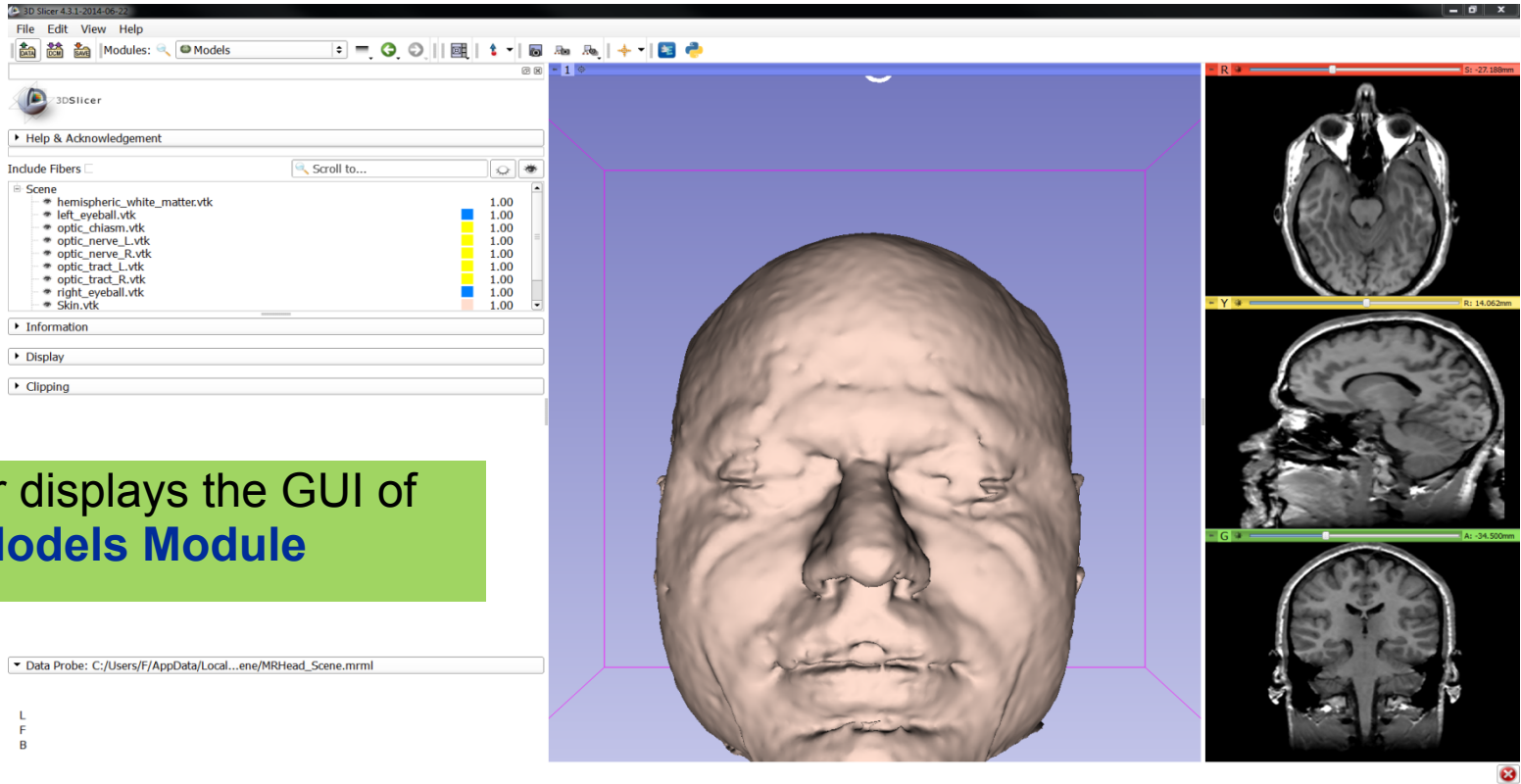


Slicer4 Minute Tutorial: Exploring Slicer's functionality





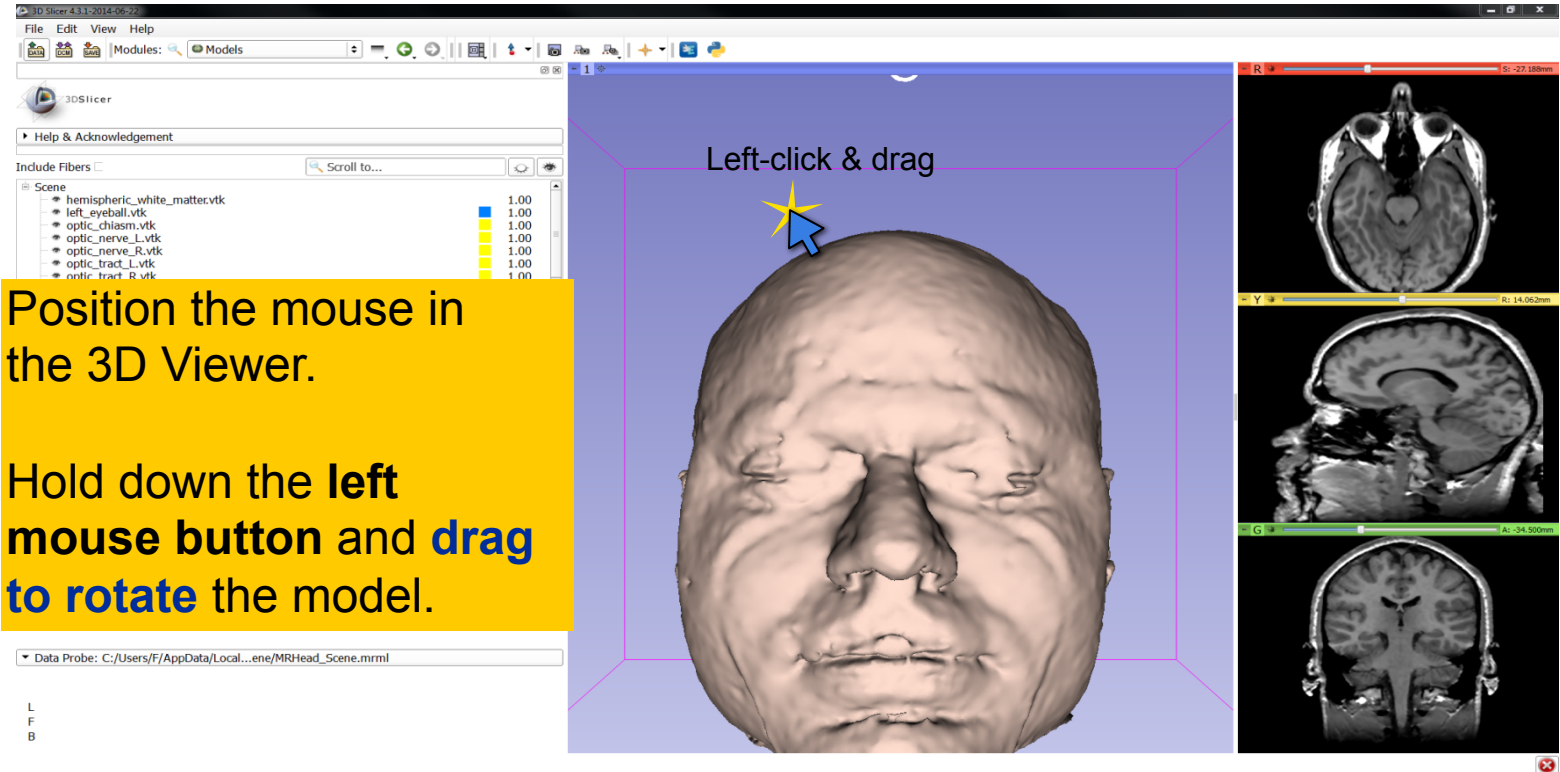
Slicer4 Minute Tutorial: Switching to the Models Module



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

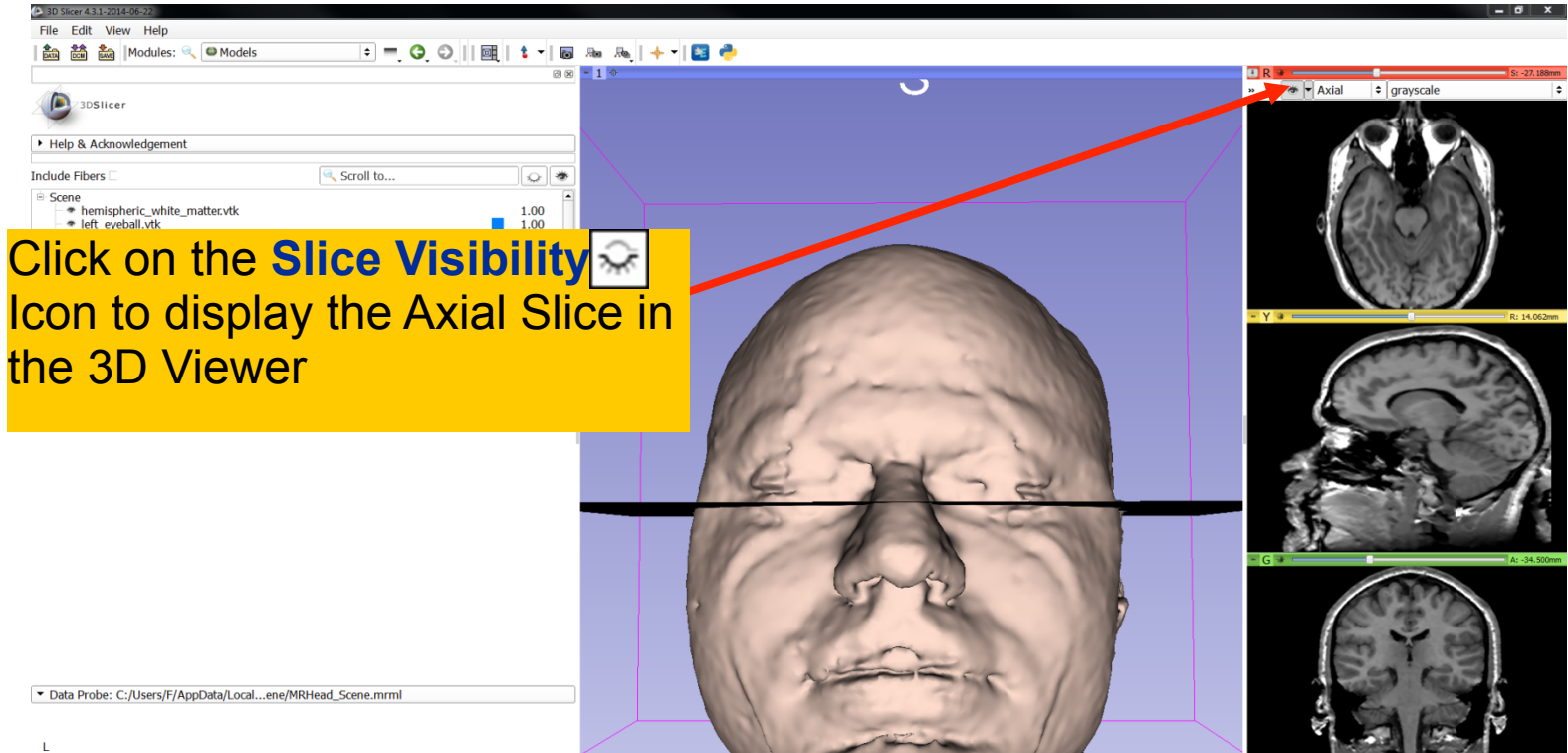


Slicer4 Minute Tutorial: Basic 3D Interaction





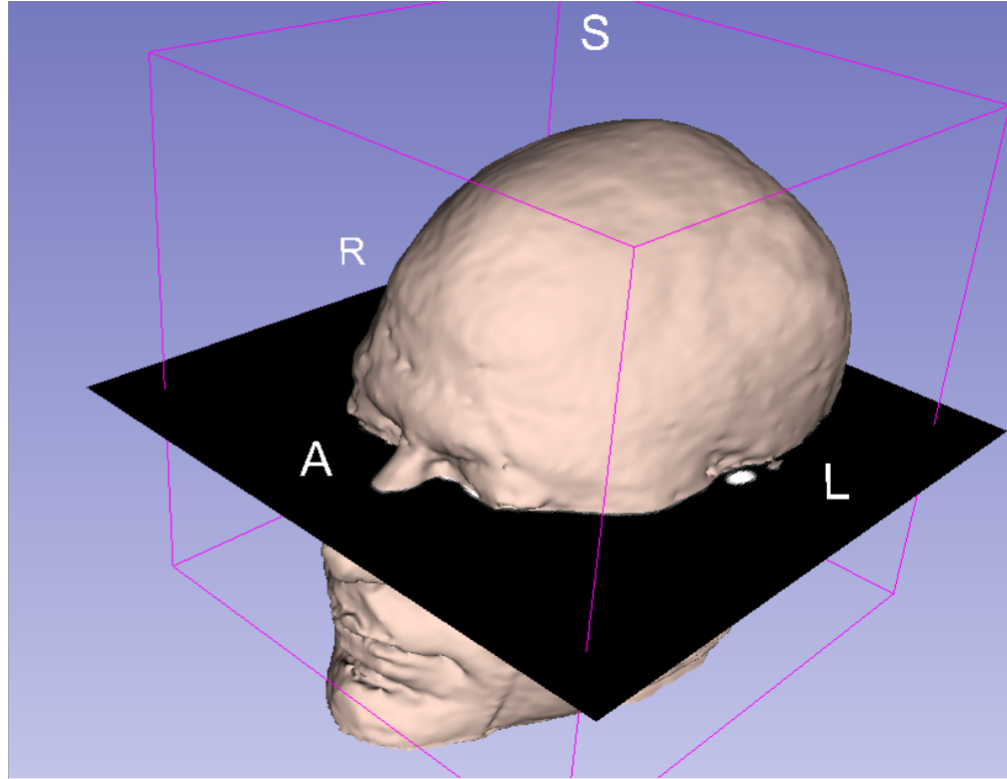
Slicer4 Minute Tutorial: Viewing Slices in the 3D Viewer





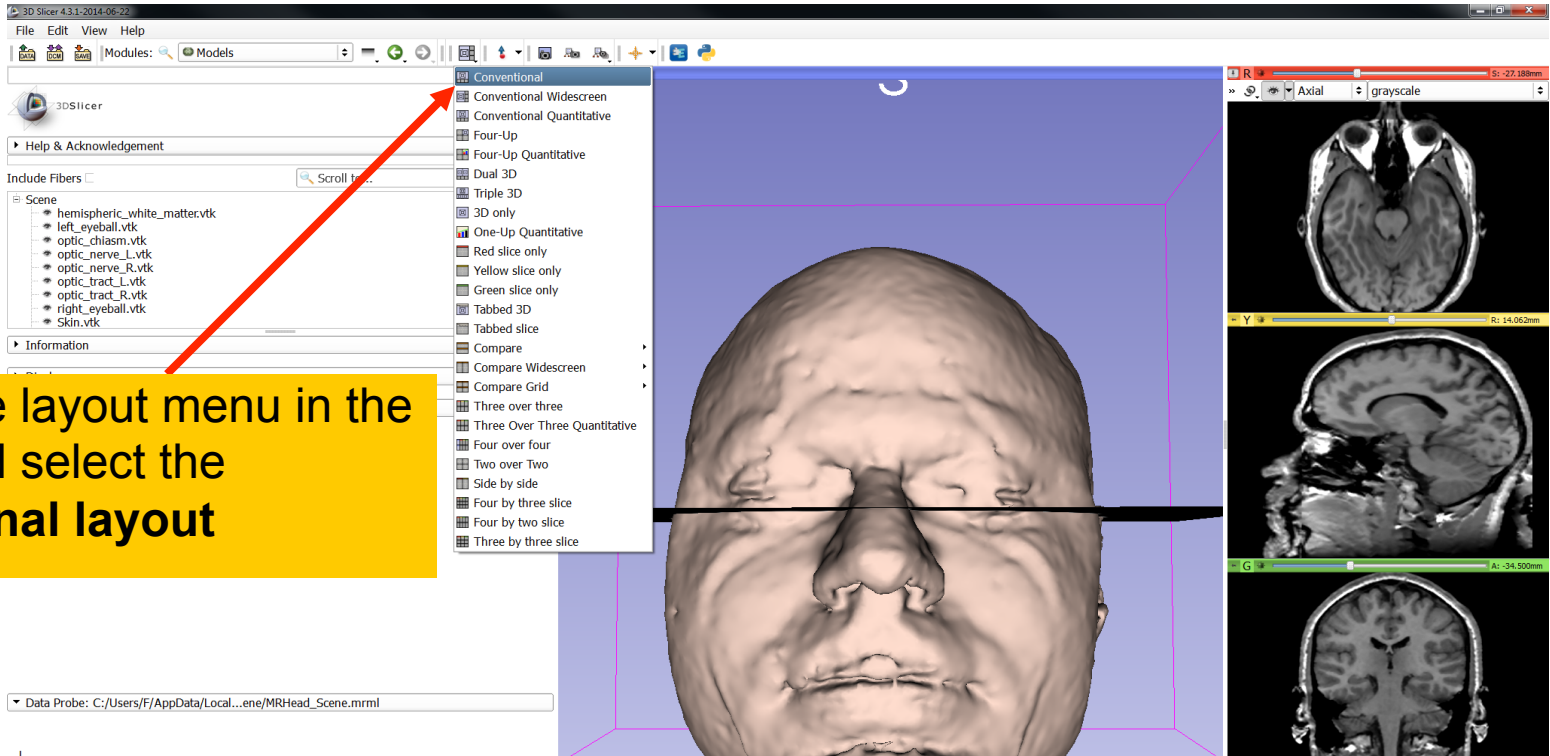
Slicer4 Minute Tutorial: 3D Visualization

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





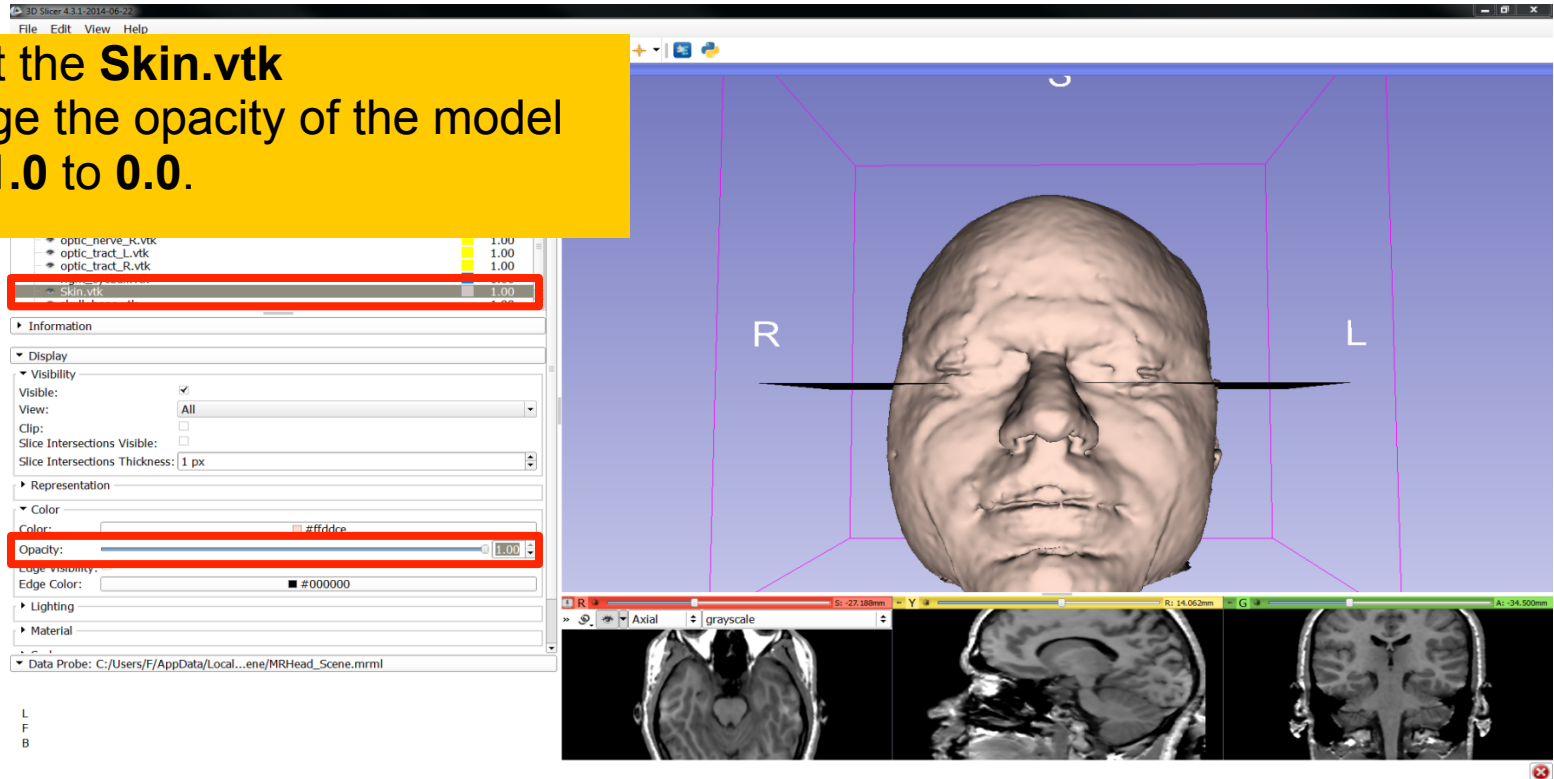
Slicer4 Minute Tutorial: Viewing Slices in the 3D Viewer





Slicer4 Minute Tutorial: 3D Visualization

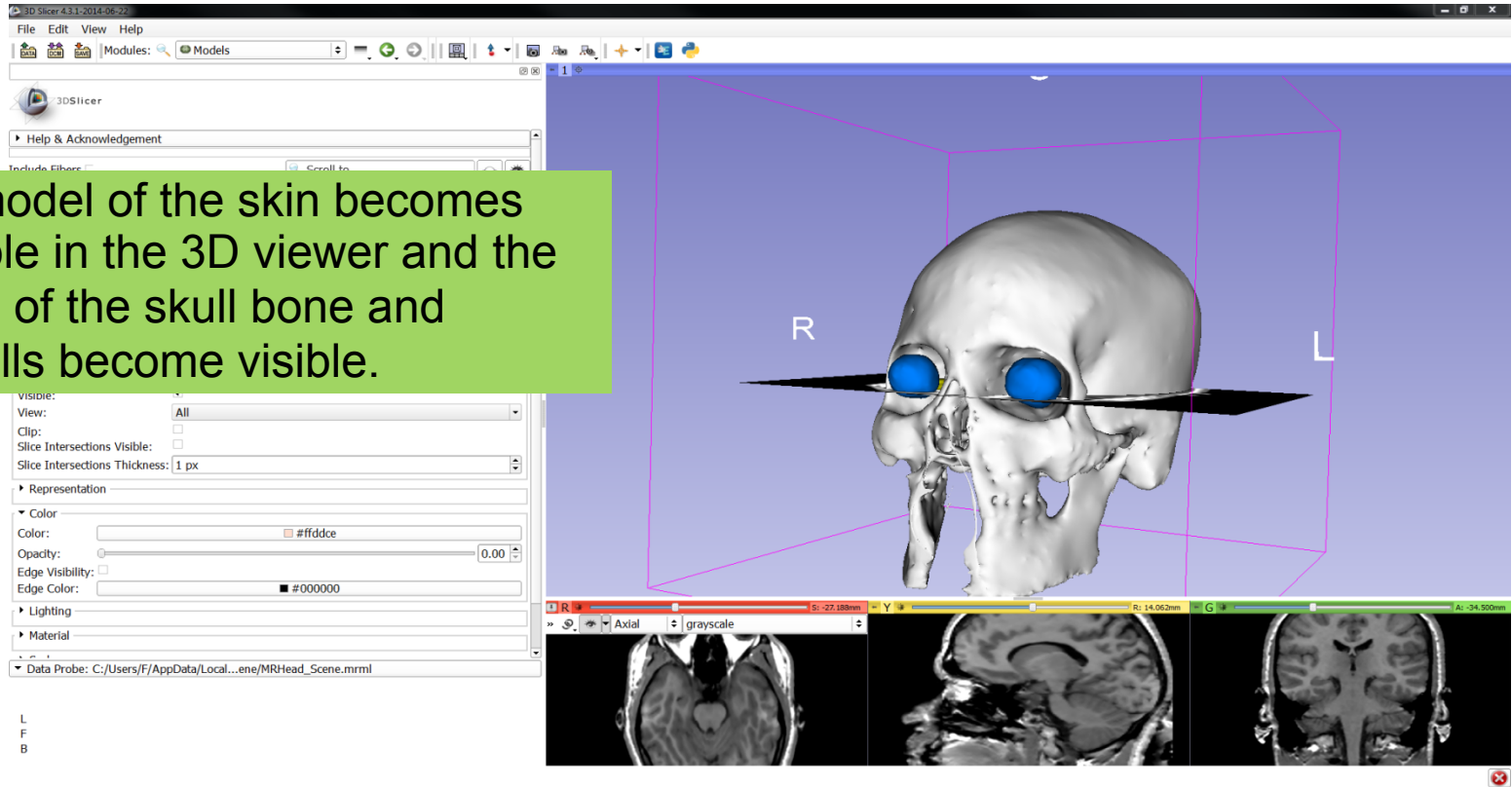
Select the **Skin.vtk**
Change the opacity of the model
from **1.0** to **0.0**.





Slicer4 Minute Tutorial: 3D Visualization

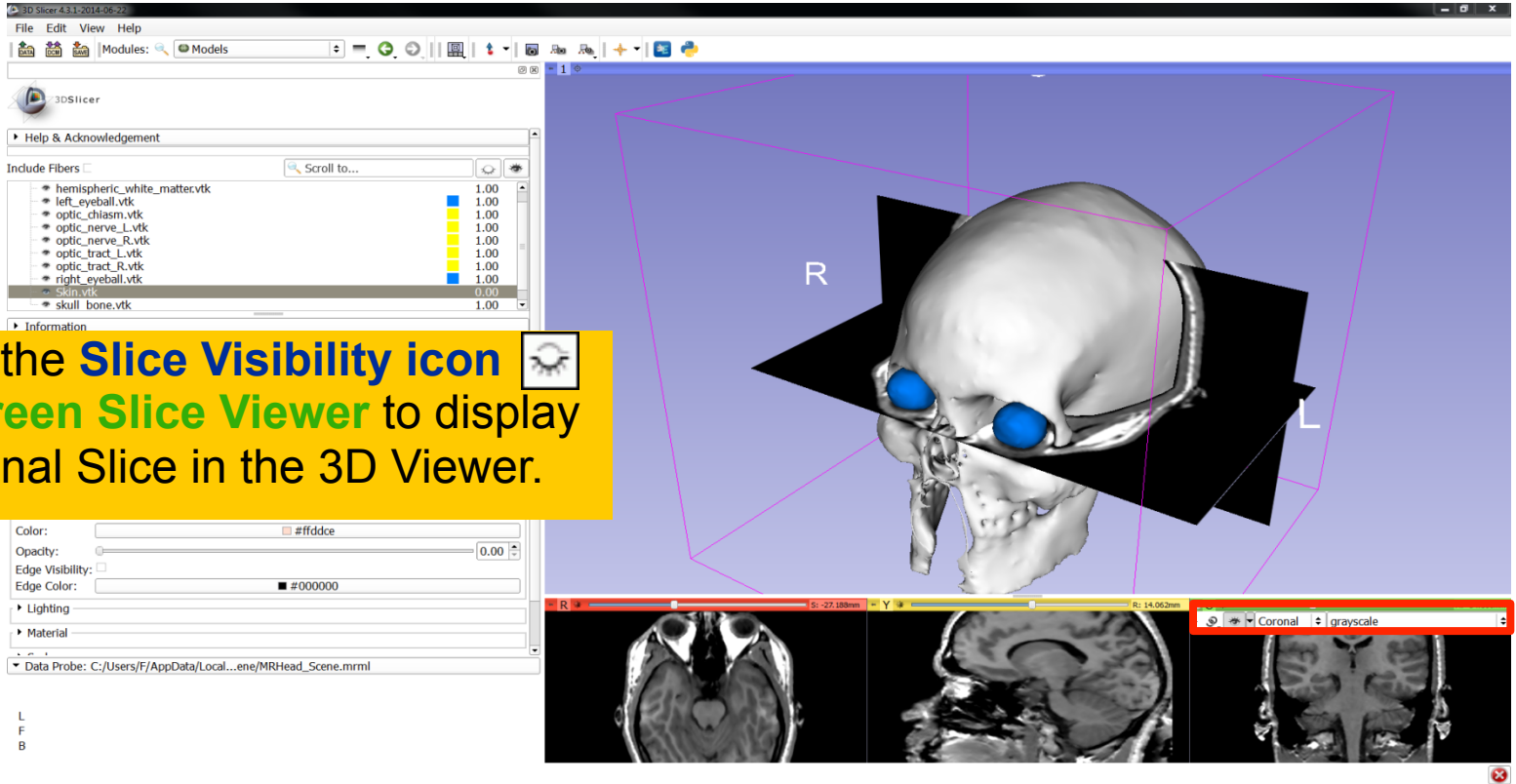
The model of the skin becomes invisible in the 3D viewer and the model of the skull bone and eyeballs become visible.





Slicer4 Minute Tutorial: 3D Visualization

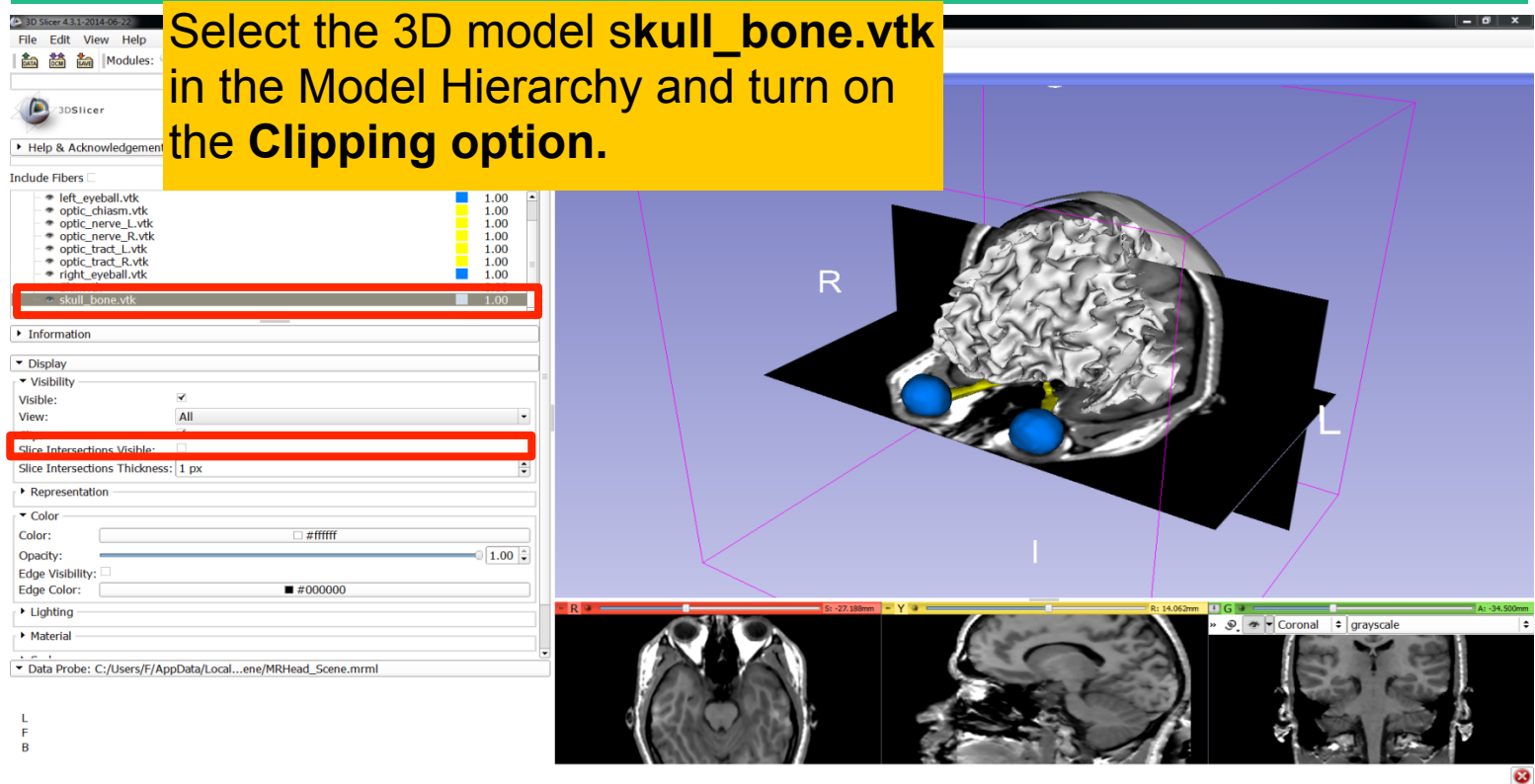
Click on the **Slice Visibility** icon  in the **Green Slice Viewer** to display the Coronal Slice in the 3D Viewer.





Slicer4 Minute Tutorial: 3D Visualization

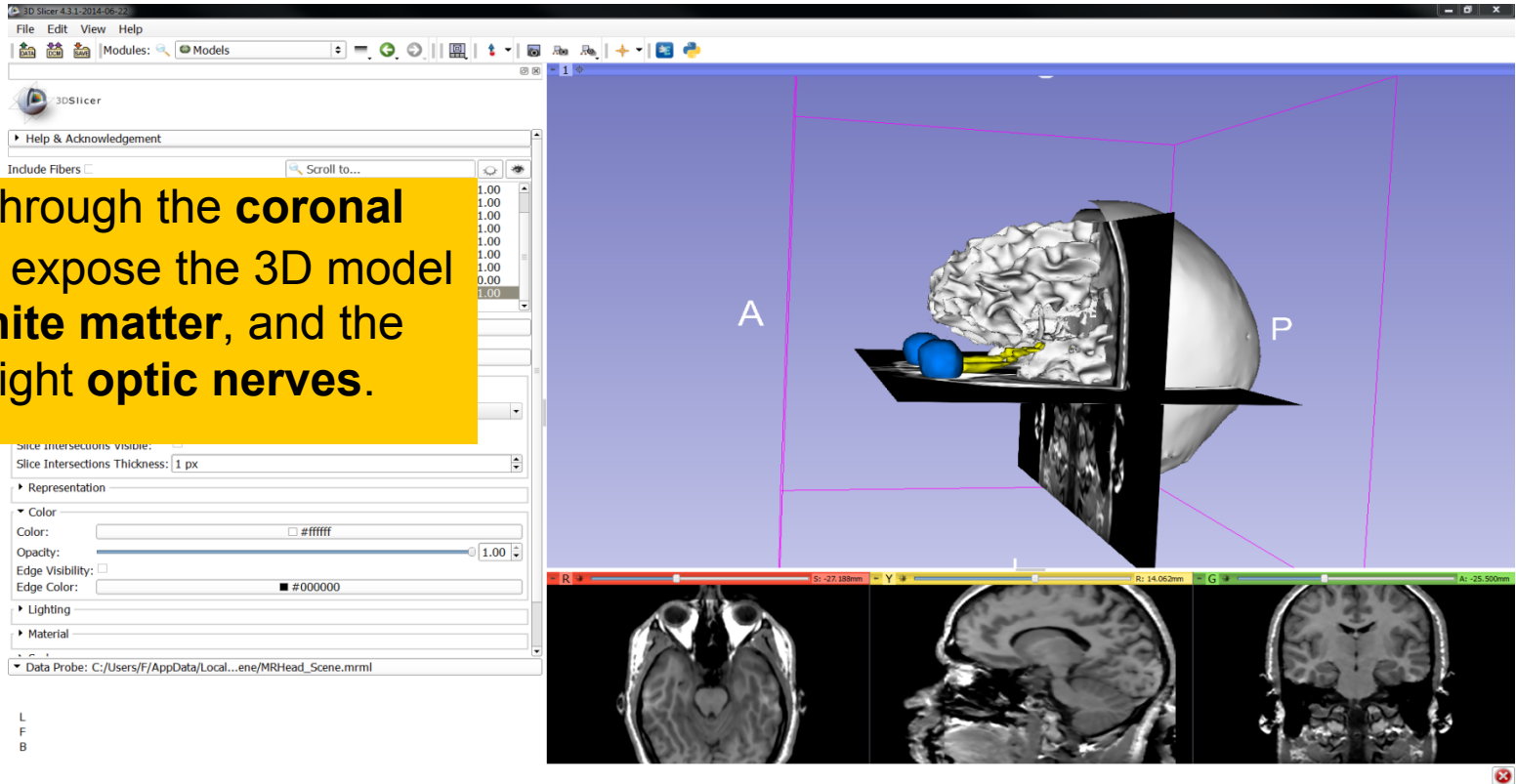
Select the 3D model **skull_bone.vtk** in the Model Hierarchy and turn on the **Clipping option**.





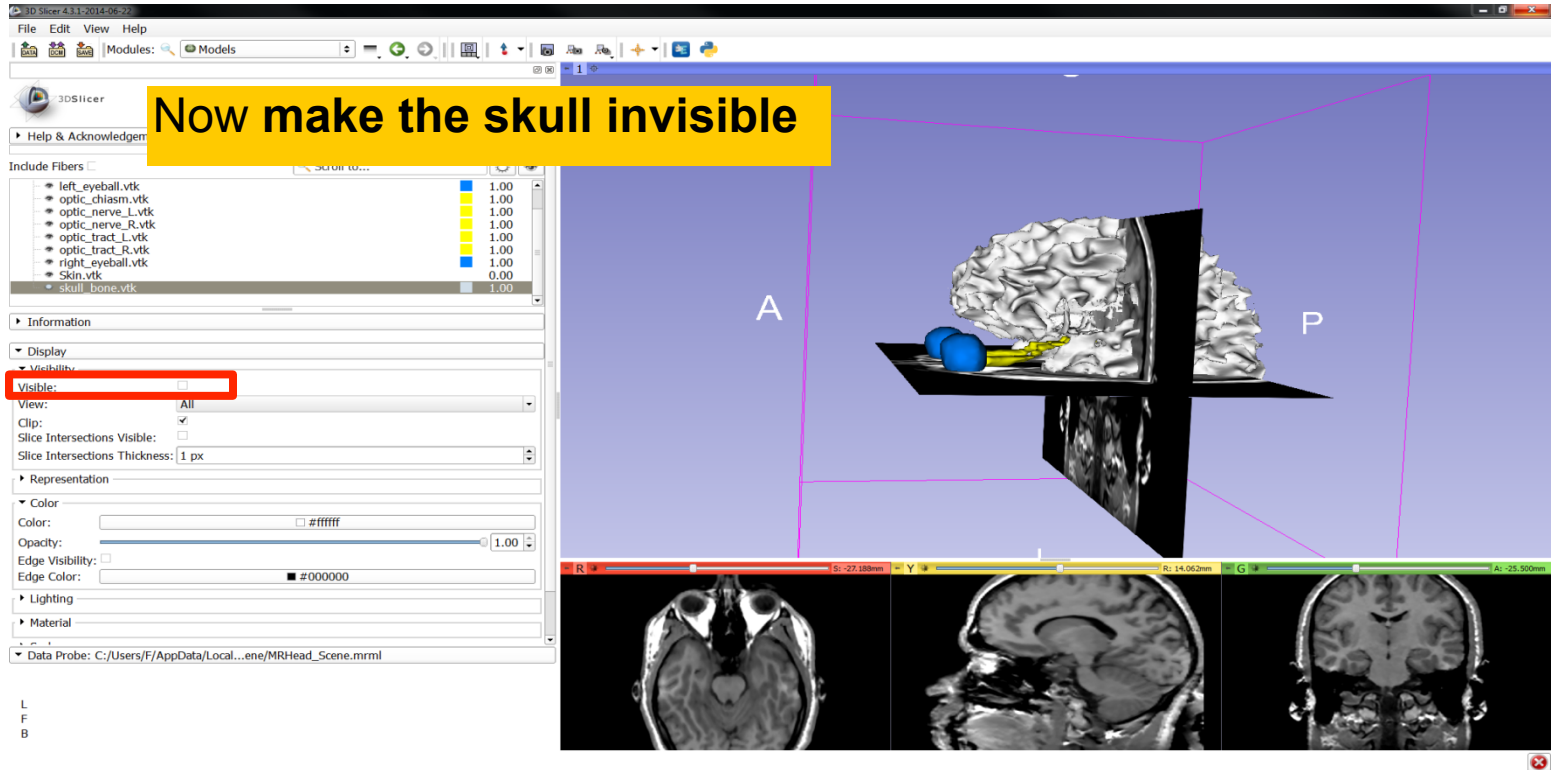
Slicer4 Minute Tutorial: 3D Visualization

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





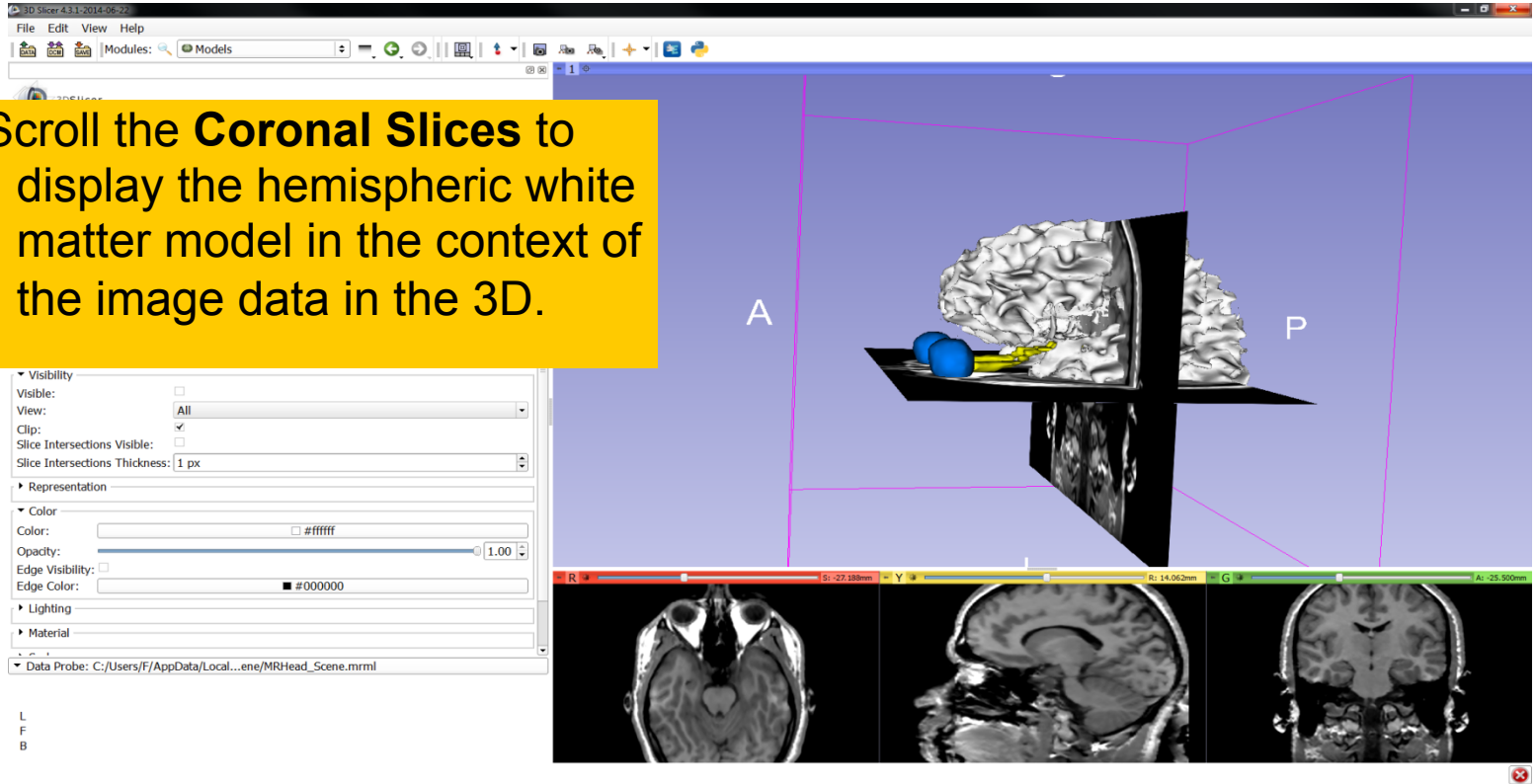
Slicer4 Minute Tutorial: 3D Visualization





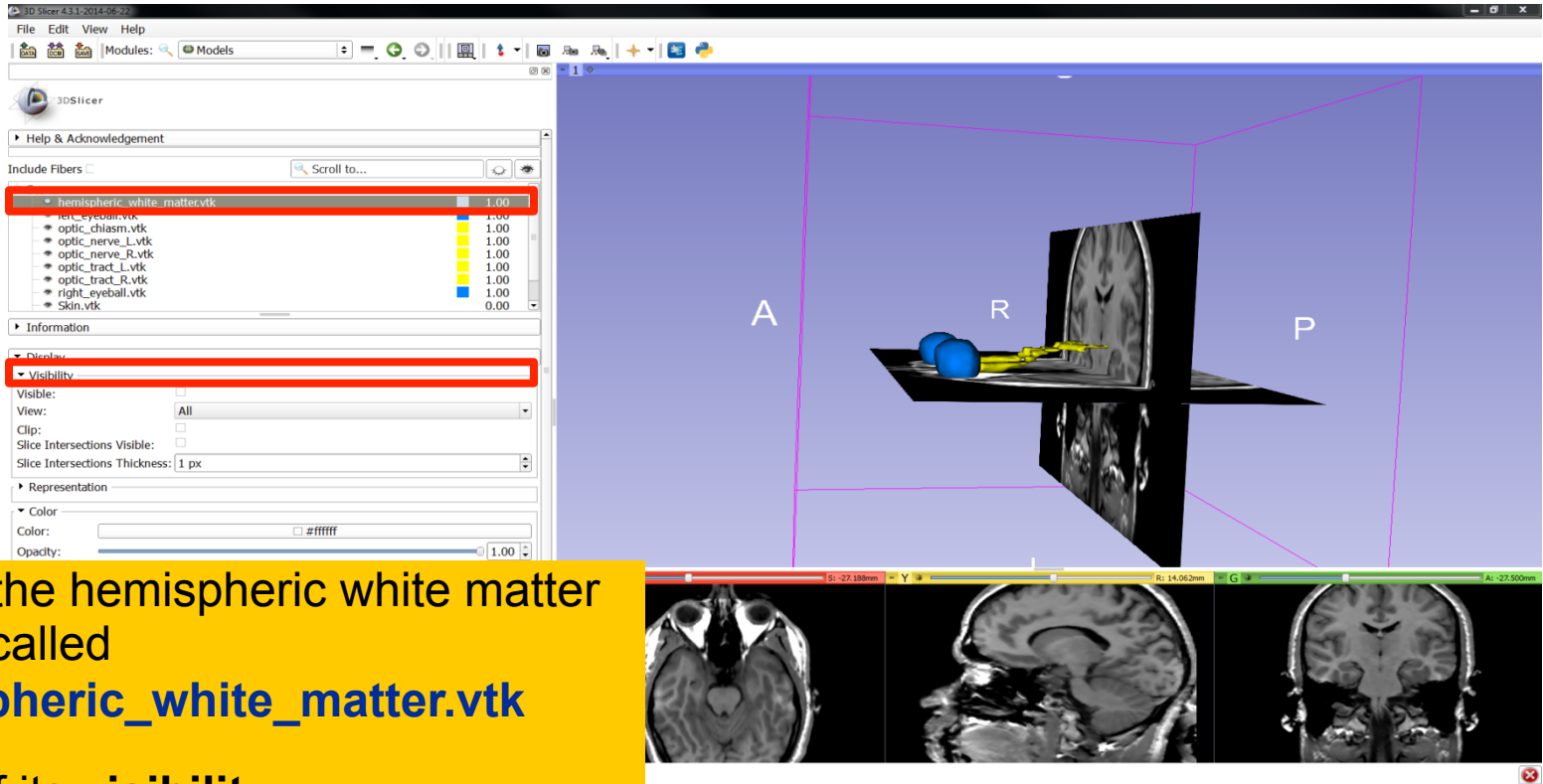
Slicer4 Minute Tutorial: 3D Visualization

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



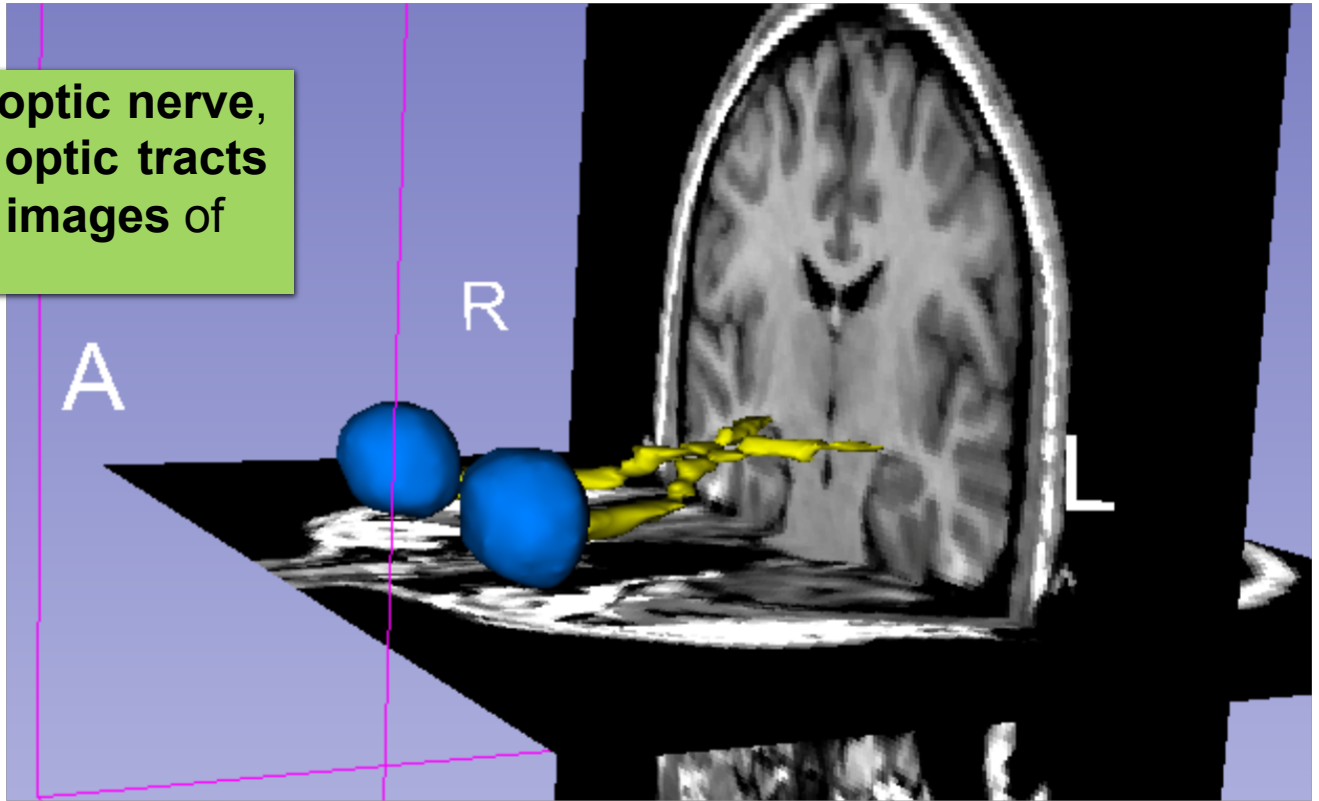
Select the hemispheric white matter model called **hemispheric_white_matter.vtk**

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.

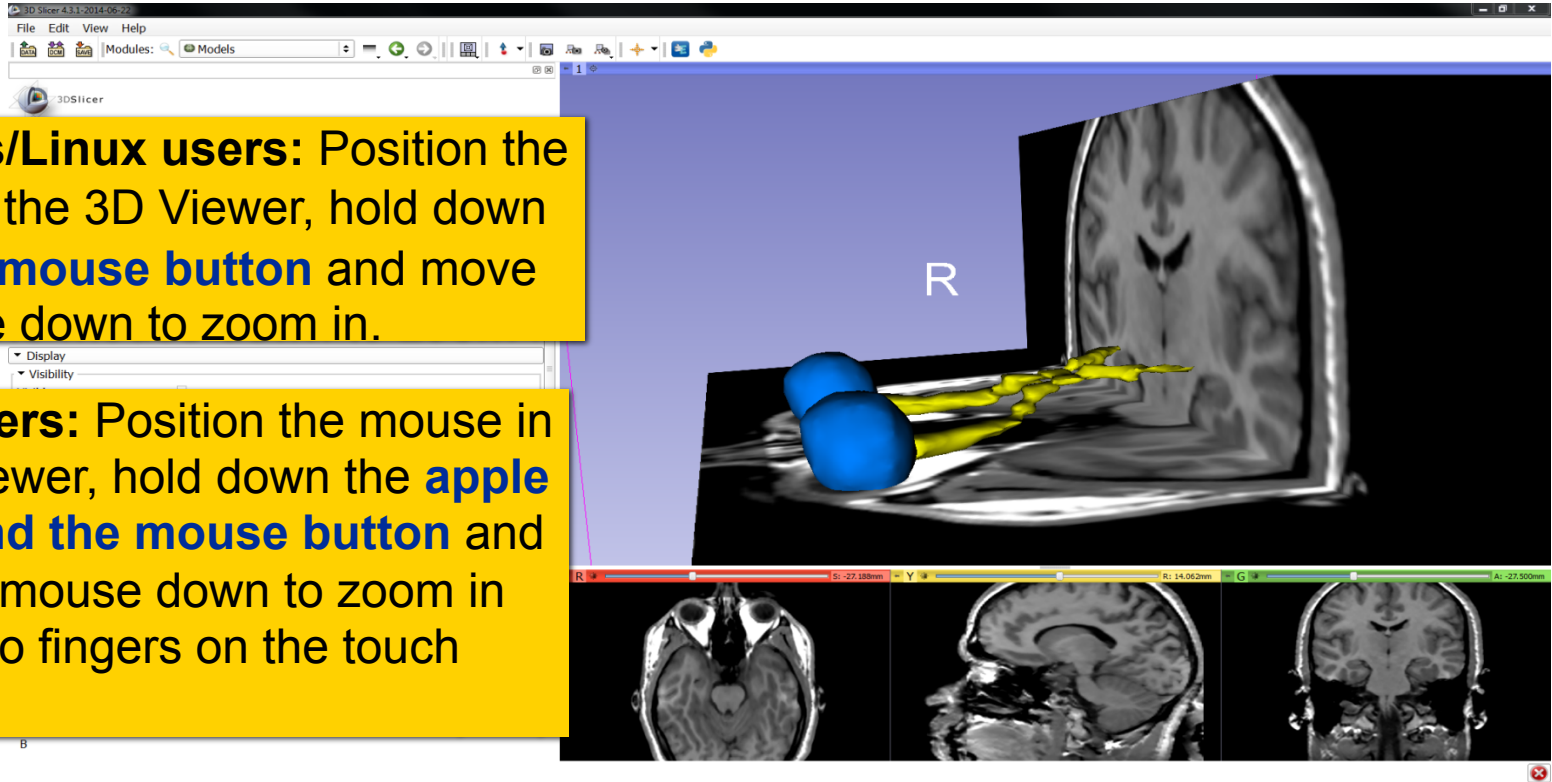




Slicer4 Minute Tutorial: 3D Visualization: Zoom the view

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

Select File->Close Scene
This removes any dataset previously loaded into slicer.

Click on Exit to exit Slicer

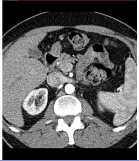
Scene:
hemispheric_white_matter.vtk
left_eyeball.vtk
optic_chiasm.vtk
optic_nerve_L.vtk
optic_nerve_R.vtk
optic_tract_L.vtk
optic_tract_R.vtk
right_eyeball.vtk
Skin.vtk

Information
Display
Visibility
View: All
Clip:
Slice Intersections Visible:
Slice Intersections Thickness: 1 px
Representation
Color
Color: #ffffff
Opacity: 1.00
Edge Visibility:
Edge Color: #000000
Lighting
Material
Data Probe: C:/Users/F/AppData/Local...ene/MRHead_Scene.mrml

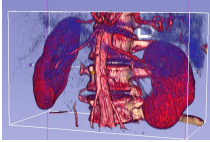
L
F
B



Overview

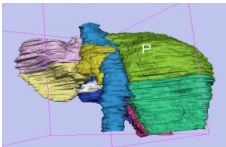
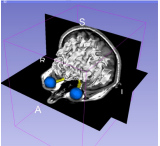


Part I: Introduction to the 3DSlicer software



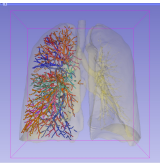
Part II: 3D Data Loading and visualization of DICOM images

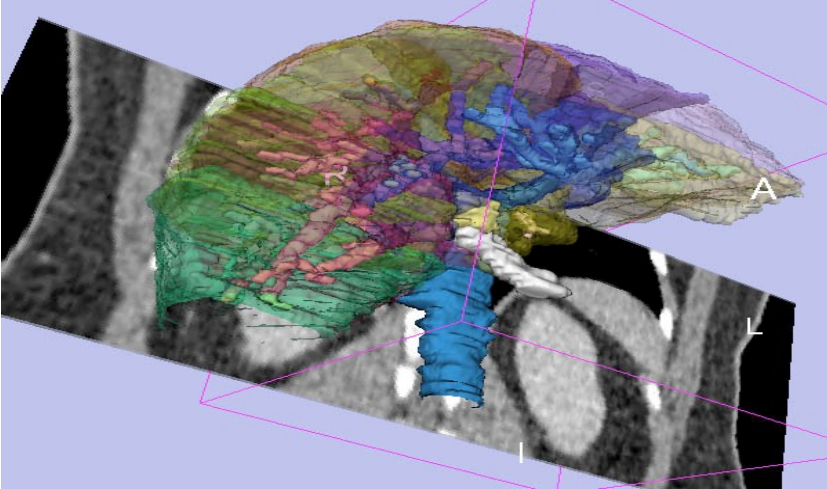
- Volume Rendering of thoraco-abdominal CT data
- Surface Rendering of MR head data



Part III: 3D interactive exploration of the anatomy

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

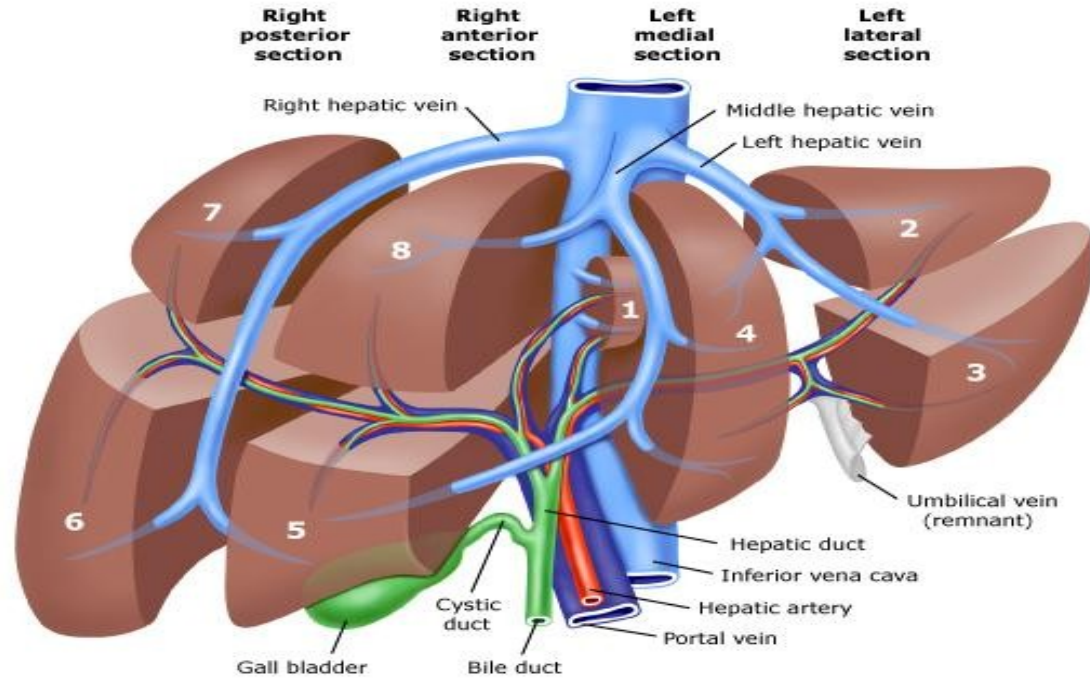




Part II:

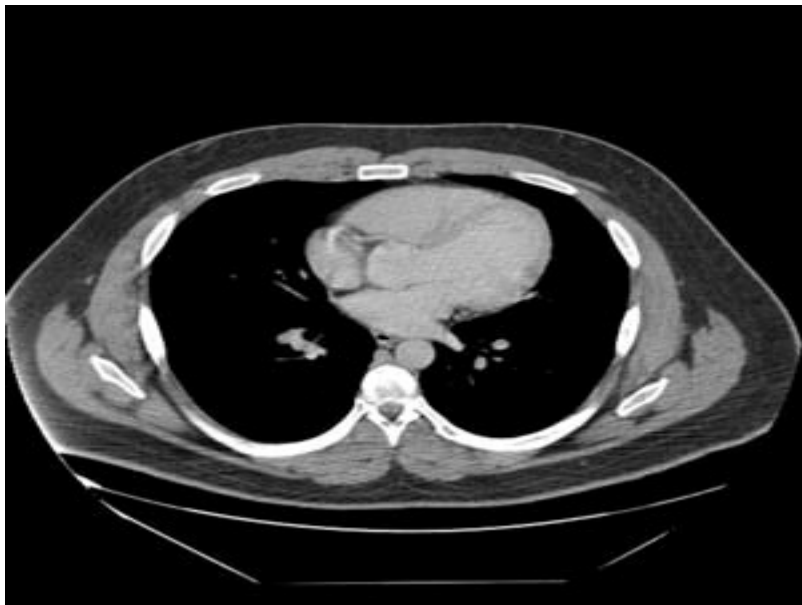
Interactive 3D Visualization
of the segments of the liver

Anatomy of the liver





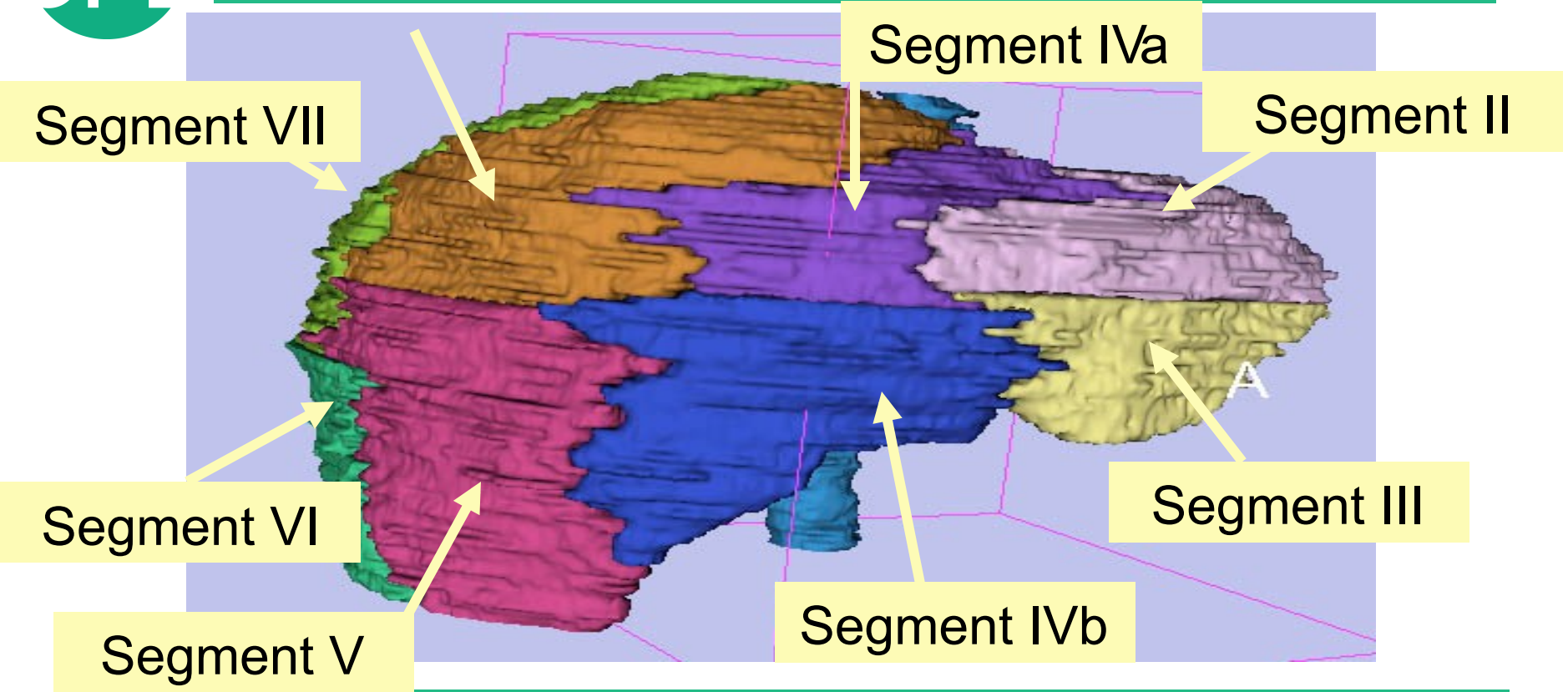
Liver dataset



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

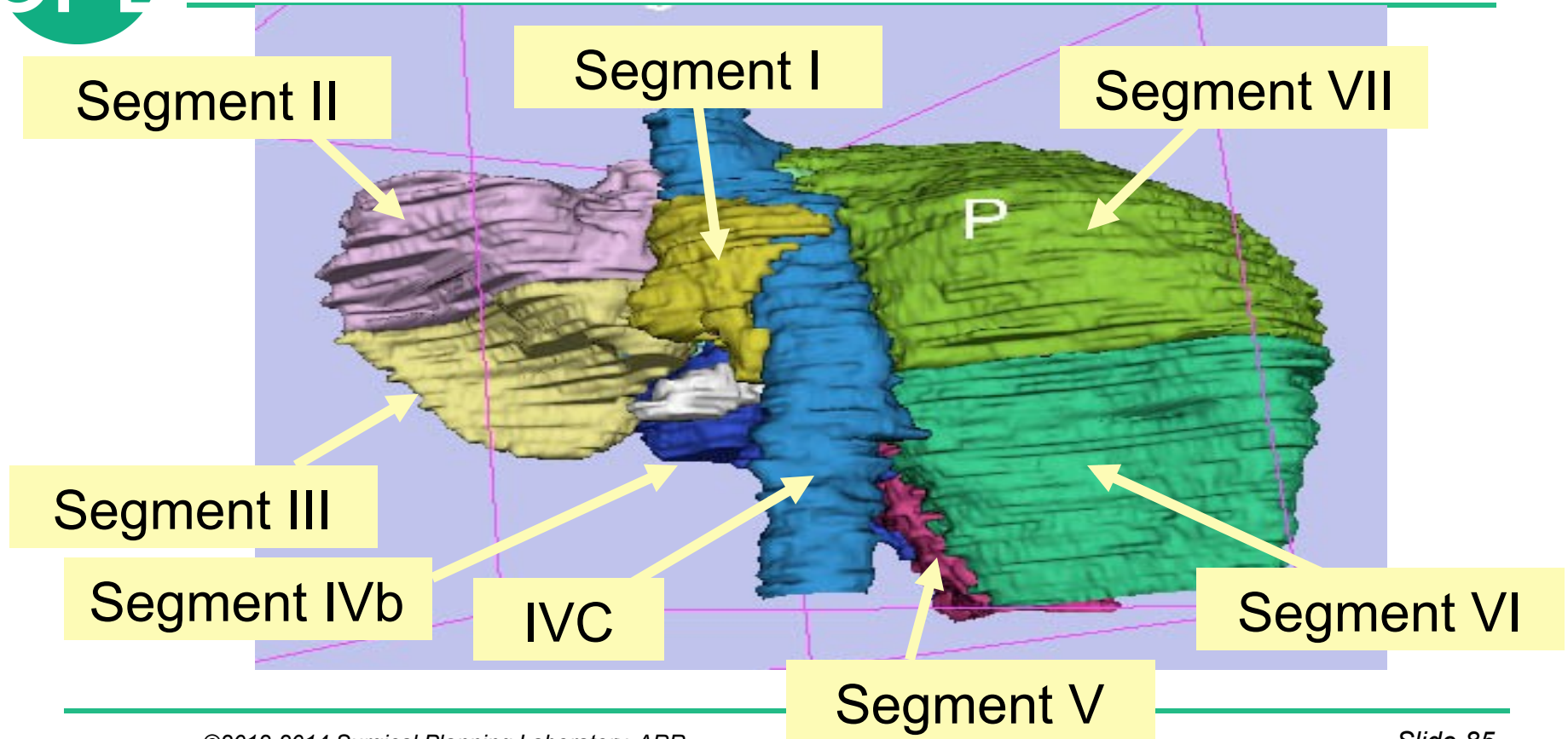


3D segments of the liver



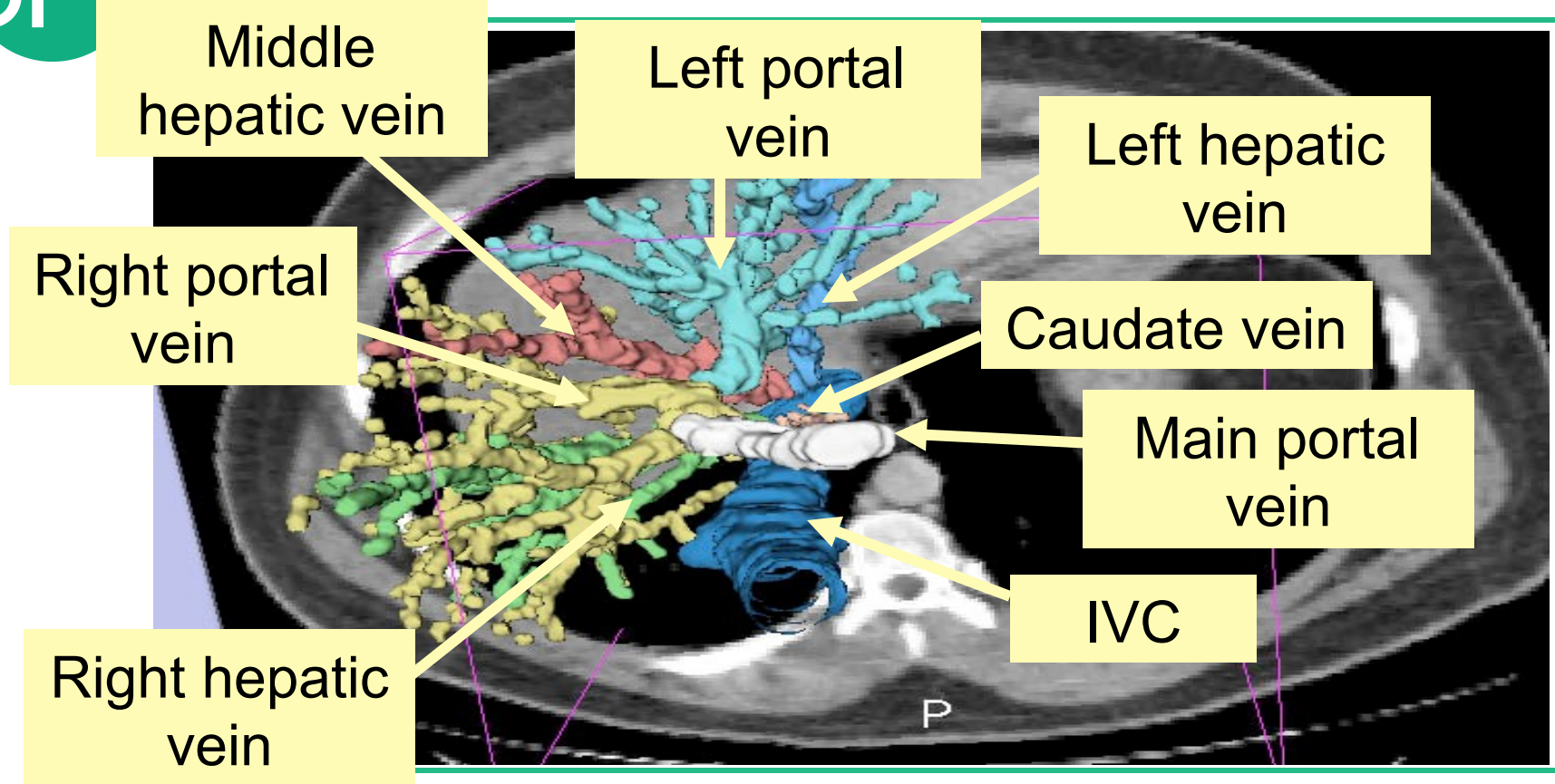


3D segments of the liver



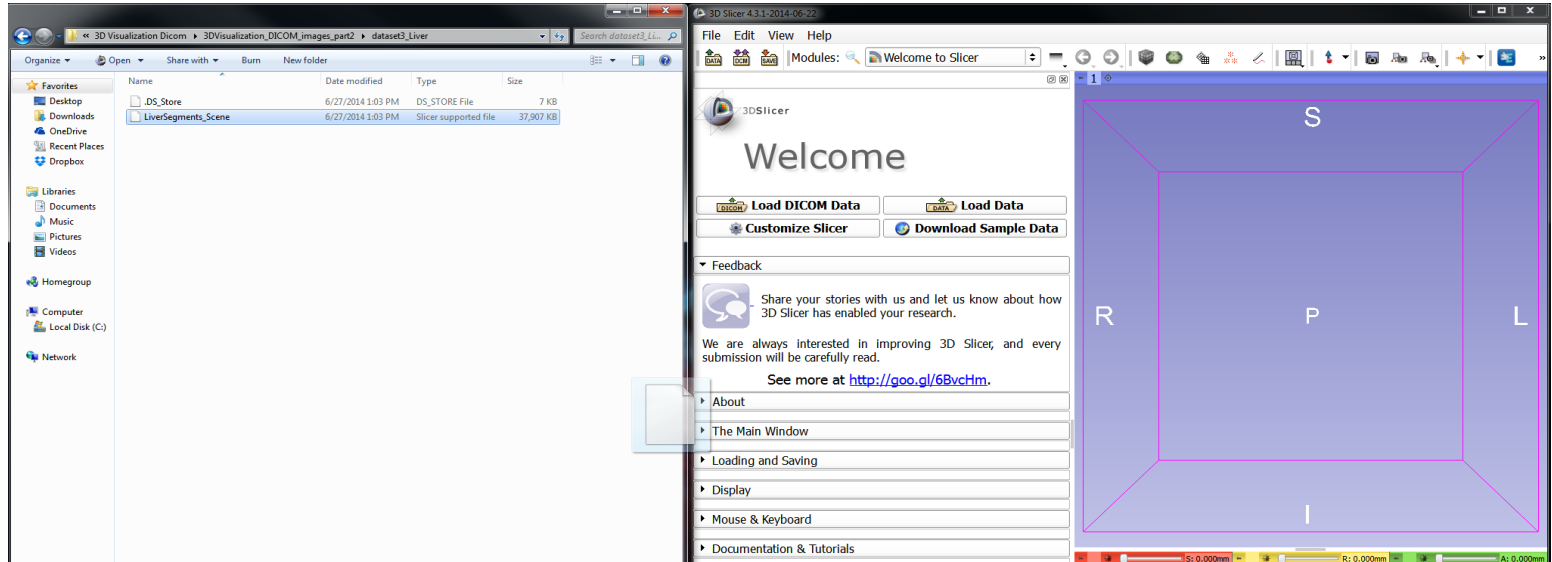


Liver vasculature





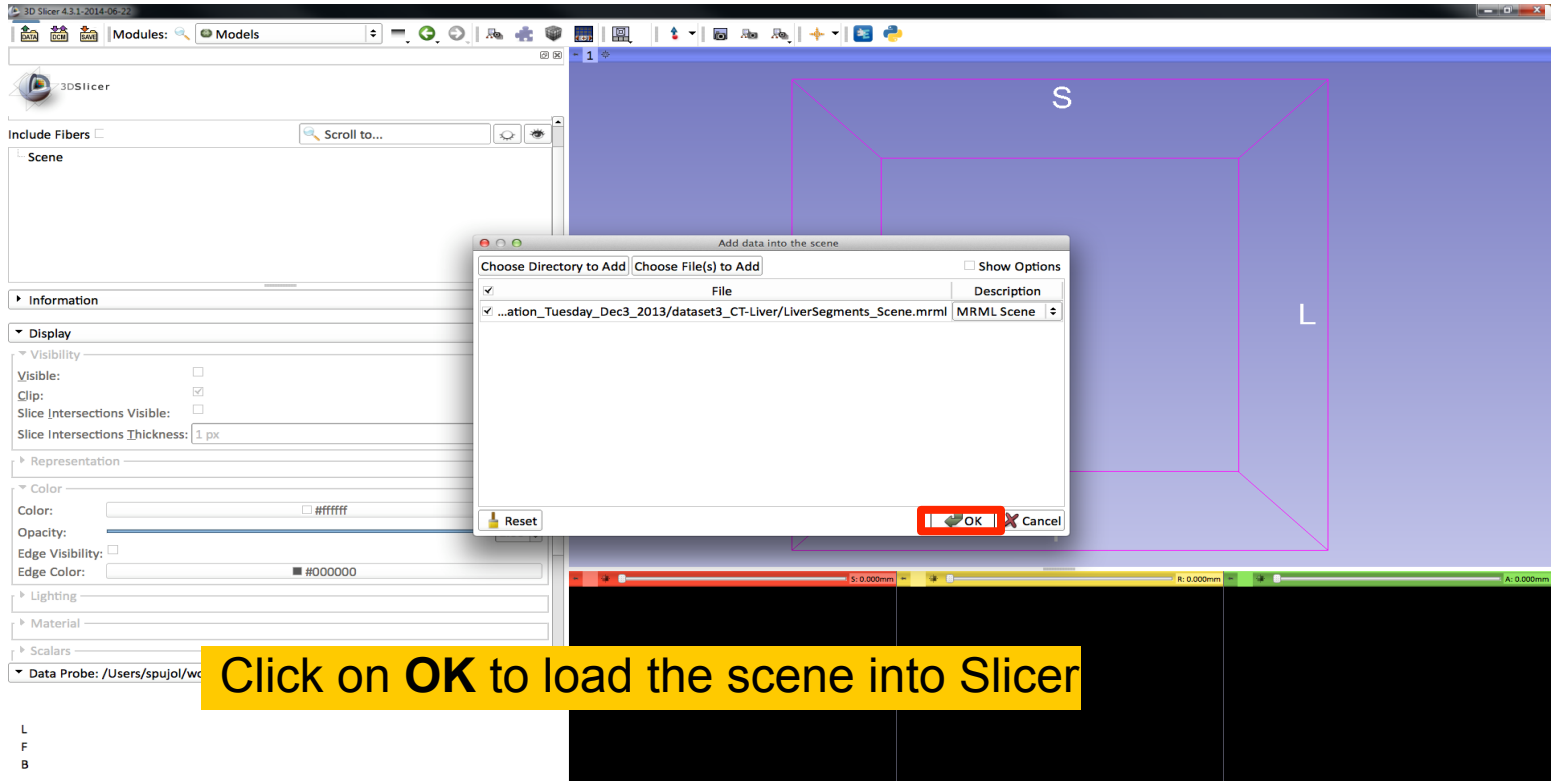
Loading the Liver Scene



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



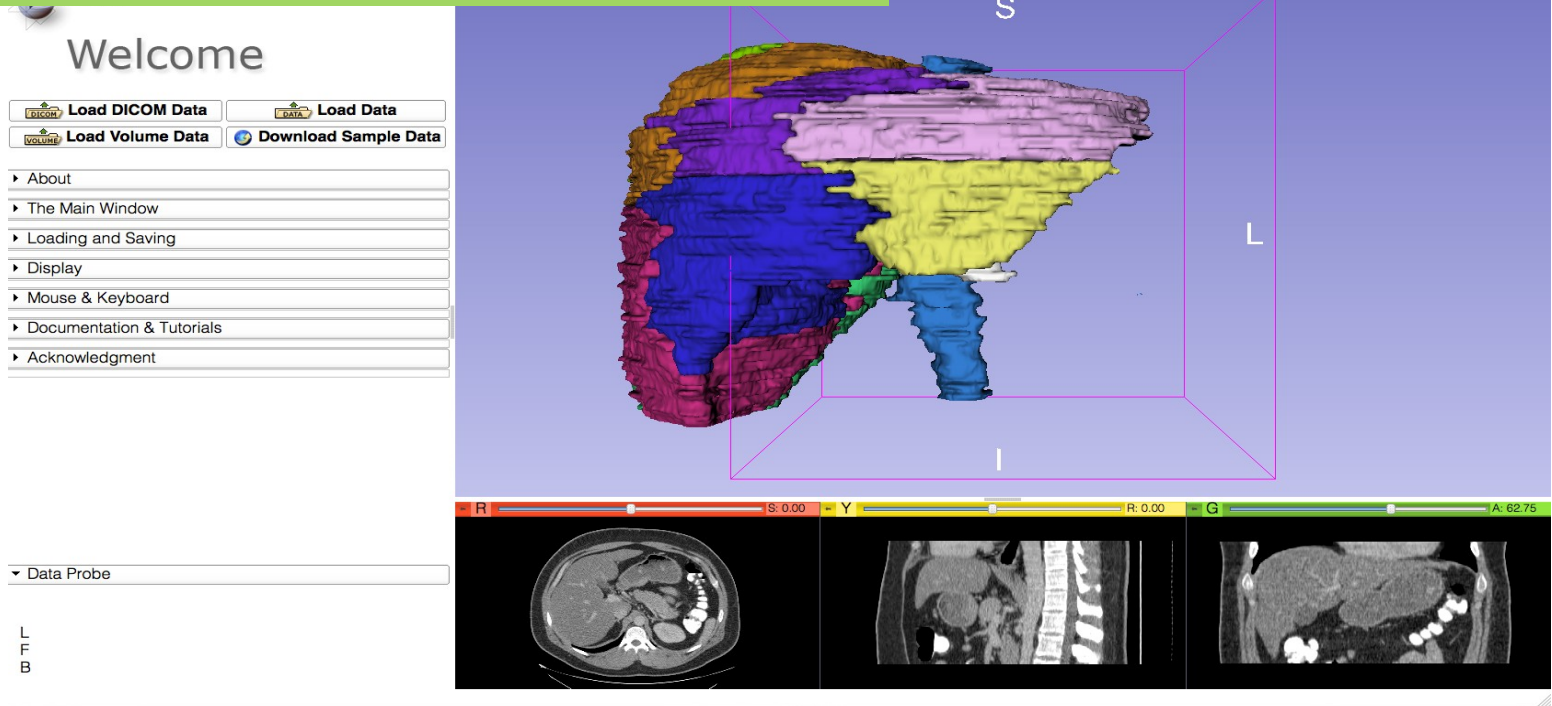
Loading the Liver Scene





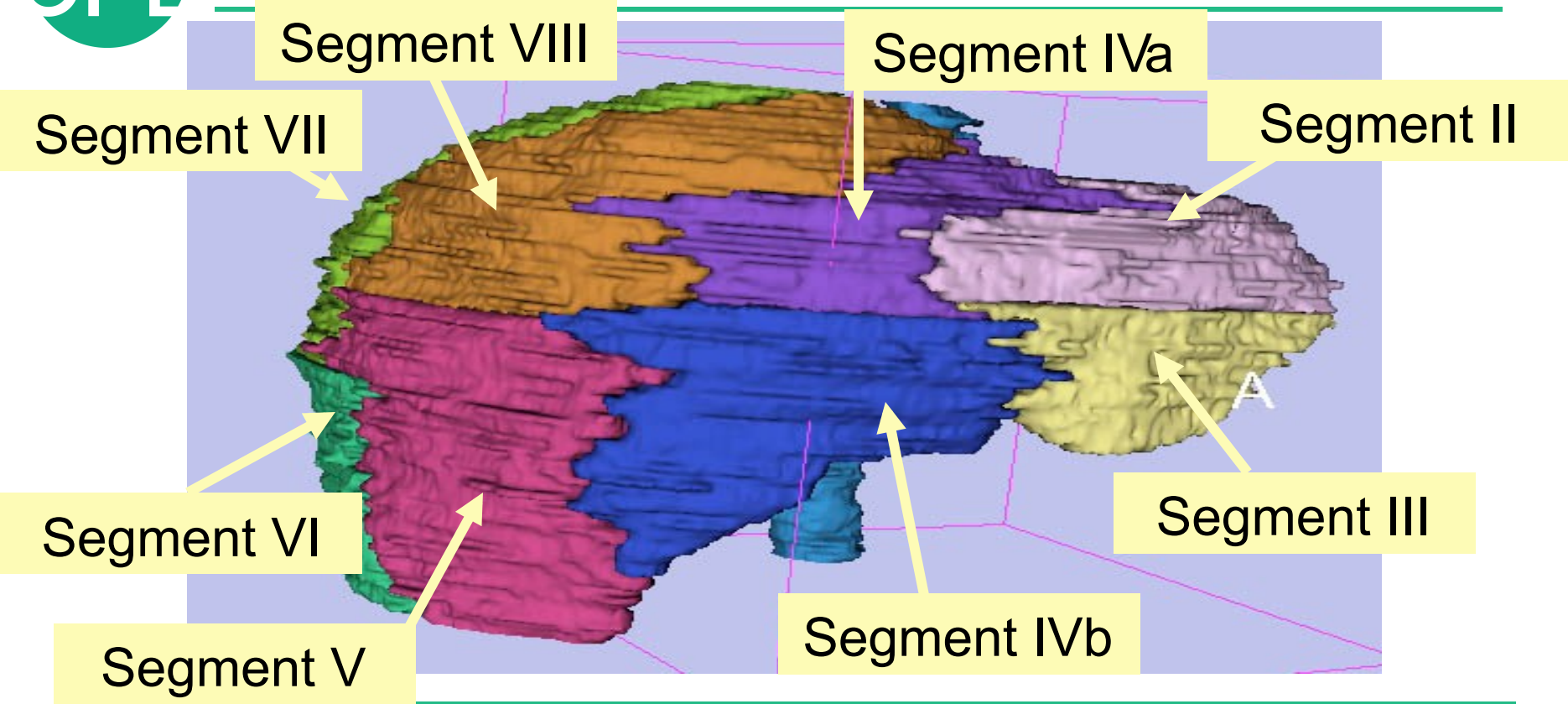
Liver Segments Scene

The elements of the scene appear in the Viewer



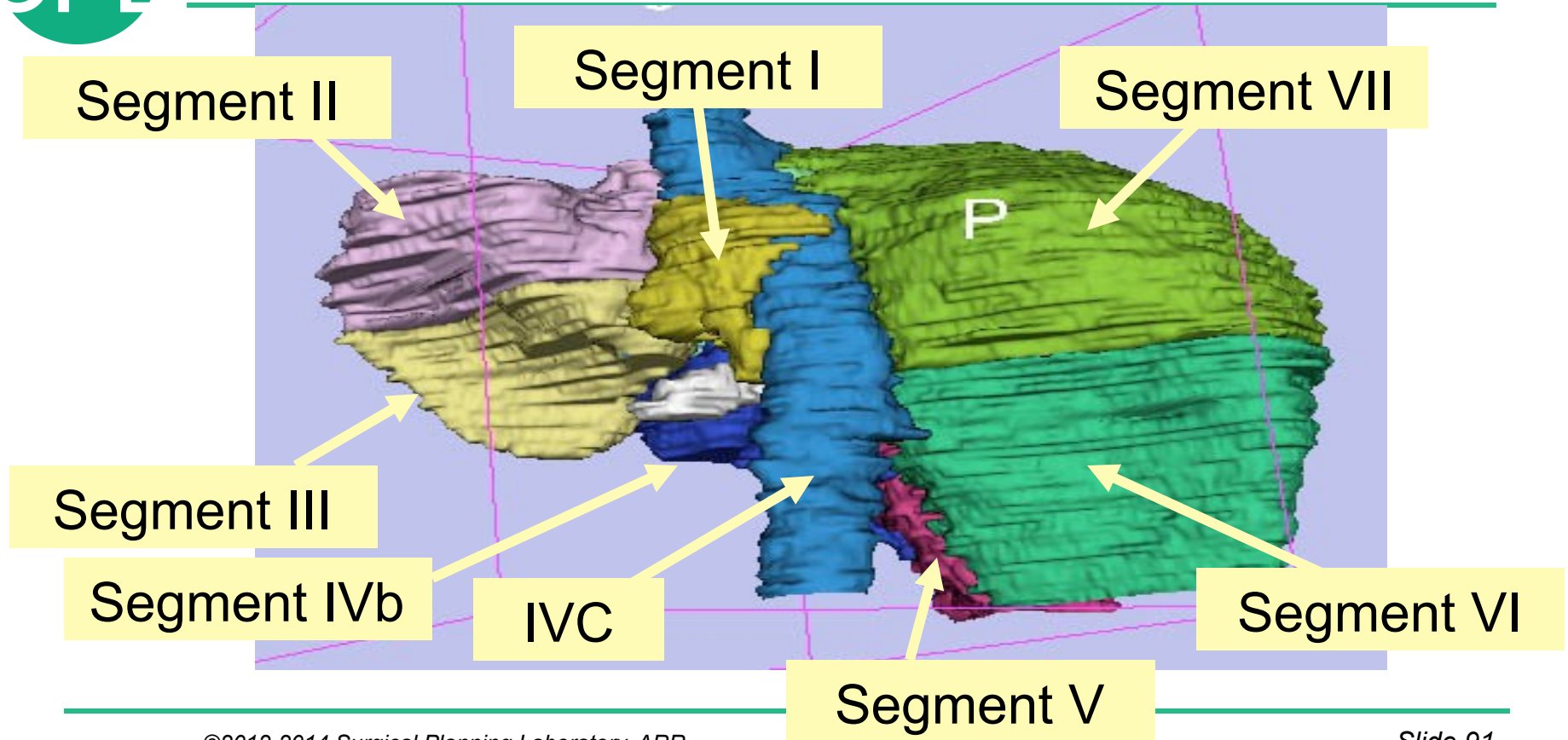


3D models of the liver



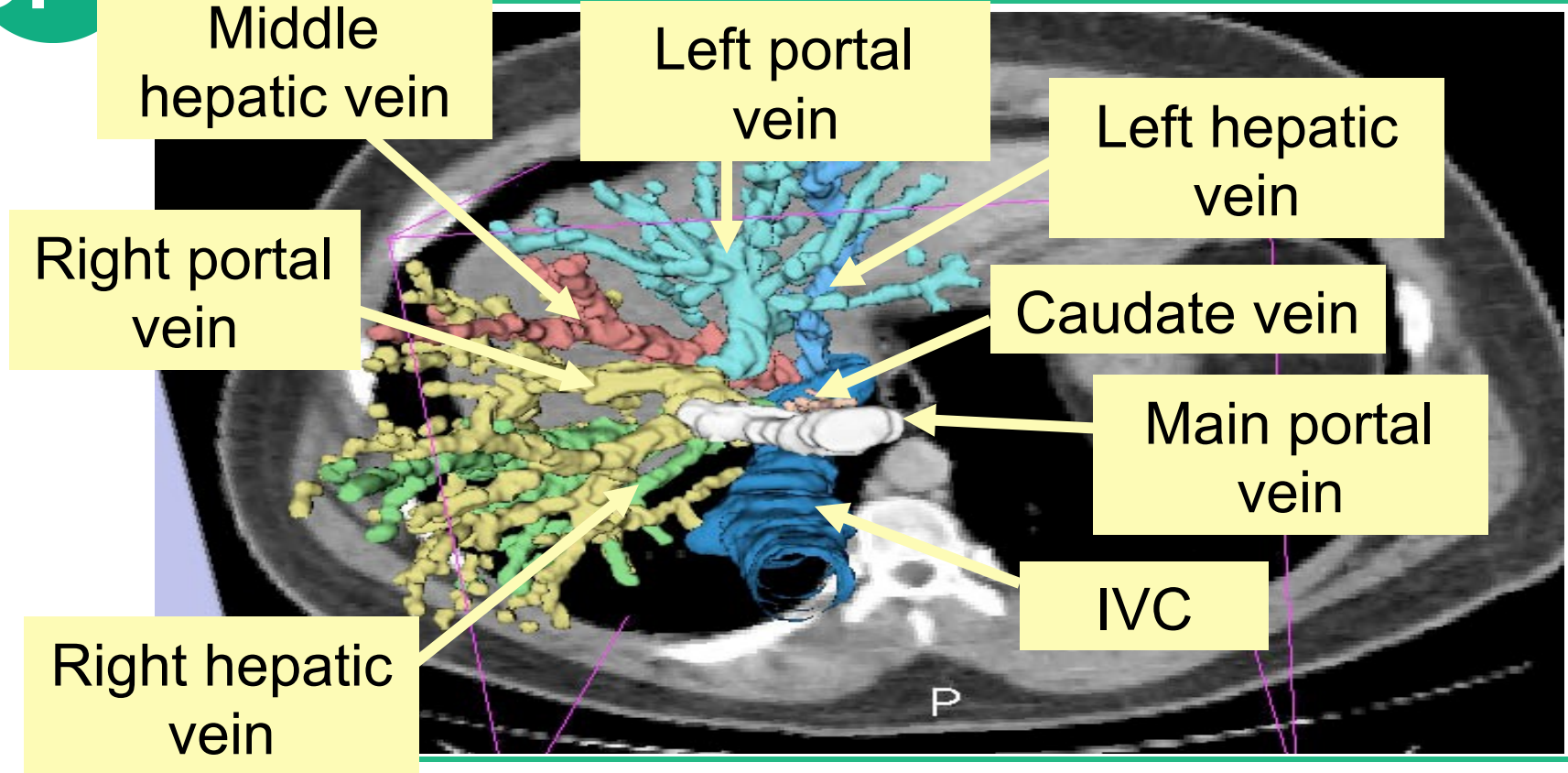


3D models of the liver



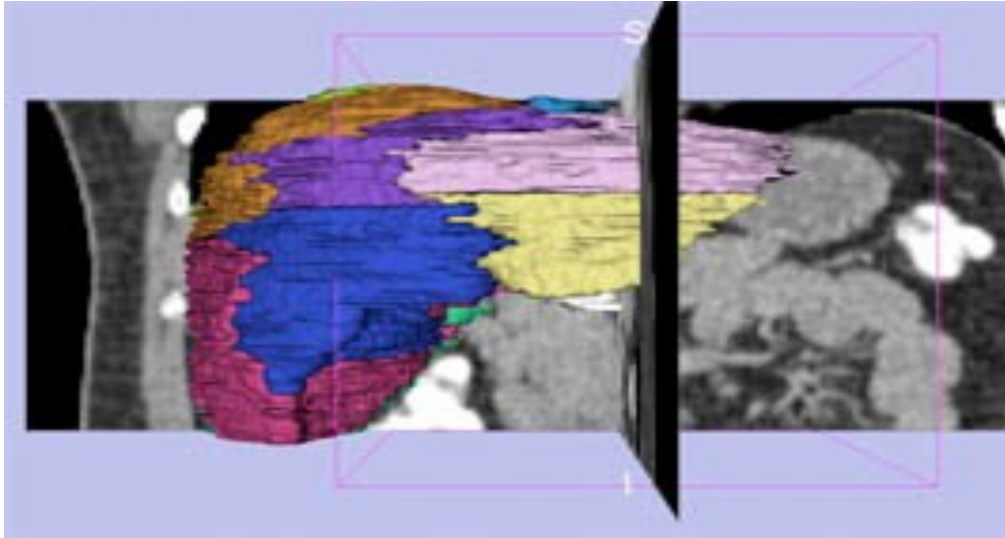


3D models of the liver





3D Exploration of Liver Segments

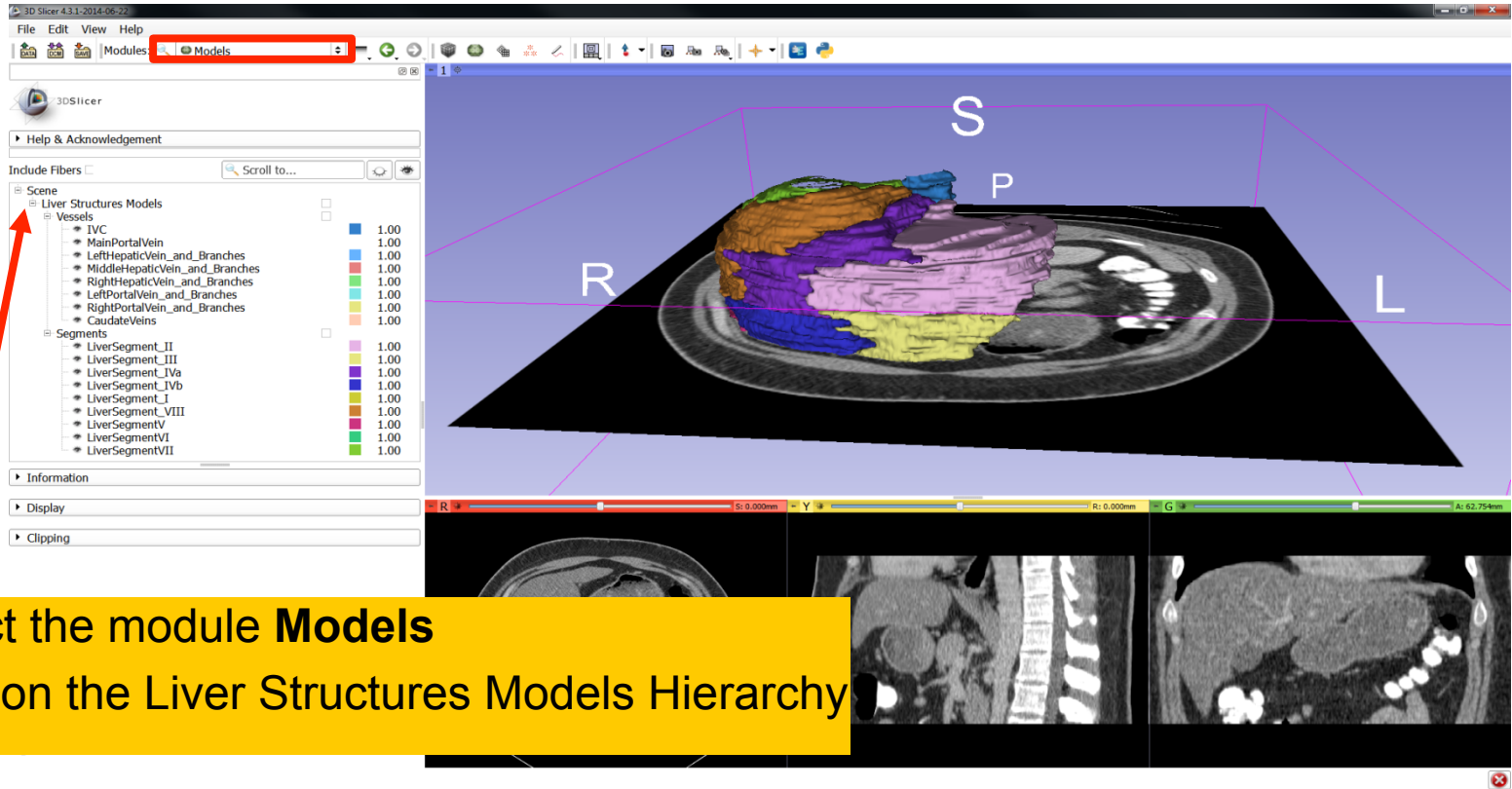


Example:

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



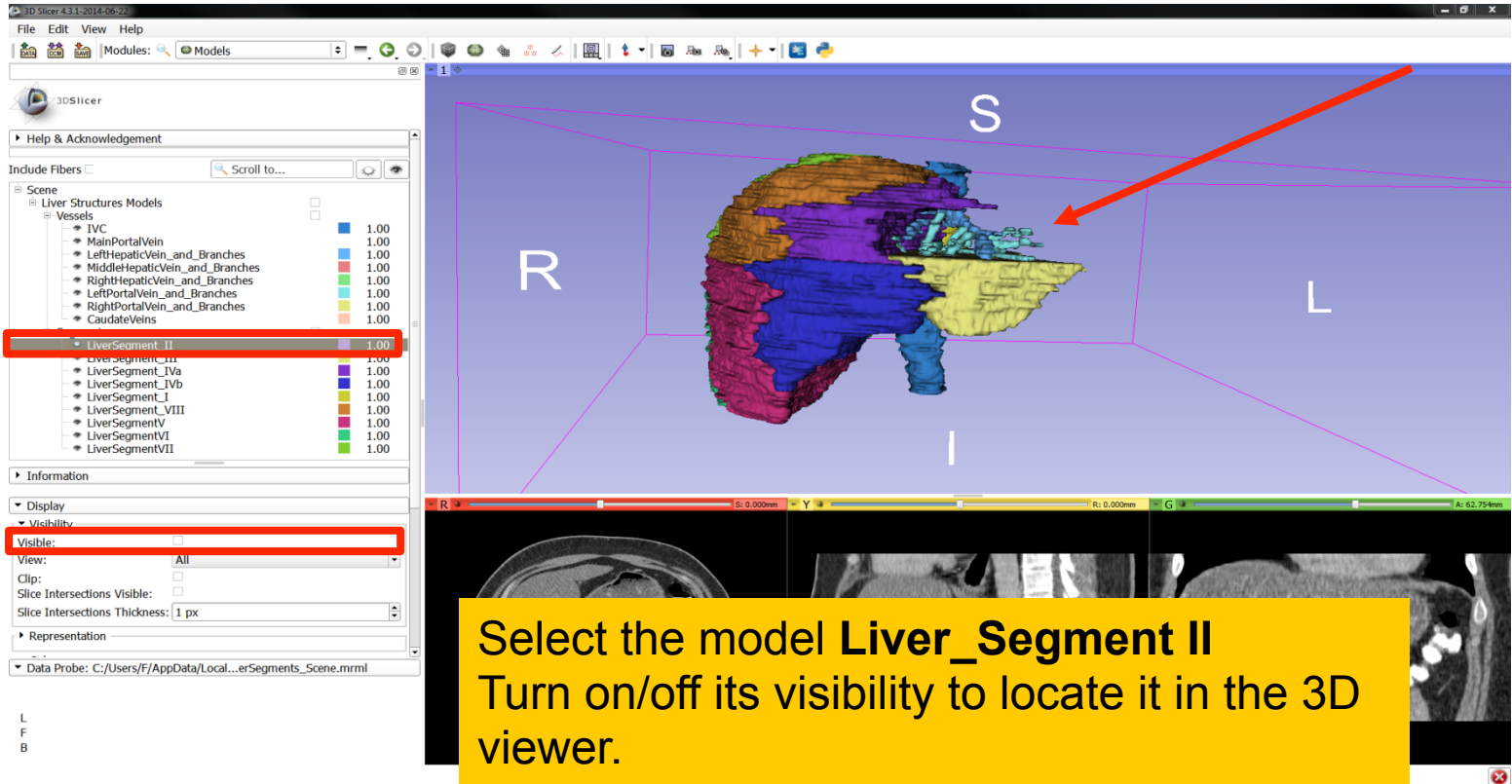
3D Exploration of Liver Segments



Select the module **Models**
Click on the Liver Structures Models Hierarchy



3D Exploration of Liver Segments

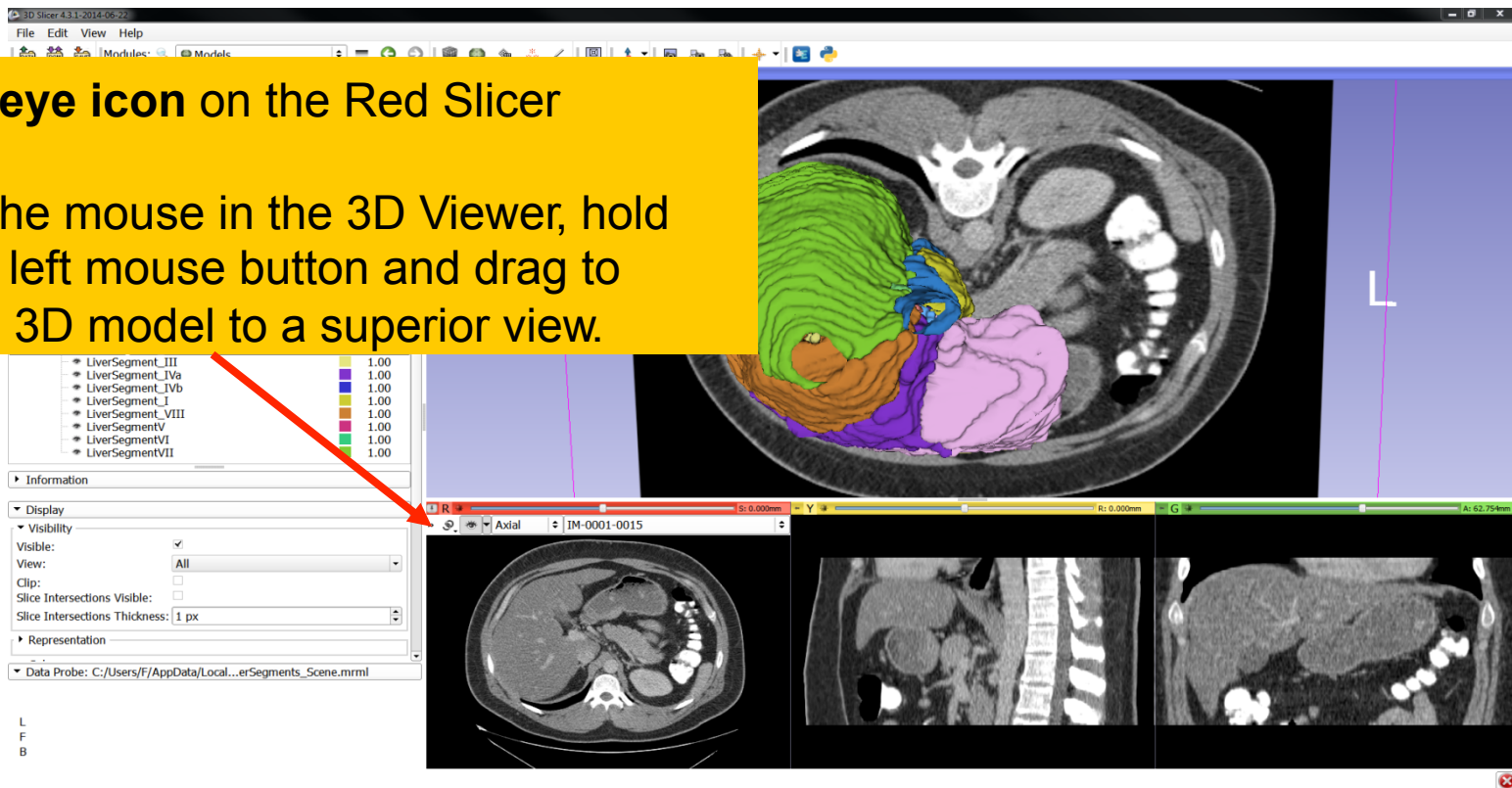




3D Exploration of Liver Segments

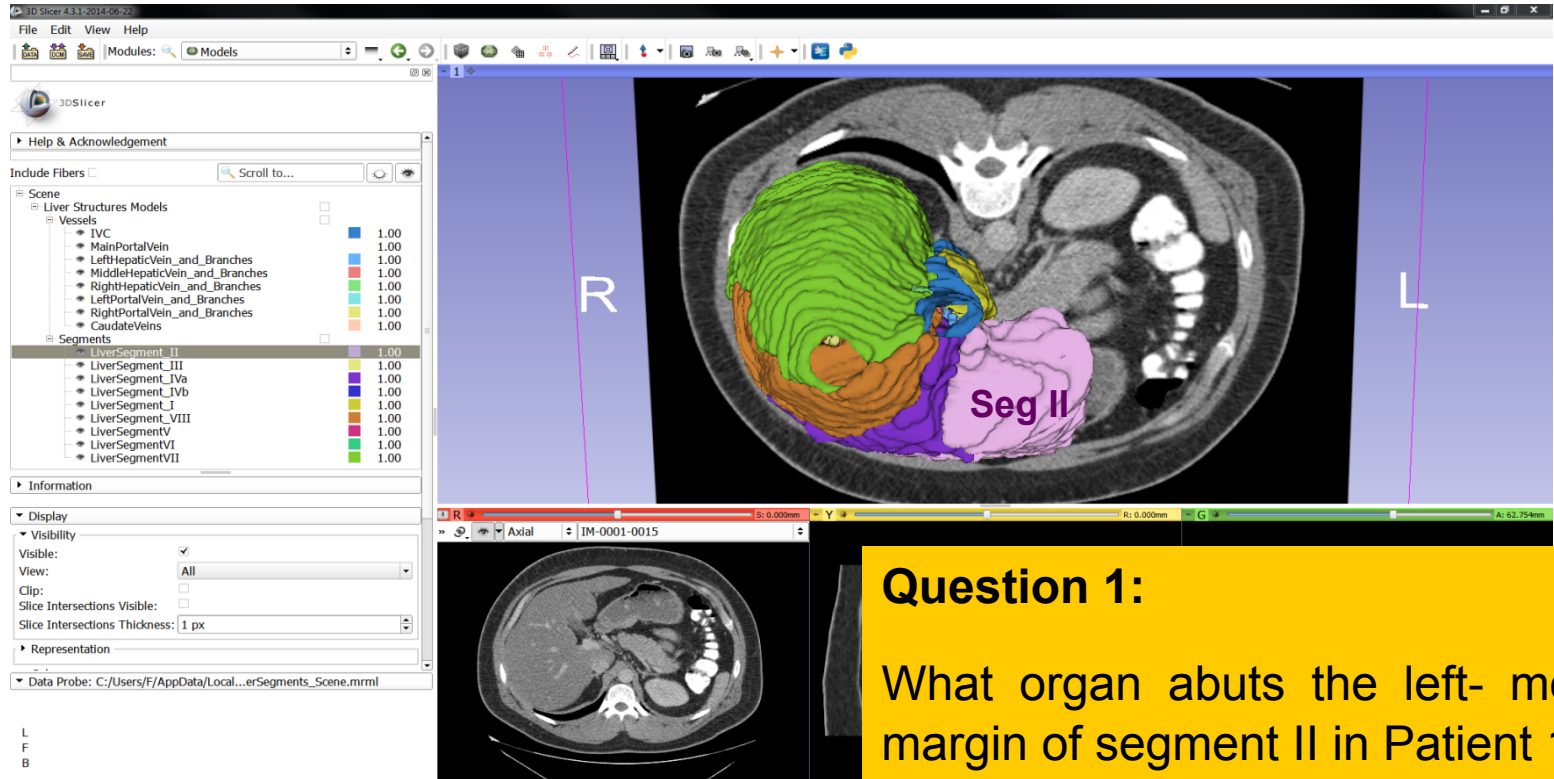
Click the **eye icon** on the Red Slicer

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



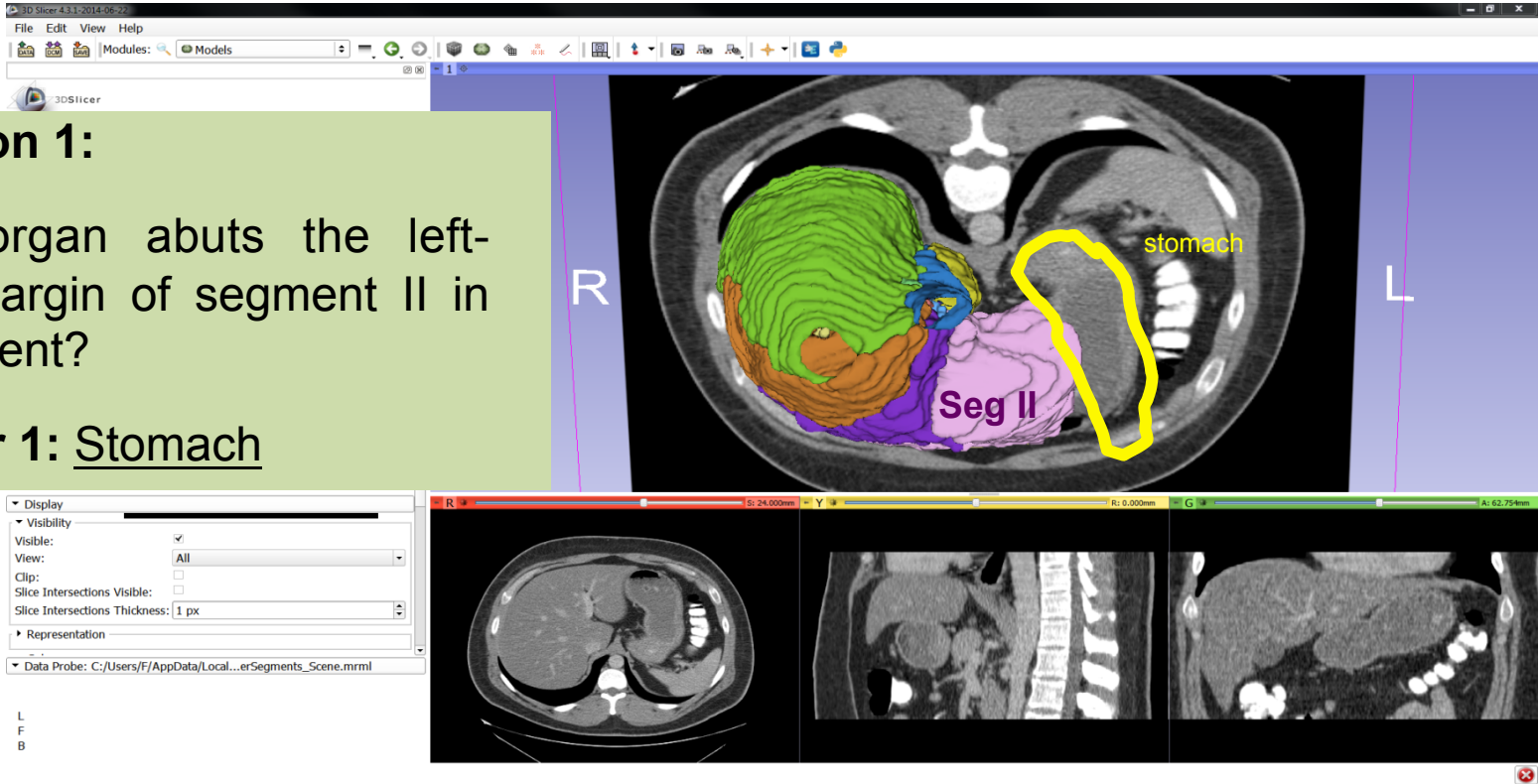


3D Exploration of Liver Segments

Question 1:

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

Answer 1: Stomach

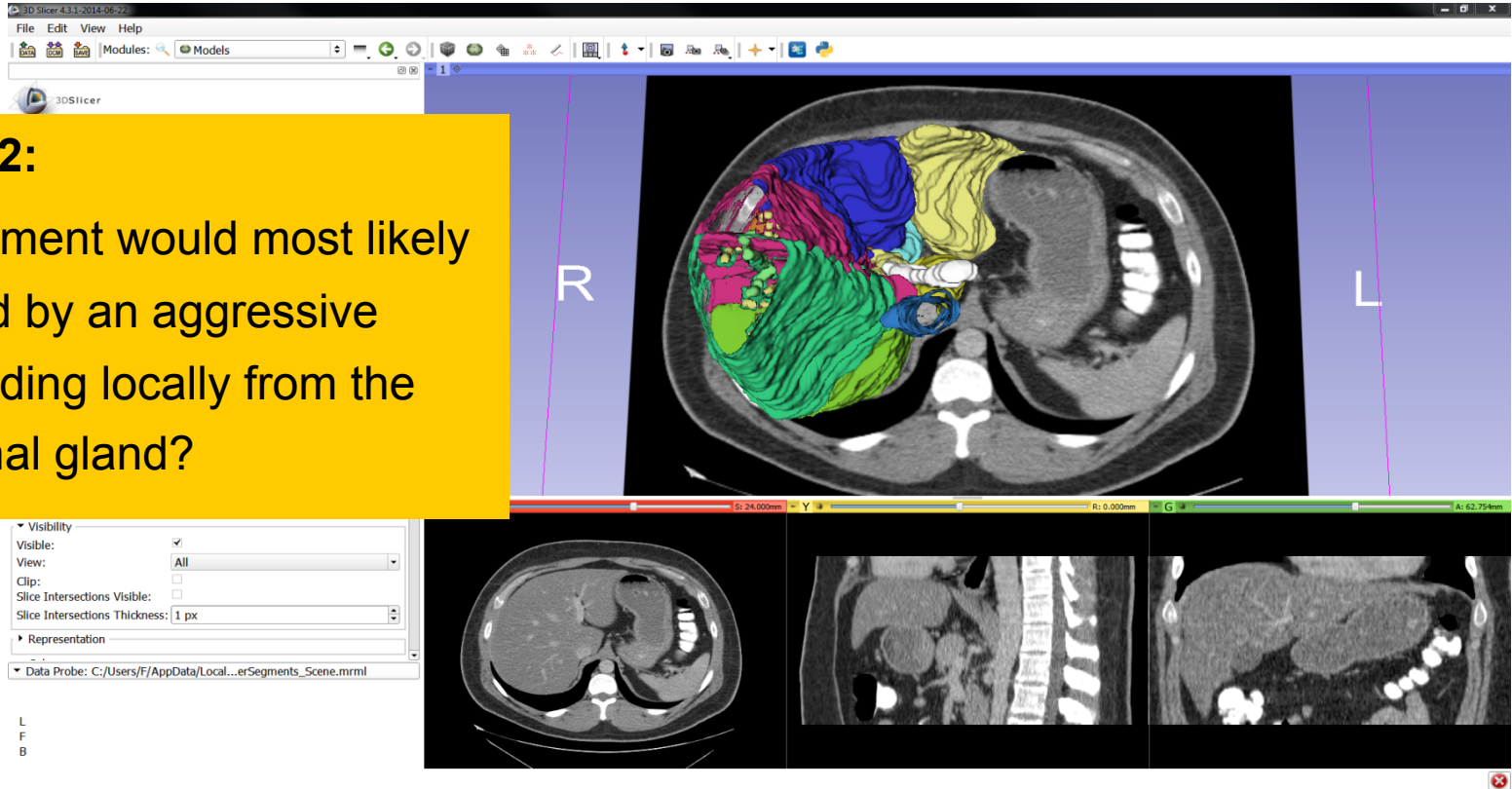




3D Exploration of Liver Segments

Question 2:

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



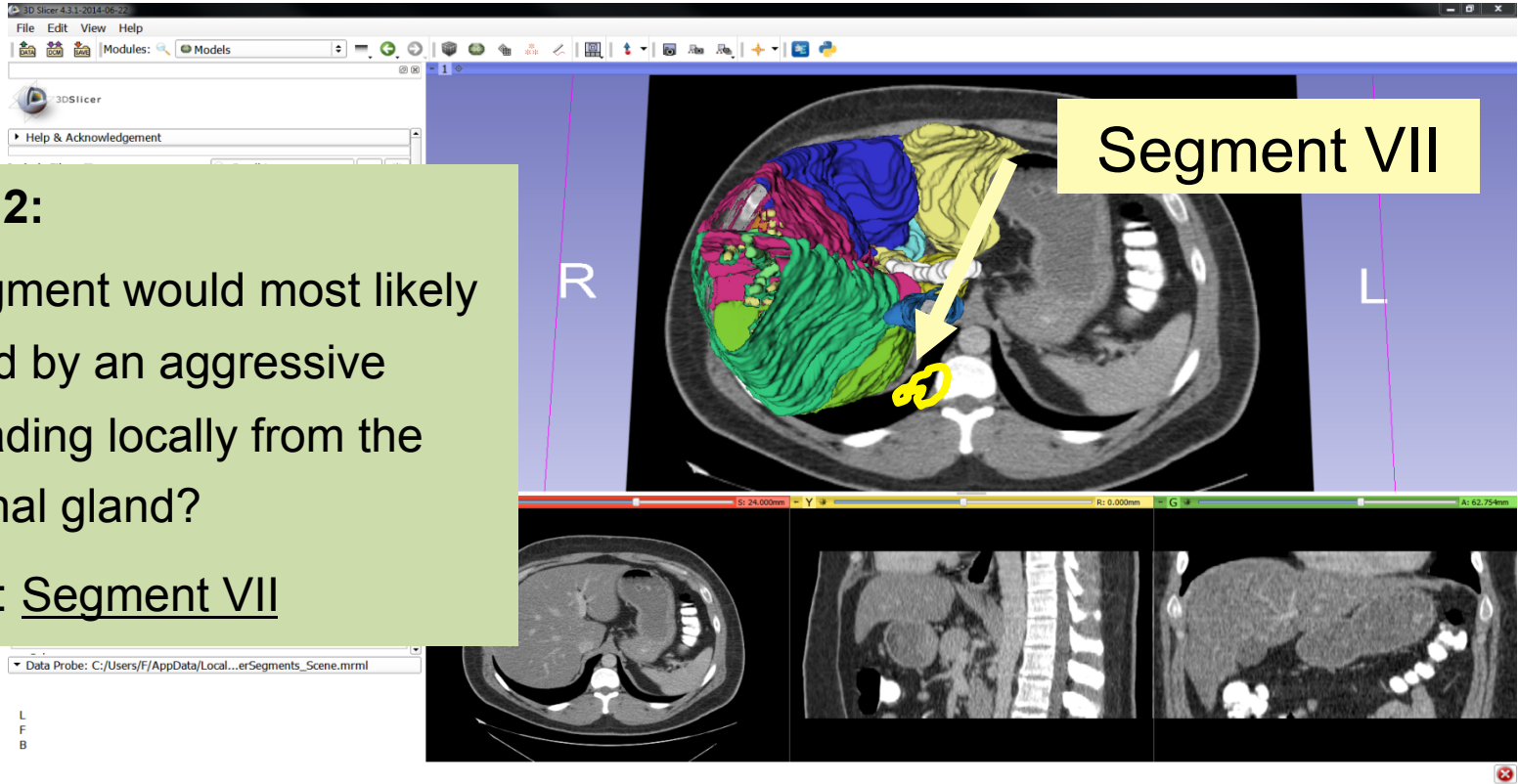


3D Exploration of Liver Segments

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

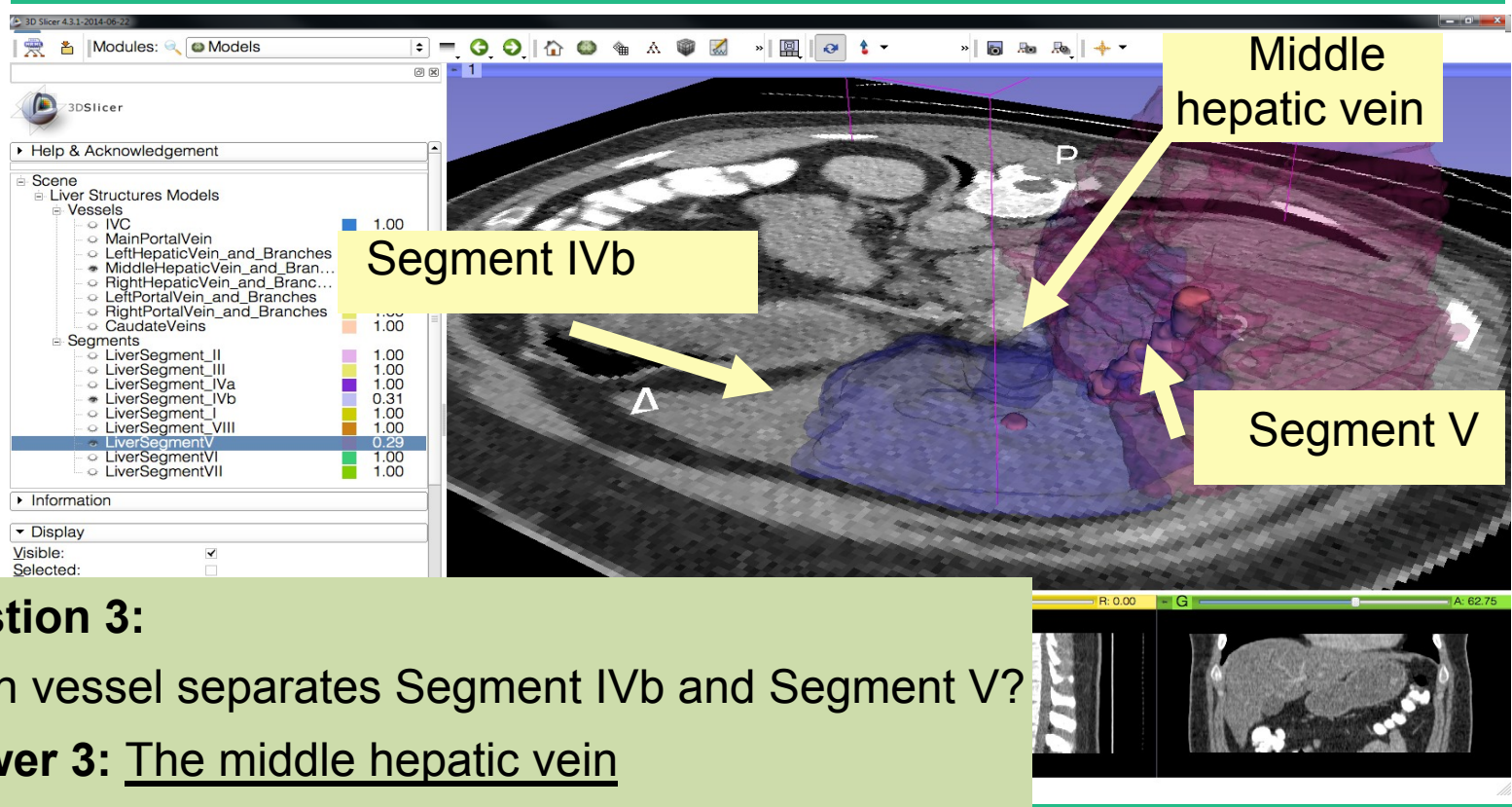


Question 3:

Which vessel separates
Segment IVb and
Segment V?

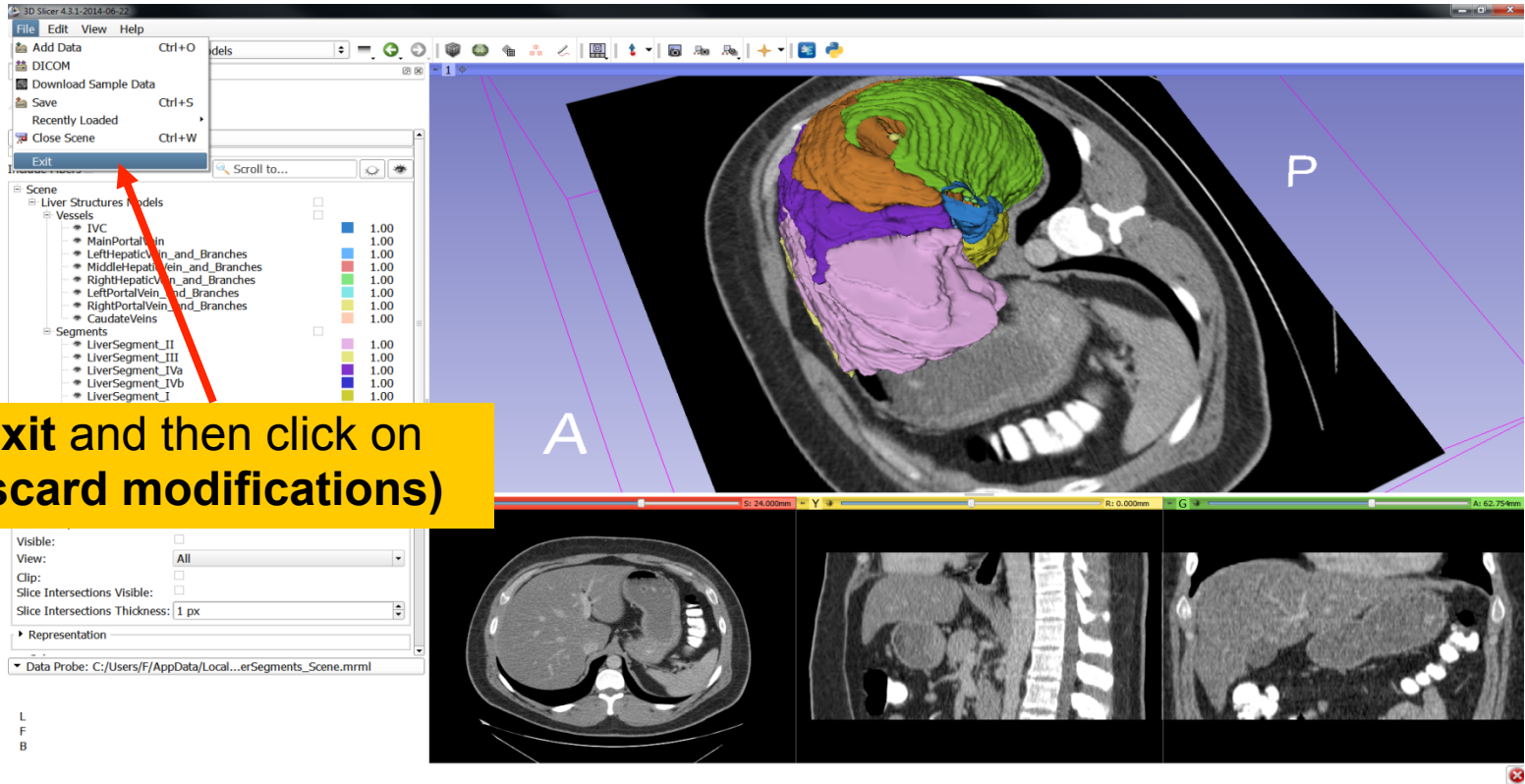


Middle Hepatic Vein

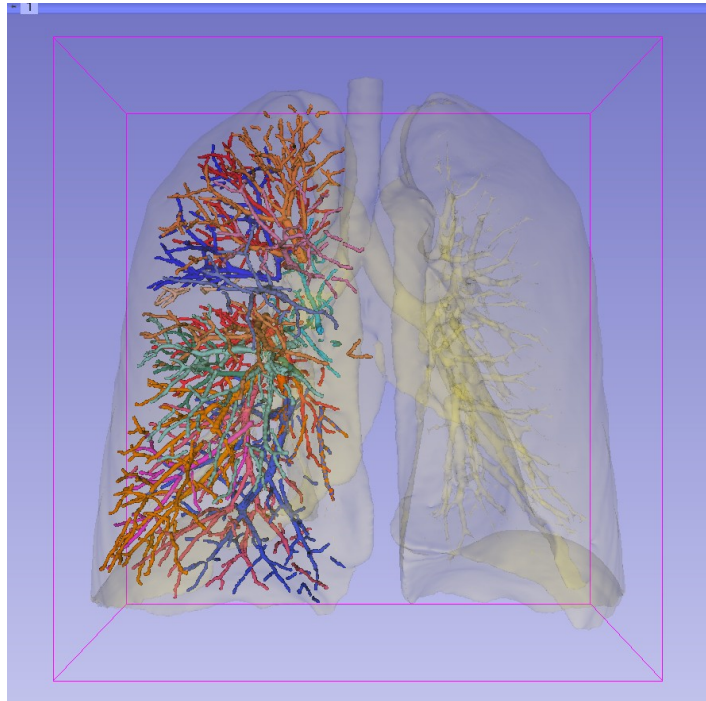




Closing the Liver Scene



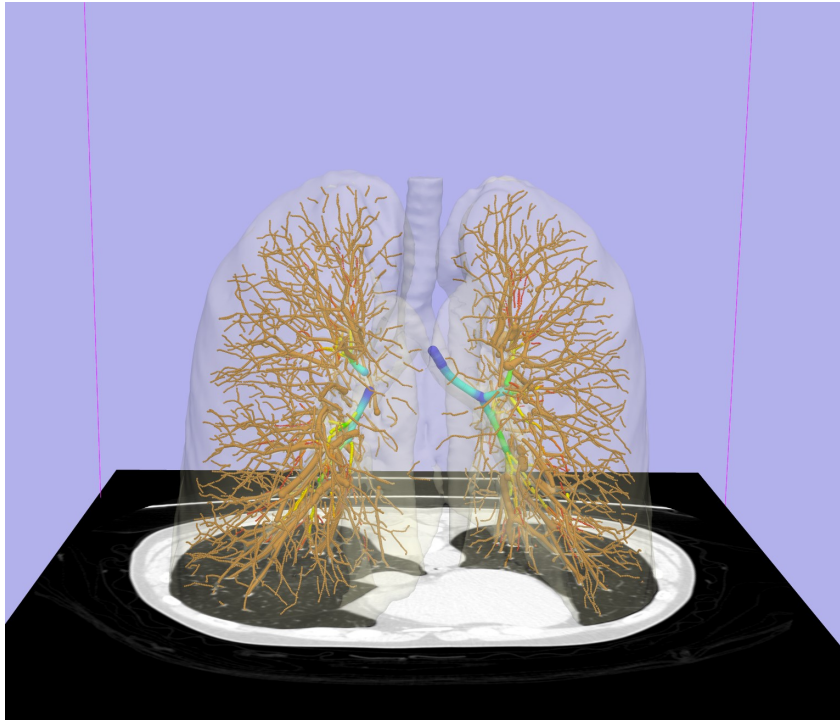
Select **Exit** and then click on **Exit** (discard modifications)



Interactive 3D Visualization of the segments of the lungs



Segments of the lung



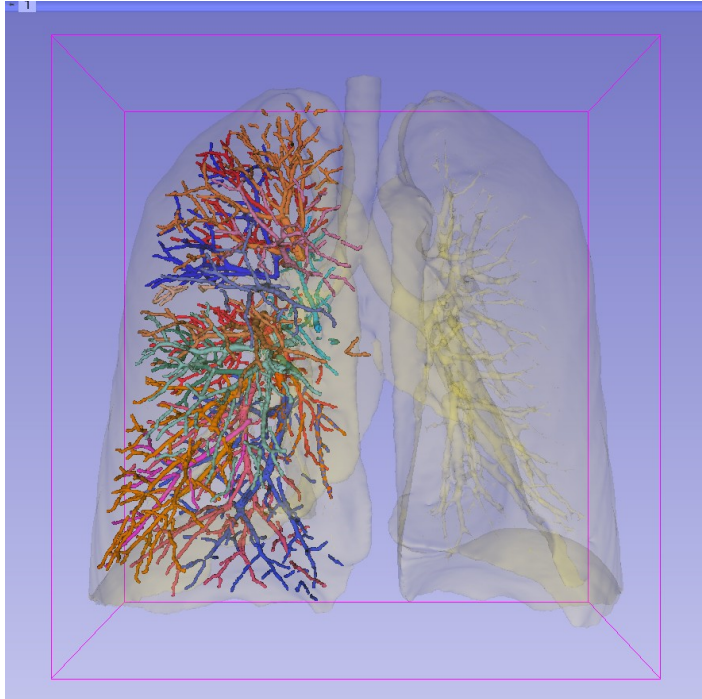
Segmentation and 3D surface reconstruction of the lung and pulmonary vessels

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

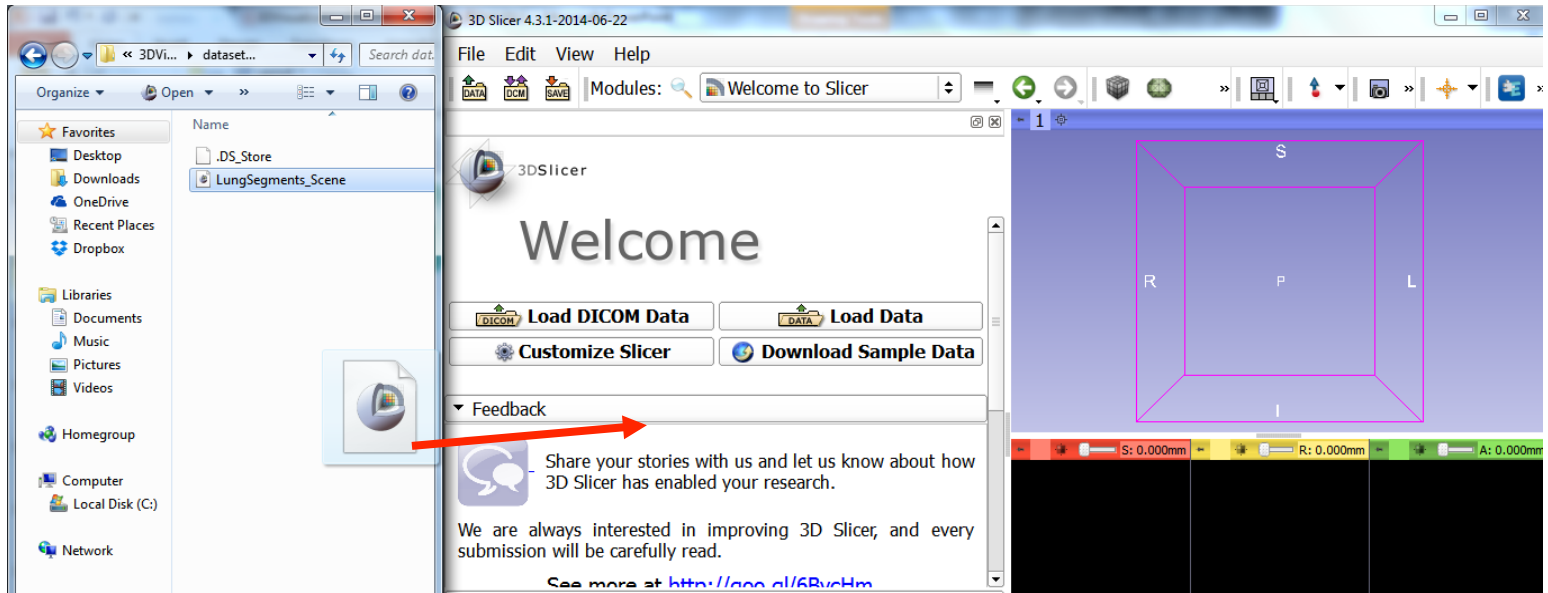


3D parcellation of arteries and veins from original model of pulmonary vessels
(Kitt Shaffer, M.D., Ph.D. - Sonia Pujol, Ph.D.)

- 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



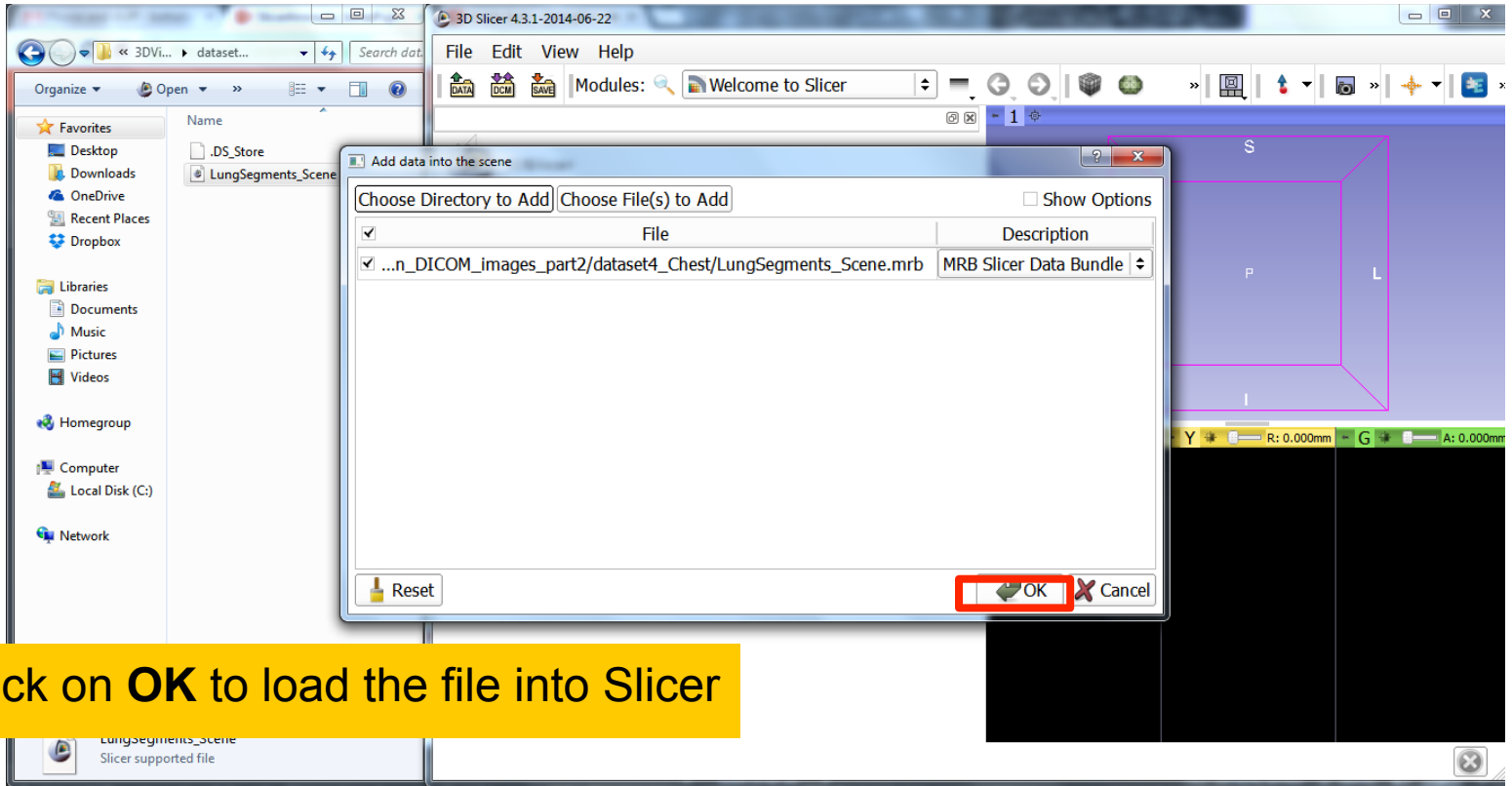
Loading the Chest Data Scene



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




Click on **OK** to load the file into Slicer



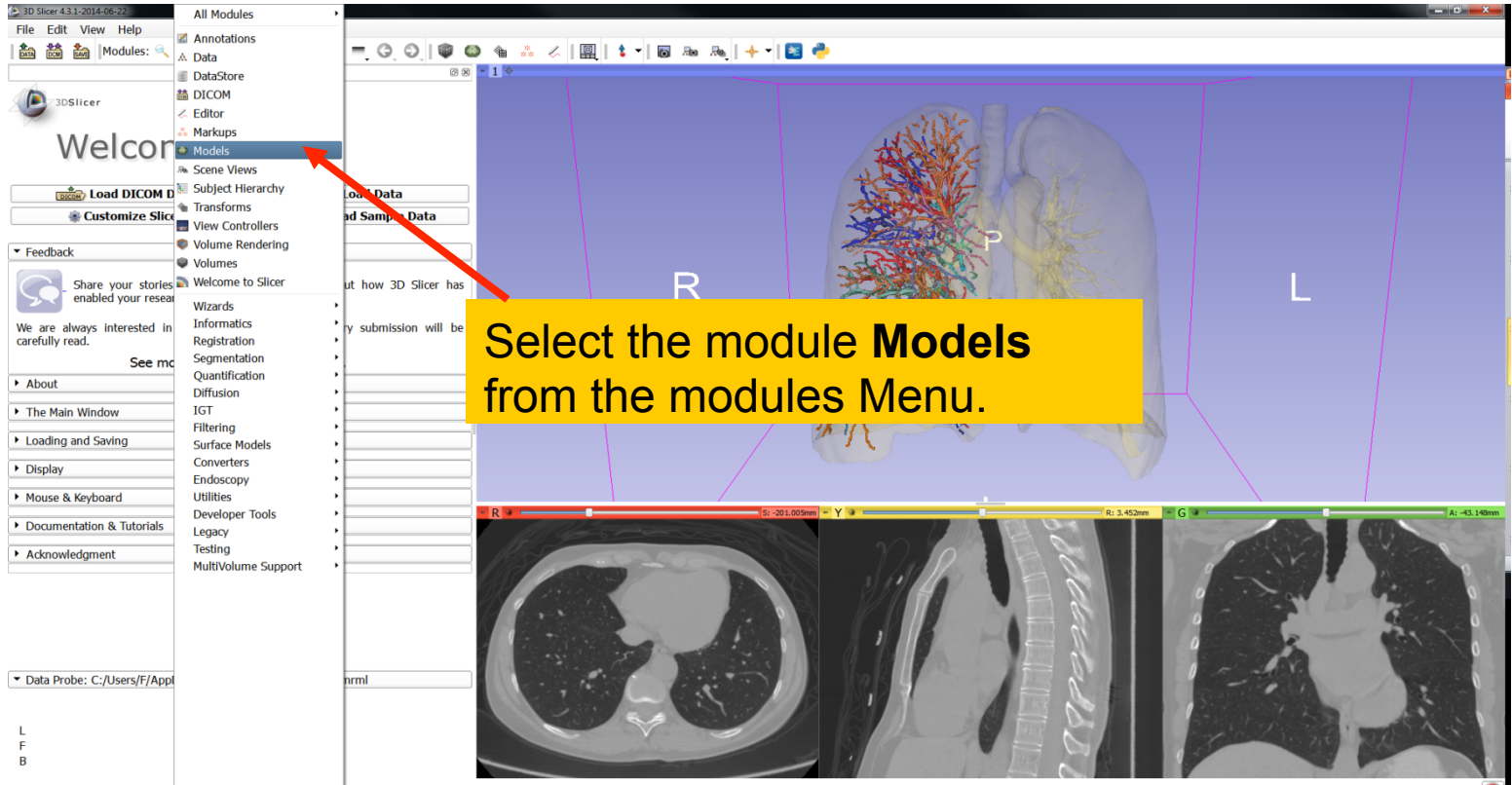
Loading the Lung Scene

The screenshot shows the 3D Slicer 4.3.1-2014-06-22 interface. The main 3D view displays a lung model with a complex network of red and blue vessels. The model is centered in the view. A yellow callout box with a red arrow points to a small icon in the top toolbar, which is used to center the 3D view. The callout box contains the text: "Click on the  icon to center the 3D view". The interface includes a menu bar (File, Edit, View, Help), a toolbar with various icons, and a sidebar on the left with a "Welcome" message and a list of links: Feedback, About, The Main Window, Loading and Saving, Display, and Data Probe: C:/Users/F/AppData/Local...ngSegments_Scene.mrml. The bottom of the interface shows three orthogonal views (axial, sagittal, and coronal) of the lung model, with coordinate axes (R, L, S, Y, G, A) and scale indicators.

Click on the  icon to center the 3D view

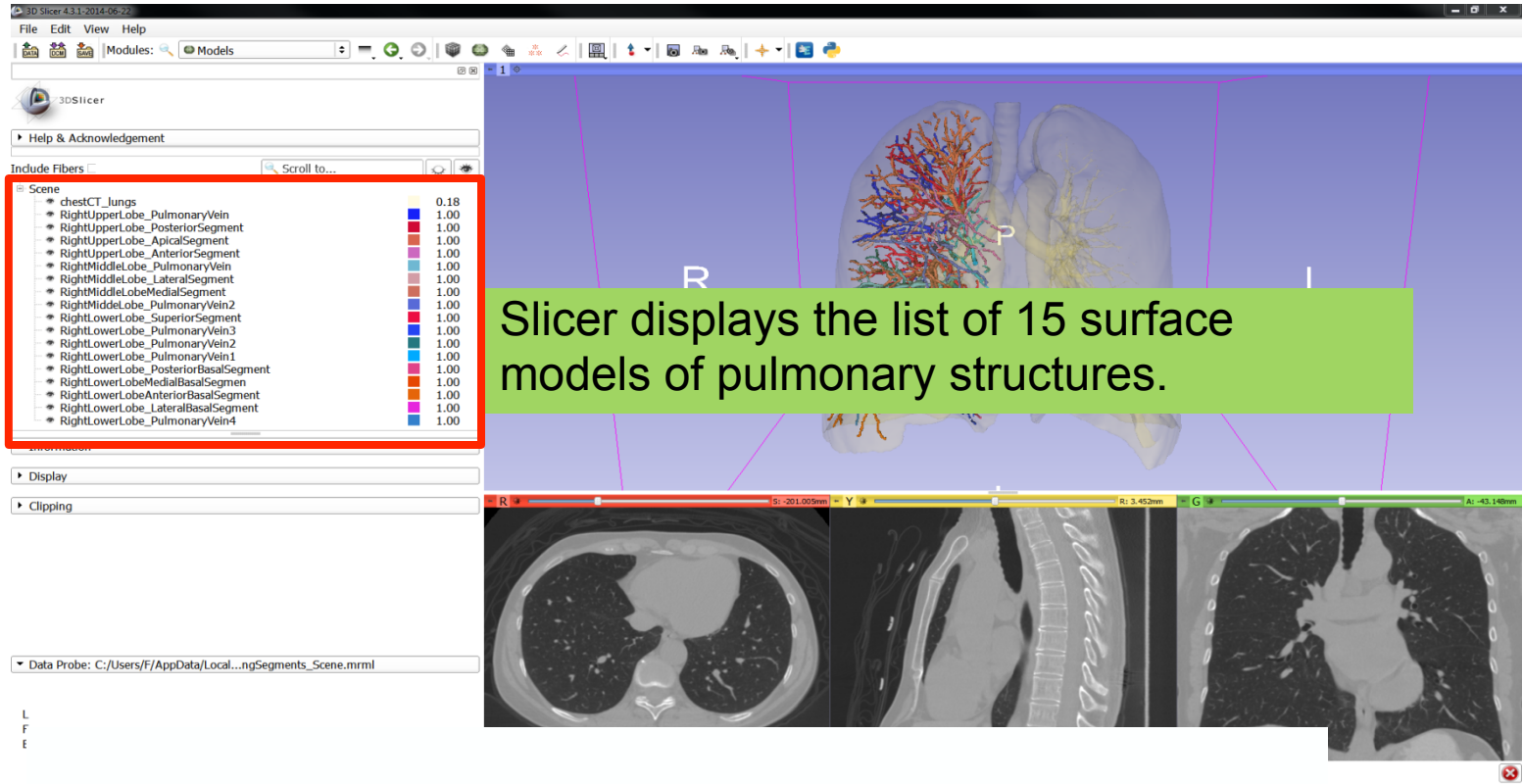


Loading the Lung Scene



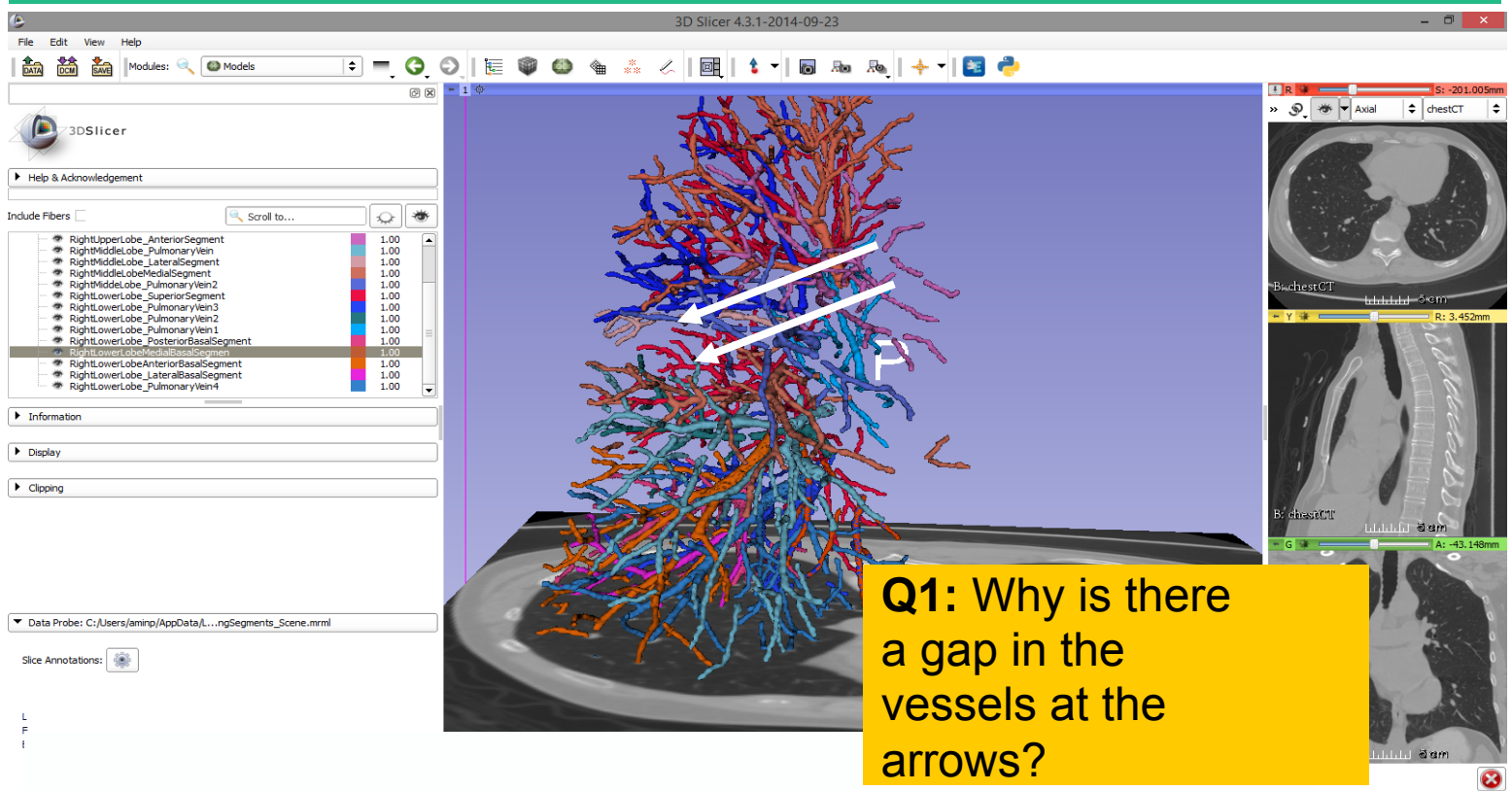


Lung Segments



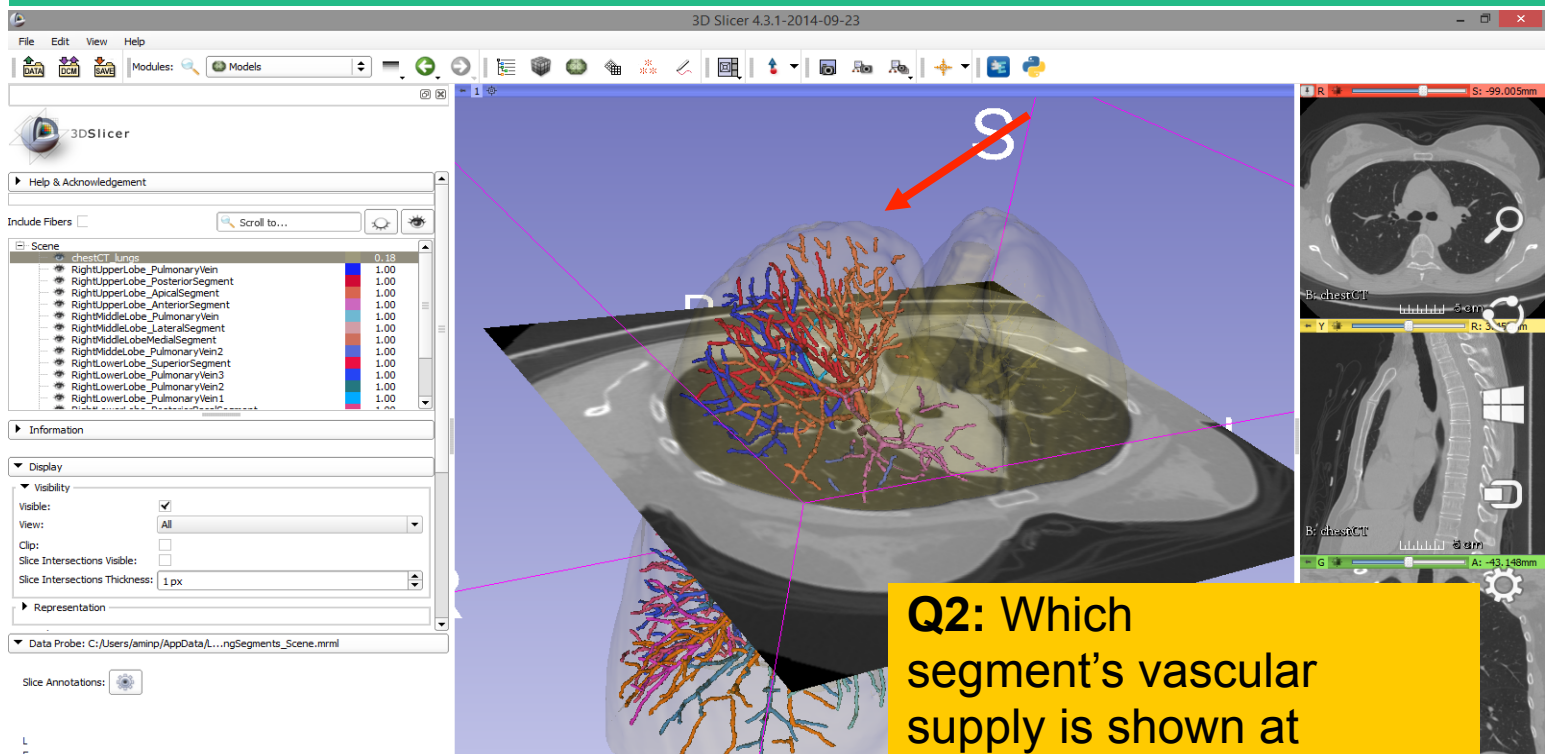


Lung Segments – Question 1





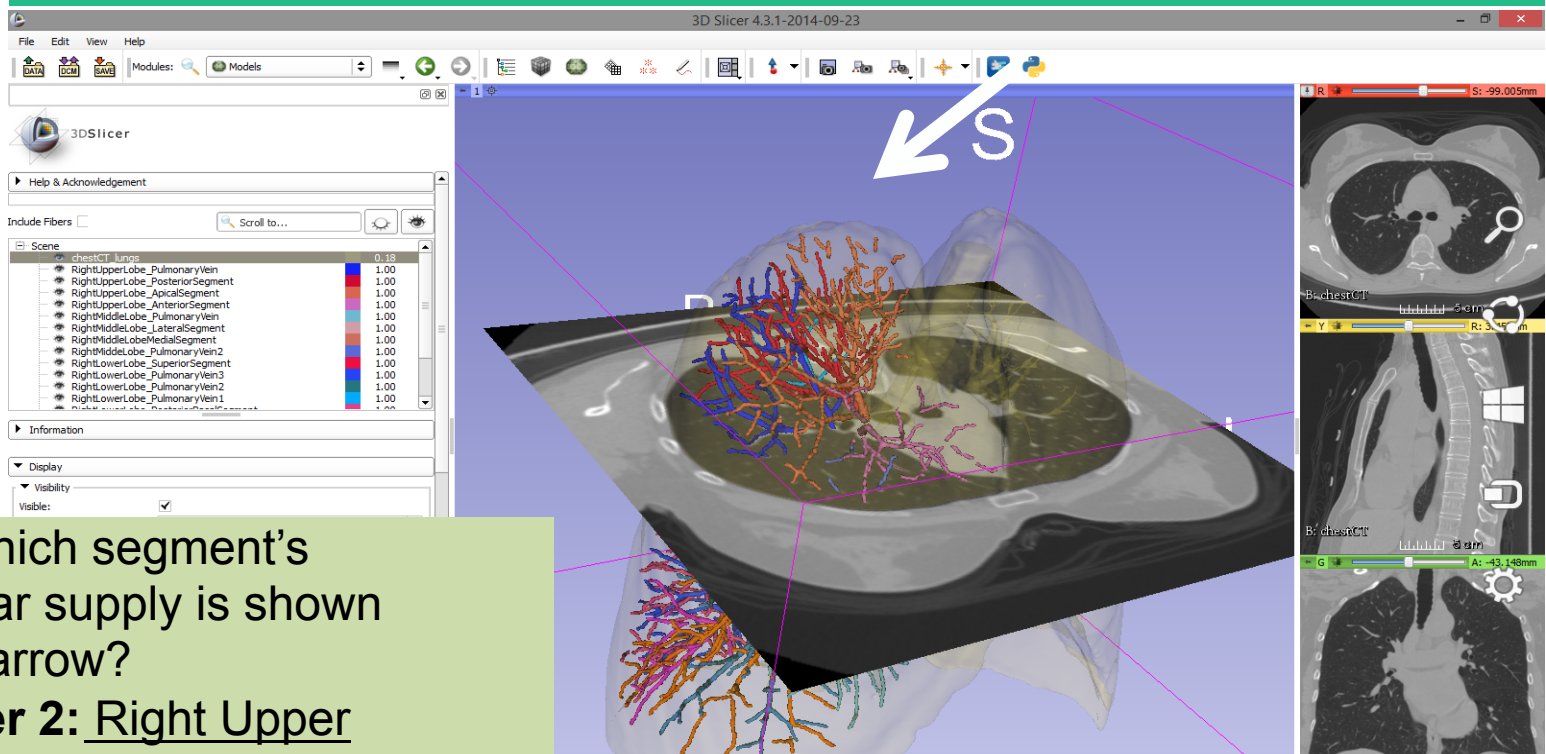
Lung Segments – Question 2



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



Lung Segments – Question 2

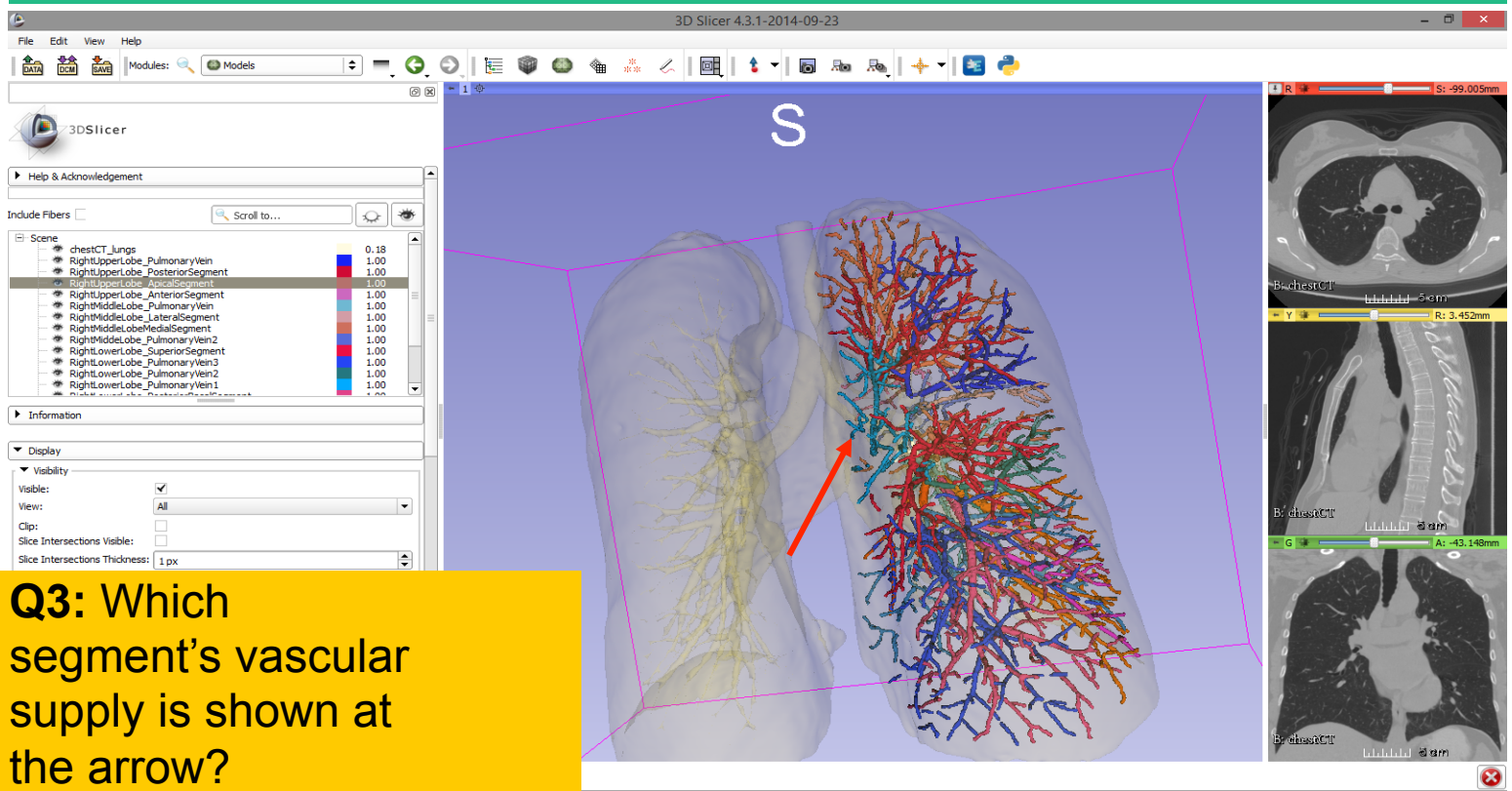


Q2: Which segment's vascular supply is shown at the arrow?

Answer 2: Right Upper Lobe Apical Segment



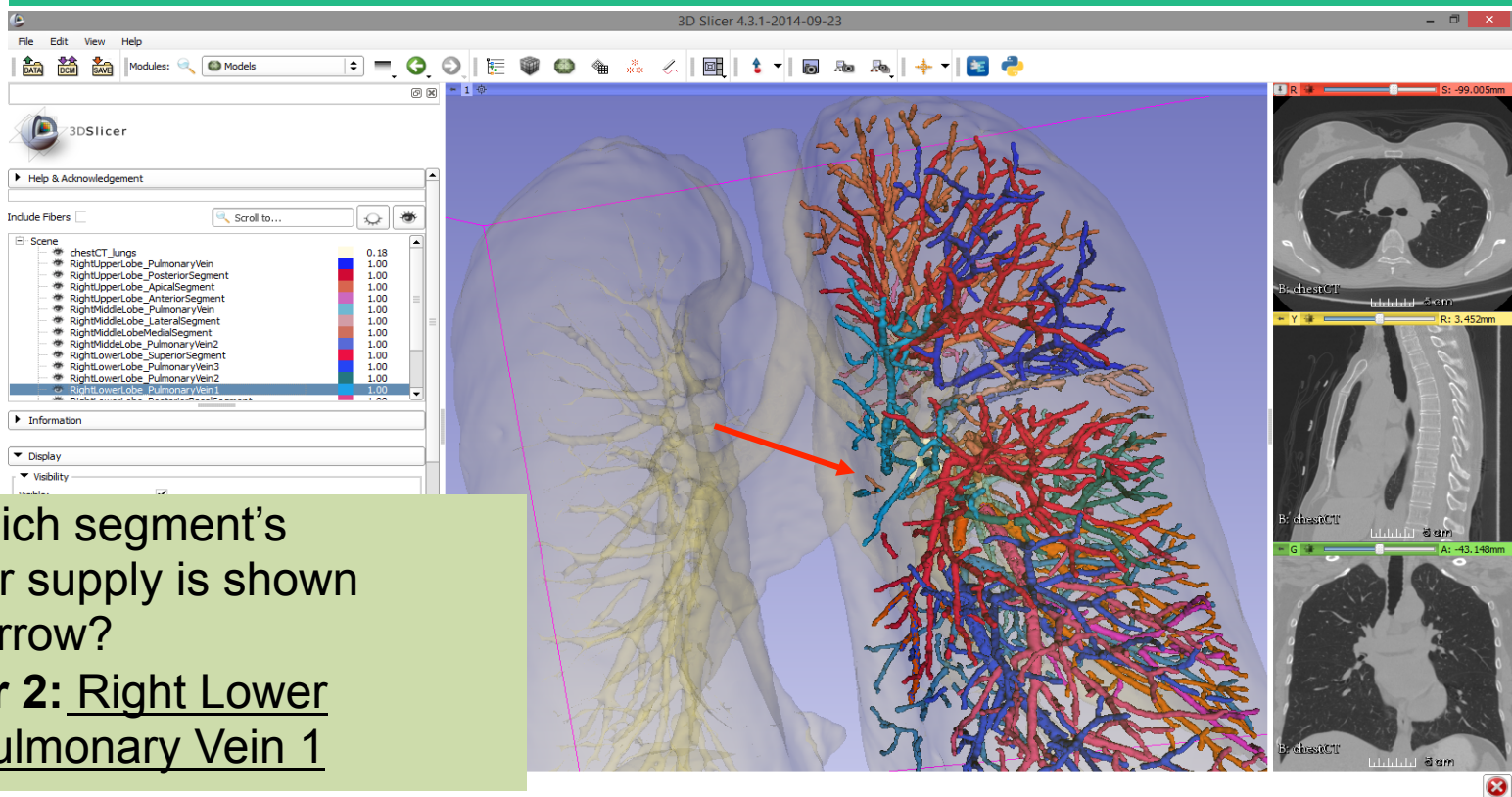
Lung Segments – Question 3



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

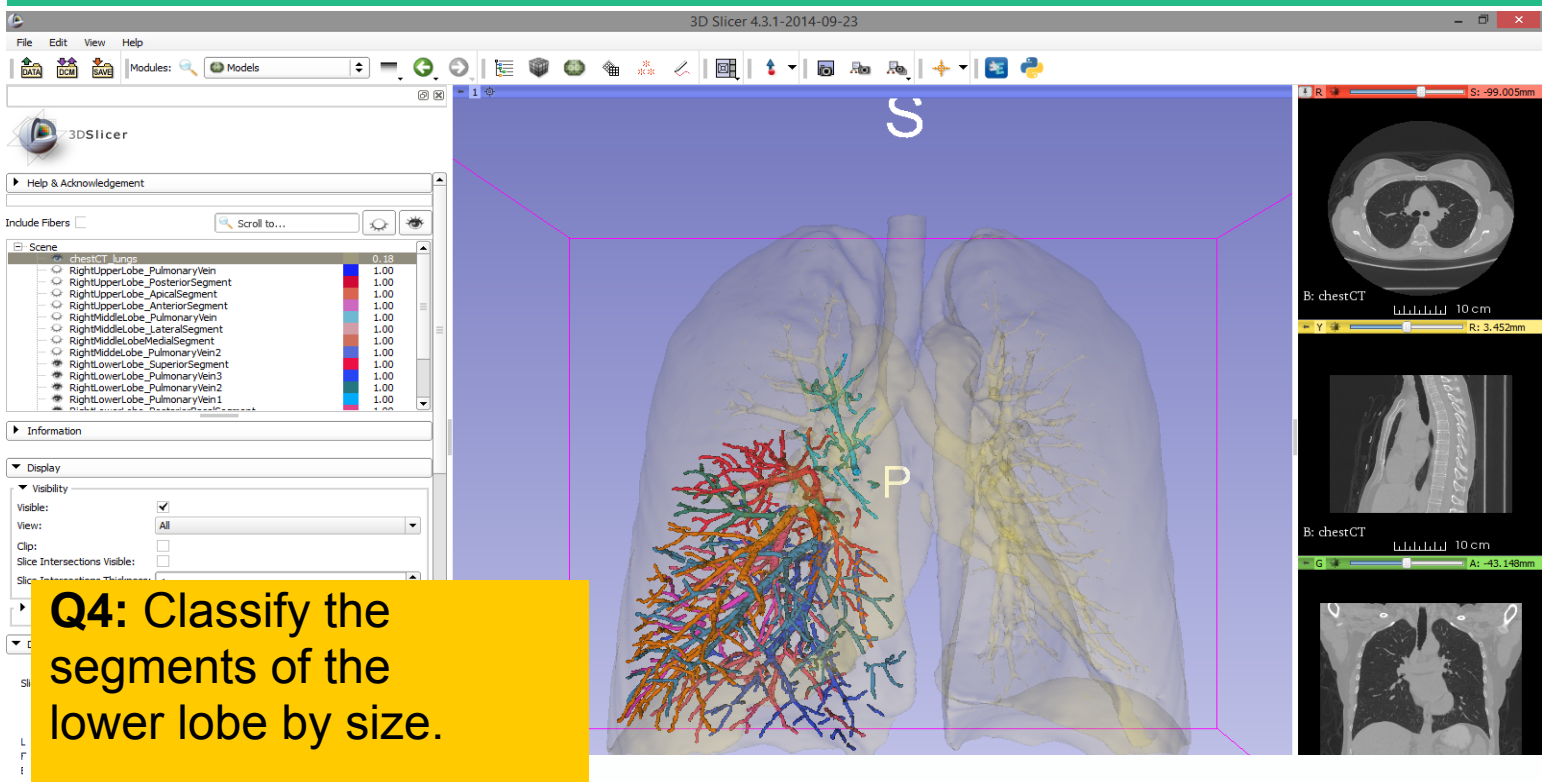


Lung Segments – Question 3



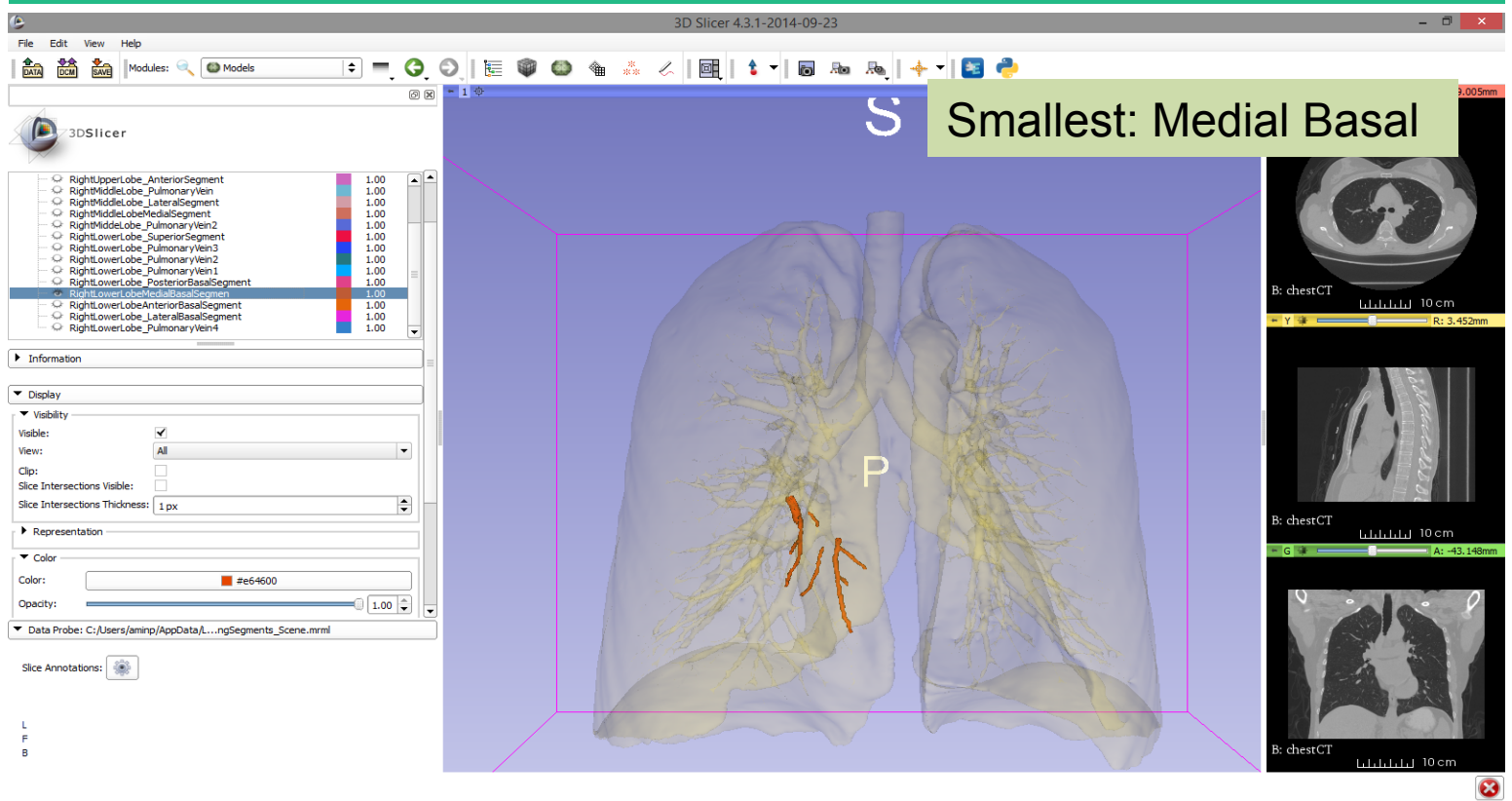


Lung Segments – Question 4



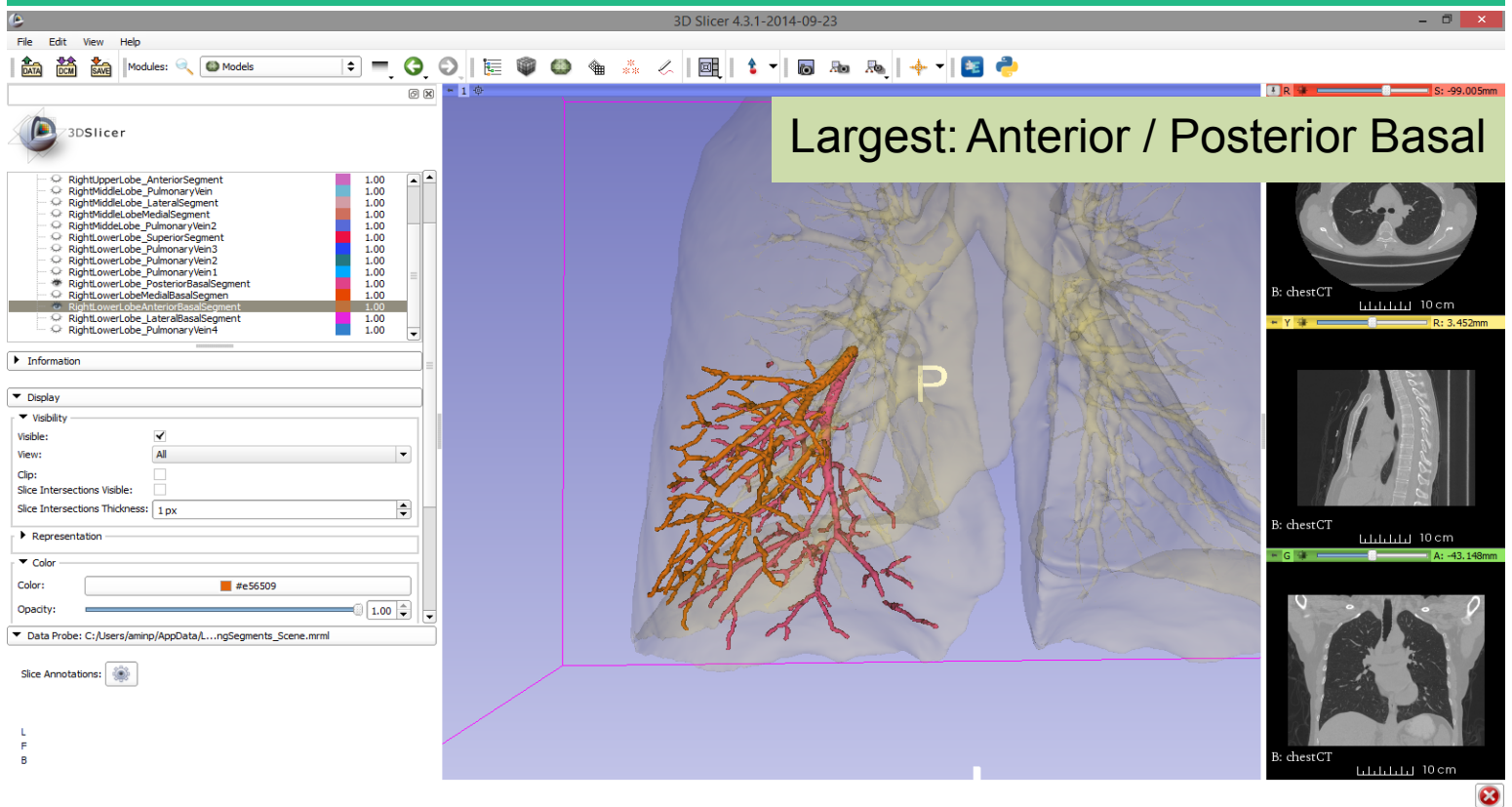


Lung Segments – Question 4



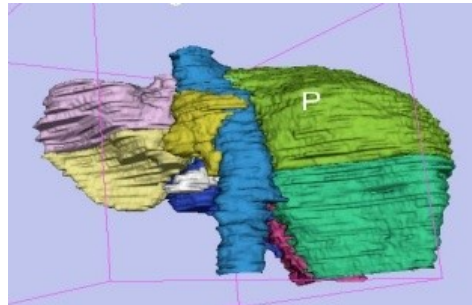
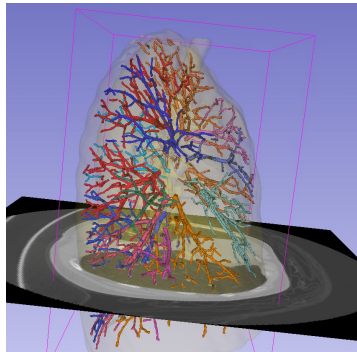
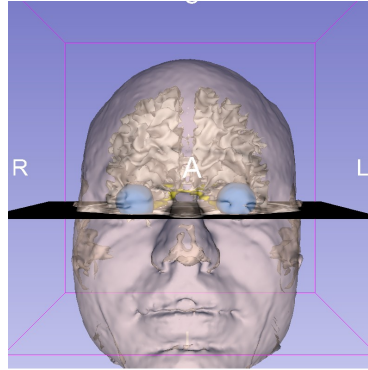
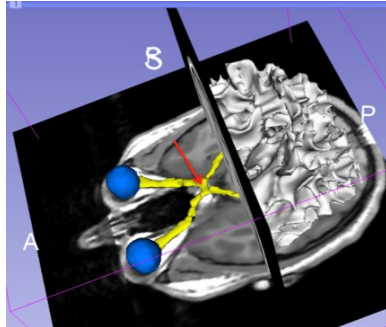


Lung Segments – Question 4





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

**3DSlicer**

A multi-platform, **free and open source** software package for
visualization and **medical image computing**

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Slicer Wiki

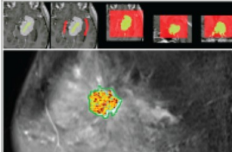
About Slicer

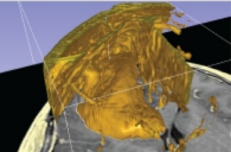
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- Acknowledgments
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Resources


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- Publication DB
- Image Gallery
- Slicer Community
- Source Code
- Licensing
- Mailing Lists
- Web Archive

Powerful processing.

Streamlined interface.

Extensible platform.

**3D Slicer** *version 4*

www.slicer.org

The community of Slicer developers is proud to announce the release of Slicer 4.2. Find out more...

Webinar: Introduction to Slicer 4.1

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Slide 121



Acknowledgments



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(NIH Grant P41 EB015902)

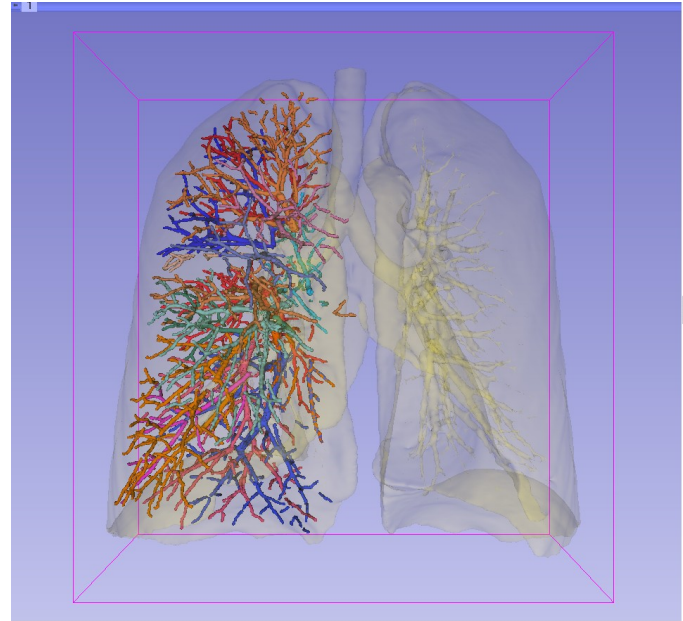


- Parth Amin, WIT '16



- Farukh Kohistani, BC '16

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



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