



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

a teaching affiliate of  
Harvard Medical School

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# 3D VISUALIZATION OF DICOM IMAGES FOR RADIOLOGICAL APPLICATIONS

Sonia Pujol, PhD, Harvard Medical School

Surgical Planning Laboratory, Brigham and Women's Hospital

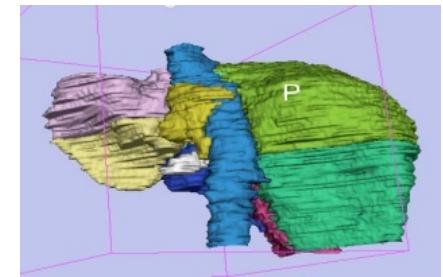
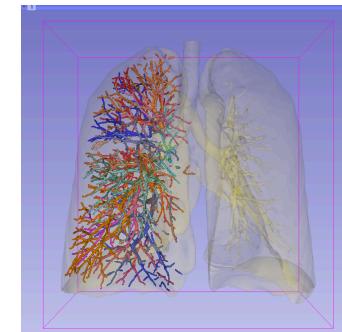
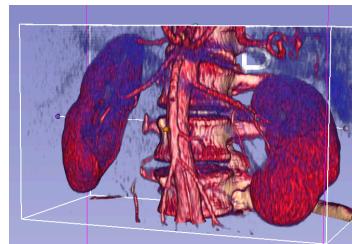
Kitt Shaffer, MD, PhD, Boston University

Vice-Chairman for Education, Boston University School of Medicine

Ron Kikinis, MD, Harvard Medical School

Surgical Planning Laboratory, Brigham and Women's Hospital

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.

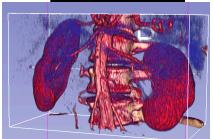


# Overview

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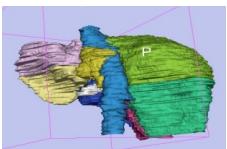
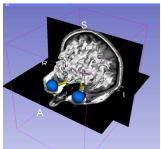


## Part I: Introduction to the 3DSlicer software



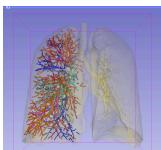
## Part II: 3D Data Loading and visualization of DICOM images

- 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

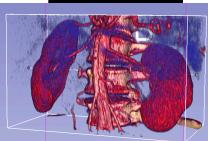


# Overview

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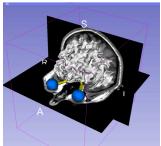


## Part I: Introduction to the 3DSlicer software



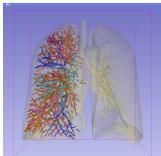
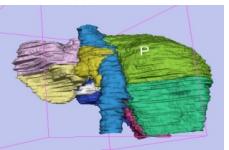
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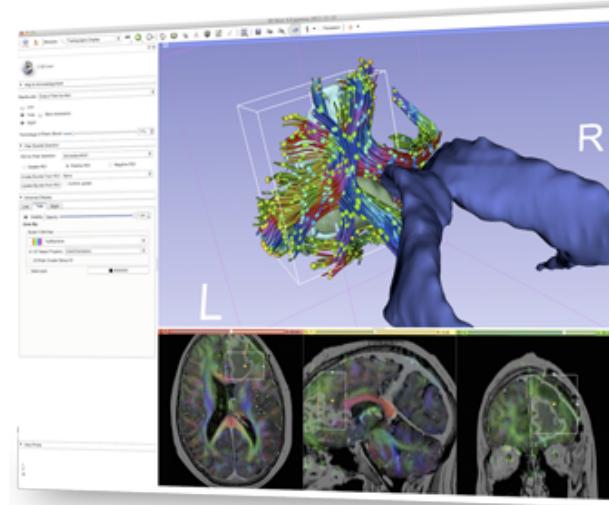


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- Exploration of the Segments of the liver
- Exploration of the Segments of the lung

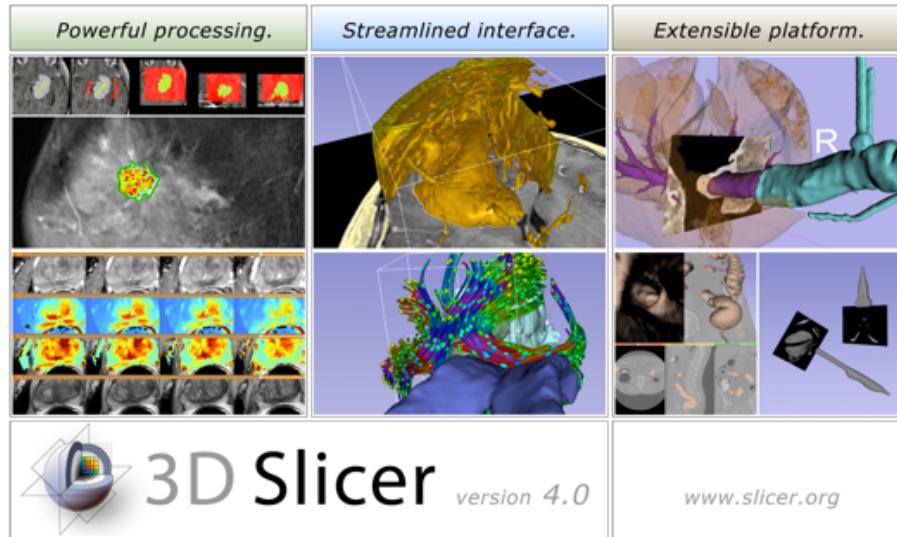


## *Introduction to the 3DSlicer software*





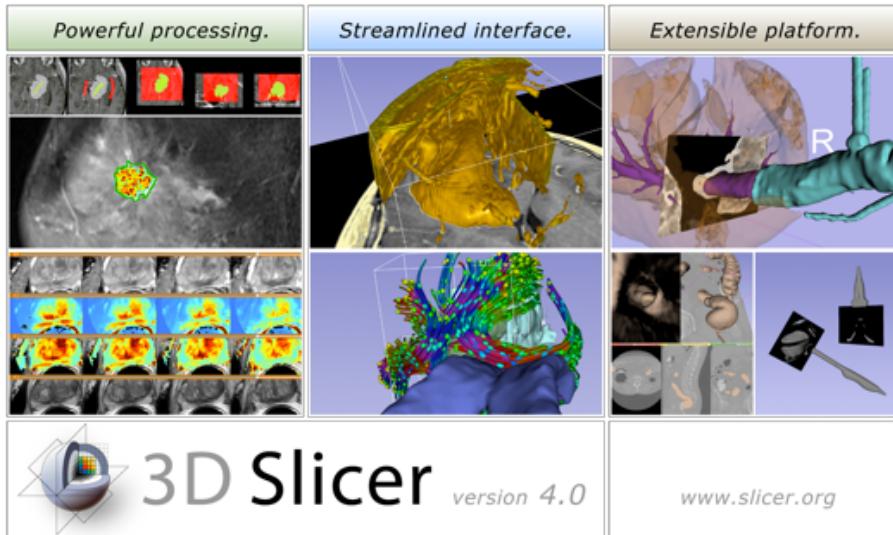
# 3DSlicer



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

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

# 3DSlicer



- 3DSlicer version 4.2 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**

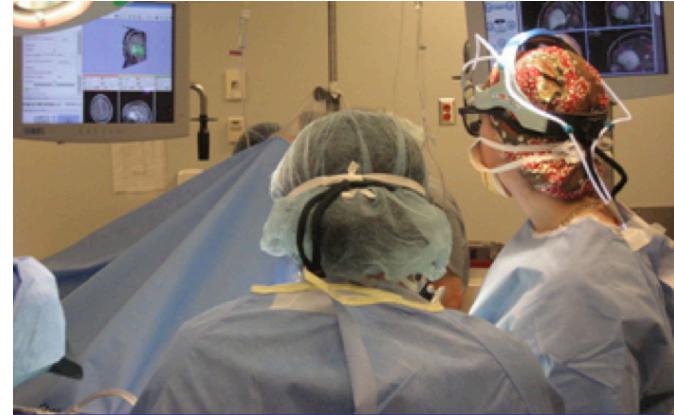
## Disclaimer

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



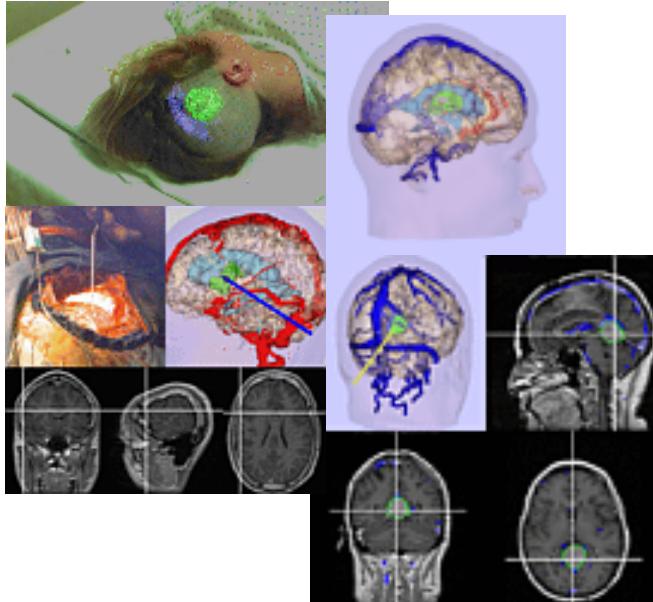
An **open-source environment** for  
software developers



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 Computer Science and Artificial Intelligence (MIT)

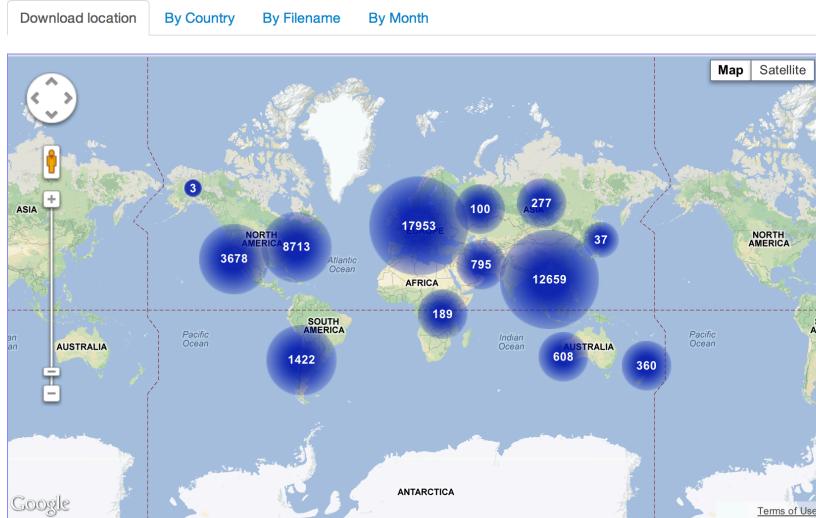
Image Courtesy of the CSAIL, MIT



# 3DSlicer History

- 1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)
- 2012: Multi-institution effort to share the latest advances in image analysis with the clinical and scientific community

Slicer 4 download statistics





# 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

**NA-MIC WIKI**

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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 research community.**

Supported by the National Institutes of Health  
Information about collaborating with NA-MIC

**PI: Ron Kikinis, M.D.**

**Neuroimage Analysis Center**  
*"understanding the human brain through imaging"*

**NAC**

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**GO**

**IMRI-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 generate a predicted tract (red), the 95% confidence interval for the predicted trajectory is shown in blue, and the 68% 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.

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**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 a unique 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...](#)

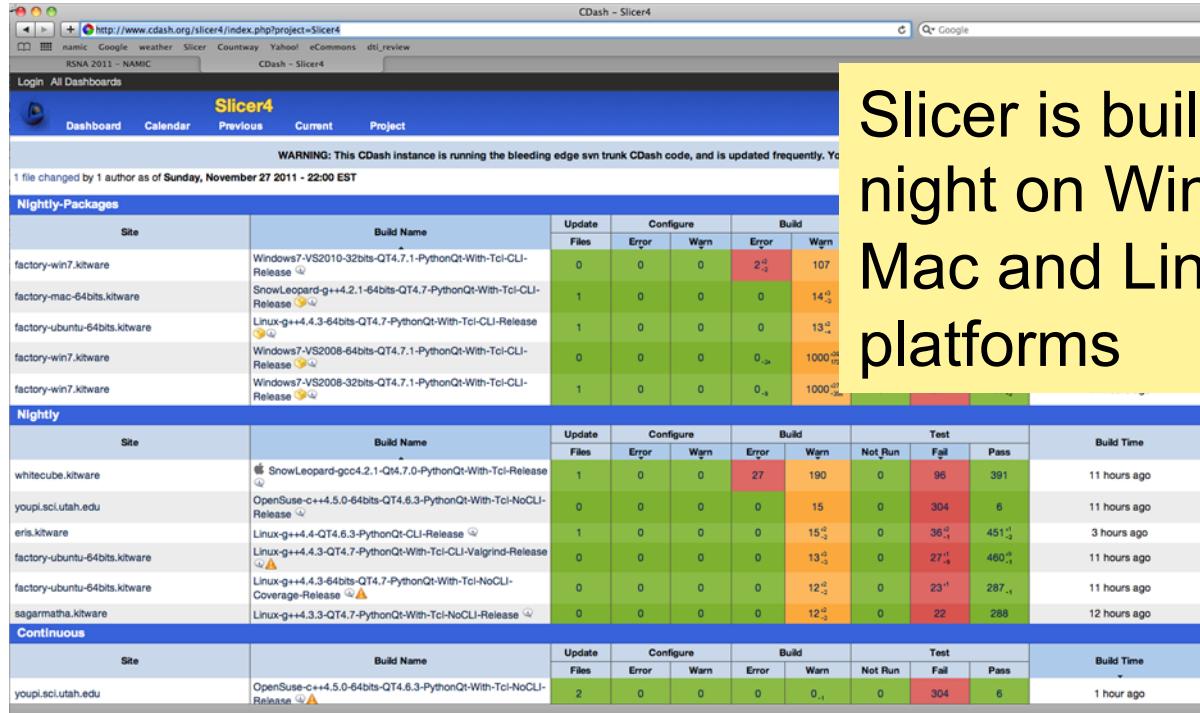
[Featured Image Archive](#)

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

**Pls: Ferenc Jolesz, M.D.,  
Clare Tempany, M.D.**



# Slicer: Behind the scenes



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



# Slicer Training events



- Hands-on training workshops at national and international venues
- More than 2,000 clinicians, clinical researchers and scientists trained since 2005

# Slicer Training events



RSNA 2011

## Major international conferences

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



# RSNA Activities

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## Hands-on refresher courses

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

## Quantitative Imaging Reading Room Exhibit

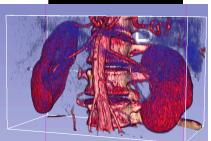
- 3DSlicer: An Open Source Platform for Segmentation, Registration, Quantitative Imaging, and 3D Visualization of Multi-Modal Image Data. #3007

# Overview

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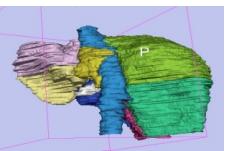
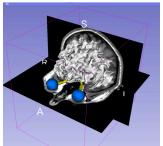


## Part I: Introduction to the 3DSlicer software



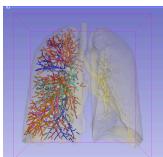
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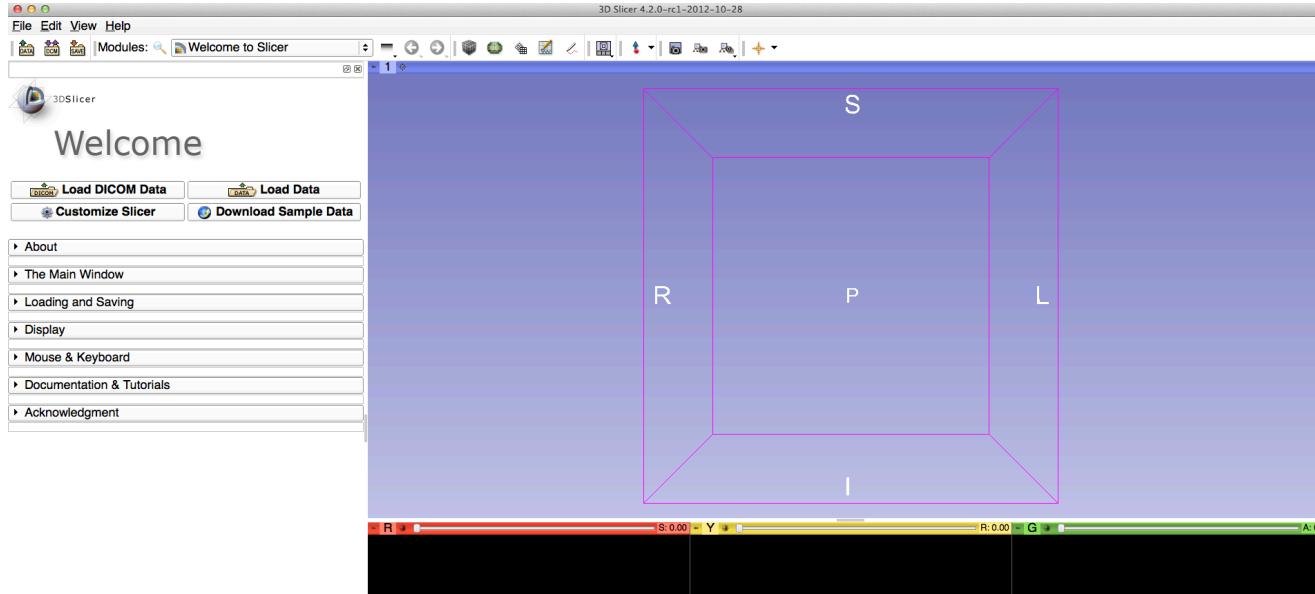
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- Exploration of the Segments of the liver
- Exploration of the Segments of the lung





# Welcome to Slicer4



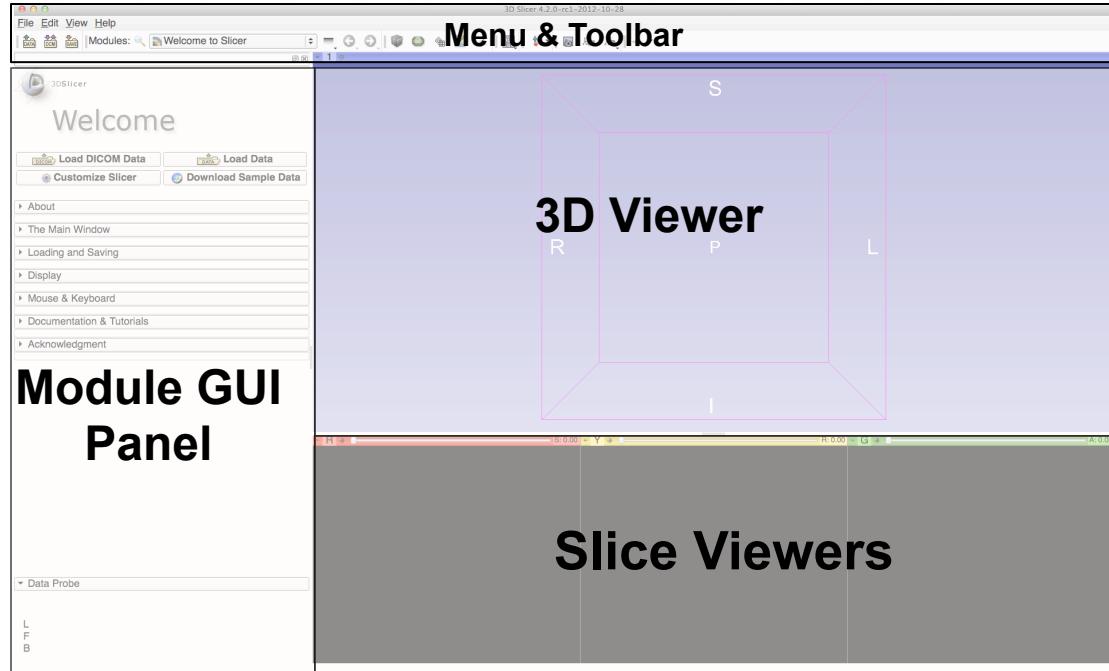
To start Slicer, select Start → Programs → Slicer4-2.0 (win64)



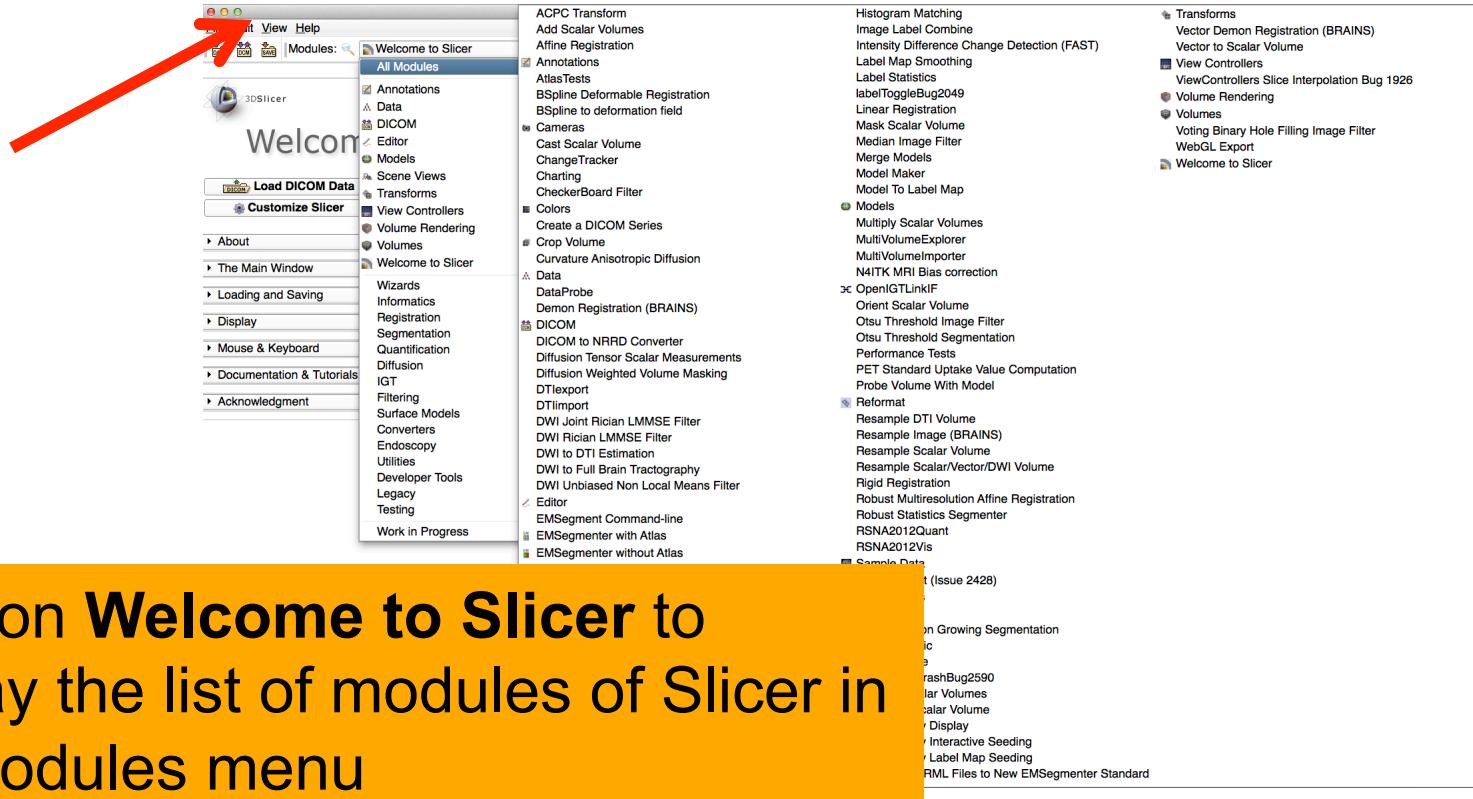
# Navigating the Application GUI

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

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

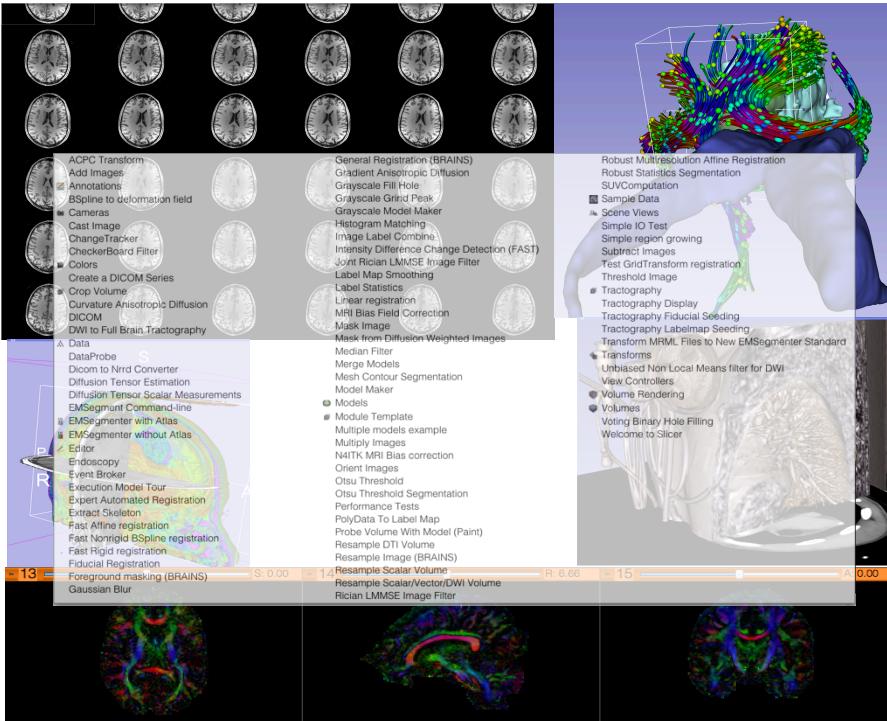


# Welcome to Slicer4.2

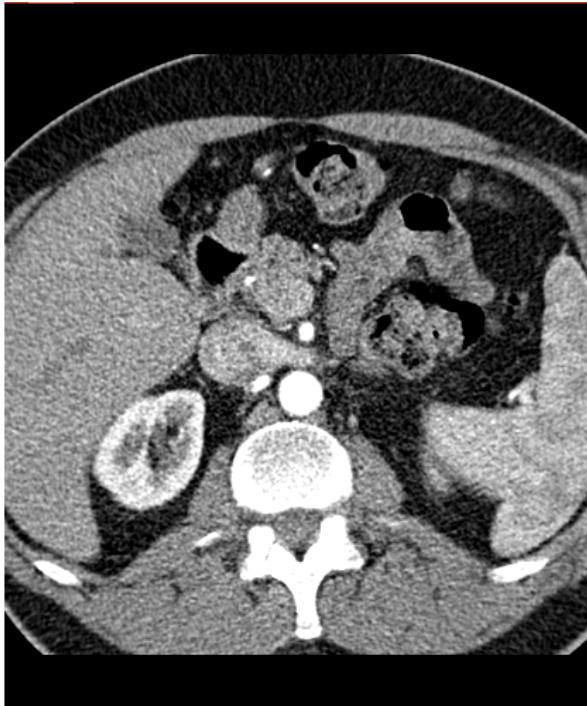


Click on **Welcome to Slicer** to display the list of modules of Slicer in the Modules menu

# Welcome to Slicer4



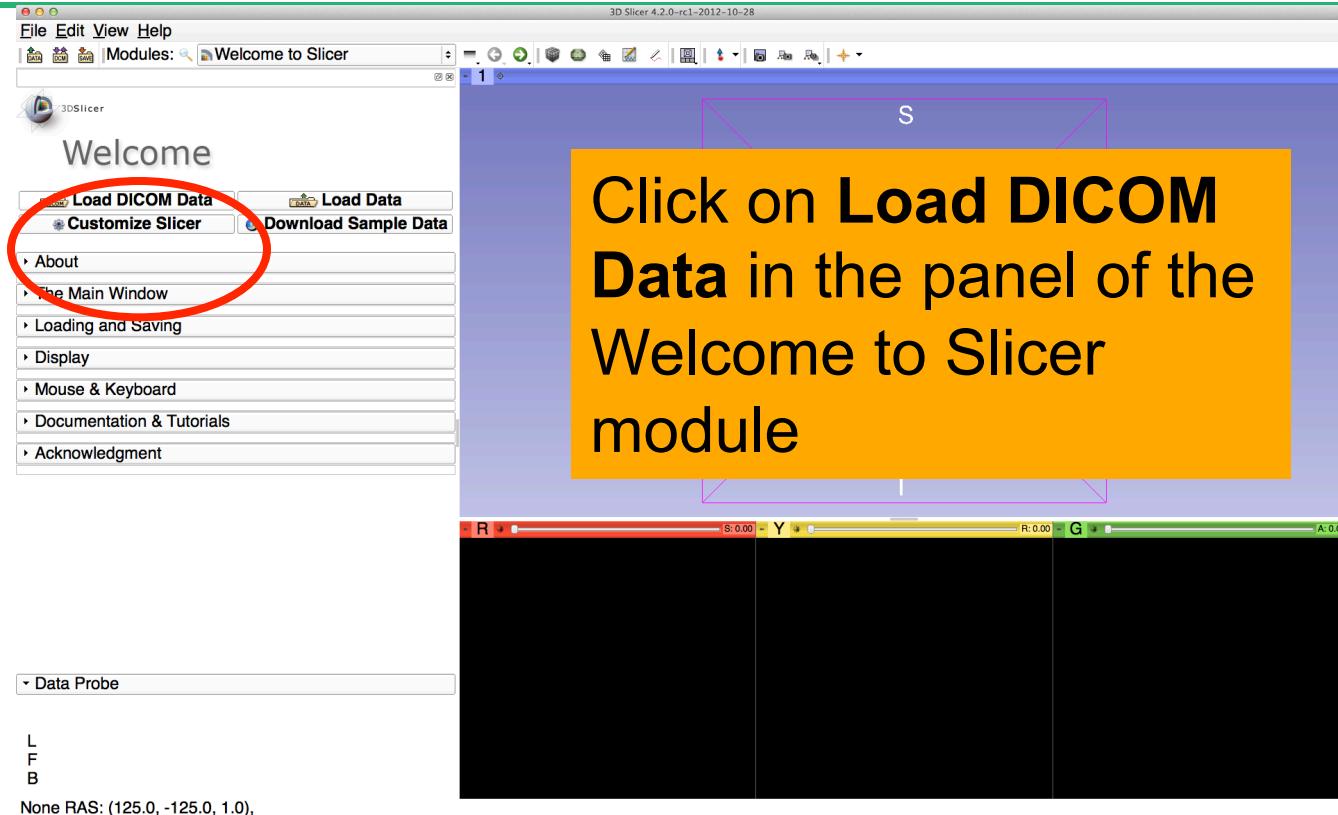
Slicer4.2 contains more than 100 modules for image segmentation, registration and 3D visualization of medical imaging data



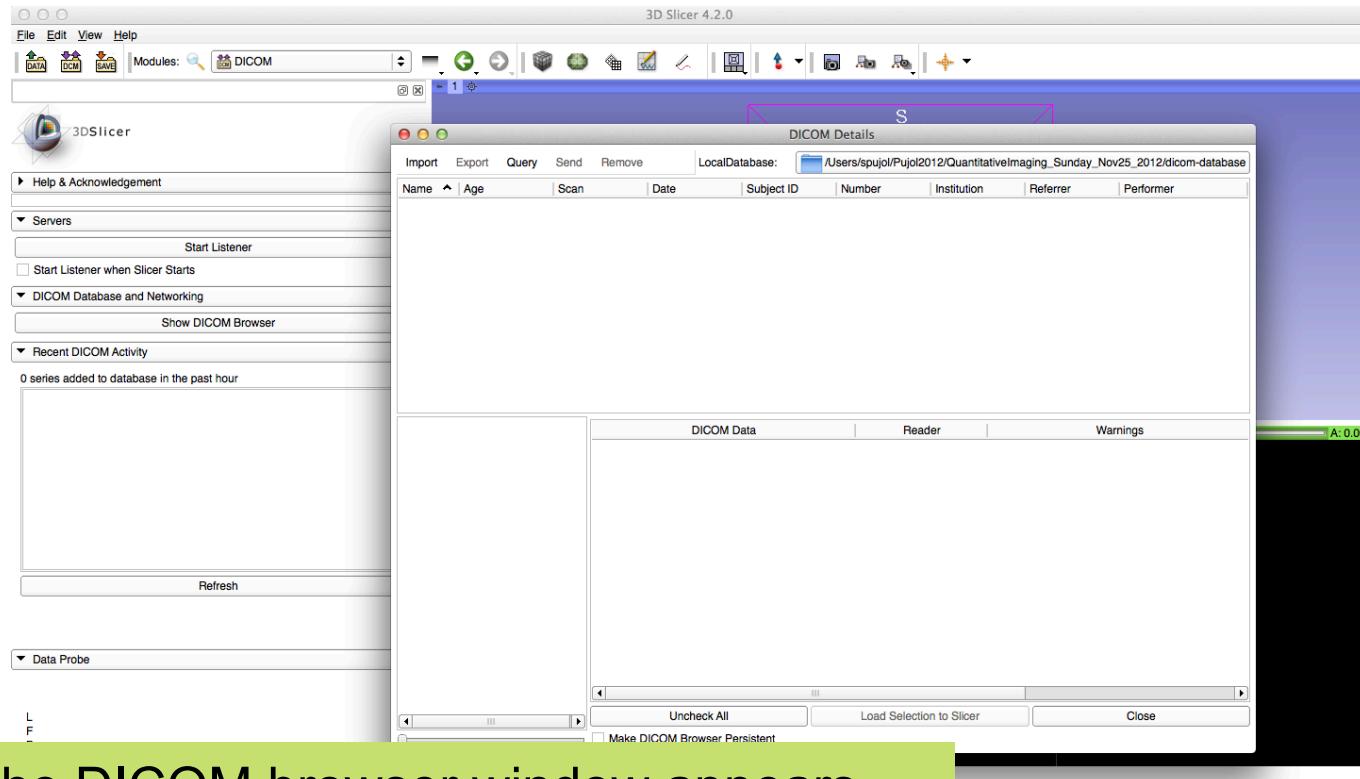
## Part 1:

# Loading a DICOM Volume

# Loading a DICOM volume



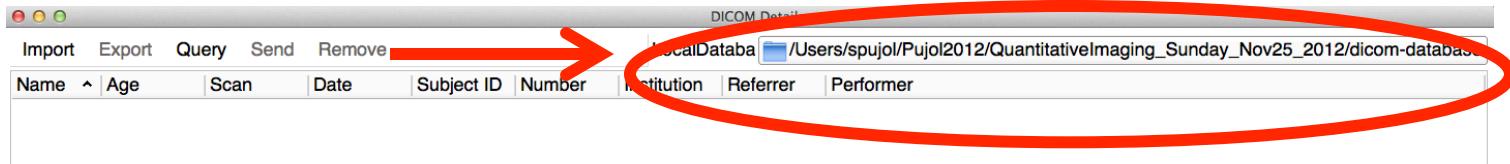
# Select DICOM local database



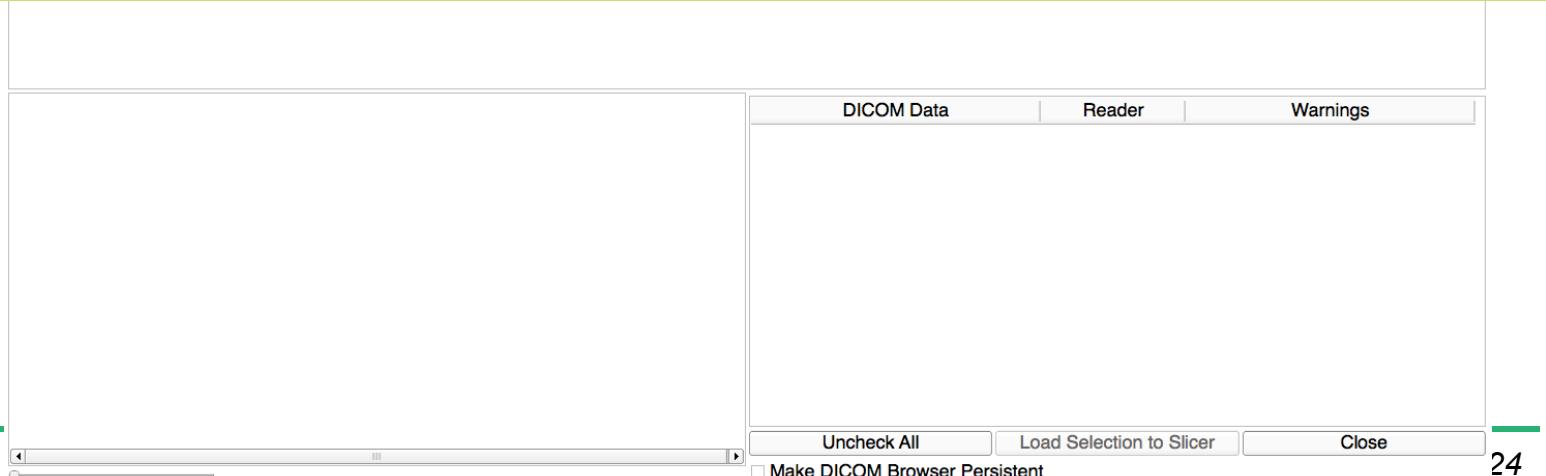
The GUI of the DICOM browser window appears



# Select DICOM local database

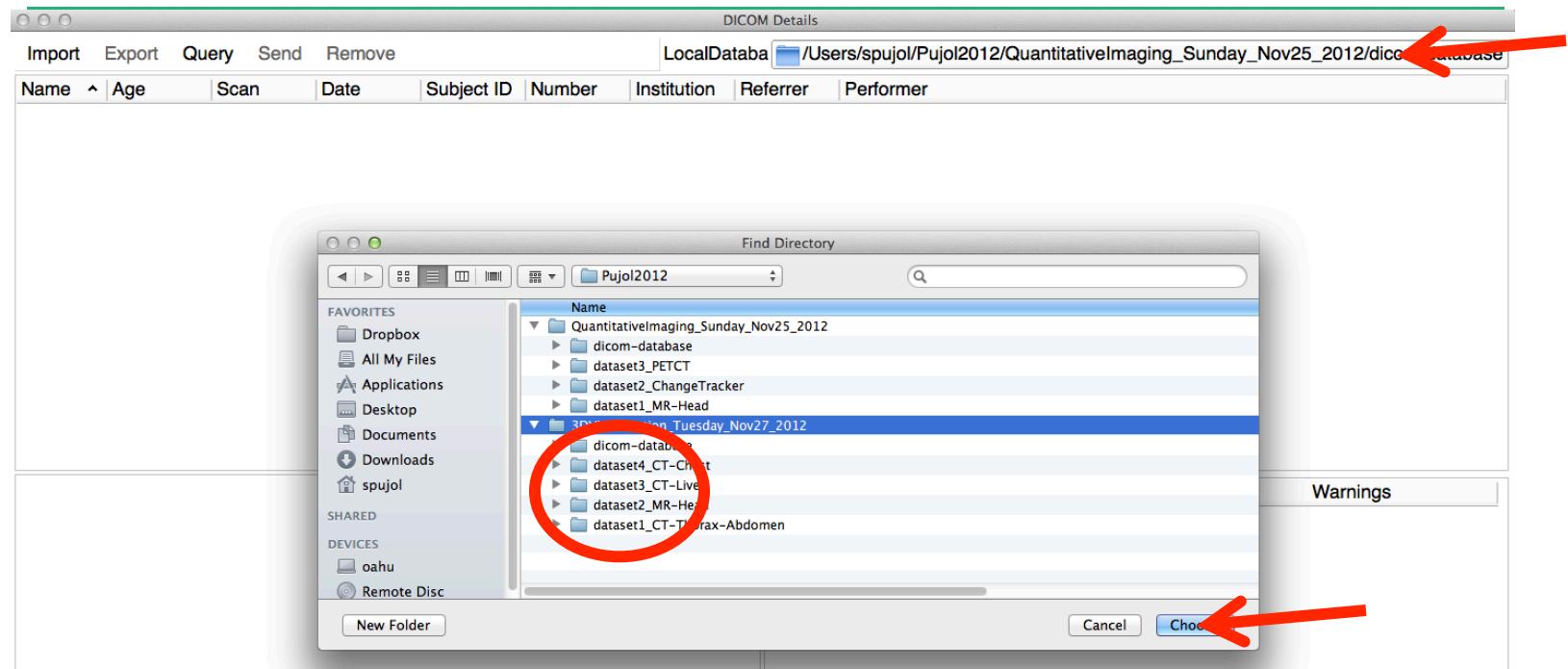


The path to the current local DICOM database of Slicer is set to  
**C:/Pujol2012/QuantitativeImaging\_Sunday\_Nov25\_2012/dicom-database**



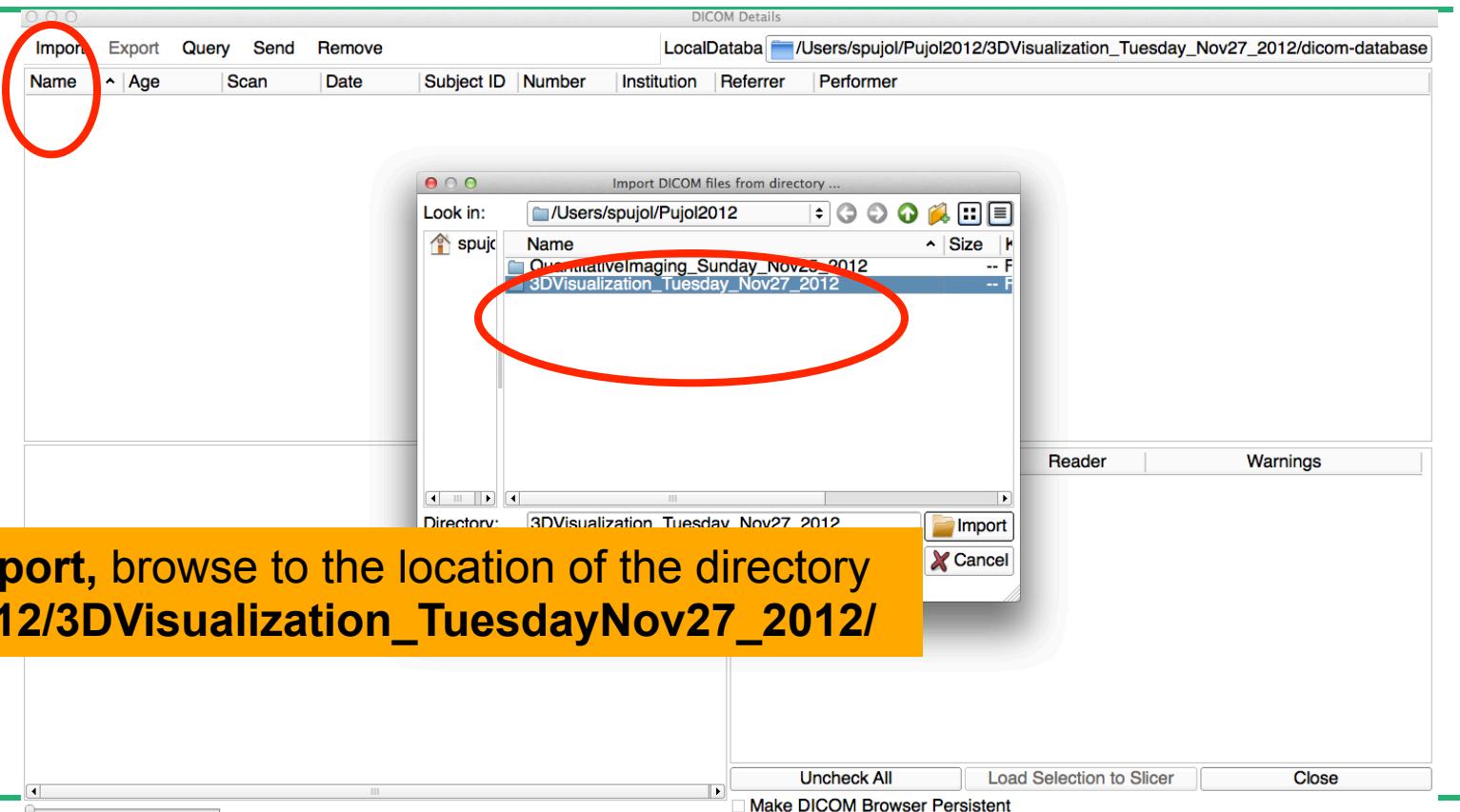


# Select DICOM local database



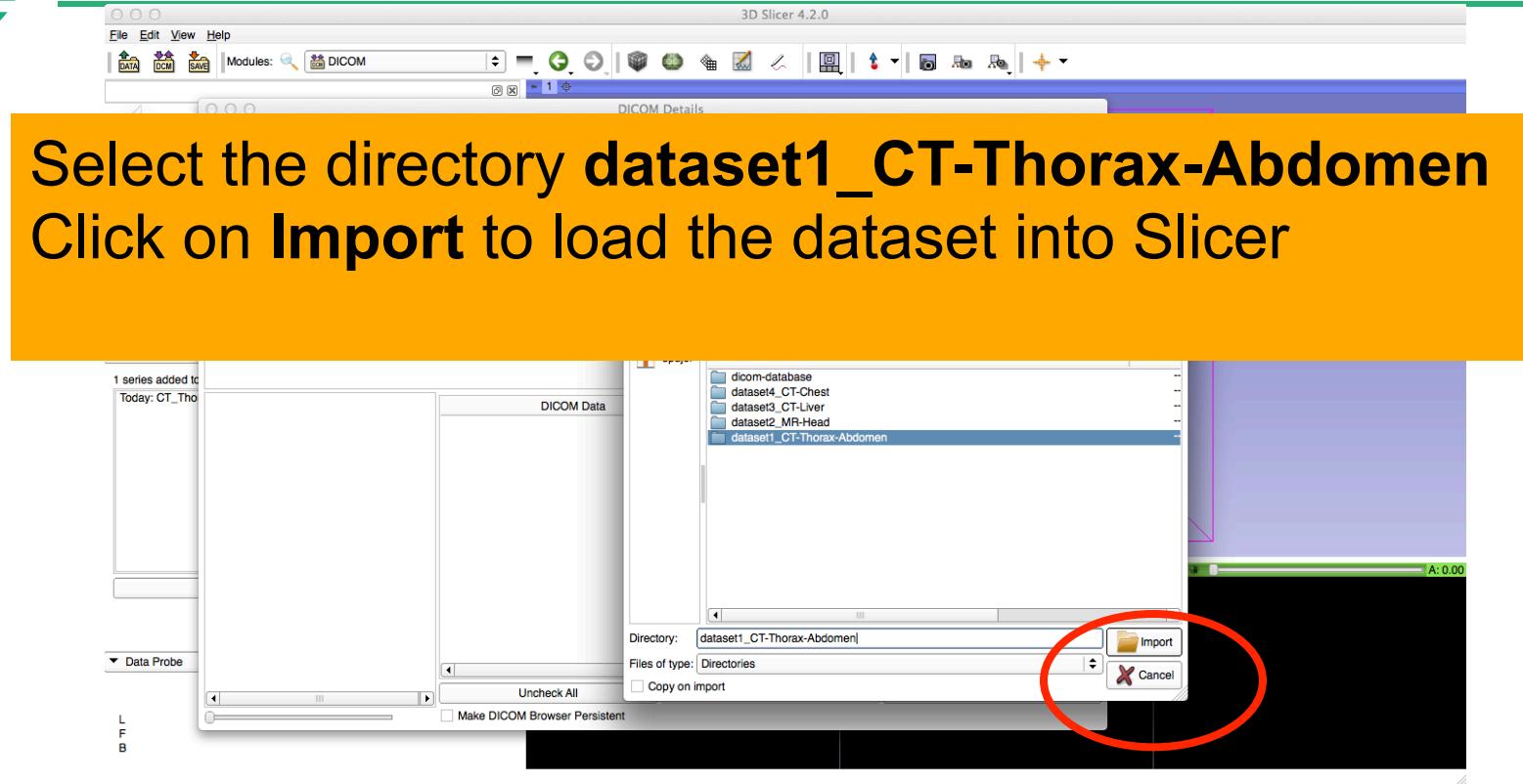
Click on this path name and change the local database directory to  
**C:/Pujol2012/3DVisualization\_Tuesday\_Nov27\_2012/dicom-database**  
Click on Choose to set this directory as the local DICOM database of Slicer

# Loading a DICOM volume



Click on Import, browse to the location of the directory  
C:/Pujol2012/3DVisualization\_TuesdayNov27\_2012/

# Loading a DICOM volume



Select the directory **dataset1\_CT-Thorax-Abdomen**  
Click on **Import** to load the dataset into Slicer

# Loading a DICOM volume

The screenshot shows a DICOM browser window with the following details:

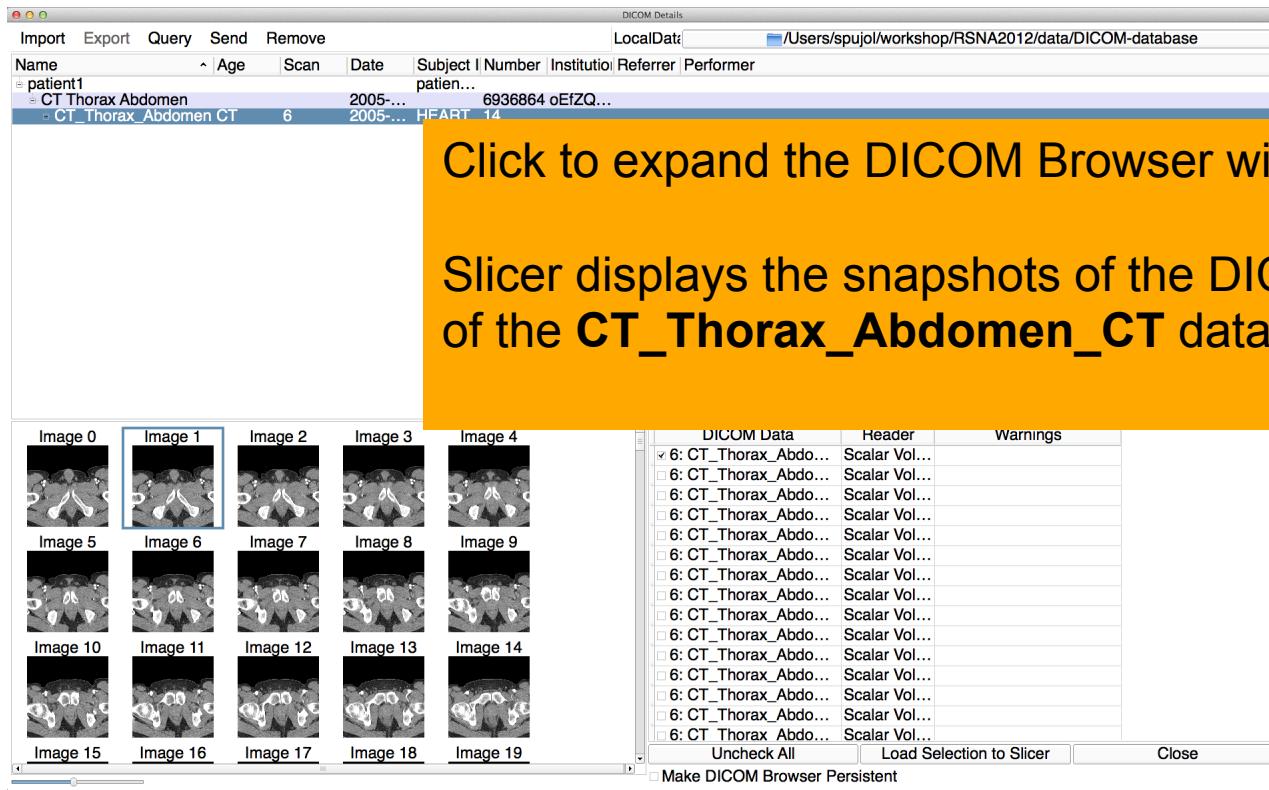
- Toolbar:** Import, Export, Query, Send, Remove, LocalData: /Users/spujol/workshop/RSNA2012/data/DICOM-database
- Table Headers:** Name, Age, Scan, Date, Subject | Number, Institution, Referrer, Performer
- Data Rows:**
  - patient1
    - CT Thorax Abdomen
      - CT\_Thorax\_Abdomen CT
  - 2005-... 6936864 oEfZQ...
  - 2005-... HEART 14
- Bottom Buttons:** Uncheck All, Load Selection to Slicer, Close, Make DICOM Browser Persistent

A red arrow points to the 'CT\_Thorax\_Abdomen CT' entry in the table.

**Text Overlay:**

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



# Loading a DICOM volume

The screenshot shows the DICOM Details window of the DICOM Browser. At the top, there are menu options: Import, Export, Query, Send, Remove, and a LocalData path set to /Users/spujol/workshop/RSNA2012/data/DICOM-database. Below the menu is a table with columns: Name, Age, Scan, Date, Subject I Number, Institution, Referrer, and Performer. A single row is selected, representing a patient named 'patient1' who is 6 years old, scanned at 'CT Thorax Abdomen' on '2005-...', and performed by 'HEART' on '2005-...'. The table has a header row and several data rows. To the right of the table is a large, empty white area. At the bottom of the window, there is a toolbar with icons for zooming and a status bar showing 'Image 15' through 'Image 19'. On the far right, there is a 'DICOM Data' table with multiple entries for 'Thorax\_Abdo...' volumes, each associated with a 'Scalar Vol...' reader. Below this table are buttons for 'Uncheck All', 'Load Selection to Slicer', and 'Close'. A red arrow points from the text in the orange box to the 'Load Selection to Slicer' button.

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

Image 15    Image 16    Image 17    Image 18    Image 19

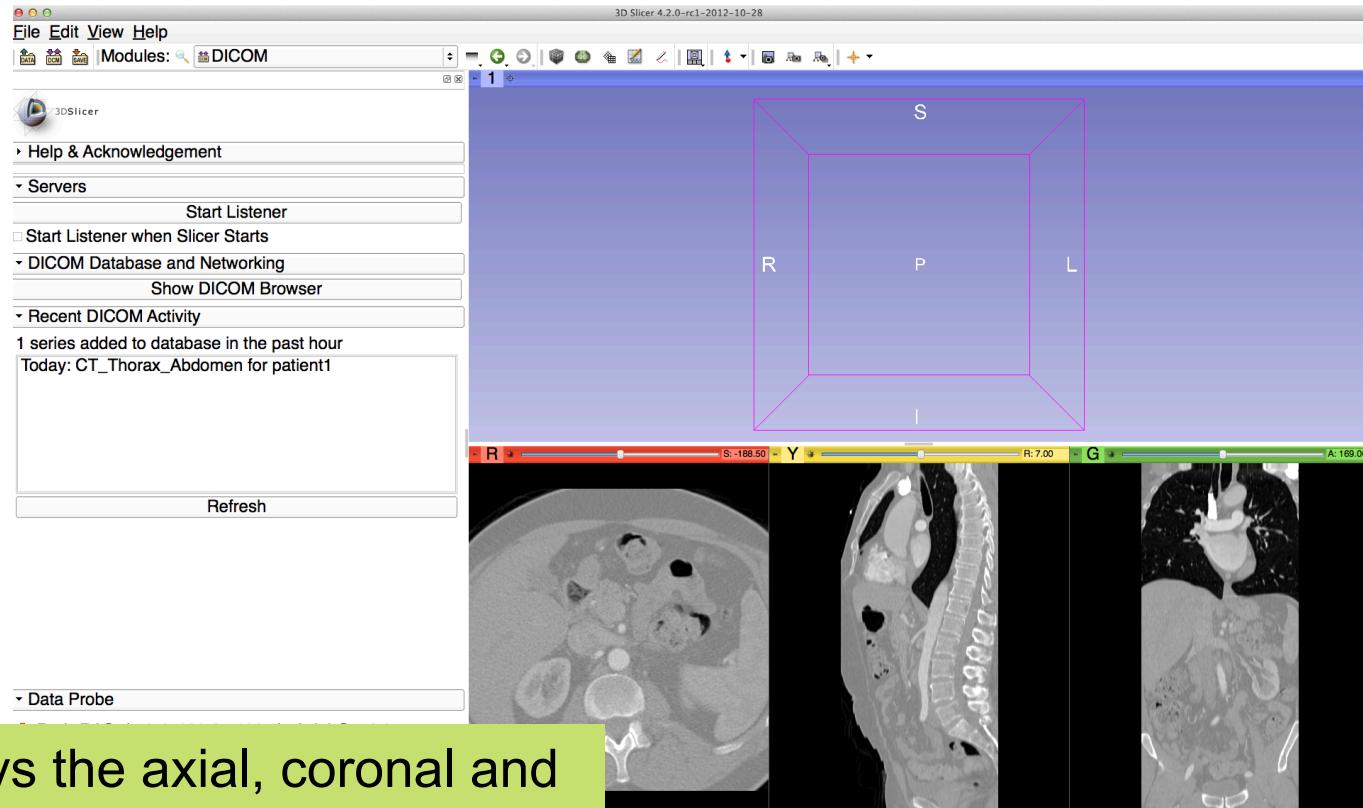
DICOM Data    Reader    Warnings

Thorax_Abdo...	Scalar Vol...	
6: CT_Thorax_Abdo...	Scalar Vol...	

Uncheck All    Load Selection to Slicer    Close

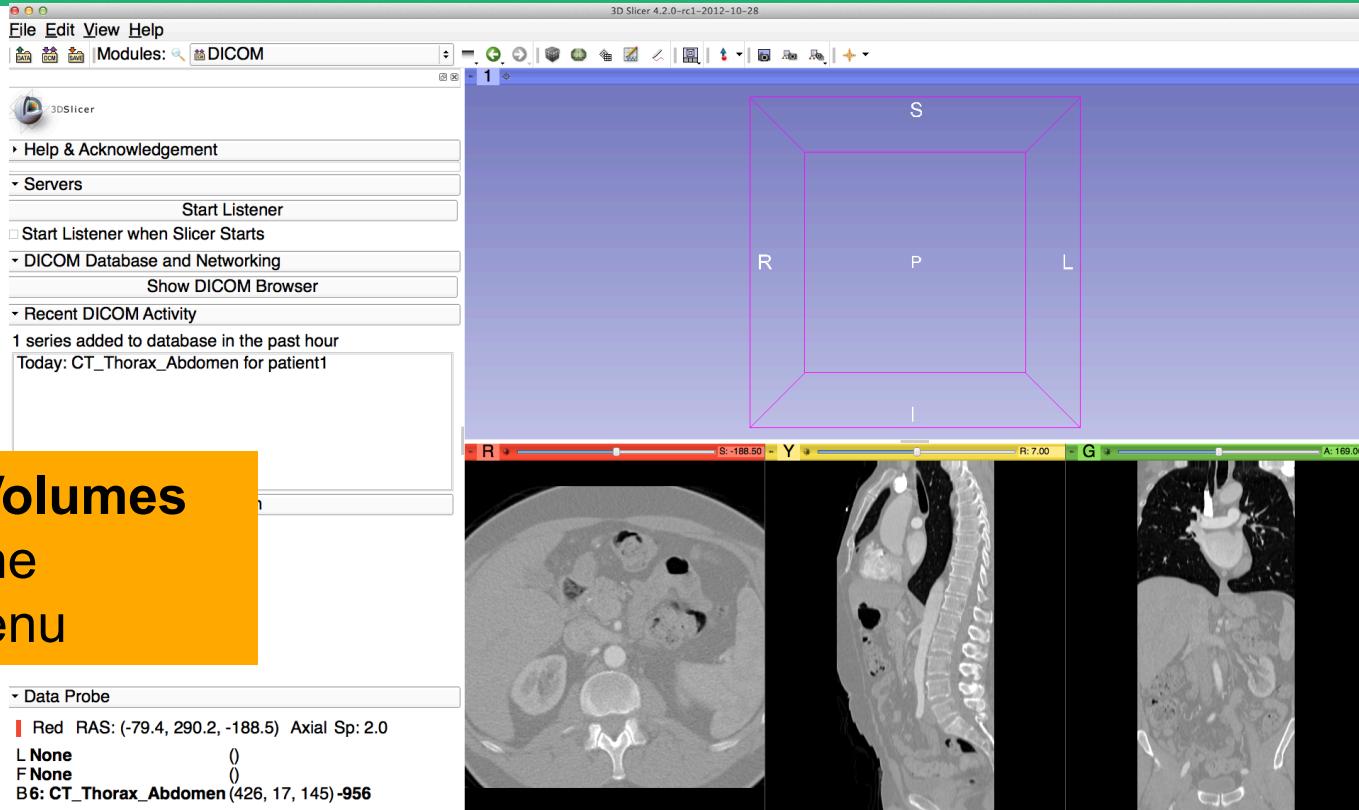
Make DICOM Browser Persistent

# Loading a DICOM volume

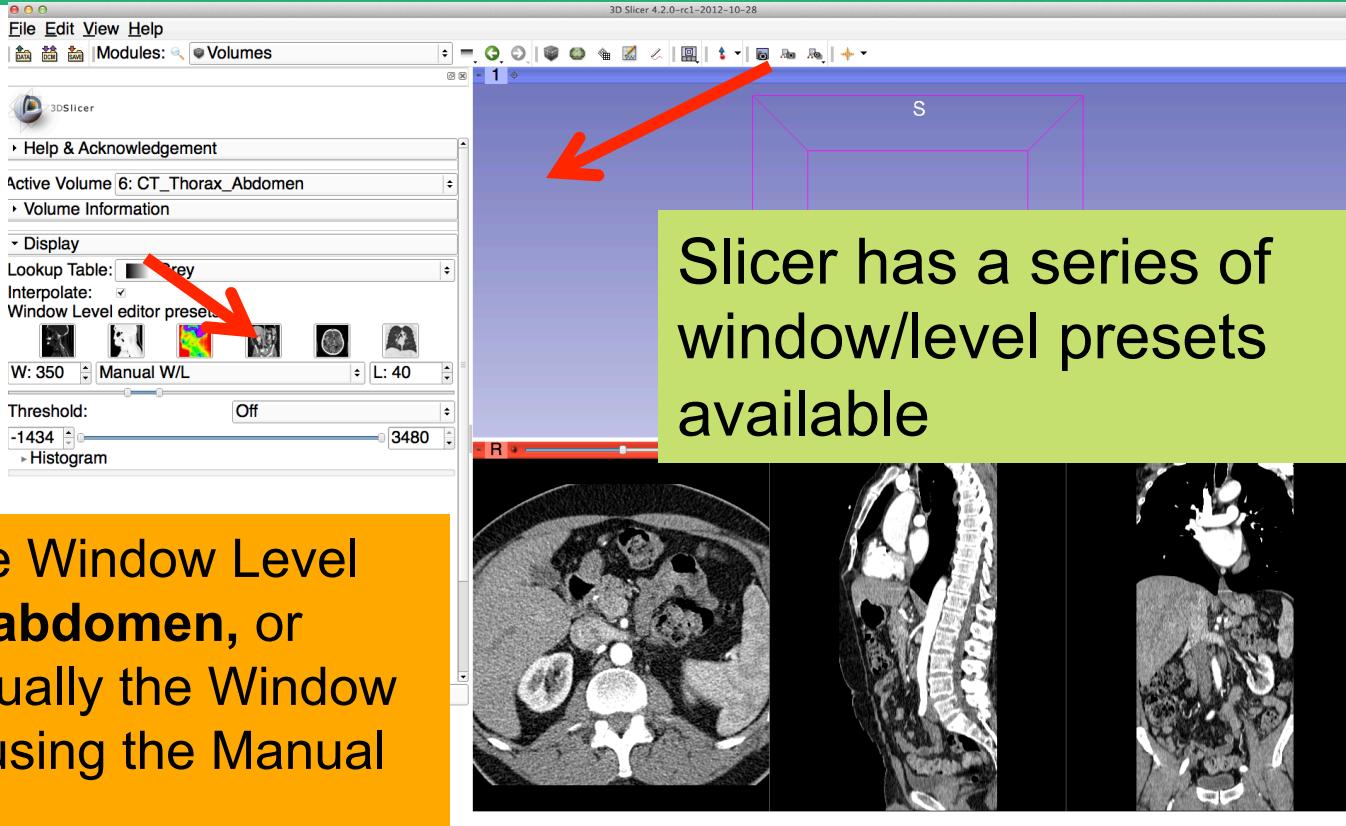


Slicer displays the axial, coronal and sagittal slices of the DICOM dataset

# Loading a DICOM volume



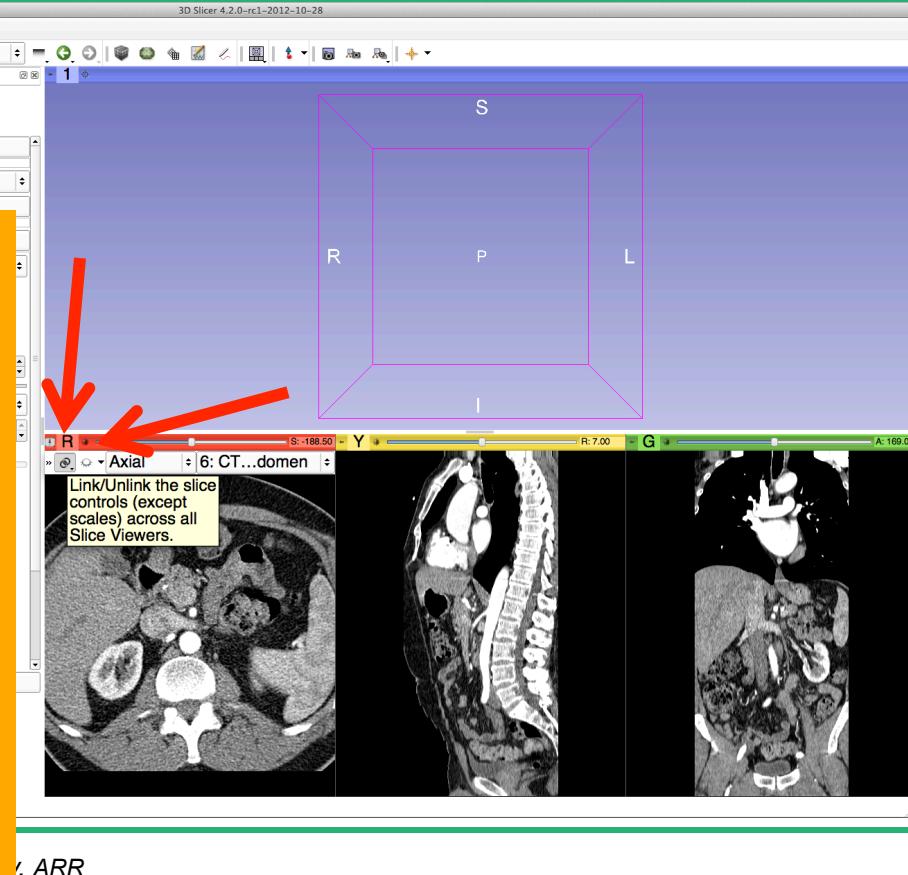
# Loading a DICOM volume



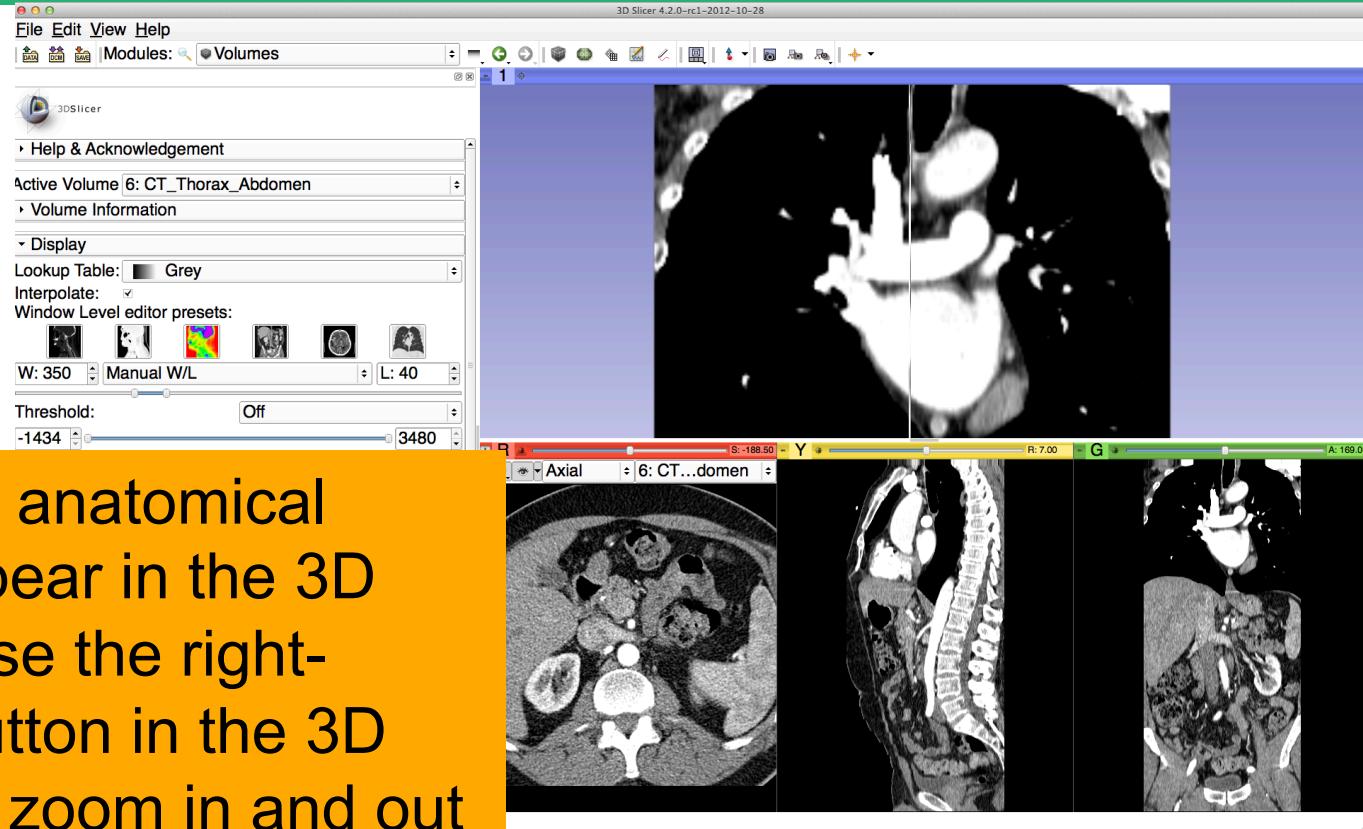
# Loading a DICOM volume

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

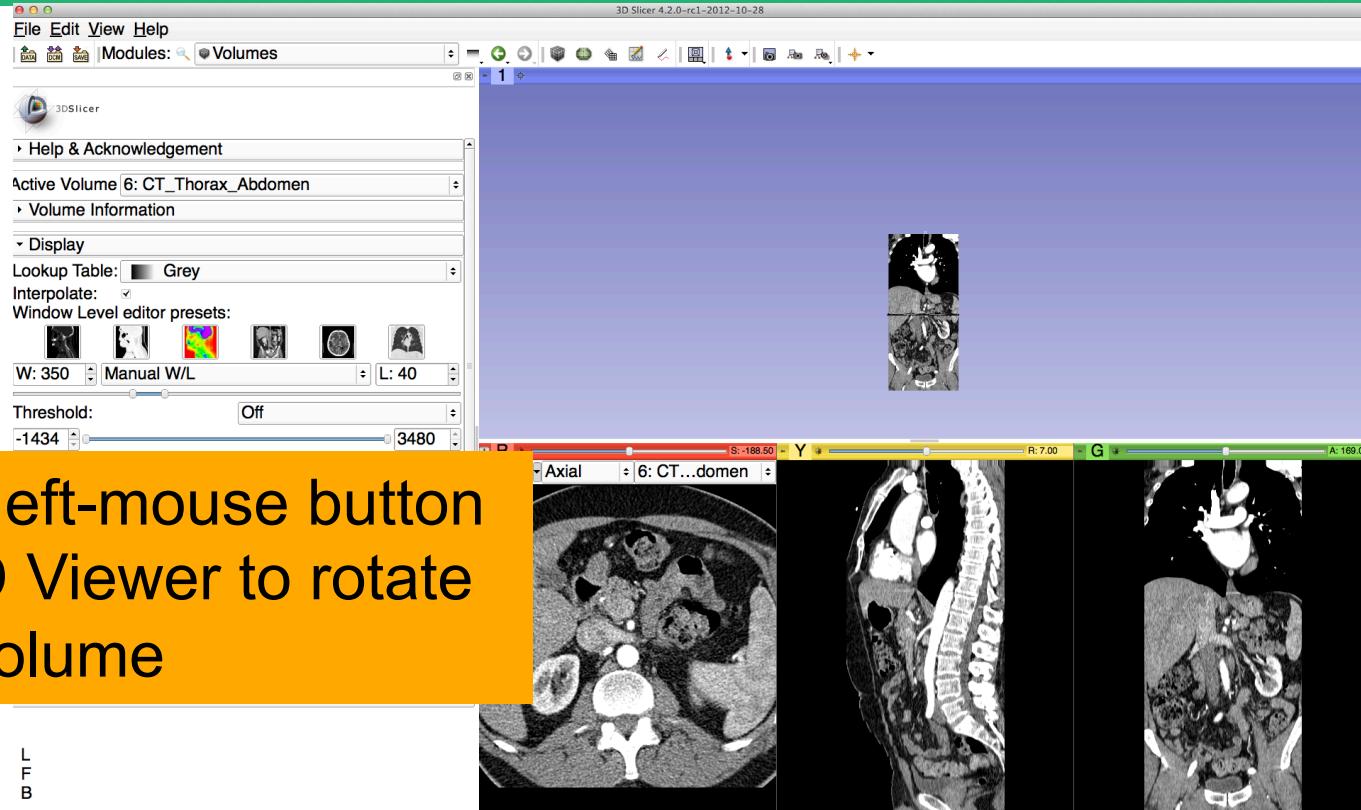


# Loading a DICOM volume



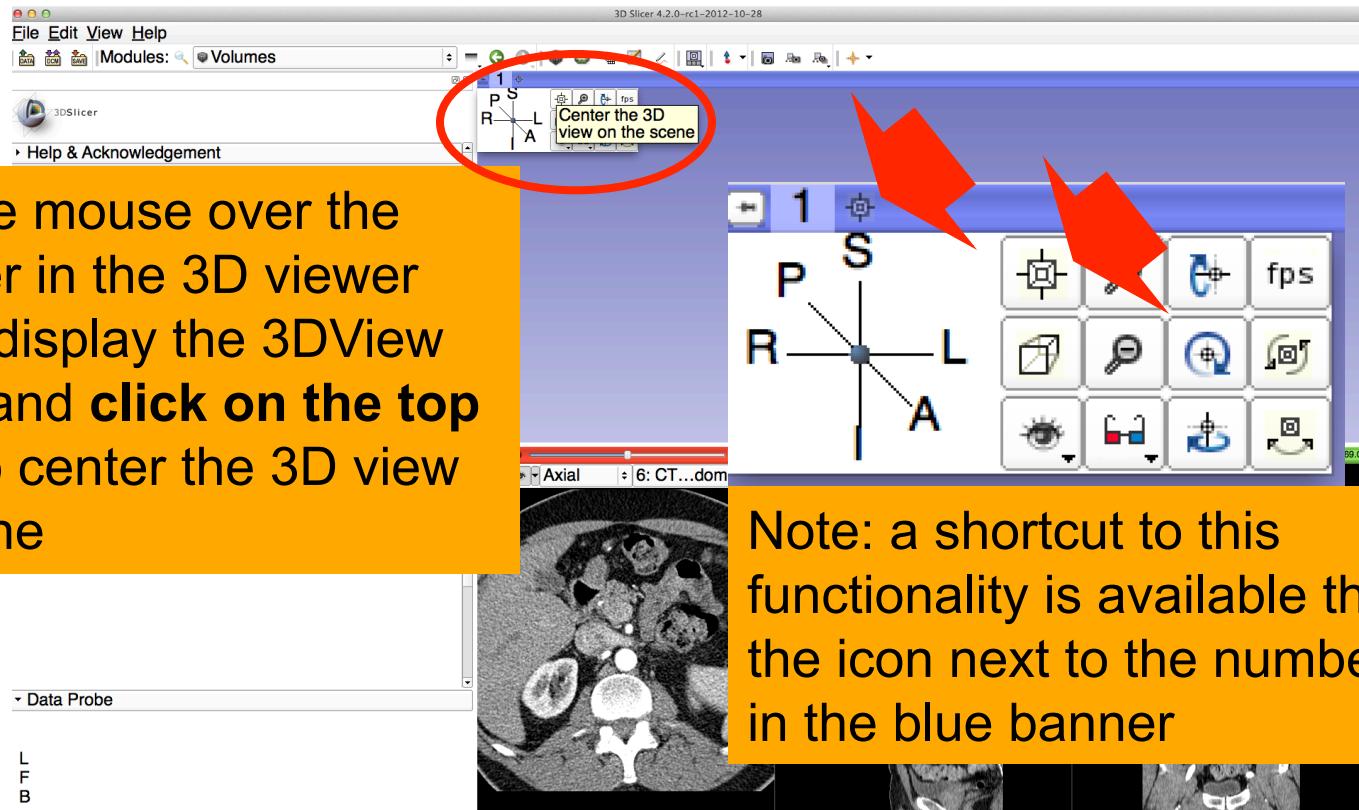
The three anatomical slices appear in the 3D viewer. Use the right-mouse button in the 3D Viewer to zoom in and out

# Loading a DICOM volume



Use the left-mouse button  
in the 3D Viewer to rotate  
the 3D volume

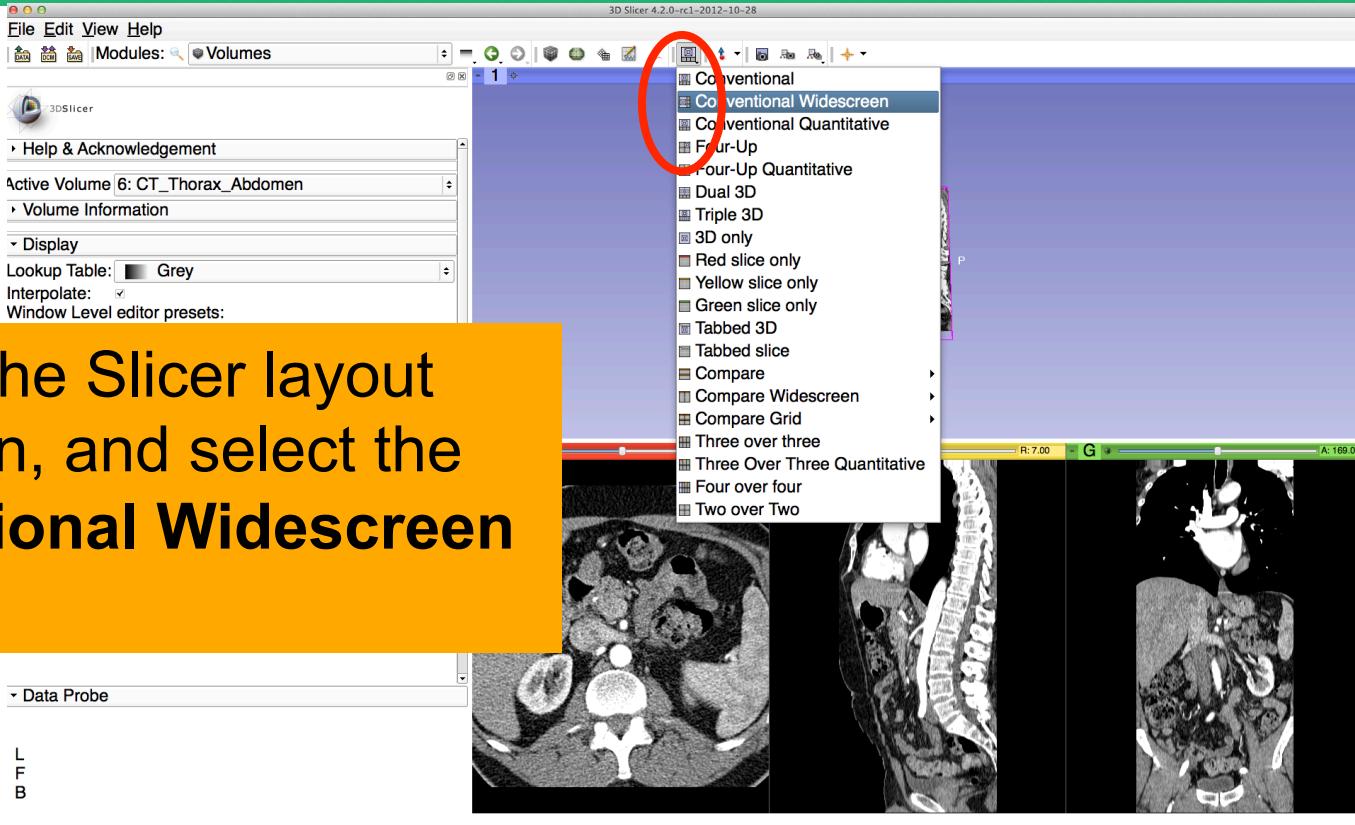
# Loading a DICOM volume



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

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

# Loading a DICOM volume



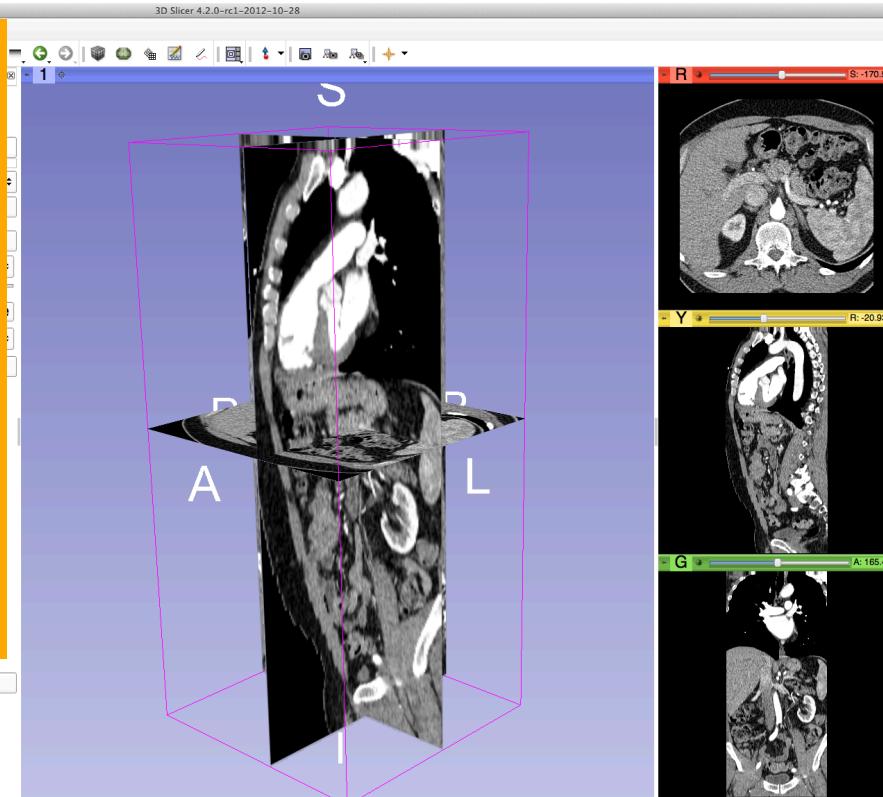
Click on the Slicer layout menu icon, and select the **Conventional Widescreen** layout

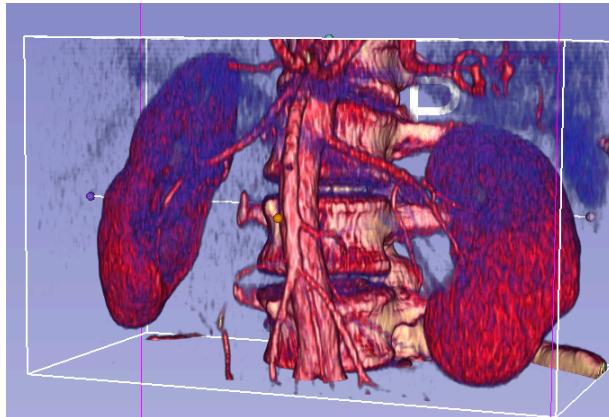
# Loading a DICOM volume

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

▼ Data Probe

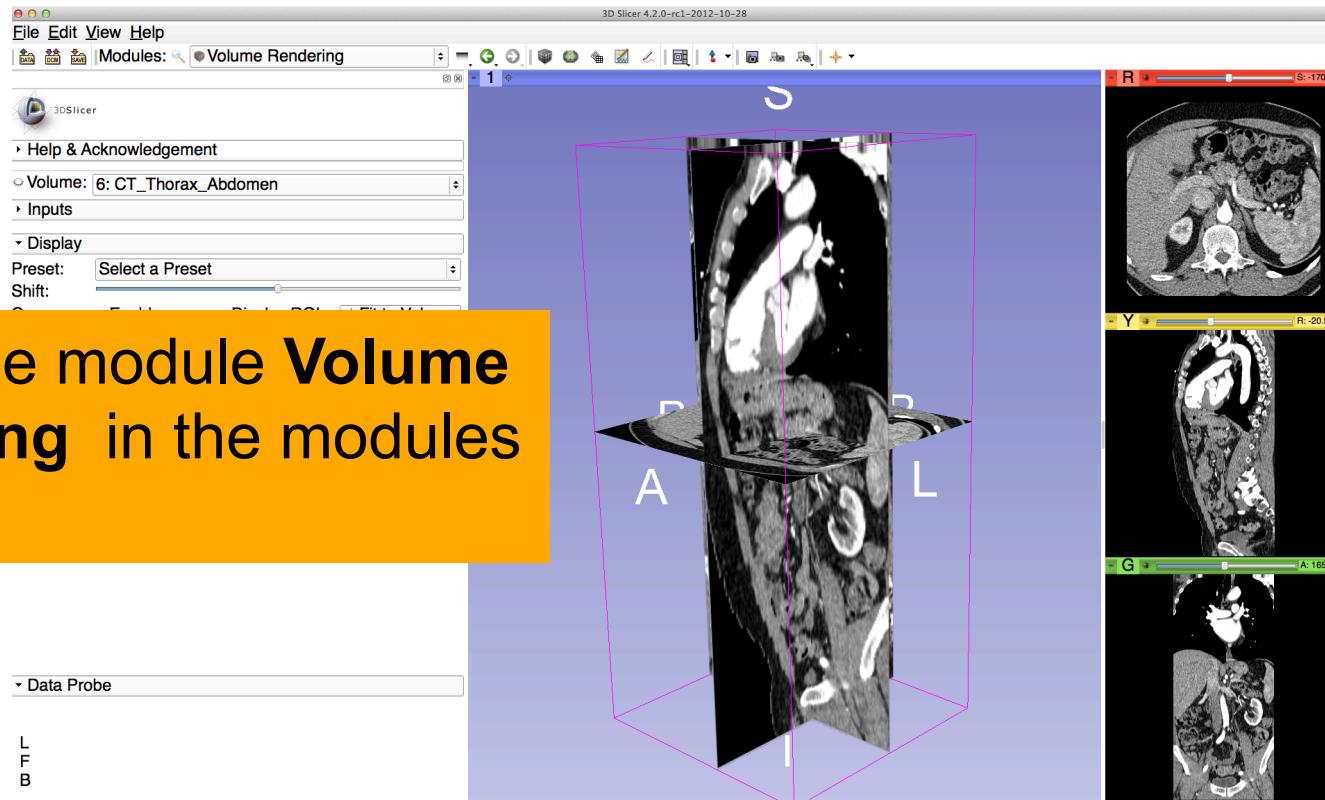
L  
F  
B



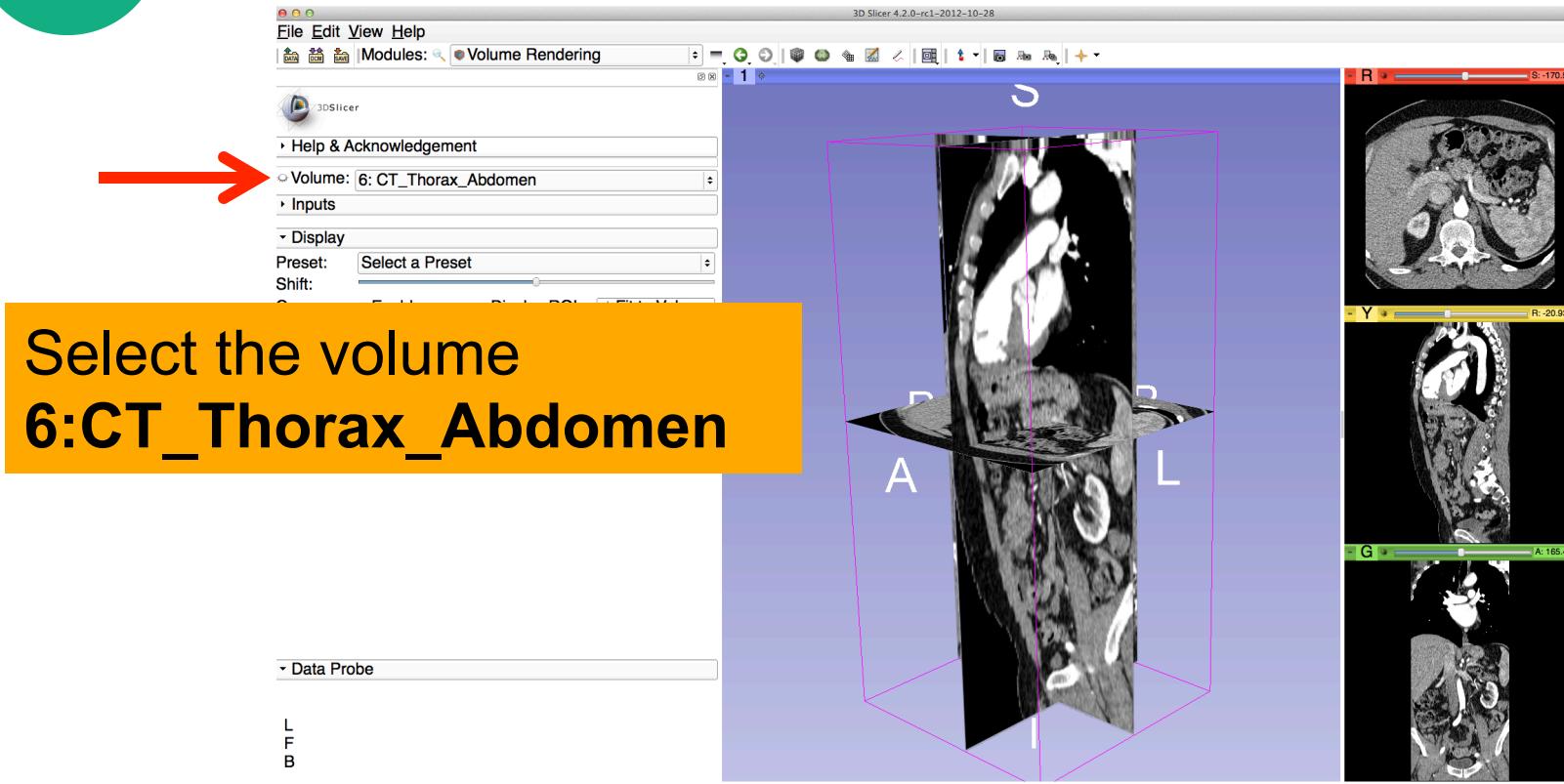


3D Interactive exploration of  
thoraco-abdominal CT data  
using Volume Rendering

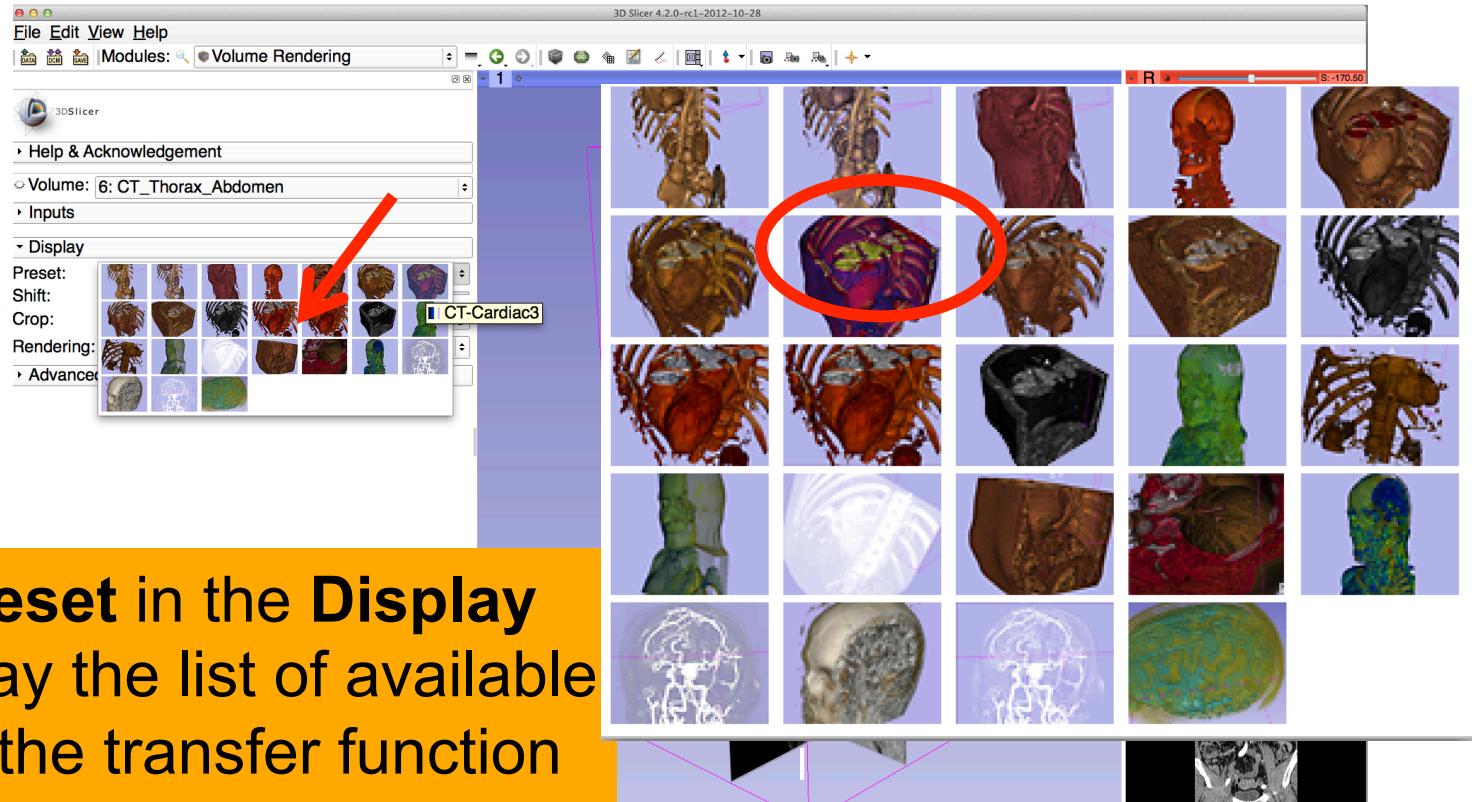
# Volume Rendering



# Volume Rendering



# Volume Rendering



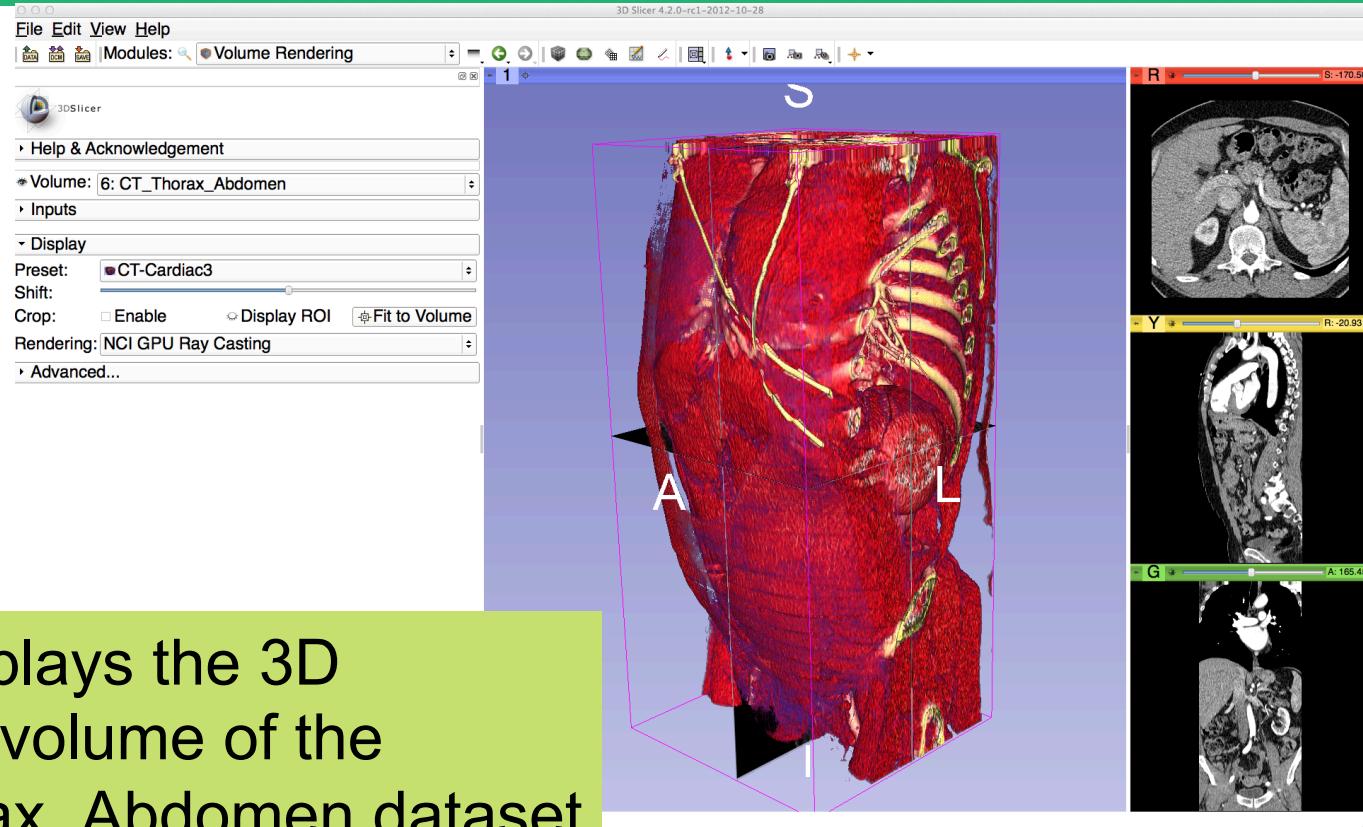
Click on **Preset** in the **Display** tab to display the list of available presets for the transfer function  
Select the Preset **CT-Cardiac3**

# Volume Rendering

The screenshot shows the 3D Slicer interface with the 'Volume Rendering' module selected. On the left, the module-specific controls are visible, including a dropdown for 'Volume' set to '6: CT\_Thorax\_Abdomen', a 'Preset' dropdown set to 'CT-Cardiac3', and a 'Rendering' dropdown set to 'NCI GPU Ray Casting'. A red arrow points from the text below to the 'Rendering' dropdown. Another red arrow points to the 'Display ROI' radio button. The main window displays a 3D volume rendering of a thorax-abdomen dataset, with a pink wireframe bounding box around the central volume. To the right are three 2D axial slices labeled R, Y, and G, corresponding to the Red, Yellow, and Green color axes of the volume rendering.

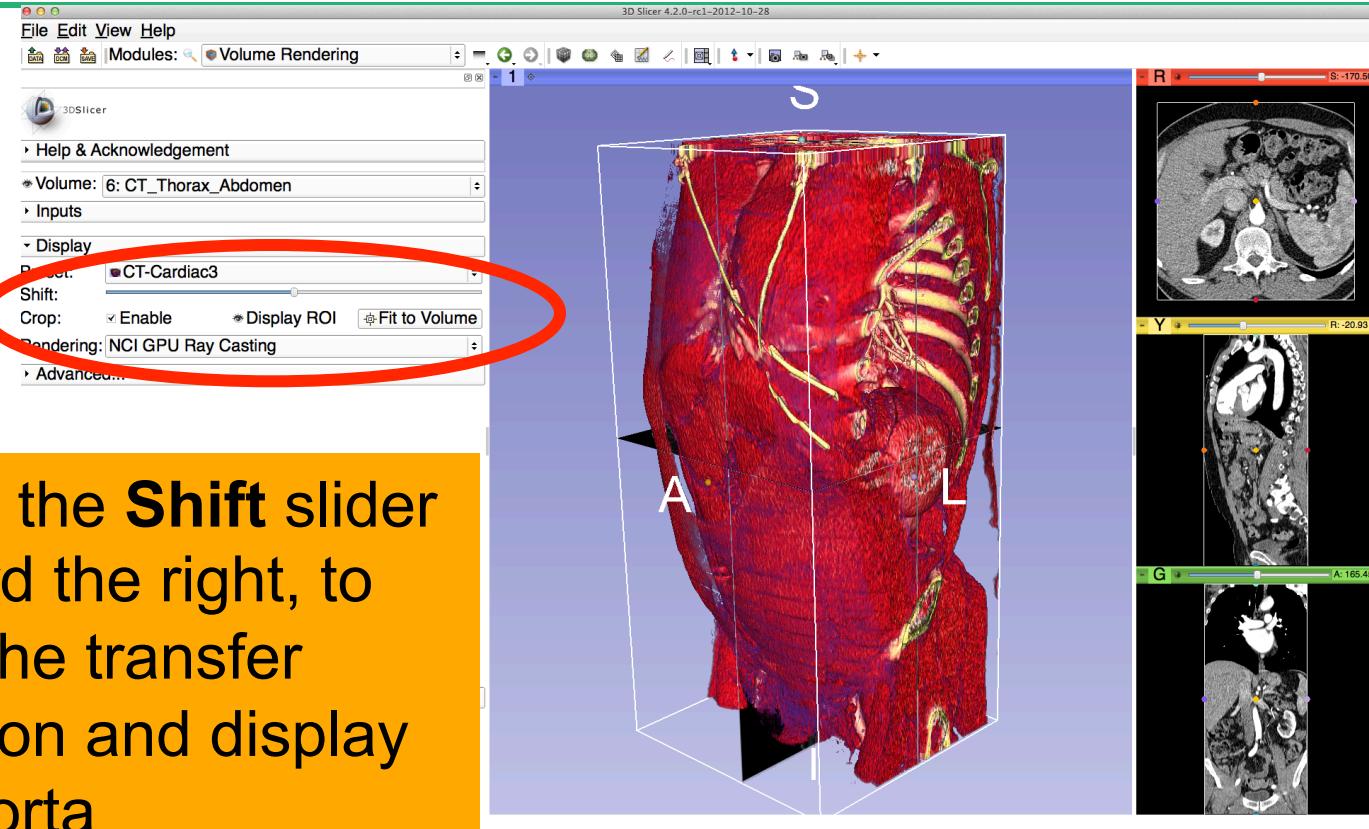
Select the Rendering **VTK CPU Ray Casting**, and click on the eye icon in the **Volume** tab to display the Volume rendered volume in the 3D viewer

# Volume Rendering



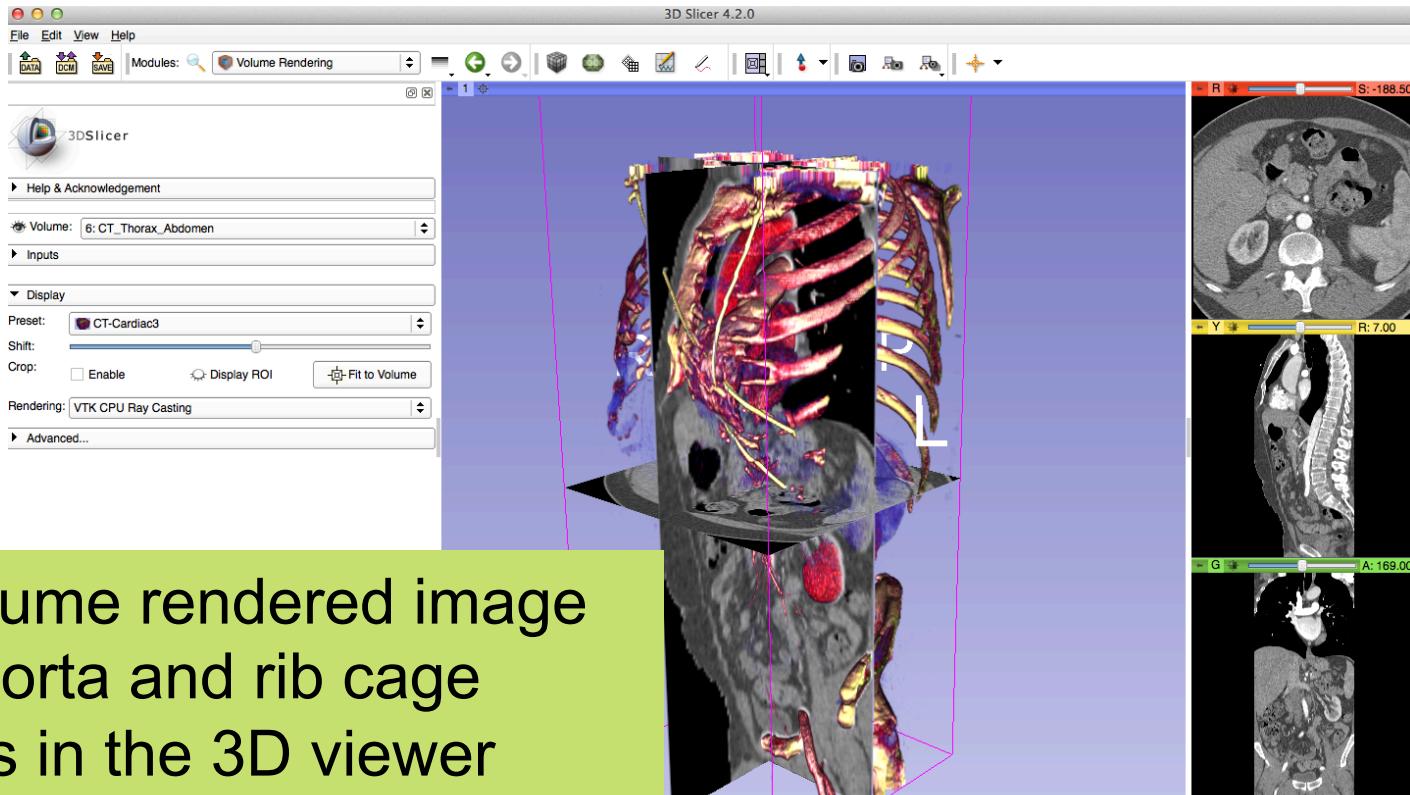
Slicer displays the 3D rendered volume of the CT\_Thorax\_Abdomen dataset

# Volume Rendering



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

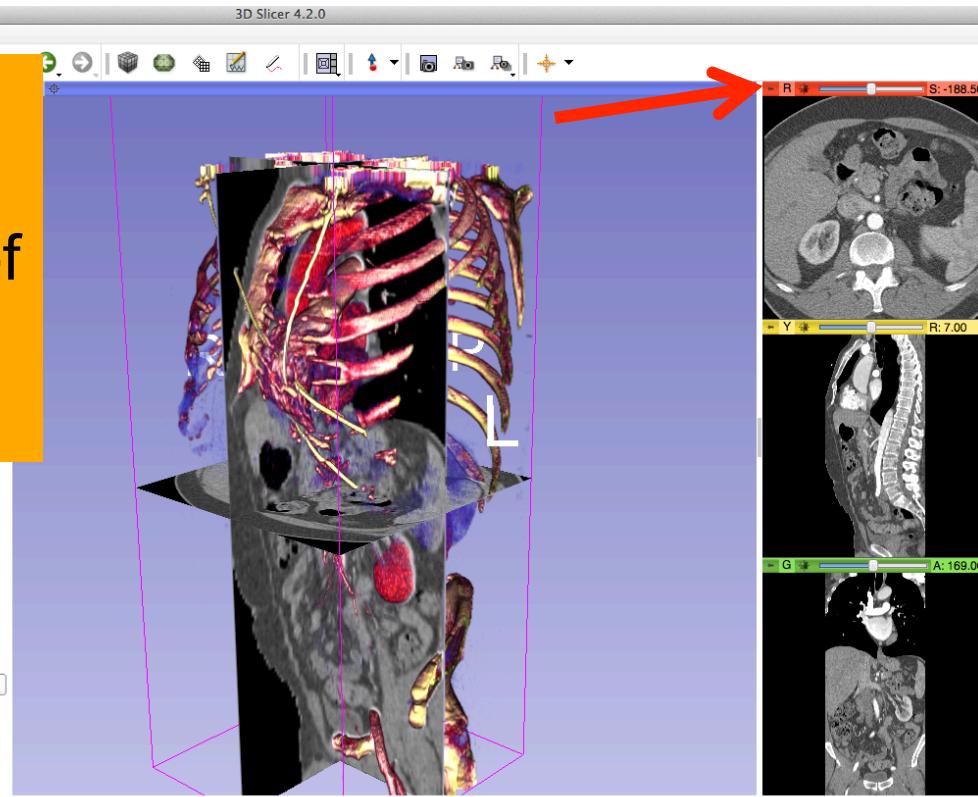
# Volume Rendering



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

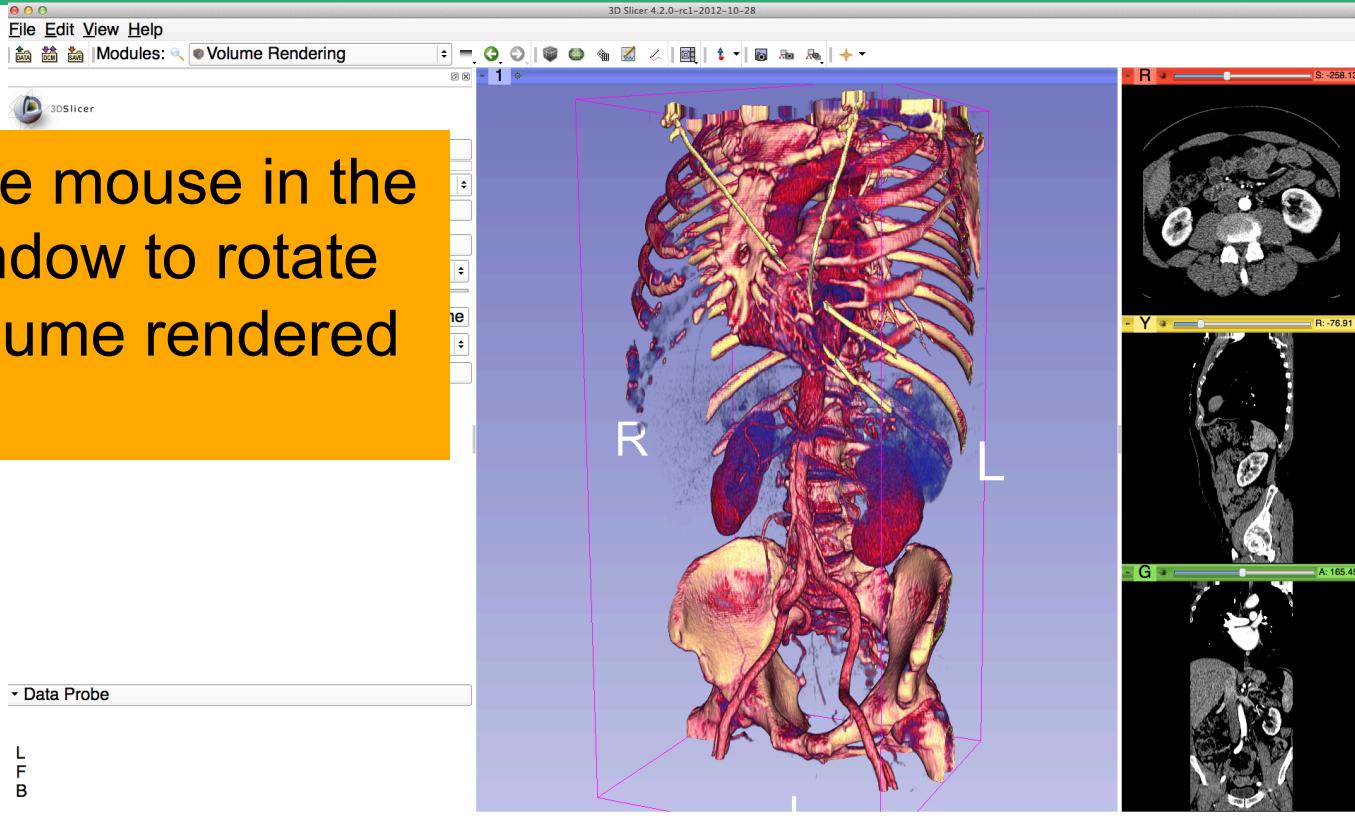
# Volume Rendering

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

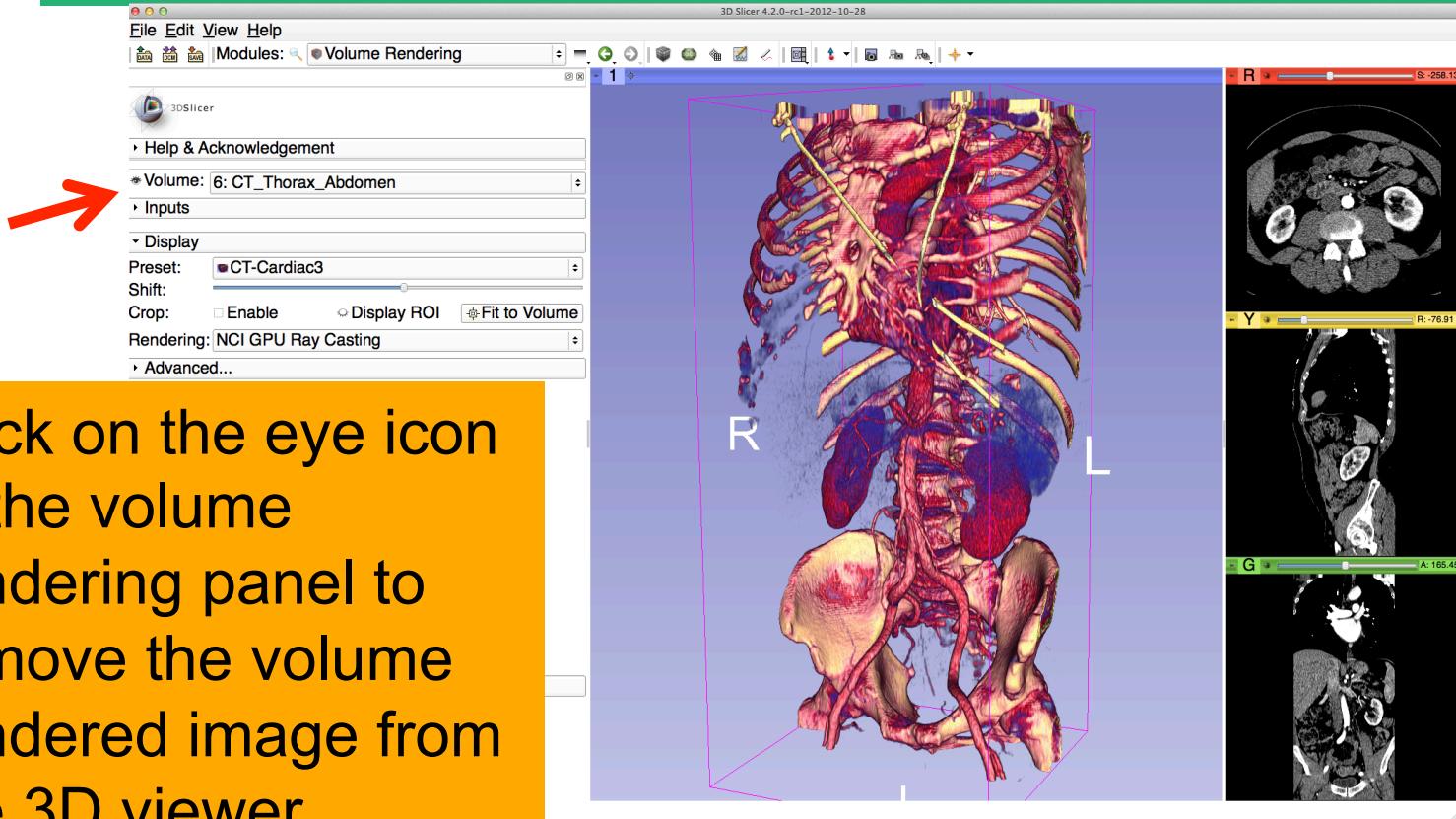


# Volume Rendering

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

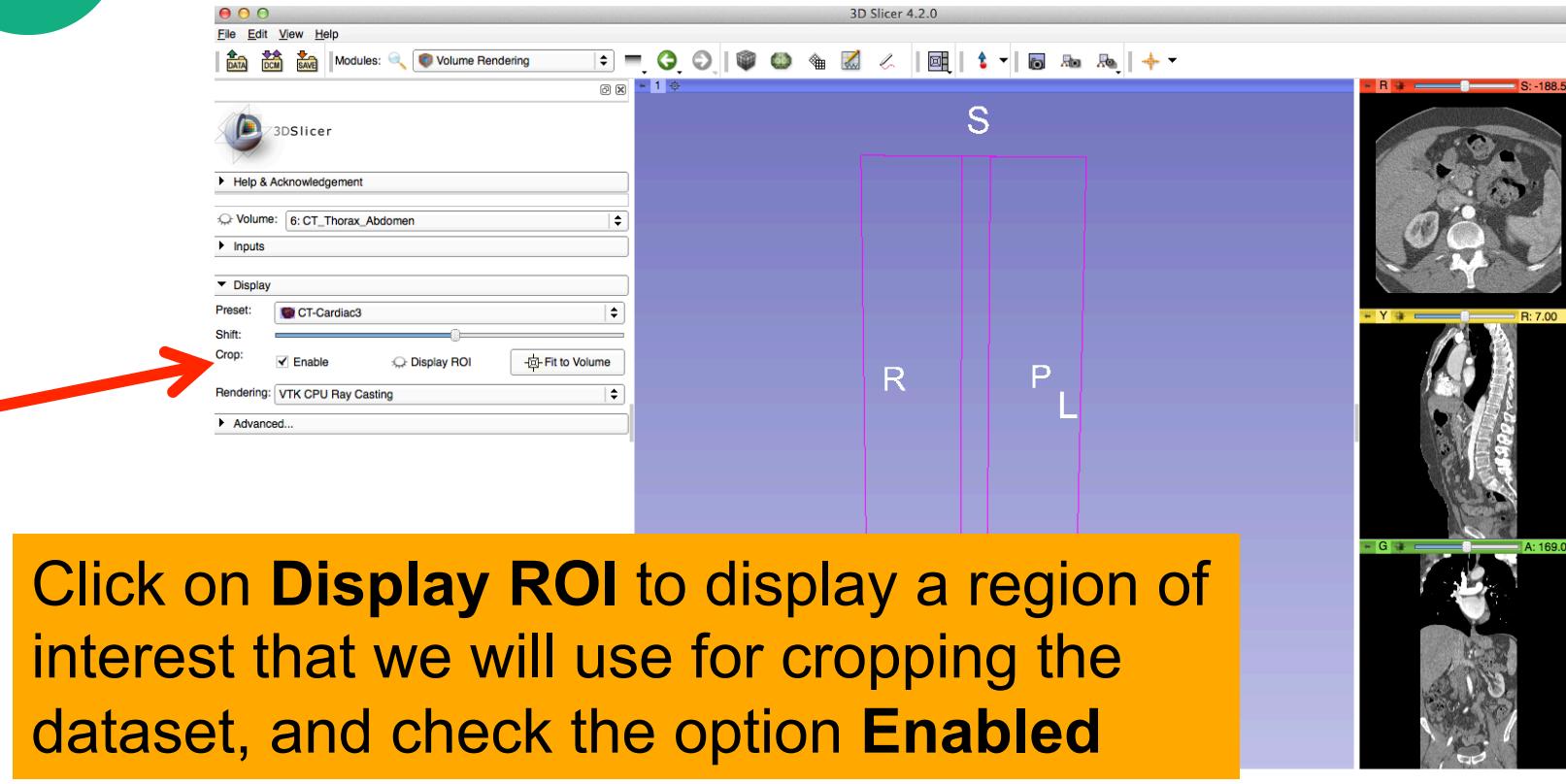


# Volume Rendering



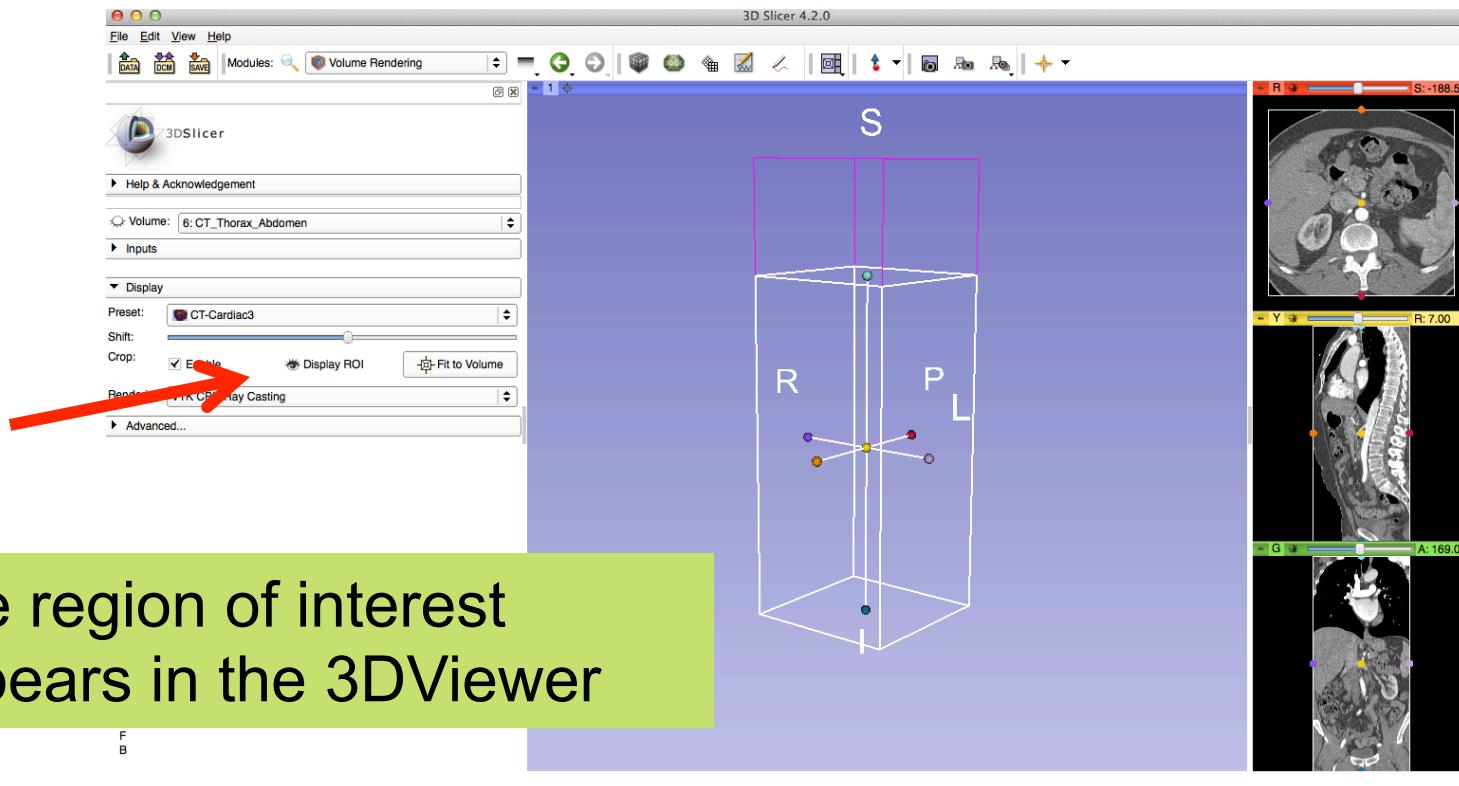
Click on the eye icon  
in the volume  
rendering panel to  
remove the volume  
rendered image from  
the 3D viewer

# Volume Rendering

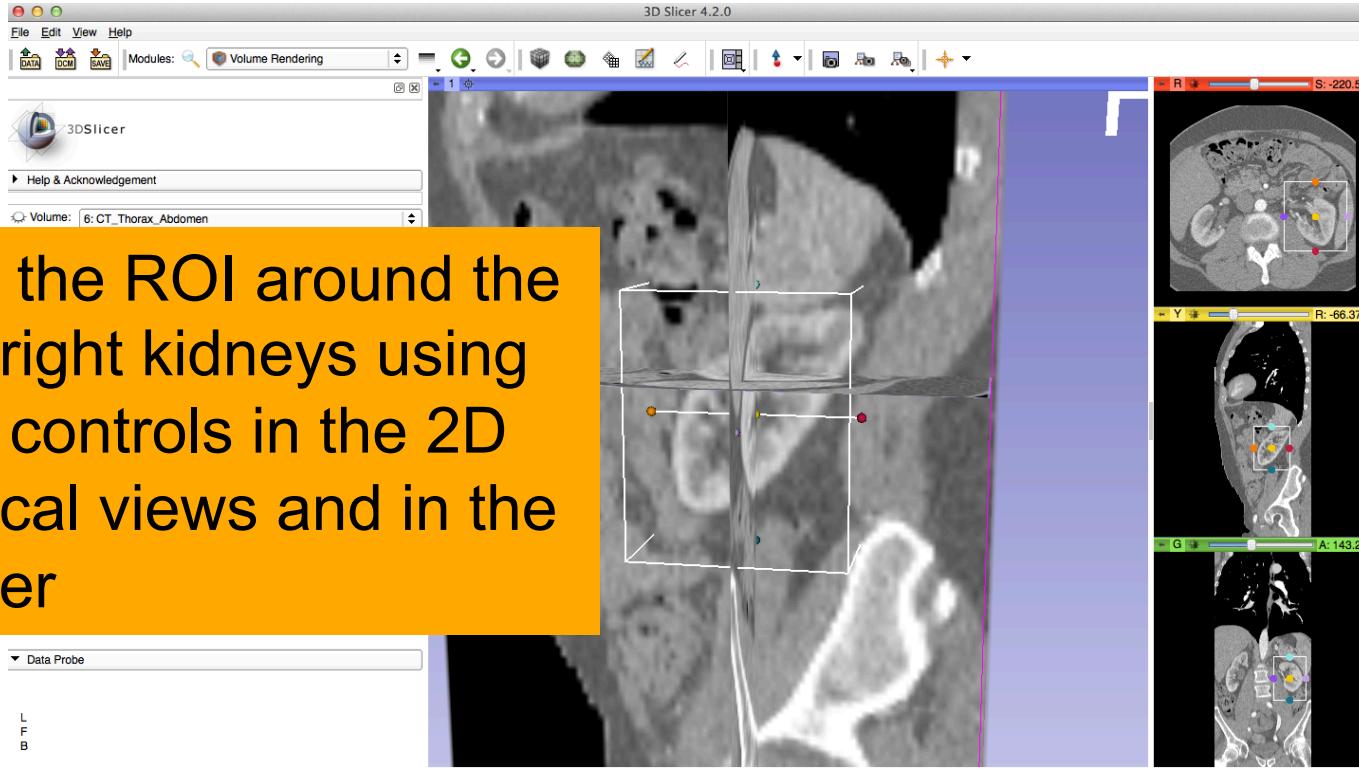


Click on **Display ROI** to display a region of interest that we will use for cropping the dataset, and check the option **Enabled**

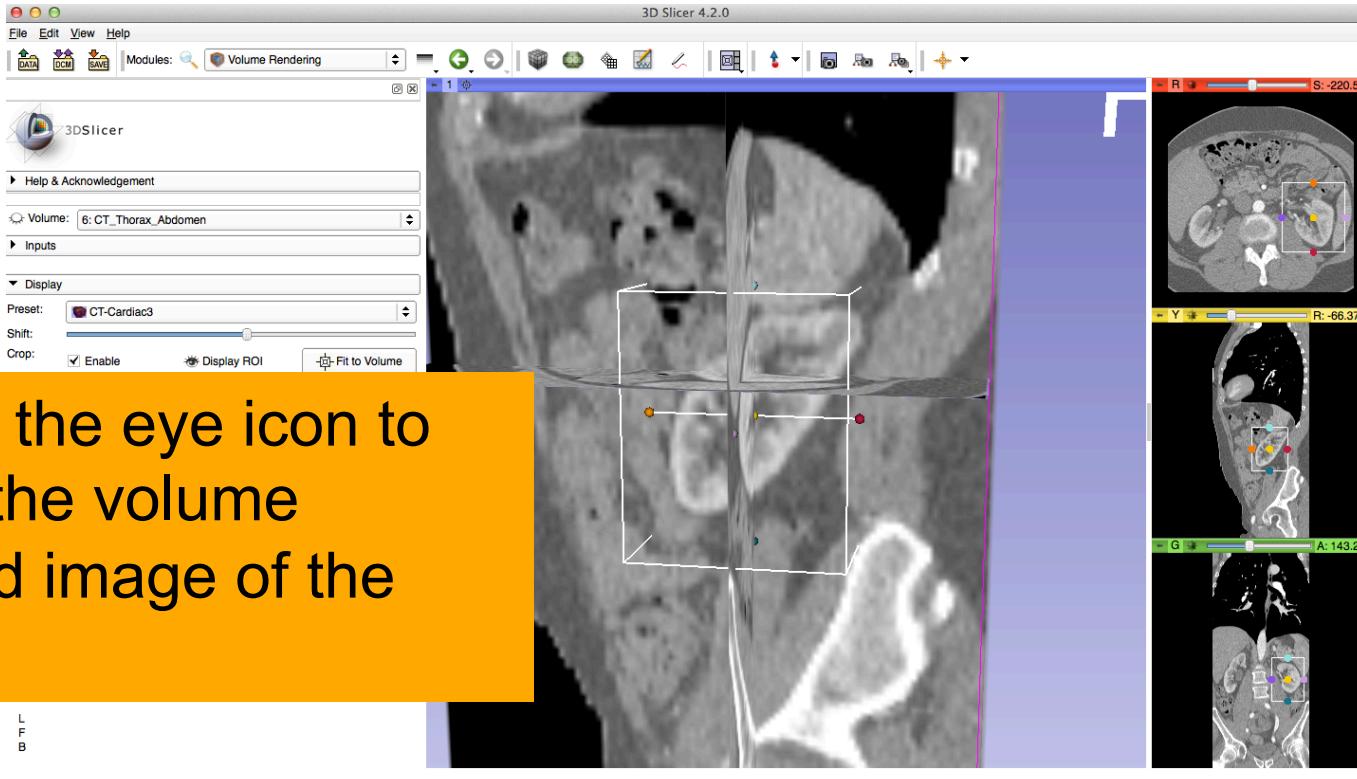
# Volume Rendering



# Volume Rendering



# Volume Rendering



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

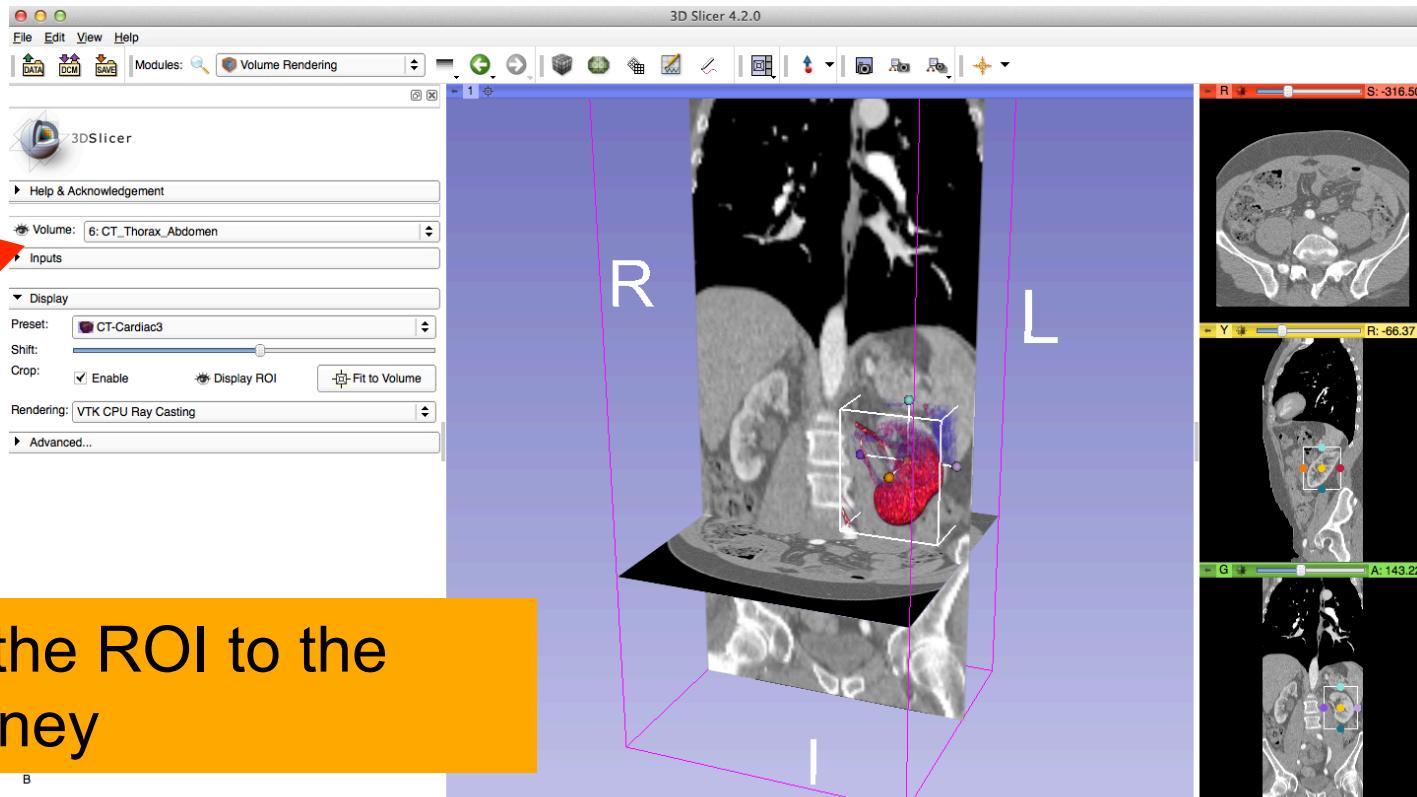
L  
F  
B

# Volume Rendering



Slicer displays the volume rendered image of the left kidney

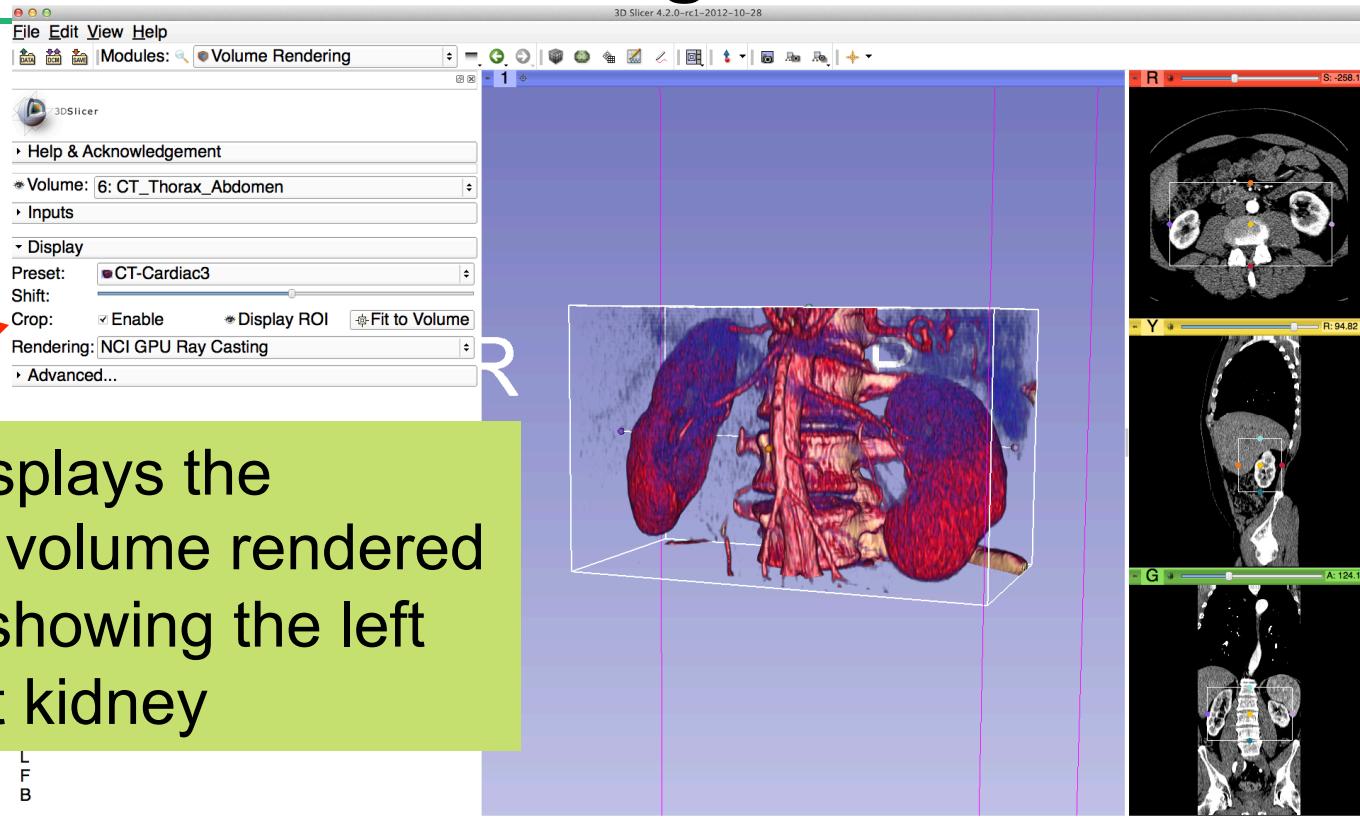
# Volume Rendering



Extend the ROI to the  
right kidney

B

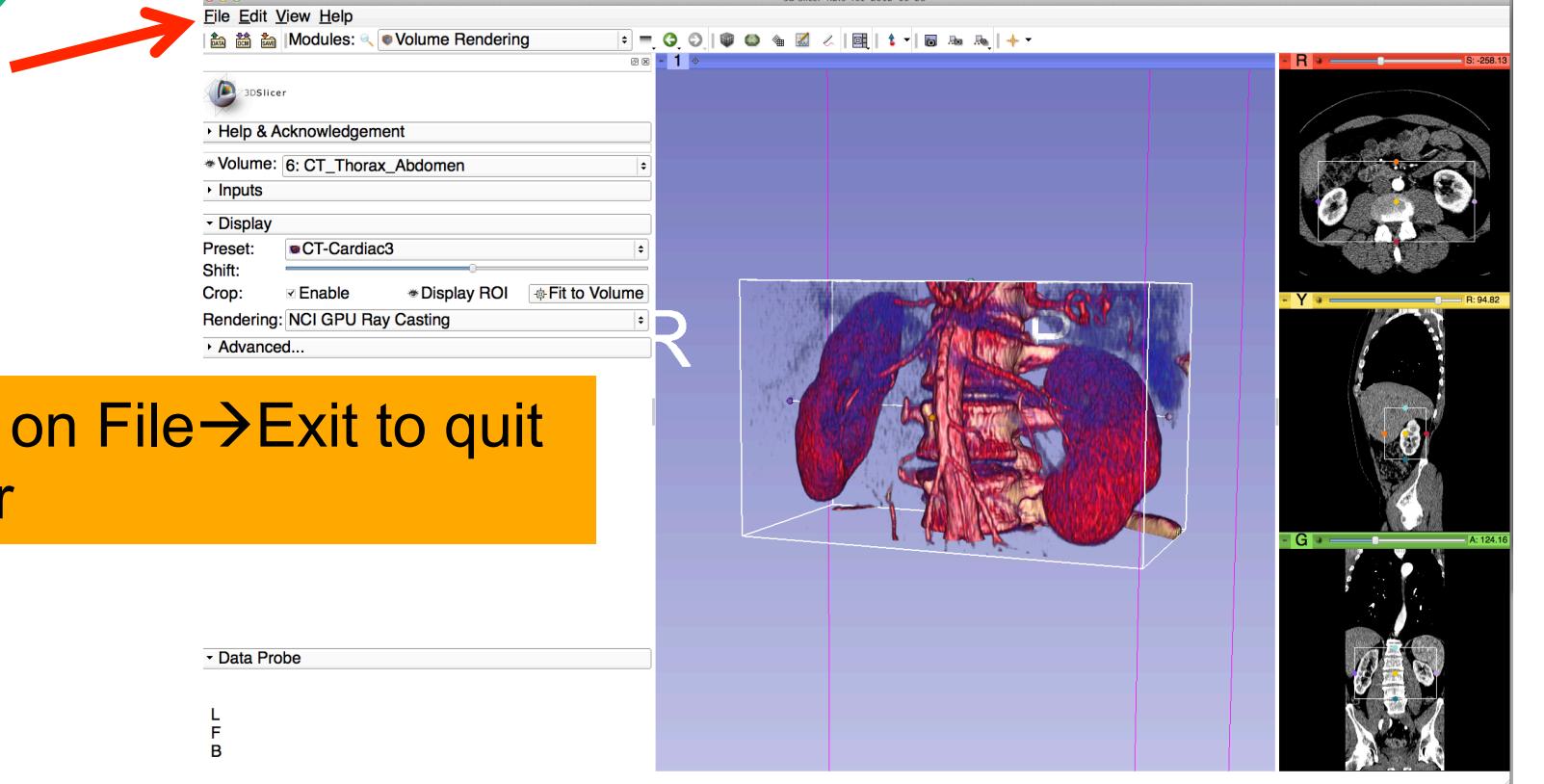
# Volume Rendering



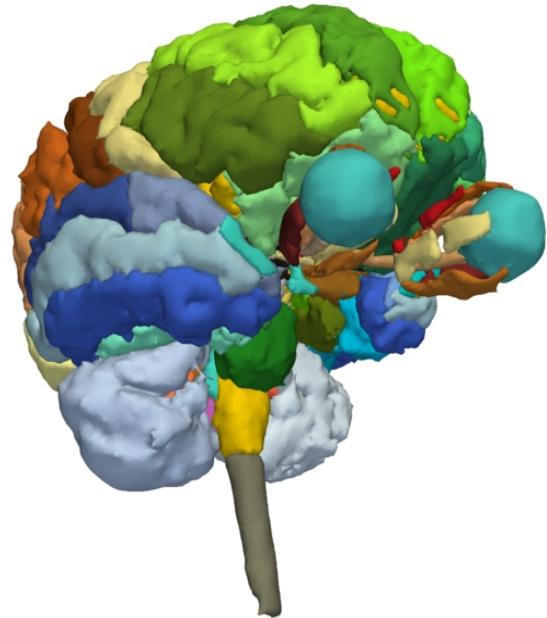
Slicer displays the cropped volume rendered images showing the left and right kidney

L  
F  
B

# Volume Rendering

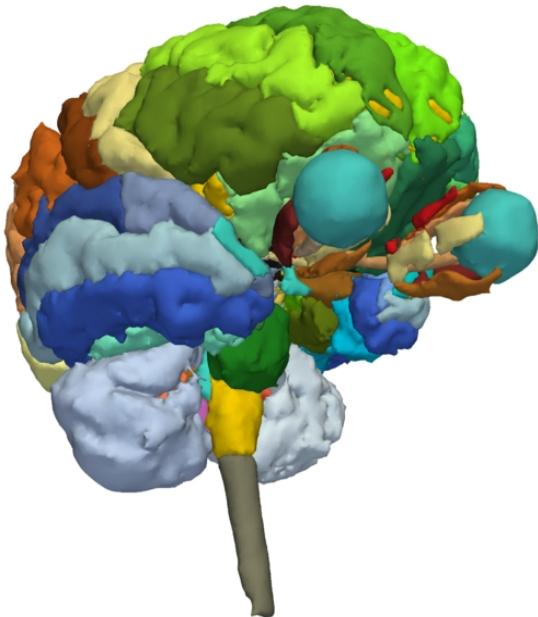


Click on File→Exit to quit  
Slicer



3D visualization of surface  
models of the brain

# 3D Data Loading and Visualization



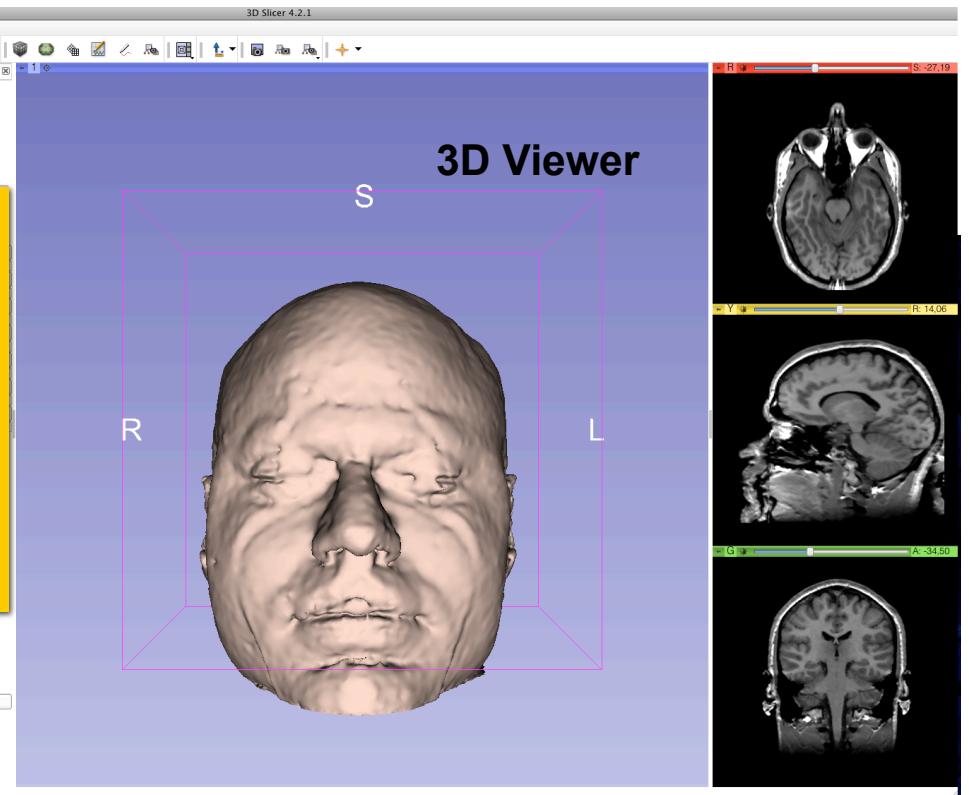
- This tutorial is a short introduction to the advanced **3D visualization capabilities Slicer**
- The Slicer4 Minute dataset is composed of an MR scan of the brain and 3D surface reconstructions of anatomical structures.
- The data are part of the SPL-PNL Brain Atlas developed by Talos, Jakab, Kikinis *et al.* The atlas is available at:

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

# Slicer4 Minute Tutorial: Viewing the Scene

When the scene is finished loading, Slicer displays:

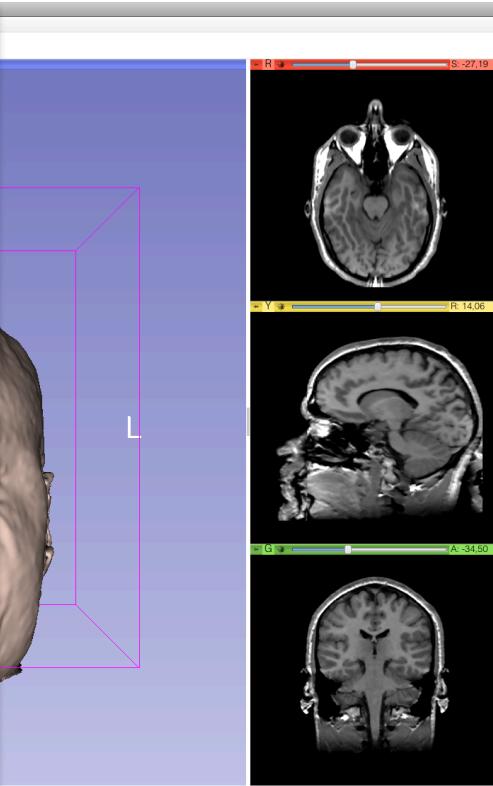
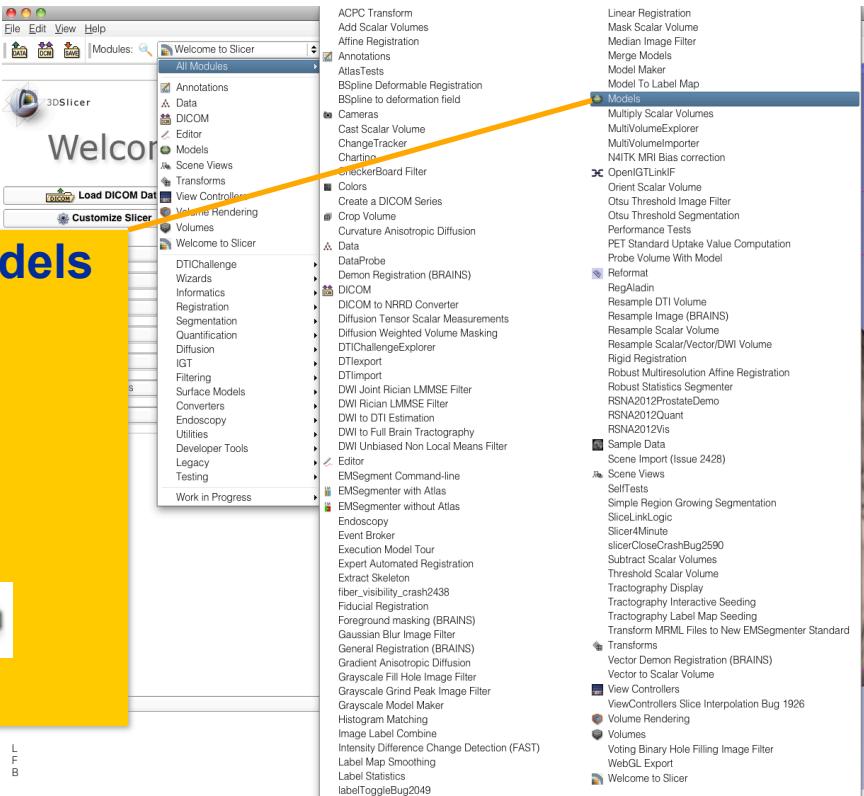
- a **3D model of the head** in the **3D Viewer**, and
- anatomical **MR slices of the brain** in the **2D Slice Viewers**.



# Slicer4 Minute Tutorial: Exploring Slicer's functionality

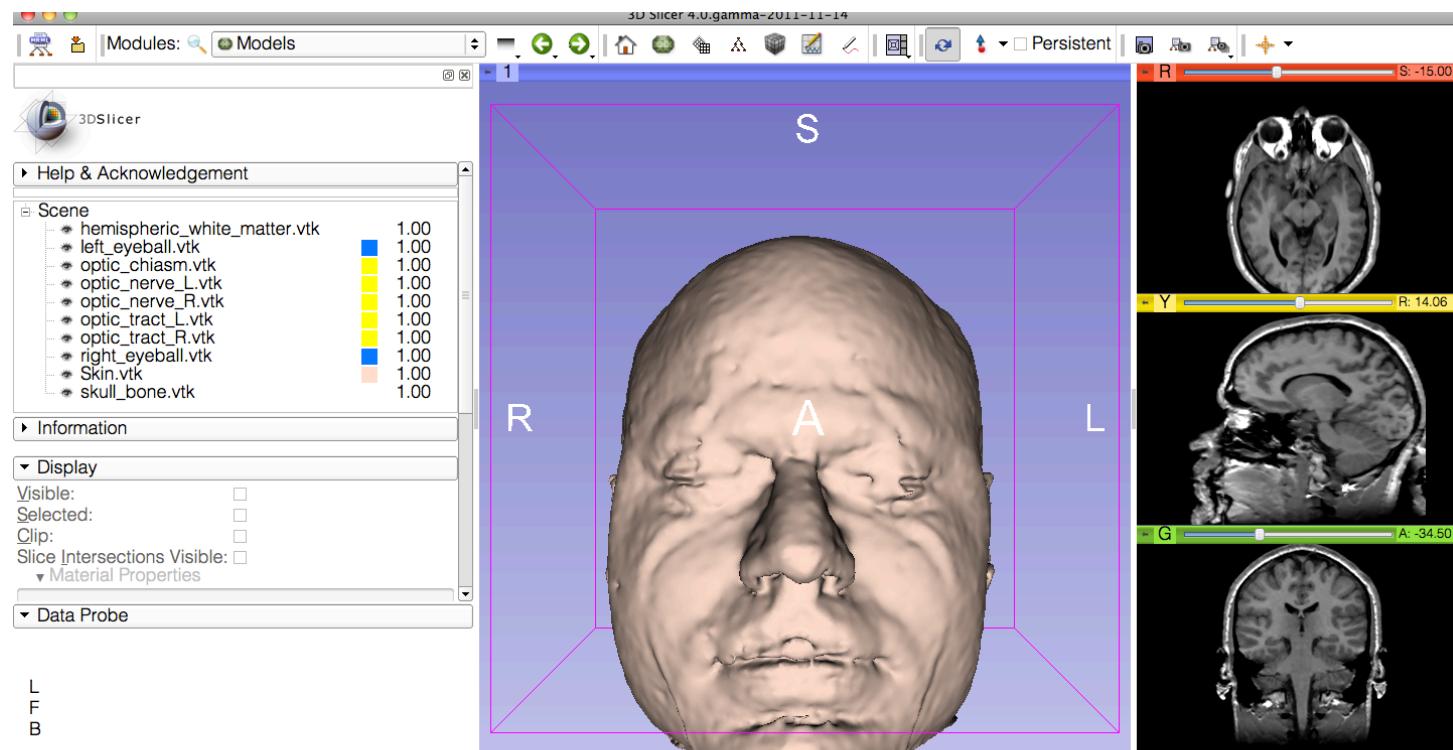
To access the **Models** module, browse through the list of modules...

...or click on the **models** icon in the toolbar

L  
F  
B



# Slicer4 Minute Tutorial: Switching to the Models Module

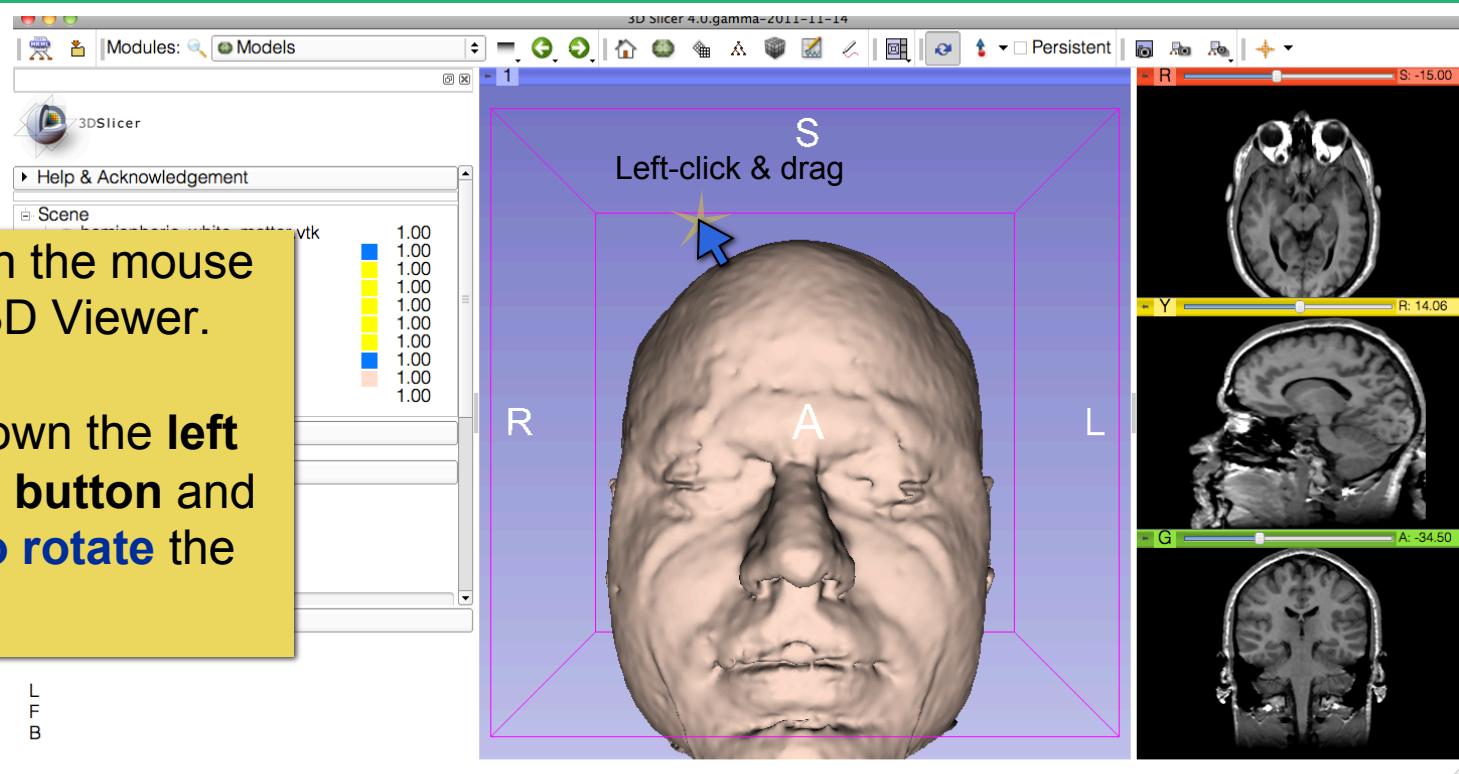




# Slicer4 Minute Tutorial: Basic 3D Interaction

Position the mouse  
in the 3D Viewer.

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

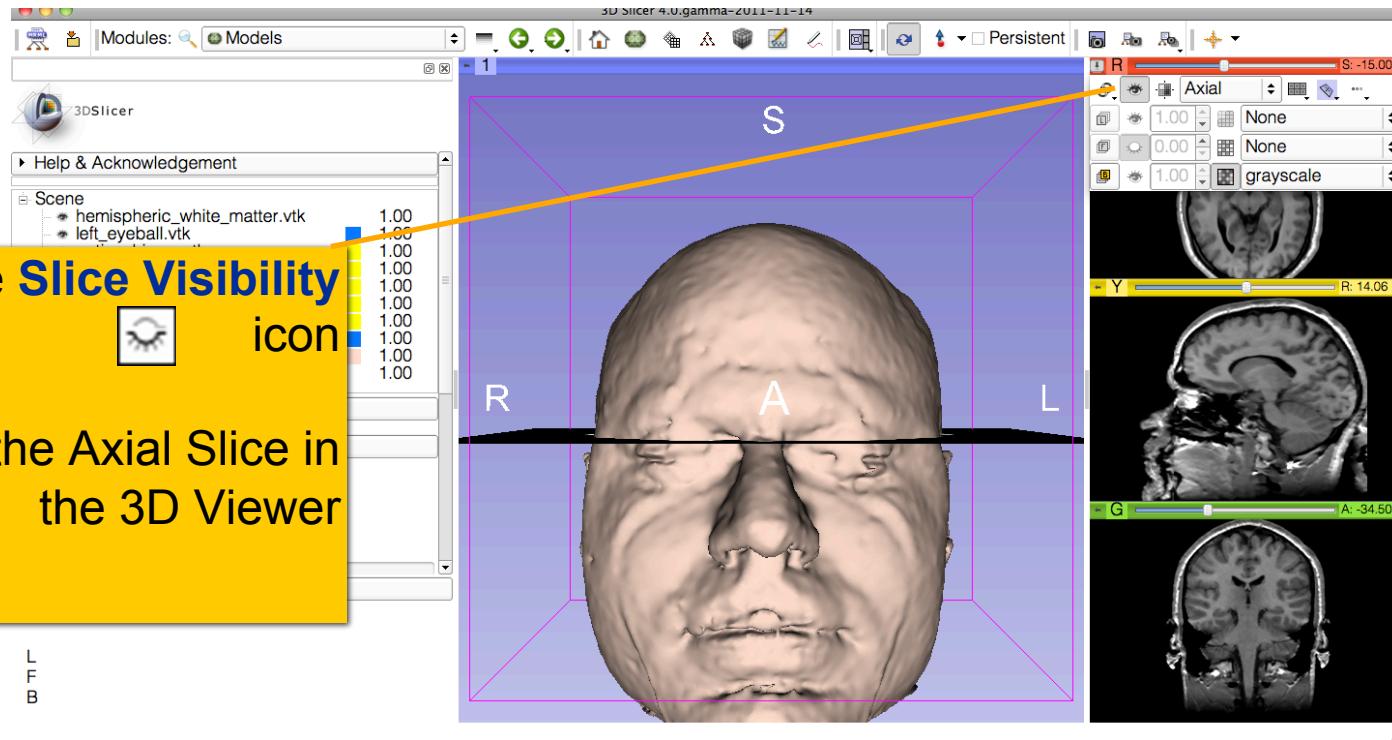


L  
F  
B



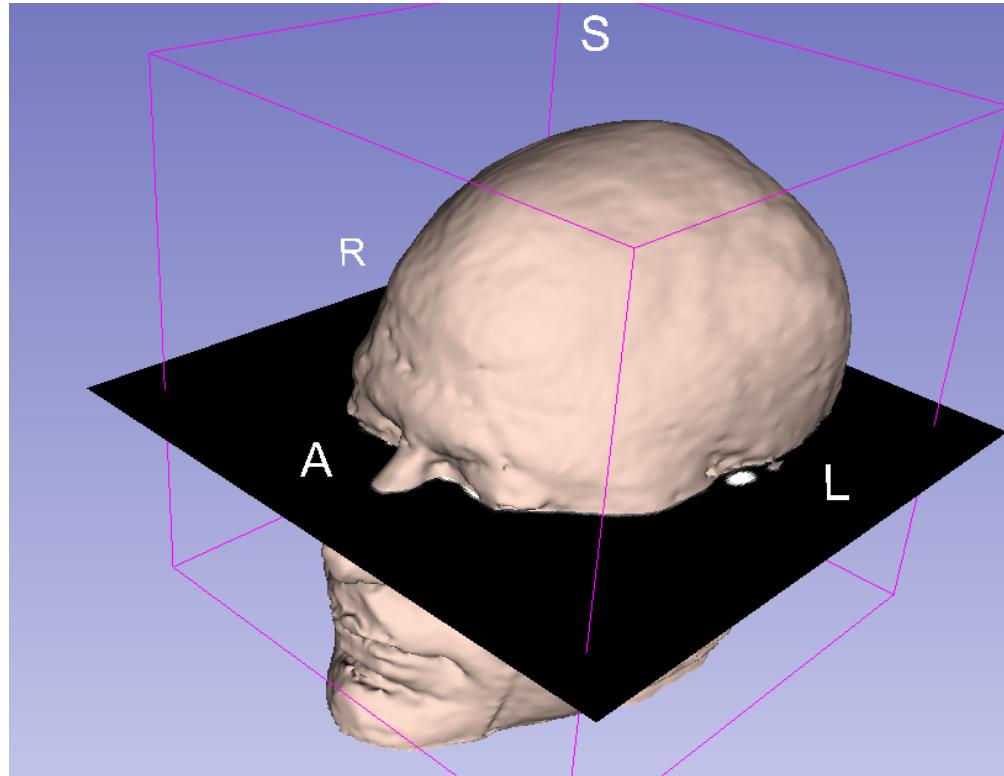
# Slicer4 Minute Tutorial: Viewing Slices in the 3D Viewer

Click on the **Slice Visibility** icon  
to display the Axial Slice in  
the 3D Viewer



# Slicer4 Minute Tutorial: 3D Visualization

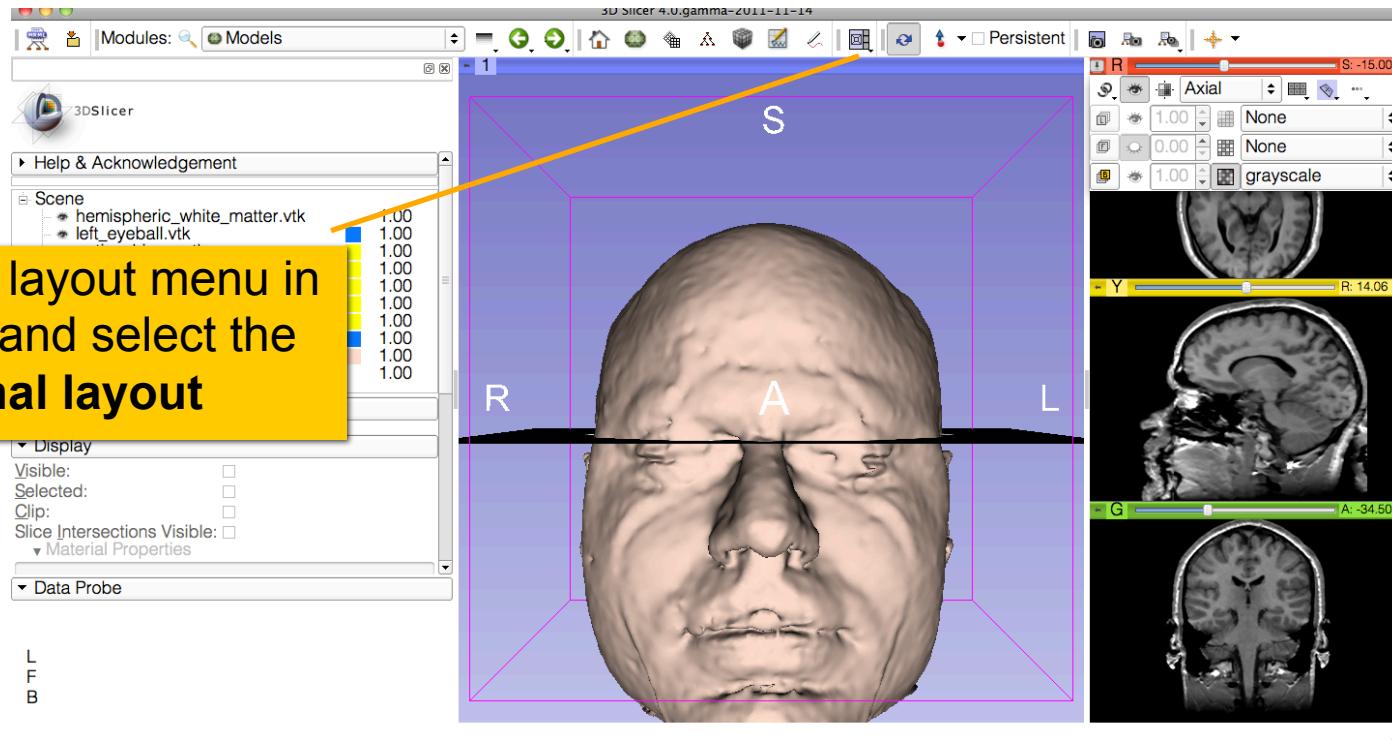
Slicer adds a view of the **Axial slice** in the 3D View.





# Slicer4 Minute Tutorial: Viewing Slices in the 3D Viewer

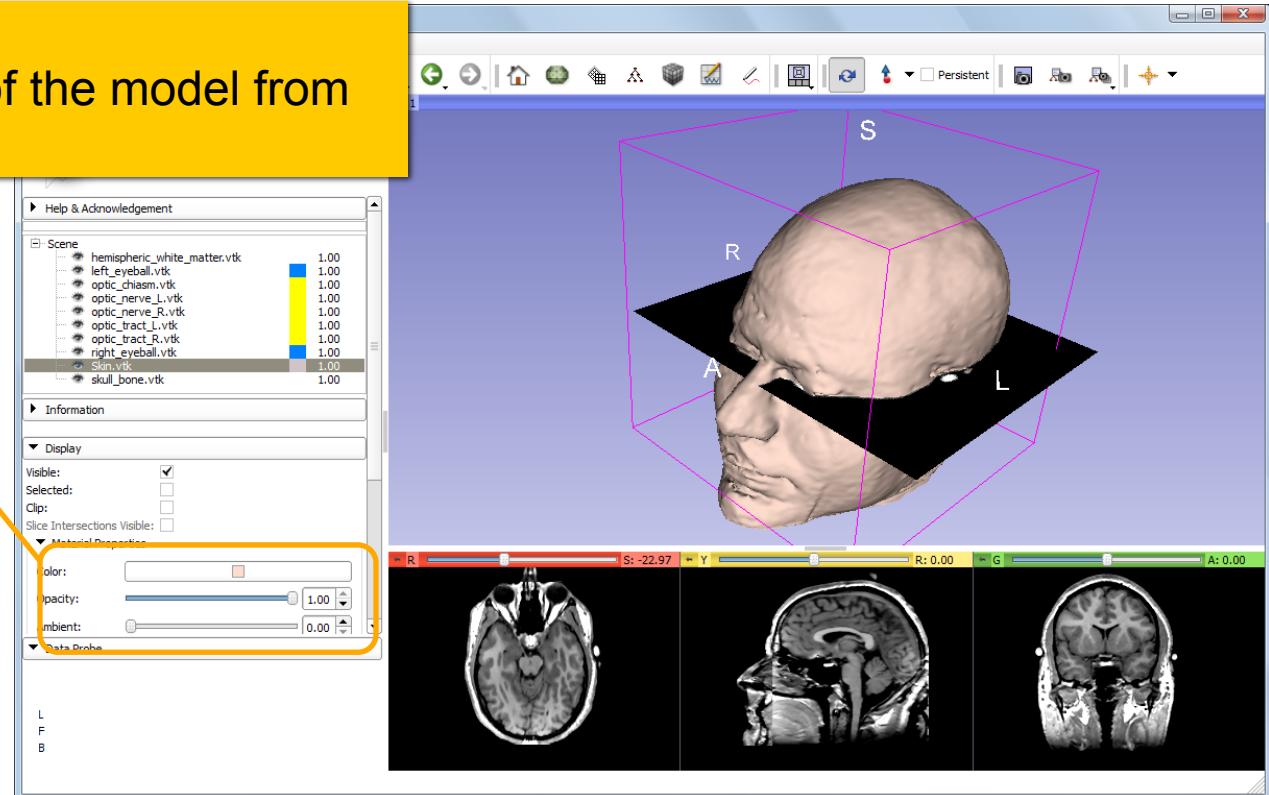
Click on the layout menu in the toolbar, and select the **Conventional layout**



# Slicer4 Minute Tutorial: 3D Visualization

Select the **Skin.vtk**

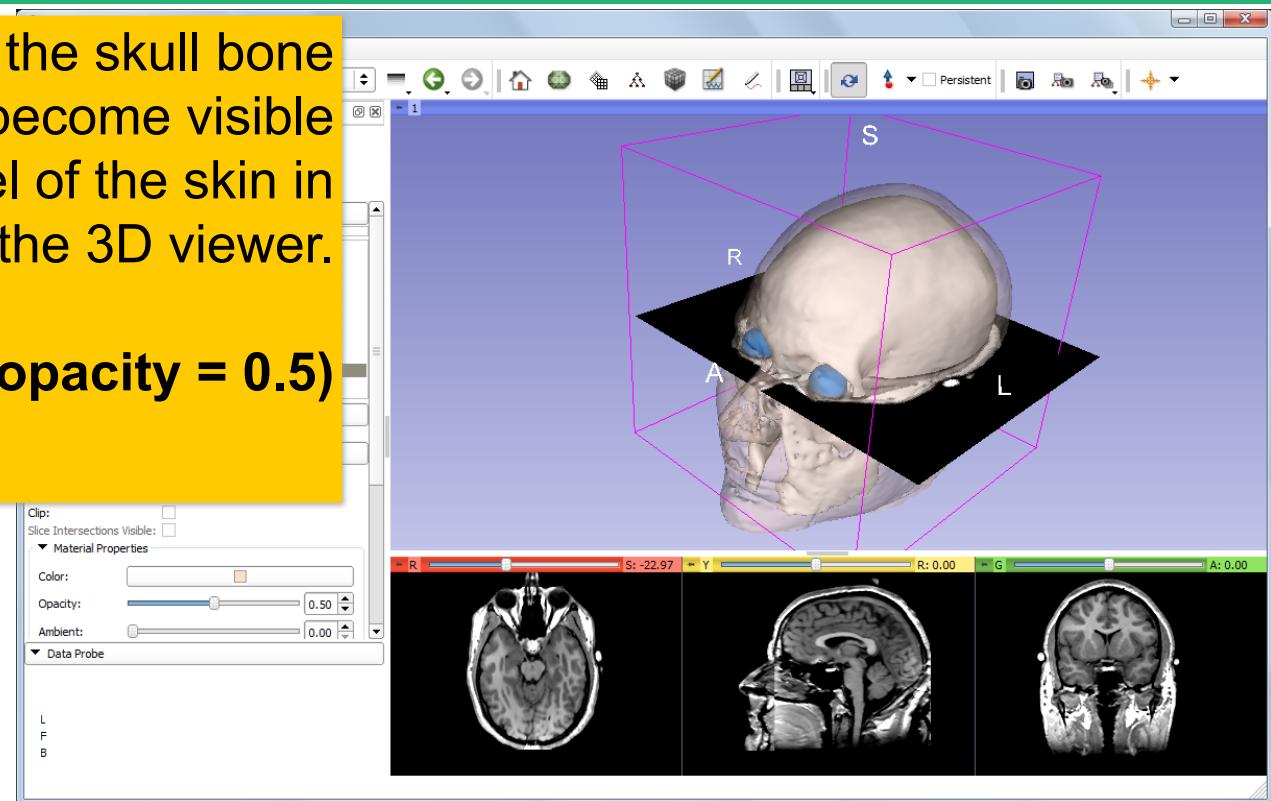
Change the opacity of the model from  
**1.0** to **0.0**.



# Slicer4 Minute Tutorial: 3D Visualization

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

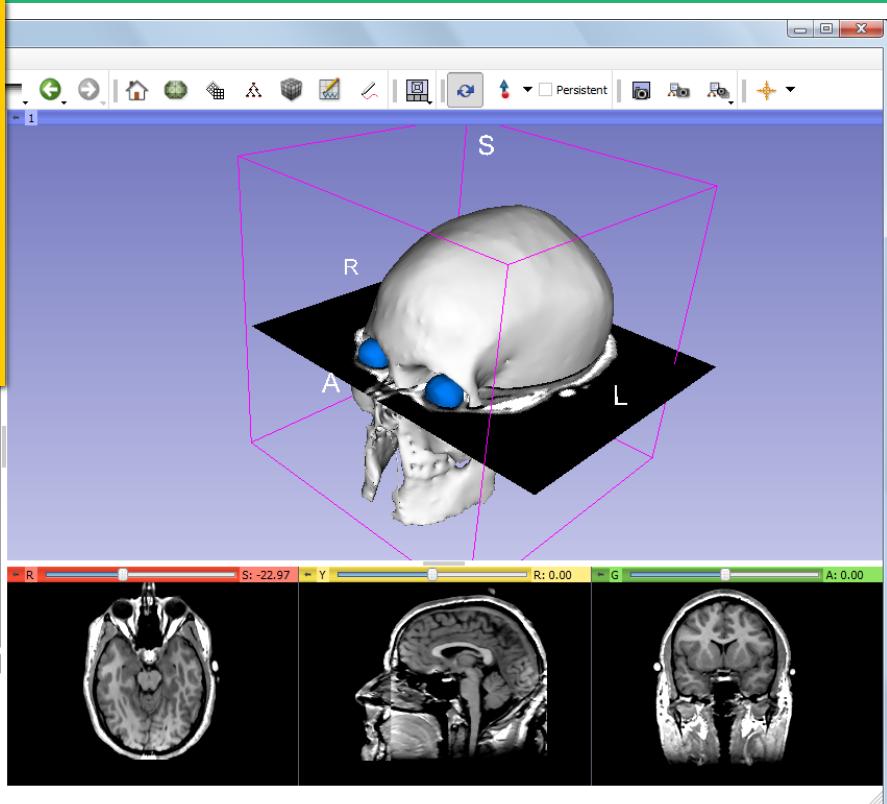
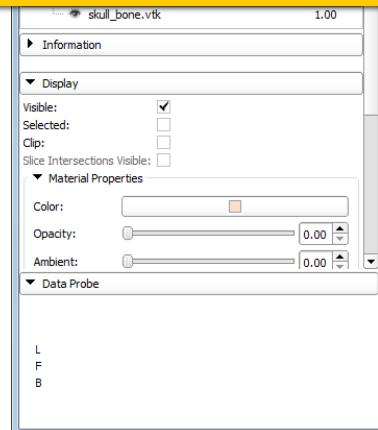
**(skin model opacity = 0.5)**



# Slicer4 Minute Tutorial: 3D Visualization

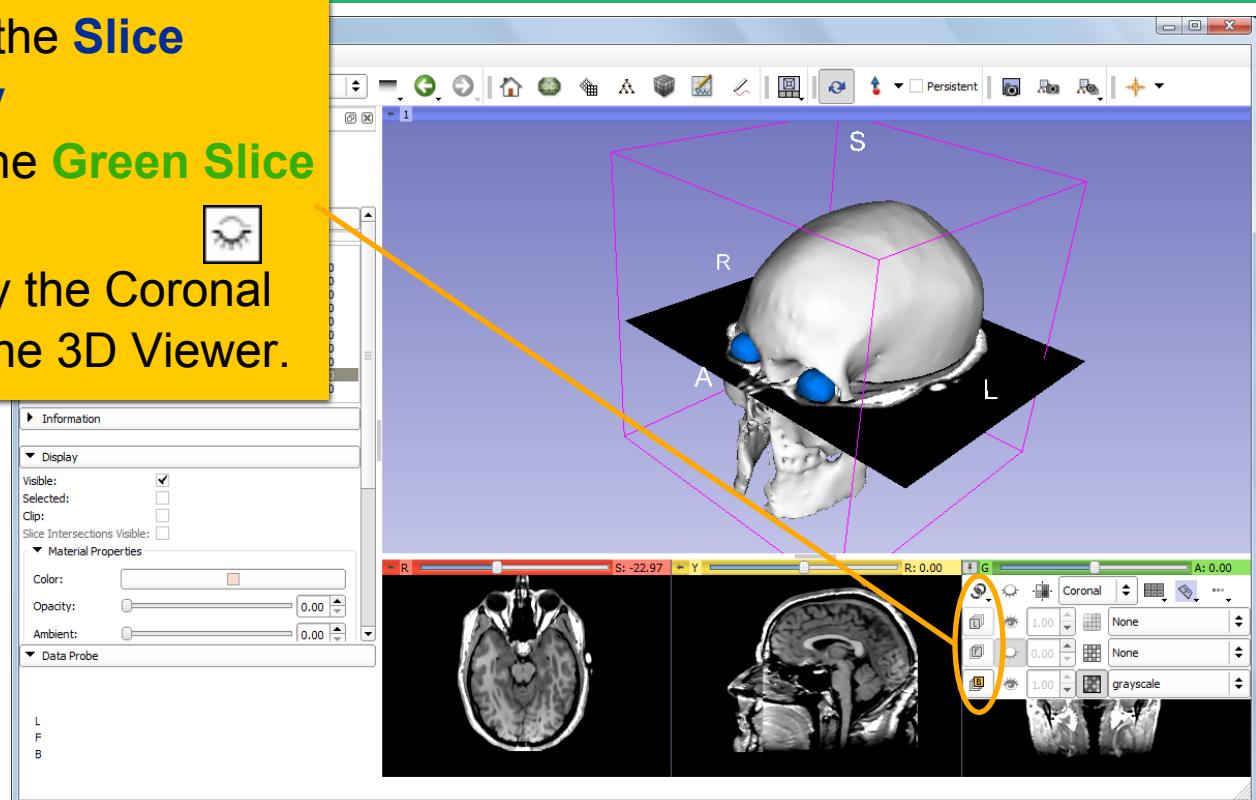
The model of the skin becomes invisible in the 3D viewer.

(skin model opacity = 0.0)  
(skull model opacity = 1.0)



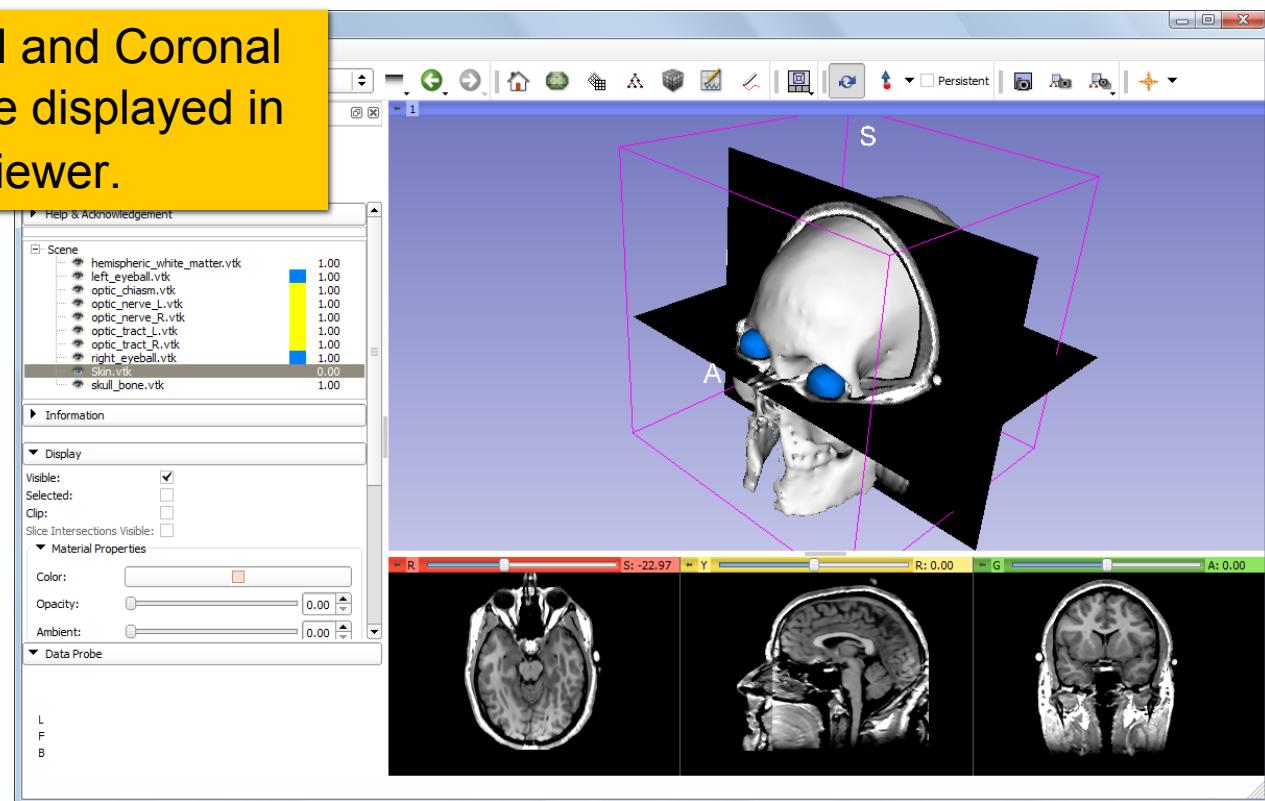
# Slicer4 Minute Tutorial: 3D Visualization

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



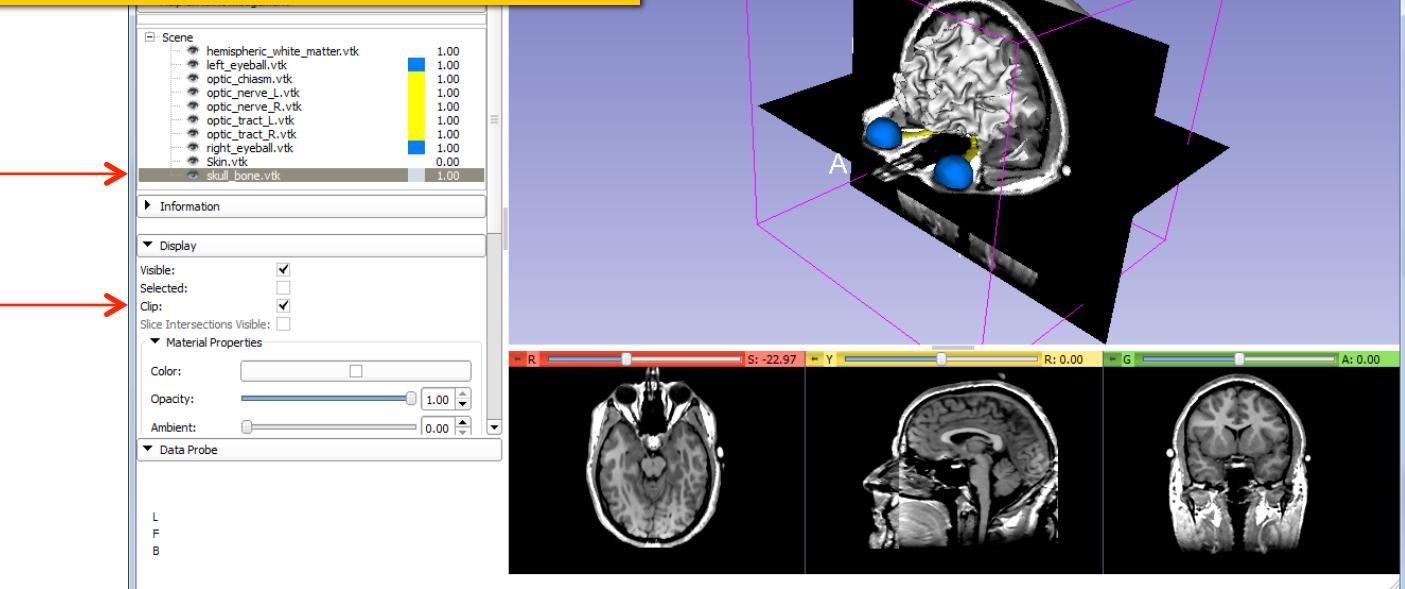
# Slicer4 Minute Tutorial: 3D Visualization

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



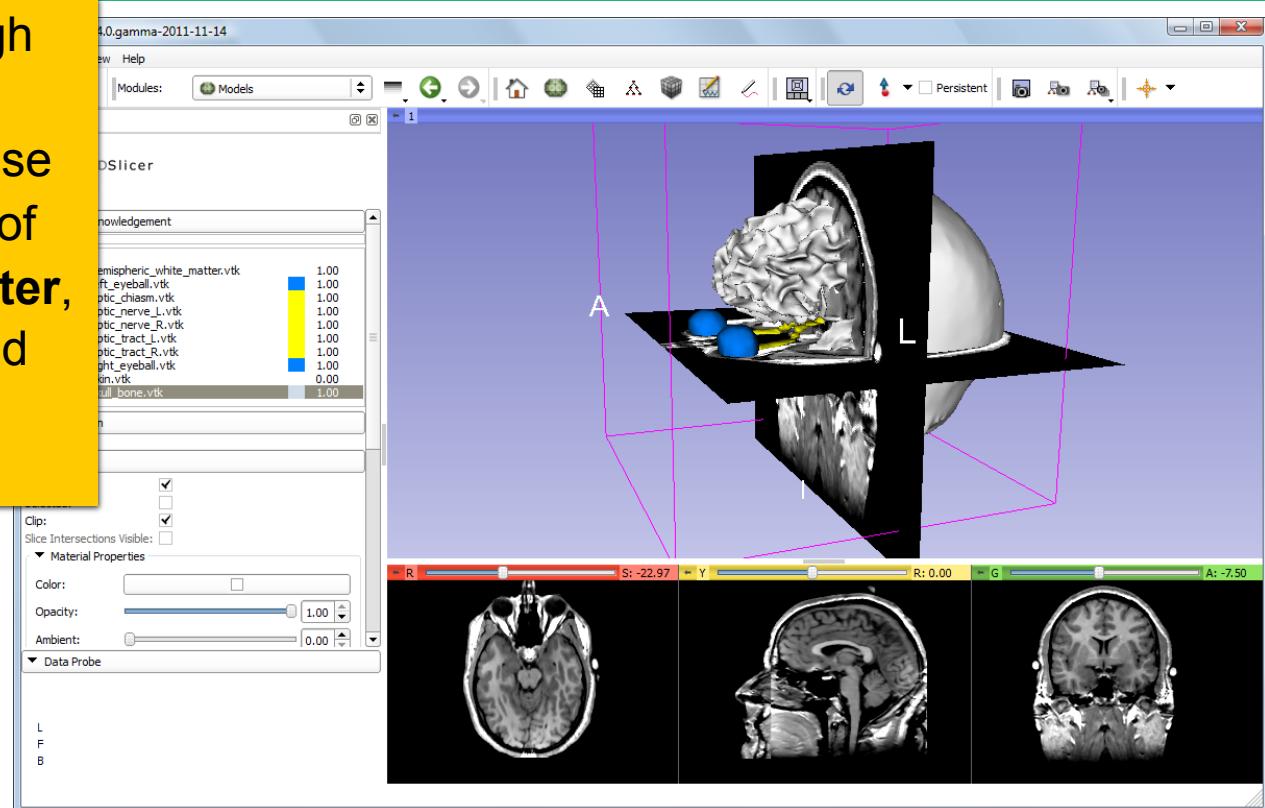
# Slicer4 Minute Tutorial: 3D Visualization

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



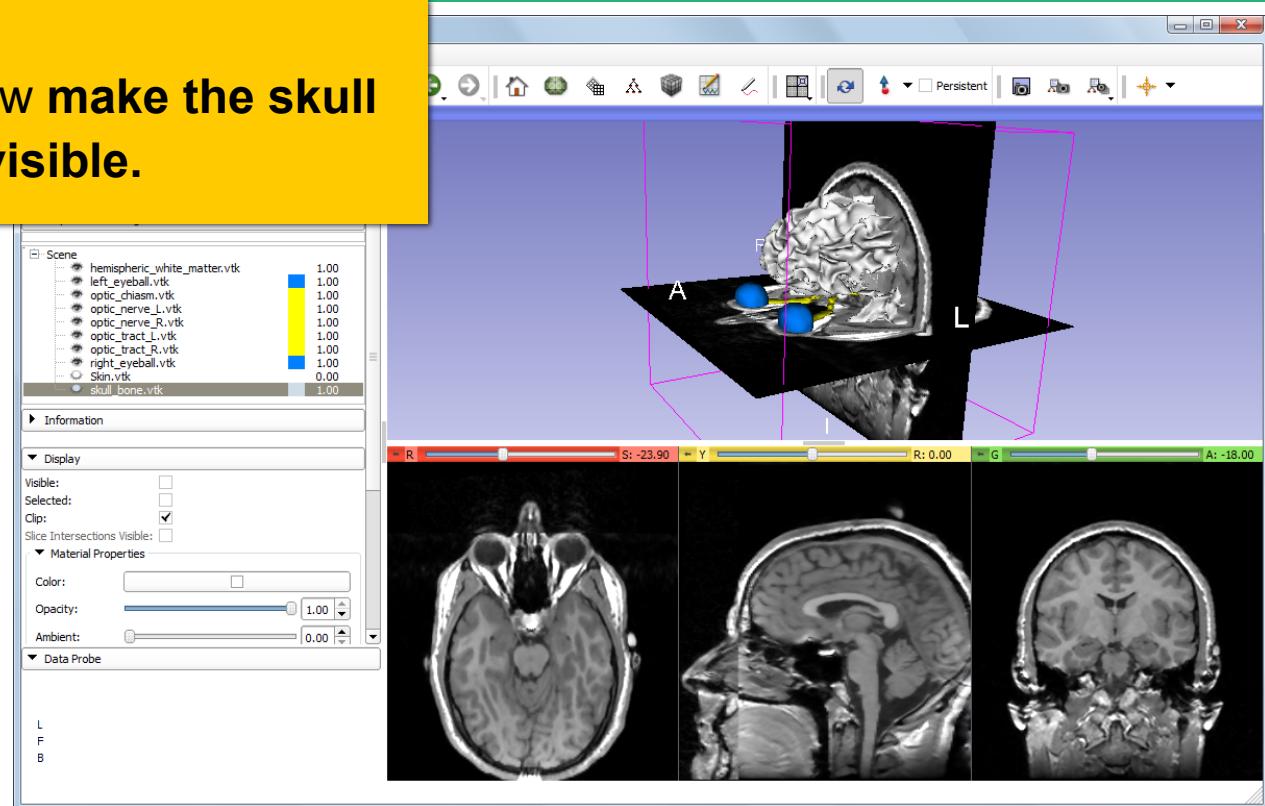
# Slicer4 Minute Tutorial: 3D Visualization

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



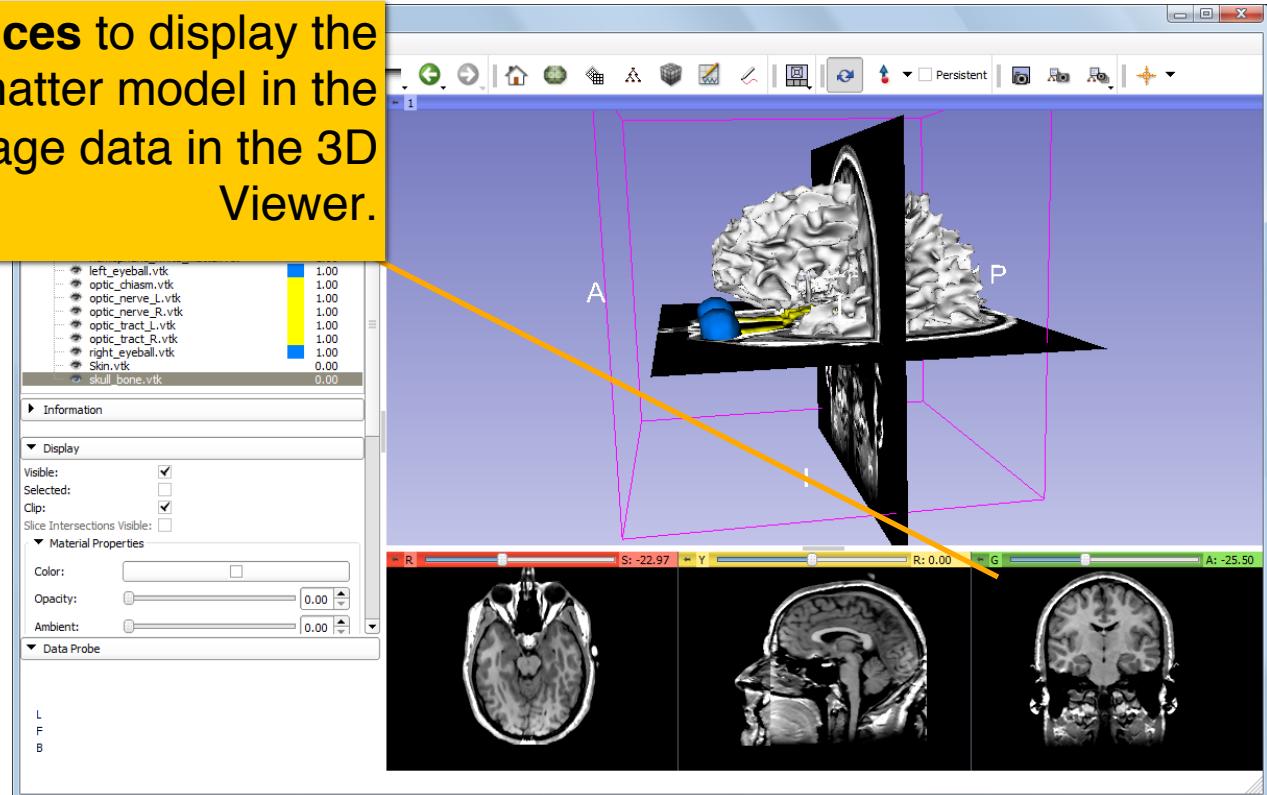
# Slicer4 Minute Tutorial: 3D Visualization

Now make the skull invisible.



# Slicer4 Minute Tutorial: 3D Visualization

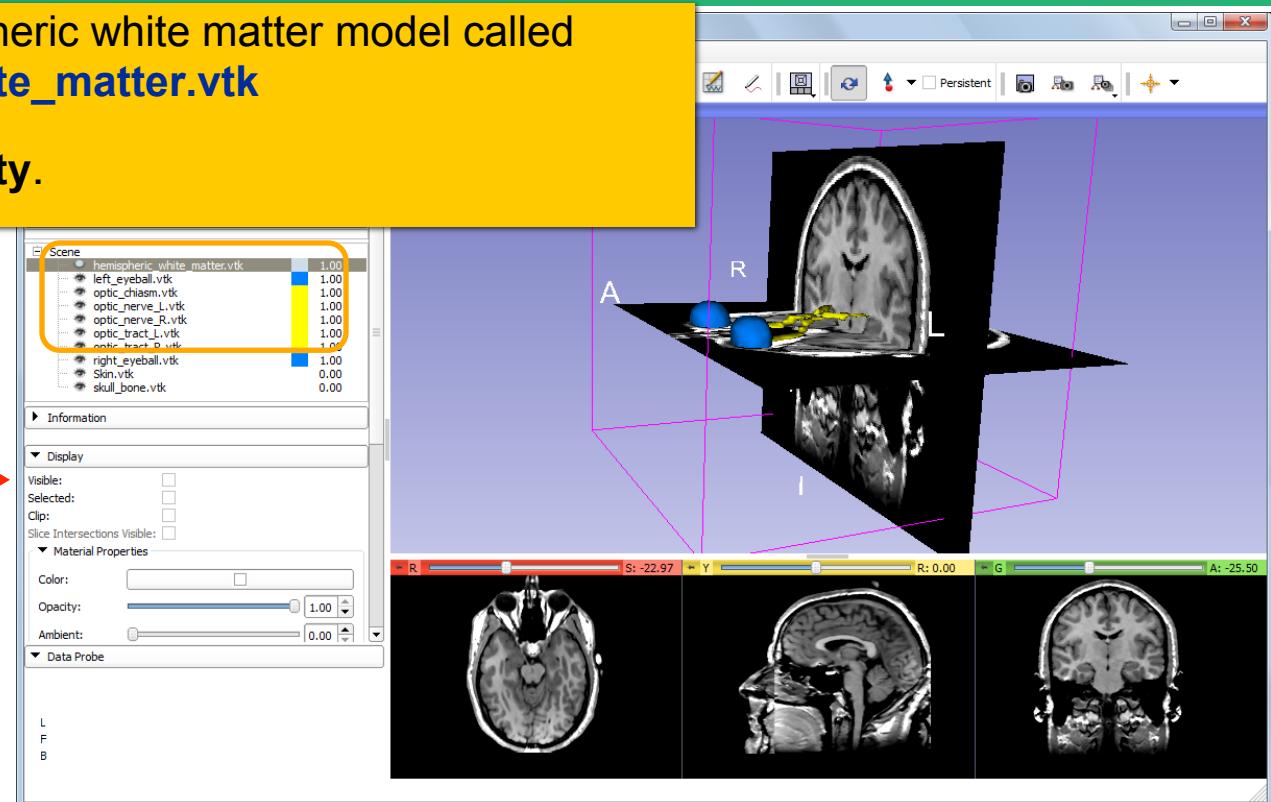
Scroll the **Coronal Slices** to display the hemispheric white matter model in the context of the image data in the 3D Viewer.



# Slicer4 Minute Tutorial: 3D Visualization

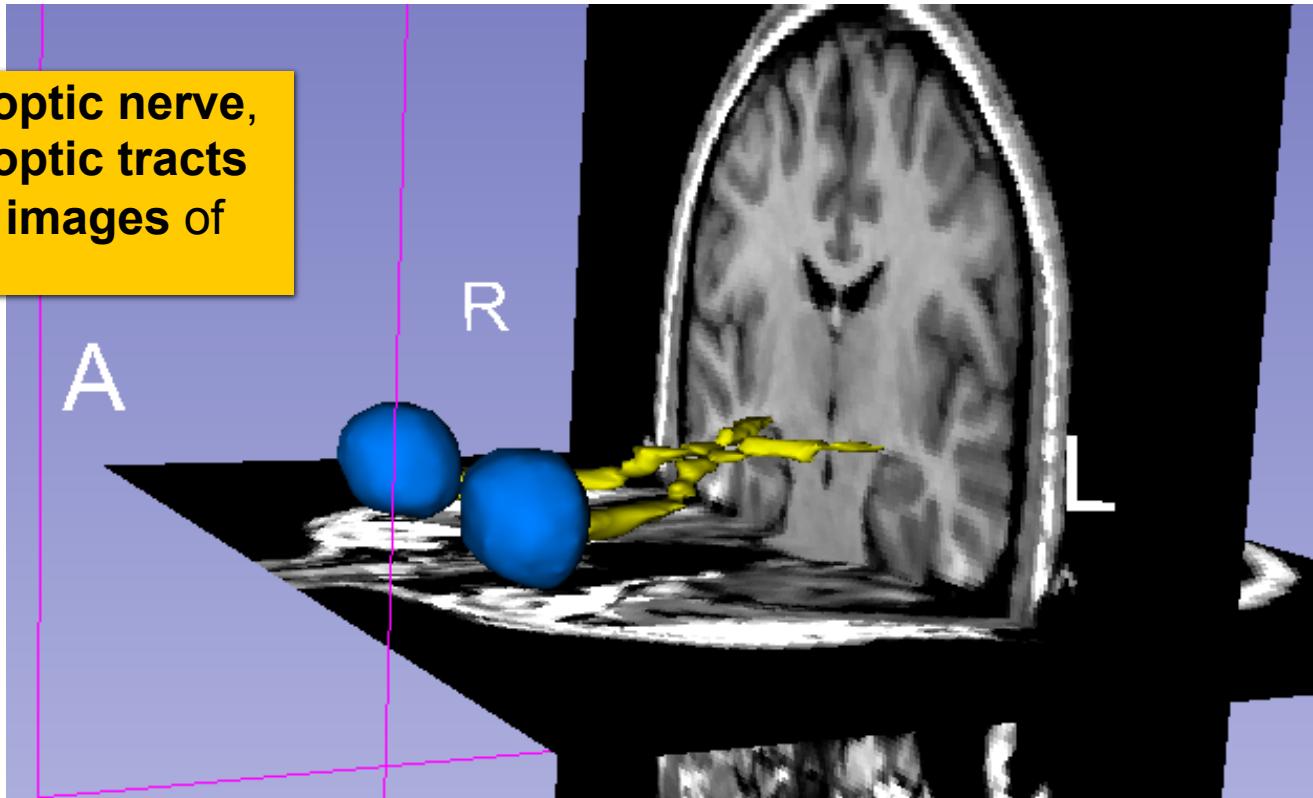
Select the hemispheric white matter model called  
[hemispheric\\_white\\_matter.vtk](#)

Turn off its **visibility**.



# Slicer4 Minute Tutorial: 3D Visualization

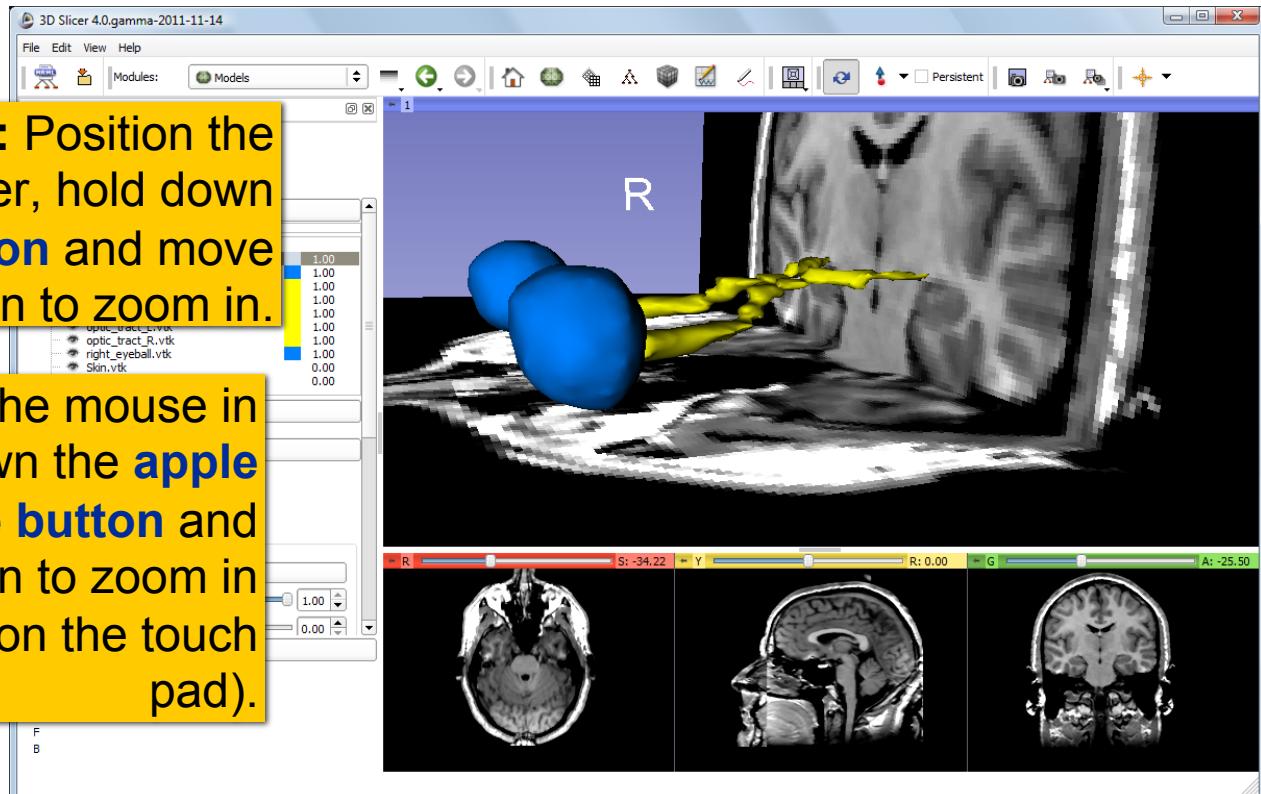
Slicer displays the **optic nerve**, **optic chiasm** and **optic tracts** overlaid on the **MR images** of the brain.



# Slicer4 Minute Tutorial: 3D Visualization: Zoom the view

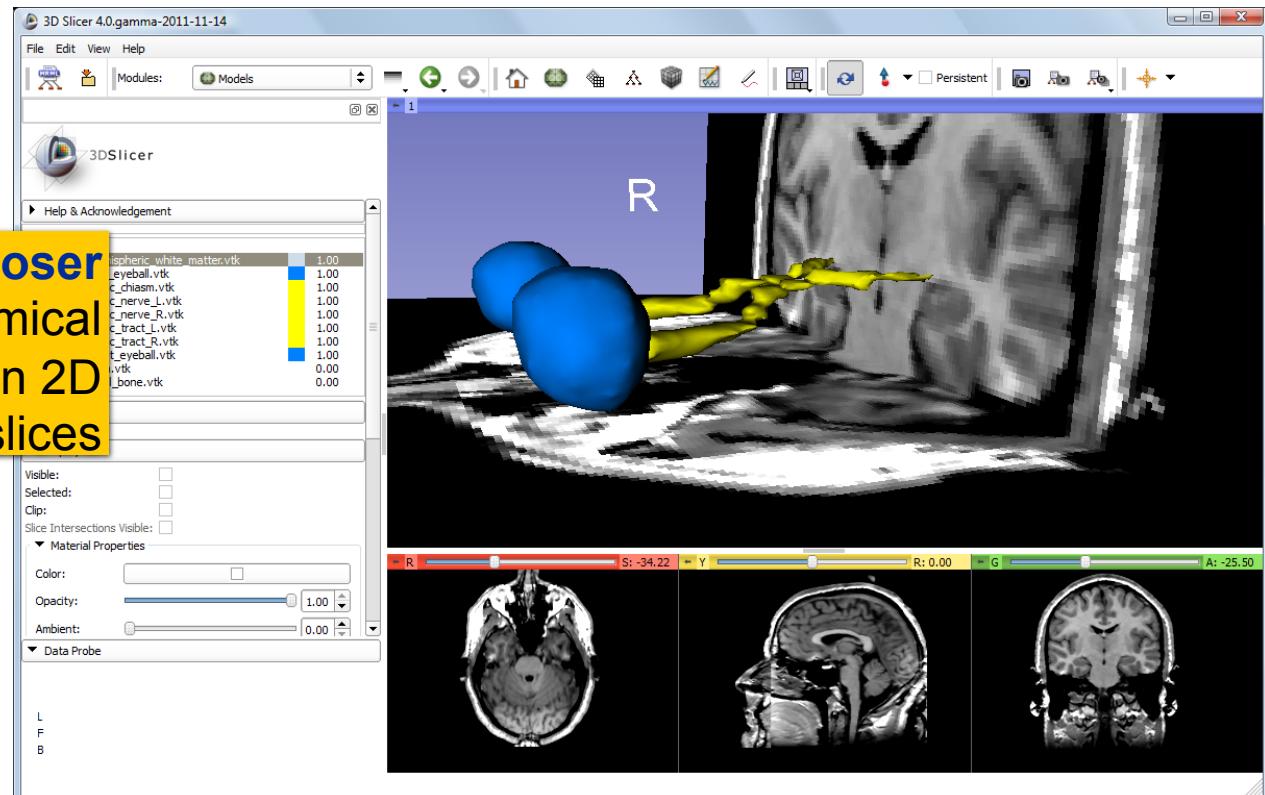
**Windows/Linux users:** Position the mouse in the 3D Viewer, hold down the **right mouse button** and move the mouse down to **zoom in**.

**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).



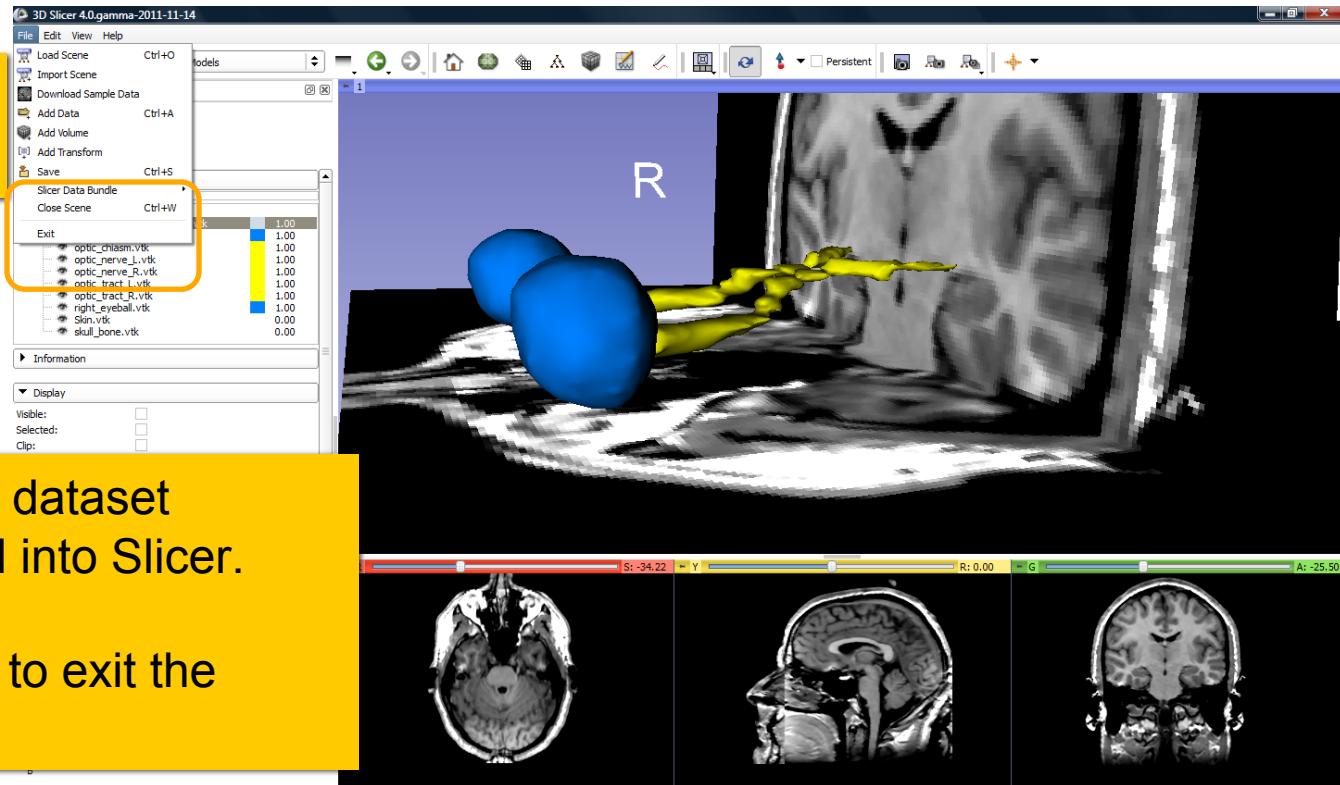
# Slicer4 Minute Tutorial: 3D Visualization: Zoom the view

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



# Close the existing scene and all its data

Select **File->Close Scene**



This removes any dataset previously loaded into Slicer.

Select **File-> Exit** to exit the software

# Overview

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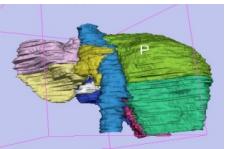
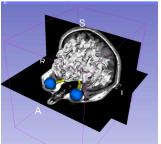


## Part I: Introduction to the 3DSlicer software



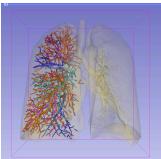
## Part II: 3D Data Loading and visualization of DICOM images

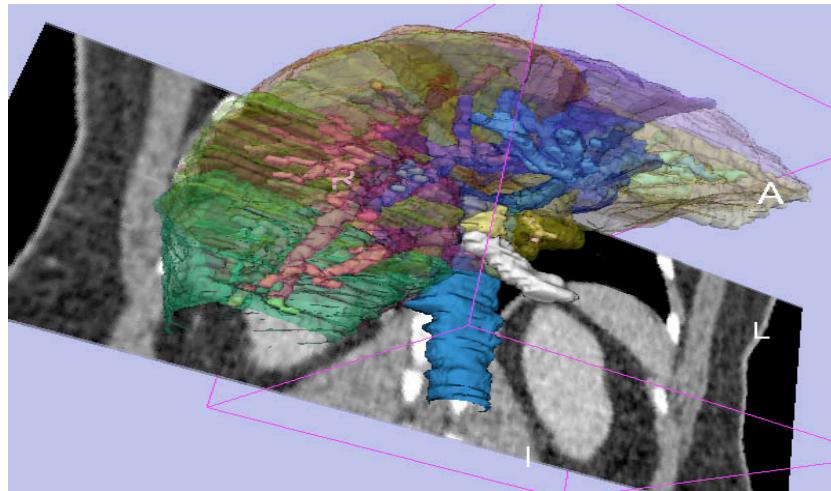
- Volume Rendering of thoraco-abdominal CT data
- Surface Rendering of MR head data



## Part III: 3D interactive exploration of the anatomy

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

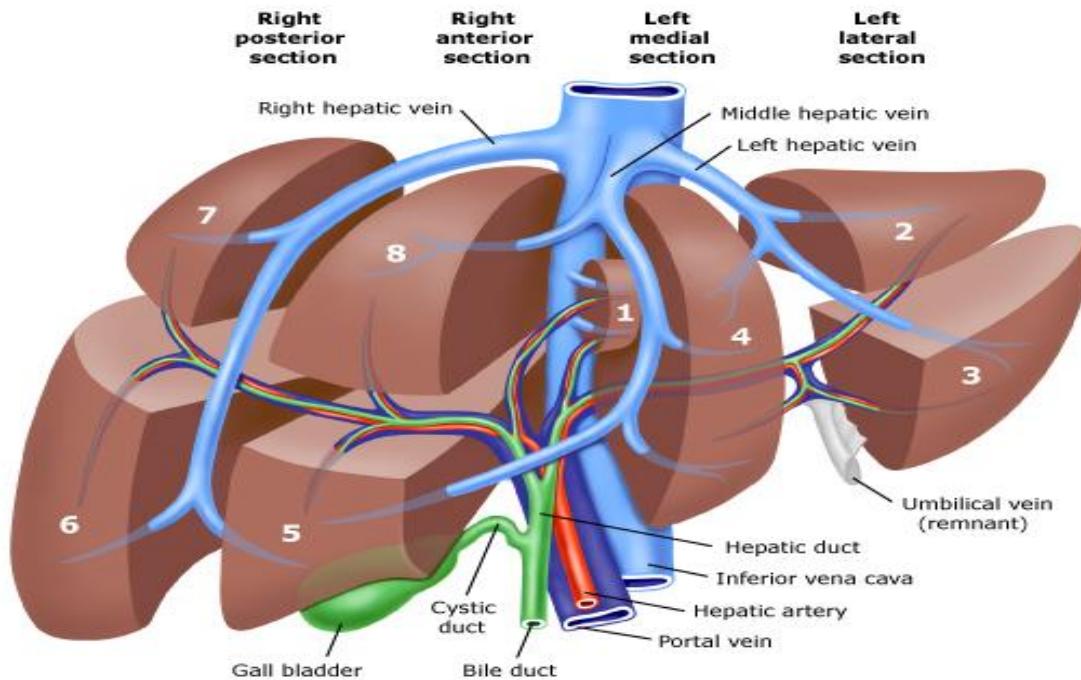




## Part II:

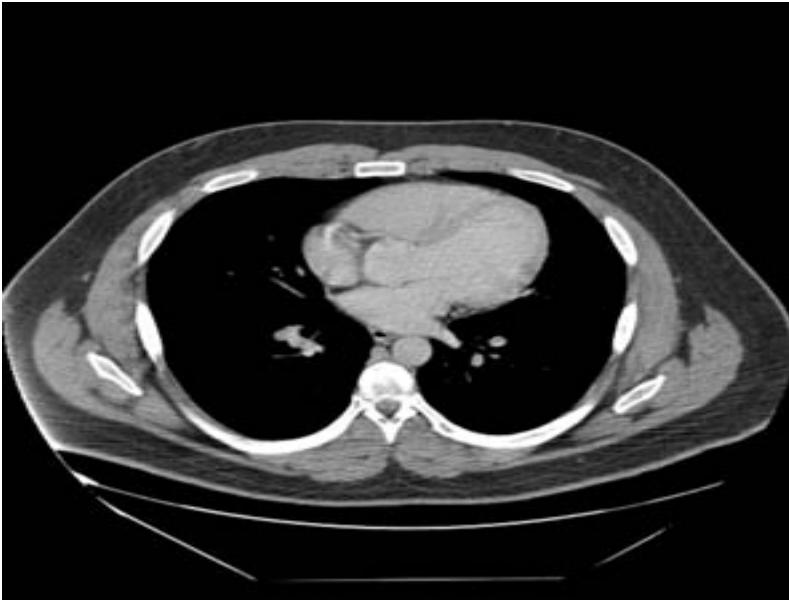
Interactive 3D Visualization  
of the segments of the liver

# Anatomy of the liver



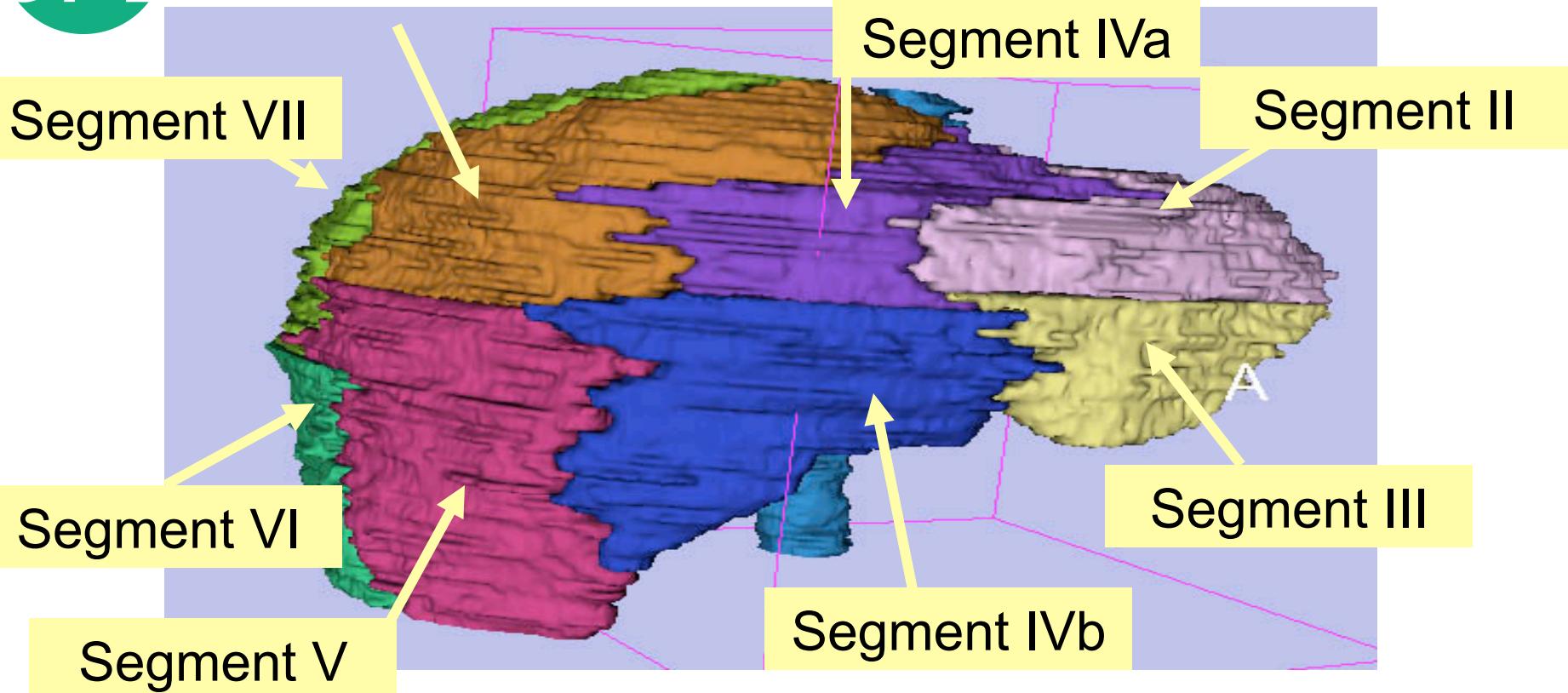
# Liver dataset

---

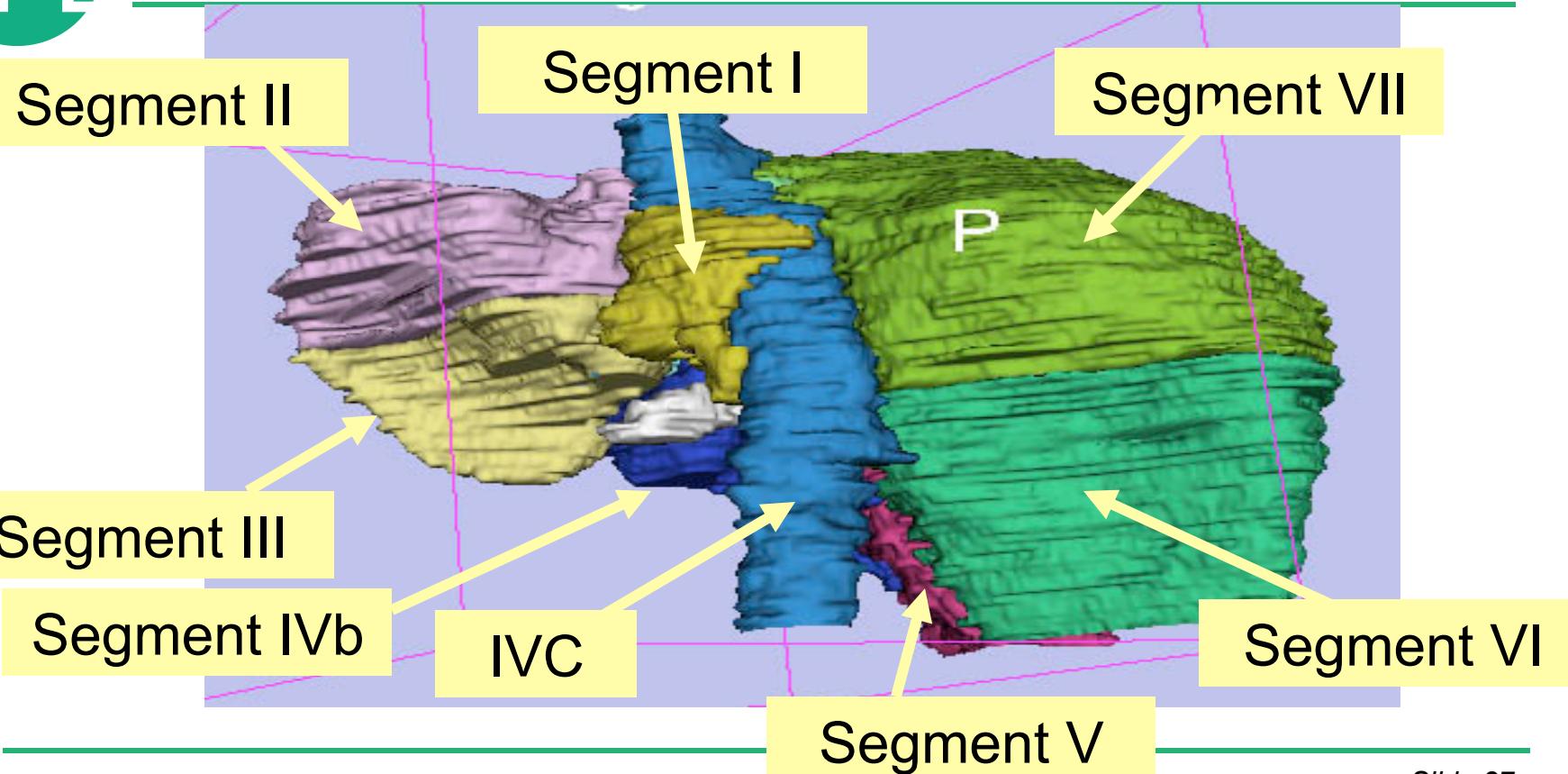


The liver dataset is a contrast-enhanced CT abdominal scan of a healthy 36 year-old male.

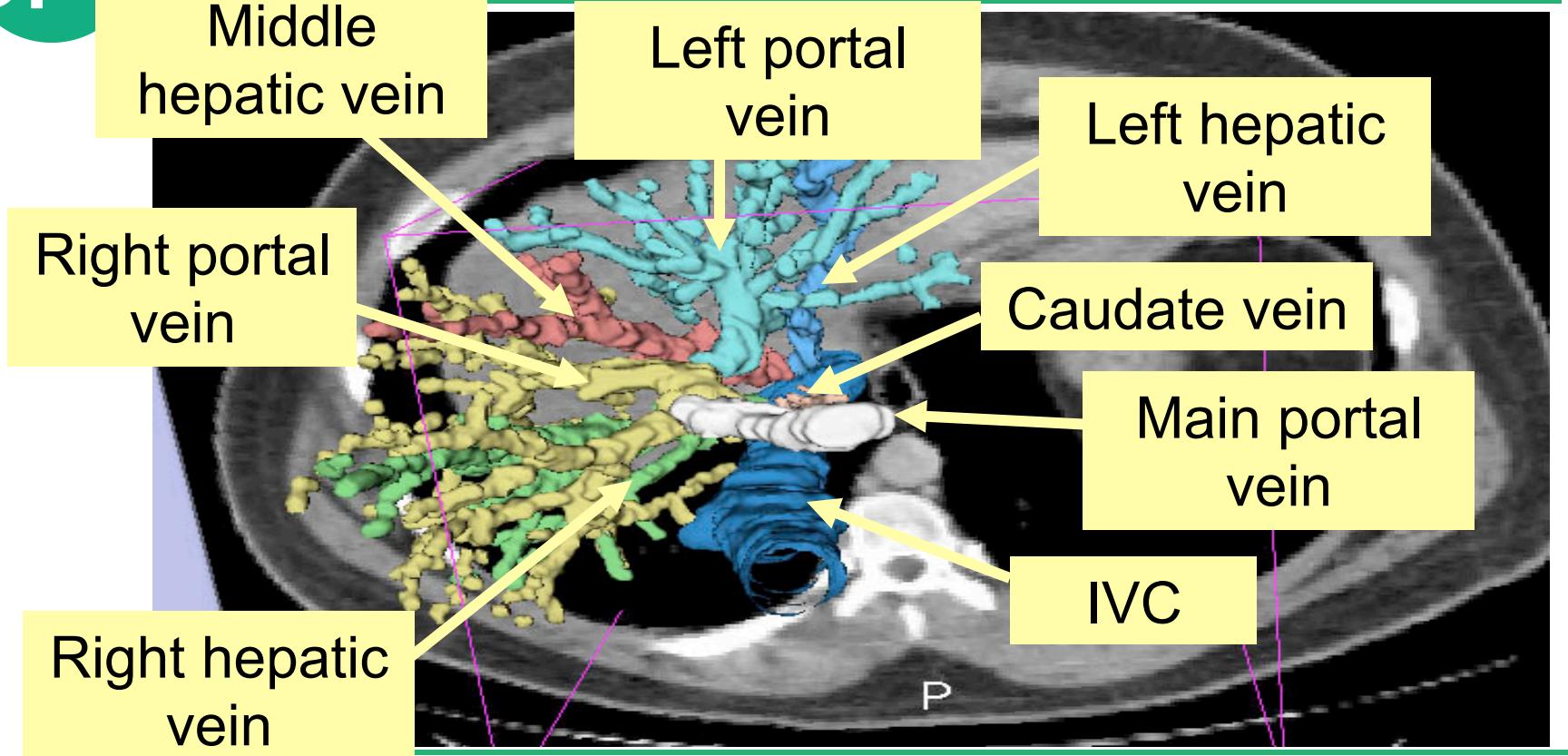
# 3D segments of the liver



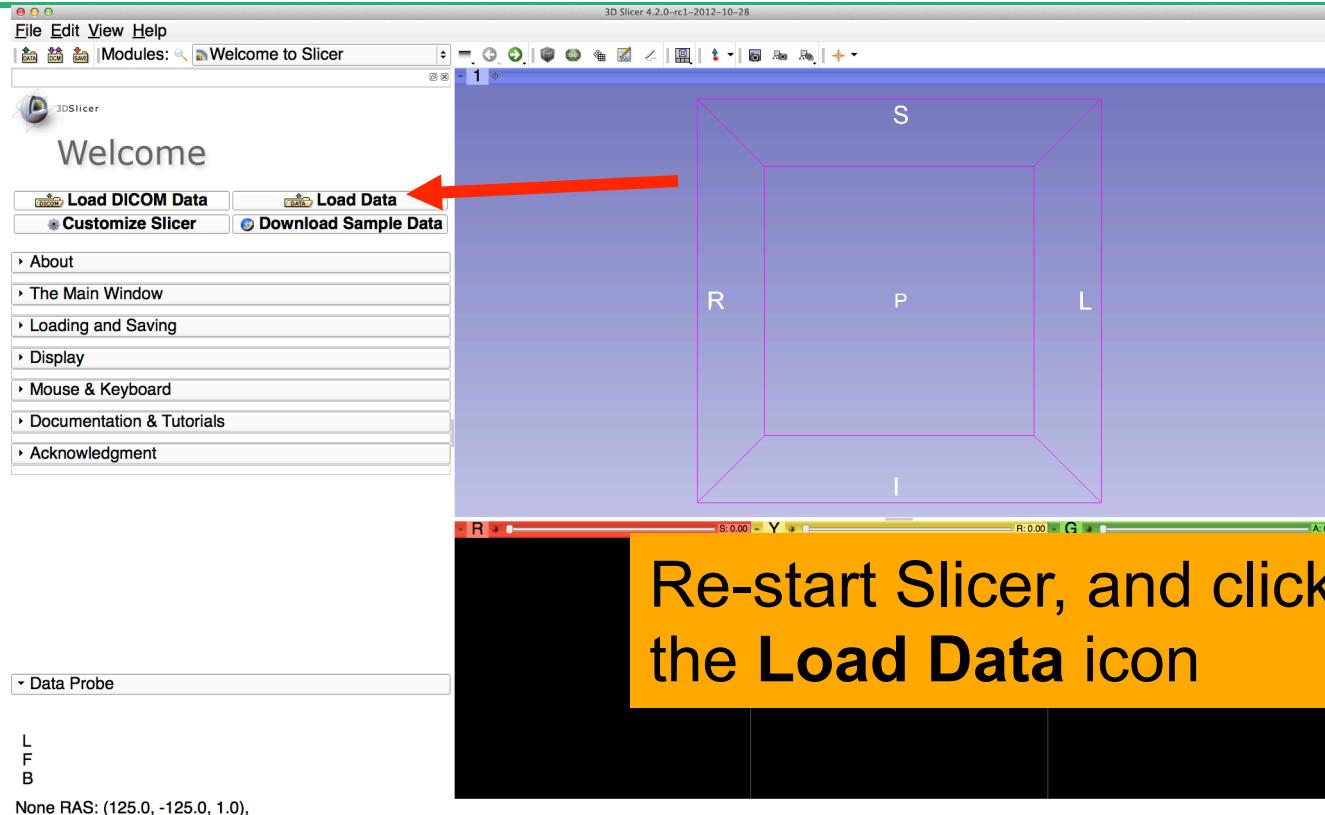
# 3D segments of the liver



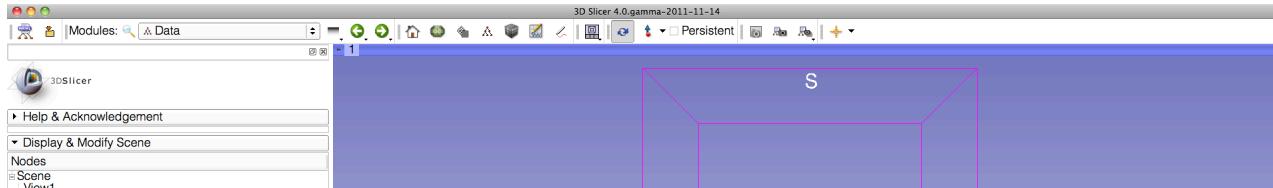
# Liver vasculature



# Loading the Liver Data Scene



# Loading the Liver Scene



Browse to the directory

**C:\Pujol2012\3Dvisualization\_Tuesday\_Nov27\_2012**

Select the directory **dataset3\_CT-Liver**

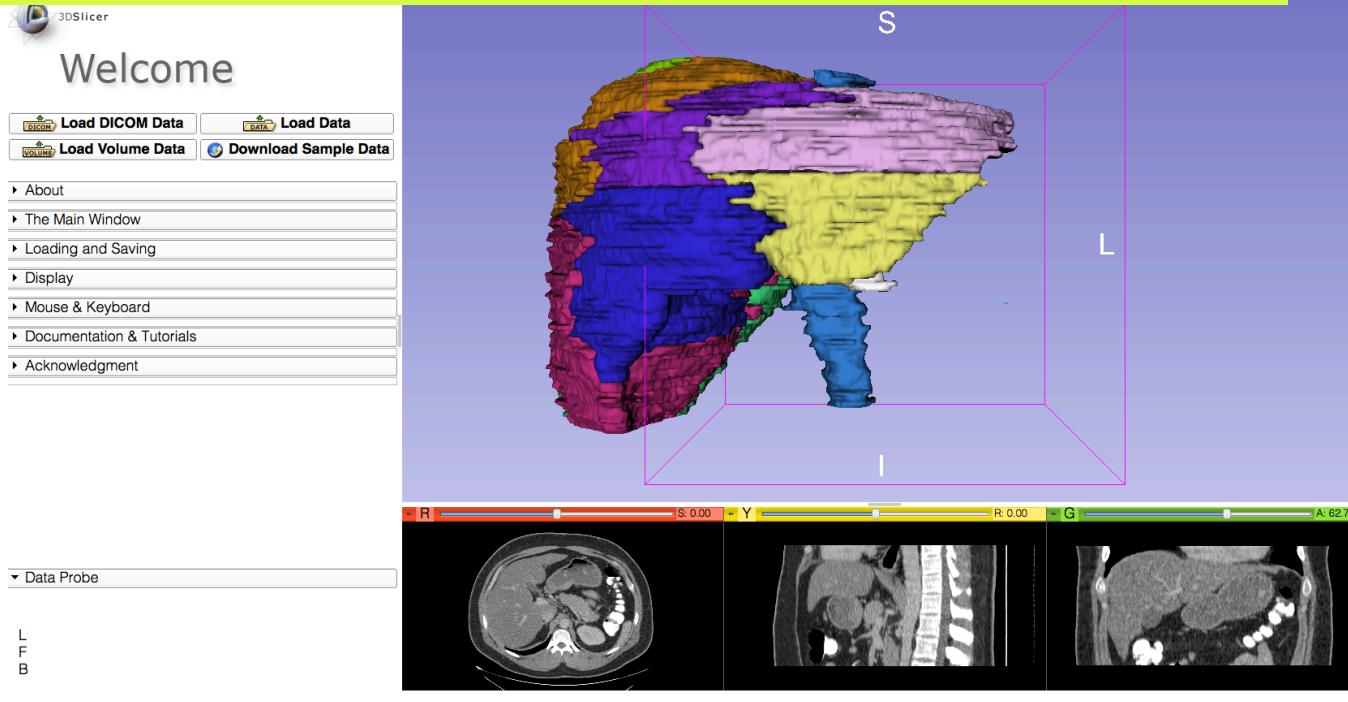
Select the file **LiverSegments\_Scene.mrml**

Click on OK to load the scene into Slicer

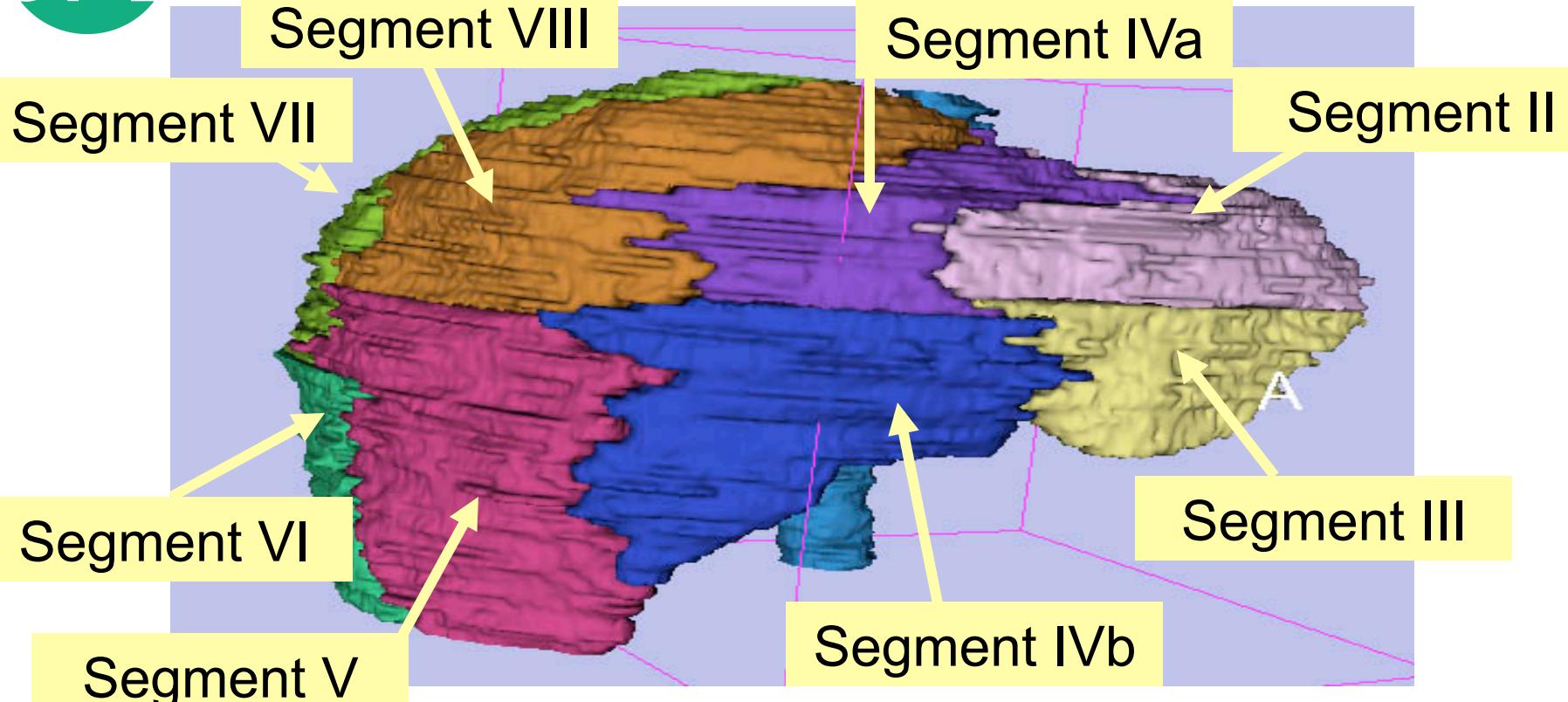
F  
B

# Liver Segments Scene

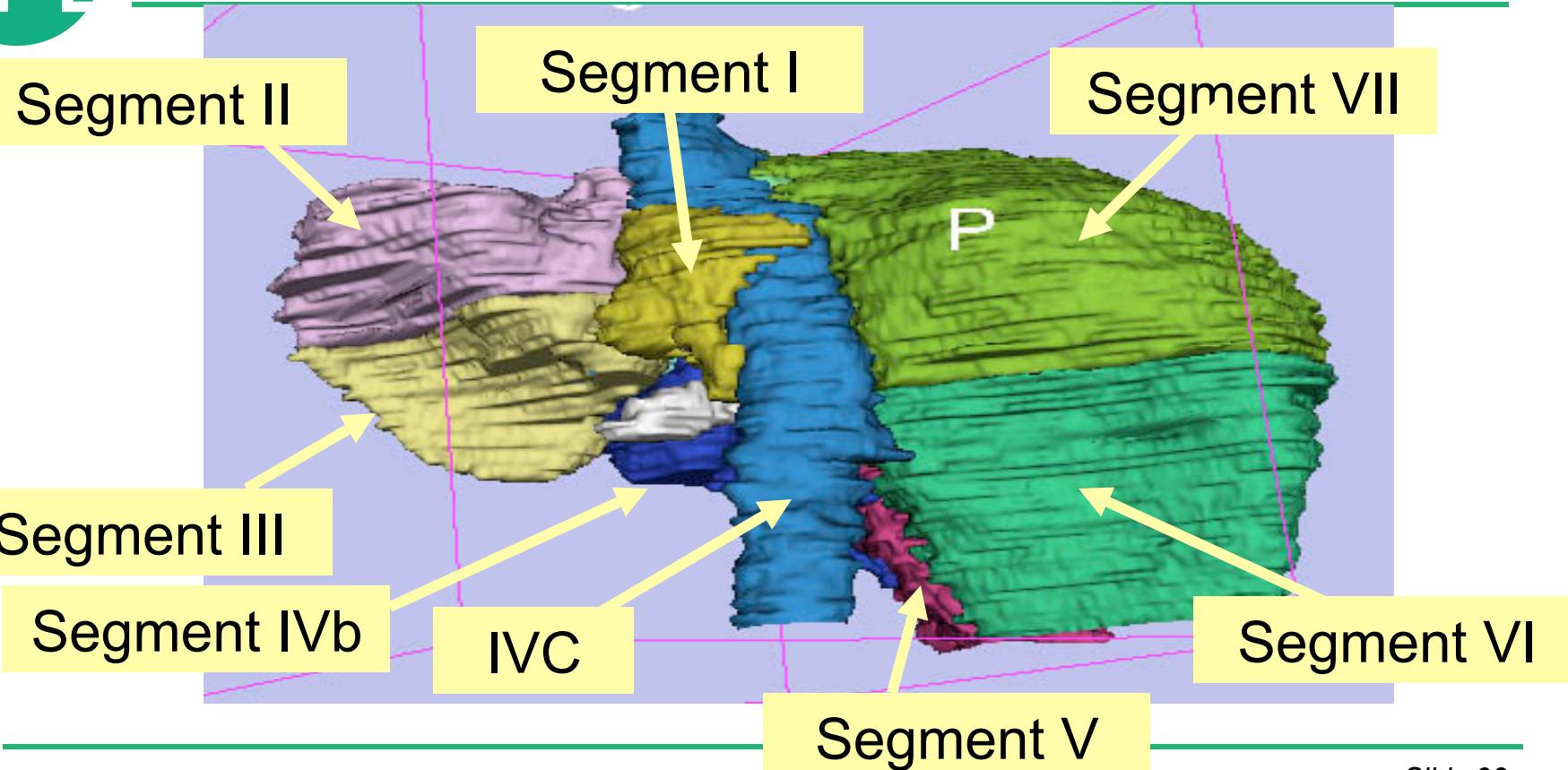
The elements of the scene appear in the Viewer



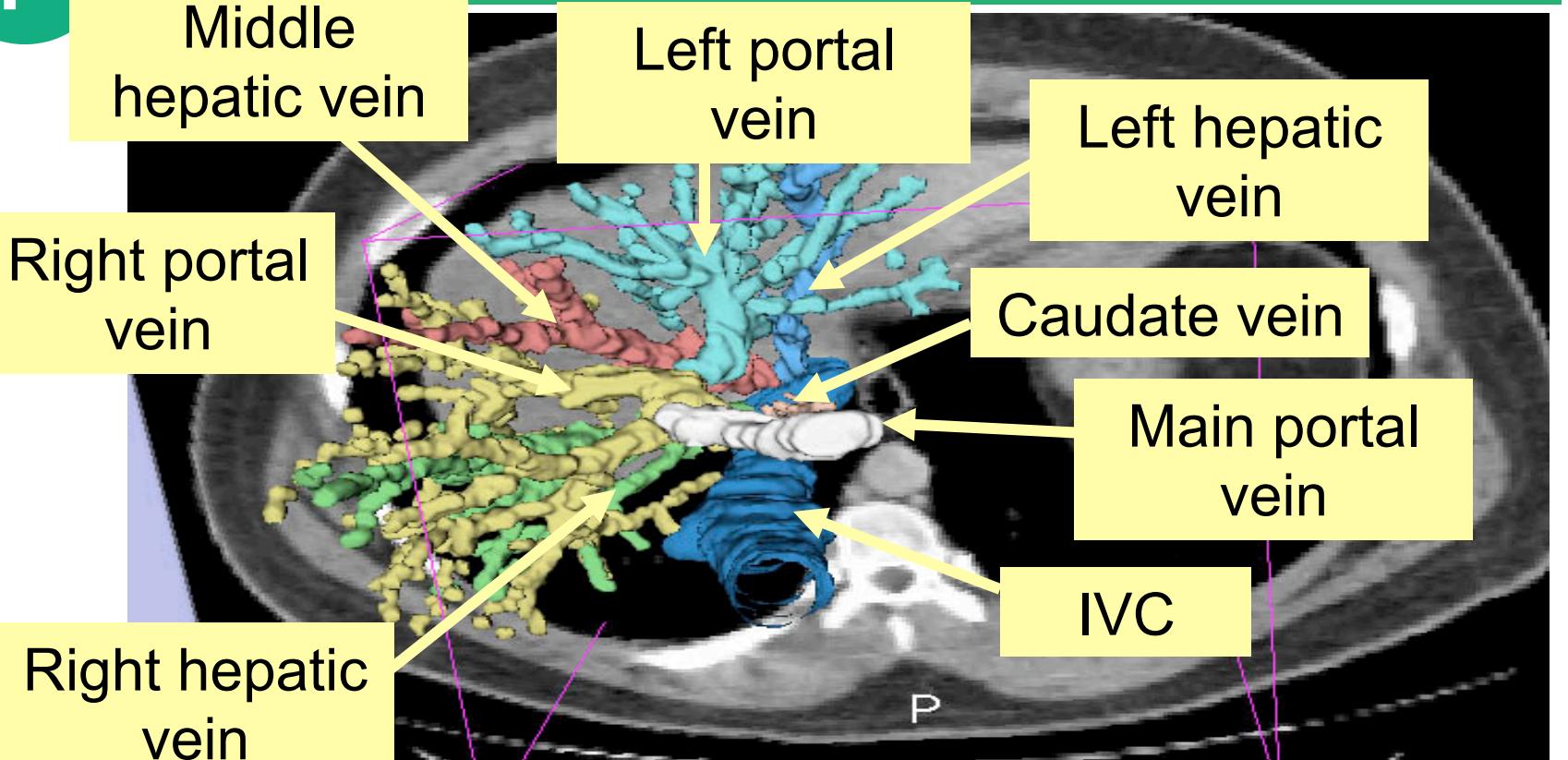
# 3D models of the liver



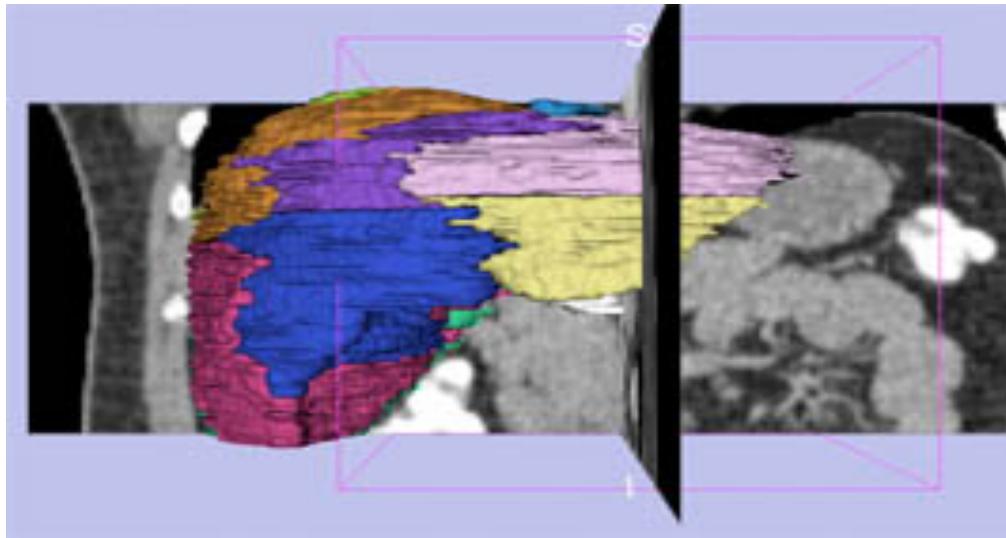
# 3D models of the liver



# 3D models of the liver



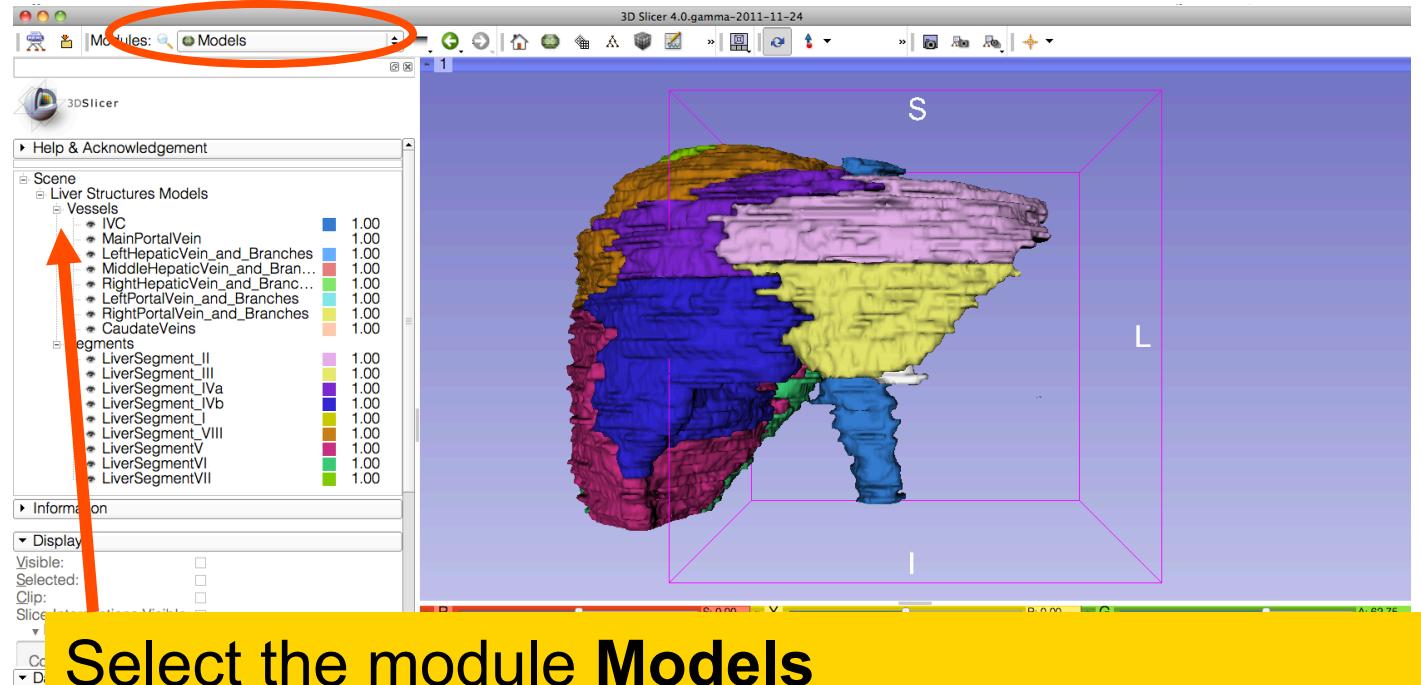
# 3D Exploration of Liver Segments



## Example:

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

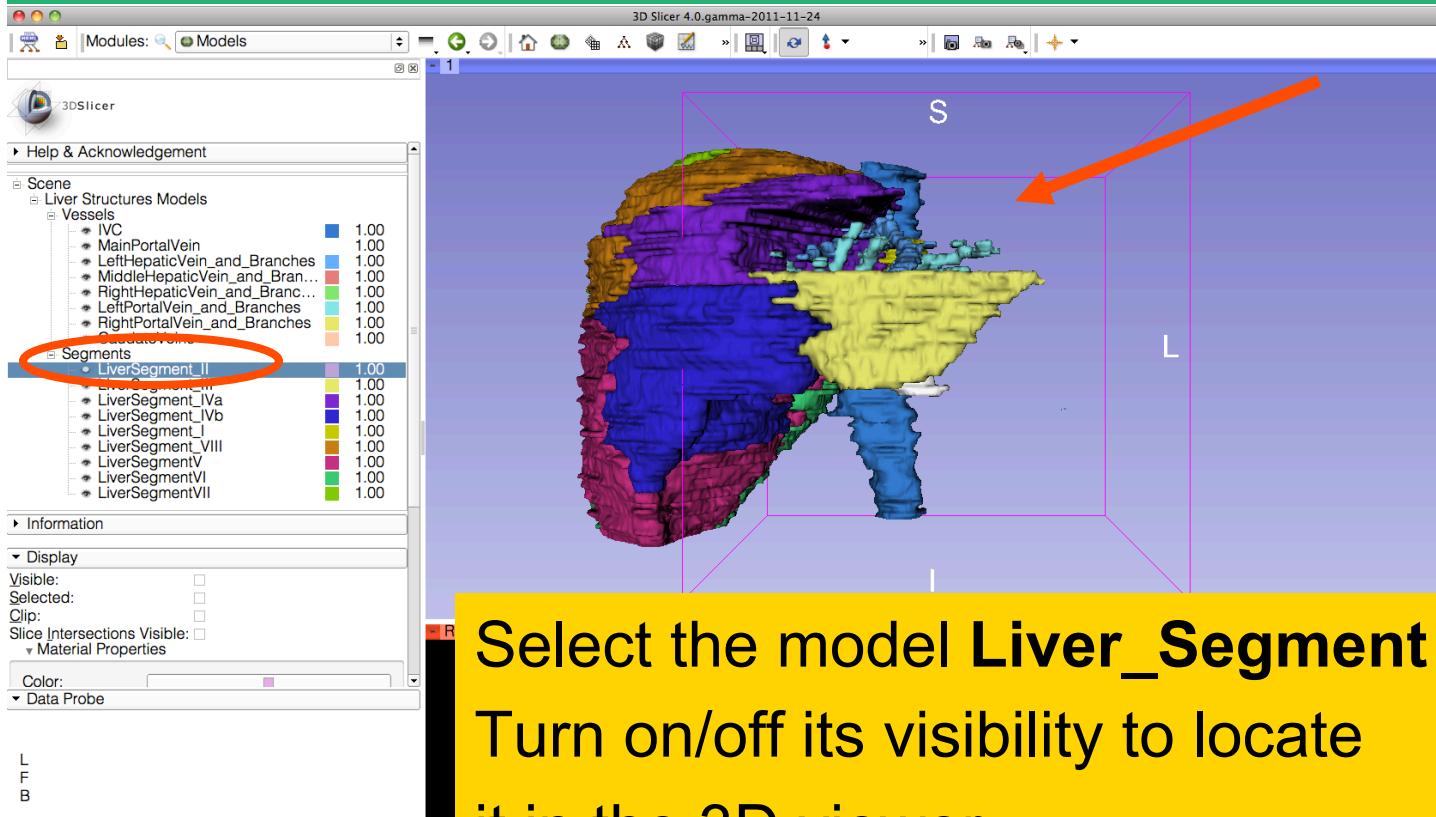
# 3D Exploration of Liver Segments



Select the module **Models**

Click on the Liver Structures Models Hierarchy

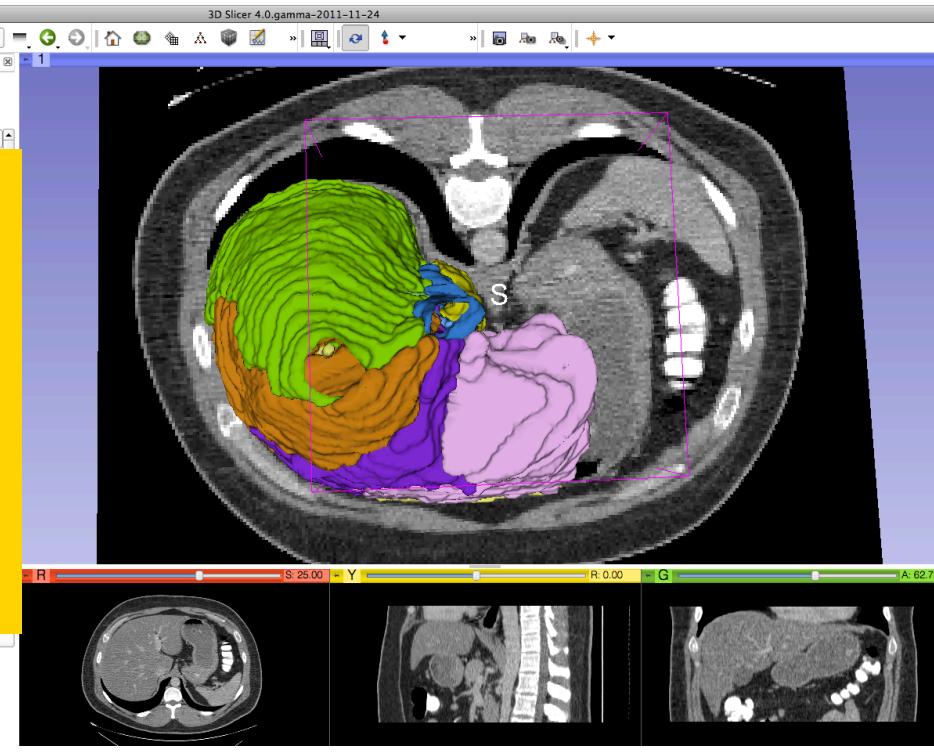
# 3D Exploration of Liver Segments



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

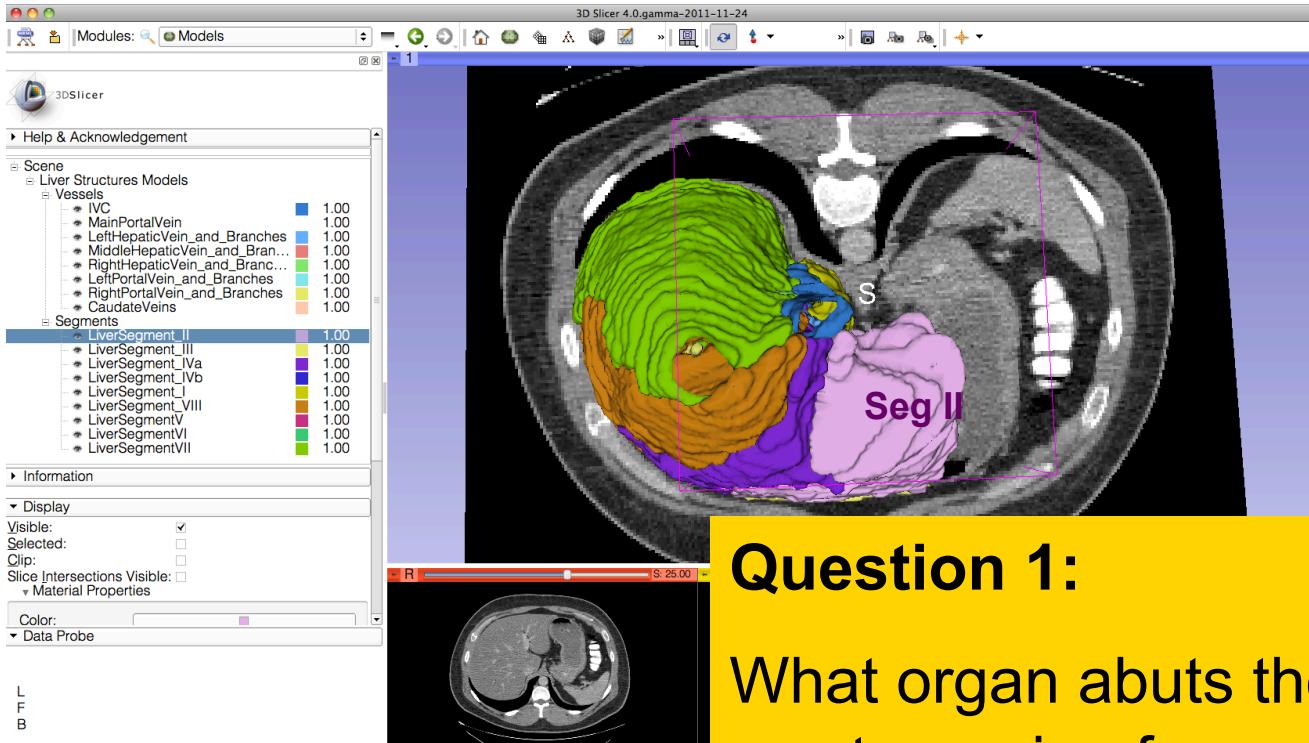
# 3D Exploration of Liver Segments

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





# 3D Exploration of Liver Segments



## Question 1:

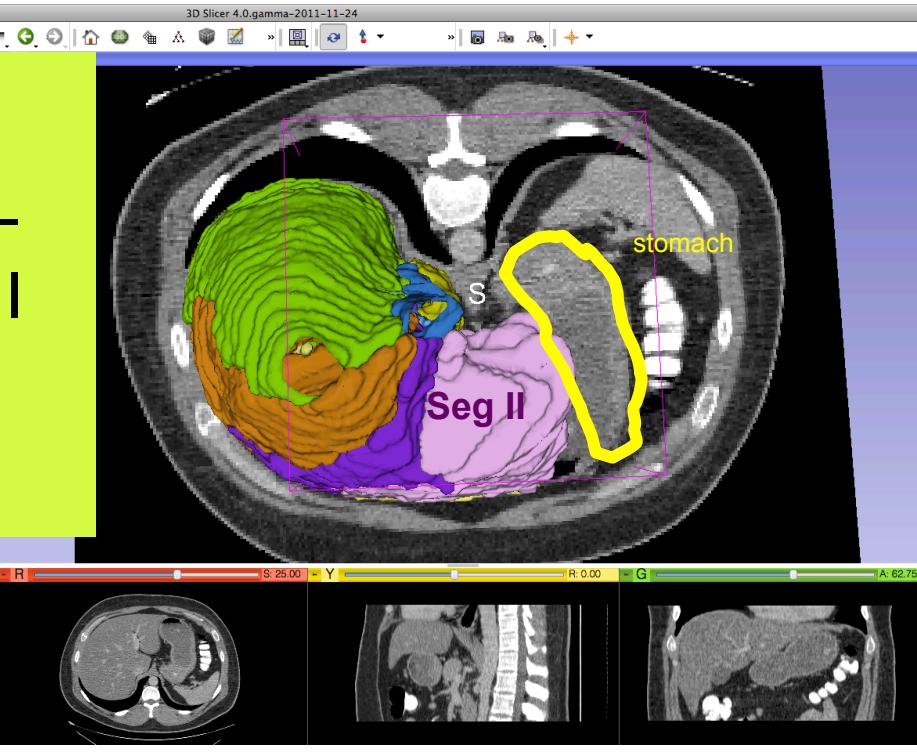
What organ abuts the left-most margin of segment II in Patient 1?

# 3D Exploration of Liver Segments

## Question 1:

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

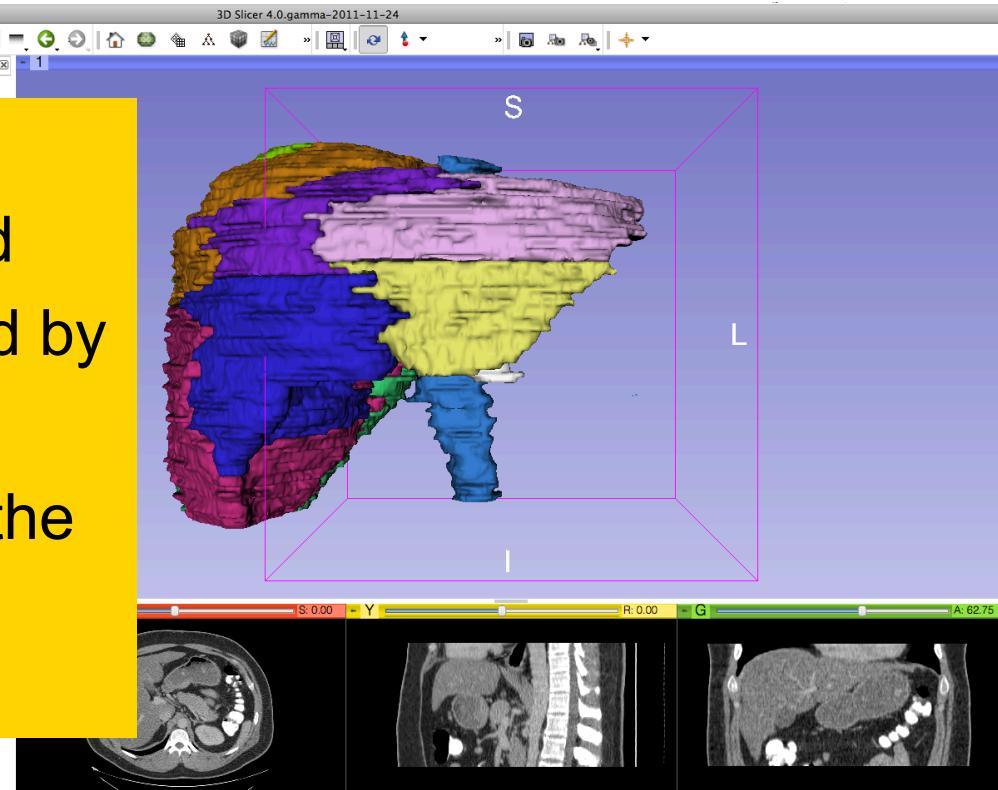
## Answer 1: Stomach



# 3D Exploration of Liver Segments

## Question 2:

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

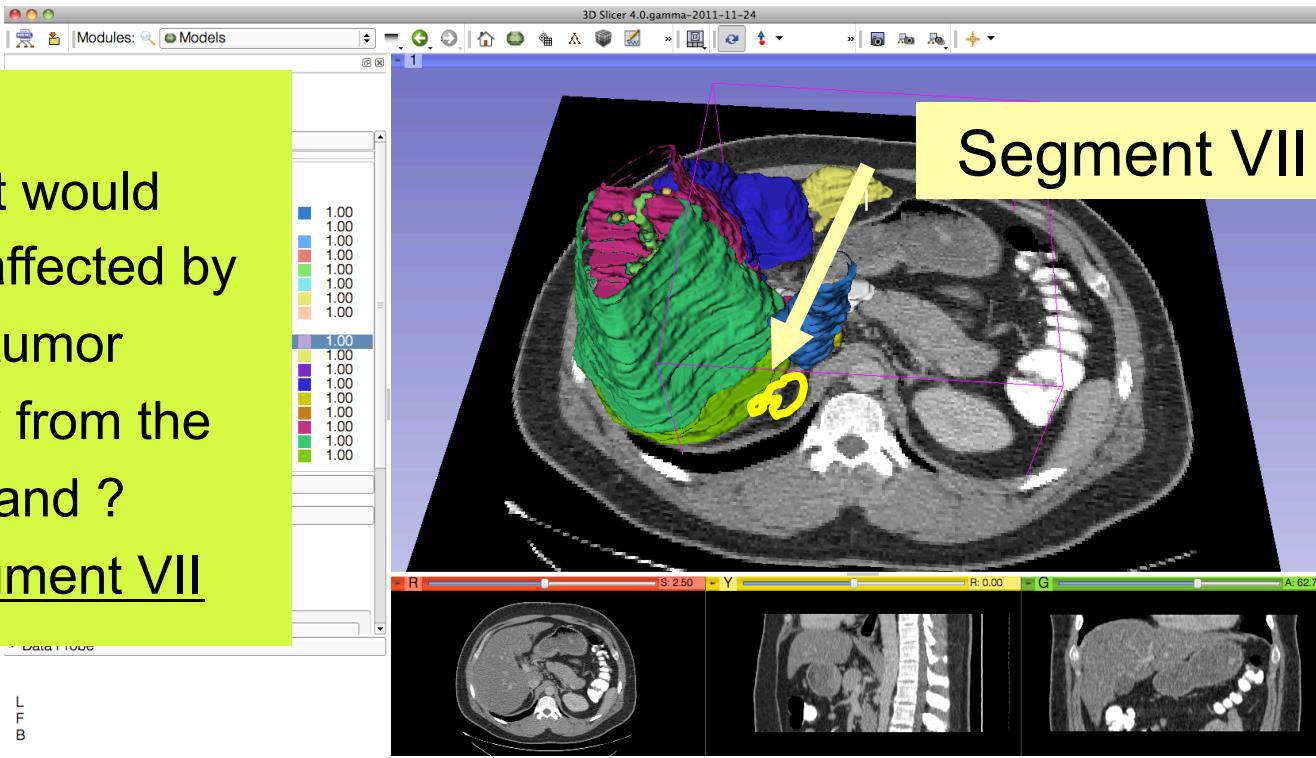


# 3D Exploration of Liver Segments

## Question 2:

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

**Answer 2: Segment VII**



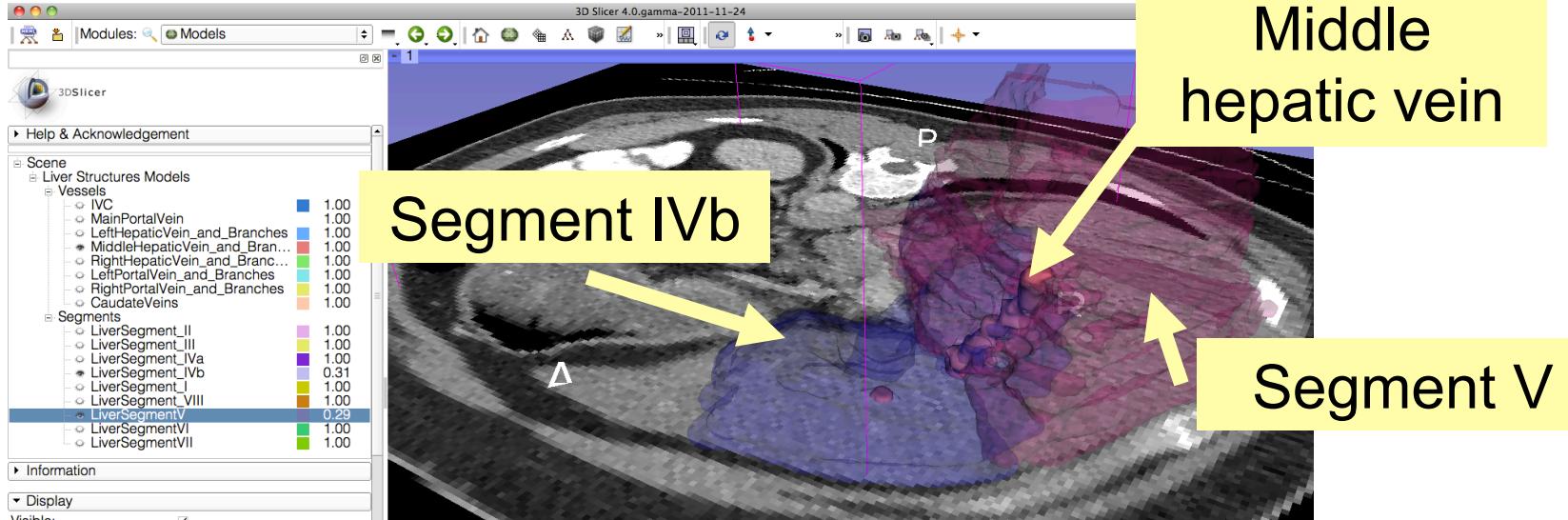
# 3D Exploration of Liver Segments



**Question 3:**

Which vessel separates  
Segment IVb and  
Segment V?

# Middle Hepatic Vein

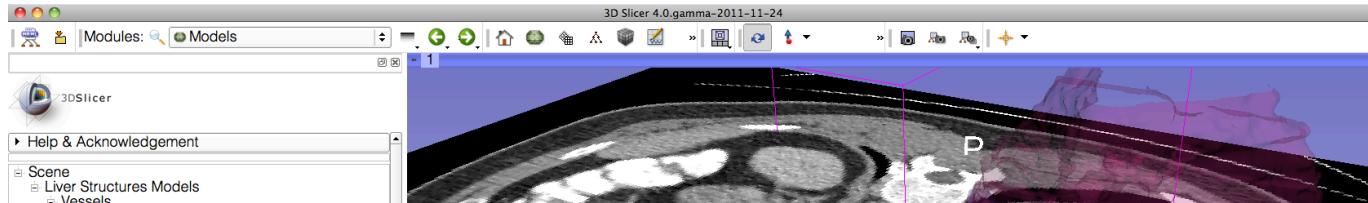


## Question 3:

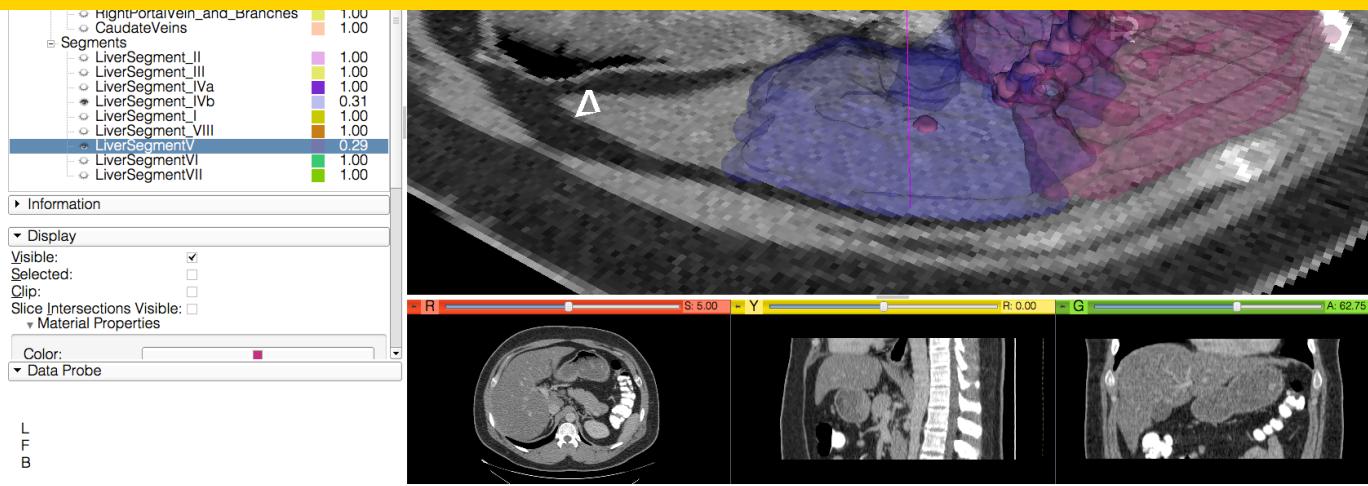
Which vessel separates Segment IVb and Segment V?

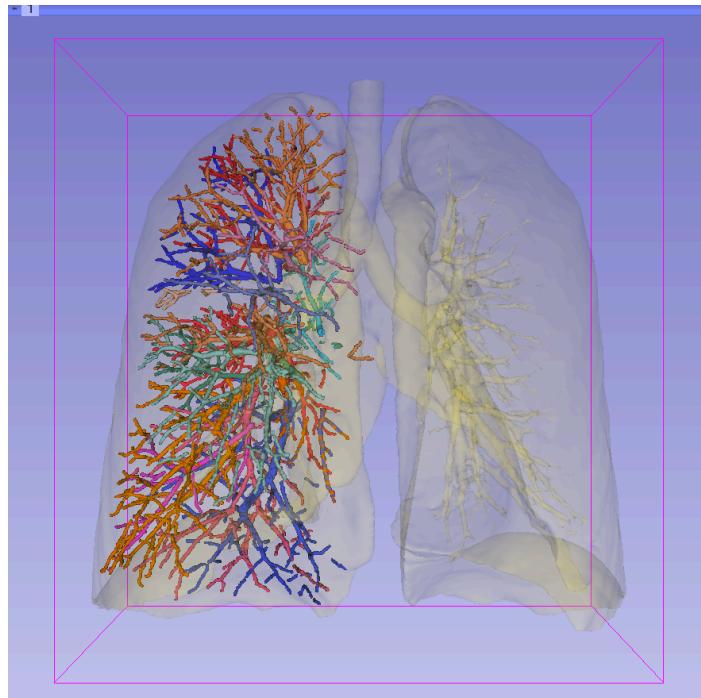
**Answer 3:** The middle hepatic vein

# Closing the Liver Scene



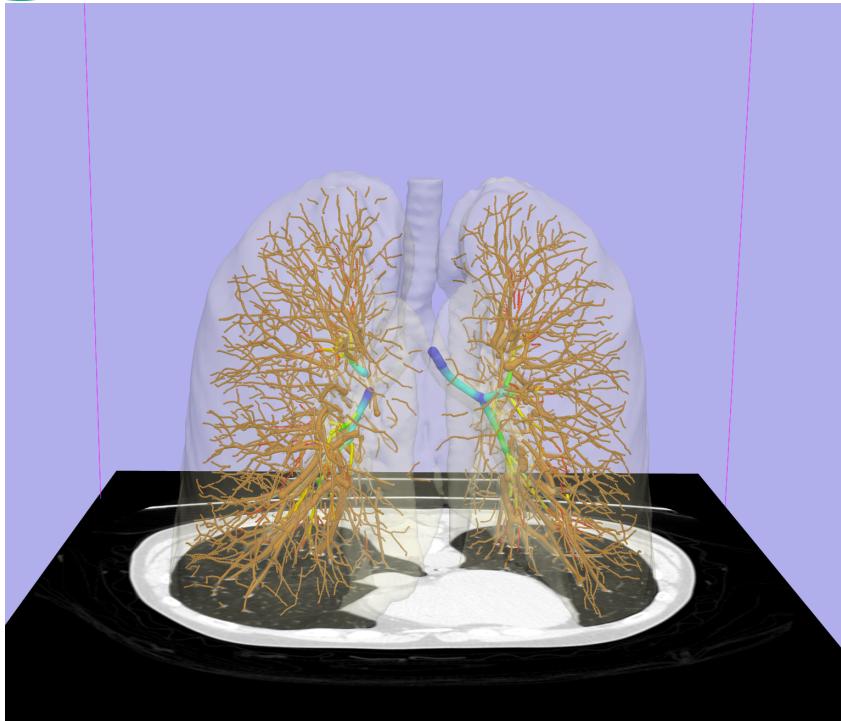
Select **File → Exit** to close the Liver Scene and exit Slicer





Interactive 3D Visualization  
of the segments of the lungs

# Segments of the lung

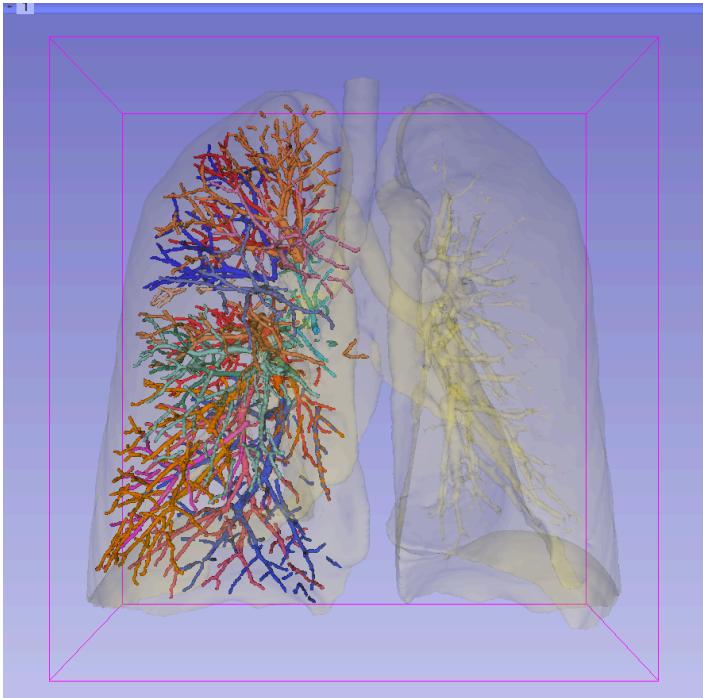


Segmentation and 3D surface reconstruction of the lung and pulmonary vessels

#### 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)

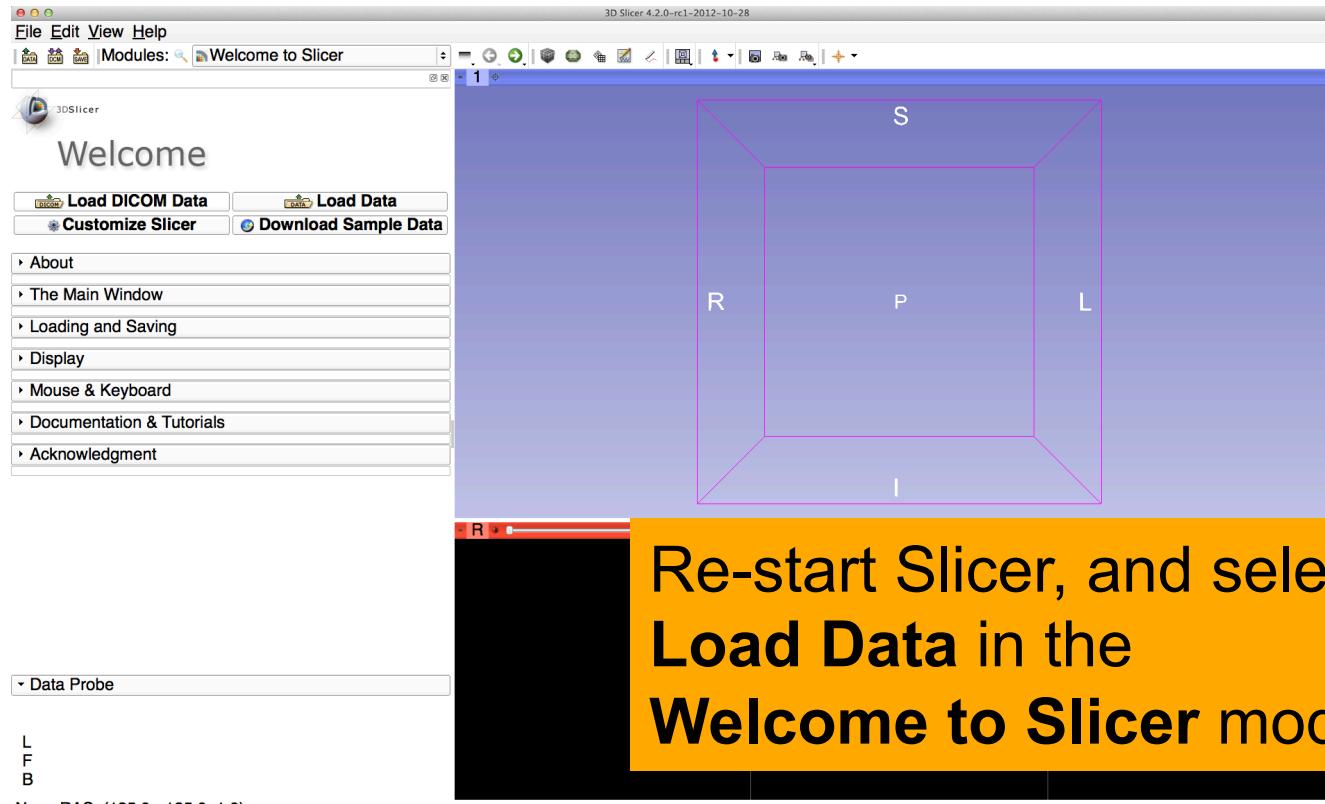
# Segments of the lung



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

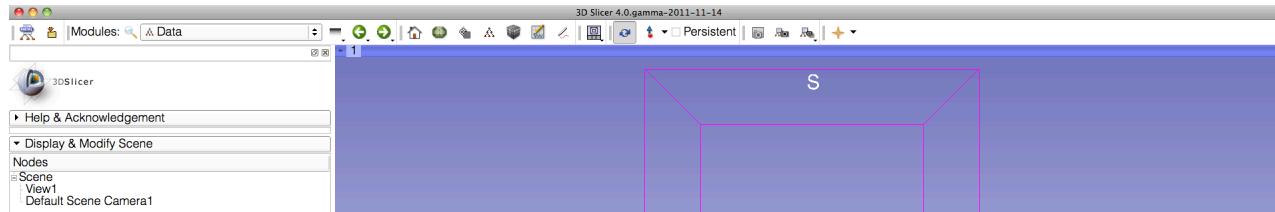
- Right Upper Lobe (RUL)
  - RUL Pulmonary Vein
  - RUL Anterior Segment
  - RUL Apical Segment
  - RUL Posterior Segment
- Right Middle Lobe (RML)
  - RML Pulmonary Vein 1 & 2
  - RML Lateral Segment
  - RML Medial Segment
- Right Lower Lobe (RLL)
  - RLL Pulmonary Vein 1,2,3
  - RLL Anterior Basal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

# Loading the Chest Data Scene





# Loading the Lung Scene



Click on Choose Files and browse to the directory

**C:\Pujol2012\3DVisualization\_Tuesday\_Nov27\_2012**

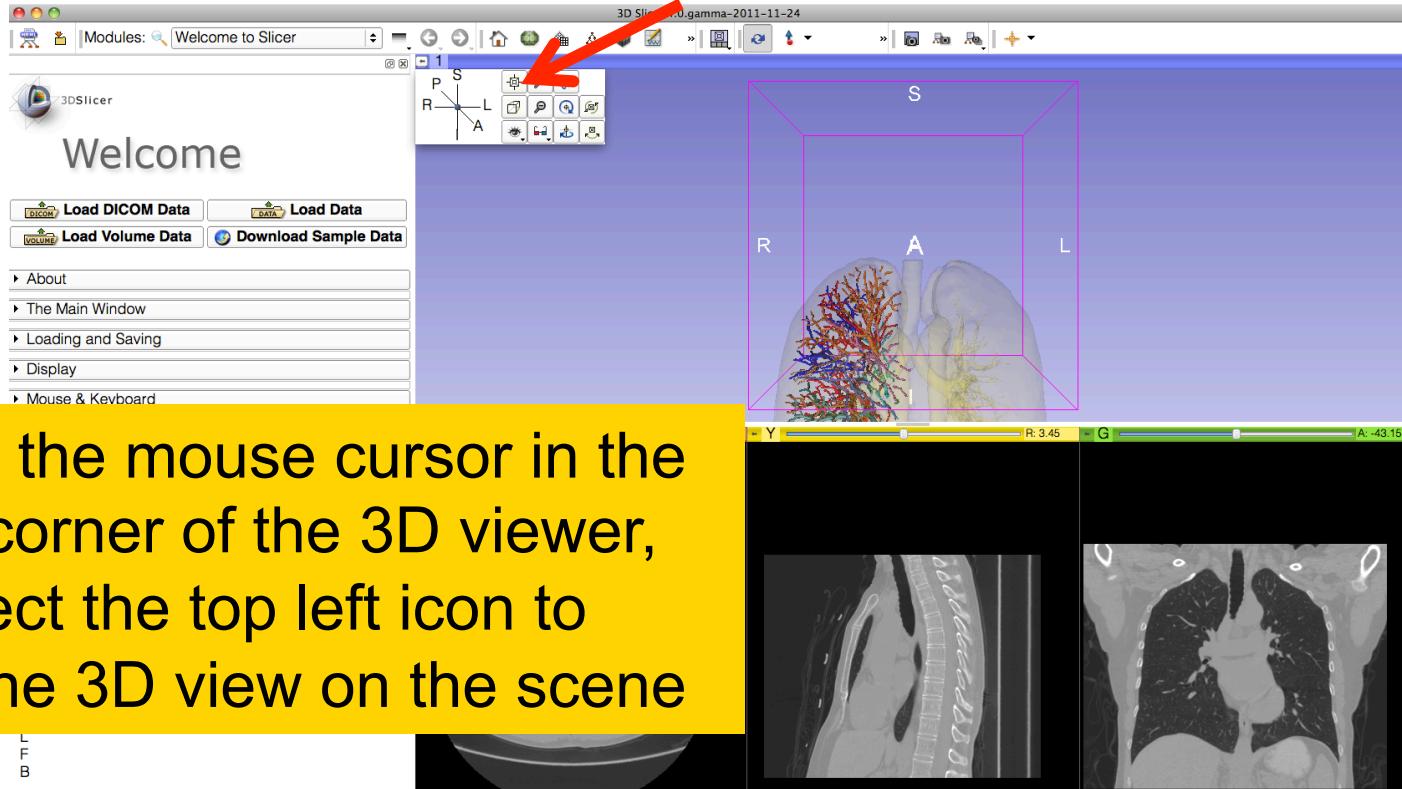
Select the subdirectory dataset4\_CT-Chest

Select the file **LungSegment\_Scene.mrml**

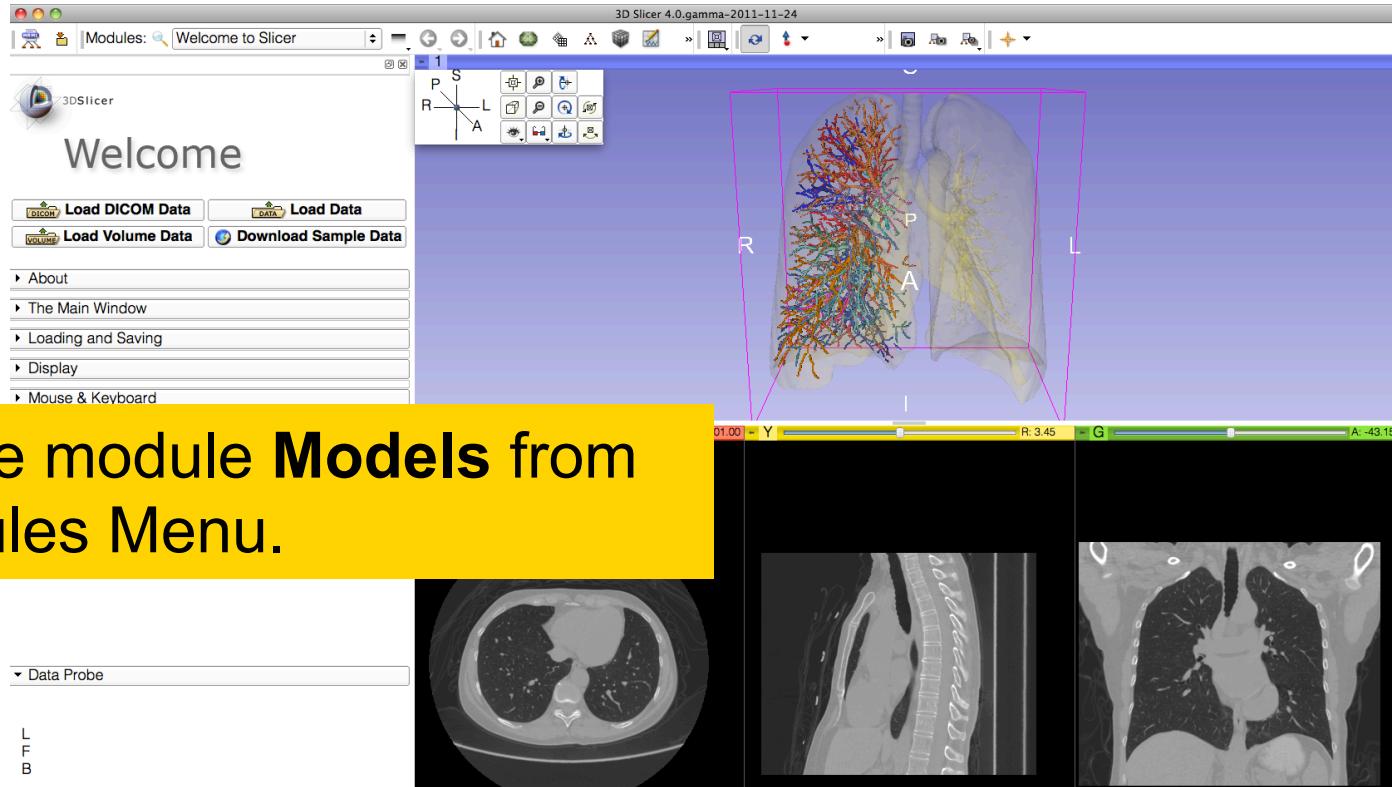
Click on Open

Click on OK to load the scene in Slicer

# Loading the Lung Scene

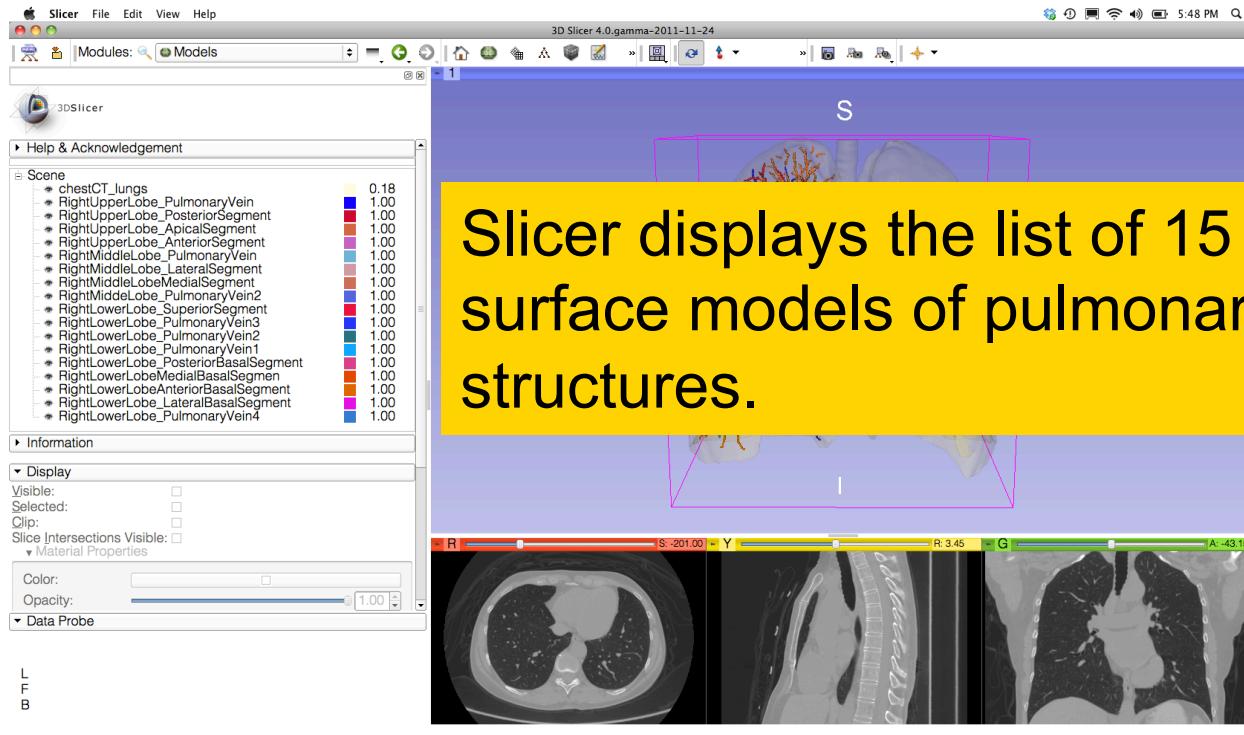


# Loading the Lung Scene

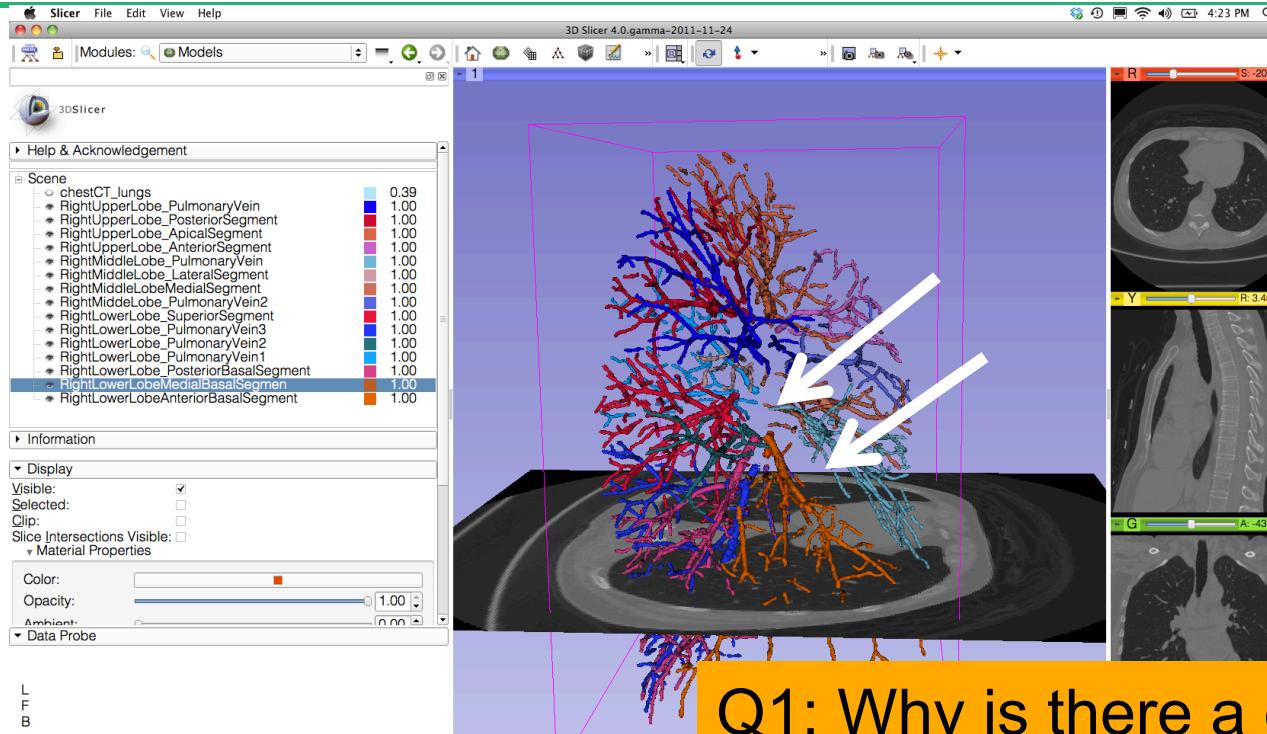




# Lung Segments

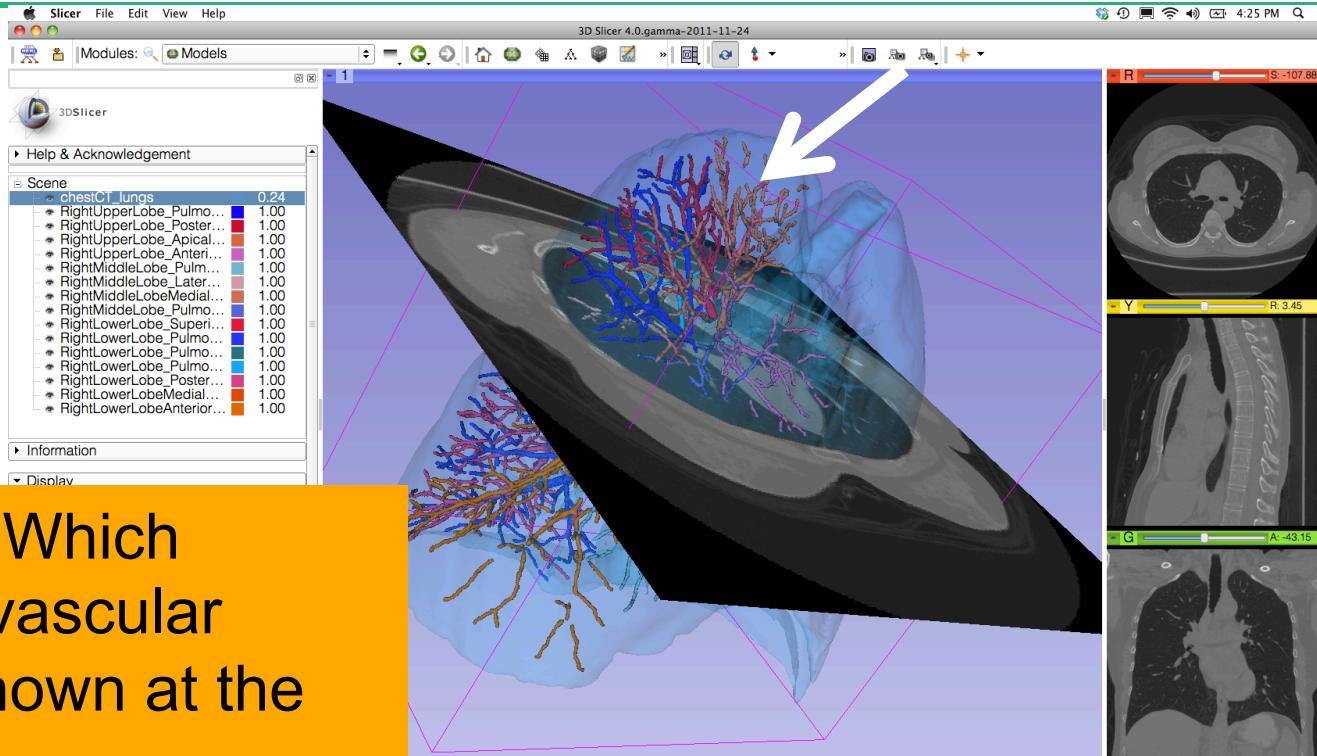


# Lung Segments – Question 1



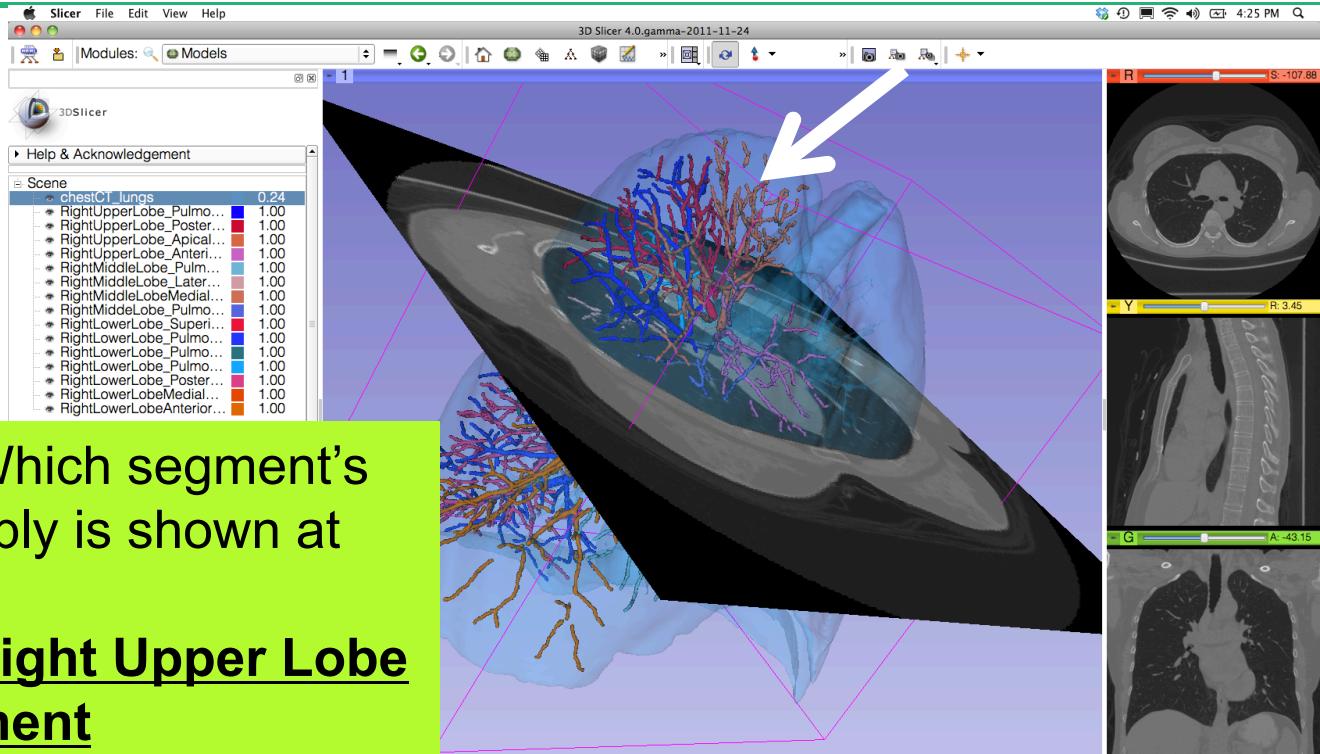
Q1: Why is there a gap in the vessels at the arrows?

# Lung Segments – Question 2



Question 2: Which segment's vascular supply is shown at the arrow?

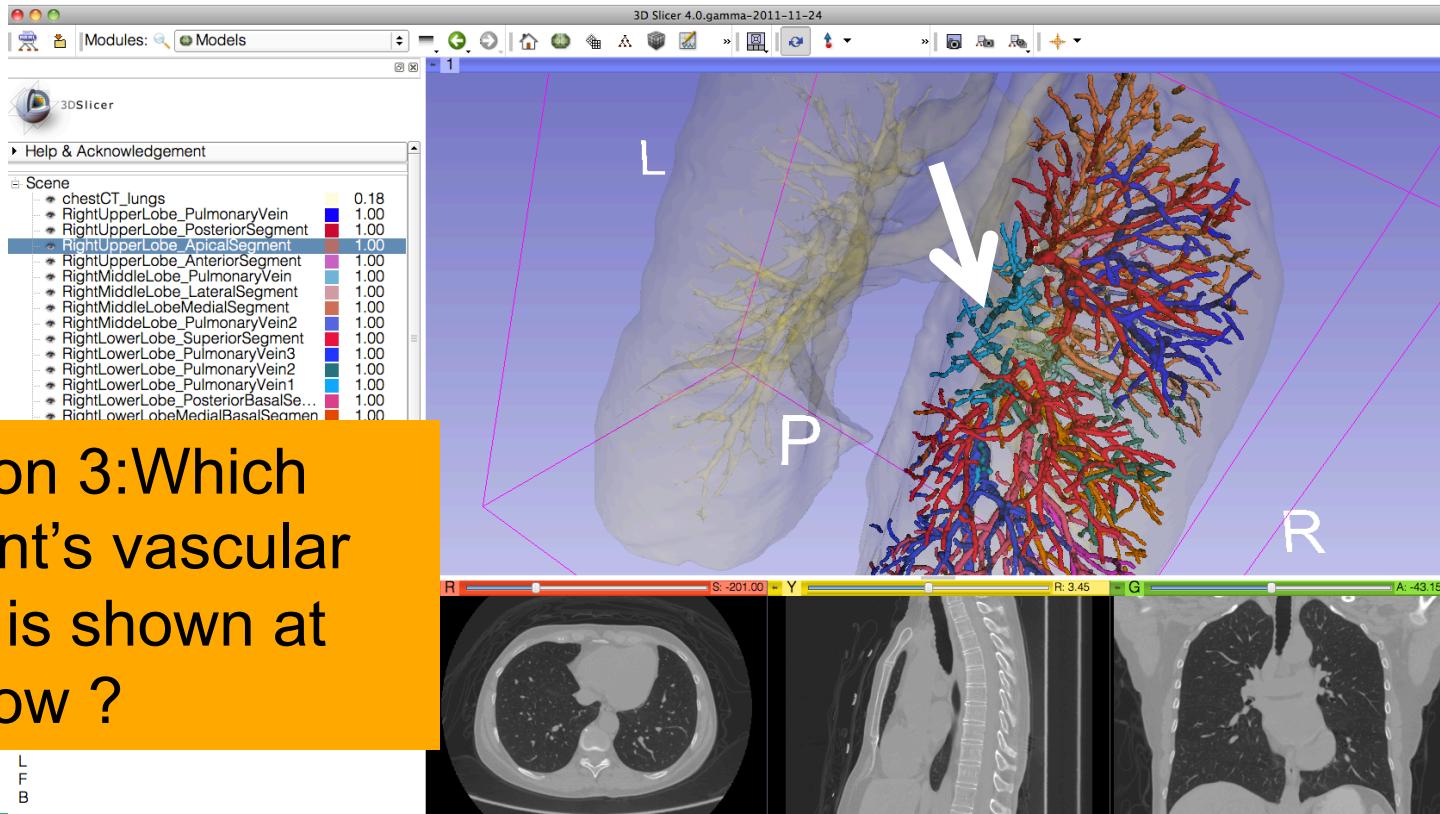
# Lung Segments – Question 2



Question 2: Which segment's vascular supply is shown at the arrow?

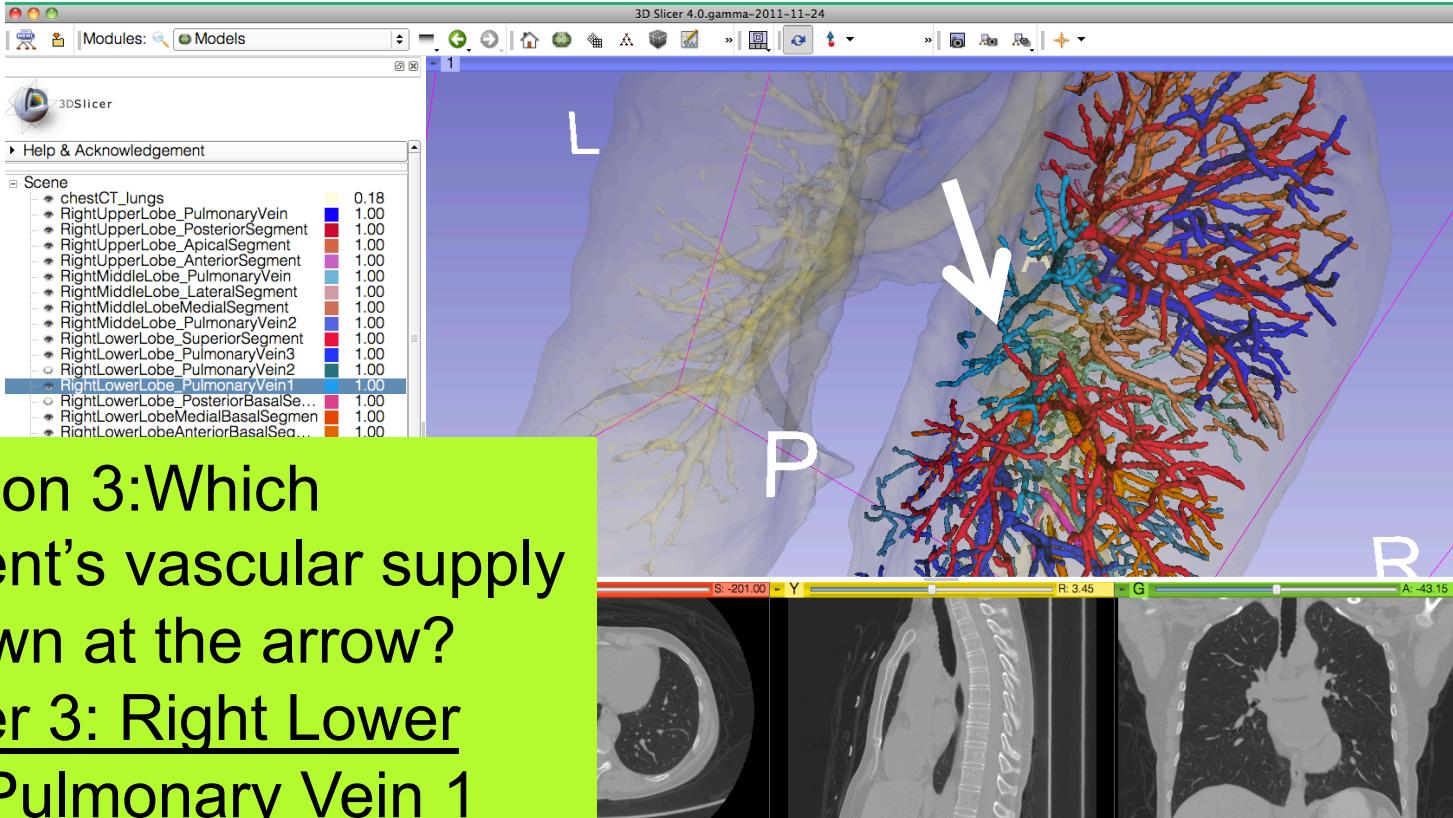
**Answer 2: Right Upper Lobe Apical Segment**

# Lung Segments – Question 3



Question 3: Which segment's vascular supply is shown at the arrow ?

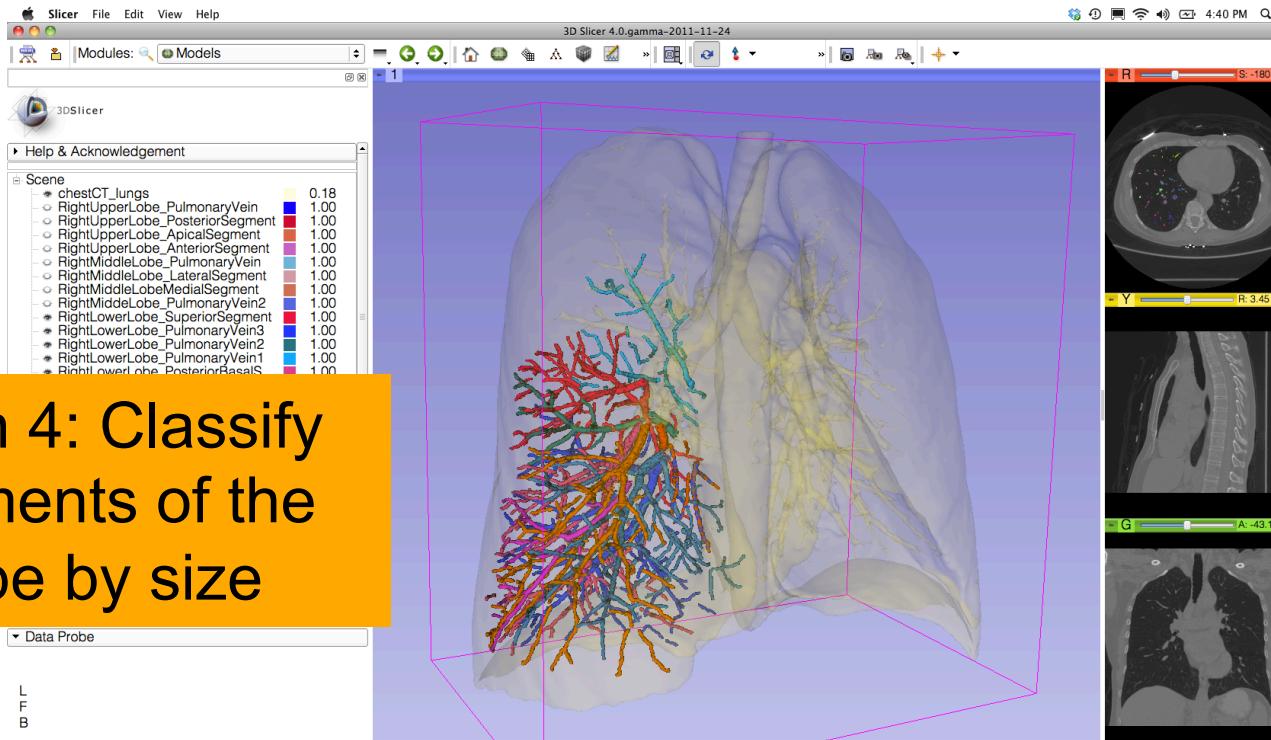
# Lung Segments – Question 3



Question 3: Which segment's vascular supply is shown at the arrow?  
Answer 3: Right Lower Lobe Pulmonary Vein 1

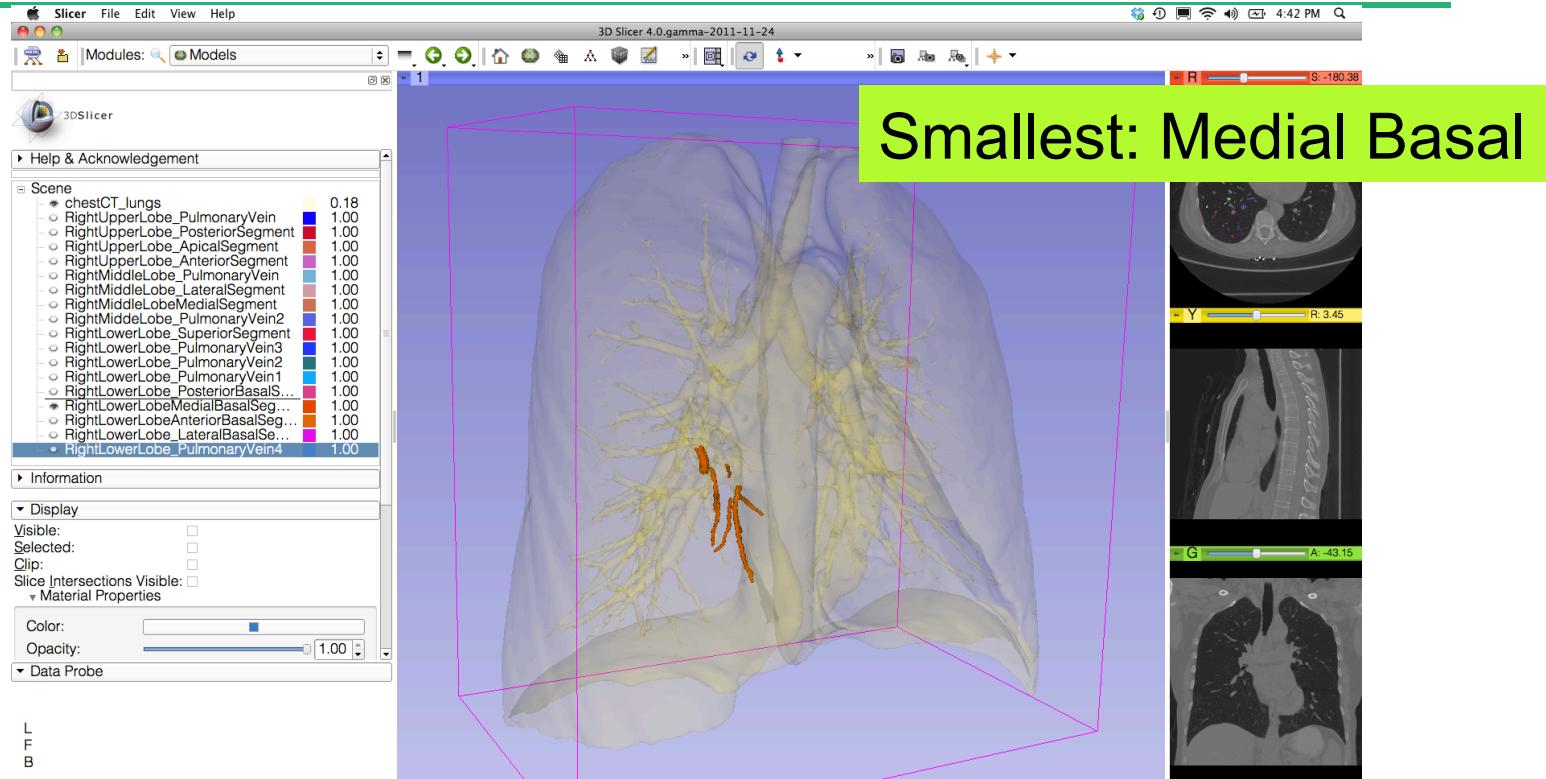
# Lung Segments – Question 4

## Question 4: Classify the segments of the lower lobe by size

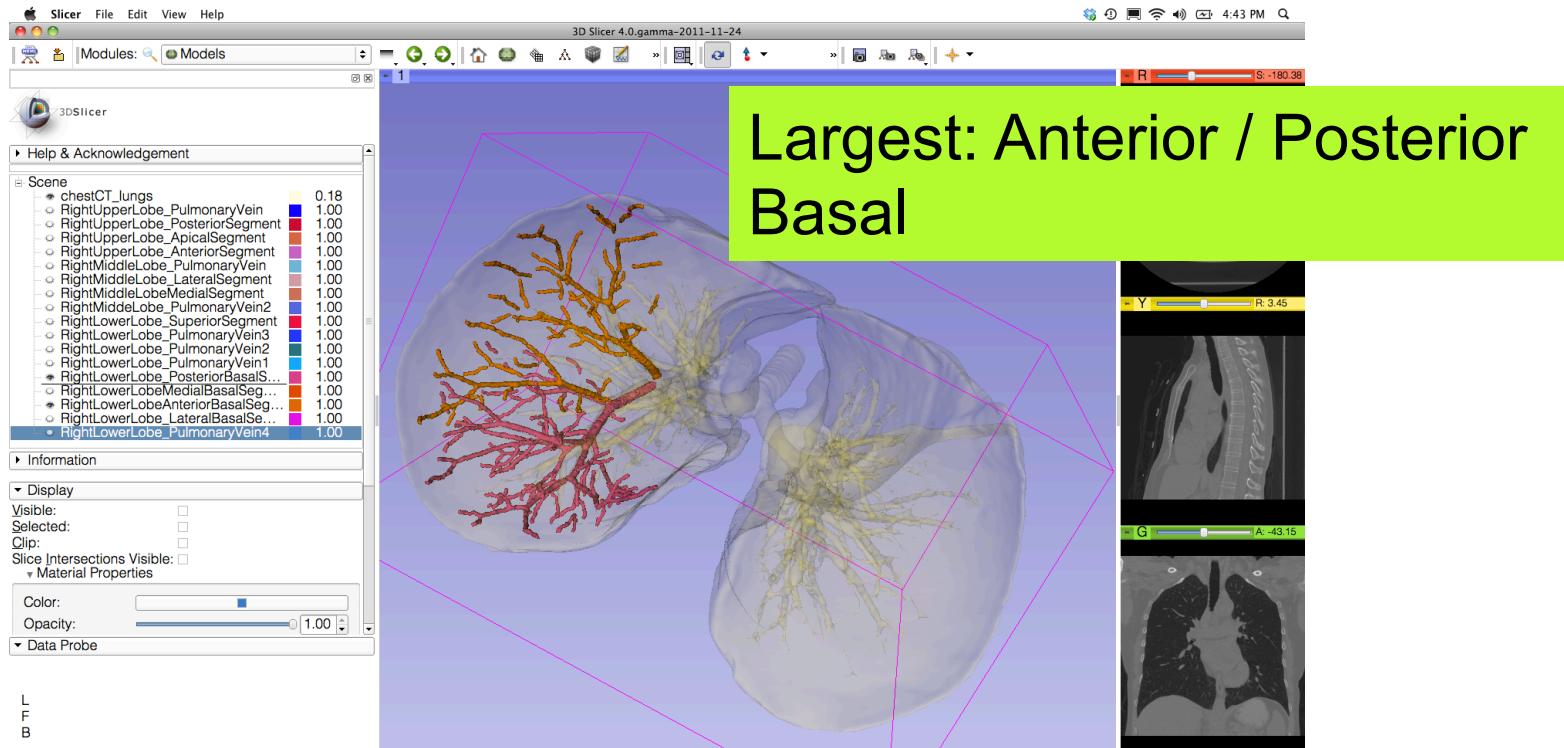




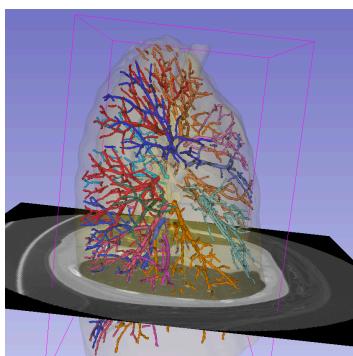
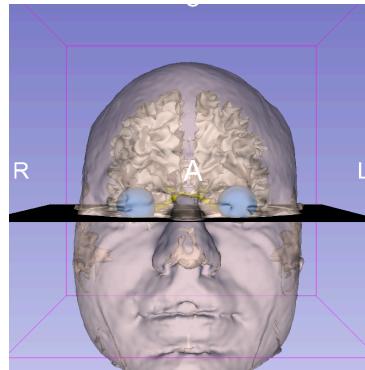
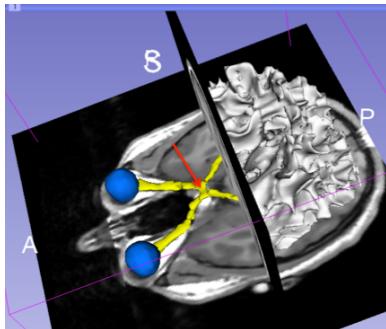
# Lung Segments – Question 4



# 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



# Acknowledgments

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National Alliance for Medical Image Computing (NA-MIC)  
(NIH Grant U54EB005149)



Neuroimage Analysis Center (NAC)  
(NIH Grant P41 RR013218)

Marianna Jakab, Surgical Planning Laboratory, Brigham  
and Women's Hospital



# 3DSlicer website

The screenshot shows the official 3DSlicer website. At the top left is the 3DSlicer logo. To its right, the text reads: "A multi-platform, **free and open source** software package for **visualization** and **medical image computing**". Below this are four navigation buttons: "Download", "Tutorial", "Feedback", and "Documentation". On the left side, there's a sidebar with sections for "Slicer Wiki", "About Slicer" (with links to Introduction, Acknowledgments, and Contact Us), and "Resources" (with links to Download, For Users, For Developers, Commercial Use, NCIA, Publication DB, Image Gallery, Slicer Community, Source Code, Licensing, Mailing Lists, and Web Archive). The main content area features three large image thumbnails: "Powerful processing.", "Streamlined interface.", and "Extensible platform.". Below these are smaller images showing various medical image visualizations. At the bottom left is the 3DSlicer logo again, followed by "version 4". To the right is the website URL "www.slicer.org". A footer note at the bottom center states: "The community of Slicer developers is proud to announce the release of Slicer 4.2. Find out more...".



# NIH/NCI Cancer Imaging Archive Course

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The NIH/NCI Cancer Imaging Archive (TCIA): A Comprehensive Source of DICOM Imaging Data for Research

C. Carl Jaffe MD, John B. Freymann BS, Justin Kirby, Fred William Prior, PhD, Lawrence R. Tarbox PhD

Wed. Nov. 28, 10:30 am – 12:00 pm SCD 401

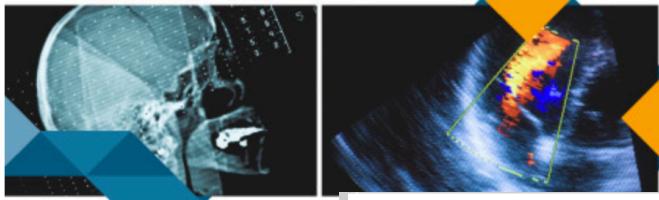


# Upcoming Slicer courses



9 - 14 February 2013  
Disney's Coronado Springs Resort  
Lake Buena Vista (Orlando Area),  
Florida, United States

**View the program online and register today**



Plan to attend this multidisciplinary, international, cutting-edge research and development meeting where you are presenting to your peers, or you will enhance your research, this conference

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**CARS 2013**  
June 26–29, 2013  
Heidelberg, Germany

search

## CARS 2013

Computer Assisted Radiology and Surgery  
27<sup>th</sup> International Congress and Exhibition

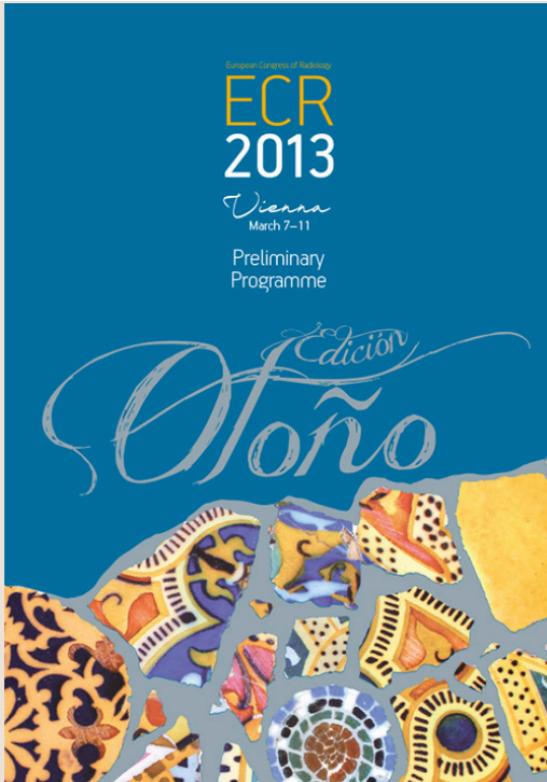
©2012-2013



**Important Notes:**

Download the  
2nd Announcement [here](#)

# Upcoming Slicer courses



## ECR 2013

### Novel technology that shapes Radiology: EIBIR presents IMAGINE

The **IMAGINE sessions** give research institutes, university groups and companies a chance to present their **novel technological developments** in medical image analysis and image-guided interventions to the radiology community.

**Be part of it!** Submit your abstract to be in with a chance to present it to the right audience.

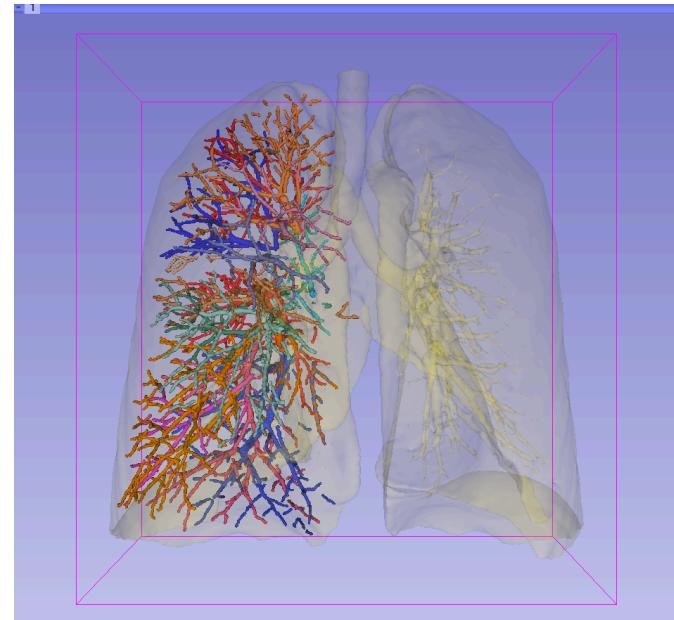
The core of the IMAGINE sessions are interactive sessions in which the presenters demonstrate their work and visitors get hands-on experience with developed techniques and tools.

The session topics will describe novel techniques in one of the following areas:

- Quantitative Image Analysis
- Computer-aided Diagnosis
- Image-guided Interventions
- Image Processing



[www.slicer.org](http://www.slicer.org)  
[www.na-mic.org](http://www.na-mic.org)



Questions and comments: [spujol@bwh.harvard.edu](mailto:spujol@bwh.harvard.edu)