SPL

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

a teaching affiliate of
Harvard Medical School

3D VISUALIZATION OF DICOM IMAGES FOR RADIOLOGICAL APPLICATIONS

Sonia Pujol, PhD

Brigham and Women's Hospital, Harvard Medical School
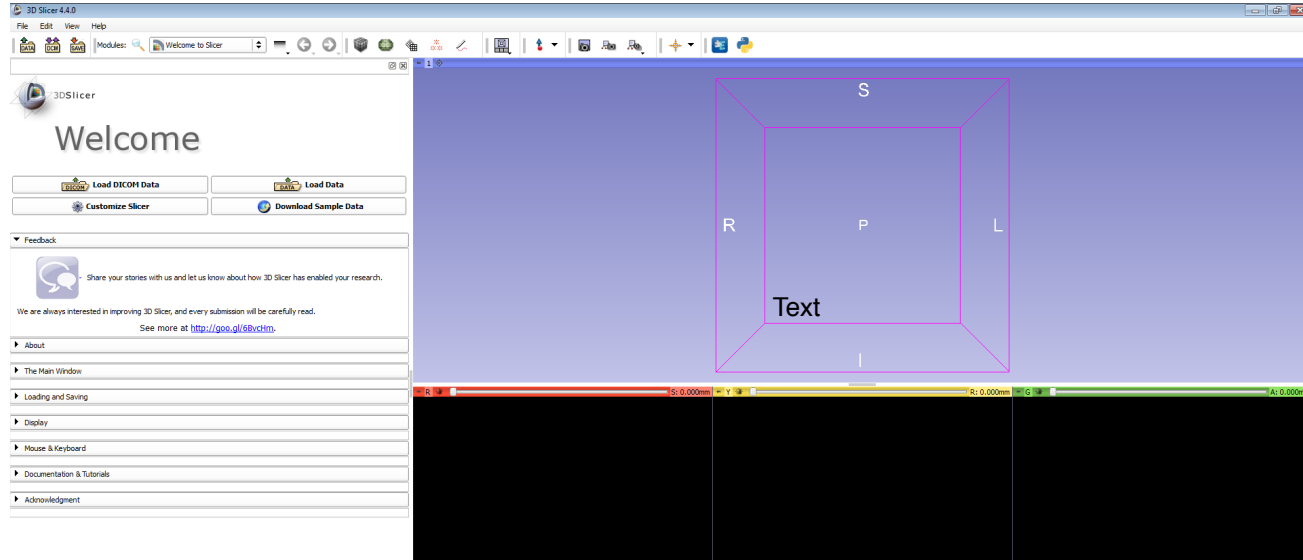
Kitt Shaffer, MD, PhD

Boston University School of Medicine

Ron Kikinis, MD,

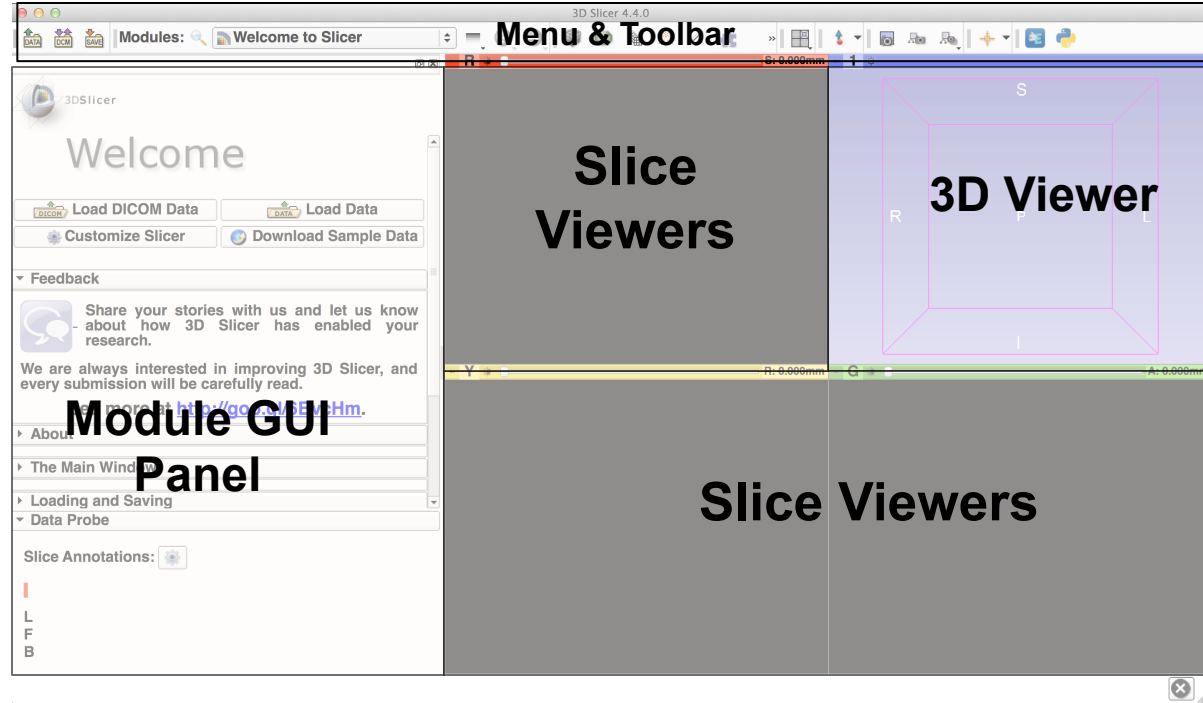Brigham and Women's Hospital, Harvard Medical School

Welcome to Slicer4

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

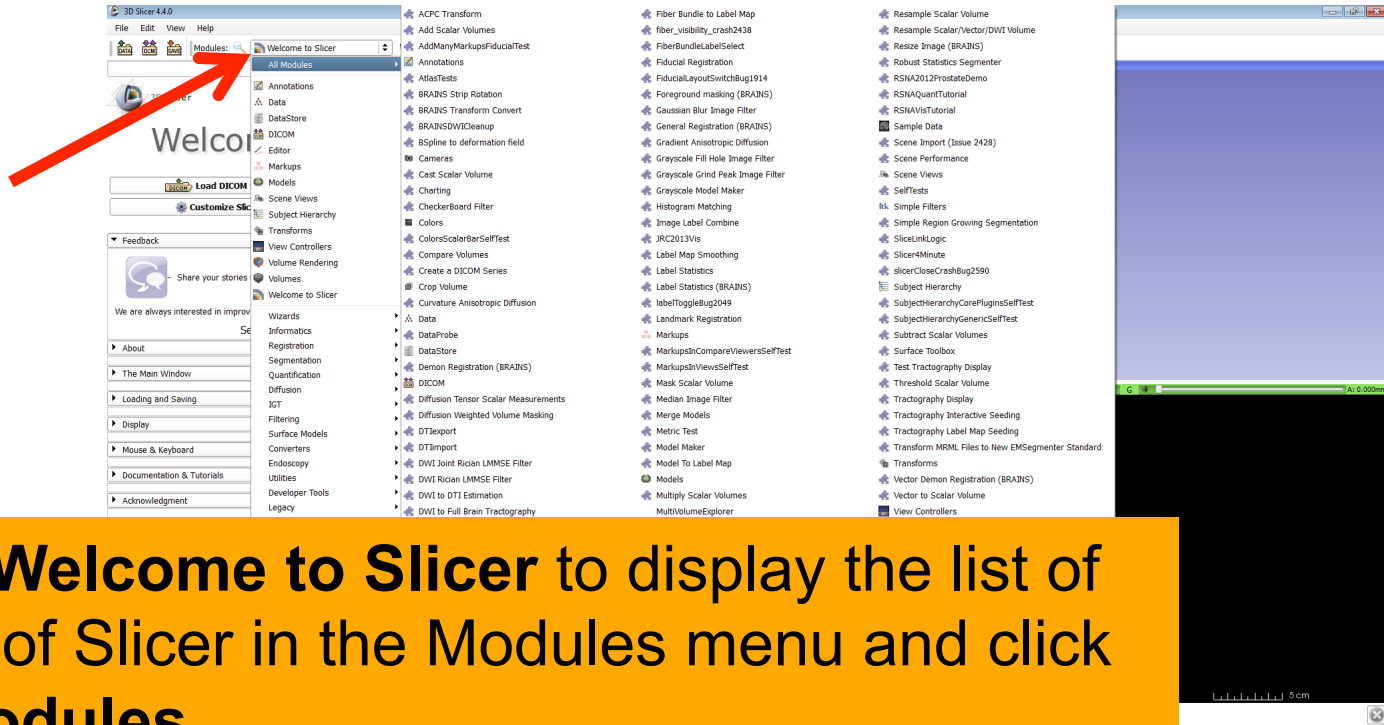# Navigating the Application GUI

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

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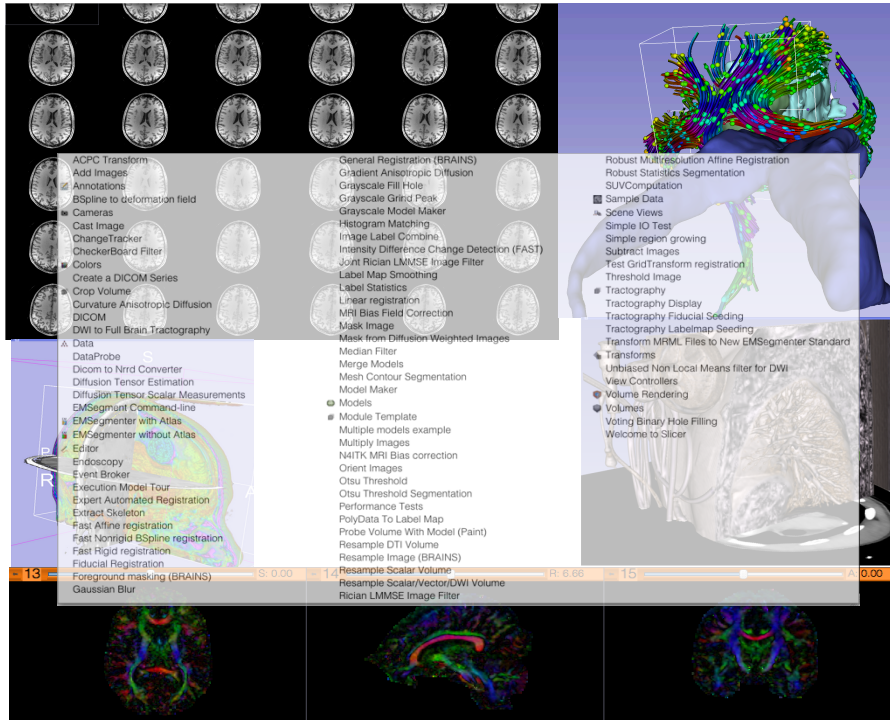- the 3D Viewer
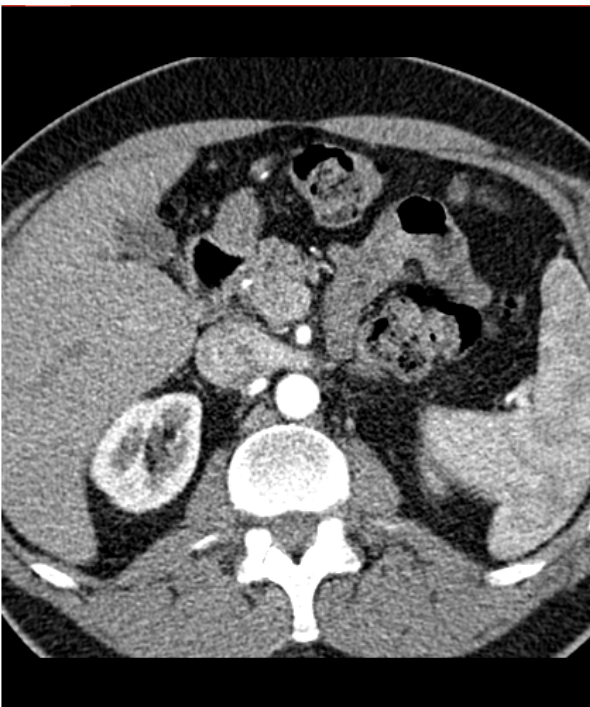- the Slice Viewers

Welcome to Slicer4.4

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

Welcome to Slicer4.4

Slicer4.4 contains more than 100 modules for image segmentation, registration and 3D visualization of medical imaging data
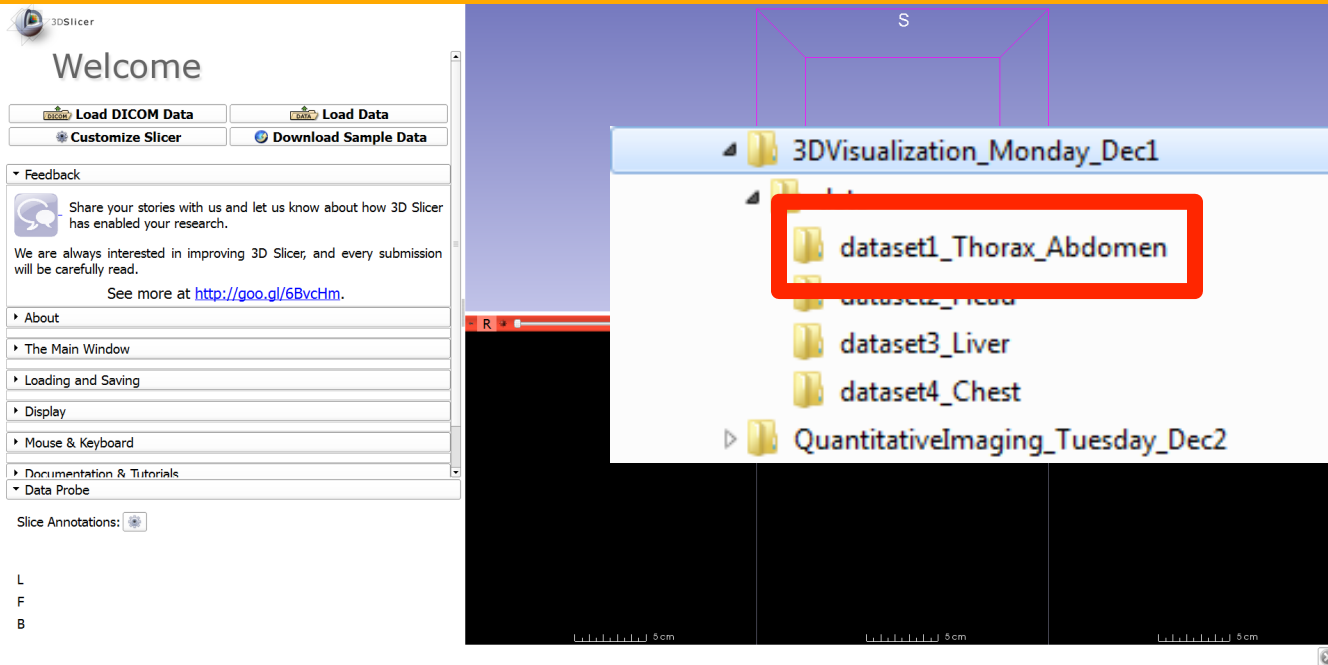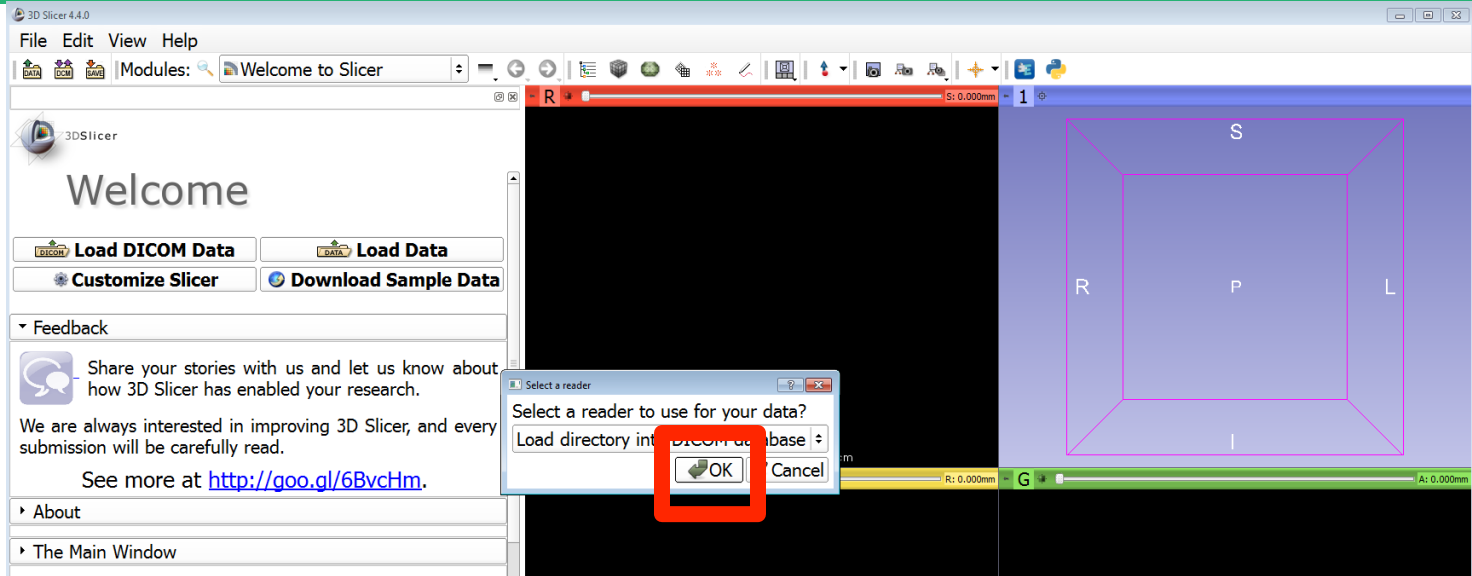
Part 1:

Loading a DICOM Volume

Loading a DICOM volume

Drag and drop the directory **'dataset1_Thorax_Abdomen'** into Slicer
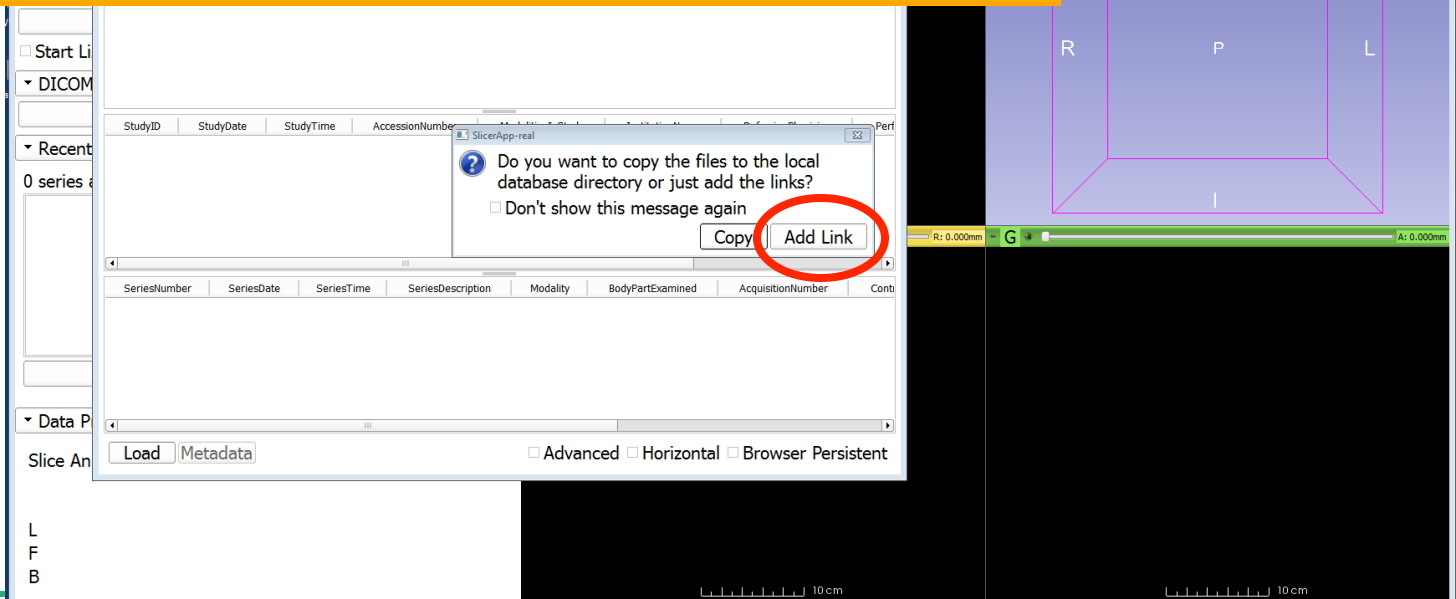
Loading a DICOM volume

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

Loading a DICOM volume

The **DICOM Browser** appears

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

Loading a DICOM volume

Slicer starts importing the DICOM images from the directory

Loading a DICOM volume

Loading a DICOM volume

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

Select the DICOM volume **CT_Thorax_Abdomen**

Click on **Load** to load the DICOM volume into Slicer
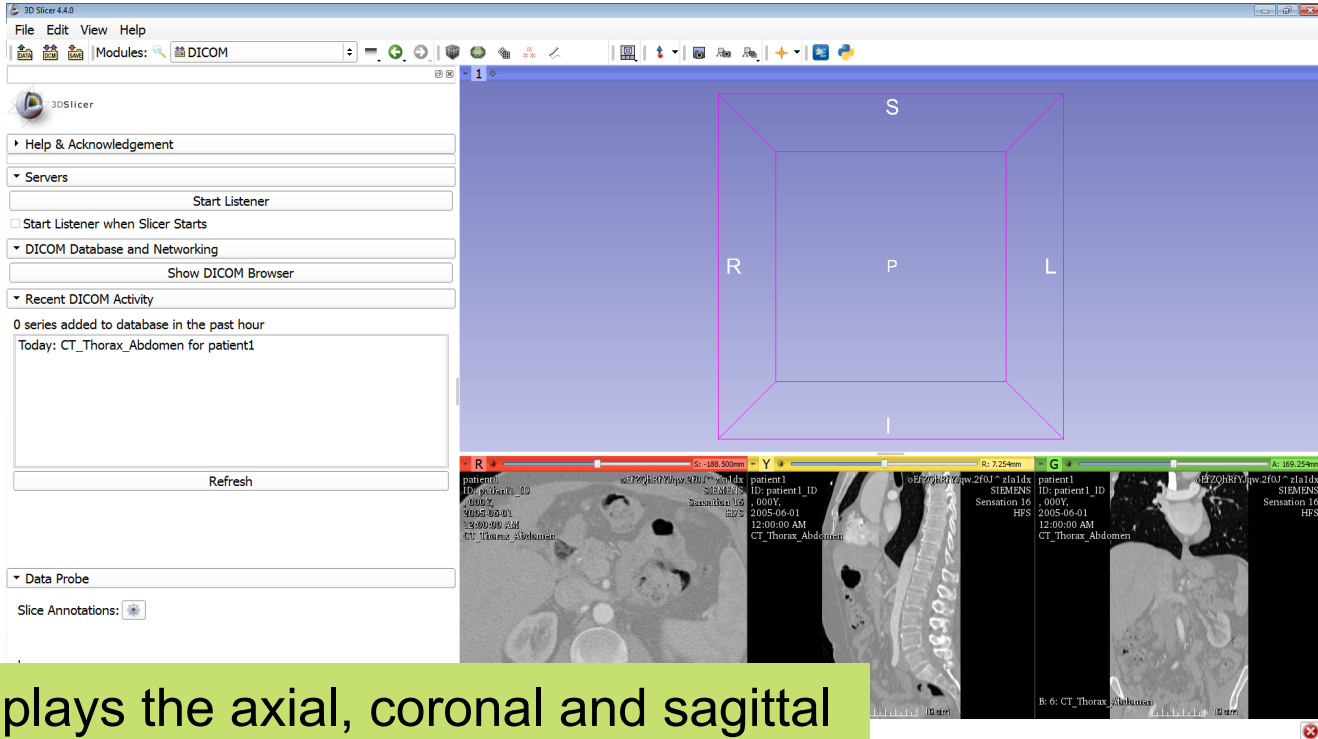
Loading a DICOM volume
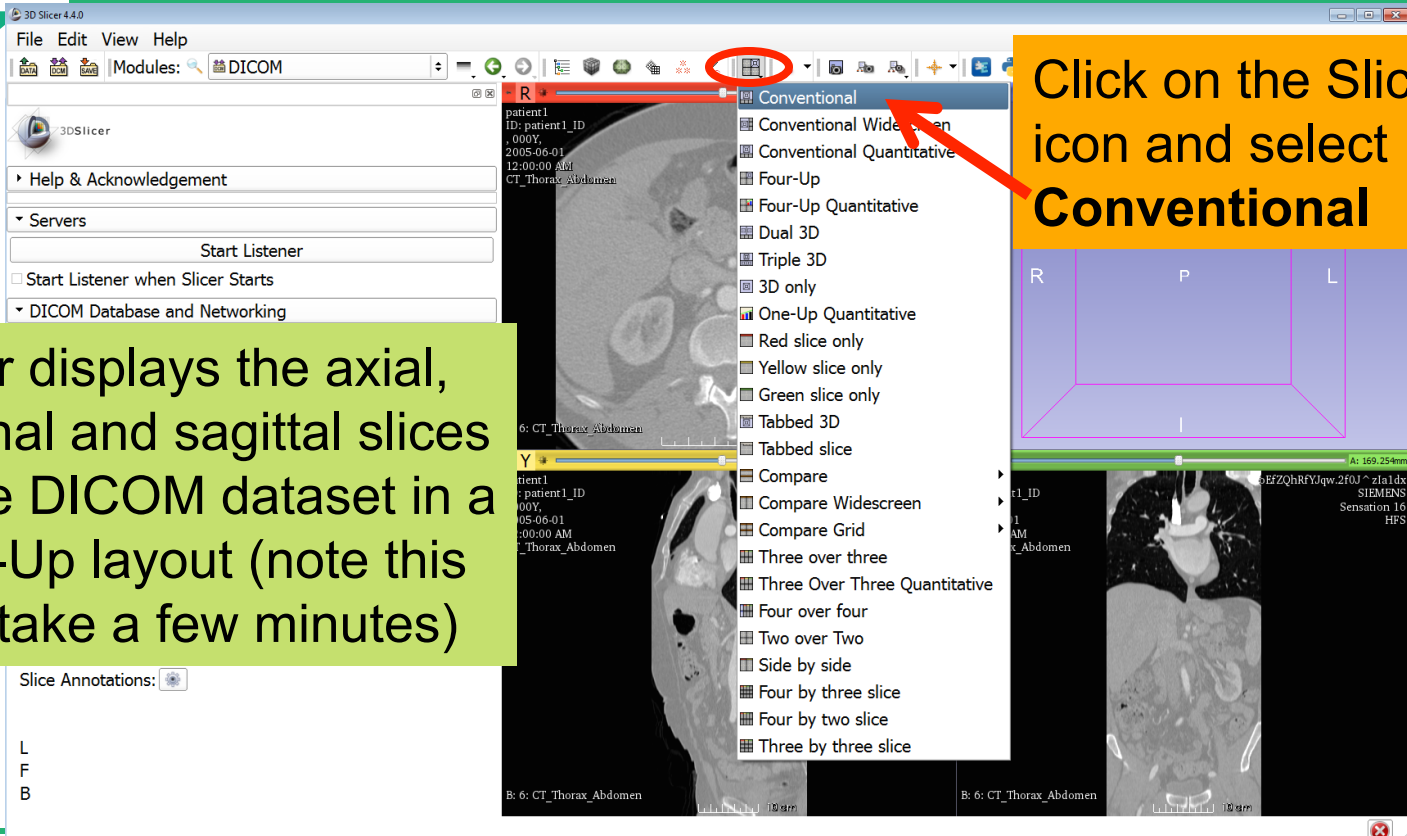
Click on the Slicer layout icon and select **Conventional**

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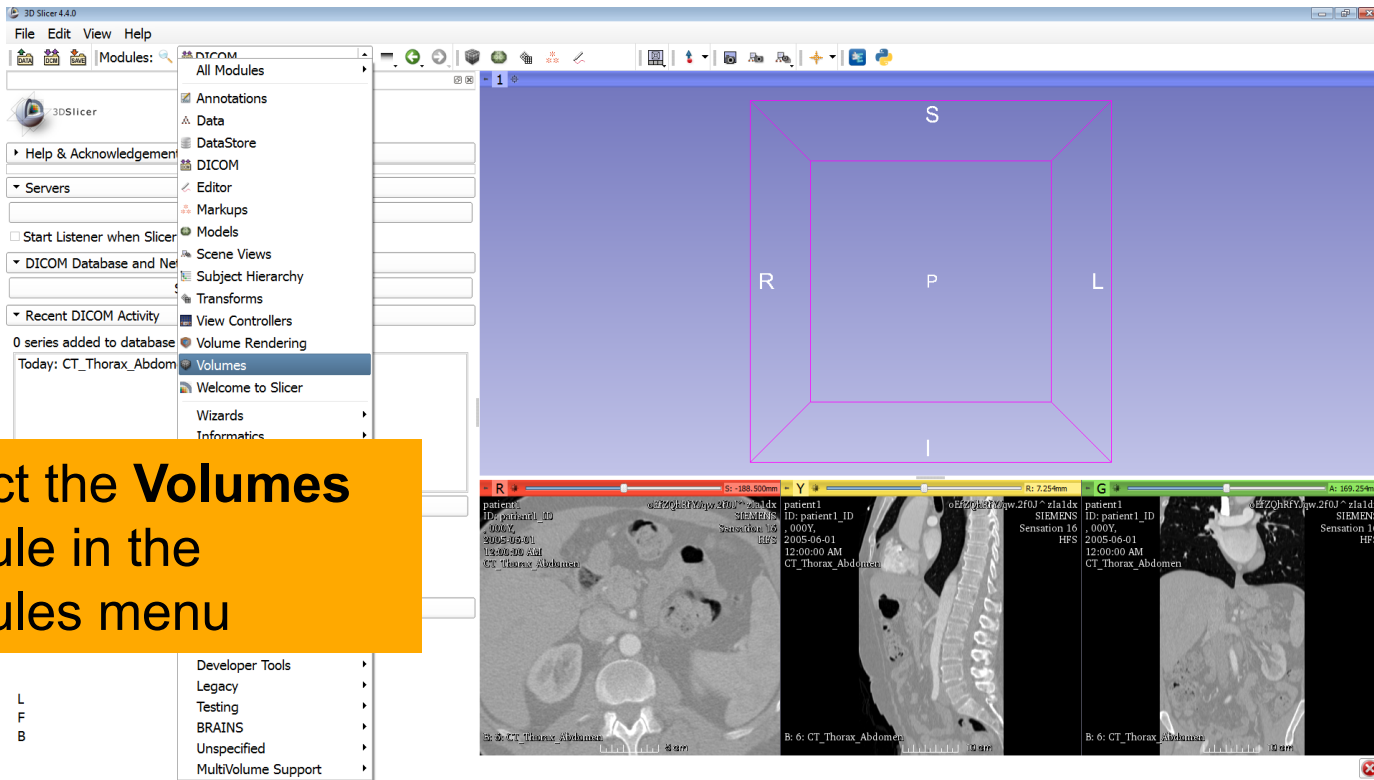
Loading a DICOM volume

Slicer displays the axial, coronal and sagittal slices in conventional viewer mode
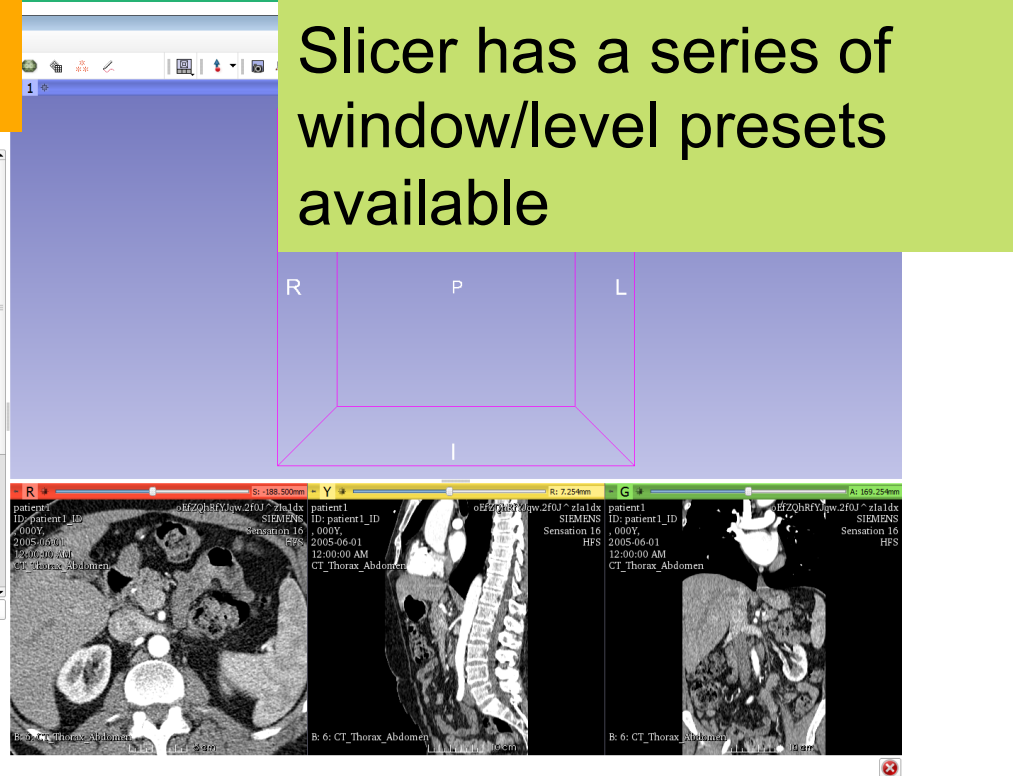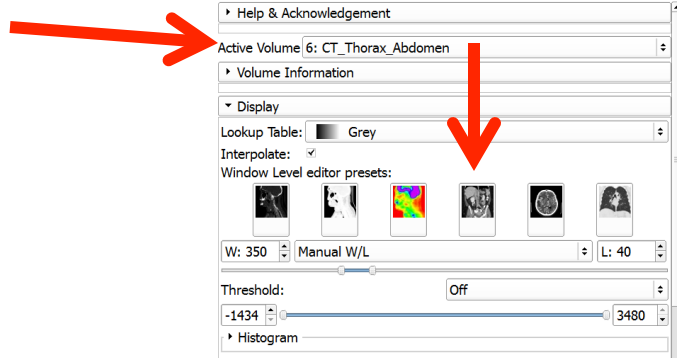
Loading a DICOM volume

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

Loading a DICOM volume

Select the Active Volume **6:CT_Thorax_Abdomen**

Slicer has a series of window/level presets available

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

Loading a DICOM volume

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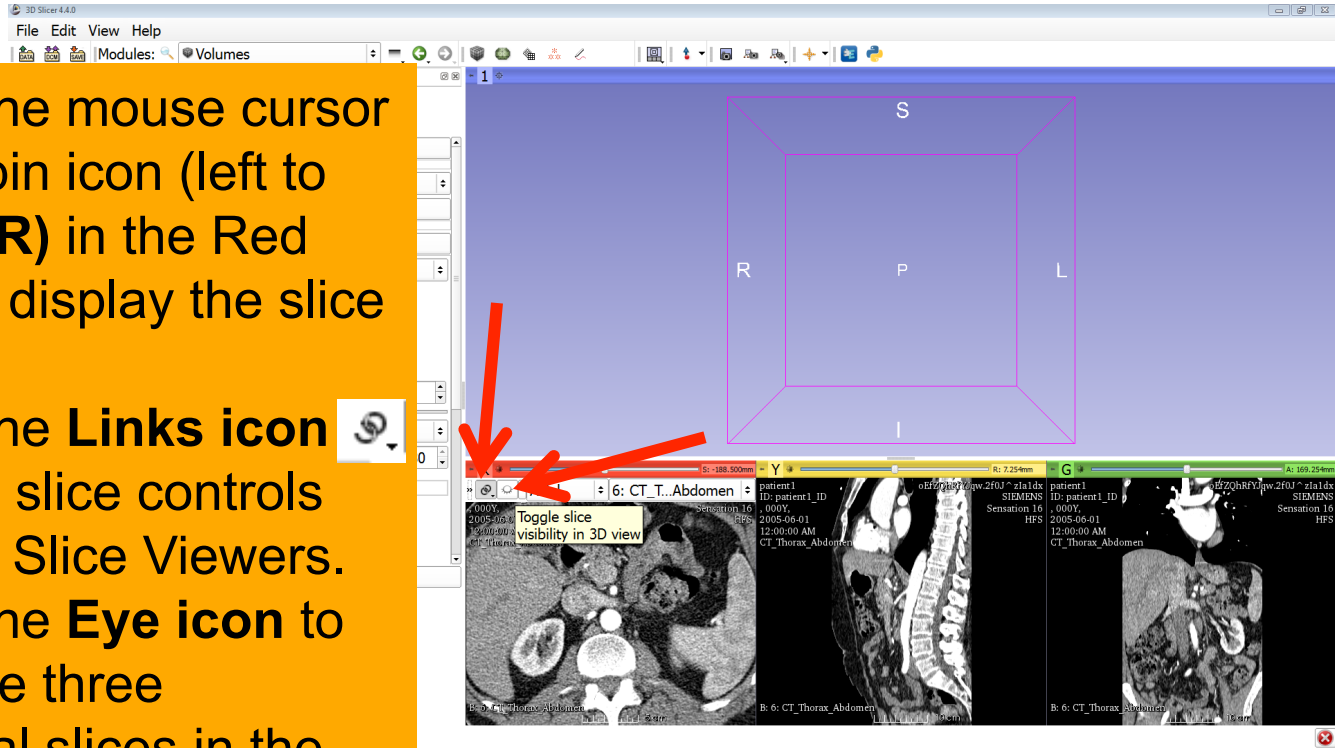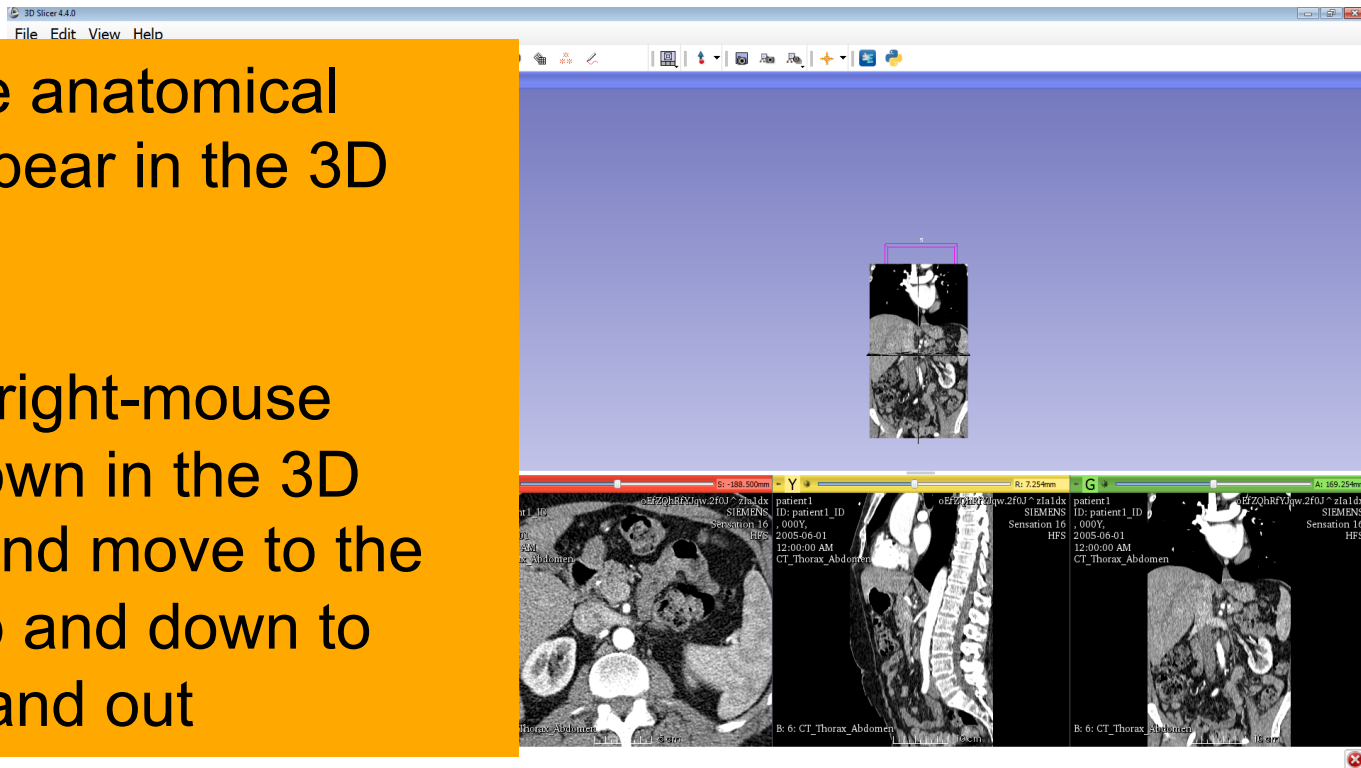
Loading a DICOM volume

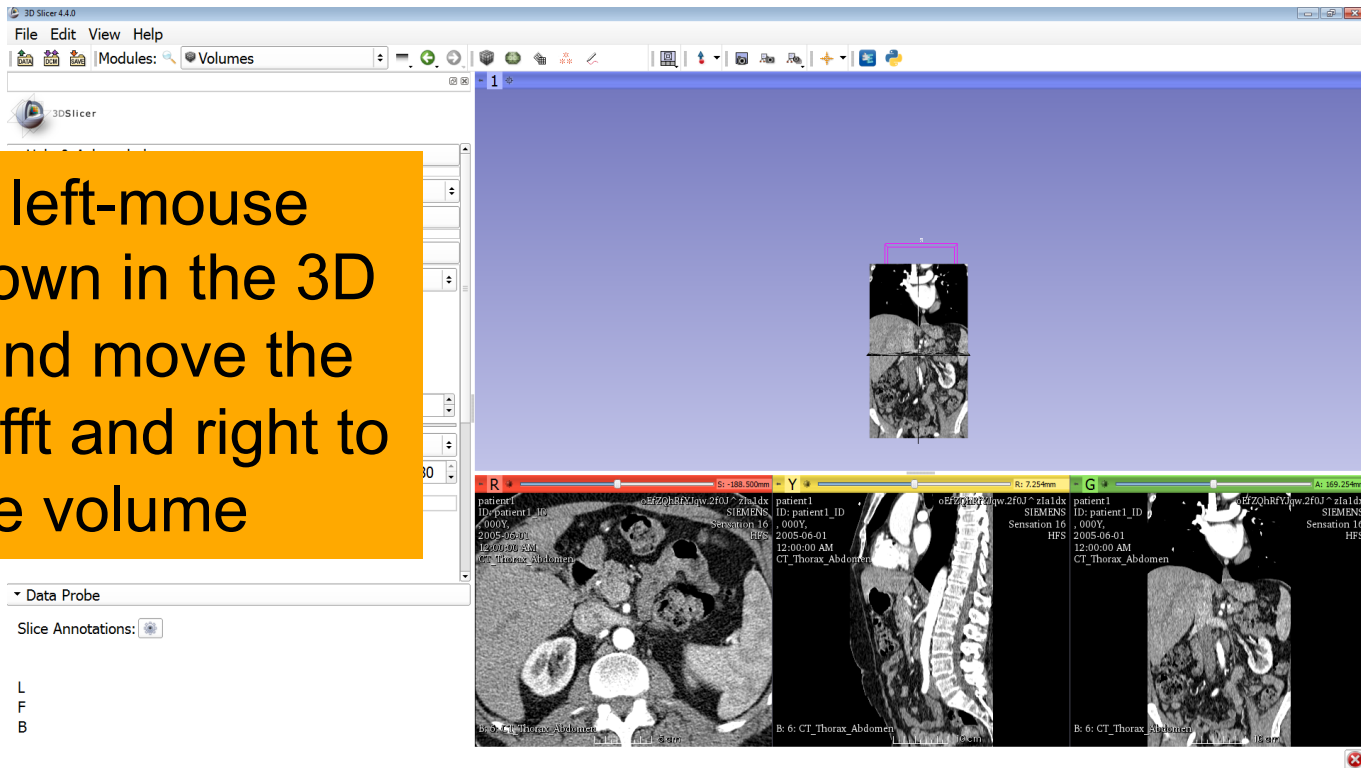The three anatomical slices appear in the 3D viewer.

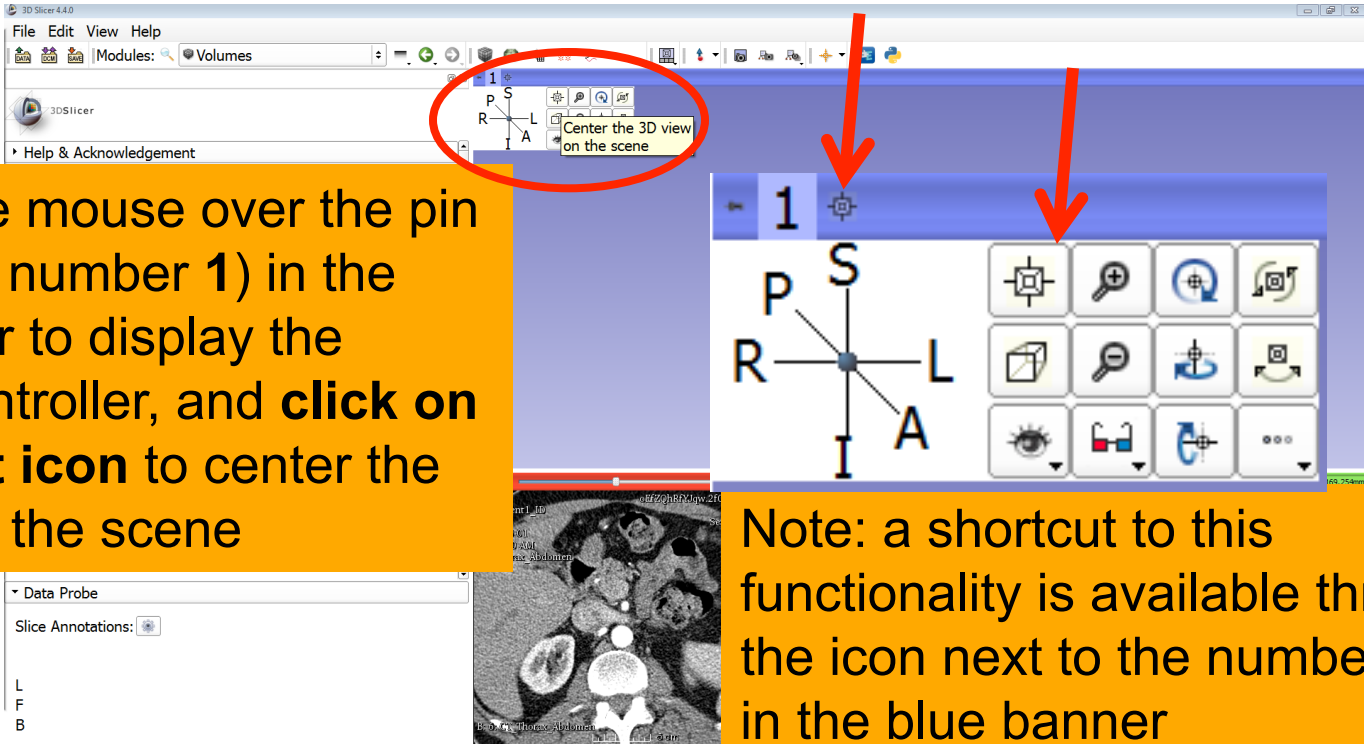Hold the right-mouse button down in the 3D Viewer, and move to the cursor up and down to zoom in and out

Loading a DICOM volume

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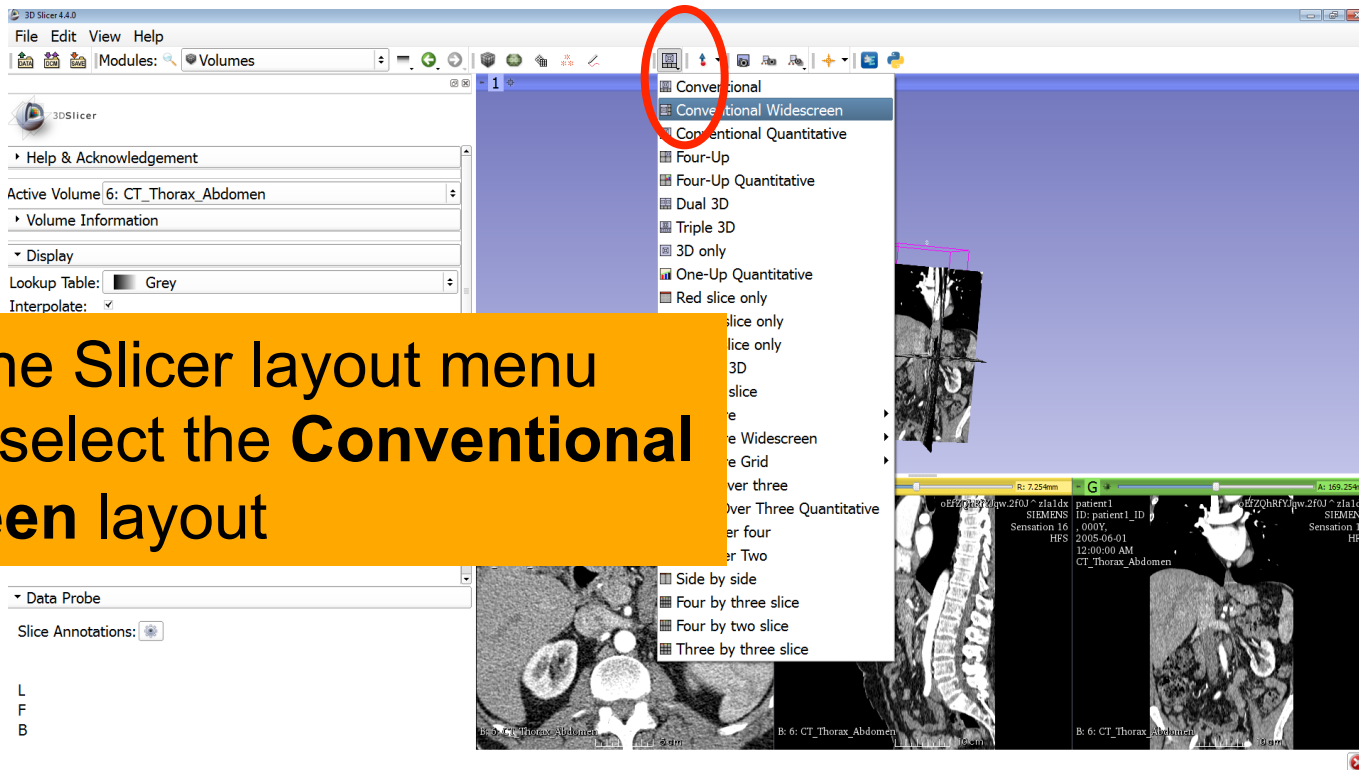
Loading a DICOM volume

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

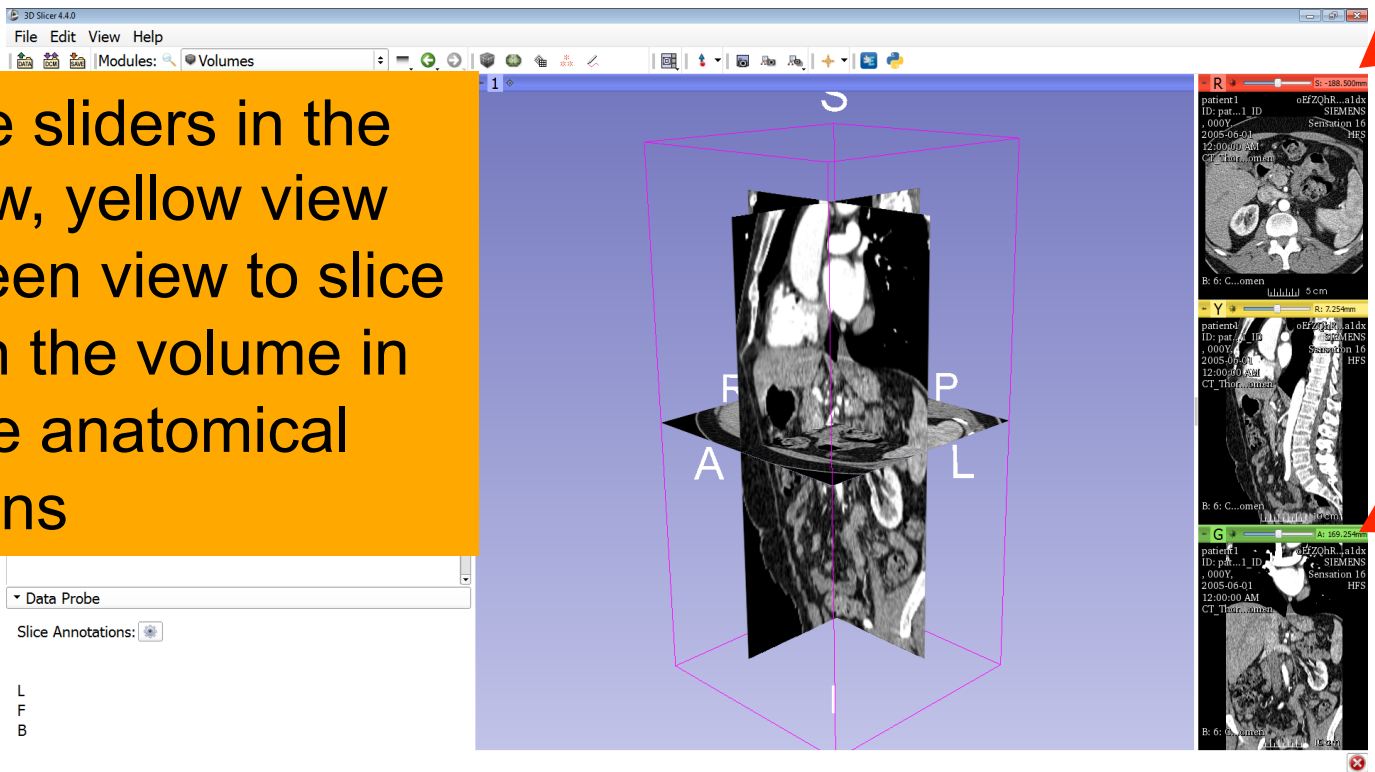Note: a shortcut to this functionality is available through the icon next to the number '1' in the blue banner
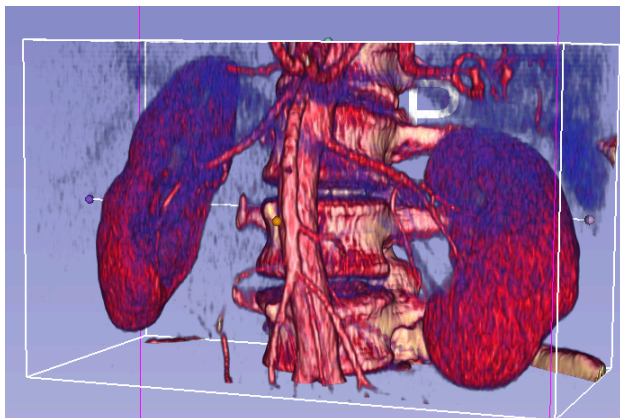
Loading a DICOM volume

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

Loading a DICOM volume

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

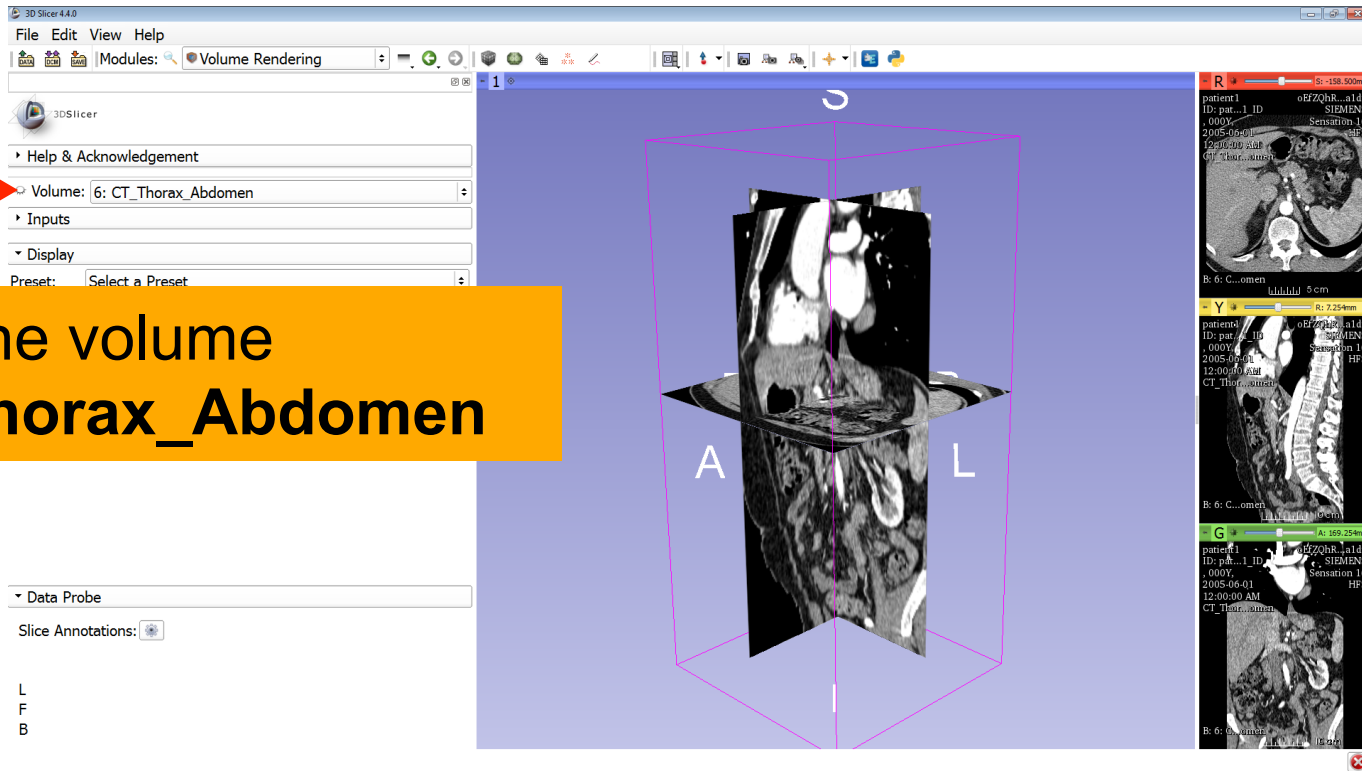3D Interactive exploration of thoraco-abdominal CT data using Volume Rendering

Volume Rendering

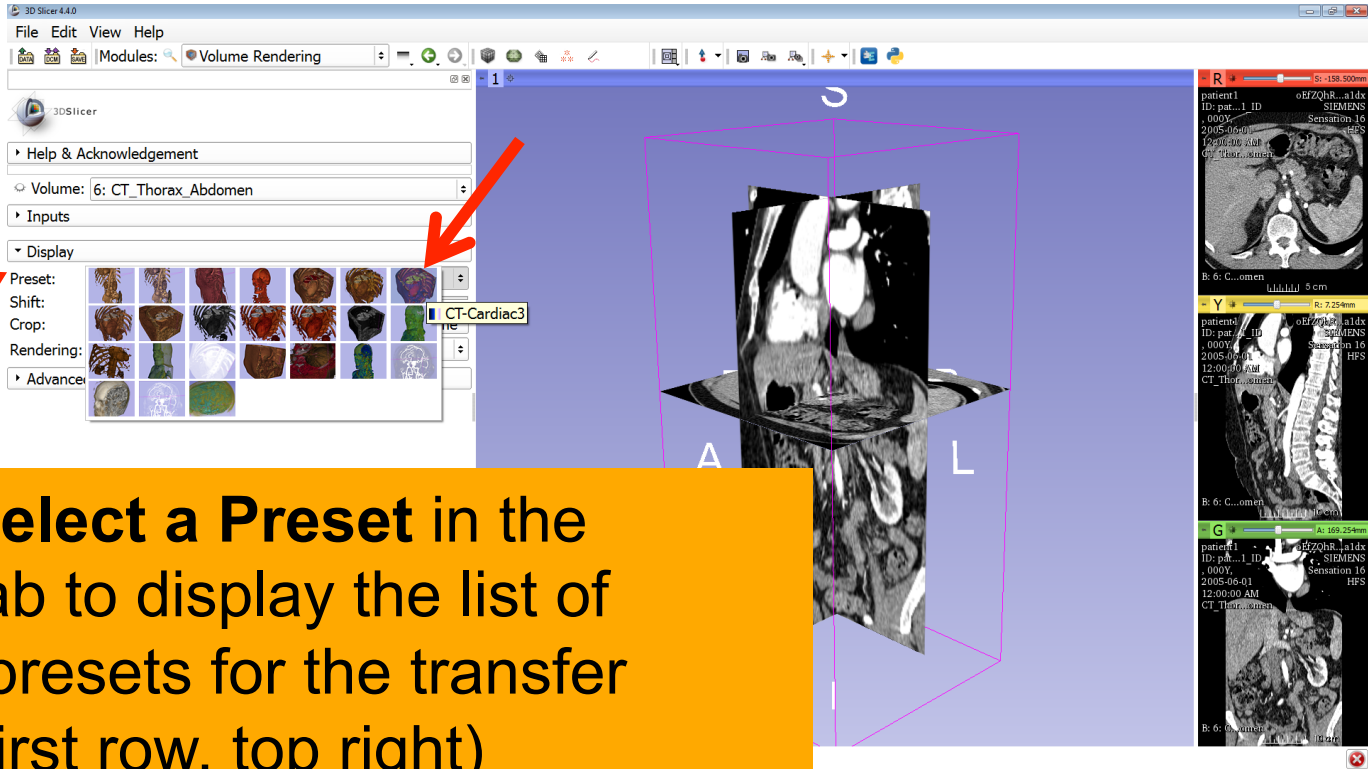Select the module **Volume Rendering** in the modules menu
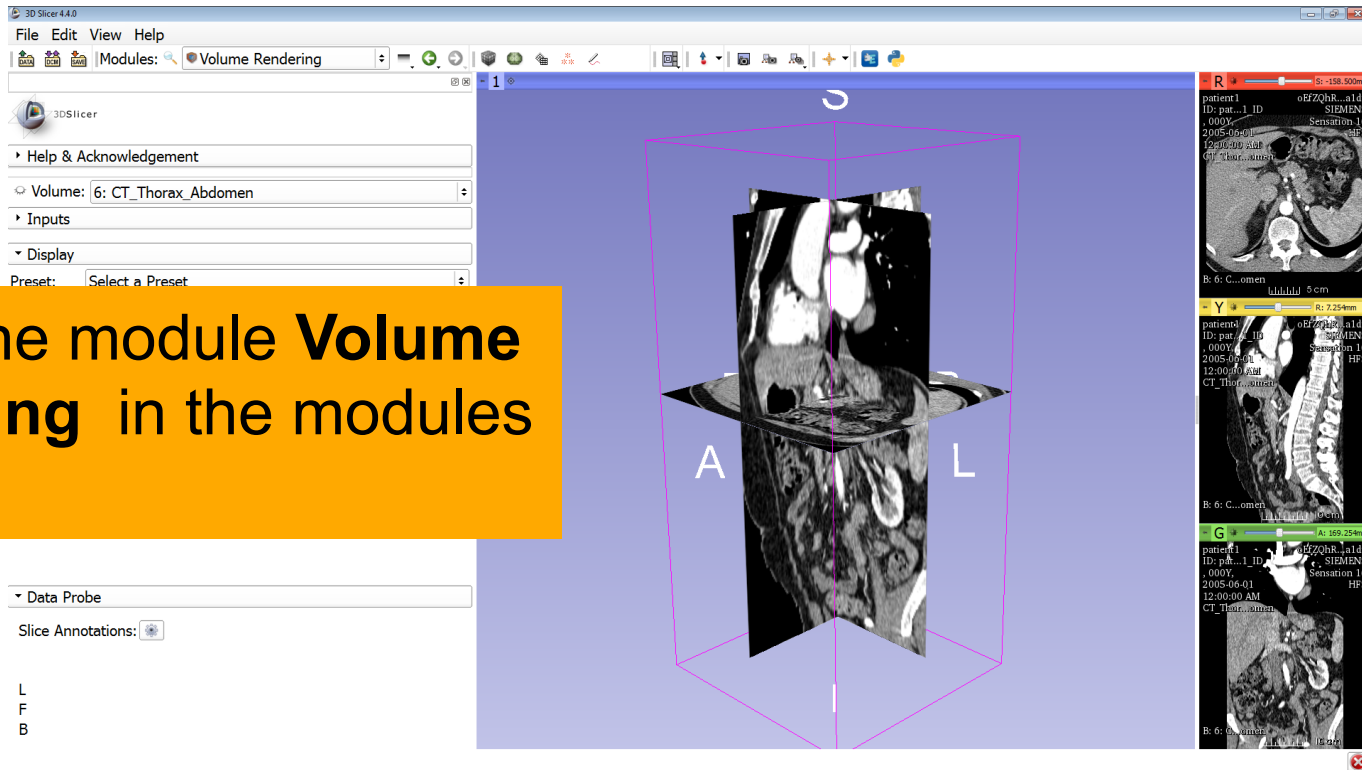
Volume Rendering

Select the volume
6:CT_Thorax_Abdomen

Volume Rendering

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

Volume Rendering

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

Volume Rendering

Click on the eye icon next to Volume to display the volume rendered image
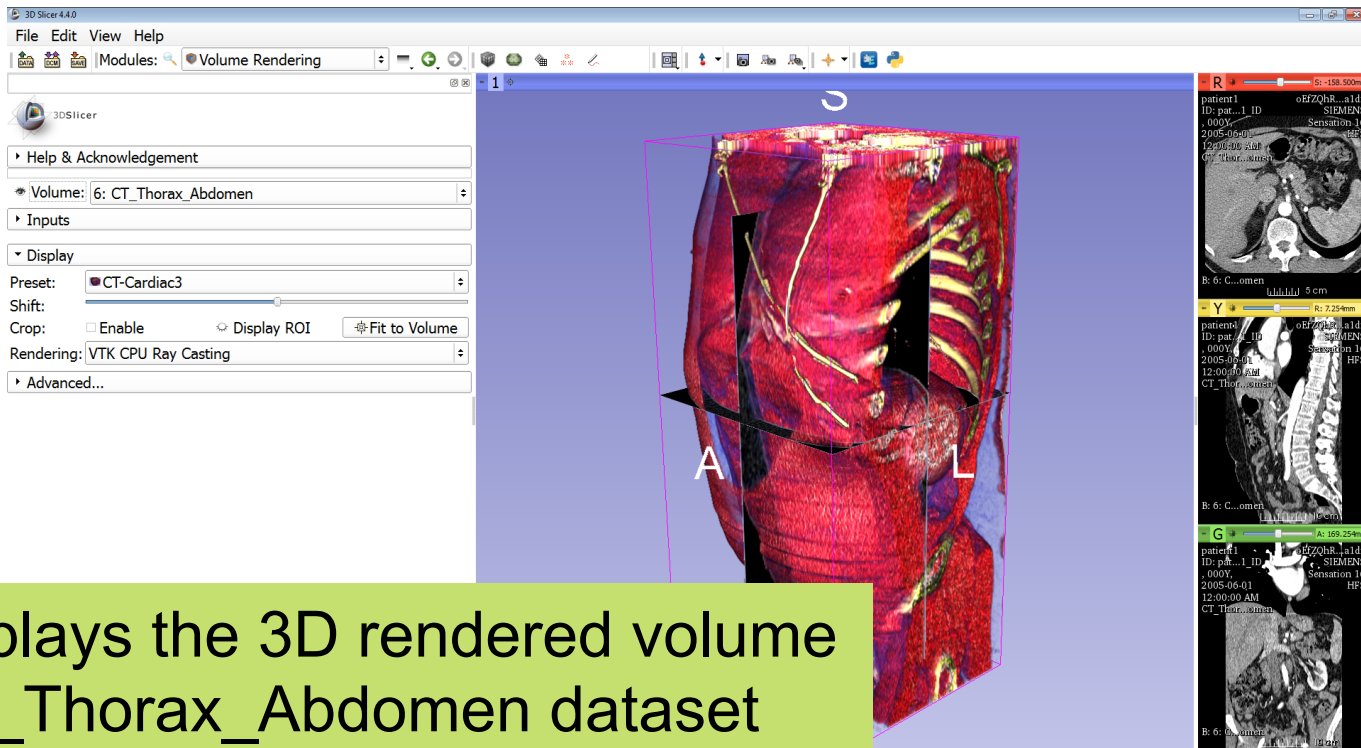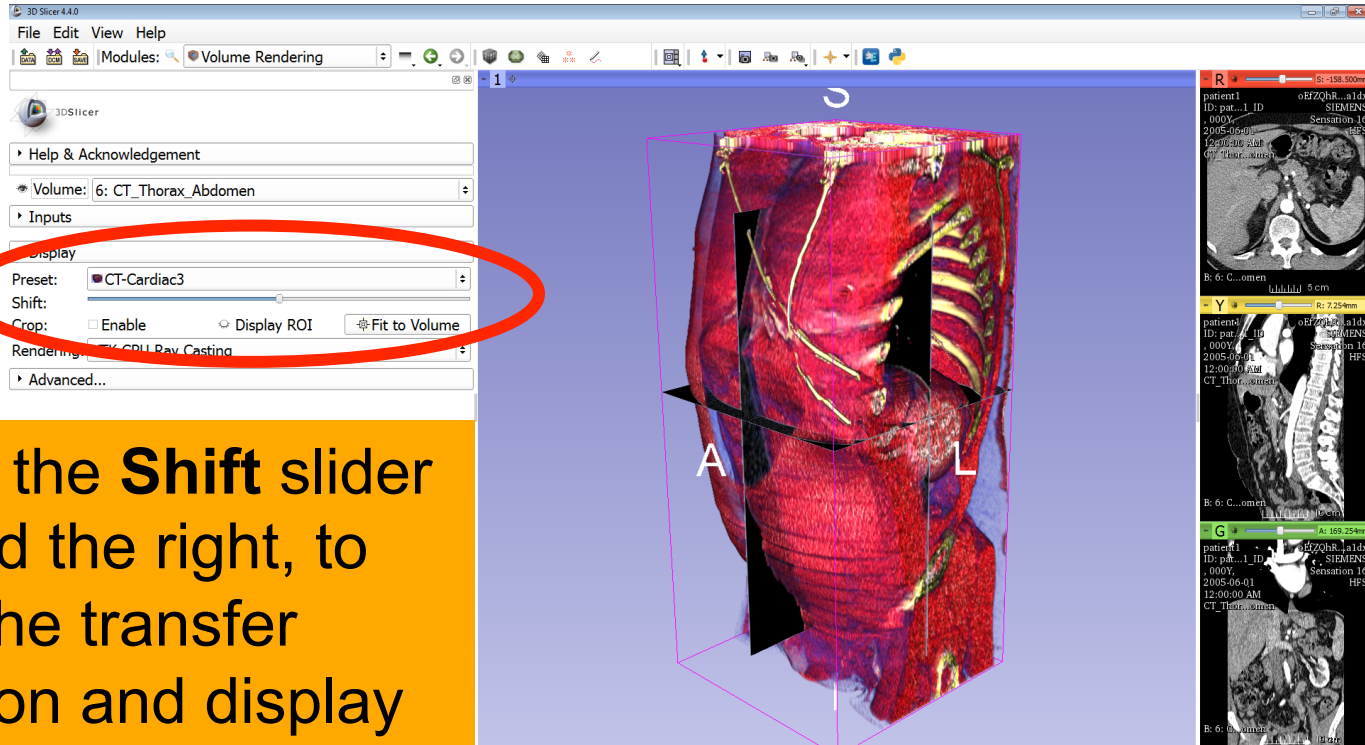
Volume Rendering

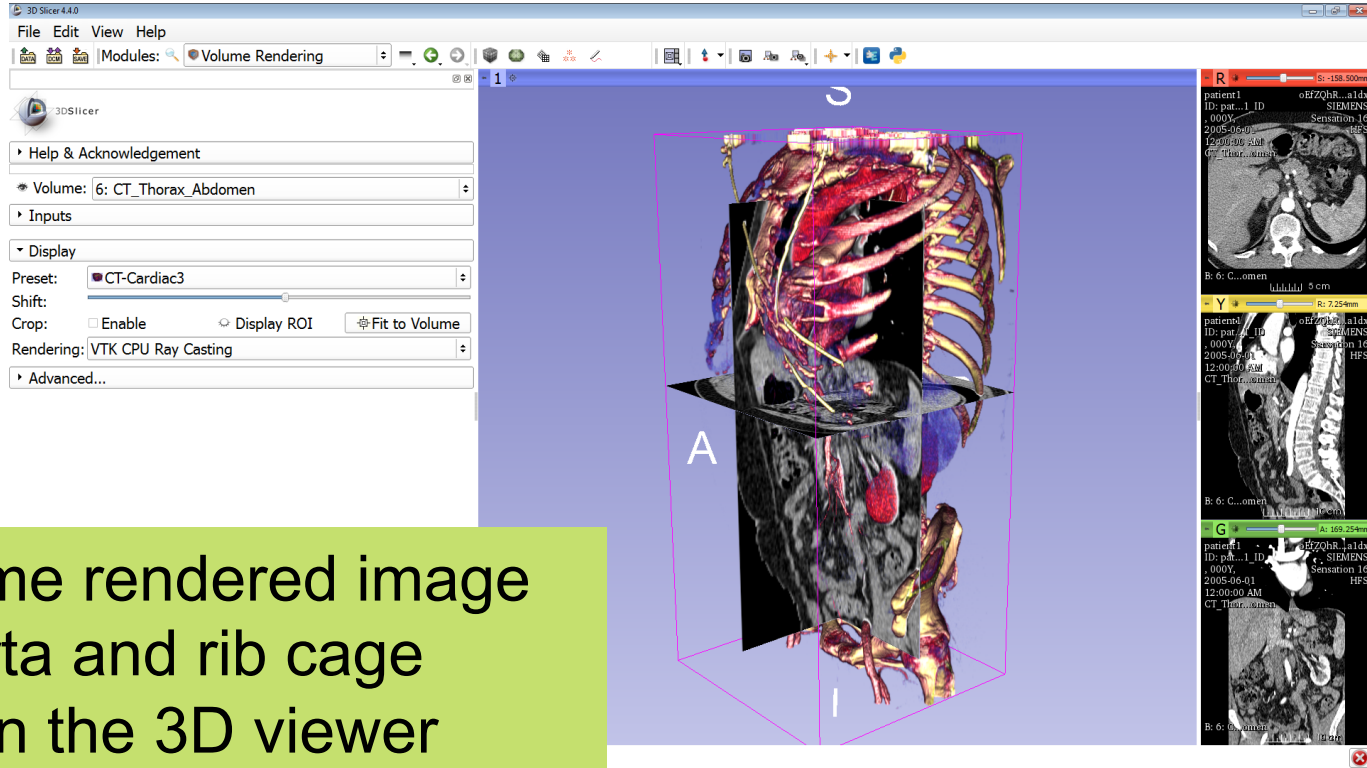Slicer displays the 3D rendered volume of the CT_Thorax_Abdomen dataset

Volume Rendering

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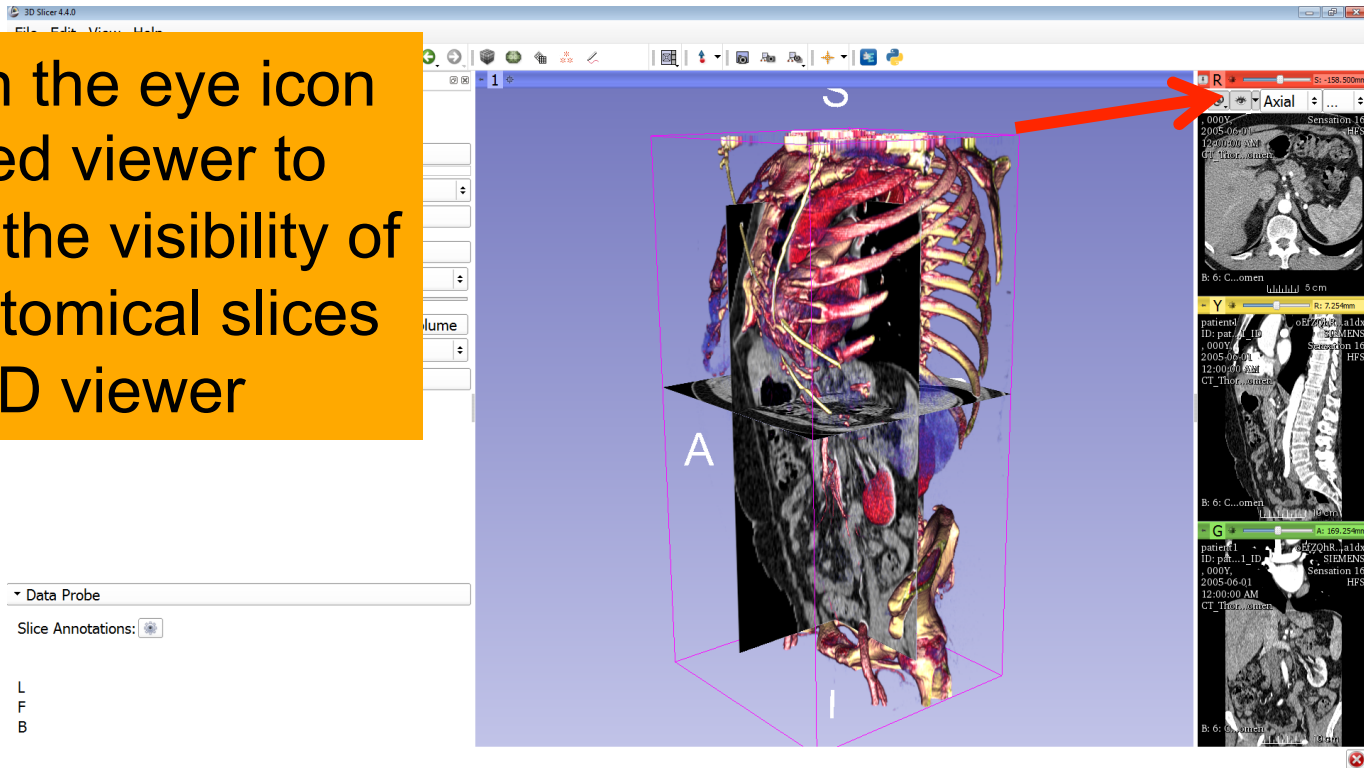
Volume Rendering

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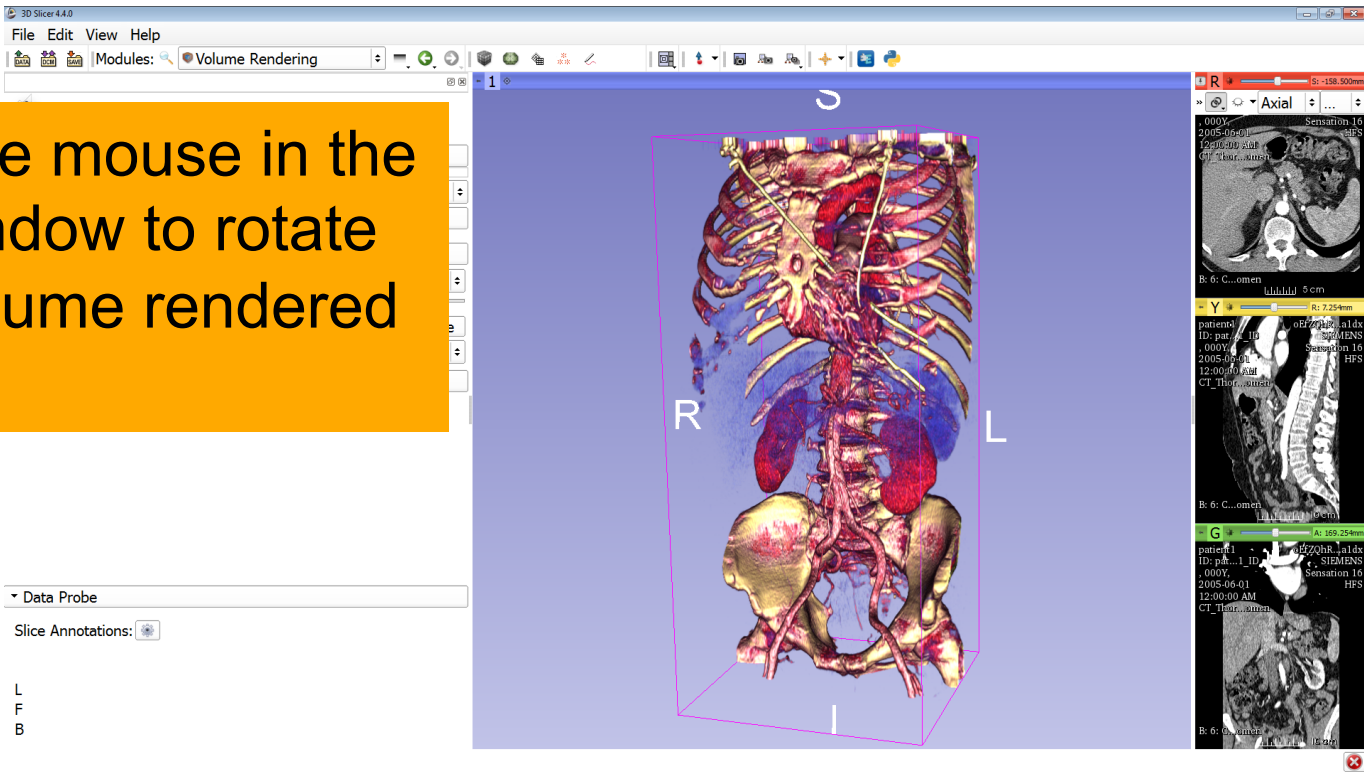
Volume Rendering

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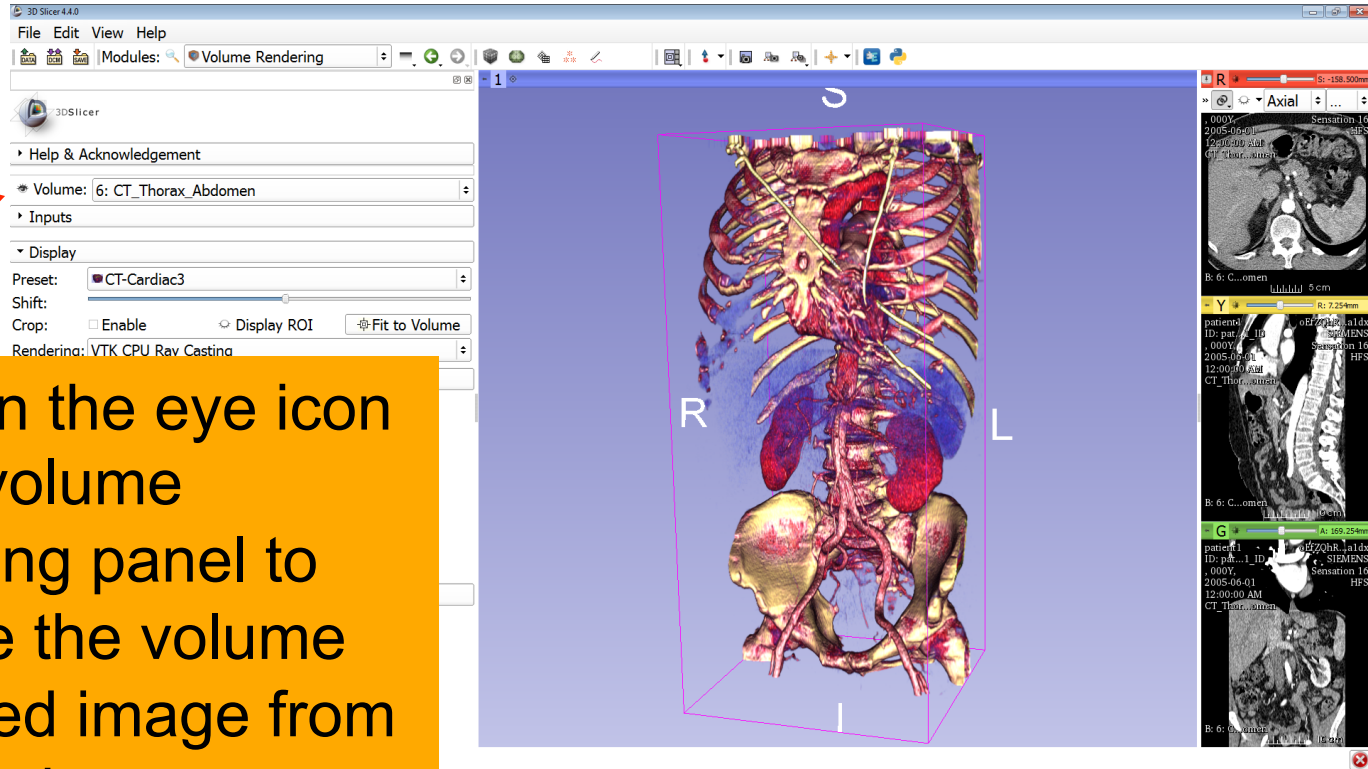
Volume Rendering

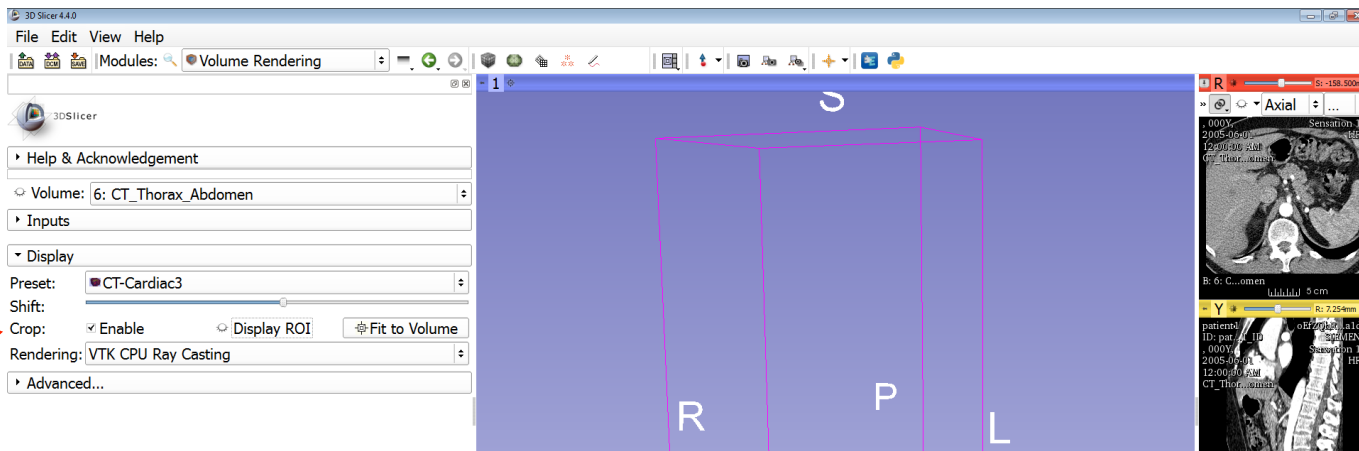Use the mouse in the 3D window to rotate the volume rendered image

Volume Rendering

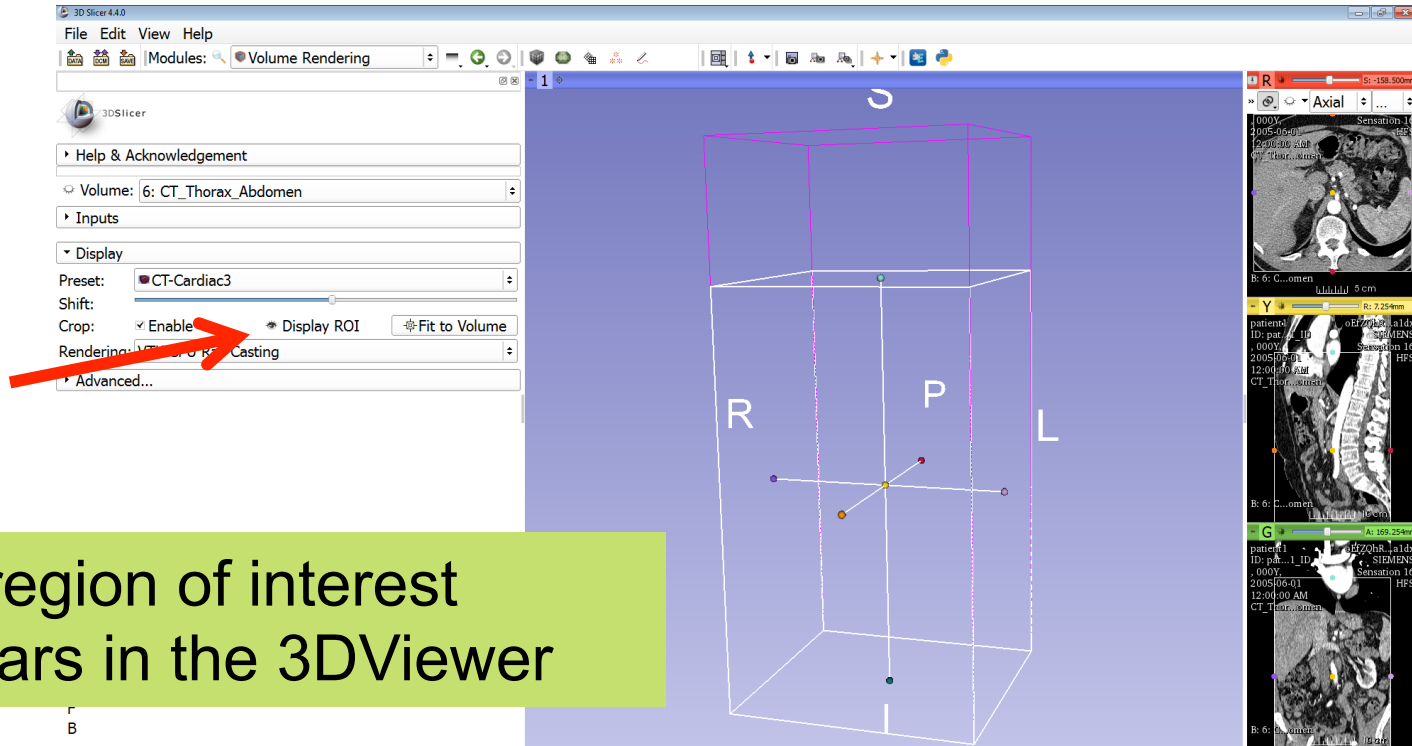Click on the eye icon in the volume rendering panel to remove the volume rendered image from the 3D viewer

Volume Rendering

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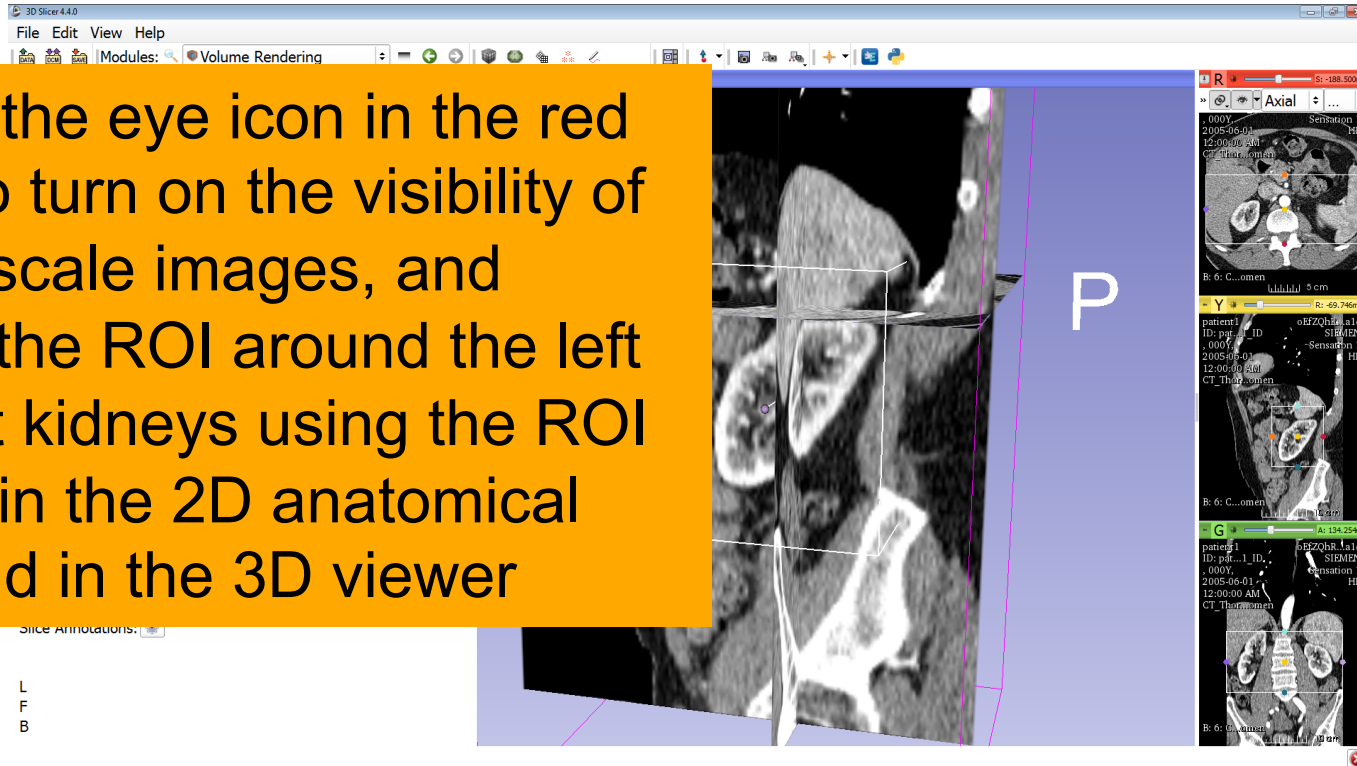
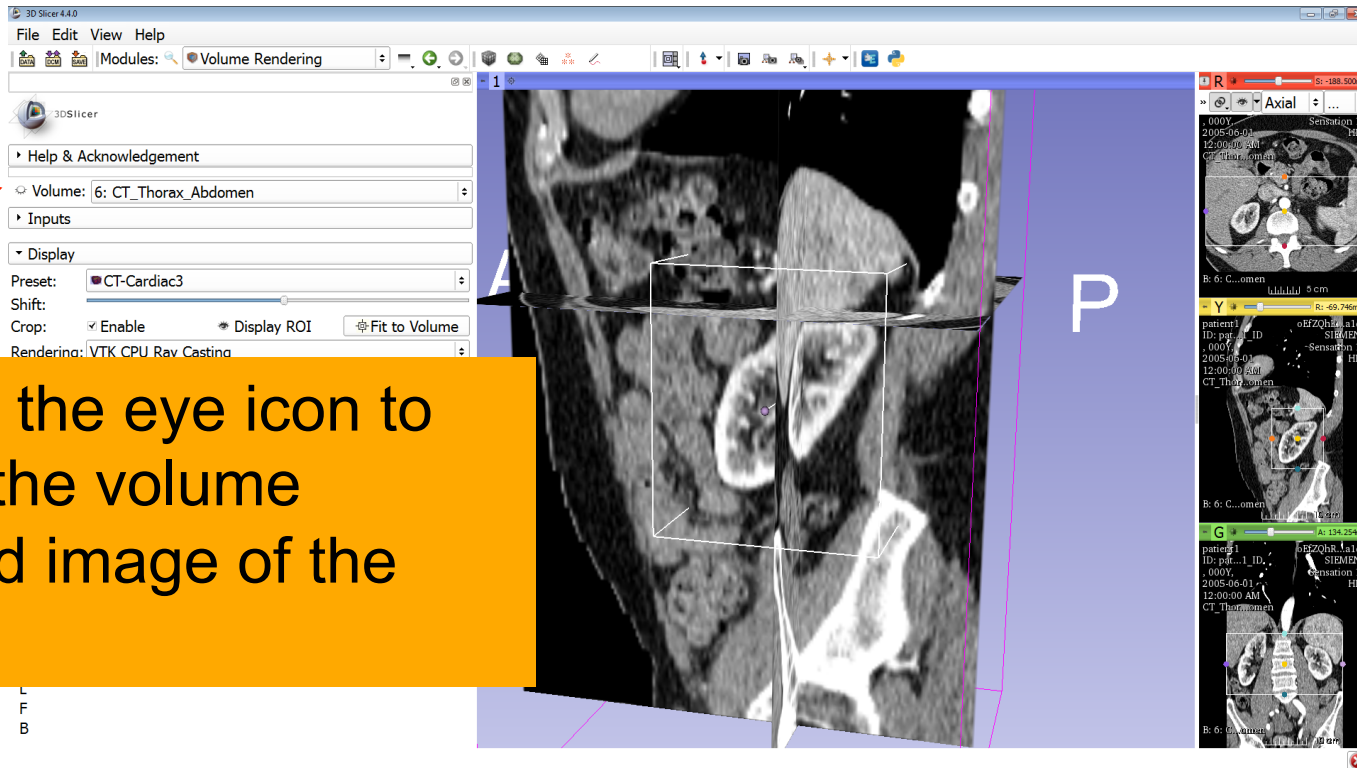# Volume Rendering

The region of interest appears in the 3DViewer

Volume Rendering

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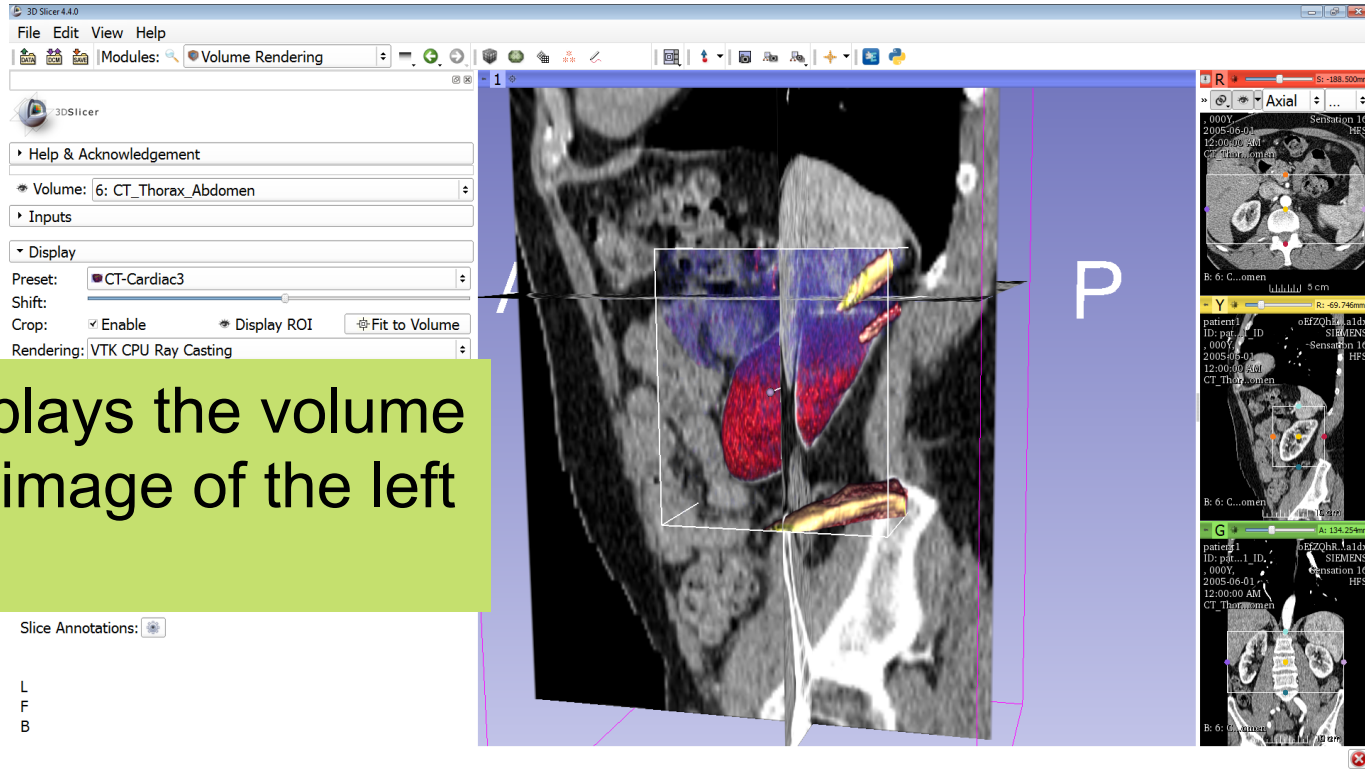
Volume Rendering

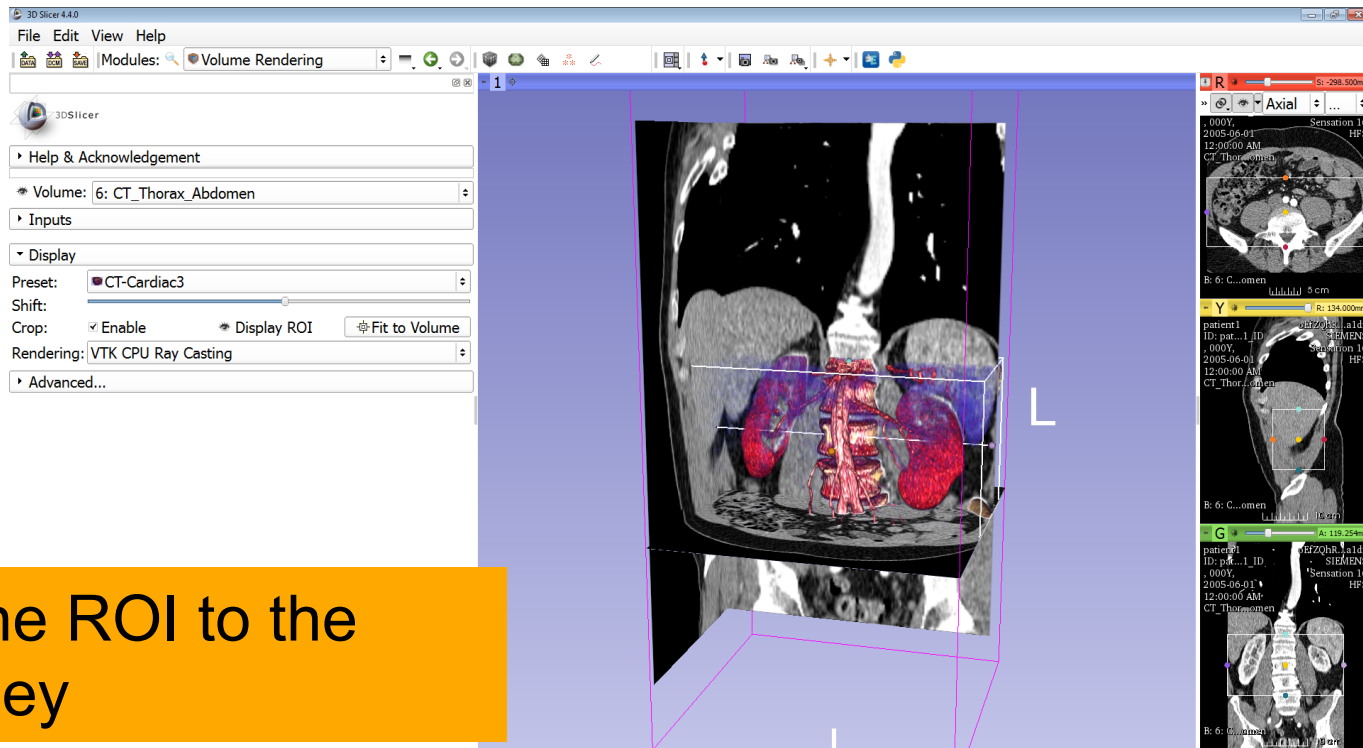Click on the eye icon to display the volume rendered image of the kidney

Volume Rendering
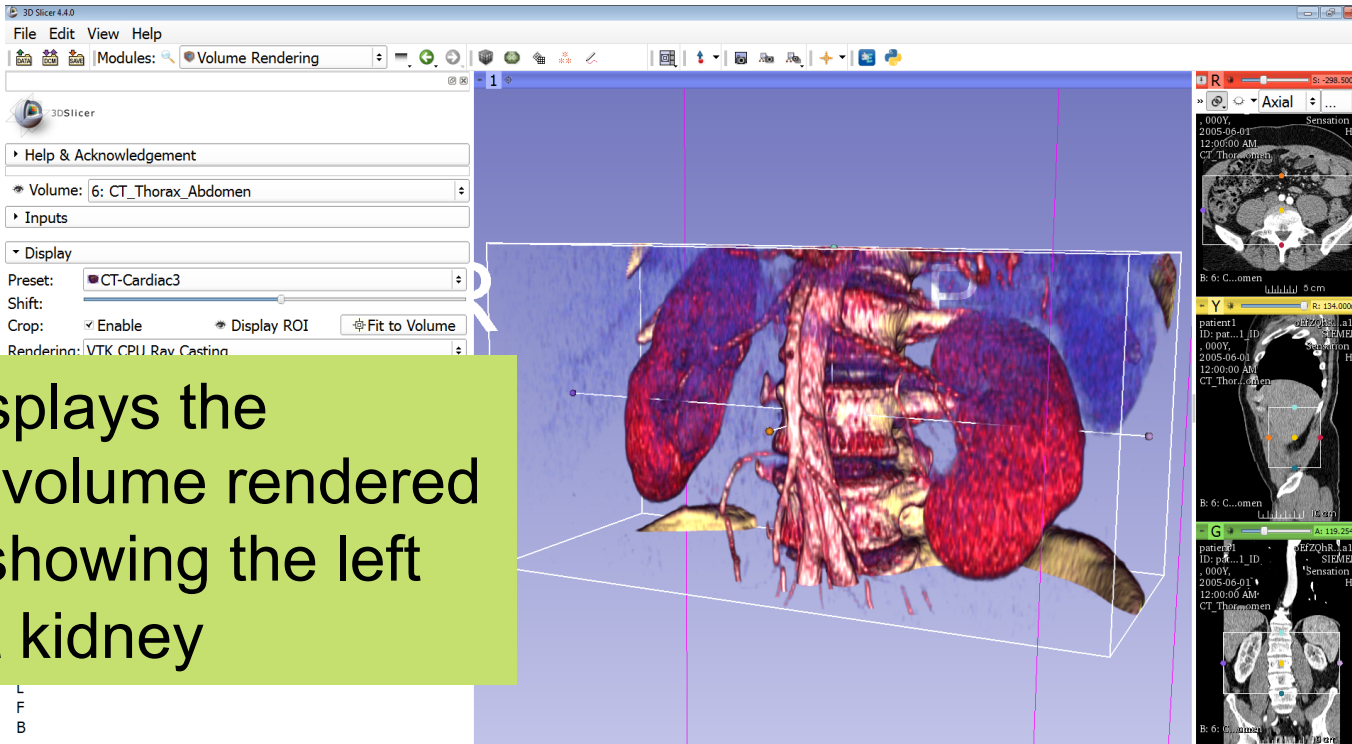

Slicer displays the volume rendered image of the left kidney

Volume Rendering

Extend the ROI to the right kidney

Volume Rendering

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

Volume Rendering

Click on **File→Close Scene** to close the scene
Click on **File→Exit** to quit Slicer
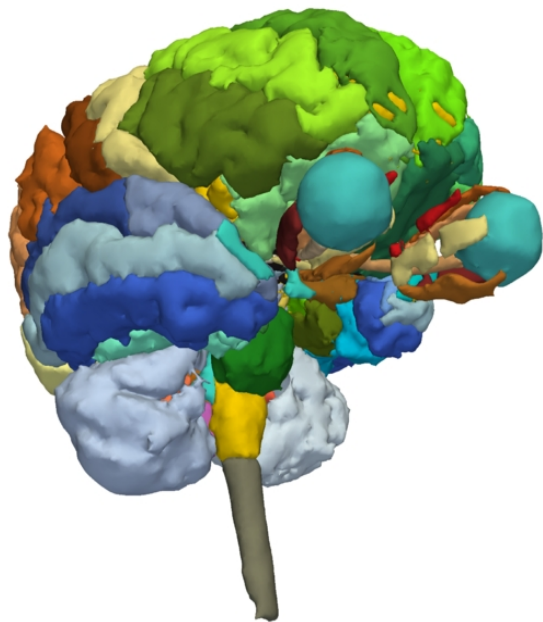
Part 2:
3D visualization of surface models of the brain

3D Data Loading and Visualization
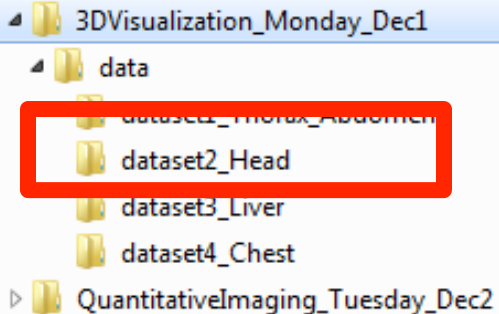
- Open the directory **3DVisualization_Monday_Dec1** on the Desktop

- Select the directory **dataset2_Head**

- Select the file **MRHead_Scene.mrb**

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

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

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

3D visualization of surface models of the brain
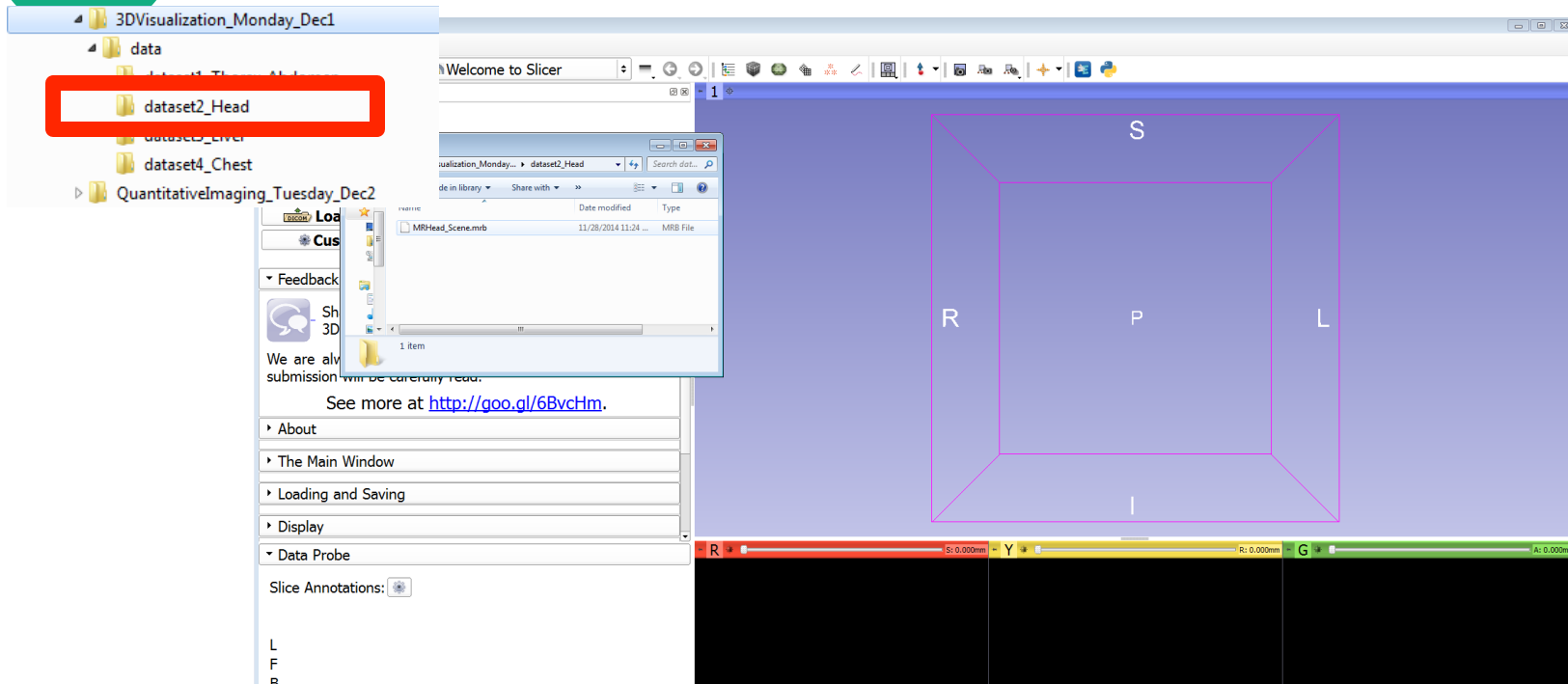
Drag and drop the file **Head_Scene.mrb** into Slicer

3D visualization of surface models of the brain
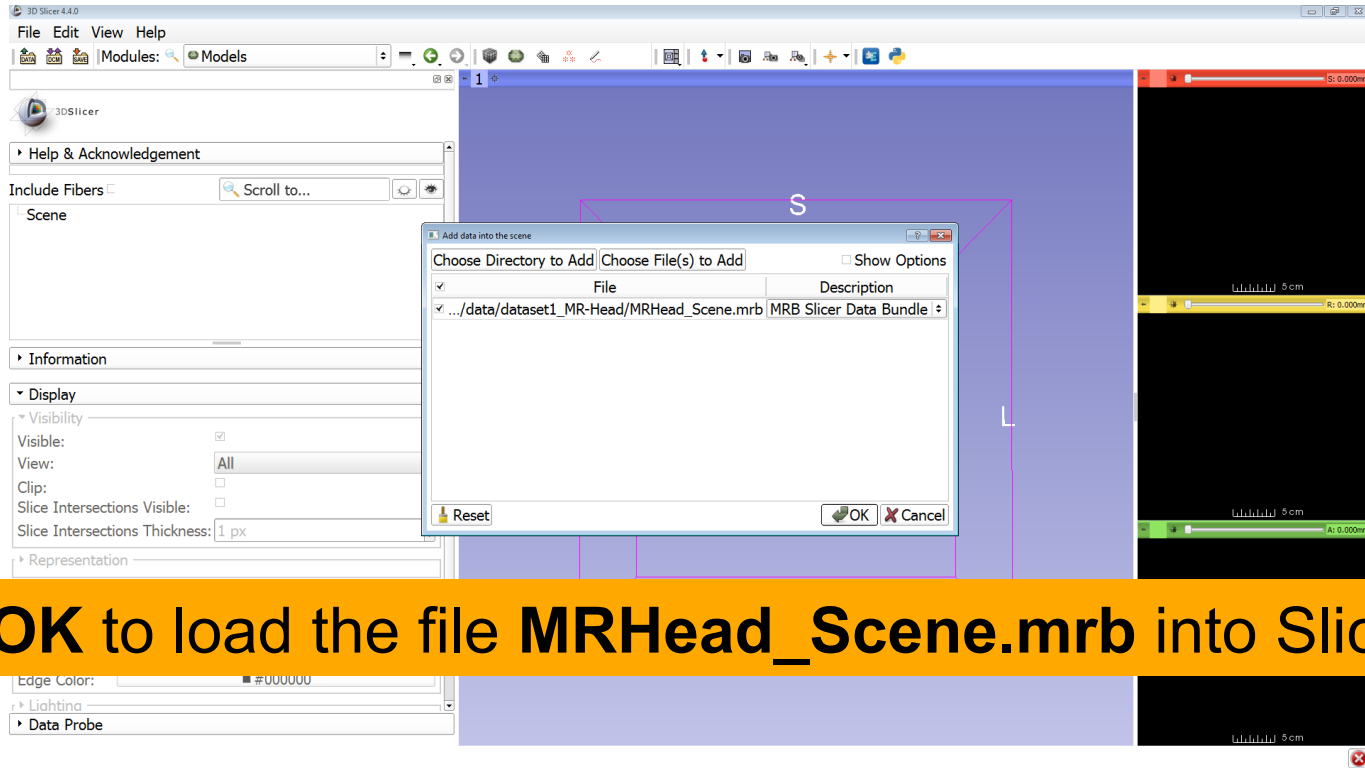
Click on **OK** to load the file **MRHead_Scene.mrb** into Slicer

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

When the scene is finished loading, Slicer displays:

- a **3D model of the head** in the **3D Viewer**, and
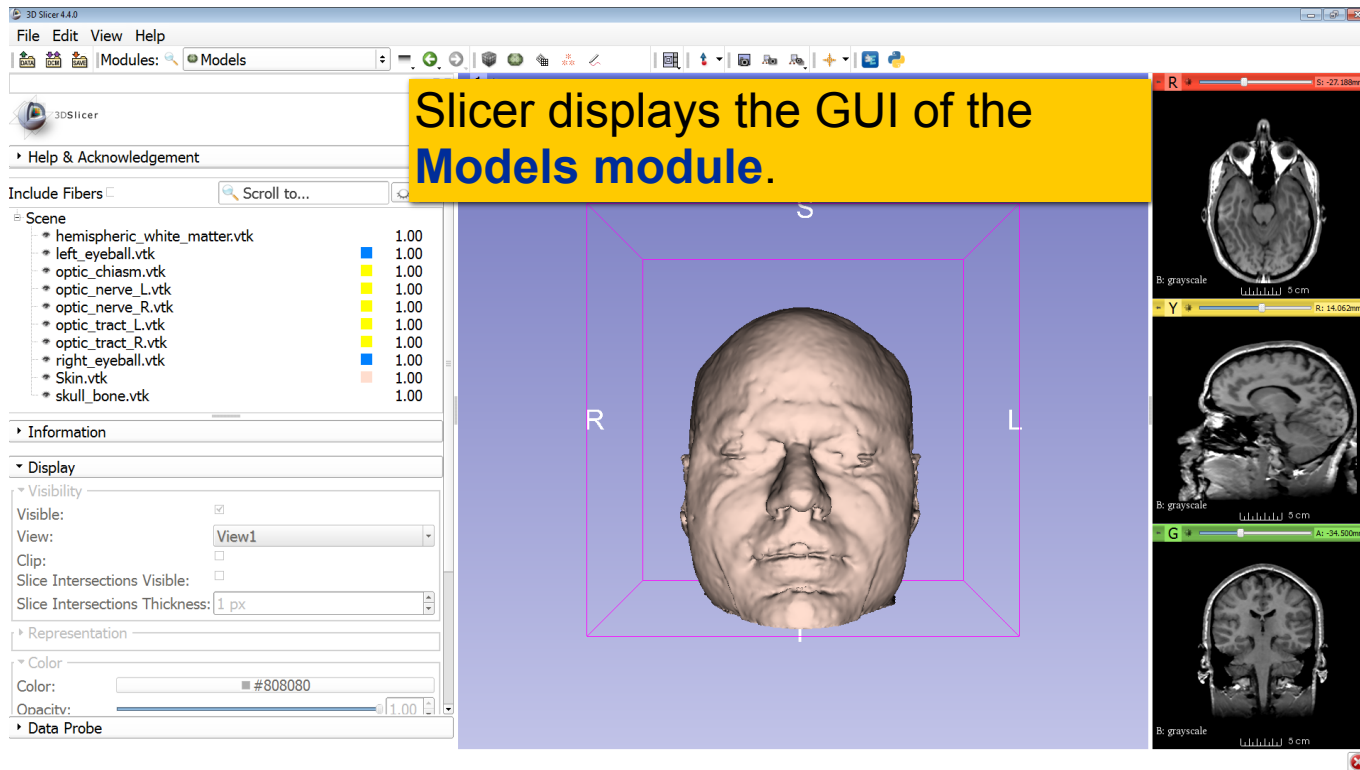- anatomical **MR slices of the brain** in the **2D Slice Viewers**.
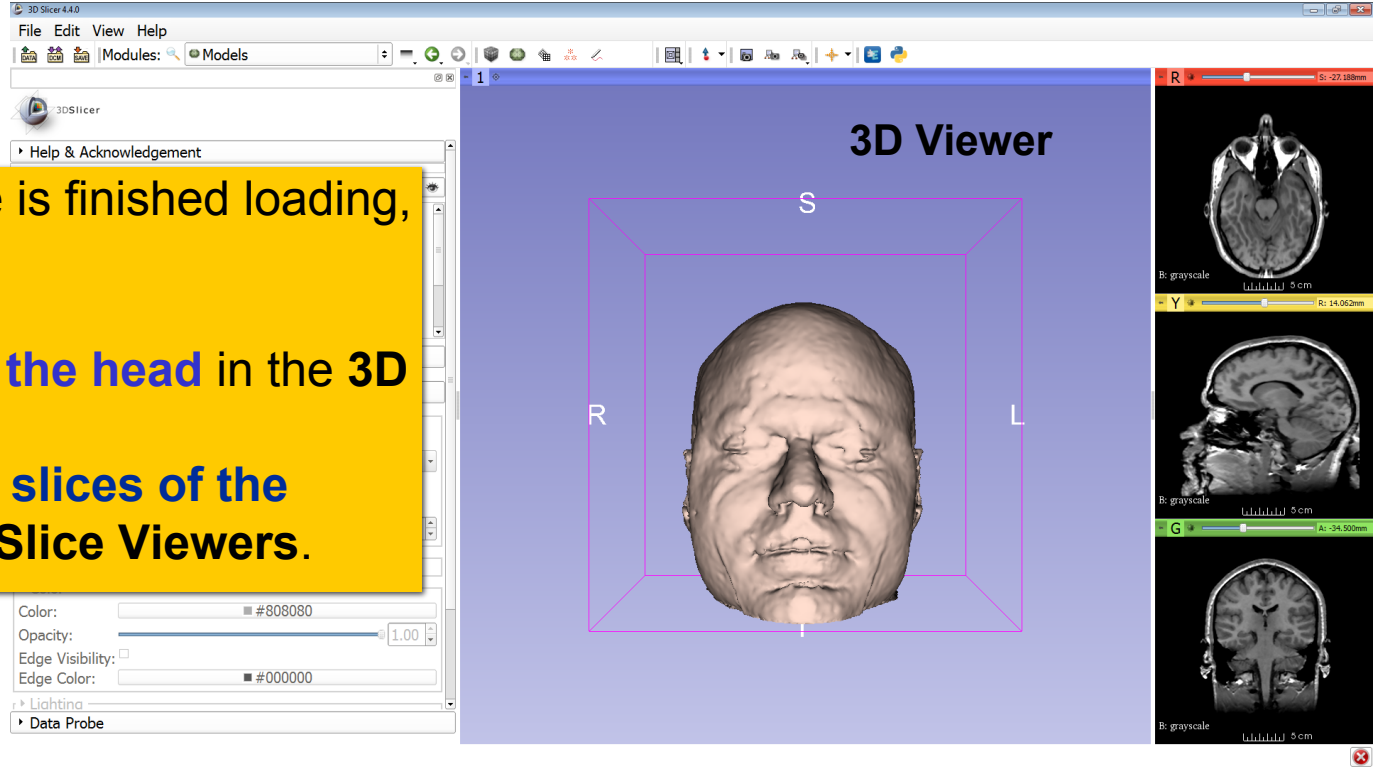
To access the **Models module**, browse through the list of modules.
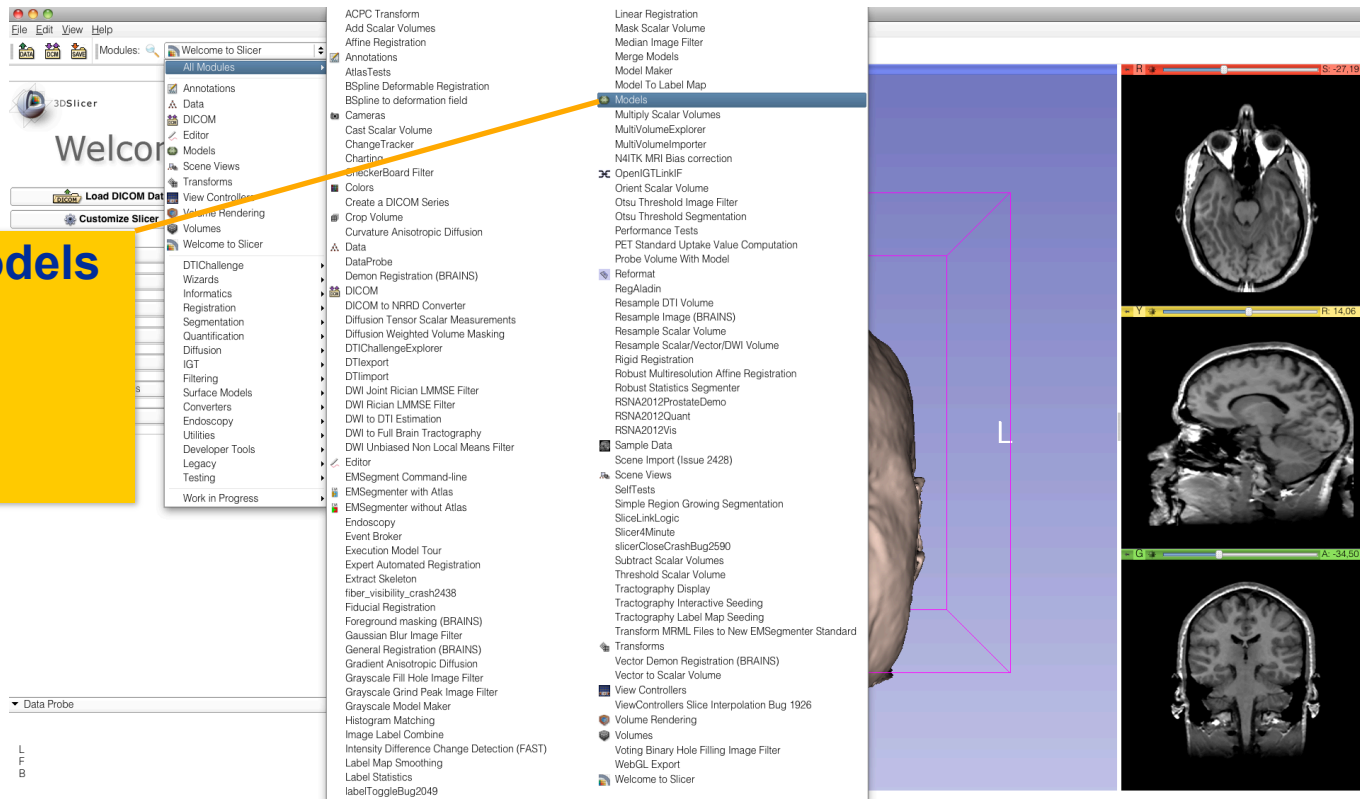
3D visualization of surface models of the brain : Switching to the Models Module

Slicer displays the GUI of the **Models module**.

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

Position the mouse in the 3D Viewer.

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

Left-click & drag

Click on the **Slice Visibility** icon

to display the Axial Slice in the 3D Viewer

3D visualization of surface models of the brain

Slicer adds a view of the **Axial slice** in the 3D View.
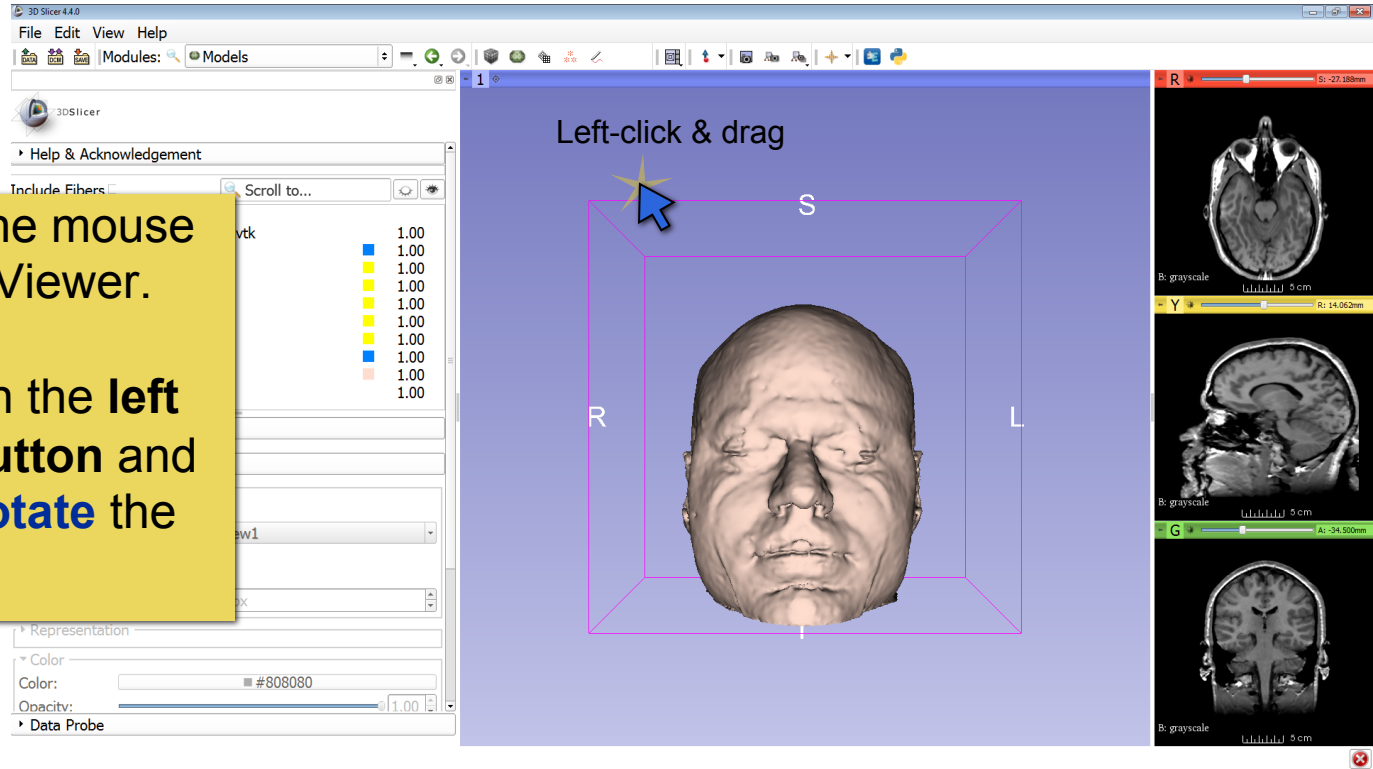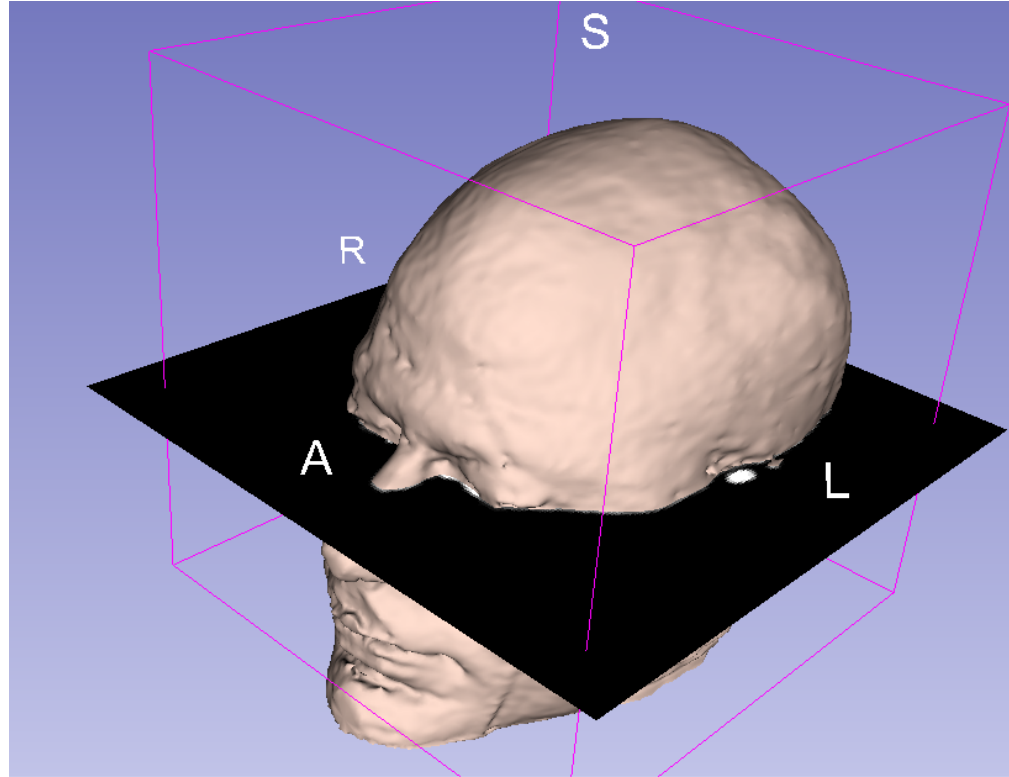
3D visualization of surface models of the brain : Viewing Slices in the 3D Viewer

Click on the layout menu in the toolbar, and select the **Conventional layout**
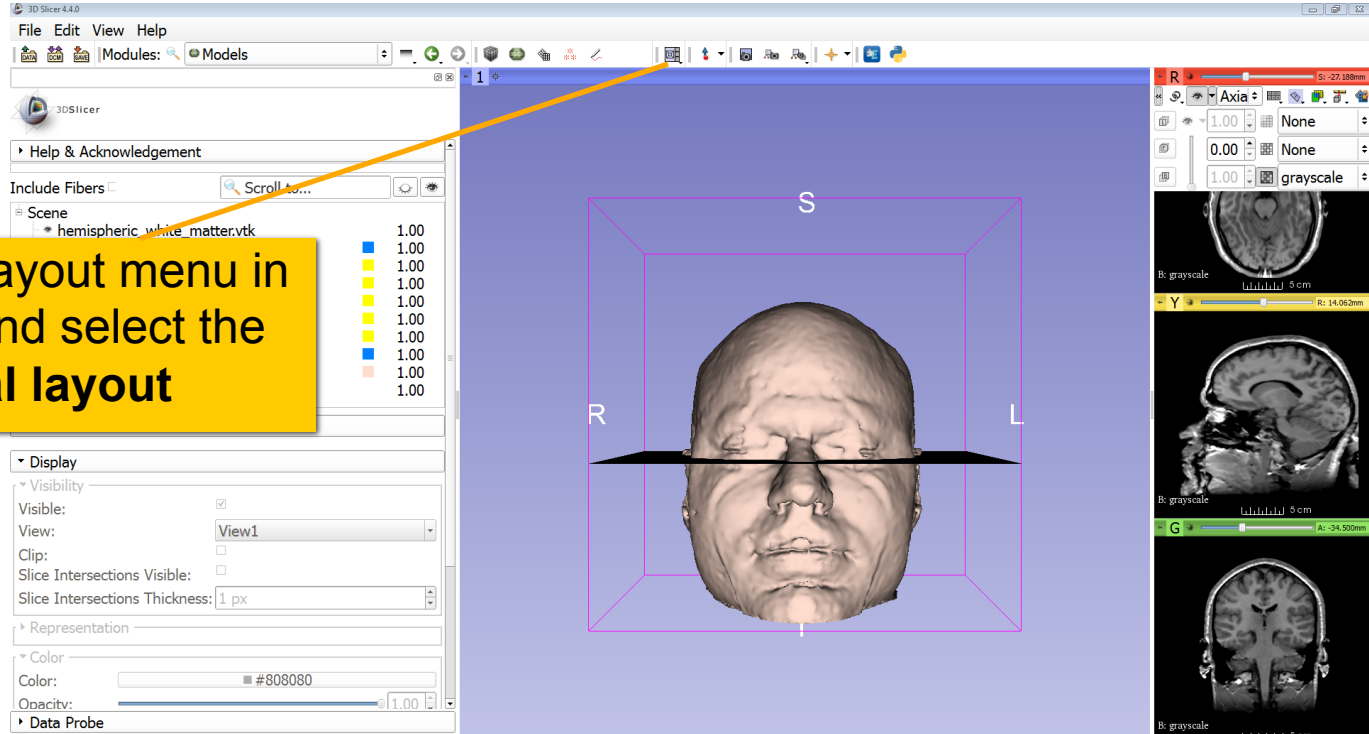
3D visualization of surface models of the brain

Select the model **Skin.vtk**

Click to expand the tab **Display**

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

3D visualization of surface models of the brain

skin model opacity = 0.5
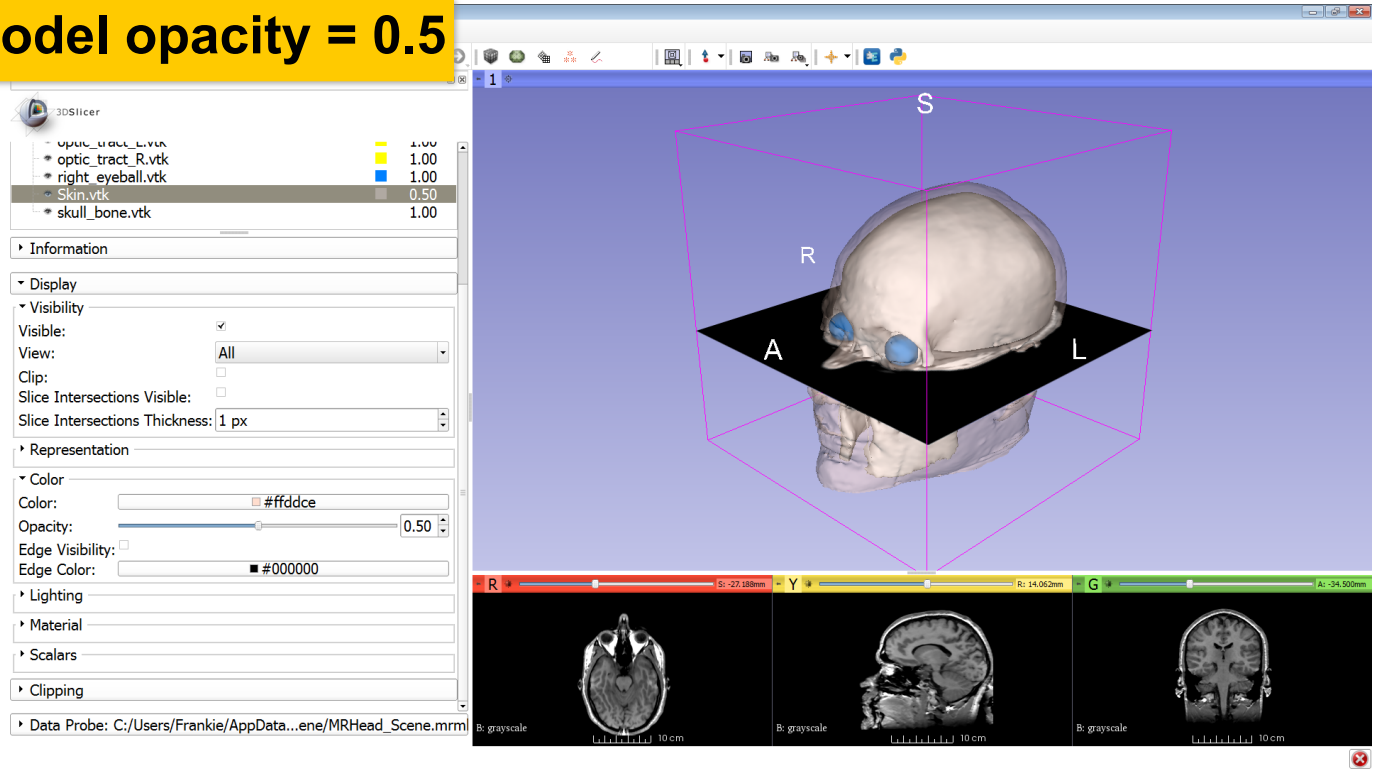
3D visualization of surface models of the brain

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

(skin model opacity = 0.0)
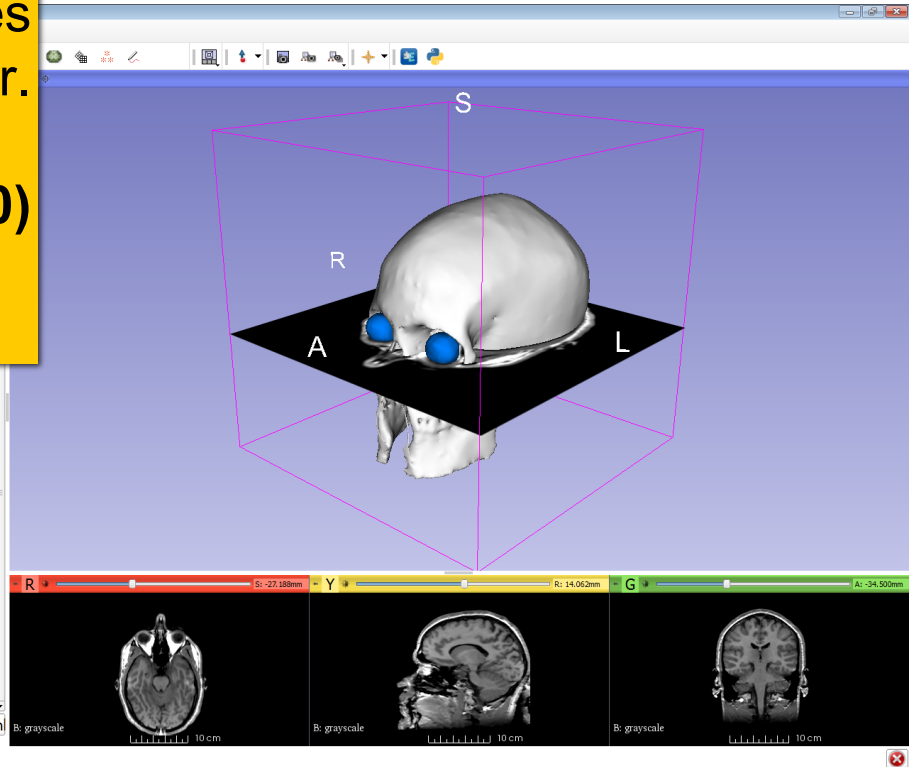
3D visualization of surface models of the brain

Click on the **Slice Visibility icon** in the **Green Slice Viewer** to display the Coronal Slice in the 3D Viewer.
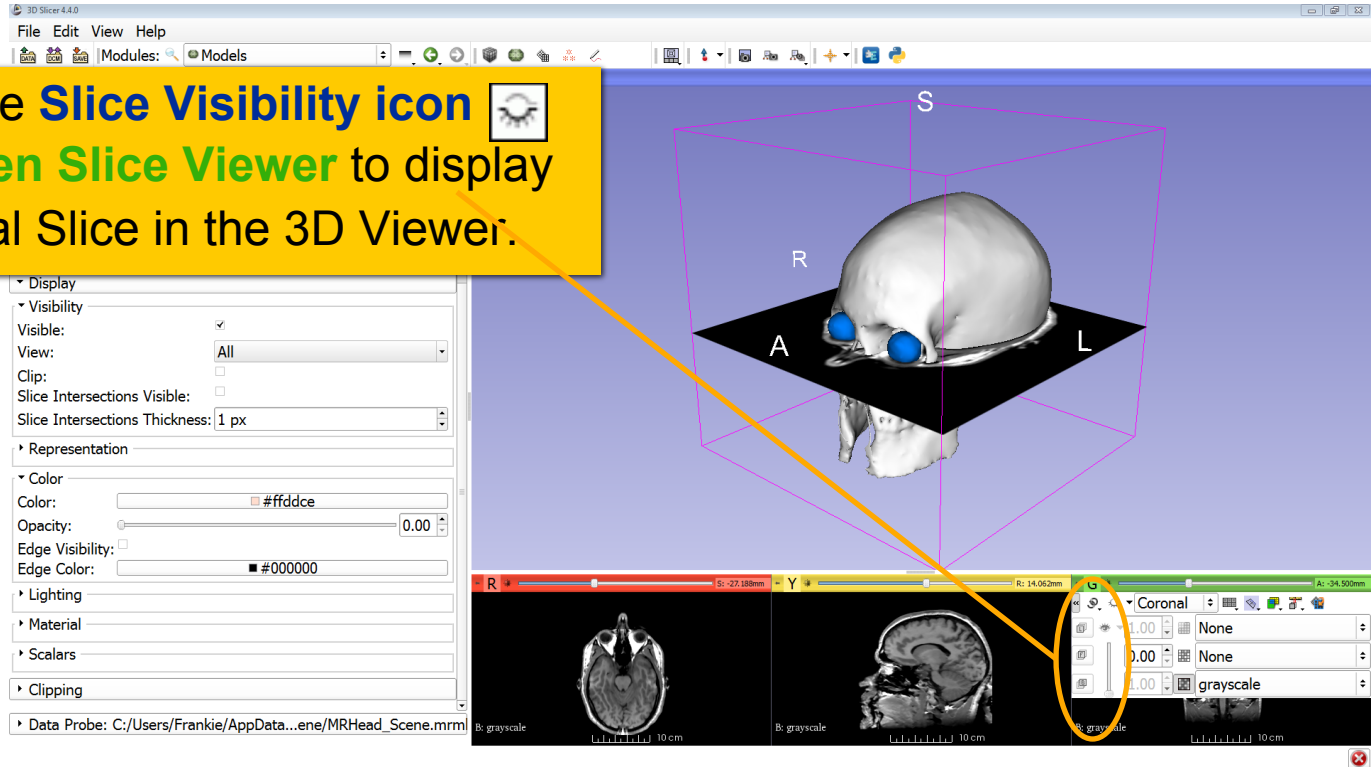
3D visualization of surface models of the brain

The Axial and Coronal Slices are displayed in the 3D Viewer.
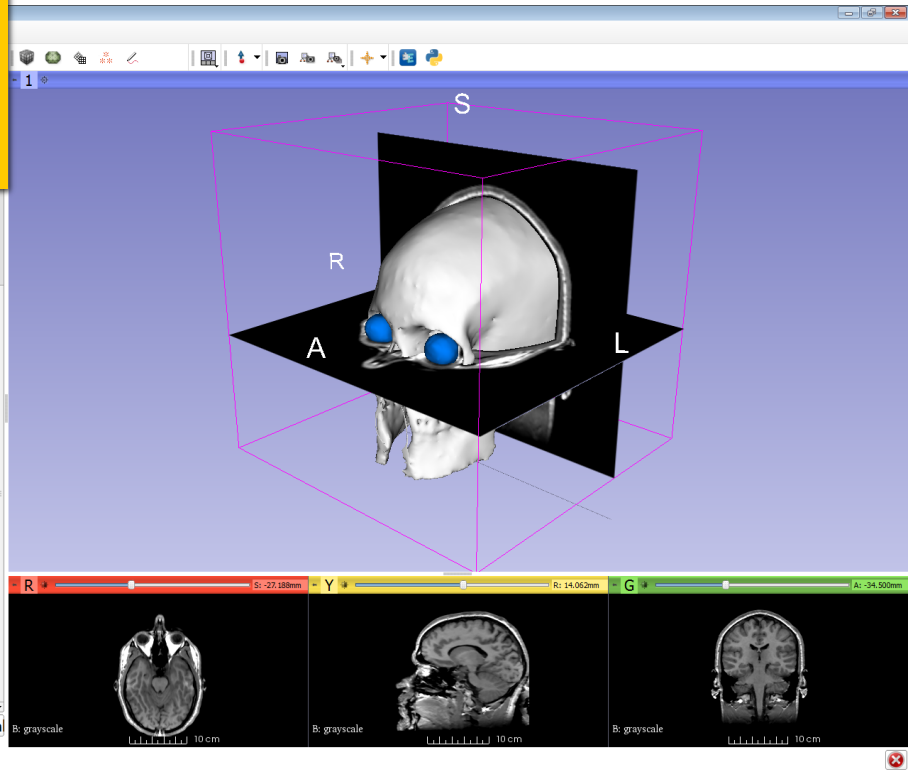
3D visualization of surface models of the brain

Select the 3D model **skull_bone.vtk** in the Model Hierarchy

Click to expand the tab **Display**

Click to expand the tab **Visibility**

Check the option **Clip**

3D visualization of surface models of the brain

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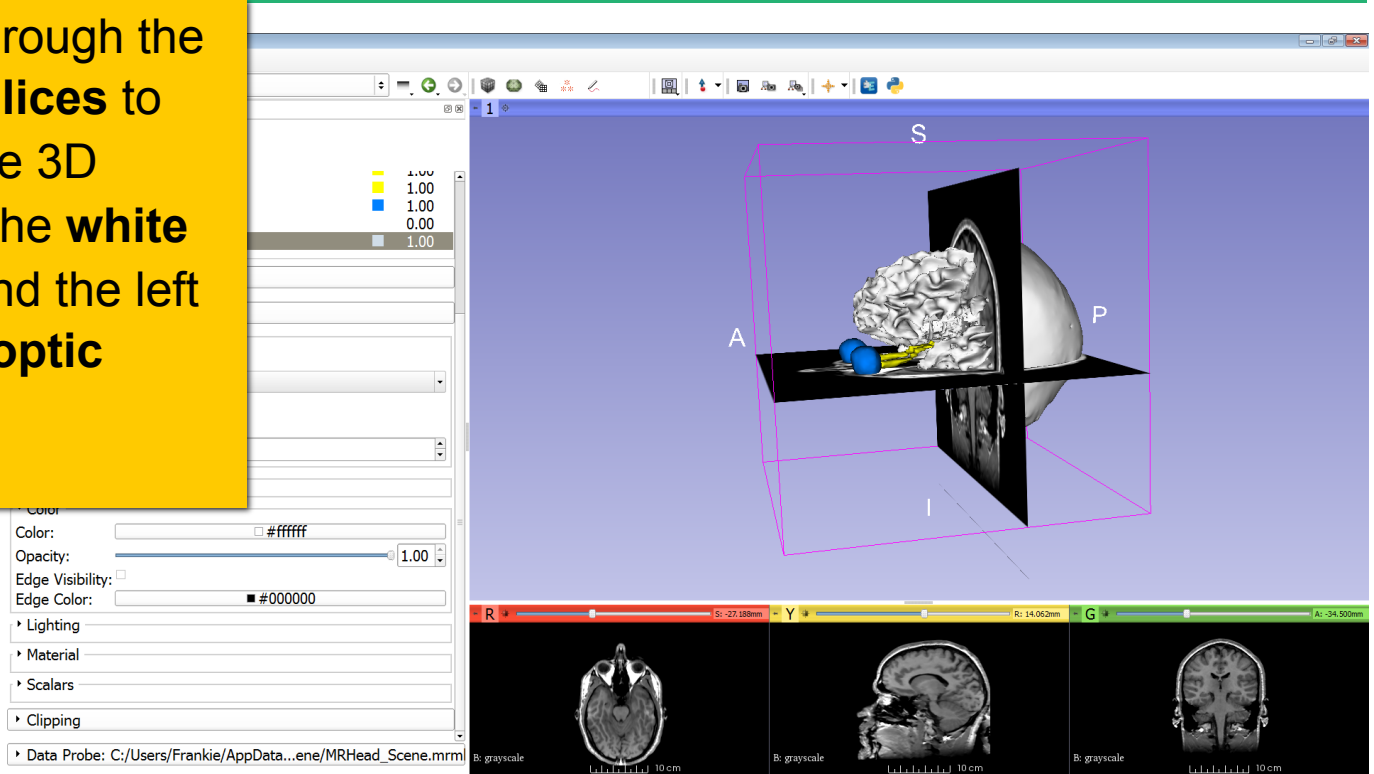
3D visualization of surface models of the brain

Uncheck the option '**visible**' to make the skull invisible.
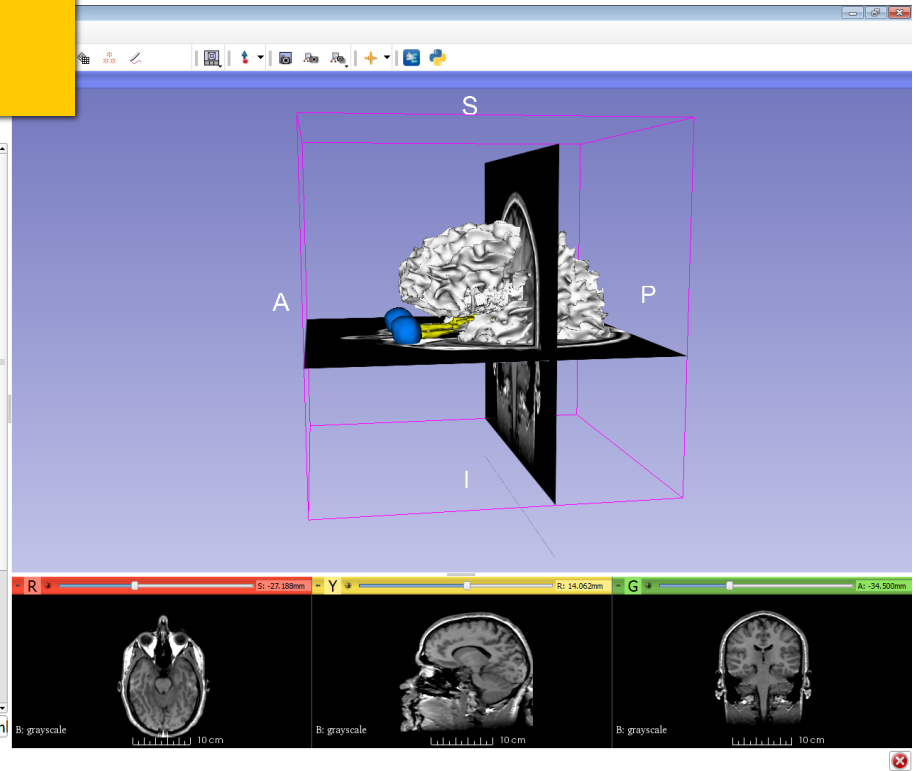
3D visualization of surface models of the brain

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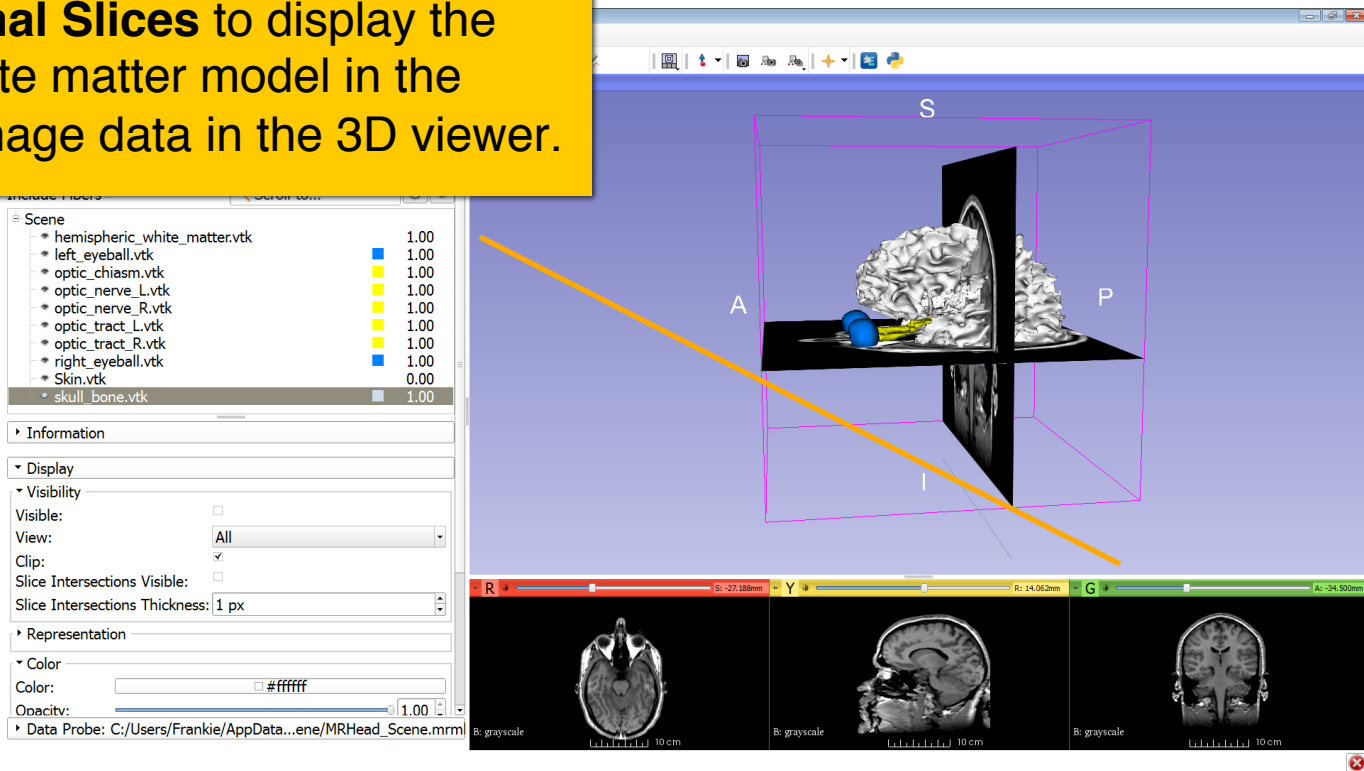
3D visualization of surface models of the brain

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

Turn off its **visibility**.

3D visualization of surface models of the brain

Slicer displays the **optic nerve**, **optic chiasm** and **optic tracts** overlaid on the **MR images** of the brain.
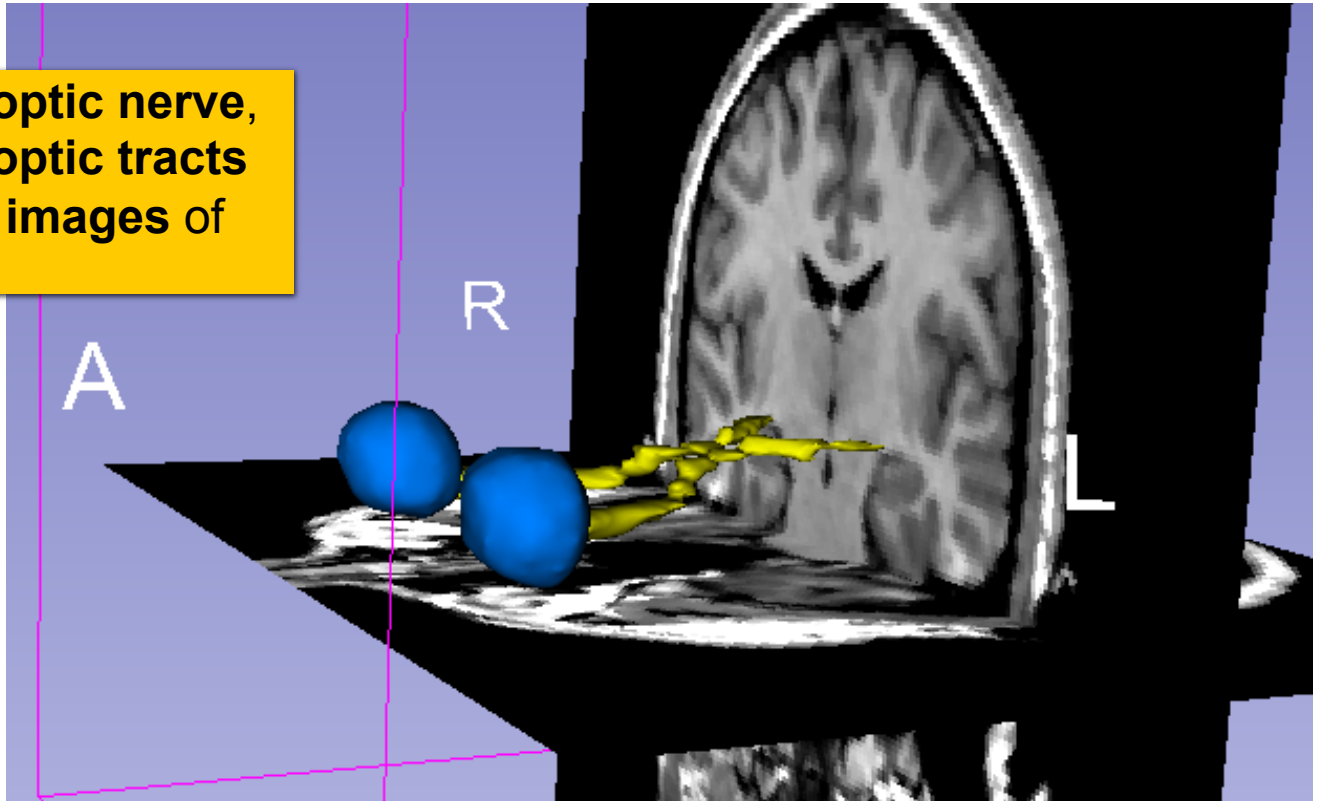
3D visualization of surface models of the brain

Slicer displays a **closer view** of 3D anatomical structures overlaid on 2D MR slices
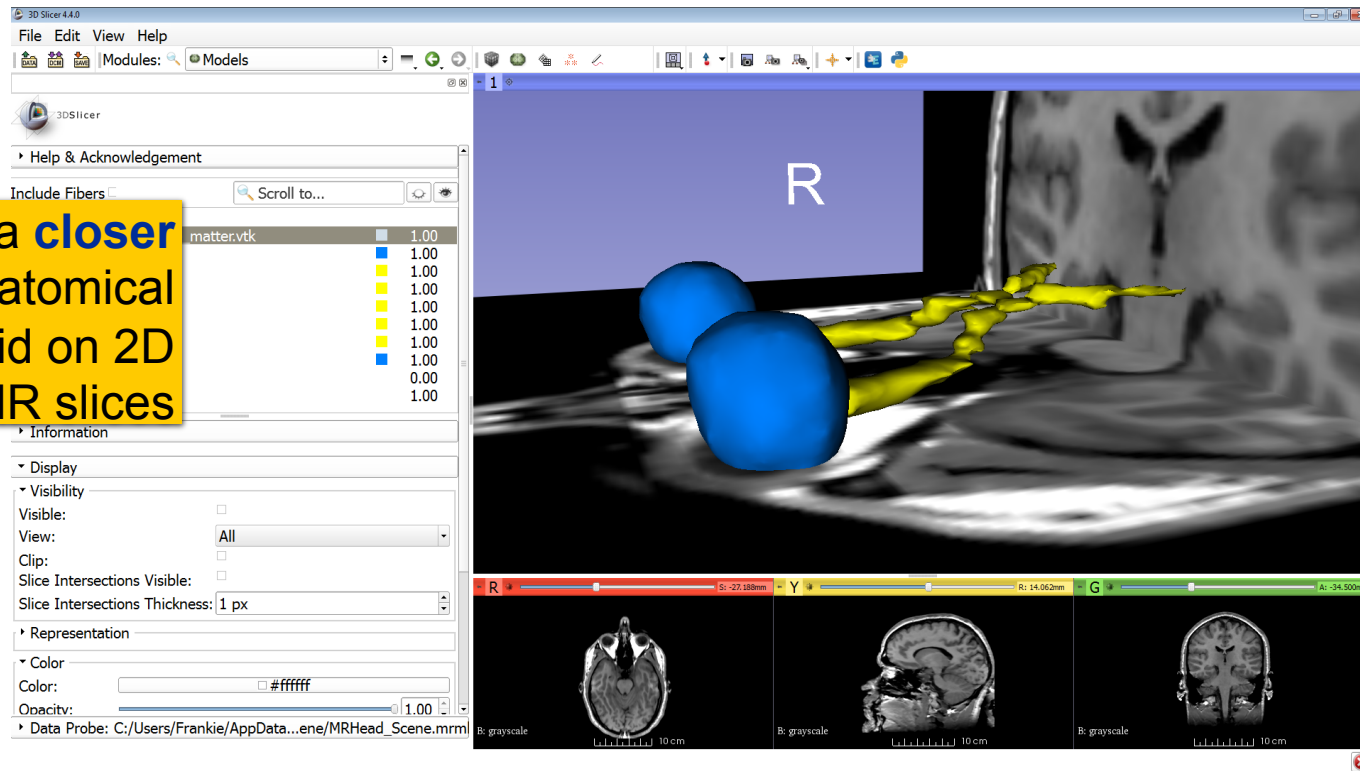
Close the existing scene and all its data

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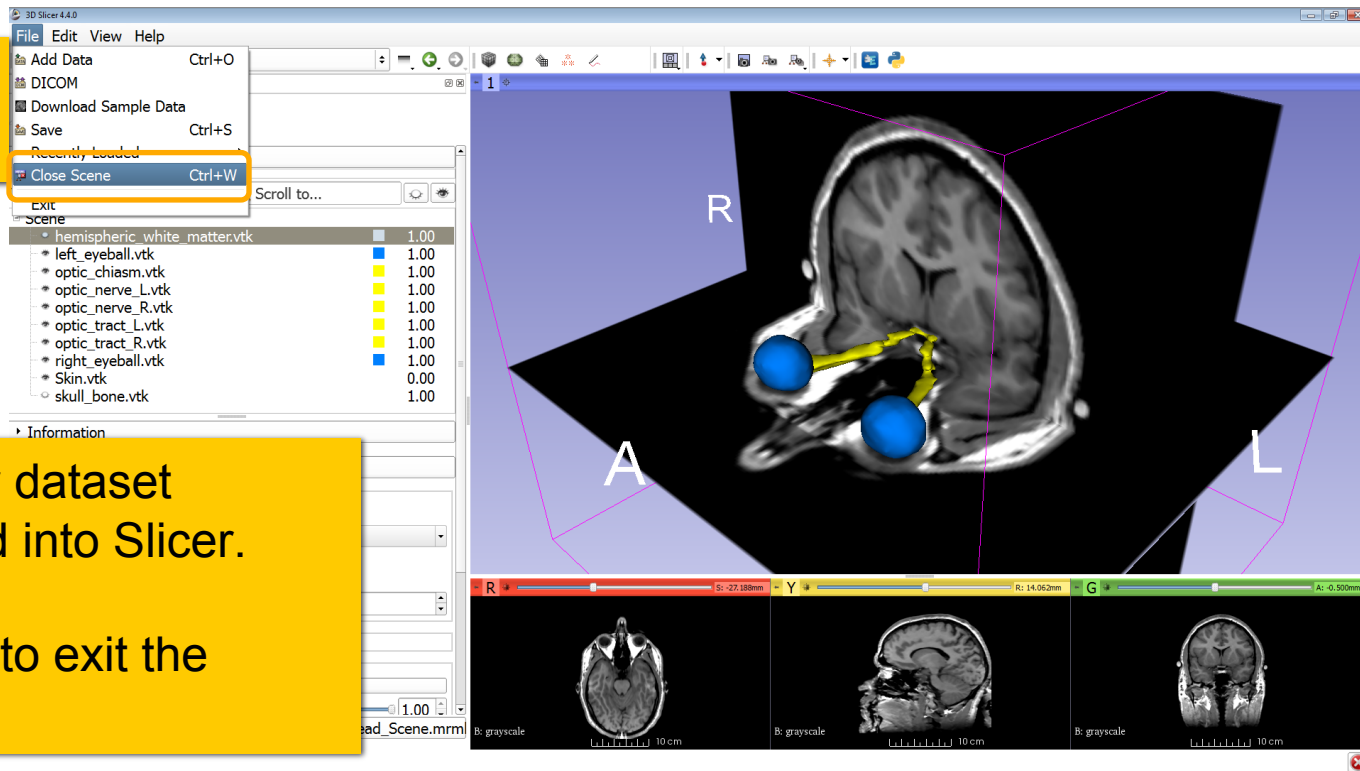
This removes any dataset previously loaded into Slicer.

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

3D Visualization of DICOM images
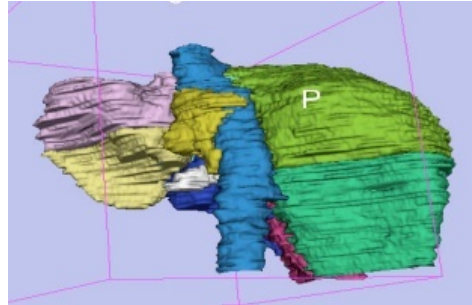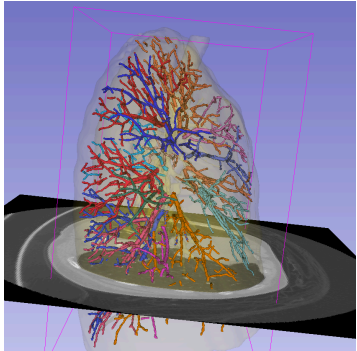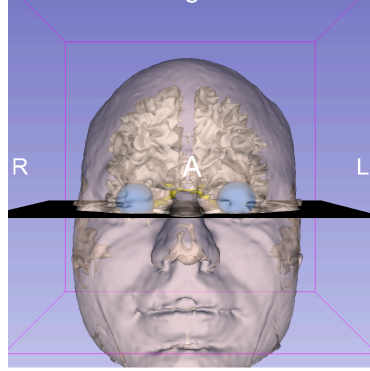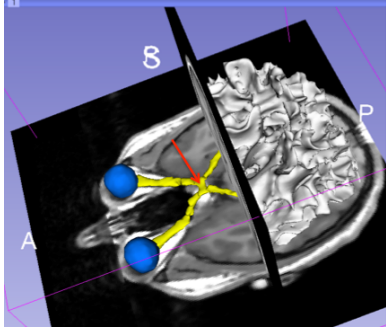
- Interactive user-interface to load and manipulate DICOM volumes, labelmaps and 3D models

- User-defined 3D view of the anatomy

www.slicer.org

Acknowledgments