



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

a teaching affiliate of
Harvard Medical School

Data Loading and 3D Visualization

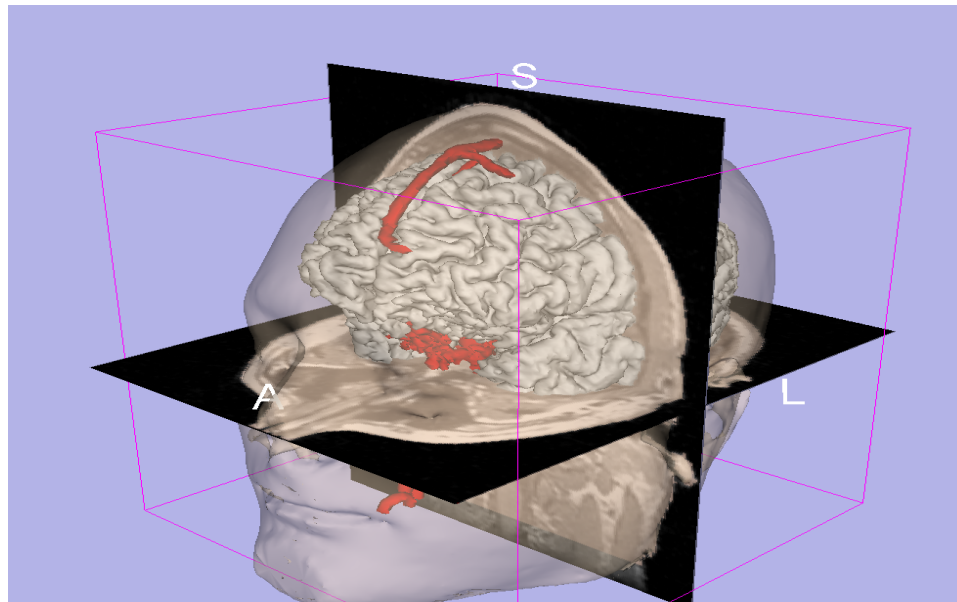
Sonia Pujol, Ph.D., Harvard Medical School

Director of Training, National Alliance for Medical Image Computing



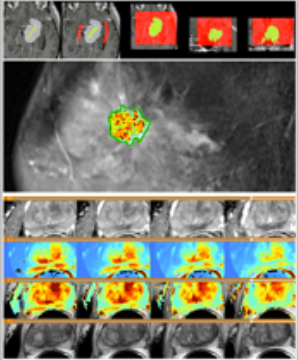
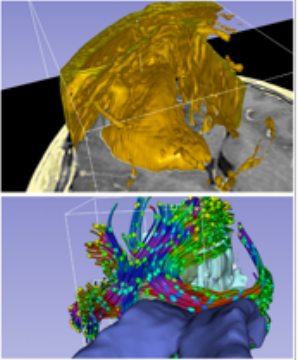
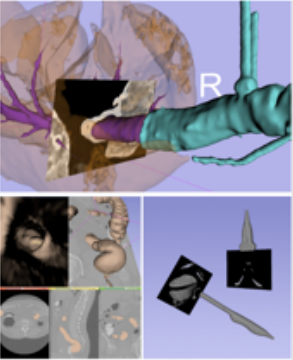

3D Visualization of the Anatomy

Following this tutorial, you will be able to **load and visualize volumes** within Slicer4, and to **interact in 3D** with structural images and models of the anatomy.





3DSlicer

Powerful processing.	Streamlined interface.	Extensible platform.
 A grid of images showing various medical image processing tasks, including segmentation of a brain lesion and heatmaps of functional data.	 A 3D visualization of a brain model, showing a yellow translucent surface and internal structures.	 A 3D visualization of a hand model, showing a purple and blue structure with a white 'R' label.
 3D Slicer <i>version 4.0</i>		www.slicer.org

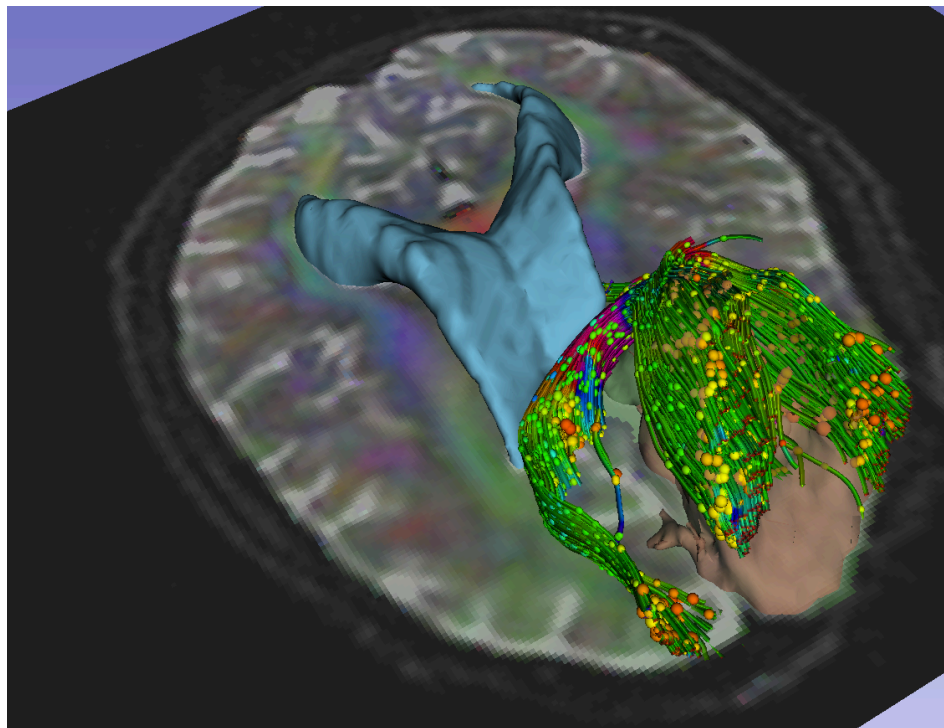
Slicer is a freely available **open-source** platform for segmentation, registration and 3D visualization of medical imaging data.

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



3DSlicer

- An **end-user application** for image analysis
- An **open-source environment** for software development
- A software platform that is both **easy to use** for clinical researchers and **easy to extend** for programmers





3DSlicer version 4 is a multi-platform software running on **Windows, Linux, and Mac OSX.**

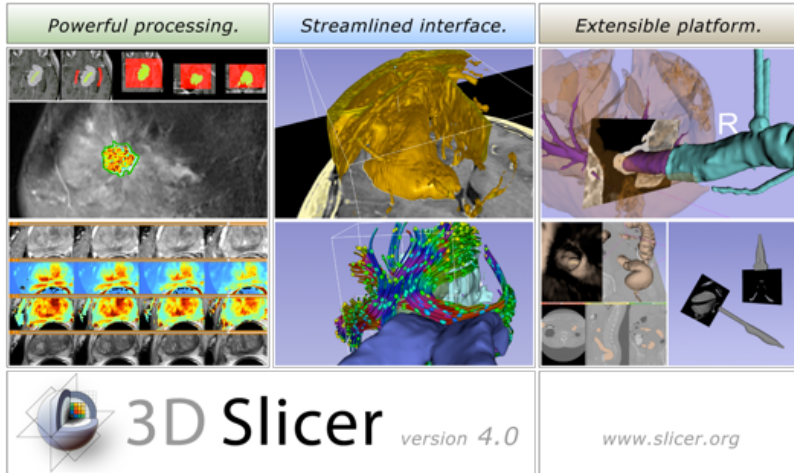


Disclaimer

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. **Slicer is a tool for research, and is not FDA approved.**



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 clinicians and scientists



NA-MIC and NAC



National Alliance for Medical Image Computing

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

Meckler Custom Search Search

NA-MIC Wiki

General

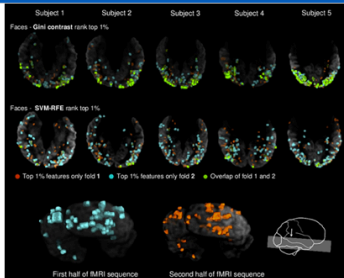
- Overview
- Organization
- Contact Us

Center Components

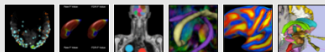
- Algorithms
- Engineering
- Diving Biological Projects
- Collaboration Grants

Resources

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



Detecting Stable Distributed Patterns of Brain Activation using Gini Contrast [Read more...](#)



1 of 23 Photos

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

Supported by the National Institutes of Health, [Roadmap Initiative](#).

Information about collaborating with NA-MIC is available [on our wiki](#).



97th Scientific Assembly and Annual Meeting

November 27 - December 2, McCormick Place, Chicago.

[Read more...](#)

[NEWS ARCHIVE](#)



Neuroimage Analysis Center

"understanding the human brain through imaging"

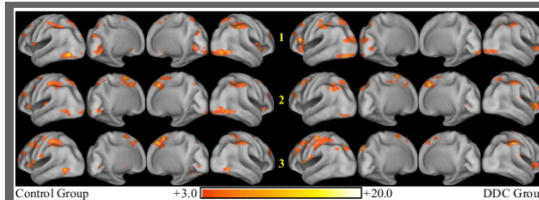
Google Custom Search

About the NAC

- Overview
- Organization
- Research Cores
- Collaborations

Resources

- Contact Us
- Publication DB
- Image Gallery
- Downloads
- Training Materials
- Web Archive



State-space Models of Mental Processes from fMRI

Spatial Activity Maps. The average t-score maps of the two groups (voxel-wise group average divided by group std. dev.) are displayed on an inflated brain-surface (left lateral-posterior, left medial-posterior, right medial-posterior and right lateral-posterior). Each row shows the maps for one phase of the task and values 1-3 have been masked out for clarity.

[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 in Boston, with collaborators throughout the United States and the rest of the world.

The NAC is a major research center supported by the National Center for Research Resources (NCRR), a component of the National Institutes of Health.



P.I. Ron Kikinis, M.D.



Slicer: Behind the scenes

Safari File Edit View History Bookmarks Window Help
CDash - Slicer4
http://www.cdash.org/Slicer4/index.php?project=Slicer4
namic Google weather Slicer Countway Yahoo! eCommons dtl_review
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
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	Error	Warn	Pass	
factory-win7.kitware	Windows7-VS2010-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0	2 ⁰	0	2 ⁰	107		
factory-mac-64bits.kitware	SnowLeopard-g++4.2.1-64bits-QT4.7-PythonQt-With-Tcl-CLI-Release	1	0	0	0	0	14 ⁰	3		
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-64bits-QT4.7-PythonQt-With-Tcl-CLI-Release	1	0	0	0	0	13 ⁰	3		
factory-win7.kitware	Windows7-VS2008-64bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	0	0	0	0	0	1000 ⁰	223		
factory-win7.kitware	Windows7-VS2008-32bits-QT4.7.1-PythonQt-With-Tcl-CLI-Release	1	0	0	0	0	1000 ⁰	226		

Nightly

Site	Build Name	Update			Configure			Build			Test			Build Time
		Files	Error	Warn	Error	Warn	Error	Warn	Not Run	Fail	Pass			
whitecube.kitware	SnowLeopard-gcc4.2.1-QT4.7.0-PythonQt-With-Tcl-Release	1	0	0	27	0	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	0	15	0	304	6			11 hours ago	
eris.kitware	Linux-g++4.4-QT4.6.3-PythonQt-CLI-Release	1	0	0	0	0	15 ⁰	2	36 ⁰	451 ⁰			3 hours ago	
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-QT4.7-PythonQt-With-Tcl-CLI-Vaigrind-Release	0	0	0	0	0	13 ⁰	3	27 ⁰	460 ⁰			11 hours ago	
factory-ubuntu-64bits.kitware	Linux-g++4.4.3-64bits-QT4.7-PythonQt-With-Tcl-NoCLI-Coverage-Release	0	0	0	0	0	12 ⁰	3	23 ⁰	287 ⁰			11 hours ago	
sagarmatha.kitware	Linux-g++4.3.3-QT4.7-PythonQt-With-Tcl-NoCLI-Release	0	0	0	0	0	12 ⁰	2	22	288			12 hours ago	

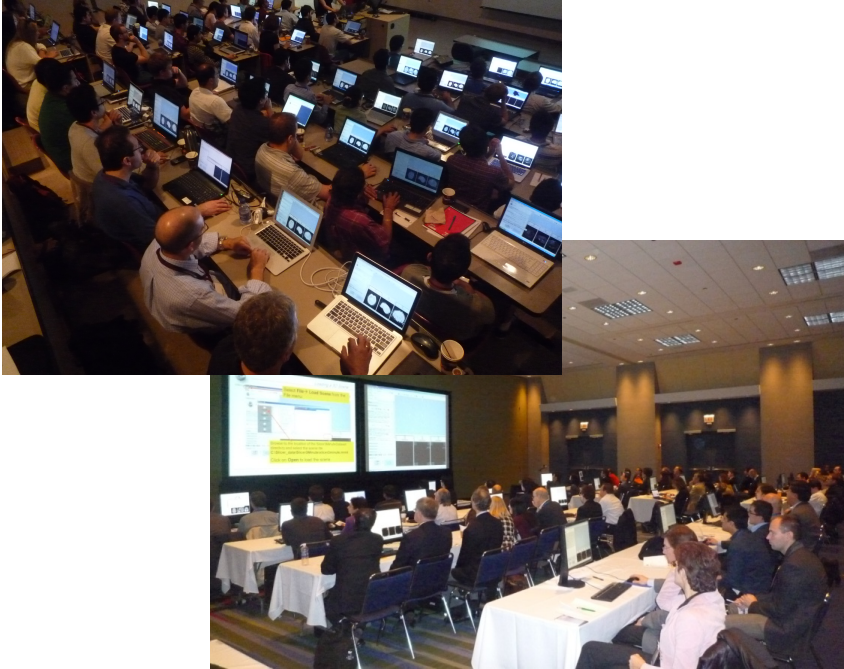
Continuous

Site	Build Name	Update			Configure			Build			Test			Build Time
		Files	Error	Warn	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	0	304	6			1 hour ago	

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



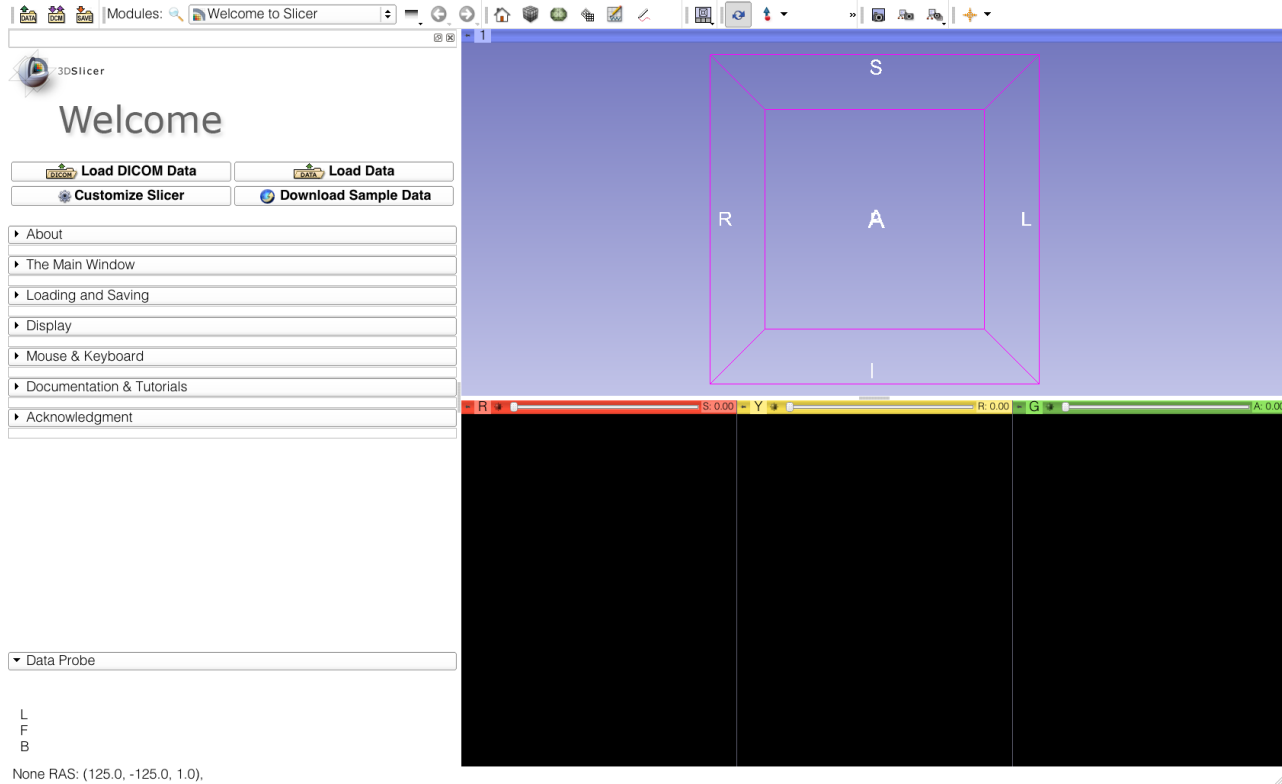
Slicer Training



- Hands-on training workshops at national and international venues
- >1,700 clinicians, clinical researchers and scientists trained since 2005



3DSlicer version 4.1



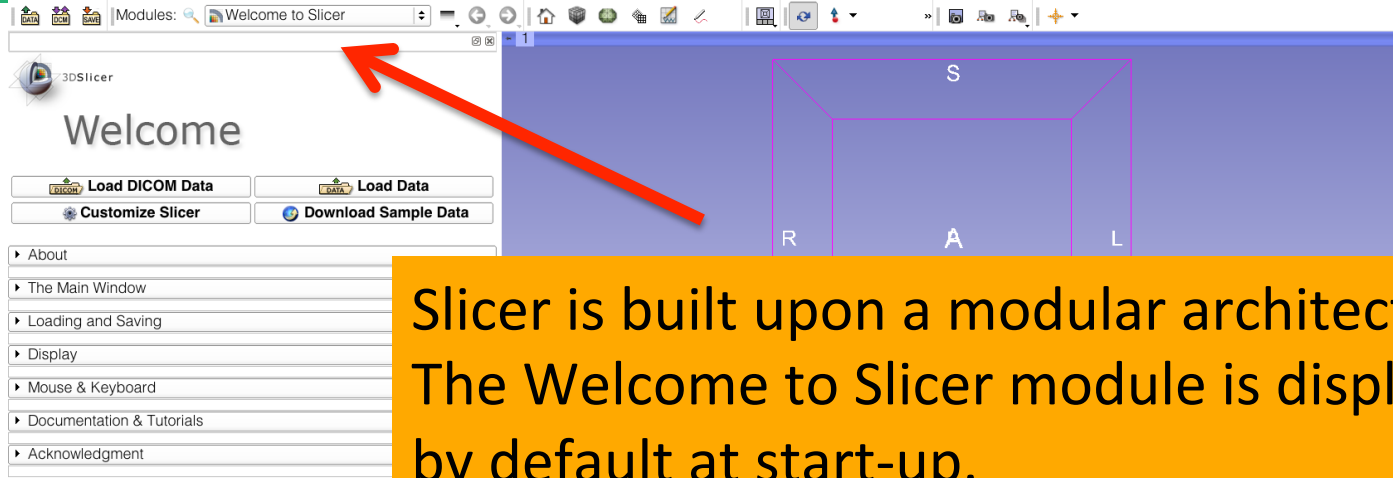


Tutorial Material

- Software: Slicer4.1 available at www.slicer.org
- Dataset: 3DVisualizationData.zip available in the Slicer 101 compendium at www.slicer.org



Welcome to Slicer4

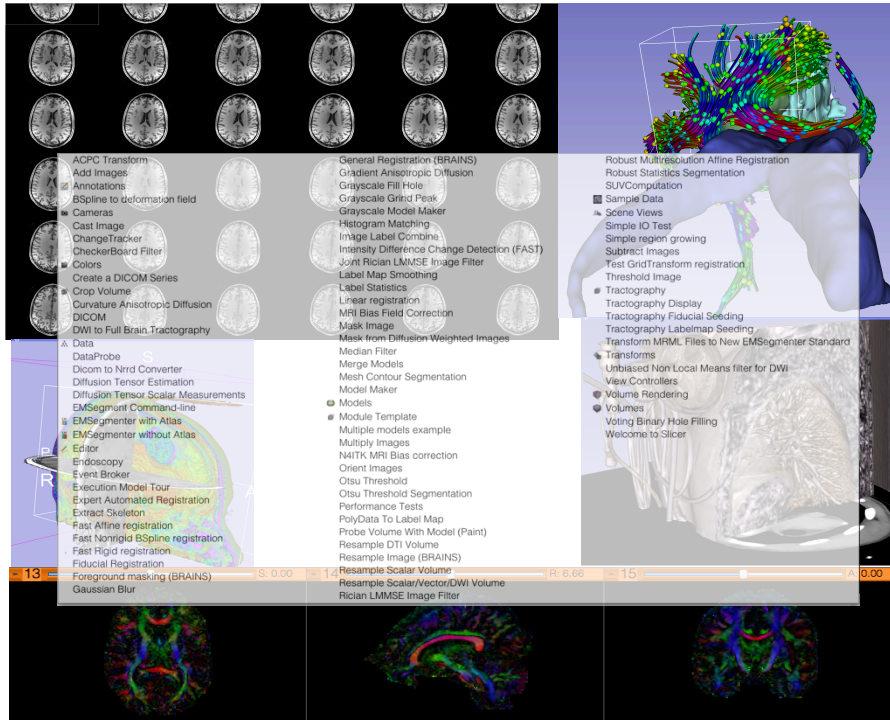


Slicer is built upon a modular architecture. The Welcome to Slicer module is displayed by default at start-up. Click on Welcome to Slicer to display the 103 modules of Slicer in the Modules menu





Welcome to Slicer4



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

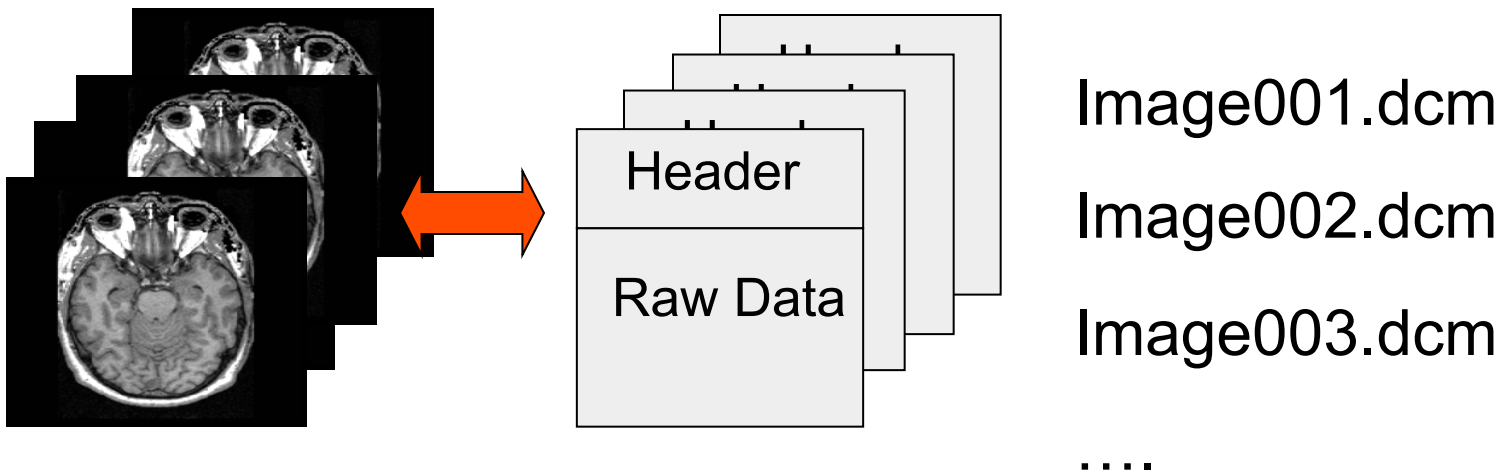


PART 1: LOADING AN MR VOLUME



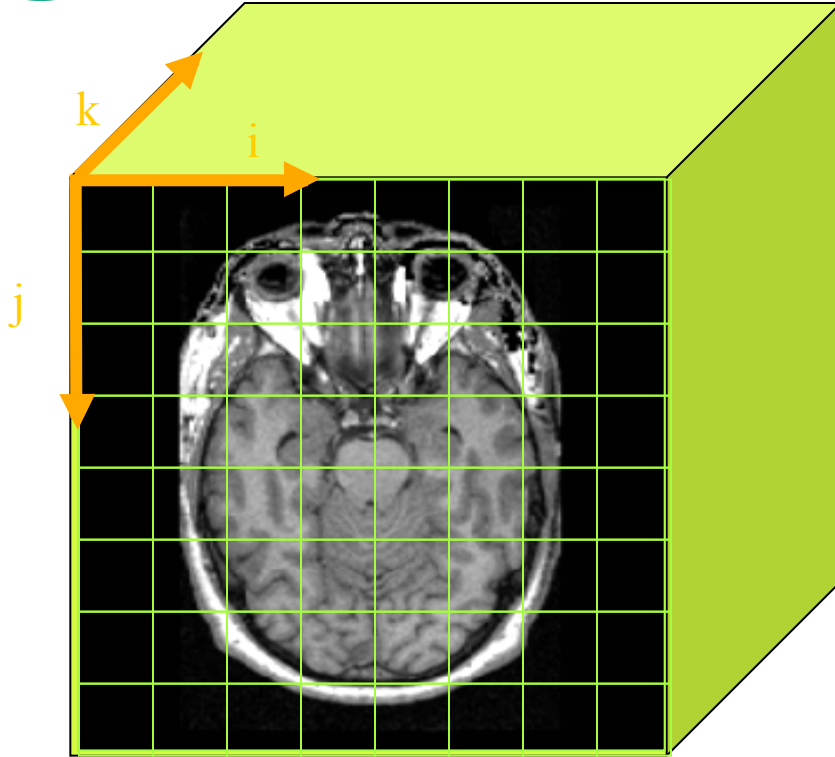
The DICOM 3.0 File Format

Most radiological imaging equipment produce images in DICOM file format (‘.dcm files’)





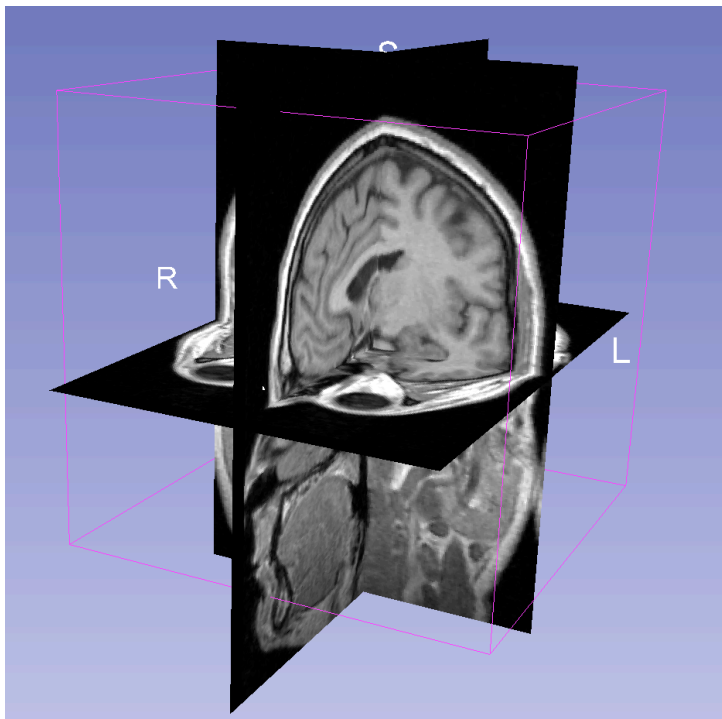
Data Representation



- The result of a volumetric acquisition is a **3D volume of data** related to the patient.
- The 3D raster dataset is sampled on a discrete grid with elements called **voxels** which contain the **signal intensity**.



Tutorial Dataset



- The tutorial dataset is an MR scan of the brain of a healthy subject.
- The data in the **Nrrd** file format, part of the NA-MIC toolkit
- DICOM data can be converted in Nrrd using the module '**DICOM to NRRD Converter**' in Slicer.



Slicer4

A screenshot of the Slicer4 software interface. The 'Welcome' module is active, showing a sidebar with navigation options like 'About', 'The Main Window', 'Loading and Saving', 'Display', 'Mouse & Keyboard', 'Documentation & Tutorials', and 'Acknowledgment'. Below these are buttons for 'Load DICOM Data', 'Load Data', 'Customize Slicer', and 'Download Sample Data'. A 'Data Probe' section is visible at the bottom left. The main 3D view area is currently empty, showing a blue background with a purple wireframe box labeled 'S'. A large yellow rectangular overlay with black text is positioned over the 3D view, reading 'Click on Load Data in the Slicer Welcome module'. The top of the window shows the 'Modules' menu and a search bar containing 'Welcome to Slicer'.

3DSlicer
Welcome

Load DICOM Data Load Data
Customize Slicer Download Sample Data

► About
► The Main Window
► Loading and Saving
► Display
► Mouse & Keyboard
► Documentation & Tutorials
► Acknowledgment

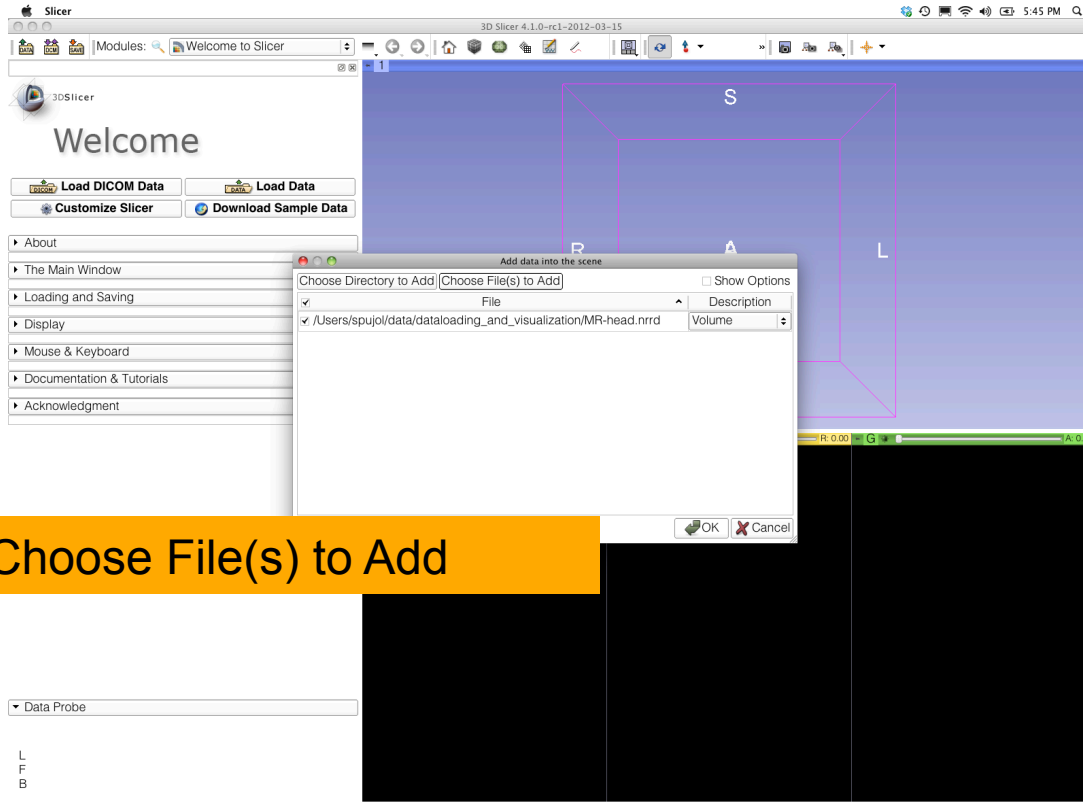
▼ Data Probe

L
F
B
None RAS: (125.0, -125.0, 1.0).

Click on Load Data in the Slicer Welcome module

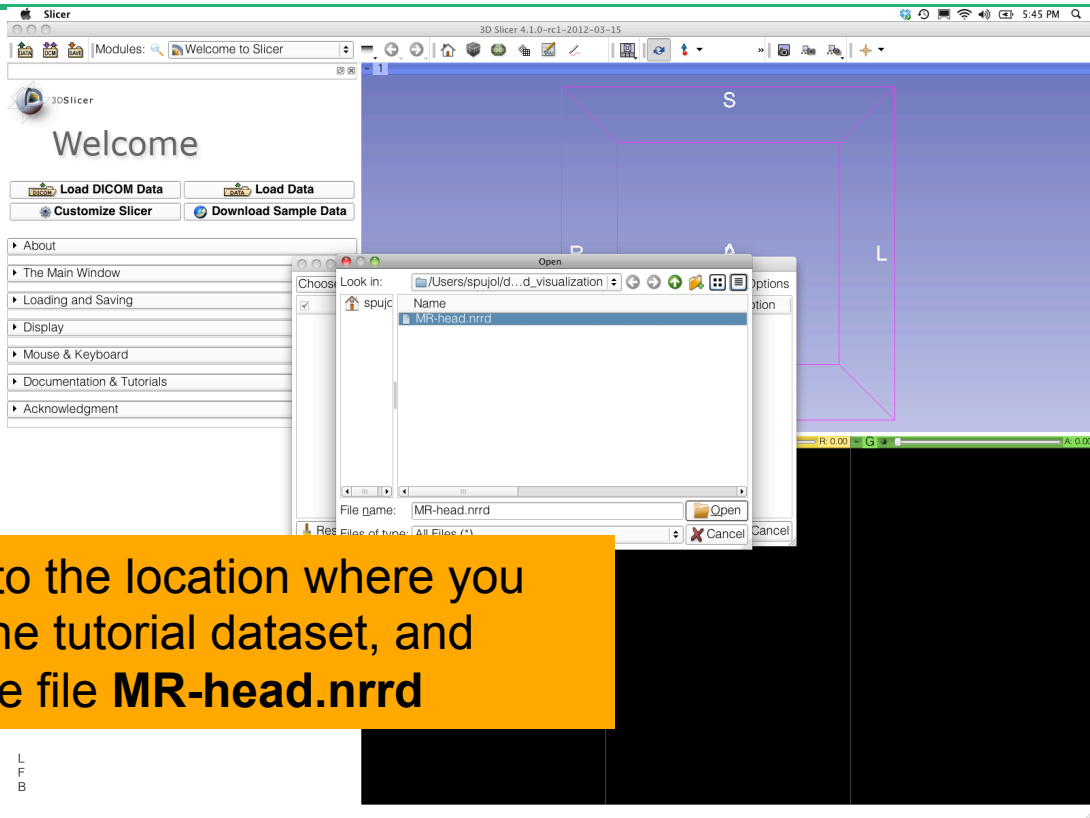


Loading a volume





Loading a volume

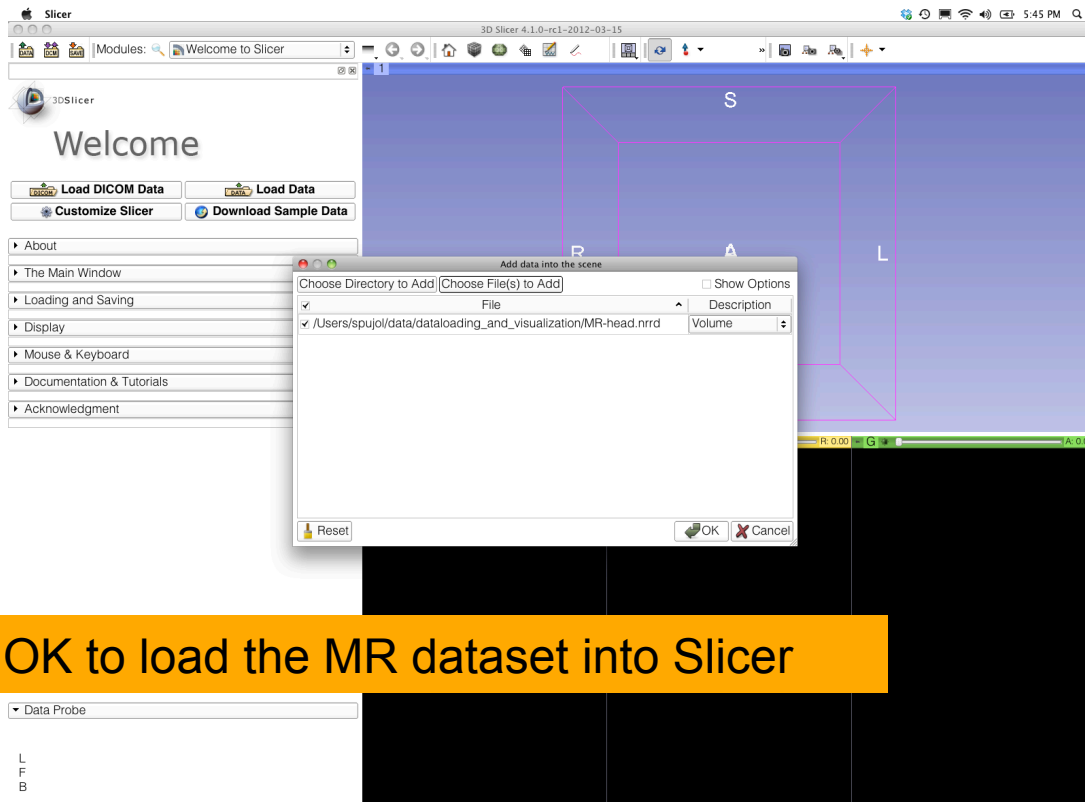


Browse to the location where you copied the tutorial dataset, and select the file **MR-head.nrrd**

L
F
B



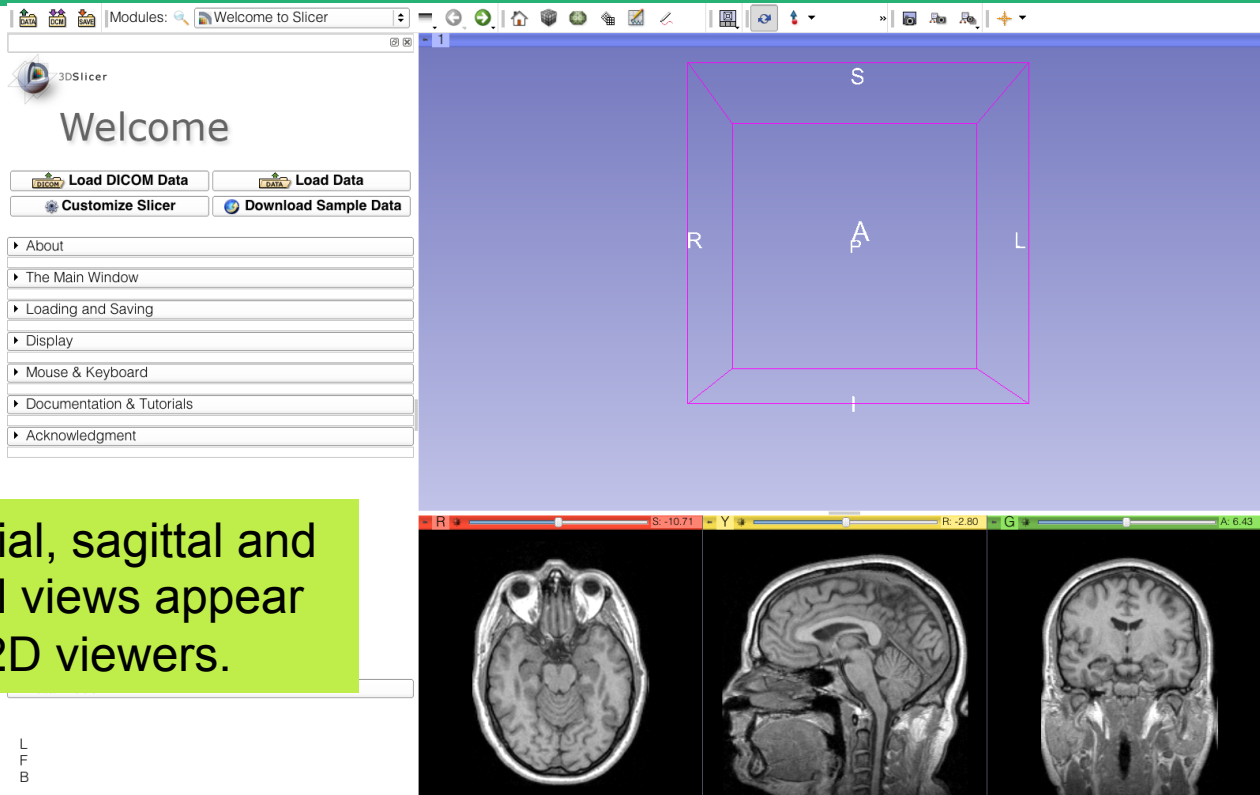
Loading a volume



Click on OK to load the MR dataset into Slicer



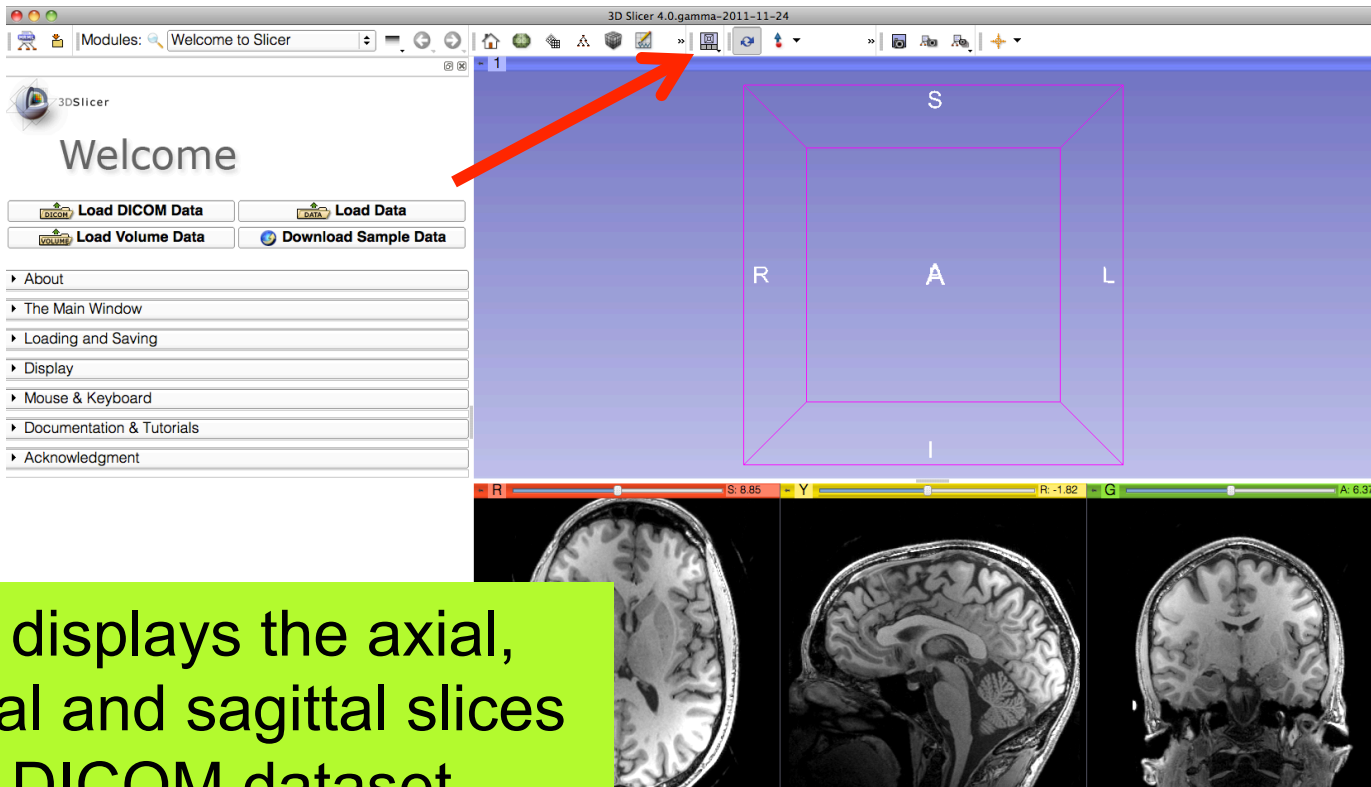
Loading a volume



The axial, sagittal and coronal views appear in the 2D viewers.



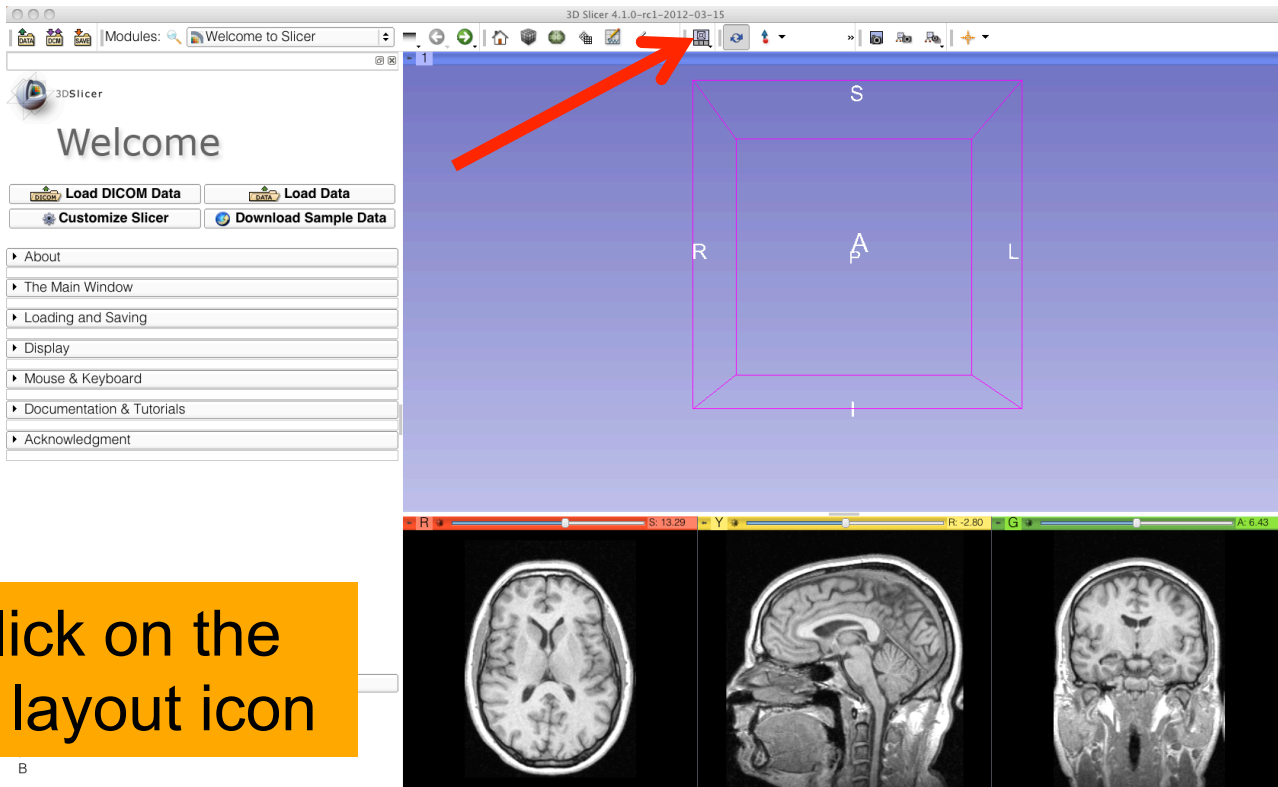
Loading a volume



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



Loading a volume

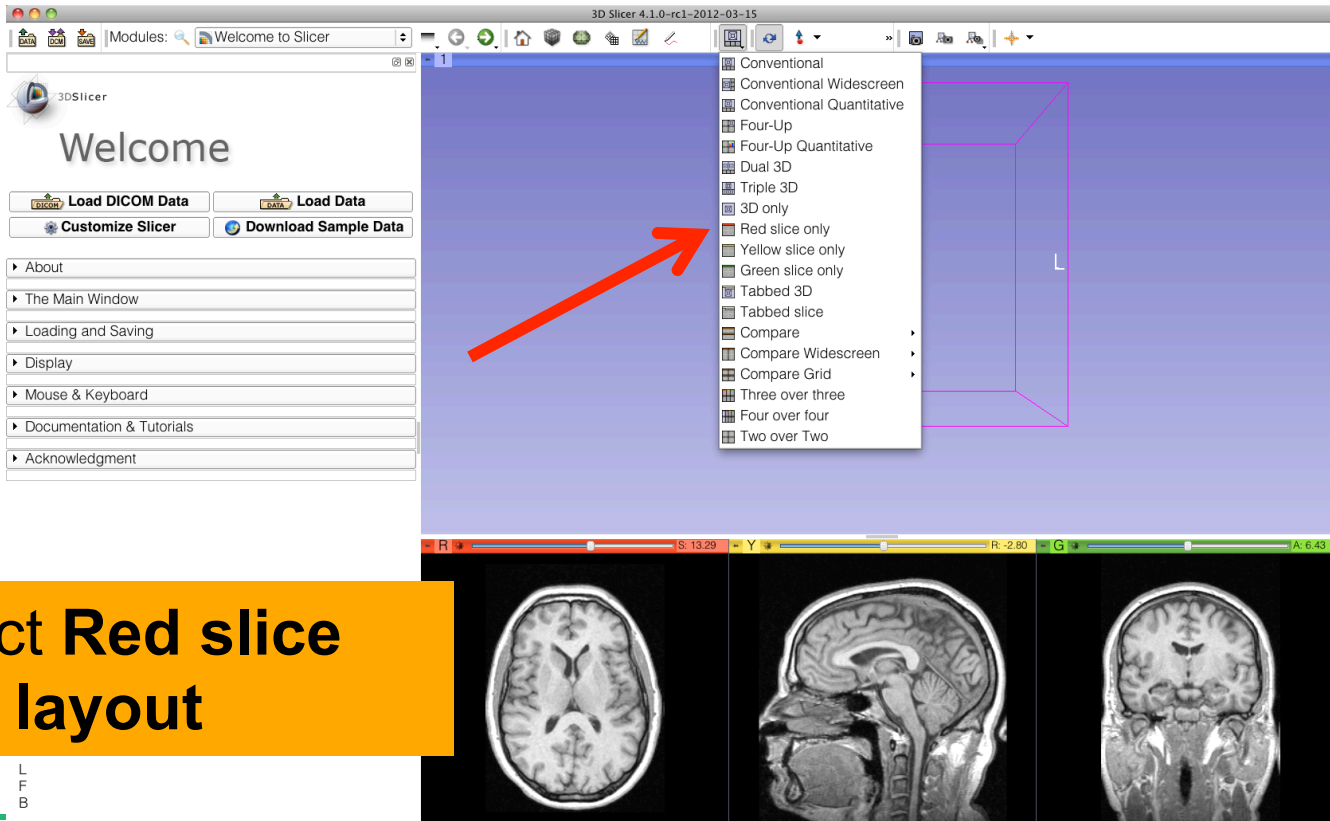


Left-click on the Slicer layout icon

B



Loading a volume

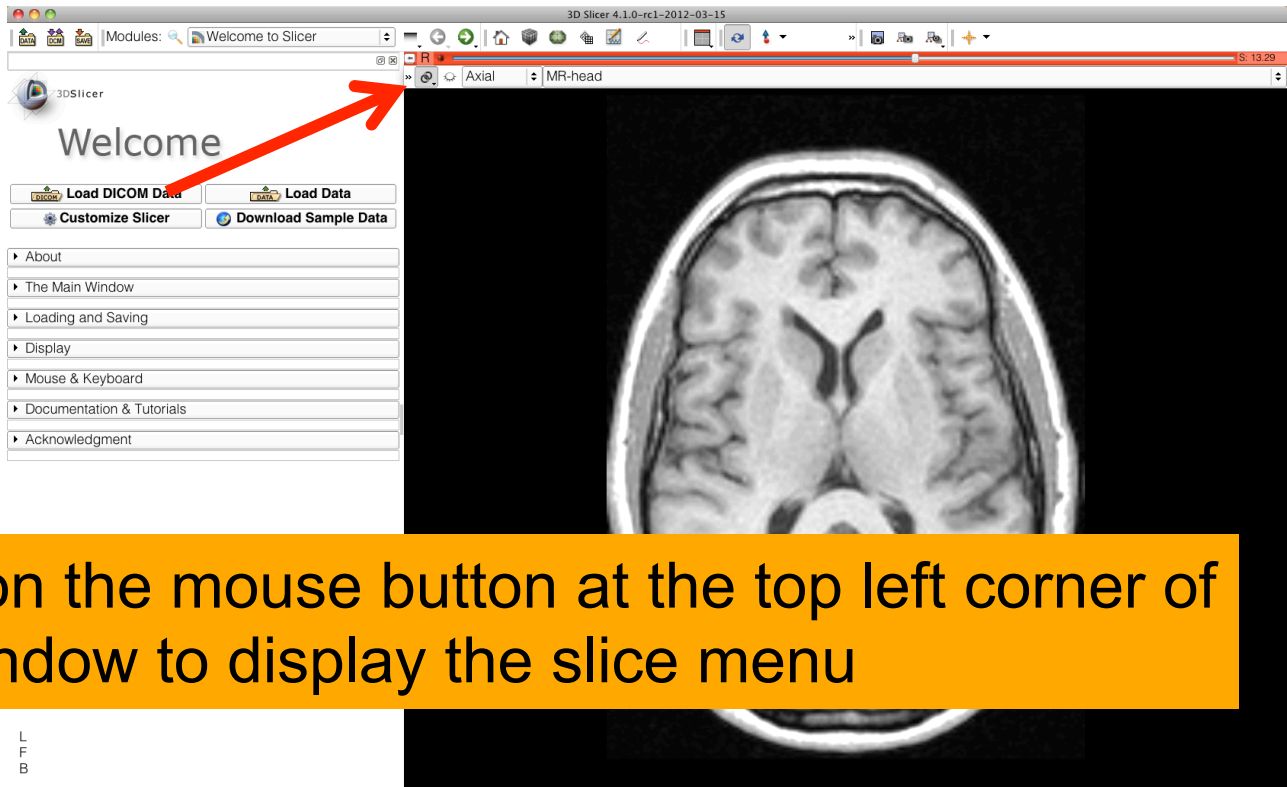


Select Red slice only layout

L
F
B



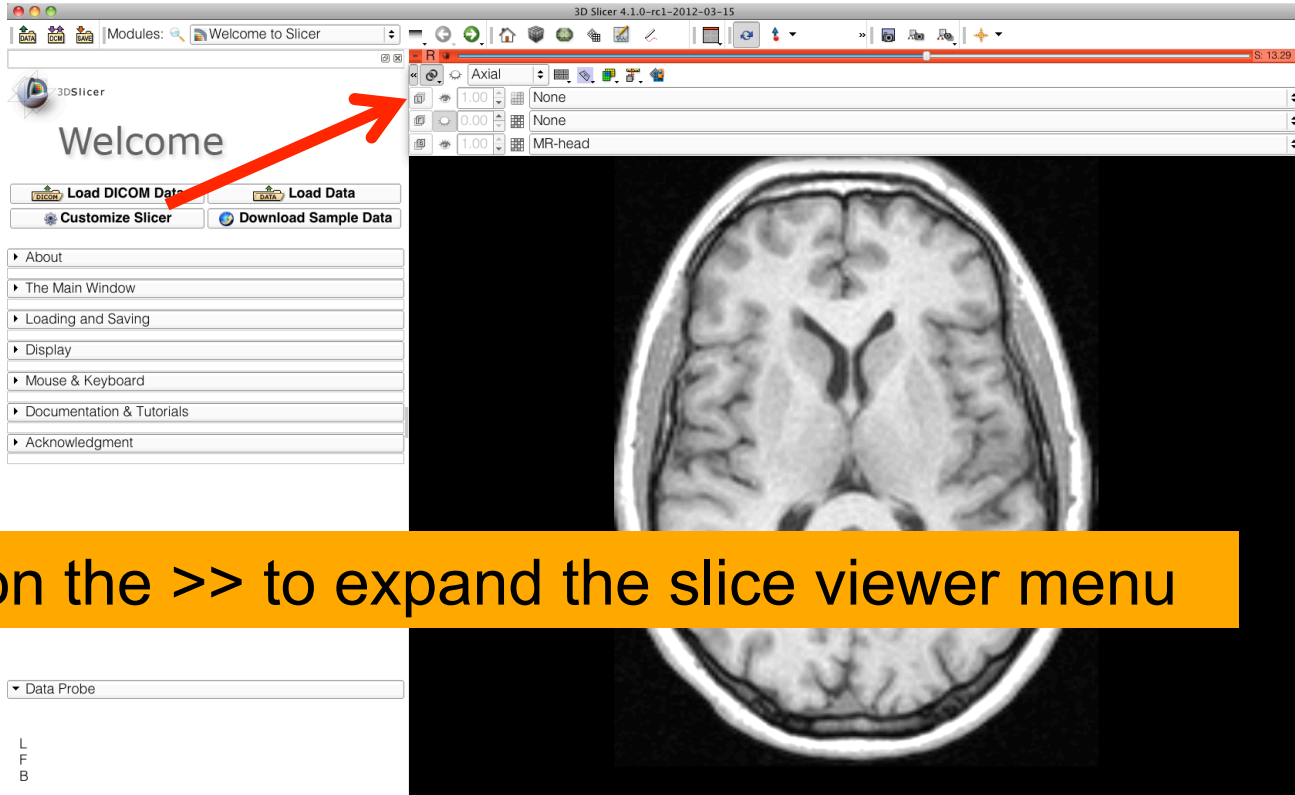
Loading a volume



Position the mouse button at the top left corner of the window to display the slice menu



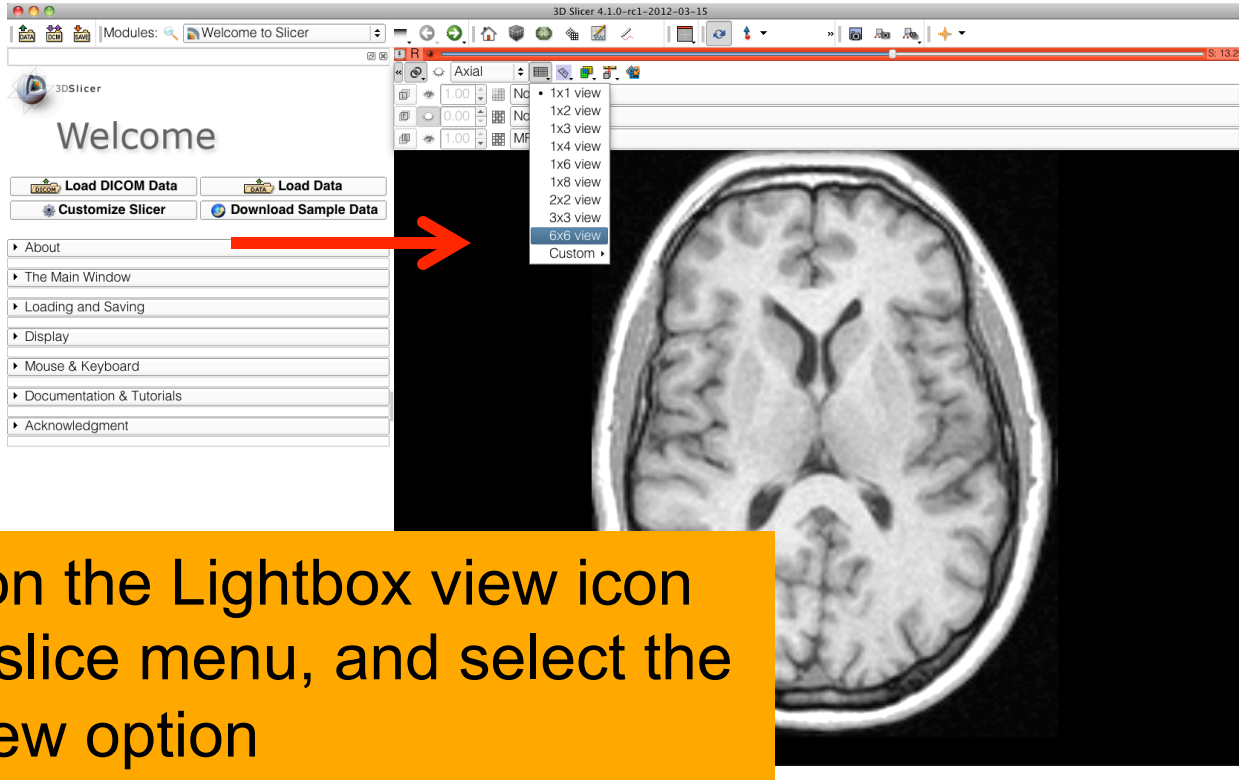
Loading a volume



Click on the >> to expand the slice viewer menu



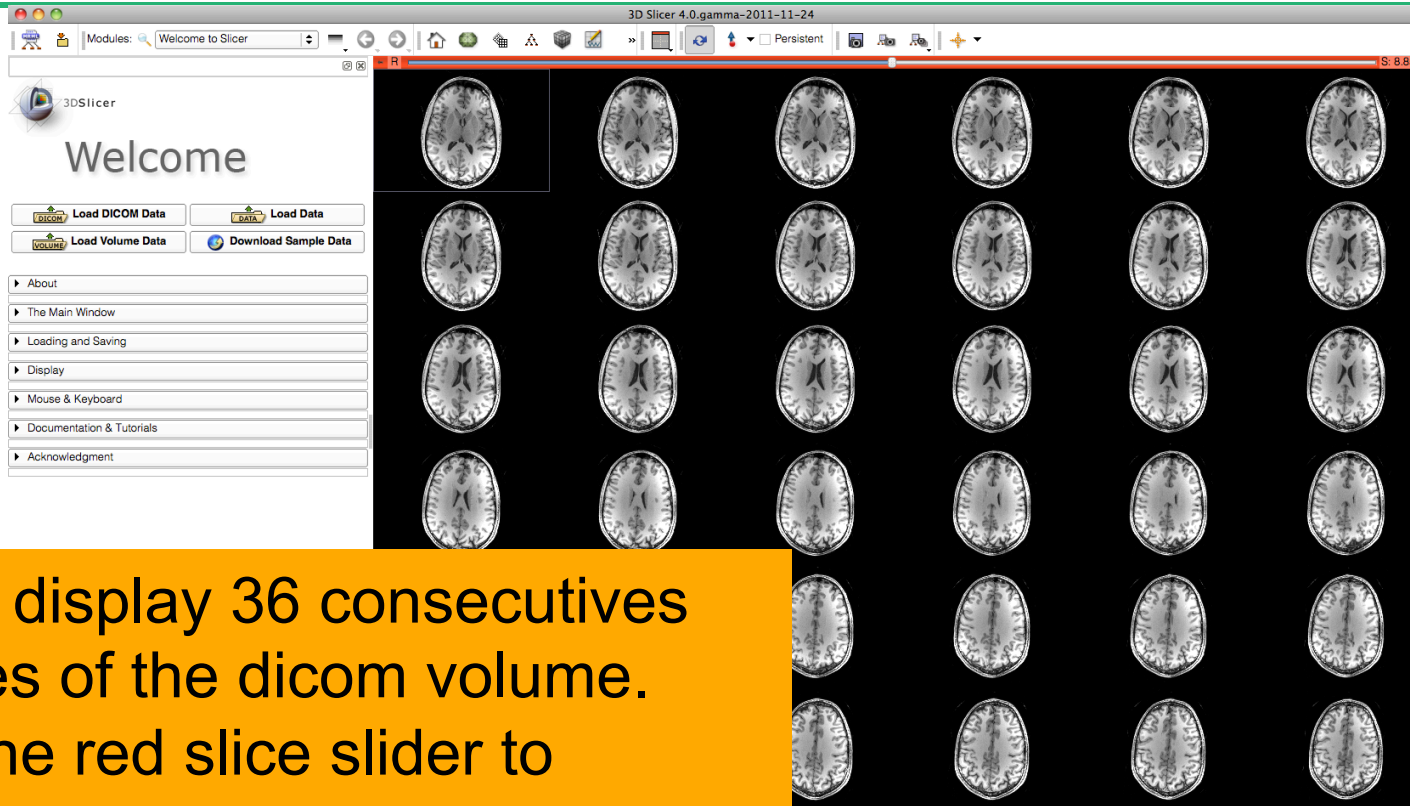
Loading a volume



Click on the Lightbox view icon in the slice menu, and select the 6x6 view option



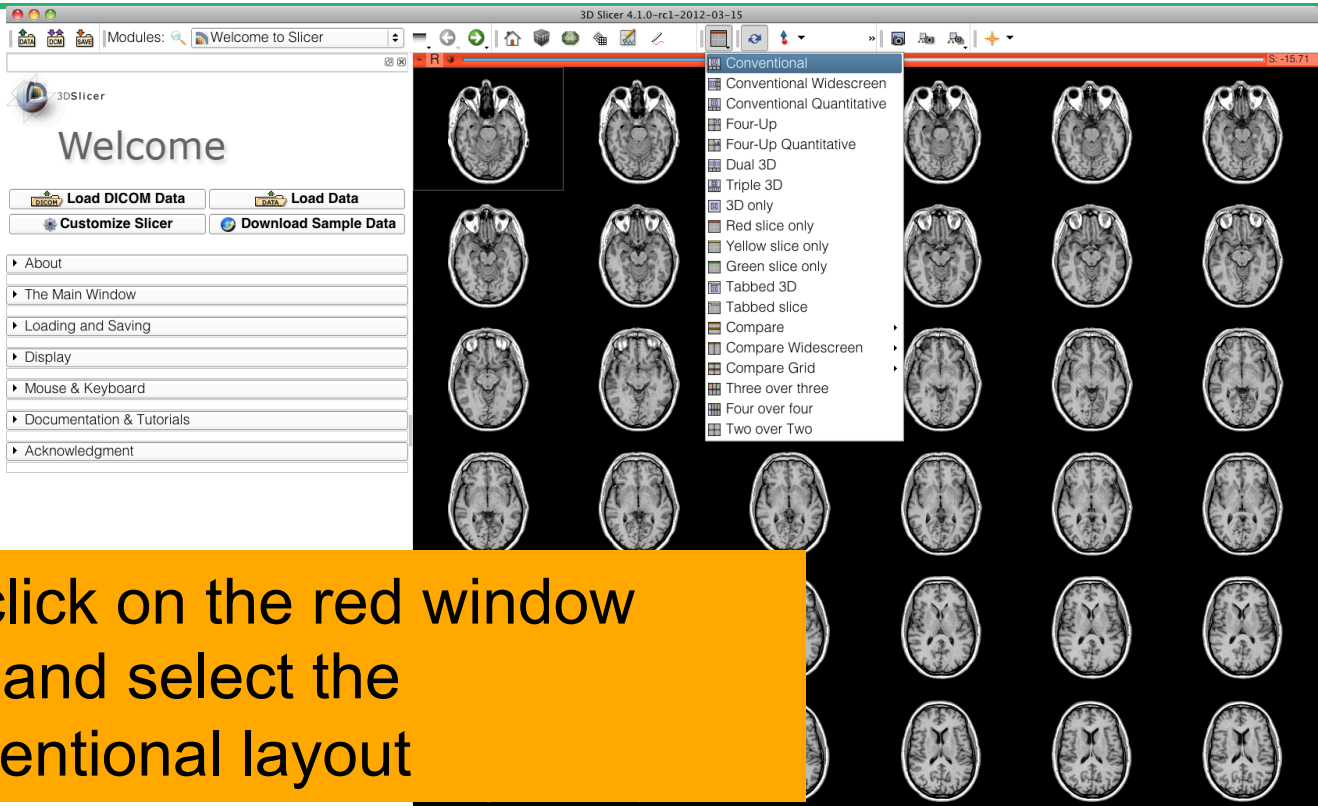
Loading a volume



Slicer display 36 consecutive images of the dicom volume.
Use the red slice slider to browse through the data



Loading a volume



Left click on the red window icon, and select the Conventional layout

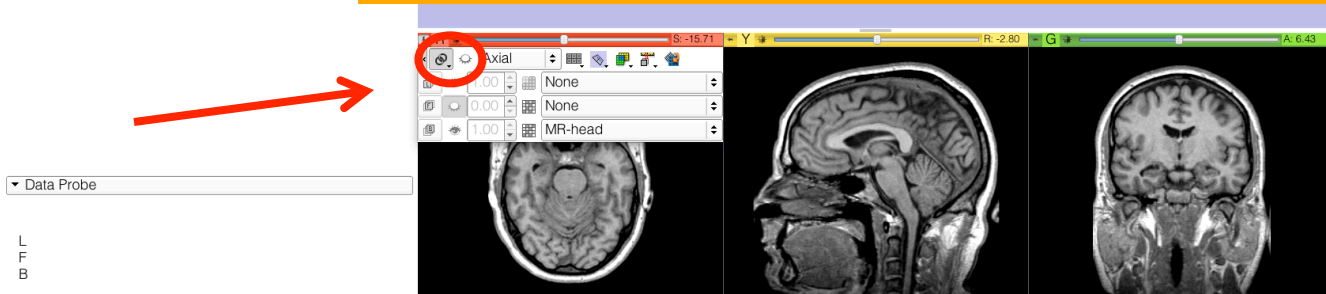
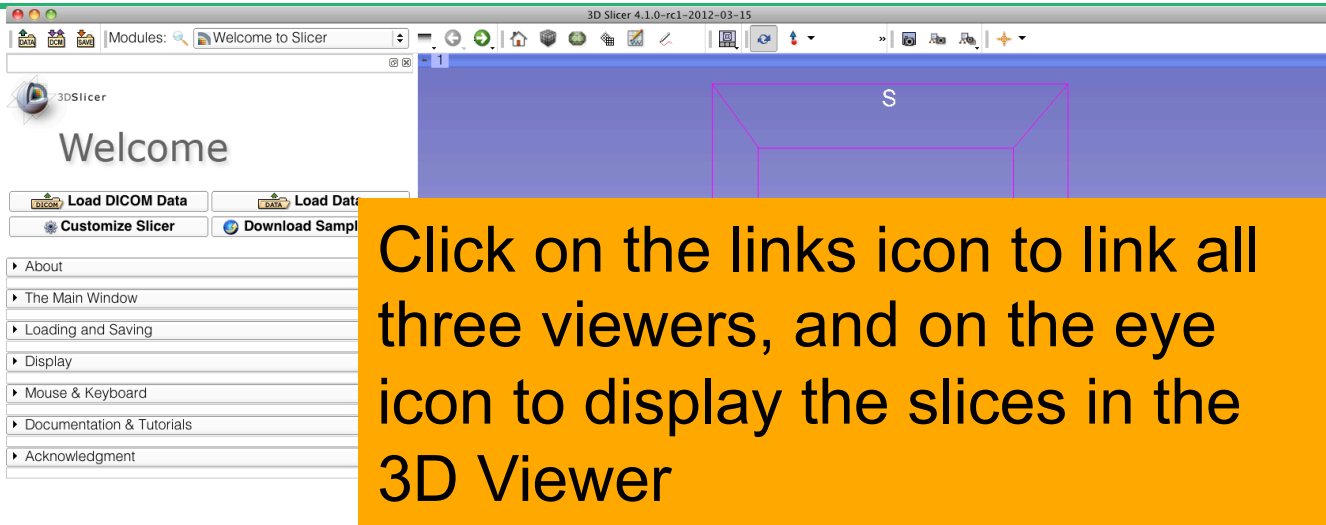


Loading a volume

The screenshot shows the 3D Slicer software interface. On the left is a sidebar with a 'Welcome' message and several buttons: 'Load DICOM Data', 'Load Data', 'Customize Slicer', and 'Download Sample Data'. Below these are expandable menu items: 'About', 'The Main Window', 'Loading and Saving', 'Display', 'Mouse & Keyboard', 'Documentation & Tutorials', and 'Acknowledgment'. At the bottom left, there is a 'Data Probe' dropdown and 'L', 'F', 'B' orientation indicators. The main window is currently in a 1x1 view, showing a single MRI slice. A red arrow points to the 'Lightbox' view in the bottom-left corner of the main window, which displays a grid of 20 small MRI slices. A yellow text box with black text is overlaid on the main window, stating: 'Select the lightbox viewer in the red slice menu, and come back to 1x1 view'. The top of the window shows a standard Windows taskbar with various icons and the text 'Modules: Welcome to Slicer'.



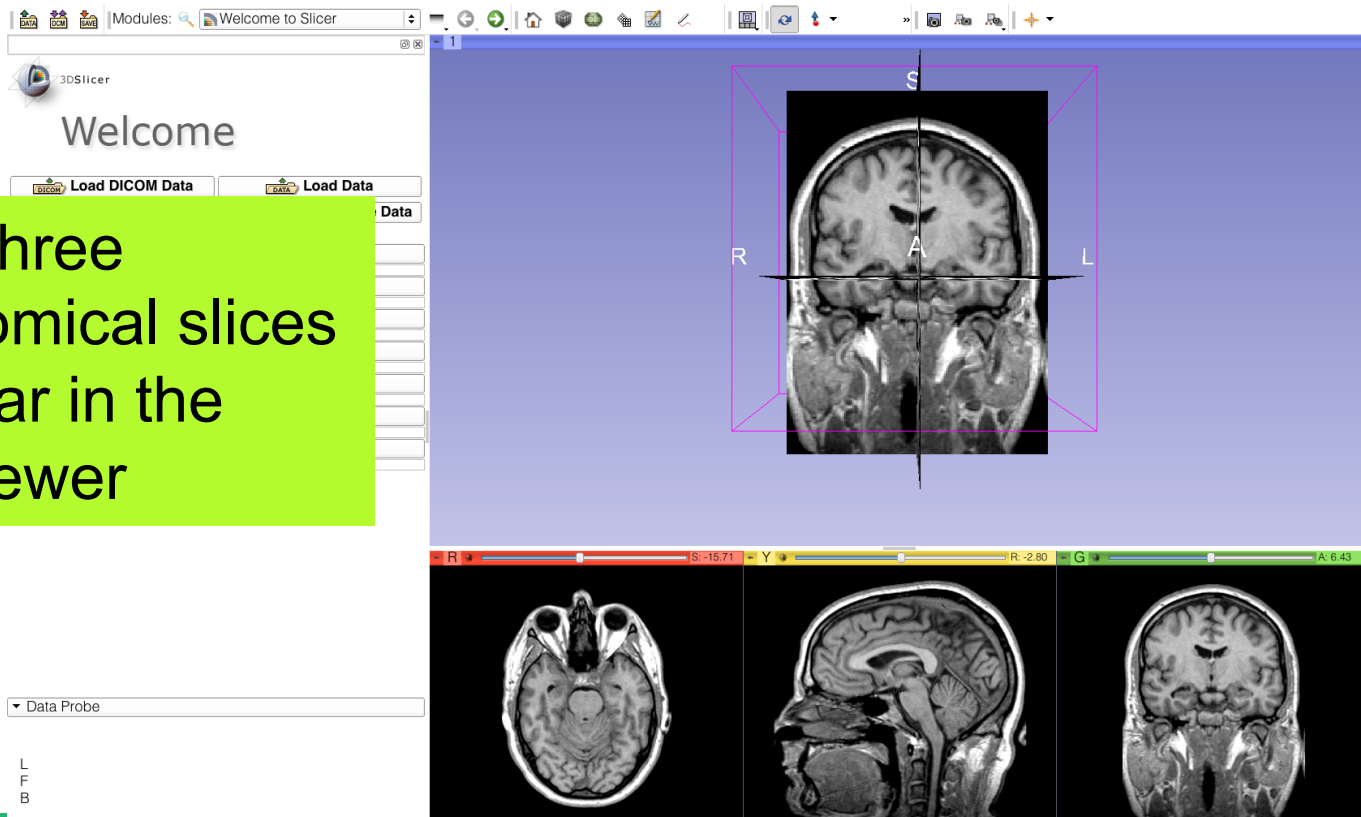
Loading a volume





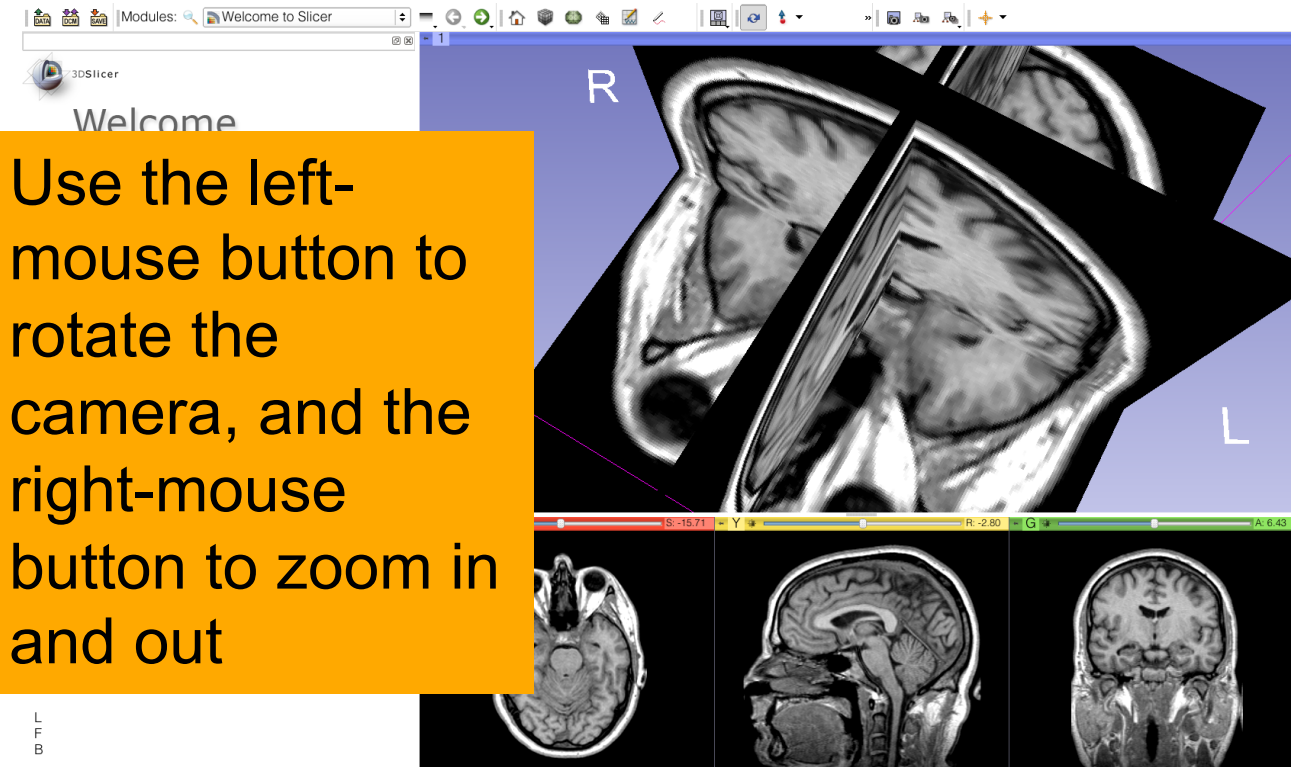
Loading a volume

The three anatomical slices appear in the 3DViewer



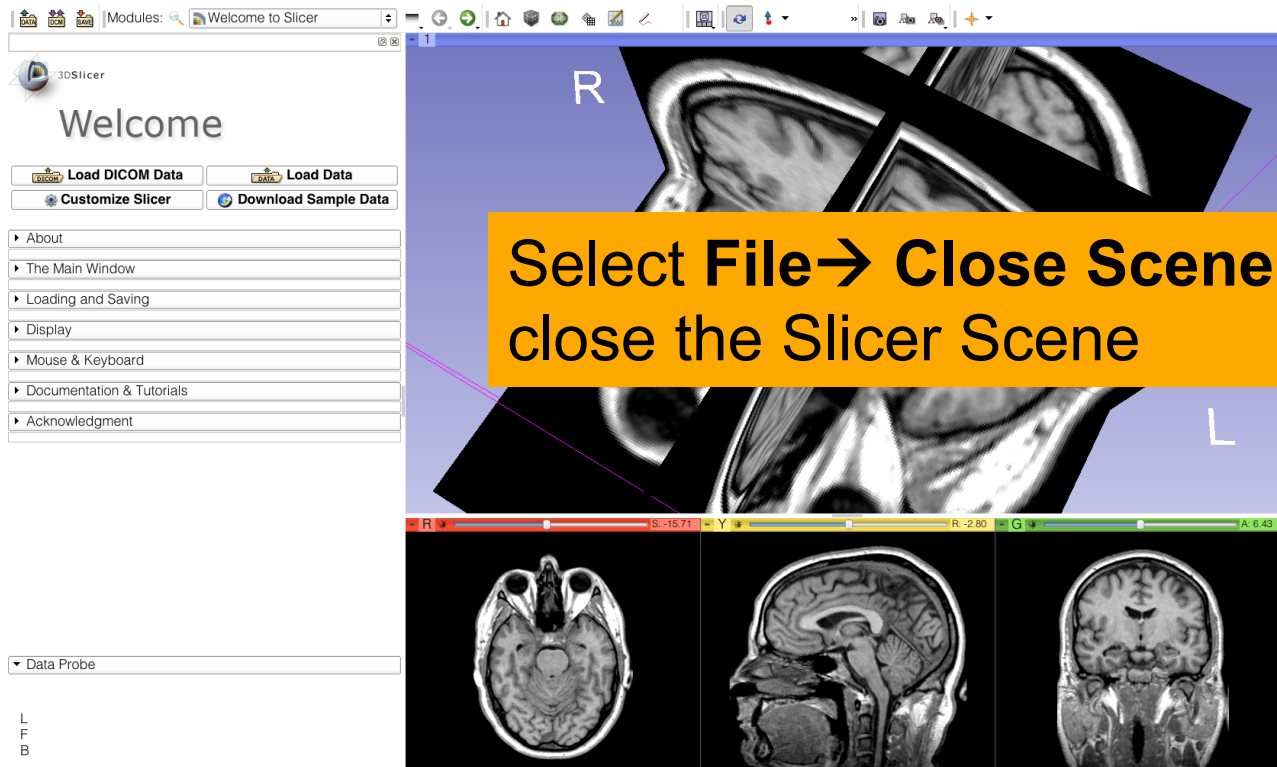


Loading a DICOM volume



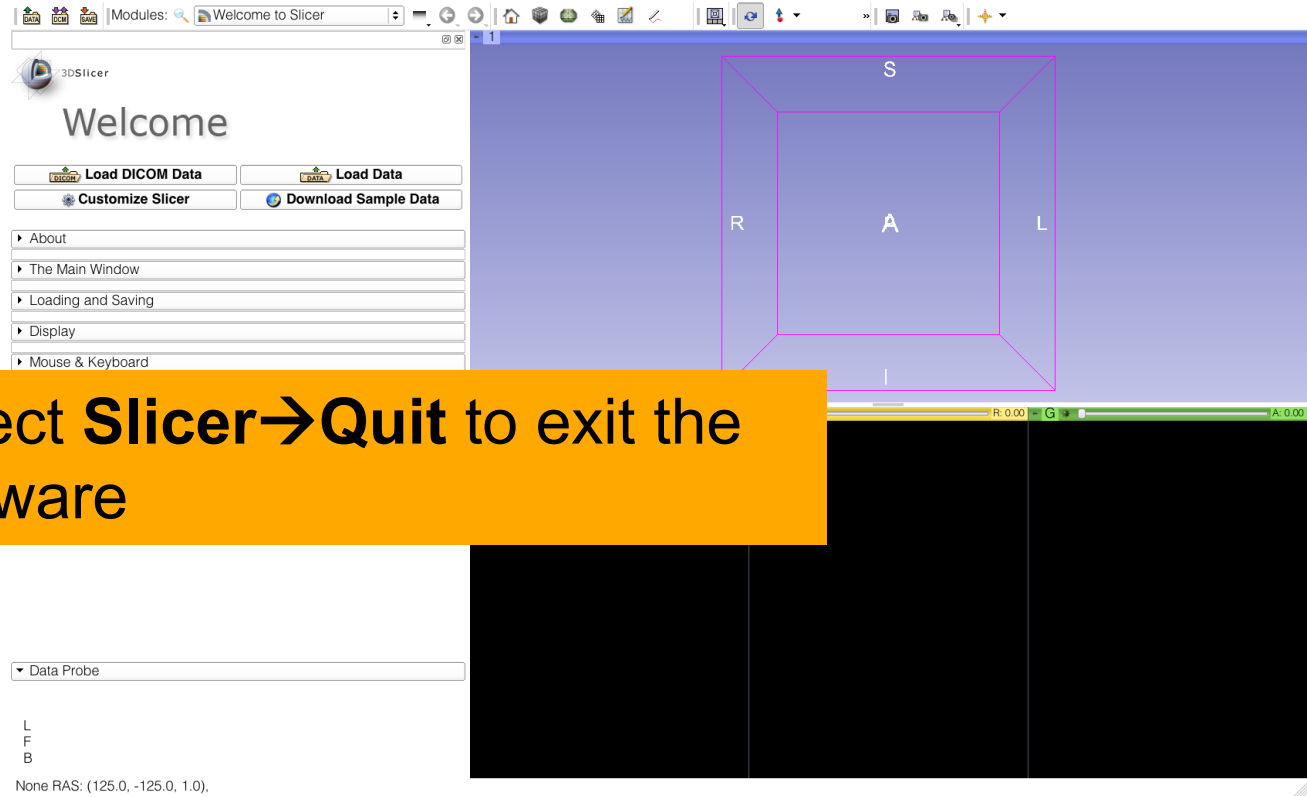


Close the scene

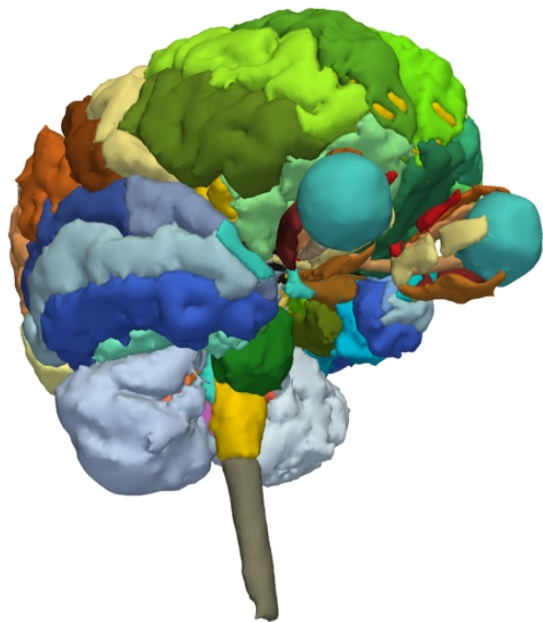




Exit Slicer



Select **Slicer** → **Quit** to exit the software

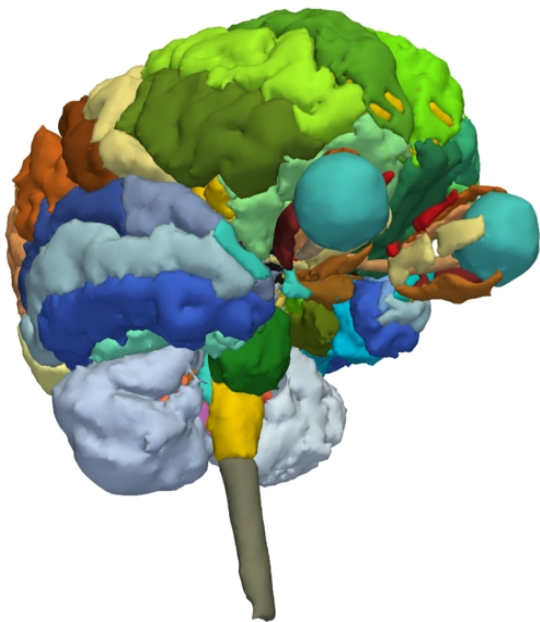


Part 2:

3D visualization of surface models of the brain



3D Slicer Scene



- A Slicer scene is a MRML file which contains a list of elements loaded into Slicer (volumes, models, fiducials...)
- The tutorial scene contains an MR scan of the brain and 3D surface models of anatomical structures.
- The tutorial data are part of the SPL-PNL Brain Atlas developed by Thalos et al



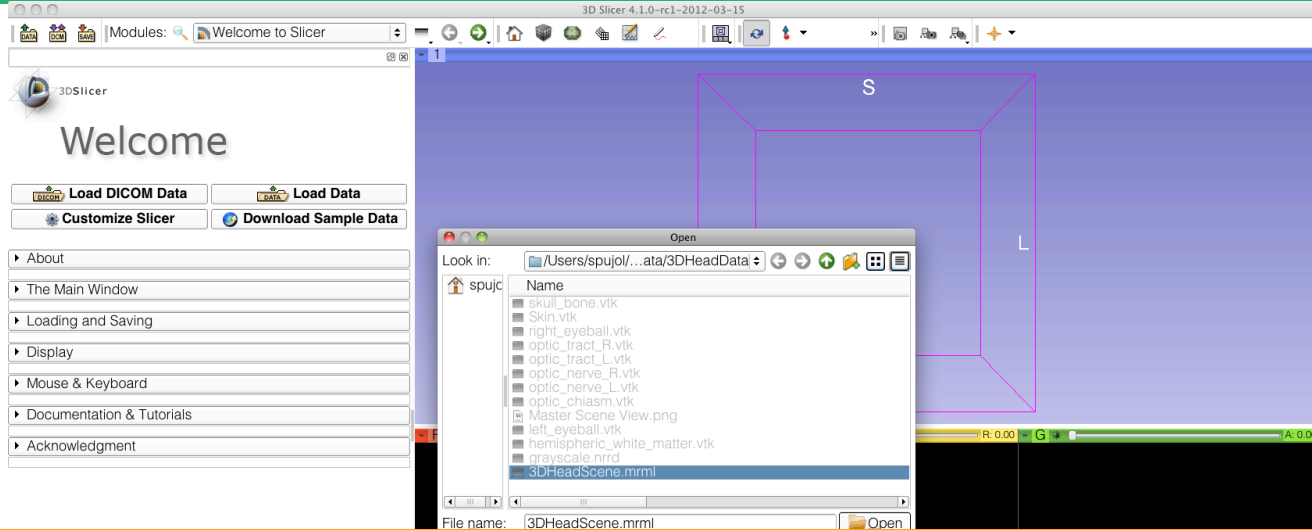
Loading a Scene

The screenshot shows the 3DSlicer software interface. On the left is a sidebar with a 'Welcome' message and several buttons: 'Load DICOM Data', 'Load Data', 'Customize Slicer', and 'Download Sample Data'. Below these are expandable menu items: 'About', 'The Main Window', 'Loading and Saving', 'Display', 'Mouse & Keyboard', 'Documentation & Tutorials', and 'Acknowledgment'. At the bottom of the sidebar, there is a 'Data Probe' dropdown menu and a coordinate system showing 'None RAS: (125.0, -125.0, 1.0)'. The main window features a 3D view area with a purple wireframe box. The box is labeled with 'S' at the top, 'I' at the bottom, 'R' on the left, and 'L' on the right. The center of the box is labeled 'A'. Below the 3D view area, there are three sliders for 'R' (red), 'Y' (yellow), and 'G' (green), each with a numerical value of 0.00. A yellow callout box is overlaid on the bottom right of the 3D view area.

**Select File → Load Scene
from the main menu**



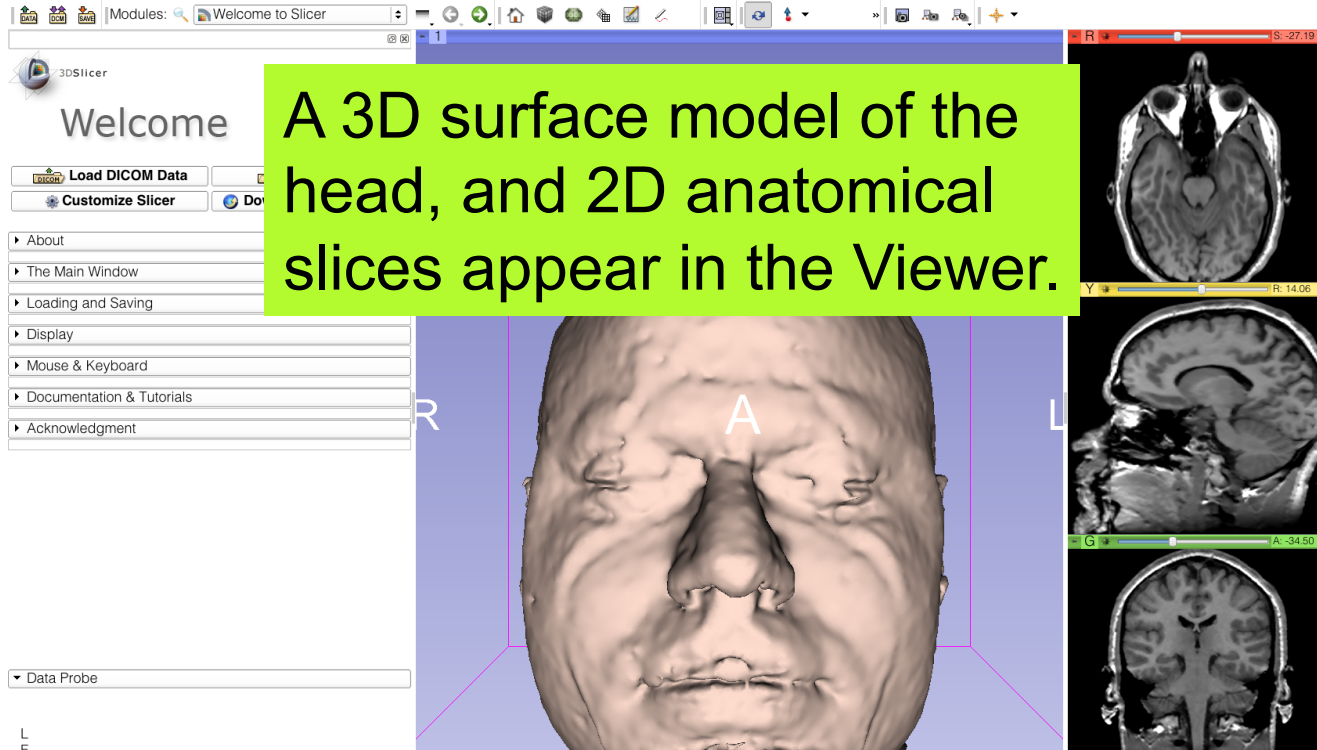
Loading a Scene



Browse to the directory **3DHeadData**, located in the **3DVisualizationData** directory, select the file **3DHeadScene.mrml** and click on **Open**

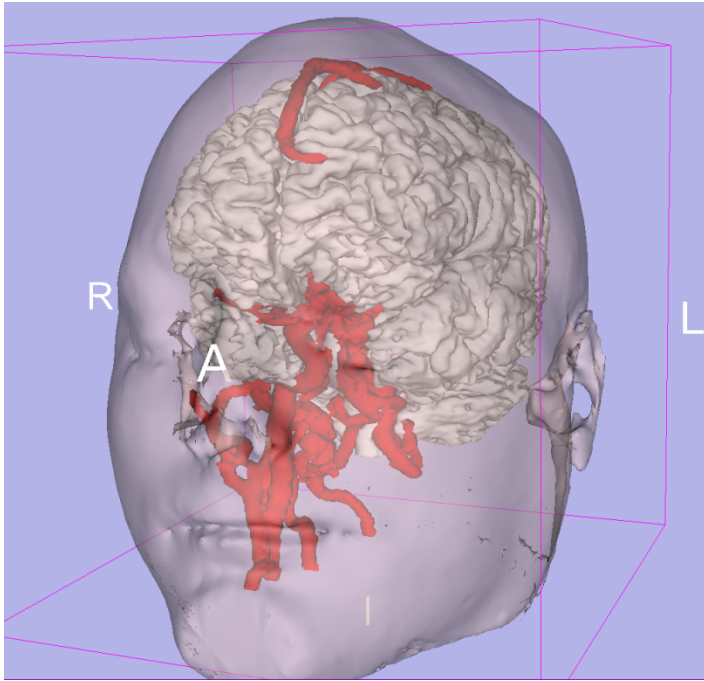


Loading the Slicer Scene





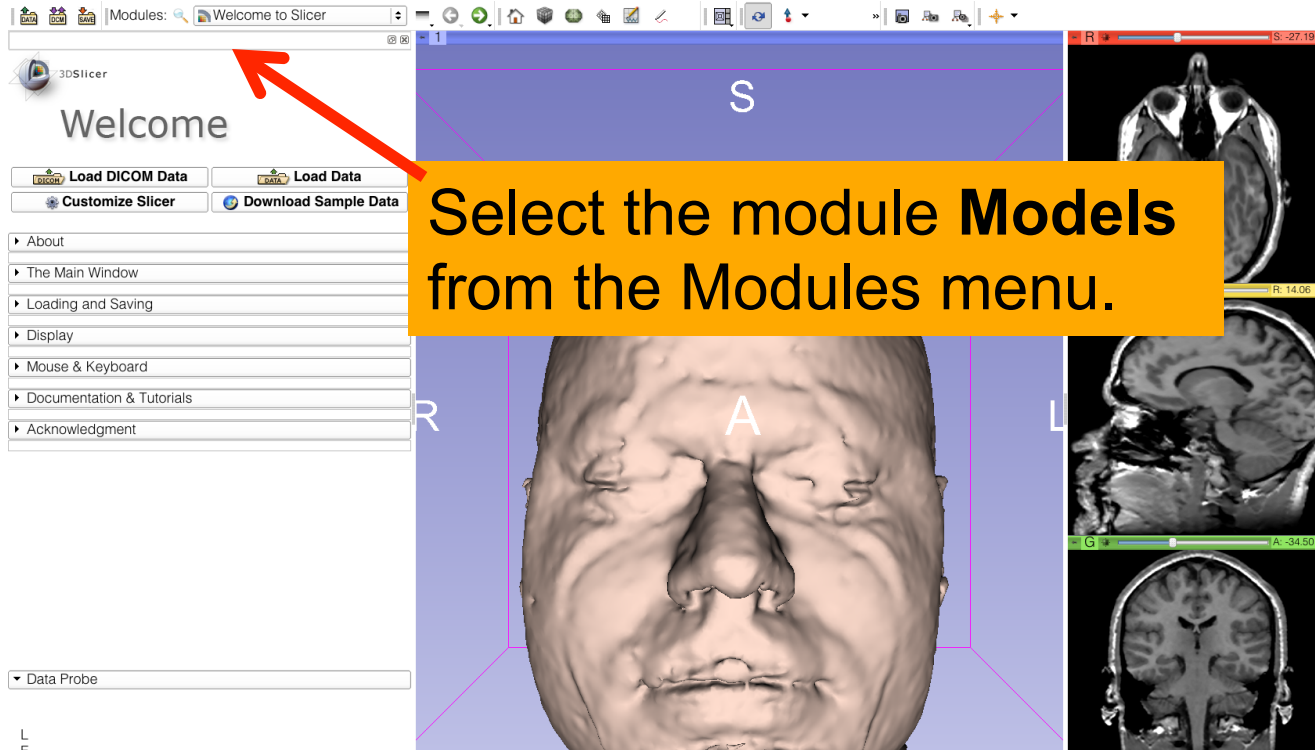
3D Surface Models



- A **3D model** is a surface reconstruction of an anatomical structure.
- The model is a **triangular mesh** that approximates a surface from a 3D label map.
- The scalar values for surface models are integers which correspond to the **label** that had been assigned in the segmentation process.



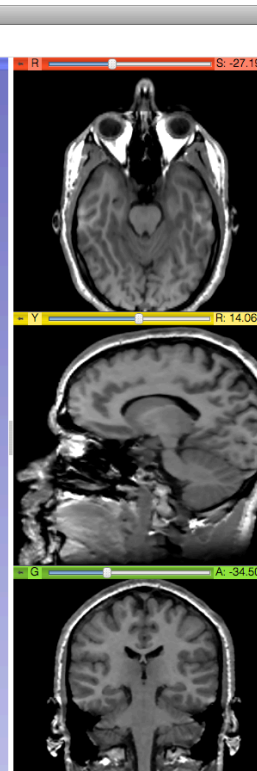
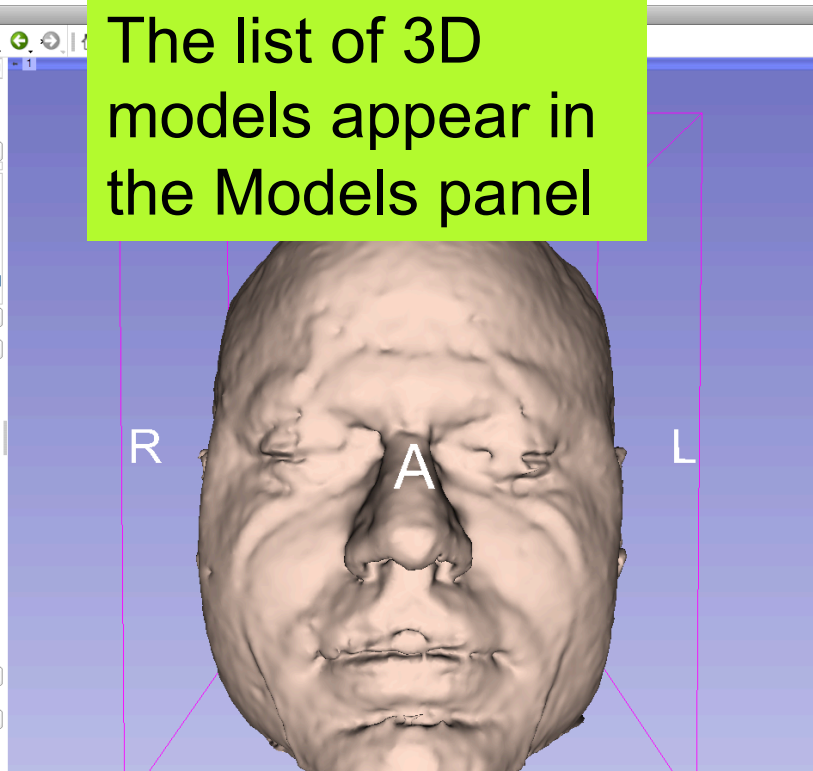
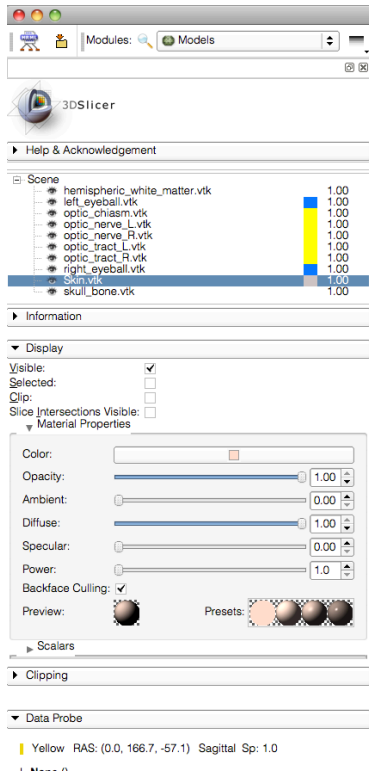
Loading the Slicer Scene





Models module

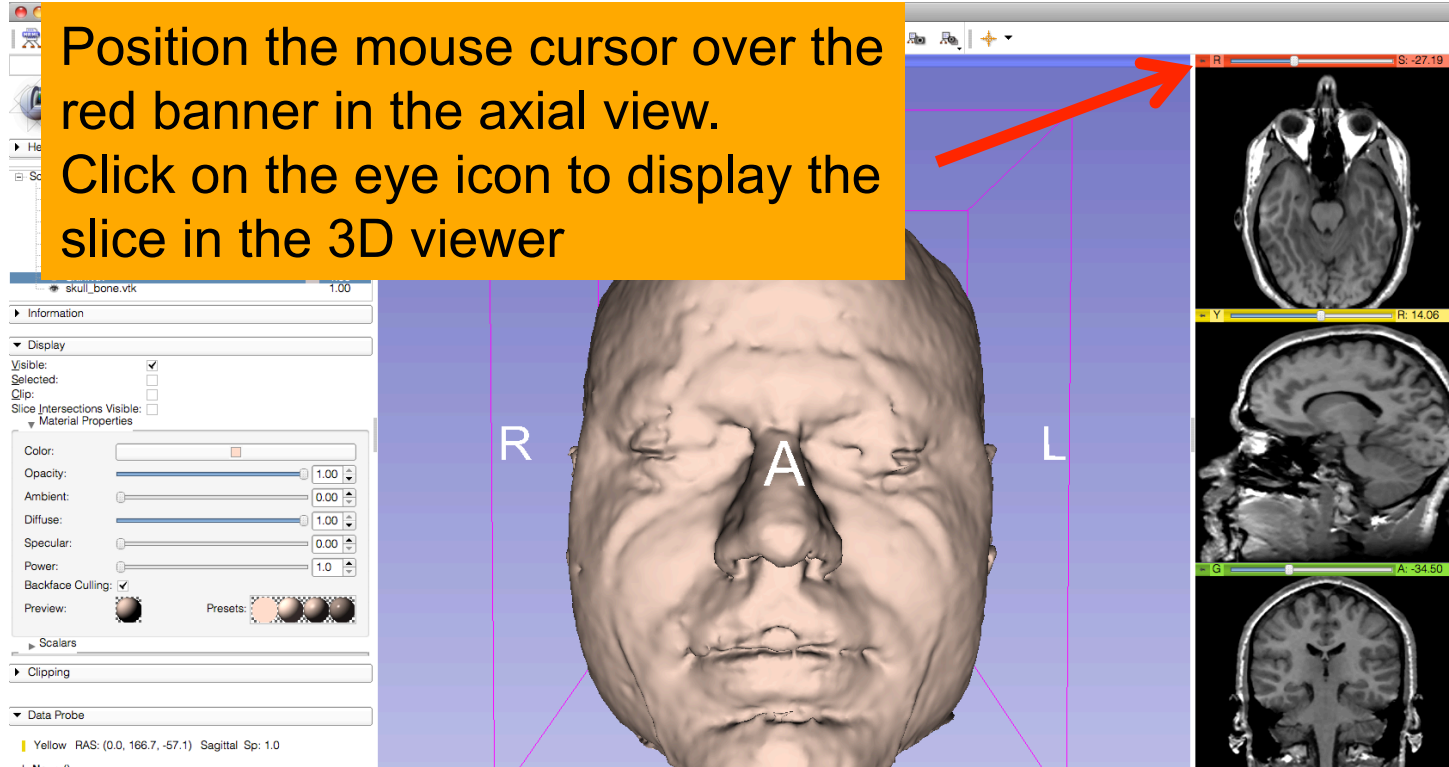
The list of 3D models appear in the Models panel





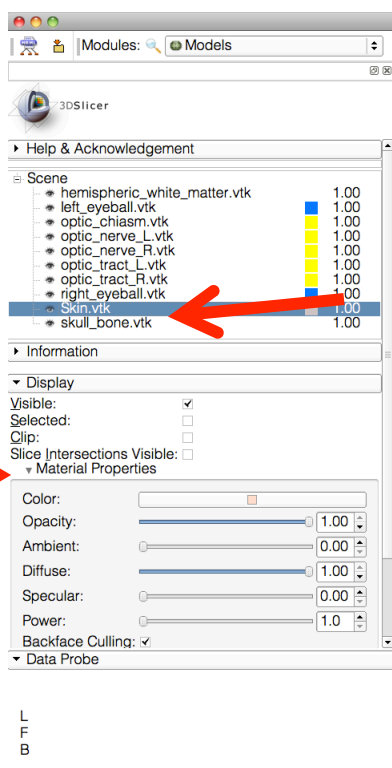
3D Visualization

Position the mouse cursor over the red banner in the axial view.
Click on the eye icon to display the slice in the 3D viewer

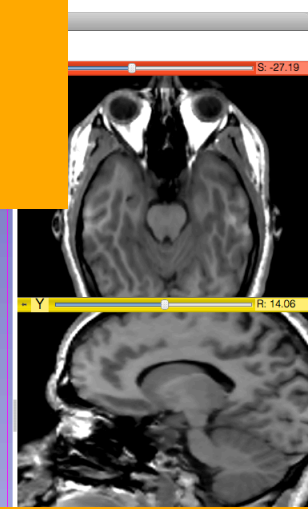
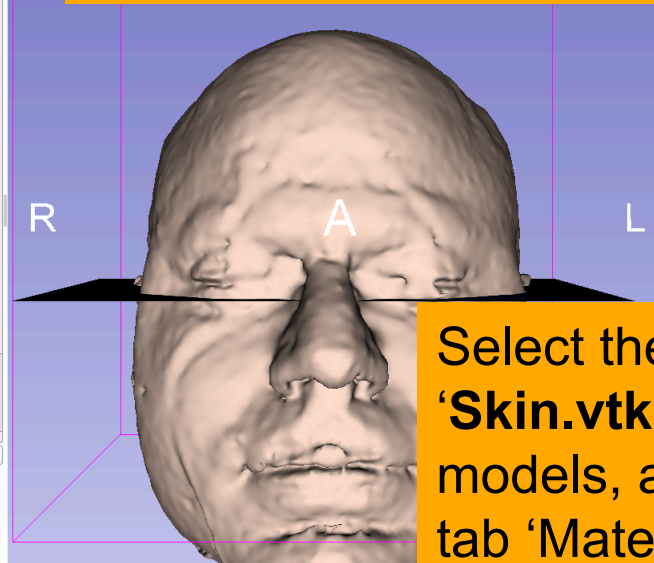




3D Visualization



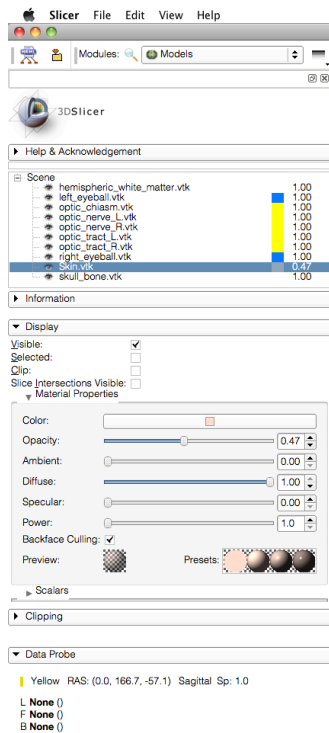
Slice through the 3D model of the head using the axial slider



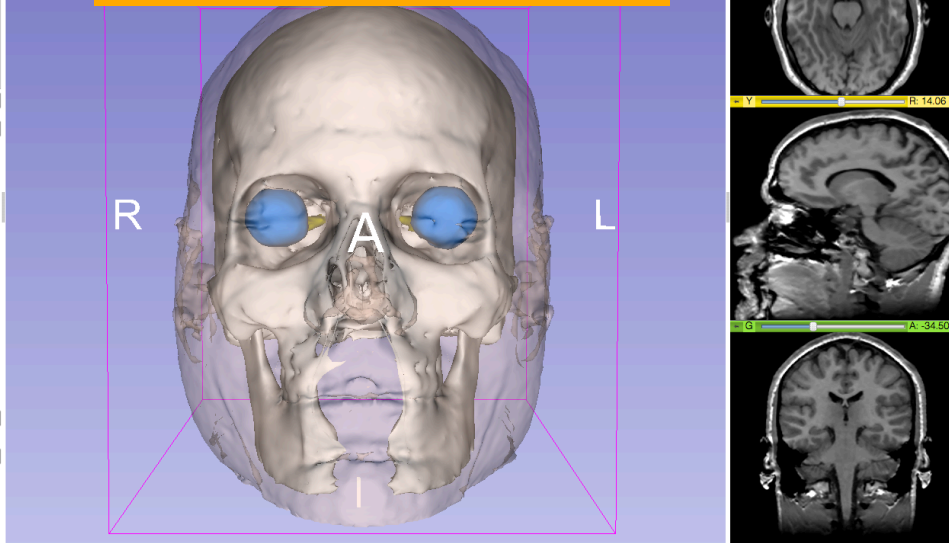
Select the model 'Skin.vtk' in the list of models, and expand the tab 'Material Properties' under 'Display'



3D Visualization



Lower the opacity of the skin model using the Opacity slider





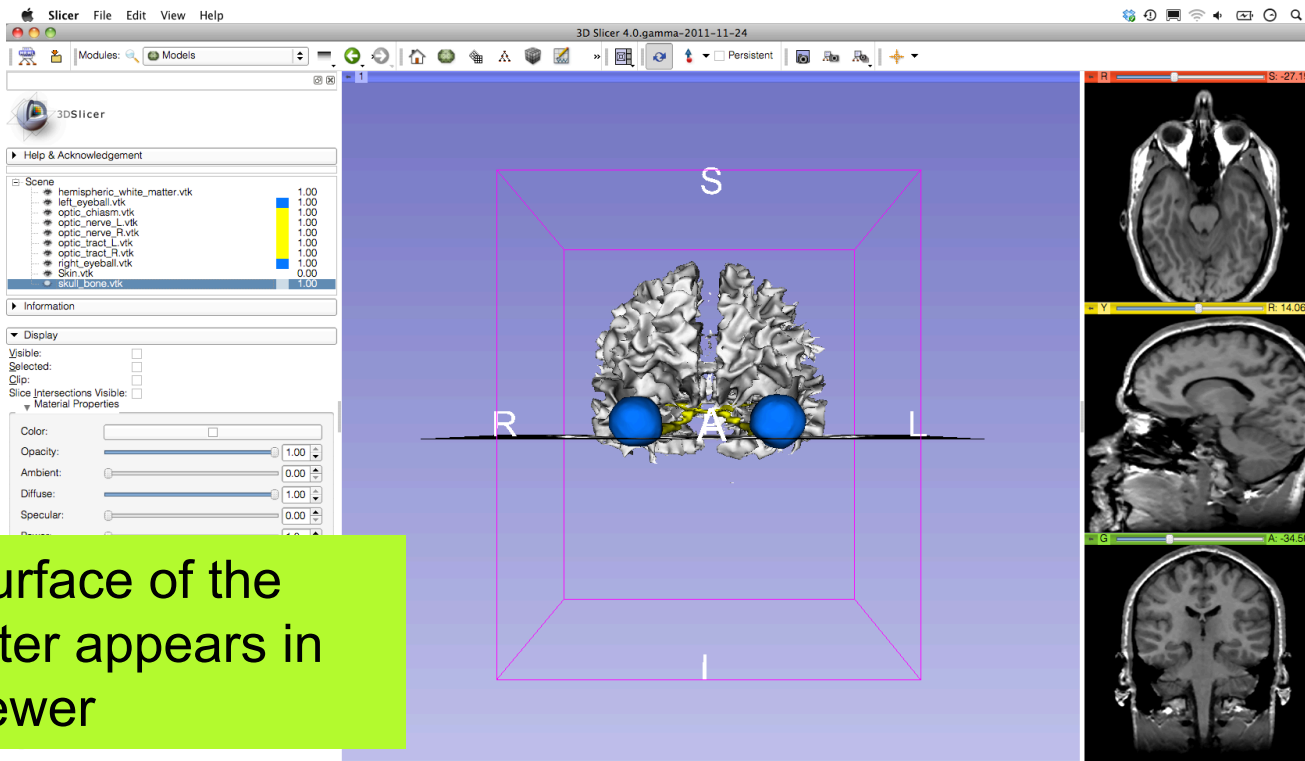
3D Visualization

Select the skull_bone.vtk model, and turn off its visibility

The screenshot displays the 3D Slicer software interface. On the left, the 'Scene' panel lists several models, with 'skull_bone.vtk' highlighted by a red arrow. Below it, the 'Information' panel shows the 'Visible' checkbox checked. The central 3D view shows a white skull model with two blue eye-like structures. To the right, three MRI slices are visible: an axial slice at the top, a sagittal slice in the middle, and a coronal slice at the bottom. The interface includes a 'Modules' menu at the top, a 'Help & Acknowledgement' section, and a 'Data Probe' section at the bottom left.



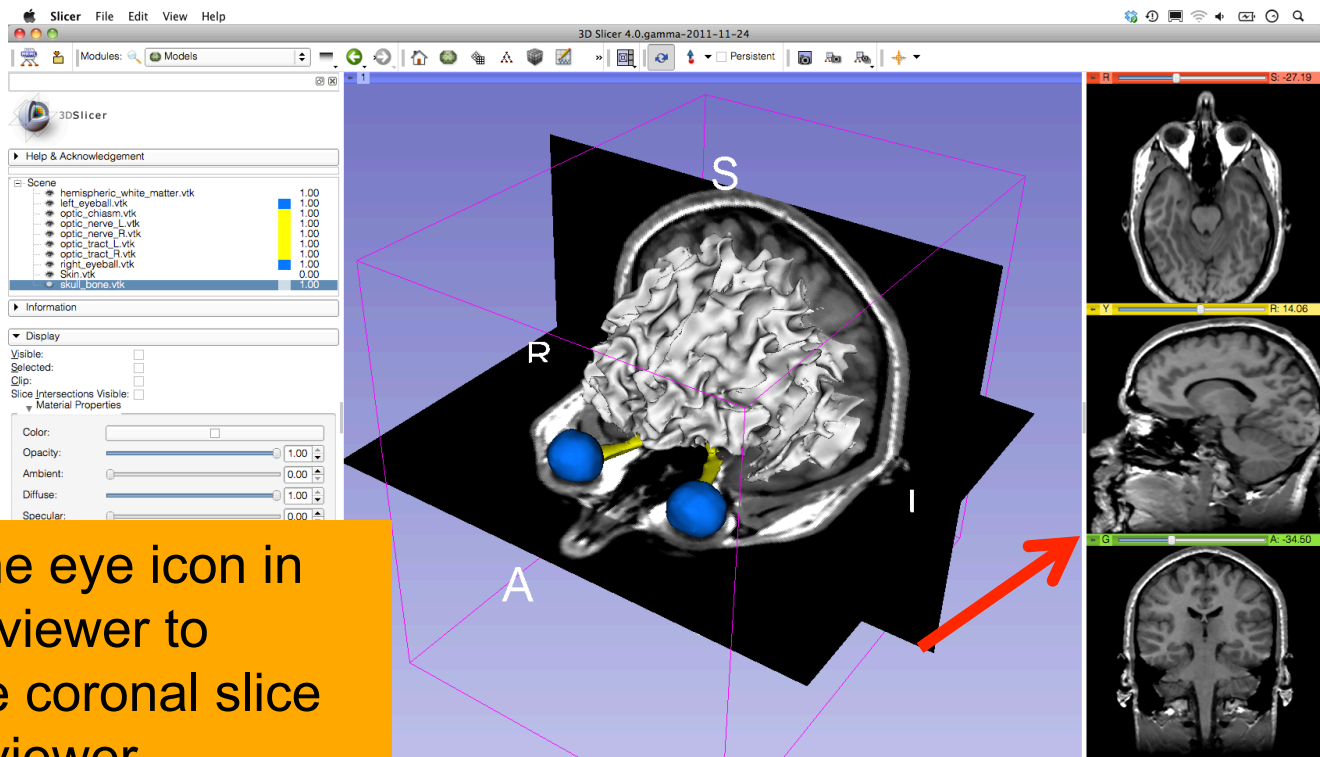
3D Visualization



The 3D surface of the white matter appears in the 3D viewer



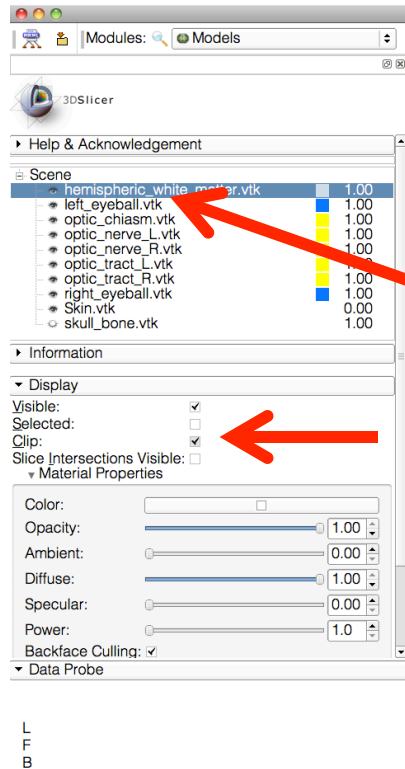
3D Visualization



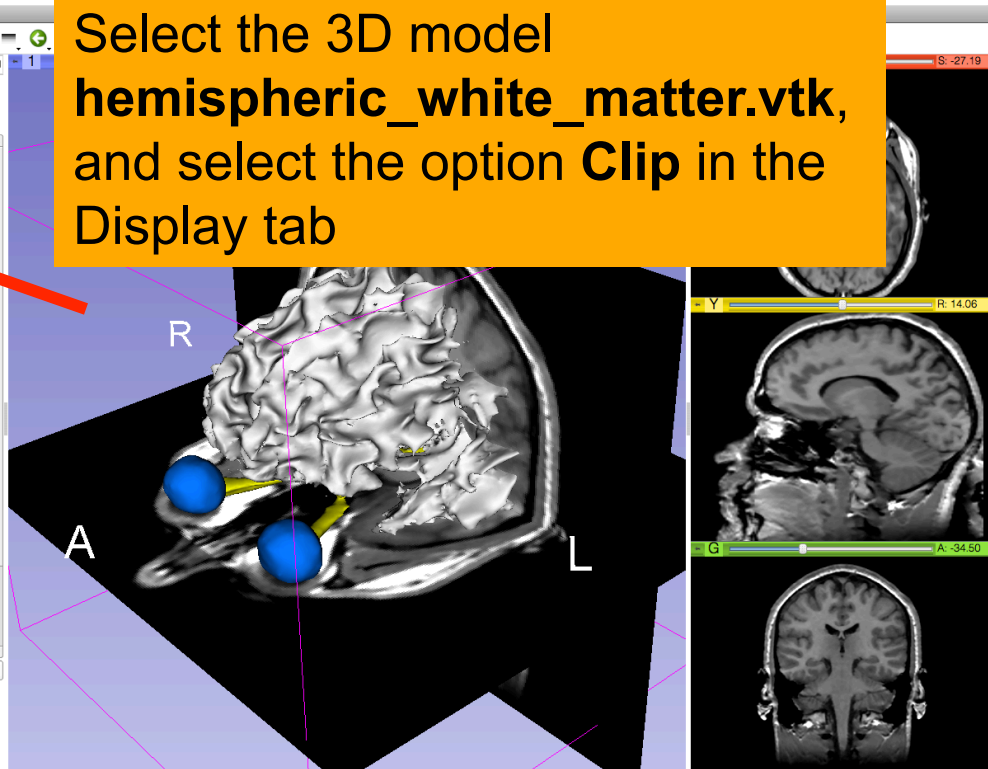
Click on the eye icon in the green viewer to display the coronal slice in the 3D viewer



3D Visualization



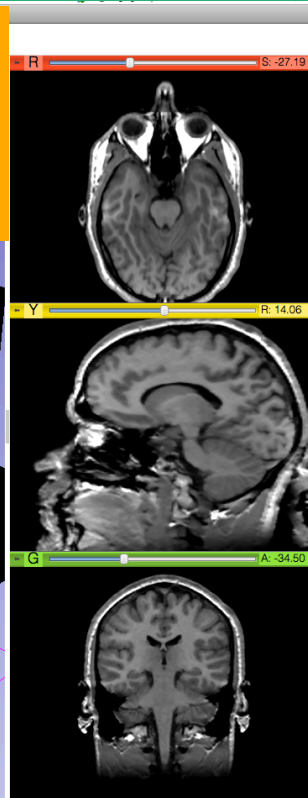
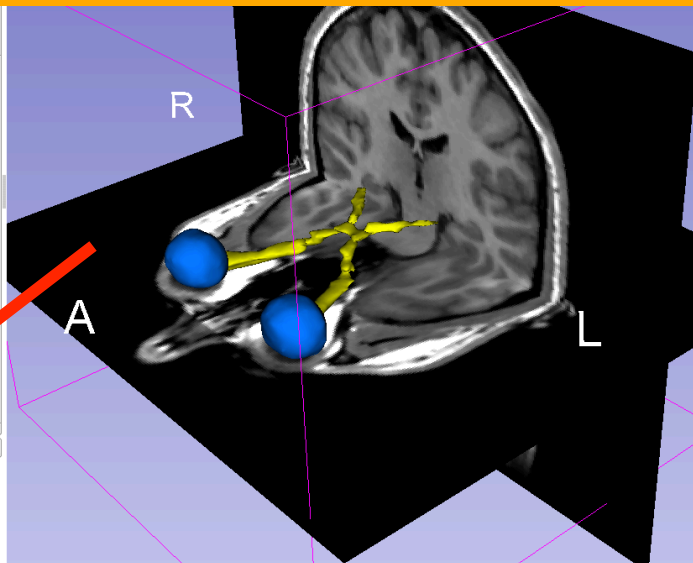
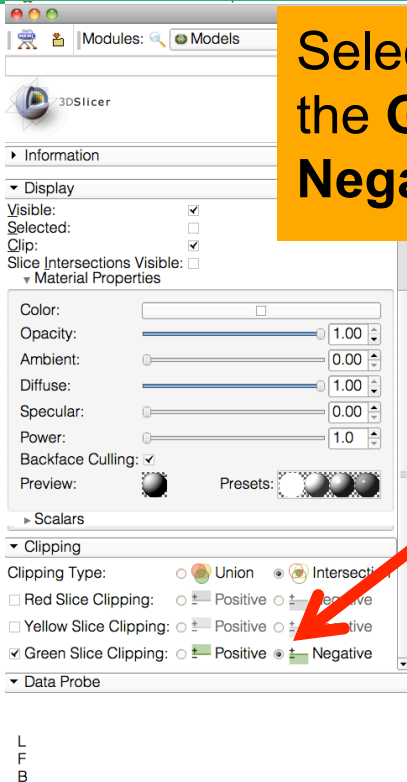
Select the 3D model **hemispheric_white_matter.vtk**, and select the option **Clip** in the Display tab





3D Visualization

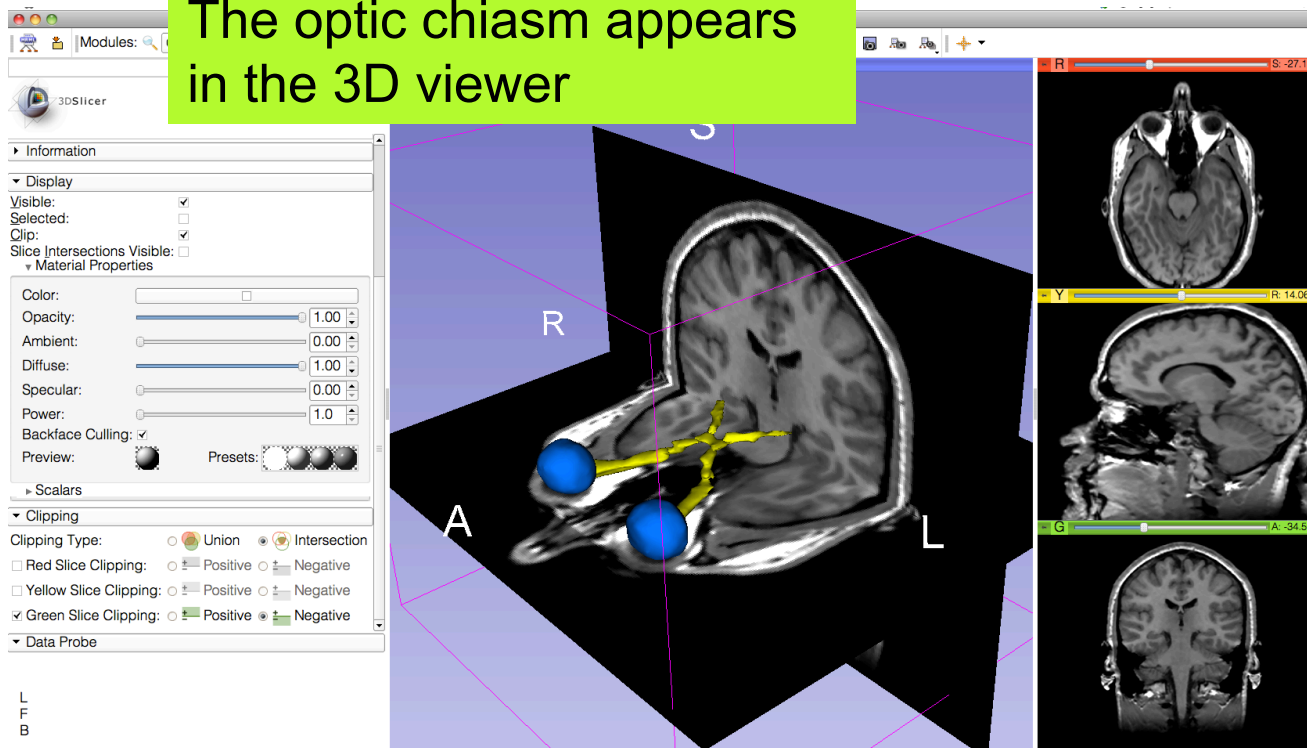
Select the tab Clipping, and set the **Green Slice Clipping** to **Negative Space**





3D Visualization

The optic chiasm appears in the 3D viewer





3D Visualization

The screenshot shows the 3D Slicer software interface. On the left, the 'Scene' panel lists several models, including 'hemispheric_white'. Below it, the 'Information' panel is expanded to show 'Display' properties. A red arrow points to the 'Clip' checkbox, which is currently checked. The 'Opacity' slider is set to 0.42. To the right of the main 3D view, there are three orthogonal slice views: axial, sagittal, and coronal. The main 3D view shows a brain model with blue eyes and a yellow crosshair. The labels 'R' (Right), 'A' (Anterior), and 'L' (Left) are visible on the 3D view.

Uncheck the option clipping and lower the opacity of the White Matter surface



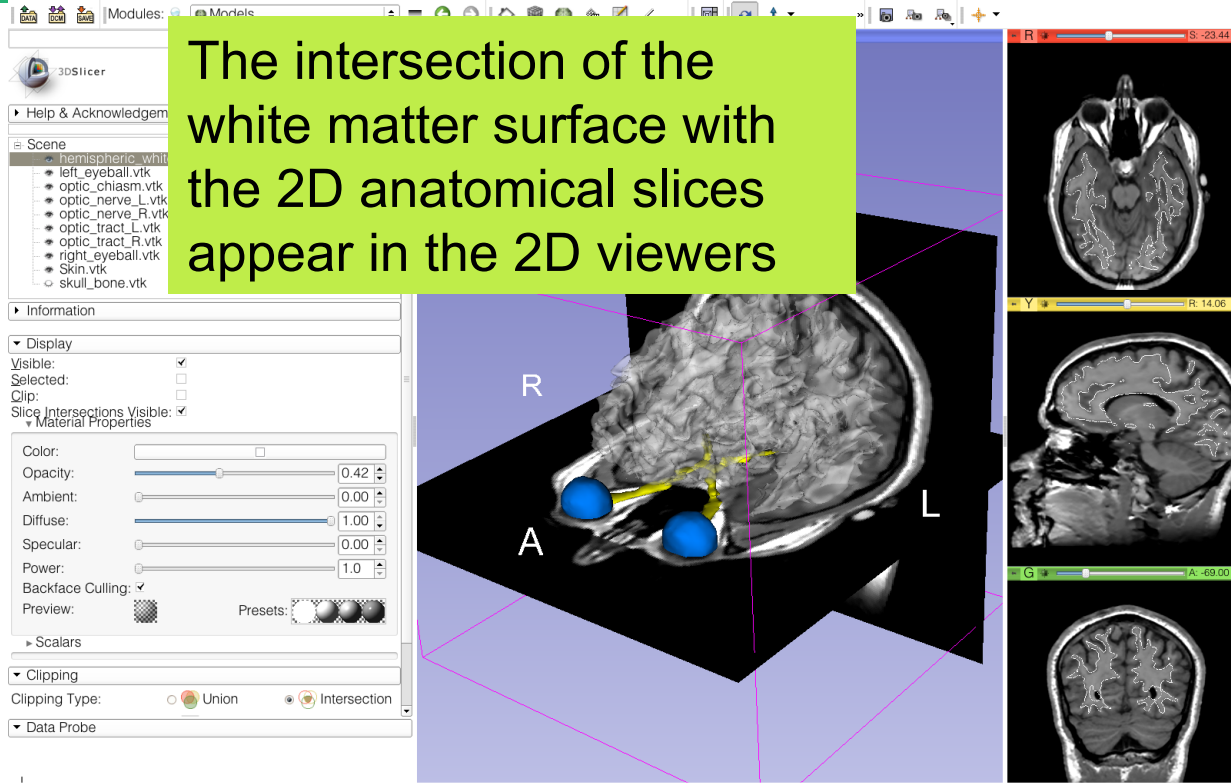
3D Visualization

The screenshot shows the 3D Slicer software interface. On the left, the 'Scene' panel lists several models, including 'hemispheric_white'. Below it, the 'Information' panel is expanded to show 'Display' properties. A red arrow points to the 'Clip' checkbox, which is currently checked. The 'Opacity' slider is set to 0.42. To the right of the main 3D view, there are three orthogonal slice views: axial, sagittal, and coronal. The main 3D view shows a brain model with blue eyes and a yellow crosshair. The 'Clipping' panel at the bottom shows 'Clipping Type' set to 'Intersection'.

Uncheck the option clipping and lower the opacity of the White Matter surface



3D Visualization





3D Visualization

Select Conventional Layout from the layout manager, and turn off the visibility of the coronal slice in the green viewer.

The screenshot shows the 3D Slicer software interface. The main window displays a 3D model of a brain with yellow and blue structures. The model is oriented with R (Right), L (Left), and A (Anterior) labels. To the right of the 3D view are three 2D slice viewers: an axial slice (top, red header), a sagittal slice (middle, yellow header), and a coronal slice (bottom, green header). The coronal slice is highlighted in green. The interface includes a scene list on the left, a display properties panel, and a clipping panel.

Scene List:

- hemispheric_whit
- 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
- skull_bone.vtk

Display Properties:

- Visible:
- Selected:
- Clip:
- Slice Intersections Visible:
- Material Properties:

Material Properties:

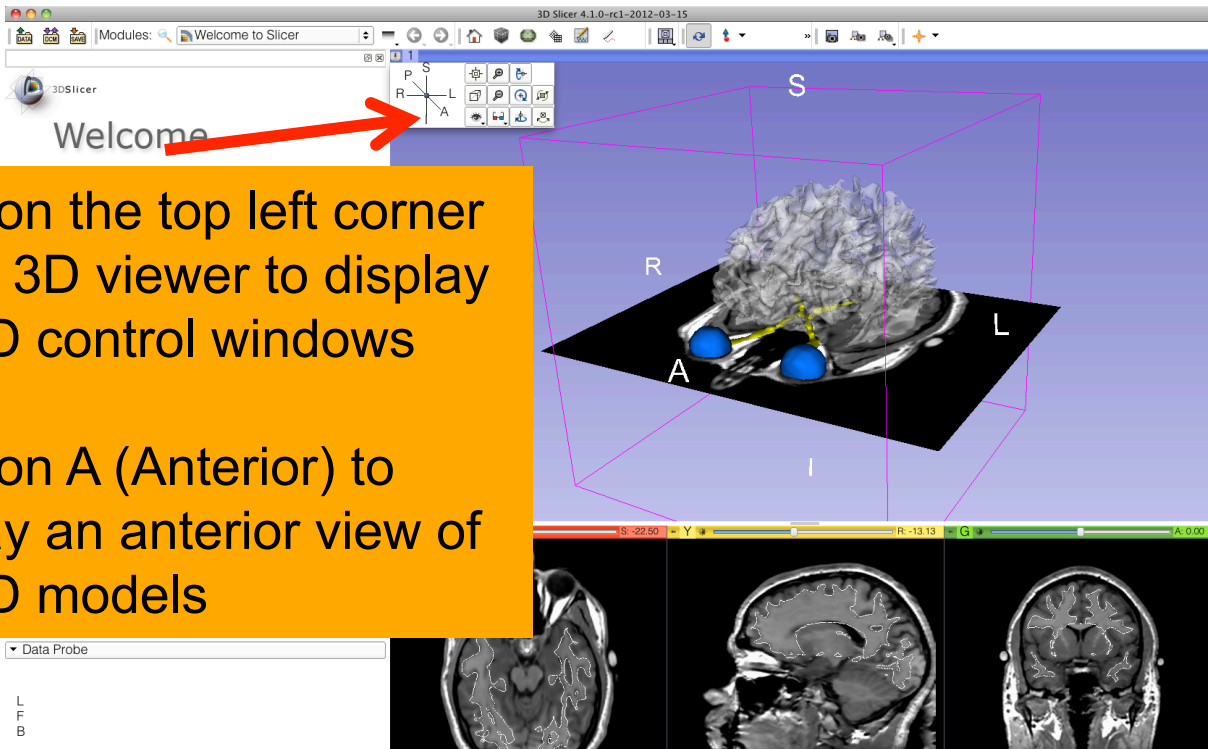
- Color:
- Opacity: 0.42
- Ambient: 0.00
- Diffuse: 1.00
- Specular: 0.00
- Power: 1.0
- Backface Culling:
- Preview:

Clipping:

- Clipping Type: Union Intersection



3D Visualization

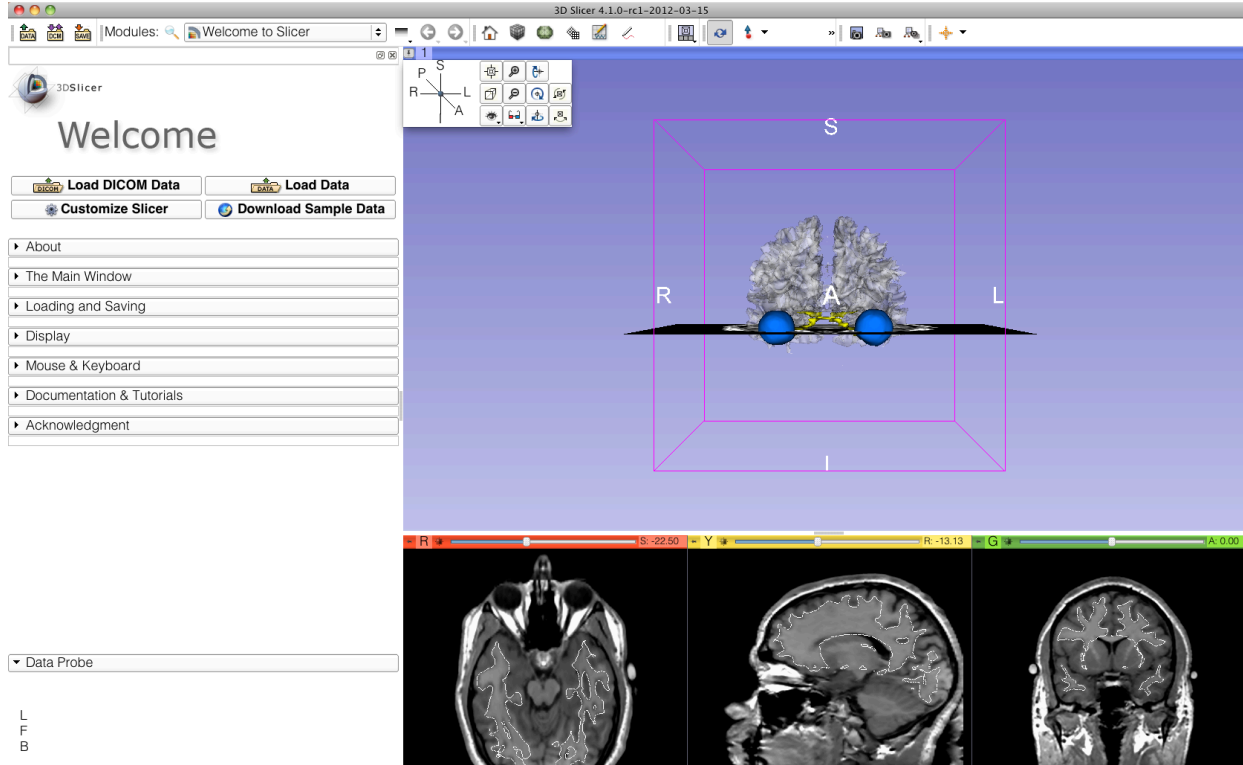


Click on the top left corner of the 3D viewer to display the 3D control windows

Click on A (Anterior) to display an anterior view of the 3D models



3D Visualization



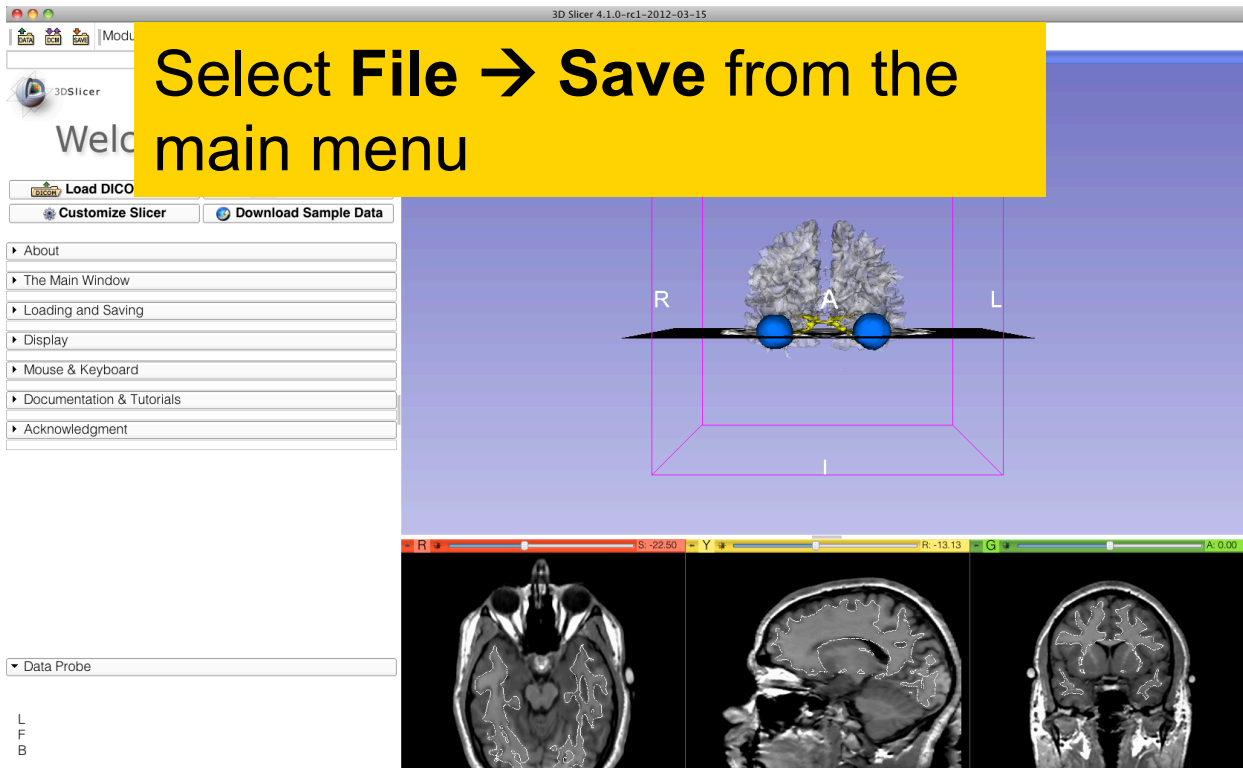


Part 3:

Saving a scene

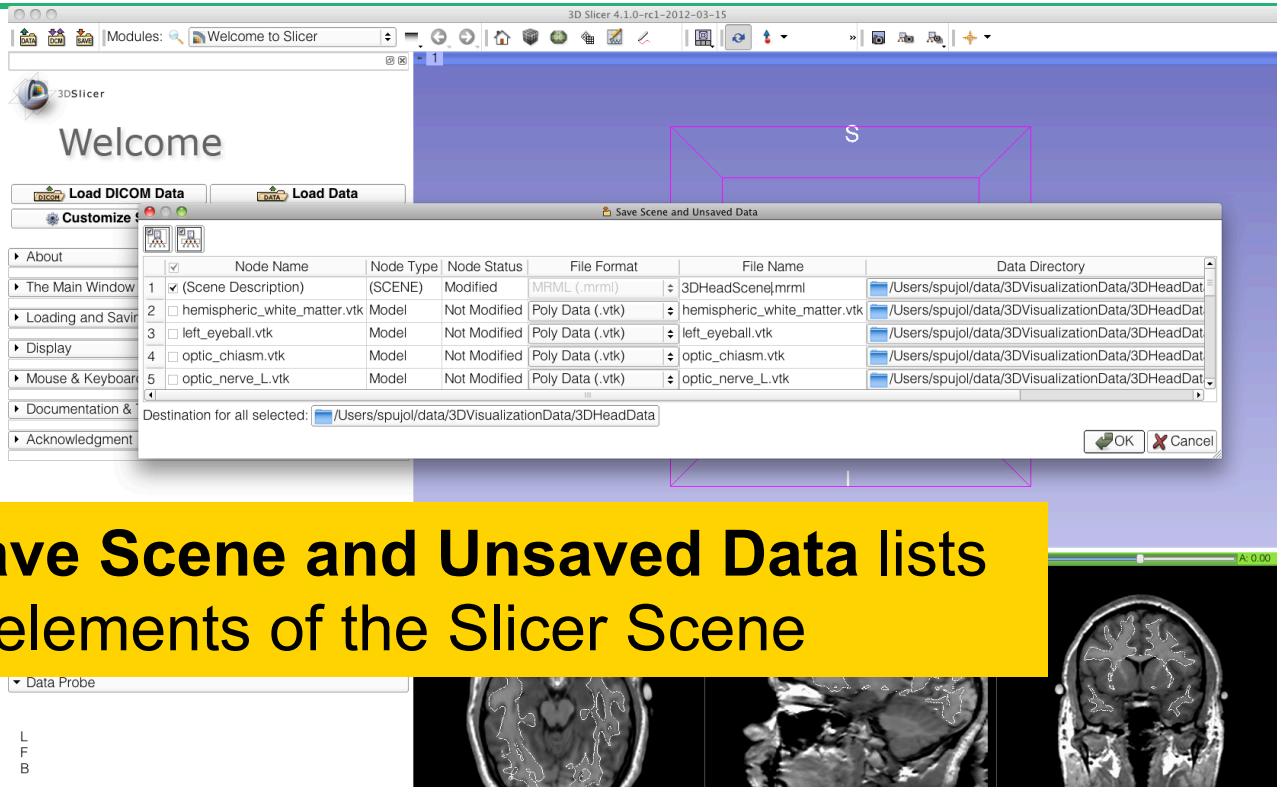


Saving a Scene





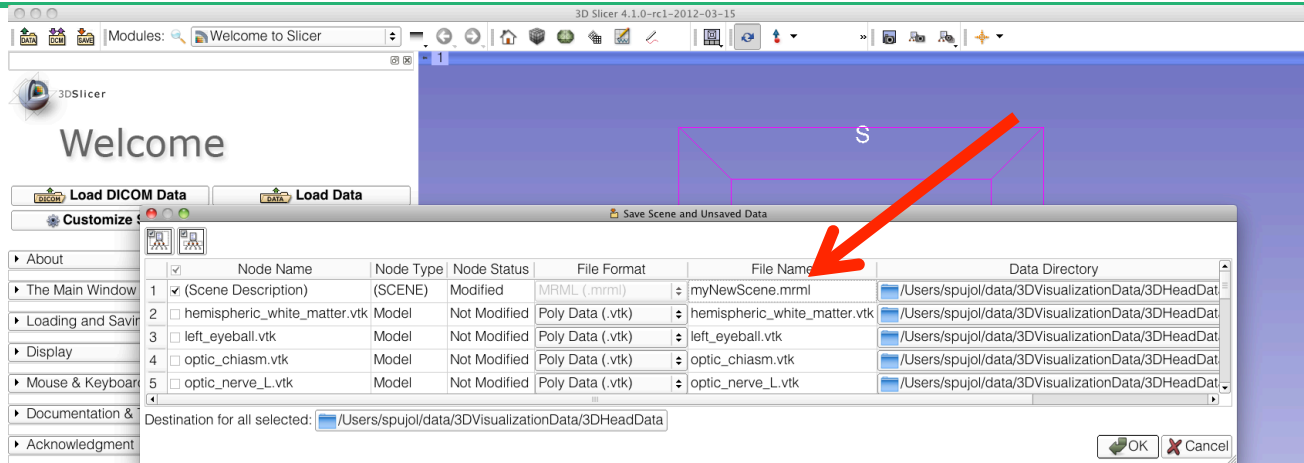
Saving a Scene



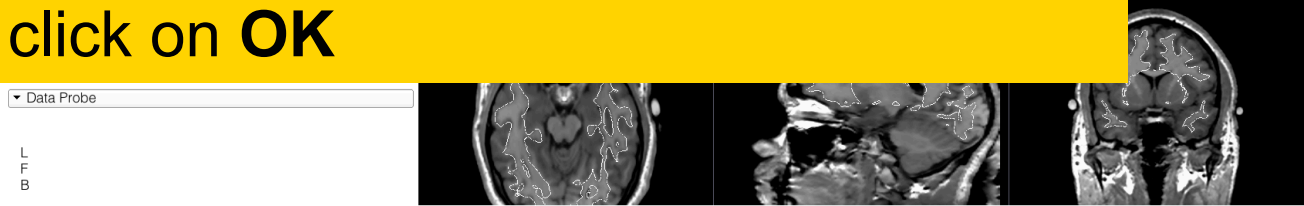
The Save Scene and Unsaved Data lists all the elements of the Slicer Scene



Saving a Scene



Rename the scene **myNewScene.mrml** and click on **OK**





Saving a Scene

The screenshot shows the 3D Slicer interface with a 'Save Scene and Unsaved Data' dialog box open. The dialog box contains the following text:

The file: /Users/spujol/data/3DVisualizationData/3DHeadData/Master Scene View.png already exists. Do you want to replace it?

Buttons: Yes, Yes to All, No, No to All

Destination for all selected: /Users/spujol/data/3DVisualizationData/3DHeadData

Buttons: OK, Cancel

A red arrow points to the 'Yes' button. A yellow text box is overlaid on the dialog with the following text:

Click on Yes to replace the current Master Scene View with the new one

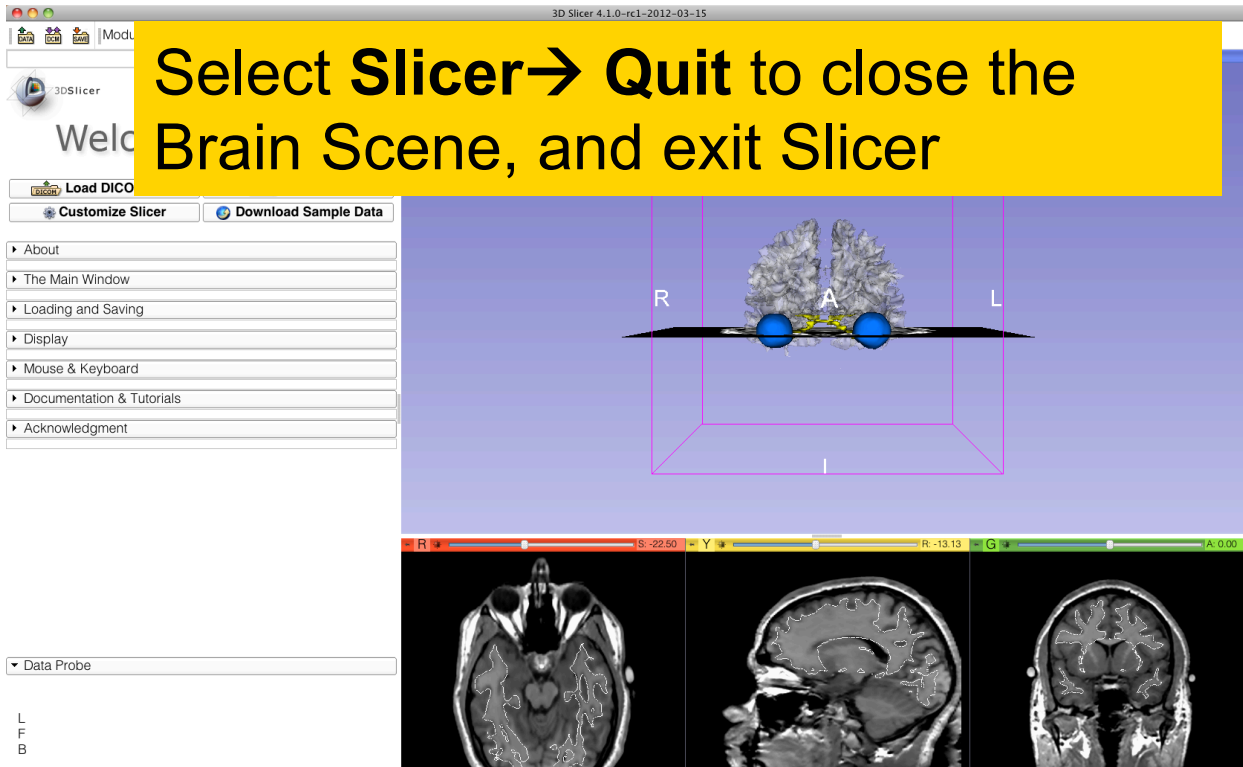
The background shows the 3D Slicer interface with a 'Welcome' message and a list of nodes:

Node Name	Node Type
1 (Scene Description)	(SCENE)
2 hemispheric_white_matter.vtk	Model
3 left_eyeball.vtk	Model
4 optic_chiasm.vtk	Model
5 optic_nerve_L.vtk	Model

At the bottom of the screenshot, there are three 3D visualizations of a brain scan: a coronal view, a sagittal view, and an axial view.



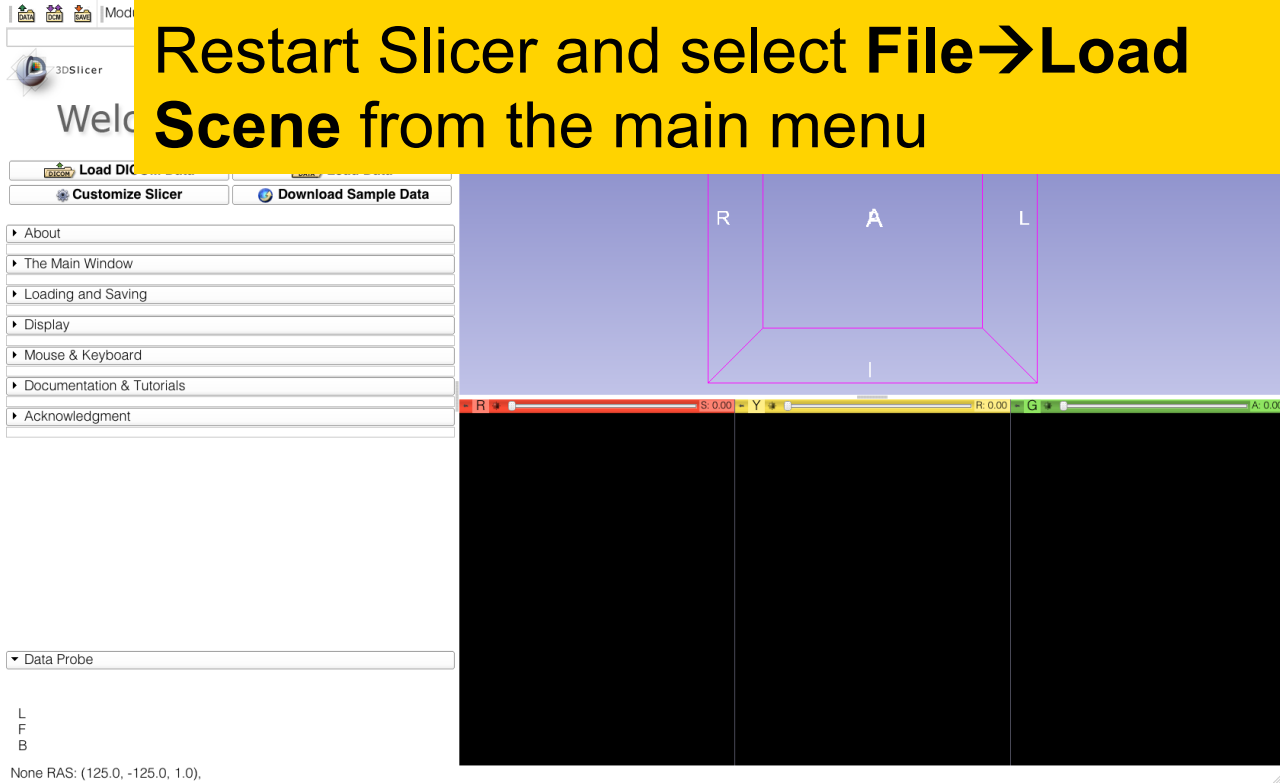
Saving a Scene





Scene Restore

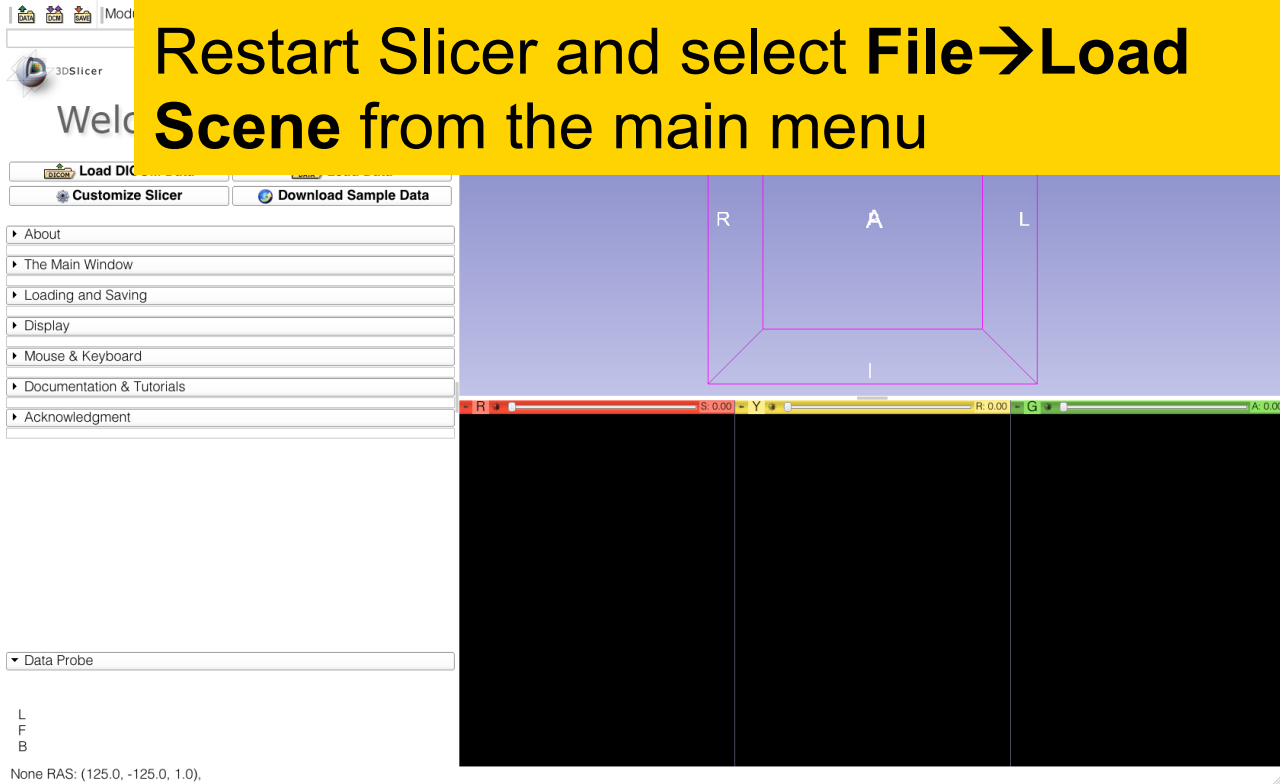
Restart Slicer and select **File**→**Load Scene** from the main menu





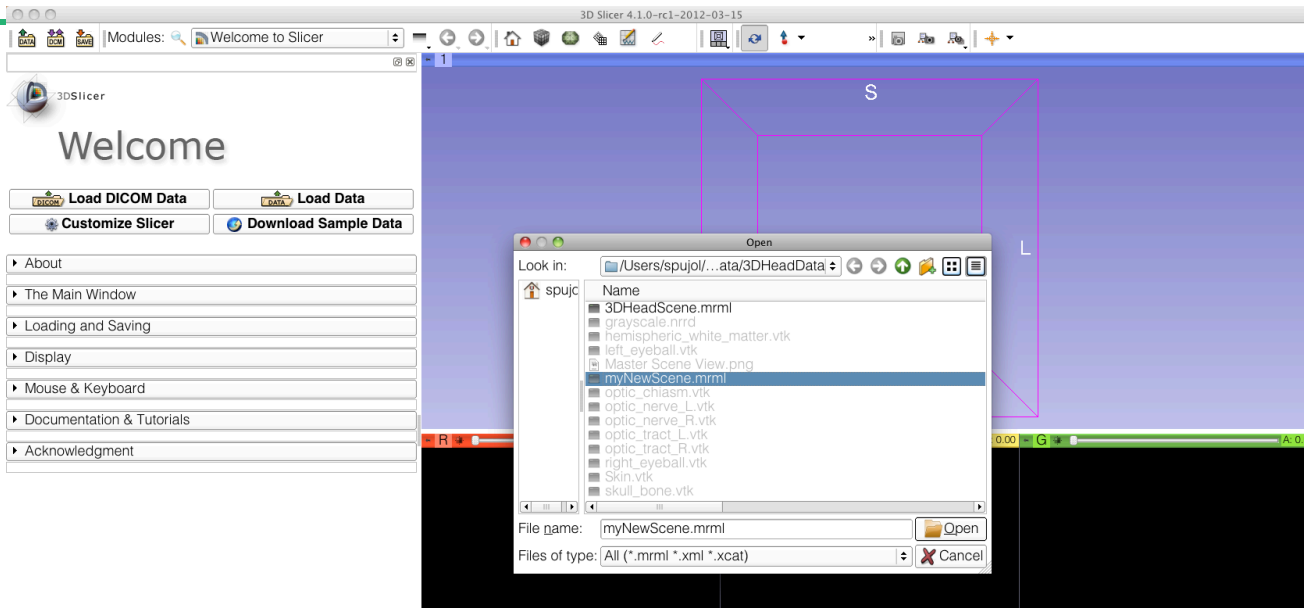
Scene Restore

Restart Slicer and select **File**→**Load Scene** from the main menu





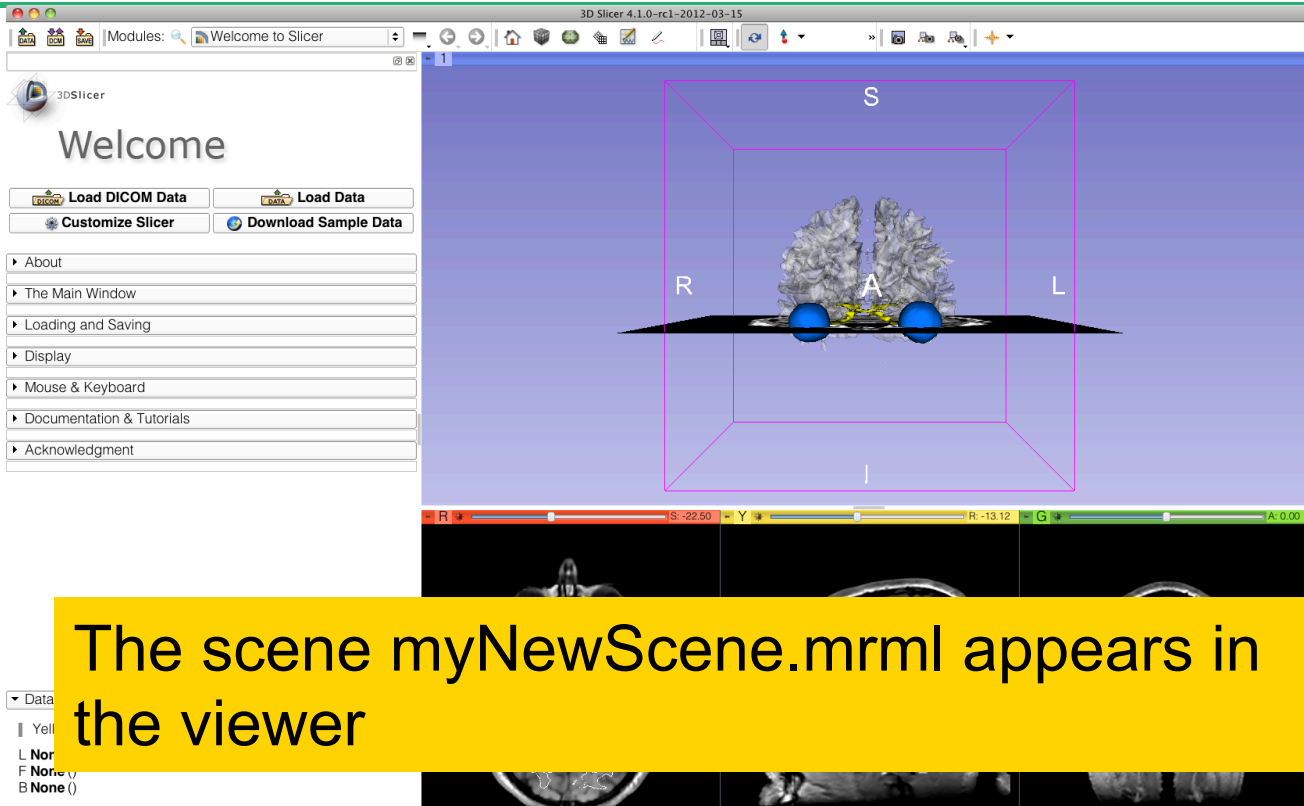
Scene Restore



Browse to the directory where you copied the scene, select the file **myNewScene.mrml** and click on **Open**



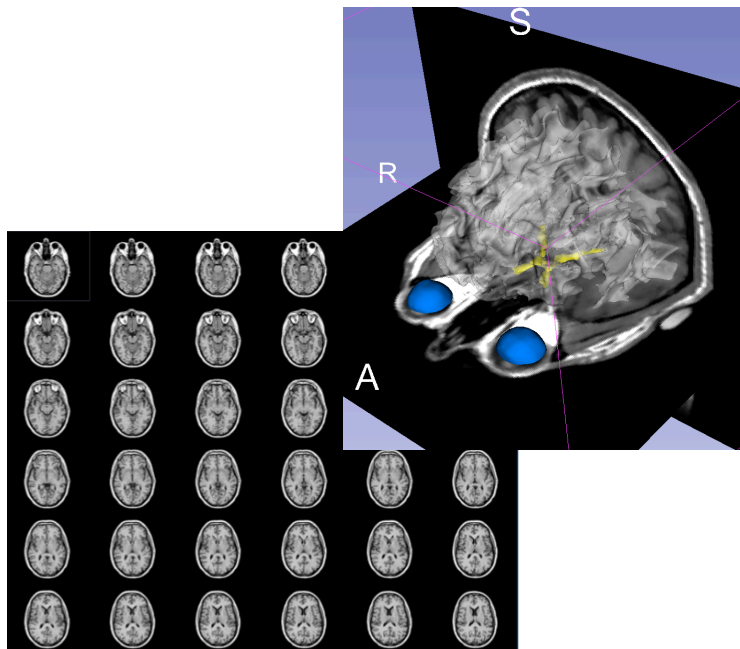
Scene Restore



The scene myNewScene.mrml appears in the viewer



Conclusion



This tutorial guided you through the basics of data loading and interactive 3D visualization of volumes and 3D surface models in Slicer4.

Contact: spujol@bwh.harvard.edu



Slicer Community

- www.slicer.org

- Mailing lists:

slicer-user@bwh.harvard.edu

slicer-devel@bwh.harvard.edu



Acknowledgment



National Alliance for Medical Image Computing
NIH U54EB005149



Neuroimage Analysis Center
NIH P41RR013218