



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

a teaching affiliate of
Harvard Medical School

Data Loading and 3D Visualization

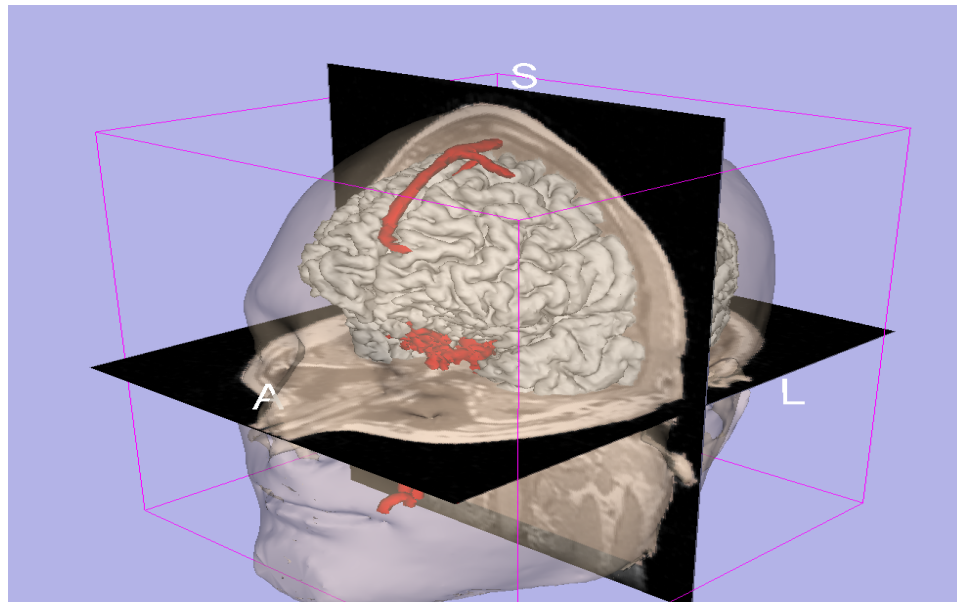
Sonia Pujol, Ph.D., Harvard Medical School

Director of Training, National Alliance for Medical Image Computing



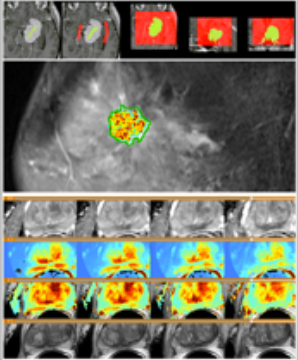
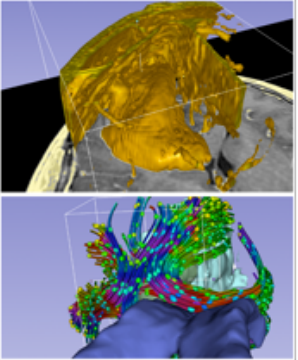
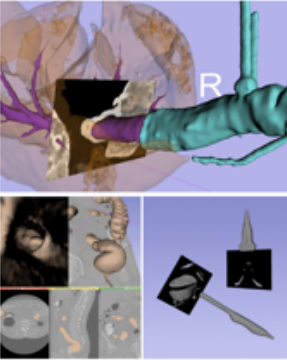

3D Visualization of the Anatomy

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 techniques, including segmentation of a brain tumor and registration of multiple scans.	 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 translucent surface and internal structures.
 3D Slicer <i>version 4.0</i>	www.slicer.org	

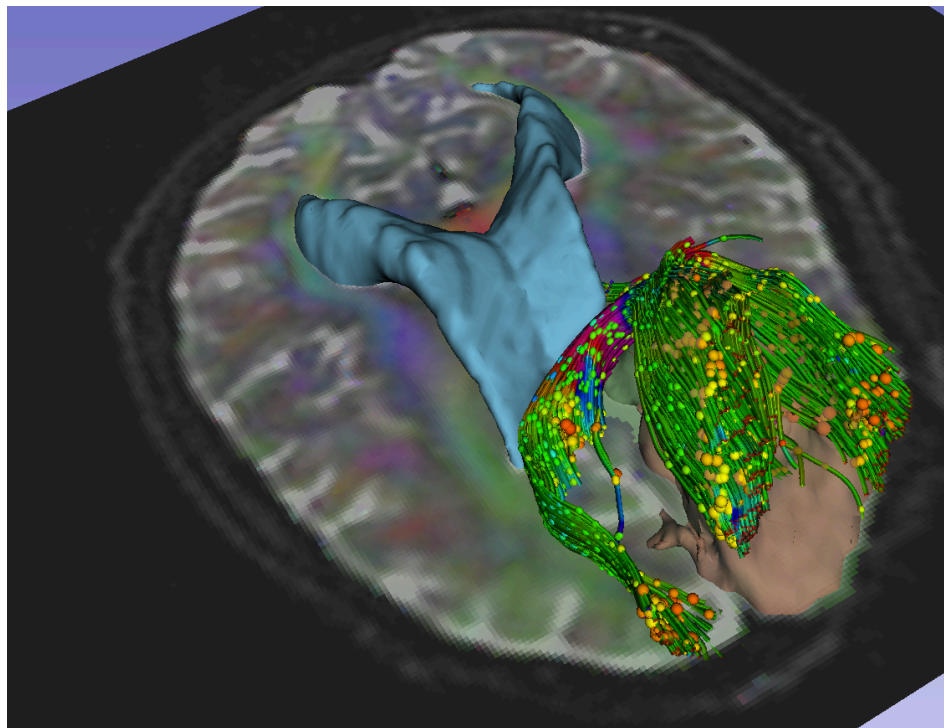
Slicer is a freely available **open-source** platform for segmentation, registration and 3D visualization of medical imaging data.

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 4.1
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)

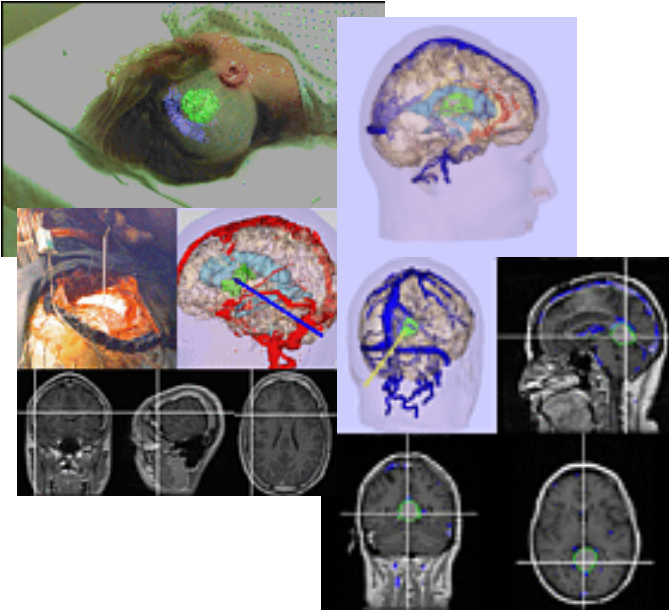
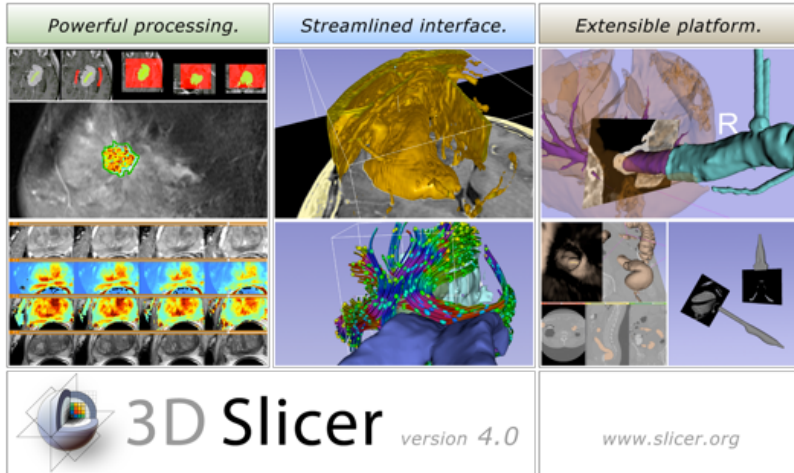


Image Courtesy of the CSAIL, MIT



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 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

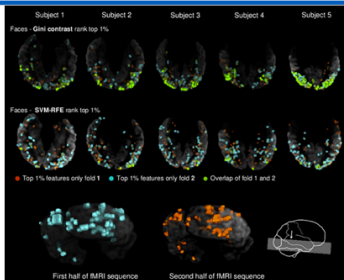
- Overview
- Organization
- Contact Us

Center Components

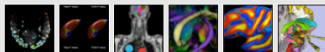
- Algorithms
- Engineering
- Diving Biological Projects
- Collaboration Grants

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"

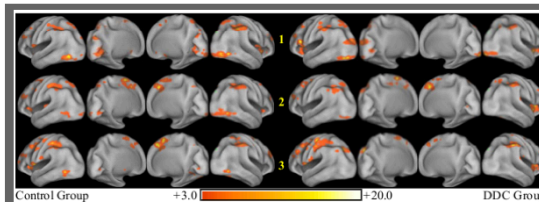
Google Custom Search

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 ± 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

CDash - Slicer4

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-Valgrind-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	2	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		

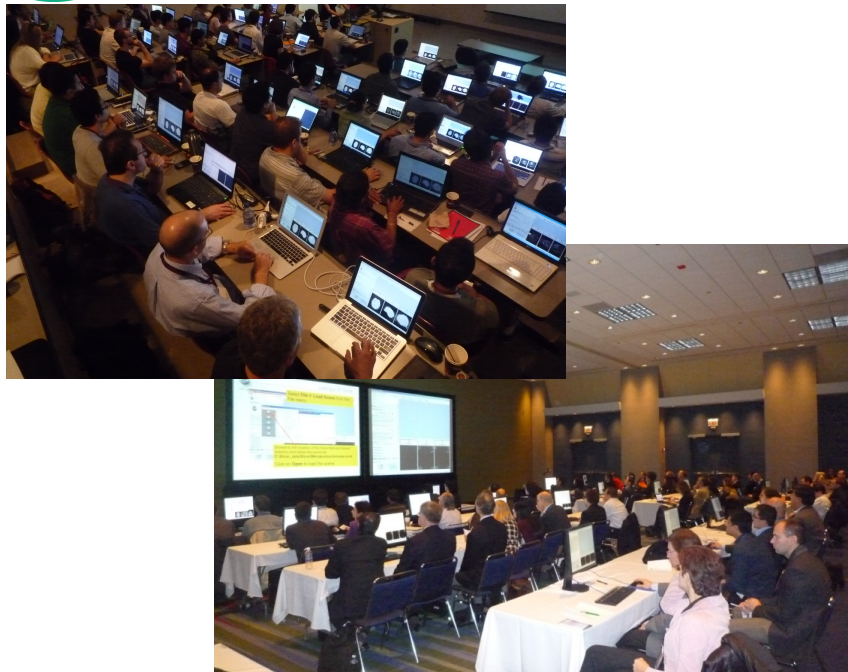
Continuous

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



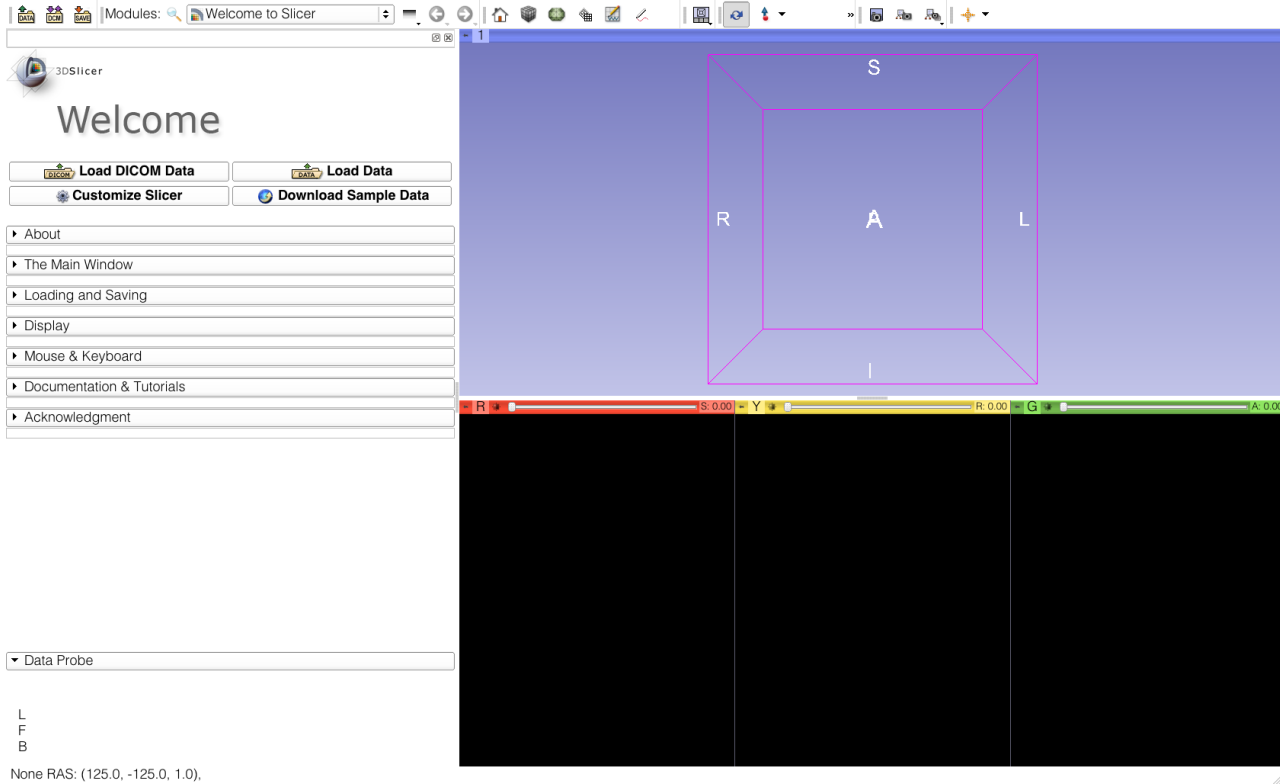
Slicer Training



- Hands-on training workshops at national and international venues (MICCAI, SfN, OHBM, RNSA..)
- >2,000 clinicians, clinical researchers and scientists trained since 2005

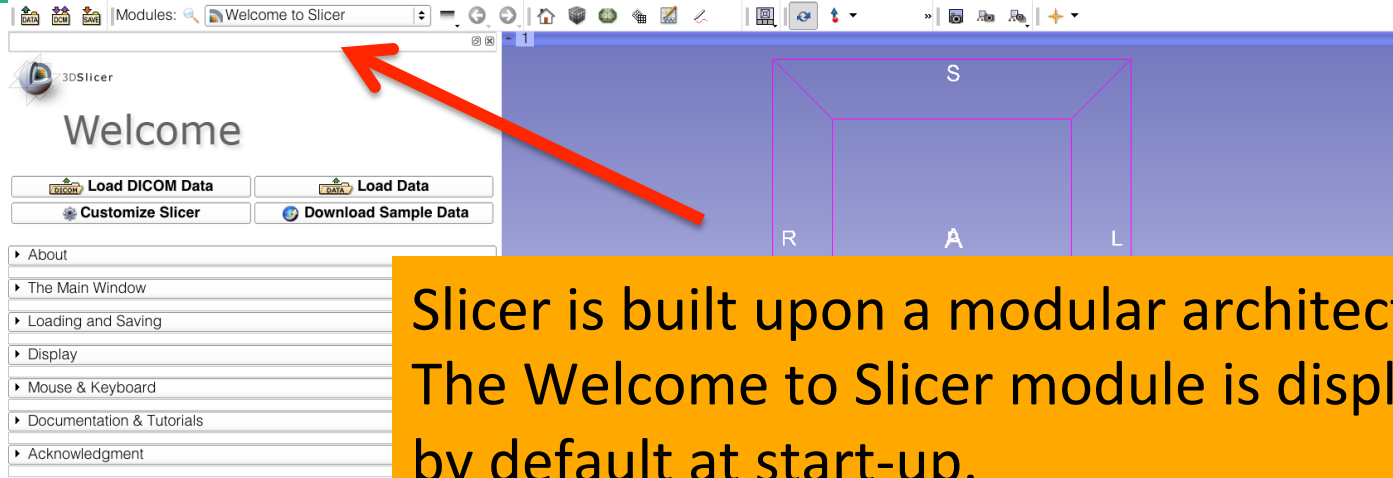


3DSlicer version 4.1





Welcome to Slicer4

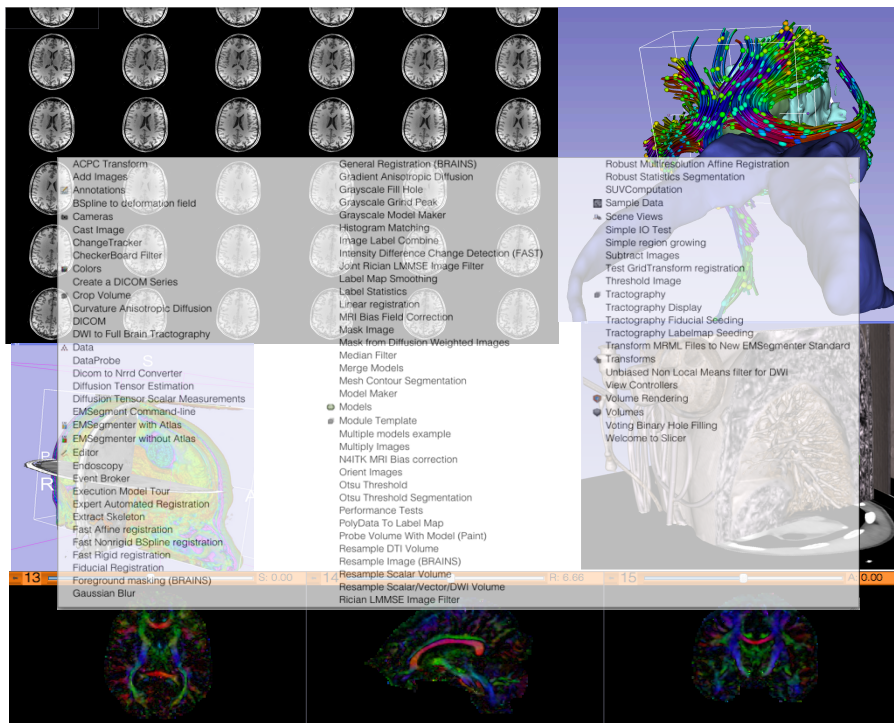


Slicer is built upon a modular architecture. The Welcome to Slicer module is displayed by default at start-up. Click on Welcome to Slicer to display the 103 modules of Slicer in the Modules menu





Welcome to Slicer4



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

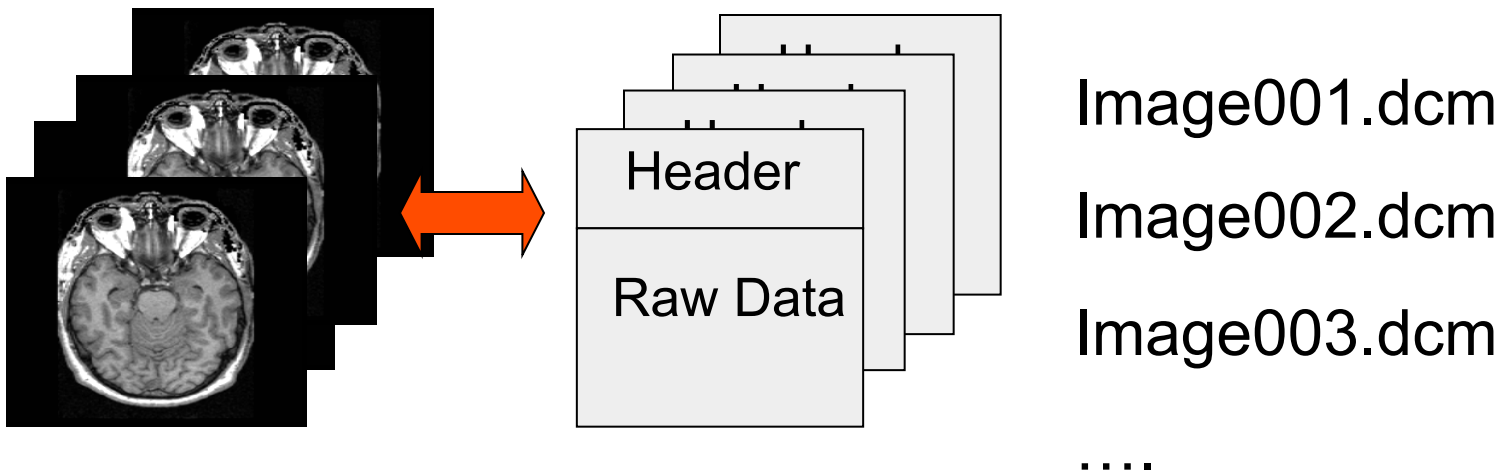


PART 1: LOADING AN MR VOLUME



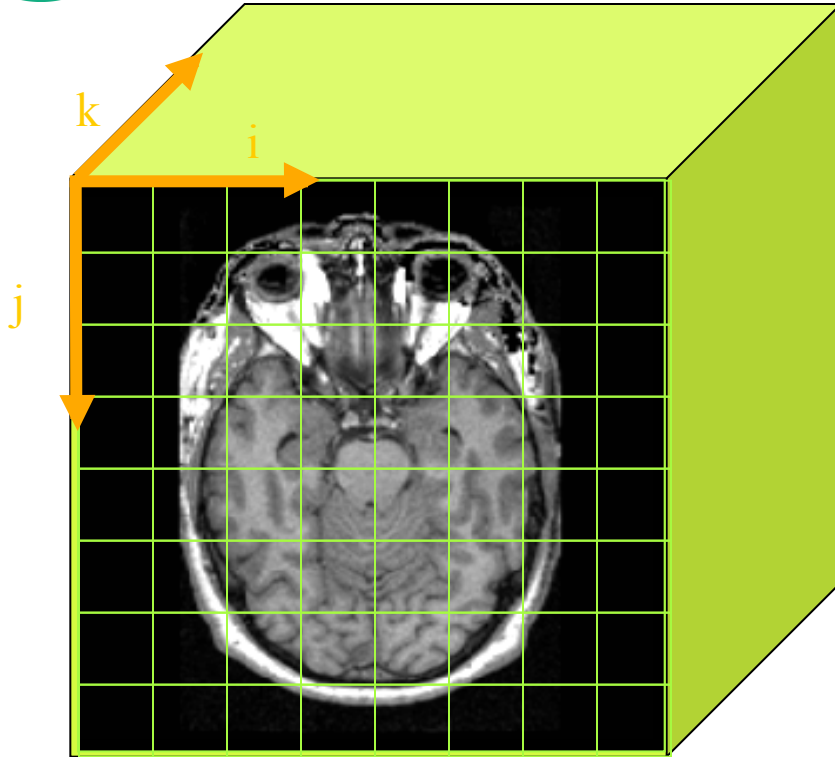
The DICOM 3.0 File Format

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





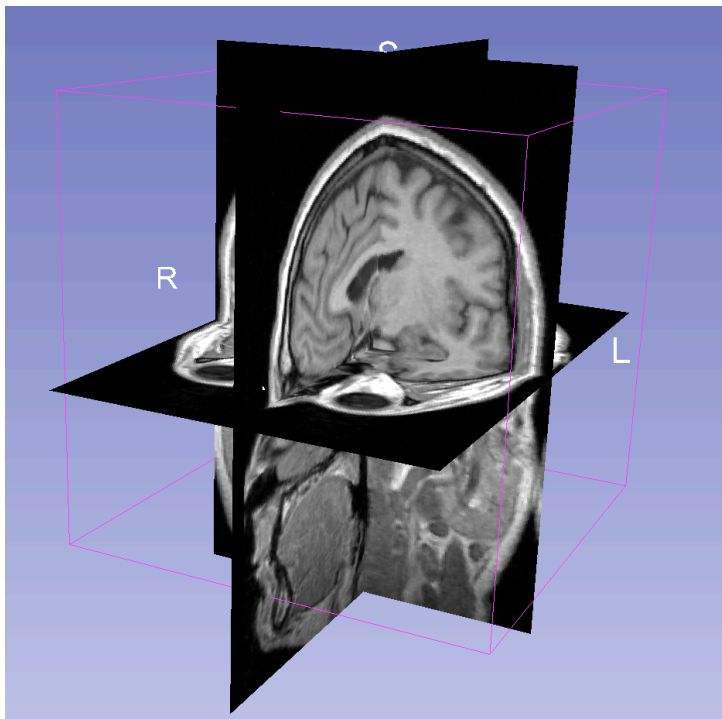
Data Representation



- 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 open-source toolkit
- DICOM data can be converted in Nrrd using the module '**DICOM to NRRD Converter**' in Slicer.

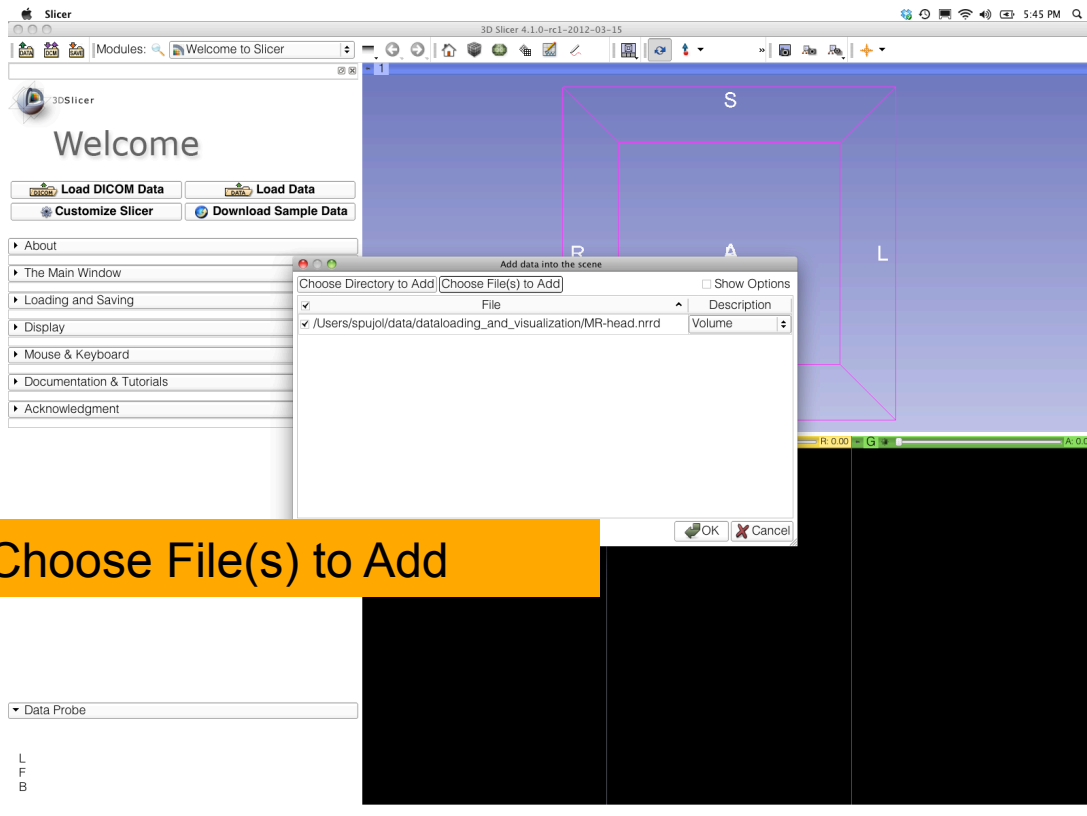


Slicer4

A screenshot of the Slicer4 software interface. The window title is '3DSlicer' and the active module is 'Welcome to Slicer'. The interface is divided into a left sidebar and a main central area. The sidebar contains a 'Welcome' heading, four buttons: 'Load DICOM Data', 'Load Data', 'Customize Slicer', and 'Download Sample Data', and a list of menu items including '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 display showing 'None RAS: (125.0, -125.0, 1.0)'. The main central area is a 3D view with a blue background and 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 a standard toolbar with various icons for file operations and navigation.



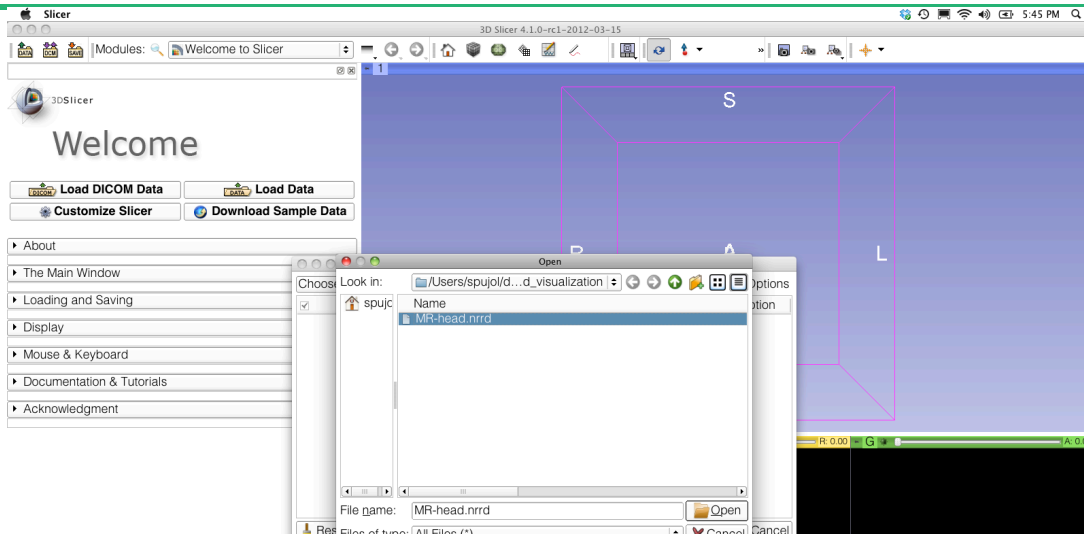
Loading a volume



Click on Choose File(s) to Add



Loading a volume

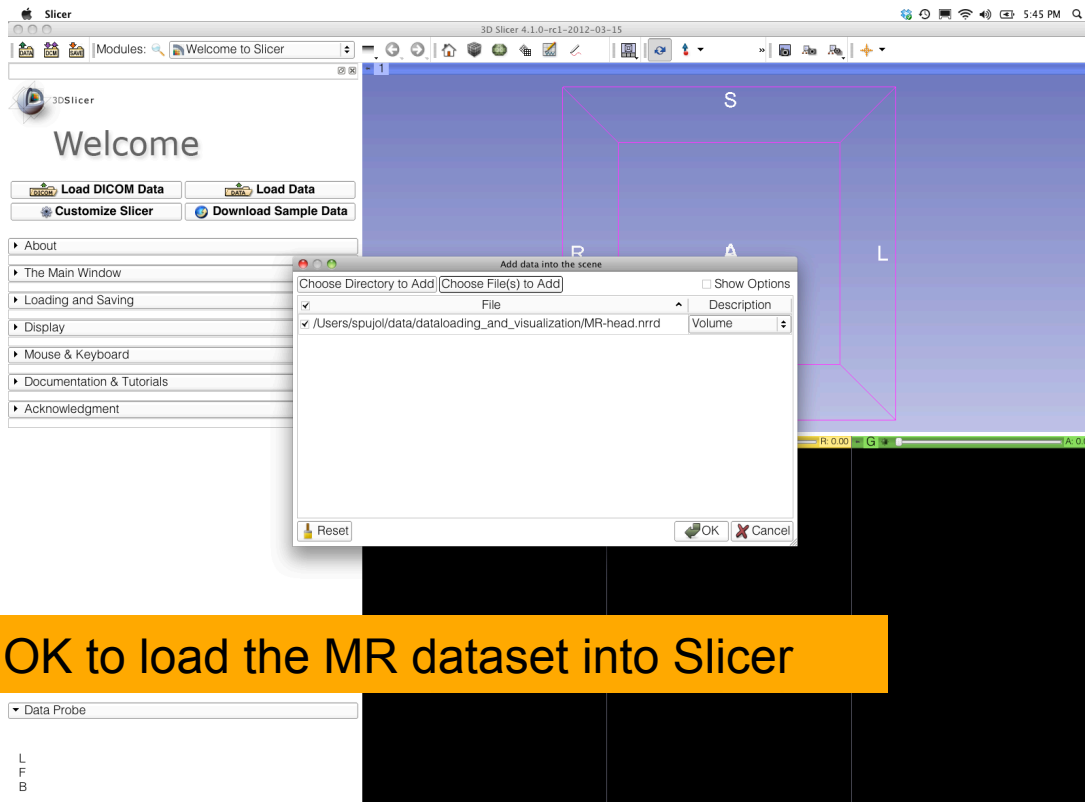


Browse to the location of the Visualization directory and select the file **MR-head.nrrd**





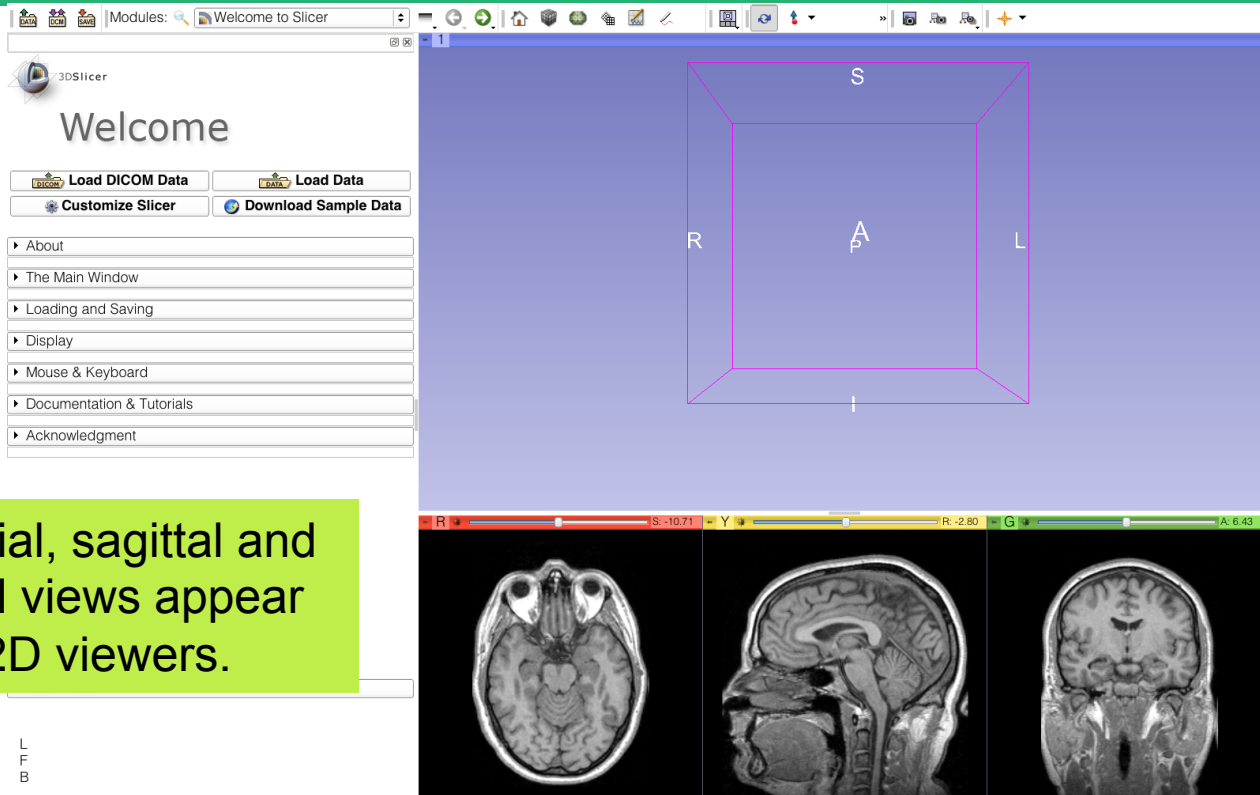
Loading a volume



Click on OK to load the MR dataset into Slicer



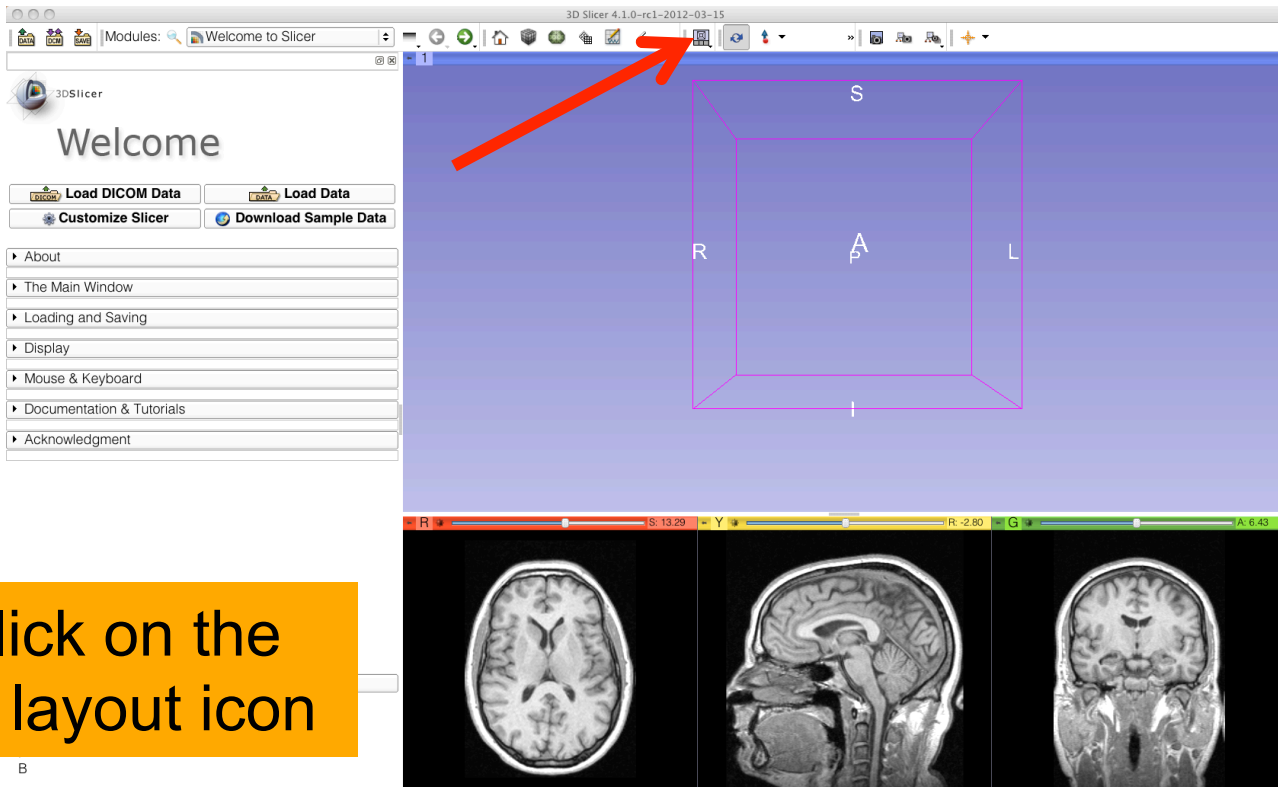
Loading a volume



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



Loading a volume

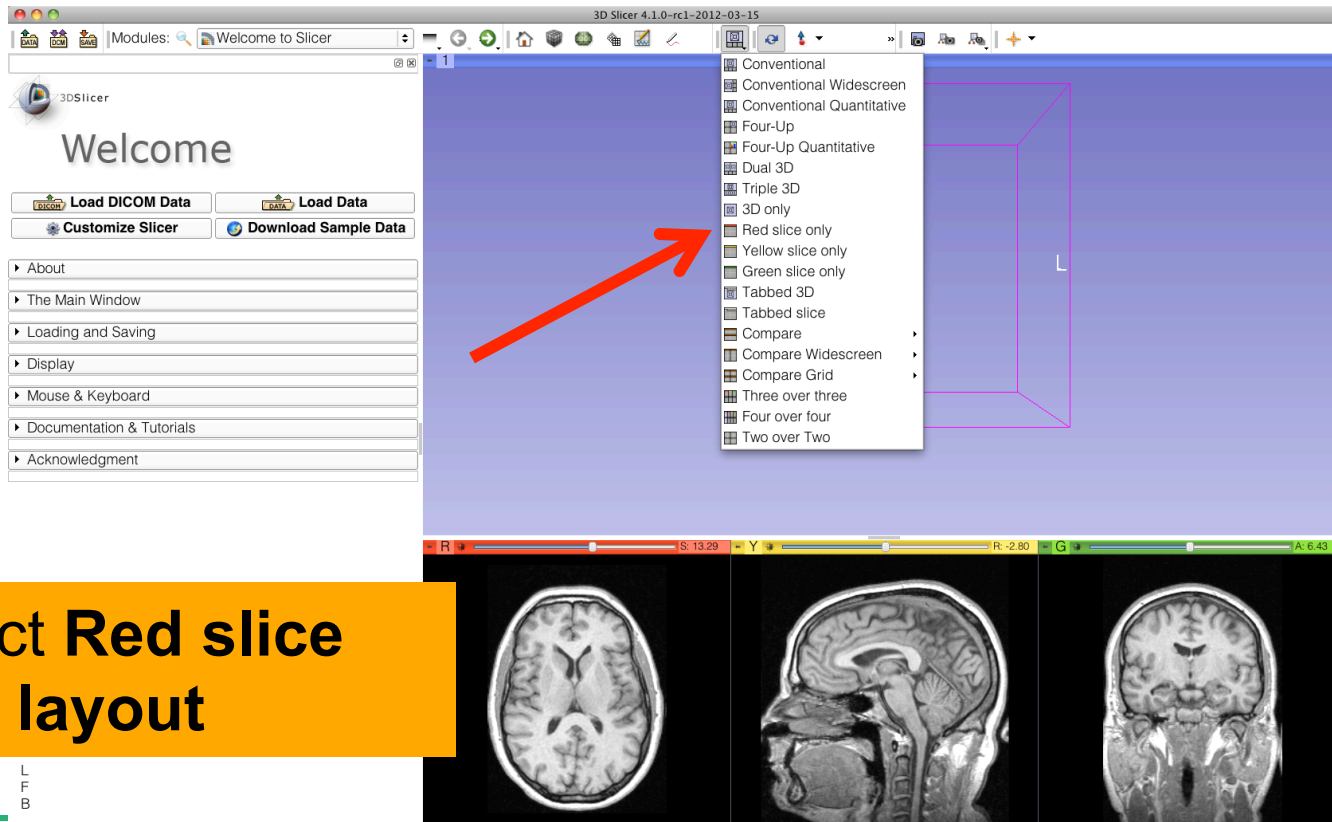


Left-click on the Slicer layout icon

B

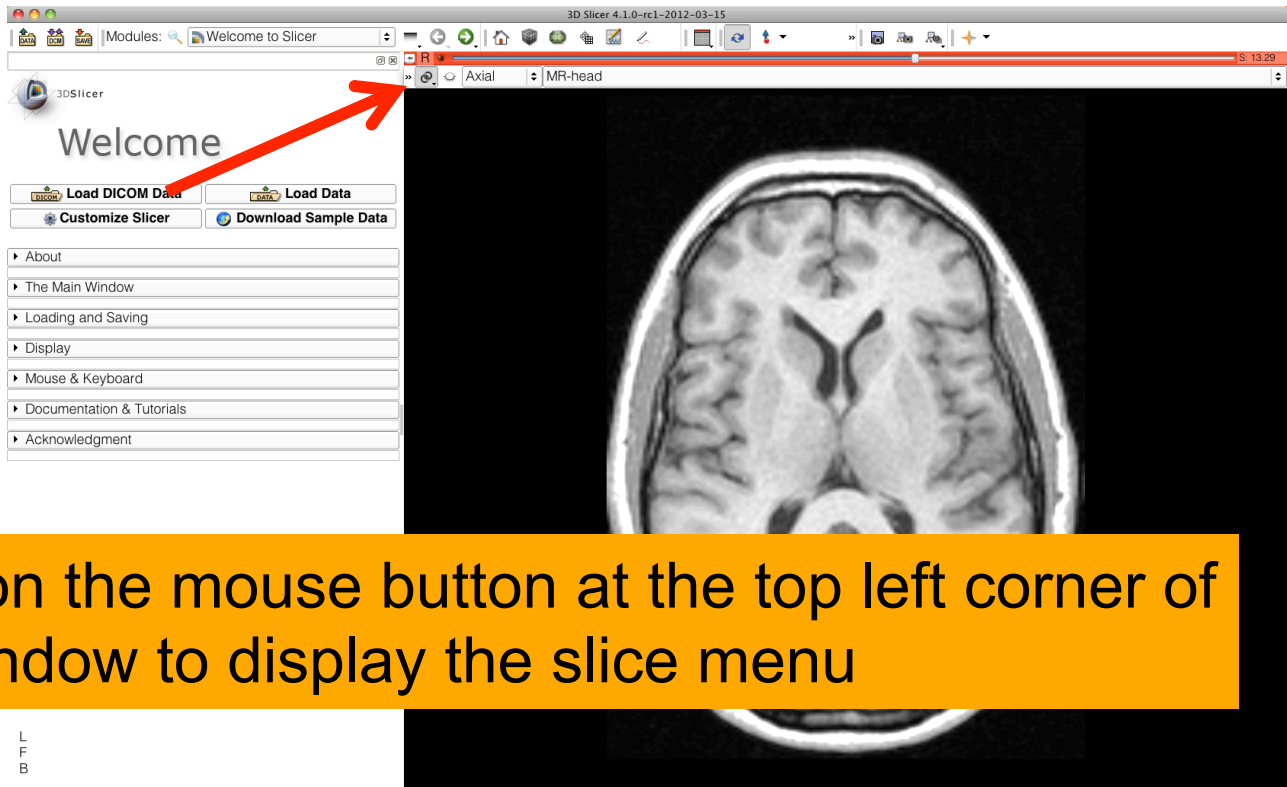


Loading a volume





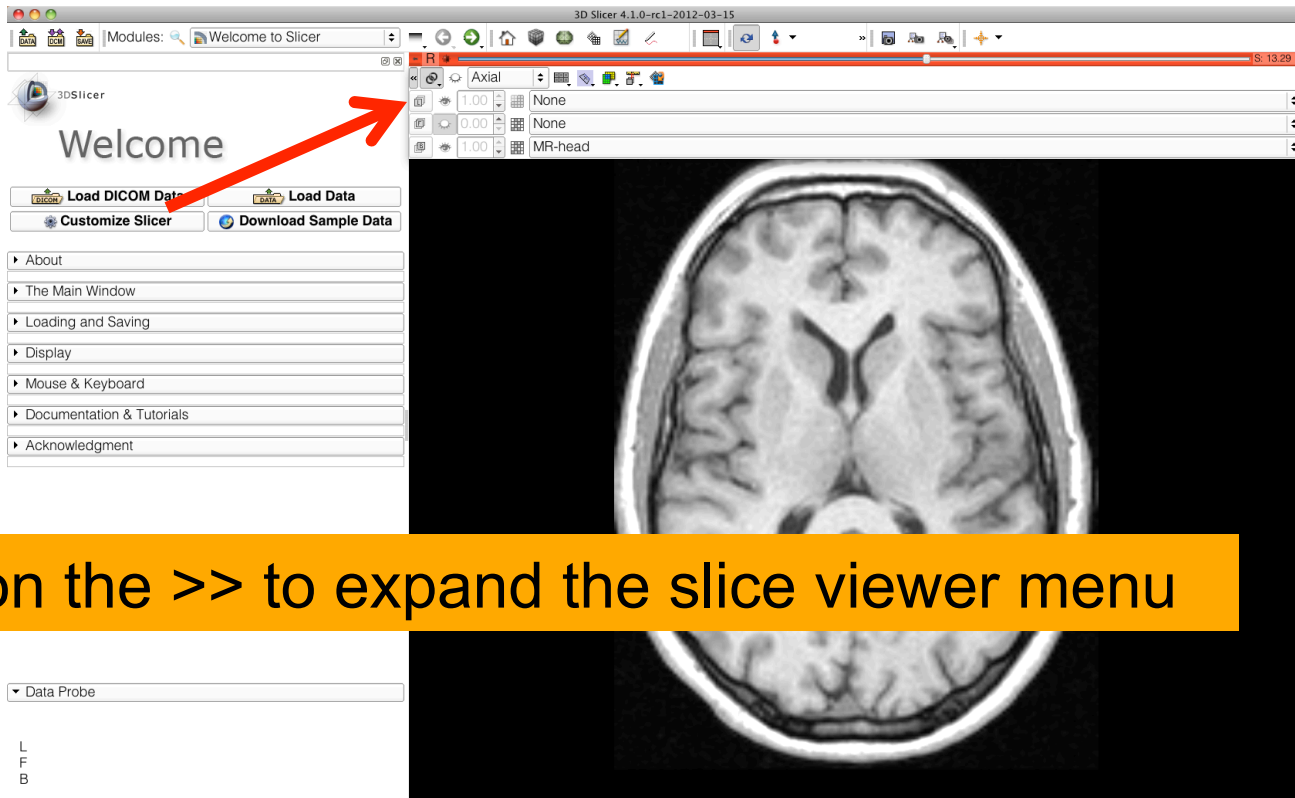
Loading a volume



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

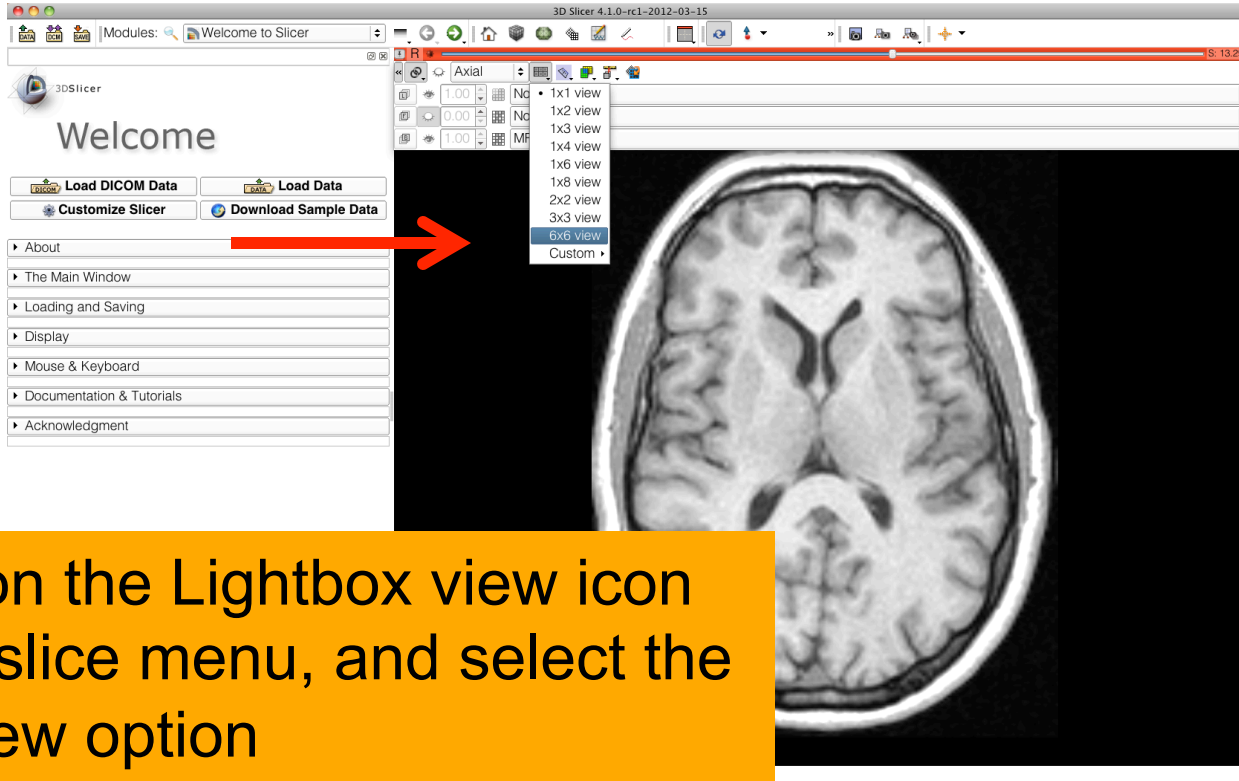


Loading a volume





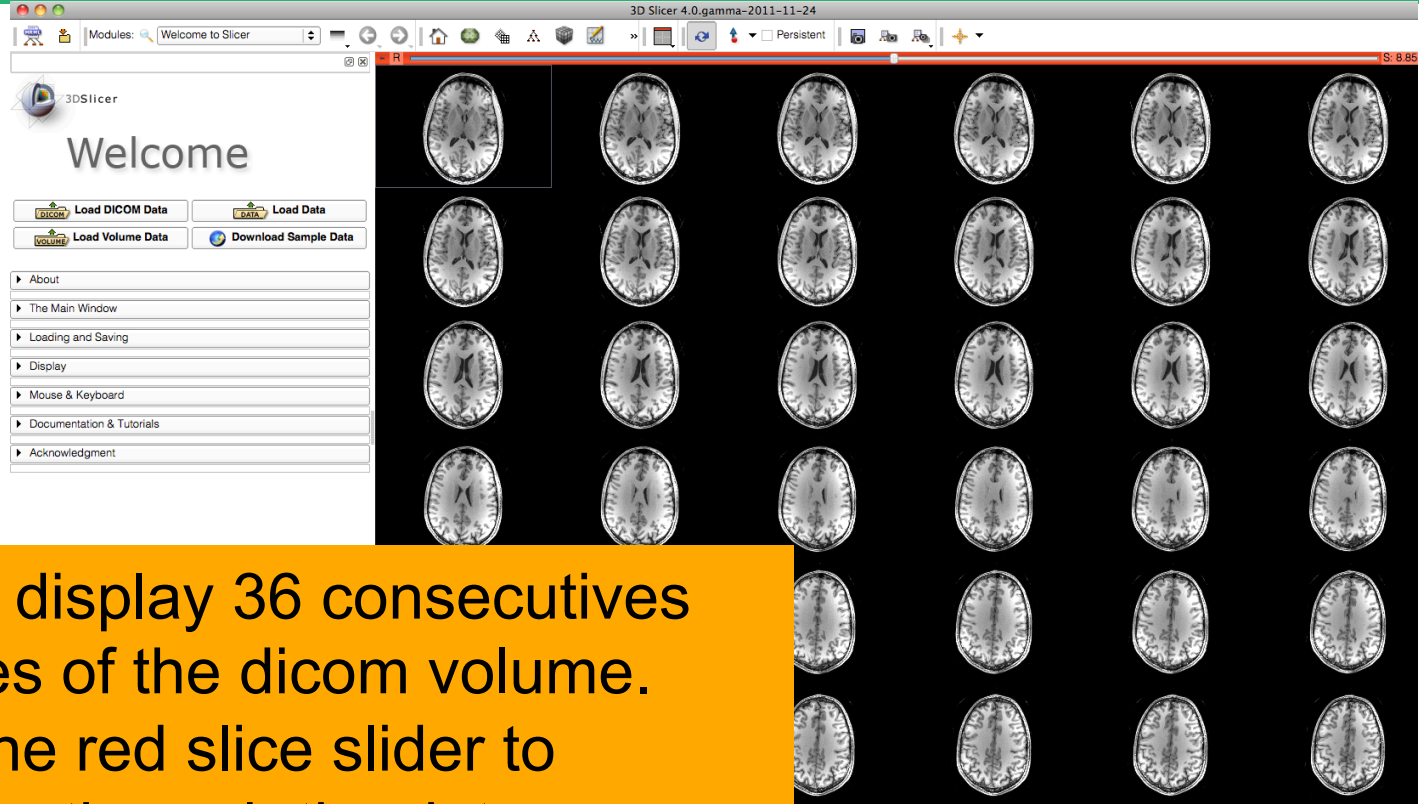
Loading a volume



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



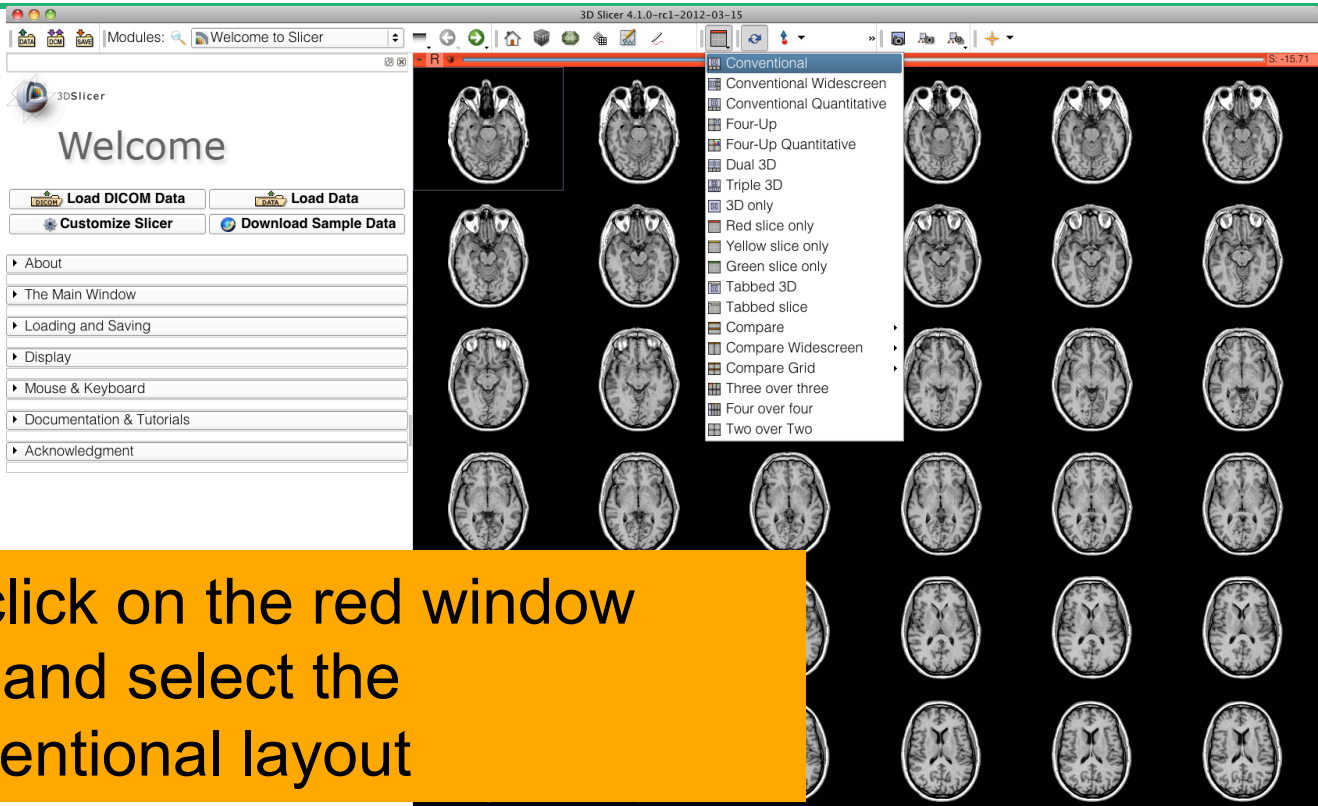
Loading a volume



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



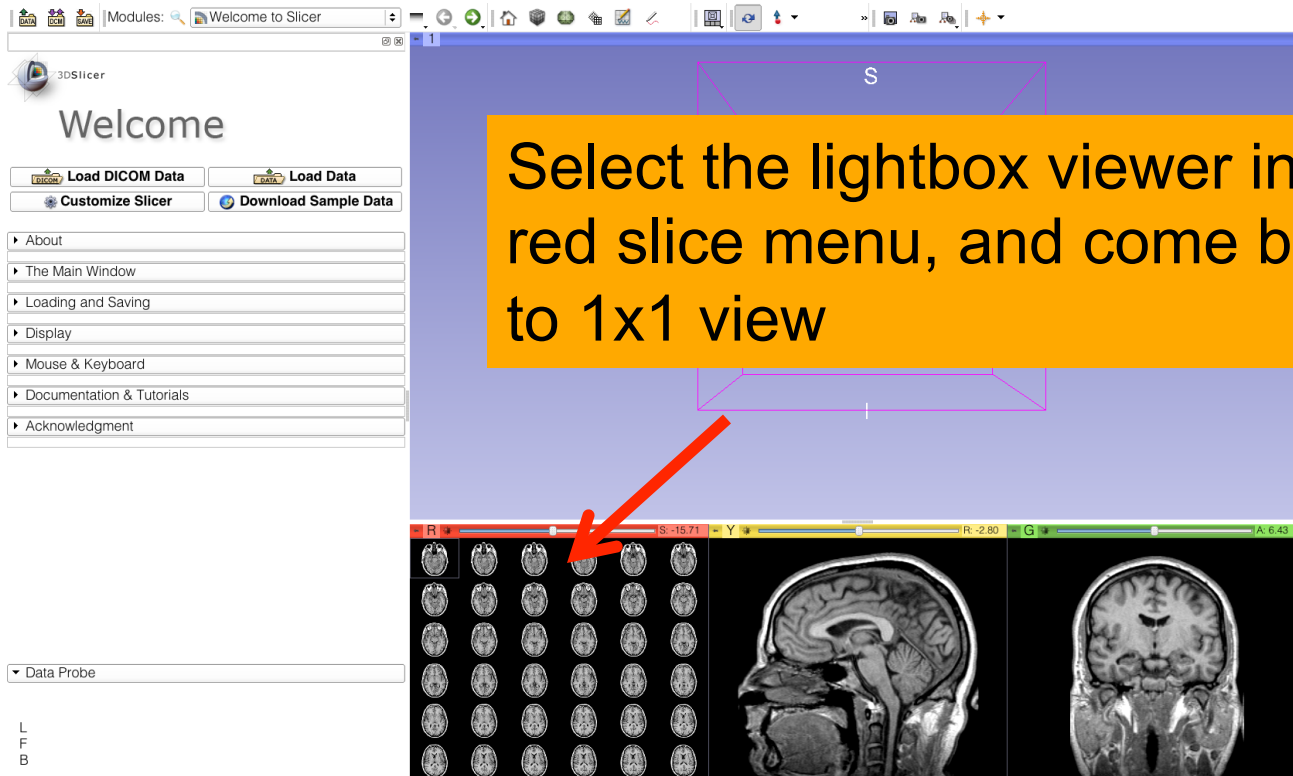
Loading a volume



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

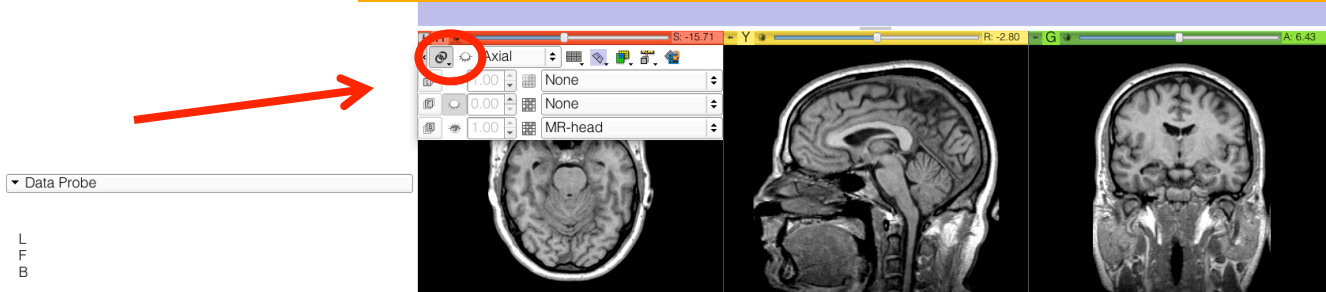
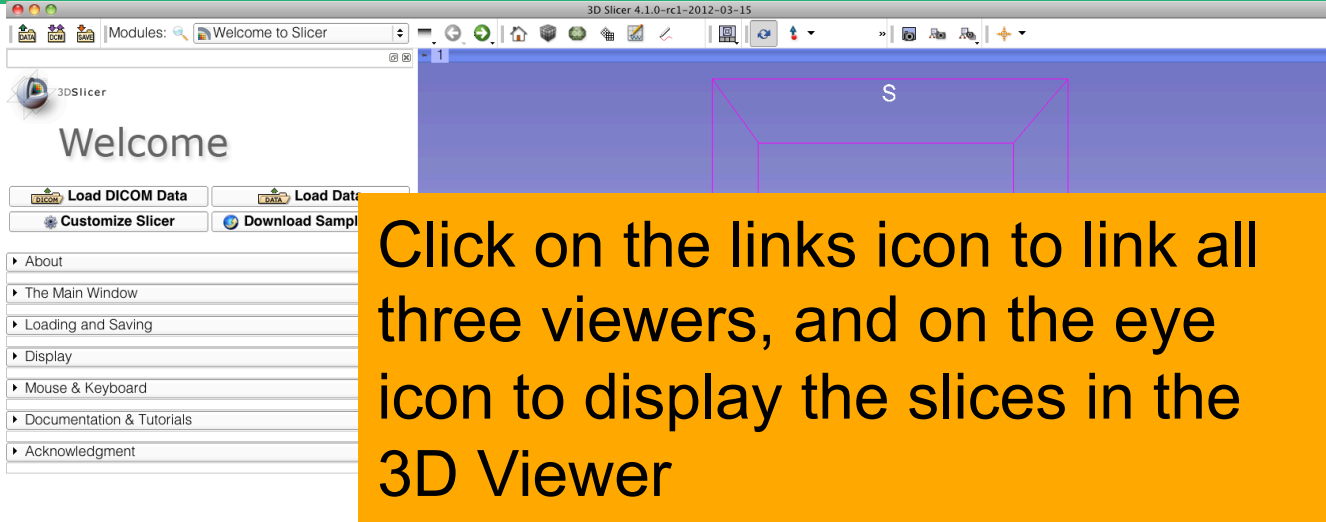


Loading a volume





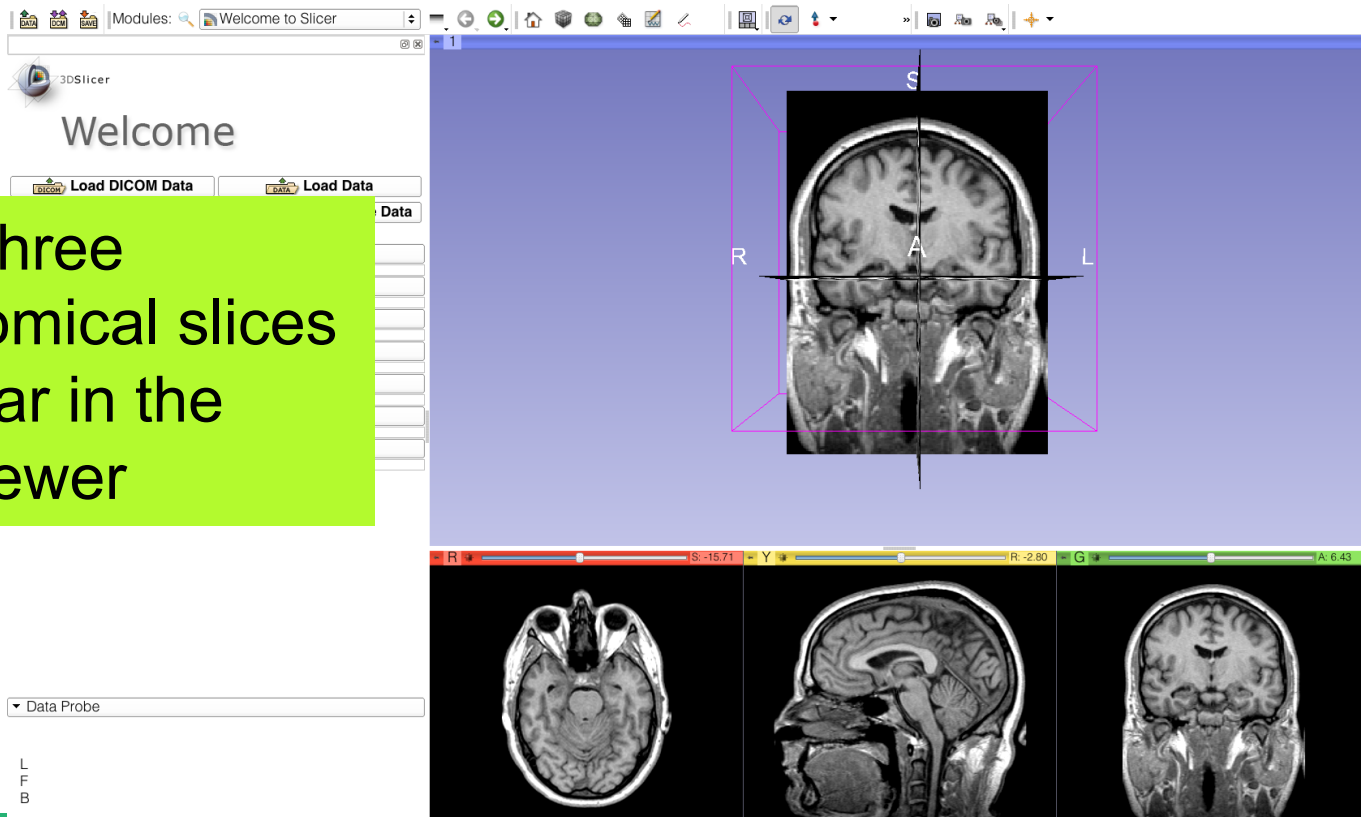
Loading a volume





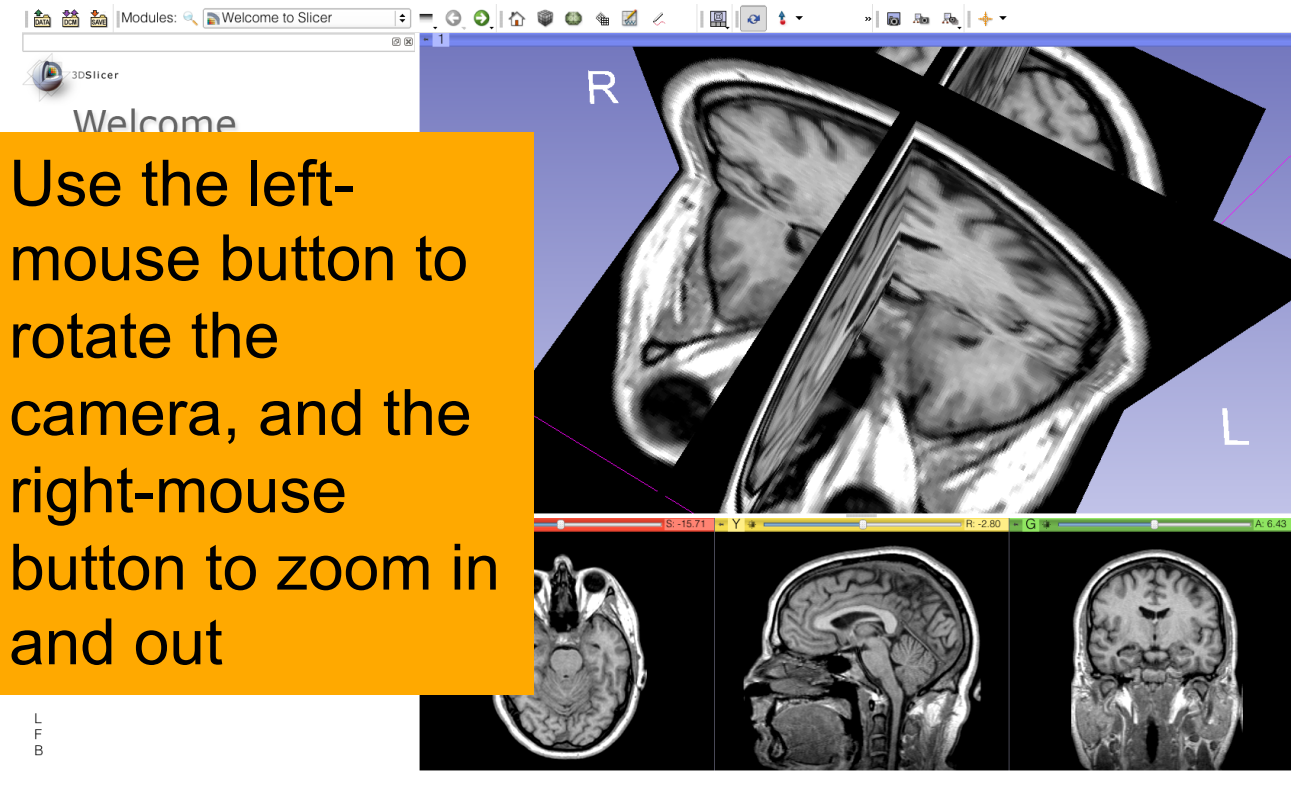
Loading a volume

The three anatomical slices appear in the 3DViewer





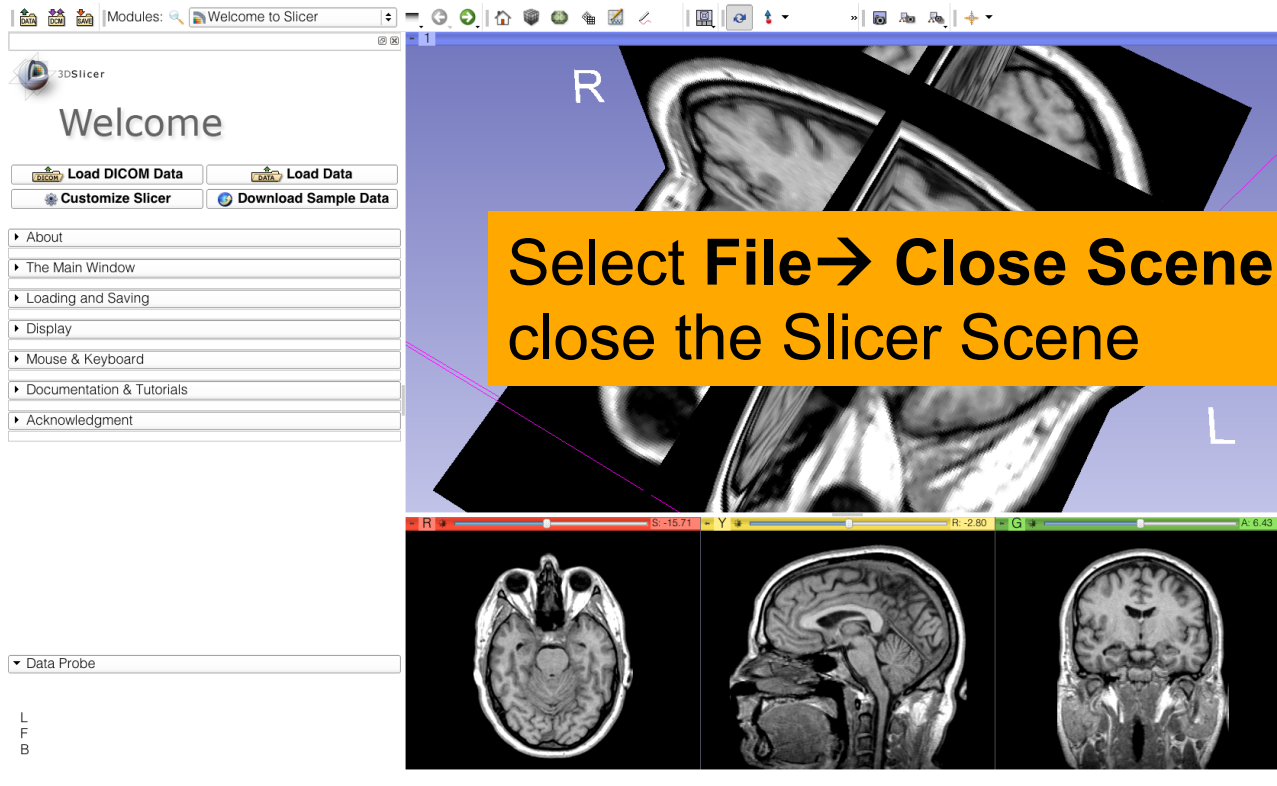
Loading a DICOM volume



Use the left-
mouse button to
rotate the
camera, and the
right-mouse
button to zoom in
and out

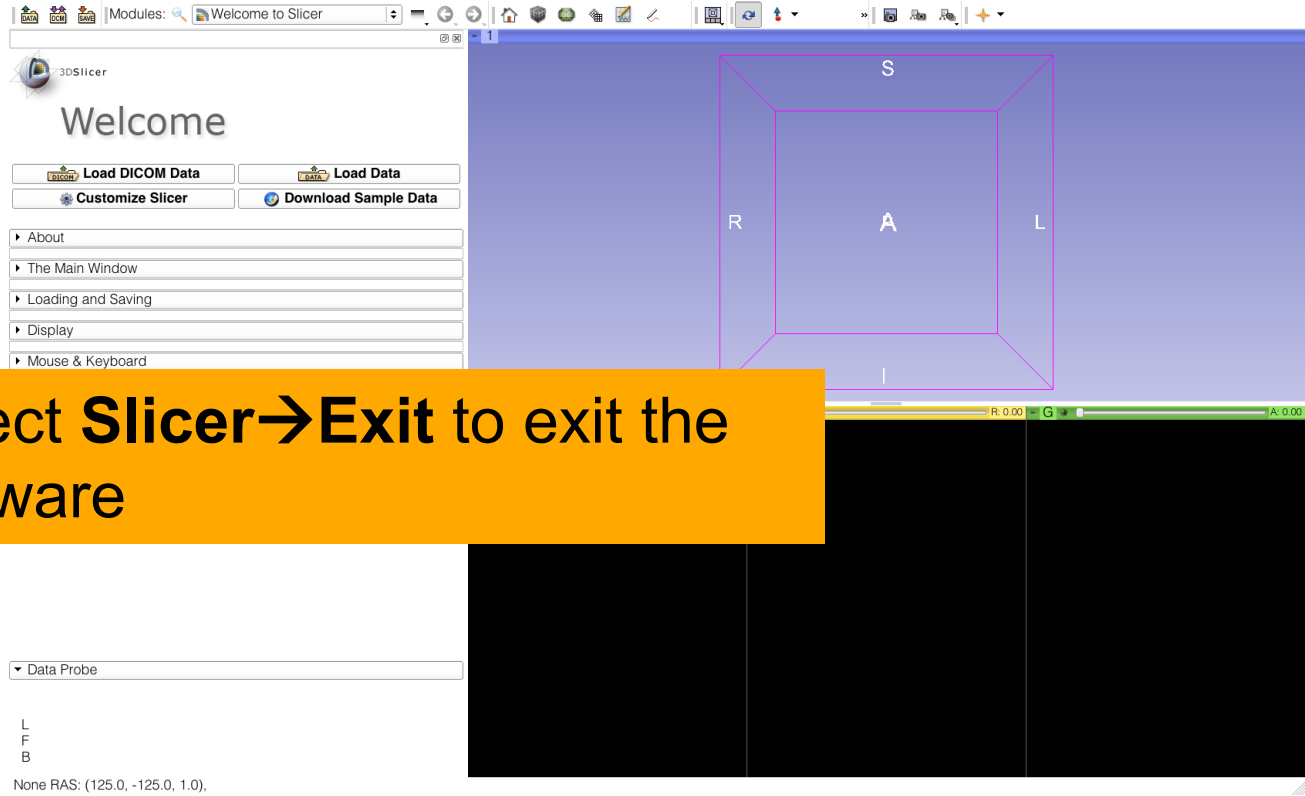


Close the scene





Exit Slicer



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

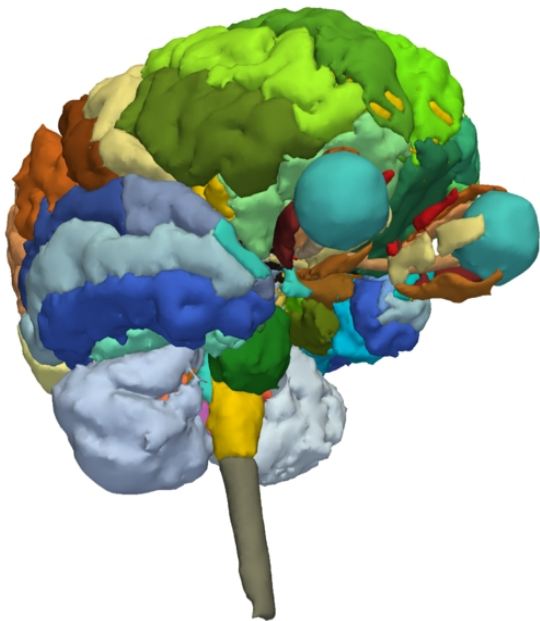


Part 2:

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.



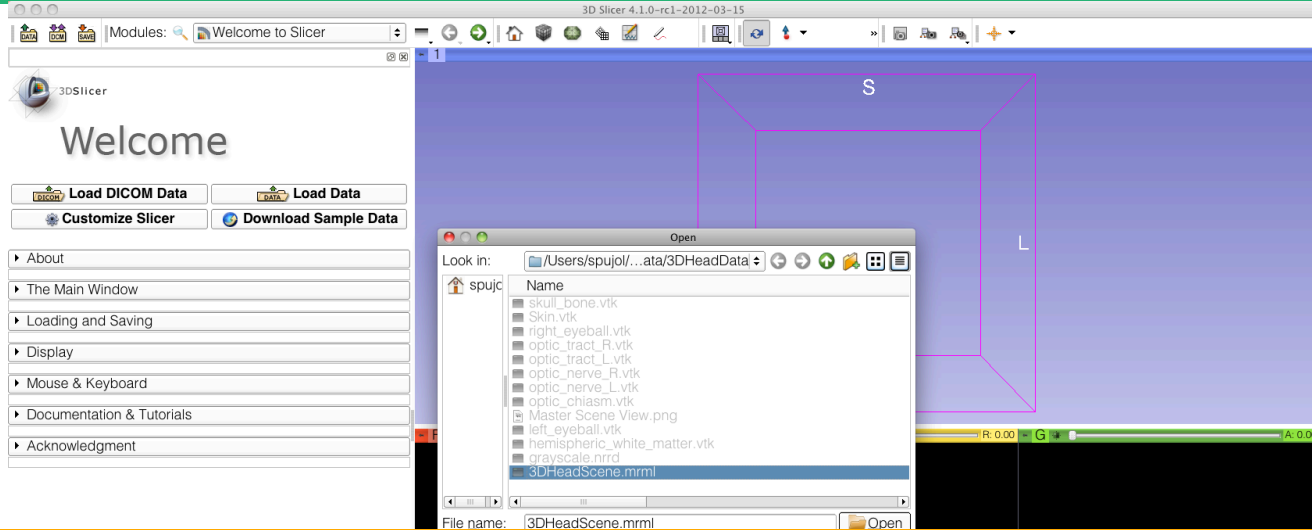
Loading a Scene

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 displays a 3D view of a scene 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 'A' label is in the center. Below the 3D view is a status bar with 'R 0.00', 'Y', 'R 0.00', 'G', and 'A 0.00'.

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



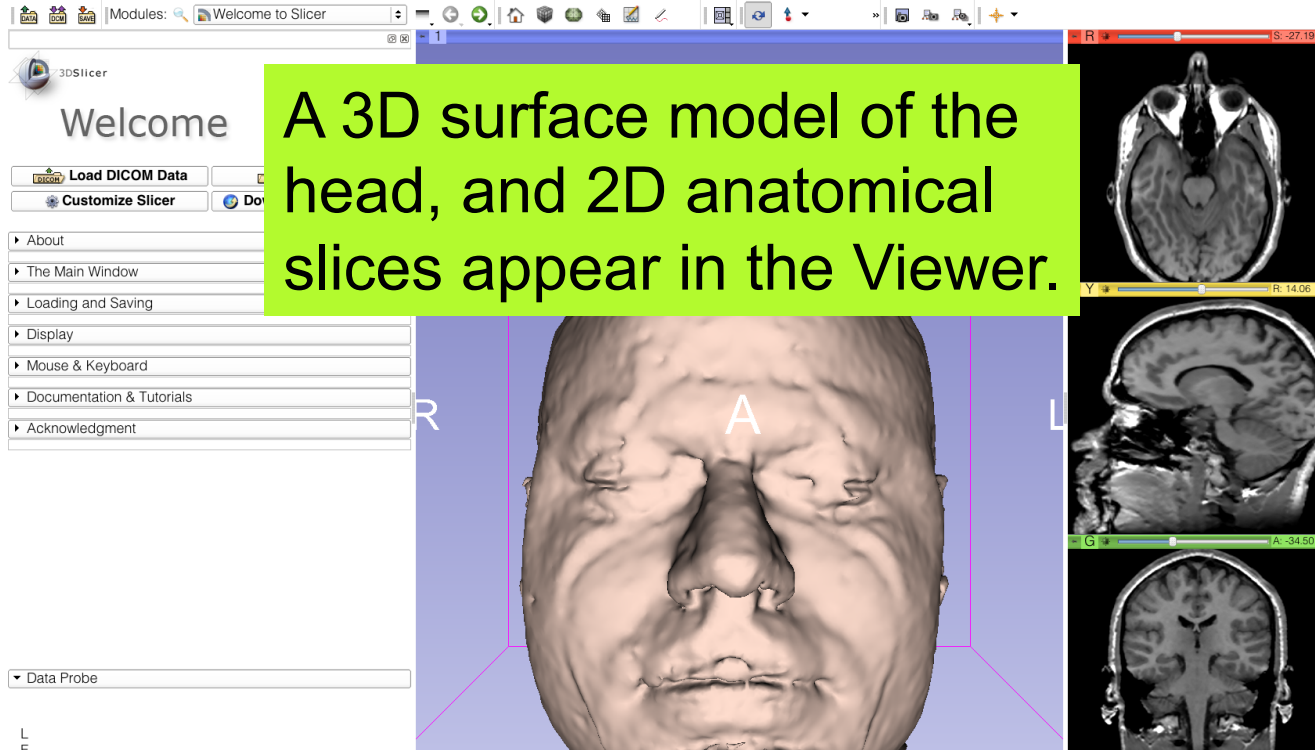
Loading a Scene



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

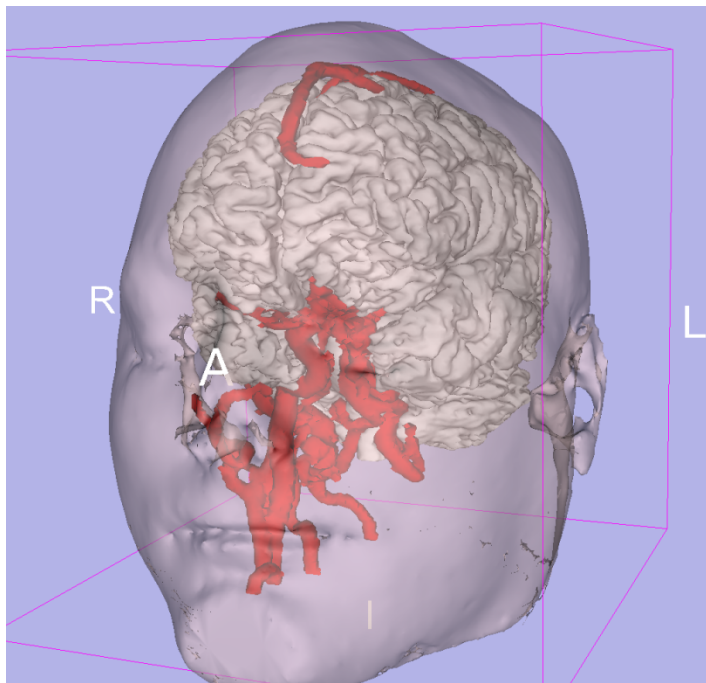


Loading the Slicer Scene





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.



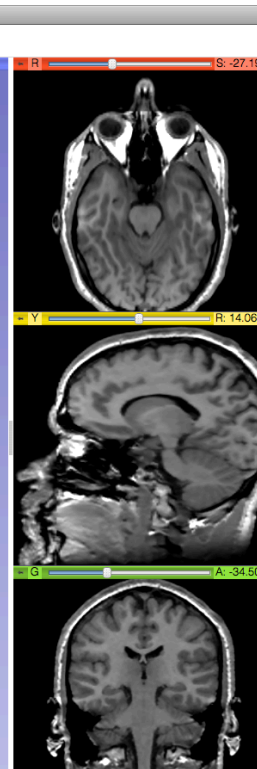
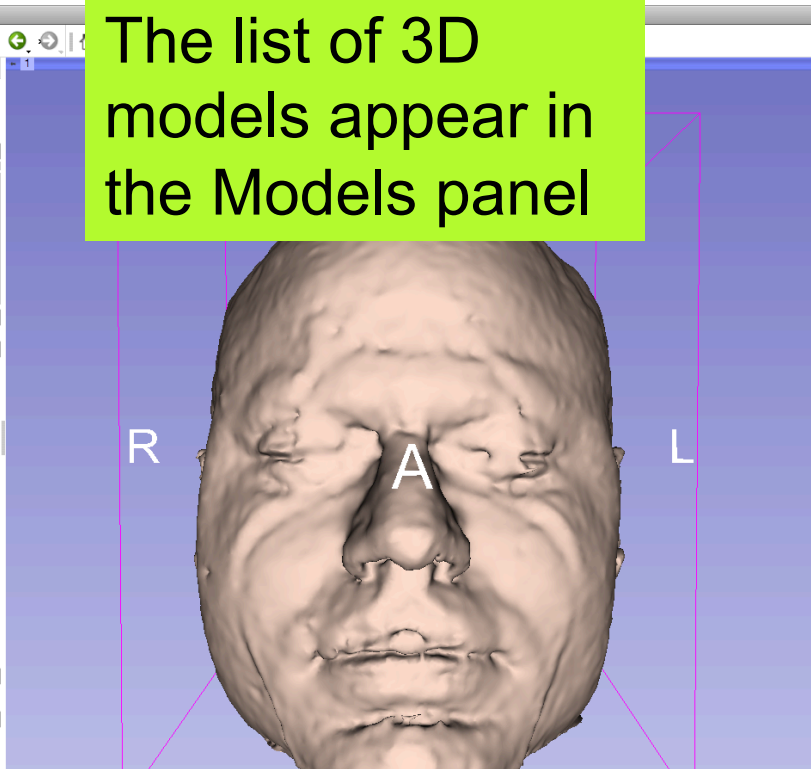
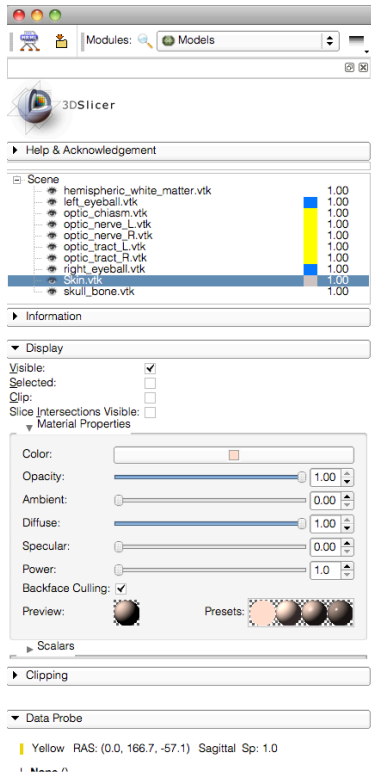
Loading the Slicer Scene

The screenshot shows the 3D Slicer software interface. On the left is the 'Welcome' sidebar with a 'Modules' menu. A red arrow points from the 'Models' option in the 'Modules' menu to a yellow callout box. The main window displays a 3D model of a human face and three orthogonal MRI slices (axial, sagittal, and coronal). The callout box contains the text: 'Select the module Models from the Modules menu.'



Models module

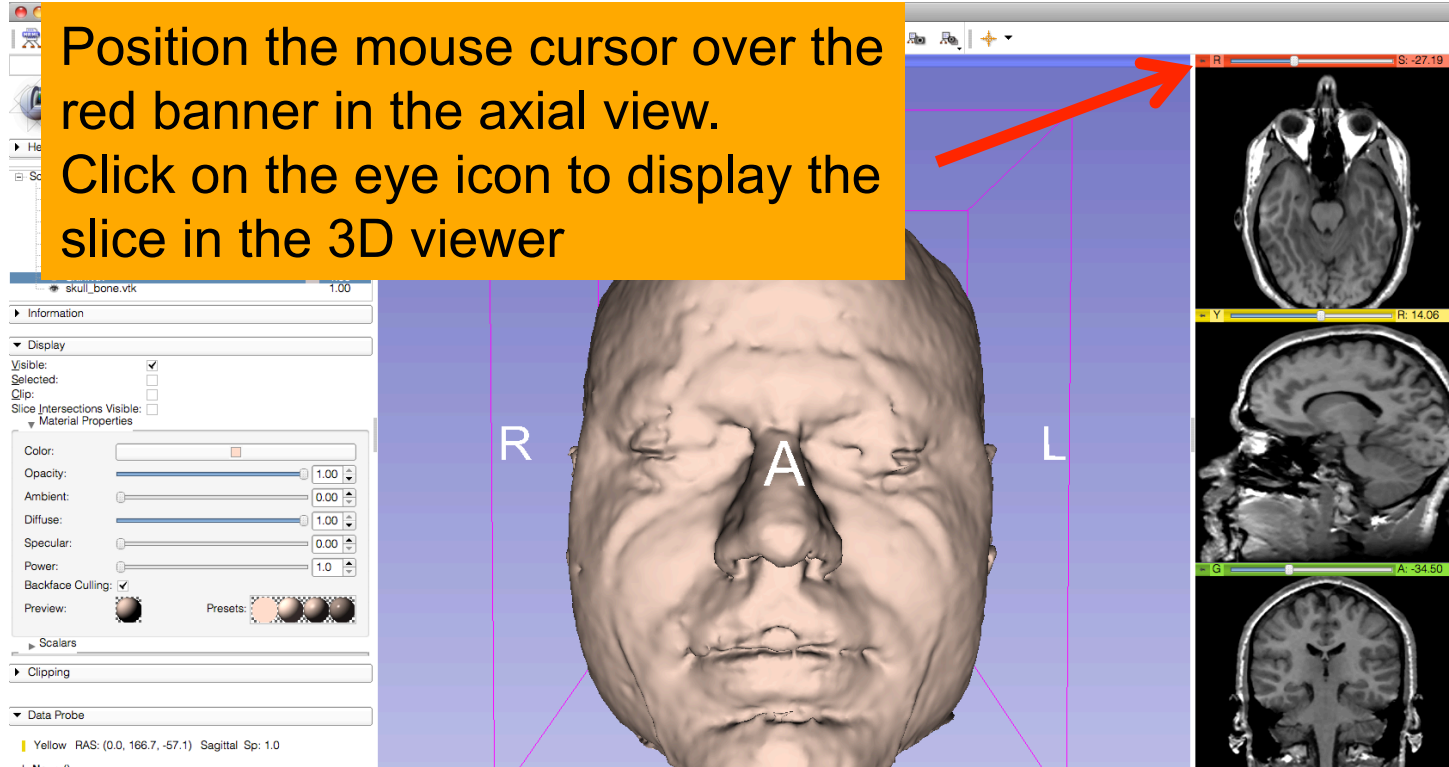
The list of 3D models appear in the Models panel





3D Visualization

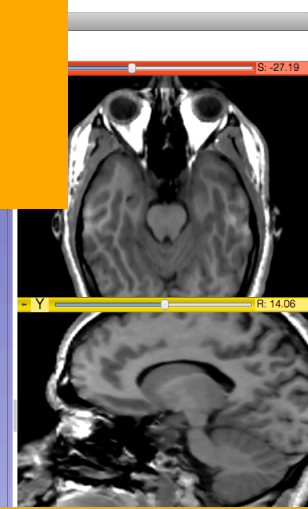
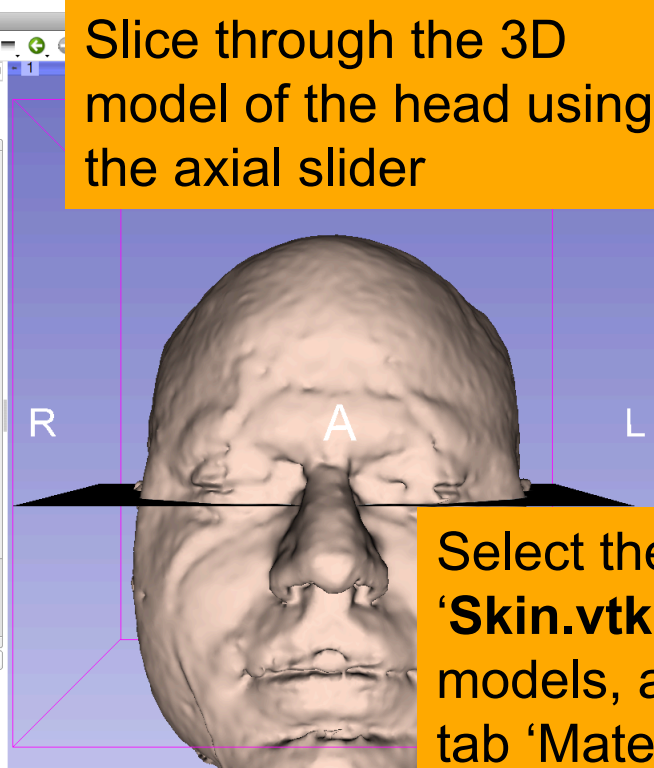
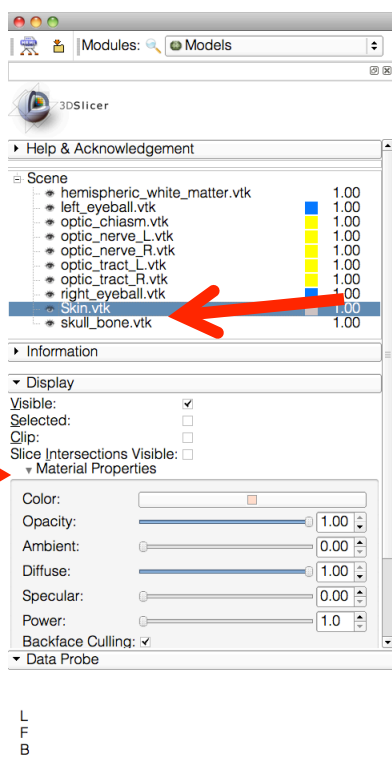
Position the mouse cursor over the red banner in the axial view.
Click on the eye icon to display the slice in the 3D viewer





3D Visualization

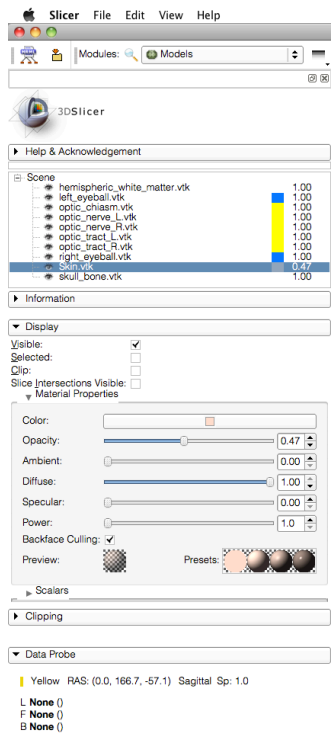
Slice through the 3D model of the head using the axial slider



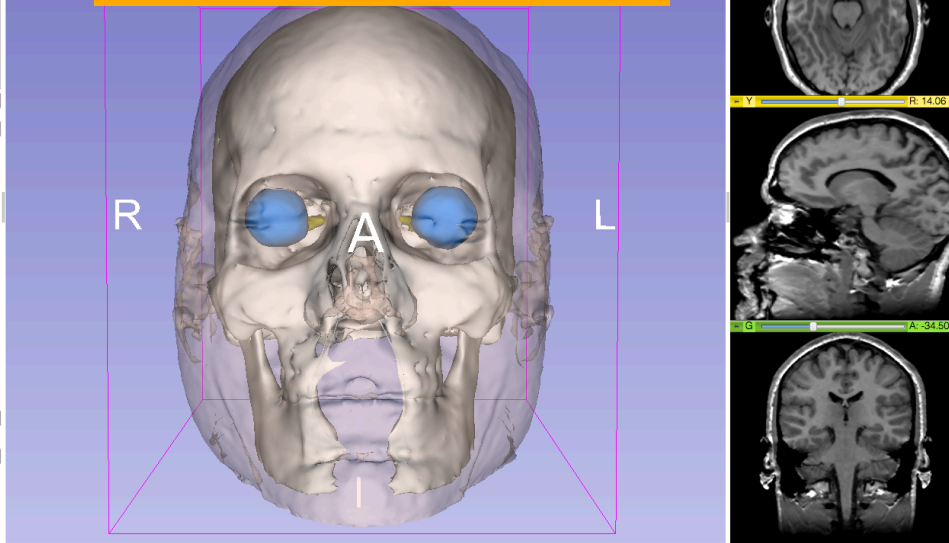
Select the model 'Skin.vtk' in the list of models, and expand the tab 'Material Properties' under 'Display'



3D Visualization



Lower the opacity of the skin model using the Opacity slider





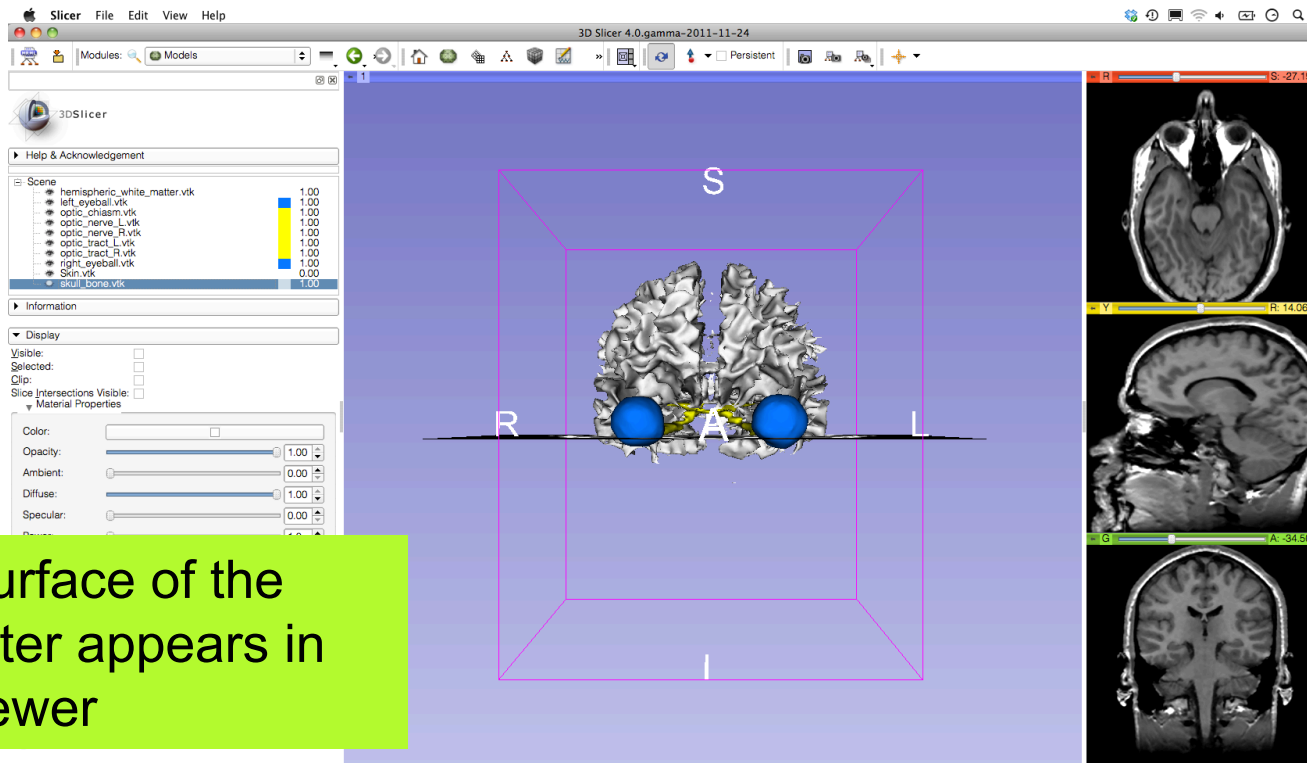
3D Visualization

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 various 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 skull model with two blue spheres representing eyes, set against a purple background with 'R', 'L', and 'I' orientation markers. On the right, three MRI slices are shown in axial, sagittal, and coronal views, with their respective axes labeled 'S', 'Y', 'G', and 'A'.



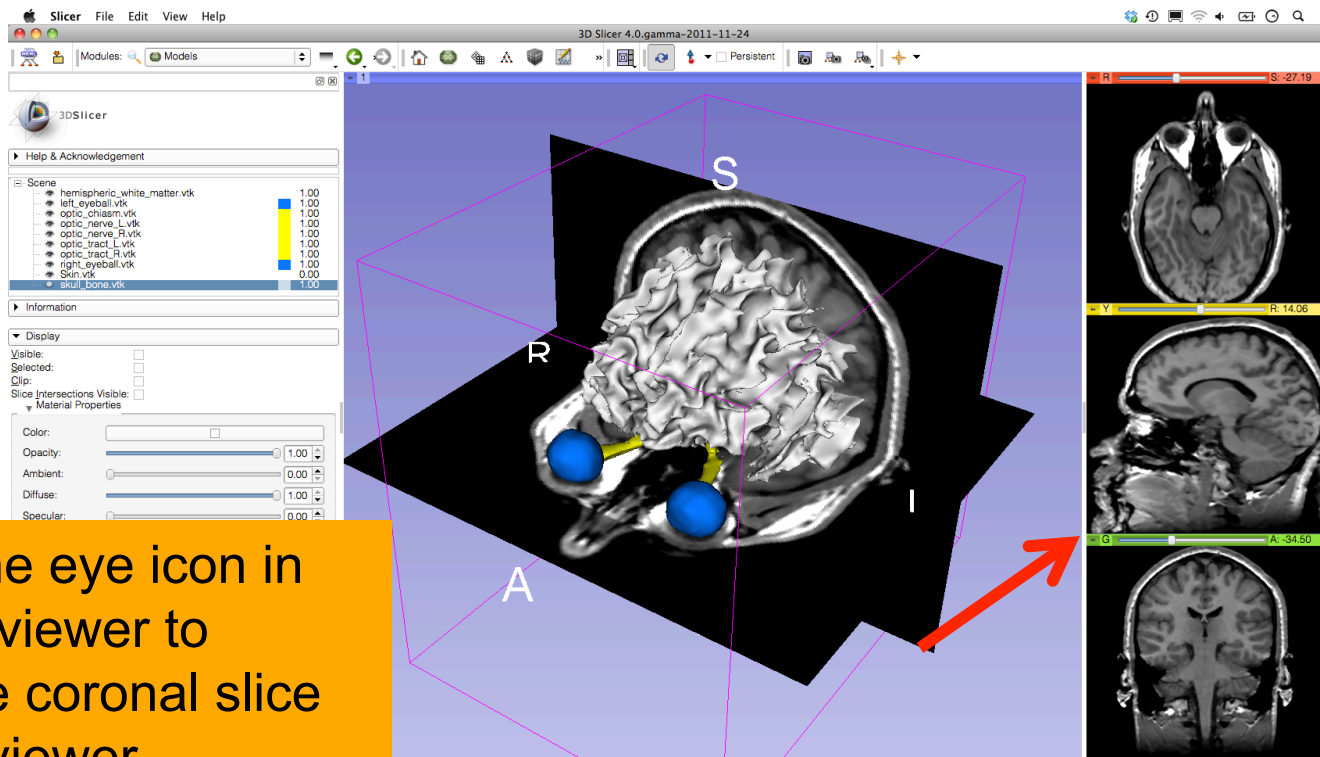
3D Visualization



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



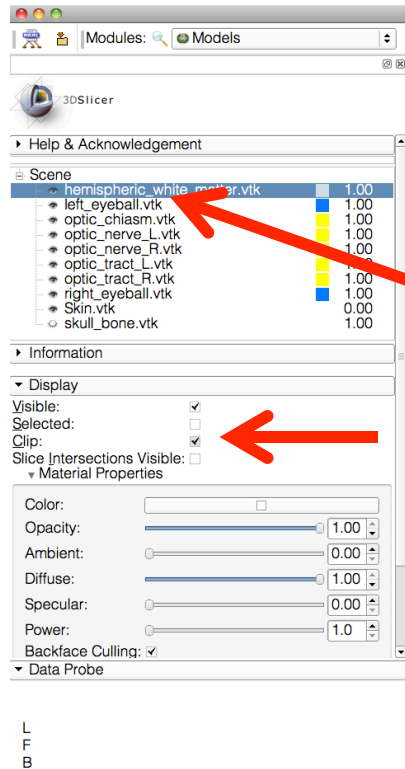
3D Visualization



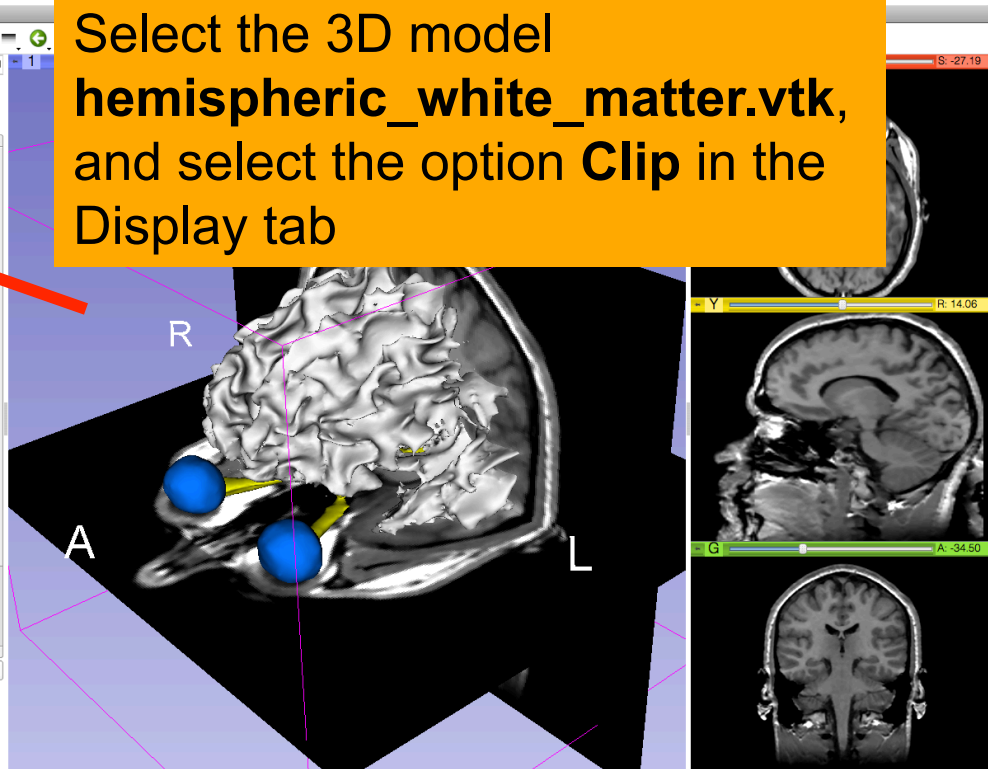
Click on the eye icon in the green viewer to display the coronal slice in the 3D viewer



3D Visualization



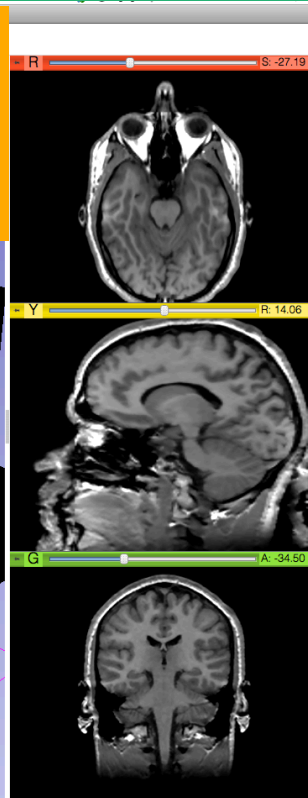
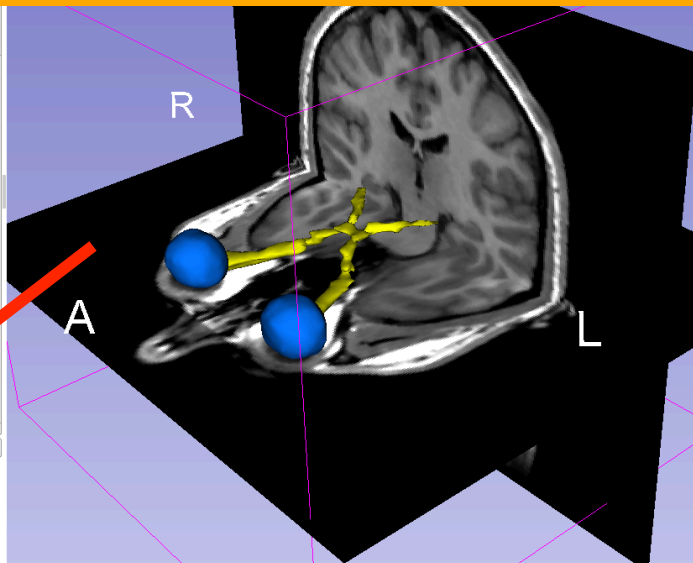
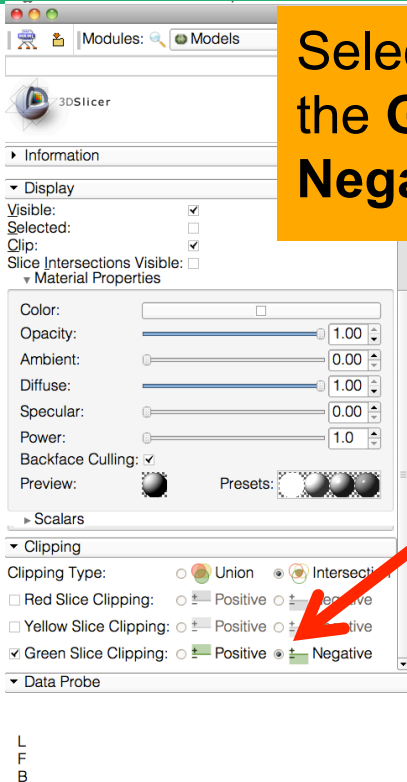
Select the 3D model **hemispheric_white_matter.vtk**, and select the option **Clip** in the Display tab





3D Visualization

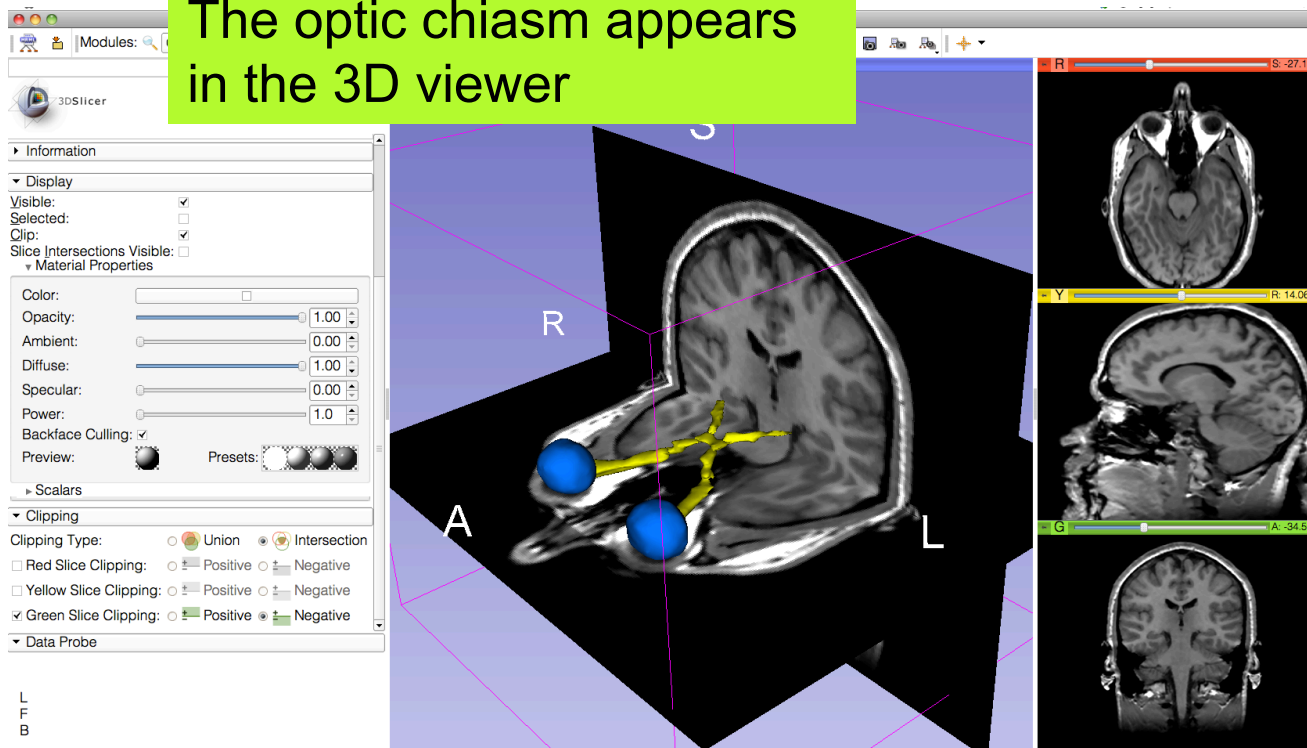
Select the tab Clipping, and set the **Green Slice Clipping** to **Negative Space**





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 the 'Display' section. In this section, the 'Clip' checkbox is checked, and the 'Opacity' slider is set to 0.42. A red arrow points from the text box to this 'Clip' checkbox. The 'Clipping' section at the bottom shows 'Clipping Type' set to 'Intersection'. The main 3D view shows a brain model with blue eyes and a yellow crosshair. To the right, three orthogonal views (axial, sagittal, and coronal) are displayed. An orange text box is overlaid on the 3D view, containing the instruction: 'Uncheck the option clipping and lower the opacity of the White Matter surface'.



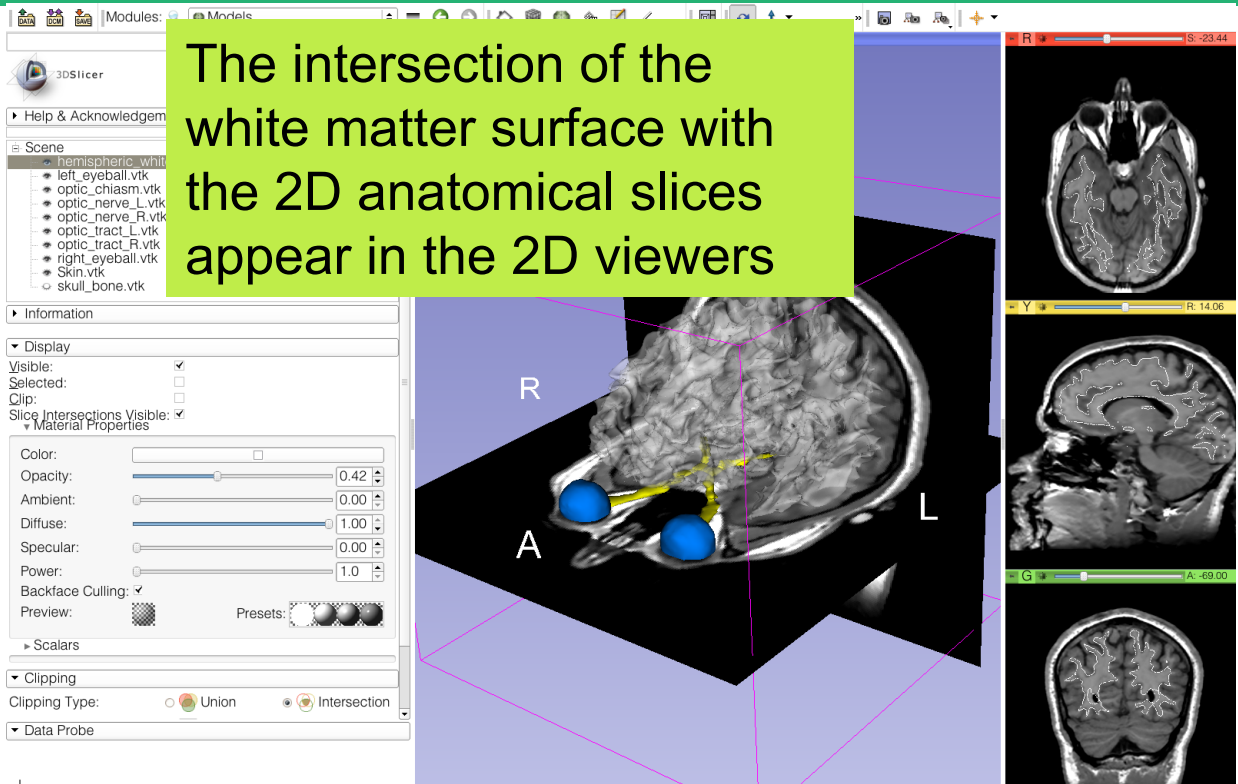
3D Visualization

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 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





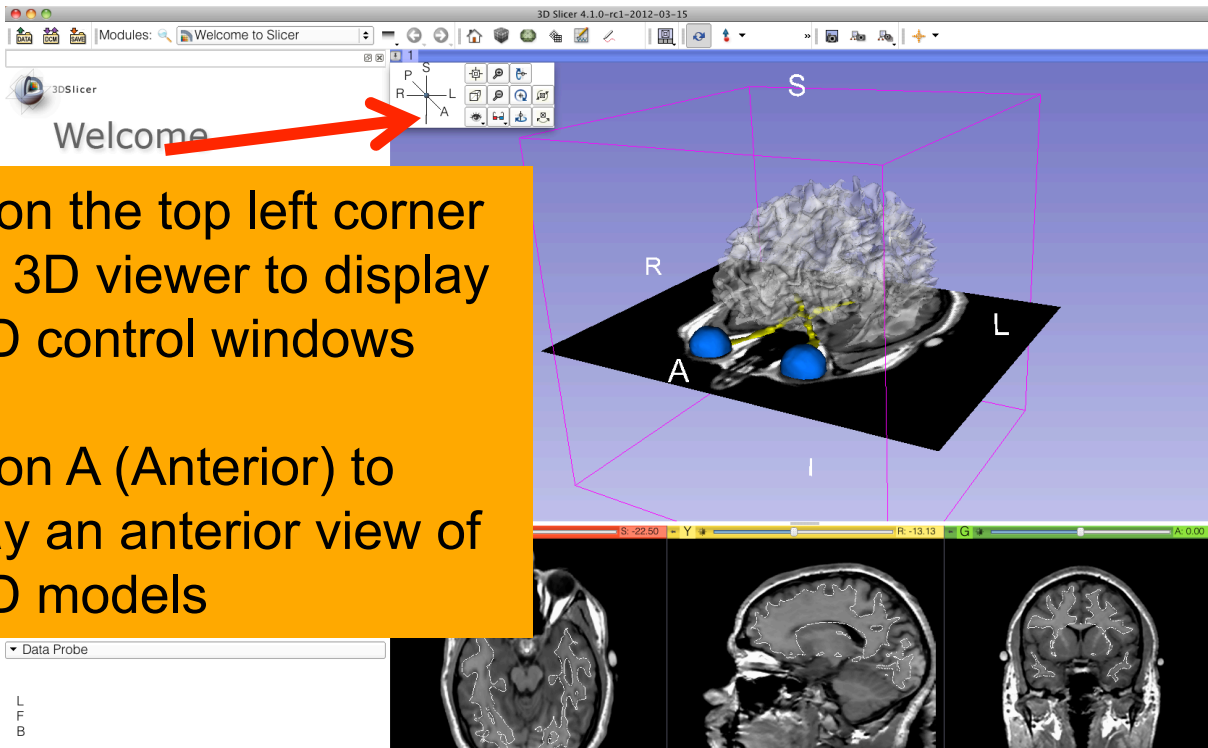
3D Visualization

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 human head with a brain slice highlighted in yellow. The model is labeled with 'R' (Right), 'L' (Left), and 'A' (Anterior). To the right of the 3D view are three orthogonal slices: an axial slice (top, labeled 'R' and 'S - 23.44'), a sagittal slice (middle, labeled 'Y' and 'R - 14.00'), and a coronal slice (bottom, labeled 'G' and 'A - 49.00'). The coronal slice is highlighted in green. The left sidebar contains a scene list with various anatomical models, a display properties panel with sliders for color, opacity, ambient, diffuse, specular, and power, and a clipping type selector set to 'Union'.



3D Visualization

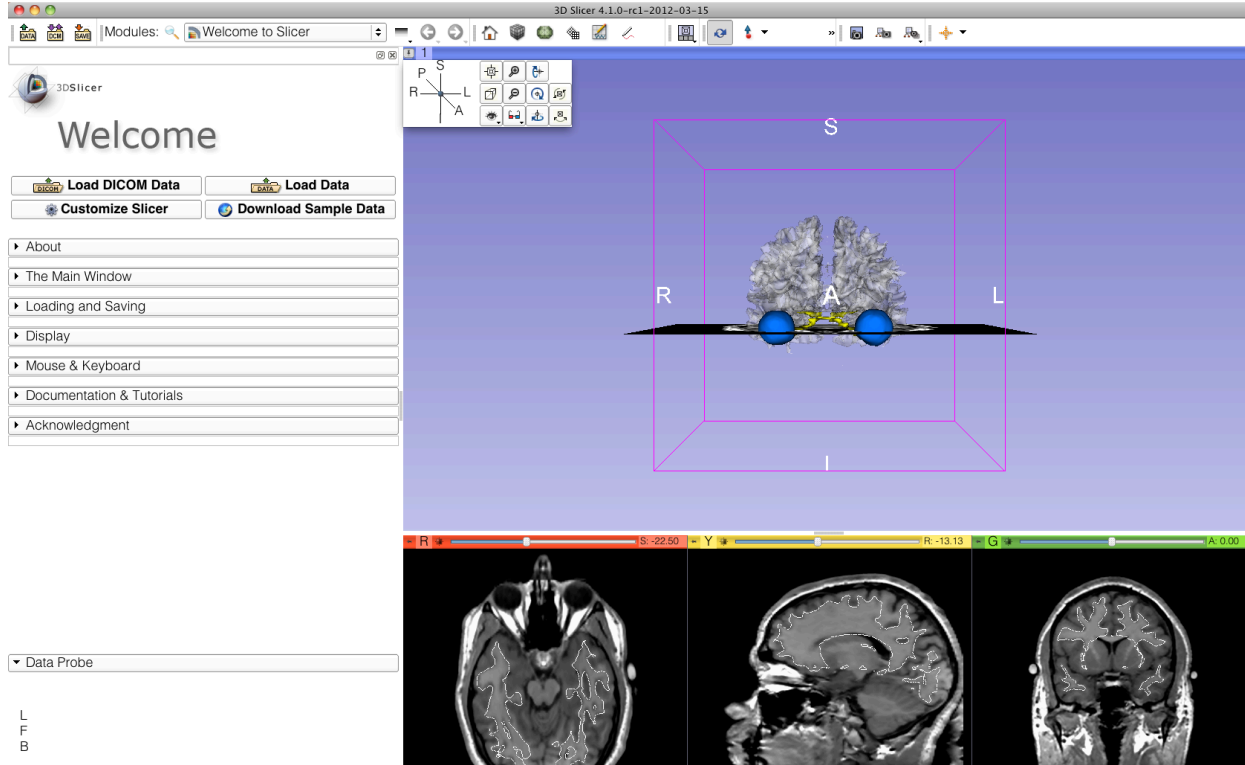


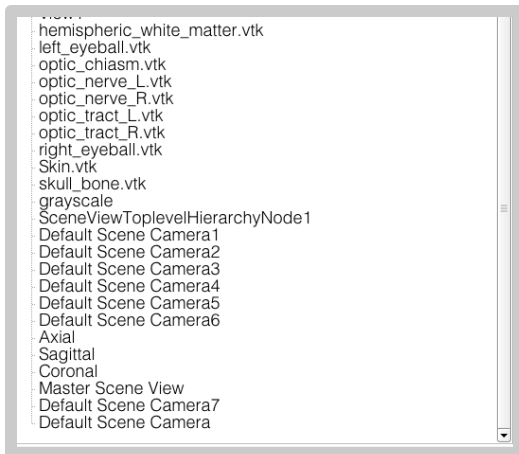
Click on the top left corner of the 3D viewer to display the 3D control windows

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



3D Visualization



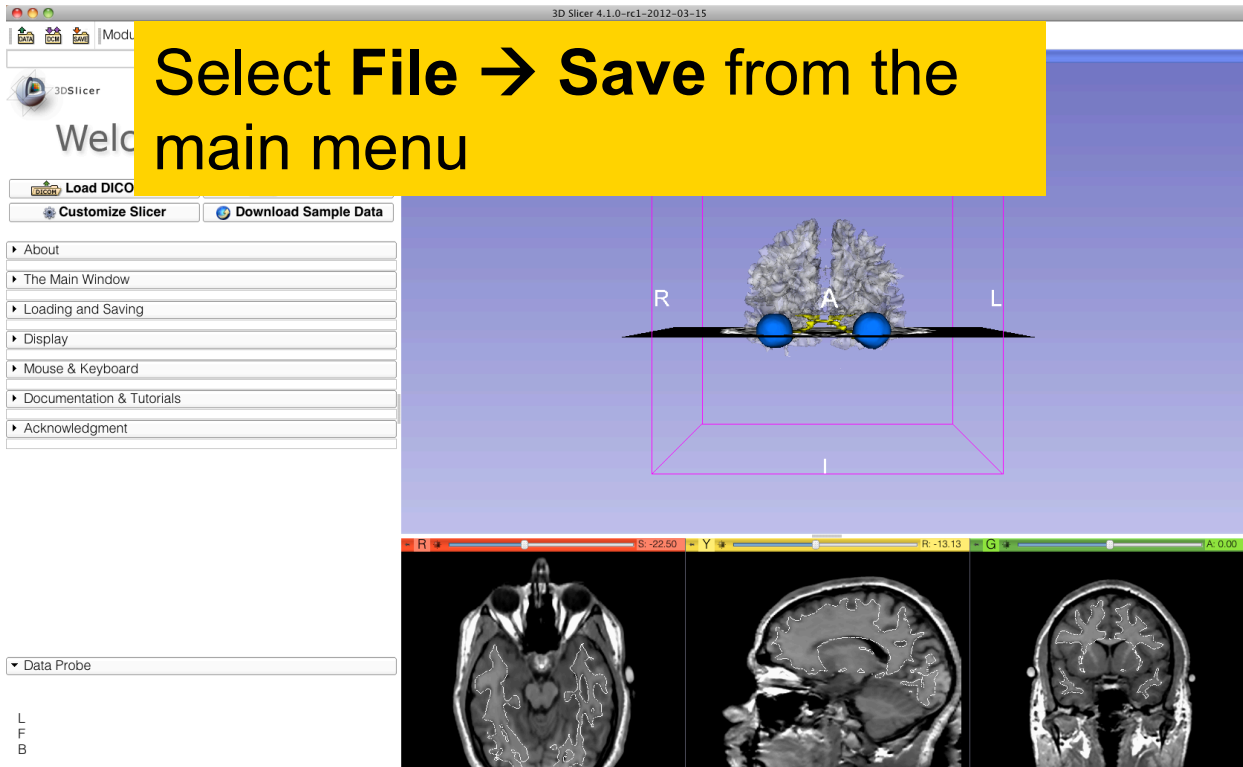


Part 3:

Saving a scene

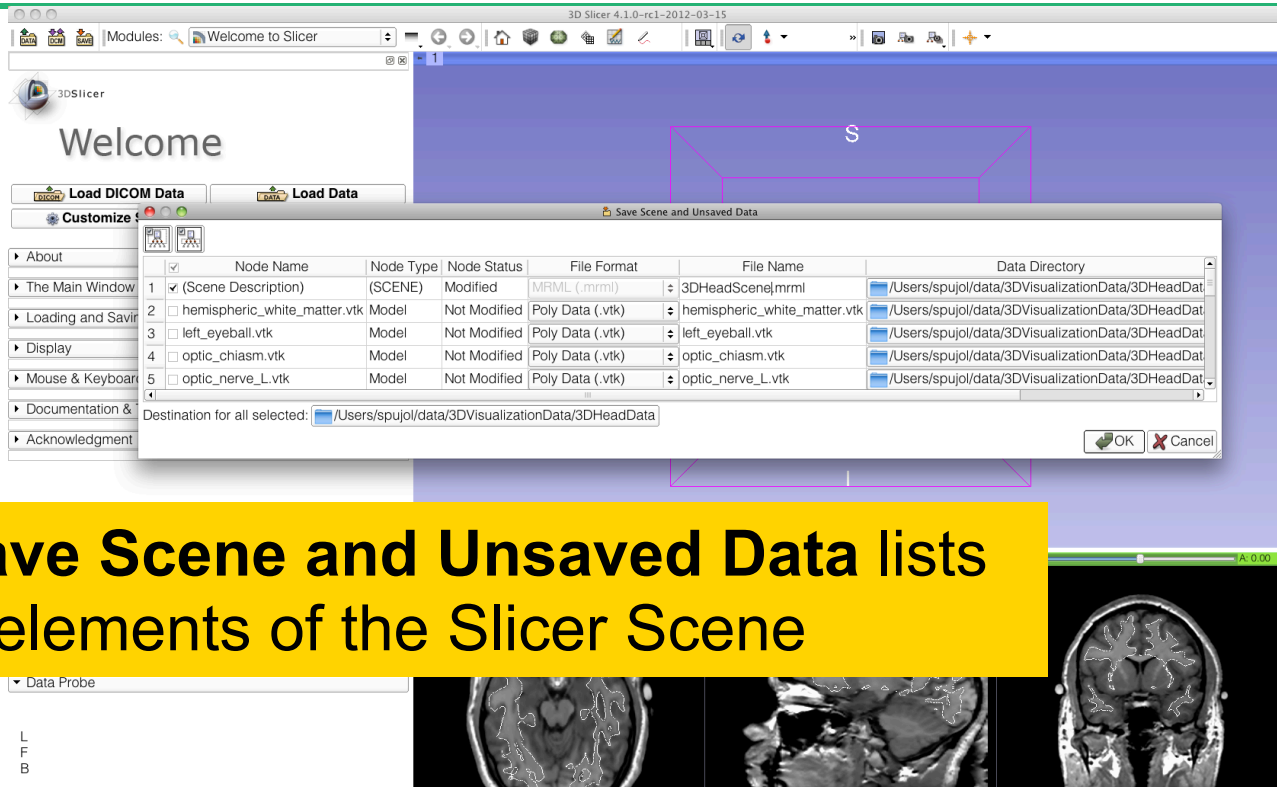


Saving a Scene





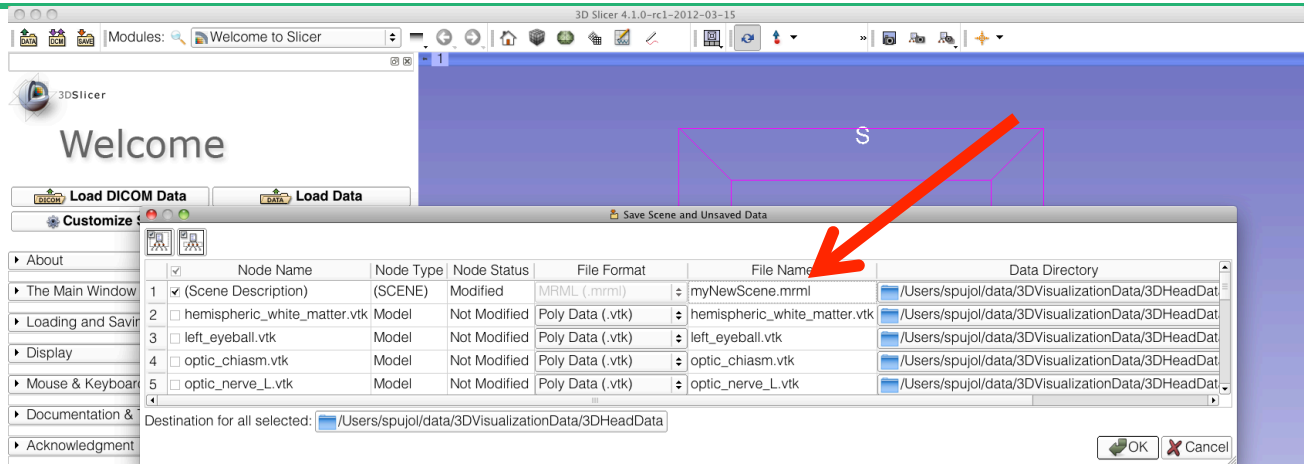
Saving a Scene



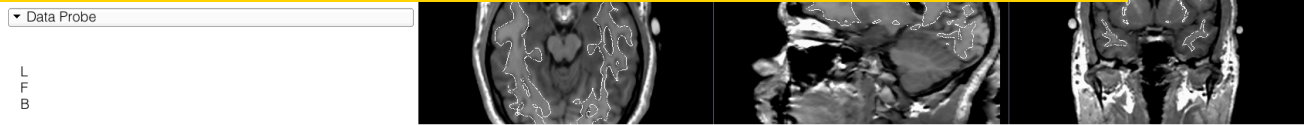
The Save Scene and Unsaved Data lists all the elements of the Slicer Scene



Saving a Scene

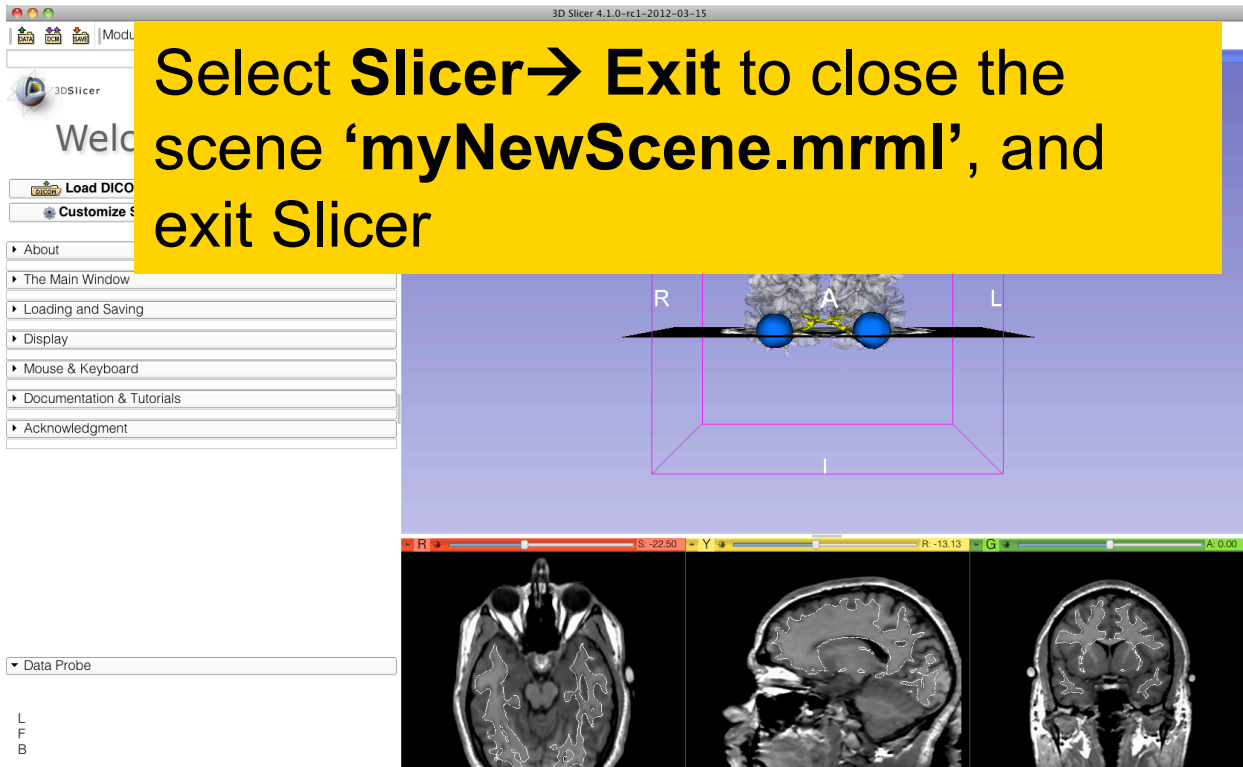


Rename the scene **myNewScene.mrml** and click on **OK**





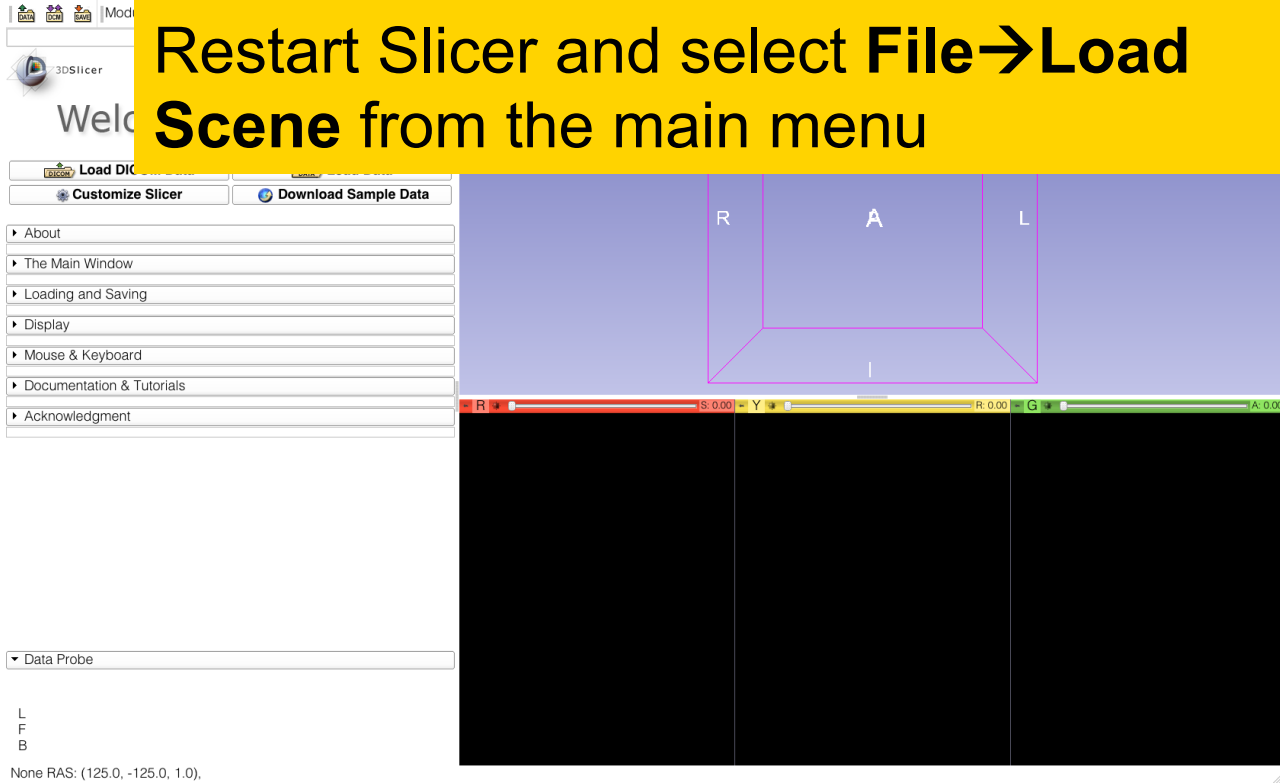
Saving a Scene





Scene Restore

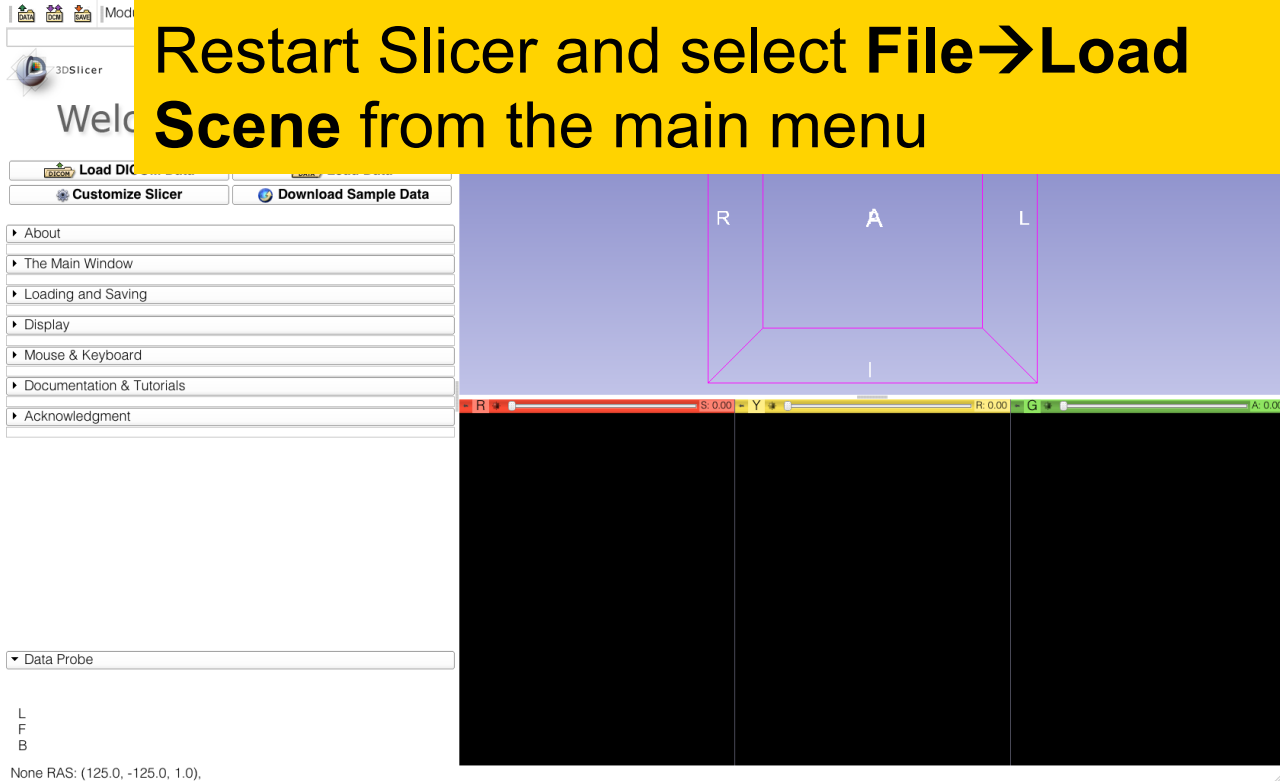
Restart Slicer and select **File**→**Load Scene** from the main menu





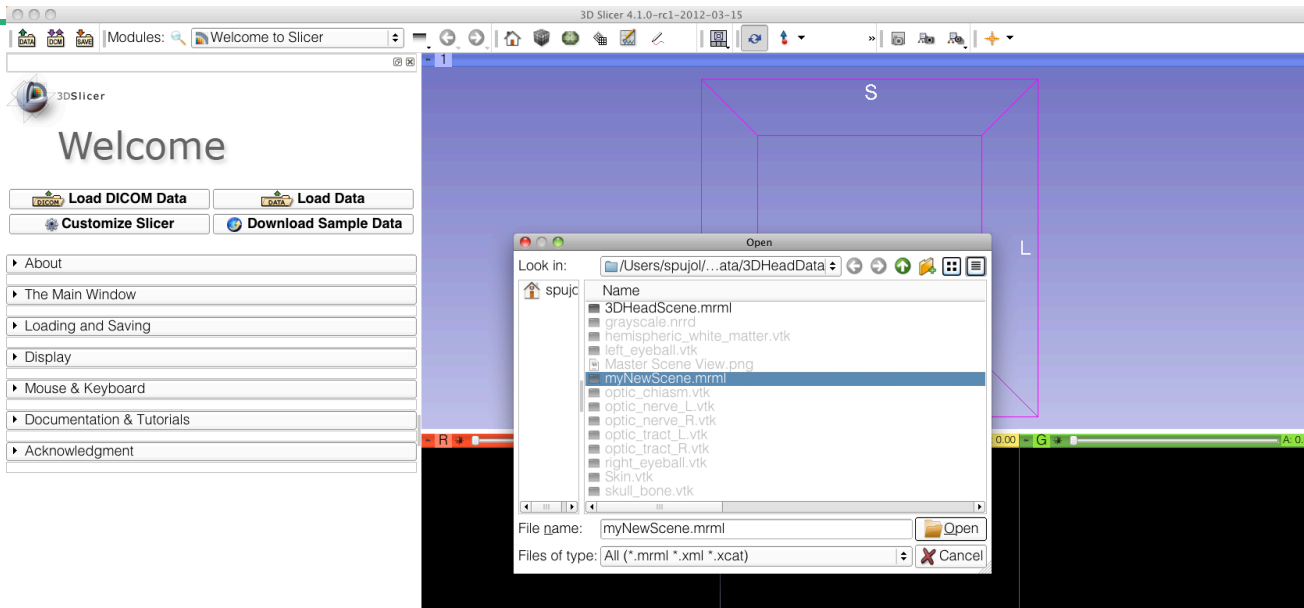
Scene Restore

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





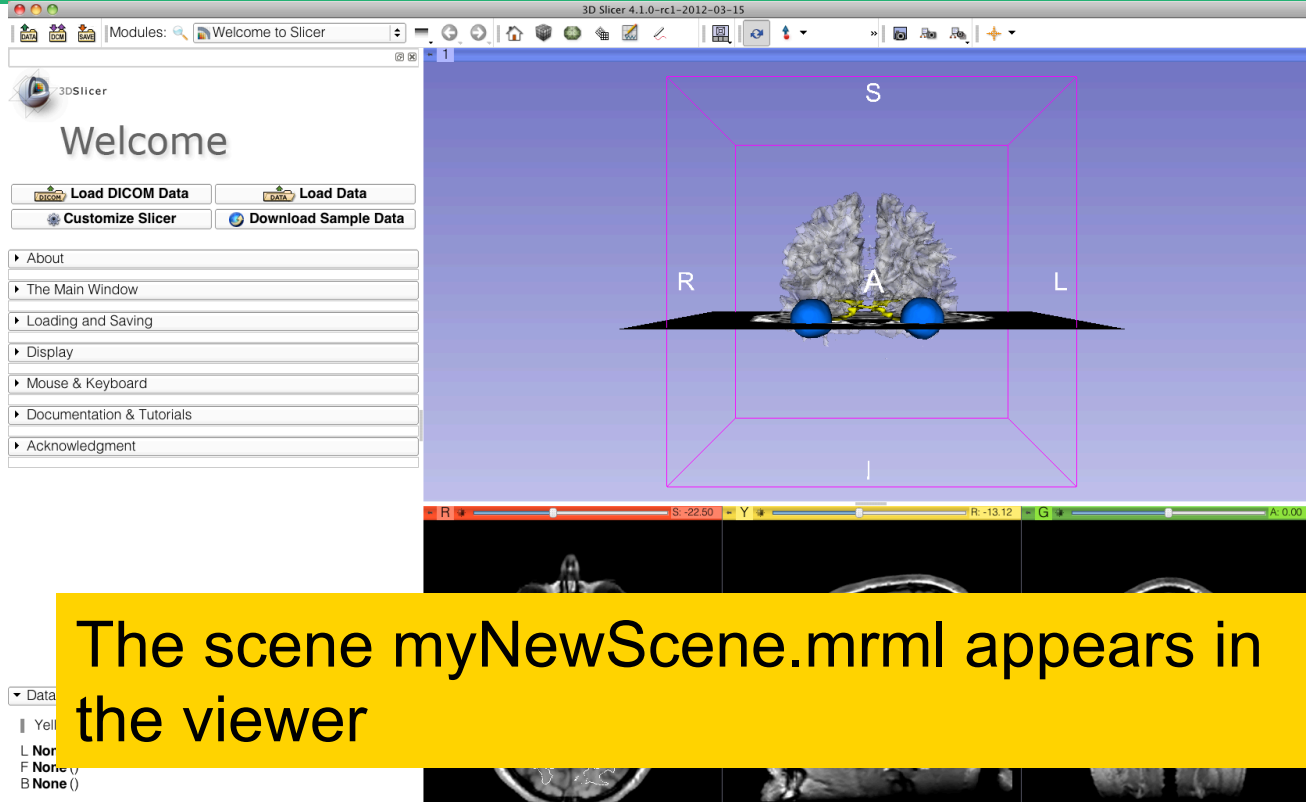
Scene Restore



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

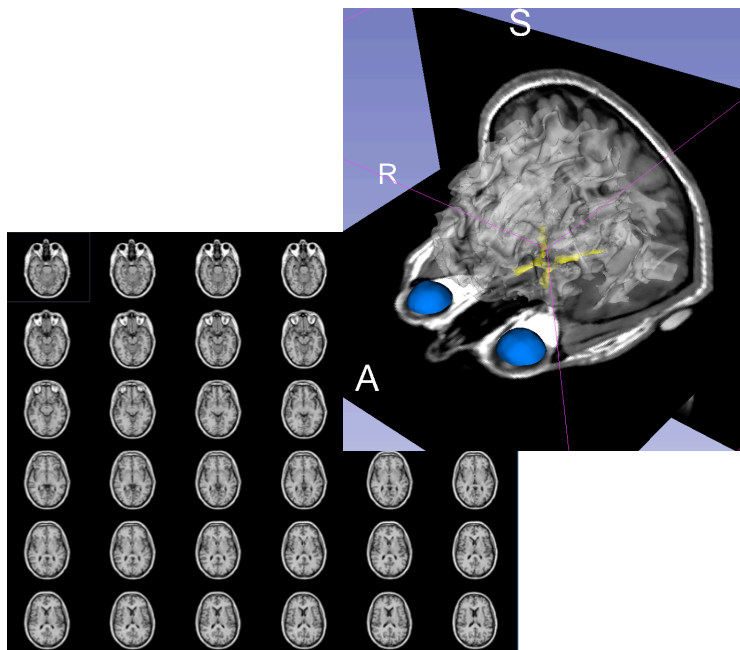


Scene Restore





Conclusion



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

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Slicer Community

- www.slicer.org

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