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

a teaching affiliate of
Harvard Medical School

Data Loading and 3D Visualization

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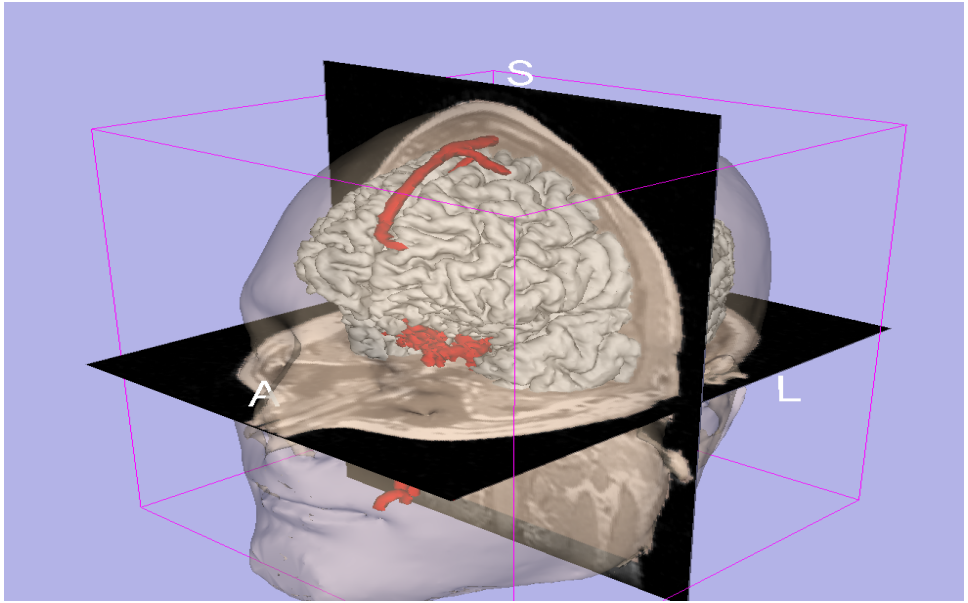
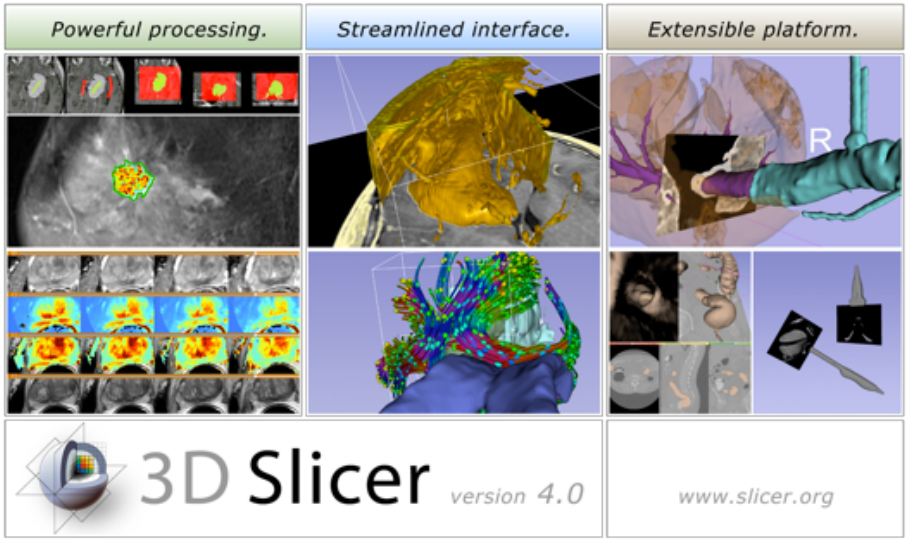
3D Visualization of the Anatomy

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

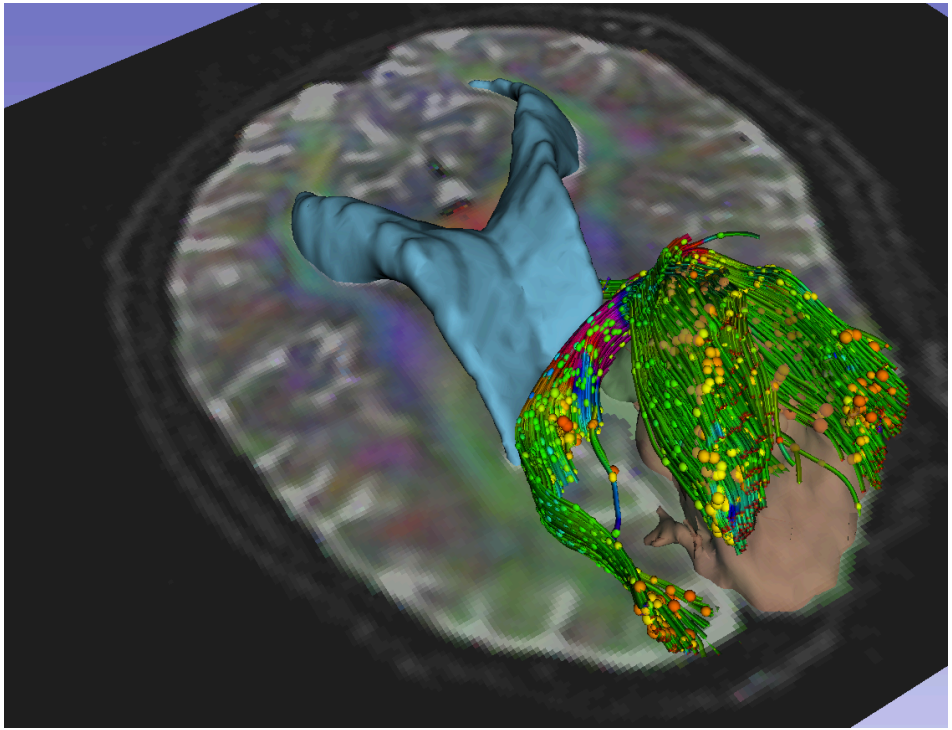


Slicer is a freely available open-source platform for segmentation, registration and 3D visualization of medical imaging data.

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



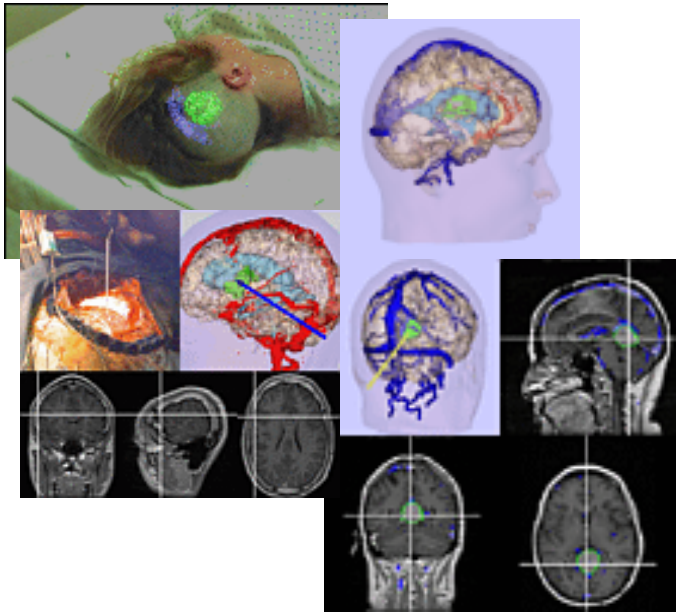
www.slicer.org

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.**

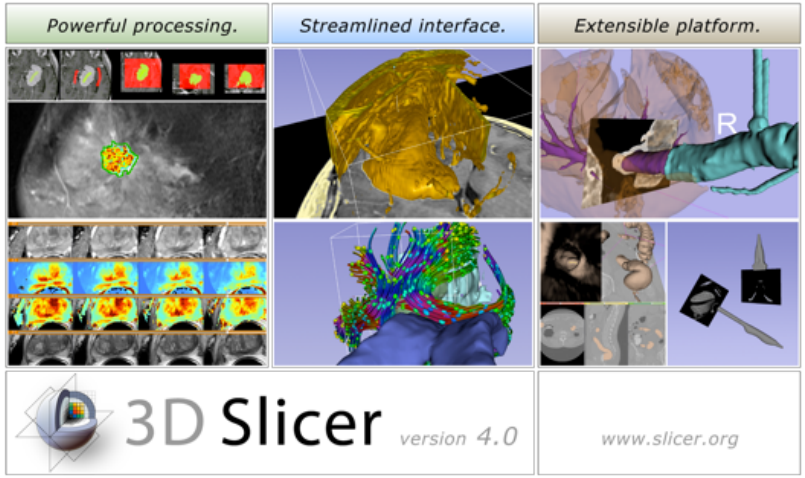
3DSlicer History



- 1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)

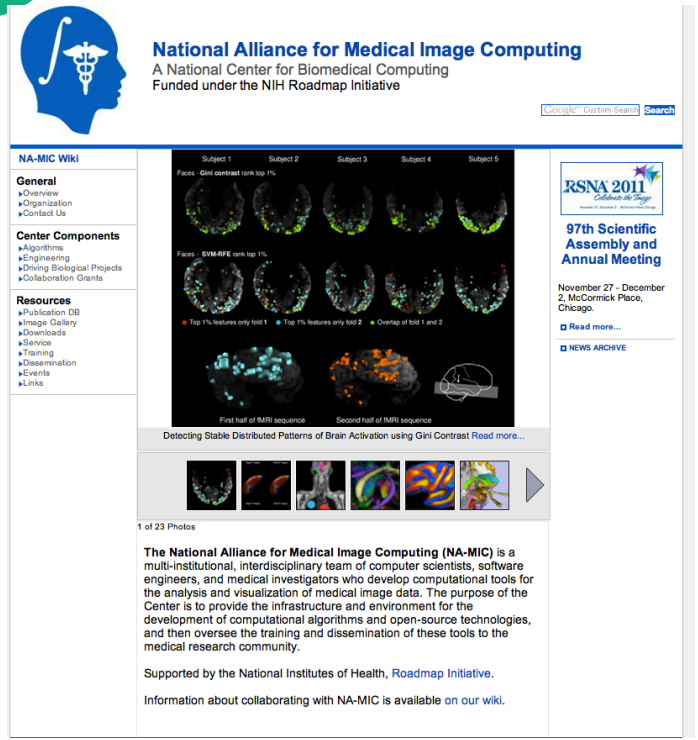
Image Courtesy of the CSAIL, MIT

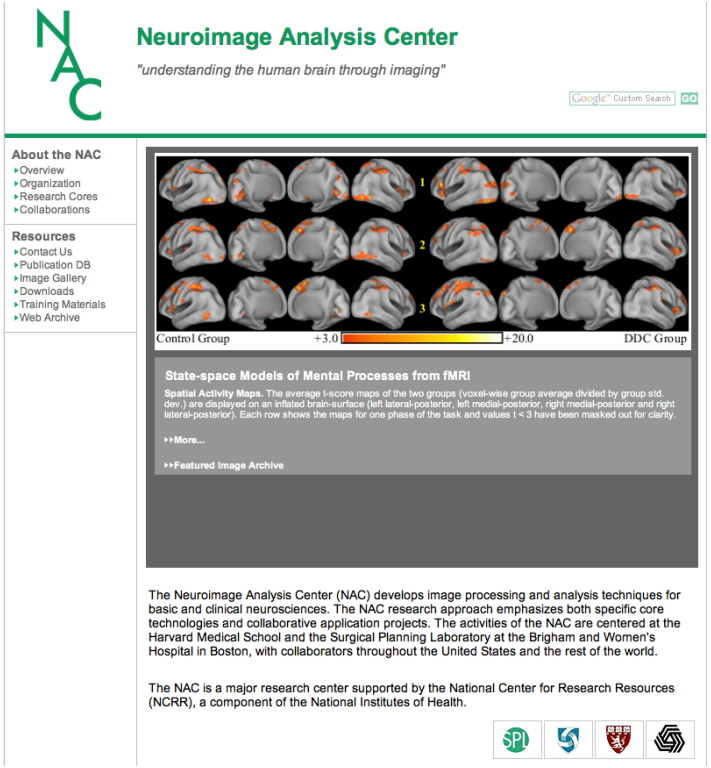
3DSlicer History



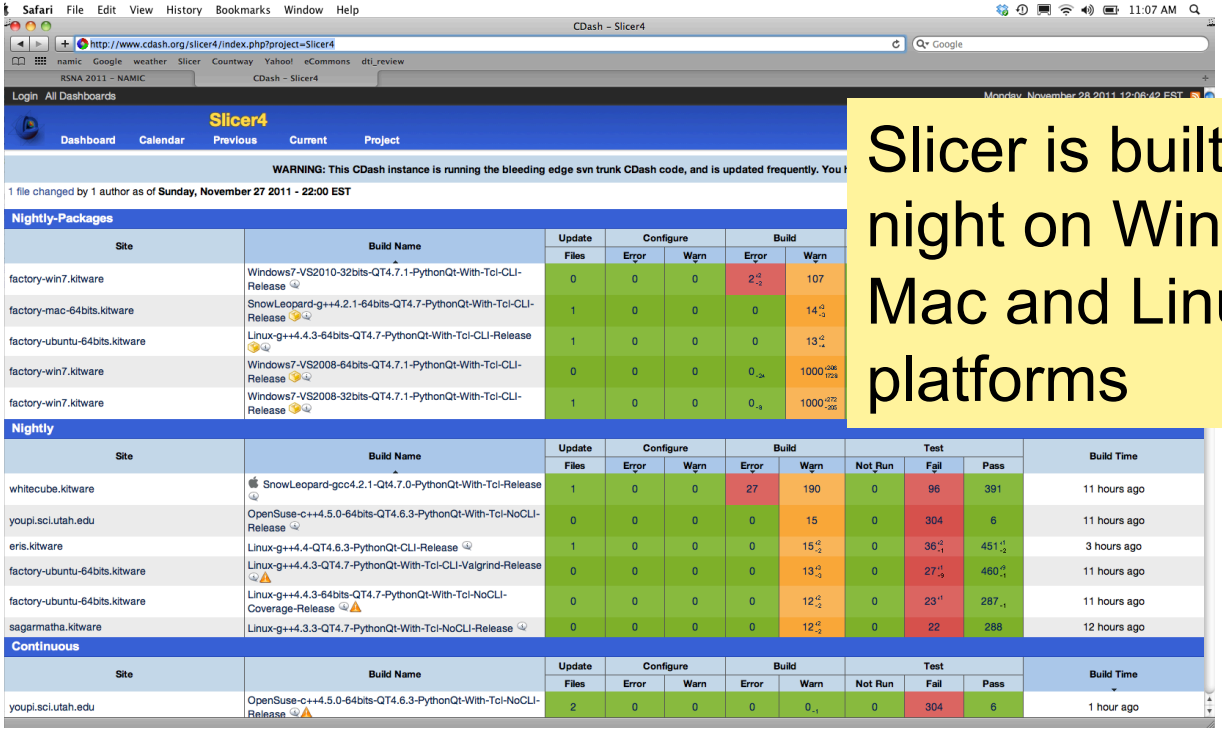
- 1997: Slicer started as a research project between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)
- 2012: Multi-institution effort to share the latest advances in image analysis with clinicians and scientists

NA-MIC and NAC



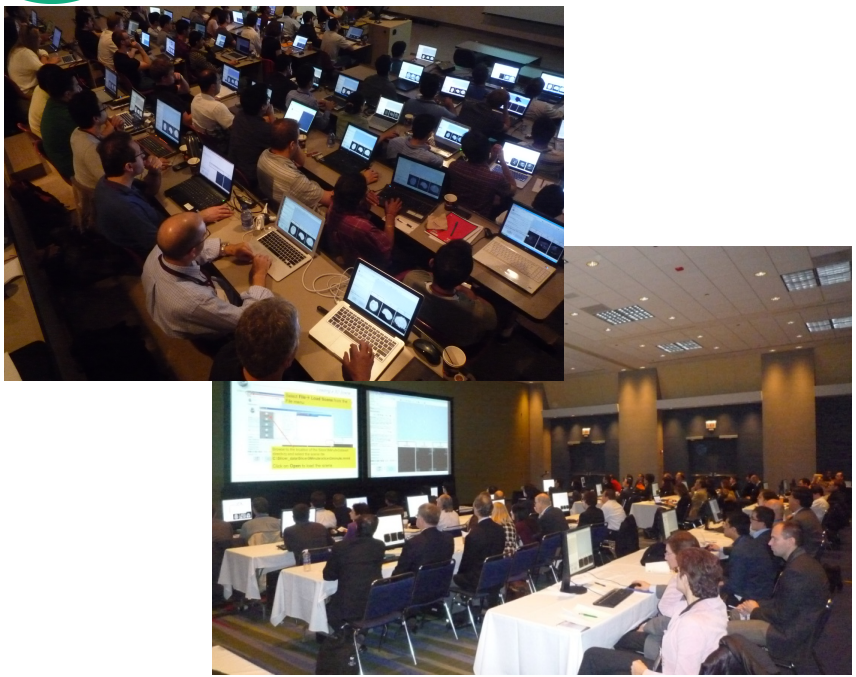


Slicer: Behind the scenes



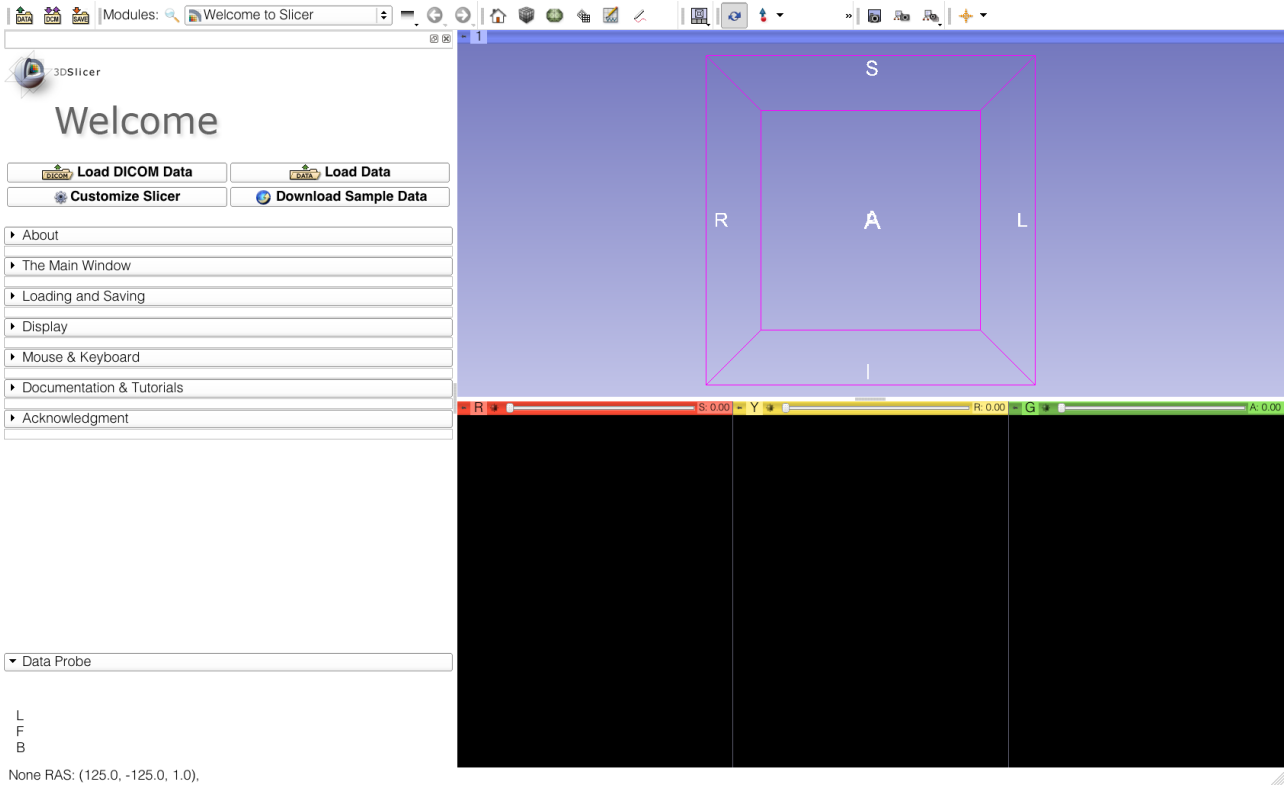
Slicer is built every night on Windows, Mac and Linux platforms

Slicer Training

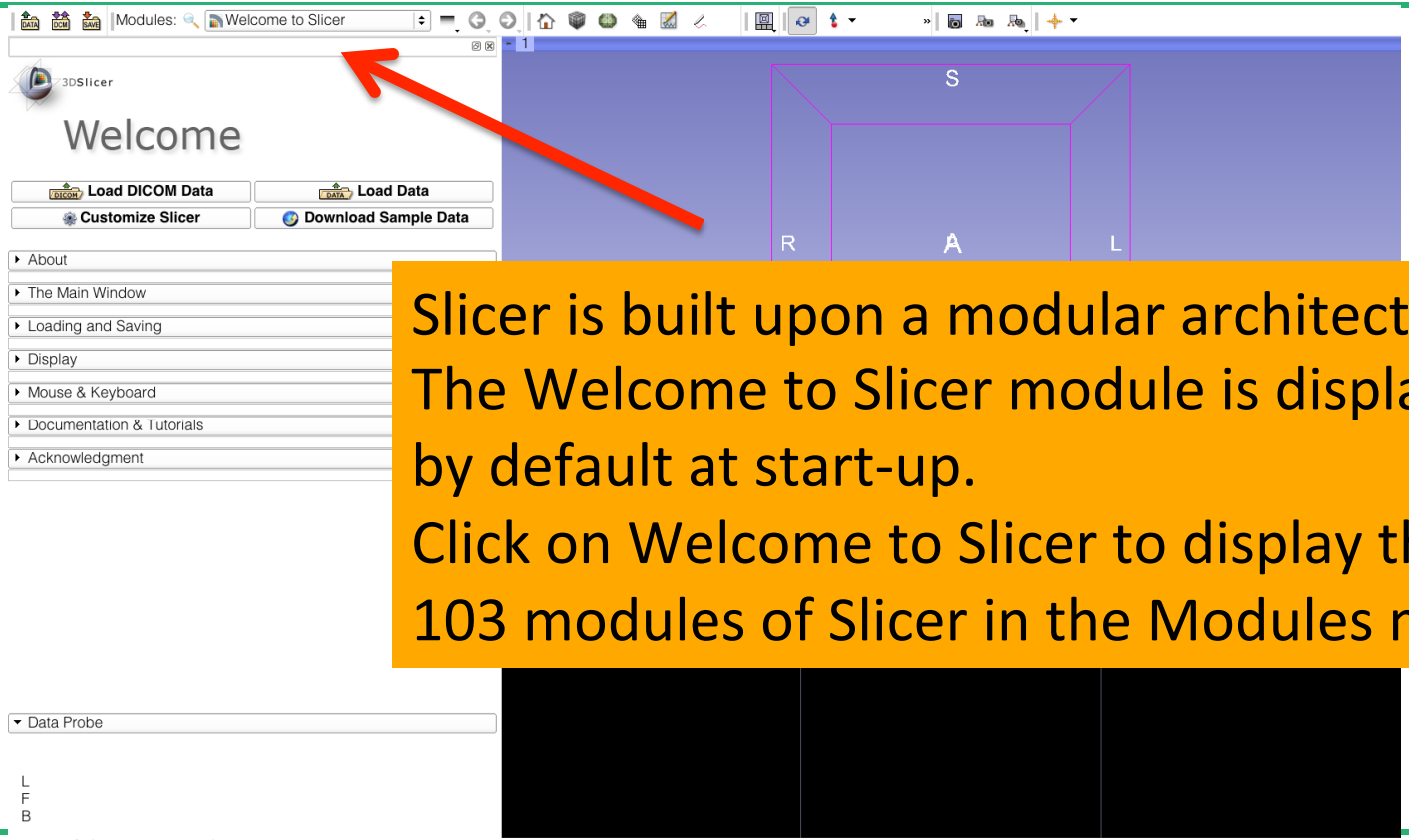


- Hands-on training workshops at national and international venues (MICCAI, SfN, OHBM, RNSA..)
- >2,000 clinicians, clinical researchers and scientists trained since 2005

3DSlicer version 4.1

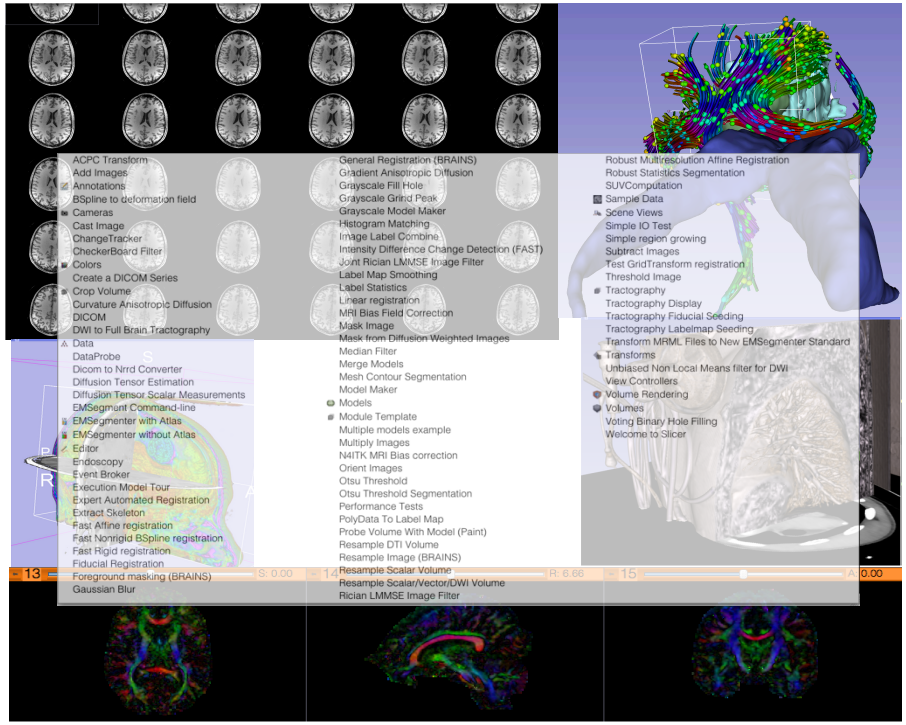


Welcome to Slicer4



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’)

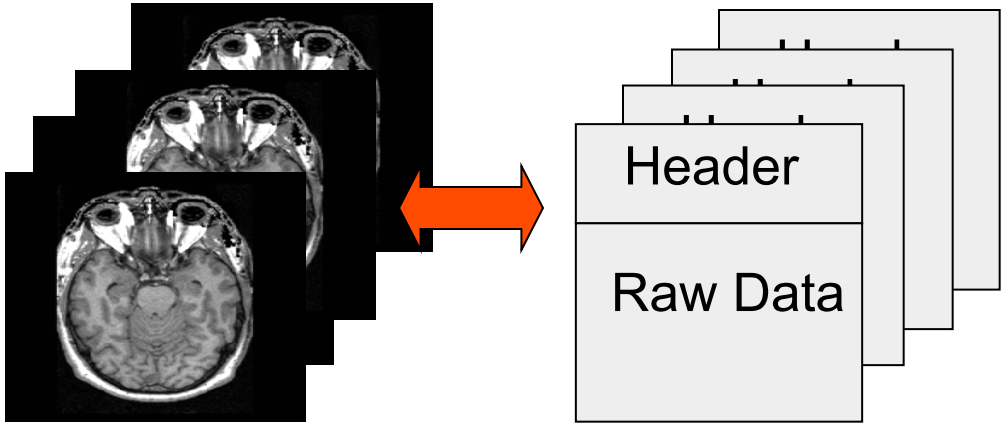


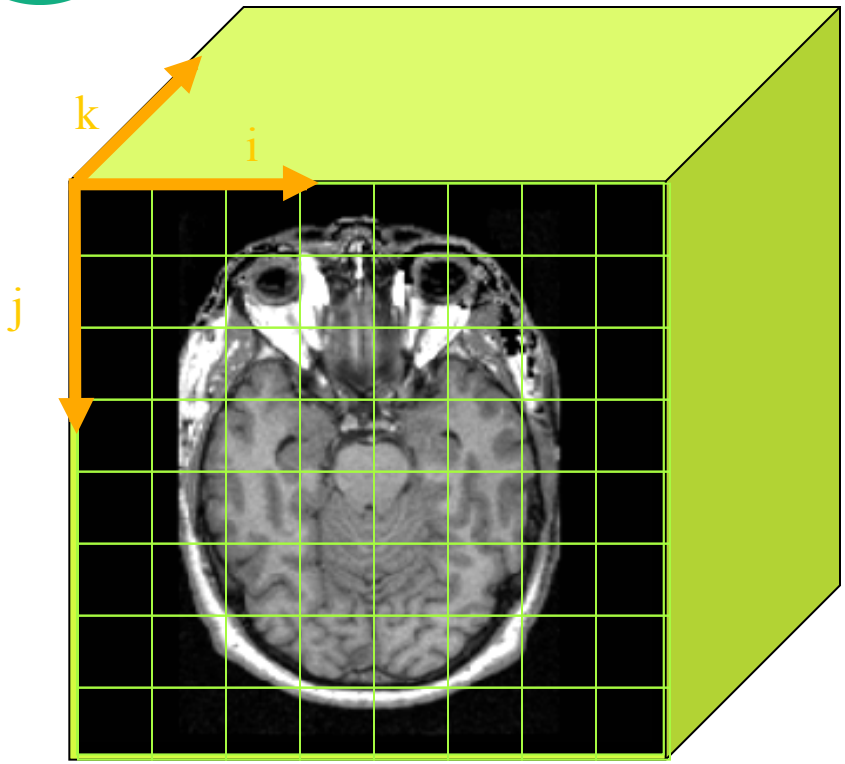
Image001.dcm

Image002.dcm

Image003.dcm

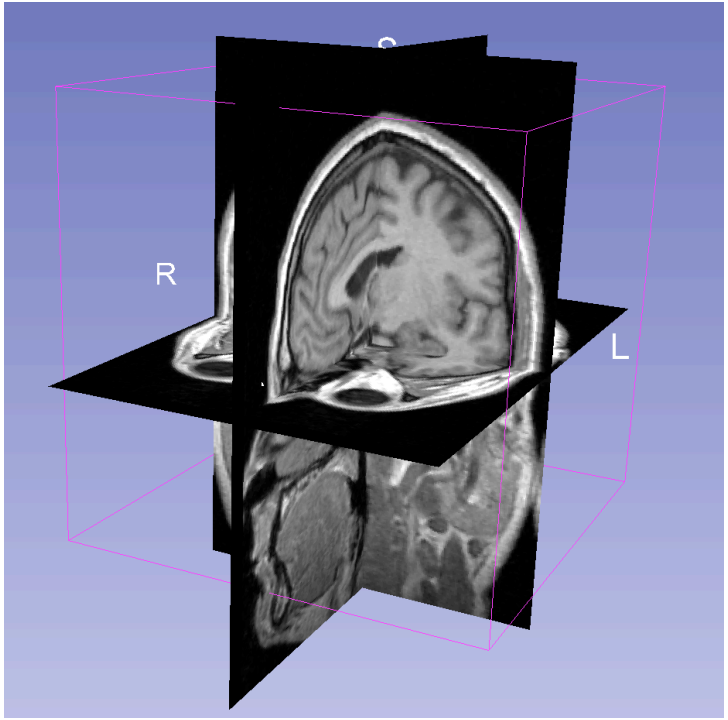
….

Data Representation



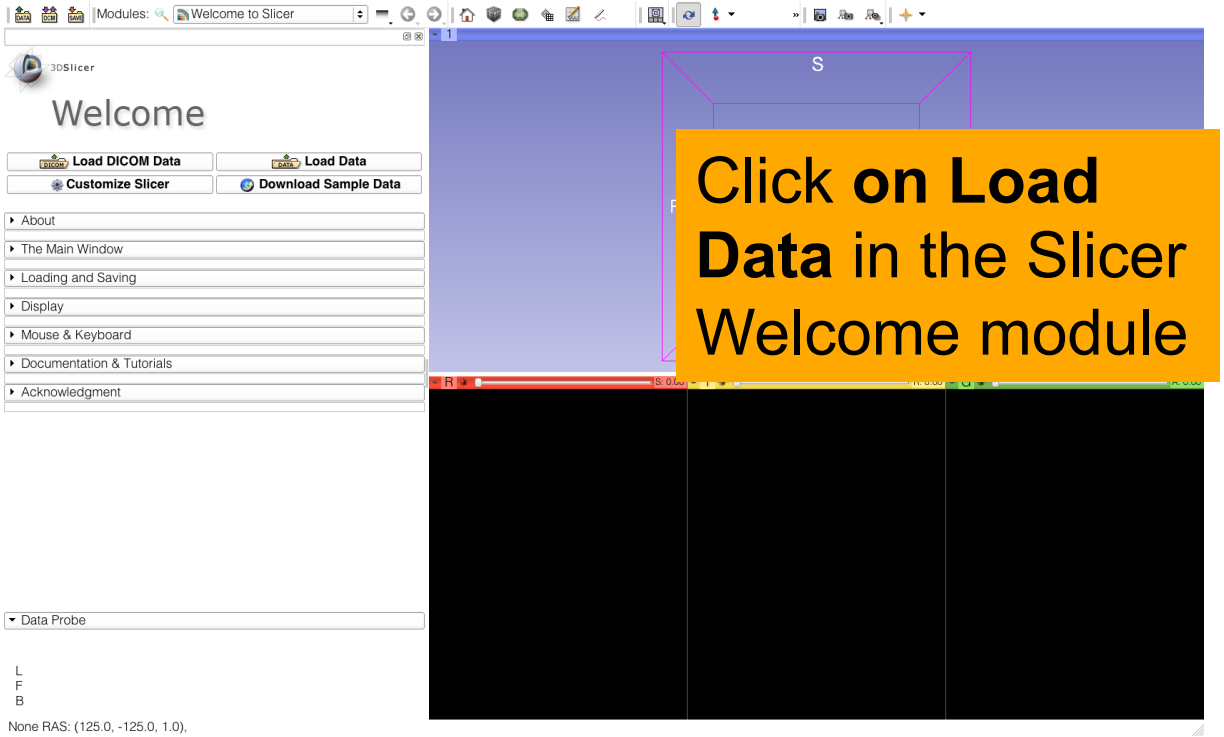
- The result of a volumetric acquisition is a 3D volume of data related to the patient.
- The 3D raster dataset is sampled on a discrete grid with elements called voxels which contain the signal intensity.

Tutorial Dataset

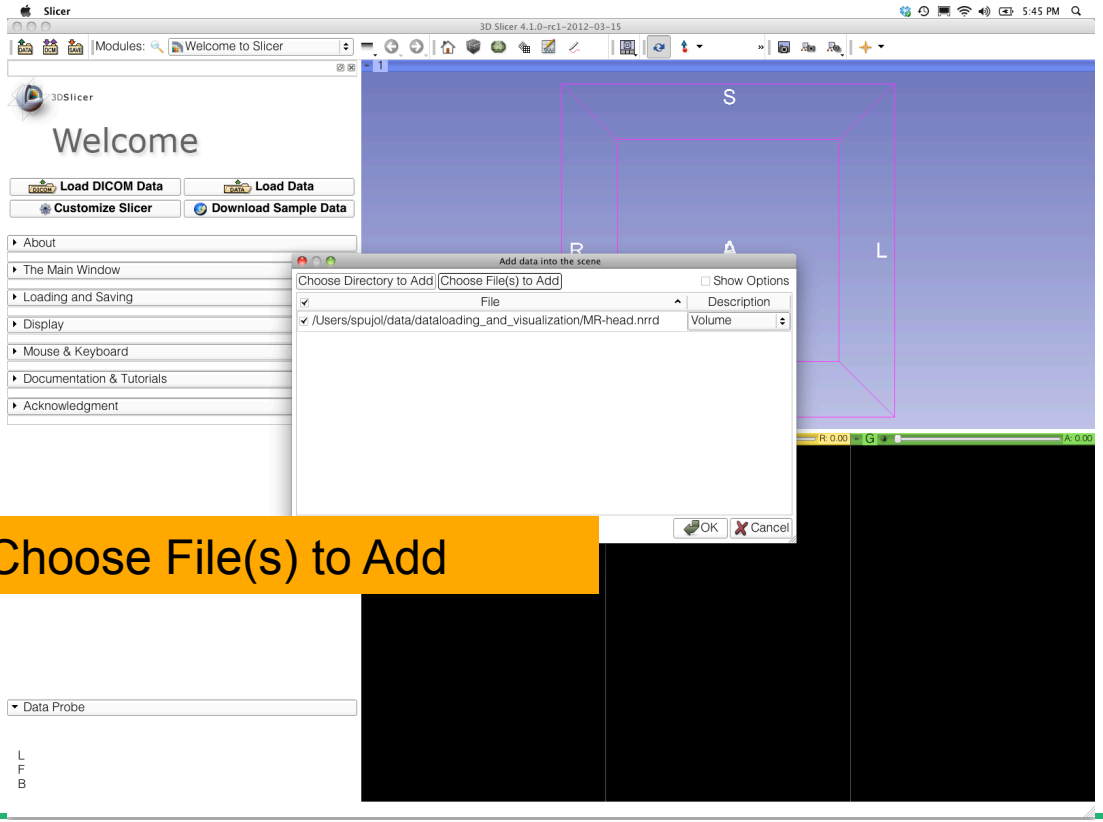


- The tutorial dataset is an MR scan of the brain of a healthy subject.
- The data in the **Nrrd** file format, part of the NA-MIC open-source toolkit
- DICOM data can be converted in Nrrd using the module '**DICOM to NRRD Converter'** in Slicer.

Slicer4

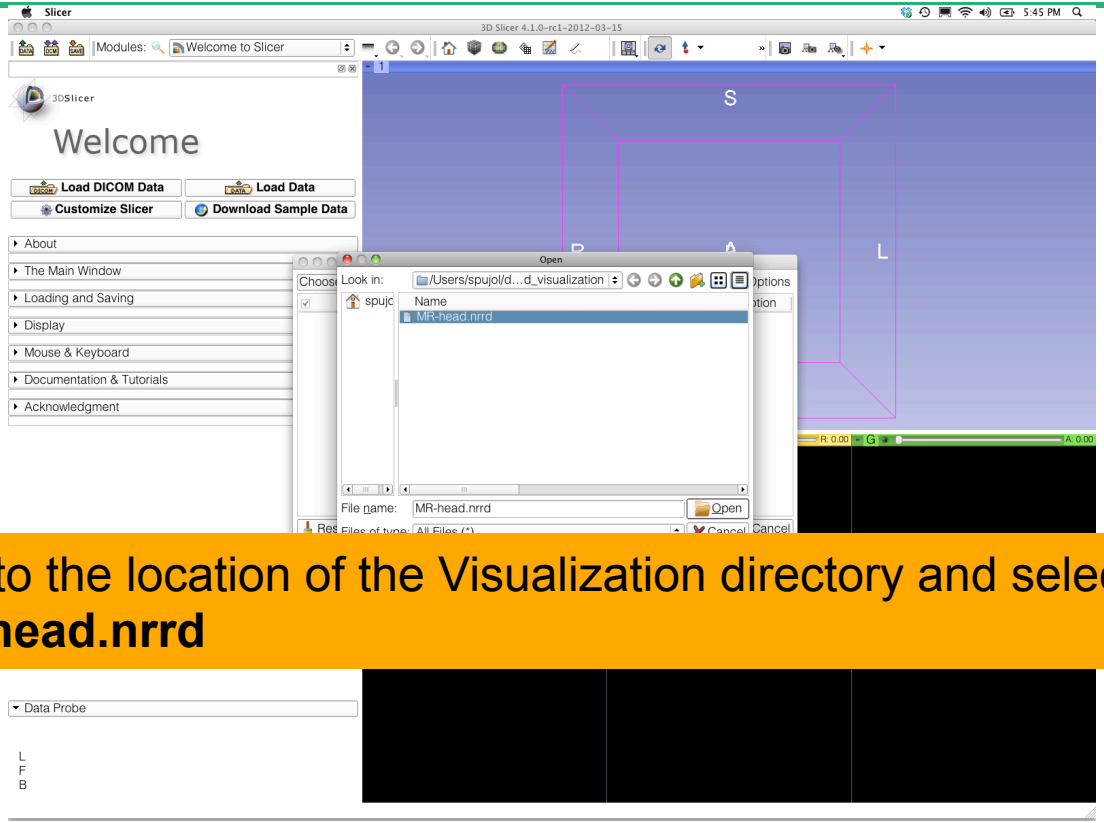


Loading a volume



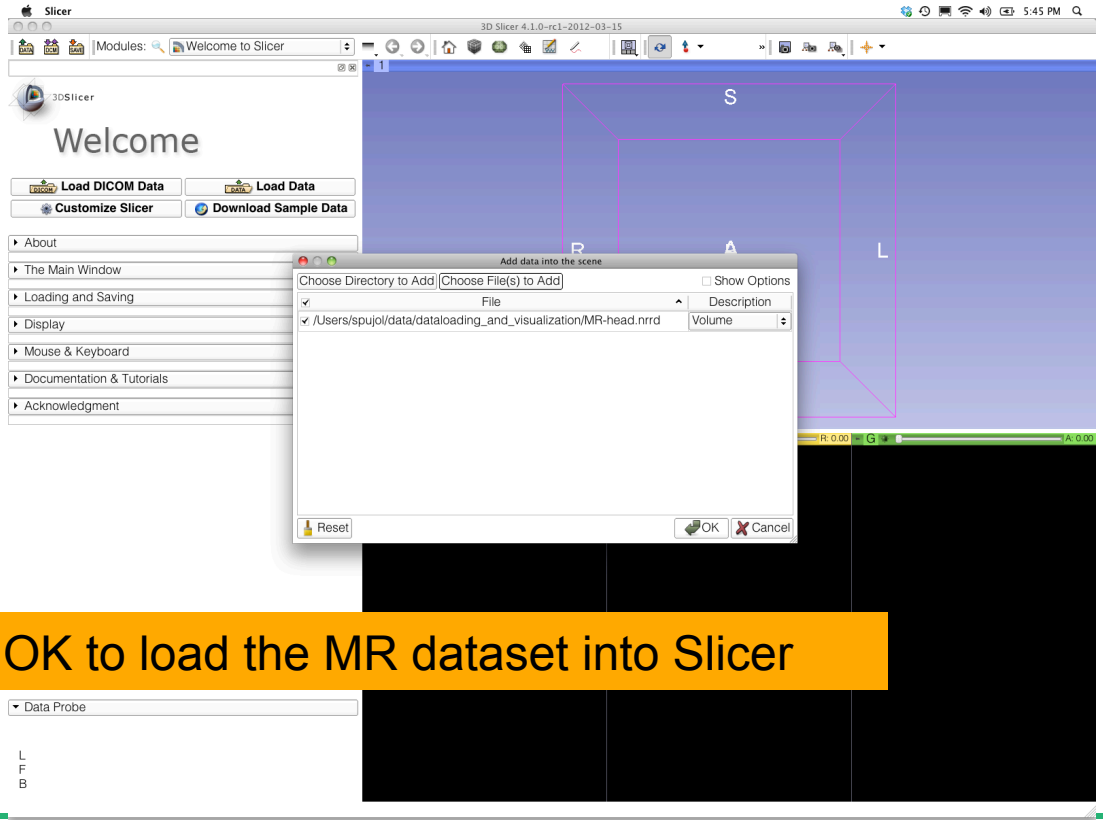
Click on Choose File(s) to Add

Loading a volume



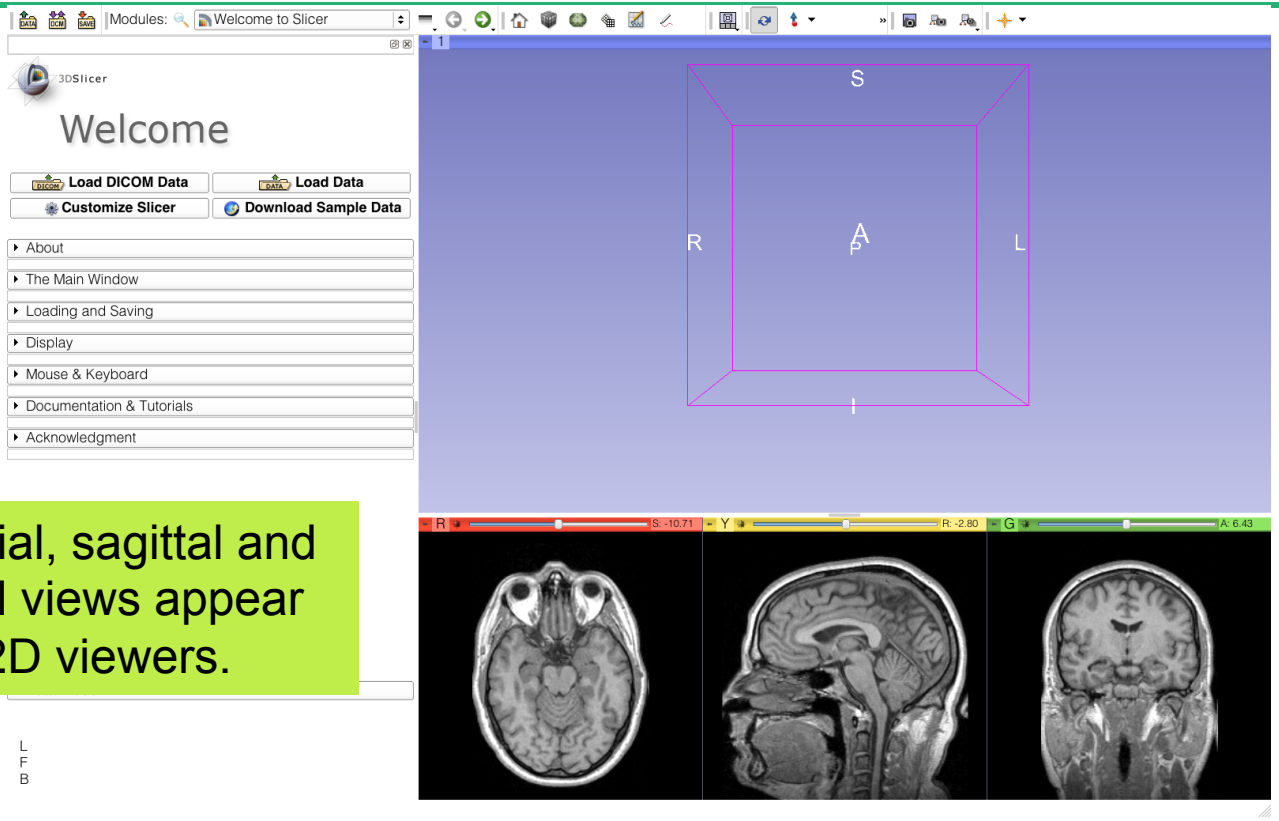
Browse to the location of the Visualization directory and select the file **MR-head.nrrd**

Loading a volume



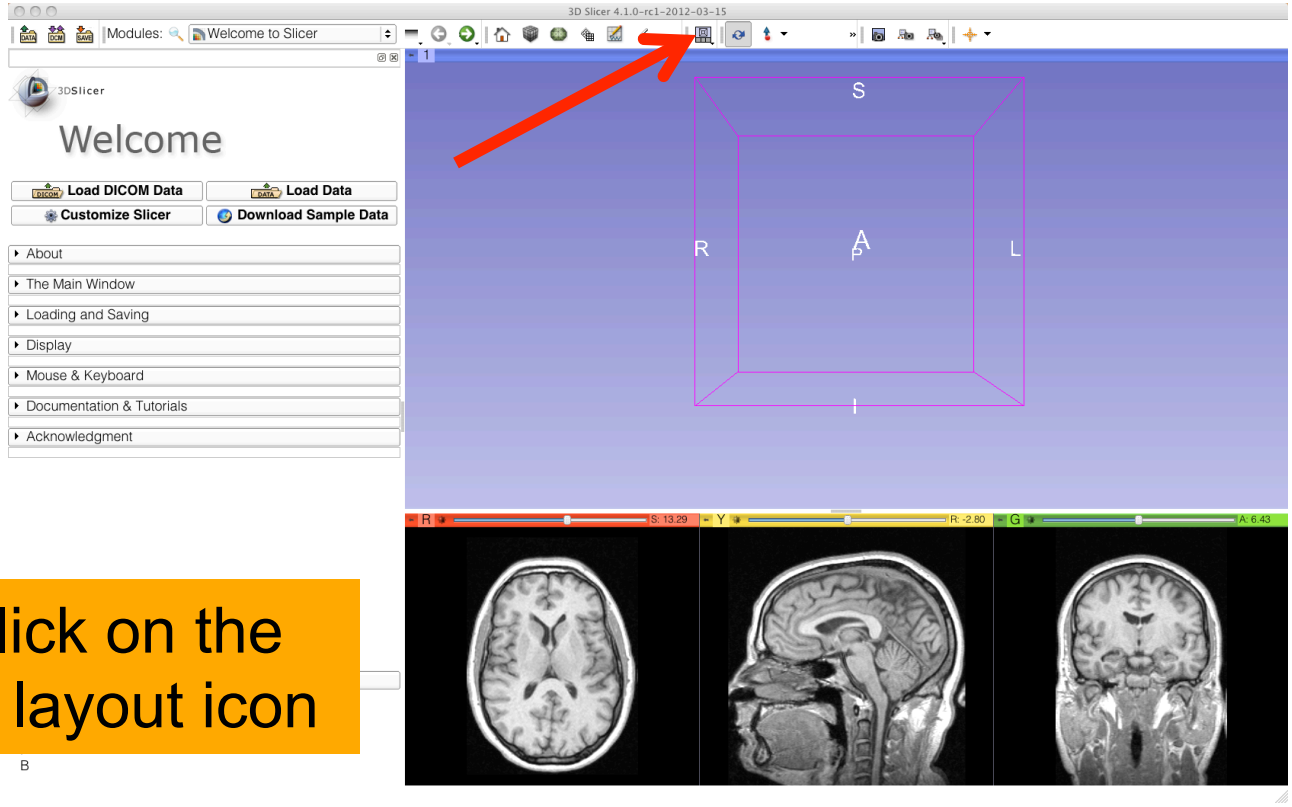
Click on OK to load the MR dataset into Slicer

Loading a volume



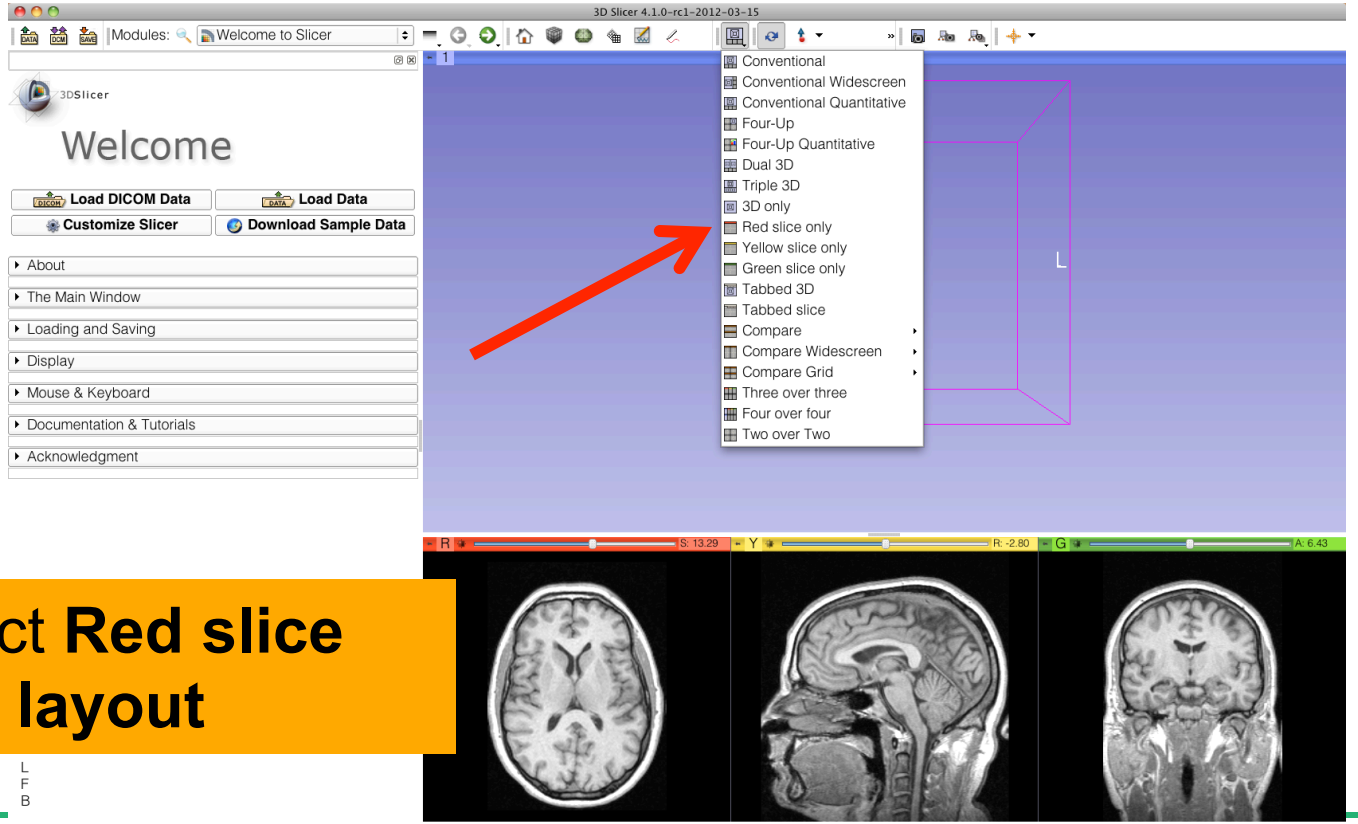
The axial, sagittal and coronal views appear in the 2D viewers.

Loading a volume



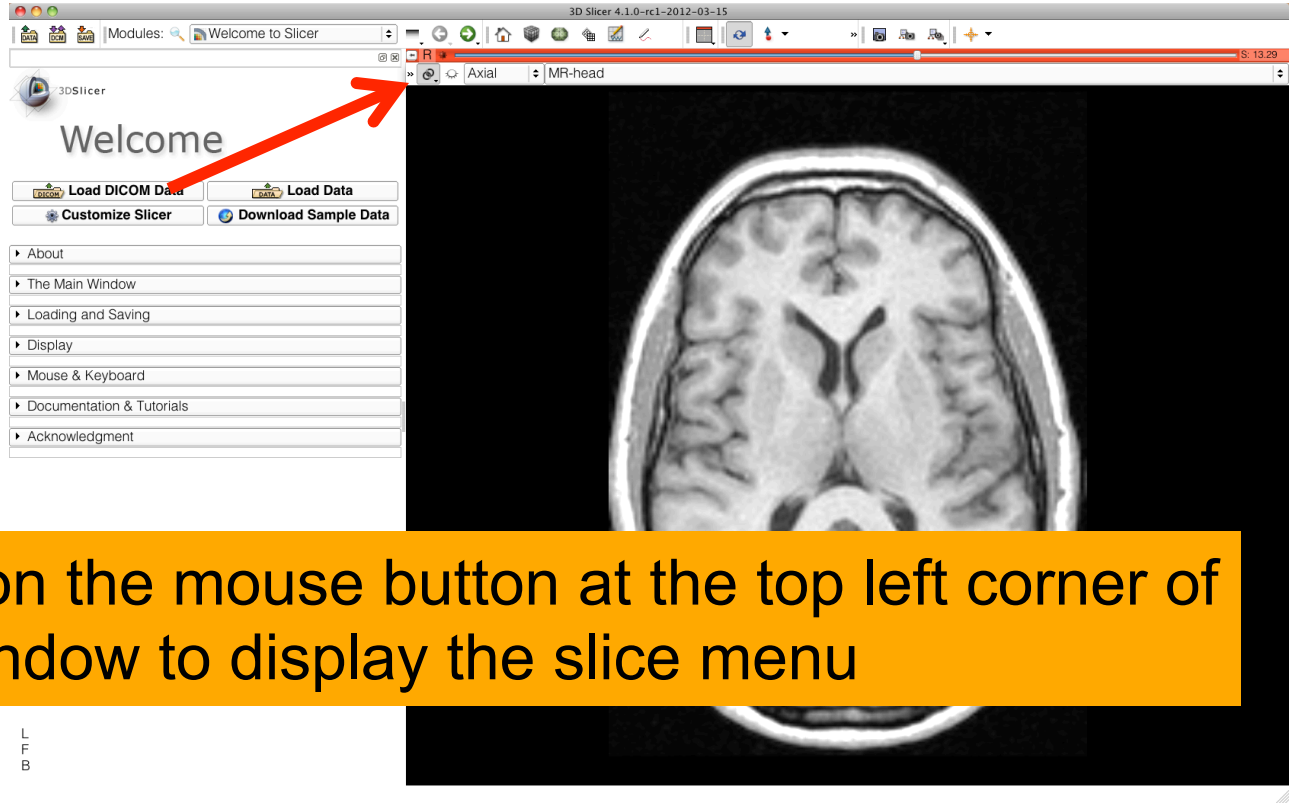
Left-click on the Slicer layout icon

Loading a volume



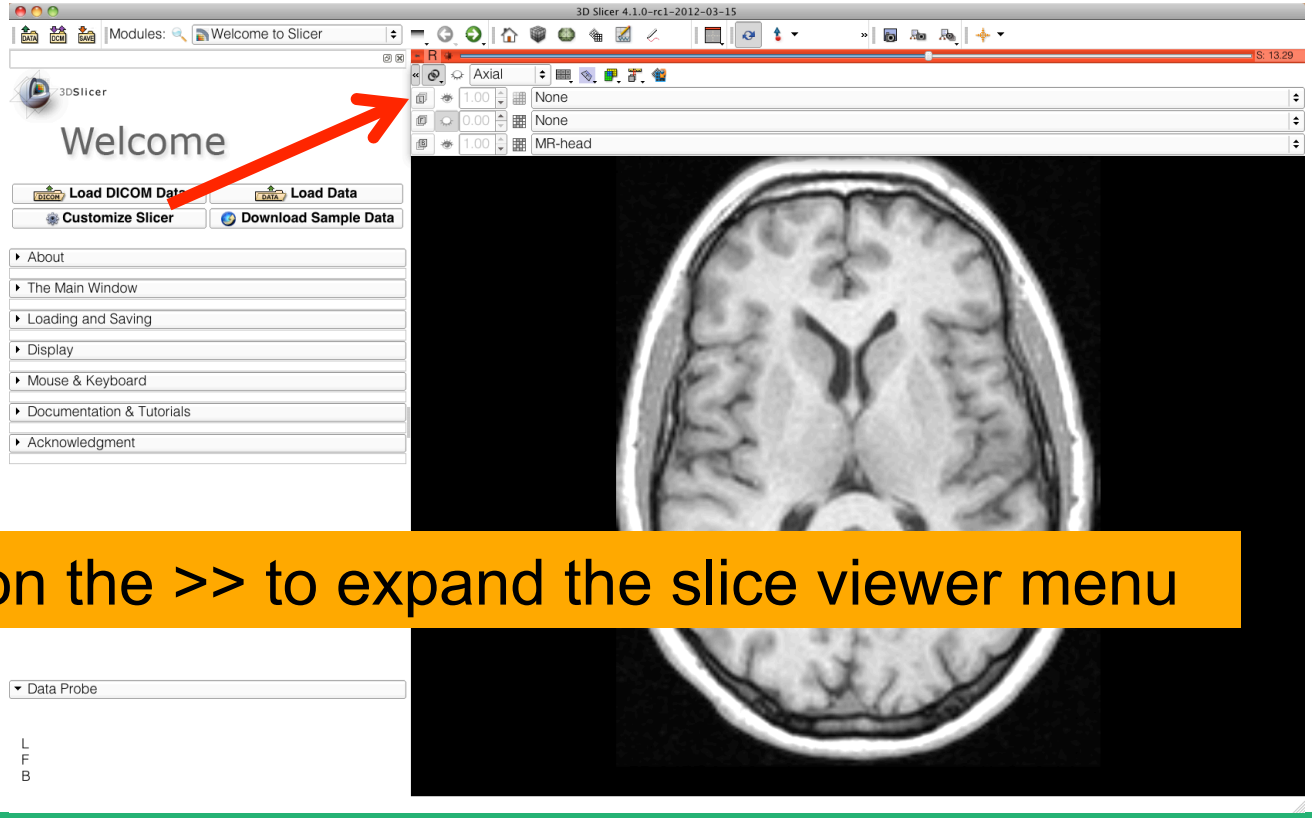
Select **Red slice only layout**

Loading a volume



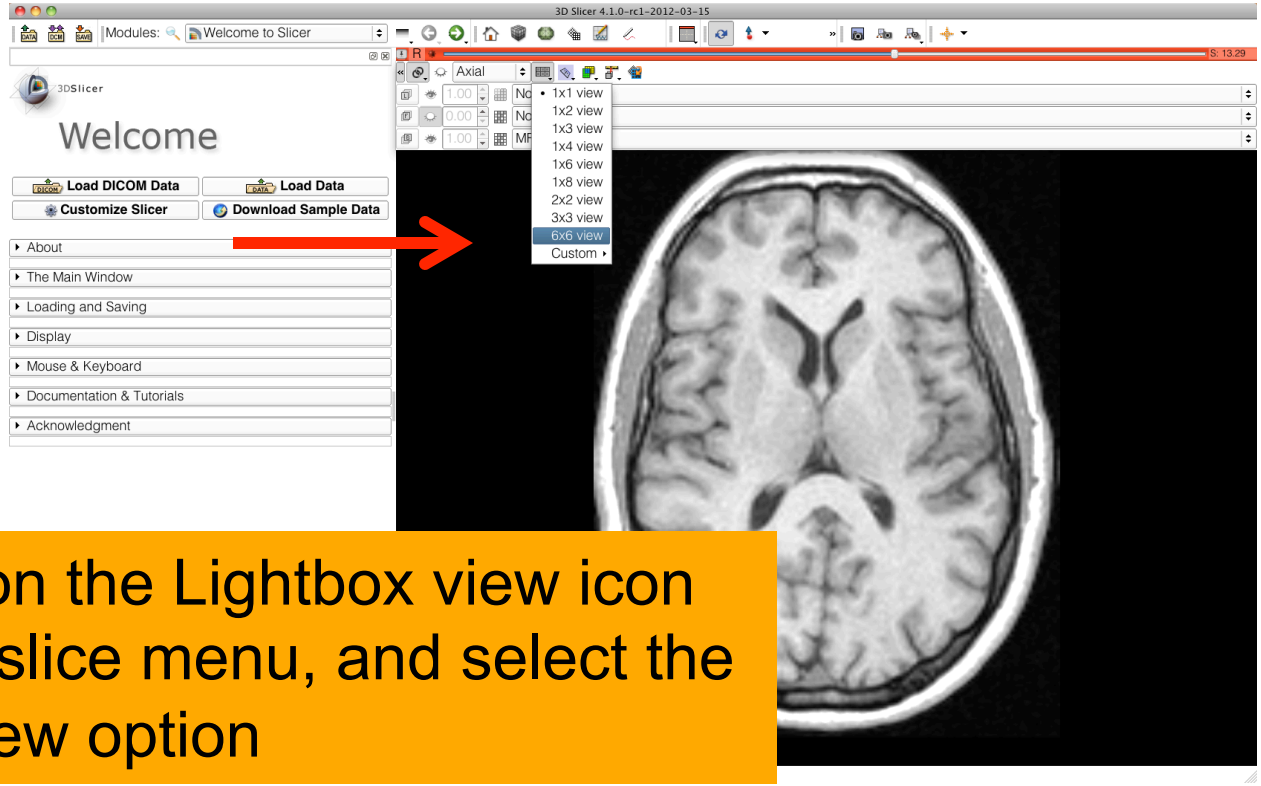
Position the mouse button at the top left corner of the window to display the slice menu

Loading a volume



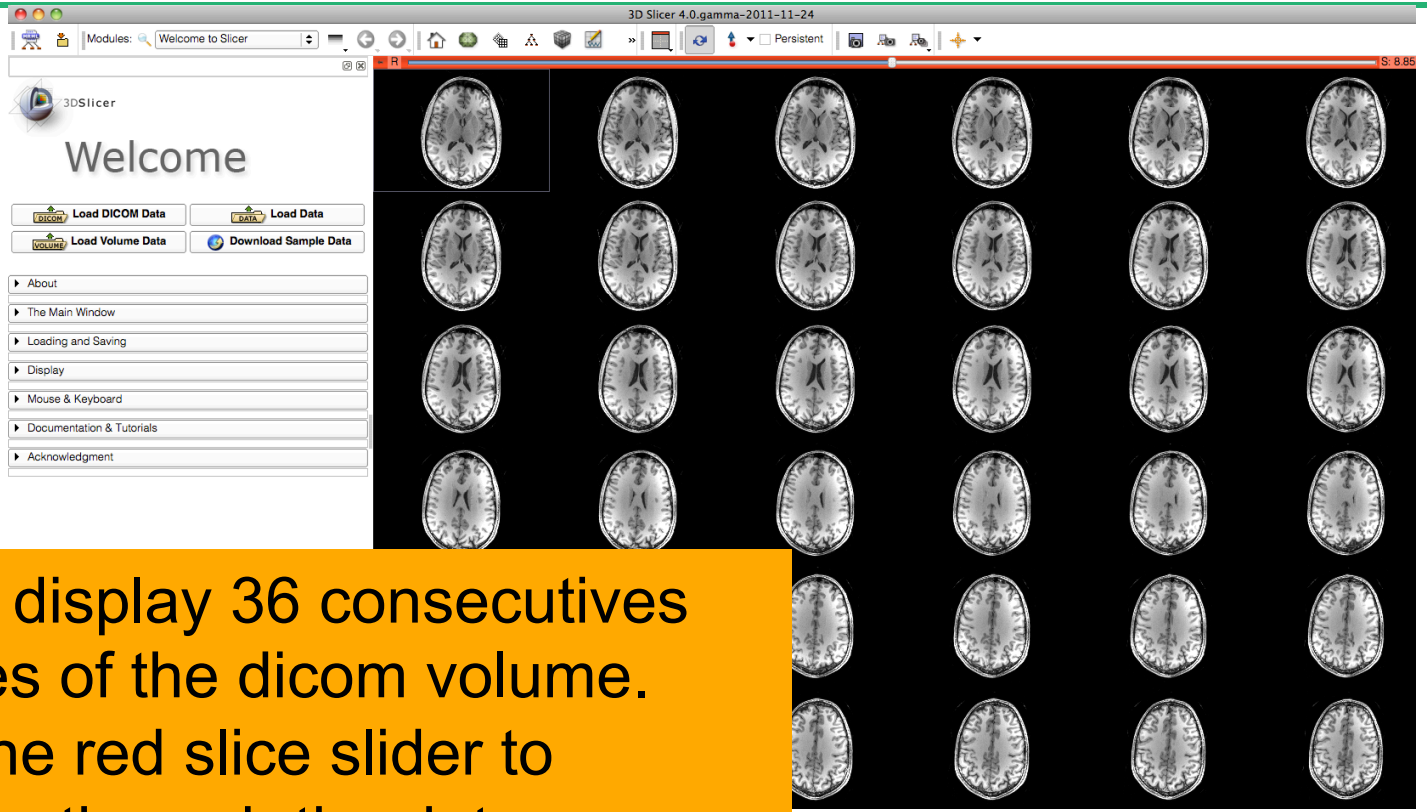
Click on the >> to expand the slice viewer menu

Loading a volume



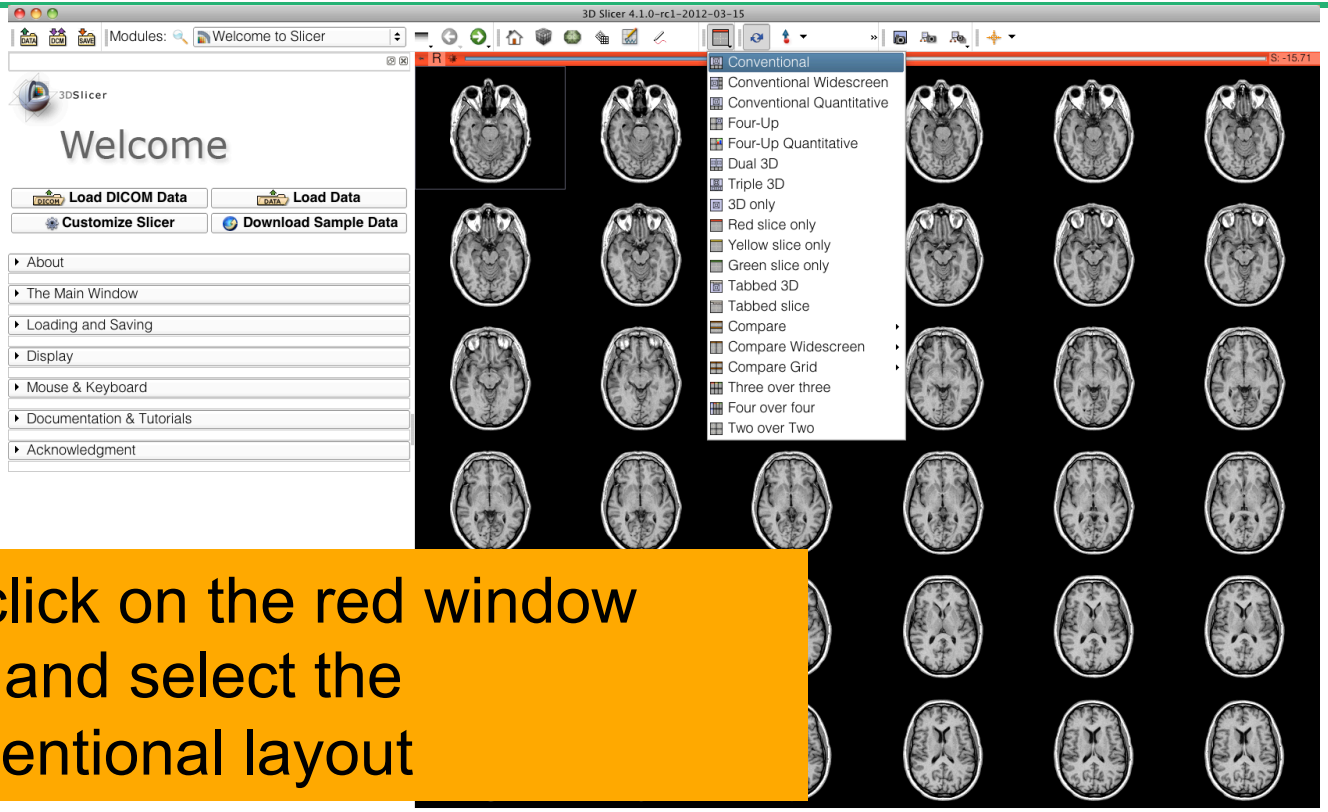
Click on the Lightbox view icon in the slice menu, and select the 6x6 view option

Loading a volume



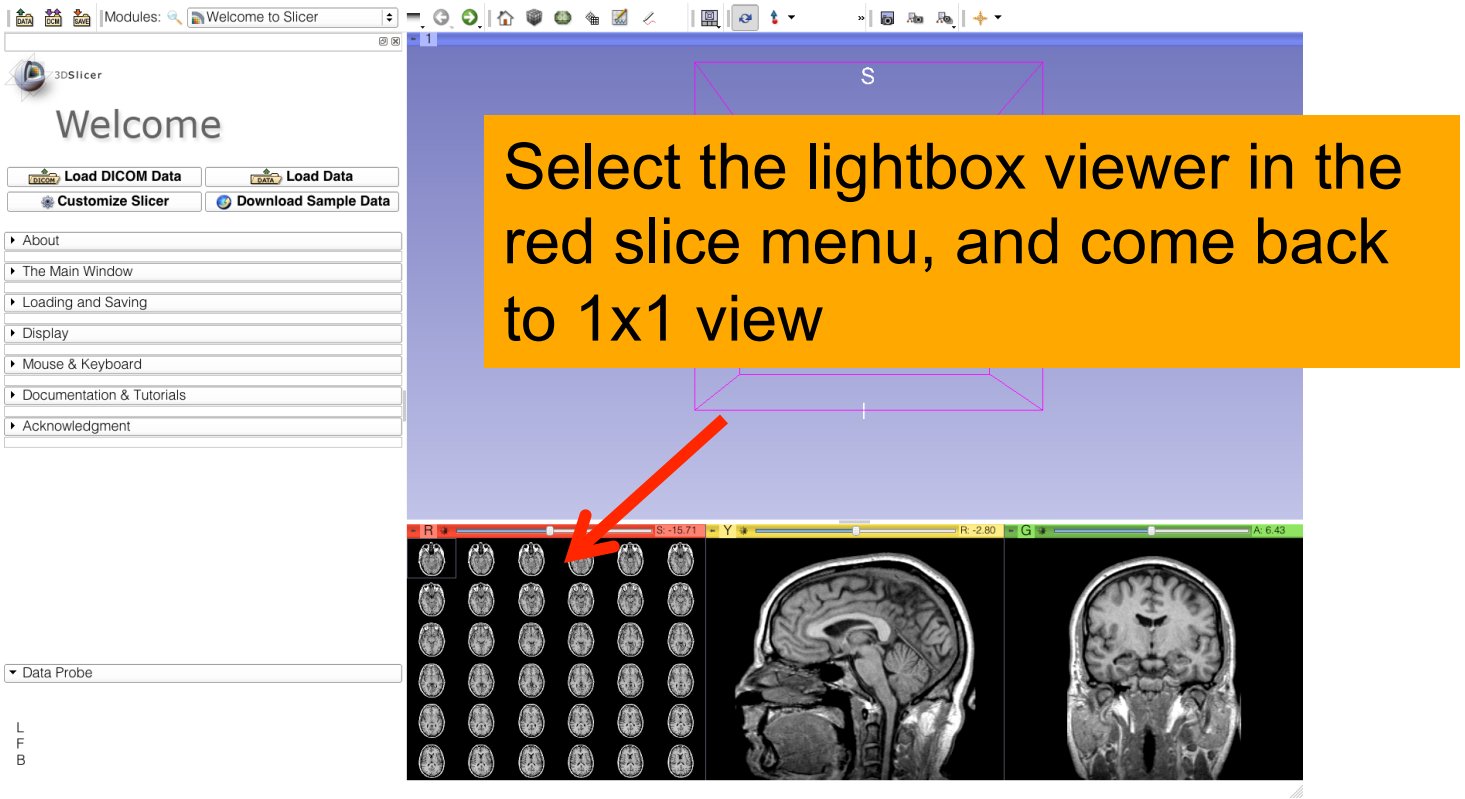
Slicer display 36 consecutives images of the dicom volume. Use the red slice slider to browse through the data

Loading a volume

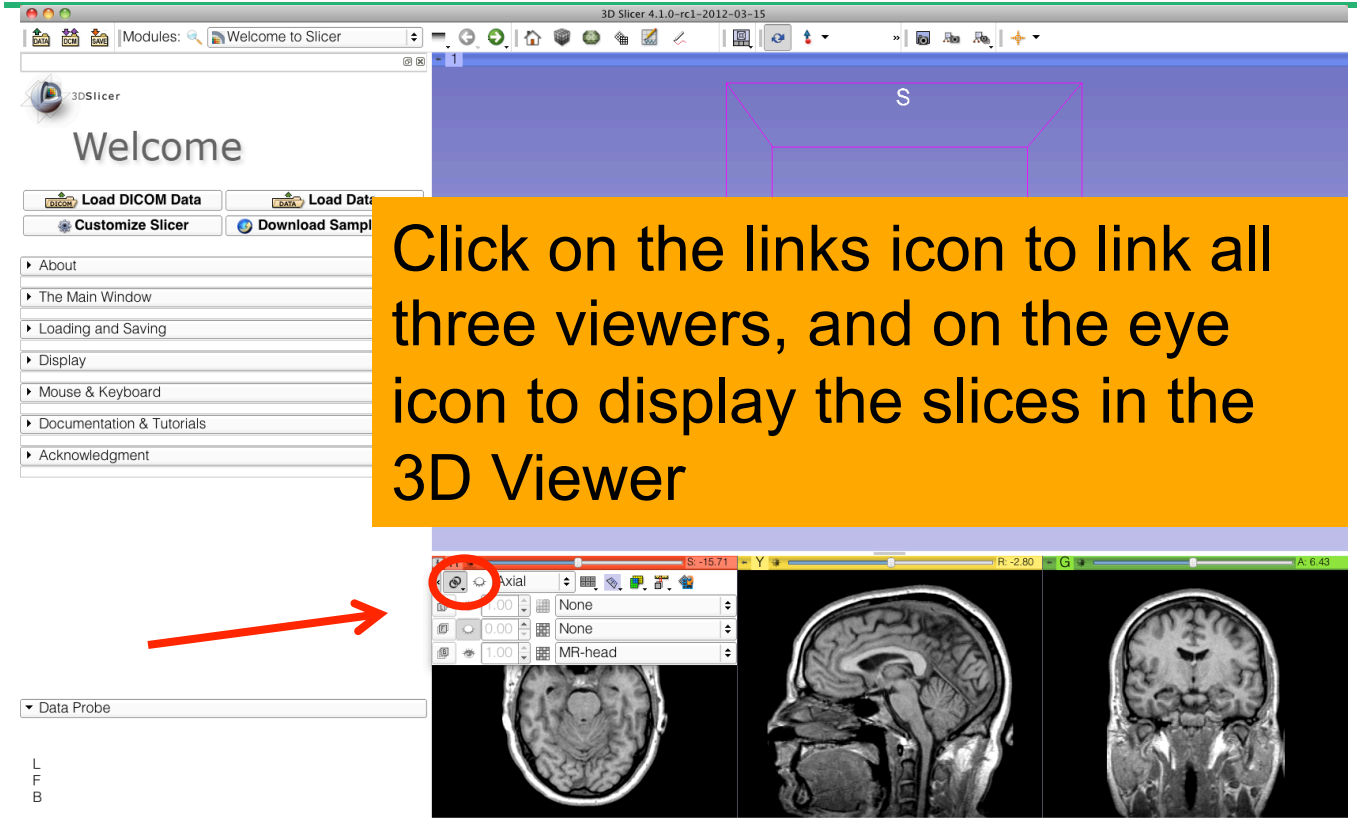


Left click on the red window icon, and select the Conventional layout

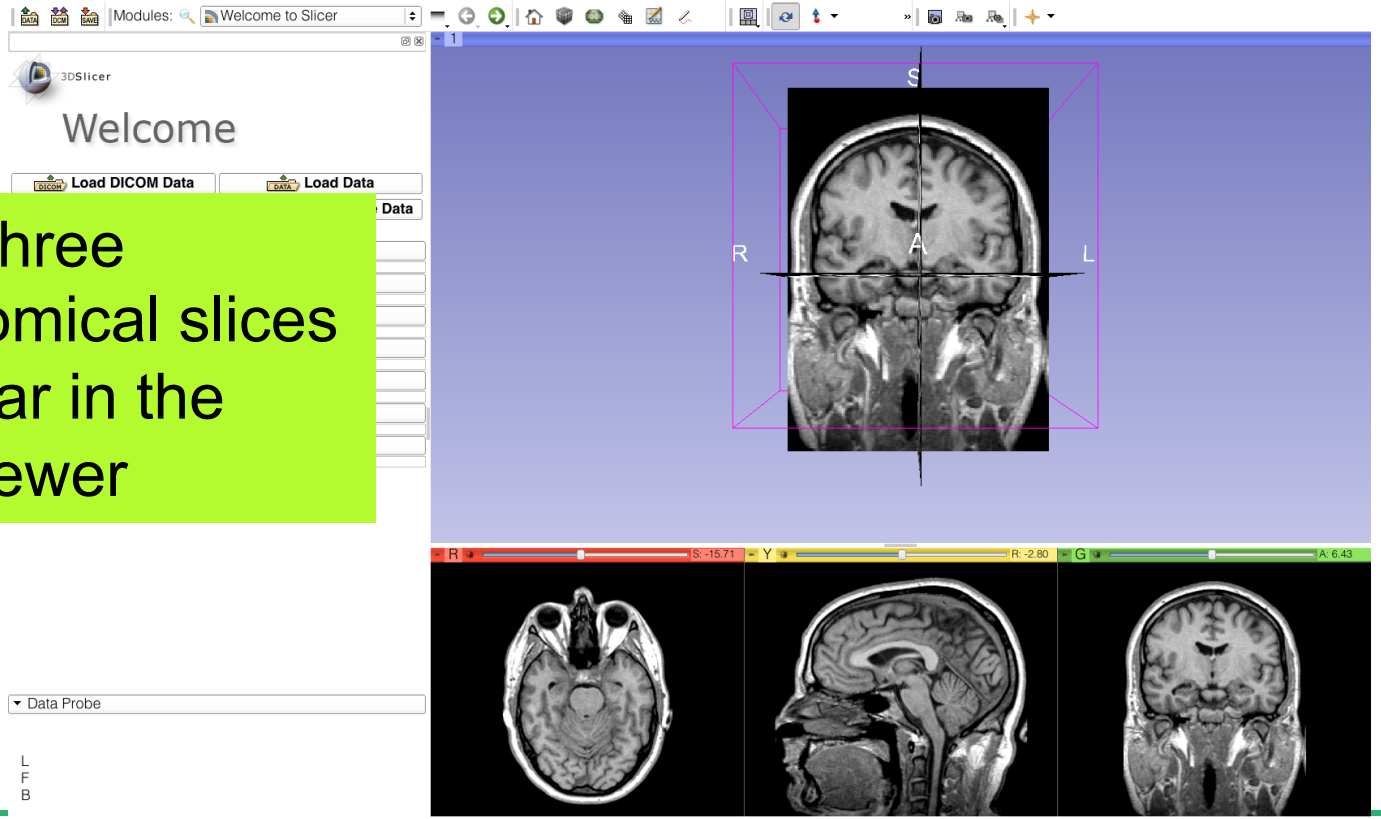
Loading a volume



Loading a volume

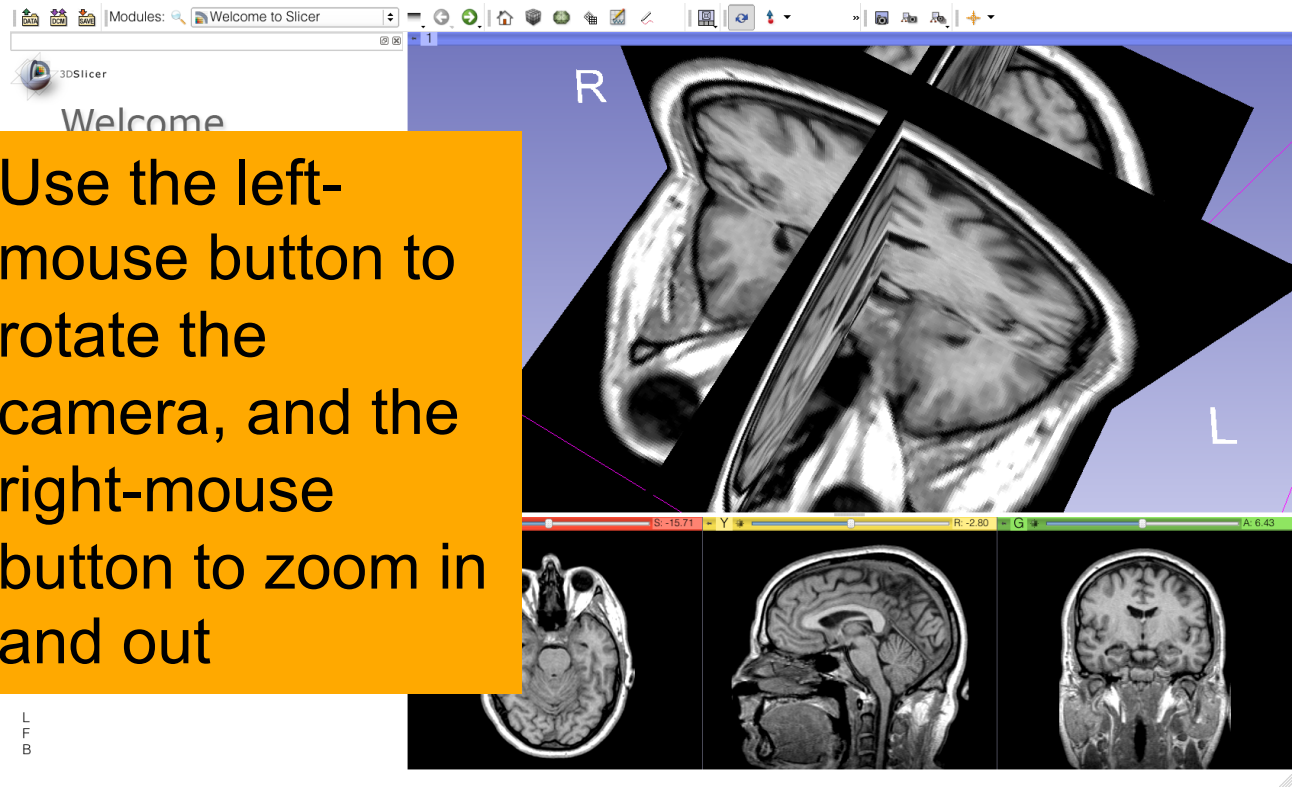


Loading a volume



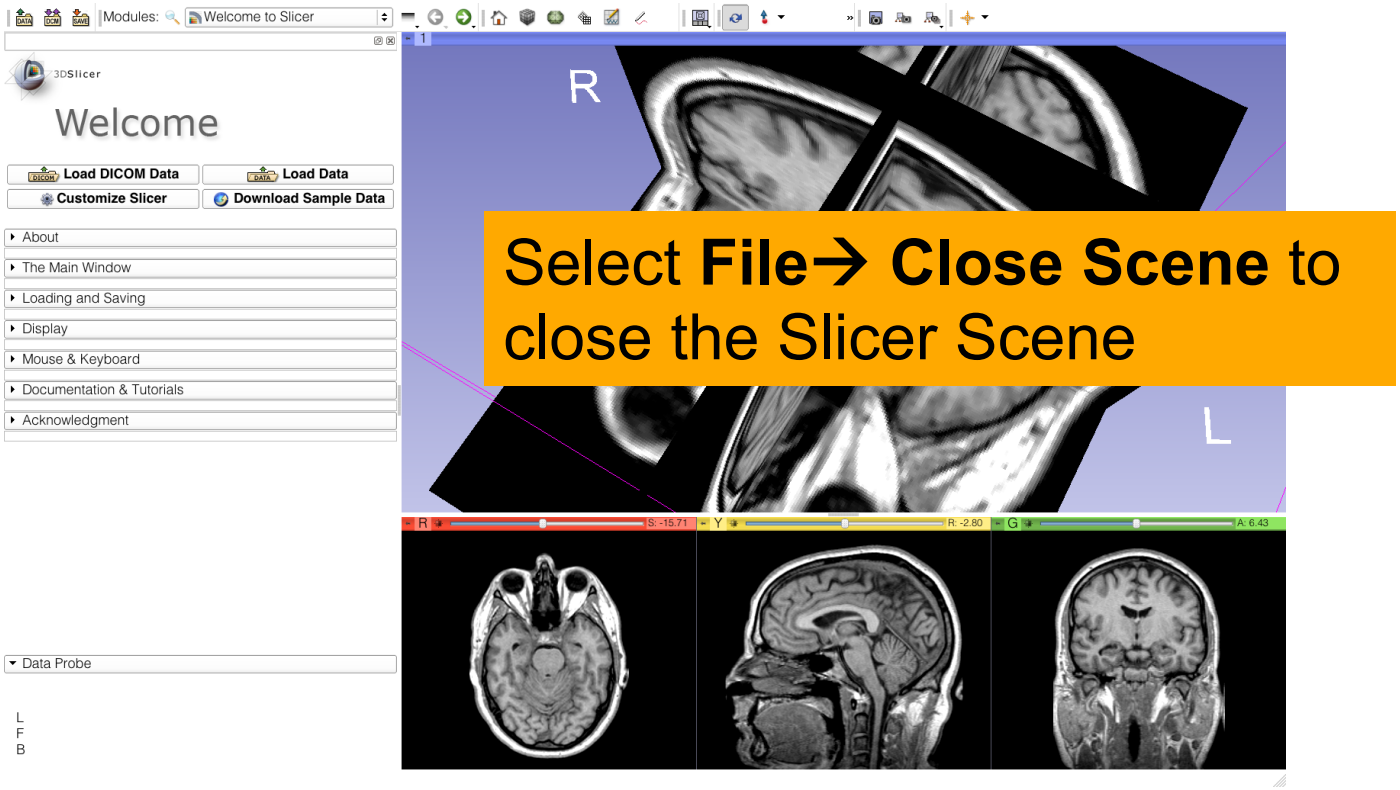
The three anatomical slices appear in the 3DViewer

Loading a DICOM volume

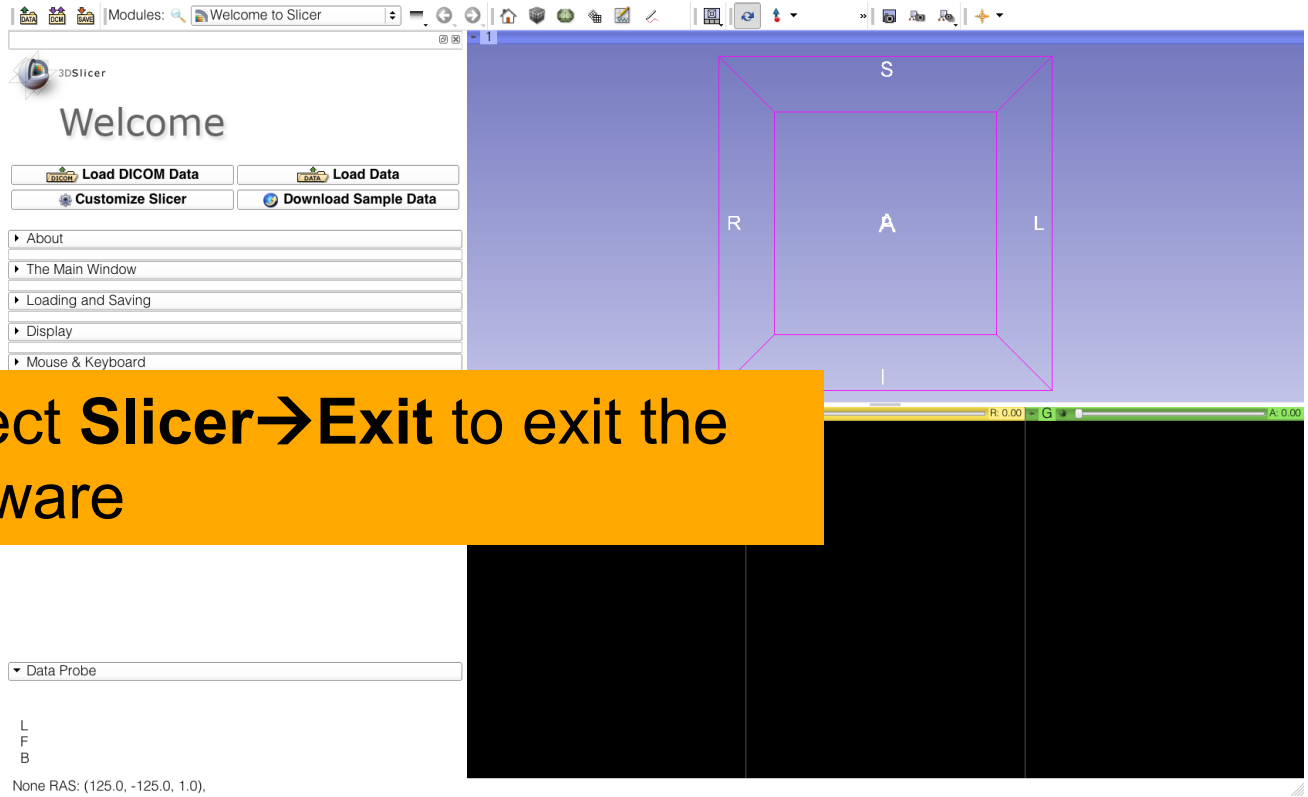


Use the left-mouse button to rotate the camera, and the right-mouse button to zoom in and out

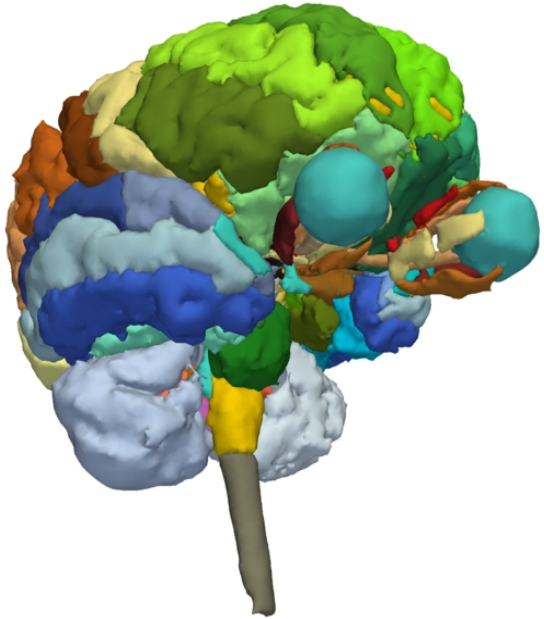
Close the scene



Exit Slicer



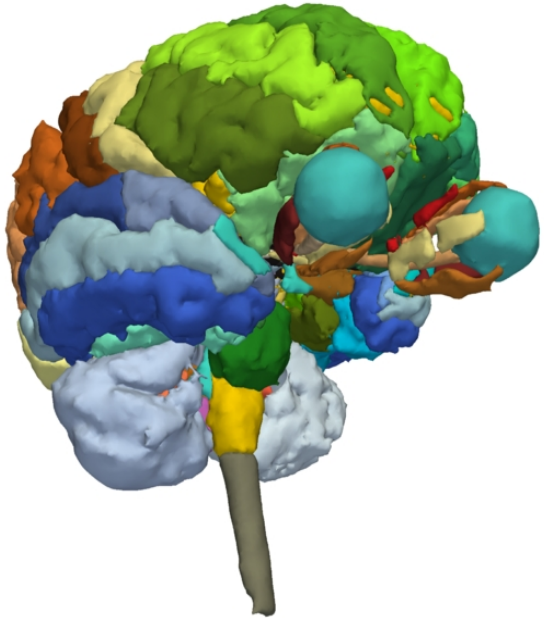
Select **Slicer→Exit** to exit the software



Part 2:

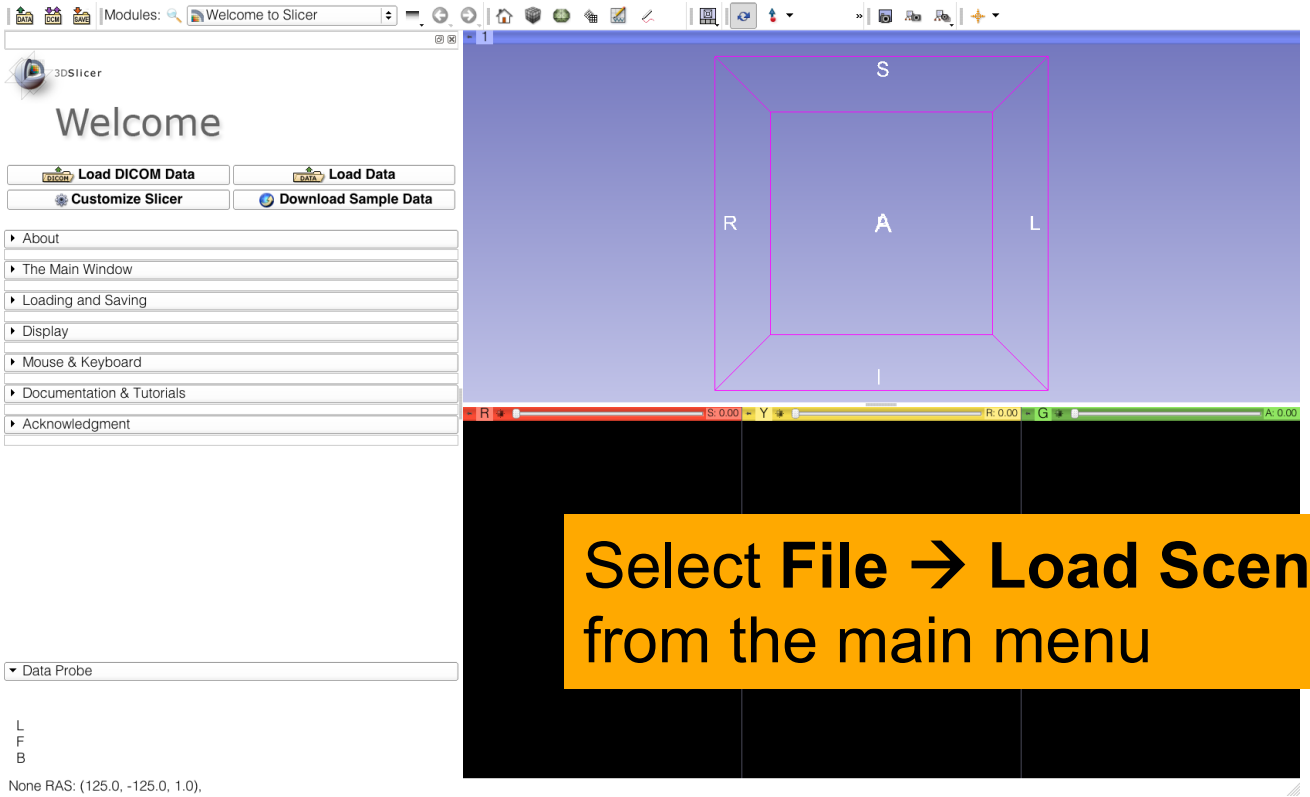
3D visualization of surface models of the brain

3D Slicer Scene

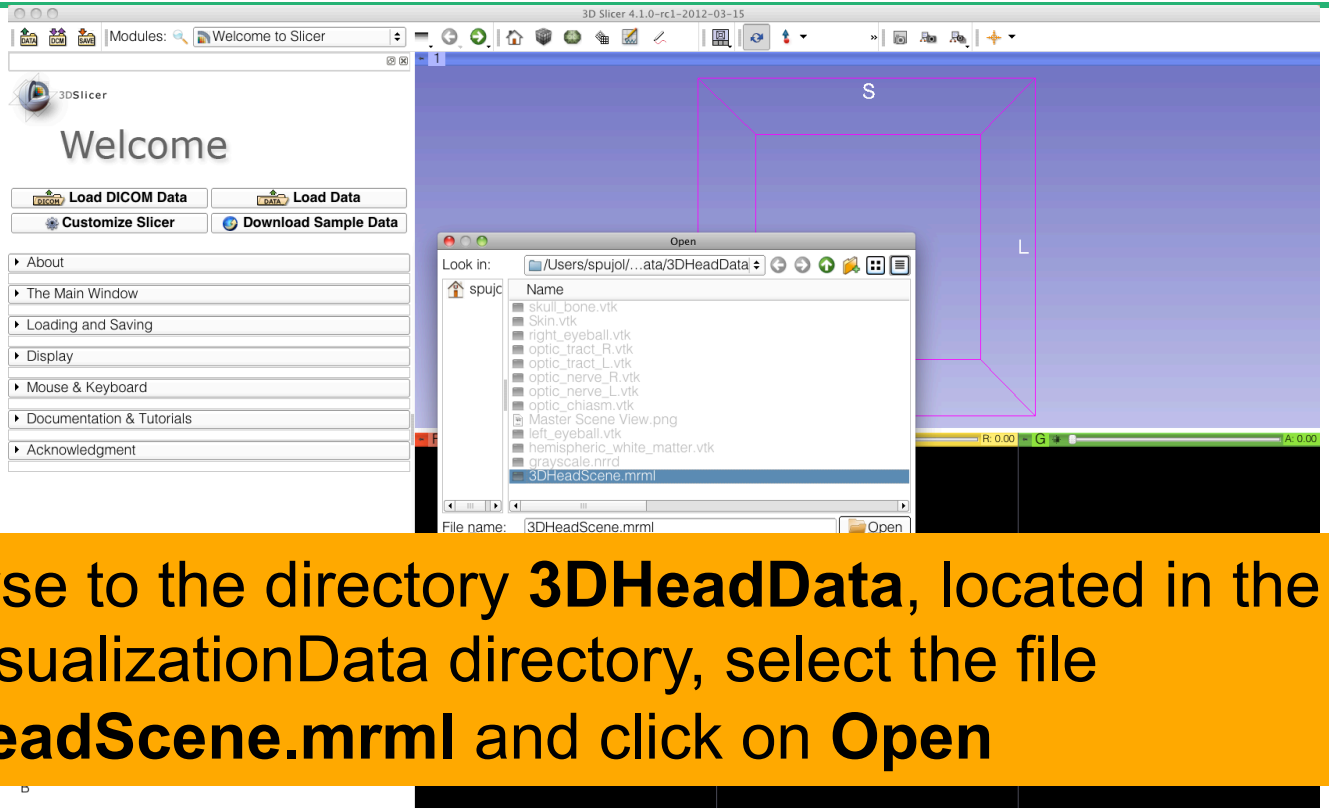


- A Slicer scene is a MRML file which contains a list of elements loaded into Slicer (volumes, models, fiducials…)
- The tutorial scene contains an MR scan of the brain and 3D surface models of anatomical structures.
- The tutorial data are part of the SPL-PNL Brain Atlas developed by Thalos et al.

Loading a Scene

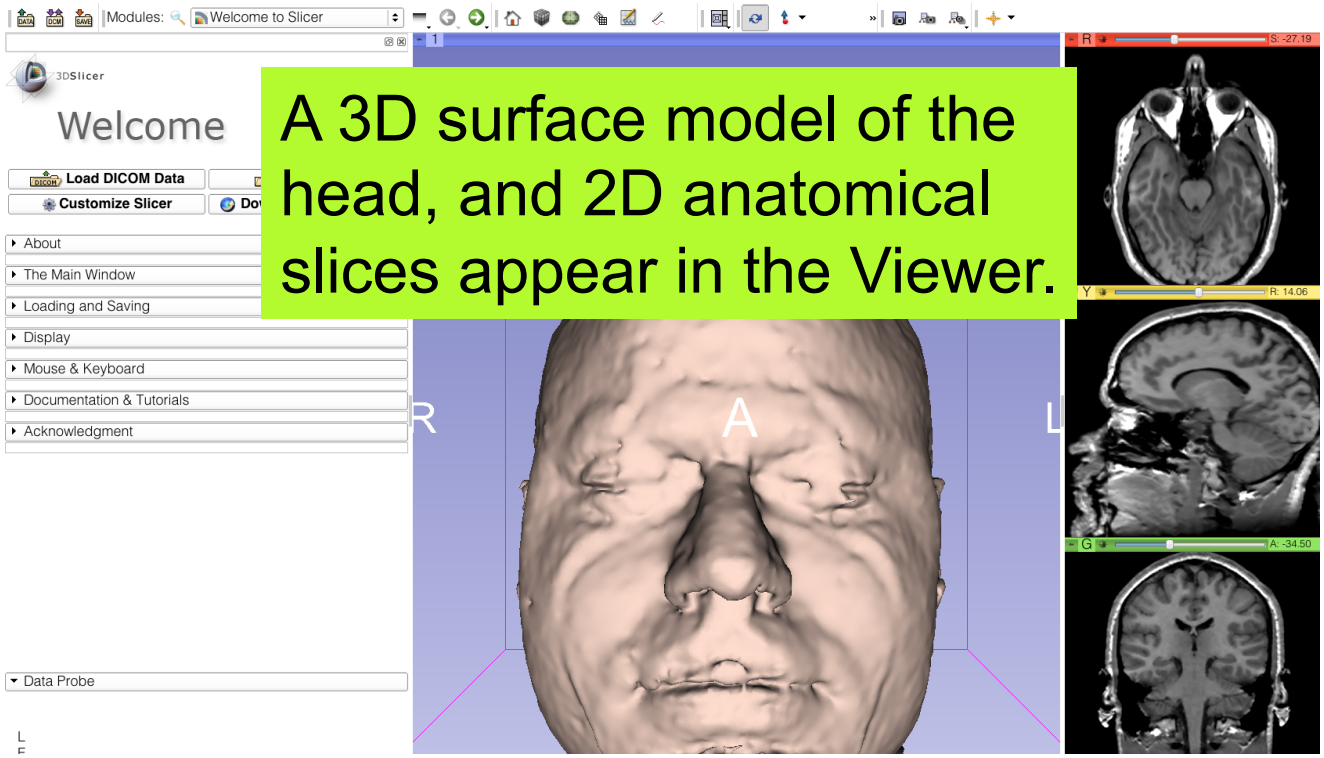


Loading a Scene



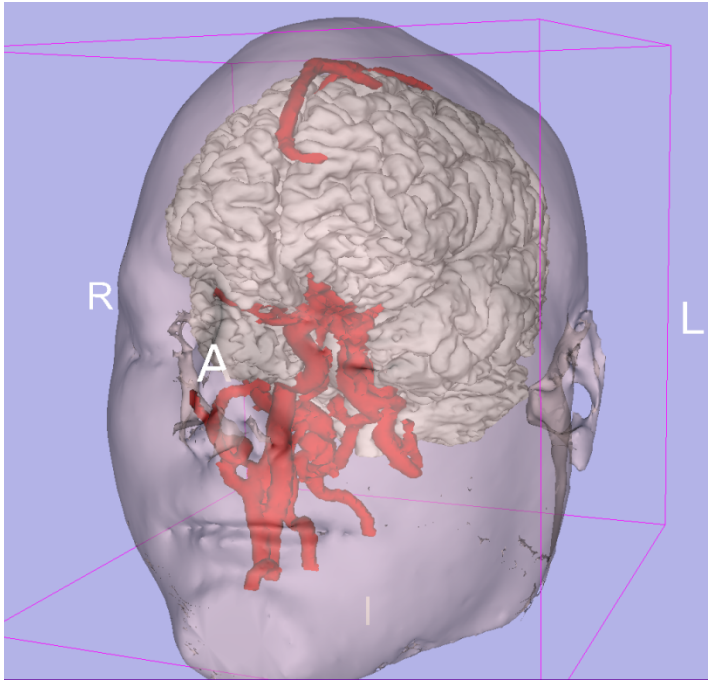
Browse to the directory **3DHeadData**, located in the 3DVisualizationData directory, select the file **3DHeadScene.mrml** and click on **Open**

Loading the Slicer Scene



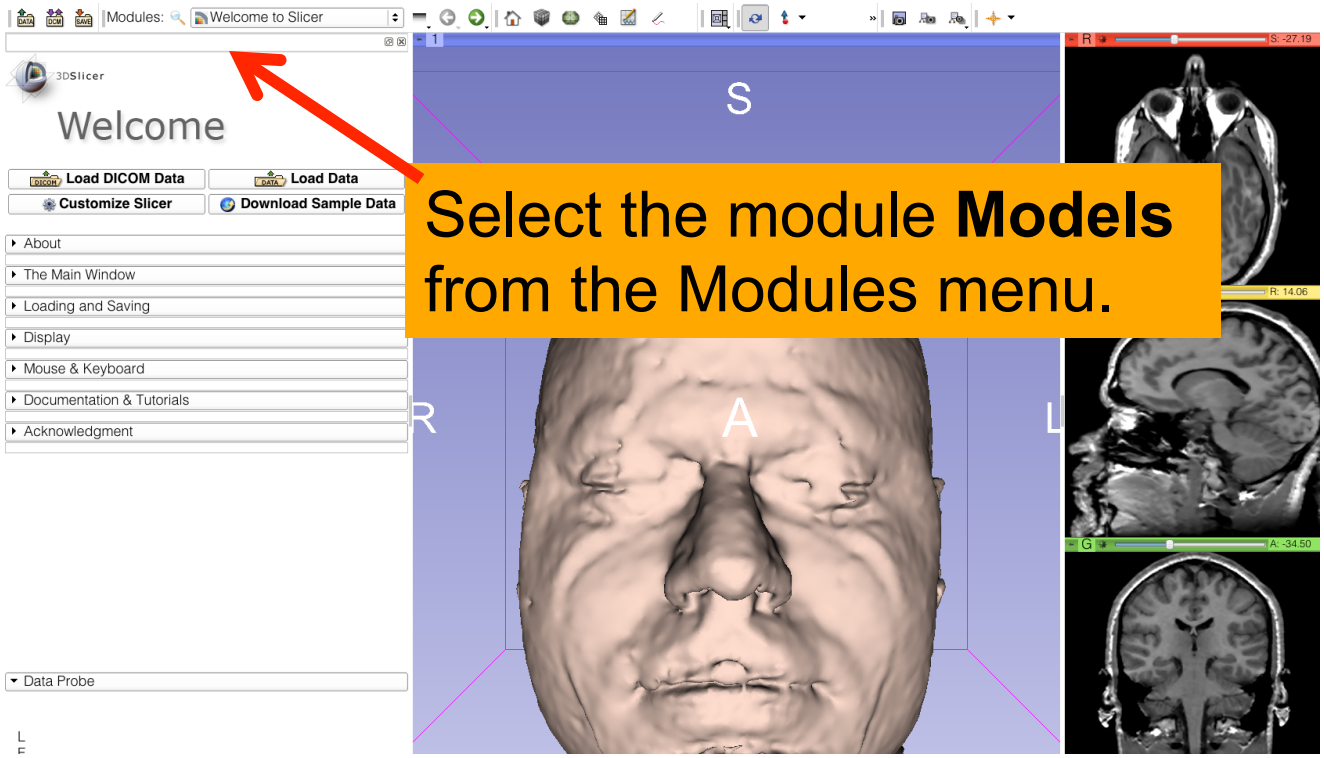
A 3D surface model of the head, and 2D anatomical slices appear in the Viewer.

3D Surface Models

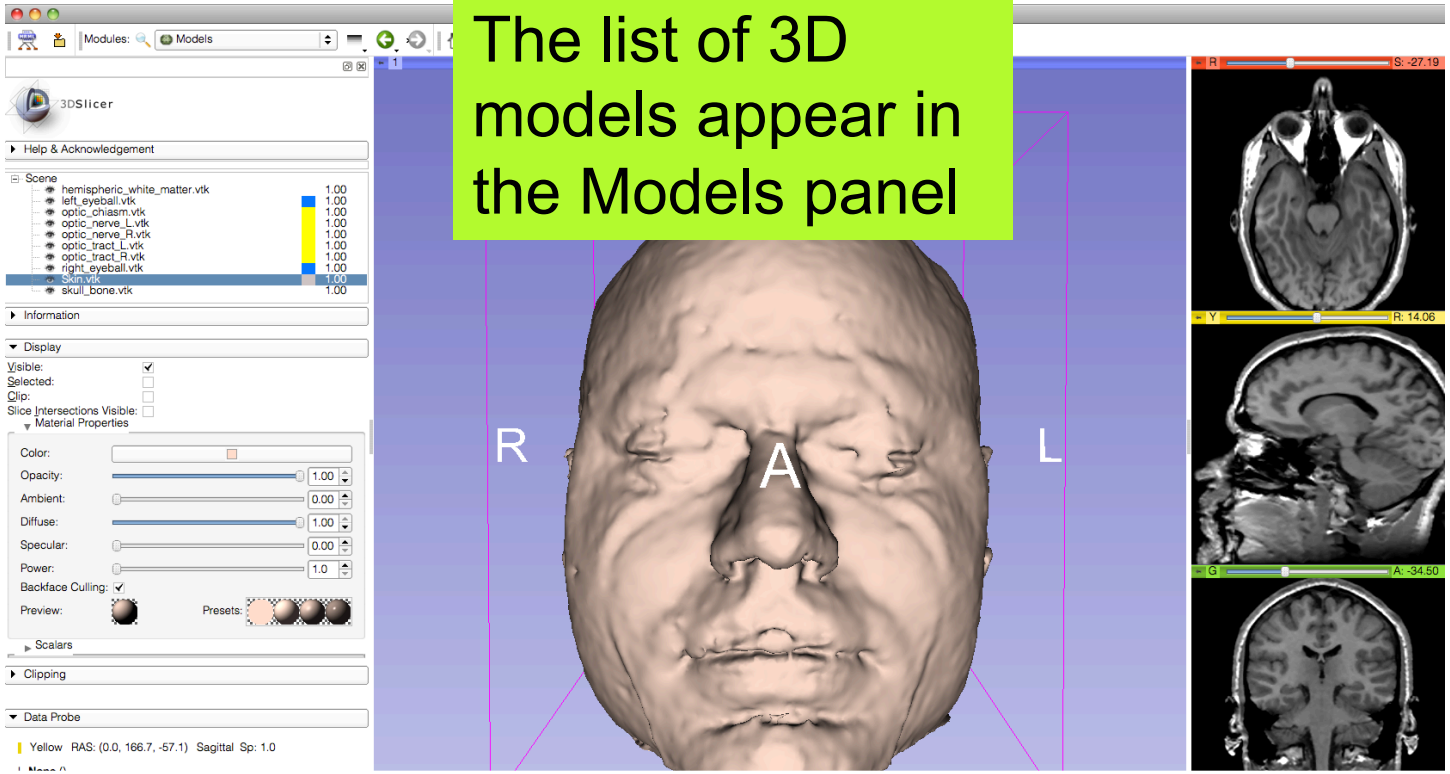


- A 3D model is a surface reconstruction of an anatomical structure.
- The model is a triangular mesh that approximates a surface from a 3D label map.
- The scalar values for surface models are integers which correspond to the label that had been assigned in the segmentation process.

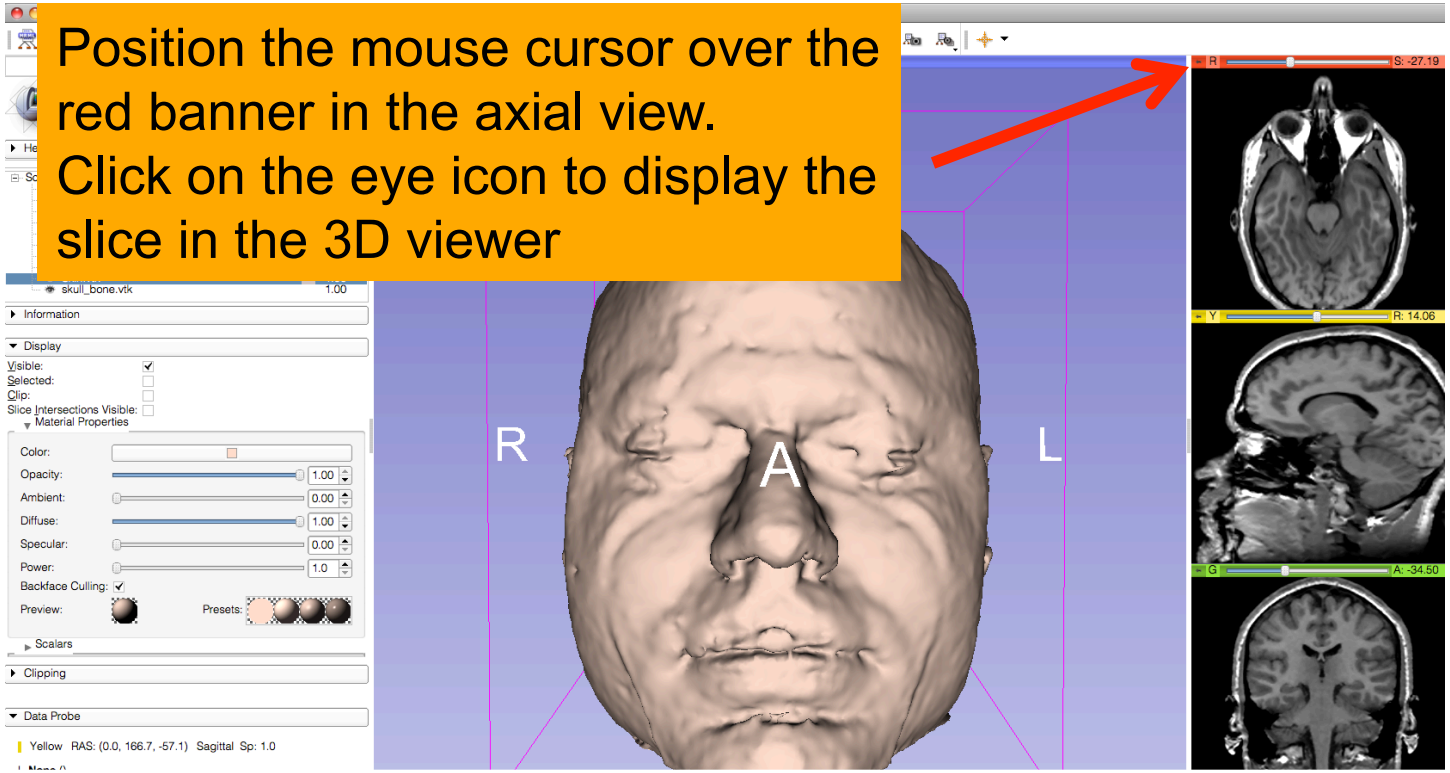
Loading the Slicer Scene



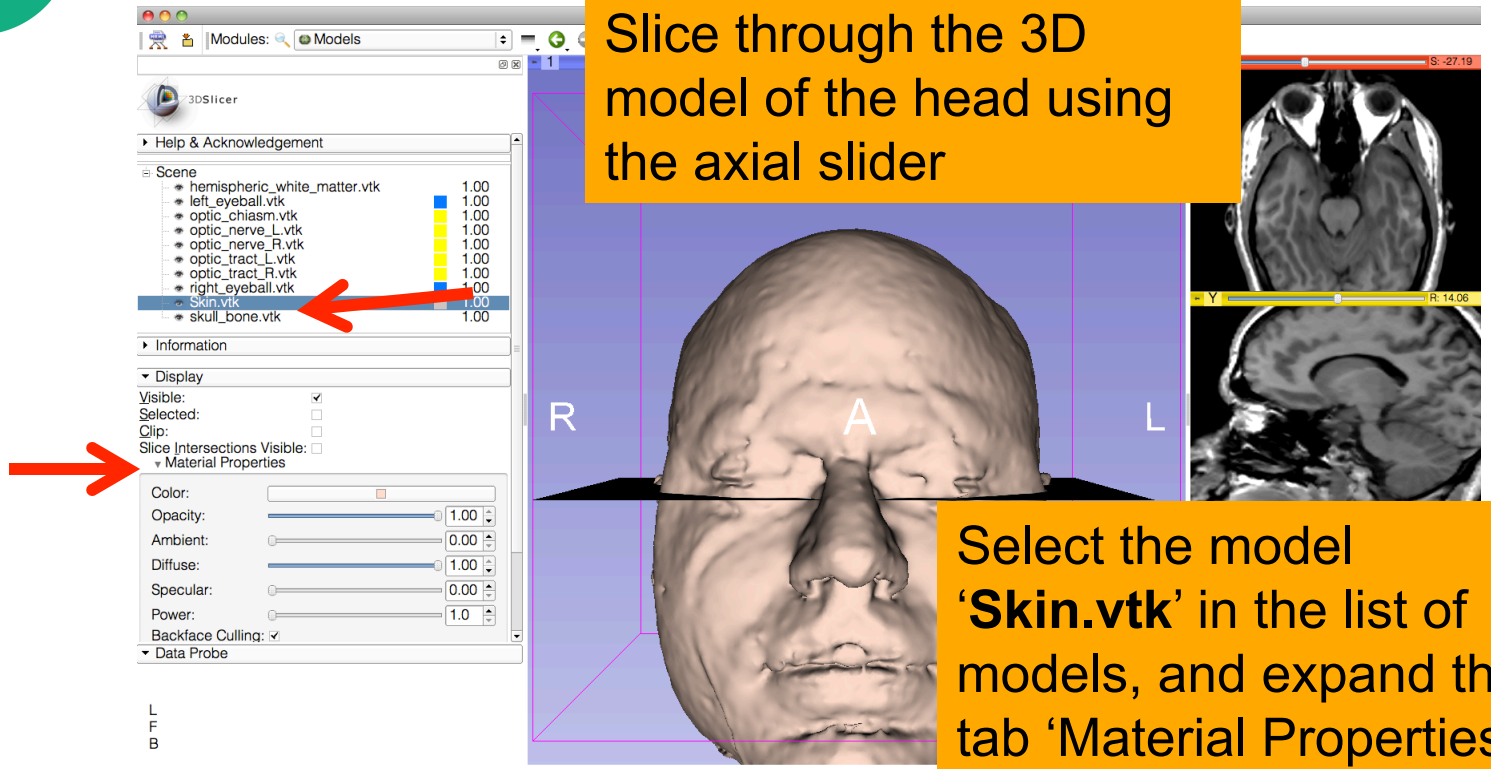
Models module



3D Visualization



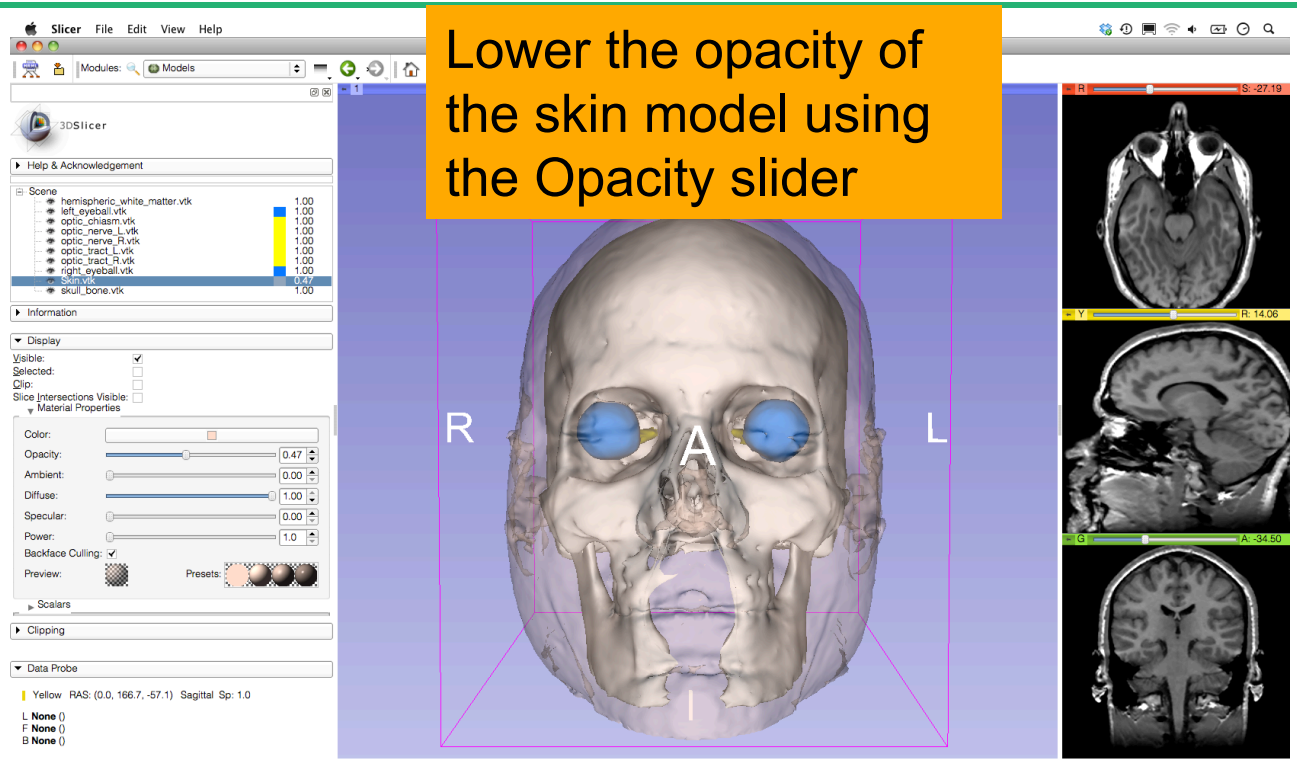
3D Visualization



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

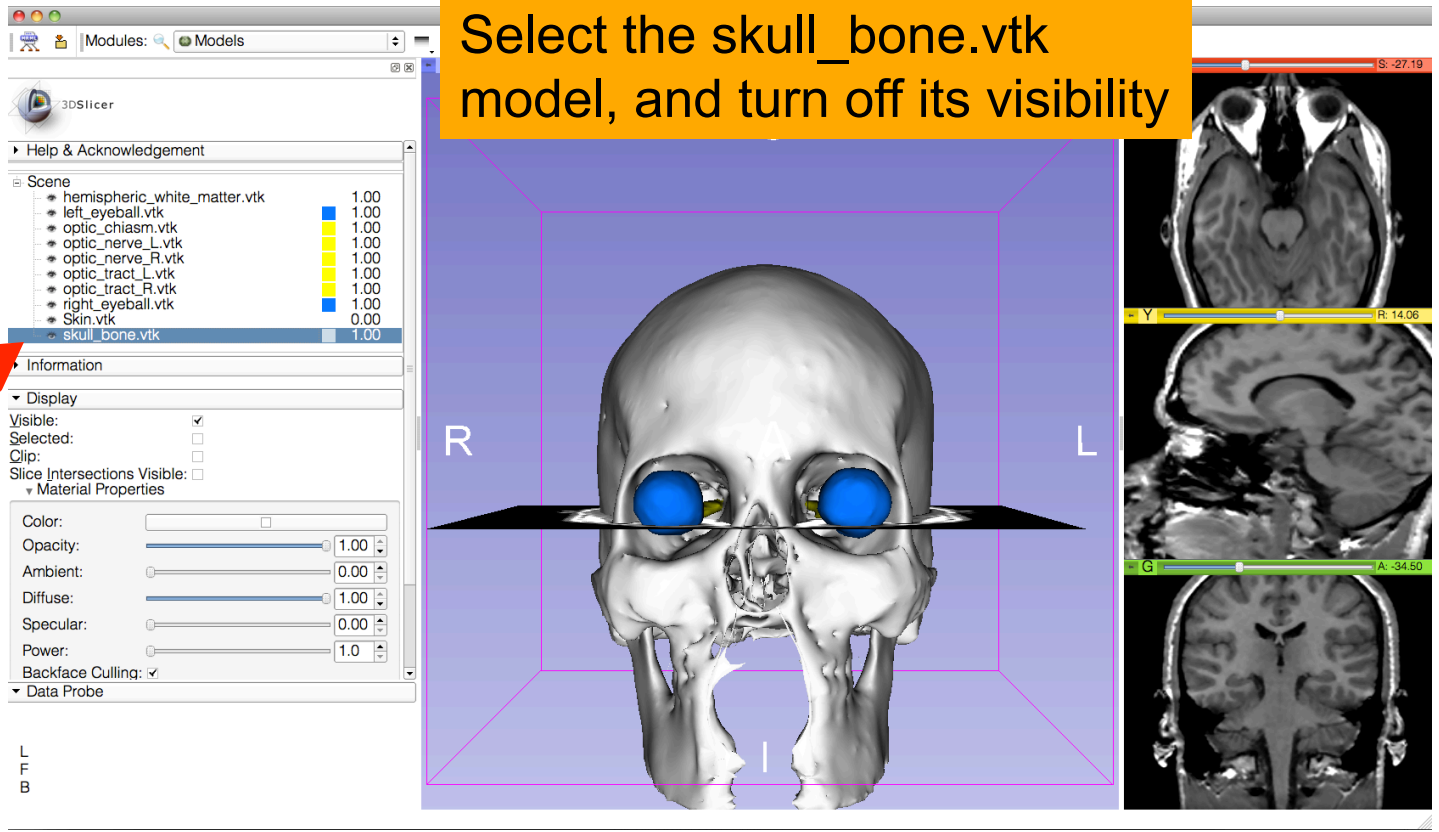
Select the model '**Skin.vtk**' in the list of models, and expand the tab 'Material Properties' under 'Display'

3D Visualization

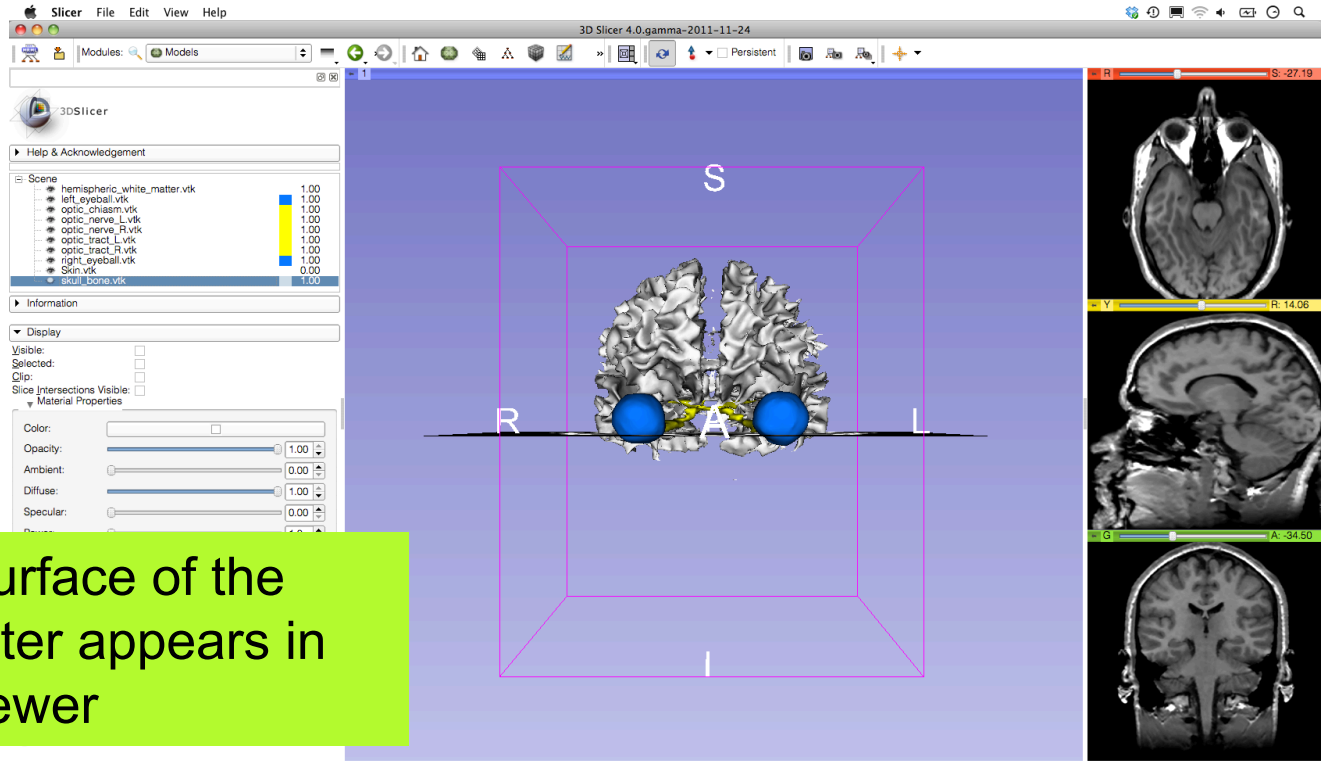


Lower the opacity of the skin model using the Opacity slider

3D Visualization

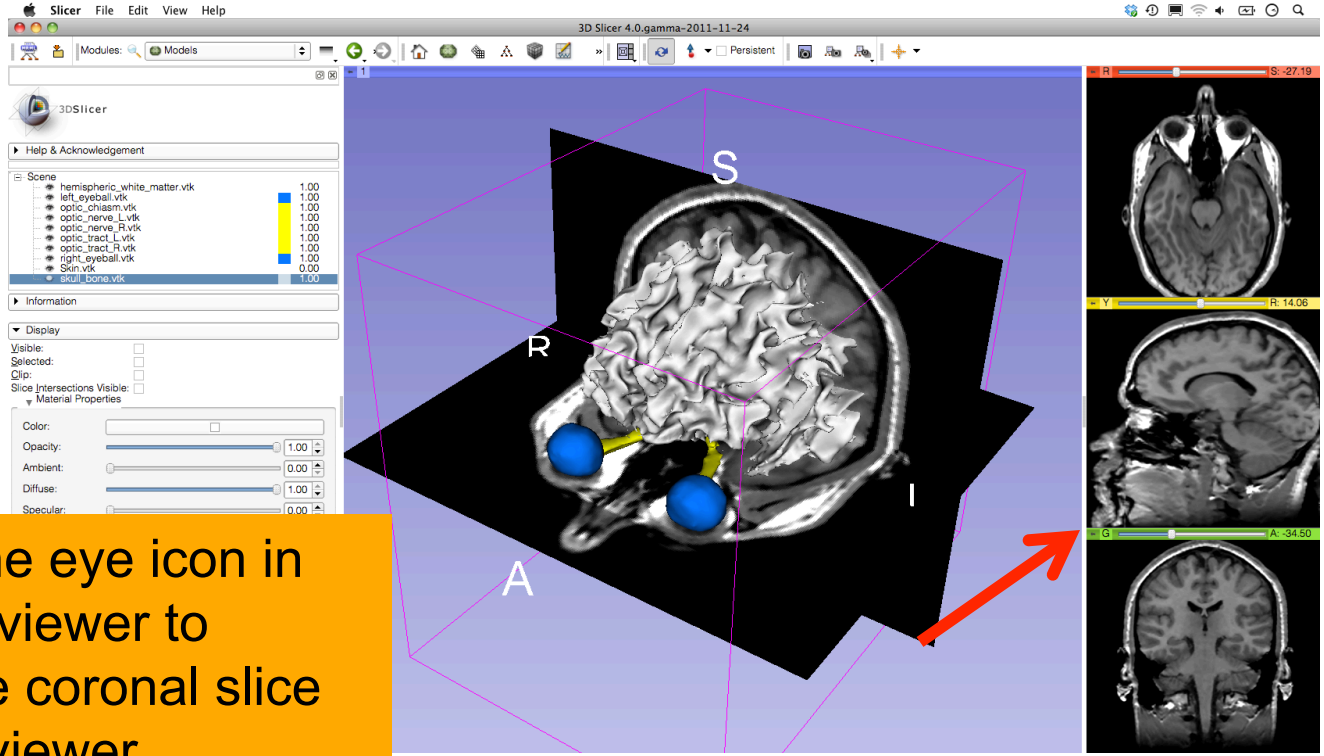


3D Visualization



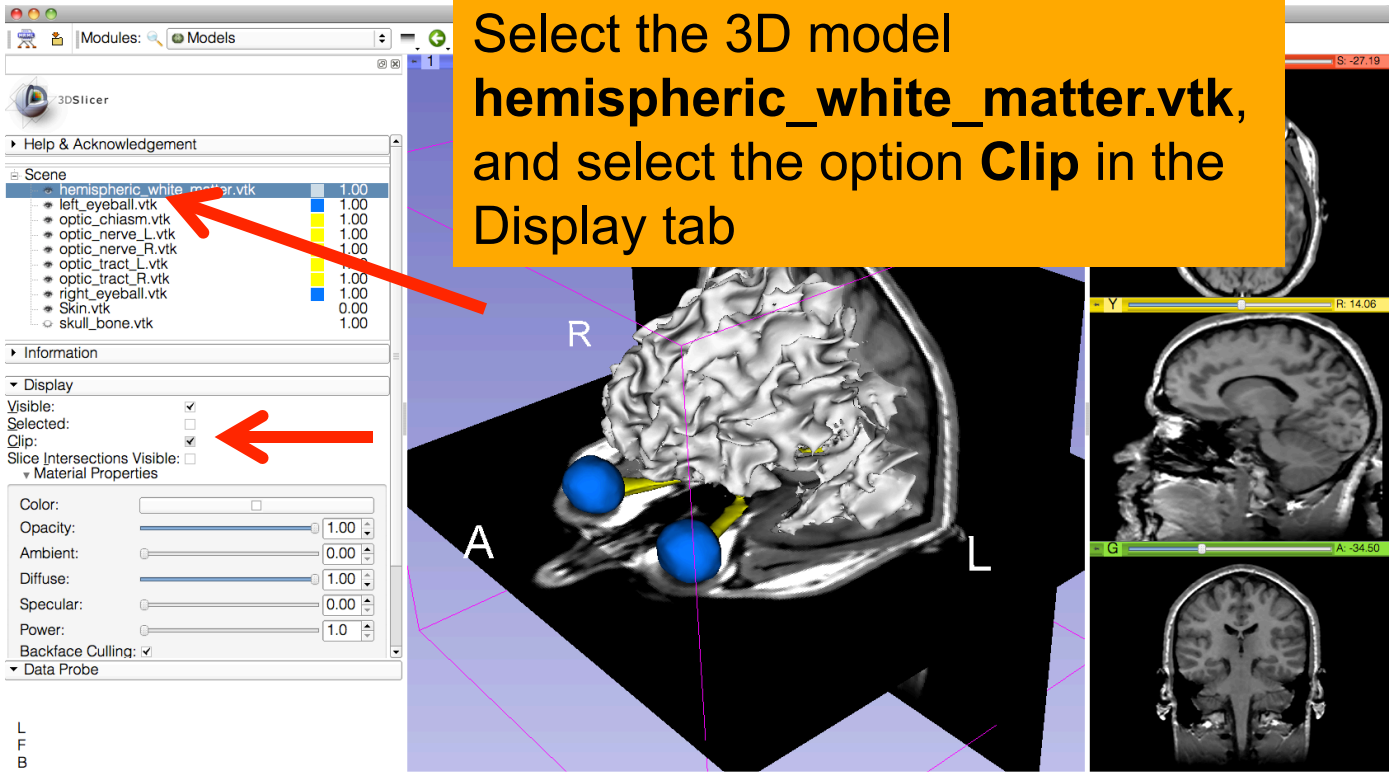
The 3D surface of the white matter appears in the 3D viewer

3D Visualization



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

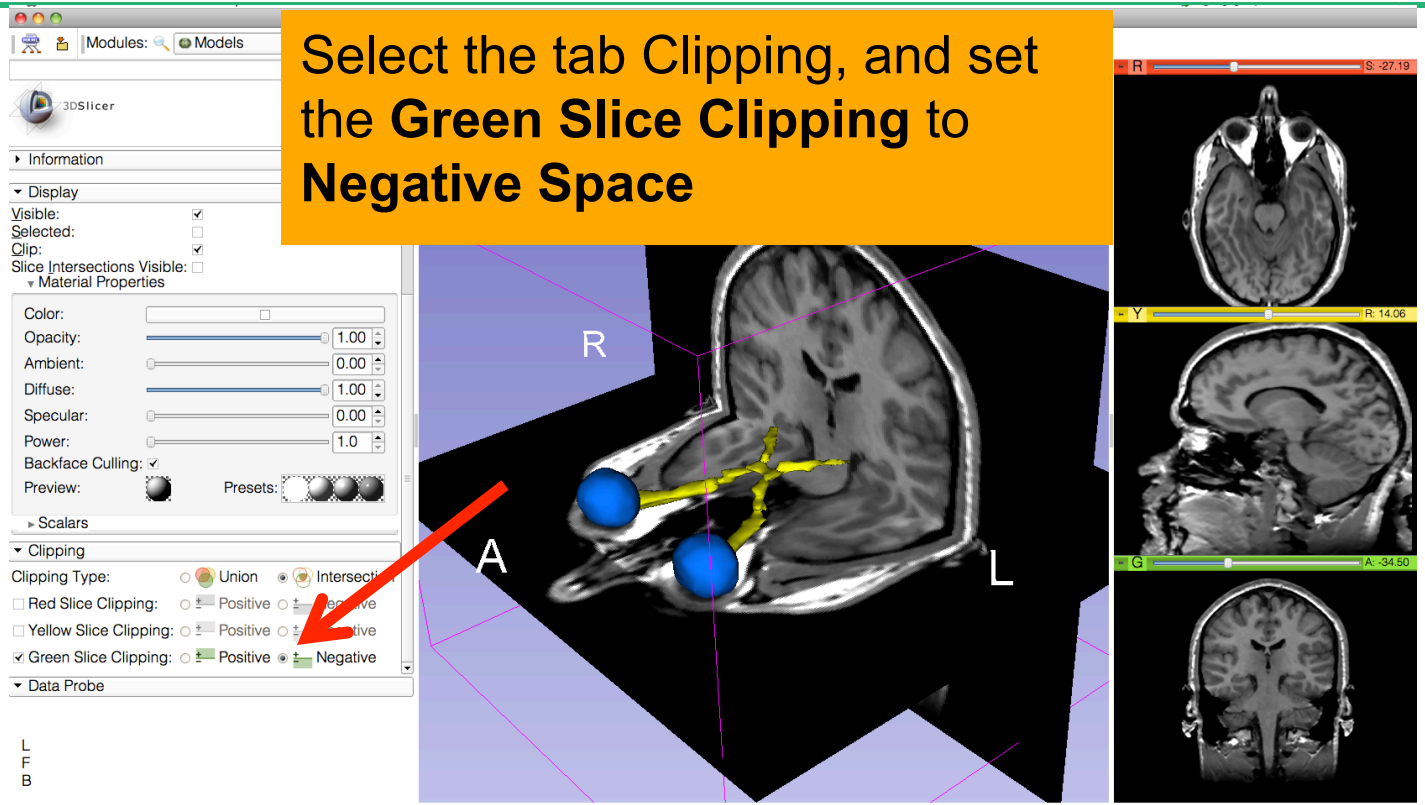
3D Visualization



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

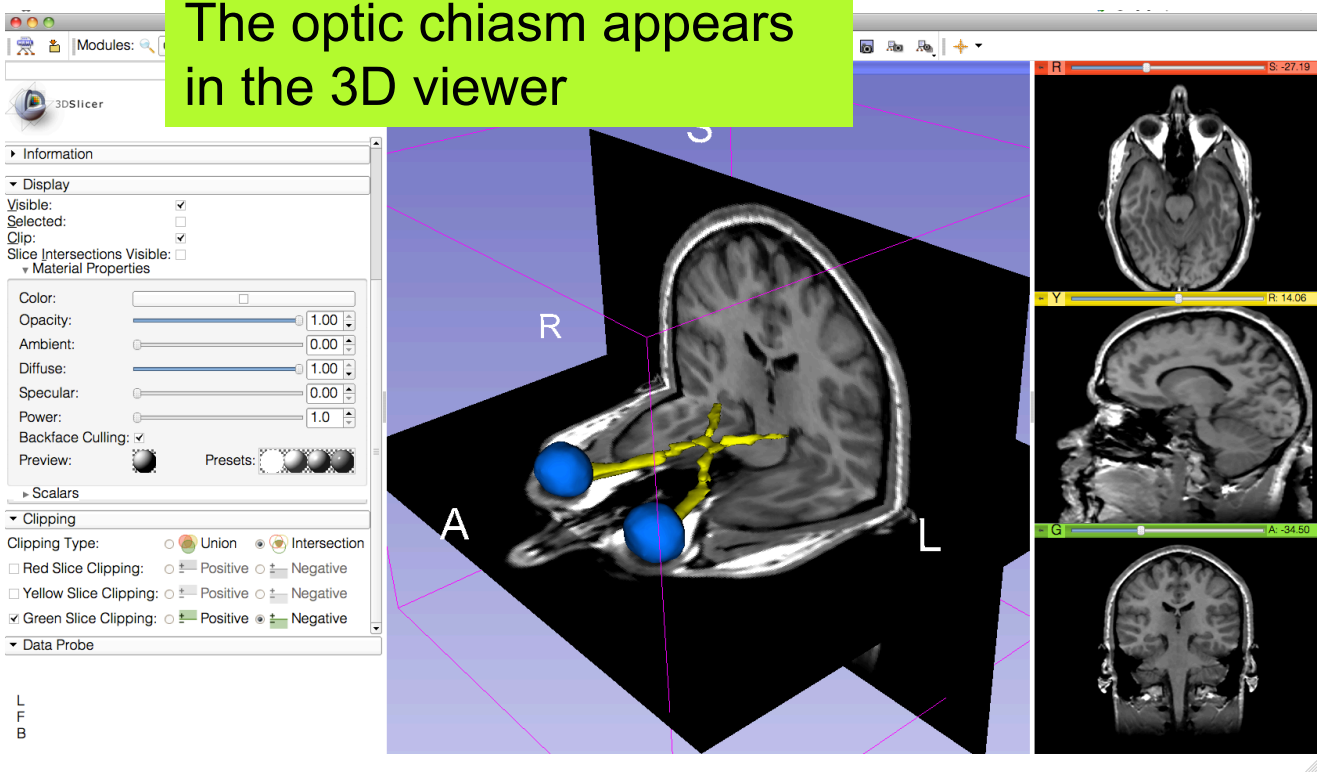
3D Visualization

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

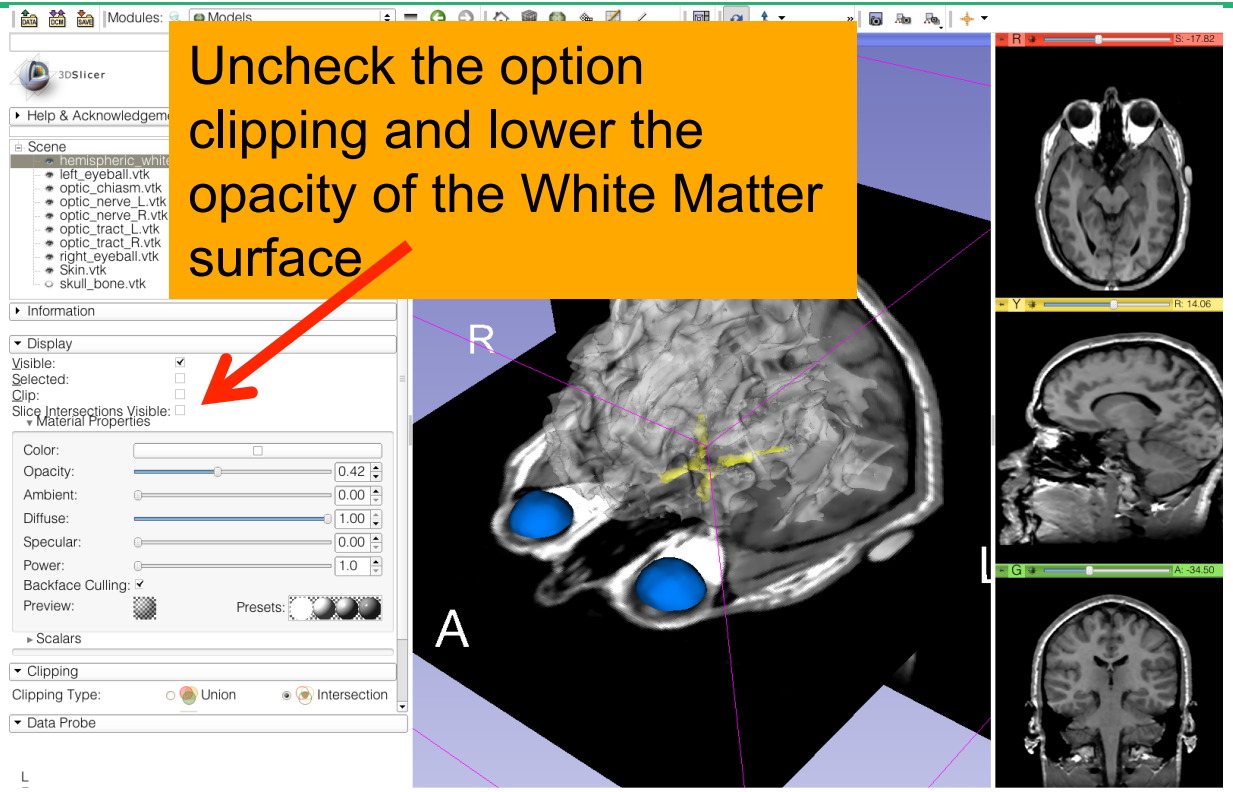


3D Visualization

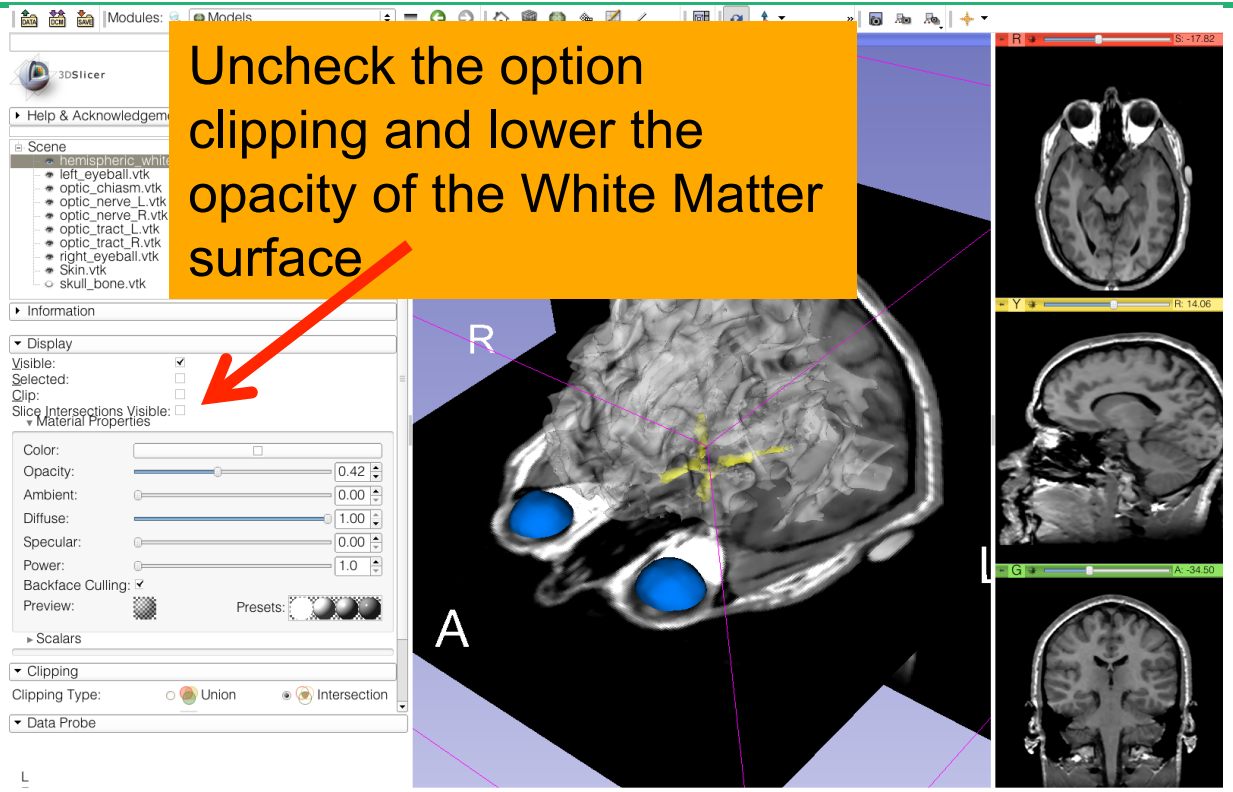
The optic chiasm appears in the 3D viewer



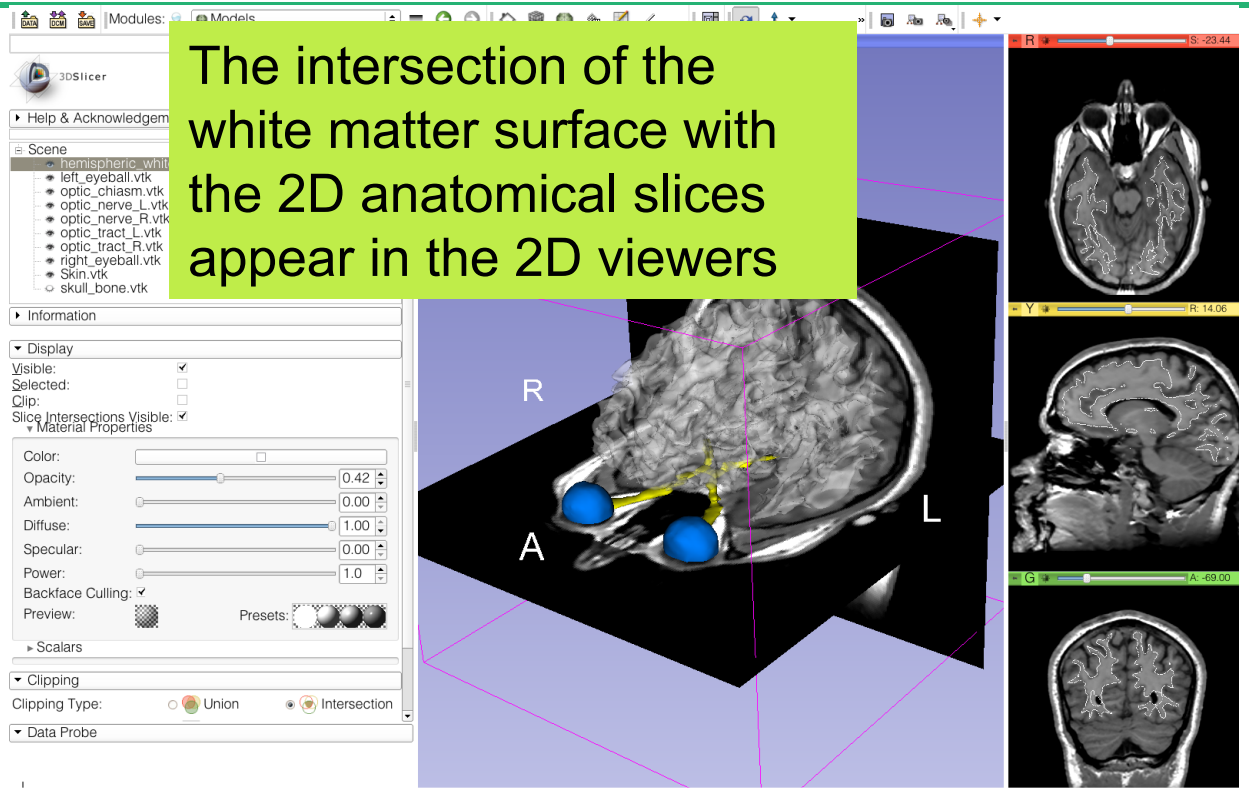
3D Visualization



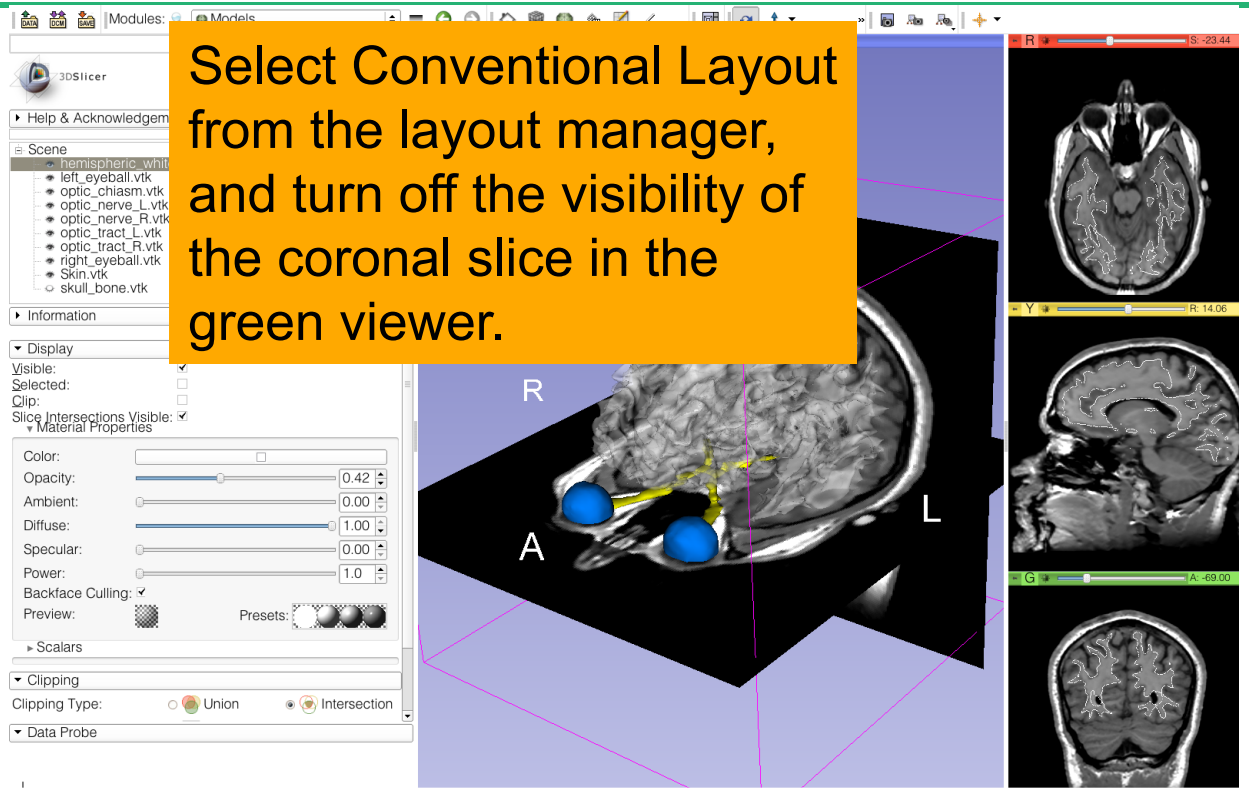
3D Visualization



3D Visualization

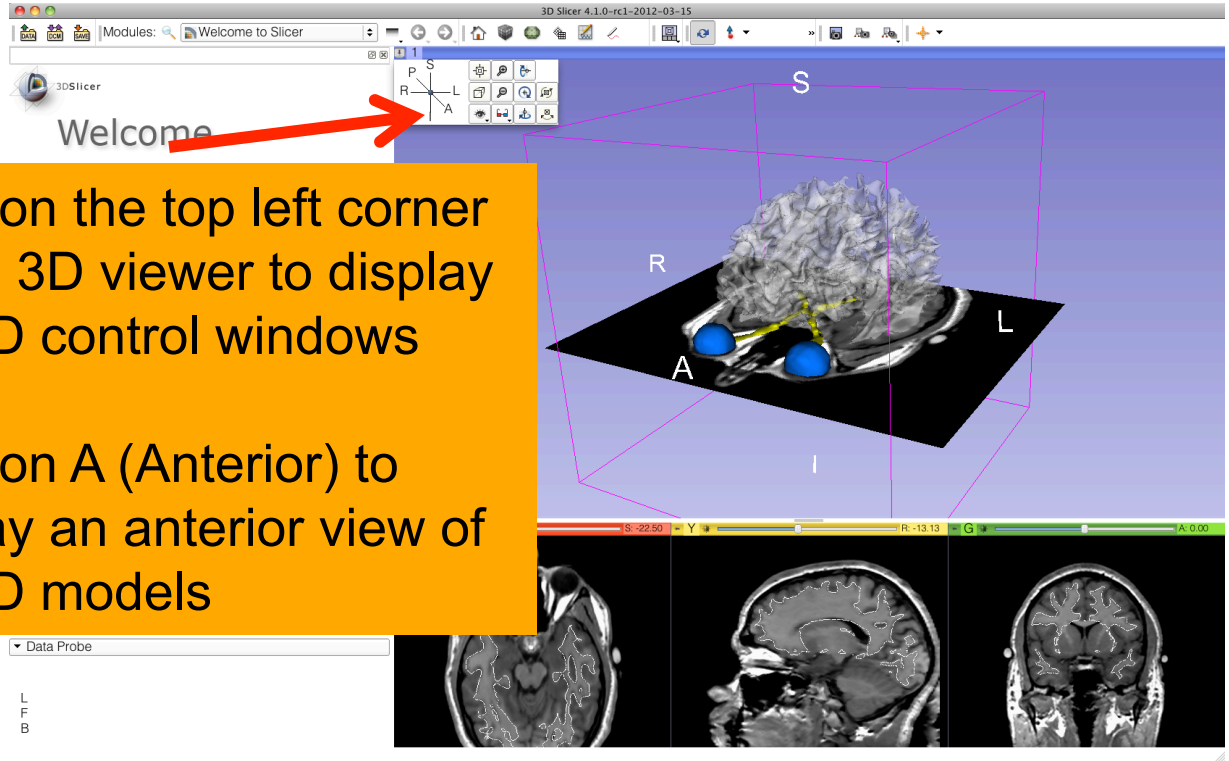


3D Visualization



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

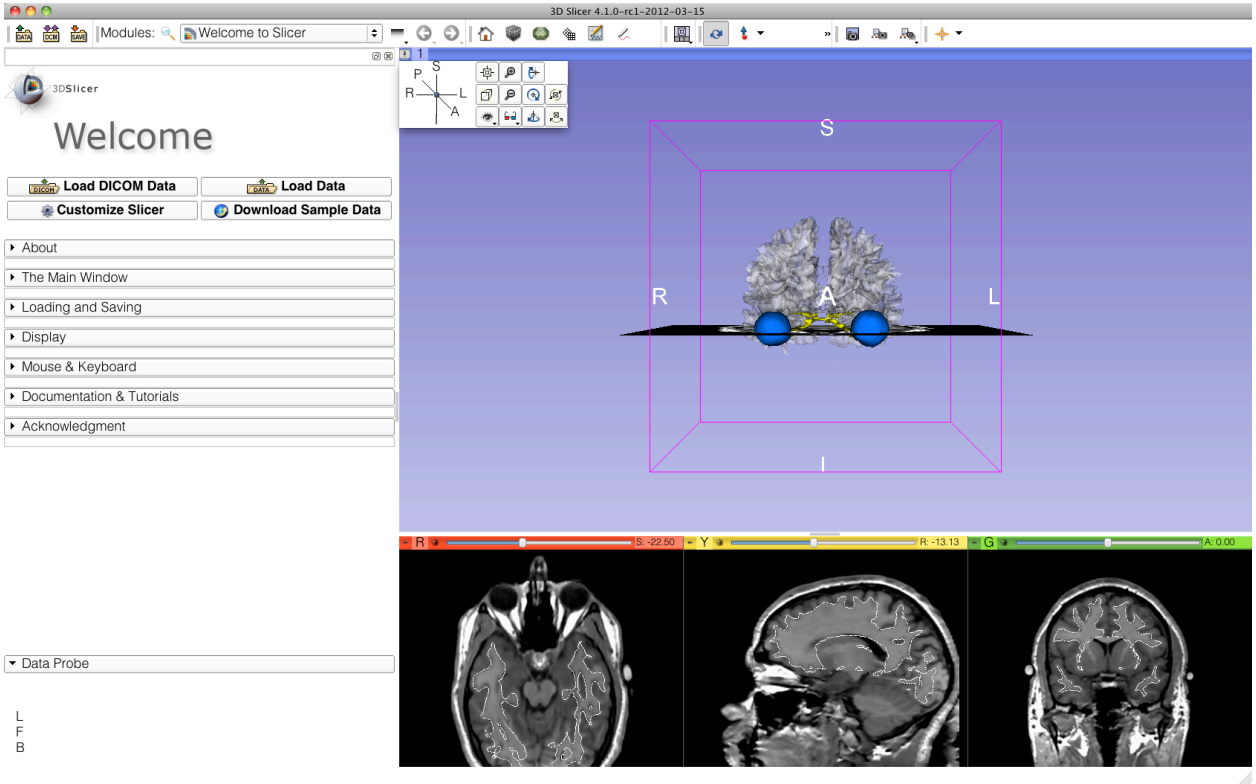
3D Visualization

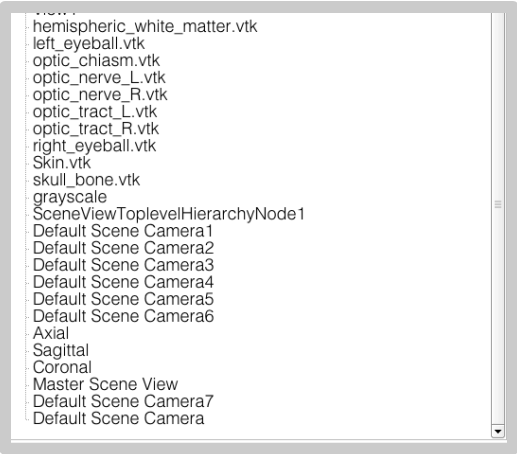


Click on the top left corner of the 3D viewer to display the 3D control windows

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

3D Visualization

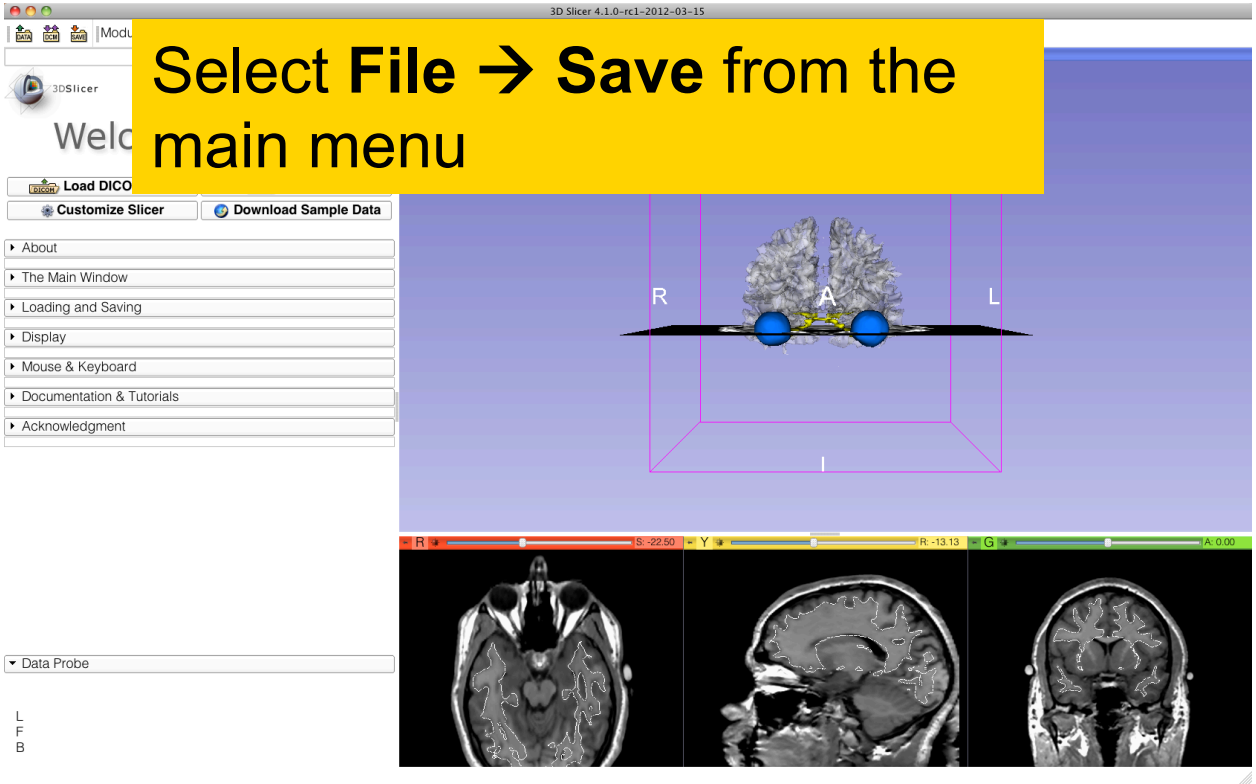




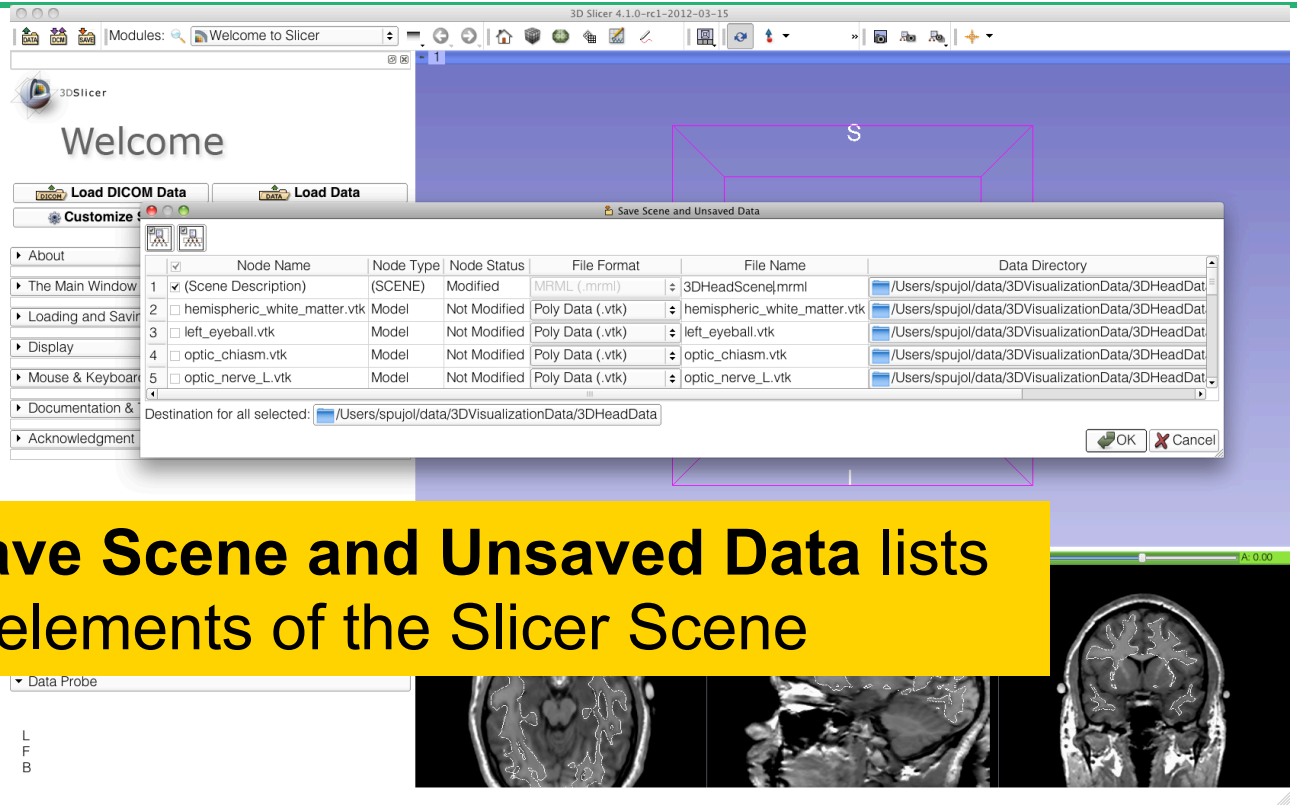
Part 3:

Saving a scene

Saving a Scene

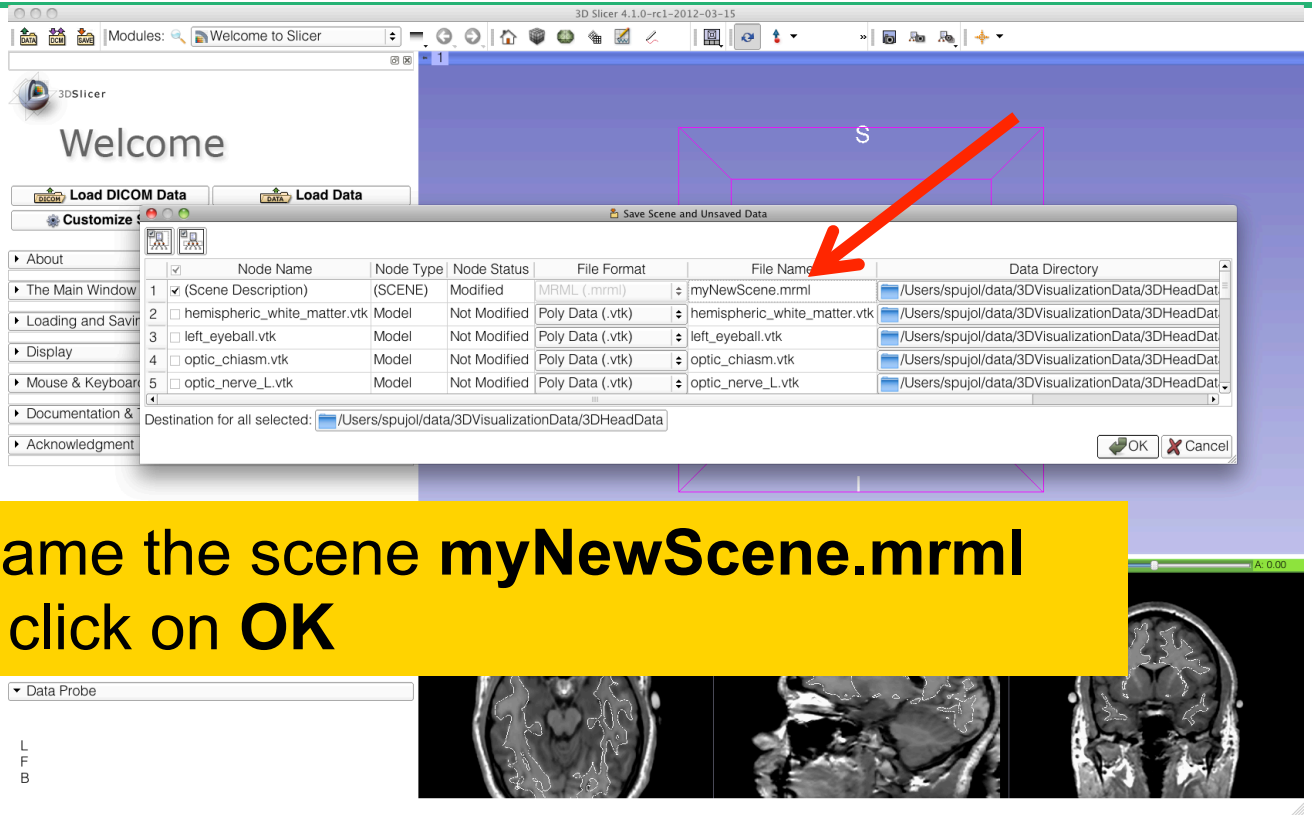


Saving a Scene



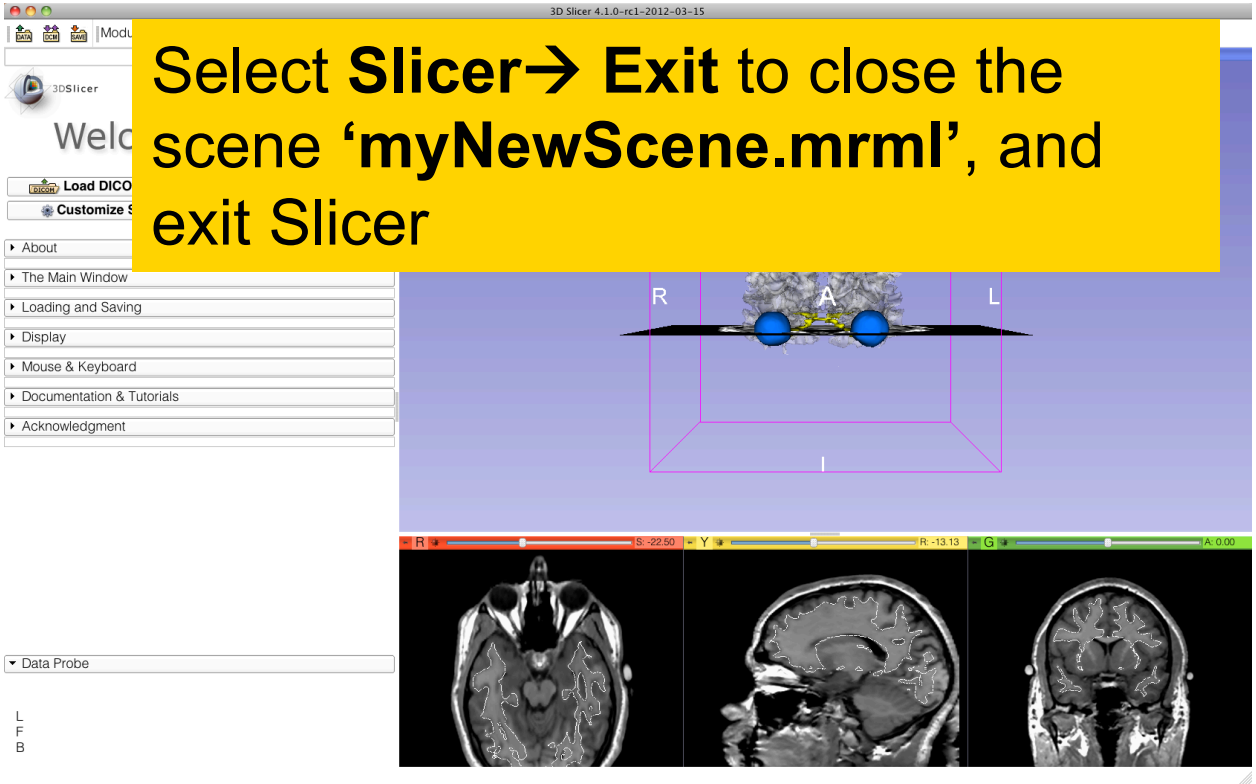
The **Save Scene and Unsaved Data** lists all the elements of the Slicer Scene

Saving a Scene



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

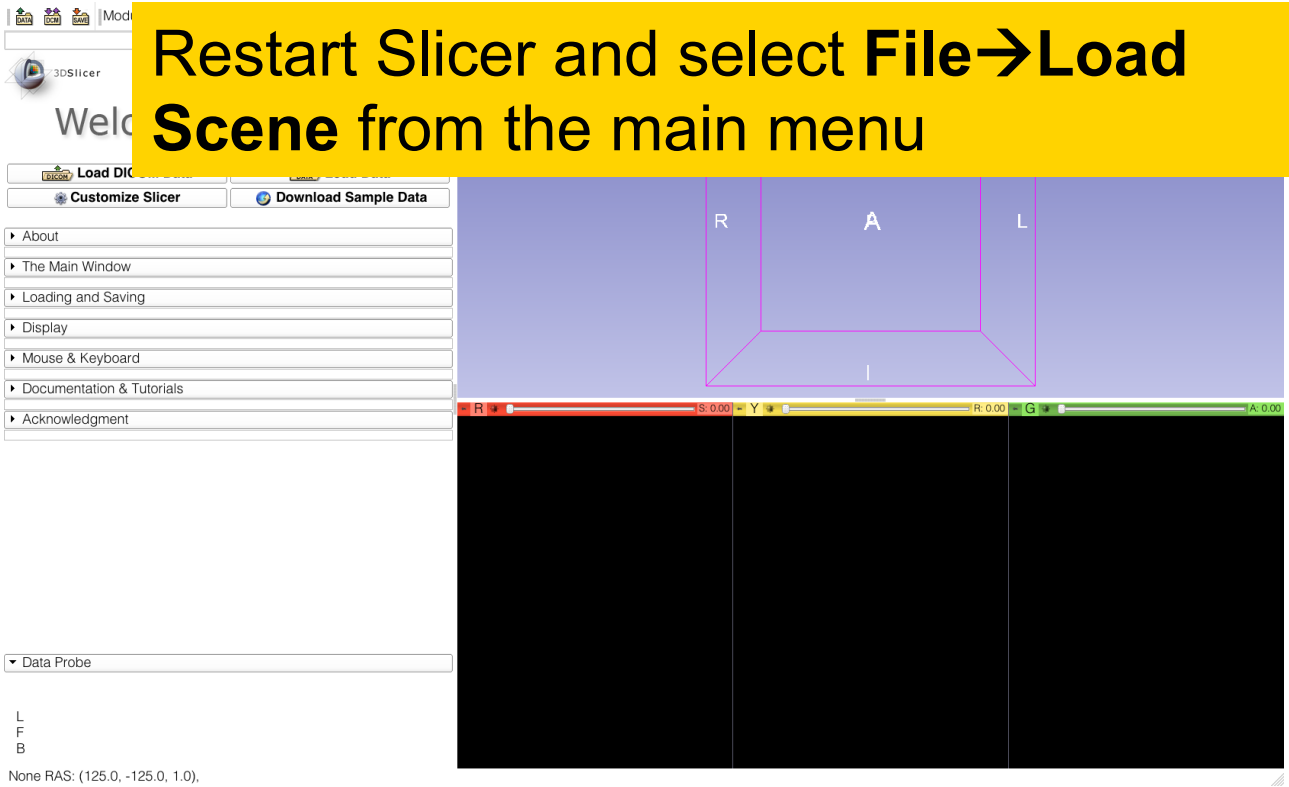
Saving a Scene



Select **Slicer→ Exit** to close the scene **'myNewScene.mrml'**, and exit Slicer

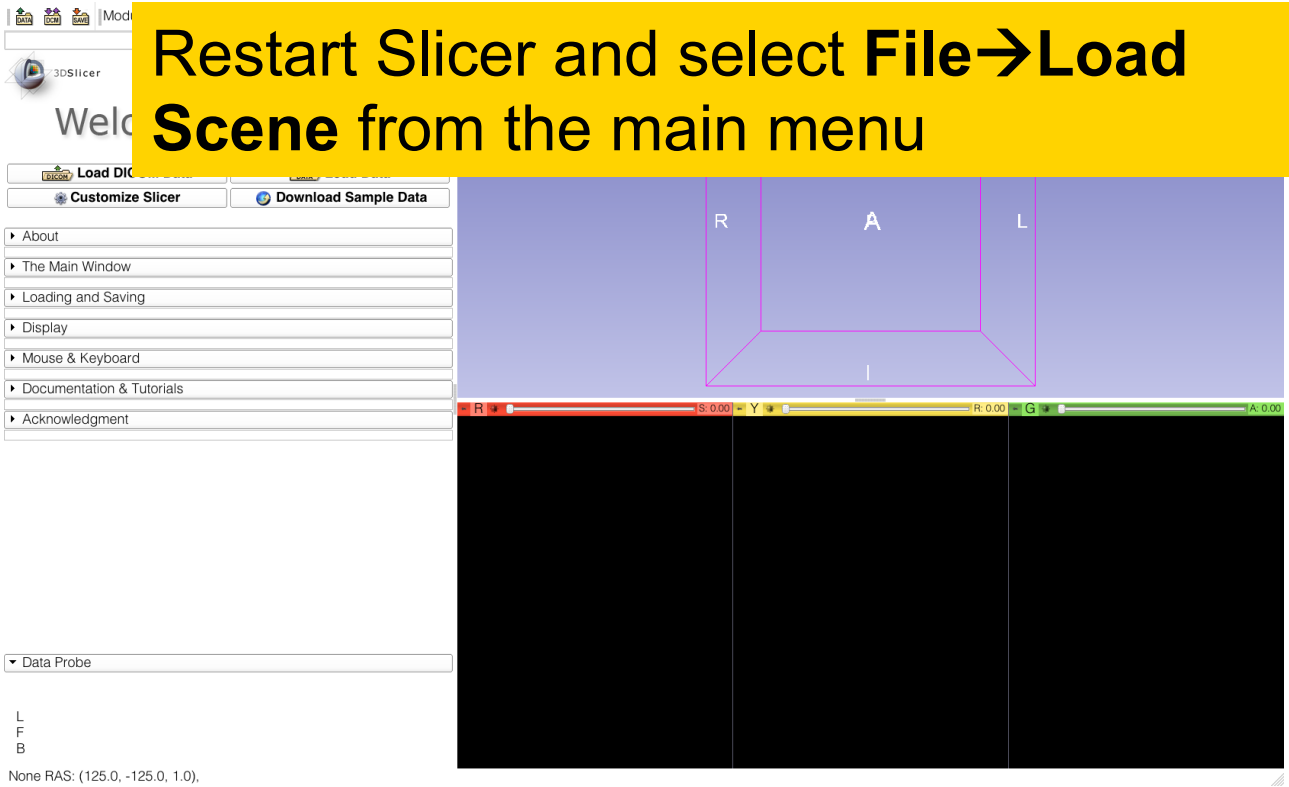
Scene Restore

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

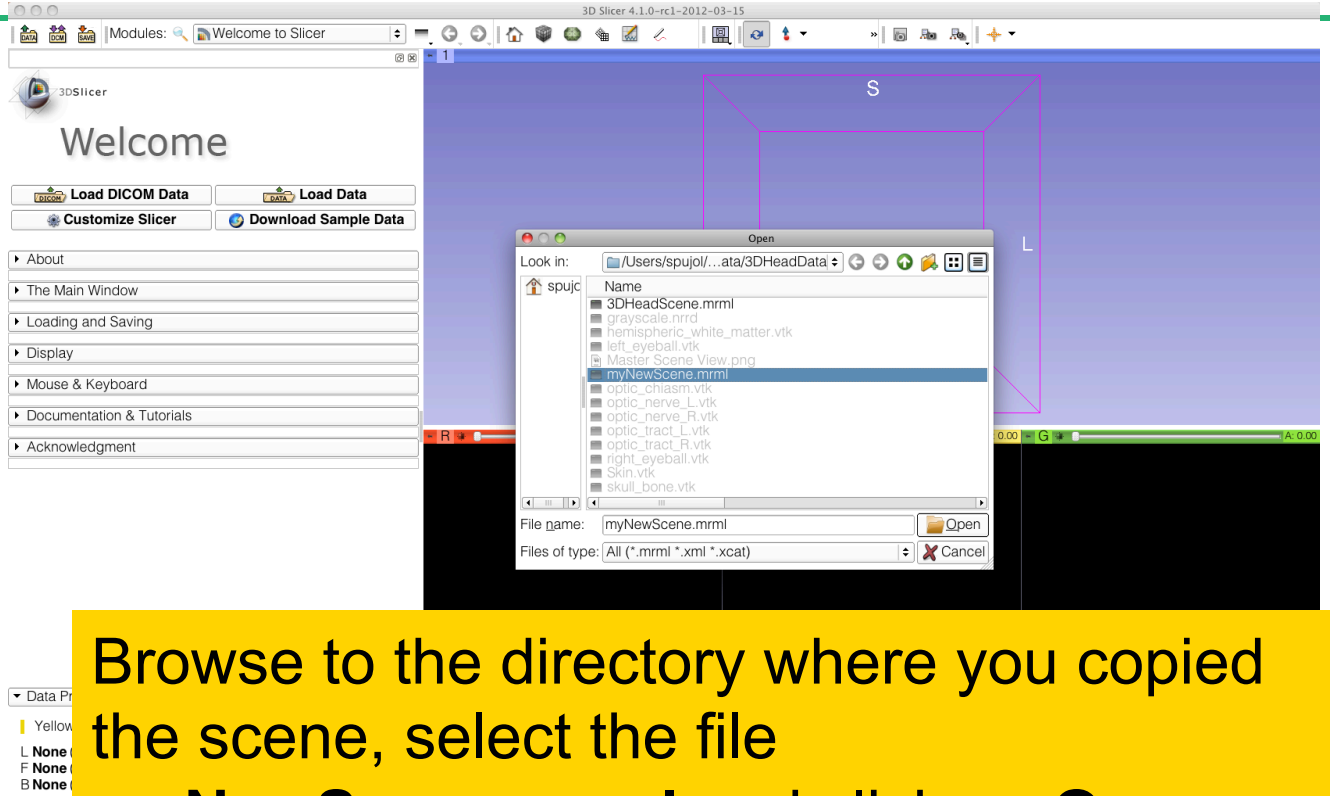


Scene Restore

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

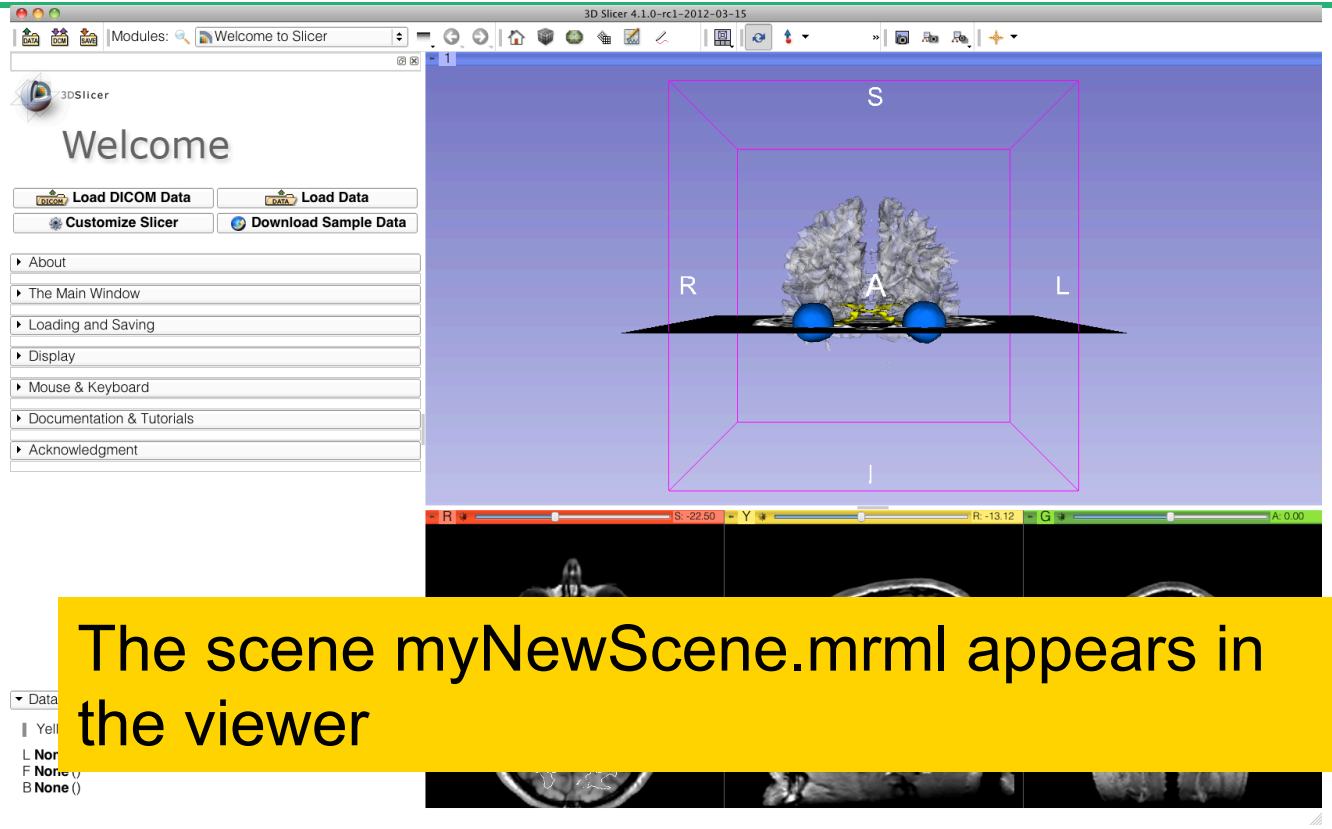


Scene Restore



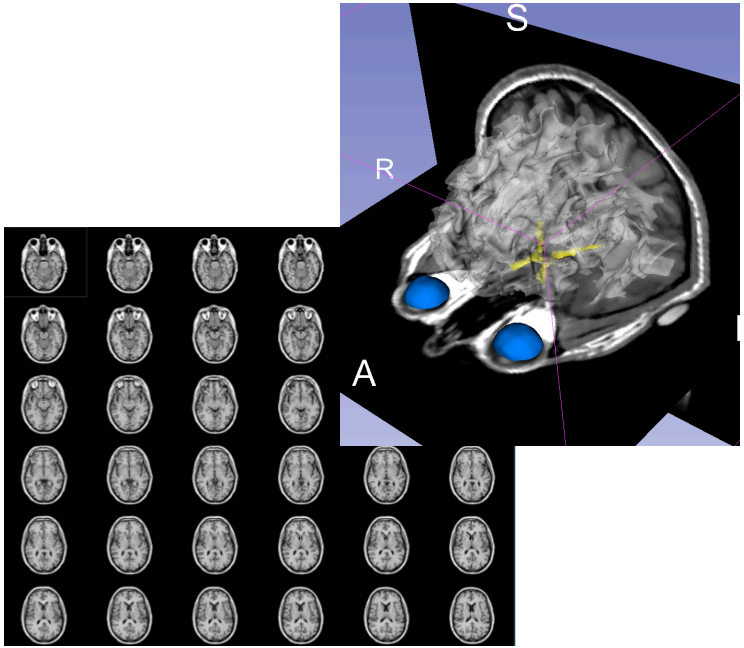
Browse to the directory where you copied the scene, select the file **myNewScene.mrml** and click on **Open**

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.

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