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# **Cardiac MRI Toolkit Slicer Extension**

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# Learning Objective

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This tutorial demonstrates how to use the Cardiac MRI Toolkit Slicer extension.



# Pre-Requirement

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To use this tutorial, you would need to have completed:

## **Data Loading and Visualization**

by Sonia Pujol, Ph.D., Harvard Medical School

<http://www.slicer.org/slicerWiki/index.php/Documentation/4.0/Training>



# Material

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This tutorial requires the installation of the Slicer4.1 release and the tutorial dataset. These are available at the following locations-

**Slicer** download page:

<http://www.slicer.org/pages/Downloads/>

**Tutorial dataset:** Cardiac MRI Toolkit Tutorial Data

[http://www.na-mic.org/Wiki/index.php/File:Cardiac\\_MRI\\_Toolkit\\_Tutorial\\_Data.zip](http://www.na-mic.org/Wiki/index.php/File:Cardiac_MRI_Toolkit_Tutorial_Data.zip)



# Platforms

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This tutorial was designed for-



10.6.8





# About This Tutorial

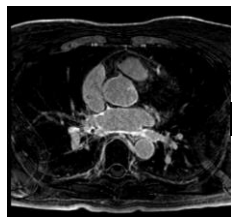
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- This tutorial explains the usage of the Cardiac MRI Toolkit with a series of screen shots and video captures
- Screen shots will explain how to initialize Slicer modules for each step
- Video captures will show the entire process of completing a step

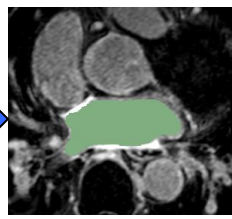
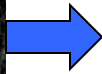


# Overview

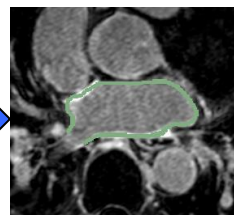
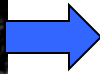
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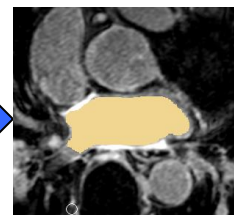
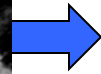
Input  
Image



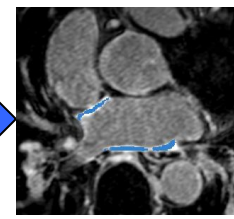
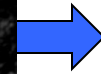
Segment  
Endo



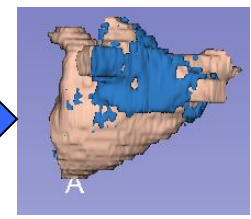
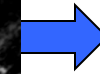
Segment  
Wall



Remove  
PVs



Auto Scar  
Detection



Visualization



# 1. Get the Extension

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The extension can be downloaded using the Extension Manager, after installing the latest nightly binary of Slicer:

<http://download.slicer.org/>

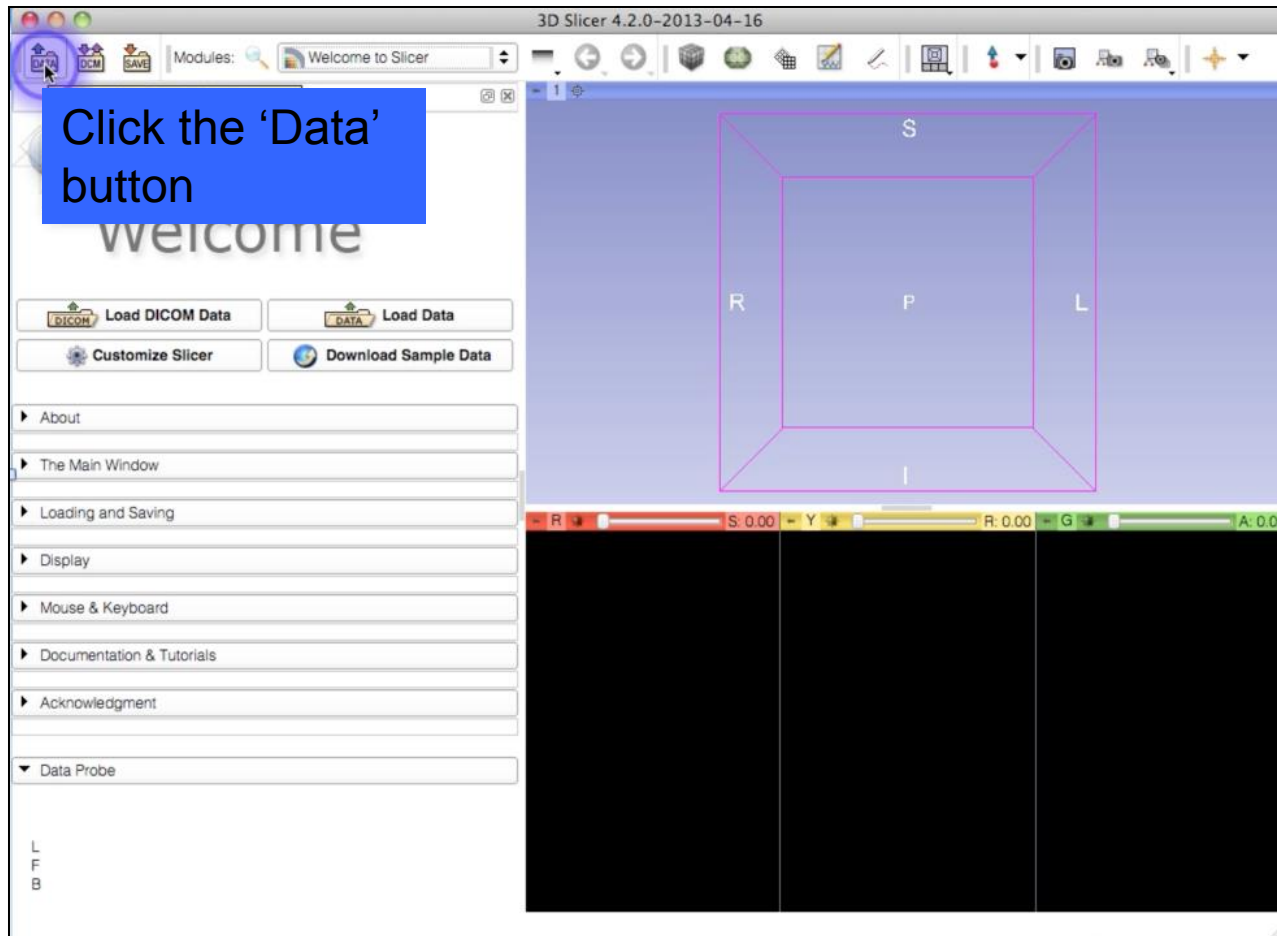
The extension can be built manually after downloading our source code from the CARMA Center GitHub repo:

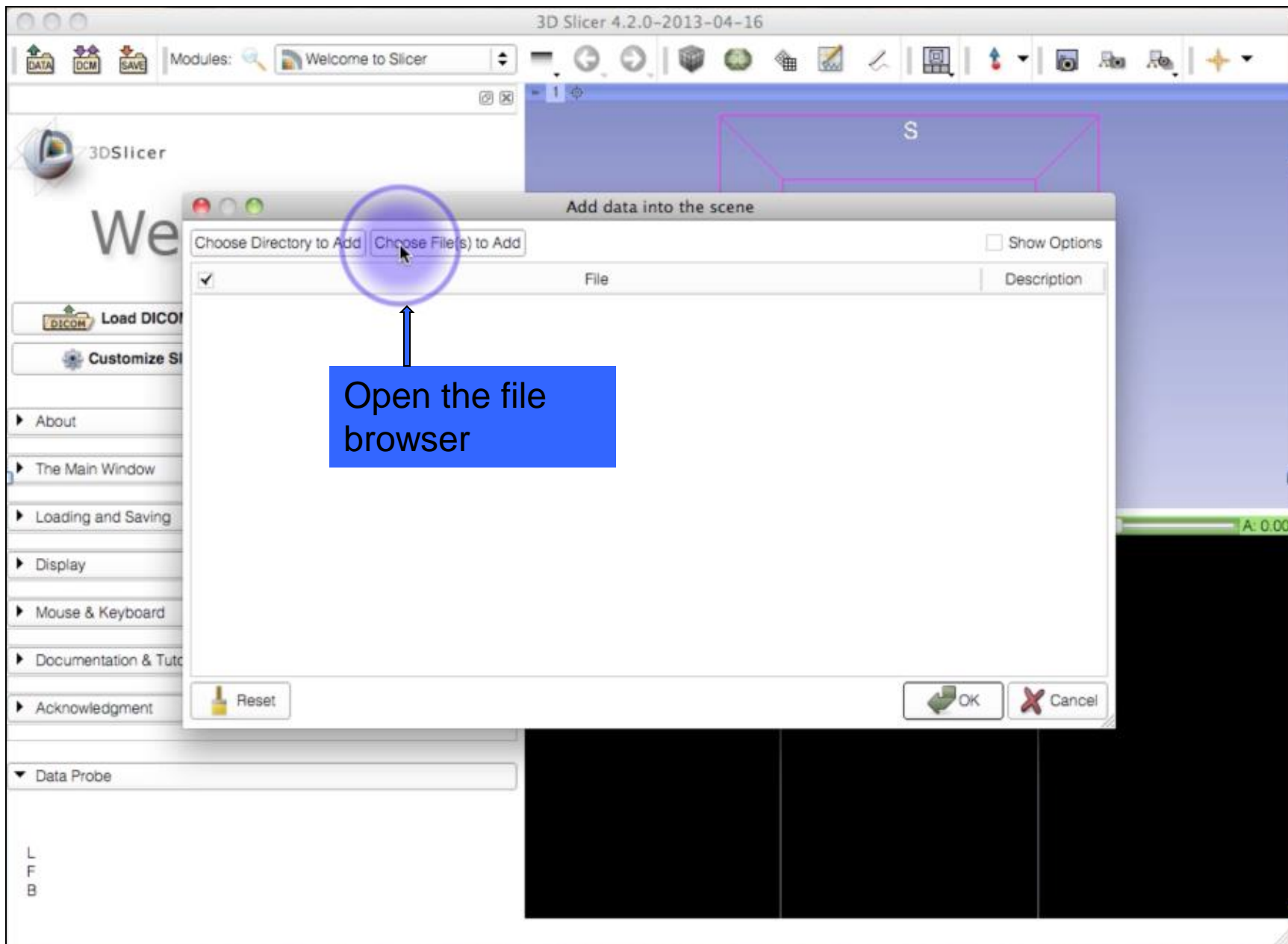
[https://github.com/carma-center/carma\\_slicer\\_extension](https://github.com/carma-center/carma_slicer_extension)

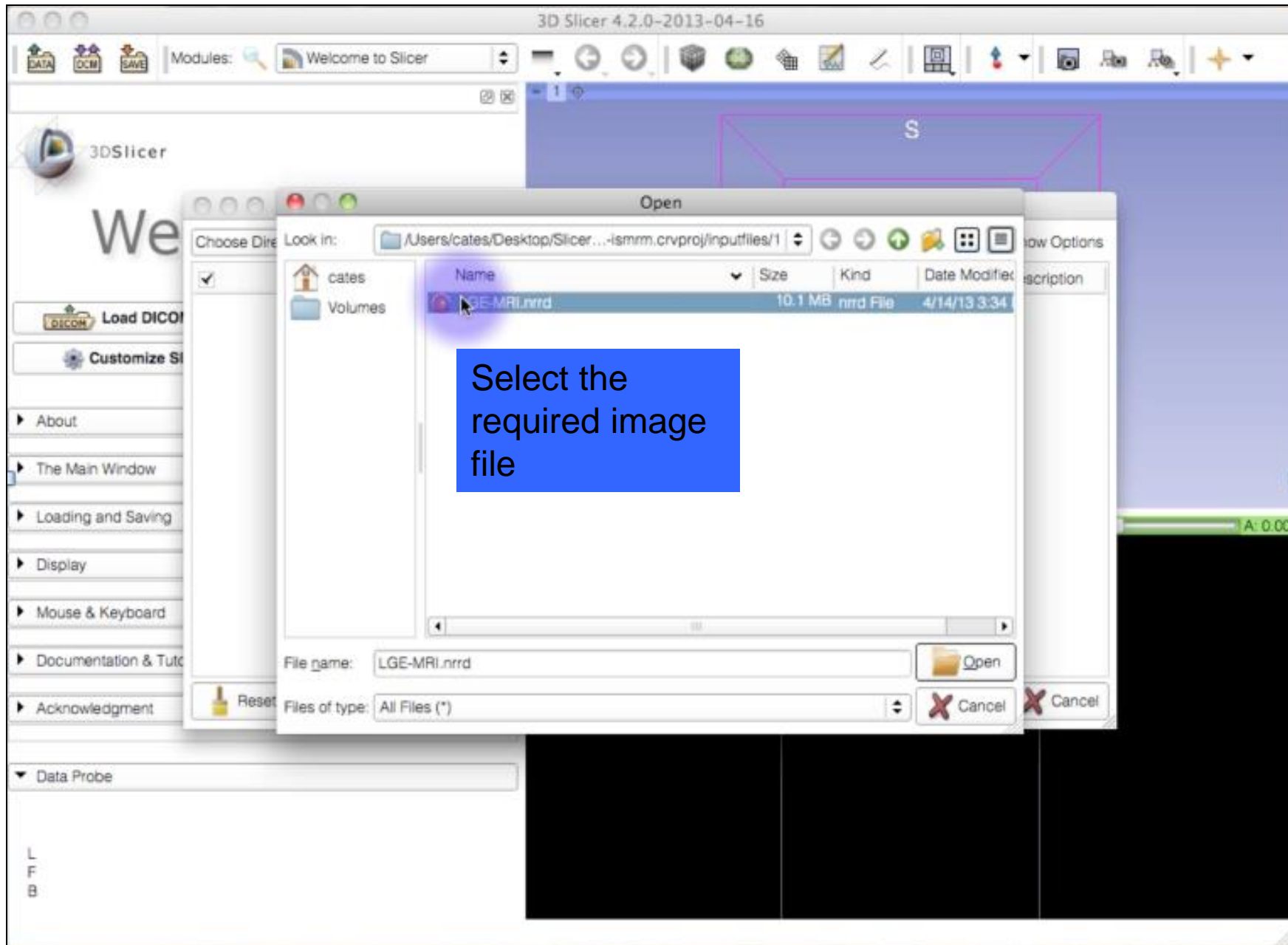


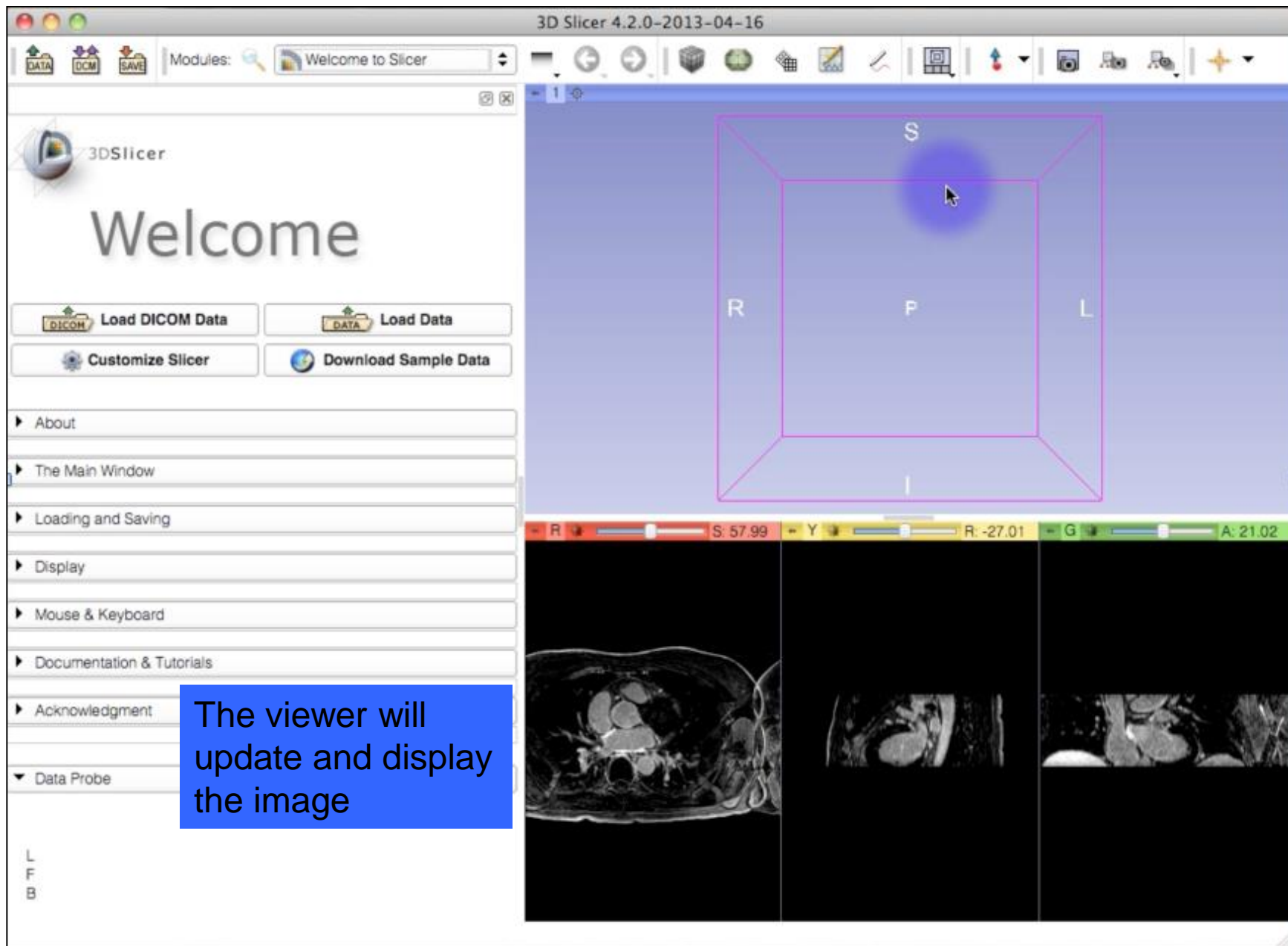


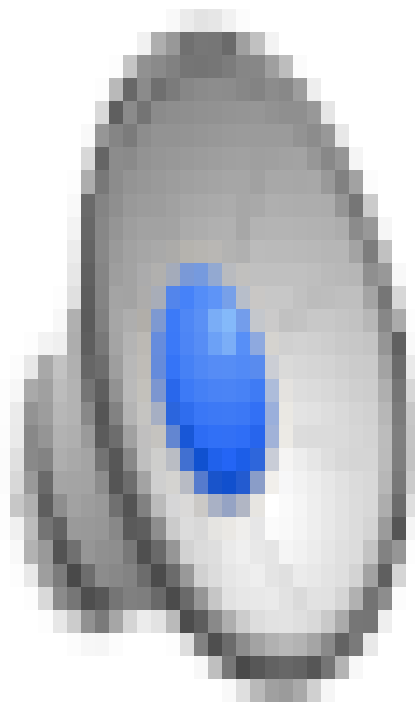
## 2. Load the Sample LGE-MRI Image







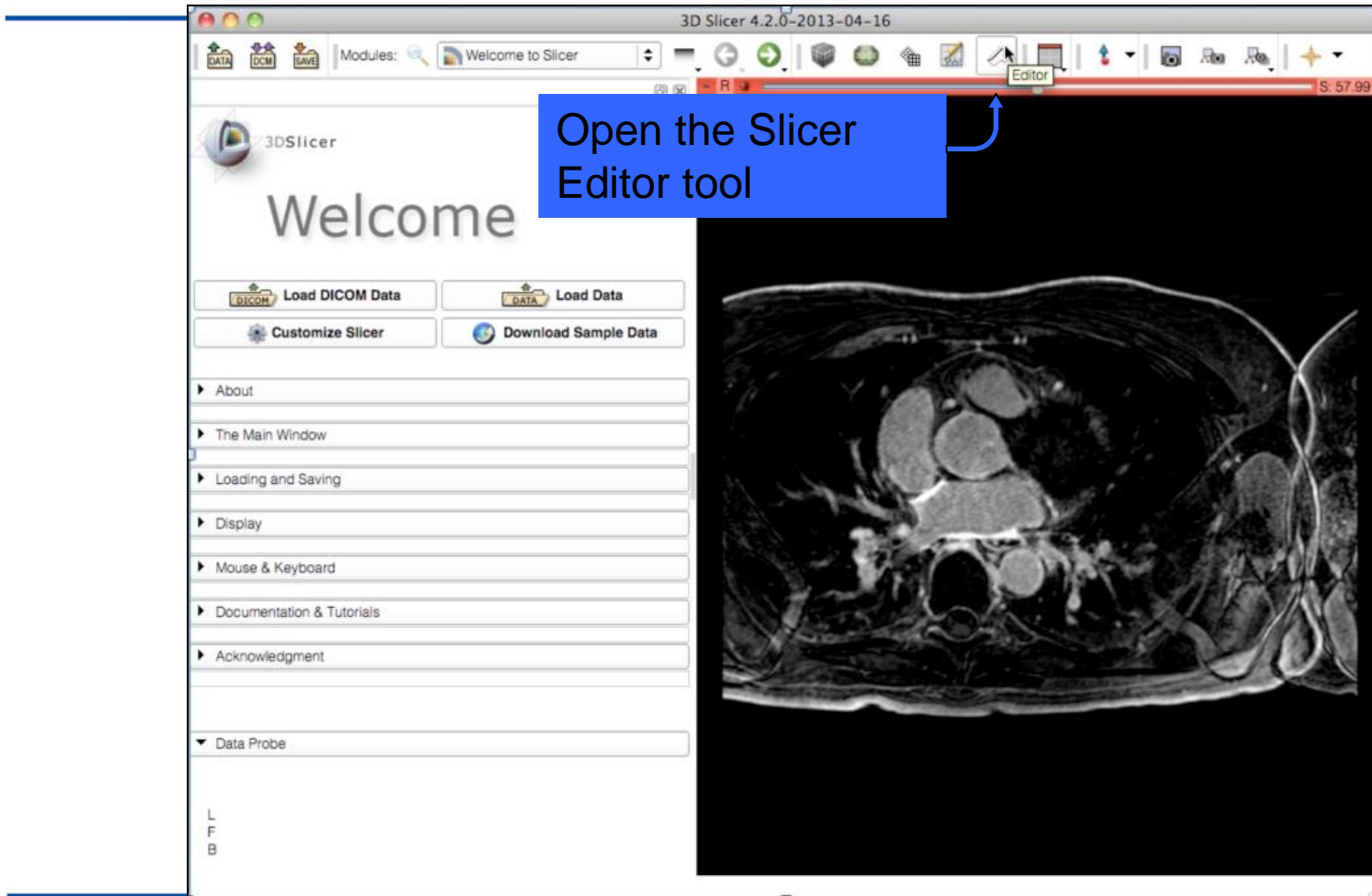


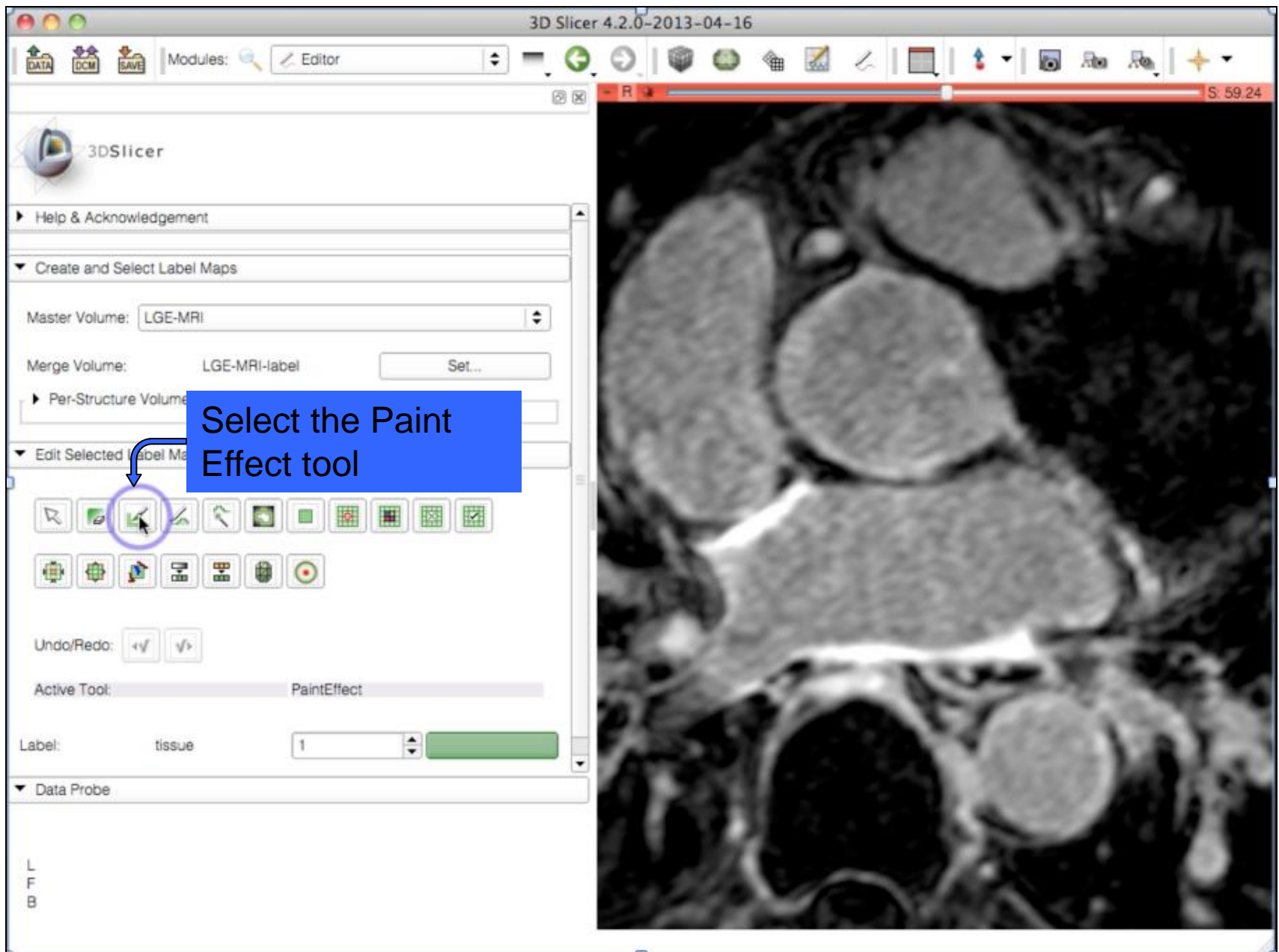


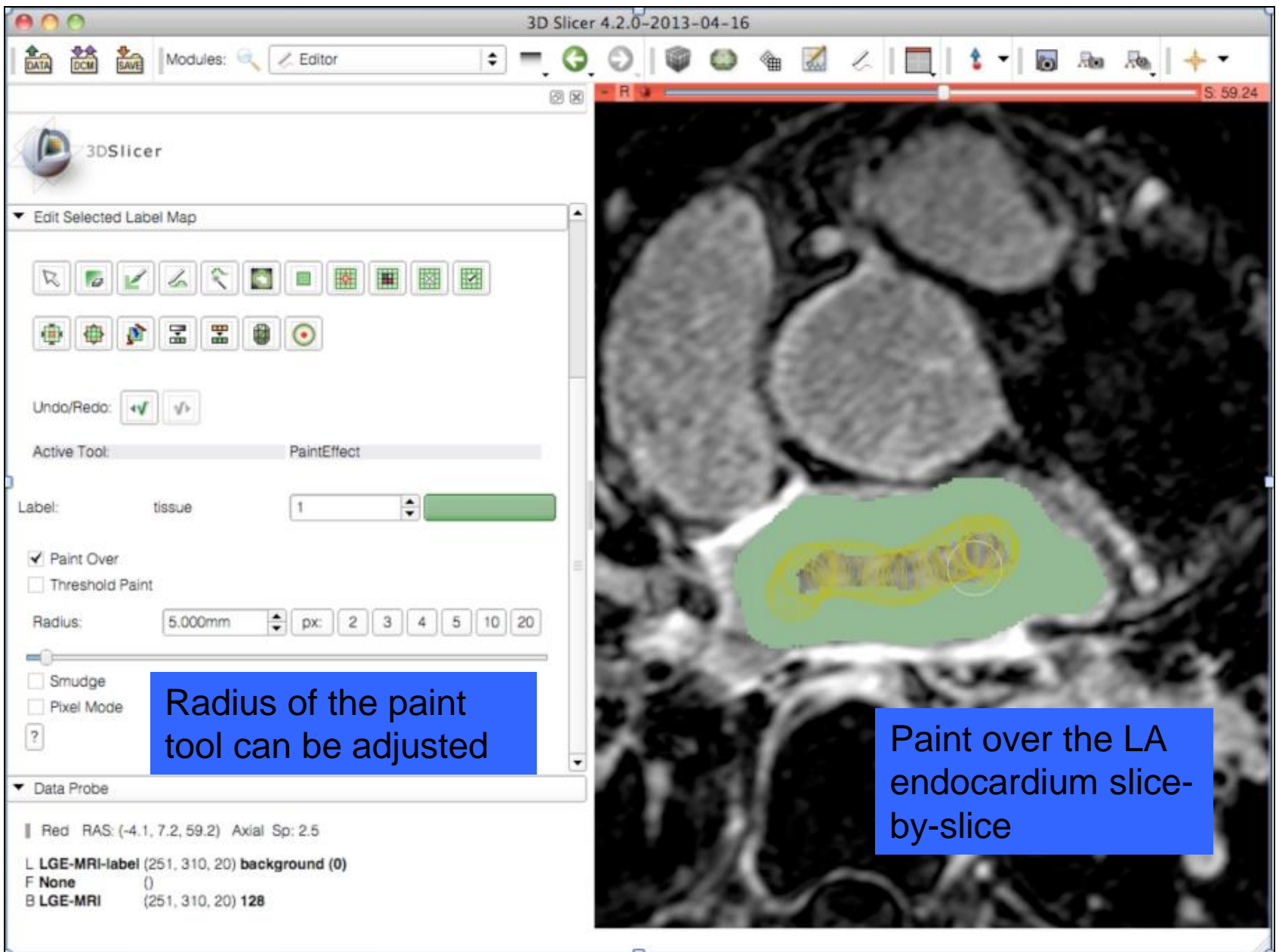
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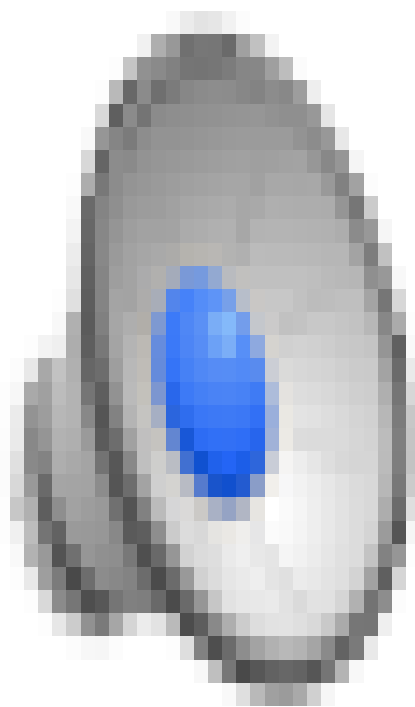
# 3. Manually Segment the LA Endocardium







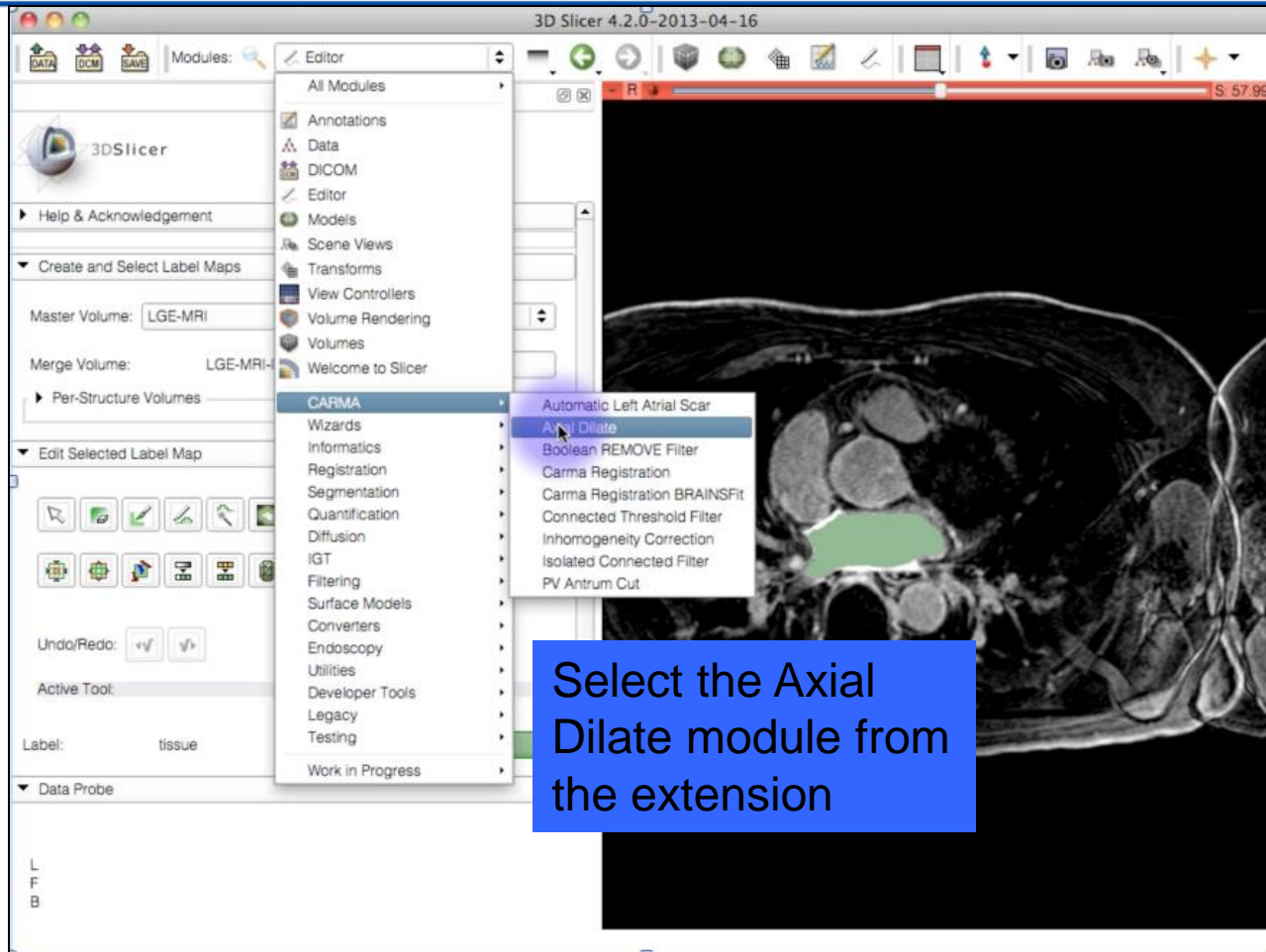




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# 4. Dilate the Endocardium Segmentation





Set the Target Mask as the endocardium segmentation



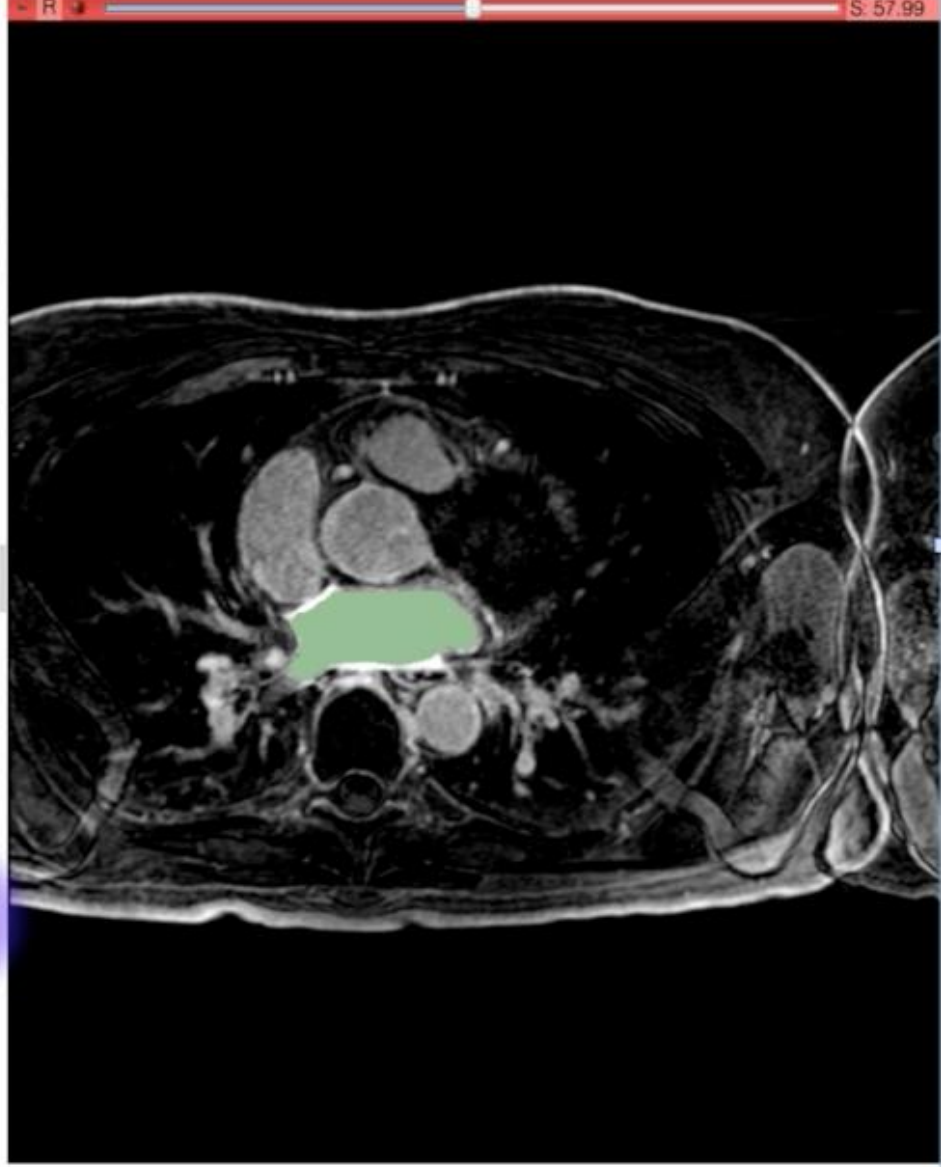
Target mask LA Endo  
Output LA-Epi

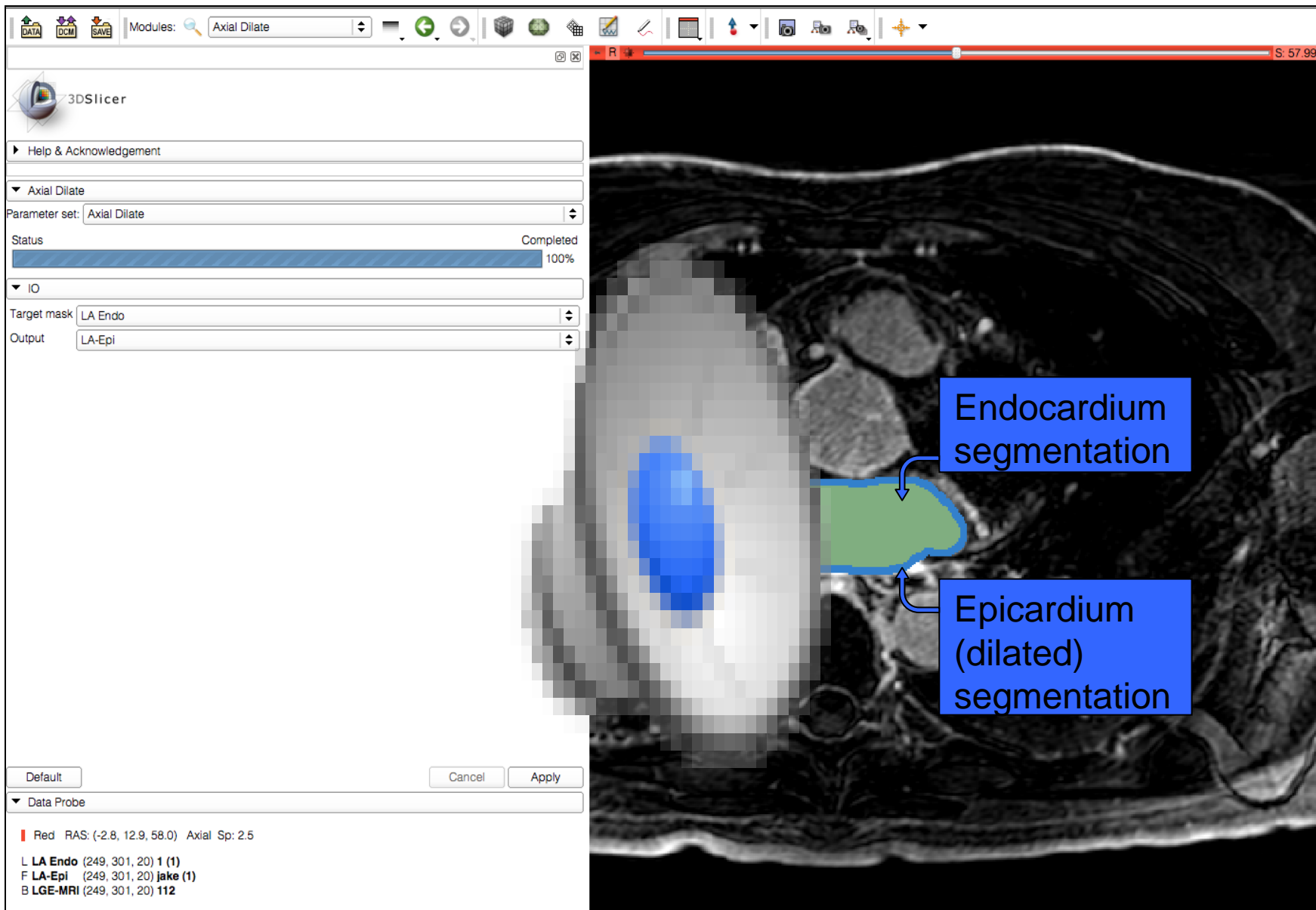


Create a new output image for the Axial Dilate result



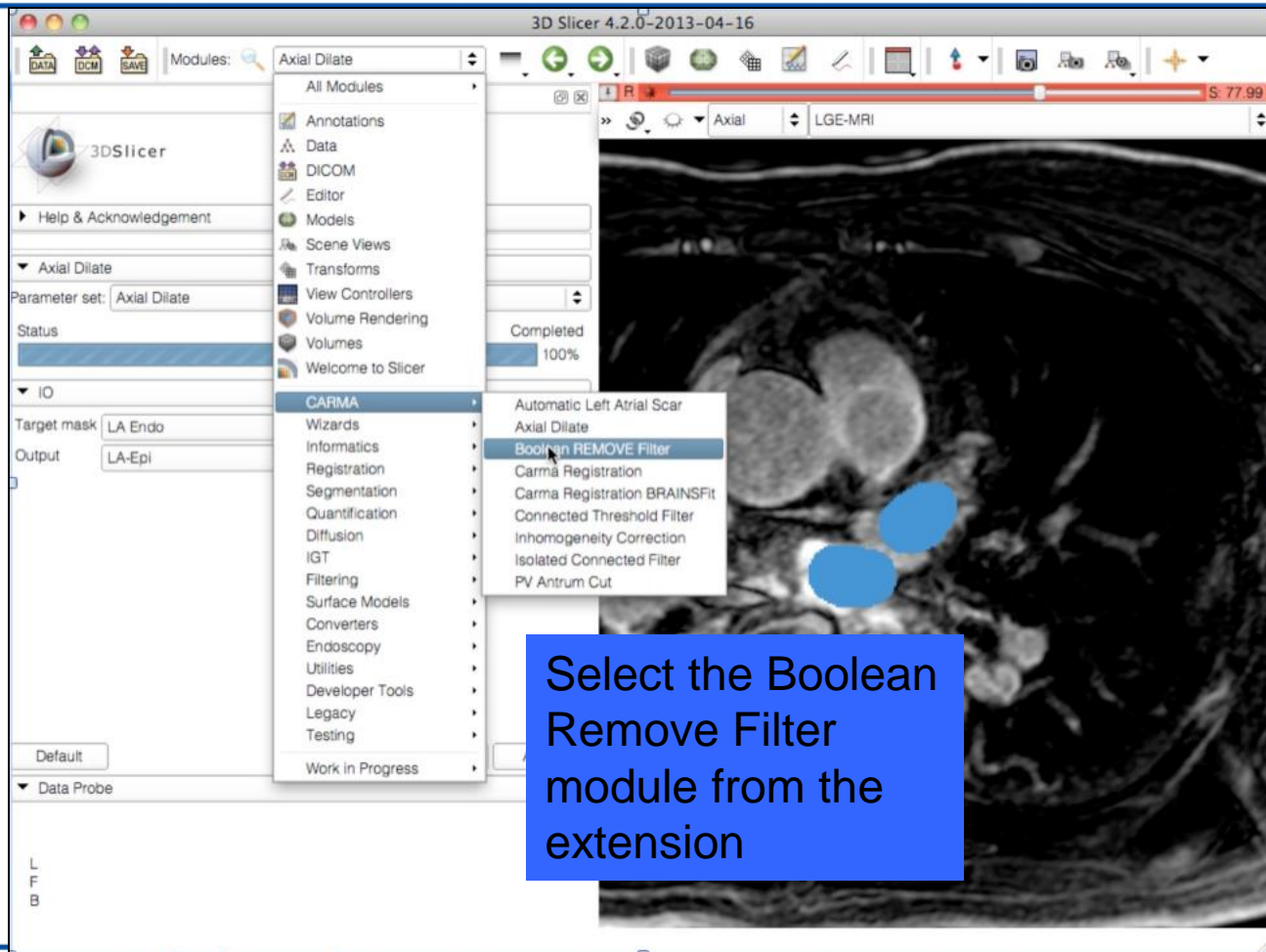
Run the module







# 5. Subtract the Segmentations



3DSlicer

Select the required input and output volumes (Subtract endo from epi)

IO

Input Volume 1 LA-Epi

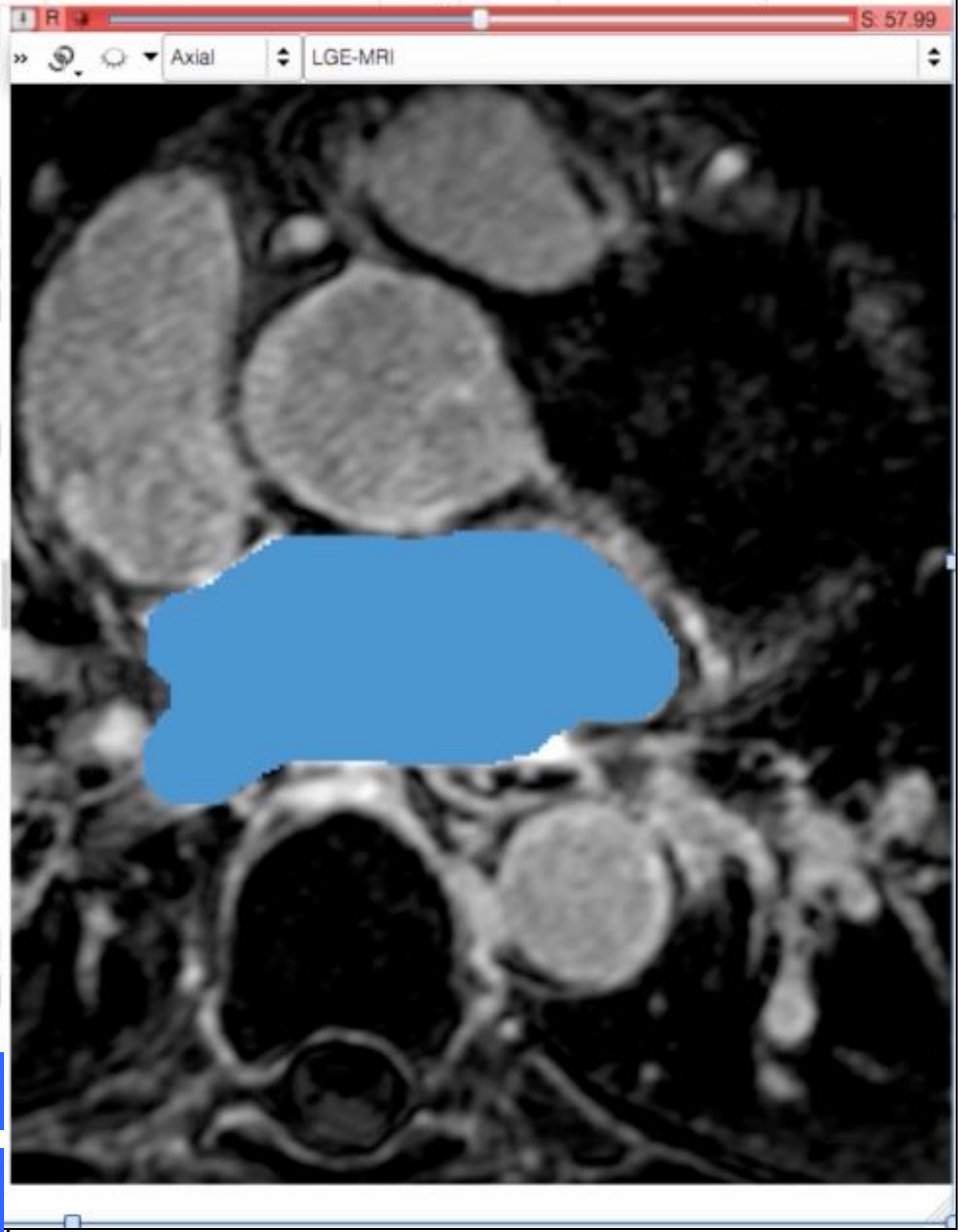
Input Volume 2 LA Endo

Output Volume LA-Wall

Default Cancel Apply

Data Probe

L  
F  
B

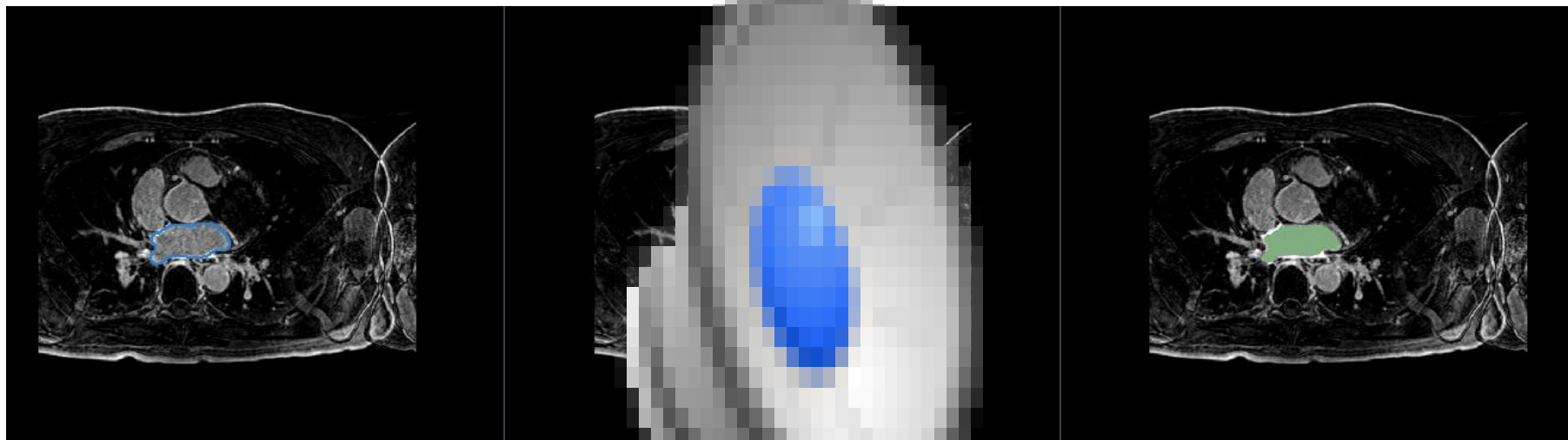


Select the required input and output volumes (Subtract endo from epi)

Create a new output image for the Boolean Remove result

Run the module

Result will be the LA wall segmentation



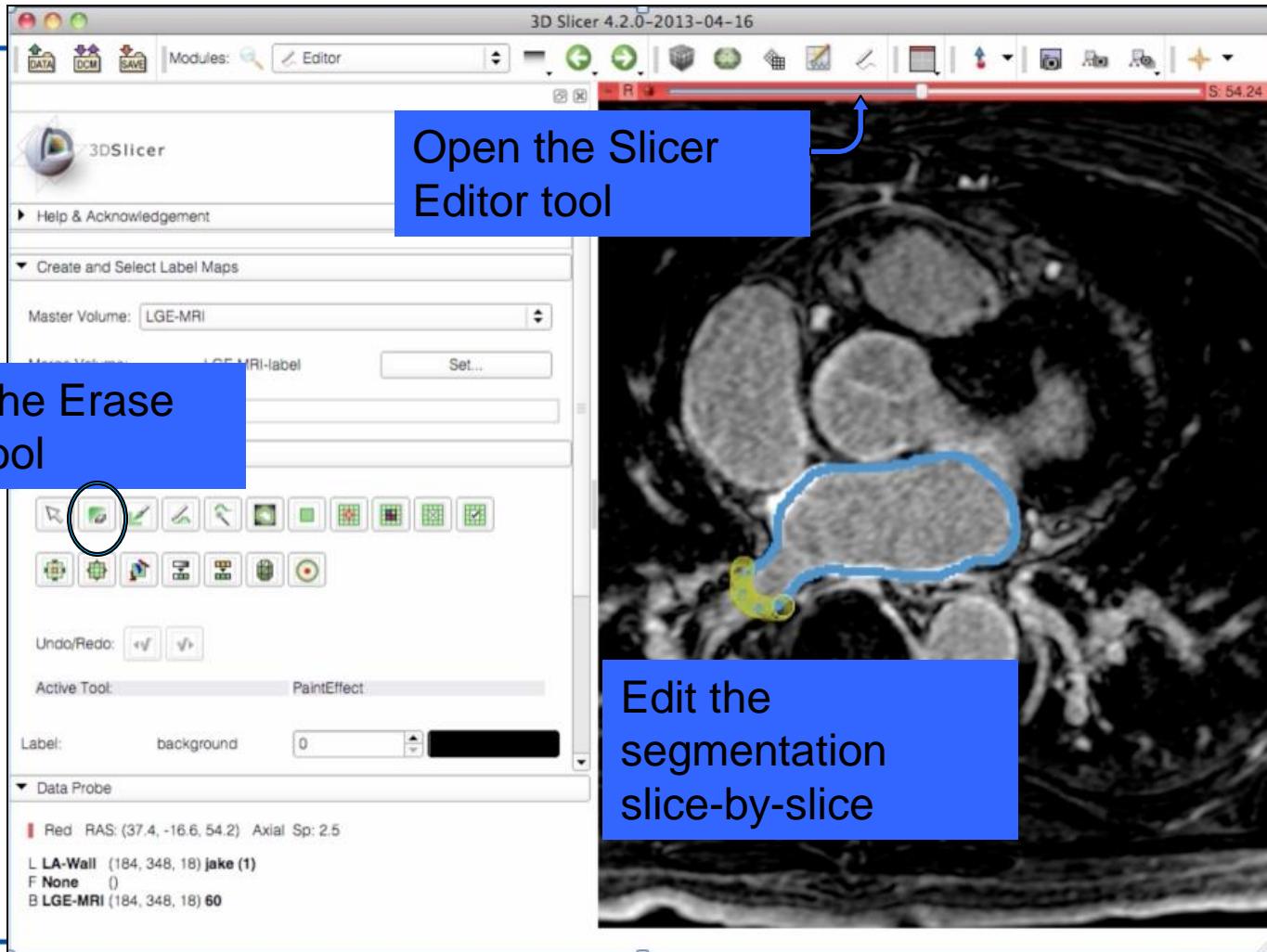
Subtraction result  
(Wall segmentation)

Epicardium  
segmentation

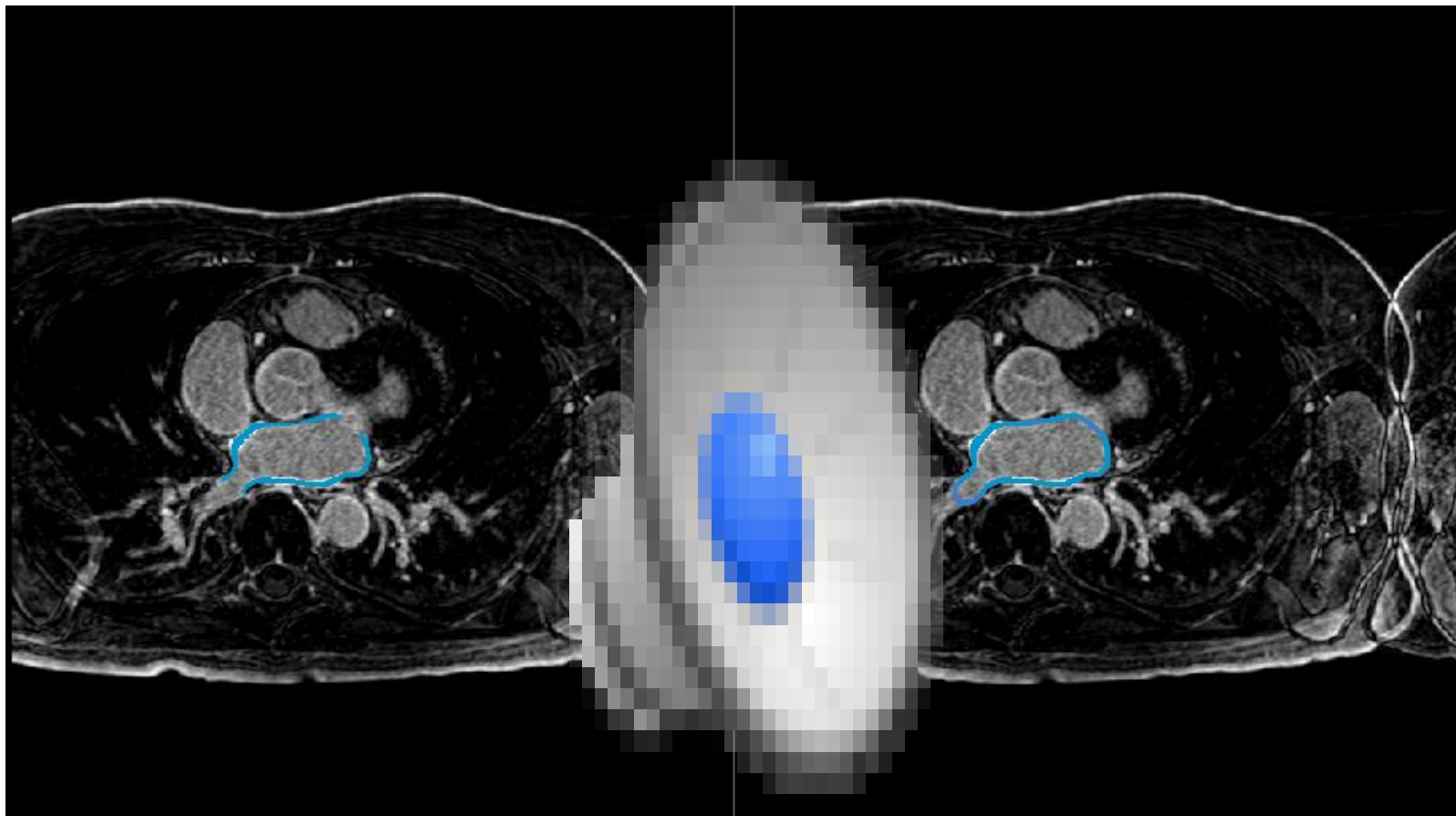
Endocardium  
segmentation



# 6. Remove Pulmonary Veins from Wall Segmentation





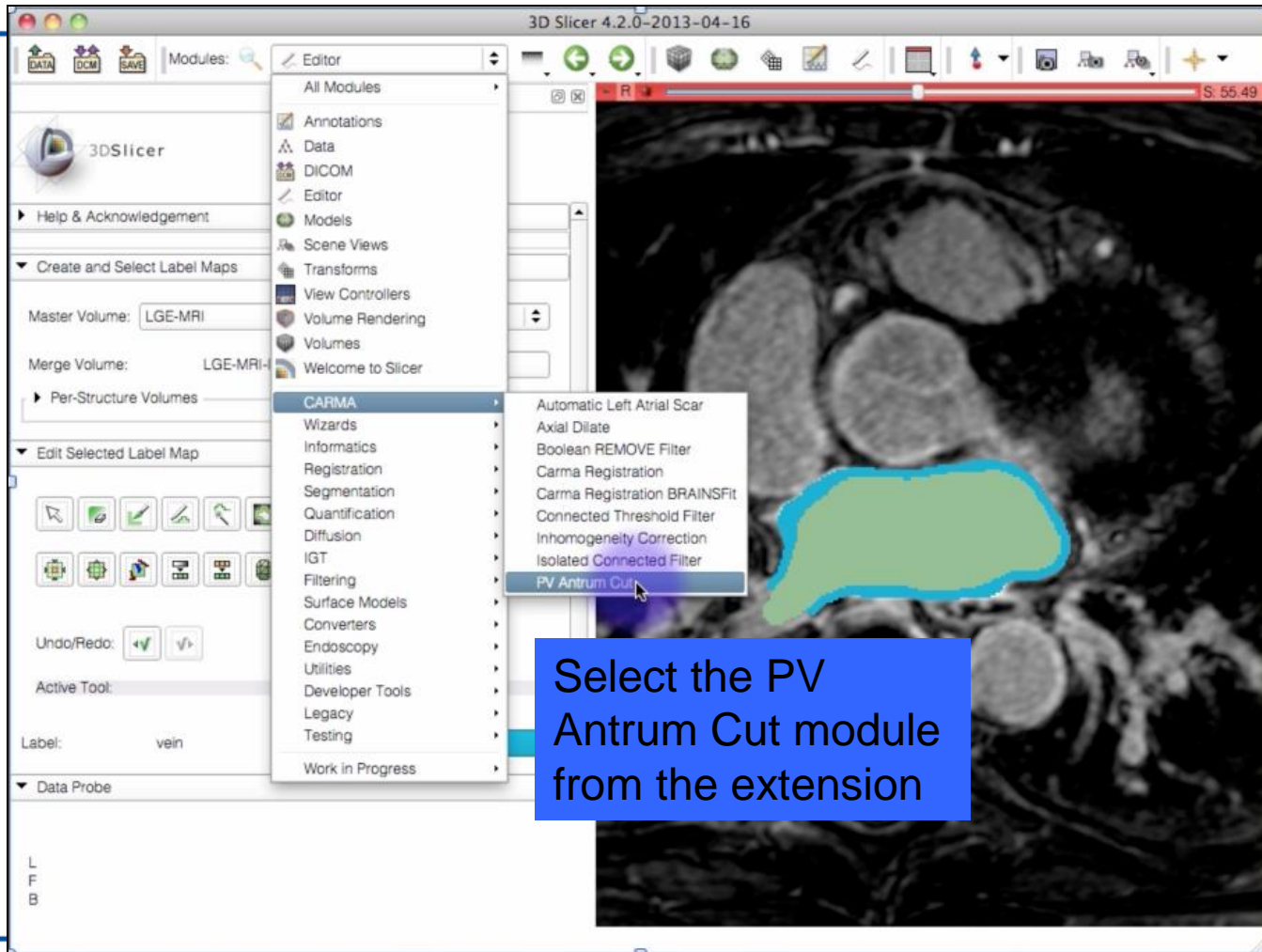


Wall segmentation  
without PVs

Wall segmentation  
with PVs



# 7. Cut Pulmonary Veins from Endocardium Segmentation





Modules: PV Antrum Cut



3DSlicer

Help & Acknowledgement

Select the required input volumes



Input Images

Endo Layer LA Endo

Wall Layer LA Wall

Output Image

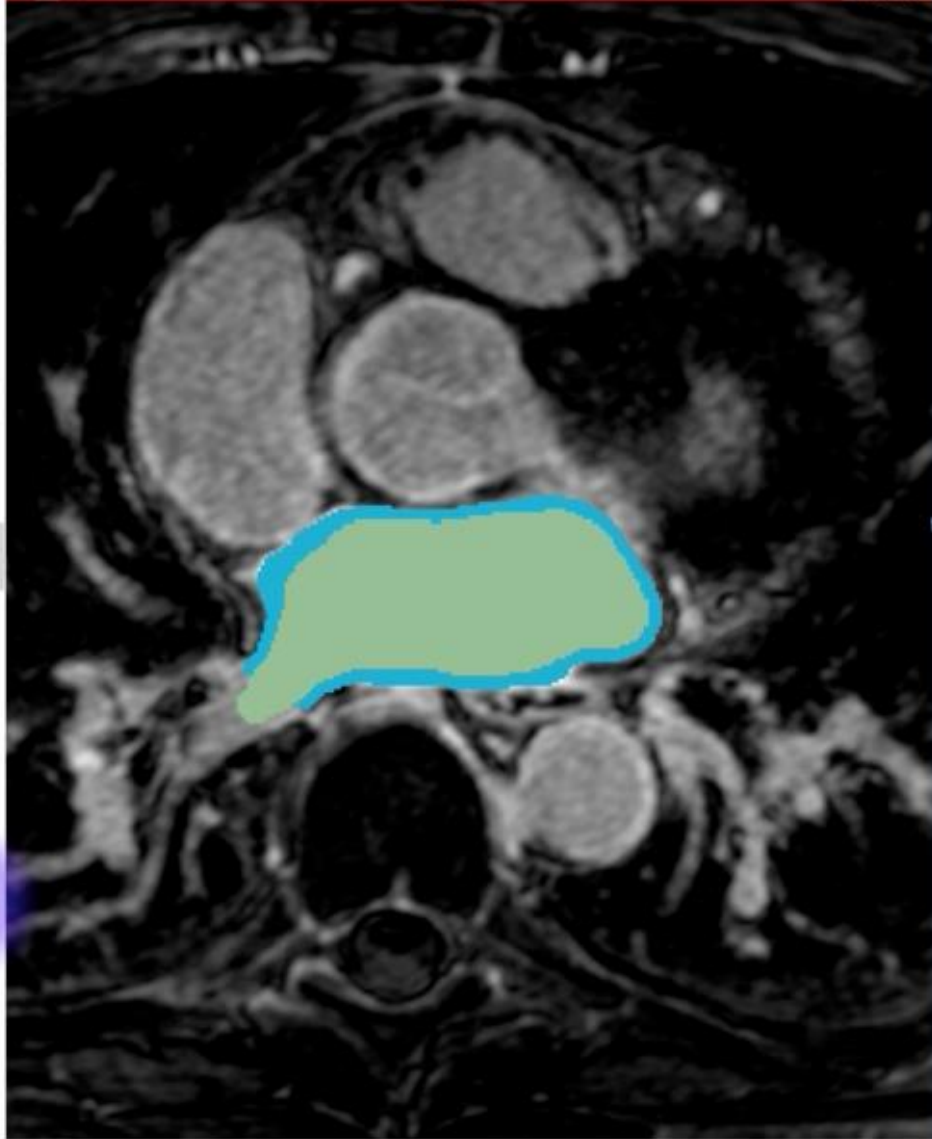
Endo Layer No Veins Endo Layer No Veins\_1

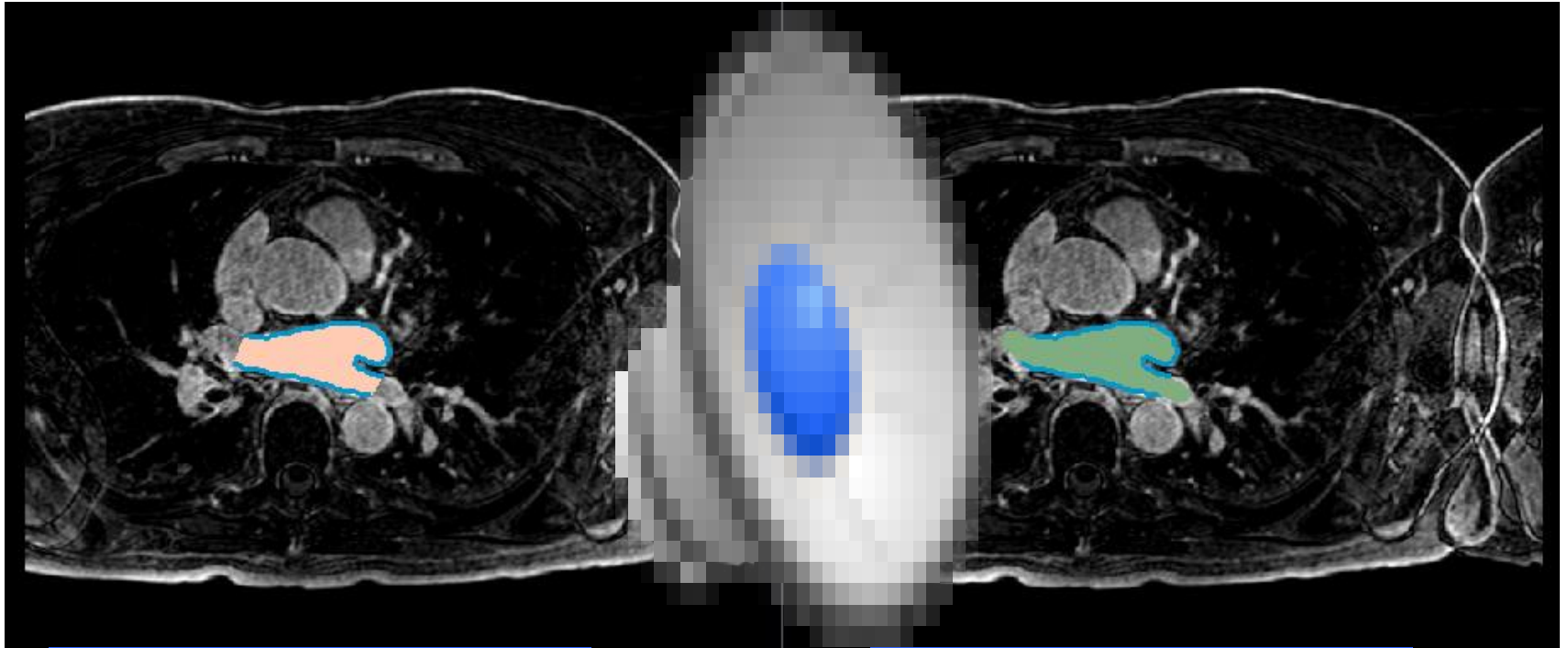
Create a new output image for the PV Antrum Cut result

Default Cancel Apply

Data Probe

Run the module



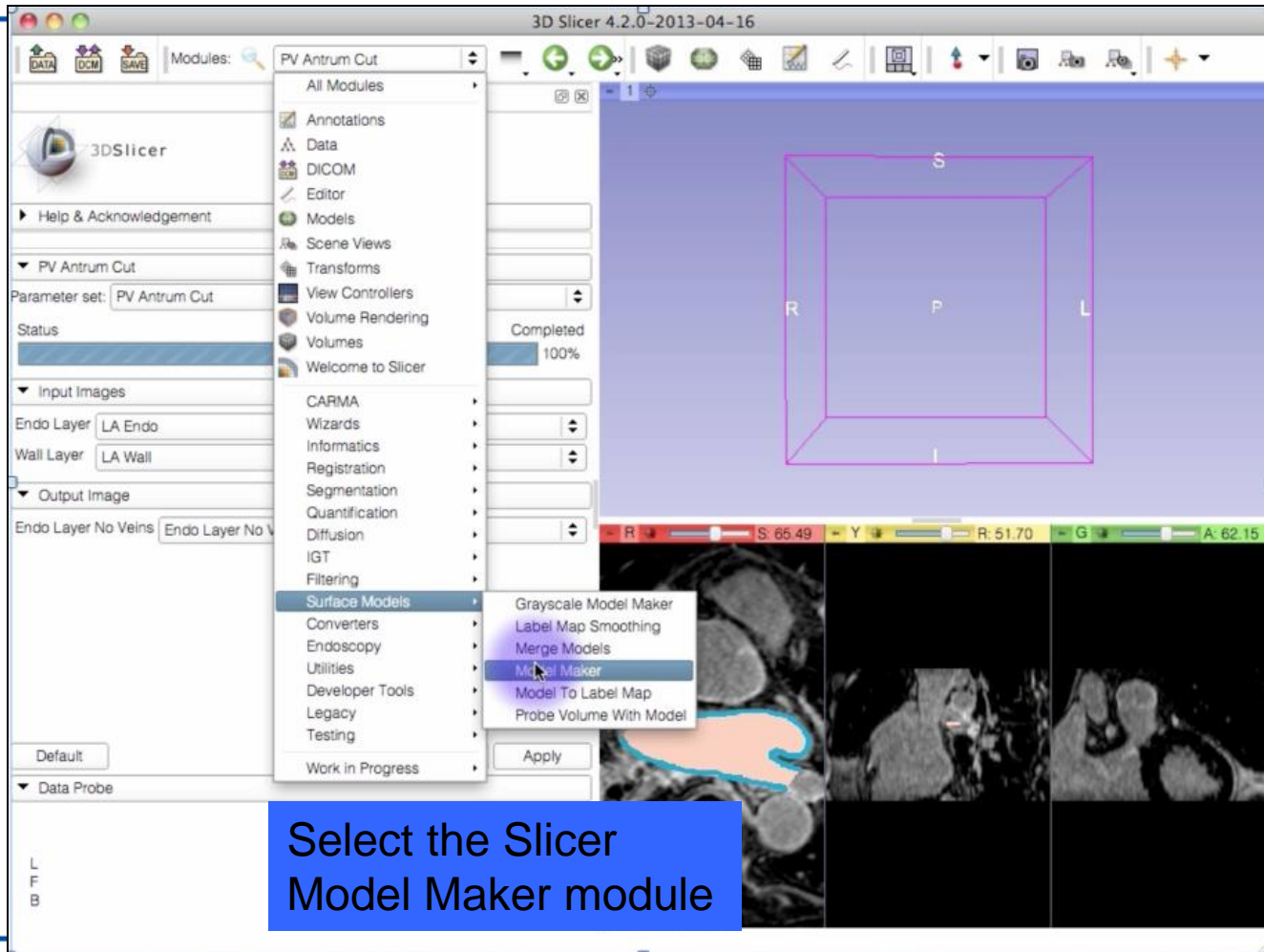


Endocardium  
segmentation minus PVs

Endocardium  
segmentation with PVs



# 8. Create Model of Endocardium Minus PVs





Help & Acknowledgement

Model Maker

Parameter set: Model Maker

Status: Idle

IO

Input Volume: Endo Layer No Veins\_1

Models: Models

Create Multiple

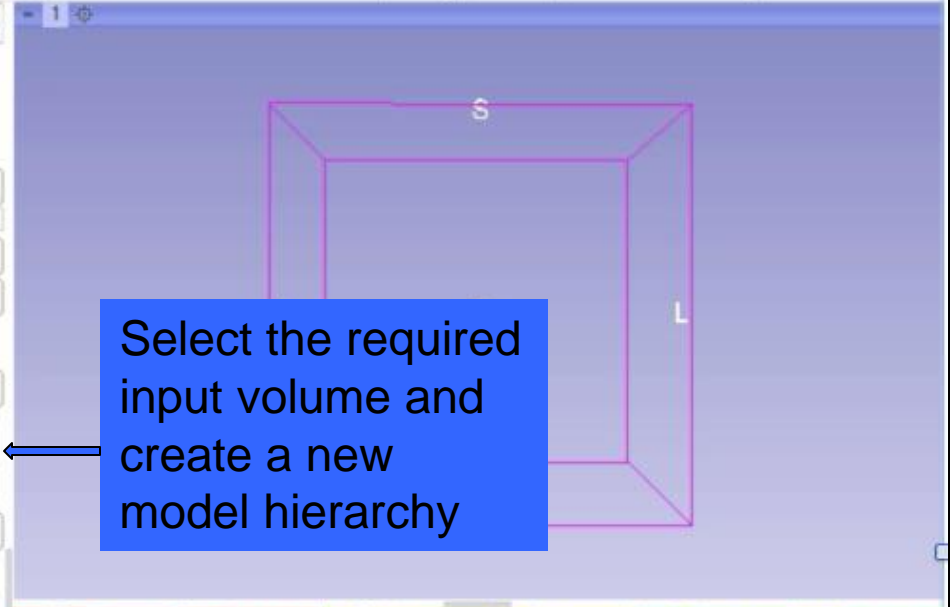
Model Name: Model

Generate All Models:

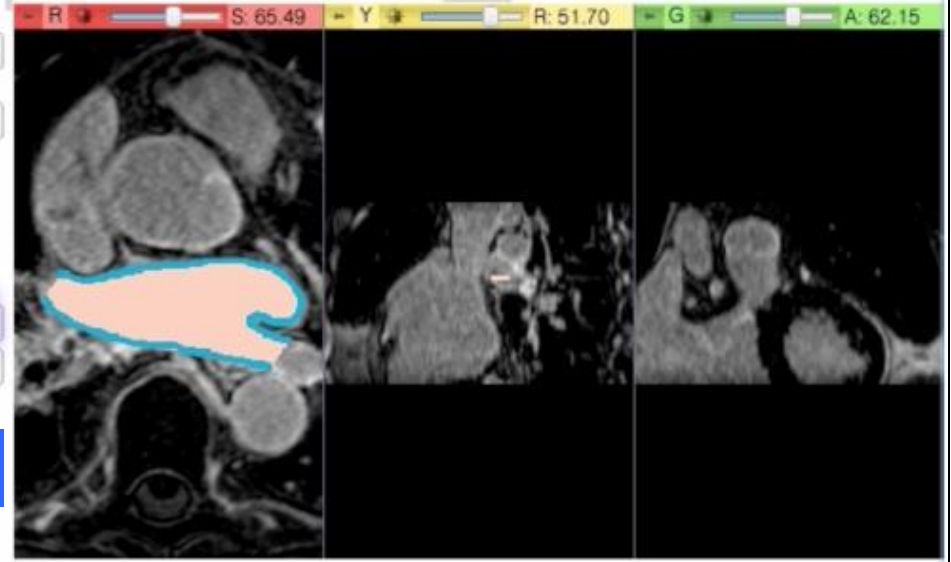
Model Maker Parameters

Debug

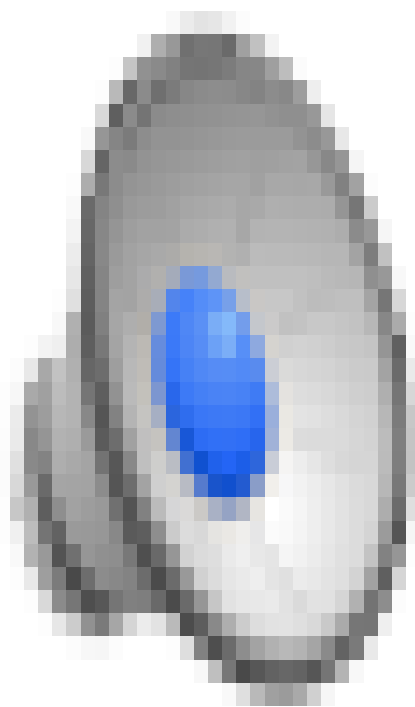
Default Cancel Apply



Select the required input volume and create a new model hierarchy



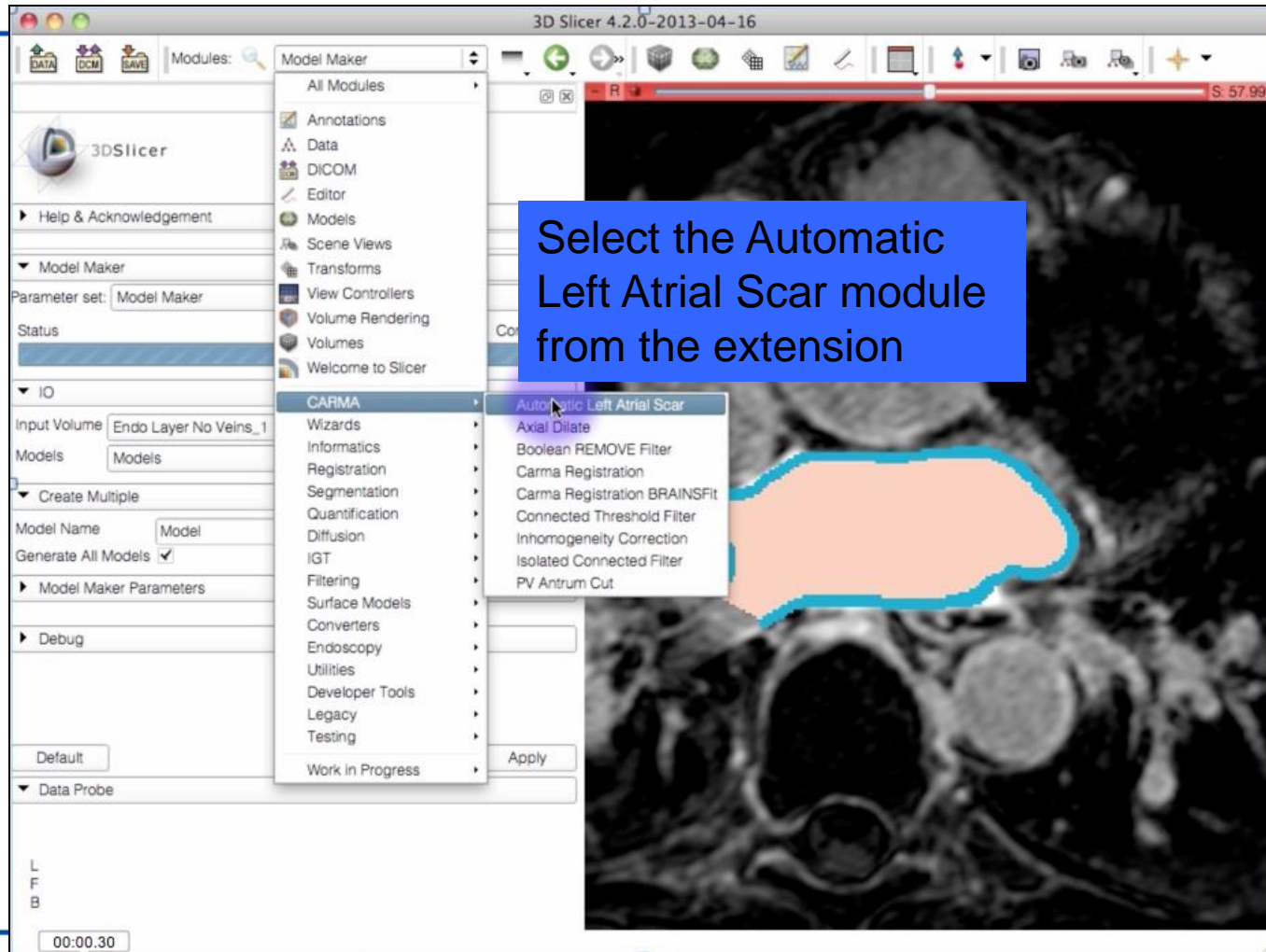
Run the module



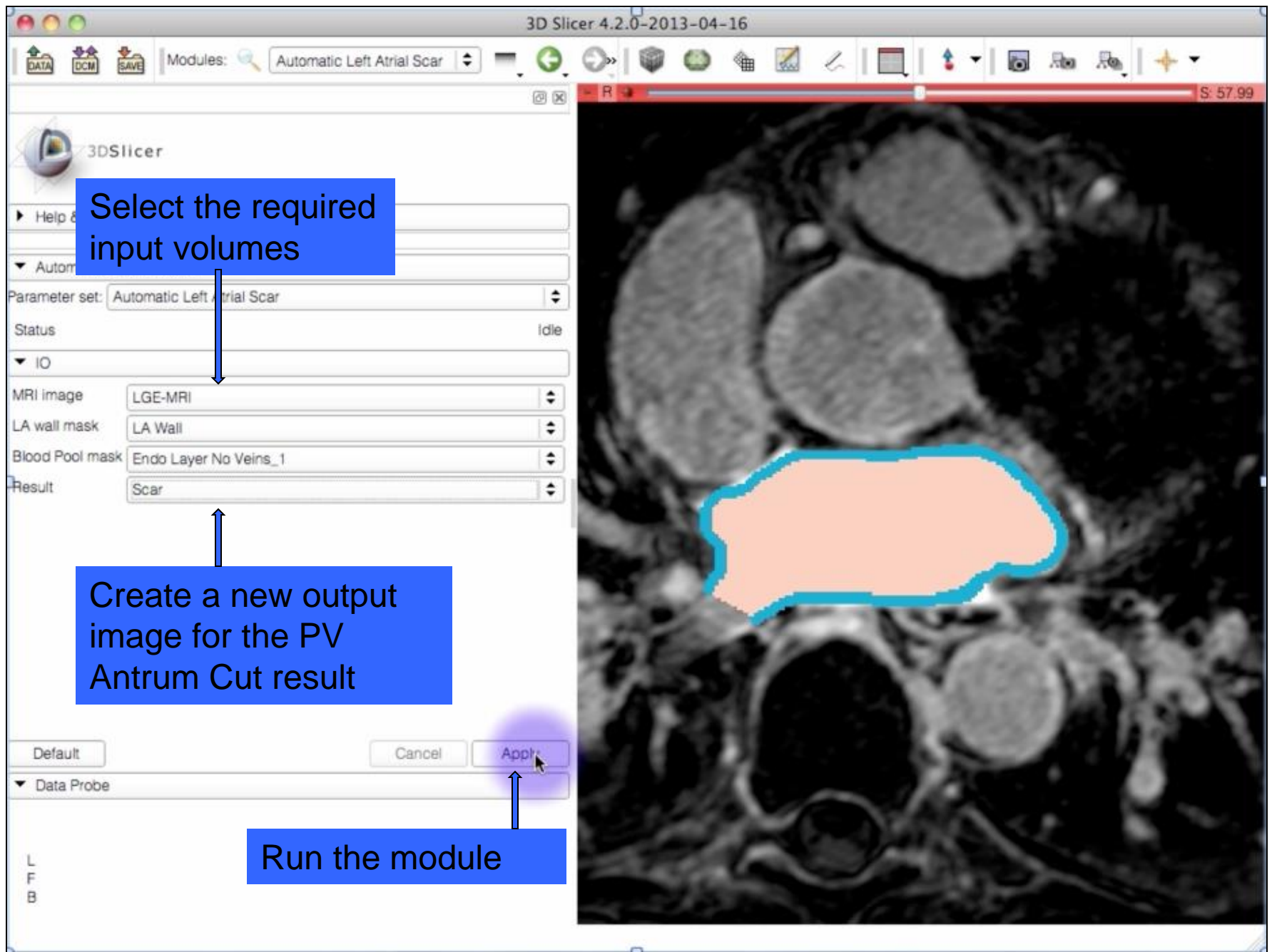
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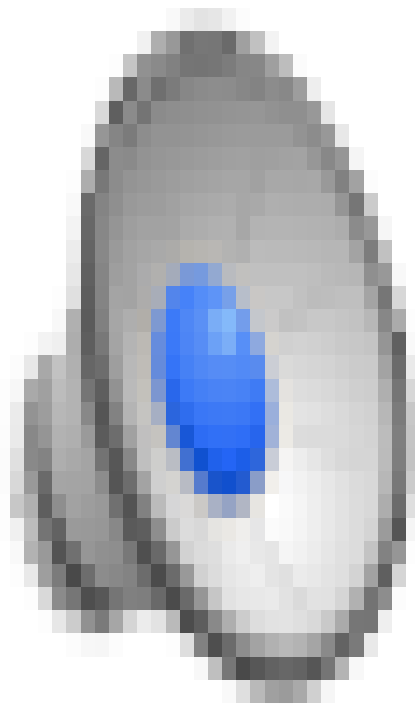


# 9. Run Automatic LA Scar Detection





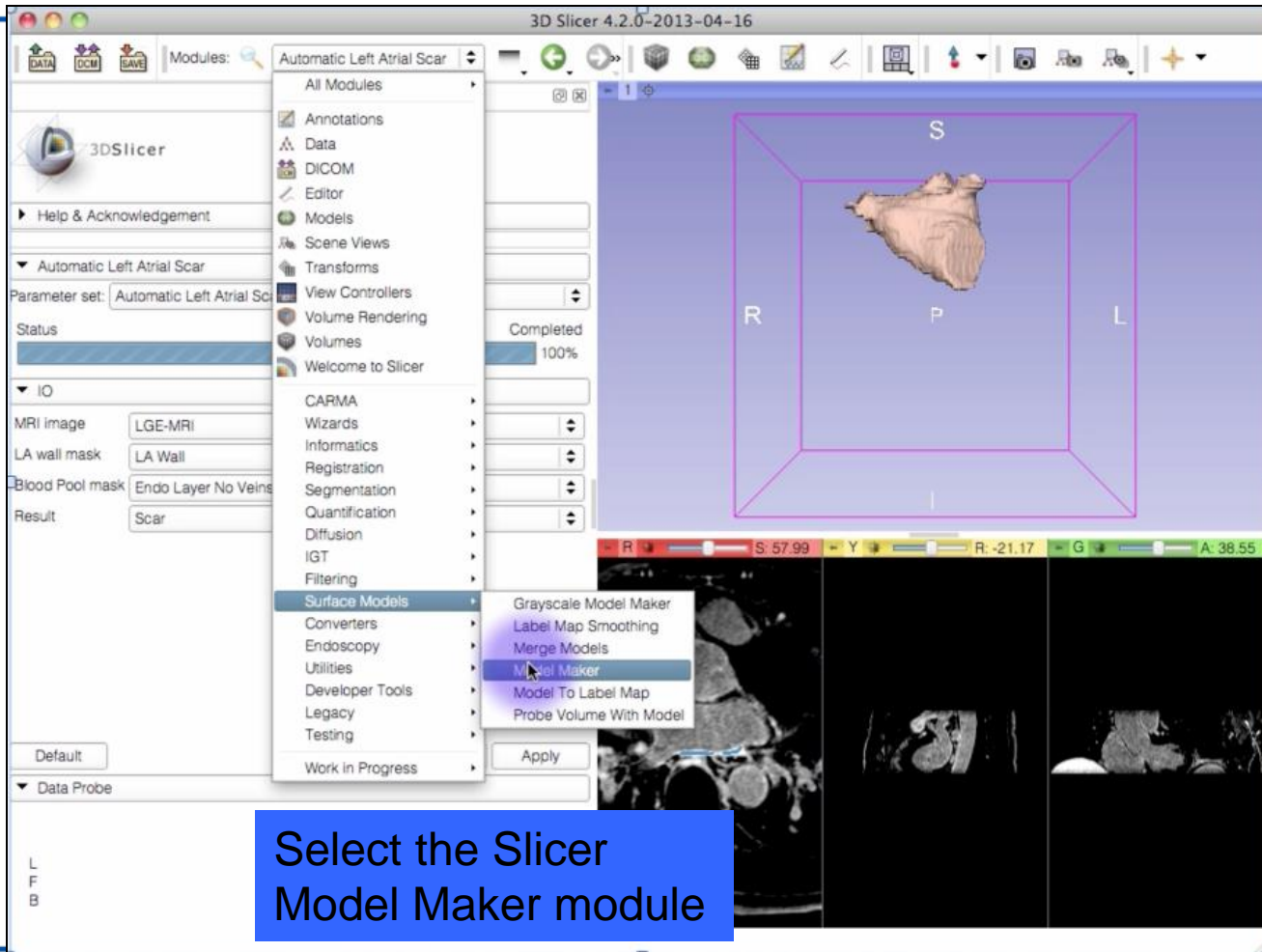




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# 10. Create Scar Model





3DSlicer

► Help & Acknowledgement

▼ Model Maker

Parameter set: Model Maker

Status Completed 100%

▼ IO

Input Volume Scar

Models Models

▼ Create Multiple

Model Name Model

Generate All Models

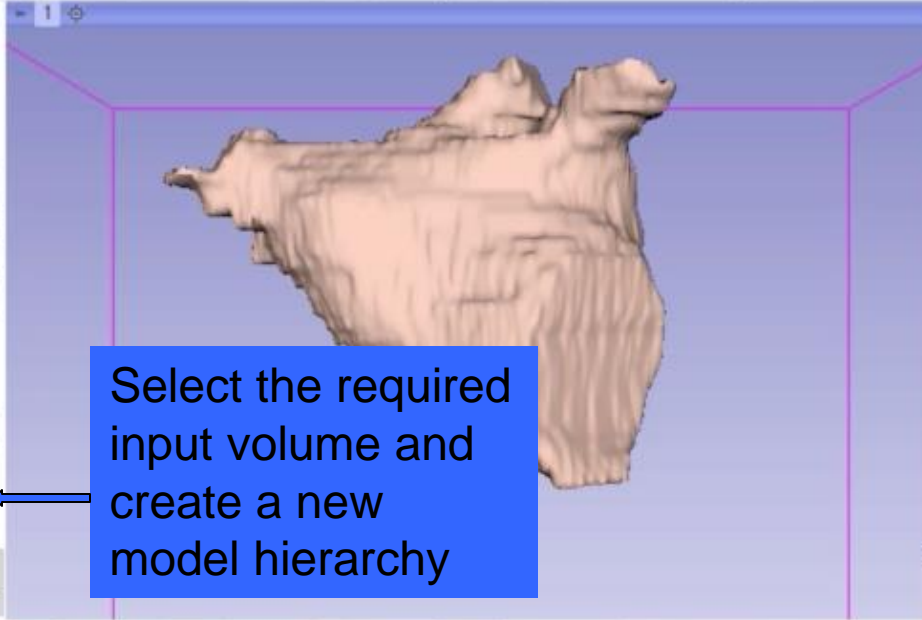
► Model Maker Parameters

► Debug

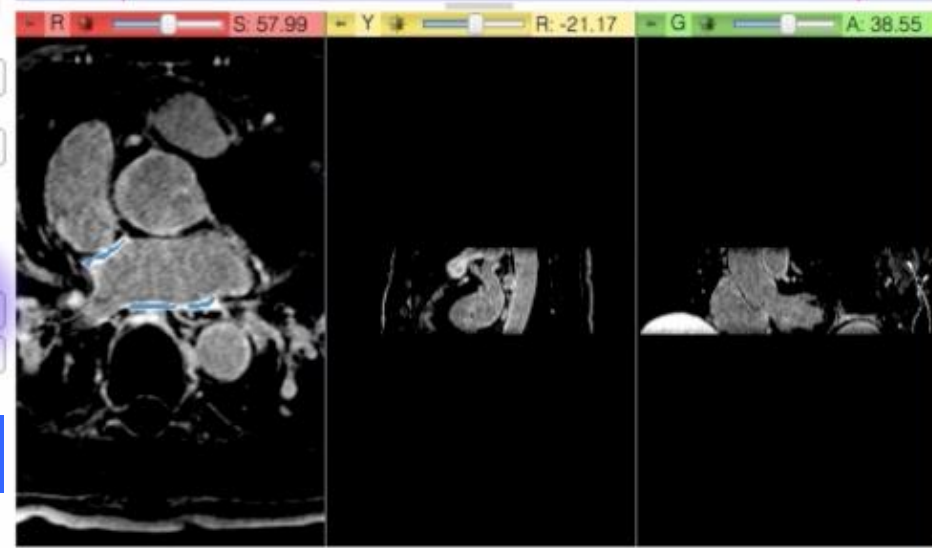
Default Cancel Apply

▼ Data Probe

L  
F  
B



Select the required input volume and create a new model hierarchy



Run the module



3DSlicer

Help & Acknowledgement

Model Maker

Parameter set: Model Maker

Status Completed 100%

IO

Input Volume Scar

Models Models

Create Multiple

Model Name Model

Generate All Models

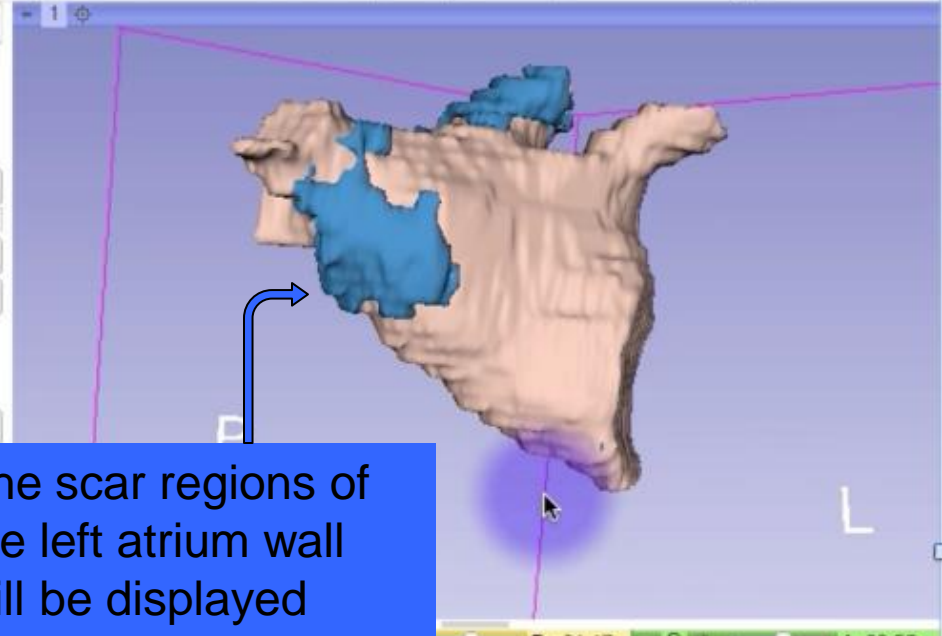
Model Maker Parameters

Debug

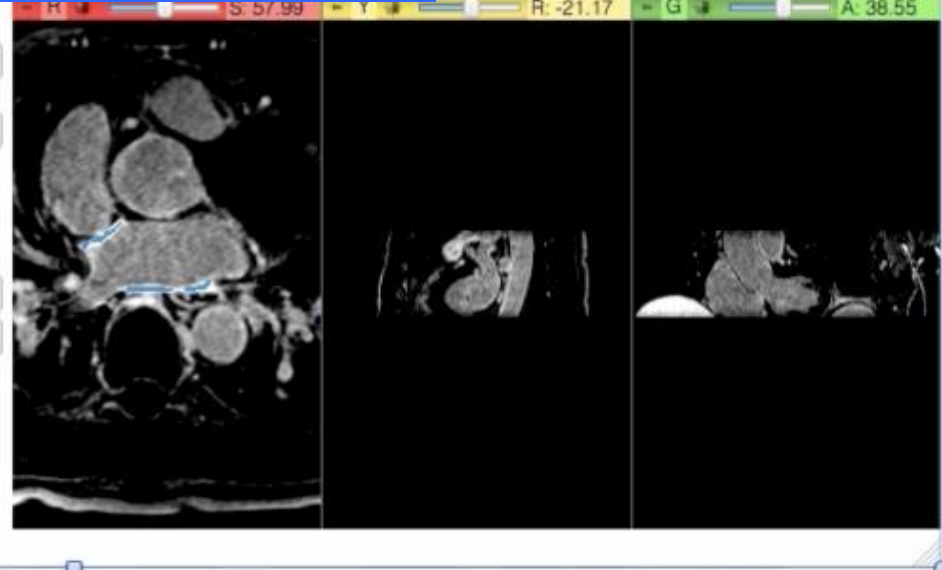
Default Cancel Apply

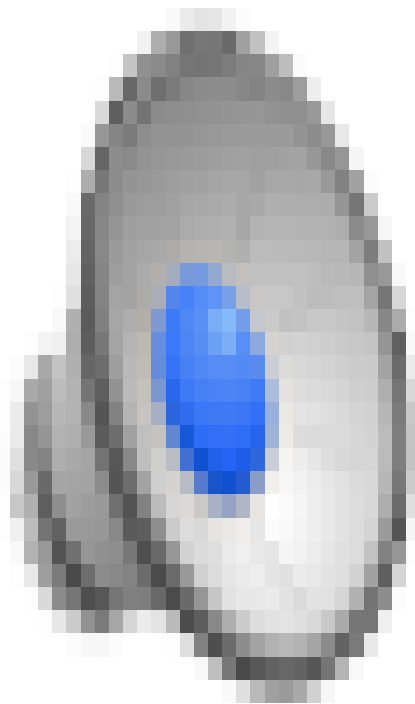
Data Probe

L  
F  
B



The scar regions of the left atrium wall will be displayed





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# Conclusion

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We have demonstrated the use of our Cardiac MRI Toolkit Slicer extension for the purpose of segmentation and enhancement quantification.



# Acknowledgments

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NIH U54EB005149





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# Thank You!