



# DICOM and Slicer: A Tutorial

Sonia Pujol, Ph.D.

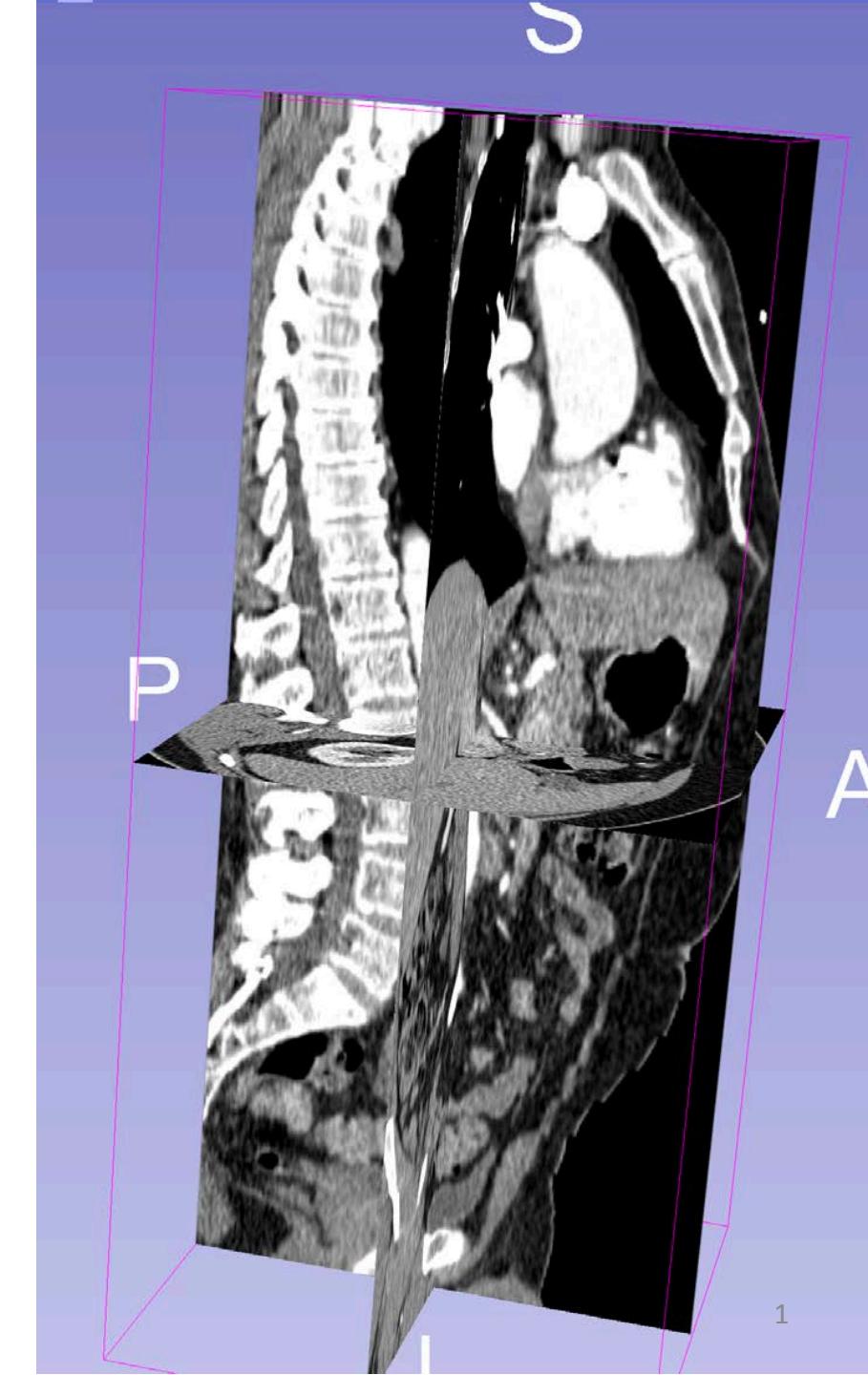
Assistant Professor of Radiology

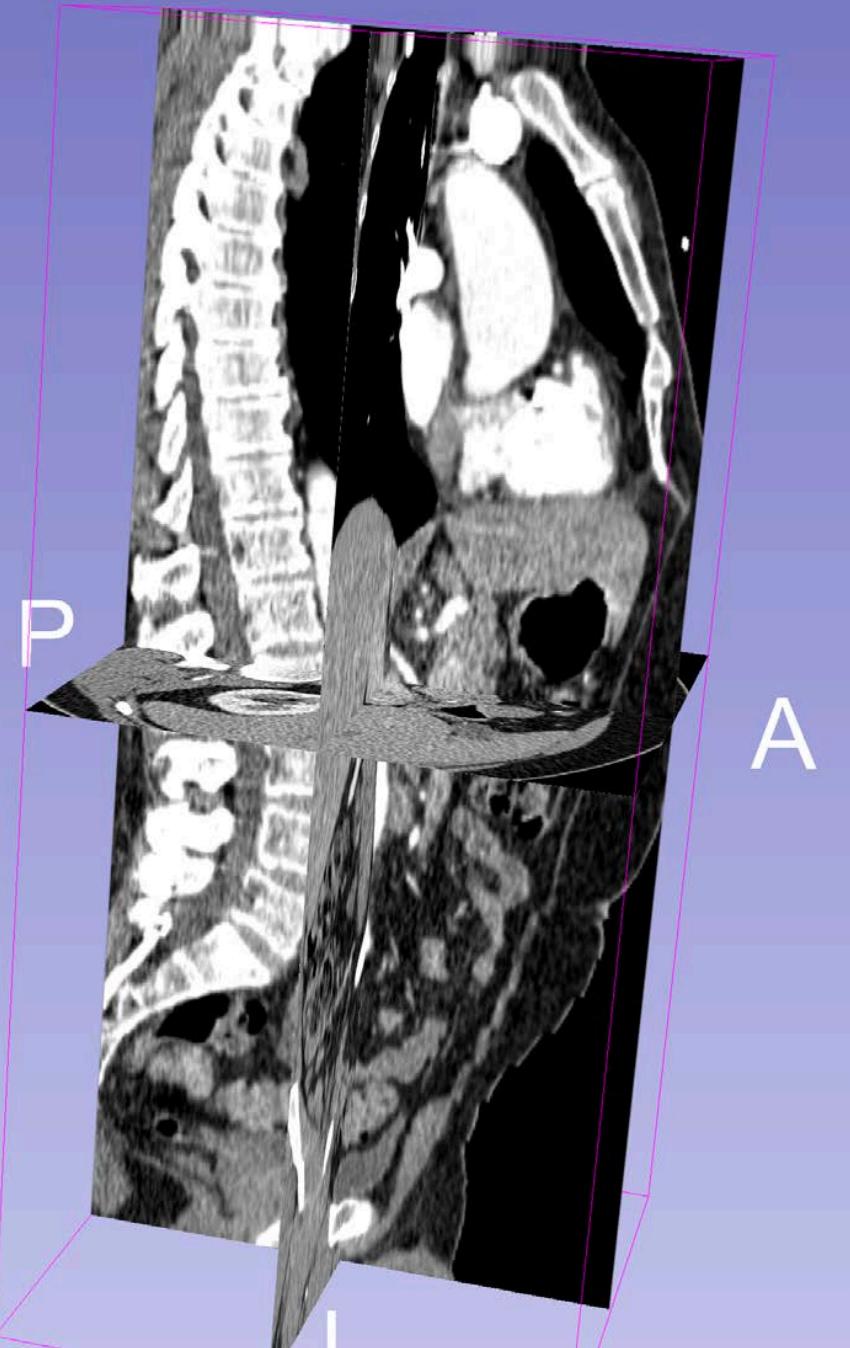
Director of 3D Slicer Training & Education

Brigham and Women's Hospital

Harvard Medical School

[spujol@bwh.harvard.edu](mailto:spujol@bwh.harvard.edu)





# Objective

This tutorial provides a basic introduction to the DICOM standard, and shows how to visualize DICOM images in 3D Slicer version 5.0



# Tutorial material

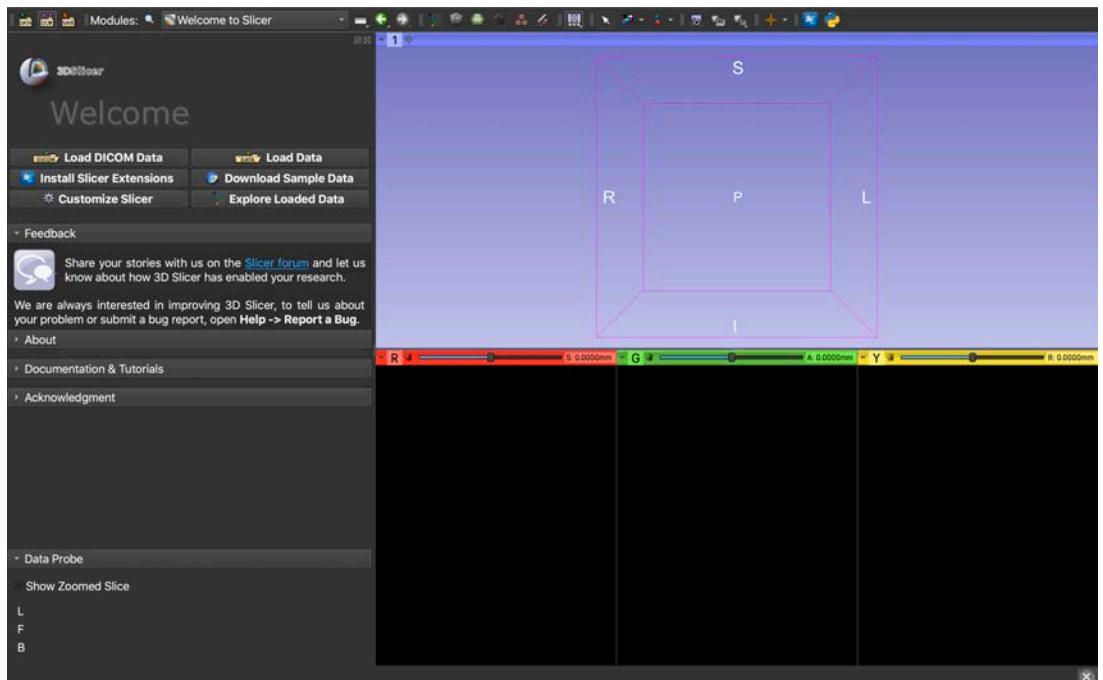
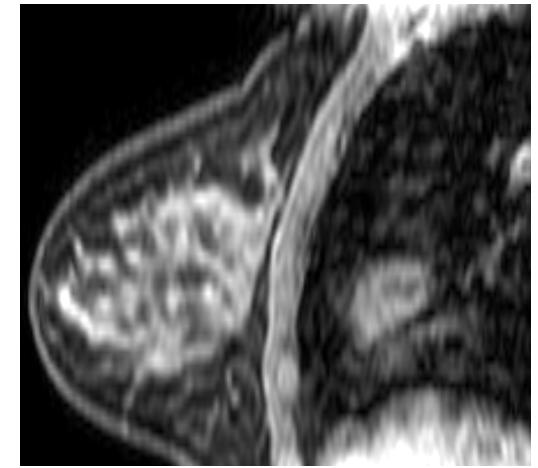
3D Slicer version 5.0

<https://download.slicer.org>

SlicerDICOMTutorialData

DICOM Torso CT

DICOM Breast MRI



# Tutorial Outline



Part 1: Introduction to DICOM



Part 2: Loading and Visualizing DICOM data in 3D Slicer version 5.0

# Disclaimer

- 3D Slicer is a free open source software application distributed under a BSD style license
- The software is not FDA approved or CE-Marked, and is for research use only



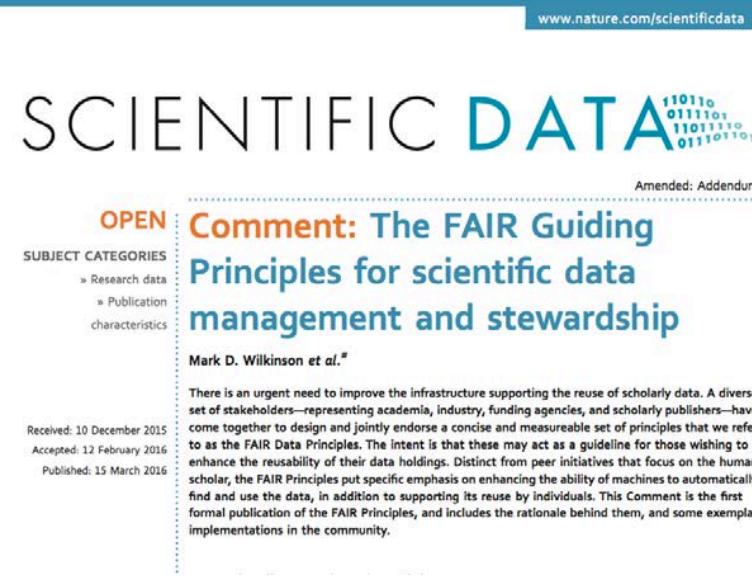
# Part 1: Introduction to DICOM

# Reproducible Science

- Reproducible science is critical to drive research and accelerate discoveries
- Open-source software tools such as 3D Slicer and data standards such as DICOM contribute to the reproducibility of scientific results in biomedical research



# F.A.I.R. Principles



*The FAIR Guiding Principles for scientific data management and stewardship.*

Wilkinson et al. Sci. Data 2016

<http://go-fair.org/fair-principles>

- **Findable:** Data are easily findable
- **Accessible:** Users know how to access the data, including authentication and authorization
- **Interoperable:** Data can be integrated with other data and can interoperate with applications for storage and analysis
- **Reusable:** Data can be replicated or combined for new research

# The DICOM standard

- DICOM (Digital Imaging and Communications in Medicine) is the international standard for handling, storing, printing and transmitting medical imaging data
- Clinical imaging equipment (CT scanners, MR scanners, X-Ray and ultrasound machines) generate DICOM files



# DICOM History

- 1982: The American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) initiate standards for the interconnection of medical imaging devices
- 1985: Publication of the ACR-NEMA Digital Imaging and Communications Standards version 1.0
- 1988: Publication of the ACR-NEMA Digital Imaging and Communications Standards version 2.0
- 1993: Publication of the ACR-NEMA Standards version 3.0 also referred to as the Digital Imaging and Communication in Medicine (DICOM) standard

# DICOM Today

- The DICOM standard is continuously being refined to address new community needs through multiple releases every year
- As of 2020/07/06, the DICOM standard is DICOM PS3 2020c and contains 4,000 pages
- DICOM Working Groups are established by the DICOM Standard Committee to develop the Standard for a particular modality, clinical domain or technical area (e.g. WG-16 Magnetic Resonance)

<http://dicomstandard.org>

# FAIR Data and the DICOM Standard

www.nature.com/scientificdata

**SCIENTIFIC DATA** 

Amended: Addendum

**OPEN**

SUBJECT CATEGORIES  
» Research data  
» Publication characteristics

**Comment: The FAIR Guiding Principles for scientific data management and stewardship**

Mark D. Wilkinson et al.\*

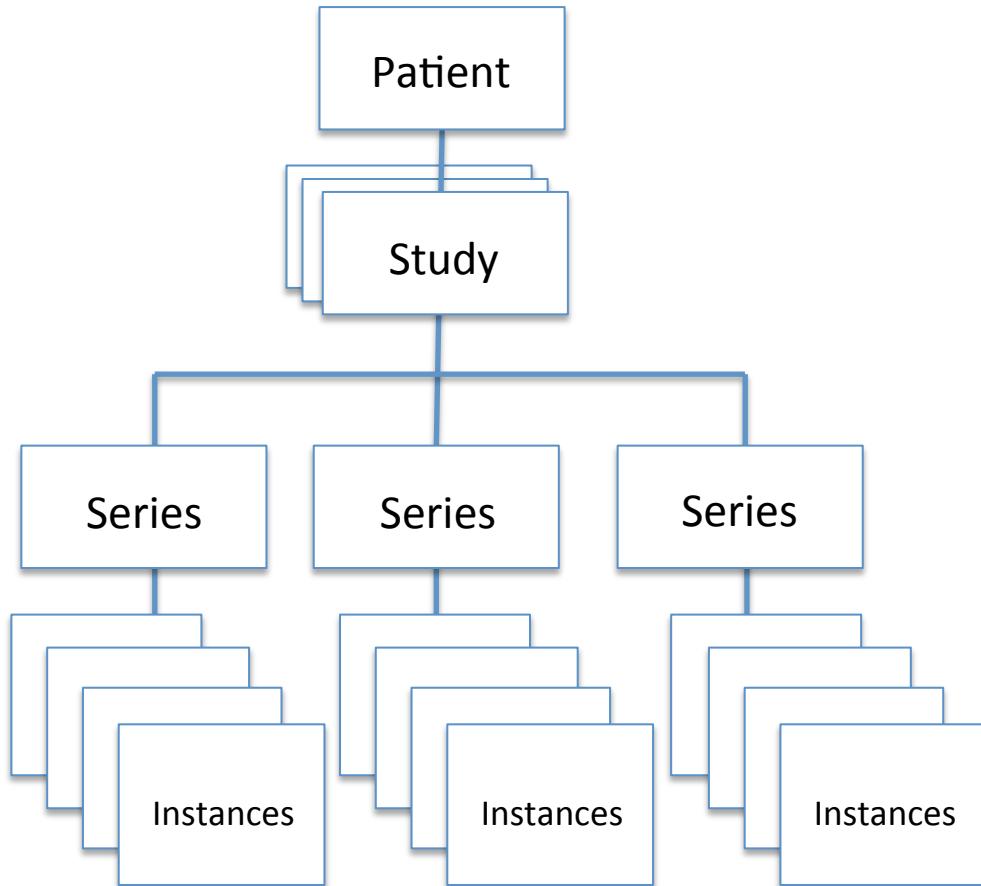
Received: 10 December 2015  
Accepted: 12 February 2016  
Published: 15 March 2016

There is an urgent need to improve the infrastructure supporting the reuse of scholarly data. A diverse set of stakeholders—representing academia, industry, funding agencies, and scholarly publishers—have come together to design and jointly endorse a concise and measurable set of principles that we refer to as the FAIR Data Principles. The intent is that these may act as a guideline for those wishing to enhance the reusability of their data holdings. Distinct from peer initiatives that focus on the human scholar, the FAIR Principles put specific emphasis on enhancing the ability of machines to automatically find and use the data, in addition to supporting its reuse by individuals. This Comment is the first formal publication of the FAIR Principles, and includes the rationale behind them, and some exemplar implementations in the community.



The DICOM Standard facilitates compliance of imaging data with FAIR principles

# DICOM Data Model



- In the DICOM data model, a **DICOM Study** consists of several **DICOM Series**, and each **DICOM Series** contains **DICOM Instances**
- Each of the **DICOM Studies**, **Series** and **Instances** are assigned a **Unique Identifier (UID)**

# Example of DICOM instances: DICOM MRI Image data

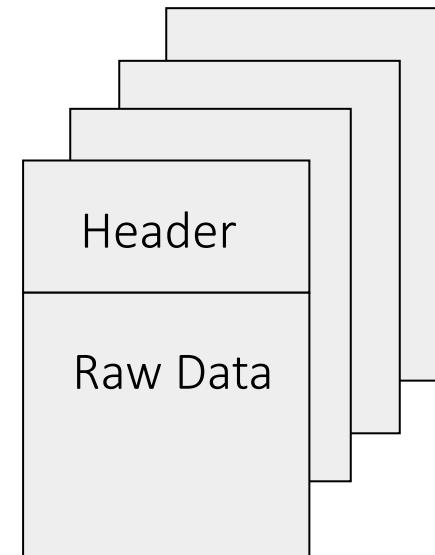
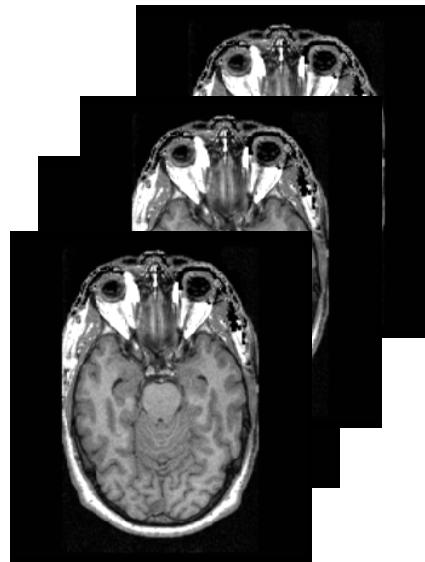


Image001.dcm

Image002.dcm

Image003.dcm

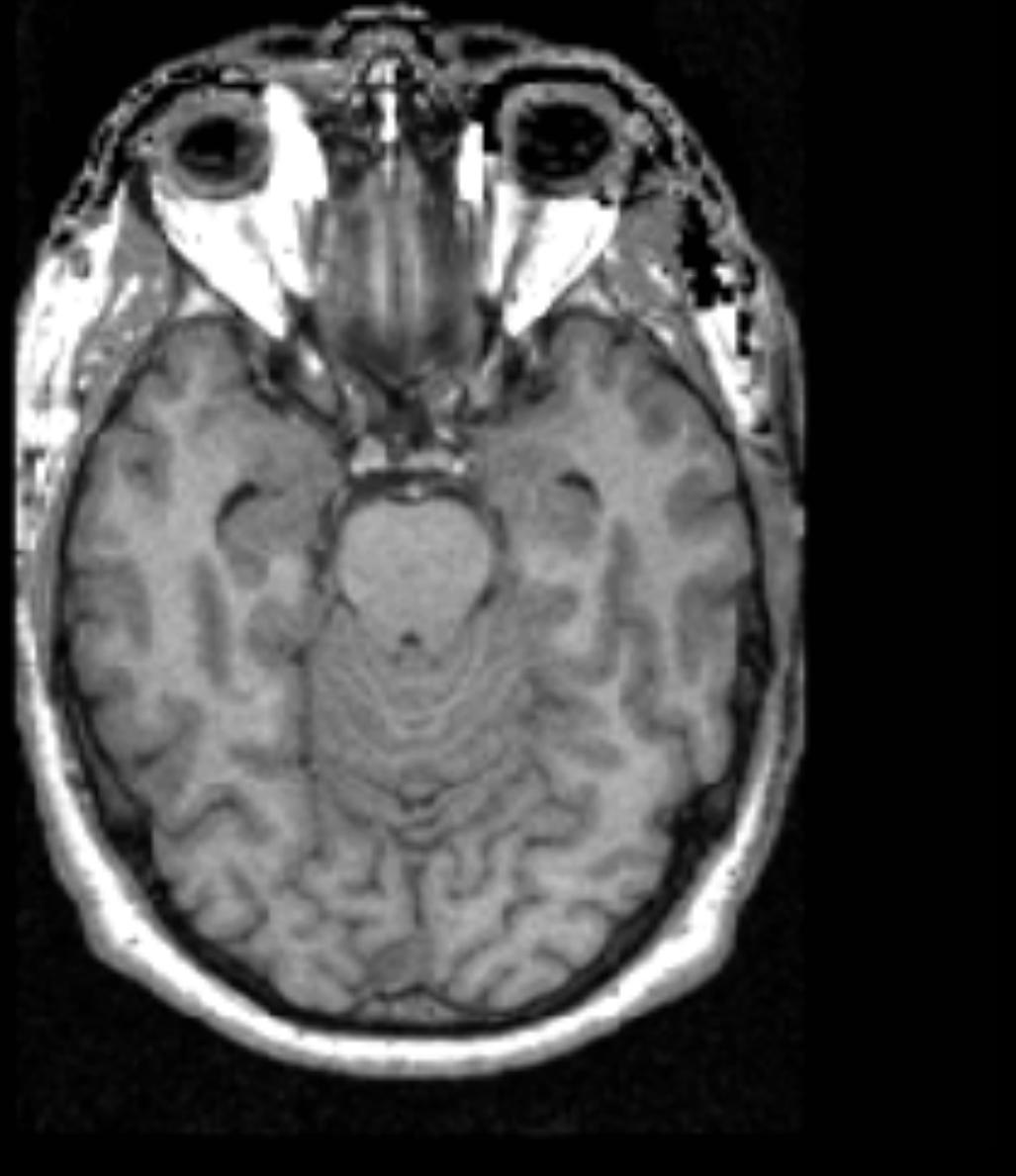
....

An MRI image is an example of DICOM Instance that consists of a **DICOM header** and an **image dataset**

```
0002,0000,File Meta Elements Group Len=148  
0002,0001,File Meta Info Version=256  
0002,0002,Media Storage SOP Class UID=1.2.840.10008.5.1.4.1.1.4.  
0002,0003,Media Storage SOP Inst UID=0.0.0.0.  
0002,0010,Transfer Syntax UID=1.2.840.10008.1.2.1.  
...  
0008,0060,Modality=MR  
0008,0070,Manufacturer=GE MEDICAL SYSTEMS  
0008,0080,Institution Name=1852796513  
0008,0081,City Name=1852796513  
0008,0090,Referring Physician's Name=1852796513  
0008,0092,?=1852796513  
0008,0201,?=-0500  
0008,1010,Station Name=1852796513  
0008,1030,Study Description=anon  
0008,103E,Series Description=anon  
0008,1040,Institutional Dept. Name=1852796513  
0008,1050,Performing Physician's Name=1852796513  
0008,1060,Name Phys(s) Read Study=1852796513  
0008,1070,Operator's Name=anon  
0008,1080,Admitting Diagnosis Description=1852796513  
0008,1090,Manufacturer's Model Name=GENESIS.SIGMA .....  
0010,0010,Patient's Name=anon  
0010,0020,Patient ID=anon  
0010,0030,Patient Date of Birth=00000000  
0010,0032,Patient Birth Time=000000  
0010,0040,Patient Sex=O  
0010,1010,Patient Age=000Y  
.....  
0028,0010,Rows=256  
0028,0011,Columns=256  
0028,0030,Pixel Spacing=0.937500 0.937500  
0028,0100,Bits Allocated=16  
0028,0101,Bits Stored=16  
0028,0102,High Bit=15  
0028,0103,Pixel Representation=1  
.....  
7FE0,0010,Pixel Data=131072
```

### Example of DICOM header content

- The DICOM header contains metadata information on the patient, study and imaging data.
- Original data from the scanner tell users important elements about the acquisition
- The metadata information is accessible through DICOM tags
- DICOM tags uniquely identify DICOM attributes



0002  
0002  
0002  
0002  
0002

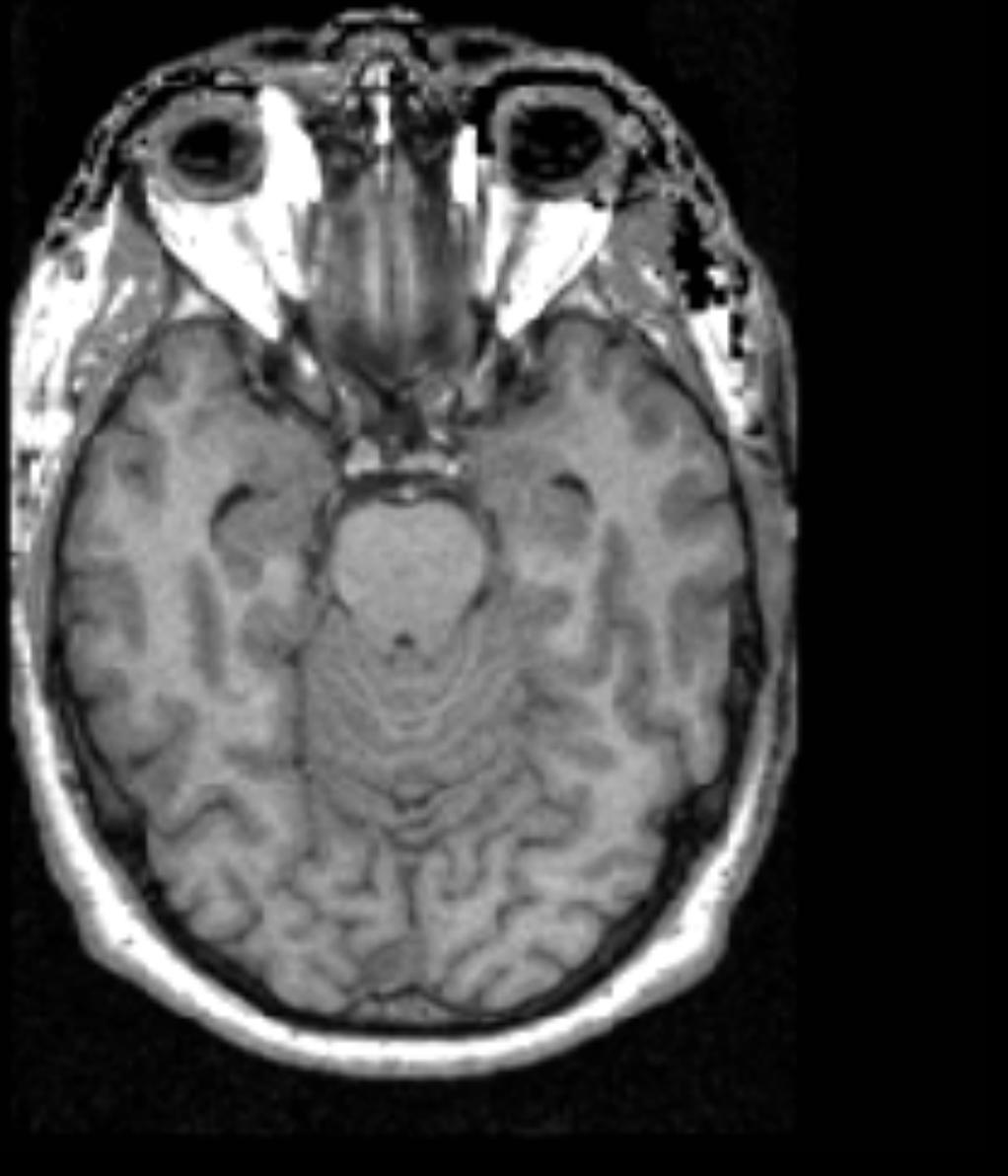
## Physician and Study Information

0008,0060,Modality=MR  
0008,0070,Manufacturer=GE MEDICAL SYSTEMS  
0008,0080,Institution Name=1852796513  
0008,0081,City Name=1852796513  
0008,0090,Referring Physician's Name=1852796513  
0008,0092,?=1852796513  
0008,0201,?=0500  
0008,1010,Station Name=1852796513  
0008,1030,Study Description=anon  
0008,103E,Series Description=anon  
0008,1040,Institutional Dept. Name=1852796513  
0008,1050,Performing Physician's Name=1852796513  
0008,1060,Name Phys(s) Read Study=1852796513  
0008,1070,Operator's Name=anon  
0008,1080,Admitting Diagnosis Description=1852796513  
0008,1090,Manufacturer's Model Name=GENESIS.SIGNA .....

0010,0010,Patient's Name=anon  
0010,0020,Patient ID=anon  
0010,0030,Patient Date of Birth=00000000  
0010,0032,Patient Birth Time=000000  
0010,0040,Patient Sex=O  
0010,1010,Patient Age=000Y  
.....

0028,0010,Rows=256  
0028,0011,Columns=256  
0028,0030,Pixel Spacing=0.937500 0.937500  
0028,0100,Bits Allocated=16  
0028,0101,Bits Stored=16  
0028,0102,High Bit=15  
0028,0103,Pixel Representation=1  
.....

7FE0,0010,Pixel Data=131072



0002,0000,File Meta Elements Group Len=148  
0002,0001,File Meta Info Version=256  
0002,0002,Media Storage SOP Class UID=1.2.840.10008.5.1.4.1.1.4.  
0002,0003,Media Storage SOP Inst UID=0.0.0.0.  
0002,0010,Transfer Syntax UID=1.2.840.10008.1.2.1.

...

0008,0060,Modality=MR  
0008,0070,Manufacturer=GE MEDICAL SYSTEMS  
0008,0080,Institution Name=1852796513  
0008,0081,City Name=1852796513  
0008,0090,Referring Physician's Name=1852796513  
0008,0092,?=1852796513  
0008,0201,?=-0500  
0008,1010,Station Name=1852796513  
0008,1030,Study Description=anon  
0008,1035,Series Description  
0008,  
0008,  
0008,  
0008,  
0008,1000,Authorizing Physician Name=1852796513  
0009,1000,Manufacturer's Model Name=CENEGIC SIGNA .....

## Patient Information

0010,0010,Patient's Name=anon  
0010,0020,Patient ID=anon  
0010,0030,Patient Date of Birth=00000000  
0010,0032,Patient Birth Time=000000  
0010,0040,Patient Sex=O  
0010,1010,Patient Age=000Y

.....  
0028,0010,Rows=256  
0028,0011,Columns=256  
0028,0030,Pixel Spacing=0.937500 0.937500  
0028,0100,Bits Allocated=16  
0028,0101,Bits Stored=16  
0028,0102,High Bit=15  
0028,0103,Pixel Representation=1  
.....

7FE0,0010,Pixel Data=131072

# HIPPA Patient privacy

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) protects the privacy and security of certain health information

<http://www.hhs.gov/hipaa/index.html>

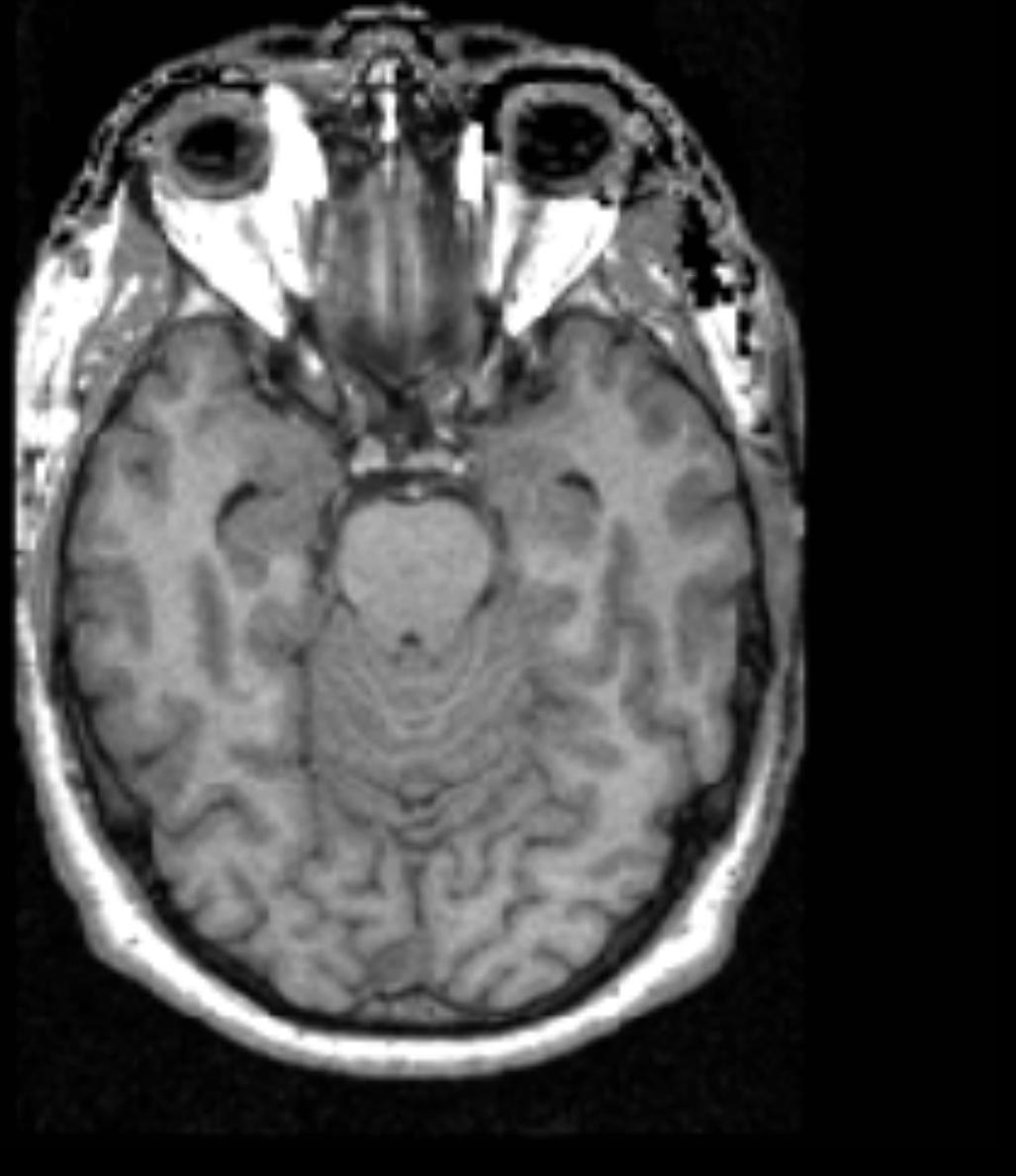
0002,0000,File Meta Elements Group Len=148  
0002,0001,File Meta Info Version=256  
0002,0002,Media Storage SOP Class UID=1.2.840.10008.5.1.4.1.1.4.  
0002,0003,Media Storage SOP Inst UID=0.0.0.0.  
0002,0010,Transfer Syntax UID=1.2.840.10008.1.2.1.

...  
0008,0060,Modality=MR  
0008,0070,Manufacturer=GE MEDICAL SYSTEMS  
0008,0080,Institution Name=1852796513  
0008,0081,City Name=1852796513  
0008,0090,Referring Physician's Name=1852796513  
0008,0092,?=1852796513  
0008,0201,?=-0500  
0008,1010,Station Name=1852796513  
0008,1030,Study Description=anon  
0008,1035,Series Description=anon  
0008,  
0008,  
0008,  
0008,  
0008,  
0008,1000,Authorizing Diagnosis Description=1852796513  
0009,1000,Manufacturer's Model Name=GENESIS SIGNA .....

Anonymized Patient Information

0010,0010,Patient's Name=anon  
0010,0020,Patient ID=anon  
0010,0030,Patient Date of Birth=00000000  
0010,0032,Patient Birth Time=000000  
0010,0040,Patient Sex=O  
0010,1010,Patient Age=000Y

.....  
0028,0010,Rows=256  
0028,0011,Columns=256  
0028,0030,Pixel Spacing=0.937500 0.937500  
0028,0100,Bits Allocated=16  
0028,0101,Bits Stored=16  
0028,0102,High Bit=15  
0028,0103,Pixel Representation=1  
.....  
7FE0,0010,Pixel Data=131072



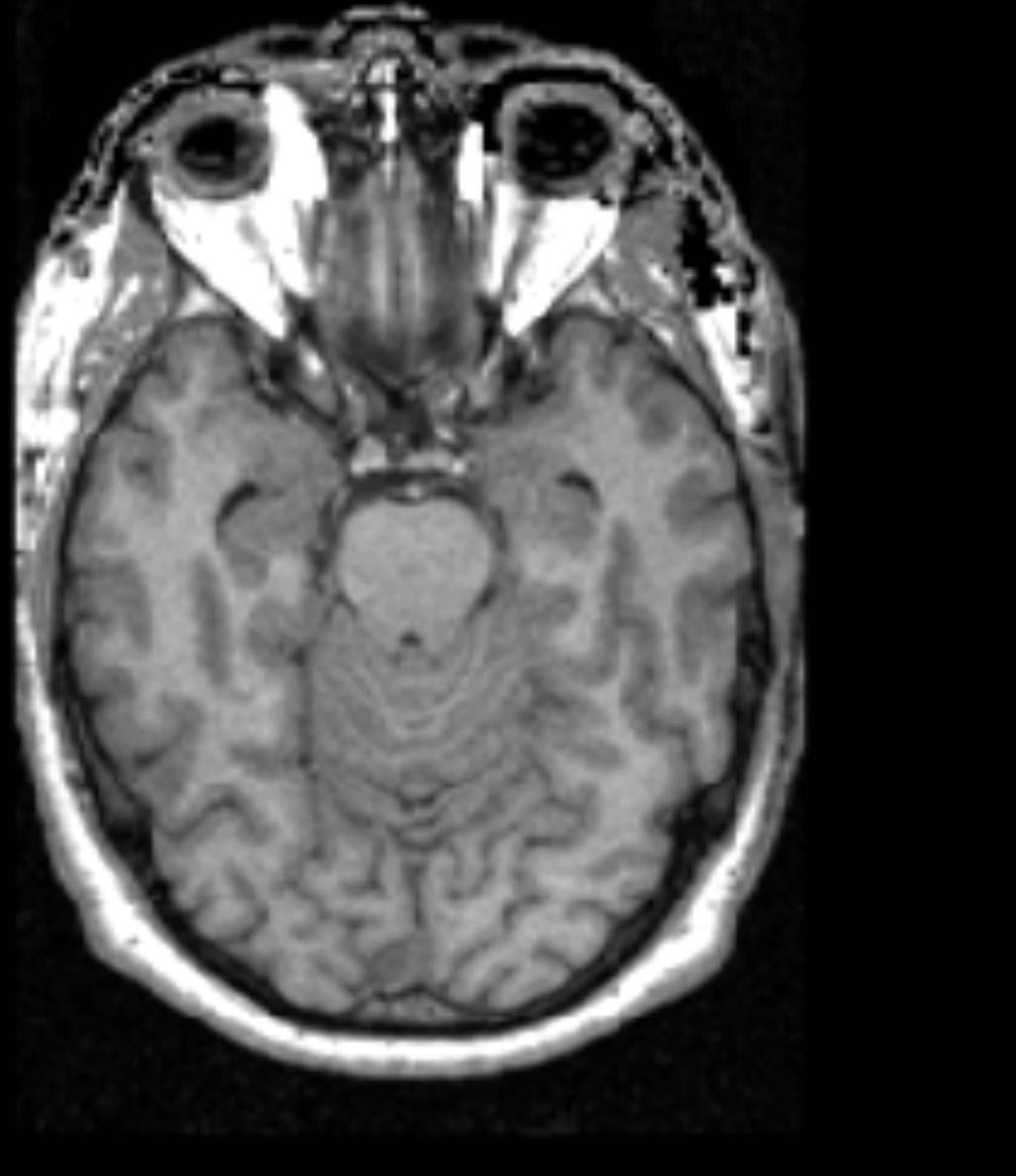
0002,0000,File Meta Elements Group Len=148  
0002,0001,File Meta Info Version=256  
0002,0002,Media Storage SOP Class UID=1.2.840.10008.5.1.4.1.1.4.  
0002,0003,Media Storage SOP Inst UID=0.0.0.0.  
0002,0010,Transfer Syntax UID=1.2.840.10008.1.2.1.

...  
0008,0060,Modality=MR  
0008,0070,Manufacturer=GE MEDICAL SYSTEMS  
0008,0080,Institution Name=1852796513  
0008,0081,City Name=1852796513  
0008,0090,Referring Physician's Name=1852796513  
0008,0092,?=1852796513  
0008,0201,?=-0500  
0008,1010,Station Name=1852796513  
0008,1030,Study Description=anon  
0008,103E,Series Description=anon  
0008,1040,Institutional Dept. Name=1852796513  
0008,1050,Performing Physician's Name=1852796513  
0008,1060,Name Phys(s) Read Study=1852796513  
0008,1070,Operator's Name=anon  
0008,1080,Admitting Diagnosis Description=1852796513  
0008,1090,Manufacturer's Model Name=GENESIS.SIGMA .....  
0010,0010,Rows=256  
0010,0  
0010,0  
0010,0  
0010,0  
0010,0  
0010,1010,Pixel Spacing=0.937500 0.937500

## Image Information

0028,0010,Rows=256  
0028,0011,Columns=256  
0028,0030,Pixel Spacing=0.937500 0.937500  
0028,0100,Bits Allocated=16  
0028,0101,Bits Stored=16  
0028,0102,High Bit=15  
0028,0103,Pixel Representation=1

7FE0,0010,Pixel Data=131072



0002,0000,File Meta Elements Group Len=148  
0002,0001,File Meta Info Version=256  
0002,0002,Media Storage SOP Class UID=1.2.840.10008.5.1.4.1.1.4.  
0002,0003,Media Storage SOP Inst UID=0.0.0.0.  
0002,0010,Transfer Syntax UID=1.2.840.10008.1.2.1.

...

0008,0060,Modality=MR  
0008,0070,Manufacturer=GE MEDICAL SYSTEMS  
0008,0080,Institution Name=1852796513  
0008,0081,City Name=1852796513  
0008,0090,Referring Physician's Name=1852796513  
0008,0092,?=1852796513  
0008,0201,?=-0500  
0008,1010,Station Name=1852796513  
0008,1030,Study Description=anon  
0008,103E,Series Description=anon  
0008,1040,Institutional Dept. Name=1852796513  
0008,1050,Performing Physician's Name=1852796513  
0008,1060,Name Phys(s) Read Study=1852796513  
0008,1070,Operator's Name=anon  
0008,1080,Admitting Diagnosis Description=1852796513  
0008,1090,Manufacturer's Model Name=GENESIS.SIGMA .....

0010,0010,Patient's Name=anon

0010,0020,Patient ID=anon

0010,0030,Patient Date of Birth=00000000

0010,0032,Patient Birth Time=000000

0010,0040,Patient Sex=O

0010,1010,Patient Age=000Y

.....

0028,0010,Rows=256

0028,0011,Cols=256

0028,0

0028,0

0028,0

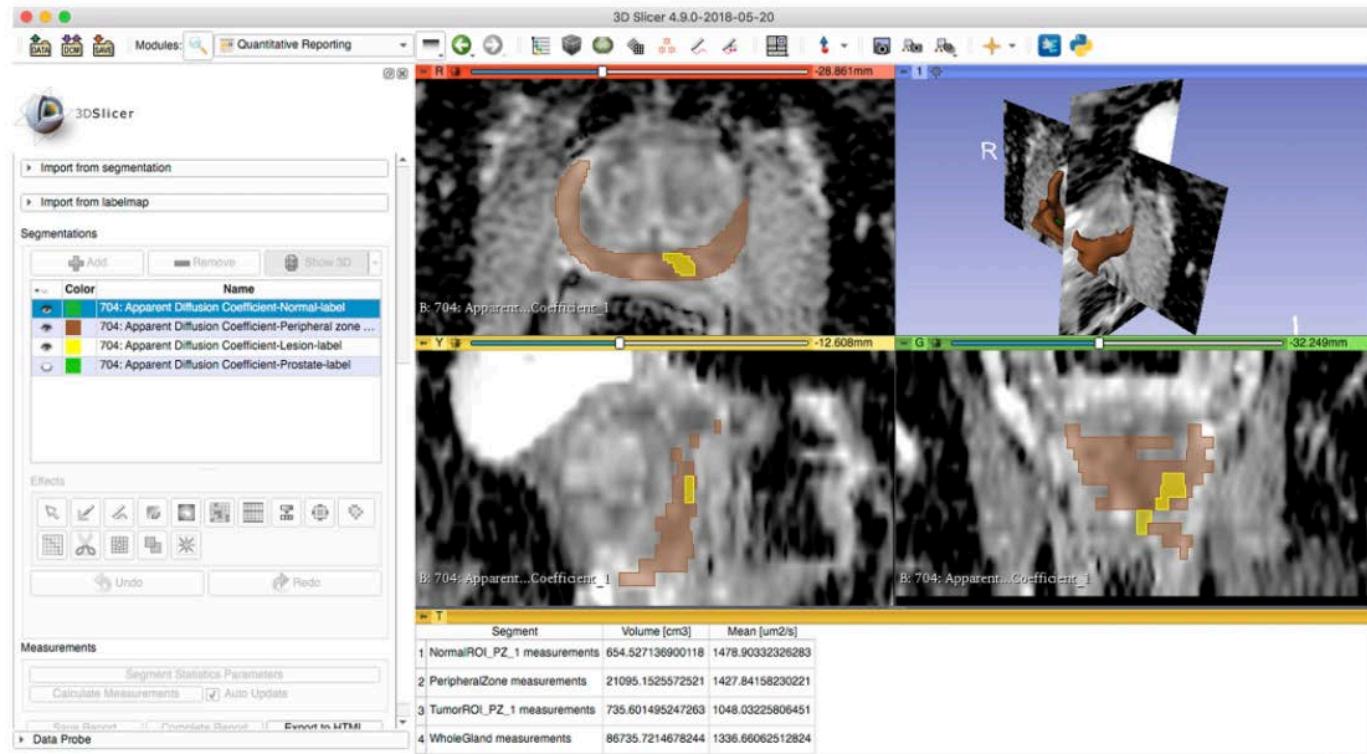
0028,0103,Pixel Representation=1

.....  
7FE0,0010,Pixel Data=131072

## Pixel Data

## Standard DICOM Instances

- **DICOM images** produced by imaging equipment: single DICOM MRI slices, DICOM CT volume, DICOM multi-frame objects (fMRI experiment)
- **DICOM Segmentation Object (SEG)**: voxels labelled in regions of interest (ROIs)
- **DICOM Structured Report (SR)**: clinical information (e.g. diagnosis, pathology, surgery, etc.), measurements computed from segmented ROIs



Segmented structure	SegmentedPropertyCategoryCodeSequence	SegmentedPropertyTypeCodeSequence	AnatomicRegionSequence
Prostate gland	("T-D000A", "SRT", "Anatomical Structure")	("T-9200B", "SRT", "Prostate")	NA
Peripheral zone of the prostate gland	("T-D000A", "SRT", "Anatomical Structure")	("T-D05E4", "SRT", "Peripheral zone of the prostate")	NA
Lesion in the peripheral zone of the prostate gland	("M-01000", "SRT", "Morphologically Altered Structure")	("M-01100", "SRT", "Lesion")	("T-D05E4", "SRT", "Peripheral zone of the prostate")
Normal tissue in the peripheral zone of the prostate gland	("T-D0050", "SRT", "Tissue")	("G-A460", "SRT", "Normal")	("T-D05E4", "SRT", "Peripheral zone of the prostate")

Measured structure	Finding	Finding Site
Prostate gland *	(T-F6078, SRT, "Entire Gland")	("T-9200B", "SRT", "Prostate")
Peripheral zone of the prostate gland	(R-404A4, SRT, "Entire")	("T-D05E4", "SRT", "Peripheral zone of the prostate")
Lesion in the peripheral zone of the prostate gland	(R-42037, SRT, "Abnormal")	("T-D05E4", "SRT", "Peripheral zone of the prostate")
Normal tissue of peripheral zone of the prostate gland	("G-A460", "SRT", "Normal")	("T-D05E4", "SRT", "Peripheral zone of the prostate")

# Examples of Standard DICOM Instances

## DICOM Images

Prostate MRI Images

## DICOM Segmented Structures

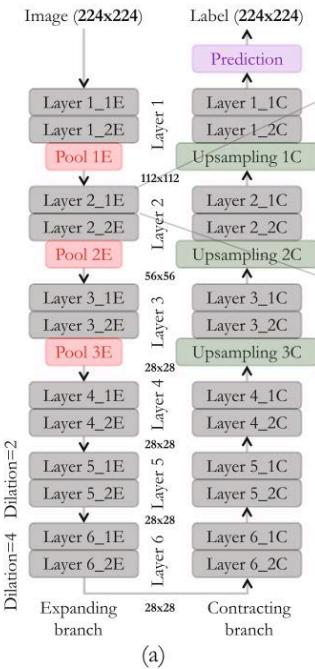
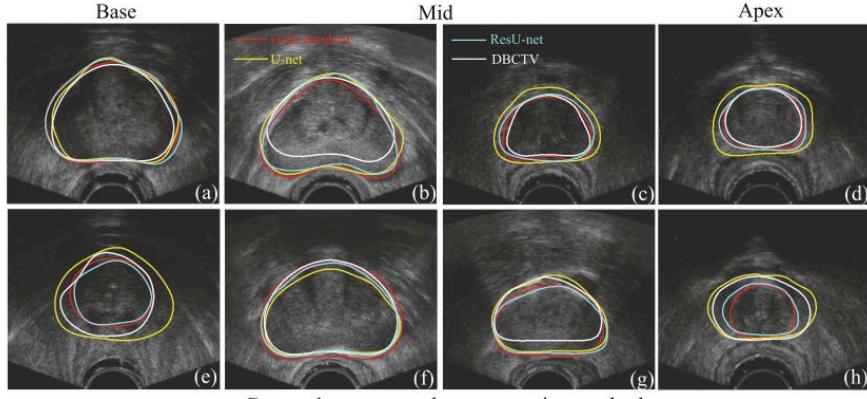
Prostate gland, peripheral zone, lesion, normal tissue

## Measurements

Volumes of prostate gland, peripheral zone, lesion, normal tissue

# DICOM Terminology

- DICOM provides support for annotation and segmentation objects
- DICOM Structured Reports enable provenance tracking
- DICOM derived data can be stored on a DICOM server or on other archive (e.g. TCIA) with permission and is compliant with FAIR principles

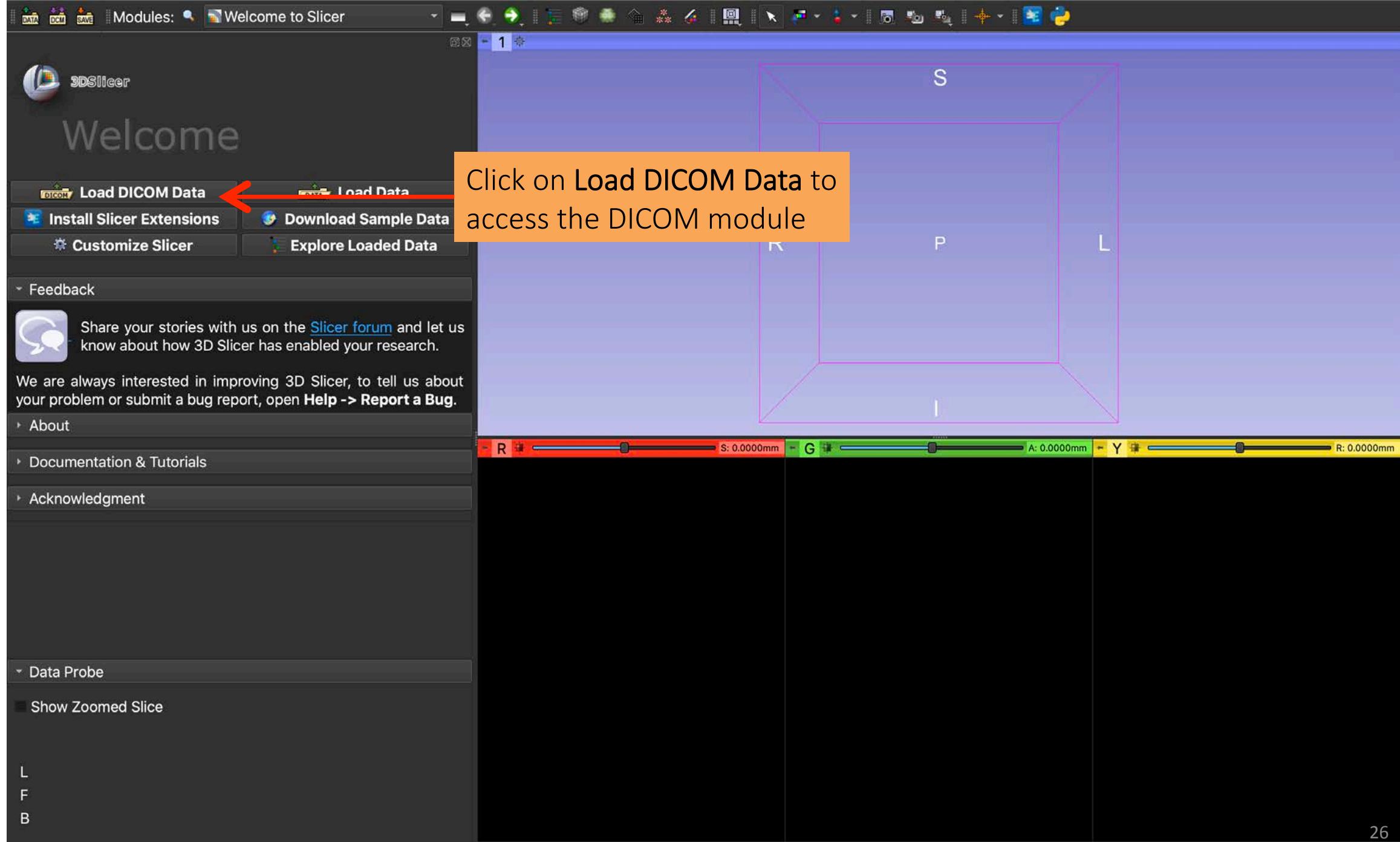


# DICOM for AI Studies

- DICOM defines **syntax rules** and **vocabularies** that enable easy extraction of knowledge from the data
- The DICOM framework for medical imaging data management enables the automation of cohort formation and maximizes the interoperability of the data for AI studies



## Part 2: Loading and Visualizing DICOM data in 3D Slicer version 5.0



The DICOM database follows the DICOM model hierarchy organized in patients, studies and series

**Patients**

**Studies**

**Series**

DICOM Data Reader      Warnings

Uncheck All      Examine      Load

Advanced

Sonia Pujol PhD, All Rights Reserved

3DSlicer

Modules: DICOM

PATIENTS STUDIES SERIES

Patient name Patient ID Birth date Sex Studies Last study c Date add e

Import DICOM files Show DICOM database

Loaded data Node

DICOM networking DICOM database settings

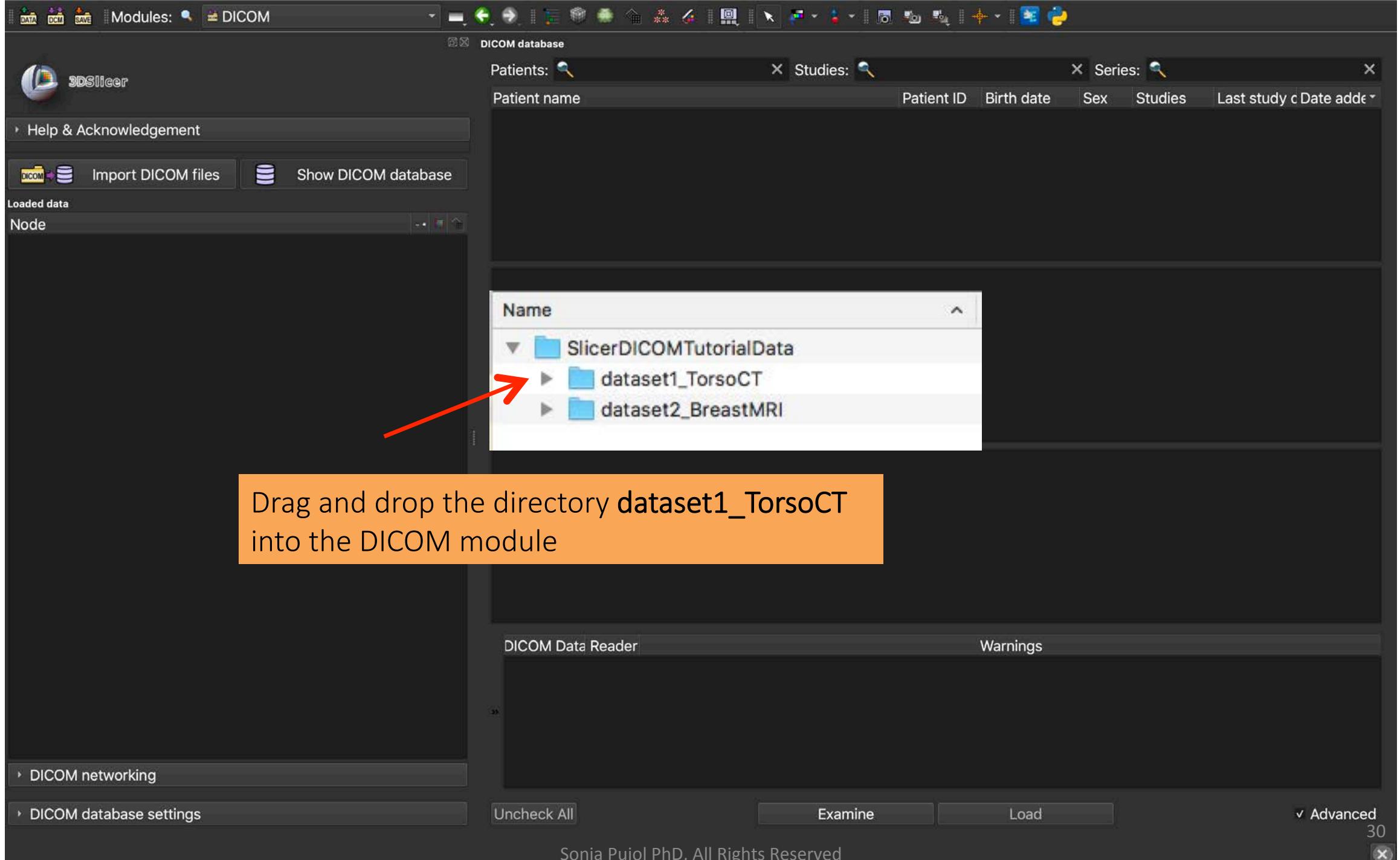
27



# Dataset #1

## Torso CT

# Loading a DICOM dataset in Slicer



The screenshot shows the 3DSlicer interface with the DICOM module open. The top menu bar includes 'DATA', 'DCM', 'SAVE', 'Modules:', and 'DICOM'. The 'DICOM' tab is selected, showing the 'DICOM database' panel.

**DICOM database:**

Patient name	Patient ID	Birth date	Sex	Studies	Last study	Date added
patient1	patient1_ID			1	Wed Jun 1 2005	2020...842

**Loaded data:**

Node

**Slicer displays the corresponding study and series**

Study date | Study ID | Study description | Series | Date added  
20050601 | 6936864 | CT Thorax Abdomen | 1 | 202...843

Series # | Series description | Modality | Size | Count | Date added  
6 | CT\_Thorax\_Abdomen | CT | 512x512 | 291 | 202...843

**DICOM networking**

**DICOM database settings**

Uncheck All Examine Load Advanced

31

3DSlicer DICOM Modules: DICOM

DICOM database

Patients: Studies: Series:

Patient name	Patient ID	Birth date	Sex	Studies	Last study	Date added
patient1	patient1_ID			1	Wed Jun 1 2005	2020...842

Import DICOM files Show DICOM database

Loaded data Node

Study date Study ID Study description Series Date added

20050601	6936864	CT Thorax Abdomen	1	202...843
----------	---------	-------------------	---	-----------

Series # Series description Modality Size Count Date added

6	CT_Thorax_Abdomen	CT	512x512	291	202...843
---	-------------------	----	---------	-----	-----------

DICOM Data Reader Warnings

✓ 6: ... Scalar Volume

Click on Examine

Uncheck All Examine Load Advanced

Sonia Pujol PhD, All Rights Reserved

3DSlicer DICOM Modules: DICOM

DICOM database

Patients: Studies: Series:

Patient name	Patient ID	Birth date	Sex	Studies	Last study	Date added
patient1	patient1_ID			1	Wed Jun 1 2005	2020...842

Import DICOM files Show DICOM database

Loaded data Node

Study date Study ID Study description Series Date added

20050601	6936864	CT Thorax Abdomen	1	202...843
----------	---------	-------------------	---	-----------

Series # Series description Modality Size Count Date added

6	CT_Thorax_Abdomen	CT	512x512	291	202...843
---	-------------------	----	---------	-----	-----------

DICOM Data Reader Warnings

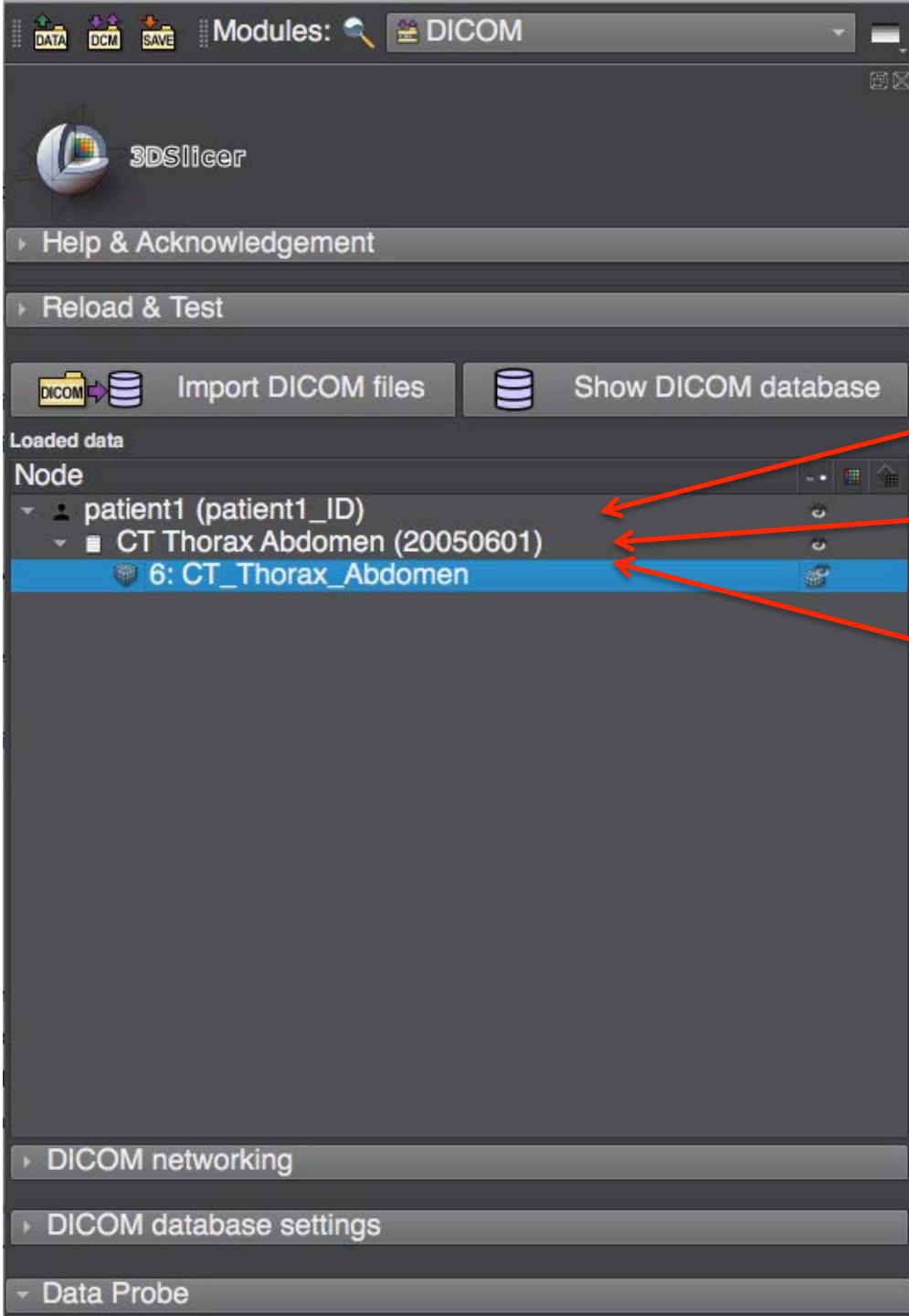
6: ... Scalar Volume

Click on Load

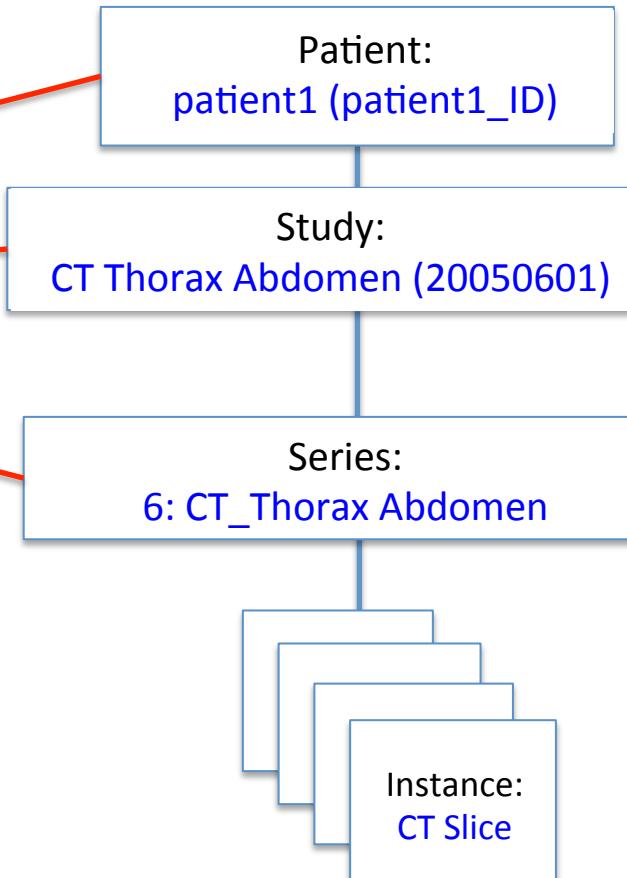
Uncheck All Examine Load Advanced

DICOM networking DICOM database settings

Sonia Pujol PhD, All Rights Reserved



The DICOM dataset is loaded into Slicer as a patient-study-series DICOM hierarchy



# Visualizing a DICOM dataset in Slicer

The screenshot shows the 3DSlicer DICOM module interface. A context menu is open over a node named "patient1". A red arrow points from the text in the orange callout box to the "Patient name" entry in the menu. The menu lists various DICOM database layouts, including "Conventional", "Conventional Widescreen", "Conventional Quantitative", "Four-Up", "Four-Up Table", "Four-Up Quantitative", "Dual 3D", "Triple 3D", "3D only", "3D Table", "One-Up Quantitative", "Red slice only", "Yellow slice only", "Green slice only", "Tabbed 3D", "Tabbed slice", "Compare", "Compare Widescreen", "Compare Grid", "Three over three", "Three over three Quantitative", "Four over four", "Two over two", "Side by side", "Four by three slice", "Four by two slice", and "Three by three slice". The "Series #" dropdown shows "6". To the right of the menu, there are two tables: one for "Studies" and one for "Series".

Click on the Slicer GUI icon to display the list of Slicer layouts and select Conventional

DICOM database

Patient name

patient1

Series #

6

Conventional

Conventional Widescreen

Conventional Quantitative

Four-Up

Four-Up Table

Four-Up Quantitative

Dual 3D

Triple 3D

3D only

3D Table

One-Up Quantitative

601

Red slice only

Yellow slice only

Green slice only

Tabbed 3D

Tabbed slice

Compare

Compare Widescreen

Compare Grid

Three over three

Three over three Quantitative

Four over four

Two over two

Side by side

Four by three slice

DICOM

6: ...

Four by two slice

Three by three slice

Modality

CT

Size

512x512

Count

291

Date added

2020...273

Series

1

Date added

2020...273

Modality

CT

Size

512x512

Count

291

Date added

2020...273

Warnings

DICOM networking

DICOM database settings

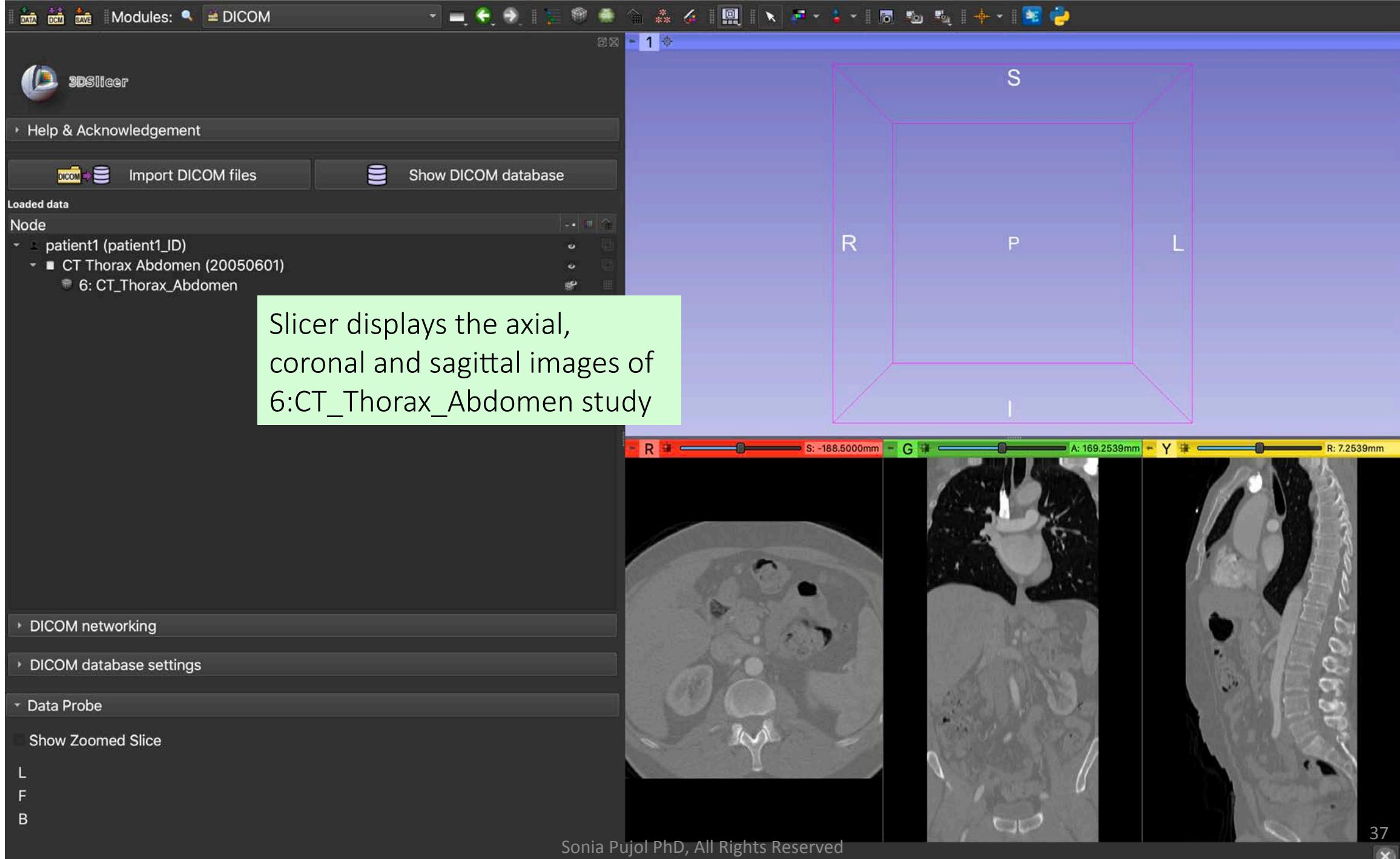
Uncheck All

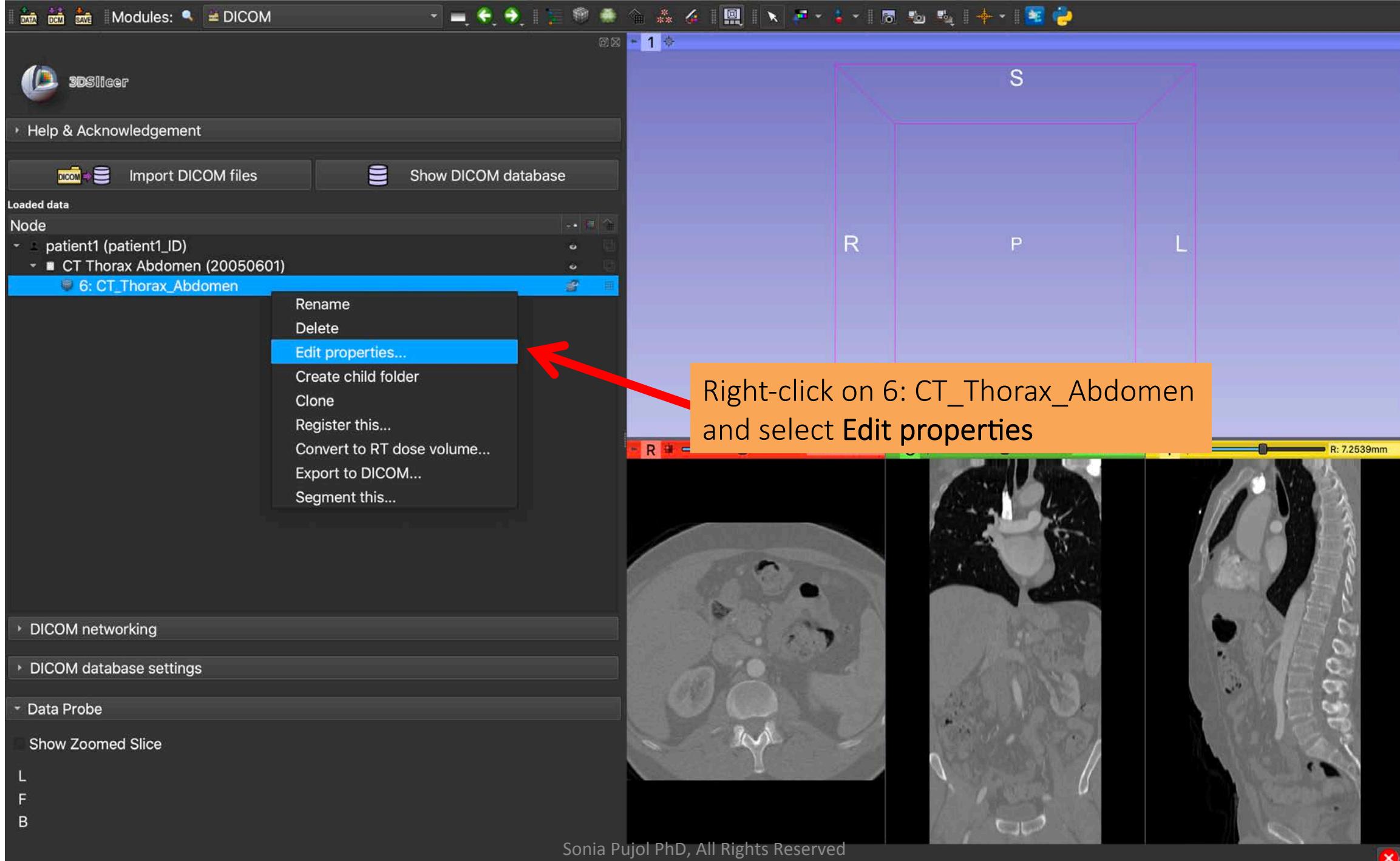
Examine

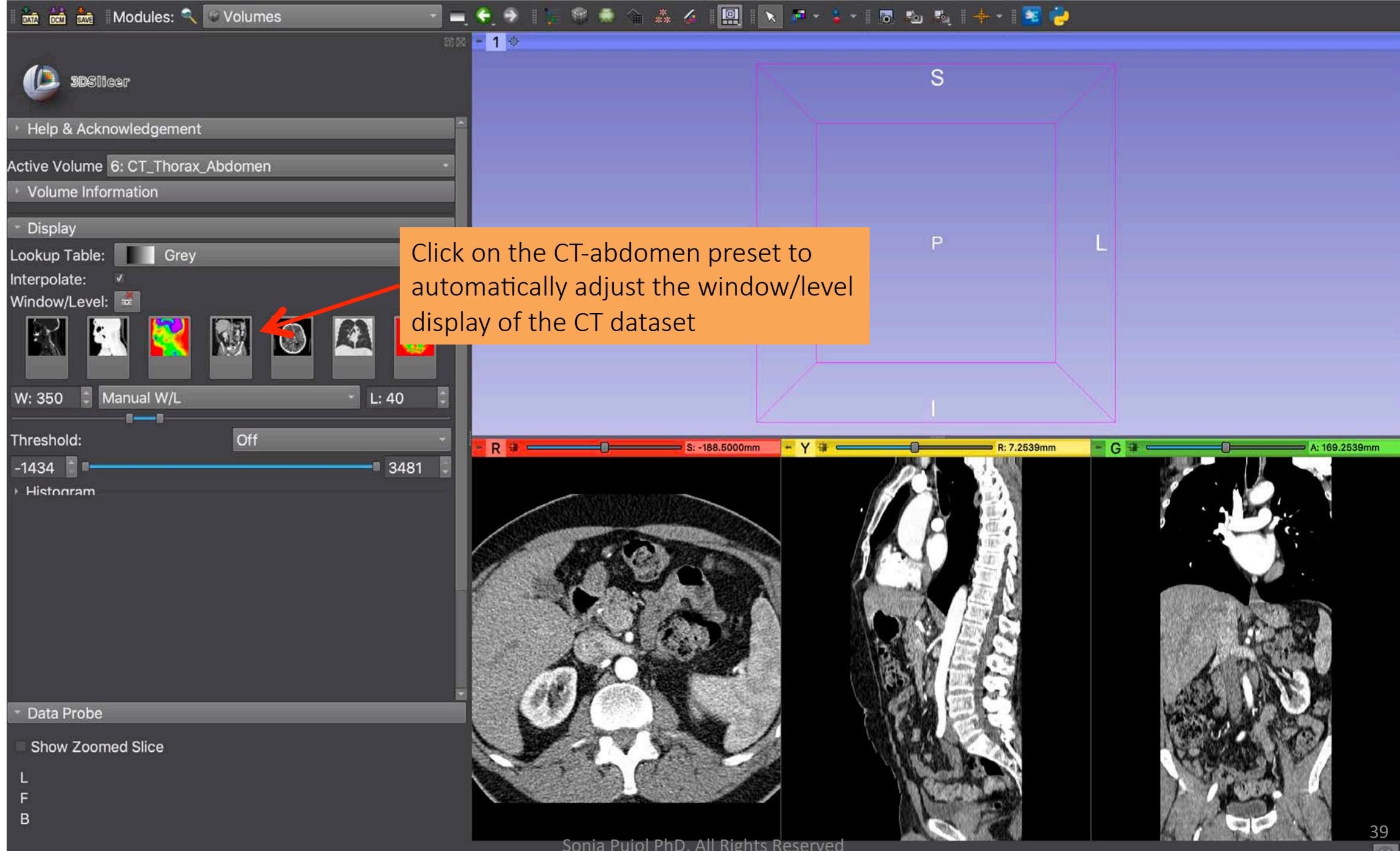
Load

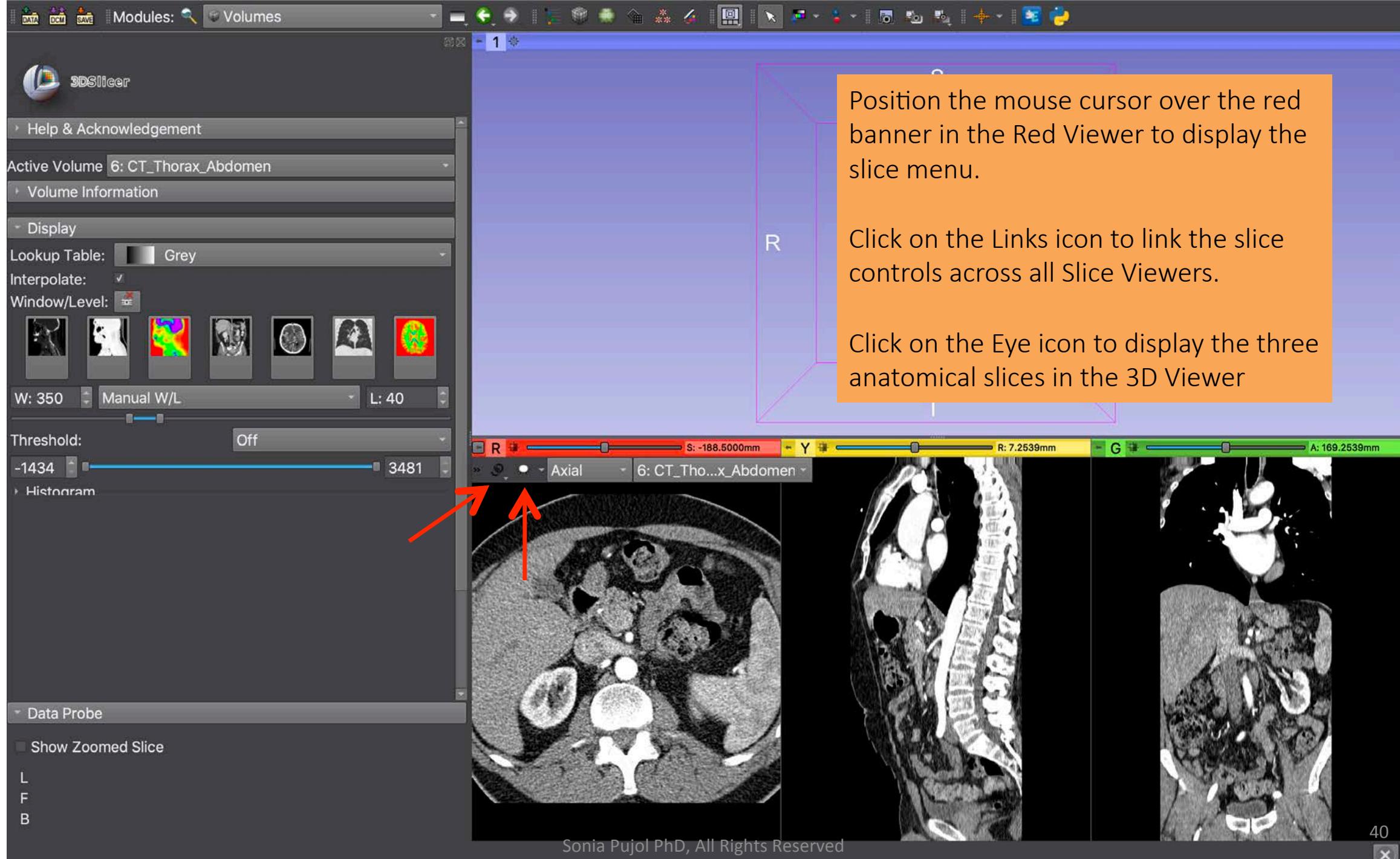
Advanced

Sonia Pujol PhD, All Rights Reserved

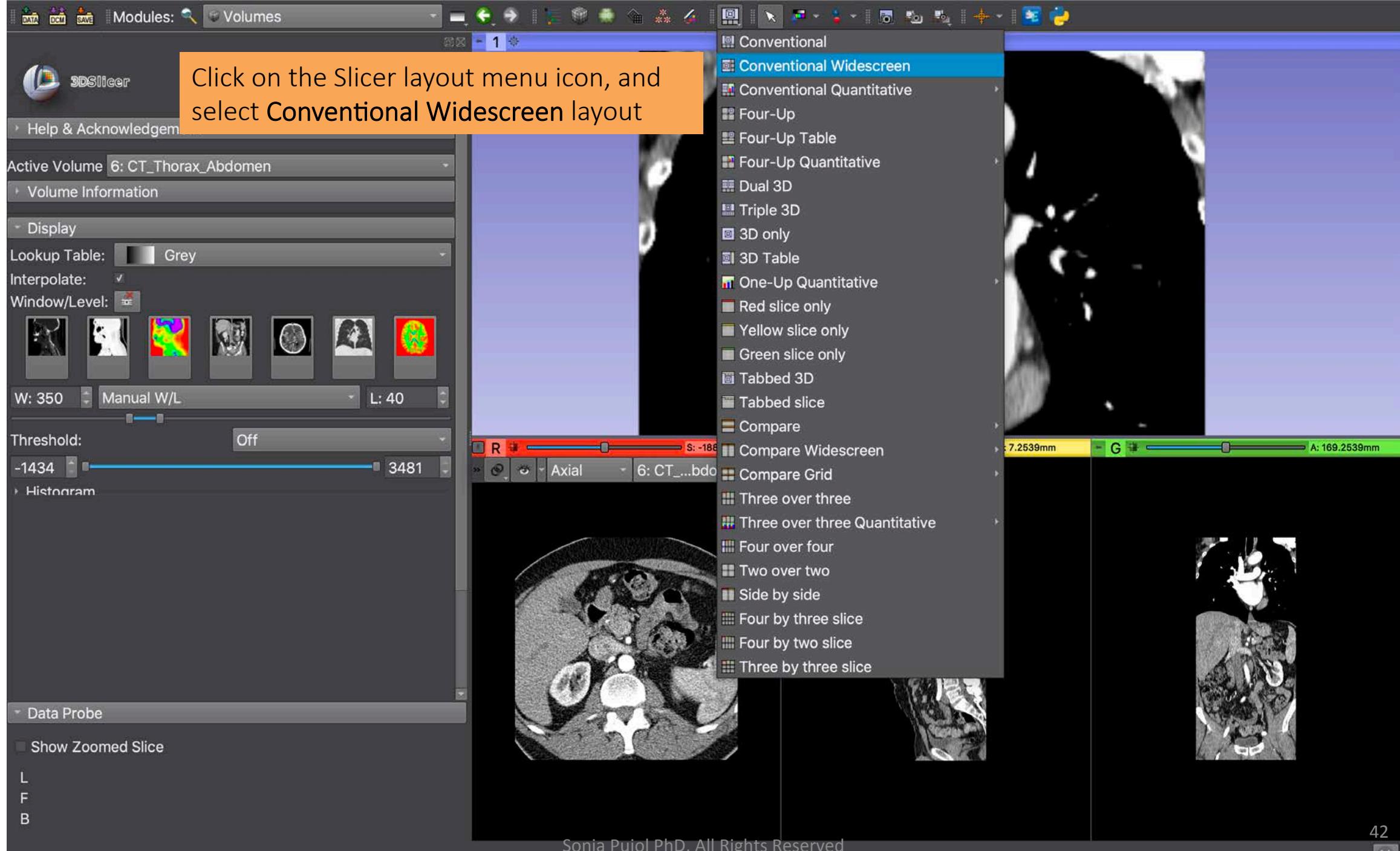


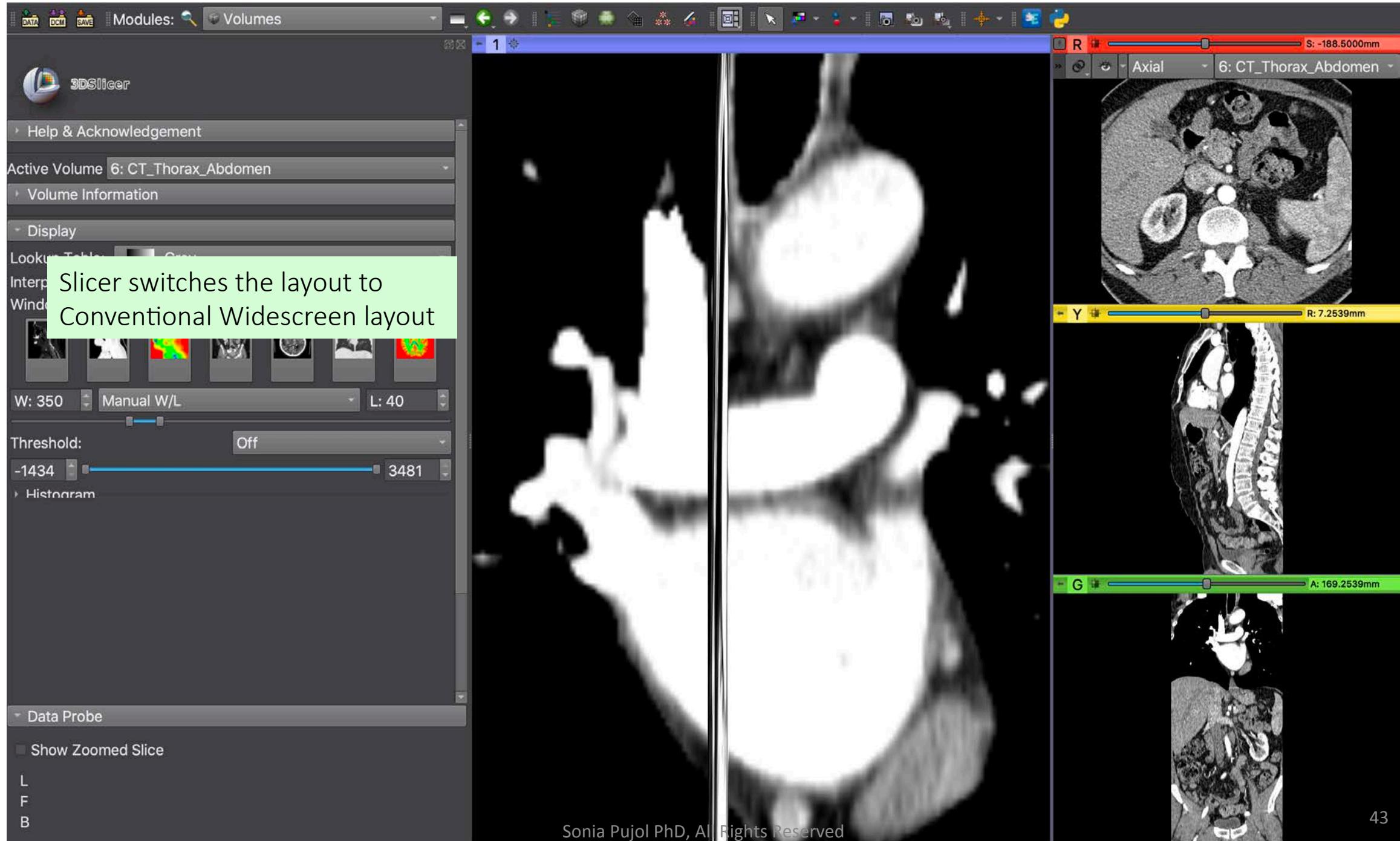


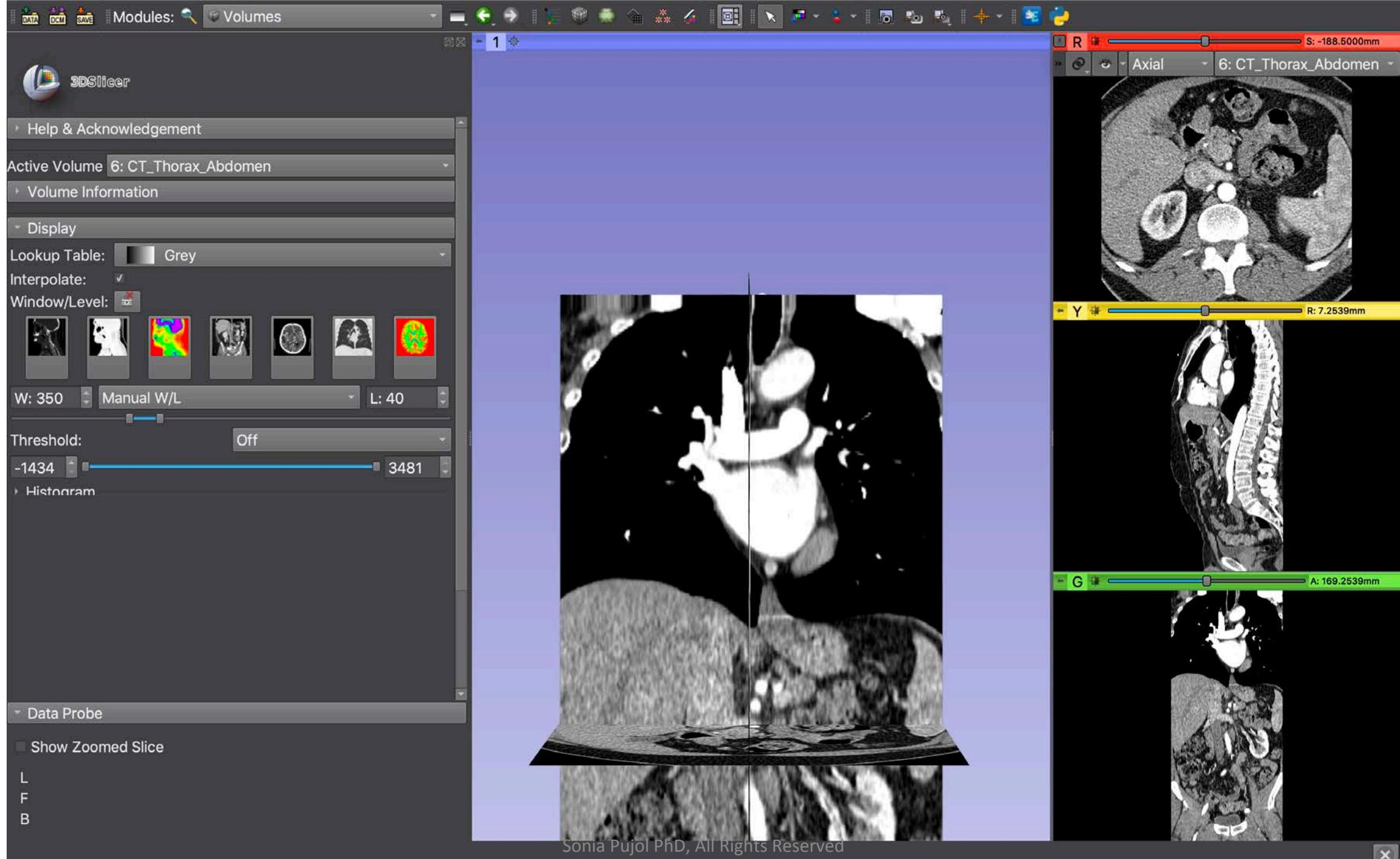


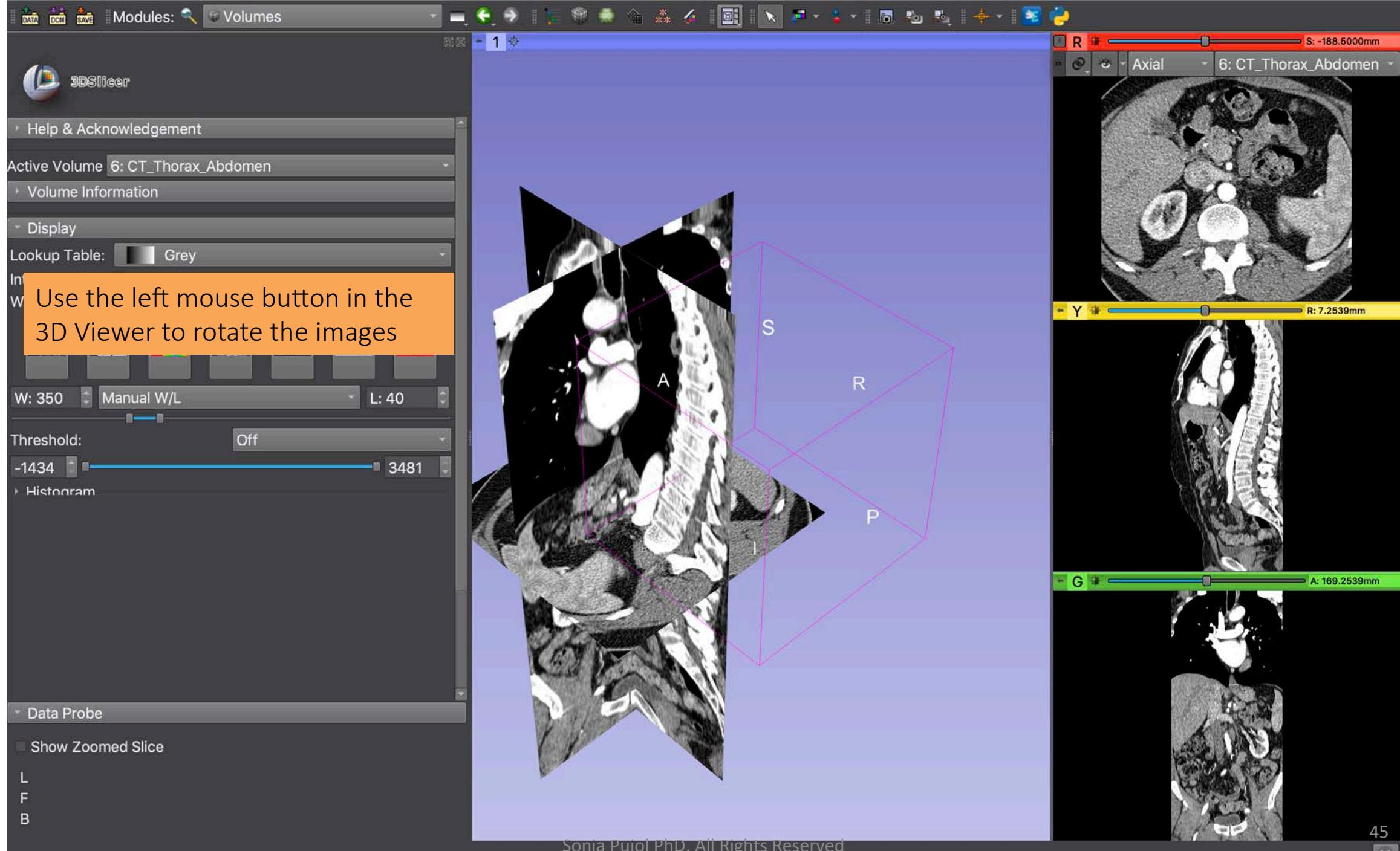


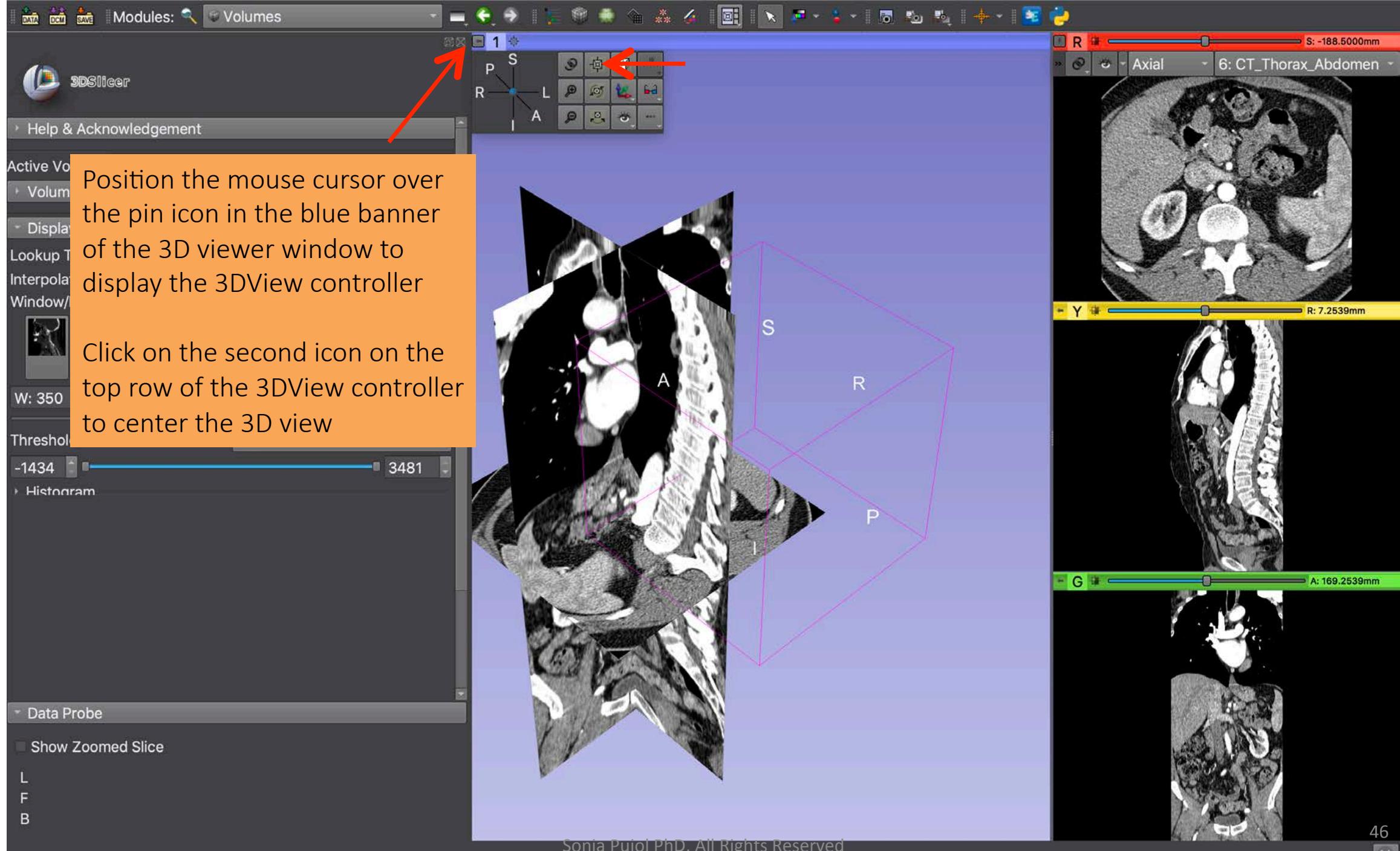


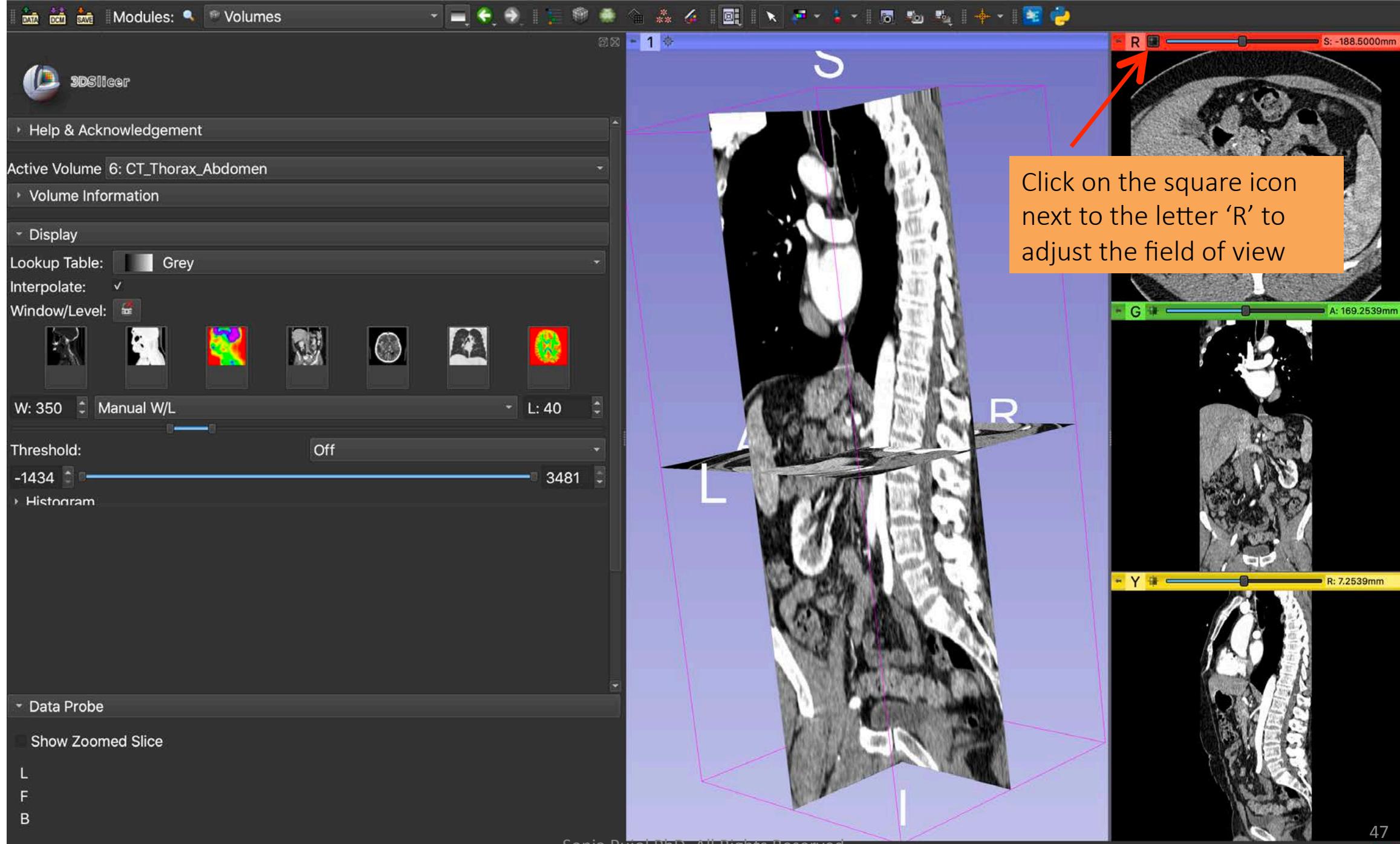


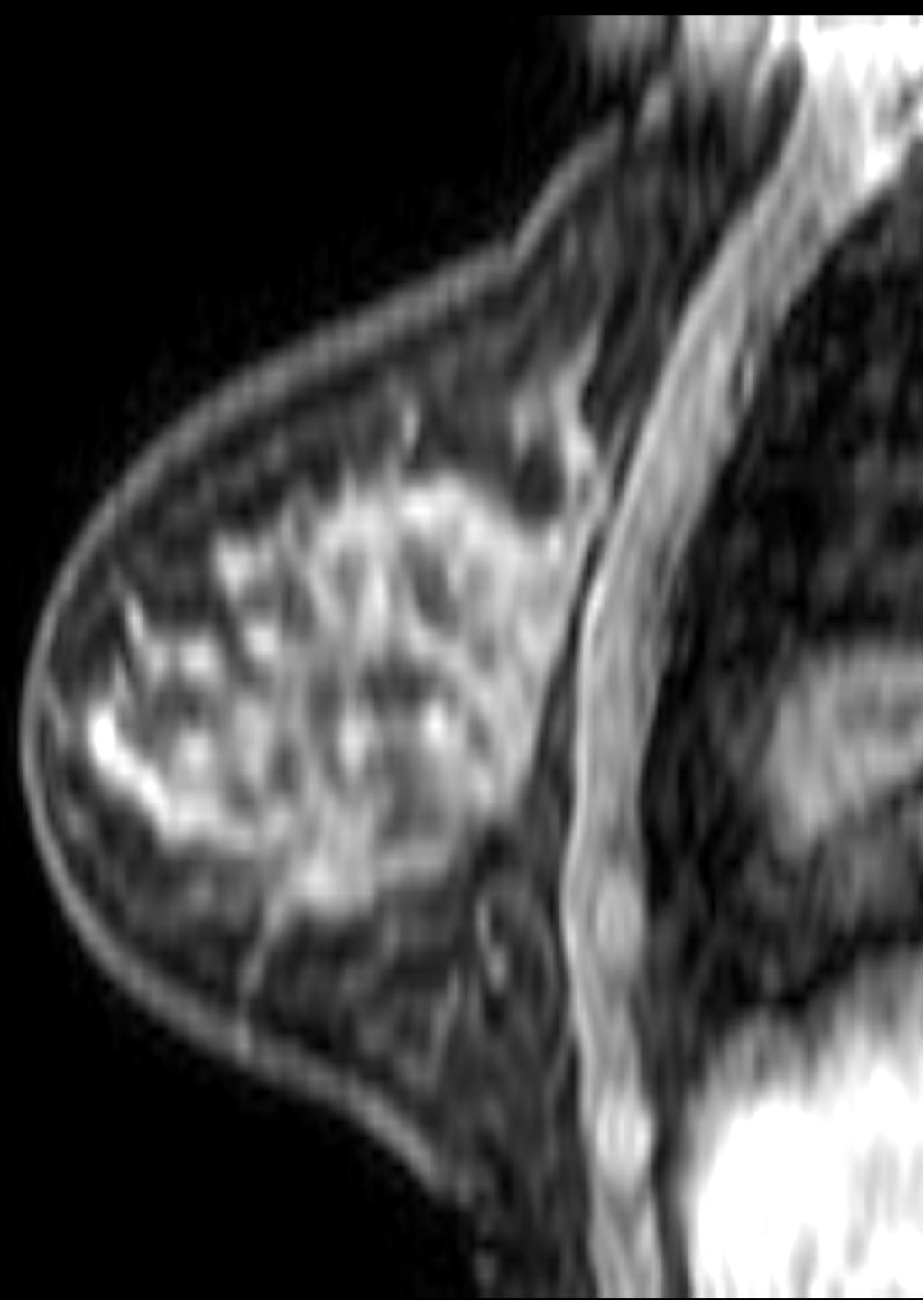












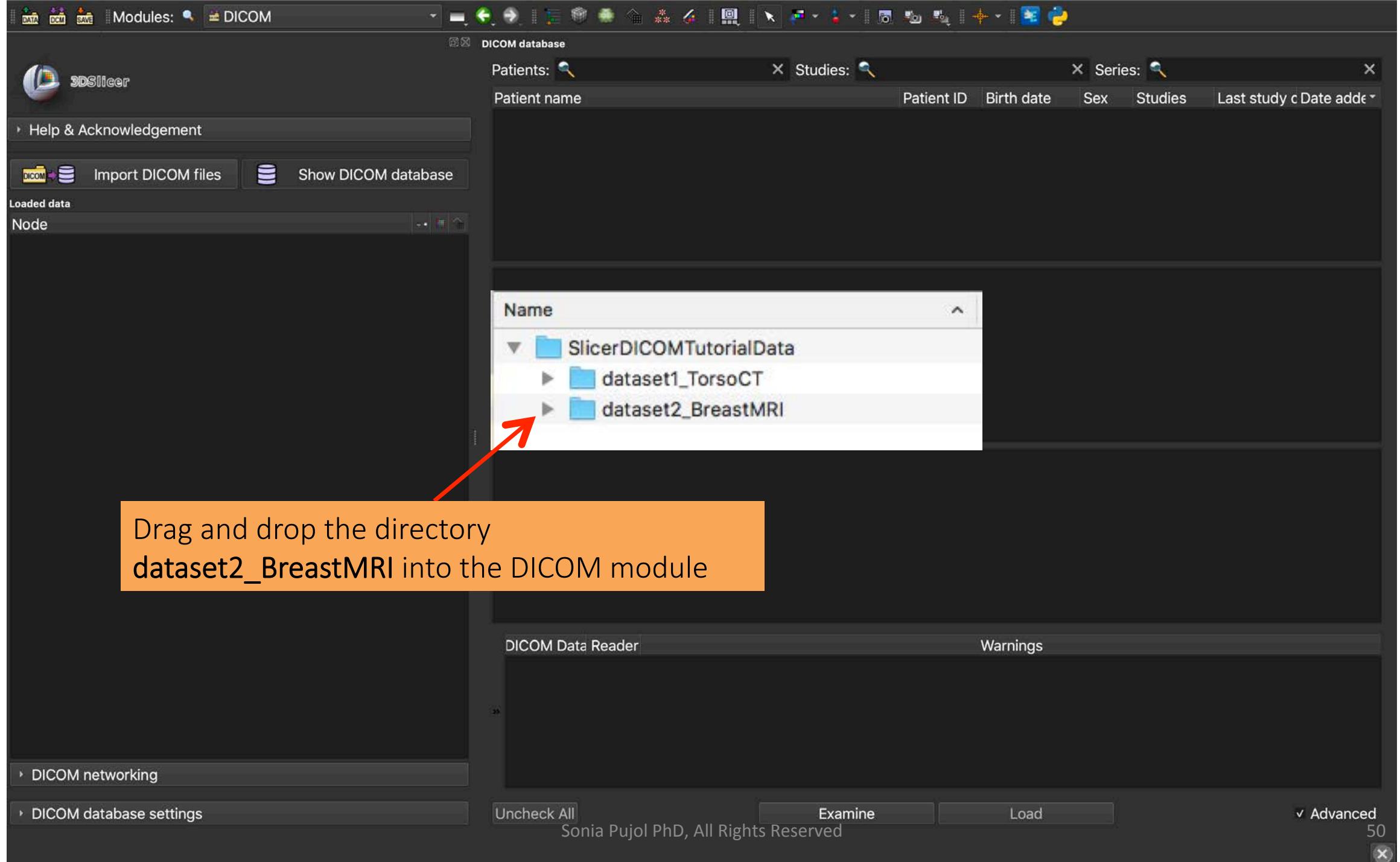
# Dataset #2

## Breast MRI

# Breast MRI Dataset

- The Breast MRI dataset is part of the BREAST-DIAGNOSIS collection of The Cancer Imaging Archive (TCIA) of the National Cancer Institute
- The dataset was acquired on patient with right breast infiltrating ductal carcinoma
- The DICOM images consist of one study and three series: T2, STIR and BLISS

Bloch, B. Nicolas, Jain, Ashali, & Jaffe, C. Carl. (2015). Data From BREAST-DIAGNOSIS. The Cancer Imaging Archive. <http://doi.org/10.7937/K9/TCIA.2015.SDNRQXXR>



Slicer imports the dataset2\_BreastMRI directory into the DICOM database

The directory contains 1 patient, 1 study and 3 series

Import completed: added 1 patients, 1 studies, 3 series, 1008 instances.

DICOM networking DICOM database settings

Uncheck All Examine Load Advanced

Sonia Pujol PhD, All Rights Reserved

51

DATA DCM SAVE Modules: DICOM

Click on the PatientID BreastDx-01-0005 to display the study and the three T2W, STIR and BLISS series

Click on Examine

DICOM database

Patients: Studies: Series:

Patient name	Patient ID	Birth date	Sex	Studies	Last study	Date added
	BreastDx-01-0005		F	1	Tue Nov 11 2008	2020...583
patient1	patient1_ID			1	Wed Jun 1 2005	2020...273

Study date	Study ID	Study description	Series	Date added
20081111		MRI BREAST, BILATERAL WITH T WITHOUT CONTRAST	3	2020...583

Series #	Series description	Modality	Size	Count	Date added
301	T2W_TSE SENSE	MR	528x528	84	2020...583
401	STIR SENSE	MR	528x528	84	2020...221
801	AX BLISS_AUTO SENSE	MR	528x528	840	202...646

DICOM Data Reader Warnings

DICOM networking

DICOM database settings

Uncheck All Examine Load Advanced

Sonia Pujol PhD, All Rights Reserved

52

DATA DCM SAVE Modules: DICOM

3DSlicer

Help & Acknowledgement

Import DICOM files Show DICOM database

Loaded data

Node

- patient1 (patient1\_ID)
  - CT Thorax Abdomen (20050601)
    - 6: CT\_Thorax\_Abdomen

DICOM database

Patients: Studies: Series:

Patient name	Patient ID	Birth date	Sex	Studies	Last study	Date added
	BreastDx-01-0005		F	1	Tue Nov 11 2008	2020...583
patient1	patient1_ID			1	Wed Jun 1 2005	2020...273

Study date	Study ID	Study description	Series	Date added
20081111		MRI BREAST, BILATERAL WITH T WITHOUT CONTRAST	3	2020...583

Series #	Series description	Modality	Size	Count	Date added
301	T2W_TSE SENSE	MR	528x528	84	2020...583
401	STIR SENSE	MR	528x528	84	2020...221
801	AX BLISS_AUTO SENSE	MR	528x528	840	202...646

Click on the double arrow to display the list of DICOM readers

DICOM Data Reader Warnings

- 301: T2W\_TSE SENSE Scalar Volume
- 401: STIR SENSE Scalar Volume
- AX BLISS\_AUTO SENSE ... MultiVolume

801: AX BLISS\_AUTO ... Scalar Volume Images are not equally spaced (a difference of 2 vs 0 in spacings ...  
AX BLISS\_AUTO SENSE ... MultiVolume

Uncheck All Examine Load Advanced

Sonia Pujol PhD, All Rights Reserved

53

The screenshot shows the 3DSlicer application interface. On the left, there's a sidebar with various icons and sections like 'Help & Acknowledgement', 'Import DICOM files' (with a 'DICOM' button), and 'Show DICOM database'. Below these are 'Loaded data' and 'Node' sections. The 'Node' section shows a tree view with 'patient1 (patient1\_ID)' expanded, revealing 'CT Thorax Abdomen (20050601)' which further expands to '6: CT\_Thorax\_Abdomen'. A red arrow points from a green callout box containing the text 'The list of DICOM plugins appear' towards the bottom left of the interface.

DICOM database

Patients: Studies: Series:

Patient name	Patient ID	Birth date	Sex	Studies	Last study date	Date added
patient1	BreastDx-01-0005		F	1	Tue Nov 11 2008	2020-0...28.583
	patient1_ID			1	Wed Jun 1 2005	2020-0...43.273

Study date Study ID Study description Series Date added

20081111		MRI BREAST, BILATERAL WITH T WITHOUT CONTRAST	3	2020-0...28.583
----------	--	---	---	-----------------

Series # Series description Modality Size Count Date added

301	T2W_TSE SENSE	MR	528x528 84	2020-0...28.583
401	STIR SENSE	MR	528x528 84	2020-0...29.221
801	AX BLISS_AUTO SENSE	MR	528x528 840	2020-0...28.646

DICOM Data Reader Warnings

301: T2W_TSE SENSE	Scalar Volume	
401: STIR SENSE	Scalar Volume	
AX BLISS_AUTO SENSE - as a 10 ...	MultiVolume	
801: AX BLISS_AUTO SENSE	Scalar Volume	Images are not equally spaced (a difference of 2 vs 0 in spacing...)
AX BLISS_AUTO SENSE - as a 10 ...	MultiVolume	
AX BLISS_AUTO SENSE - as a 10 ...	MultiVolume	

DICOMPETSVPlugin DICOMParametricMapPlugin DICOMRWVMPPlugin DICOMScalarVolumePlugin DICOMSegmentationPlugin DICOMSlicerDataBundlePlugin DICOMTID1500Plugin DICOMVolumeSequencePlugin DicomRtImportExportPlugin DicomSrlmportExportPlugin MultiVolumeImporterPlugin

Uncheck All Examine Load Advanced

# Slicer DICOM Plugins

- ✓ DICOMPETSUVPlugin
- ✓ DICOMParametricMapPlugin
- ✓ DICOMRWVMPPlugin
- ✓ DICOMScalarVolumePlugin
- ✓ DICOMSegmentationPlugin
- ✓ DICOMSlicerDataBundlePlugin
- ✓ DICOMTID1500Plugin
- ✓ DICOMVolumeSequencePlugin
- ✓ DicomRtImportExportPlugin
- ✓ DicomSroImportExportPlugin
- ✓ MultiVolumeImporterPlugin

- Slicer implements a list of DICOM plugins to handle a diverse set of DICOM data objects
- These plugins need to be enabled in order to read specific DICOM data objects such DICOM RT data or DICOM DWI data

3DSlicer

DICOM database

Patients: Studies: Series:

Patient name	Patient ID	Birth date	Sex	Studies	Last study date	Date added
patient1	BreastDx-01-0005		F	1	Tue Nov 11 2008	2020-0...28.583
	patient1_ID			1	Wed Jun 1 2005	2020-0...43.273

Import DICOM files Show DICOM database

Loaded data

Node

- patient1 (patient1\_ID)
  - CT Thorax Abdomen (20050601)
    - 6: CT\_Thorax\_Abdomen

Study date Study ID Study description Series Date added

20081111		MRI BREAST, BILATERAL WITH T WITHOUT CONTRAST	3	2020-0...28.583
----------	--	---	---	-----------------

Series # Series description Modality Size Count Date added

301	T2W_TSE SENSE	MR	528x528 84	2020-0...28.583
401	STIR SENSE	MR	528x528 84	2020-0...29.221
801	AX BLISS_AUTO SENSE	MR	528x528 840	2020-0...28.646

✓ DICOMPETSUVPPlugin ✓ DICOParametricMapPlugin ✓ DICOMRWVMPPlugin ✓ DICOMScalarVolumePlugin ✓ DICOMSegmentationPlugin ✓ DICOMSlicerDataBundlePlugin ✓ DICOMTID1500Plugin ✓ DICOMVolumeSequencePlugin ✓ DicomRtImportExportPlugin ✓ DicomSrlImportExportPlugin ✓ MultiVolumeImporterPlugin

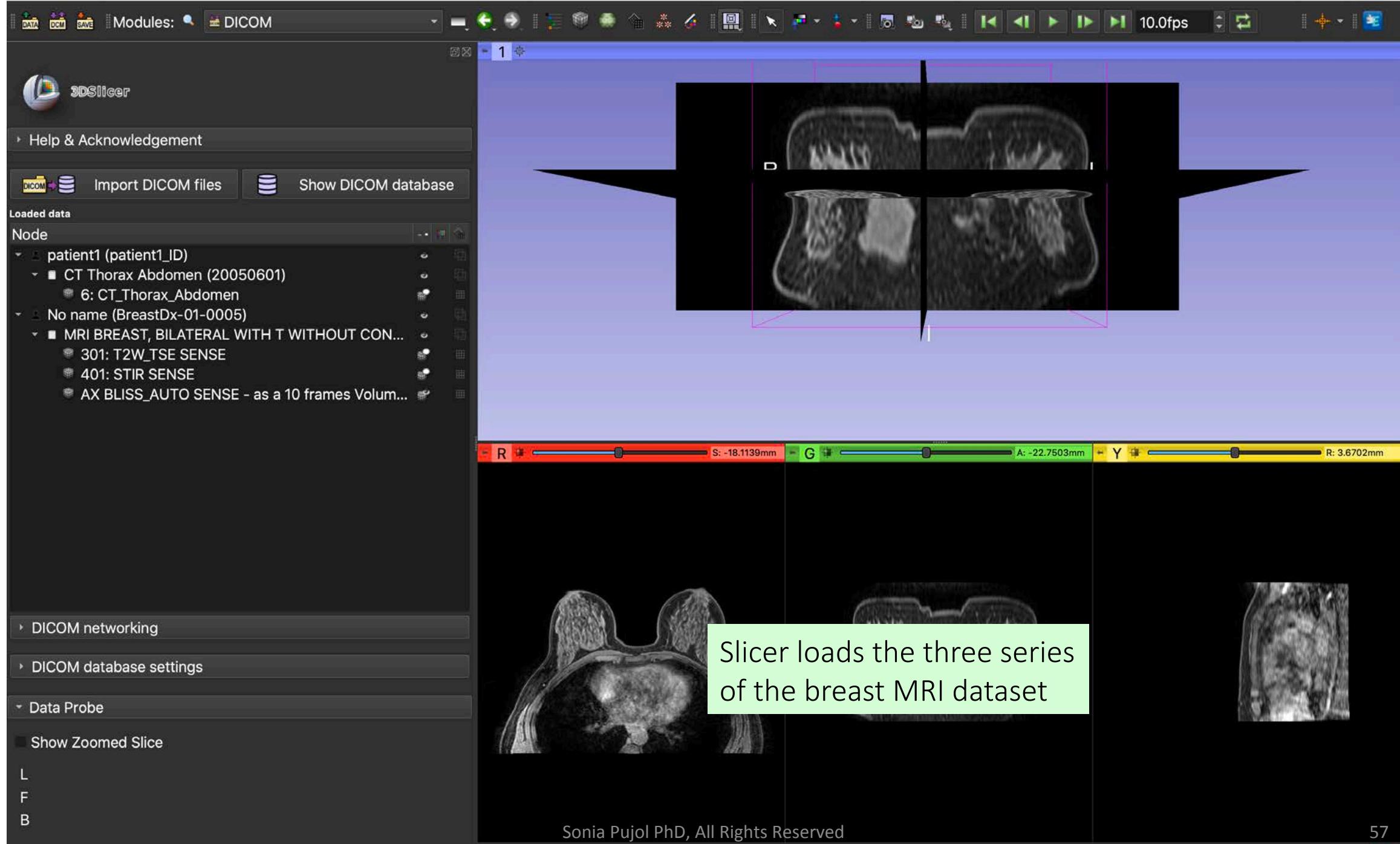
301: T2W\_TSE SENSE ✓ 401: STIR SENSE ✓ AX BLISS\_AUTO SENSE - as a 10 ... MultiVolume  
801: AX BLISS\_AUTO SENSE Scalar Volume Images are not equally spaced (a difference of 2 vs 0 in spacing...) AX BLISS\_AUTO SENSE - as a 10 ... MultiVolume AX BLISS\_AUTO SENSE - as a 10 ... MultiVolume

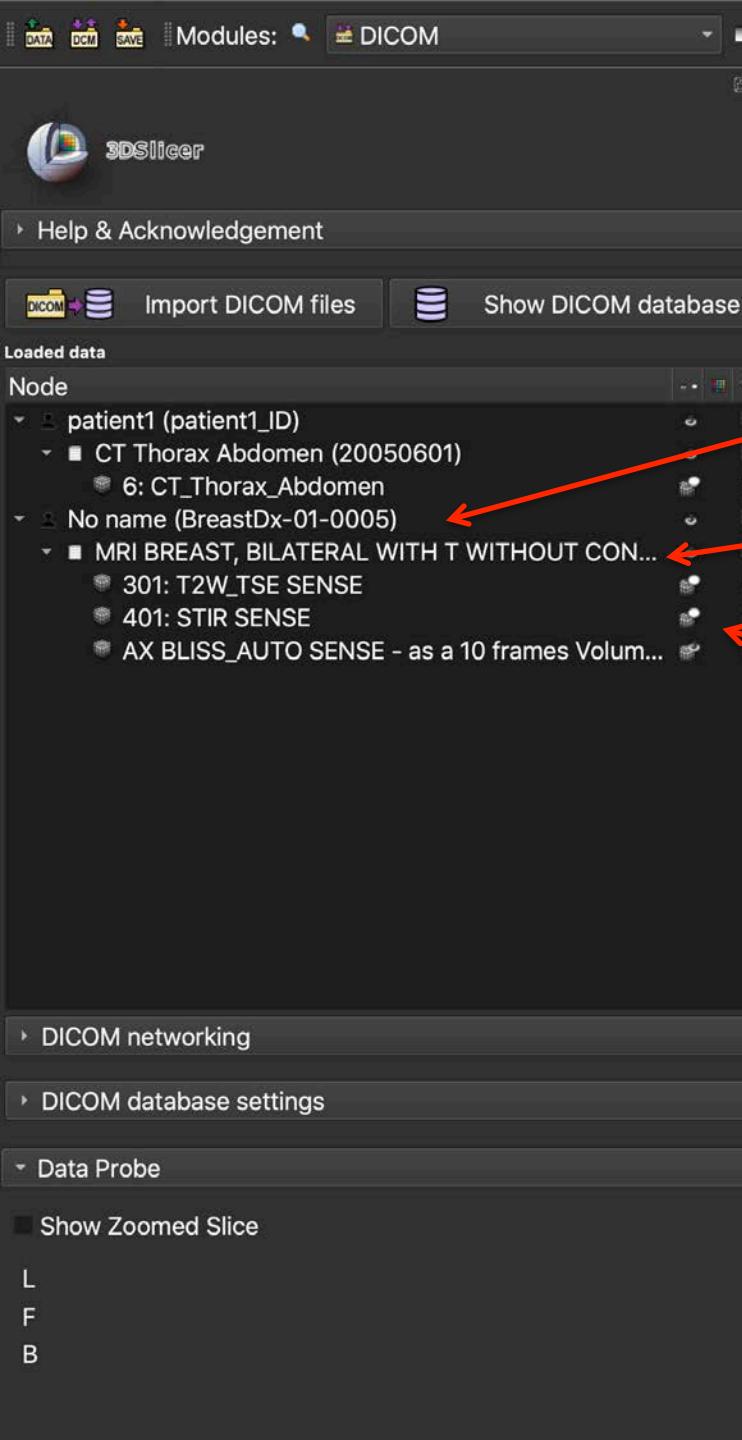
Uncheck All Examine Load Advanced

Sonia Pujol PhD, All Rights Reserved

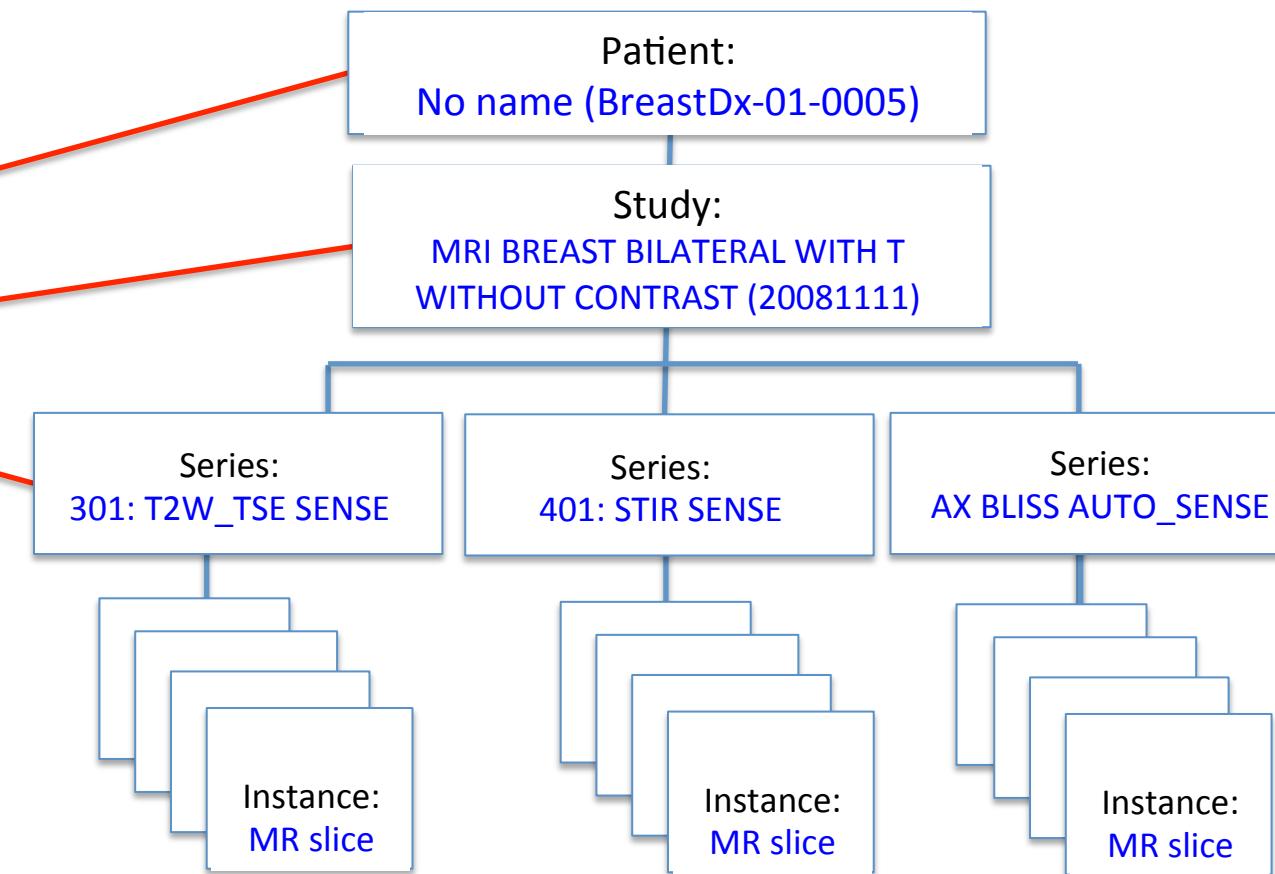
Click on Load to load the data into Slicer

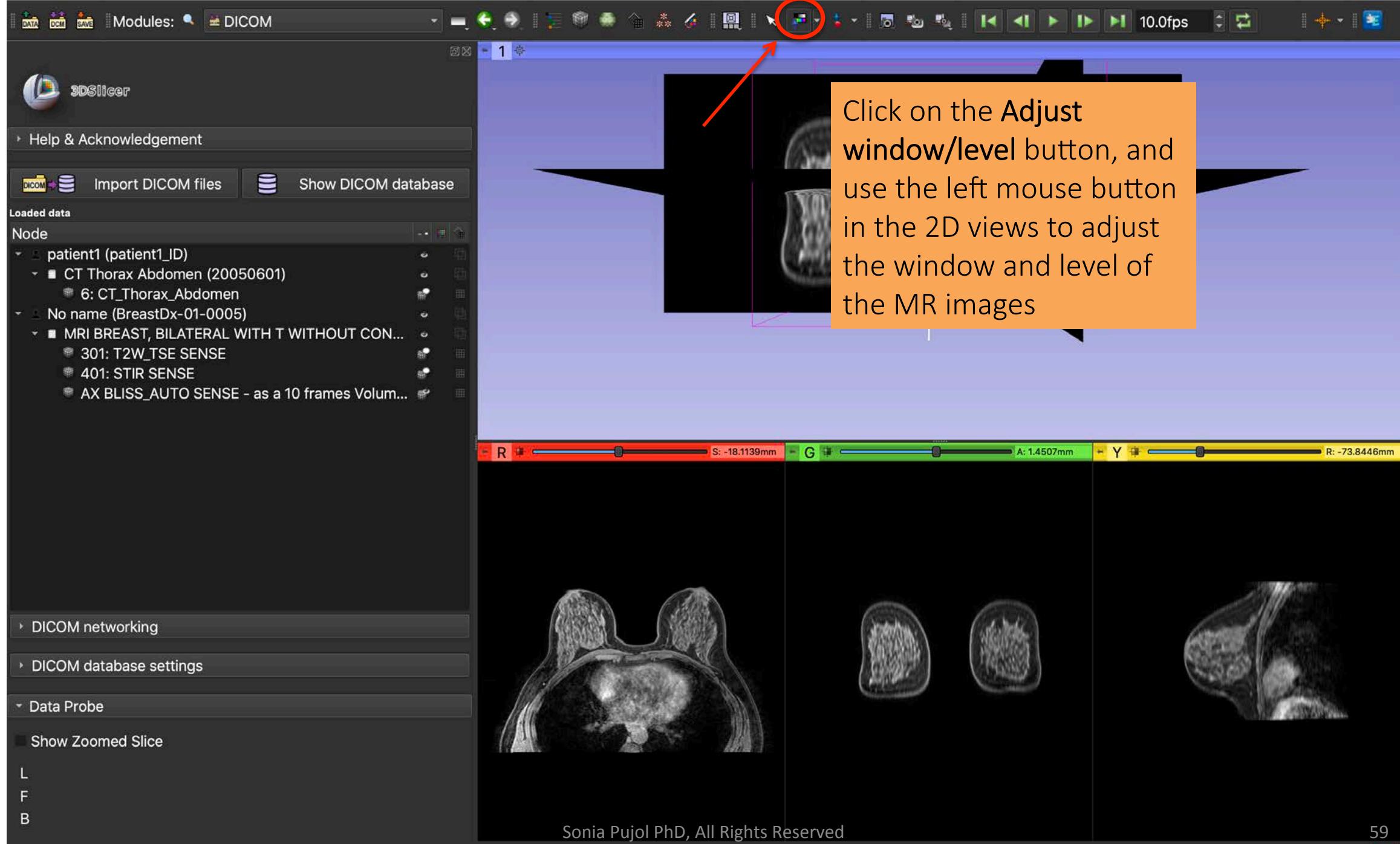
56





DICOM data are loaded into Slicer as a patient-study-series hierarchy







Help &amp; Acknowledgement

Import DICOM files

Show DICOM database

## Loaded data

## Node

patient1 (patient1\_ID)

CT Thorax Abdomen (20050601)

6: CT\_Thorax\_Abdomen

No name (BreastDx-01-0005)

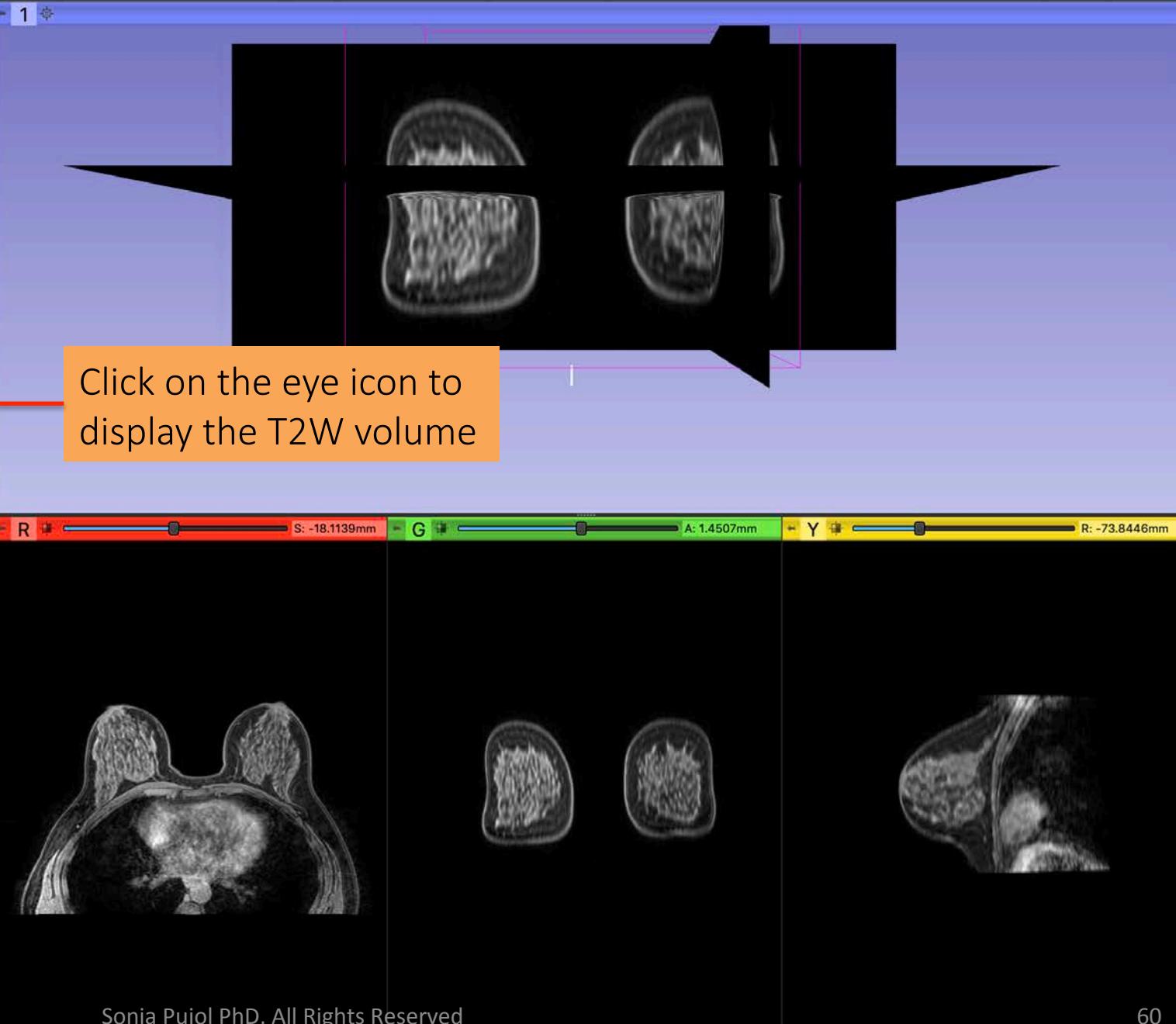
MRI BREAST, BILATERAL WITH T WITHOUT CON...

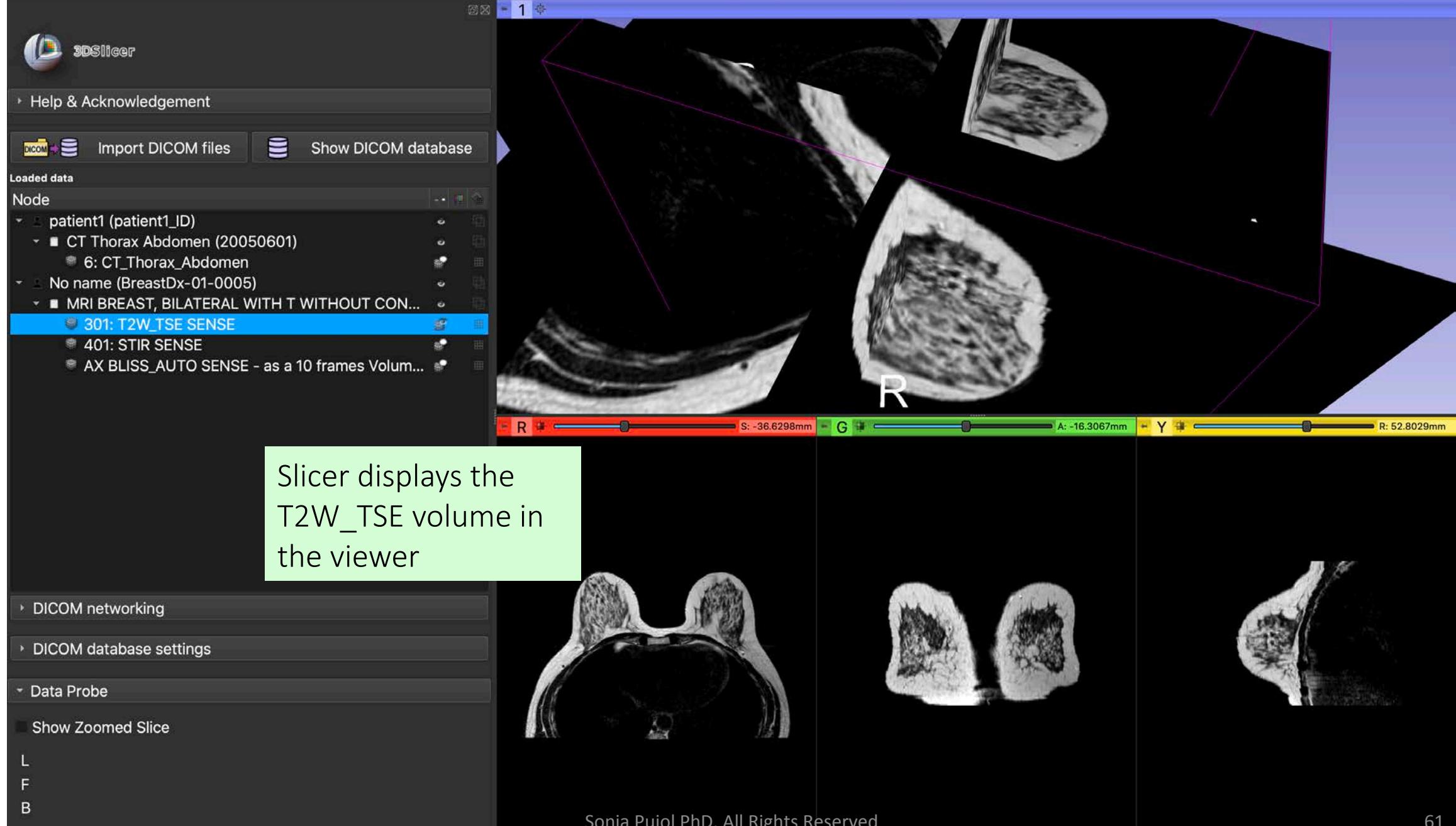
301: T2W\_TSE SENSE

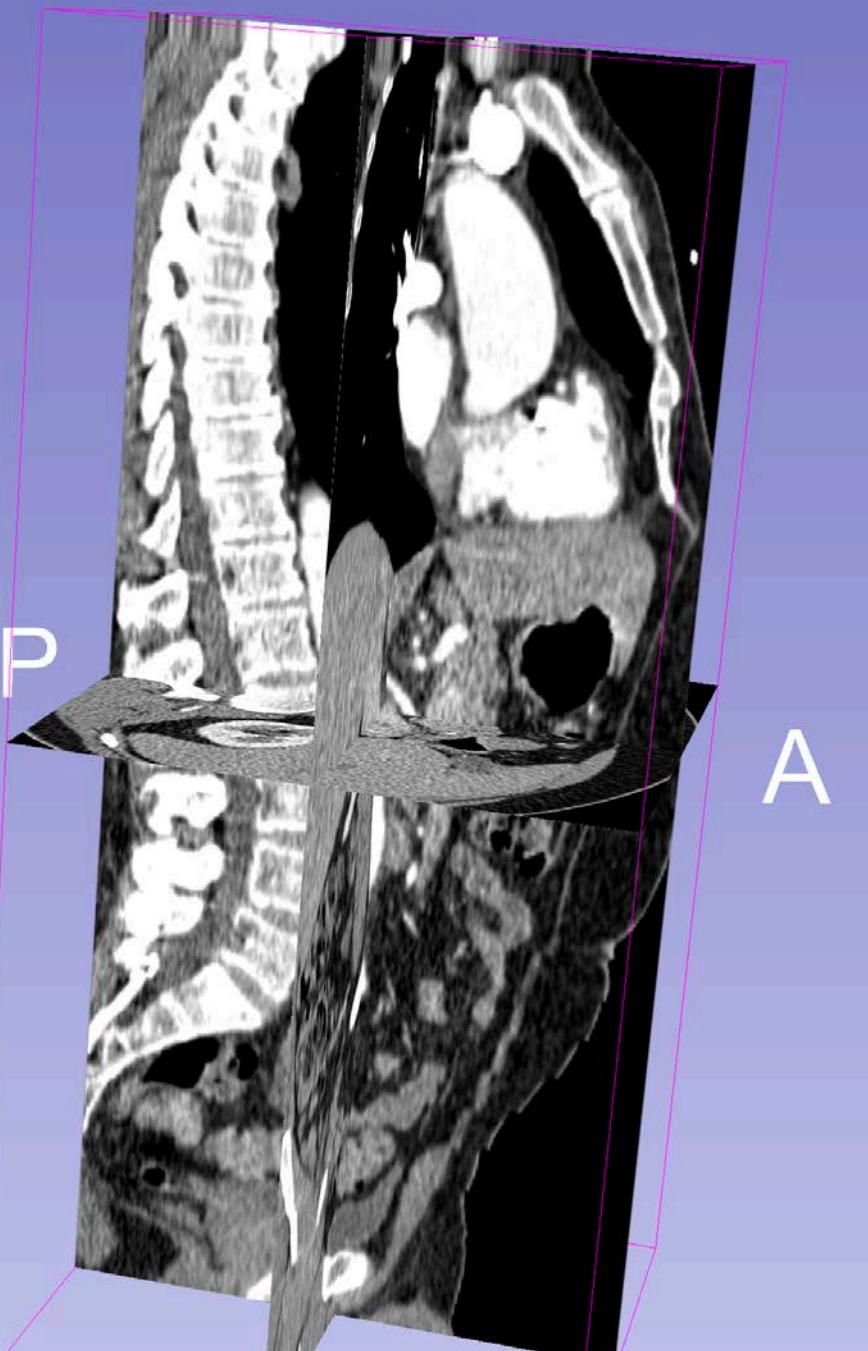
401: STIR SENSE

AX BLISS\_AUTO SENSE - as a 10 frames Volum...

Click on the eye icon to  
display the T2W volume







## Conclusion

---

- 3D Slicer and the DICOM standard enable compliance with the FAIR principles for biomedical research
- By enabling interoperability between research and clinical environment, 3D Slicer and the DICOM standard lower the inherent barriers to the translation of research advances to patient care

# Acknowledgments

 Neuroimage Analysis Center  
(NIBIB P41 EB015902)