



NA-MIC

*National Alliance for Medical Image Computing*

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# Subject Hierarchy

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# Learning Objective

This tutorial demonstrates the basic usage and potential of Slicer's data manager module Subject Hierarchy using a two-timepoint radiotherapy phantom dataset.

The screenshot shows the Slicer Node browser window titled "Node". The tree view displays the following hierarchy under the "Scene" node:

- RANDO^ENT
  - Planning study
    - 5: RTDOSE: BRAI1
    - 4: RTPLAN: BRAI1\_Isocenters
    - 4: RTPLAN: BRAI1\_BeamM...
  - 3: RTSTRUCT: ENT
    - BODY
    - BRAIN
    - BRSTEM
    - Optic Chiasm
    - Orbit - left
    - Orbit - right
    - PTV1
  - 2: ENT IMRT- Day 2 study
  - 2\_ENT\_IMRT\_Day2
  - 5\_RTDOSE\_Day2

At the bottom of the window, there are checkboxes for "Transforms" (checked) and "ID's" (unchecked), and a link to "MRML Node Inspector".



# Material

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This tutorial requires the installation of the Slicer4.5 release and the tutorial dataset. They are available at the following locations:

**Slicer download page:**

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

**Tutorial dataset: IGRT Tutorial Dataset**

[http://slicer.kitware.com/midas3/download/item/205404/  
SlicerRT\\_WorldCongress\\_TutorialIGRT\\_Dataset.zip](http://slicer.kitware.com/midas3/download/item/205404/SlicerRT_WorldCongress_TutorialIGRT_Dataset.zip)

**Wiki page:** [http://wiki.slicer.org/slicerWiki/index.php/  
Documentation/Nightly/Modules/SubjectHierarchy](http://wiki.slicer.org/slicerWiki/index.php/Documentation/Nightly/Modules/SubjectHierarchy)

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# Platforms

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- Developed and maintained on Windows 64bit, Mac OSX, and Linux 64bit & 32bit



- Slicer requires
  - Minimum 2GB RAM
  - 64 bit strongly suggested



# General module information

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- Subject hierarchy is the main data manager module of 3D Slicer
  - Data type specific visualization and handling of different data objects
  - Organization of the data objects into hierarchies
  - Access select Slicer features applicable to the data objects directly from the tree
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# Overview

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1. Install SlicerRT extension
  2. Import and load planning data
  3. Explore loaded data in Subject hierarchy
  4. Load second timepoint data
  5. Add loaded data into new study
  6. Register second timepoint to planning study with Subject hierarchy
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# Part 1: Install SlicerRT extension

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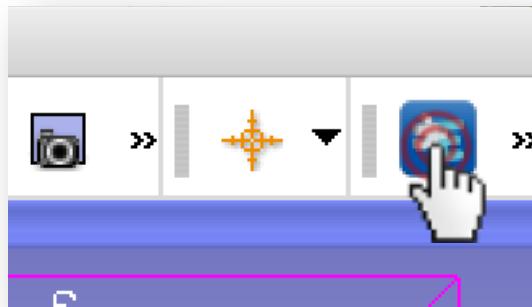
- Enables loading radiotherapy data
  - Allows demonstrating support of “exotic” data types in Subject hierarchy
  - Multiple studies by nature
  - (Please ask the author about support of your data type if not yet available)



# 1/1: Install SlicerRT extension

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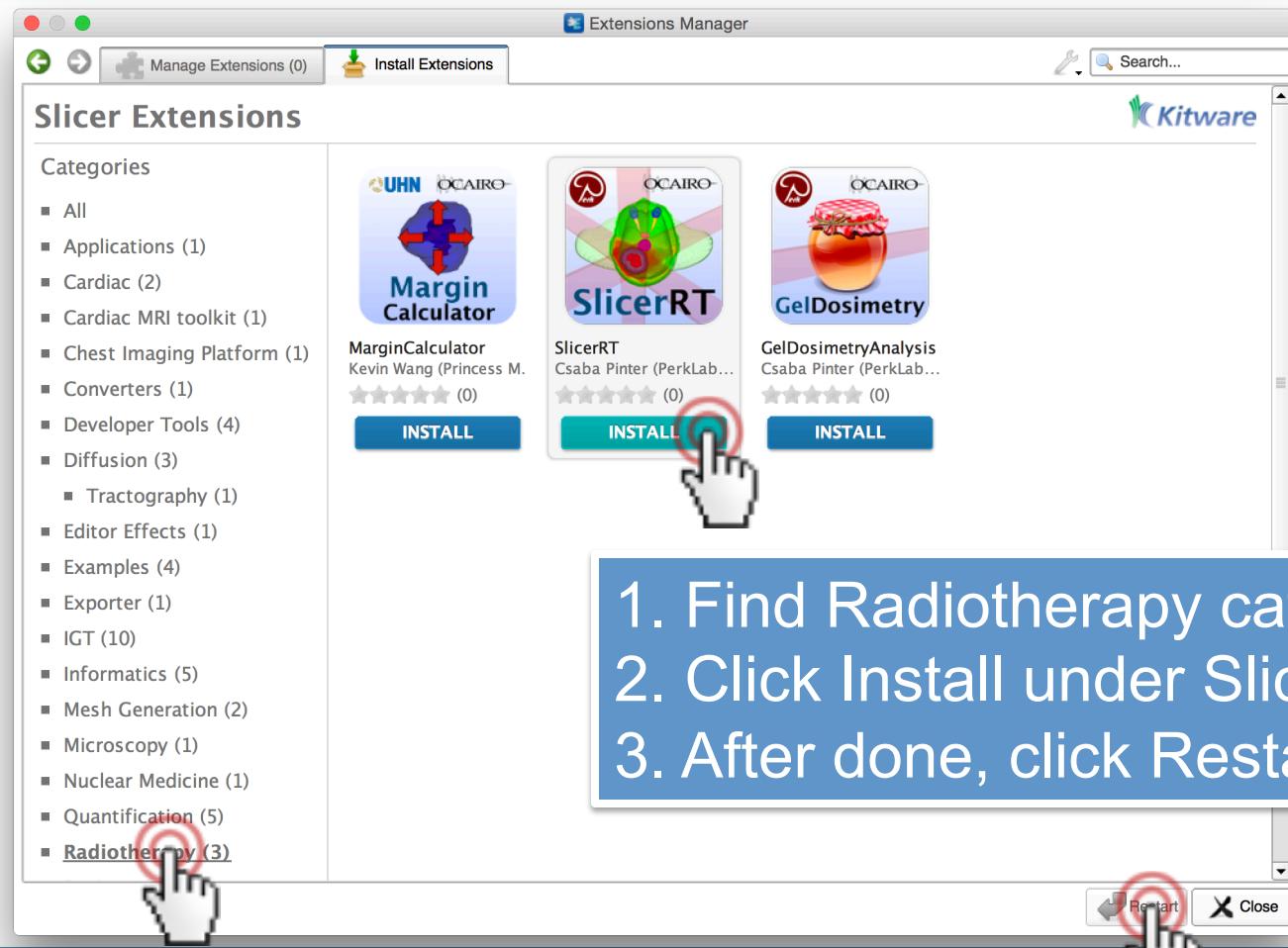
- Open Extension Manager from the toolbar:



- Or from menu  
View / Extension Manager



# 1/2: Install SlicerRT extension





# Part 2: Import and load planning data from DICOM

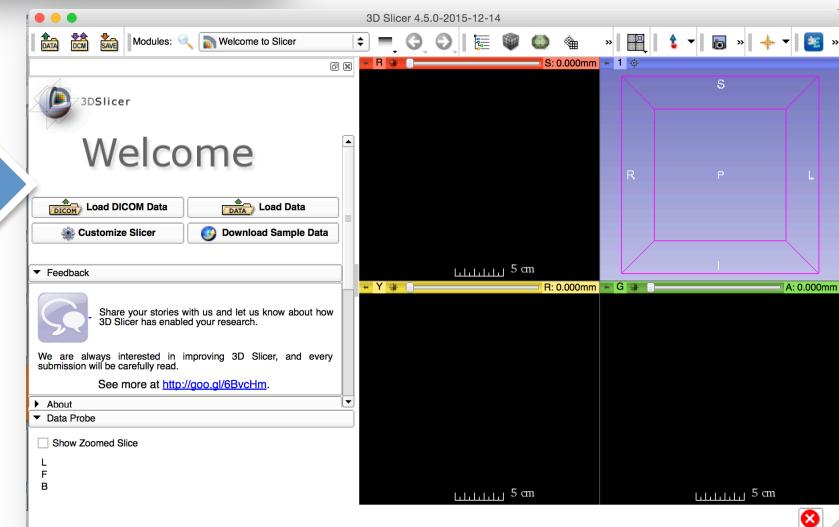
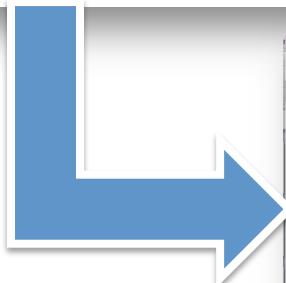
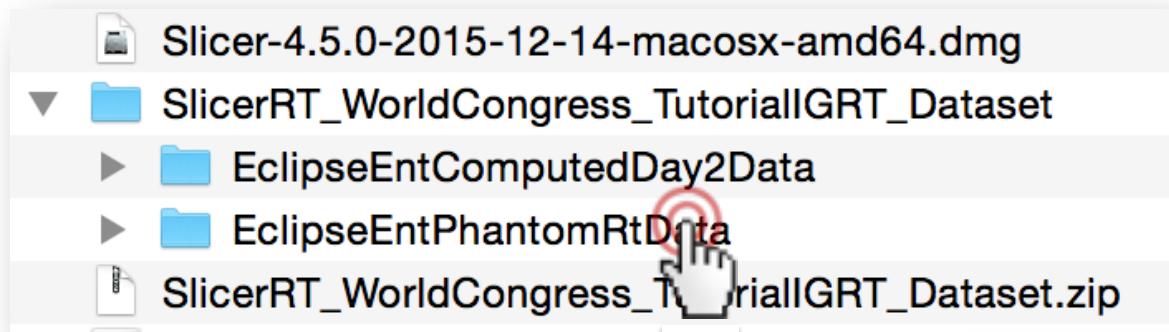
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- Phantom dataset taken from a RANDO<sup>1</sup> head&neck phantom
- Study contains a CT grayscale image and radiotherapy data: contours, dose distribution, treatment beams, plan information

<sup>1</sup>RSD RANDO: [http://www.rsdphantoms.com/rt\\_art.htm](http://www.rsdphantoms.com/rt_art.htm)



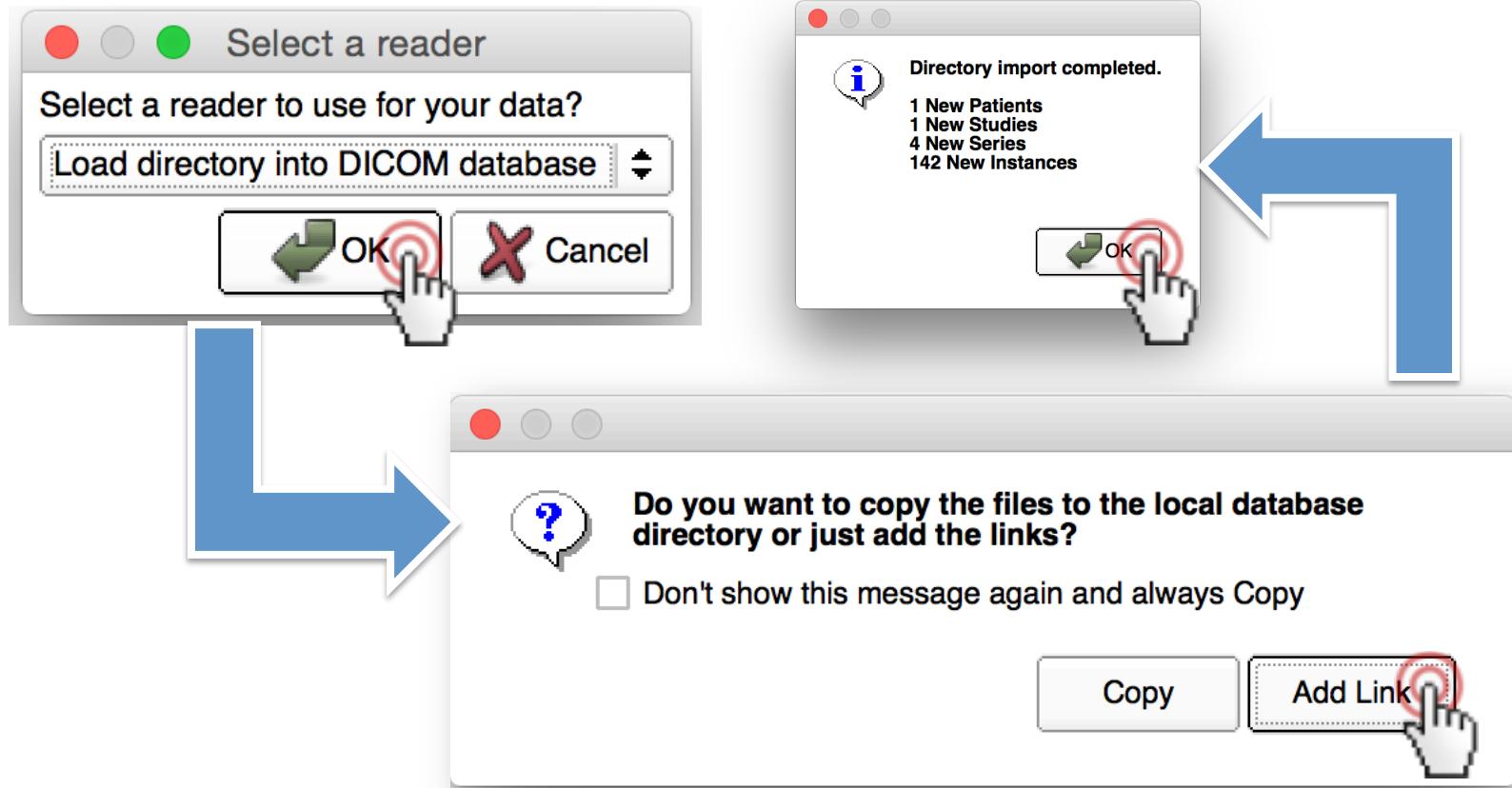
# 2/1: Import and load planning data from DICOM



Drag&drop  
'EclipseEntPhantomRtData'  
onto the Slicer window



# 2/2: Import and load planning data from DICOM





# 2/3: Import and load planning data from DICOM

The screenshot shows a DICOM Browser window with the following interface elements:

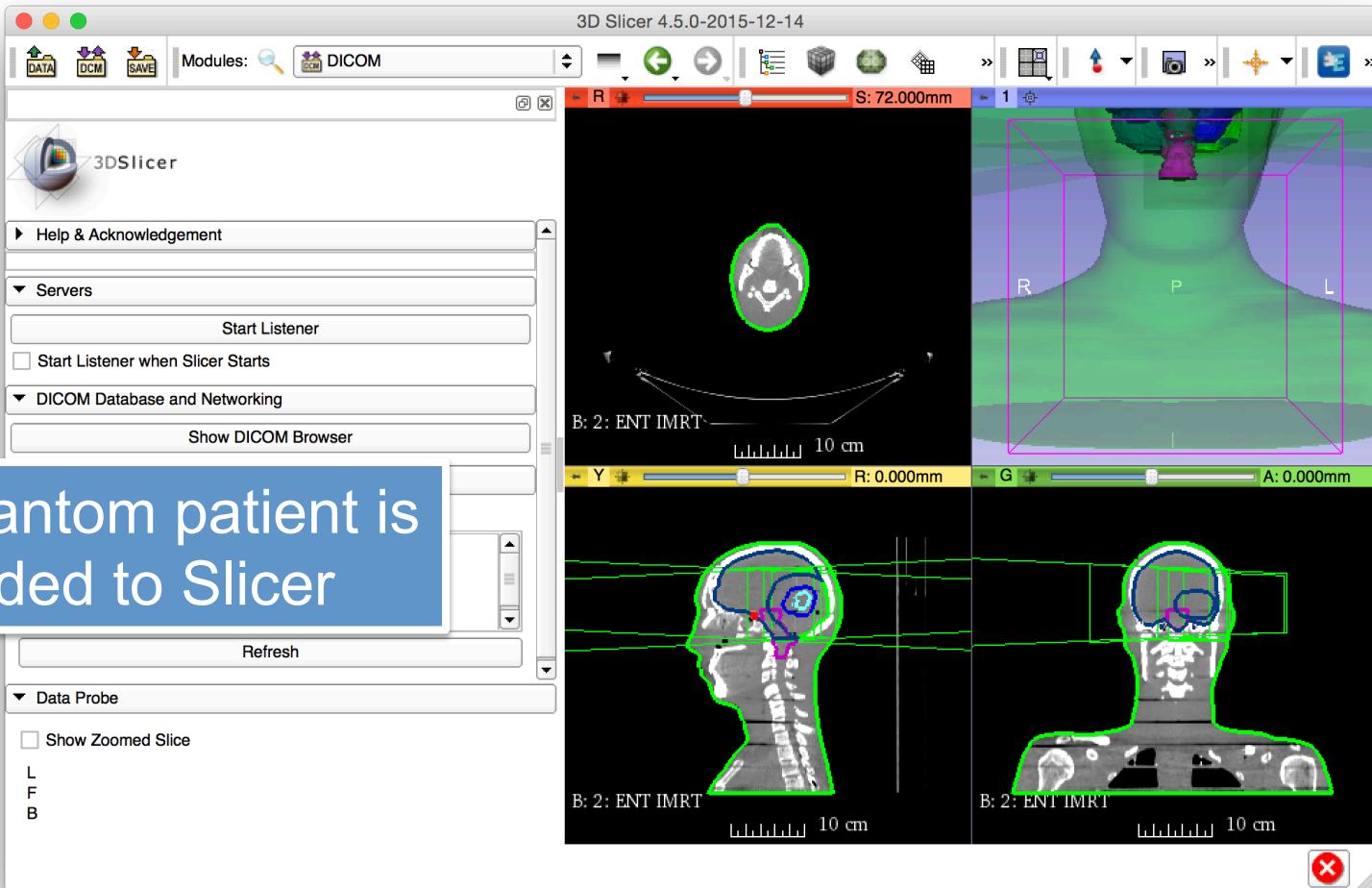
- Toolbar:** Import, Export, Query, Send, Remove, Repair, >>
- Search Fields:** Patients: [search icon], Studies: [search icon], Series: [search icon]
- Patient List:** A table with columns: PatientsName, PatientID, PatientsBirthDate, PatientsBirthTime, PatientsSex, PatientsAge. One row is selected: RANDO^ENT TEST PHYS ENT.
- Study List:** A table with columns: StudyID, StudyDate, StudyTime. One row is selected: 1445 2011-09-20 085705.
- Series List:** A table with columns: SeriesNumber, SeriesDate, SeriesTime, SeriesDescription, Modality, BodyPartExamined. Four rows are listed:
  - SeriesNumber 2, SeriesDate 2011-09-20, SeriesTime 085816, SeriesDescription ENT IMRT, Modality CT, BodyPartExamined
  - SeriesNumber 5, SeriesDate 2011-09-20, SeriesTime 085816, SeriesDescription RTDOSE, Modality RTDOSE, BodyPartExamined
  - SeriesNumber 4, SeriesDate 2011-09-20, SeriesTime 085816, SeriesDescription RTPLAN, Modality RTPLAN, BodyPartExamined
  - SeriesNumber 3, SeriesDate 2011-09-20, SeriesTime 085816, SeriesDescription RTSTRUCT, Modality RTSTRUCT, BodyPartExamined
- Action Buttons:** Load [button with cursor], Metadata, Advanced, Horizontal, Browser Persistent.

A blue callout box on the right side contains the following text:

New patient appears  
1. Select patient 'RANDO ENT'  
2. Click 'Load'



# 2/4: Import and load planning data from DICOM





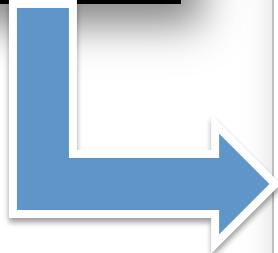
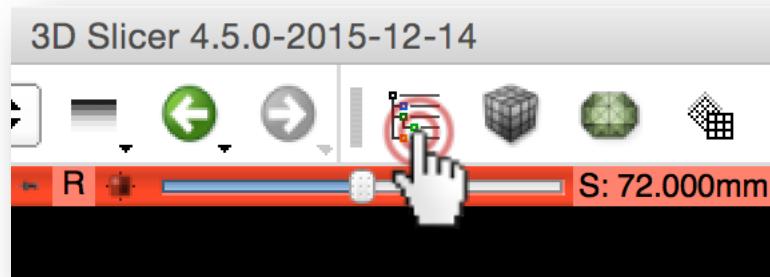
# Part 3: Explore loaded data in Subject hierarchy

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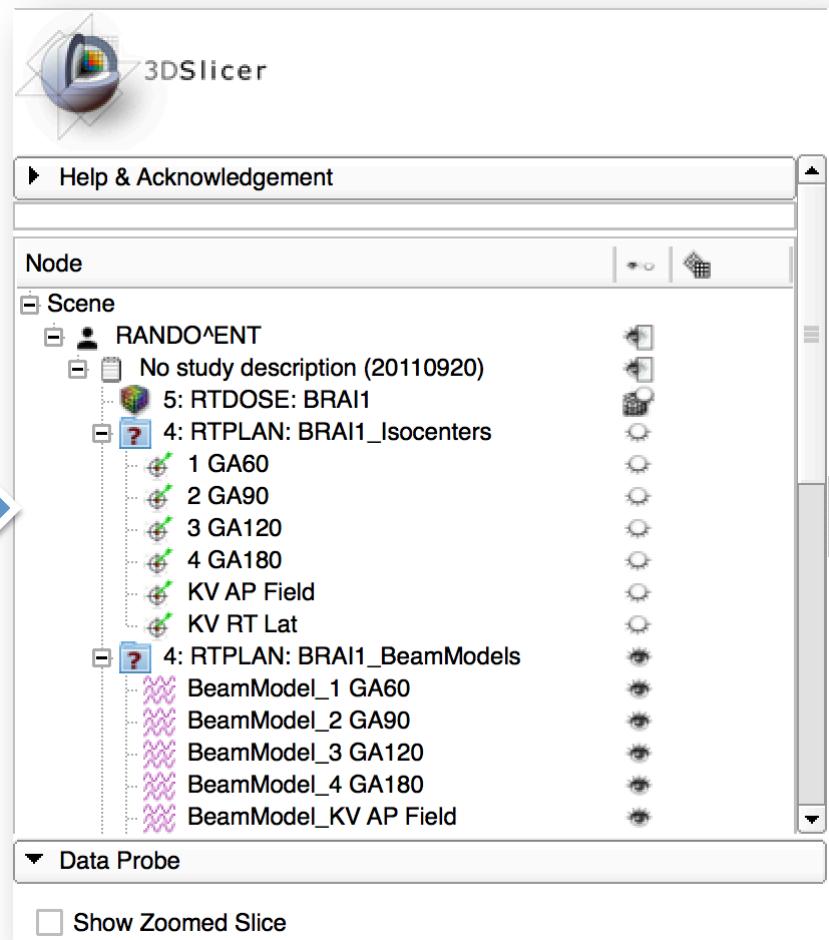
- Subject hierarchy automatically creates hierarchy for supported DICOM types
  - DICOM support can be added for any modality if not yet available



# 3/1: Explore loaded data in Subject hierarchy

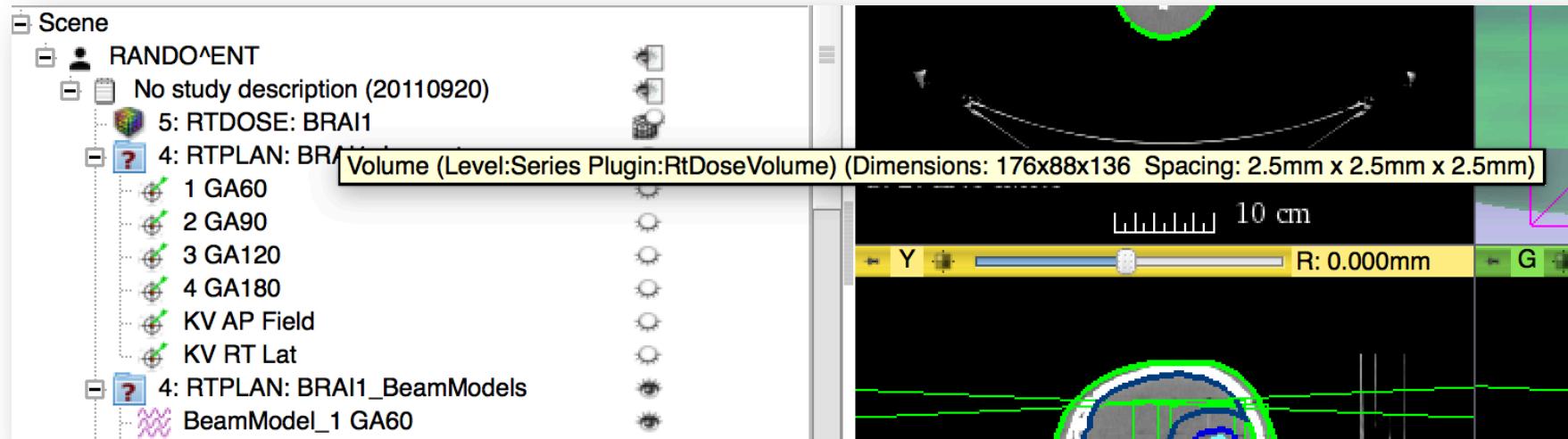


Open Subject hierarchy  
module from the toolbar  
or from the module list  
- Choose 'Yes to All'





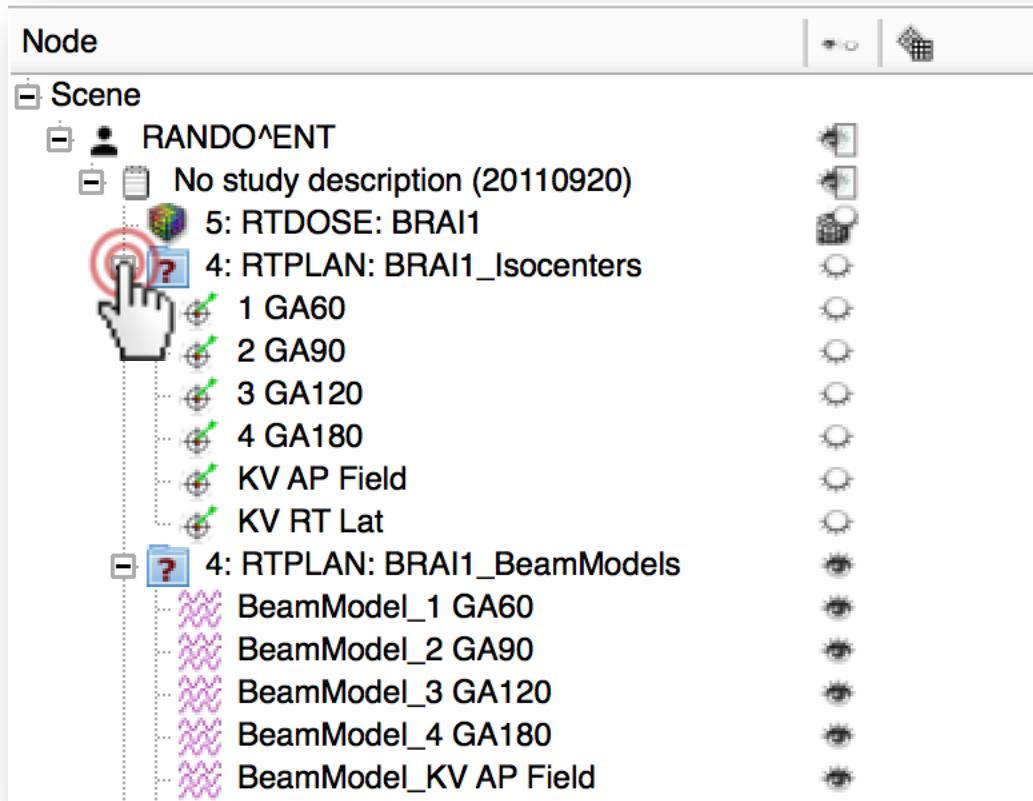
# 3/2: Explore loaded data in Subject hierarchy



Get more information about nodes by moving the mouse over the node in the tree



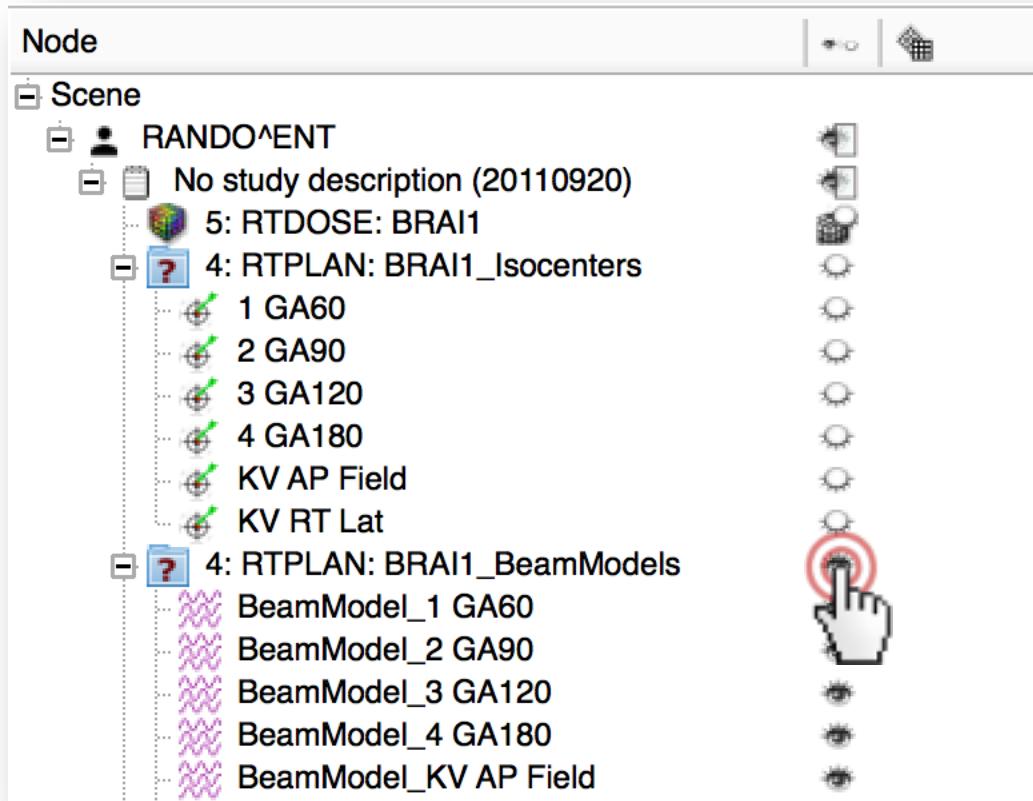
# 3/3: Explore loaded data in Subject hierarchy



Collapse branches by clicking the box next to the node's icon



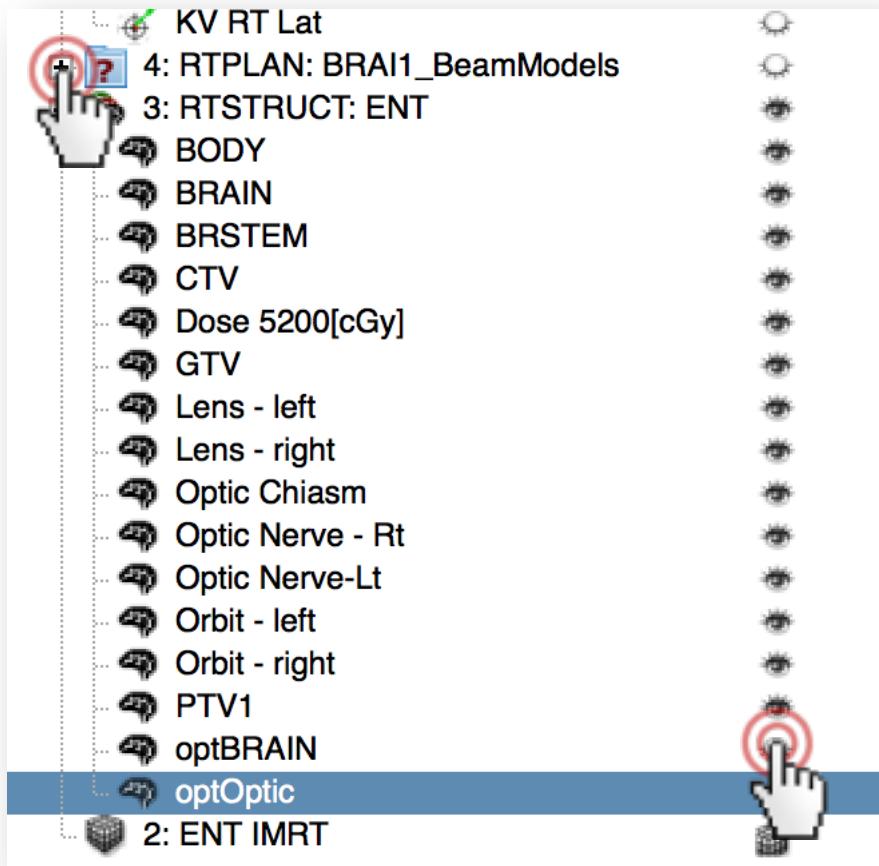
# 3/4: Explore loaded data in Subject hierarchy



Show/hide  
nodes or entire  
branches by  
clicking the eye  
icon in the  
node's row



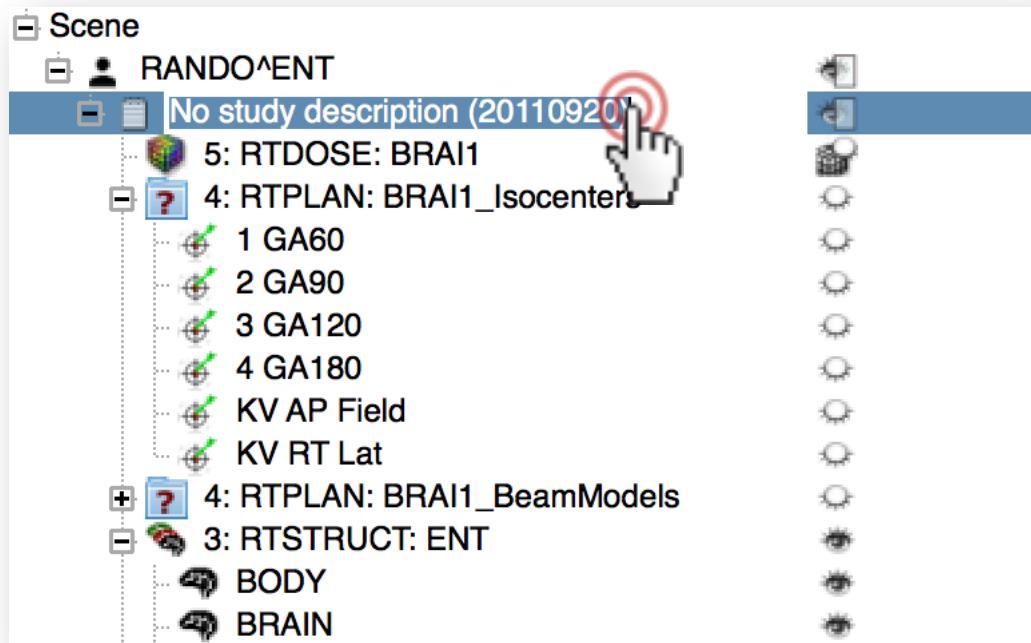
# 3/5: Explore loaded data in Subject hierarchy



1. Hide and collapse beam models to make the tree more compact
2. Hide structures 'optBRAIN' and 'optOptic' to see the inner organs in the head in the 3D view



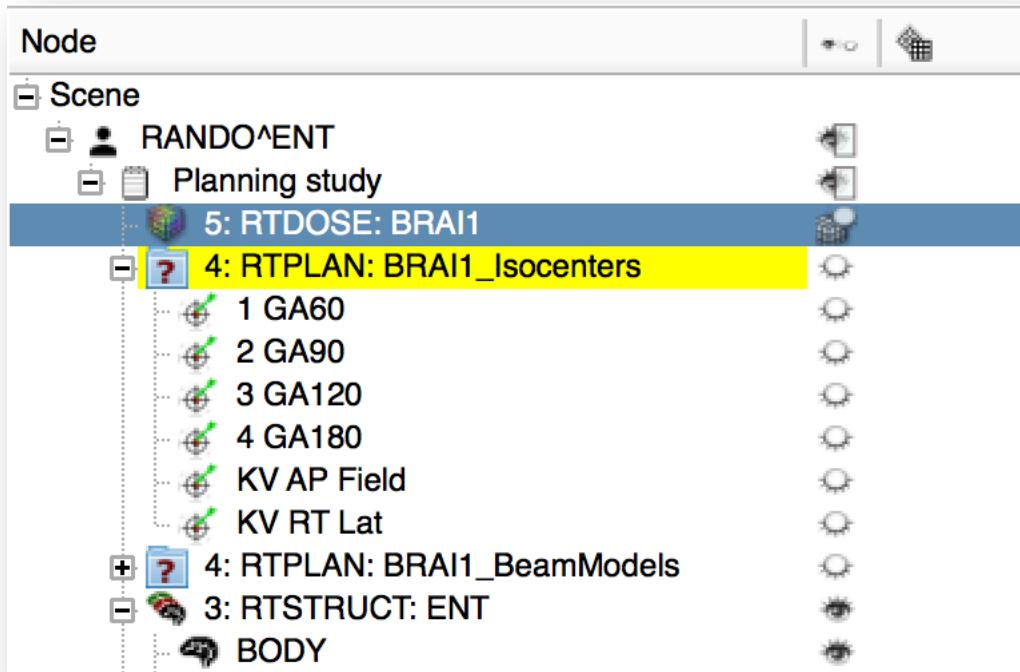
# 3/6: Explore loaded data in Subject hierarchy



1. Enter renaming mode for the study node by double clicking on its name 'No study description...'.
2. Rename it to 'Planning study'
3. Press Enter



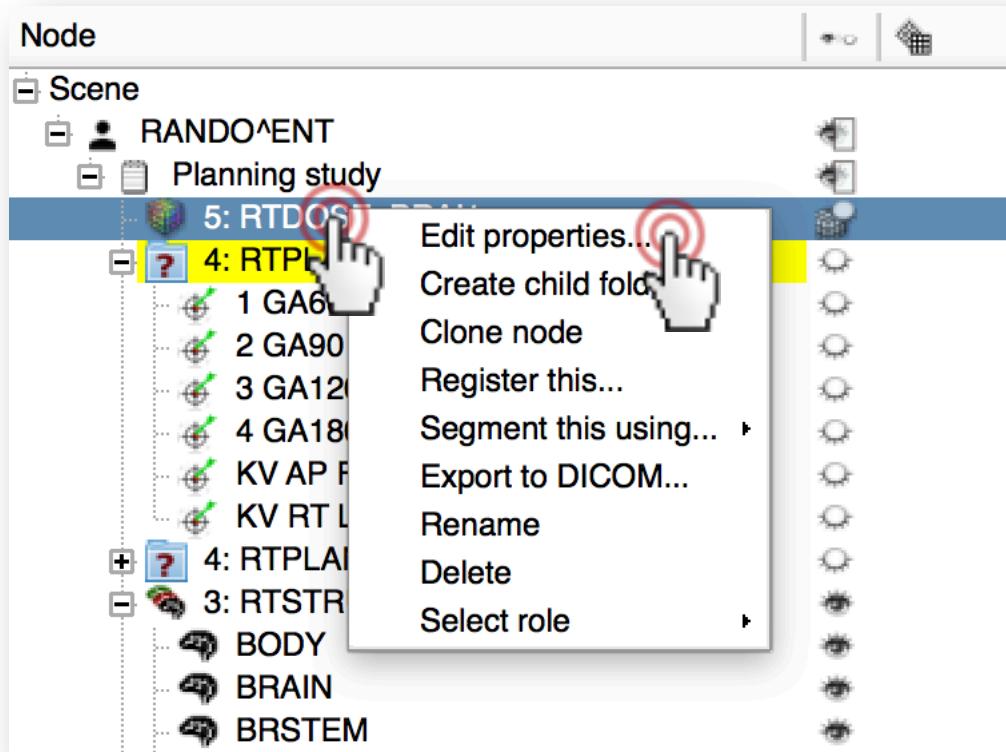
# 3/7: Explore loaded data in Subject hierarchy



Data objects referenced in DICOM by the selected node are highlighted in yellow



# 3/8: Explore loaded data in Subject hierarchy



1. Right-click on a node to access all actions associated to it.
2. Click 'Edit properties...' to switch to the module that handles the node



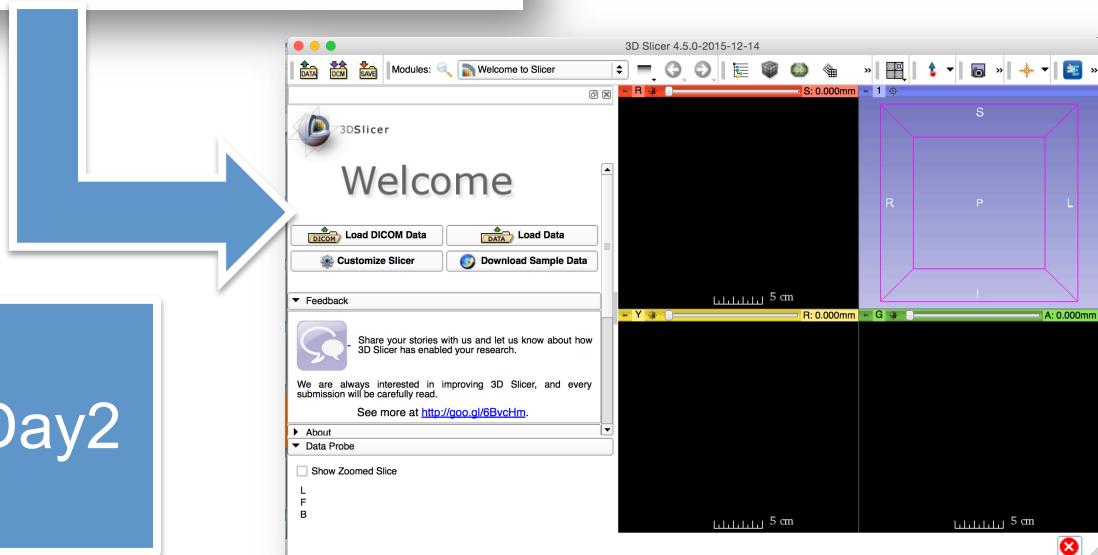
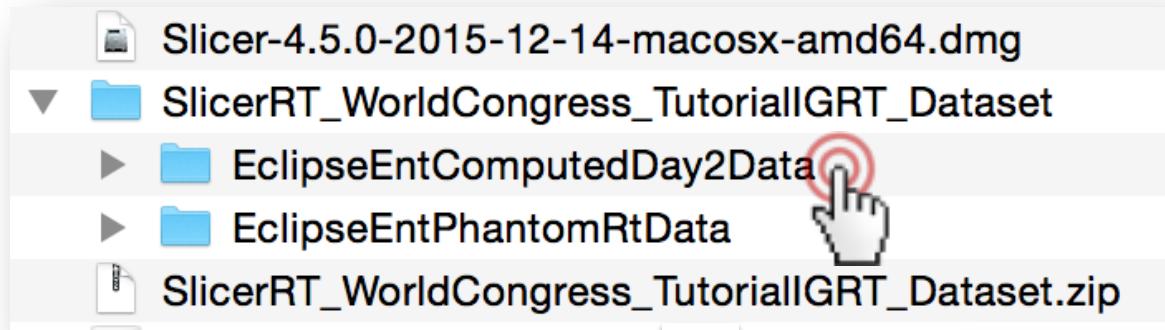
# Part 4: Load second timepoint data

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- Simulated second timepoint for the same phantom dataset
  - Artificial deformation field applied on phantom CT and dose distribution
- Illustrates “day two” scenario of a hypothetical radiotherapy patient
- Stored in NRRD files



# 4/1: Load second timepoint data



Drag&drop  
'EclipseEntComputedDay2  
Data' onto the Slicer



# 4/2: Load second timepoint data

The image shows two windows side-by-side. The left window is titled "Select a reader" and has a dropdown menu with "Any Data" selected. The right window is titled "Add data into the scene" and shows a list of files being added. A hand cursor is pointing at the "OK" button in the "Add data into the scene" window.

Select a reader to use for your data?

Load directory into DICOM database

Any Data

Add data into the scene

Choose Directory to Add Choose File(s) to Add

Show Options

File	Description
...s/SlicerRT_WorldCongress_TutorialIGRT_Dataset/EclipseEntComputedDay2Data/2_ENT_IMRT_Day2.nrrd	Volume
...ads/SlicerRT_WorldCongress_TutorialIGRT_Dataset/EclipseEntComputedDay2Data/5_RTDOSE_Day2.nrrd	Volume

OK Cancel

1. Choose 'Any Data' in the pop-up dialog  
2. Click OK. Add data window appears.  
3. Click OK



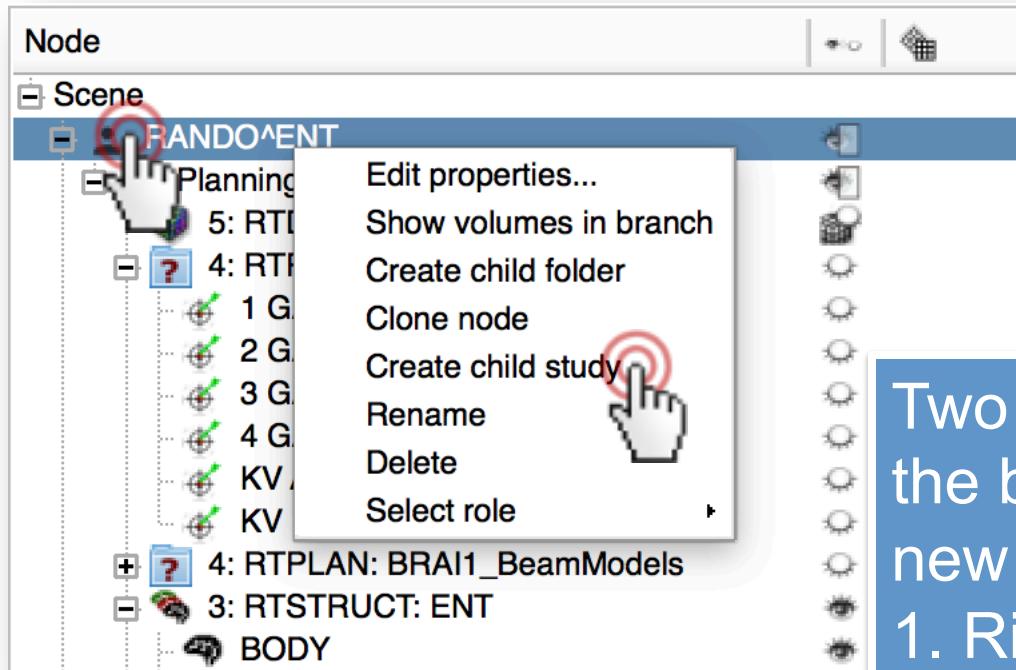
# Part 5: Add day two data into new study

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- Non-DICOM data such as NRRD are not automatically added to hierarchy
- Manual assignment of data into studies is possible
- (Solution is in place for automatic arrangement for data loaded from local directory structure – please consult module wiki page)



# 5/1: Add day two data into new study

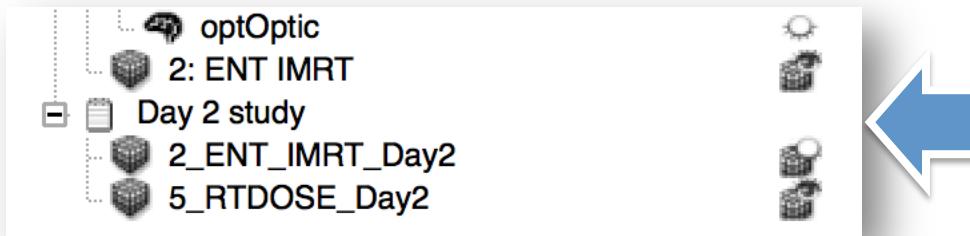


Two volumes appeared on the bottom. Let's create a new study for them.

1. Right-click the patient
2. Select 'Create child study'



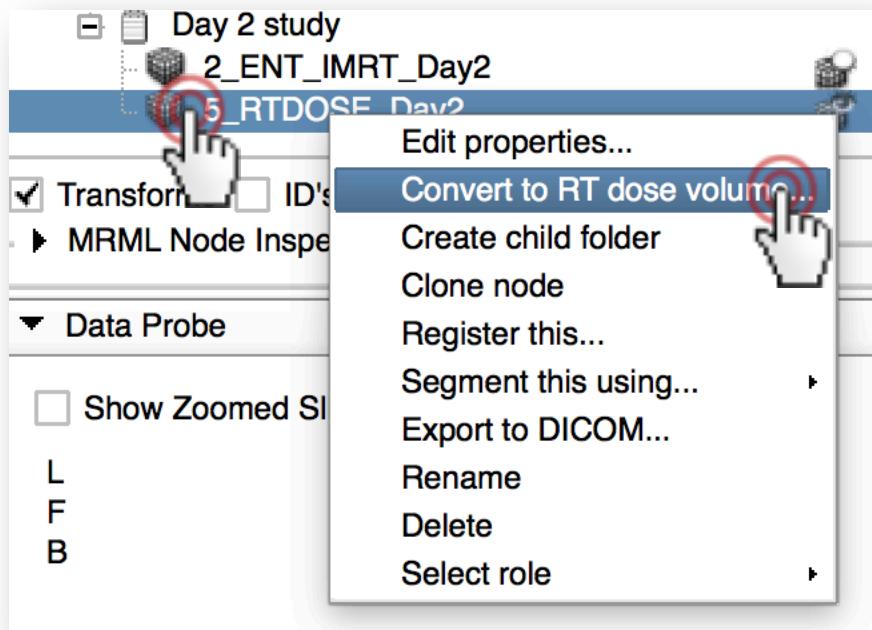
# 5/2: Add day two data into new study



1. Rename new study (appearing under the data in the planning study) to 'Day 2 study' after double-clicking its name
2. Select the two nodes by clicking the first one, then holding shift button and clicking the second one
3. Drag&drop the two selected nodes onto Day 2 study



# 5/3: Add day two data into new study



Let's use a modality-specific action.

1. Right-click on the volume named '5\_RTDOSE\_Day2'
2. Choose 'Convert to RT dose volume...'
3. Click OK on both dialogs
4. Notice the icon change



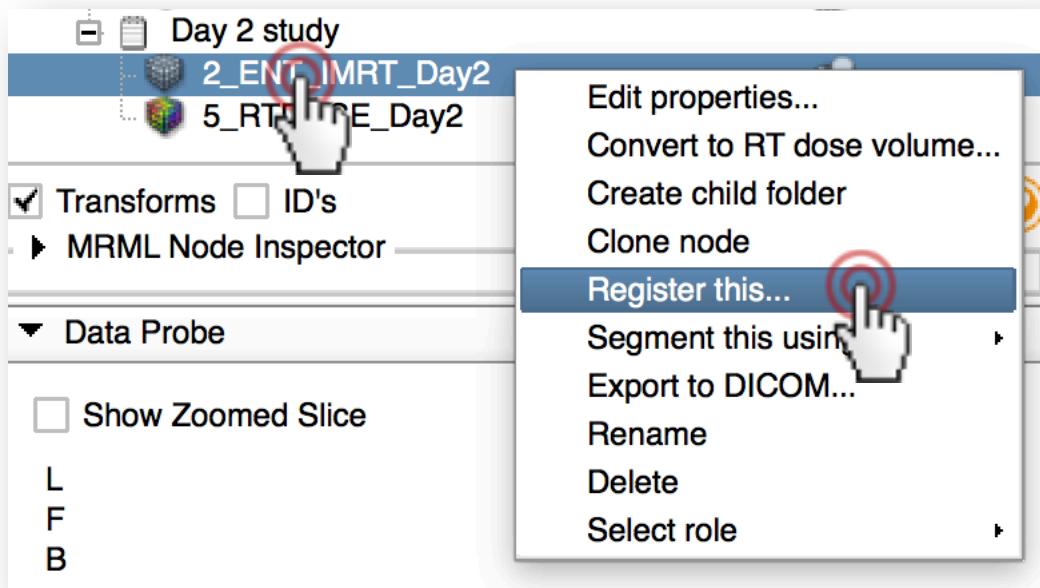
# Part 6: Register day two study to planning study

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- Allows accumulation of dose for both day's treatment sessions
- Demonstrates actions defined by Subject hierarchy plugins facilitating direct access of functions from the hierarchy
- (Please ask the author about potential new actions)



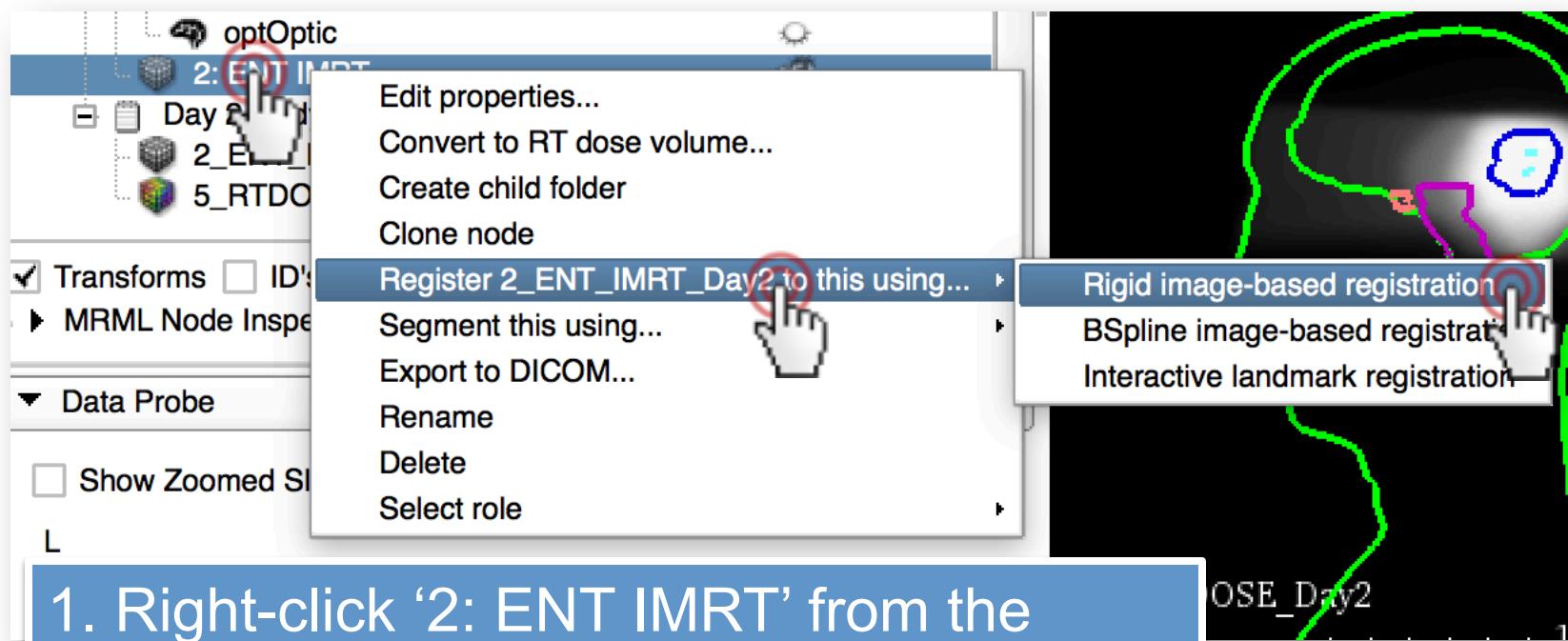
# 6/1: Register day two study to planning study



1. Right-click on '2\_ENT\_IMRT\_Day2'
2. Select 'Register this...'



# 6/2: Register day two study to planning study



1. Right-click '2: ENT IMRT' from the planning study
2. Go to 'Register 2\_ENT\_...'
3. Select 'Rigid image-based registration'



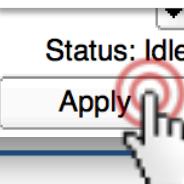
# 6/3: Register day two study to planning study

Fixed Image Volume	2: ENT IMRT
Moving Image Volume	2_ENT_IMRT_Day2
Percentage Of Samples	0.002
B-Spline Grid Size	14,10,12
▼ Output Settings (At least one output must be specified)	
Slicer Linear Transform	LinearTransform_2_ENT...T_Day2_To_2: EN
Slicer BSpline Transform	None
Output Image Volume	None
▶ Transform Initialization Settings	
▼ Registration Phases (Check one or more, executed in order listed)	
Rigid (6 DOF)	<input checked="" type="checkbox"/>
Rigid+Scale(7 DOF)	<input type="checkbox"/>
Rigid+Scale+Skew(10 DOF)	<input type="checkbox"/>
Affine(12 DOF)	<input type="checkbox"/>
Restore Defaults	AutoRun
Cancel	
Apply	

Notice that

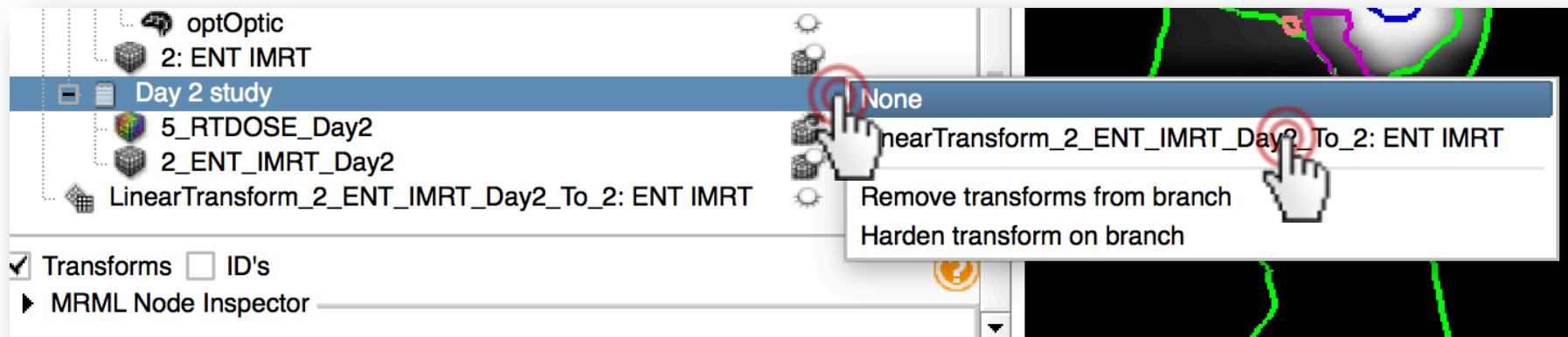
- BRAINS registration module was selected
- Inputs were selected
- Output transform was created
- Rigid (6 DOF) phase was selected

1. Click Apply





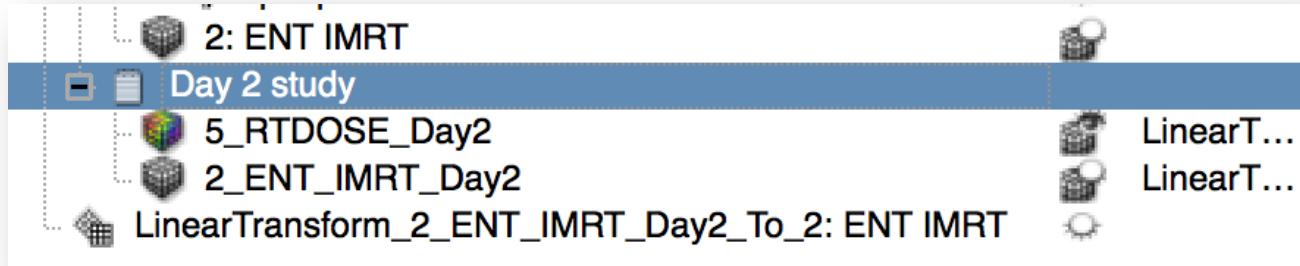
# 6/4: Register day two study to planning study



1. Once registration is done, switch back to Subject hierarchy
2. Notice that the transform was already applied to the CT volume
3. Double-click on the empty space in the rightmost transform column of Day 2 study
4. Open the selector by clicking 'None', and select the transform



# 6/5: Register day two study to planning study



Notice that the transform was also set to the dose volume. Using the same action, any transform can be applied to whole branches.

This step allowed us to accumulate dose distributions for a patient delivered over two time points.



# Conclusion

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Subject hierarchy is a central access point to review and organize data loaded into Slicer, while offering direct access to Slicer functions.

New data types and actions can be added to Subject hierarchy.

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# Acknowledgments

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**National Alliance for Medical Image Computing**  
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**Ontario Consortium for Adaptive  
Interventions in Radiation Oncology**