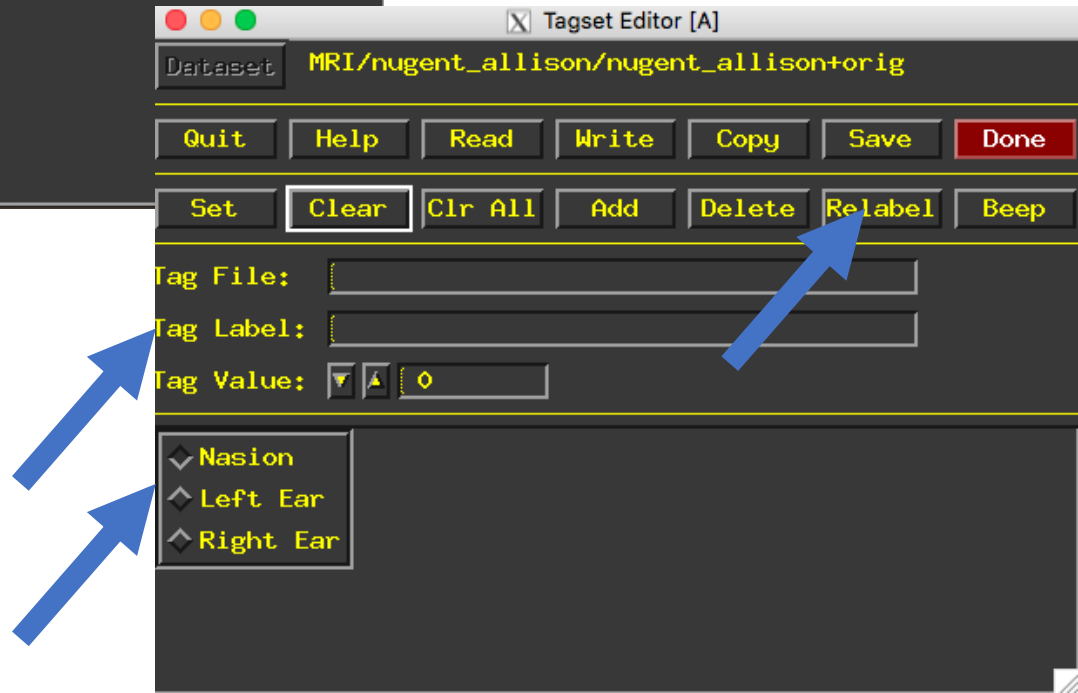
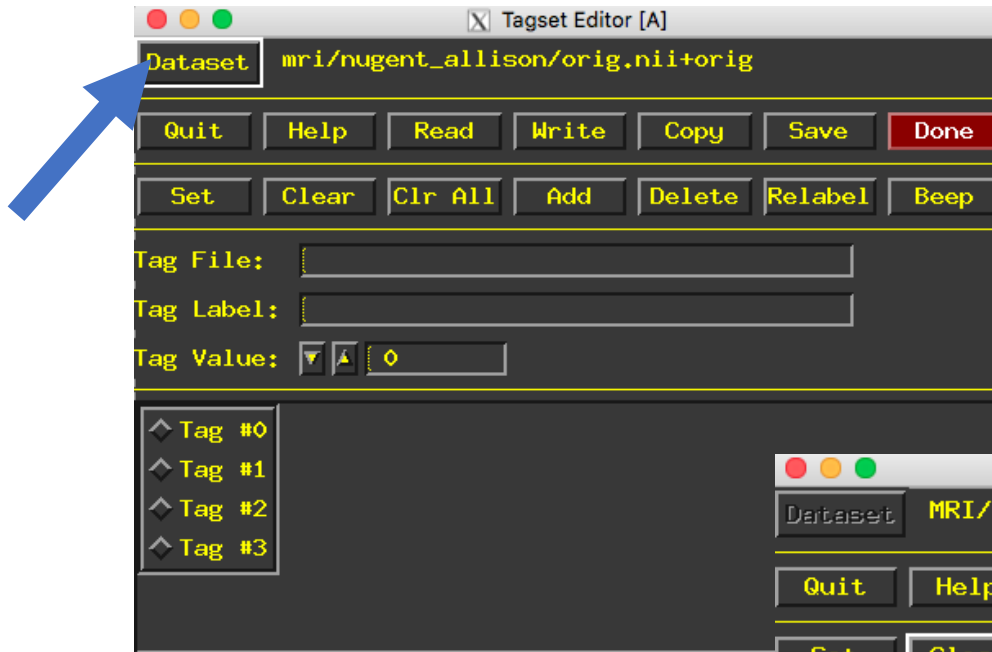


# MRI Processing and Headmodel Creation

# Open the MRI in AFNI

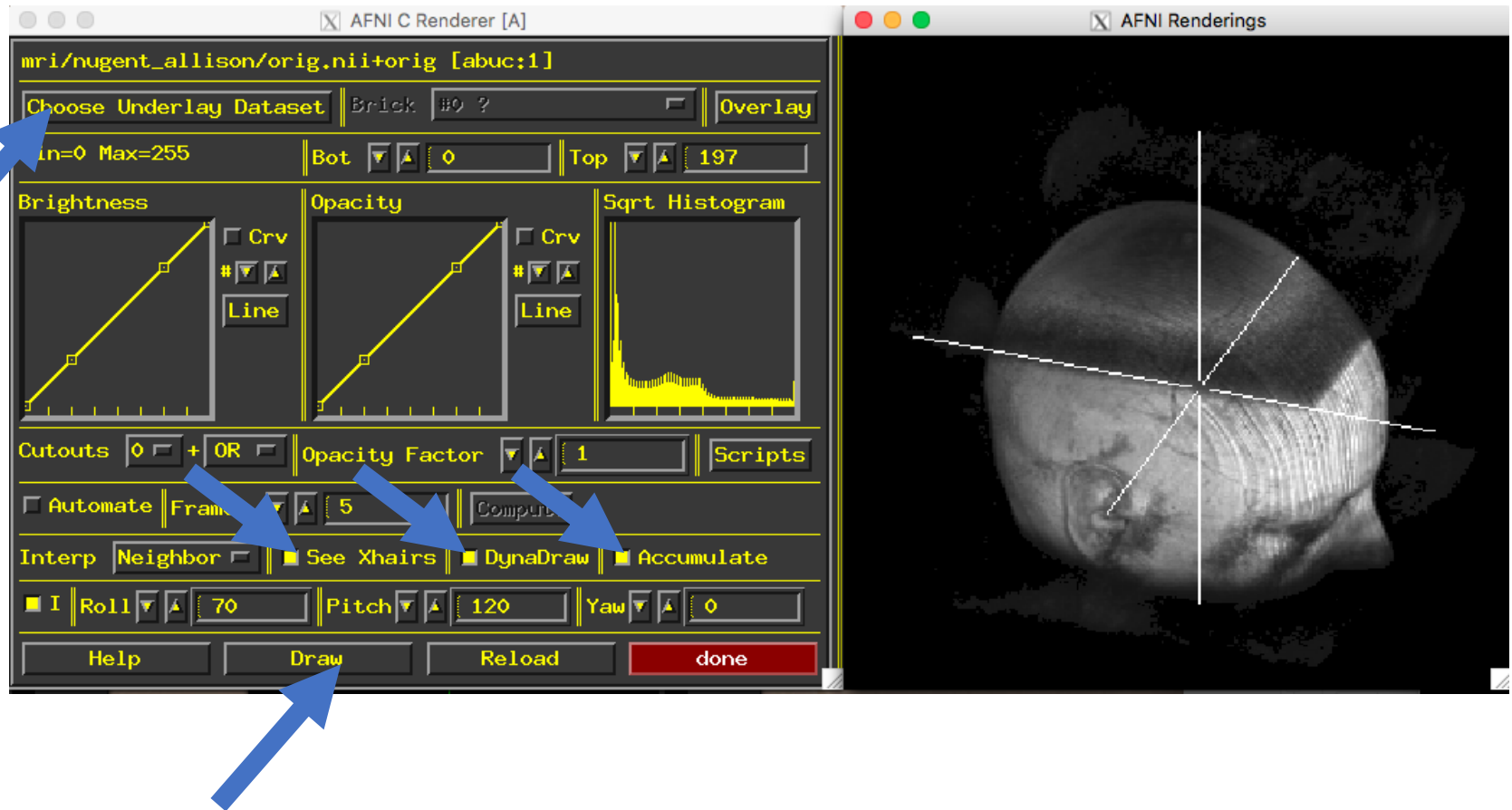


# Edit Tagset Plugin





# Render Plugin



# Placing the Nasion

The image displays the AFNI software interface with several windows open. The main window shows a sagittal MRI slice with a green crosshair indicating the Nasion position. The 'AFNI C Renderer' window shows a 3D rendering of the brain with a white line indicating the Nasion position. The 'Tagset Editor' window is open, showing the 'Dataset' as 'MRI/nugent\_allison/nugent\_allison+orig' and a list of tags: 'Nasion', 'Left Ear', and 'Right Ear'. The 'Nasion' tag is highlighted in yellow. A blue arrow points from the 'Set' button in the Tagset Editor to the 'Nasion' tag. Another blue arrow points from the 'Nasion' tag to the 'AFNI C Renderer' window, indicating the placement of the Nasion in the 3D rendering.

Order: RAI=DICOM  
x = 3.015 mm [L]  
y = -116.155 mm [A]  
z = -6.330 mm [I]

Xhairs Multi  X+  
Color green   
Gap 5  Wrap   
Index

Axial Image Graph  
Sagittal Image Graph  
Coronal Image Graph

New Etc-> AFNI  
BHelp done

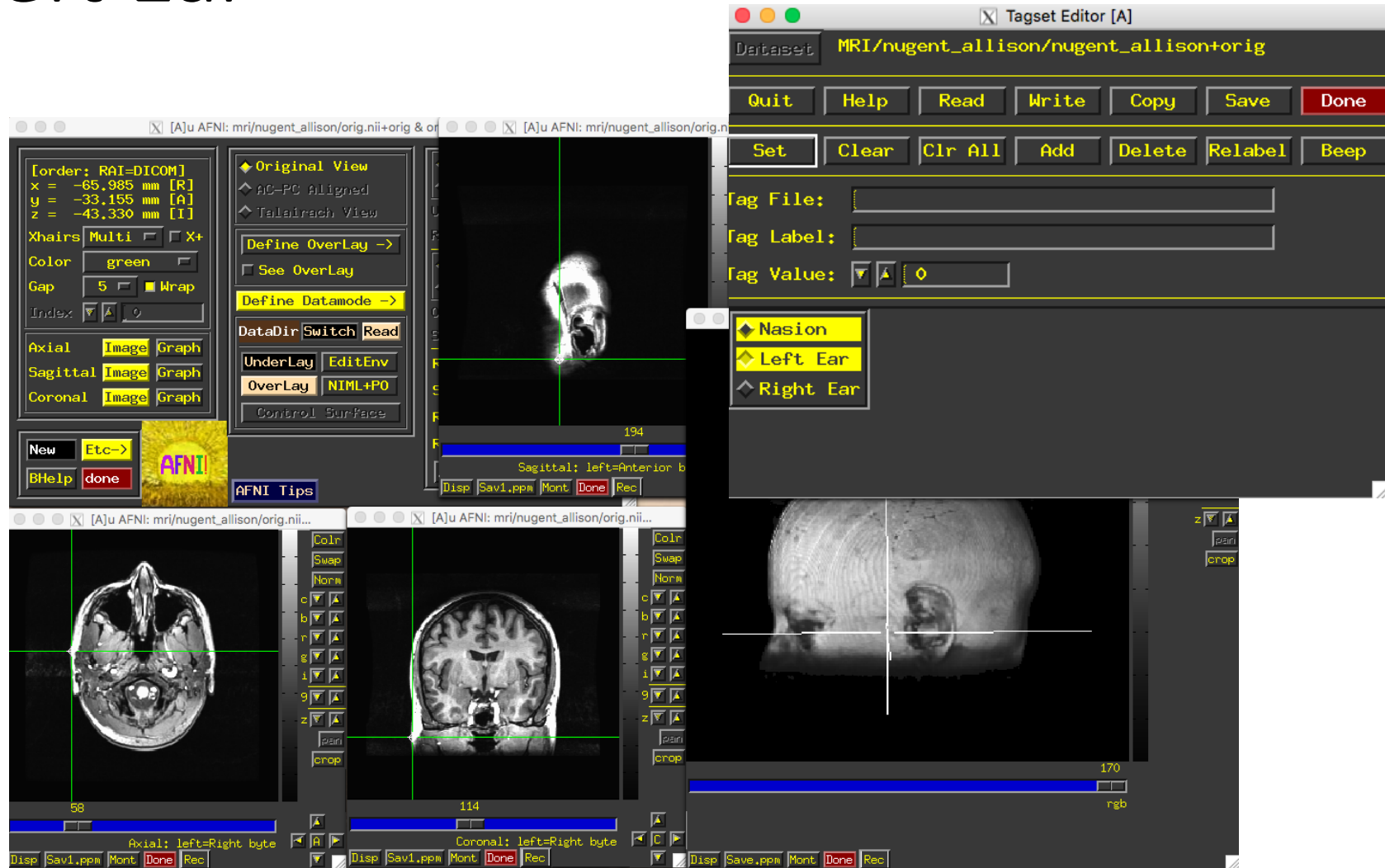
Original View  
AC-PC Aligned  
Talairach View  
Define OverLay ->  
See OverLay  
Define Datamode ->  
DataDir Switch Read  
UnderLay EditEnv  
OverLay NIIML+PO  
Control Surface

mri/nugent\_allison/orig.nii+orig [abuc:1]  
Choose Underlay Dataset Brick #0 ? Overlay  
Min=0 Max=255 Bot 0 Top 197  
Brightness Opacity Sqrt Histogram  
Crv #

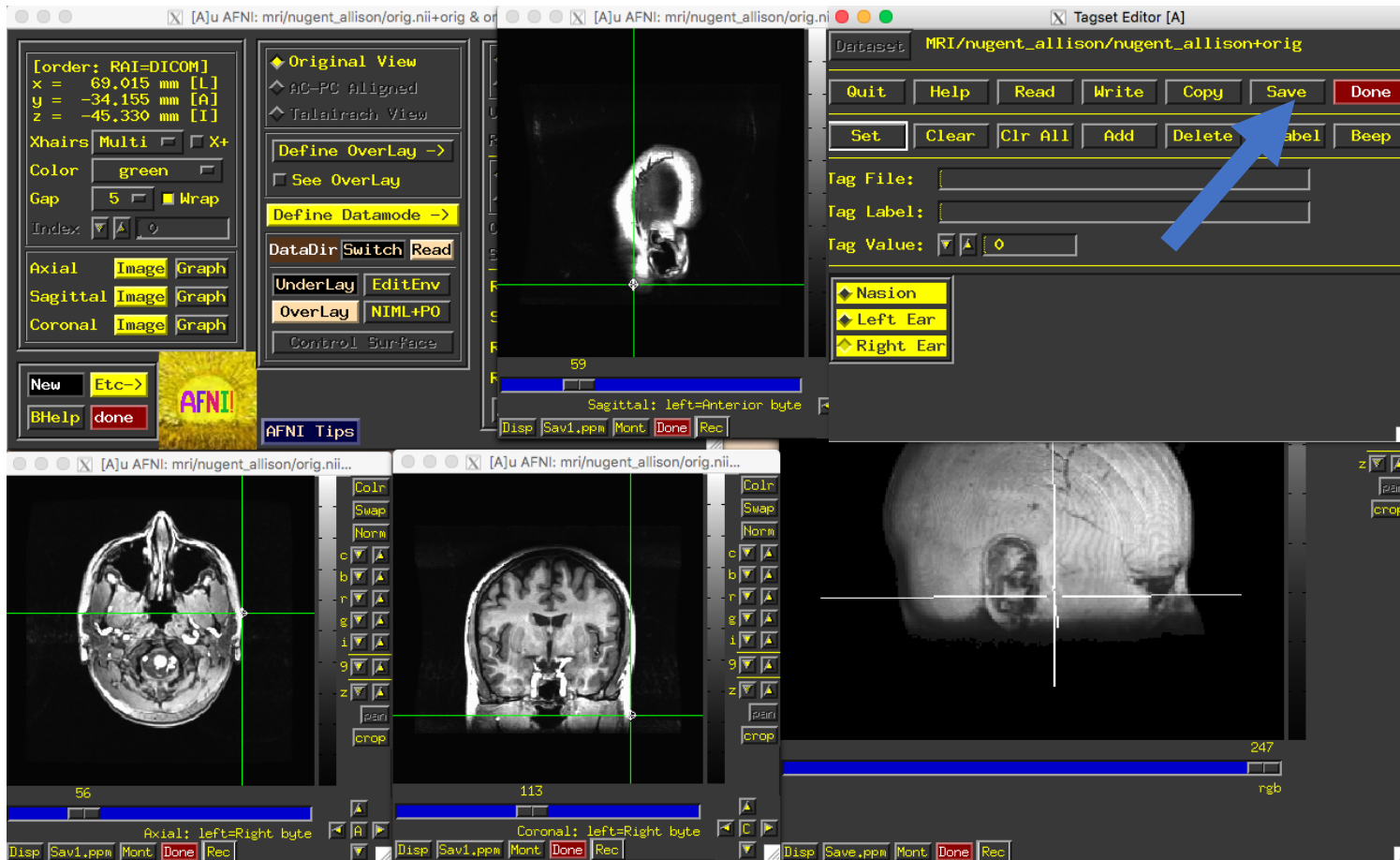
AFNI Renderings  
Colr Swap Norm  
c    
b    
r    
g    
i    
z    
pair crop

Tagset Editor [A]  
Dataset MRI/nugent\_allison/nugent\_allison+orig  
Quit Help Read Write Copy Save Done  
Set Clear Clr All Add Delete Relabel Beep  
Tag File:   
Tag Label:   
Tag Value:   
Nasion  
Left Ear  
Right Ear

# Left Ear



# Right Ear – save tags





# Using fiddist.py

2. nugenta@calc:/net/tako/eon1/normal/mri/nugent\_allison (ssh)

```
calc/net/tako/eon1/normal/mri/nugent_allison> fiddist.py orig+orig.
```

```
nasion: 11.620 0.302 -0.633
```

```
left ear: 3.416 6.901 -4.533
```

```
right ear: 3.316 -6.599 -4.333
```

```
left - right: 13.502 cm
```

```
nasion - left: 11.228 cm
```

```
nasion - right: 11.413 cm
```

```
calc/net/tako/eon1/normal/mri/nugent_allison> █
```

# Running orthohull: Default Behavior

```
$module load afni
```

```
$module load python
```

```
$orthohull -t -l .005 -nugent_allison+orig
```

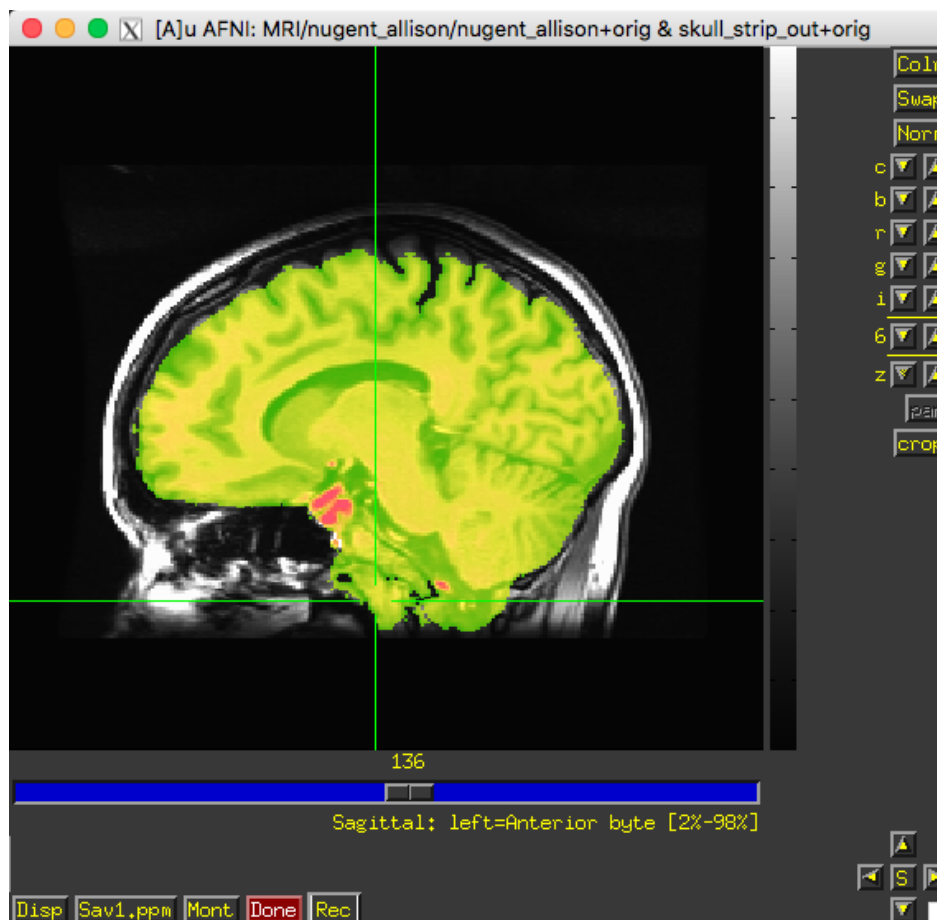
Output:

```
anat_brainhull.ply  ortho_brainhull.ply
anat_innerskull.ply ortho_innerskull.ply
anat_outerskull.ply ortho_outerskull.ply
anat.ply           ortho.ply
anatmask+orig
brain+orig         brain+tlrc
mask+orig
ortho+orig
brain.Xaff12.1D   brain.Xat.1D
hull.shape        nolte.shape
multisphere.shape multisphere.shape_info
```

# Naming Conventions

- Default behavior is set up assumes that MRIs are in subdirectories using hash codes
- Output files are generic names within each directory
- You can follow other models, just ask me for an alternative to orthohull allowing control of filenames.
- SAM tools are flexible enough to allow filenames outside the default behavior

# Problems with 3dSkullStrip

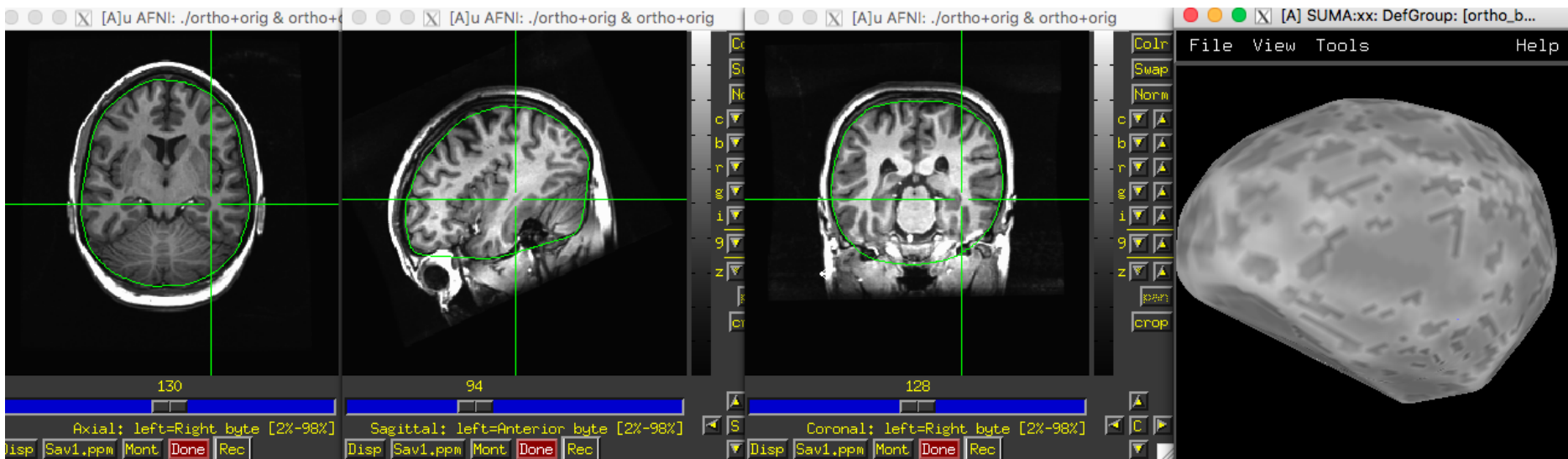
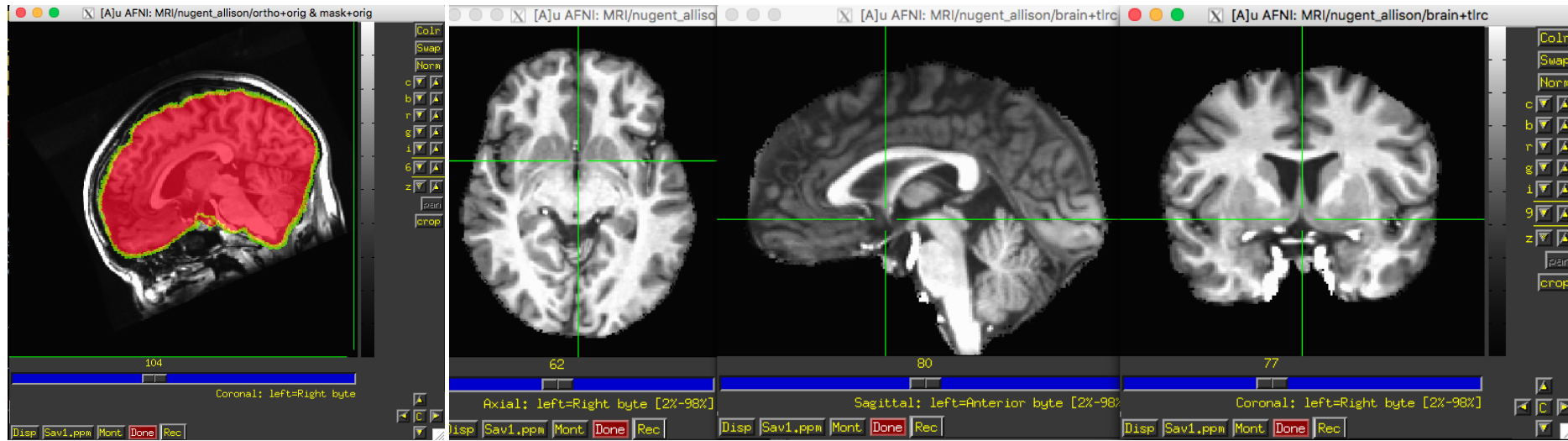


3dSkullStrip -help

Many options and suggestions for fixing common problems. If all else fails, send problem brains to the AFNI core.

Solution: -shrink\_fac\_bot\_lim 0.8

# Checking Results



# Multisphere Headmodel

Requires the output of orthohull:

multisphere.shape

multisphere.shape\_info

```
$localSpheres -s multisphere.shape -d ABCDEFG_rest_20180806_01.ds
```

This must be run for every MEG dataset, as the head model will vary with the position of the fiducial coils relative to the dewar

# Using Structure Sensor Surfaces

- Image of me

# Surface co-registration

- Fieldtrip workflow

<http://www.fieldtriptoolbox.org/tutorial/3dscanner>

[http://www.fieldtriptoolbox.org/tutorial/headmodel\\_eeg\\_bem](http://www.fieldtriptoolbox.org/tutorial/headmodel_eeg_bem)

- MNE/SAM workflow

Full tutorial

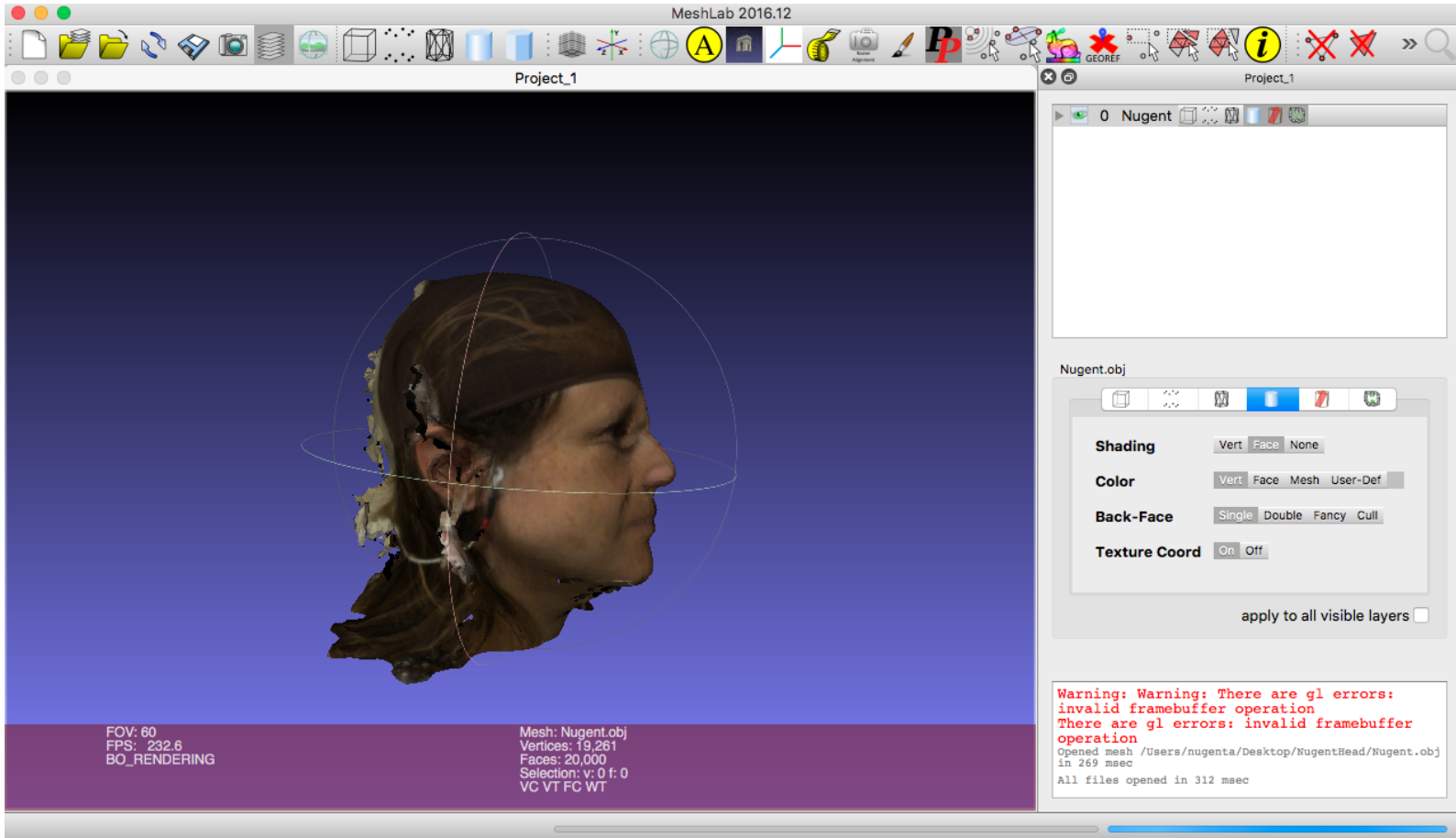
Requires meshlab: <http://www.meshlab.net>

MNE\_python: <http://martinos.org/mne>

Freesurfer: <https://surfer.nmr.mgh.harvard.edu>



# Open the surface in meshlab



# Prepare output file

```
$ python prep_meshlabfile.py nugent.pp nugent
```

Output:

nugent_hsp.txt.	←	fiducials
nugent_elp.txt	←	point cloud
nugent.fif	←	merged files in .fif format

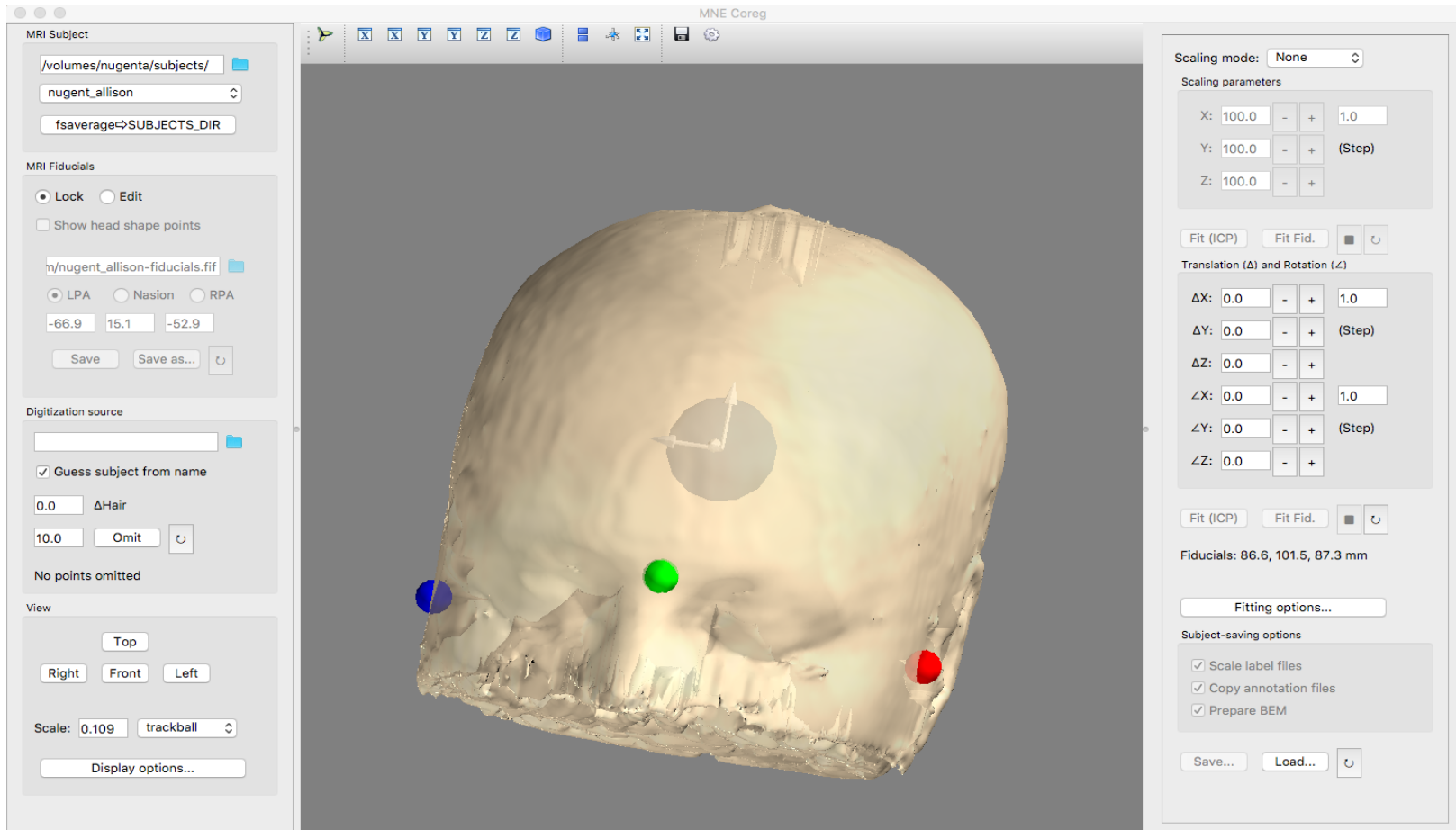
# Prep the MRI

This assumes the MRI has been processed with Freesurfer, and SUBJECTS\_DIR is set

```
$ mkheadshape -s nugent_allison
```

# Start the MNE coreg tool

\$mne coreg



# Initialize fiducials in MRI space

The screenshot displays the MNE Coreg interface. The central window shows a 3D model of a skull with three fiducial markers: a blue dot on the left ear, a green dot on the forehead, and a red dot on the right ear. A coordinate system is visible on the skull's surface.

**MRI Subject**

- Path: /volumes/nugenta/subjects/
- Subject: nugent\_allison
- fsaverage → SUBJECTS\_DIR

**MRI Fiducials**

- Lock  Edit  (indicated by a blue arrow)
- Show head shape points
- File: n/nugent\_allison-fiducials.fif
- LPA  Nasion  RPA
- Coordinates: -66.9, 15.1, -52.9 (indicated by a blue arrow)
- Buttons: Save, Save as...

**Digitization source**

- Guess subject from name
- 0.0 ΔHair
- 10.0 Omit
- No points omitted

**View**

- Top, Right, Front, Left
- Scale: 0.109 trackball
- Display options...

**Scaling mode:** None

**Scaling parameters**

- X: 100.0 - + 1.0
- Y: 100.0 - + (Step)
- Z: 100.0 - +

**Fit (ICP) Fit Fid.**

**Translation (Δ) and Rotation (∠)**

- ΔX: 0.0 - + 1.0
- ΔY: 0.0 - + (Step)
- ΔZ: 0.0 - +
- ∠X: 0.0 - + 1.0
- ∠Y: 0.0 - + (Step)
- ∠Z: 0.0 - +

**Fit (ICP) Fit Fid.**

**Fiducials: 86.6, 101.5, 87.3 mm**

**Fitting options...**

**Subject-saving options**

- Scale label files
- Copy annotation files
- Prepare BEM

**Save... Load...**

# Load the Point Cloud, Initialize

The screenshot displays the MNE Coreg software interface for subject 'nugent\_allison'. The central window shows a 3D point cloud of a head with fiducial markers. The interface is divided into several panels:

- MRI Subject:** Shows the subject directory and name, with 'nugent\_allison' selected. A 'Copy fsaverage' to subjects directory button is present.
- MRI Fiducials:** Includes options for 'Lock' (selected) or 'Edit', and 'Always Show Head Shape Points'. The file path is 'nugent\_allison/bem/nugent\_allison-fiducials.fif'. The set is 'LPA' (selected), with 'Nasion' and 'RPA' as alternatives. Position coordinates are: X: -0.06691, Y: 0.01507, Z: -0.05294.
- Head Shape Source (Raw/Epochs/Evoked/DigMontage):** The file path is 'up/course/HeadmodelTutorial/Nugent\_digmont.fif'. A blue arrow points to the 'Nugent\_digmont.fif' text. The 'Guess Subject from File Name' checkbox is checked. A value of '15' is entered, with 'Omit [mm]' and 'Reset' buttons. A status message indicates '9 points omitted'.
- View:** Contains buttons for 'Top', 'Right', 'Front', 'Left', and 'Trackball'. The scale is set to '0.16'.
- Parameters Panel (Right):** Contains settings for 'Grow Hair [mm]: 4', 'MRI Scaling' (set to 'None'), and sections for 'Scaling', 'Translation', and 'Rotation'. Each section has numerical input fields and adjustment buttons. A blue arrow points to the 'Fit Fiducials' button in this panel. The 'Error' status at the bottom reads: 'Error: LPA=15.5 NAS=8.8 RPA=8.0 mm'.

# More options

The screenshot displays the MNE Coreg software interface for subject registration. The central window shows a 3D model of a head with fiducial markers (red, blue, green) and a grid of points. The interface is divided into several panels:

- MRI Subject:** Shows the subject directory and subject name (nugent\_allison). It includes a checkbox for "High Resolution Head" and a button to "Copy 'fsaverage' to subjects directory".
- MRI Fiducials:** Allows locking or editing fiducials. It shows the file path for fiducials and options for the set (LPA, Nasion, RPA) and position.
- Head Shape Source (Raw/Epochs/Evoked/DigMontage):** Shows the file path for the head shape source and a checkbox to "Guess MRI Subject from File Name". A blue arrow points to the "15" value in the "Points omitted" field.
- Registration Parameters:** A panel on the right with three sections:
  - Grow Hair [mm]:** Set to 4.
  - MRI Scaling:** Radio buttons for None (selected), Uniform, and 3-axis.
  - Scaling:** Sliders for R (X), A (Y), and S (Z) with values 1.00000, 1.00000, and 1.00000 respectively.
  - Translation:** Sliders for R (X), A (Y), and S (Z) with values 0.00516, 0.00100, and 0.00700 respectively.
  - Rotation:** Sliders for R (X), A (Y), and S (Z) with values 0.21198, 0.07280, and 0.03316 respectively.
- View:** Includes buttons for "Top", "Right", "Front", "Left", and "Trackball", along with a "Scale" field set to 0.16.

At the bottom right, an error message reads: "Error: LPA=15.5 NAS=8.8 RPA=8.0 mm".

# Save final transform

The screenshot displays the MNE software interface for subject registration. The main window, titled "nugent\_allison - MNE Coreg", shows a 3D model of a head with fiducial points. The left sidebar contains the following sections:

- MRI Subject**: Subjects directory and subject: `_MEGCoregroup/course/HeadmodelTutorial/SUBJECTS`; subject: `nugent_allison`; High Resolution Head: ; Copy 'fsaverage' to subjects directory:
- MRI Fiducials**: Lock  Edit ; Always Show Head Shape Points: ; File: `gent_allison/bem/nugent_allison-fiducials.ff`; Set: LPA  Nasion  RPA ; Pos: `-0.06691` `0.01507` `-0.05294`; Buttons: Save, Save As..., Reset to File
- Head Shape Source (Raw/Epochs/Evoked/DigMontage)**: File: `up/course/HeadmodelTutorial/Nugent_digmont.ff`; Nugent\_digmont.ff;  Guess MRI Subject from File Name; `15` Omit [mm] Reset; 9 points omitted

The right-hand panel contains the following settings:

- Translation: R (X): `0.00516`; A (Y): `0.00100`; S (Z): `0.00700`
- Rotation: R (X): `0.21198`; A (Y): `0.07280`; S (Z): `0.03316`
- Buttons: Fit Head Shape, Fit LPA/RPA, Fit Fiducials, Load trans...
- Error: LPA=15.5 NAS=8.8 RPA=8.0 mm; Points:  $\mu=4.1$ ,  $\sigma=2.8$  mm
- Scaling options:  Scale \*.label files;  Copy annotation files;  Run mne\_prepare\_bem\_model
- Buttons: Save As..., Reset

A blue arrow points to the "Save As..." button in the right panel.



# Set fiducial points on the MRI

```
$ module load freesurfer
```

```
$python set_mri_fids.py subject_elp.txt head_mri_transform  
SUBJECTS/nugent_allison/mri/orig.nii nugent_allison+orig
```

You can now proceed with SAM software as usual