HOWARD UNIVERSITY HOSPITAL

HOLTON-ARMS SCHOOL ALUMNAE ASSOCIATION

# NOVEL RESEARCH USING MAGNETIC RESONANCE IMAGING (MRI)

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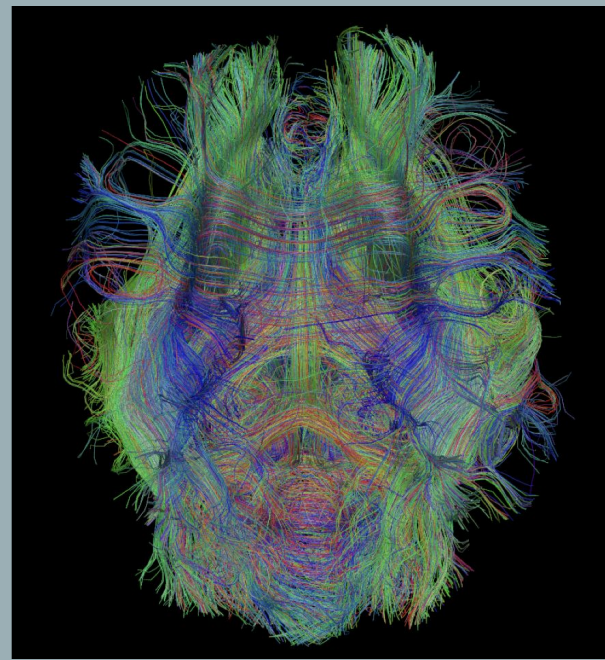
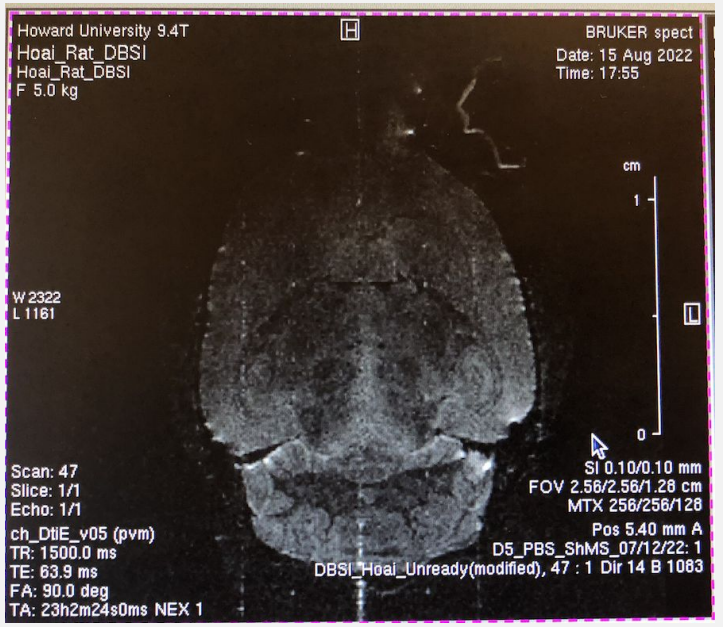


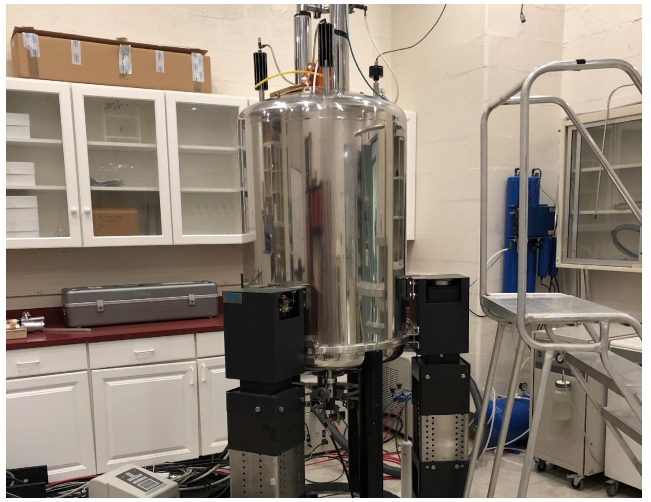
# MRI BASICS

- Magnetic Resonance Imaging- a non-invasive imaging technology
- Uses a magnet with a strong magnetic field

  - MRI can differentiate between different tissues based on how quickly protons in body release energy
  - 2 Magnets- 7 Teslas and 9.4 Teslas



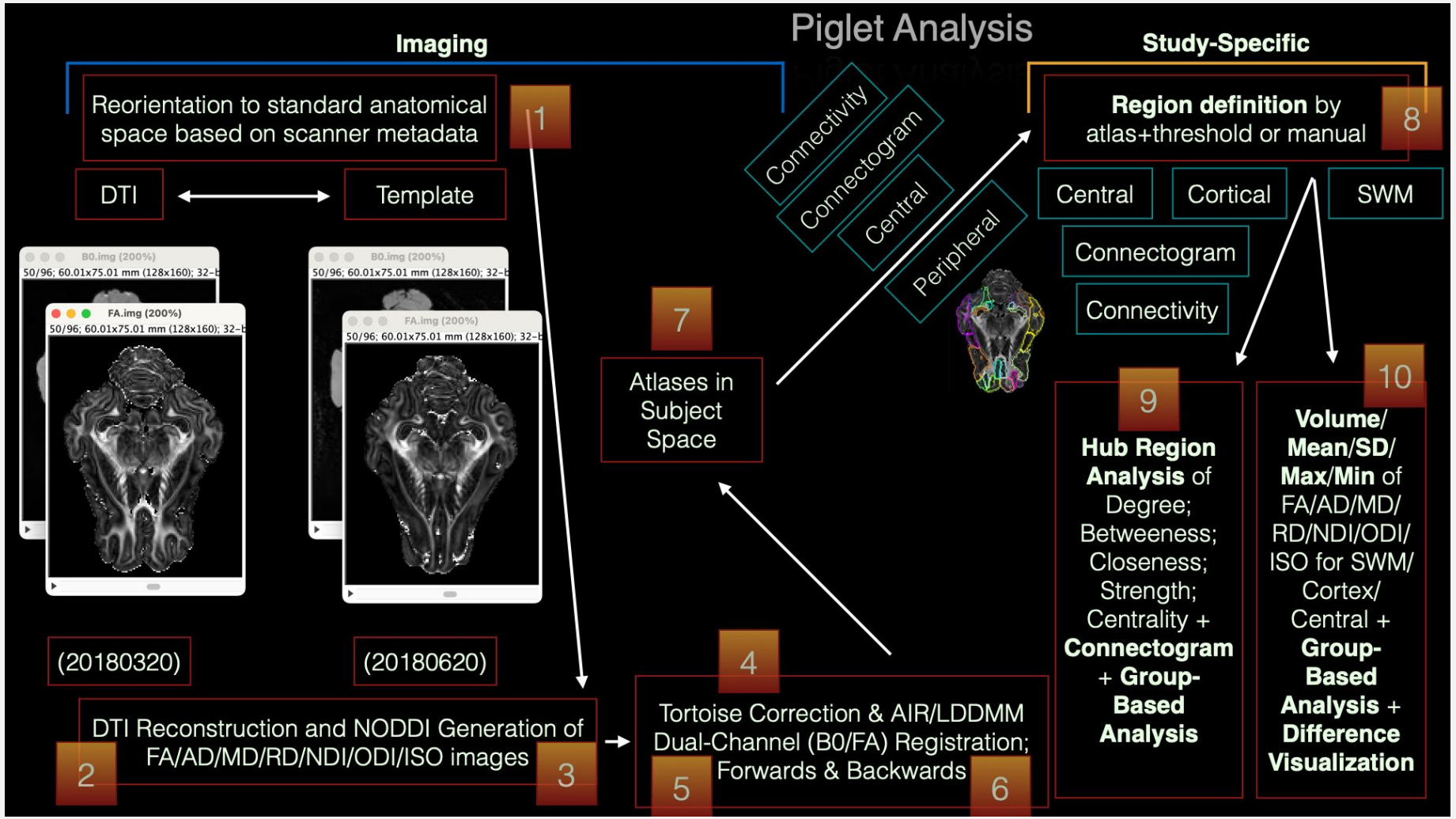

9.4T Magnet in lab (used for animals):



Human MRI machine

Image from NIH

# MRI IMAGE ACQUISITION PROCEDURE




**Final goal:** To be able to warp an atlas onto any scan

**Atlas**: a labeled image that provides the standardized segmentations/regions on a template image

# MRI IMAGE ACQUISITION PROCEDURE

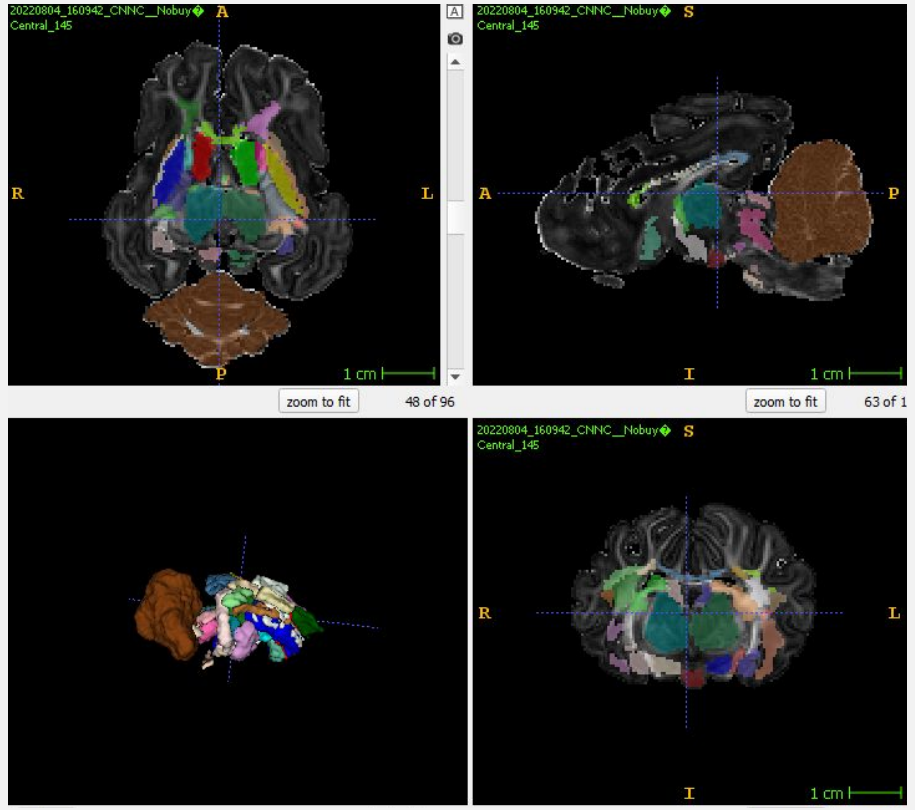
DMC Correction → Reconstruction → Registration

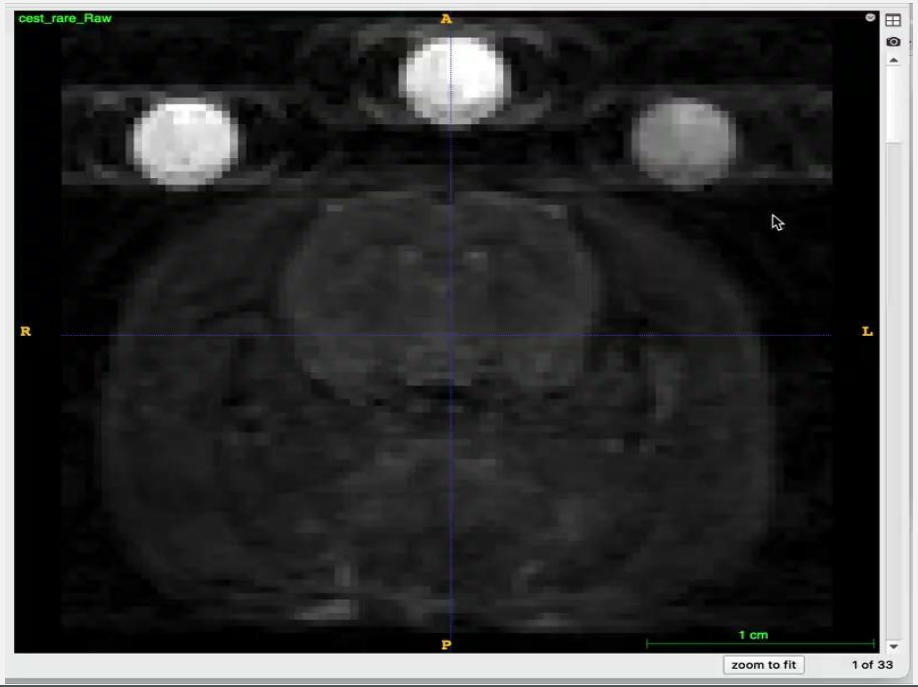
Before correction:


After correction:

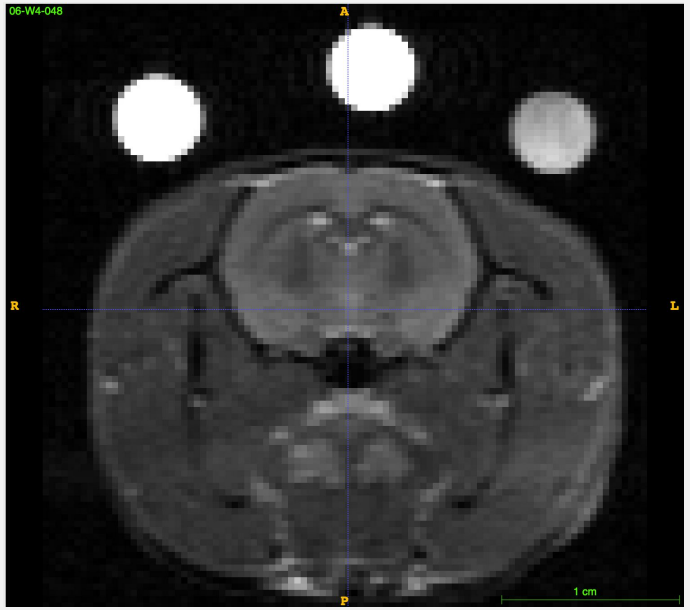

Make fa, md, rd, and ad files (different measures of diffusivity)

Final central atlas:

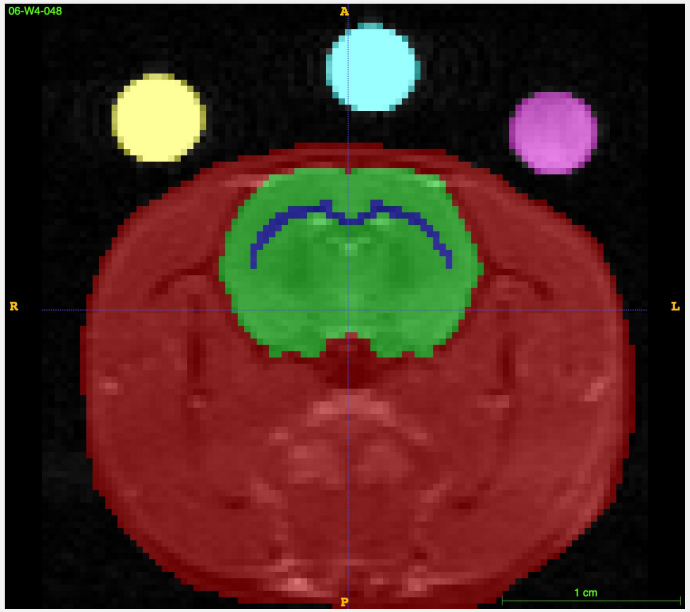





Before segmentation:




After segmentation:




# CEST (CHEMICAL EXCHANGE SATURATION TRANSFER) SEGMENTATION

- Image Segmentation: identifying and labeling each part of an image a different color
  - Red: body; green: brain; blue: corpus callosum; yellow, cyan, purple: phantoms
- CEST (Chemical exchange saturation transfer): a type of MRI image with a black saturation band
- Purpose of image segmentation: groundtruth for machine learning to learn what the brain, body, corpus callosum, and phantoms are
  - Since the saturation band (ring) and movement can cover parts of the brain, which can move, it can confuse the machine learning

# INTERPOLATION CODE WITH MATLAB

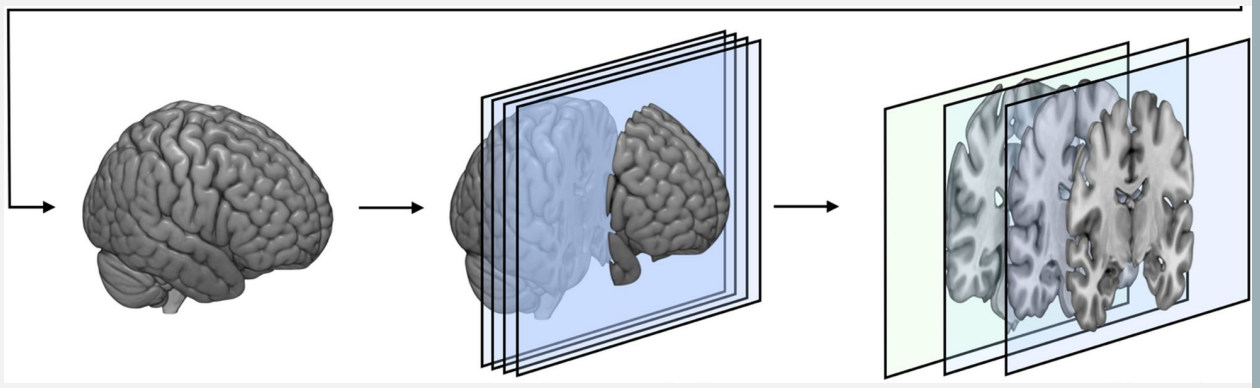
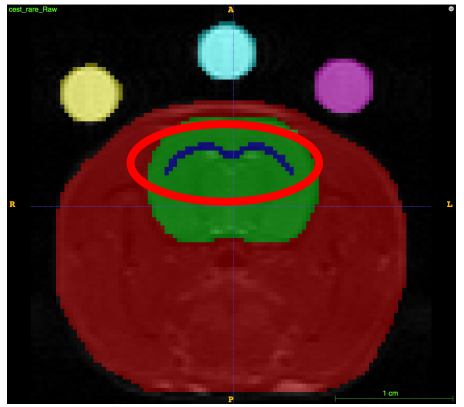


Image from Scientific Reports Journal

- CEST images: a collection of 2D "slices" of the brain
  - 33 slices per image
- Interpolation: segment first and last slice of image, and ITK-SNAP software should fill in slices in between
- Error faced: interpolation didn't work for the corpus callosum
- Solution: Write my own interpolation code using MATLAB!

Failed interpolation:

Successful interpolation:



```
a = []
for iii = (1:81)
    for i=(1:64)
        for ii=(1:64)
            if S(i,ii,iii)==1
                if ismember(iii,a)==false
                    a(end+1)=iii
                end
            else
                continue
            end
        end
    end
end
fprintf(join(string(a),' '))
LL = length(S)
L = length(a);
X = zeros(64,64,L);
```


# SEGMENTATION RESULTS

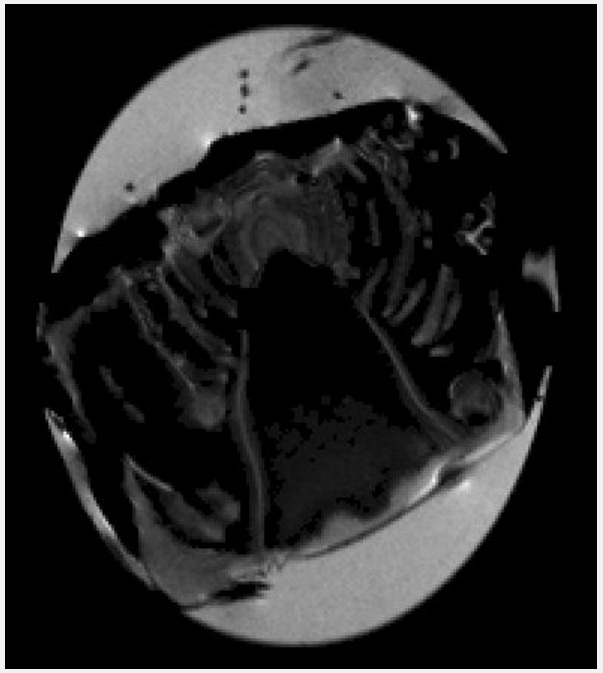
Completed for 200 data sets

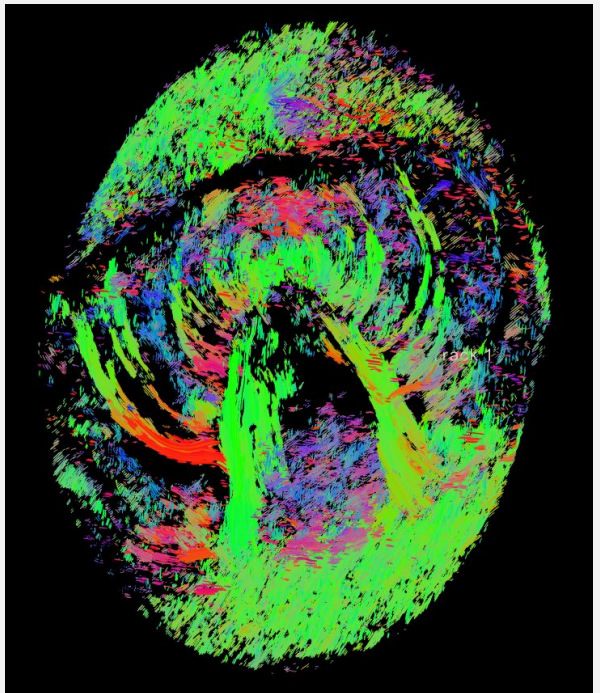
Will serve as groundtruth (baseline) for machine learning automatic segmentation of CEST images

# SCANNING TWO BRUSSELS SPROUT

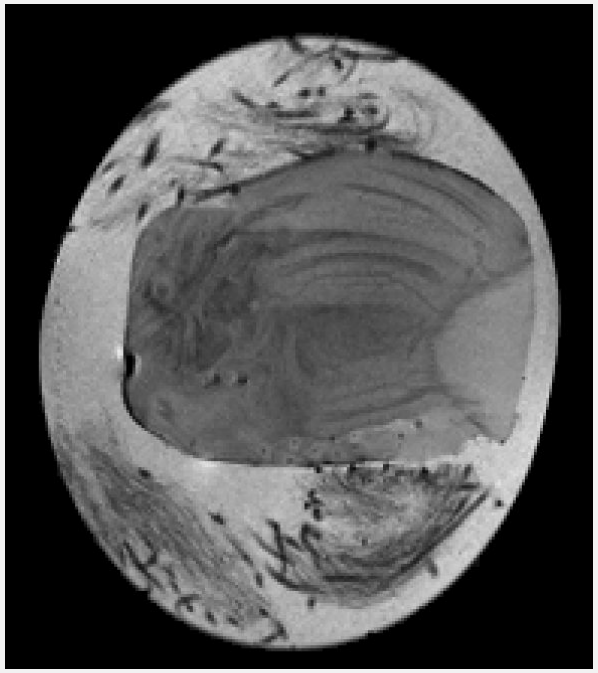
- Goal: follow scanning procedure on two brussels sprouts (one cooked and one uncooked) to compare results
- Conclusions: Fiber tracking shows "injury" (or cooking) of sprout
- Implications in brain injury (comparing "injury" to a brussels sprout)

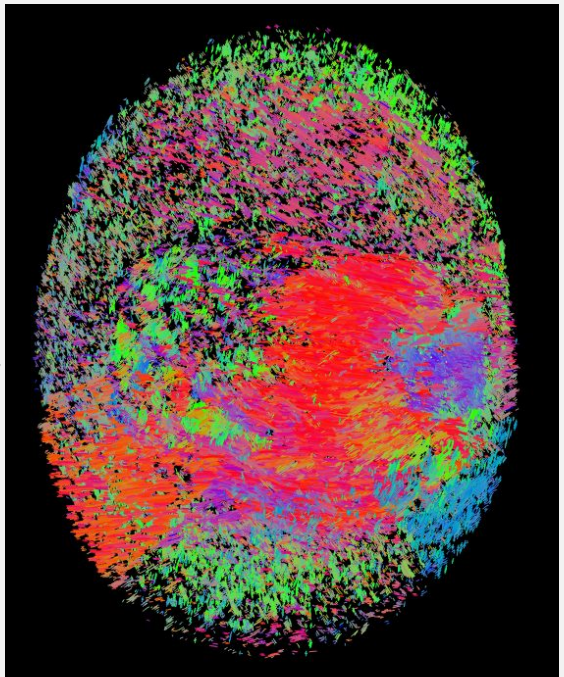
Uncooked:





Cooked:





Green- anterior and posterior
Red- left and right
Blue- inferior and superior

# LESSONS LEARNED

- Always understand the big picture idea of what you are doing (what is the final goal, implications, etc.)
  - Ask questions if you don't know
- Try to troubleshoot on your own first! Especially for coding, google is your best friend.
- Problem solving! Lots of novel scientific software isn't perfect, it's up to you to find your way around issues
  - New science isn't certain; that's what making new discoveries is about

# ACKNOWLEDGEMENTS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