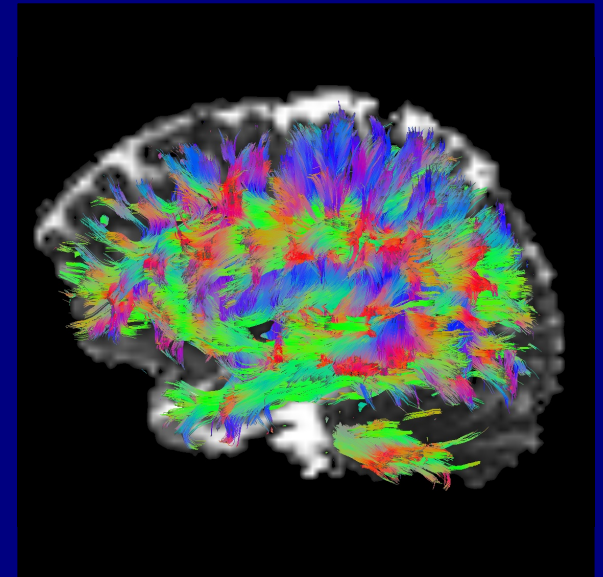


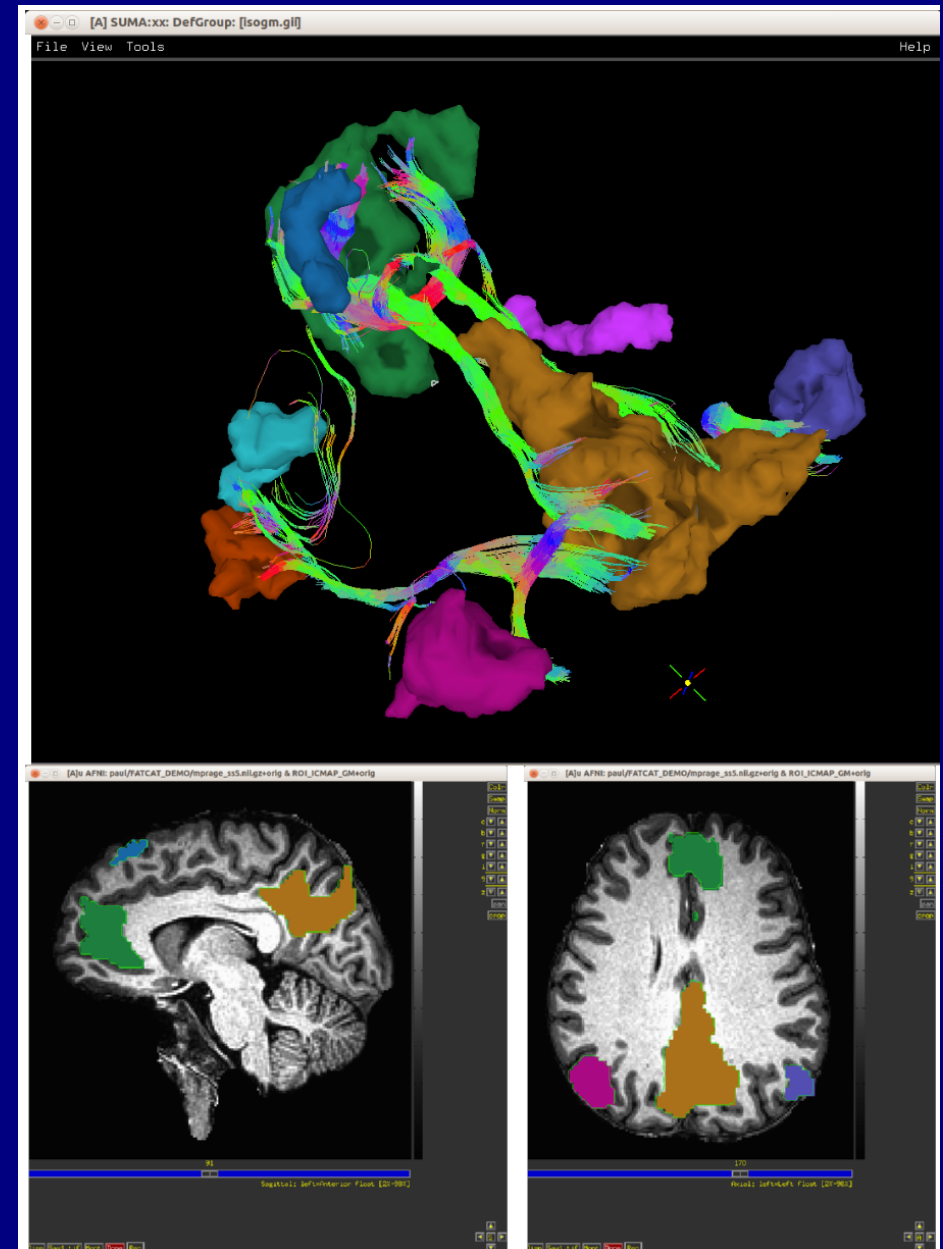
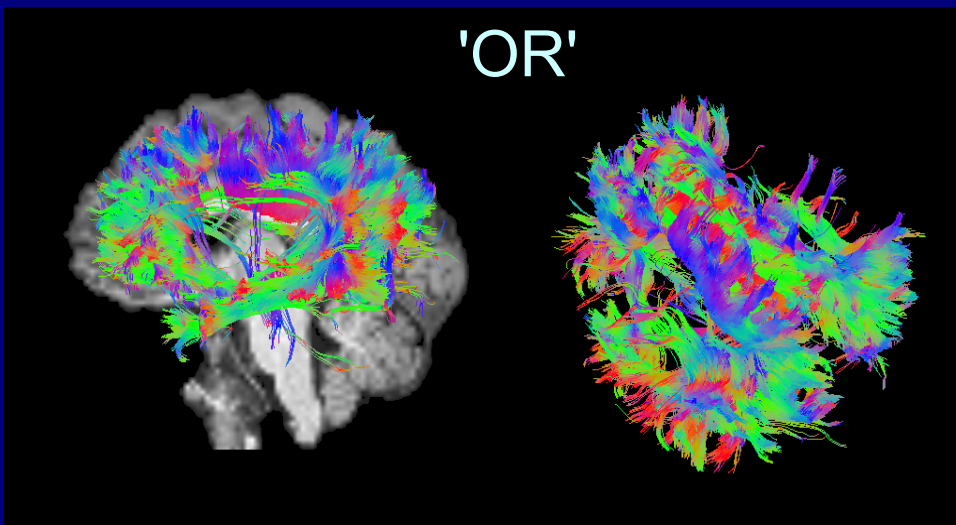
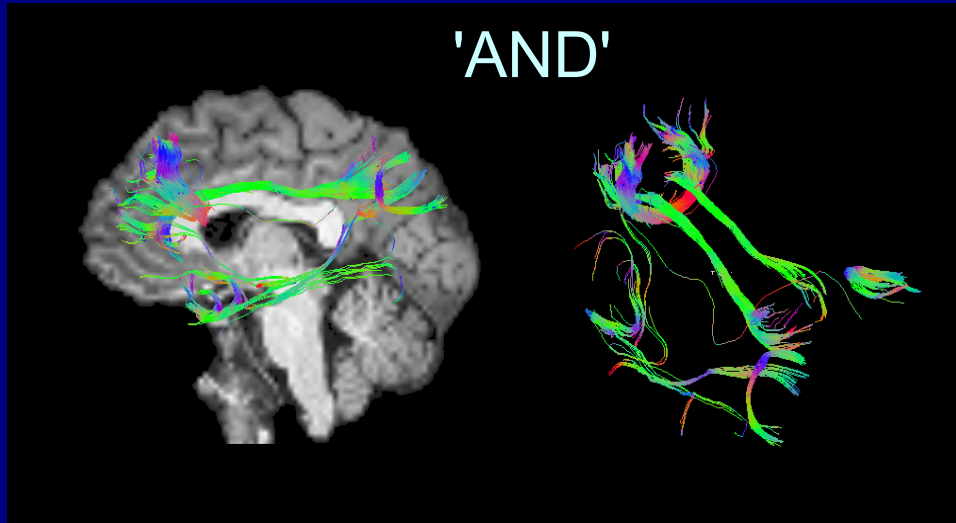
# Supplementary notes: Tracking modes and comparisons

**AFNI Bootcamp (SSCC, NIMH, NIH)**



# Example: Deterministic Tractography

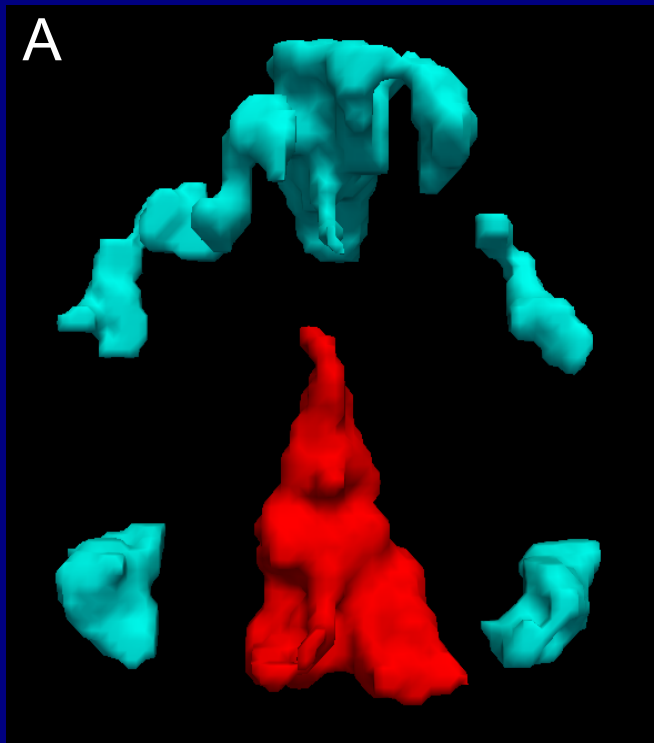
Use DTI-tractography to find likely location of WM associated with these 'targets'



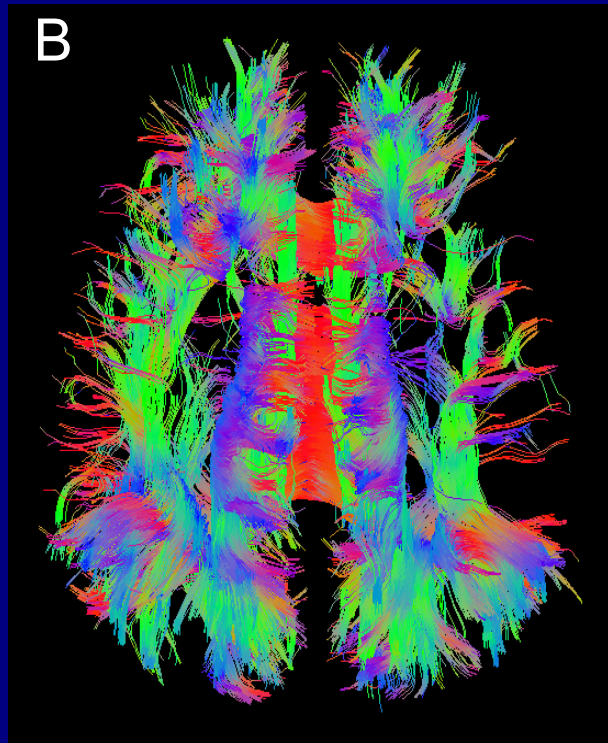
(Deterministic tracking using '3dTrackID -mode DET ...')

# Sidenote: "anti-mask" (and "thru-mask")

Can control track propagation with `anti-mask` regions, simply defined by voxels = -1:



ROI values:  
> 0, in network  
< 0, anti-mask



results when:  
all ROI values > 0  
(no anti-mask)

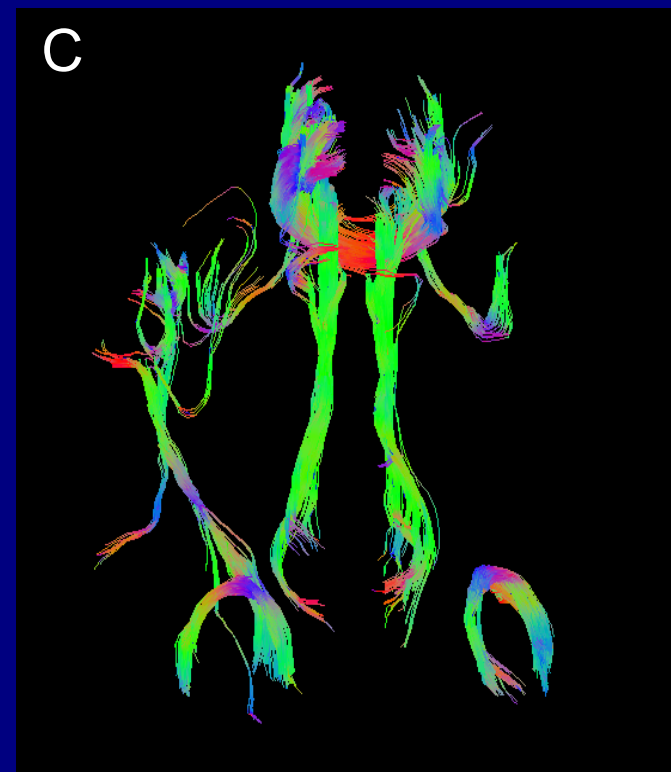
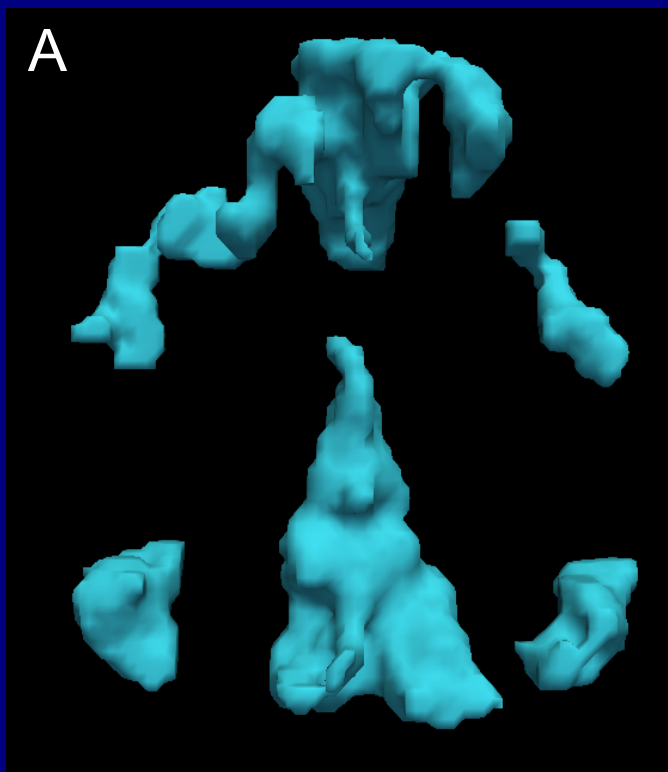


results when:  
blue > 0, red < 0  
(using anti-mask)

*Can also include "-thru\_mask ..", to restrict tract propagation.*

# Mini-Probabilistic Tracking

- + Full probabilistic methods generate voxelwise brain maps without linear track structure
- + 'Mini-probabilistic' tracking performs a few extra iterations of 'deterministic' tracking on uncertainty-perturbed data sets
  - track structure is retained,
  - results generally exhibit more robust tracks and fewer false negatives than deterministic tracking alone
  - false positives tend to be isolated and visually apparent.



Deterministic (AND)

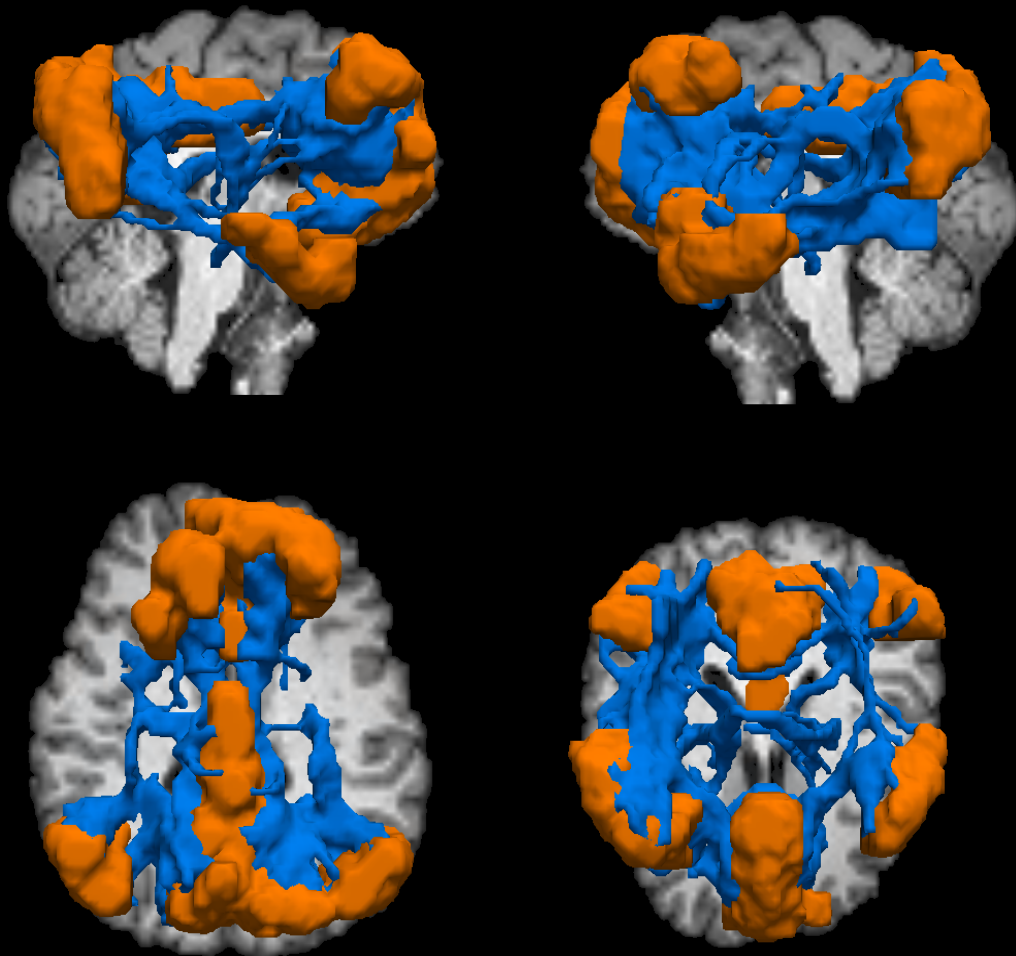
with '-mini\_prob 7'



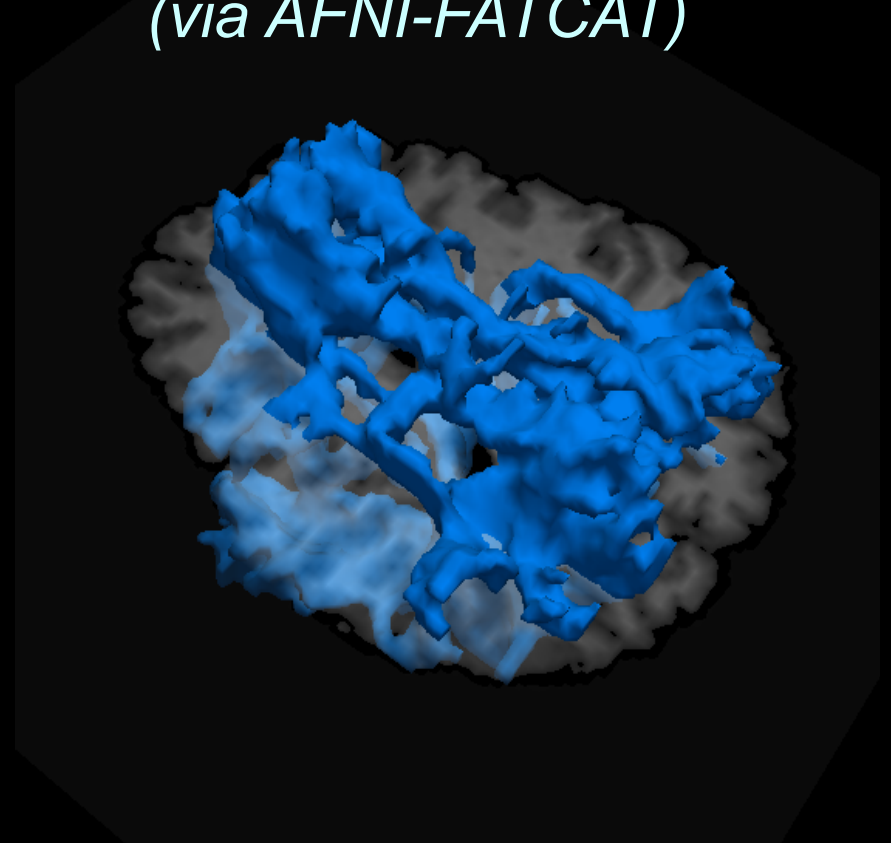
# Example: Probabilistic tractography

More robust tracking method (many Monte Carlo iterations)

→ '*most likely*' locations of WM



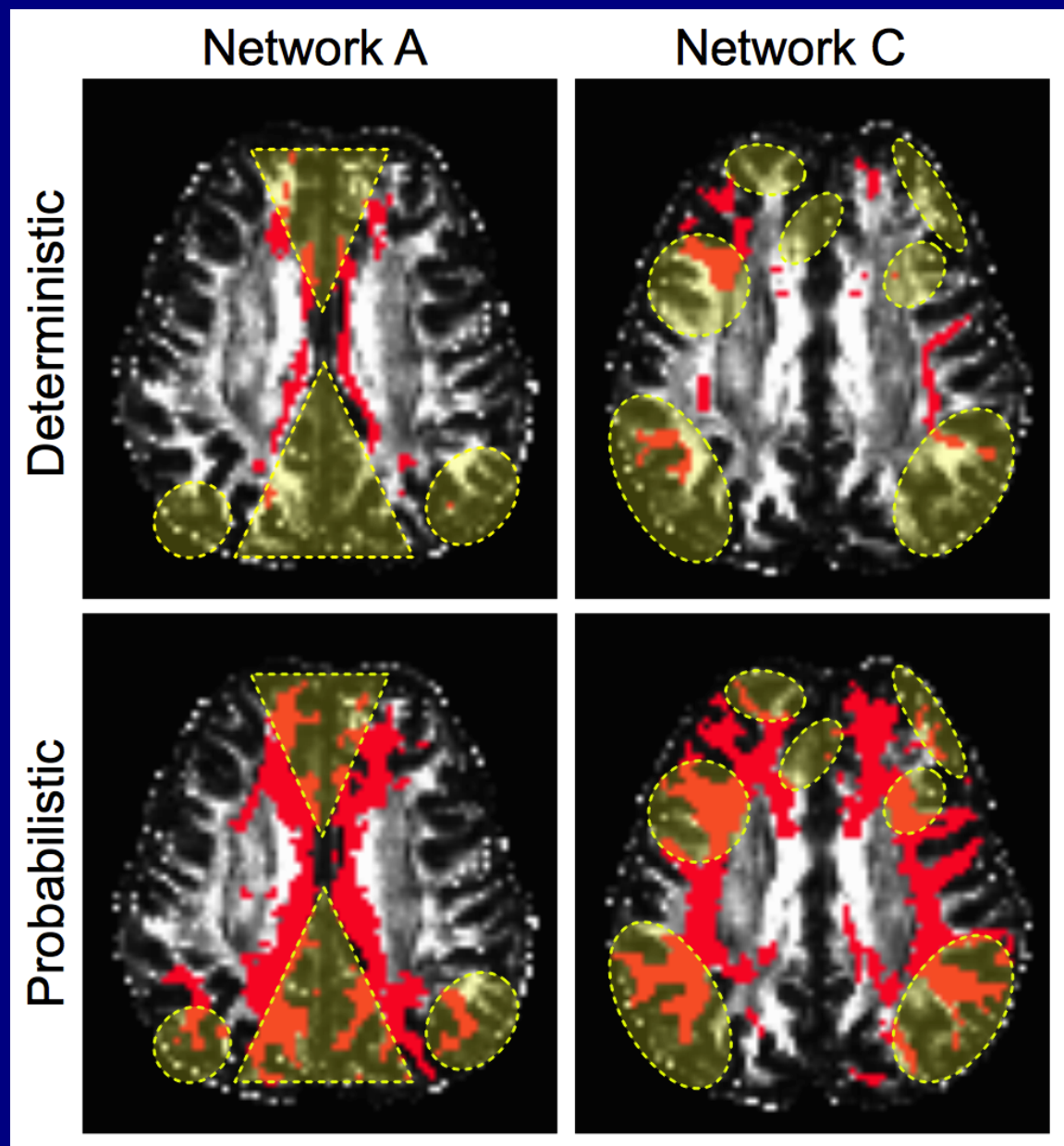
orange = GM ROIs  
blue = WM estimates  
(via AFNI-FATCAT)



(Fully probabilistic tracking using '3dTrackID -mode PROB ...')

# Deterministic vs Probabilistic

- + NB: coverage and connectivity differences between tractography types
- + Deterministic can be useful for initial investigations, but is more susceptible to noise/errors and truncation



# Probabilistic tractography

- + with networks of ROIs from **3dROIMaker** and uncertainty from **3dDWUncert** (as well as tensor estimates from, e.g., 3dDWItoDT), can finally do probabilistic tractography
- + **3dTrackID -mode PROB**
  - does lots of **Monte Carlo simulations**: wholebrain tractography -> perturb FA & e1 based on uncertainty -> wholebrain tracking -> perturb -> wholebrain tracking -> etc.

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  - can **trim** saved tracts to only keep voxels *between* 2 ROIs (i.e., no overrunners in the 'connection' ROIs)



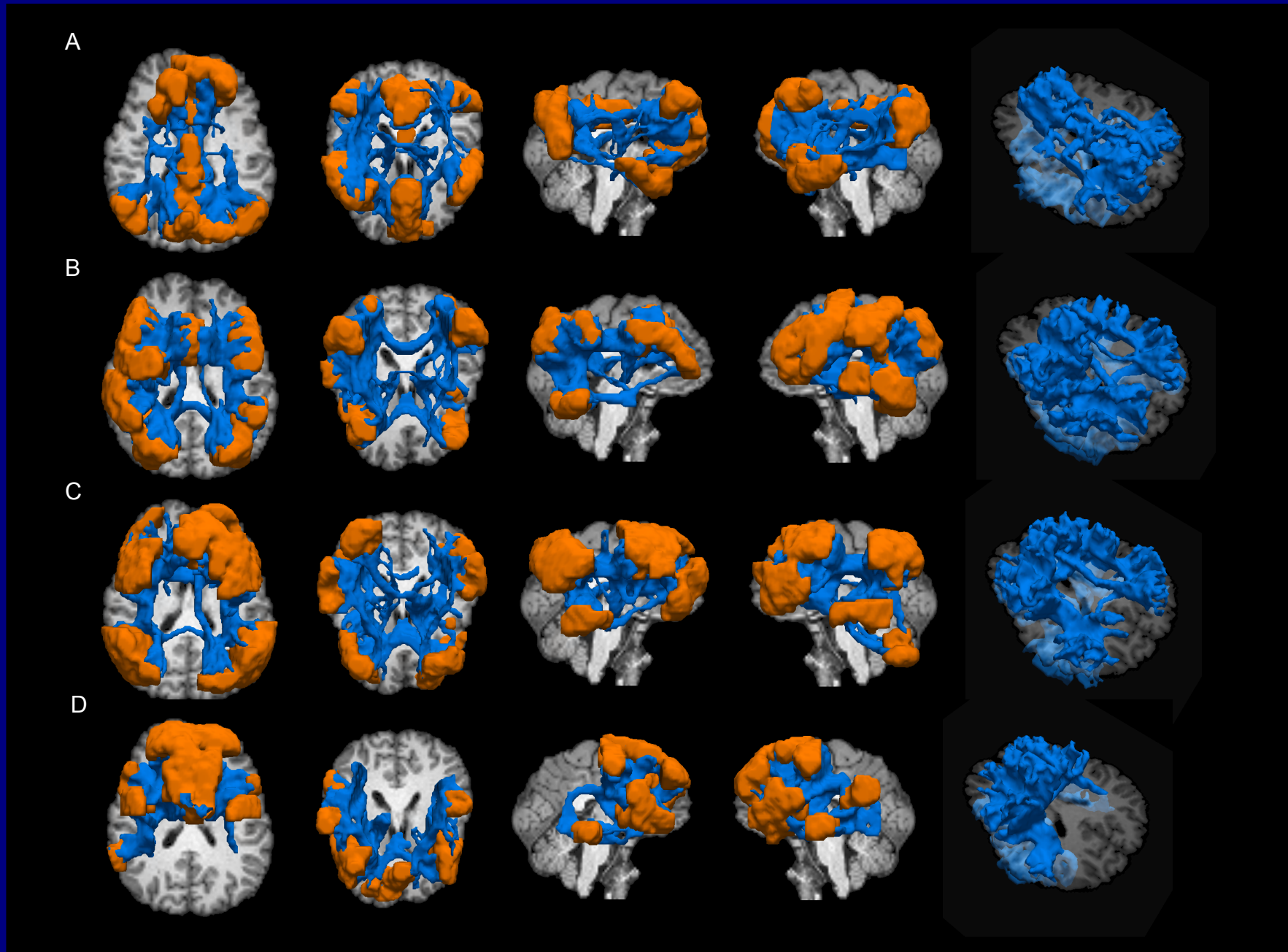
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  - to find WM region connecting, say, ROI 1 and 2: keep voxels through which Ntracks which intersected both ROI1 and ROI2 is greater than a user-defined threshold

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    - keep voxels through which Ntracks which intersected both ROI1 and ROI2 is greater than a user-defined threshold
  - calculate stats on final WM ROIs found
  - analyze multiple networks **simultaneously** for efficiency (i.e., very little extra cost)

# 3dTrackID: Probabilistic tractography

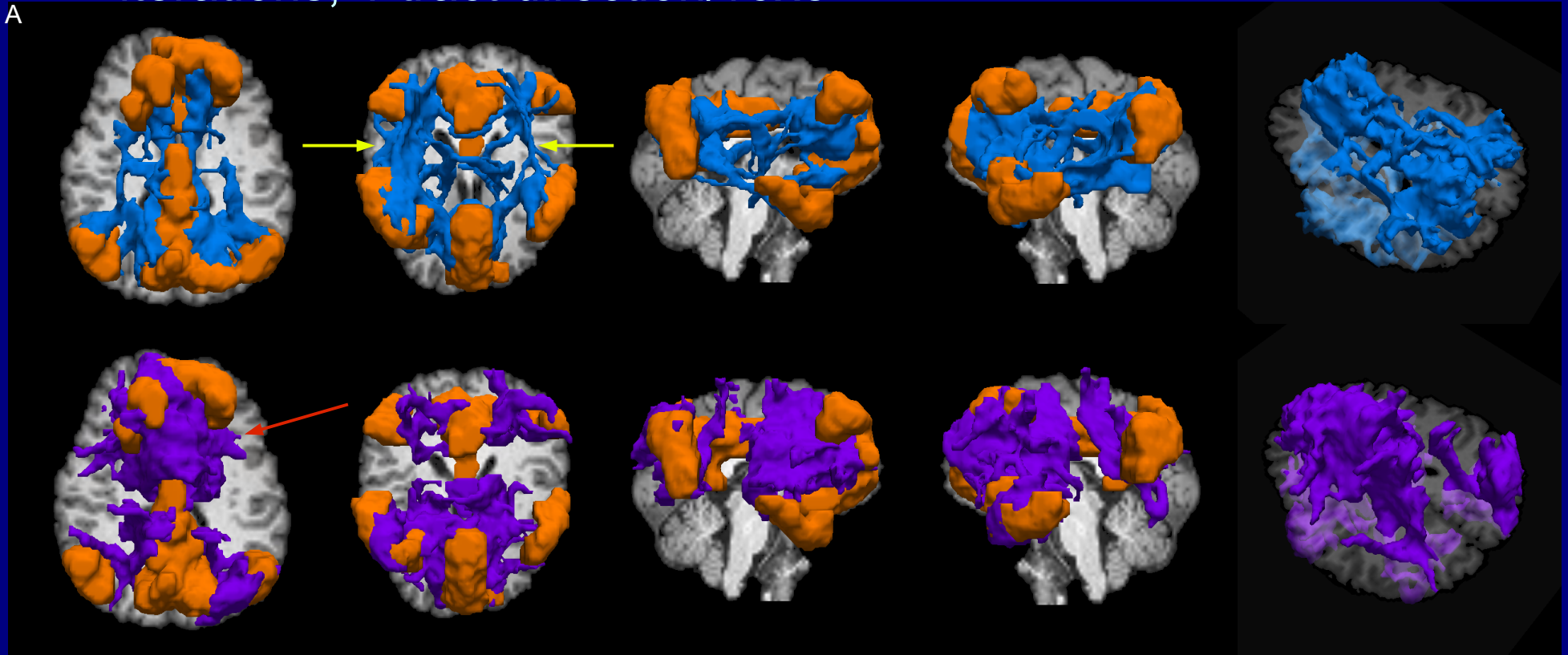


(orange is ROI; blue is set of WM regions with tracts connecting)

# 3dTrackID: Probabilistic tractography

+ compare with existing algorithms:

- purple: FSL-probtrackX (and FSL-bedpostX for uncertainty)
- same parameters:  $FA > 0.2$ , max angle 60deg, 5000 Monte Carlo iterations; 1 tract direction/voxel

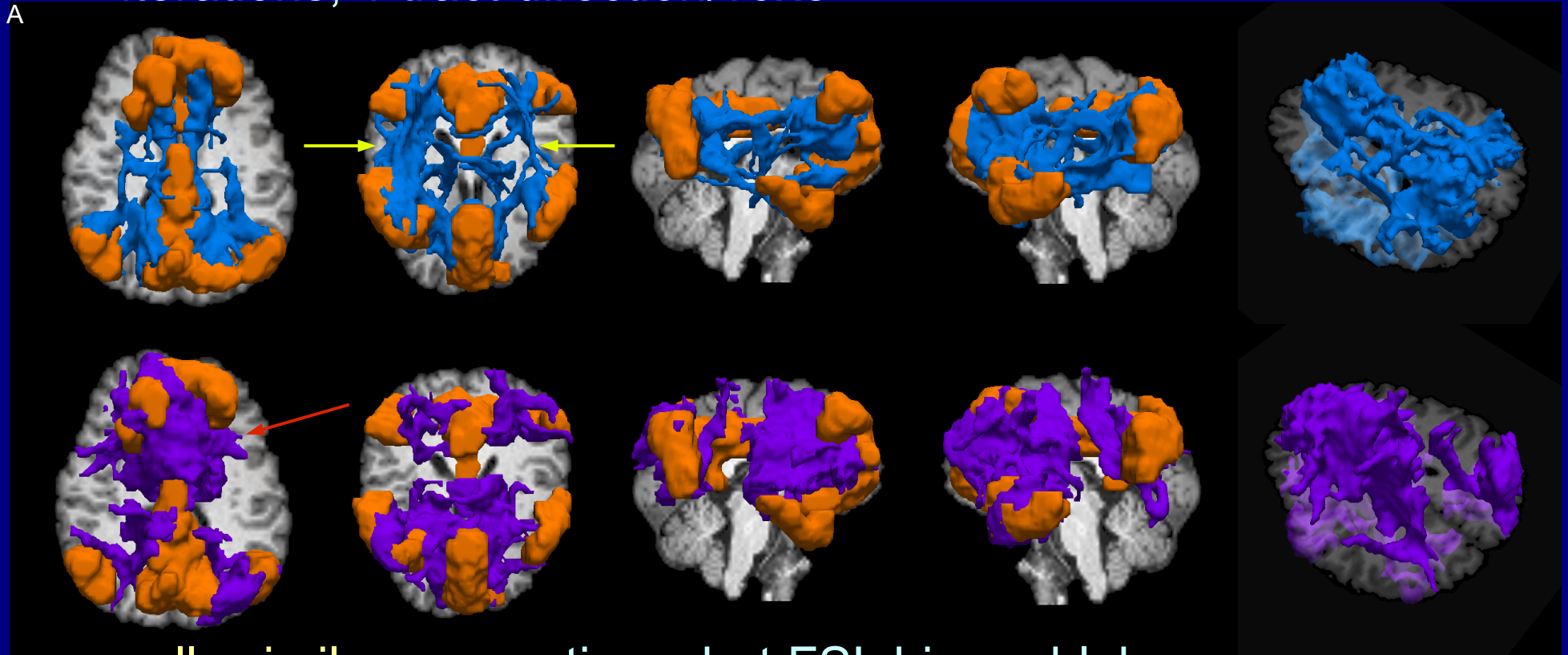




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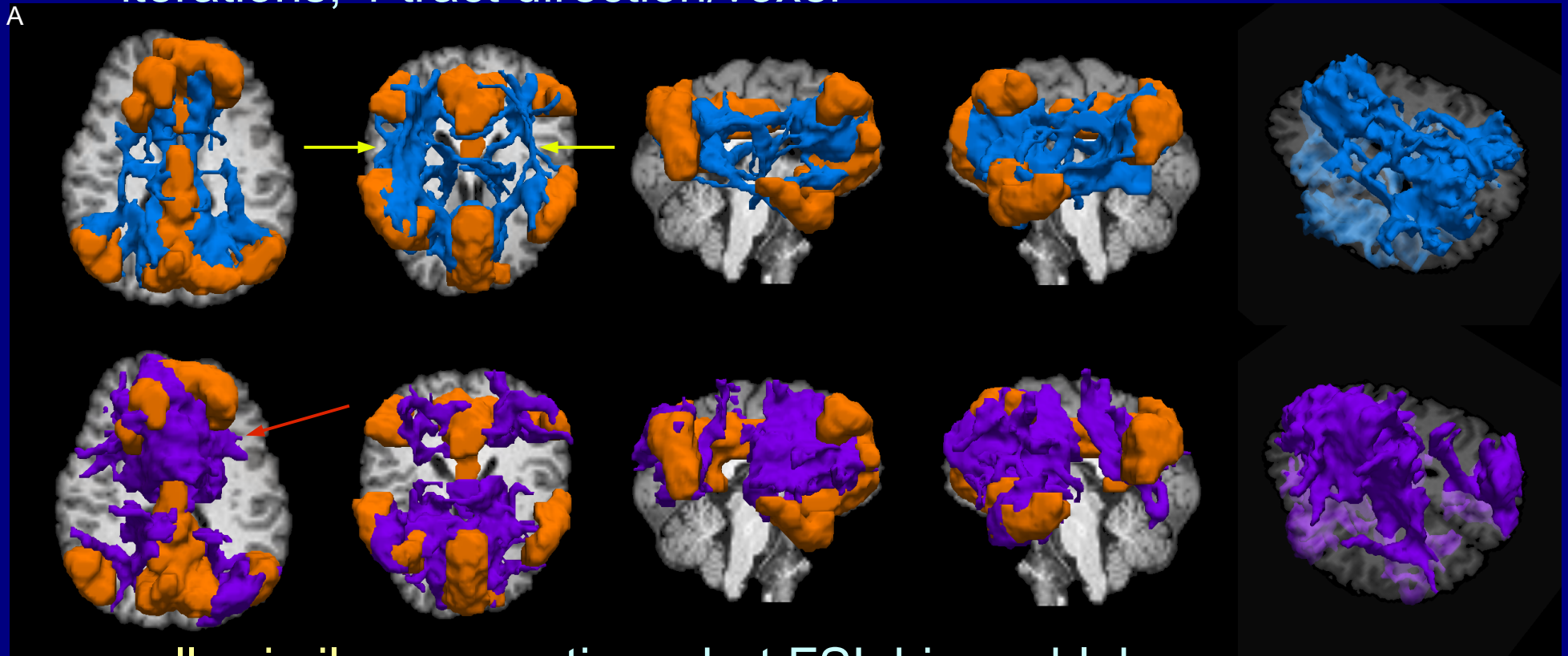


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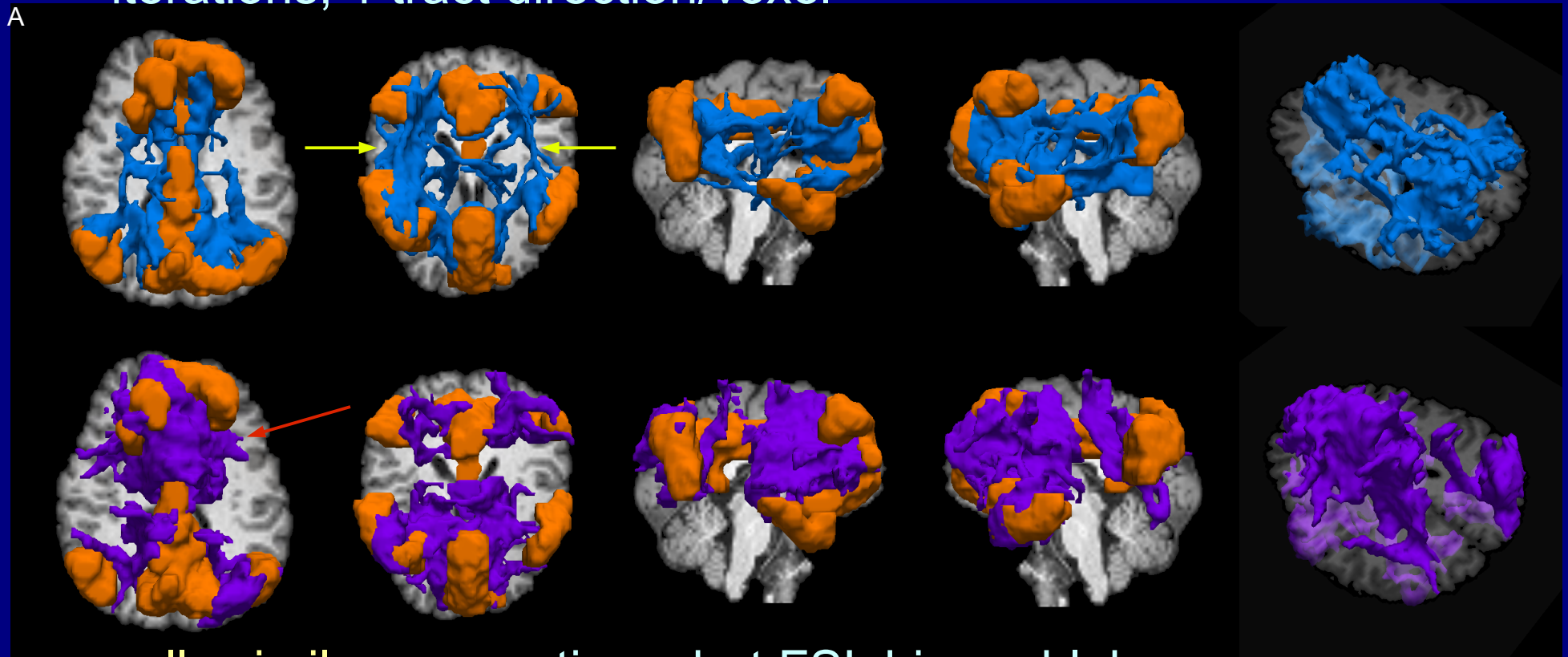


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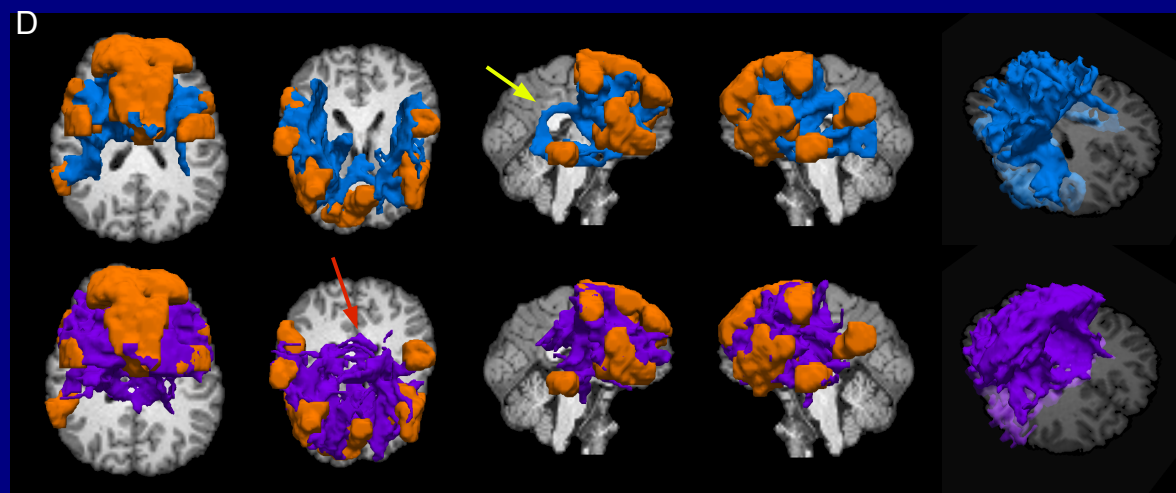
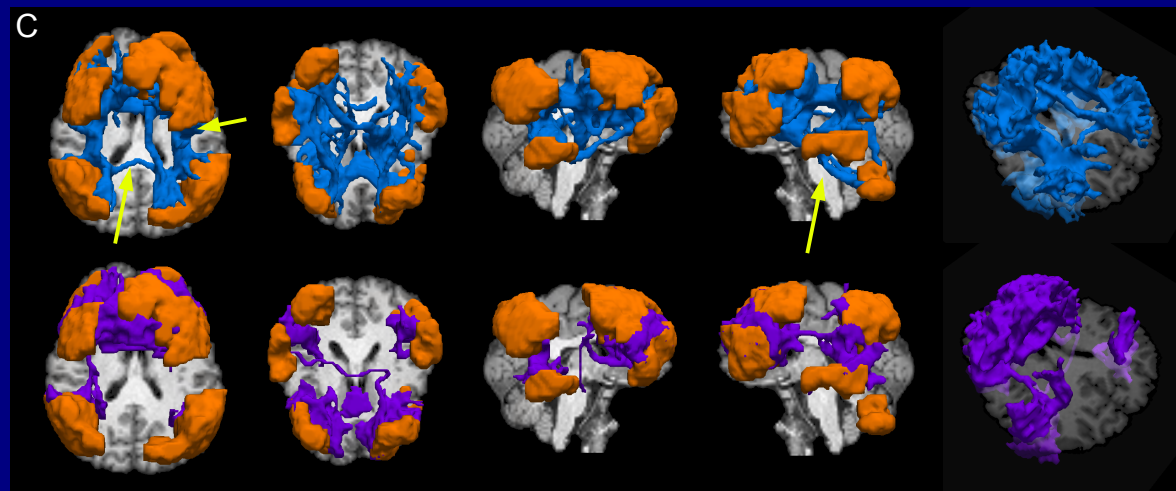
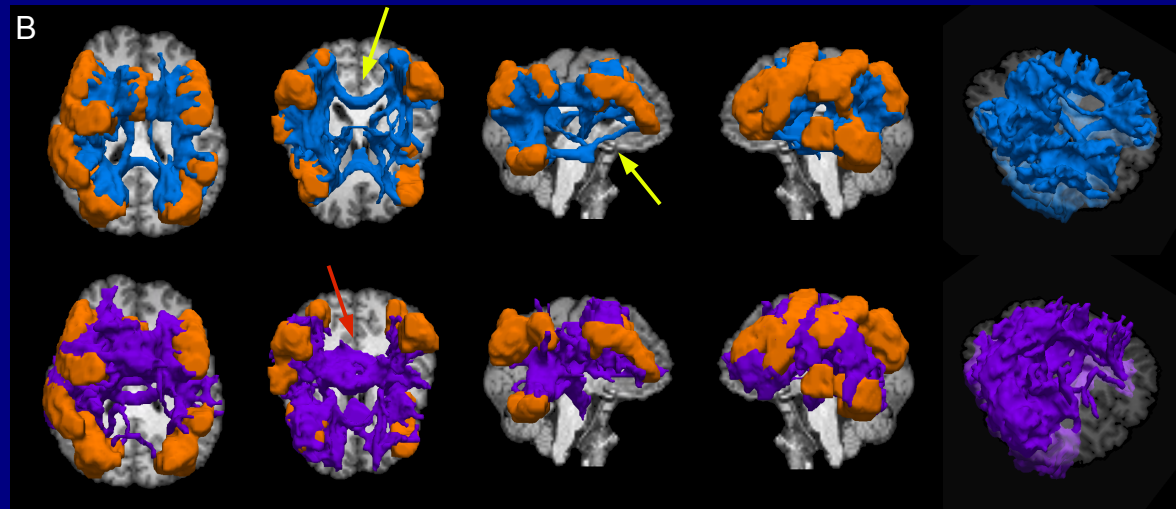
- + generally similar connections, but FSL bigger blobs
- + FSL took **several hours** for uncertainty, and then **>24 hours** for tracking this single network (and had to run 4 for this study)
- + **3dDWUncert** took **7min**; **3dTrackID** took **25mins** total for 4 netw.



# 3dTrackID:

(other networks show similar results in terms of:

- narrow/wide regions of tracts;
- broadly similar locations;
- each program shows some tracks which the other doesn't )





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(3dTrackID automatically creates \*.grid files for probabilistic files, as well.)

