

The background features a large, light gray watermark of the Stanford University seal. The seal is circular and contains the text "LELAND STANFORD JUNIOR UNIVERSITY" around the top edge and "1891" at the bottom. In the center is a redwood tree with the motto "DIE ET DER FREIHEIT" (Die and of Freedom) written in a circular path around it. There are also five stars along the bottom inner edge of the seal.

CNI User Meeting

OCTOBER 14, 2022

A solid, dark red horizontal bar spans the width of the page at the bottom.

CNI

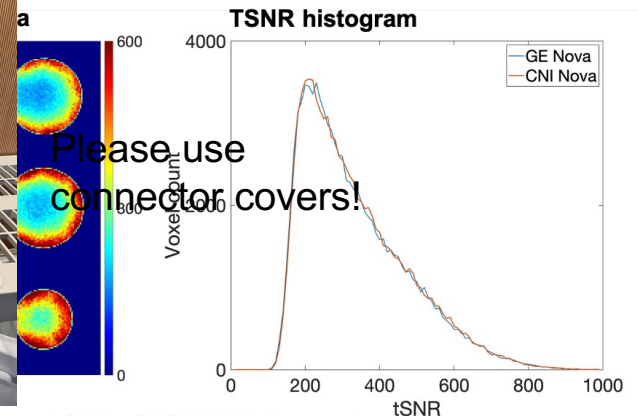
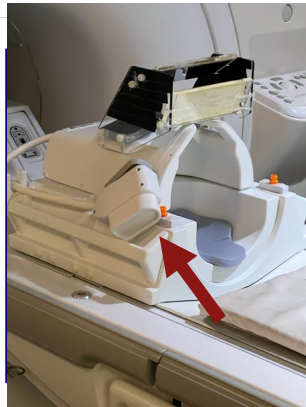
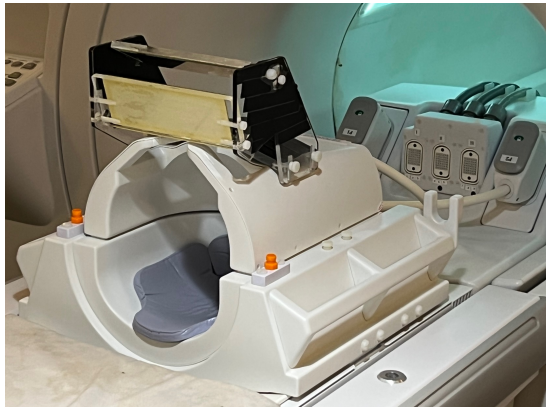
**User
Meeting
Agenda**

Oct. 14, 2022

- Technology developments
- Flywheel update
- Future system upgrade
- C-ShARP RFP & Experiential Learning
- Friendly reminders

Technology – New Nova Coil

- New Nova 32-channel installed
- No meaningful differences with previous Nova coil borrowed from GE



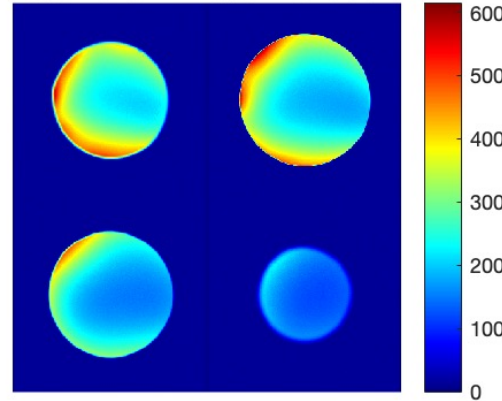
Technology – New Infant Coil

- Custom 32-channel coil sized for infants 0-1 years old, Boris Keil THM^[1]
- Funded by Prof. Kalanit Grill-Spector
- Equivalent FDA safety testing for GE commercial coils, but still an investigational device
- Improves SNR compared to 32-channel Nova adult coil, especially anterior
- Contact us if you're interested in using



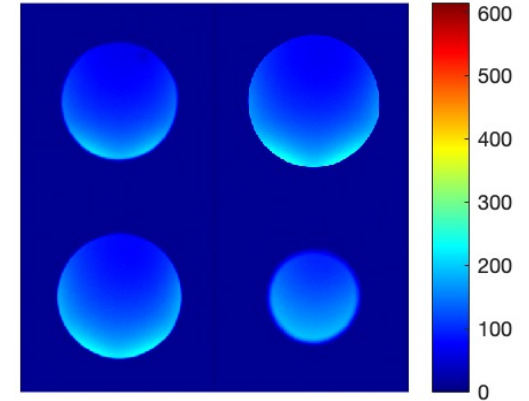
CNI

Optimal SNR Maps: Infant Coil



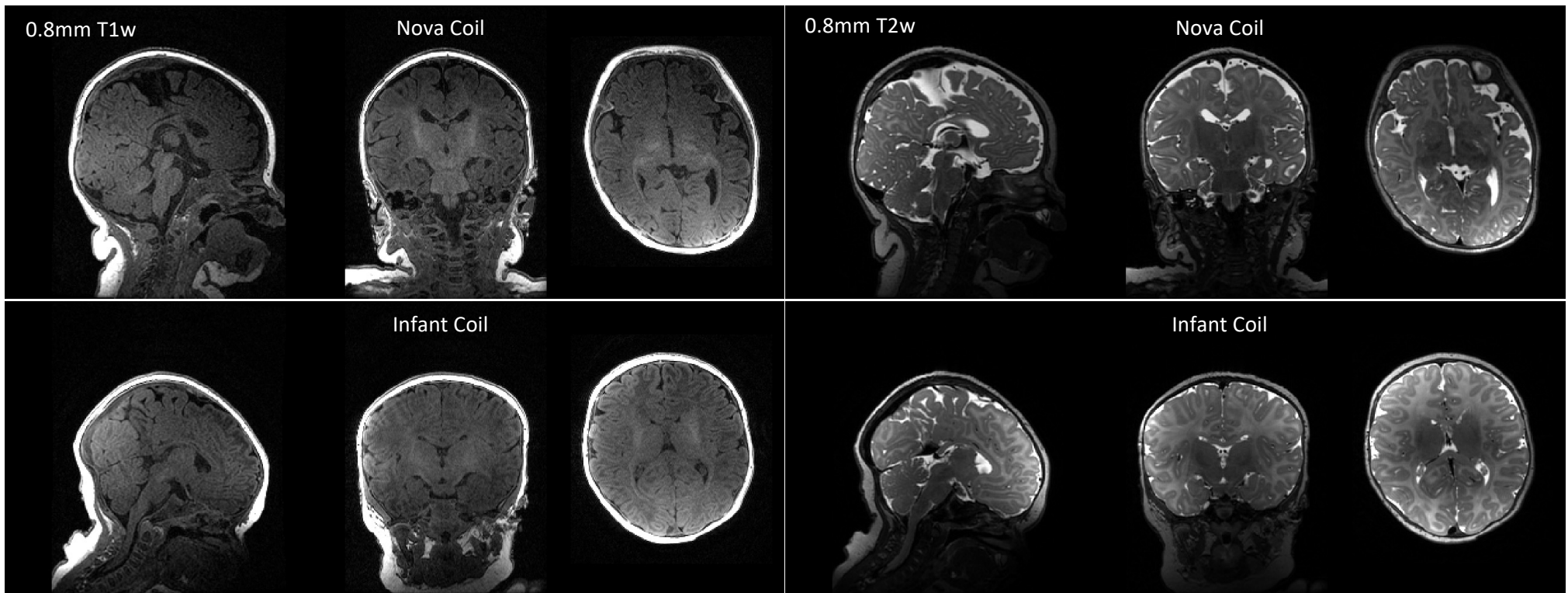
[1] Ghotra *et al.* *MRM* 86.3 (2021): 1773-1785.

Optimal SNR Maps: CNI Nova



Stanford University

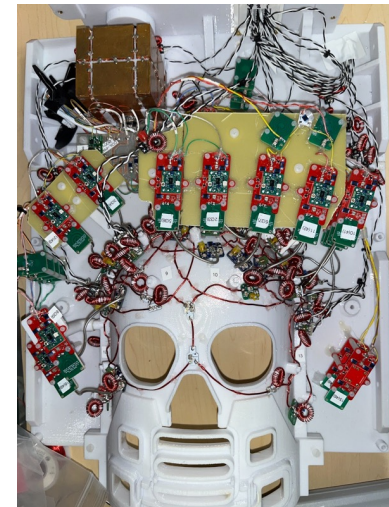
Technology – New Infant Coil



Technology – AC/DC Coil

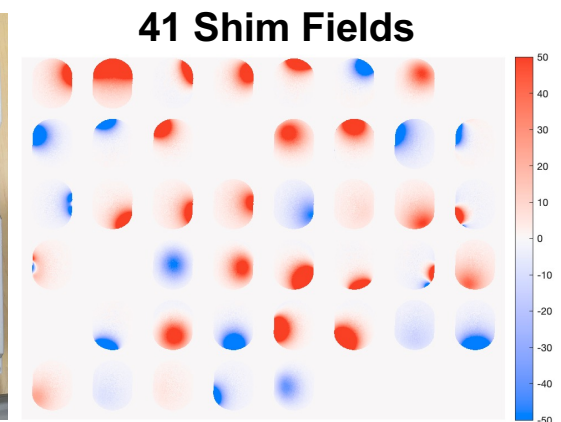
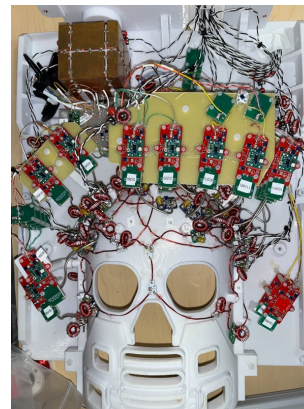
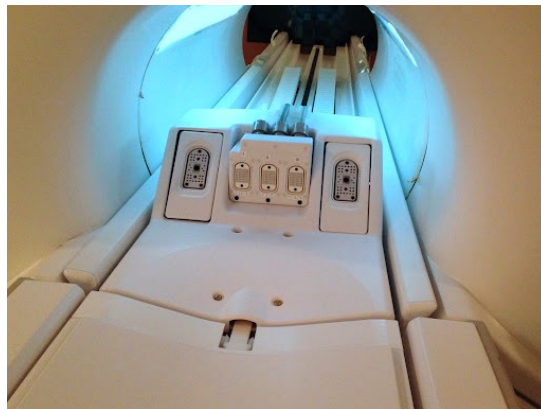
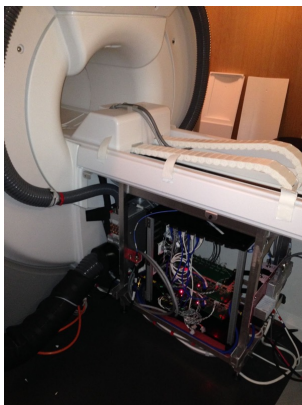


- Collaboration with C. Liao & K. Setsompop (Stanford EE/Radiology) and J. Stockmann (Radiology, Harvard/MGH)
- Developing 48-channel RF receive coil, with receive coils also providing local shim control



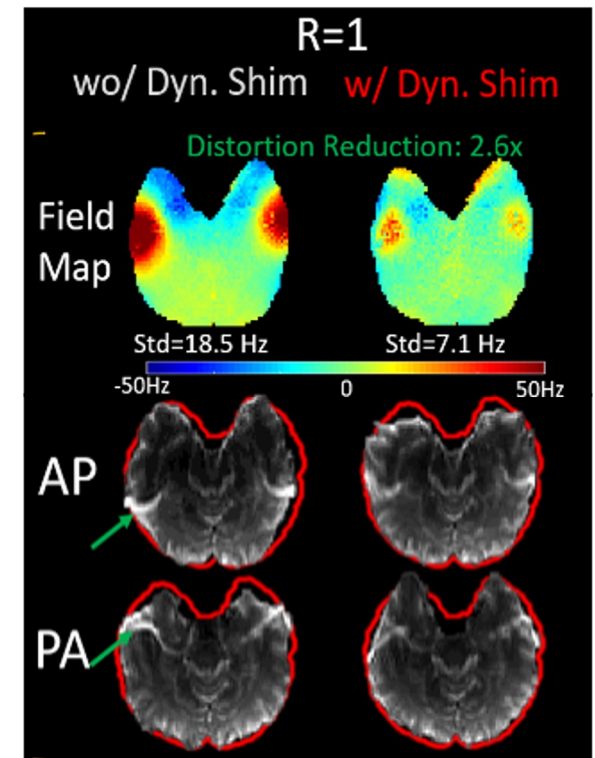
Technology – AC/DC Coil

- Tightly integrated with CNI Scanner
 - Shim amplifier in rear pedestal, coupled to GE coolant system
 - Shim coil cables incorporated in GE cable management system
 - Provides DC shim currents to 41 of 48 receive coils



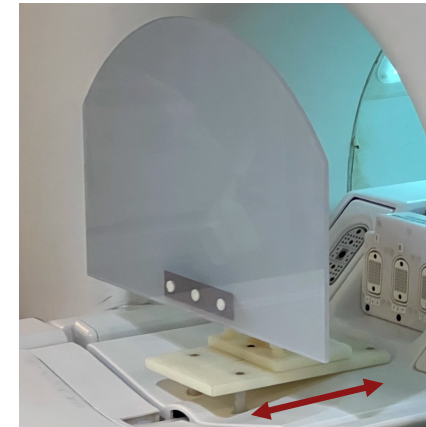
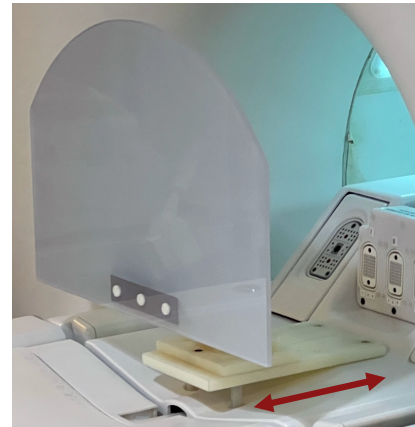
Technology – AC/DC Coil

- Current status
 - Workflow process still in development
 - Scanner operation causing unintended interaction with shim control
 - Expect first *in vivo* images by early November
- Applications
 - Improving quality in MRI and MRSI
 - Enabling fMRI and diffusion in regions of high B0 inhomogeneity
 - Enabling new types of MR sequences



Technology – Projector Screen

- Universal screen holder built to work with all coils
- Permanent base near coil ports
- Screen can be installed with just two thumbscrews, adjustable S/I
- Will safely traverse entire scanner bore including rear air vent

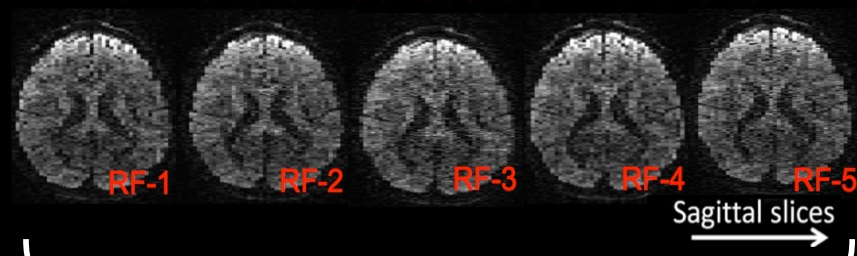




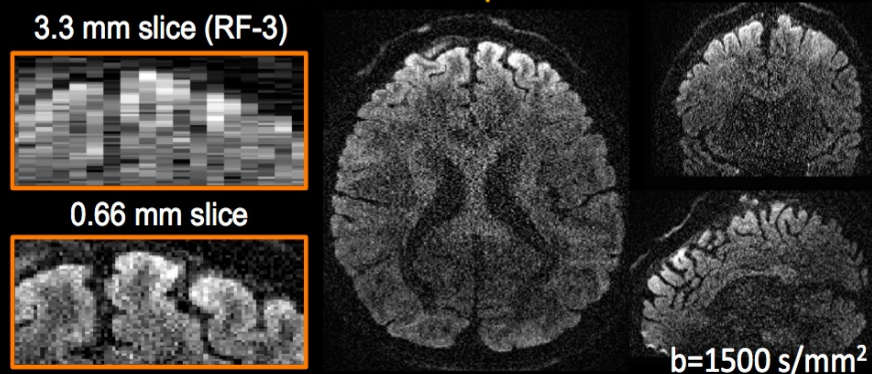
Ultra-High-Resolution Diffusion: gSlider-SMS¹⁻²

gSlider-SMS (*Generalized SLice Dithered Enhanced Resolution Simultaneous multiSlab*)

5 RF encoded volumes at 3.3 mm thick slice



Combined: 660 μm slice

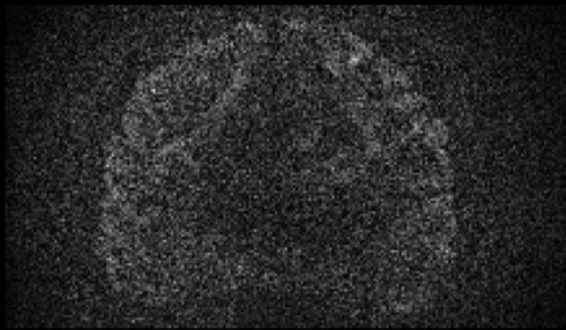


SNR Improvement of gSlider

standard EPI: 1 mm iso
 $b=1000 \text{ s/mm}^2$

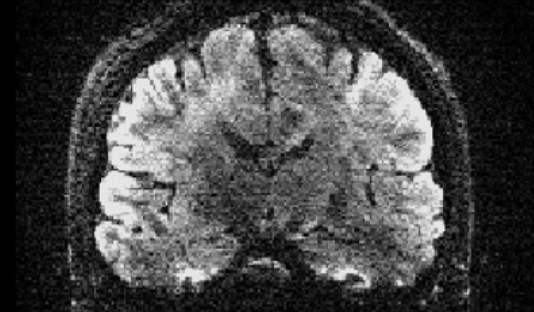


$b=2500 \text{ s/mm}^2$

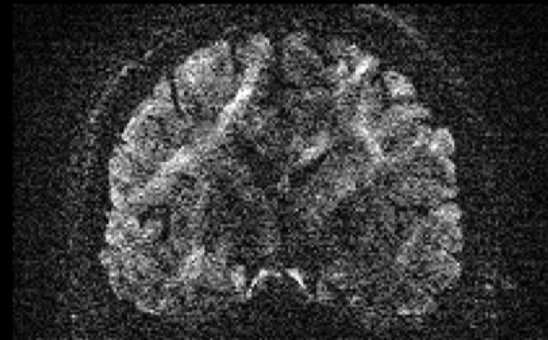


TA: 20 sec

gSlider: 1 mm iso
 $b=1000 \text{ s/mm}^2$



$b=2500 \text{ s/mm}^2$

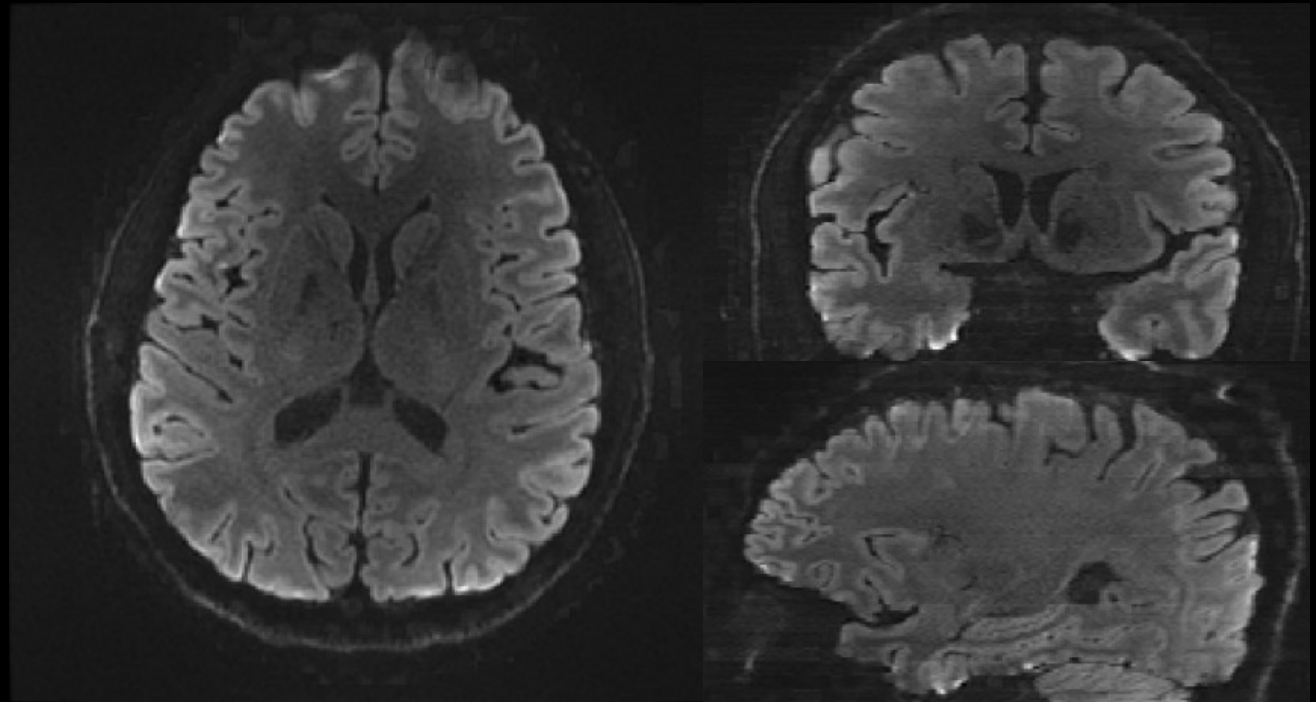


TA: 17.5 sec
(TR 3.5×5 RF-encodings)

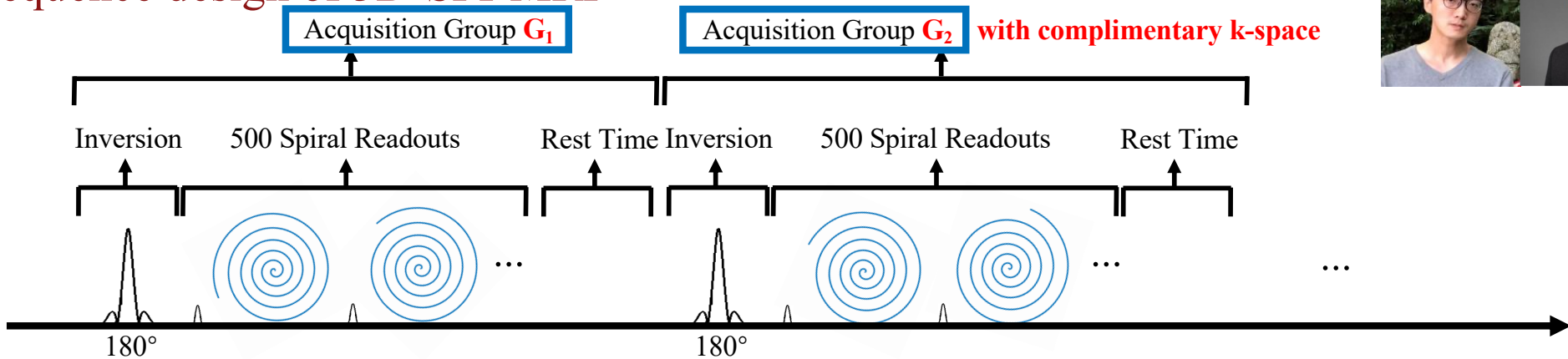
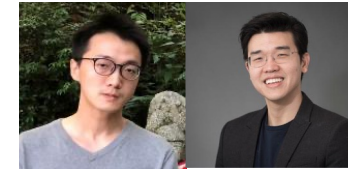
Whole-Brain 1-mm DWIs in 10 Minutes

30 diffusion-direction averaged DWIs

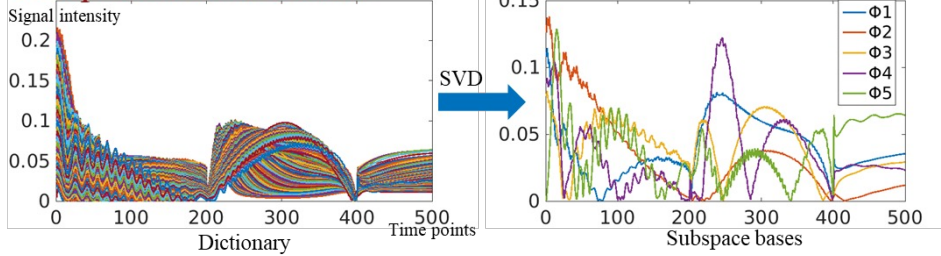
30 directions
b-value=1000s/mm²
TR/TE =3500/75ms
Partial Fourier 6/8
FOV = 220 mm
Total acquisition time: 9min 24s
Reconstruction ~35min



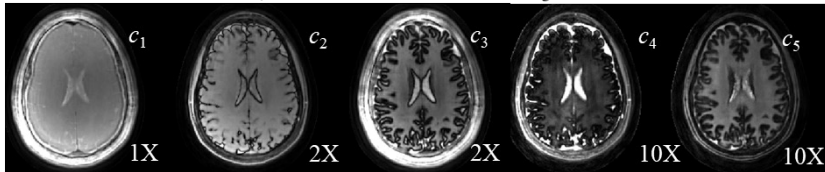
Sequence design of 3D-SPI-MRF



Subspace reconstruction

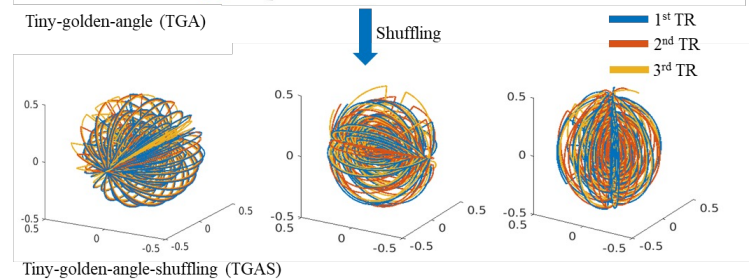
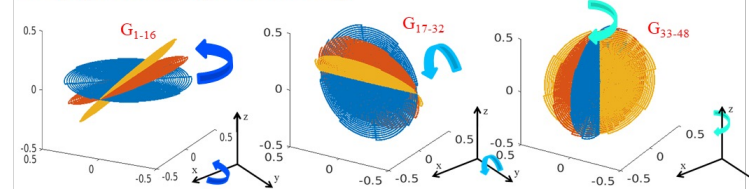


Subspace recon w/ LLR $\min_c \|PFS\Phi c - y\|_2^2 + \lambda R_r(c)$



Subspace recon w/ LLR

Tiny-golden-angle-shuffling

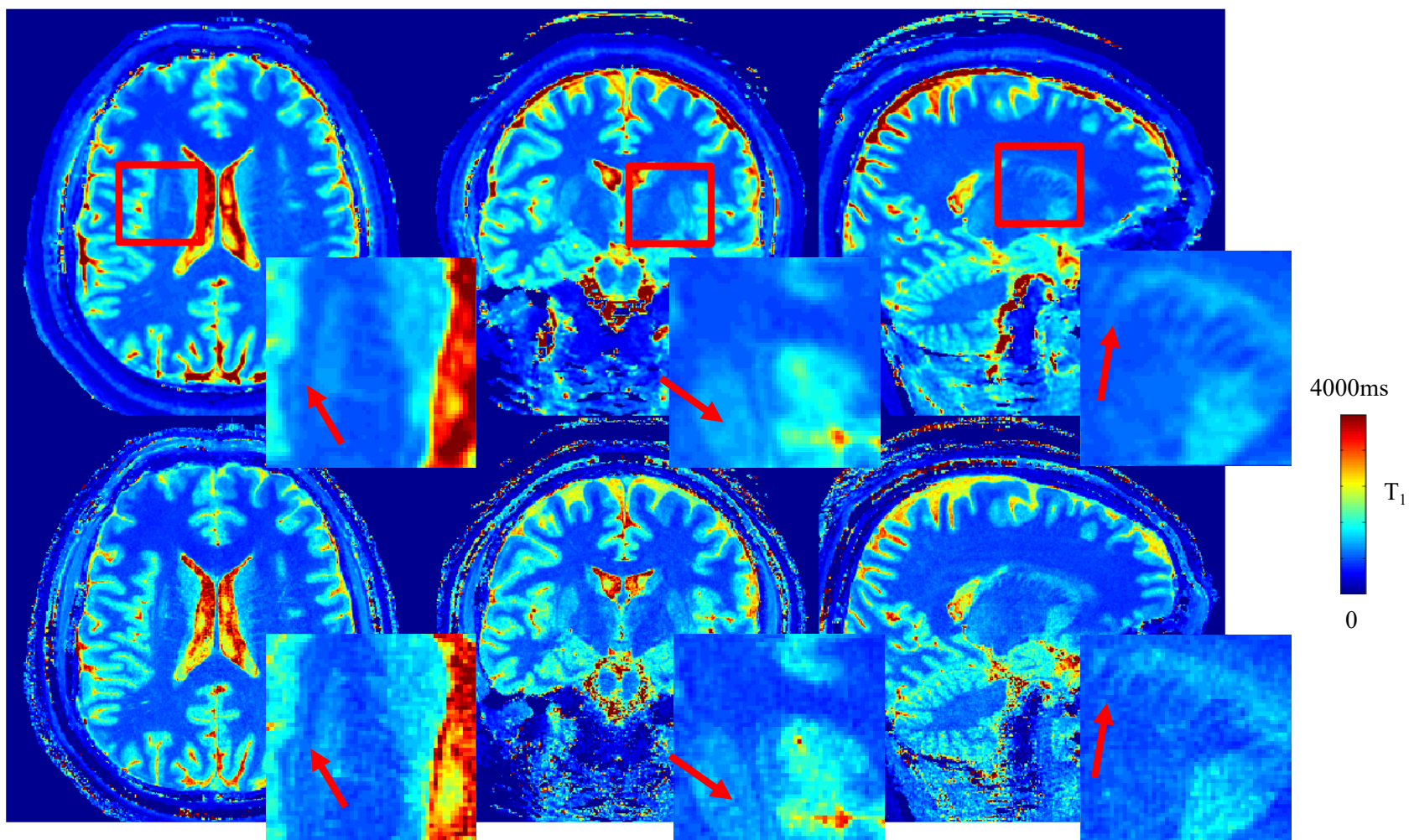


Optimized SPI trajectory

Results from GE 3T UHP scanner

Resolution: 1-mm iso
FOV: 220mm iso
Acquisition: 2 min
Max Slew raw: 100 T/m/s
Recon time: ~0.5H

Resolution: 0.66-mm iso
FOV: 220mm iso
Acquisition: 4 min
Max Slew raw: 100 T/m/s
Recon time: ~4H

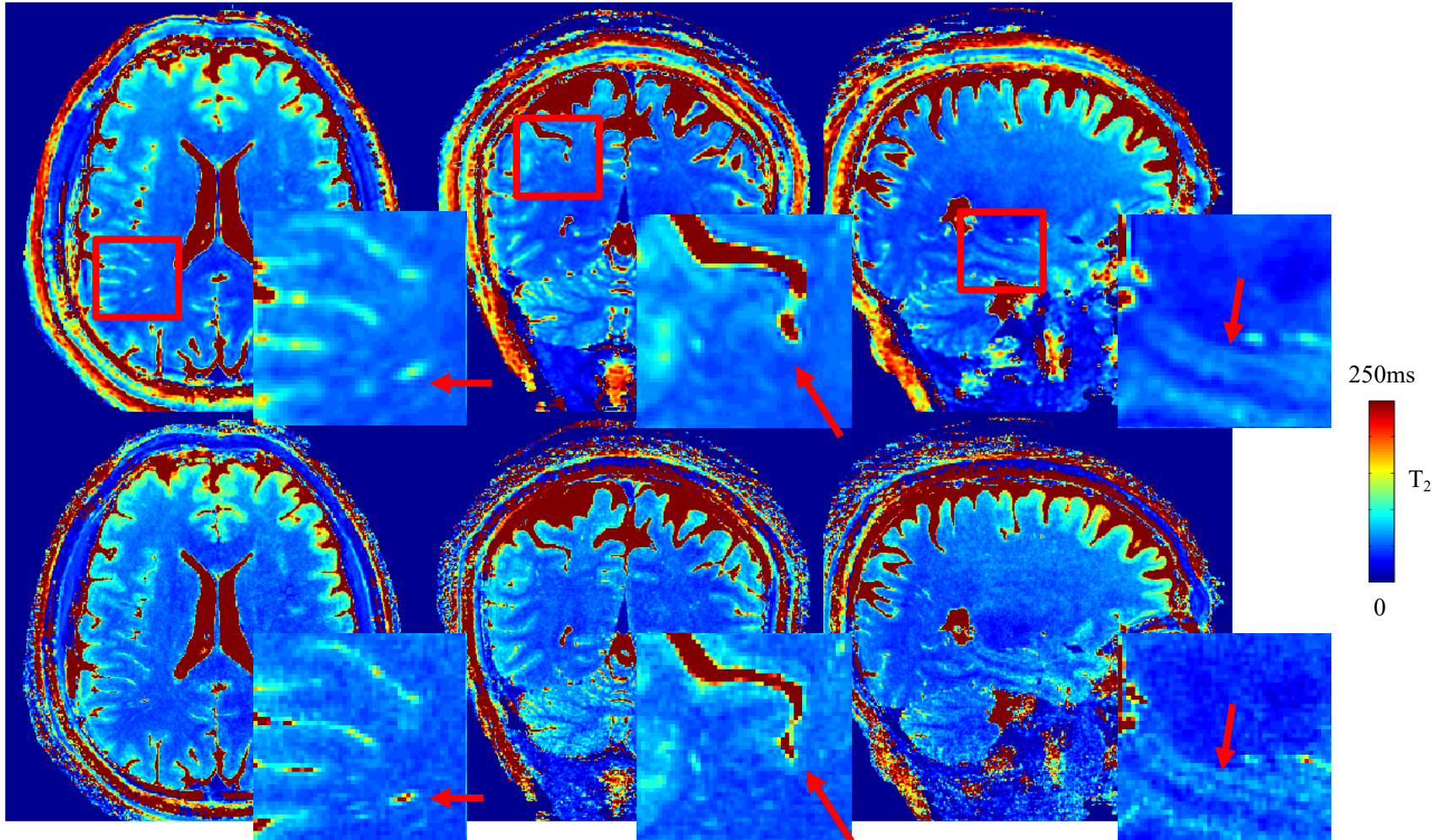


Results from GE 3T UHP scanner

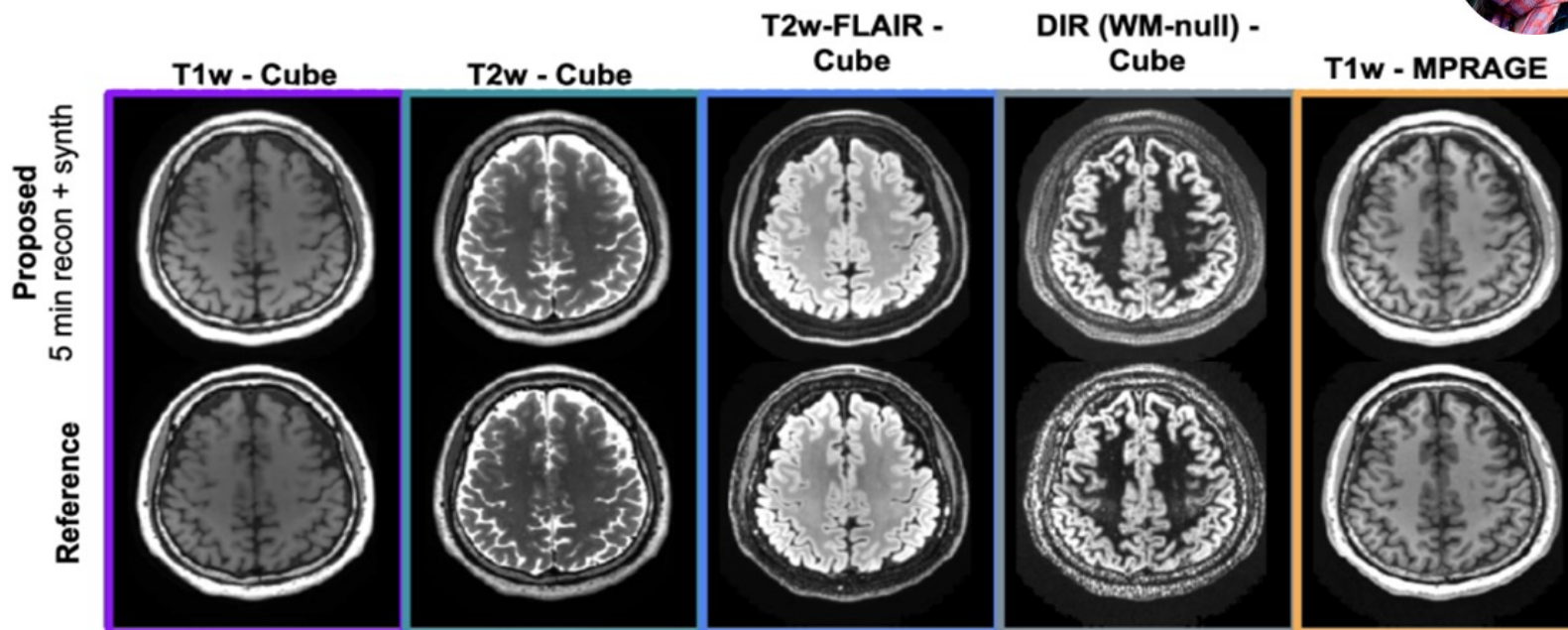
On GE 3T UHP scanner

Resolution: 1-mm iso
FOV: 220mm iso
Acquisition: 2 min
Max Slew raw: 100 T/m/s
Recon time: ~0.5H

Resolution: 0.66-mm iso
FOV: 220mm iso
Acquisition: 4 min
Max Slew raw: 100 T/m/s
Recon time: ~4H



Towards clinical application using MRF



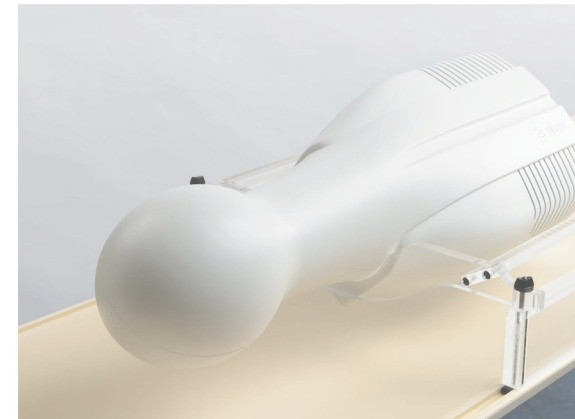
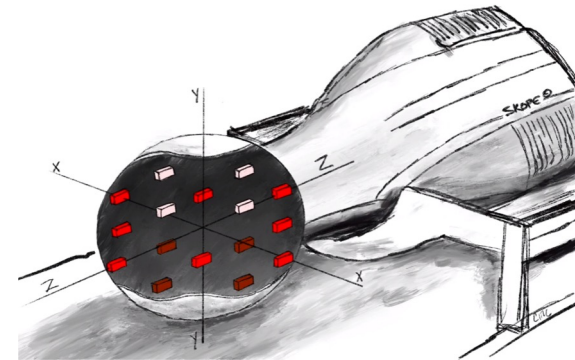
Using deep learning to synthesize T_1w/T_2w images with MRF results

Synthesized MPRAGE offered high-quality brain segmentation

This 3D-SPI-MRF sequence has been deployed on CNI, Lucas Center, Stanford Hospital and Stanford Children Hospital with collaborators. Automatic data transfer and reconstruction scripts have also been well developed.

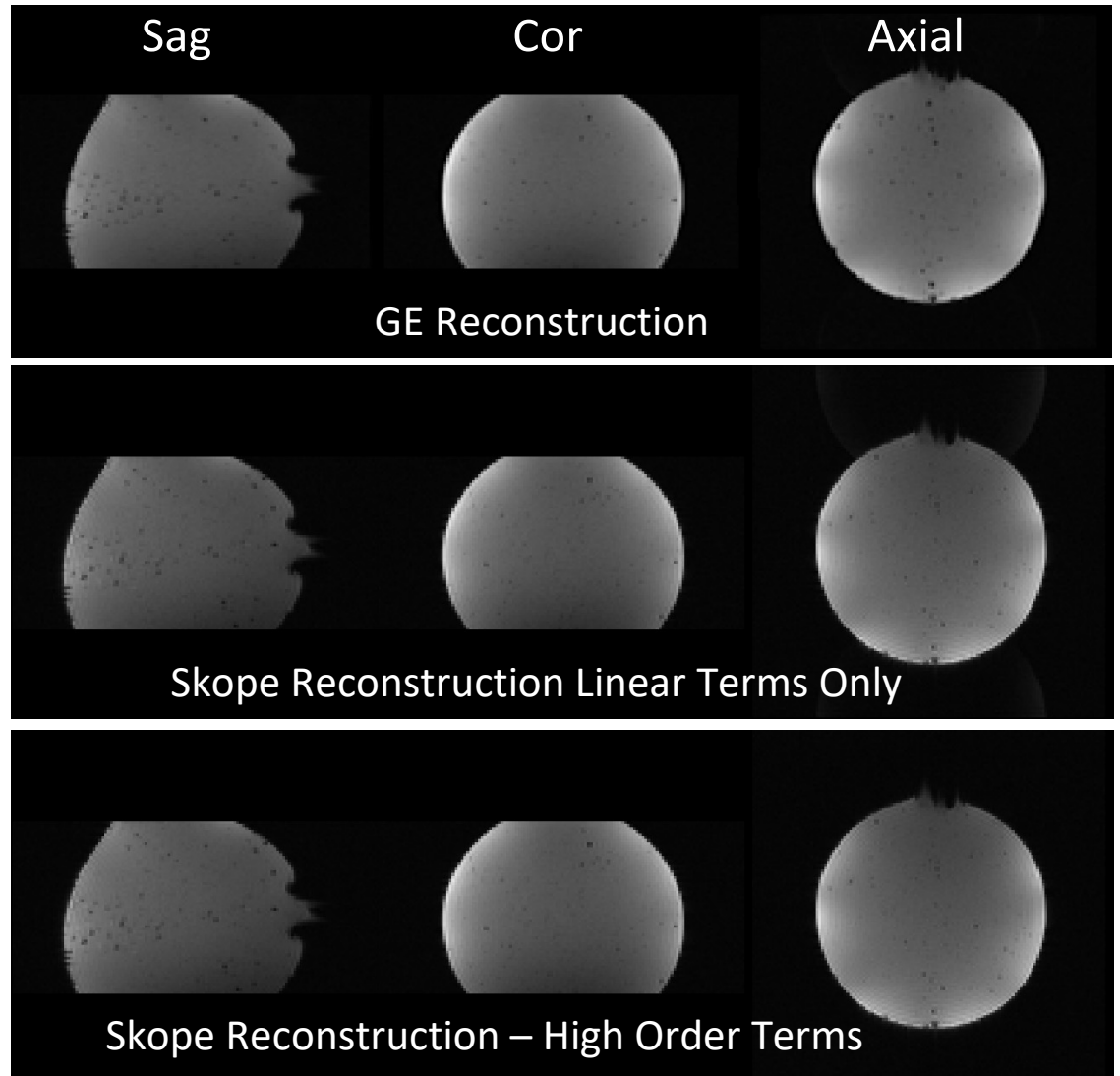
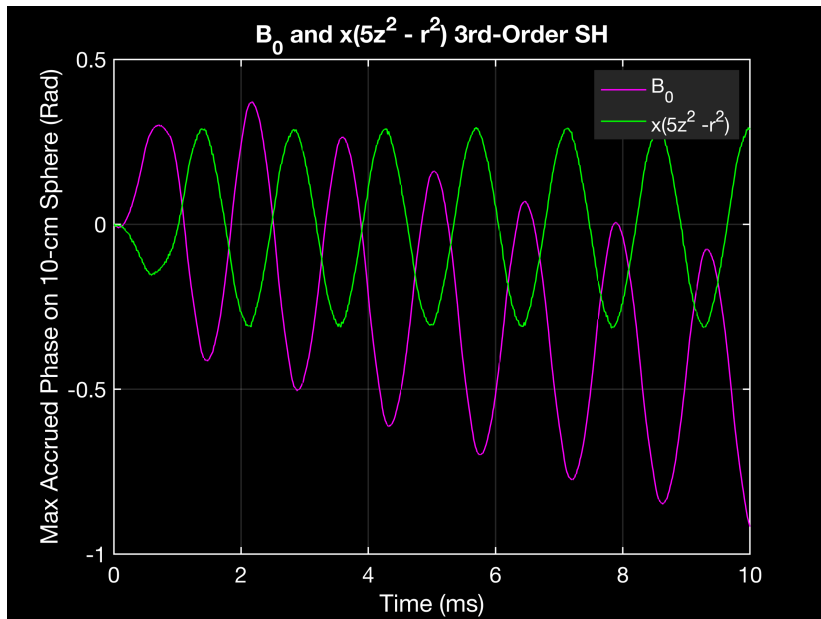
Technology – Skope Field Camera

- Internal Stanford award (Kerr, Pauly, Wandell - \$438K) to improve quality and precision of MRI at Stanford:
 - 3T dynamic field camera providing 1 μ s resolution of up to 3rd order spherical harmonic model of field perturbations
 - 7T system extension
 - High bandwidth data storage
 - Image reconstruction software



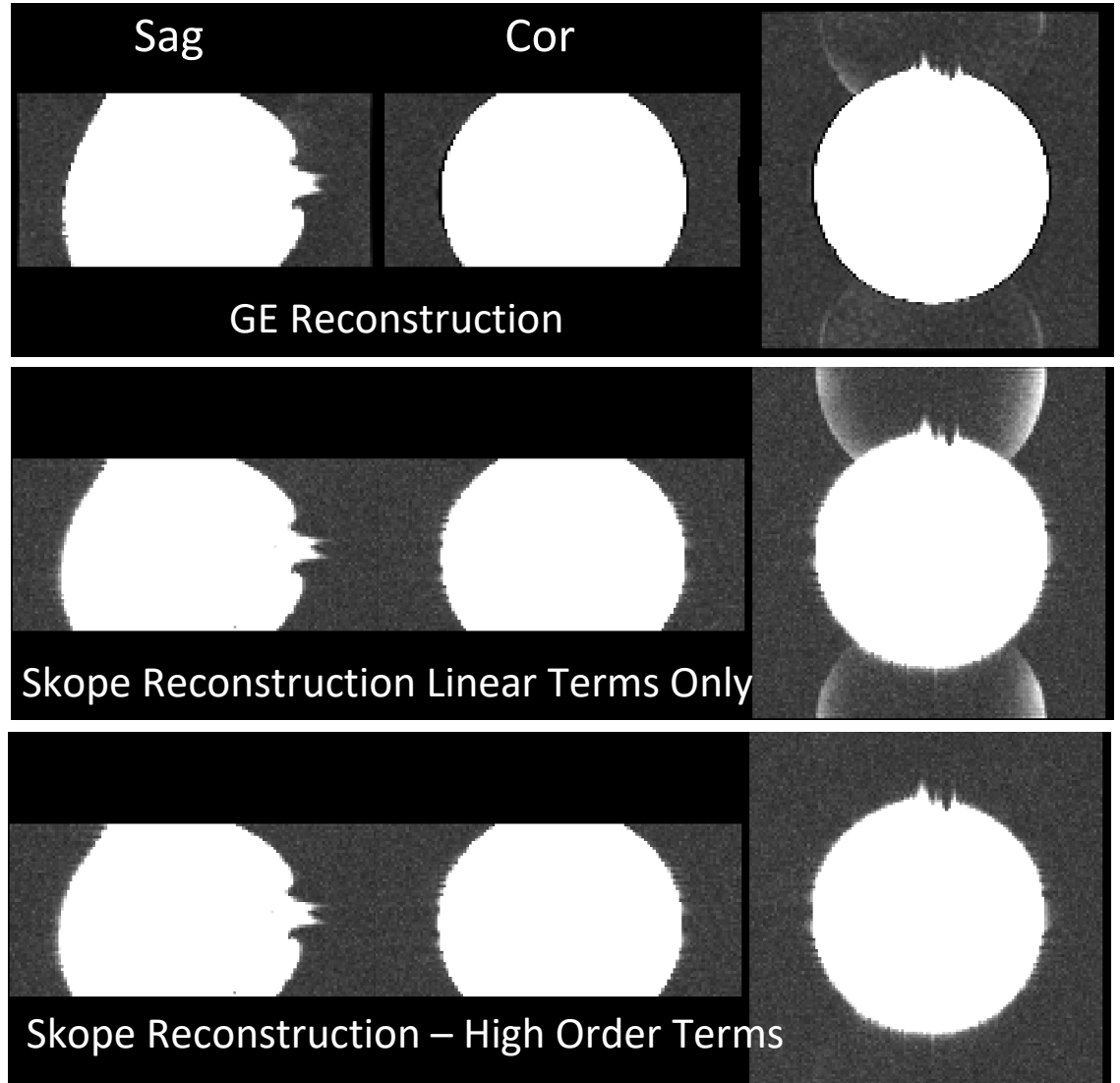
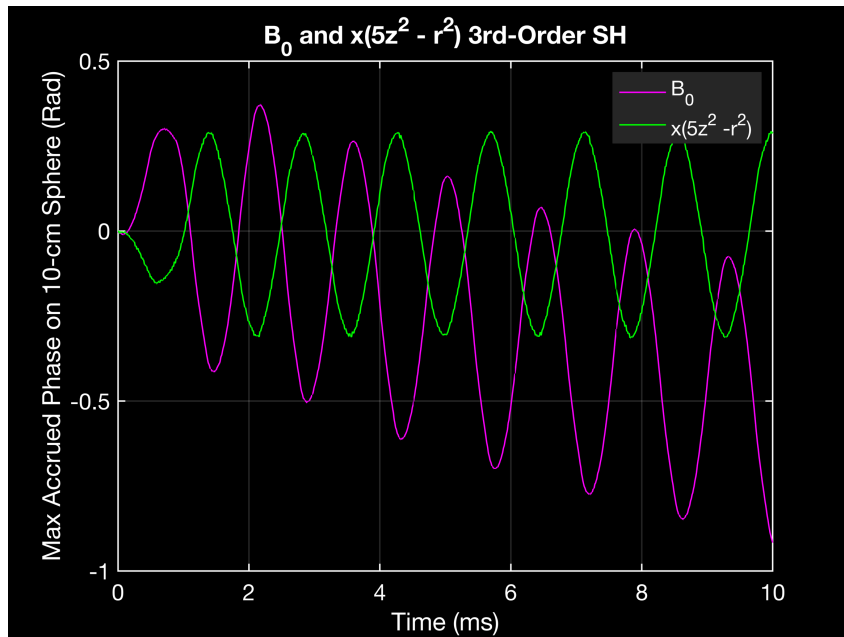
EPI R1 Acquisition

R=1
25.6-cm FOV
60 slices
2-mm iso resolution
128x128 matrix
TE = 42.0ms



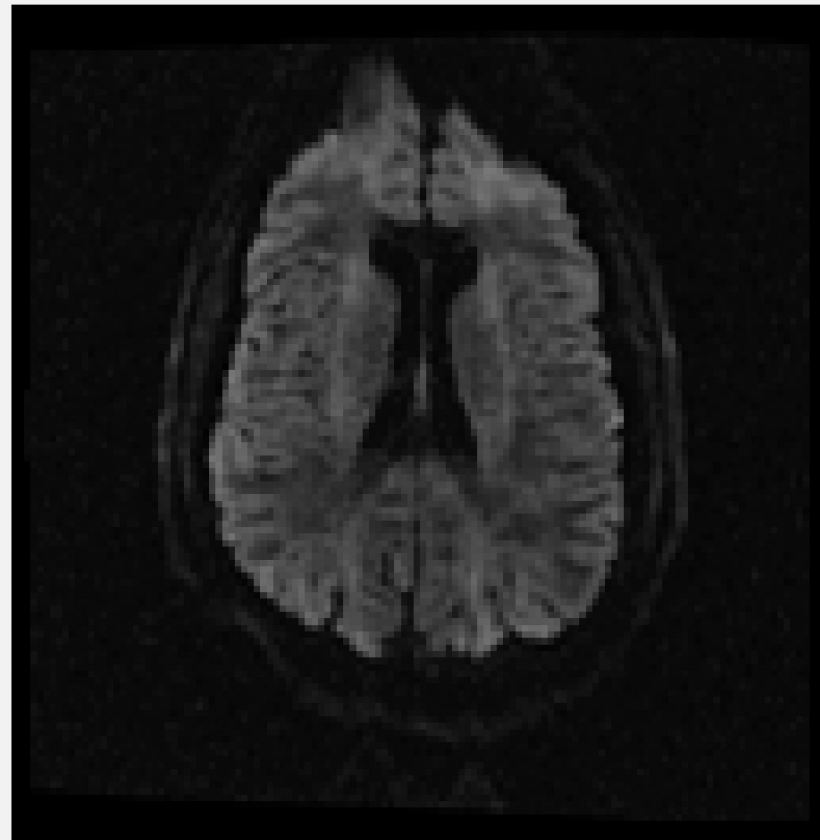
EPI R1 Acquisition (Windowed)

R=1
25.6-cm FOV
60 slices
2-mm iso resolution
128x128 matrix
TE = 42.0ms



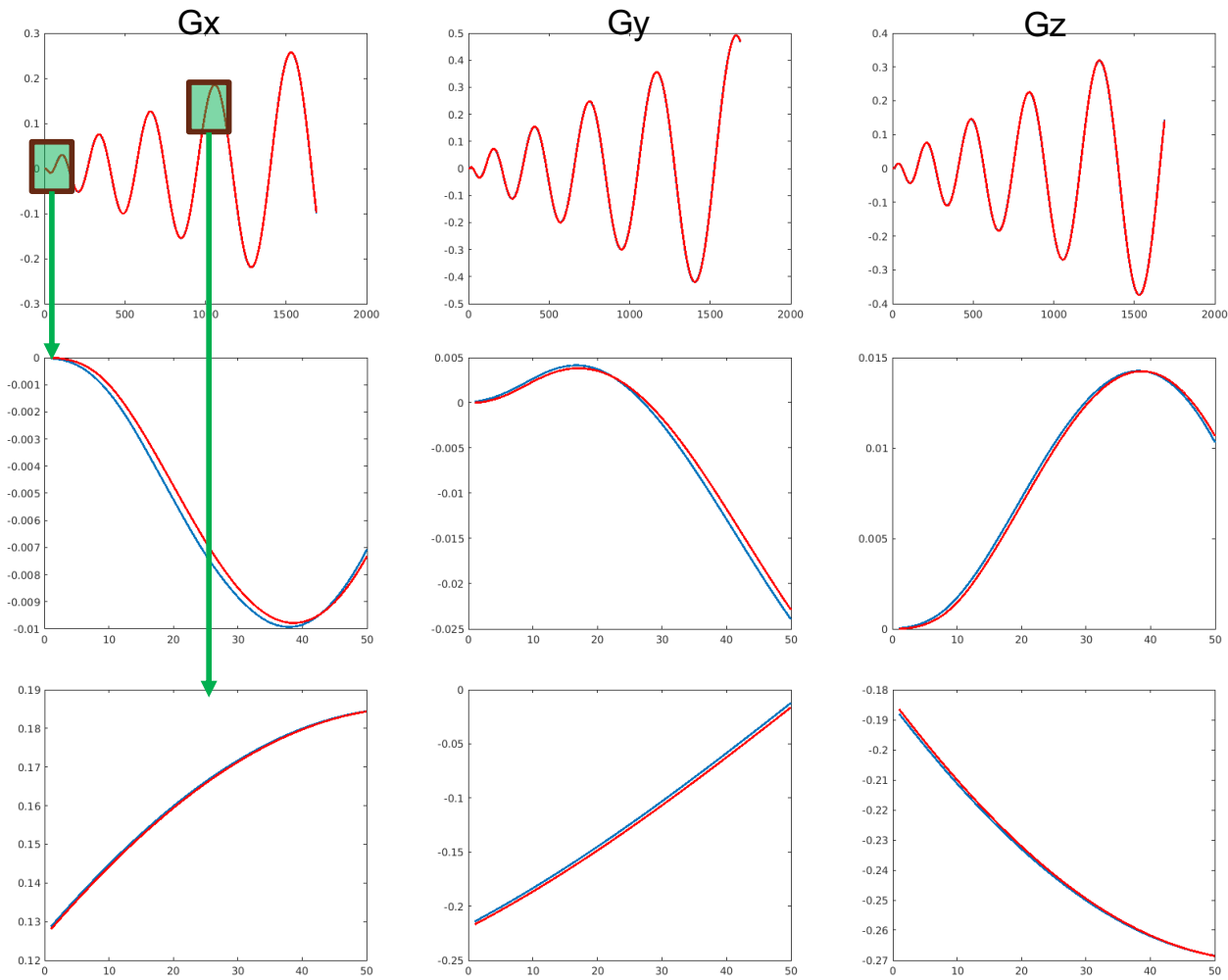
DWI R1 Acquisition, Diffusion Weighted Volumes

GE reconstruction without B0 correction

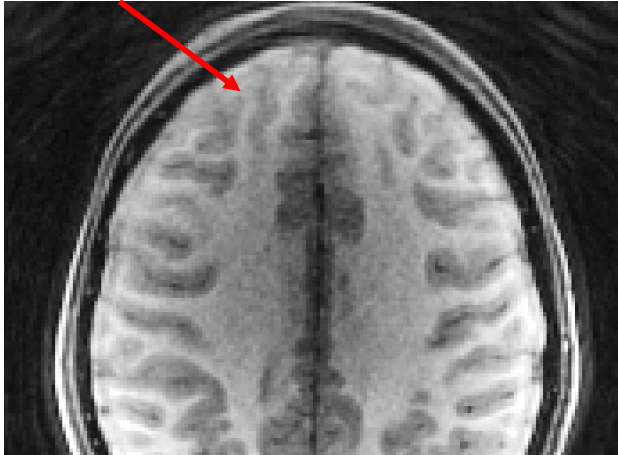


Skope reconstruction with B0 correction

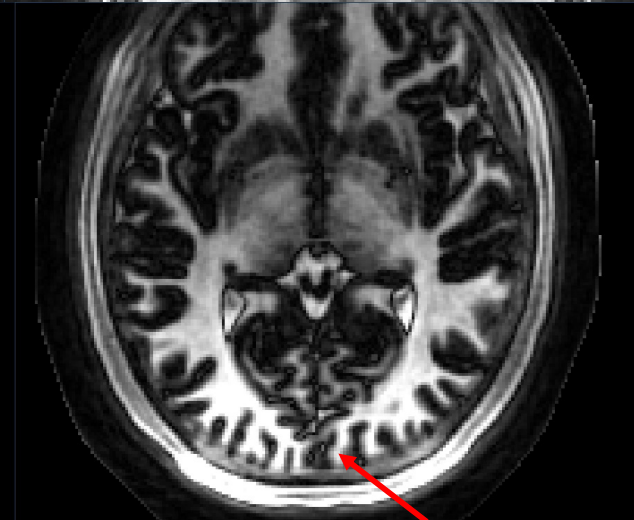
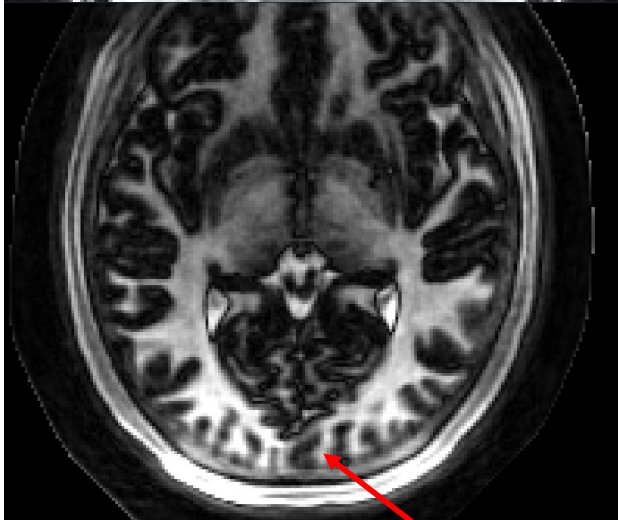




Recon using nominal trajectory



Recon using measured trajectory



NUFFT

Subspace
reconstruction with
locally low rank

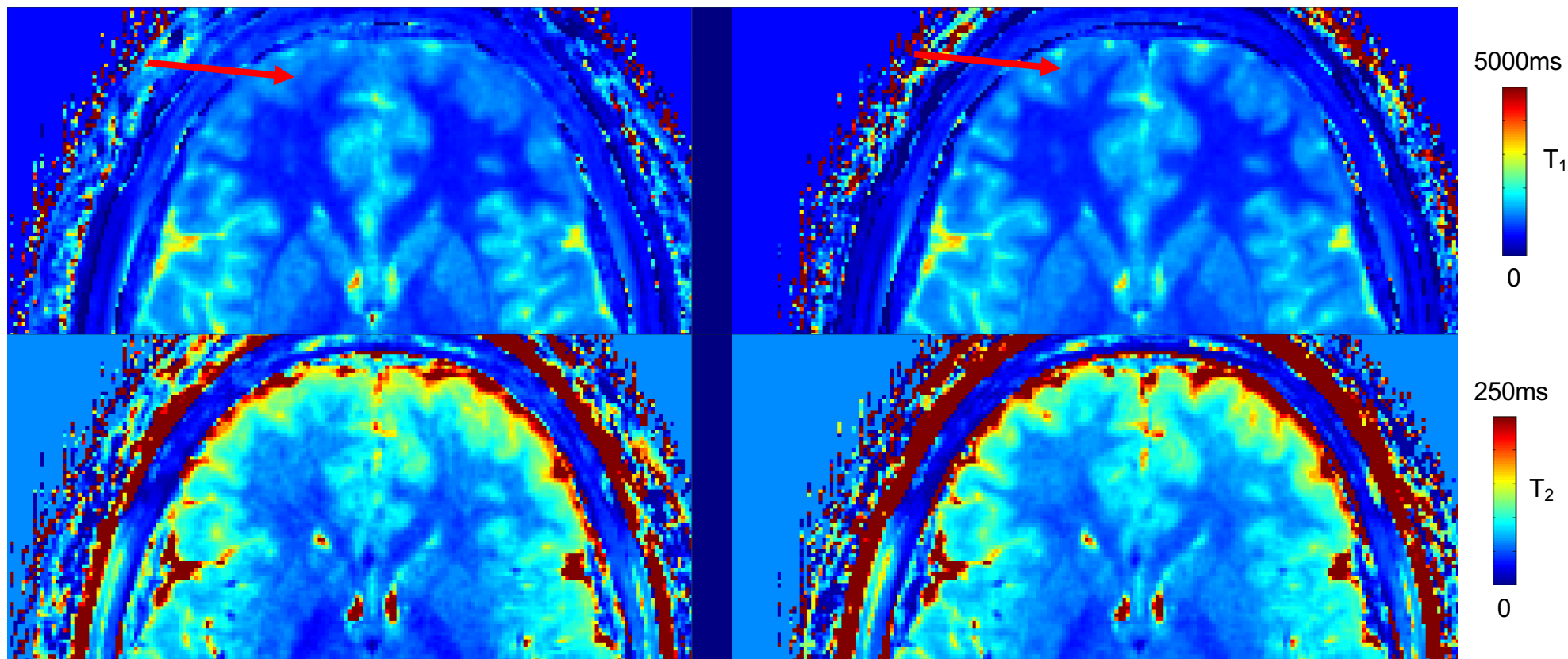


Max slew rate: 100 T/m/s
Max gradient amplitude: 30 mT/m

Resolution: 1-mm isotropic
FOV: 220-mm isotropic
Acquisition time: 1m 56s

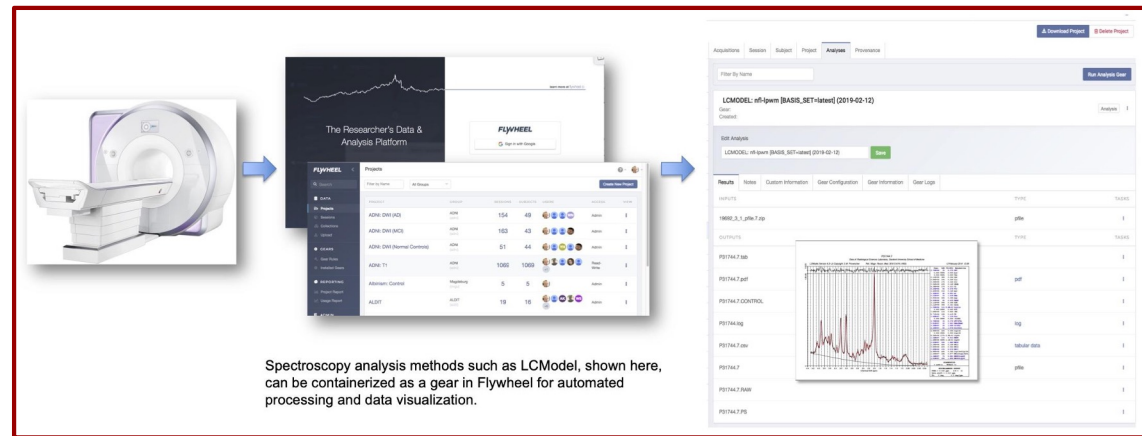
MRF using nominal trajectory

MRF using measured trajectory



Technology – Spectroscopy

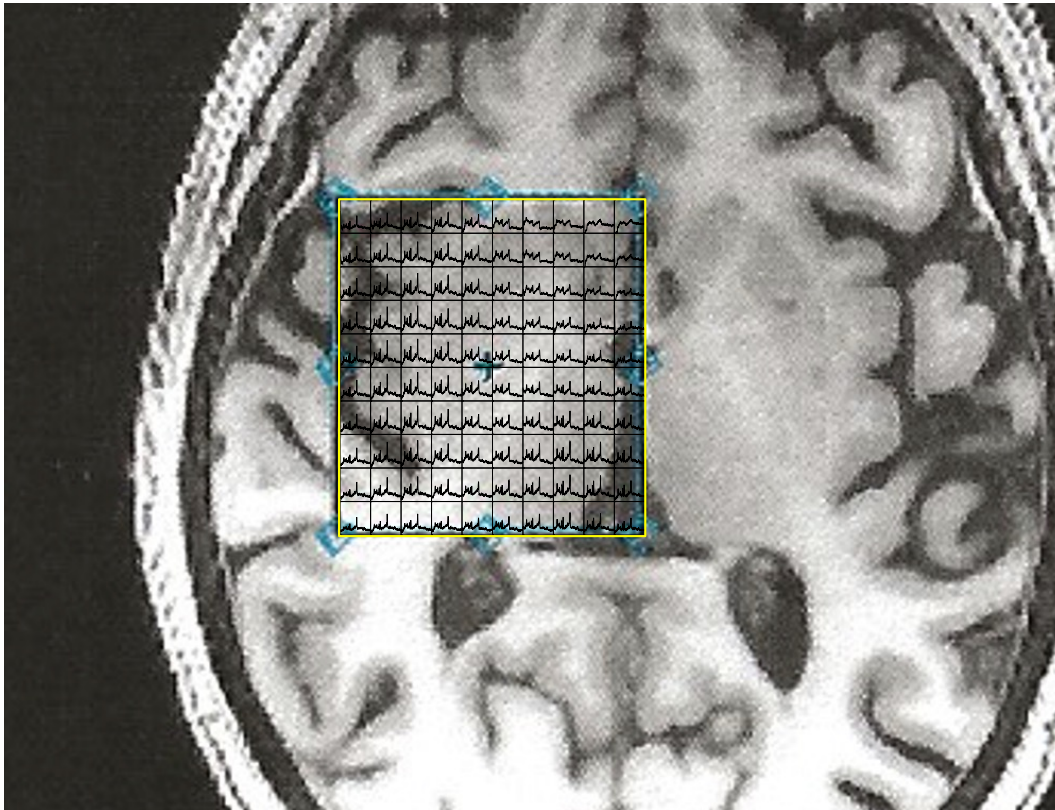
Interest in measuring metabolic changes via MRS techniques and combining that information with functional MRI measurements continues to grow. CNI continues to support the research of its user community by providing state of the art data acquisition and data processing techniques in spectroscopy.



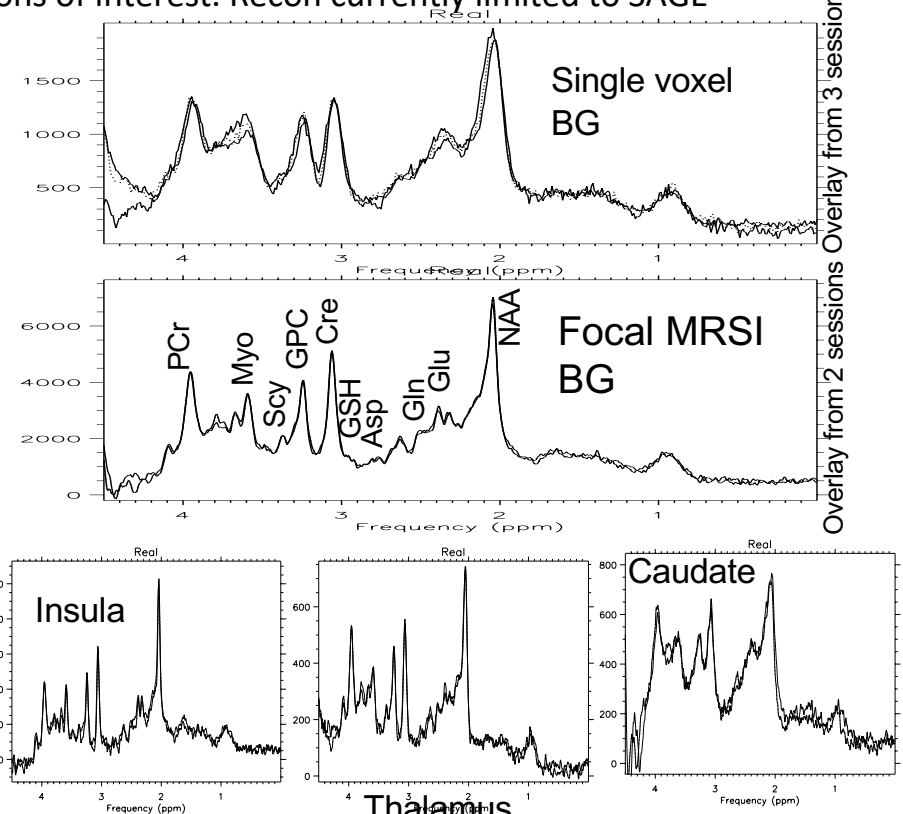
<i>Spectroscopy Sequences</i>	<i>Measured Metabolites</i>	<i>Analysis Methods</i>
MEGA-PRESS ¹	GABA+, Glx (Glutamate, Glutamine)	Gannet ²
IM-SPECIAL ³	GABA, Glu (Glutamate), Glx	Sequence specific Matlab code
Optimized-PRESS ^{4,5,6}	All metabolites	Sequence specific Matlab code, LCModel fitting ⁷
semi-LASER ^{9,10,11,12,13}	All metabolites	Sequence specific Matlab code, LCModel fitting ⁷

Technology – Spectroscopy

GE WIPs (s-Laser sequence) allow focal MRSI acquisitions. Application to difficult Basal Ganglia region demonstrates improved repeatability plus the flexibility to separate different BG regions of interest. Recon currently limited to SAGE



CNI



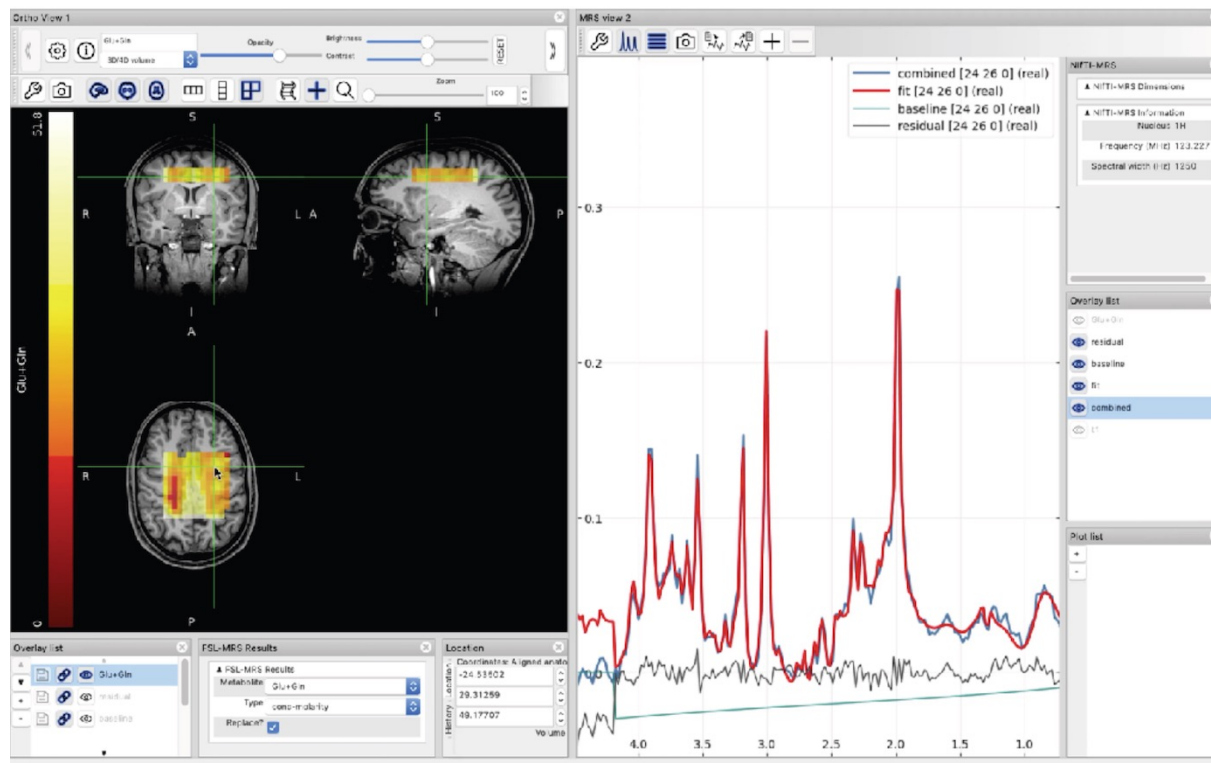
Overlay from 3 sessions

Overlay from 2 sessions

Stanford University

Technology – Spectroscopy

Spectroscopy data processing capabilities for single voxel and MRSI are currently being evaluated for optimally combining open-source processing packages such as FSL-MRS (using FSLeaves (MRS plugin)) with Flywheel gears.



Technology – Spectroscopy

- CNI Spectroscopy resources
 - Spectroscopy Wiki page (literature references, data acquisition and data processing tools) https://cni.stanford.edu/wiki/GABA_spectro
 - Spectroscopy special interest group meetings
 - to support CNI users with ongoing spectroscopy projects
 - to evaluate and implement new spectroscopy methods for data acquisition (example: GE WIP's) and processing (example: FSL-MRS) particularly in challenging areas of the brain
 - Contact Laima if you'd like to find out more

Technology – Compute & Data Resources

- NIH management plans require *keeping data for as long as useful to research community*
 - All acquired data preserved in Flywheel in an appropriate repository
- Increasing compute demands
 - Increasing load on Flywheel reaper
 - Increasing demand for offline reconstruction capabilities
- Plan for new servers
 - Funded by C-ShARP service center refreshment grant
 - New Flywheel reaper expected by December
 - Massively powerful compute server order in preparation

Managing New Technologies

- CNI is an open-door environment :-)
- We invite groups to request meetings with CNI to review existing protocols and workflow
- As new technologies come on board we'll announce via CNI blog, Slack and host targeted user meetings
- Please share info and questions on our Slack channel



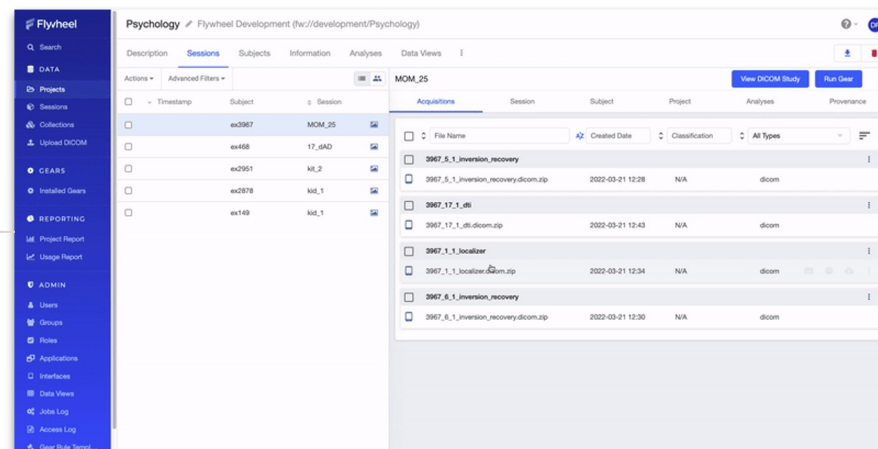
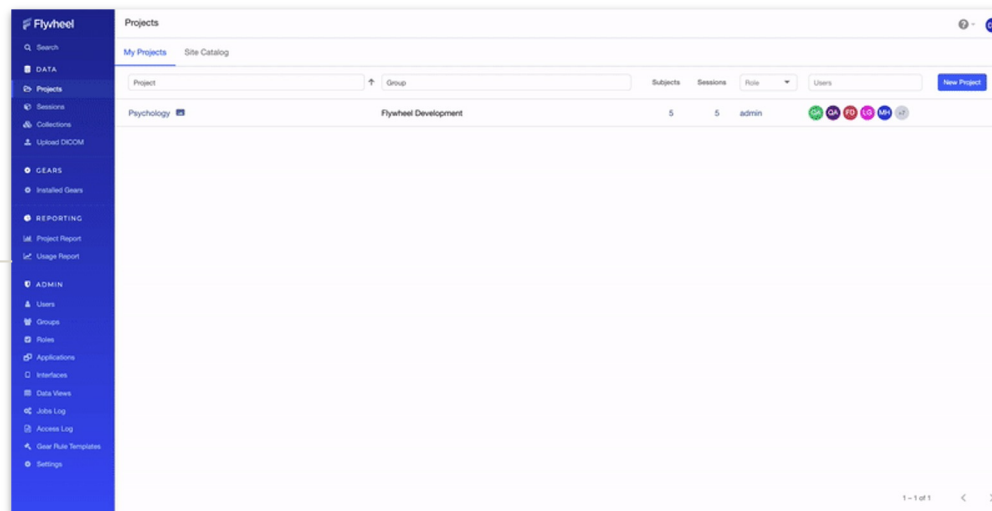
Welcome to 16.10!

Upgraded Wednesday 10/12

- At CNI: some issues have been noted. Initial site slowness, issues with analysis gear outputs. FW team is working to remedy.

New features include:

- Project Catalog [\(doc\)](#)**
 - Projects with re-usable data can be found and shared
- File enhancements**
 - Rename Files
 - Change file type
 - Move files across containers
- Site wide Jobs Log [\(doc\)](#)**
 - Now YOU can see your jobs all in one place
- Data Views [\(doc\)](#)**
 - Filtering, Grouping, Aggregation





Project Catalog [\(doc\)](#)

- Projects with re-usable data can be found and shared
- By default, your project is not shared on the catalog
- In order to share it, a user with the right permissions must go into project “Settings” and “Project Sharing”
- There they can toggle sharing “on” or “off” and add pertinent catalog details for their project
- Multiple options are presented for users to easily navigate to projects of interest in the catalog
- Can be used with Smart Copy to provide a “zero-footprint” copy of project to another group.

The screenshot displays the Flywheel web application interface. The top navigation bar includes 'Psychology' and 'Flywheel Development (fw://development/Psychology)'. The left sidebar contains a navigation menu with sections like DATA, PROJECTS, REPORTING, and ADMIN. The main content area shows a table of sessions with columns for Timestamp, Subject, and Session. Below this, there is a modal window for 'Project Sharing' settings. The modal includes a toggle for 'Share in Site Catalog', a 'Catalog Project Summary' section with a 'Copy Existing Project Description' button, and several input fields for project details: Institution Name (ACME University), Institution URL (https://acmeu.edu), Contact Name (John Doe), Contact Email (johndoe@acmeu.edu), Therapeutic Areas (Neurology), Body Regions (Head), and Organ Systems (Brain, Nervous System). The modal also has 'Reset' and 'Save' buttons.



Jobs Log Page [\(doc\)](#)

- Previously this was an administrator task... now every user can manage their jobs
- Any user can manage their jobs
 - View logs
 - View inputs
 - View outputs
 - Download files
 - Cancel running jobs

GEAR NAME	USER	GROUP	PROJECT	SUBJECT	SESSION	CREATED	COMPLETED
dicom-mr-classifier v1.3.2	System	Jeff	DRtestimages	Bloom_subj_001	MX_Baby_US_2	2022-08-09 14:39	2022-08-09 14:39
dicom-mr-classifier v1.3.2	System	Jeff	DRtestimages	Bloom_subj_001	MX_Baby_US	2022-08-09 14:35	2022-08-09 14:35
stress-test v0.0.14	System	Finn	GE Test	Testimage5	Image5	2022-08-09 10:00	
dicom-mr-classifier v1.3.2	System	Finn	GE Test	Testimage5	Image5	2022-08-09 10:00	2022-08-09 10:00
awesome-gear v0.1	ryansanford@flywheel.io	RyanS Group	rts scratch all	sub1	ses1	2022-08-09 09:29	
analysis-rule v2.3	System	jengroup	Jen-GearTesting	jensubject	jensession	2022-08-02 09:20	
dcm2nix v1.3.0_1.0.20201102	System	Flywheel	Blind_Reader	S004	07-19-08 12_00 PM	2022-08-02 08:02	
dicom-mr-classifier v1.3.2	System	Jeff	DRtestimages	Sub_neosoma_01	MR (Native & Registered)	2022-08-01 06:41	
dicom-mr-classifier v1.3.2	System	Jeff	DRtestimages	Sub_neosoma_01	MR (Native & Registered)	2022-08-01 06:40	
dicom-mr-classifier v1.3.2	System	Finn	GE Ultrasound	Patient 2	Day 10	2022-07-29 16:38	2022-07-29 16:38
dicom-mr-classifier v1.3.2	System	Finn	GE Ultrasound	Patient 2	Day 10	2022-07-29 16:25	2022-07-29 16:25

Information Configuration Log

Information

Gear: dicom-mr-classifier System User

Job Created: 2022-08-09 14:35

Job Completed: 2022-08-09 14:35

Group: Jeff

Project: DRtestimages

Subject: Bloom_subj_001

Session: MX_Baby_US

Acquisition: Ultrasound

Tags: auto, dicom-mr-classifier

Inputs

File Name: Actions

Mexico Baby 1.zip 1

Outputs

This job does not have any outputs.



Lab Edition Upgrade

Increased functionality

- Upload, manage, and analyze retrospective data
- Analyze data directly in Flywheel via Gears
 - Gear Exchange Access
 - Data provenance
 - Reproducibility
 - Cloud scalability
- Run analyses locally and store outputs directly in Flywheel for secure, permissions-based sharing
- Develop and upload custom Gears

Available to groups at Stanford at discounted rates

- [Contact](#) Flywheel for more information and pricing

CNI

Flywheel Core

Powering Your *Imaging Research*

Streamline multimodal data capture, curation, processing, and sharing with a scalable data management platform. Flywheel delivers tools that dramatically improve efficiency and service, helping core facilities differentiate their expertise and ensure reproducibility.

Enable improved data security, efficiency and productivity

Flywheel is a biomedical research data platform that streamlines data capture from multiple sources, curates it to common standards, automates processing and machine learning pipelines, and provides for secure collaboration with internal and external partners.

Flywheel's comprehensive data management platform offers tools for:

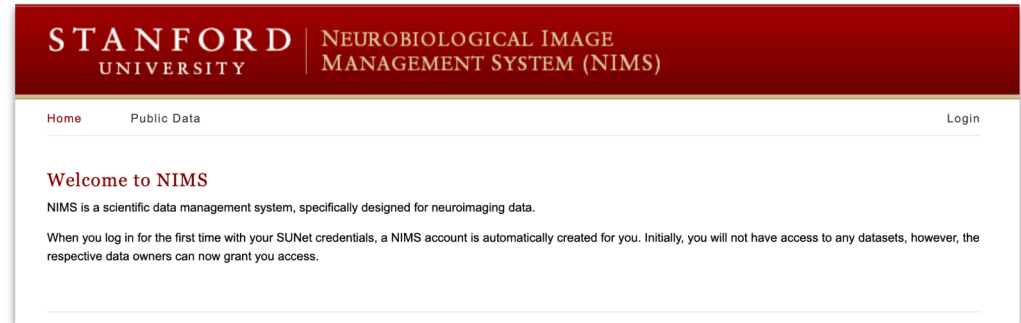
- Efficient data capture**
 - Automated DICOM & raw data capture
 - PACS and VNA integration
 - Integrated de-identification
- Quality, consistency and reproducibility**
 - Automated pre-processing & pipeline execution
 - Data quality controls
 - BIDS curation and apps
 - Comprehensive provenance
- Findable and reusable data**
 - Automated metadata indexing to enable search
 - Secure collaboration
 - Efficient cohort creation

Stanford University



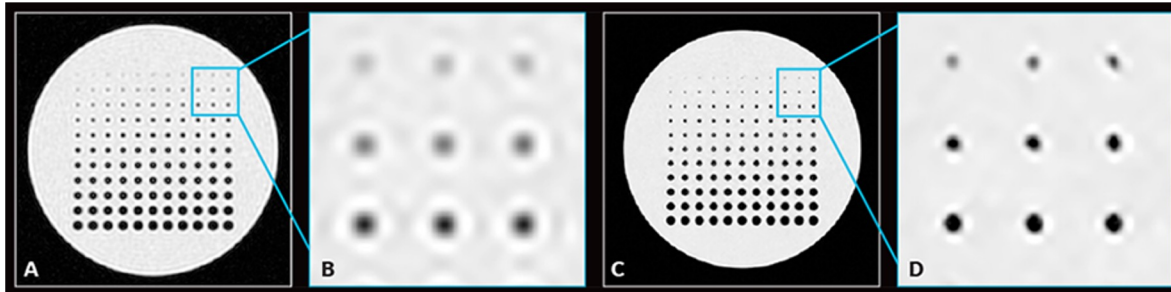
NIMS DATA

- Over the years we have migrated the majority of the data from our legacy image management system - NIMS
- If your group has data on NIMS you would like migrated on priority to Flywheel please reach out to Michael Perry
- NIMS will eventually be retired, though our goal is to transfer (almost) everything

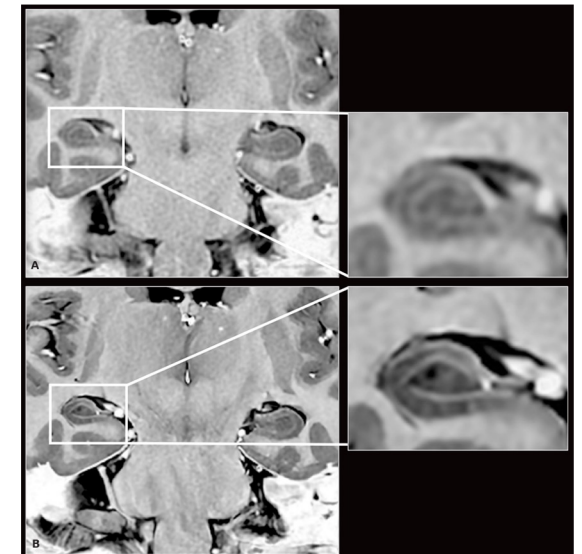
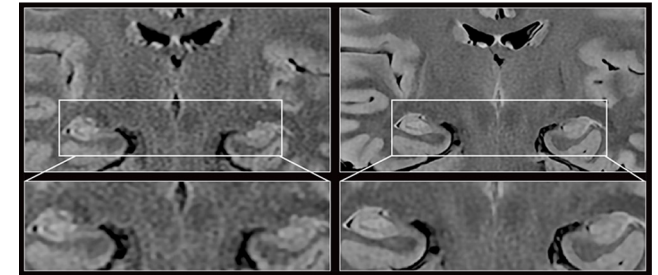


GE System Upgrade

- Will move from RX28 to RX30 Q1/2023
 - New ICN (Image Compute Node) with significant GPU resources to support deep learning applications
 - System will support AIR Recon DL
 - Deep-learning based convolutional neural network for denoising and image sharpening
 - Possibility new hardware will come in advance



CNI



Stanford University

C-ShARP RFP & Experiential Learning Grant

- Community of Shared Advanced Research Platforms formed 2020
 - Re-imagining shared facilities
 - Bridging Departmental and School boundaries
 - Annual RFP to support service center missions, next RFP due Jan. 2023
- CNI has \$23K grant to support experiential learning in FY23
 - Class tours/demos
 - Class projects using CNI
 - Contact Adam if you are interested in participating

Friendly Reminders

- CNI uniquely welcoming and pleasant research MRI space
 - Use all organizational bins
 - Think wilderness trip – *Leave No Trace*
- Please following scheduling policies
- Respect other group's space / subjects
- Always open to suggestions on how to improve





Questions?