Microstructure – Effect on MRI

(Role Residual Dipolar Dephasing)

Nick Szeverenyi, Ph.D.

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Dept. of Radiology, UCSD

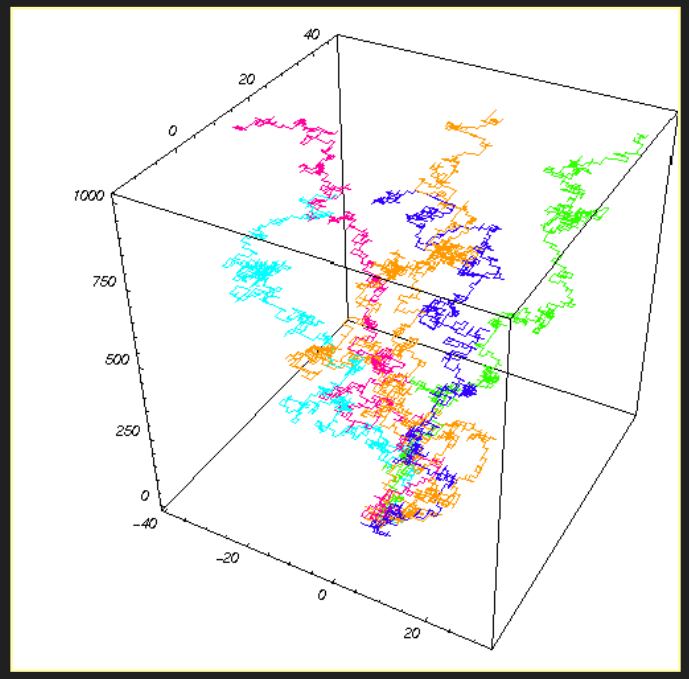
UCSD

Collagen

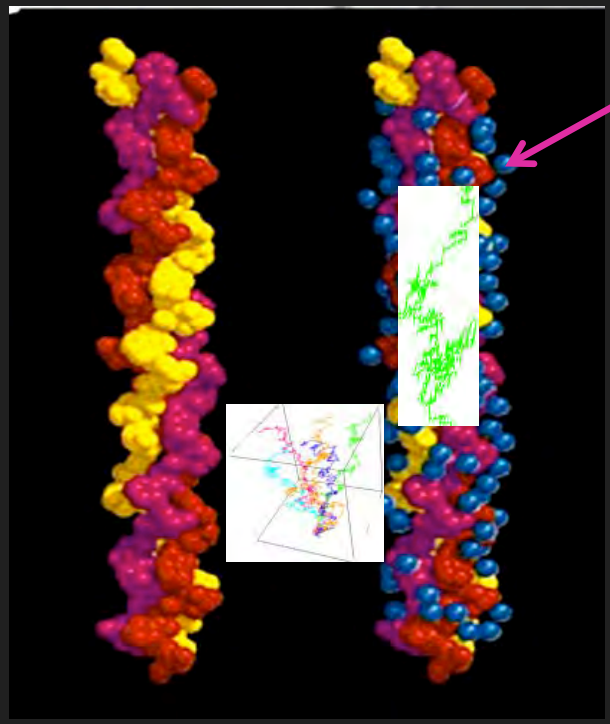
Most prevalent protein in human body

- Tendon
- Meniscus
- Nerves
- Skin
- Liver
- Etc., etc.

Water Motion

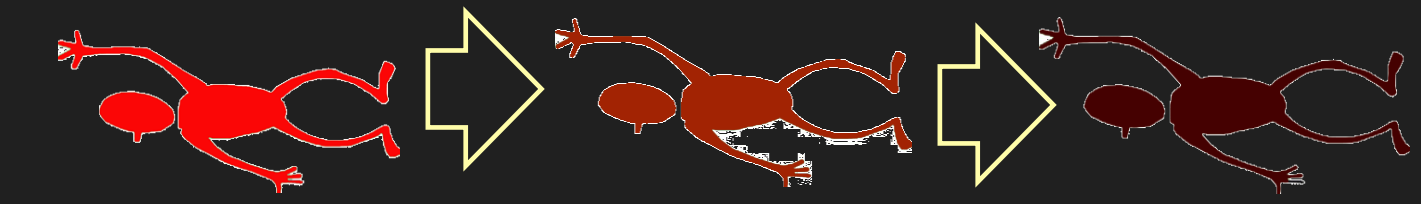


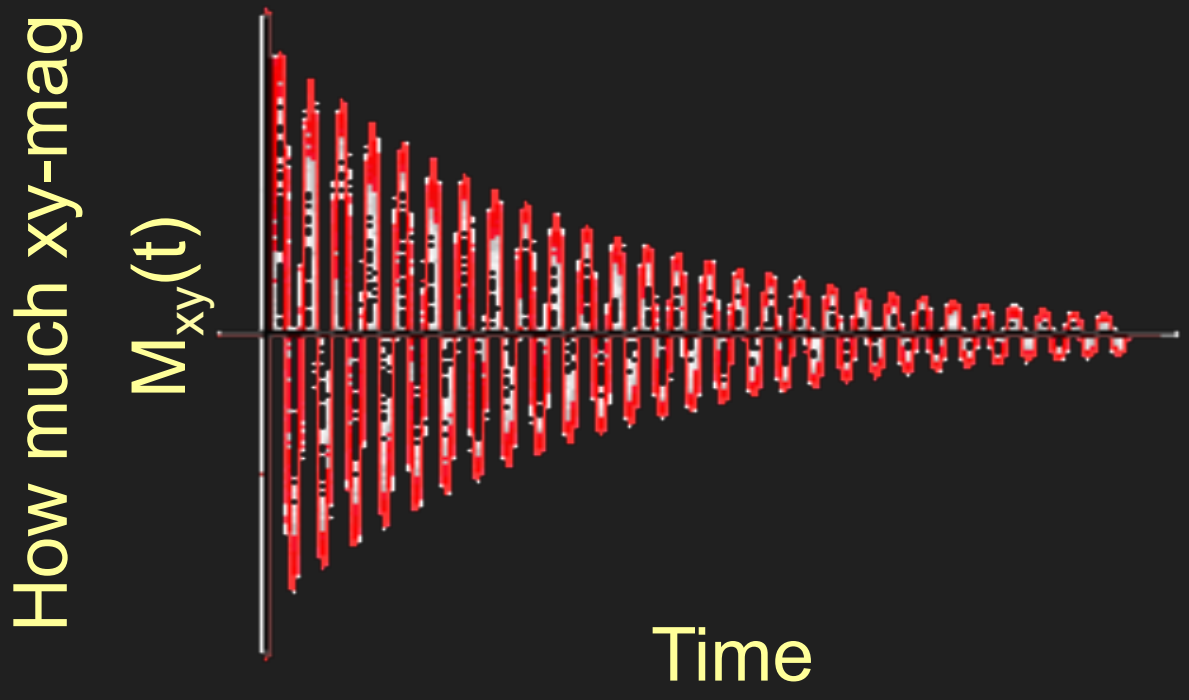
Isotropic liquid



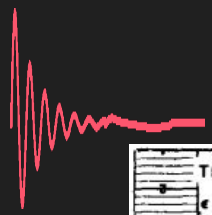
Water trapped in collagen

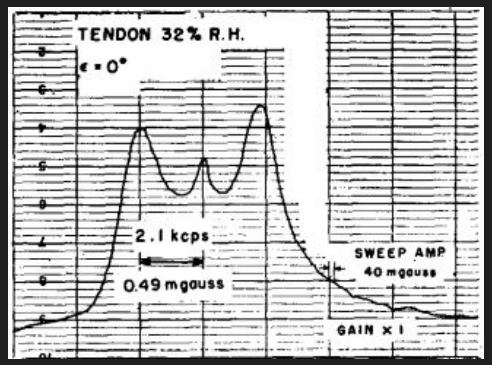
Loss of Coherence = T_2

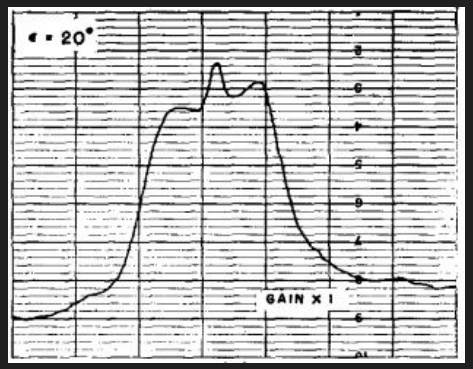


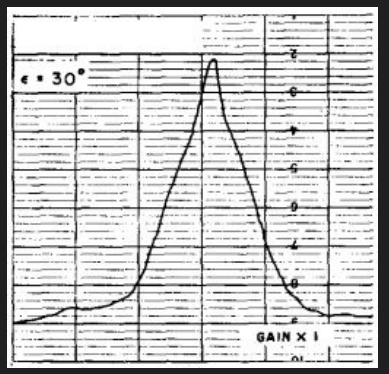


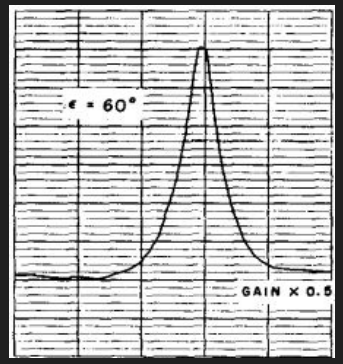
NMR Spectra of Tendon

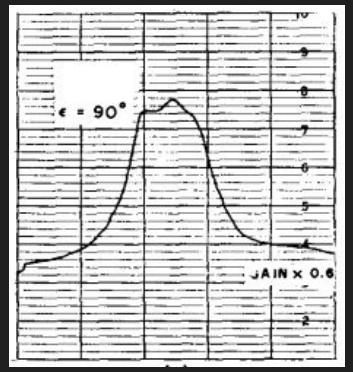


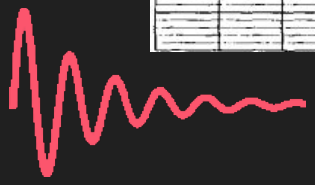








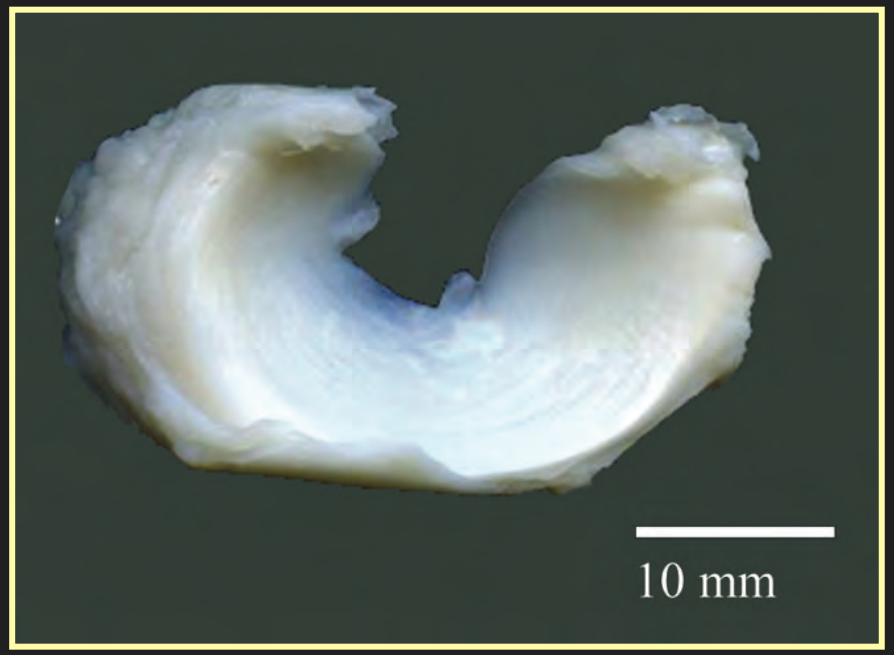


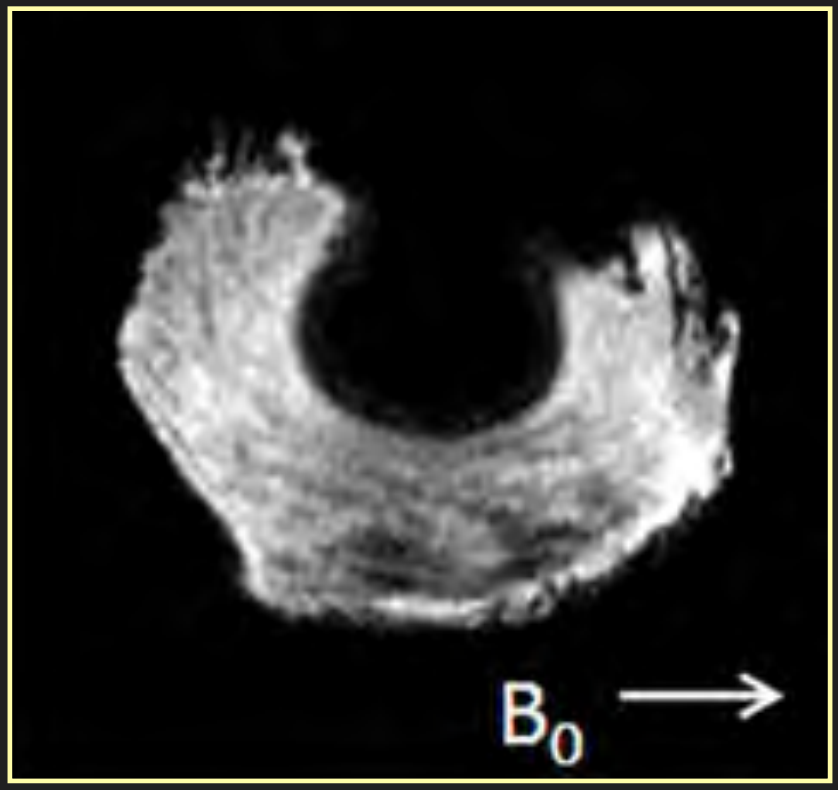


Berendsen H, NMR Study of Collagen Hydration, JChemPhys, 36 3297-05 (1962).

The Magic Angle Effect

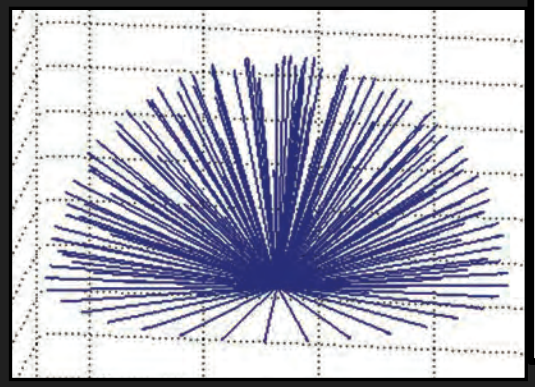
Goat Knee Meniscus
(Fibrocartilage)

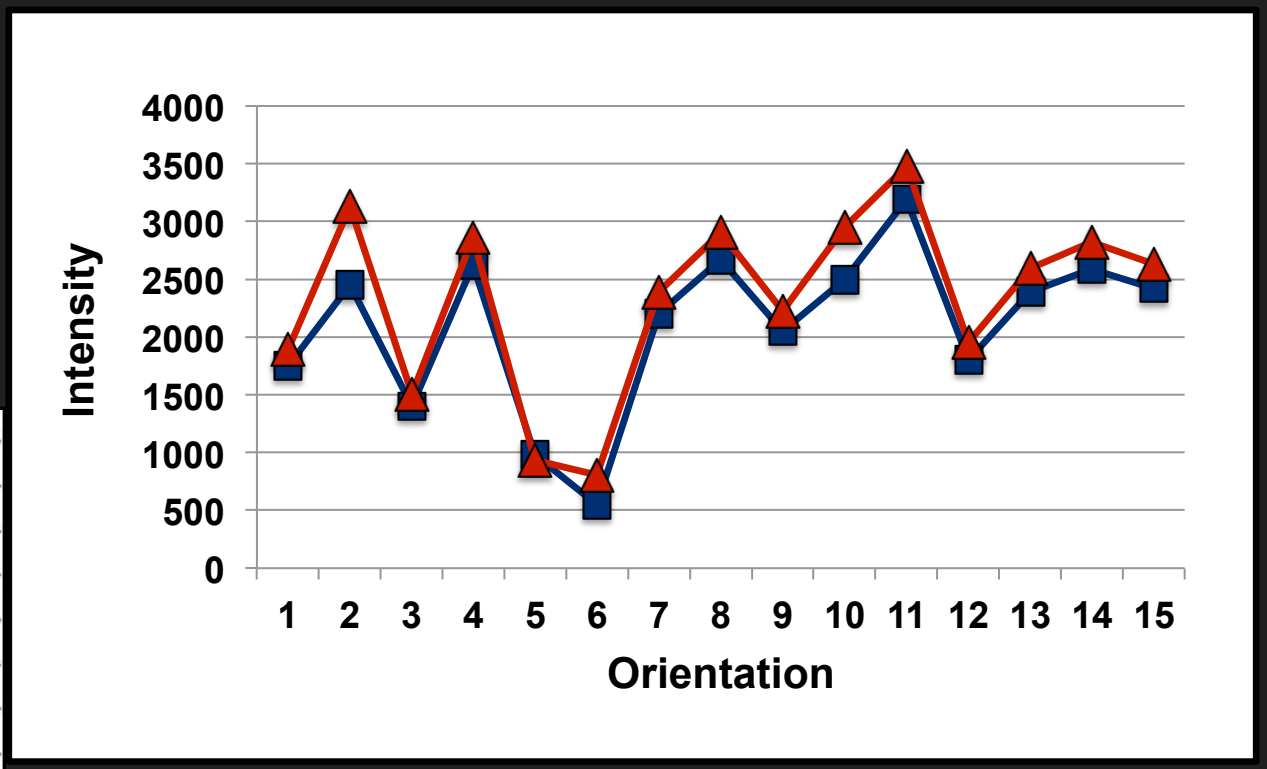




GRE; TE=9 ms

Measure Intensity vs Orientation

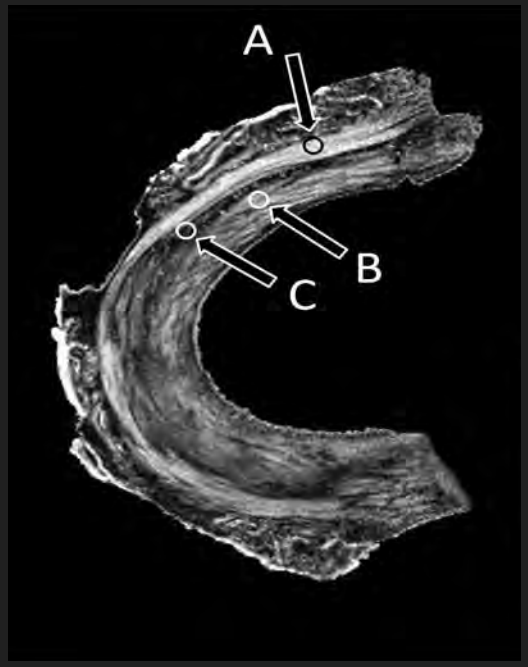




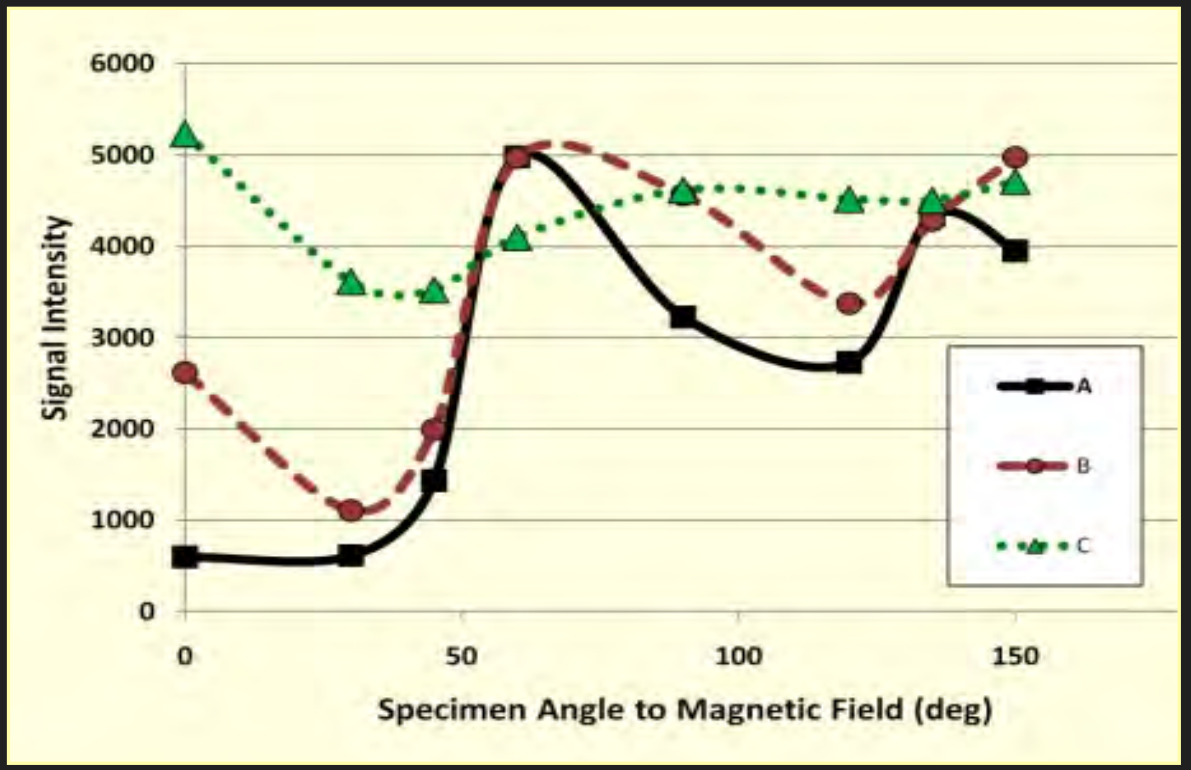
Make MR images with several specimen to field orientations.

Generate Maps

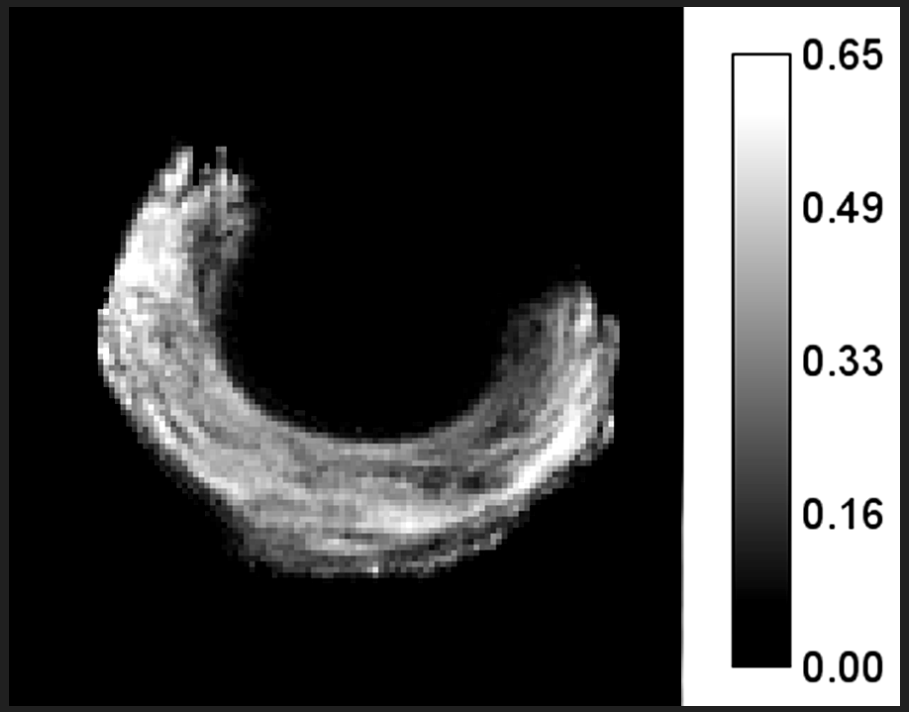
Minimum Intensity



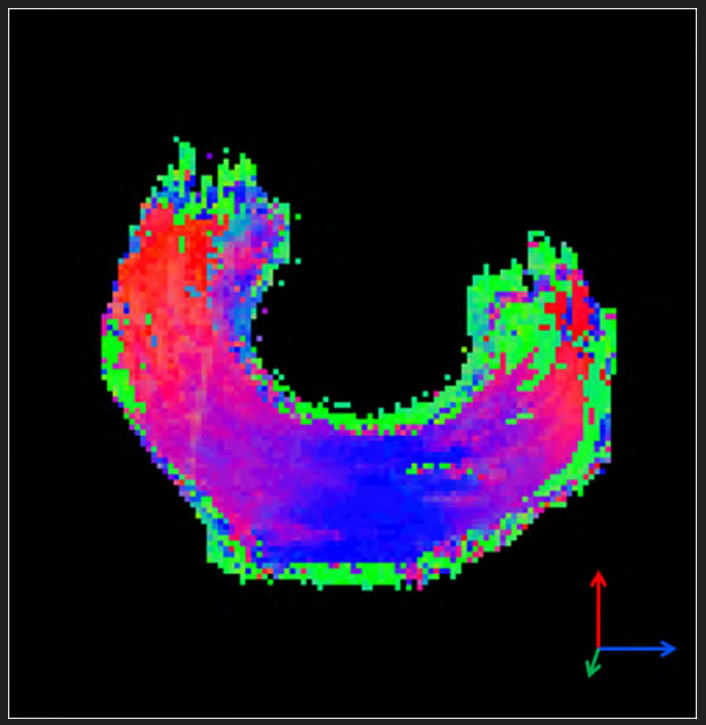
Coefficient of Variation



Input to Fiber Tracking



Standard Deviation Map

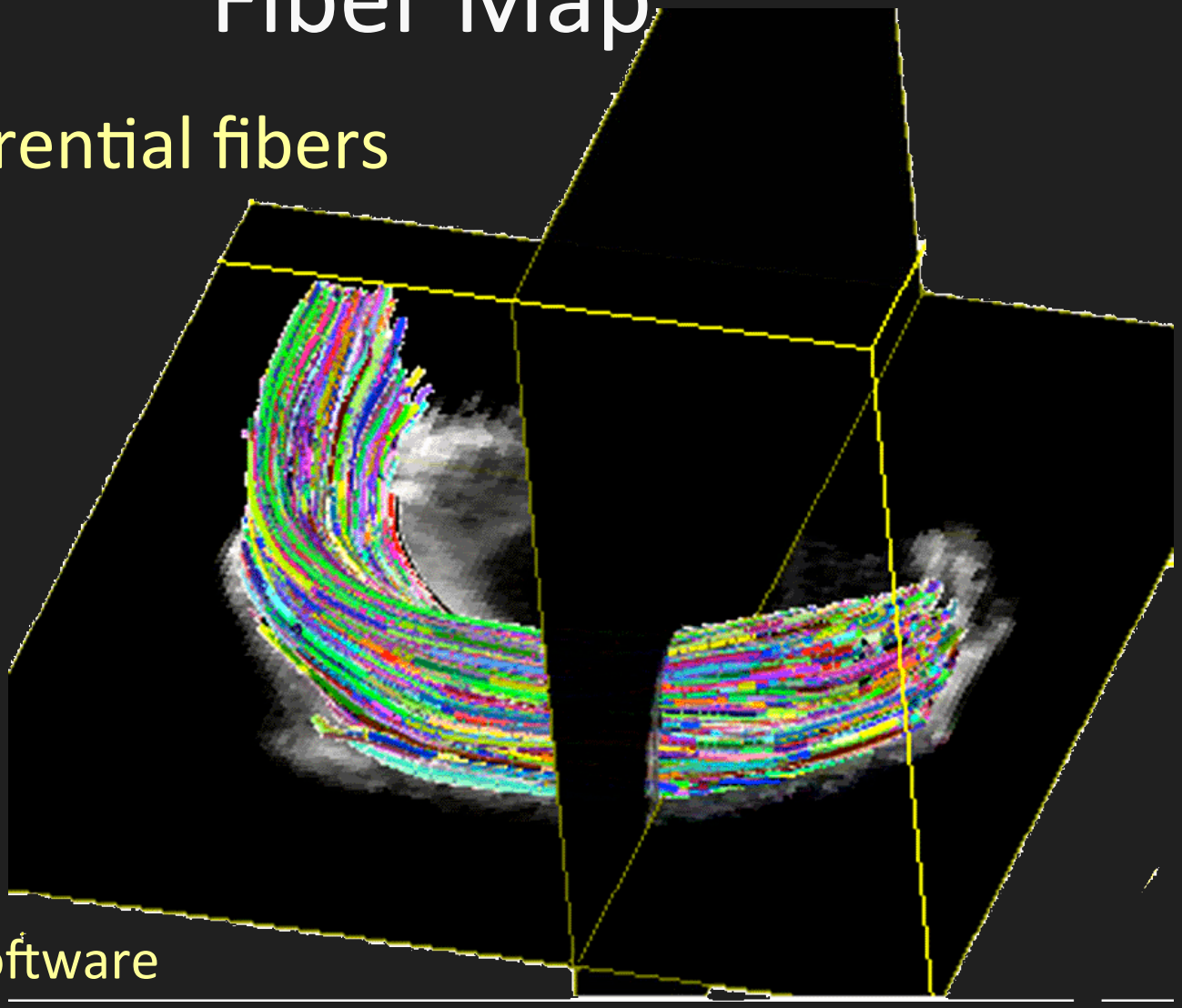


Direction Map

Use these with DTI software (FA and direction maps) to grow fibers.

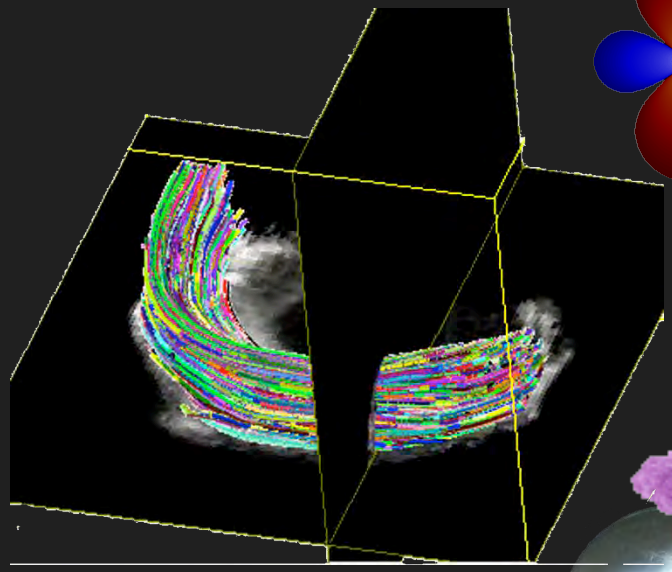
Fiber Map

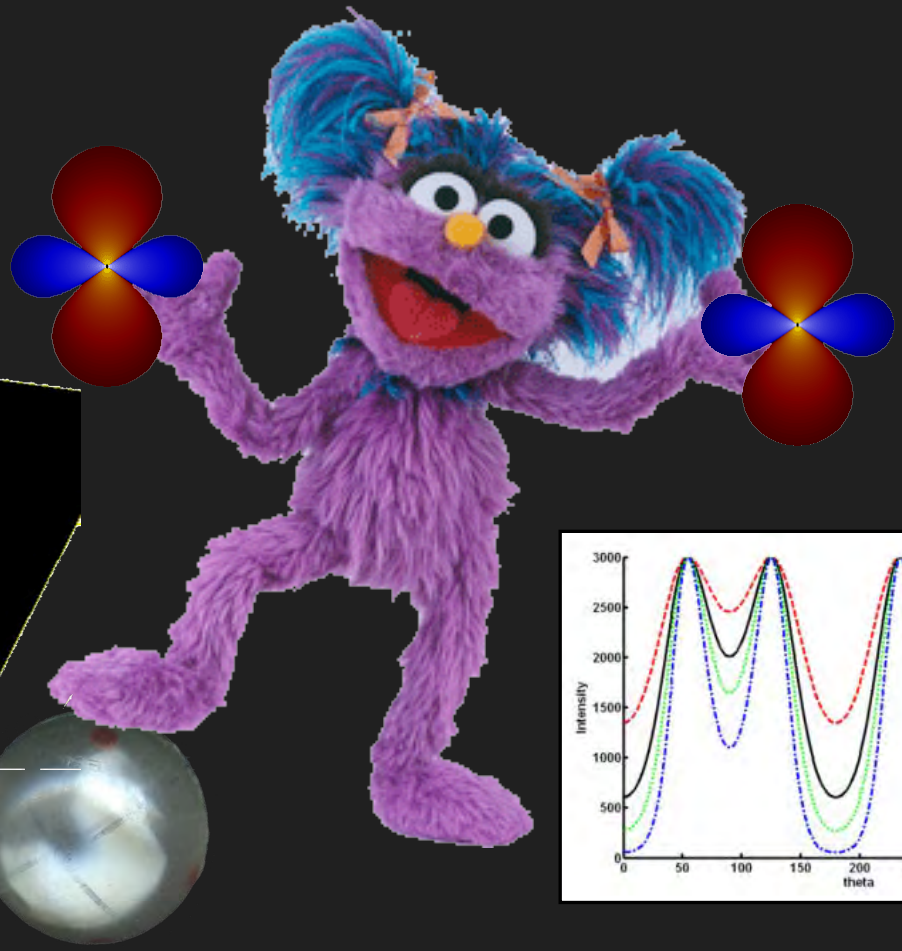
Circumferential fibers



DTI Studio Software
Kennedy Krieger

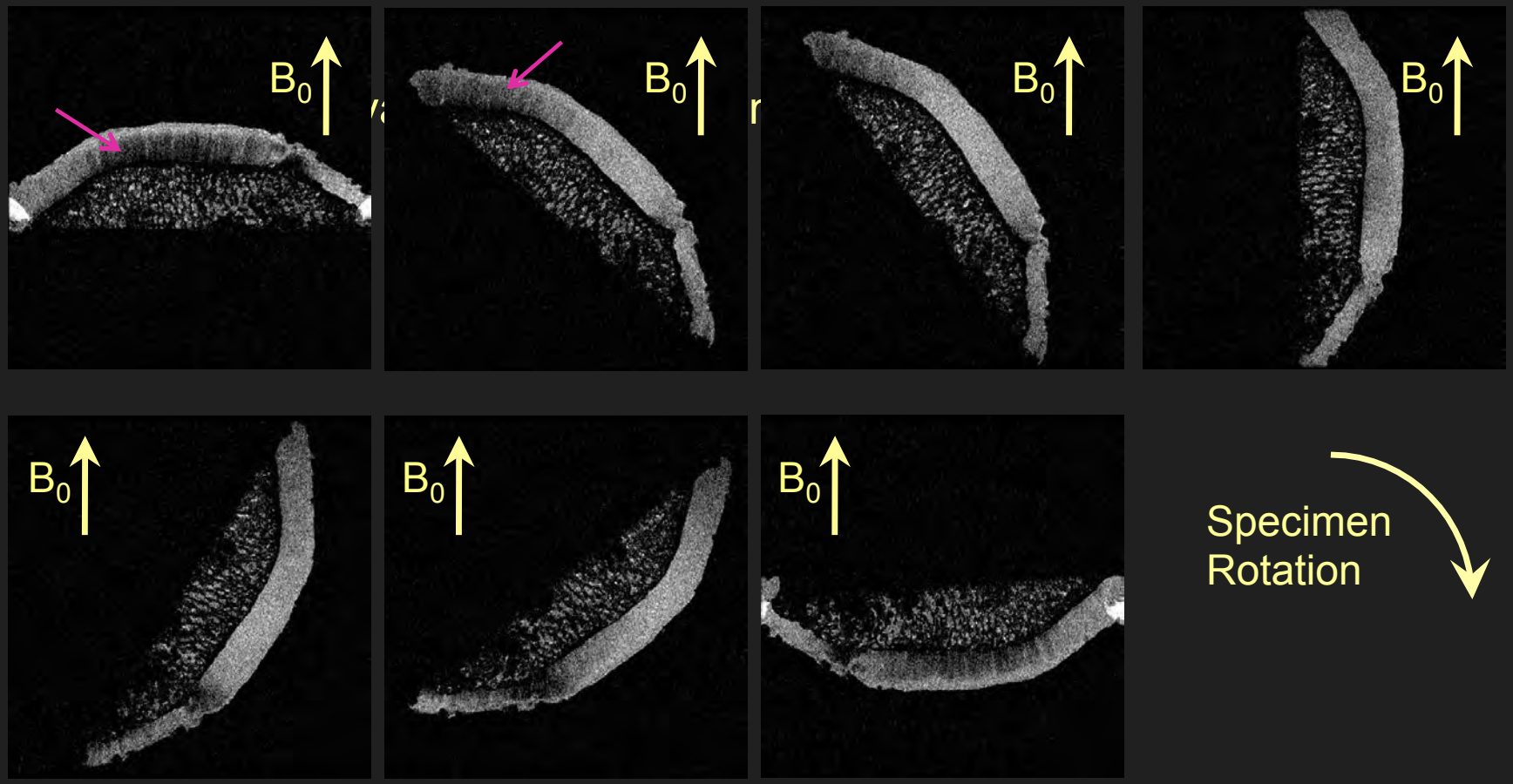
DAFI





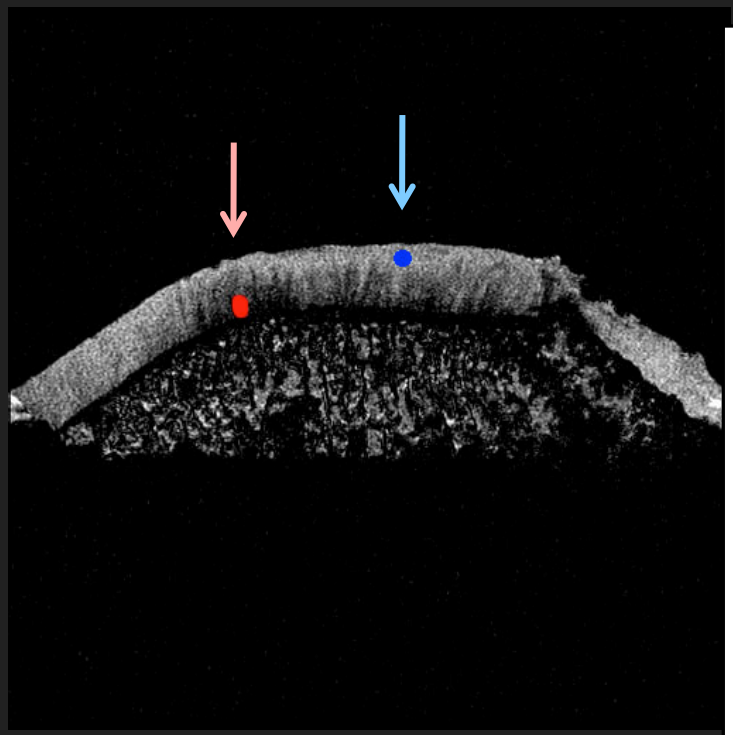
Dipolar Anisotropy Fiber Imaging

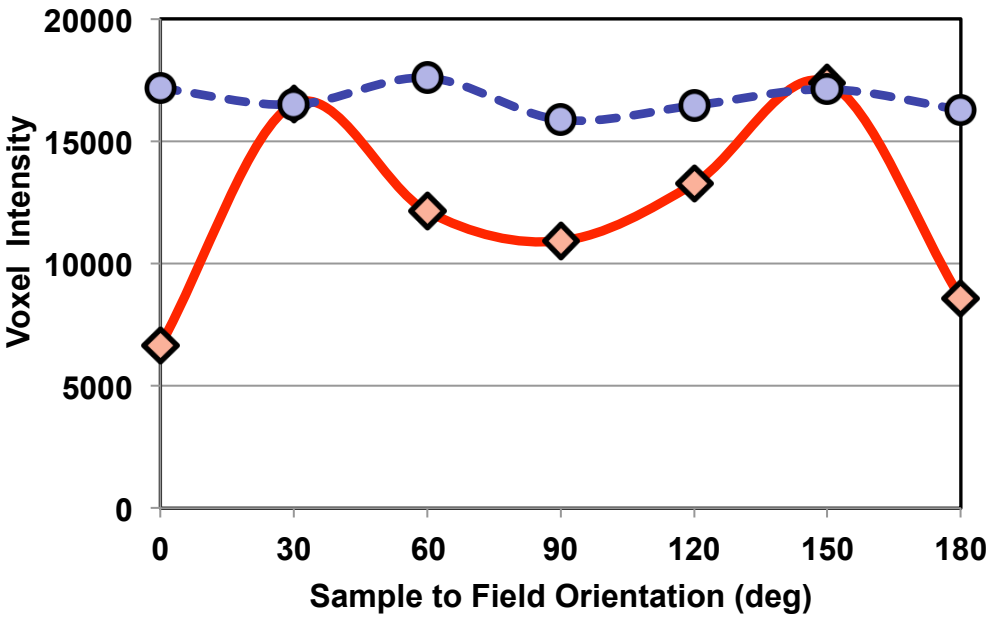
Patella -- Effect of Orientation



Lowest intensity when fibers are parallel to B_0

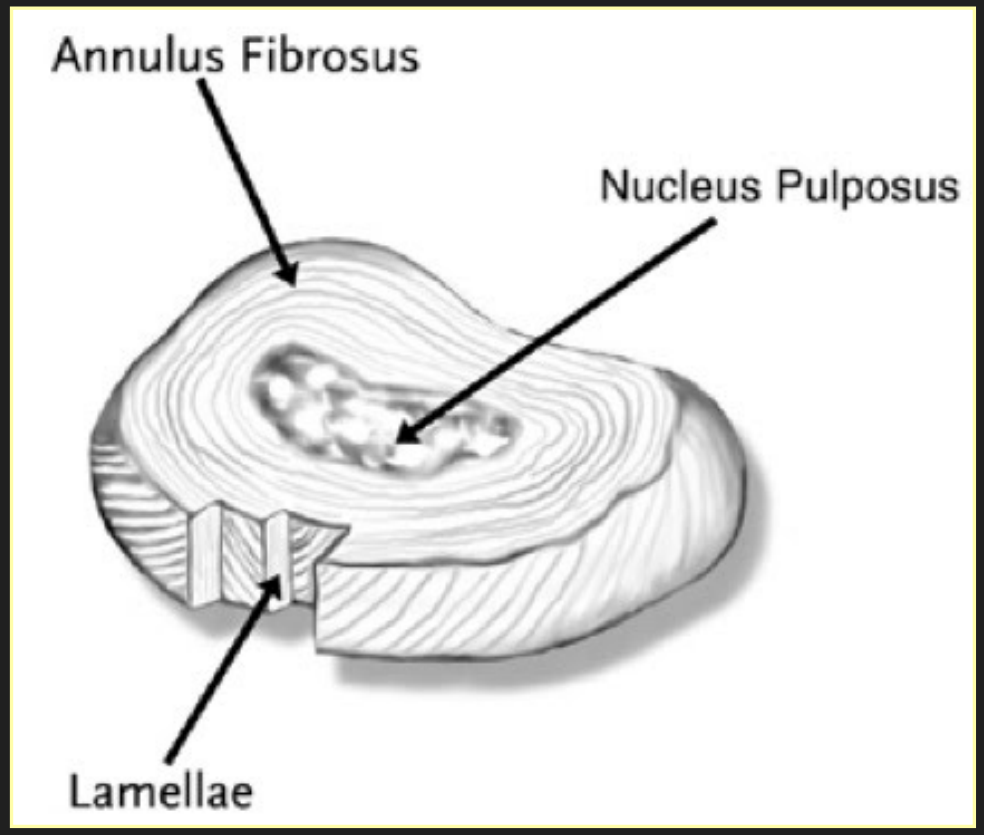
Intensity vs. Orientation





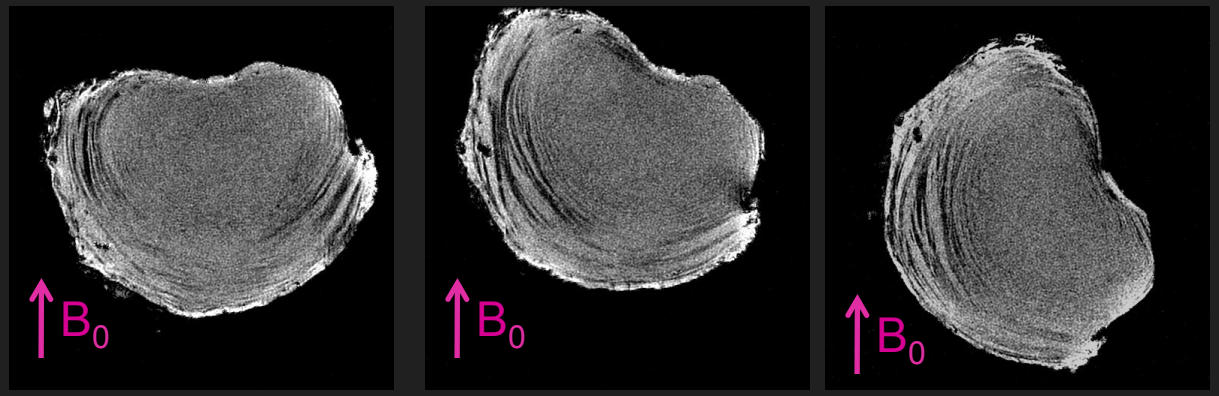
Intensity changes depend on fiber content, direction of fibers and rotation axis.

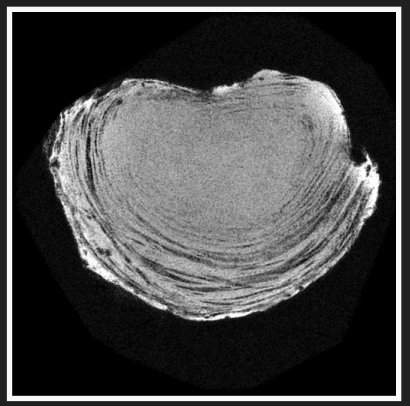
IV Disc



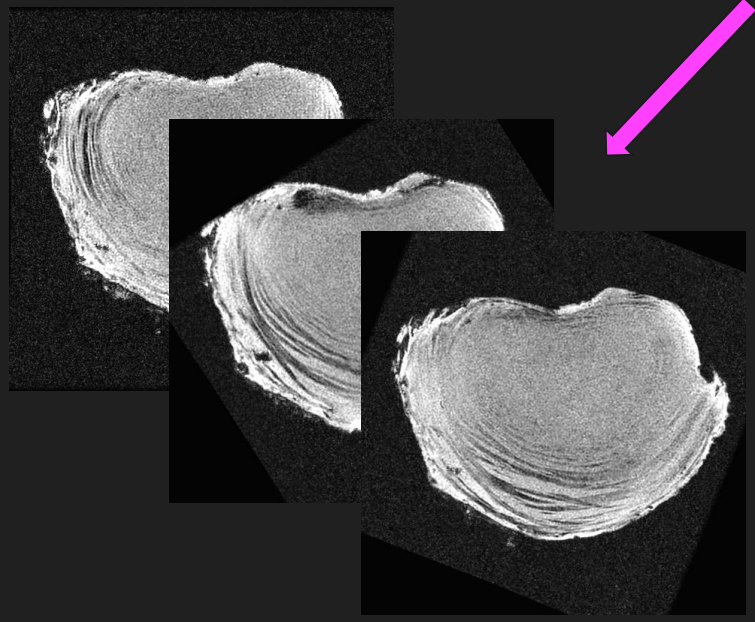
Dipolar Effects in IV Disc

Intensity of a voxel depends on fiber direction relative to B_0



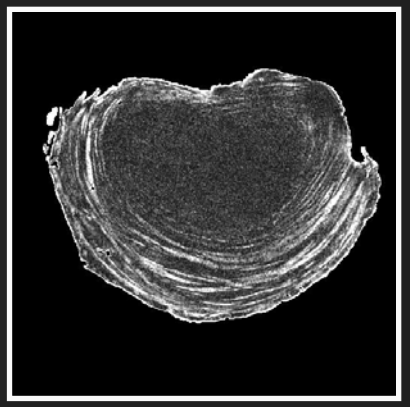


Minimum Intensity



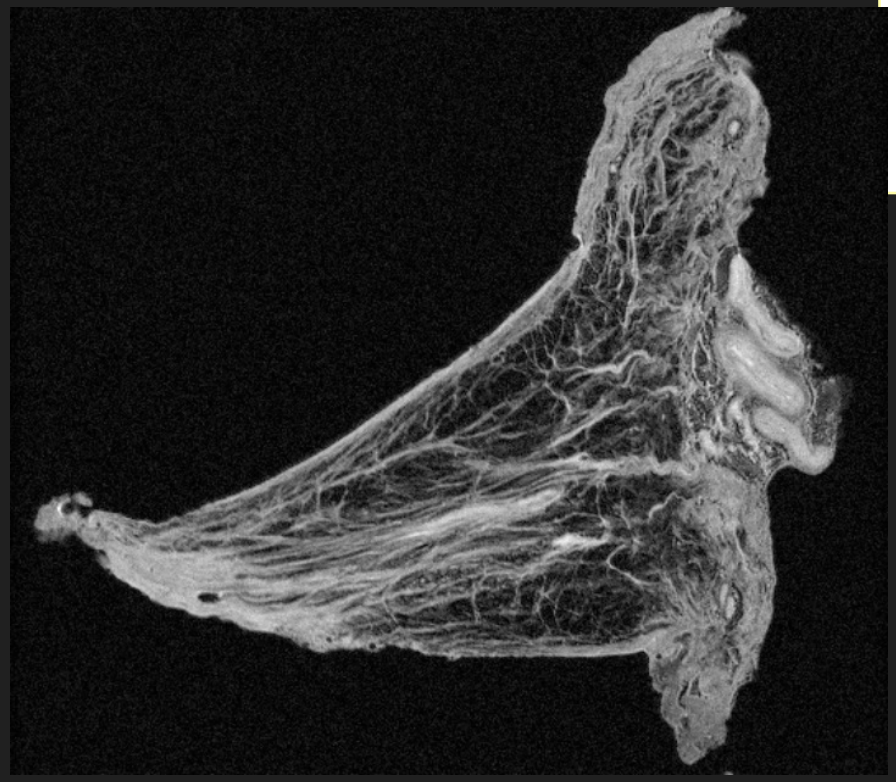
Registration
(FLIRT FSL)

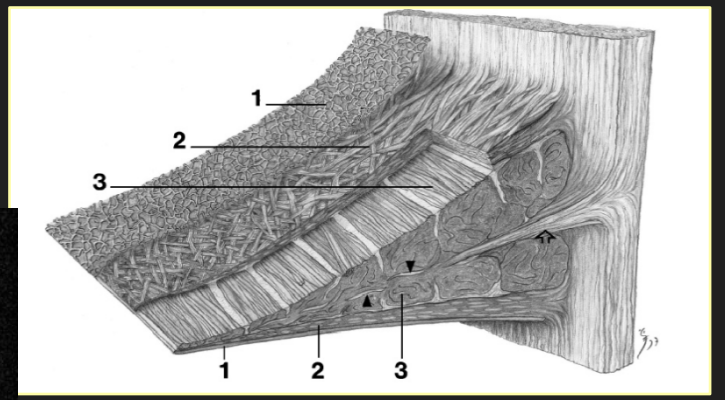
Maps



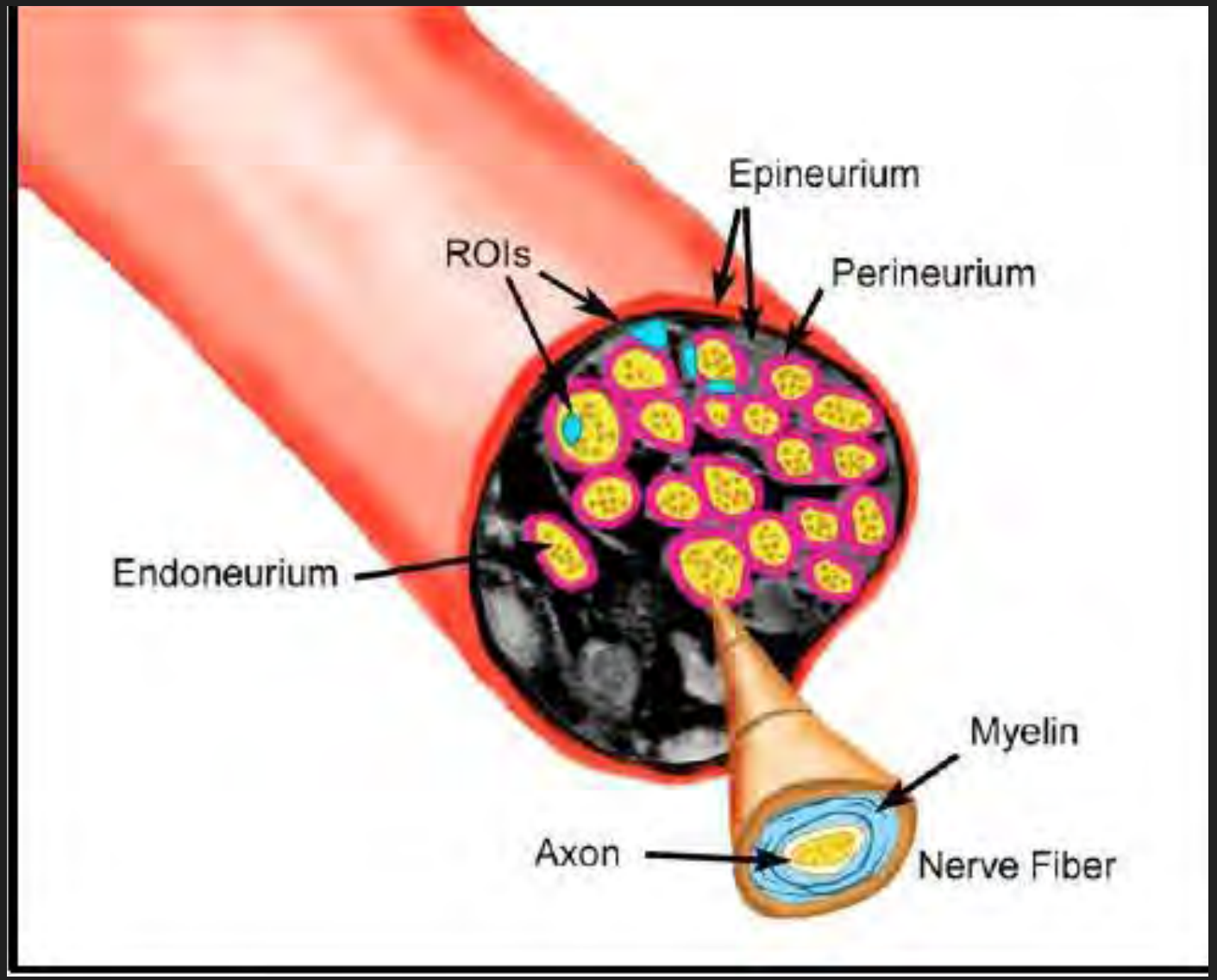
Coefficient of Variation

Meniscus



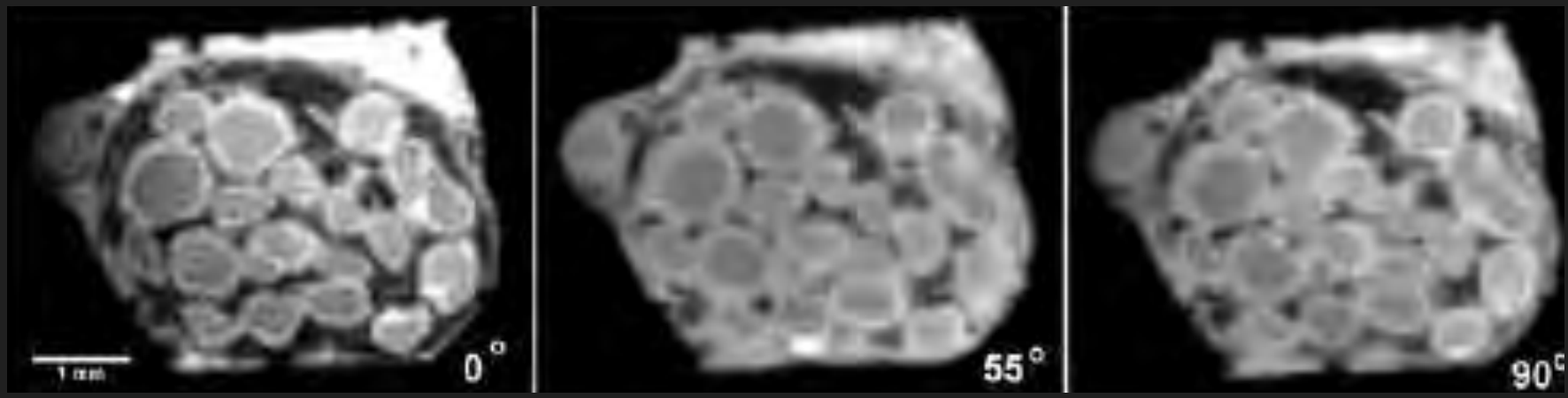


Median Nerve

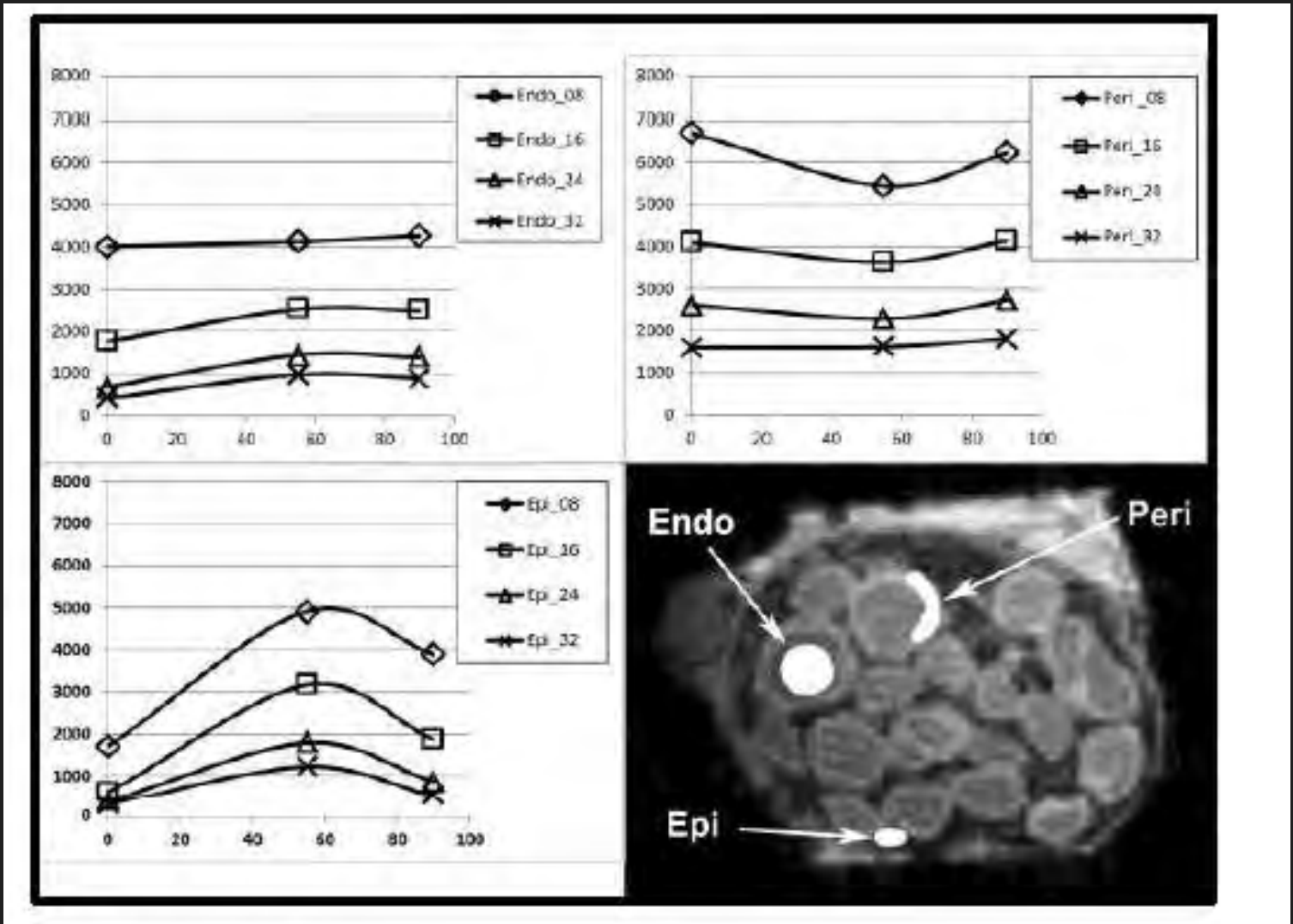


DAFI
(Dipolar Anisotropy Fiber Imaging)

- Various orientations with respect to B_0



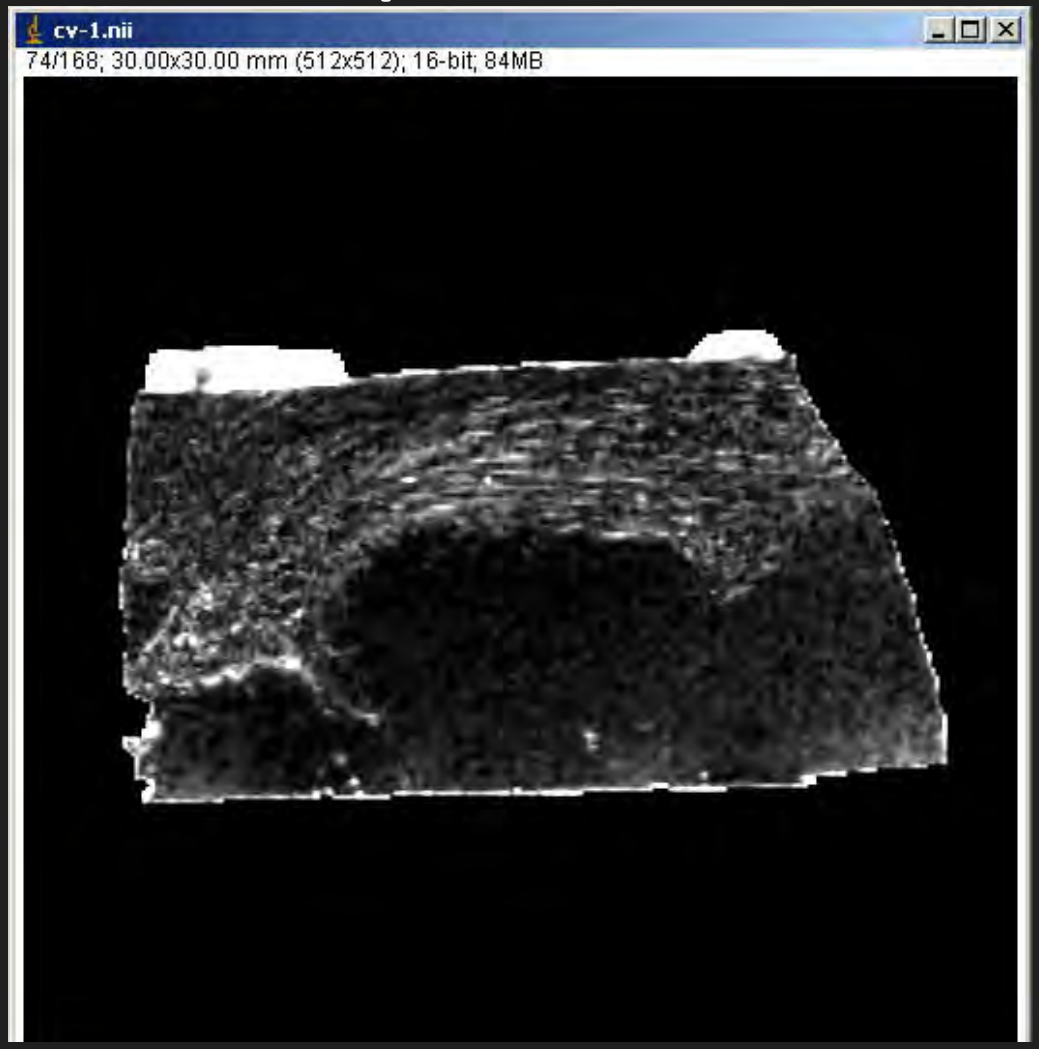
DAFI Results



High Res 3D SPGR

- Three distinct tissues – tumor, boundary zone, normal liver.

CV Map – EOVLEX007



- Based on 6 orientations (30 deg rotations).

Collaborators

Graeme Bydder

Sanford Consortium
(Molecular Imaging Inc.)

Jiang Du
& Group

Christine Chung
& Group

Claude Sirlin
& Group