



# MR Microscopy at the Cellular Level

UF UNIVERSITY of FLORIDA

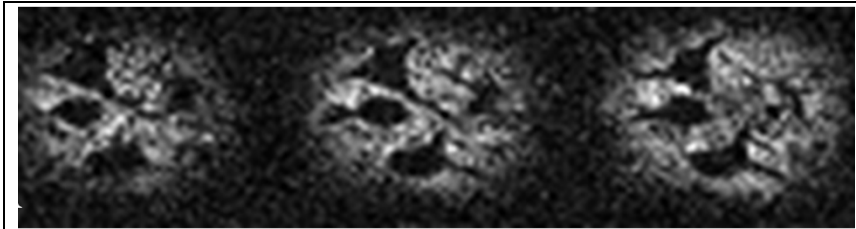
Gregory S. Boebinger, National High Magnetic Field Laboratory

DMR-Award 0654118

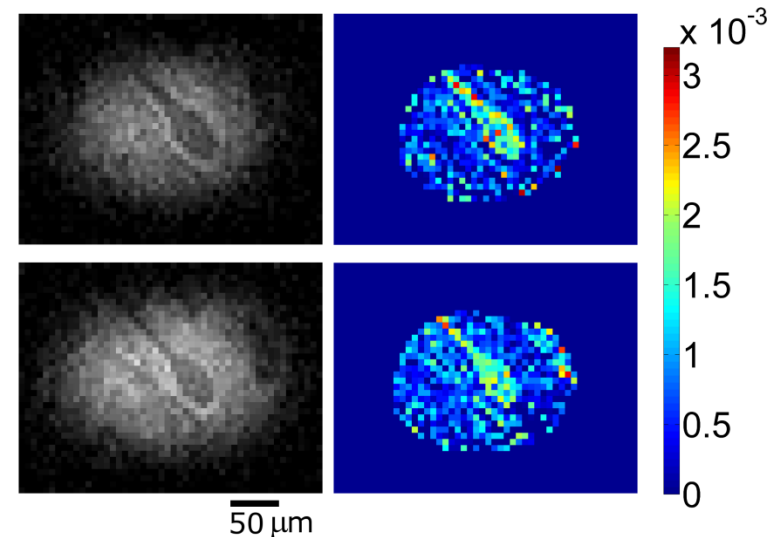
AMRIS Facility, University of Florida

Using newly developed microsurface coils at high fields, we reported the first ever visualization of mammalian cells in the rat brain (1) and followed that work with the first cellular level fiber tract mapping (2). Further, we presented the first quantitative fiber tract mapping at the cellular level in human spinal cord tissue (3). These works have now been extended, generating the first Magnetic Resonance Microscopy visualization of human neurons and their processes in fixed tissue (4). In addition, pig neural tissue, very similar in pathology to human tissue, has also been studied as a more accessible tissue model (Figure 1).

- (1) Flint et al, *Neuroimage* 46:1037(2009)
- (2) Flint et al, *Neuroimage*. 52:556(2010)
- (3) Hansen et al, *Neuroimage*. 57:1458(2011)
- (4) Flint et al, Submitted (2011)



**Figure 1.** Visualization of pig neurons and processes at  $6.25 \mu\text{m}$  resolution.



**Figure 2.** Calculated Apparent Diffusion Coefficient, or ADC, maps (color) of a pig motor neuron from Magnetic Resonance Microscopic images (grayscale). ADC units are  $\text{mm}^2\text{s}^{-1}$ .



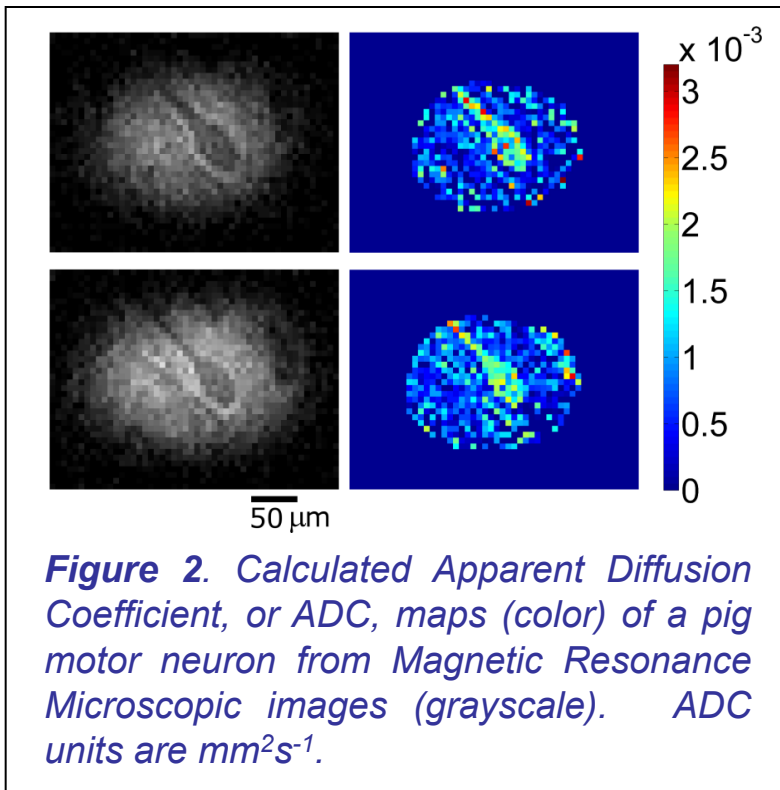
# MR Microscopy at the Cellular Level

UF UNIVERSITY of FLORIDA

Gregory S. Boebinger, National High Magnetic Field Laboratory

DMR-Award 0654118

AMRIS Facility, University of Florida



The era of extracting quantitative information from Magnetic Resonance signals within the tissues has begun, including quantitative diffusion measurements on a pig neuron (Figure 2). With such data illuminating the origins of MR signals at the cellular level we hope to be able to build working mathematical models of MR signals in tissues and how they change with perturbation. *We believe that these capabilities are transformative, for the first time providing direct information on the origins of MR signals at the cellular level, i.e. on the very building blocks of tissues.* Similar resolutions are being applied to other tissues, including heart, muscle, kidney, liver, retina and prostate tissues. Non-medical potential is also being explored, including studies on plant tissues, and materials studies planned. With the support of the NHMFL and NIH, a significant multidisciplinary bioengineering effort is now underway in order to fulfill this promise, including new rf coils, higher magnetic fields, improved and novel imaging techniques, and the development of microperfusion equipment for the maintenance and perturbation of live tissues.

- (1) Flint et al, *Neuroimage* 46:1037(2009)
- (2) Flint et al, *Neuroimage*. 52:556(2010)
- (3) Hansen et al, *Neuroimage*. 57:1458 (2011)
- (4) Flint et al, Submitted (2011)