In vivo High Resolution Proton MR Imaging of Mice at 21.1 T

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Introduction

New advances in high magnetic fields expand our ability to investigate biomedical processes. The highest magnetic fields are especially attractive for *in vivo* imaging because of their capability to yield the highest spatial resolution within the limited time available during *in vivo* experiments. Here, we present MRI proton images of a mouse brain demonstrating the unique capability of the high field MR imaging at 21T.

Experimental

The MR imaging experiments were performed using 900 UWB magnet and Bruker Avance console at a proton frequency of 900 MHz using PV4.0 / TopSpin 1.5 software. The imaging gradient coil set (Bruker Micro2.5) has a 40-mm internal diameter and can provide gradients up to 1.5 T/m using Bruker GREAT60 gradient amplifiers. New RF probes specifically designed for *in vivo* MR imaging at 900 MHz were developed at the NHMFL. The RF coil was mounted so that the animals could be placed in a more desirable head-up configuration. Internal diameter of the RF coil (Alderman-Grant design) was 17.5 mm, the length of coil was 25 mm. The *in vivo* probe had a water heated blanket to help animals maintain their body temperature when inside the magnet. Mouse breathing rate was monitored inside the magnet during experiments, using Small Animal Monitoring and Gating System (SA Instruments, Inc. Model 1025), which also can be used to trigger the acquisitions. Animals for MR imaging were anesthetized using an isoflurane/oxygen mixture. All experiments were conducted in accordance with the animal protocol approved by the FSU ACUC.

Results and Discussion

The high resolution ^{1}H MR images of the living mouse brain obtained at 21.1 T are presented in Fig. 1. Two sets of thirty-five coronal images of the head of a normal mouse (C57BL/6J) were acquired using a gradient recalled-echo sequence (FLASH) with TR/TE = 750/5.4 ms, FOV = 17x15 mm, matrix = 244x214 and NA=8. The in-plane resolution was 70x70 µm with a slice thickness of 70 µm and gap of 70 µm. The position of the second set of images was shifted 70 µm in Y direction. The acquisition time of each set was ~ 20 min. The resulting 3D image was obtained after joining both MR image sets. The achieved level of *in vivo* imaging resolution is a valuable tool for a variety of biomedical studies.

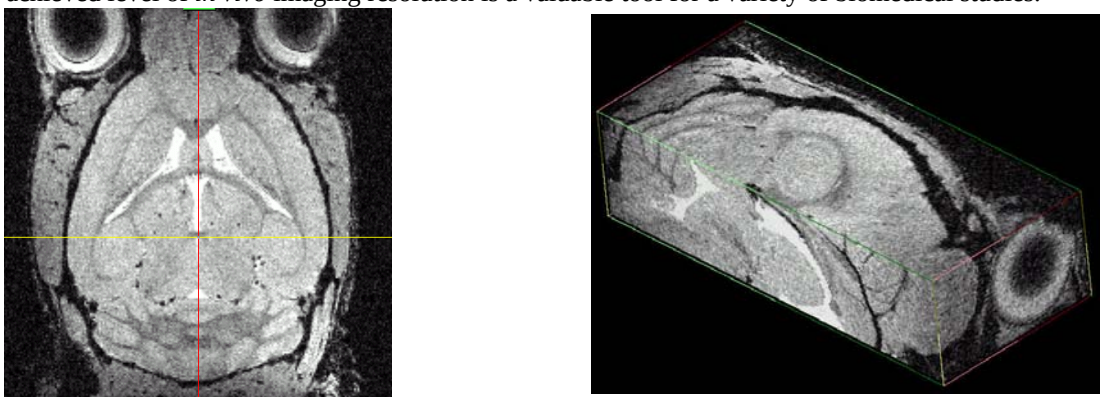

Fig.1. FLASH MR images of a mouse head, resolution for both images is 70x70x70 µm

Conclusions

High resolution *in vivo* proton MR images of mice demonstrate unique sensitivity and resolution of the UWB 900 MRI system which can be achieved in a short period of time. The novel *in vivo* MR imaging capabilities at the NHMFL create advanced opportunities to conduct specialized biomedical research. These current efforts will enable NHMFL users from around the country to investigate a host of animal models with the unique resolution and contrast enhancement afforded by this special instrument.

Acknowledgements

Our NHMFL user's support and MR probe development program is grateful to Richard Desilets for his innovative contributions. The *in vivo* rodent studies were supported by NIH grant R21 CA119177.