Initial Results: Ultra-High Field 32-ch Tx Body Array with Bright Centers.

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Target Audience: Researchers who are interested in Ultra-high Field (UHF) Body imaging

Introduction: Since its first introduction, researchers have been pushing clinical applications of 7T MRI for various realms of the human body. Till now, major efforts of 7T have been focused mainly on imaging the brain compared to human torso/body. Body imaging exams are increasingly growing as a part of total clinical MRI exams at lower field (<=3T) and should translate towards UHF imaging because of its excellent promises [1]. Thus, there is a critical need to investigate advancing MR body imaging (kidney, liver and pancreatic) at 7T. The goal of this study is to introduce a new 32-ch Tx array design that; similar to head coils, is capable of producing bright centers inside the torso at 7T using its CP mode.

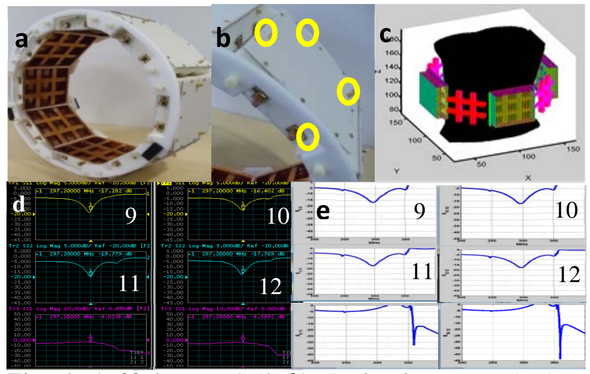

*Fig: 1 **a)** 32ch TTT Coil, **b)** single element Excitation scheme, **c)** FDTD Model, **d, e)** Exp. and sim. S11 for Port 9 to 12 (out of 32 ports), and corresponding S12 between Port 9 and 11, Port 10 and 12.*

Methods: Eight 2x2 cross pole elements [2] are arranged in octagon fashion as shown in Fig. 1a. Each element is tuned with the body phantom (GE body sphere: 46-265635G6) and a human subject and excited from the four alternate ends (yellow circles in Fig. 1b) of the array to produce independent excitation. The minimum reflection coefficient (S11) of -15dB as shown in Fig. 1. (d: exp., e: sim.). Fig. 1.c. shows FDTD modeling of the coil and torso. There are four Z levels (L) in the coil as shown in Fig. 3.a. Referred to as L1 to L4, each level contains eight Tx channels. The first set of experiments were conducted to excite each level by itself (allowing eight channels to transmit while the remaining 24 channels are terminated) and then compared to the corresponding level's simulation. In the second experiment, L1 and L4 were combined with a 180° difference and L2 and L3 were not used (terminated to 50 ohms) as shown in Fig. 3.a. diagram. The third experimental design was tested in simulation only where all 32 ports were utilized with a 180° between levels as shown in Fig. 5.a. diagram. All the experiments were conducted with the 7T Siemens Magnetom scanner.

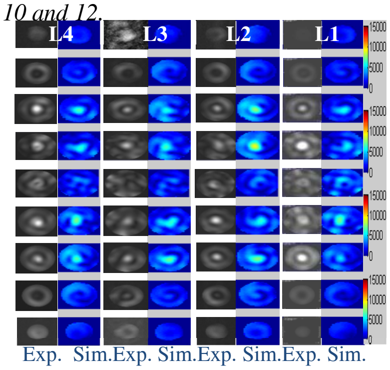

Fig 2: Each level byitself (L4 to L1: Rt to Lt)

Results: Fig. 1 (d, e) demonstrate the matching and isolation measured on the vector network analyzer and simulation are in agreement. Fig. 2. (First set of experiments) also shows good matching between each level pattern throughout the volume of the phantom. Fig. 3 (second experiment: L1 and L4 only) shows good match between (b) phantom experiment, and (c) phantom simulation, it also indicates that intensity in the center of phantom increases (adds up from two levels) compare to first set of experiments. Moreover, we calculated the B_1^+ field distributions on an anatomically detailed human torso for same combination of L1 and L4 which is shown in Fig 3.d. Fig. 4. shows the B_1^+ maps in complete volume of the body phantom for L1 and L4 combination. Lastly, Fig. 5. shows the results for the third experiment where intensity increases compared to the first and second case in not only in the phantom but also in anatomically detailed model of the human torso following the same center bright pattern.

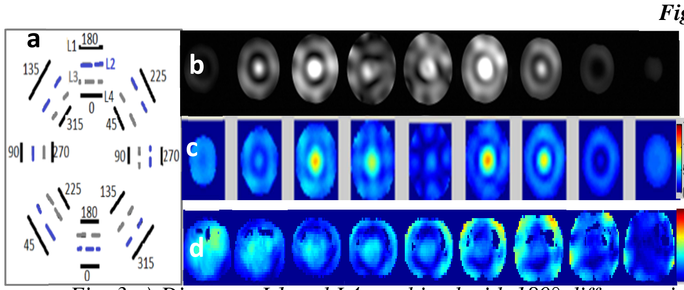

*Fig. 3 **a)** Diagram: L1 and L4 combined with 180° difference in between; **b)** Phantom Experiment; **c)** Phantom simulation; and **d)** Torso simulations*

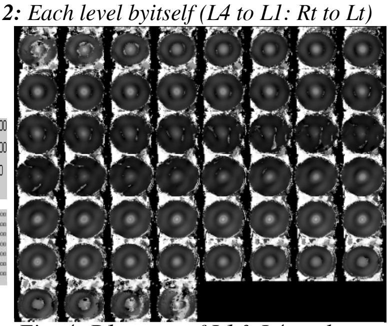

Fig. 4: B1+ map of L1& L4comb.

Conclusion and ongoing work: The initial experiments in phantom and simulations show good center bright of the region of the B_1^+ Field distribution in the human body, overcoming the severe RF penetration issues normally encountered with body imaging at 7T. As a result, this developed 32-ch Tx array in conjunction with a decoupled receive-only array in order to increase SNR (an ongoing effort in our lab) provides excellent potential of whole body imaging at 7T with acceptable SAR limits.

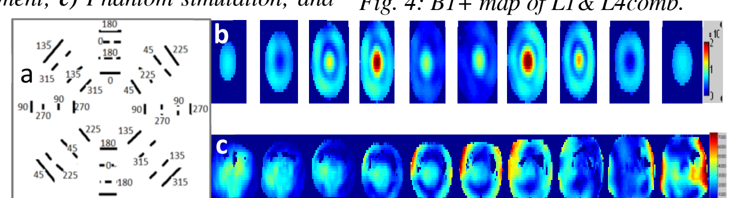

*Fig. 5 **a)** Diagram: L1, L2, L3, and L4 combined with 180° difference; **b)** Phantom simulation; and **c)** Torso simulations*

References: [1] Vaughan JT, 7 T Whole Body Imaging: Preliminary Results, MRM. 2009 Jan., 244–248 2. [2] Ibrahim TS, ISMRM, Toronto Canada, p 438, 2008.