Introduction: Recent results of PTX approaches [1-3] have emerged as answers for alleviating the RF inhomogeneity issues as well as the, potentially unsafe, local and global RF power deposition associated with ultrahigh field human MRI. Several major obstacles have dampened the enthusiasm for widespread implementation of parallel transmission methods for ultrahigh field imaging including: 1) the need for accurate $B_1^+$ field mapping, 2) coil and subject dependent increases in local/global SAR at low flip angles as a result of RF excitation ($B_1^+$ field) losses, and 3) concerns regarding the unclear RF safety assurance of the PTX experiment due to inappropriate electromagnetic models for the estimation of the SAR at ultra-high fields (mapping the $B_1^+$ field does not provide the complete picture of the electric field and thus power deposition.) The work aims at alleviating these issues through the extension of the 4-port Tic Tac Toe coil [4] to a more elaborate (covers the whole head volume,) 8-20 Tx channel, subject insensitive array for imaging at ultra high fields.

Methods: The current configuration of the 5-sided multi-transmit array contains 2 2X2 sides, 1 1X2 side, and 2 1X3 sides. This design was realized from extensive simulations and practicality (photograph of the array is shown in Fig. 1.)

Results and Discussion: The coupling matrix of the loaded 5-sided array is shown in Fig. 2. The strong coupling in this design exists only between elements on an array side, minimal coupling (maximum of $-15.4$dB and an average well below $-25$dB) is observed between elements on different sides (thus marinating the subject-insensitivity attribute.) In our tuning of the 5-sided RF array, we did not attempt to decouple the sides; rather we only focused on tuning every element of interest. Thus, it is possible to further lower the side to side coupling.

As we currently posses an 8-channel transmit array, the 5-sided coil was tested using 8-ports (front and back Tx port or top and sides Tx ports.) Figs 3-5 shows wide variety of $B_1^+$ shimming results on 4 different subjects (as of to date this coil has been successfully tested on a total of 6 subjects.) The results show excellent insensitivity to different subjects as the $B_1^+$ maps were seamlessly exchanged between different subjects with minimal (if any) observable effects on the design of the $B_1^+$ shimming patterns. Clearly the $B_1^+$ field distribution is dominated by positioning in the coil geometry rather than in the subject as the designed excitation patterns are observed in the same coil positioning.