Introduction: At high field strengths like 7 Tesla, conventional external coils do not generate sufficient B$_1$ deeper in the body (e.g. prostate). More efficient external single-sided adapted dipole antennas (SiSiAD)\textsuperscript{[1]} can provide sufficient B$_1$ for MRI. However, the B$_1$ level required for effective MRS in the human prostate using the current amplifier setup, can only be obtained with an endorectal transmit coil (ERC). In this work we demonstrate the low RF coupling between the external elements and the ERC\textsuperscript{[2]} at 7T, that offers the possibility to combine the ERC and external elements in the same session. Since residual RF coupling can be counteracted using active decoupling \textsuperscript{[3]}, no high power PIN diodes are required in the ERC. Therefore, optimized MRS with uniform MRI of the human prostate at 7 T is possible.

Methods: An array of six SiSiAD antennas\textsuperscript{[1]} (two on top and four below the volunteer) and a two-elements ERC\textsuperscript{[4]} where used (two upper antennas connected to a 4 kW power RF amplifier each and the other six elements to 1kW amplifiers). All measurements were performed on a 7 Tesla Achieva system (Philips, Best, The Netherlands). In-vivo measurements were acquired in clinical prostate cancer patients. After performing B$_1$ shimming at the prostate location and determining the strength of the coupling\textsuperscript{[3]}, T2-weighted images (MS TSE, TSE factor 18, TE/TR=100 or 72/5000 or 2500 ms, 250x400x58 mm$^3$ FOV, 10 slices) were acquired when transmitting (Tx) with either the ERC or only the external array, while receiving (Rx) with all elements or only the ERC. The MRSI acquisition was obtained with all elements as transceivers (Tx/Rx) (2D nsLASER\textsuperscript{[5]}, TE/TR= 56/3600 ms, 100x35 mm FOV, 30x300 VOL, 5x5x5 voxel, 20x70 matrix, 2048 samples, 4000 Hz bandwidth).

Results/Discussion: When Tx is done only with the external antennas the uniformity of the T2w-images is significantly improved compared to Tx with the ERC only (Figure 1). This uniformity is maintained even when the tuned ERC is still present, while the SNR substantially improves. When transmitting with the ERC, the strong B$_1$ fields can be used for MRSI, which due to the presence of the externally applied fields extends to the anterior part of the prostate. The results of the 56 ms TE MRSI are shown in Figure 2, showing clear signals of citrate, creatine, polyamines, choline and even myo-inositol+choline, taurine and scyllo-inositol at this short TE. Due to the adiabatic properties of the nsLASER sequence, the MRS signals remain uniform over the whole prostate. The temperature measurements (Fig, 2b) resulted in a maximum temperature change of less than 1 °C, during the MRSI protocol.

Conclusions: the combination of an external array with an ERC, both used as transceivers (Tx/Rx) for uniform MRI and short TE MRSI of the prostate is feasible, due to the low coupling between the elements and the use of active decoupling at 7T. Consequently, accurate detection of metabolite levels in the human prostate can be obtained, while providing clinically relevant MRI at 7T.

References: