# RF Coil Selective Adiabatic Excitation in sLASER Sequence for 7T Prostate MRSI at short TE

Catalina S. Arteaga de Castro[1], Mariska P. Luttje[1], Marco van Vulpen[1], Uulke A. van der Heide[2], Peter R. Luijten[1], and Dennis W.J. Klomp[1]
[1]*University Medical Center Utrecht, Utrecht, Netherlands,* [2]*Netherlands Cancer Institute, Amsterdam, Netherlands*

**Introduction:** Higher magnetic field strengths like 7T can offer increased signal to noise (SNR) and spectral resolution that can be advantageous for MR spectroscopy (MRS). However, these high fields also suffer from strong RF non-uniformities. Particularly when combined with surface transceivers like an endorectal coil (ERC) these non-uniformities get pronounced. In order to obtain accurate MRS information in non-uniform $B_1$ fields, adiabatic sequences can be used. However, adiabatic sequences suffer from high SAR deposition and long echo times due to the required number of pulses necessary for 3D localization. Incidentally, the limited field of view (FOV) of the ERC in the right-left (RL) direction also limits the RF transmission outside the prostate aiding naturally to signal suppression (e.g lipids) from the surrounding structures. Using these characteristics of the ERC non-selective RF pulses in the RL direction can be used, thereby excluding a pair of refocusing pulses from a LASER sequence making it a fully adiabatic semi-LASER[1]. Therefore, we propose the implementation of a non-selective-adiabatic-excitation semi-LASER (nsLASER) sequence in combination with an ERC transceiver for prostate MRSI at reduced SAR and TE.

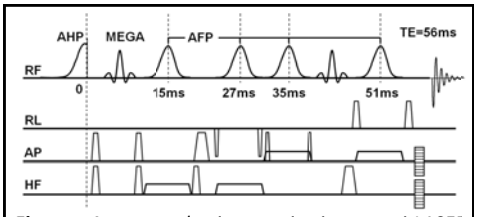


***Figure 1:*** *non-selective excitation semi-LASER sequence (nsLASER). An adiabatic half passage (AHP) of 6 ms, based on hypsec/sec functions is used for excitation. One pair of 5 ms MEGA pulses are used for simultaneous water and lipid suppression. Two pairs of 8 ms long AFP (hypsec/sec) are used to refocus the spins in one slice. Inter-pulse timings are optimized to obtain the strongly coupled spin system of citrate in maximum absorption mode.*

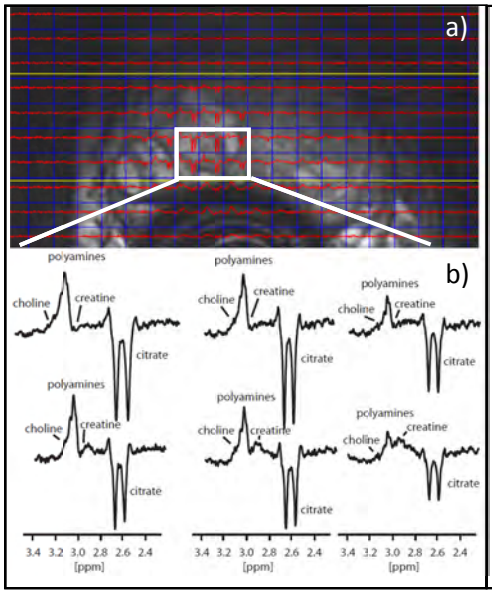


***Figure 2:*** *In-vivo MRSI results obtained with the nsLASER sequence showing in a) negligible water and lipid residual signals outside the prostate in the RL direction and in b) a voxel selection from a relatively healthy region in the prostate showing fully resolved metabolites, including polyamines. Notice the absence of artifacts from water and lipid in the spectra.*

**Methods:** Adiabatic half (AHP) and full passage (AFP) RF pulses were implemented based on hypsec/sec functions. The AHP was 6 ms long and needed 18μT for excitation. Two pairs of AFP (8ms, 18μT needed) were used for refocusing on two directions (bar selection). Water and lipid suppression was achieved simultaneously using two 5 ms Mescher-Garwood (MEGA) RF pulses (needed 15μT). The MEGA pulses also refocus the polyamines compound at 3.1ppm by inverting the peaks at 2.1 and 1.8ppm which are coupled to the 3.1ppm part. Inter-pulse timings were optimized for maximum absorption mode of the strongly coupled spin system of citrate. Ten patients diagnosed with prostate cancer were examined at a 7 Tesla scanner (Philips, Cleveland, OH, USA) with a 2-elements endorectal coil[2] (ERC) tuned and matched at 298 MHz and filled with fluorinated fluid (GALDEN; Solvay Solexis, Milan, Italy). 3D $B_0$ map based shimming was performed prior to obtaining $T_2$-weigthed images to localize the tumor. 2D MRSI (nsLASER, TE/TR=56/2000 ms, 30x10 matrix, 5x5x5 $mm^3$ voxel) was obtained in the slice with hypo-intense signals in the T2-weighted MRI corresponding to the tumor location. A hamming filter was applied and zero order phase correction was performed in all spectra.

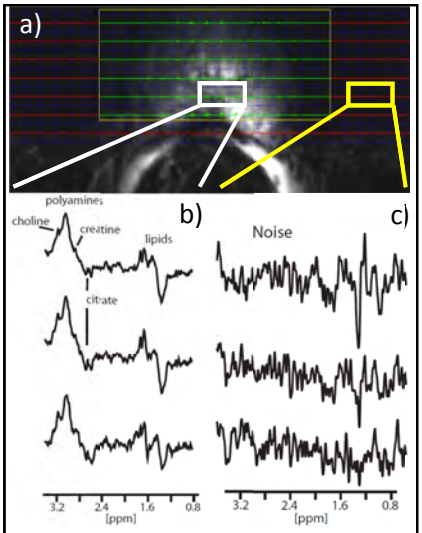


***Figure 3:*** *In-vivo MRSI obtained with the nsLASER sequence. In this example increased water and lipid signals are evident on the spectra. However, no baseline distortion (a) or artifacts coming from these signals is affecting the metabolite peaks (b) as can be observed on the zoomed-in spectra. Indeed only noise is left outside the prostate (c).*

**Results and discussion:** The nsLASER sequence schematics are shown in Figure 1. Due to the non-selective excitation a large field of view (FOV) had to be used to avoid folding-in artifacts on the RL direction. In-vivo results show that the ERC sensitivity remains mainly within the prostate. Regions outside the prostate do not show any spurious signals on the MRSI (Figures 2a and 3c). Spectra obtained in-vivo corroborate the absence of artifacts due to water or lipids and shows fully resolved metabolites including polyamines in a relatively healthy area of the prostate (Figures 2b and 3b).

**Conclusions:** We have shown that it is possible to obtain high quality spectra without spurious signals from water or lipids when using a sequence with a non-selective excitation as it is with the nsLASER combined with RF coil selection. The use of an ERC makes this sequence ideal for prostate 2D MRSI at 7T.

**References:** [1] Klomp et al. NMR in Biomed. 2011; 24: 299-306; [2] Arteaga et al. Proc. Intl. Soc. Mag. Reson. Med. 17 (2009), p.4744