



# Quality Improvement of In Vivo <sup>31</sup>P-MR-Spectroscopy by Proton Decoupling

Uwe H. Melchert<sup>1</sup>, Harald G. Scholand-Engler<sup>1</sup>, Kerstin Oltmanns<sup>2</sup>, Dirk Petersen<sup>1</sup>  
<sup>1</sup>Dept. of Neuroradiology and <sup>2</sup>Dept. of Psychiatry • University of Lübeck  
melchert@uni-luebeck.de



## Purpose

Beside homogeneity of the static magnetic field, motion of living subjects under investigation due to respiration or pulsating blood flow and the high temperature of 37°C lead to a line broadening of in vivo <sup>31</sup>Phosphorous magnetic resonance spectra (<sup>31</sup>P-MRS). Therefore it can be even difficult to identify the duplet ( $\alpha$ - and  $\gamma$ -) and triplet structure ( $\beta$ -) of adenosinotriphosphate (ATP). Additionally, proton coupling of phosphorous nuclei is the main reason for poor spectral resolution in frequency region of phosphomono- (PME) and diesters (PDE).

The study was done to improve the quality <sup>31</sup>P-MRS by means of proton decoupling within a measurement time of 3 min.

## Material and Methods

All measurement were done on a clinical used 1.5 T whole body MR-scanner (Fa. Siemens, Germany) with volunteers in supine position inside the magnet bore.

First of all, the repetition time (TR) was fixed to 1500 ms to allows an acceptable relaxation of the metabolites. Together with a number of excitations (NEX) of 128 in combination with 4 dummy excitations (DEX) the total scan time was 3:18 min. The static field was shimmed to a full width half maximum (FWHM) of the water resonance line less than 35 Hz for muscle tissue and less than 15 Hz for the primary visual cortex and. Proton decoupling was done during excitation in use of the nuclear overhauser effect (NOE) and additional wideband alternating-phase technique for zero-residual splitting (WALTZ)-decoupling during readout. All parameters are listed in Table 1.

## Results

To show the effects of proton decoupling on <sup>31</sup>P-MR-spectra measurements from calf muscle of a male volunteer were done. In figure 1 no decoupling was used. In figure 2 only decoupling during excitation was performed and in figure 3 only WALTZ-4 worked in the readout phase. Both decoupling, during excitation and receiving were used in figure 4. Here the quality improvement in comparison with no decoupling (figure 1) can be clearly seen, especially in the frequency region of PDE.

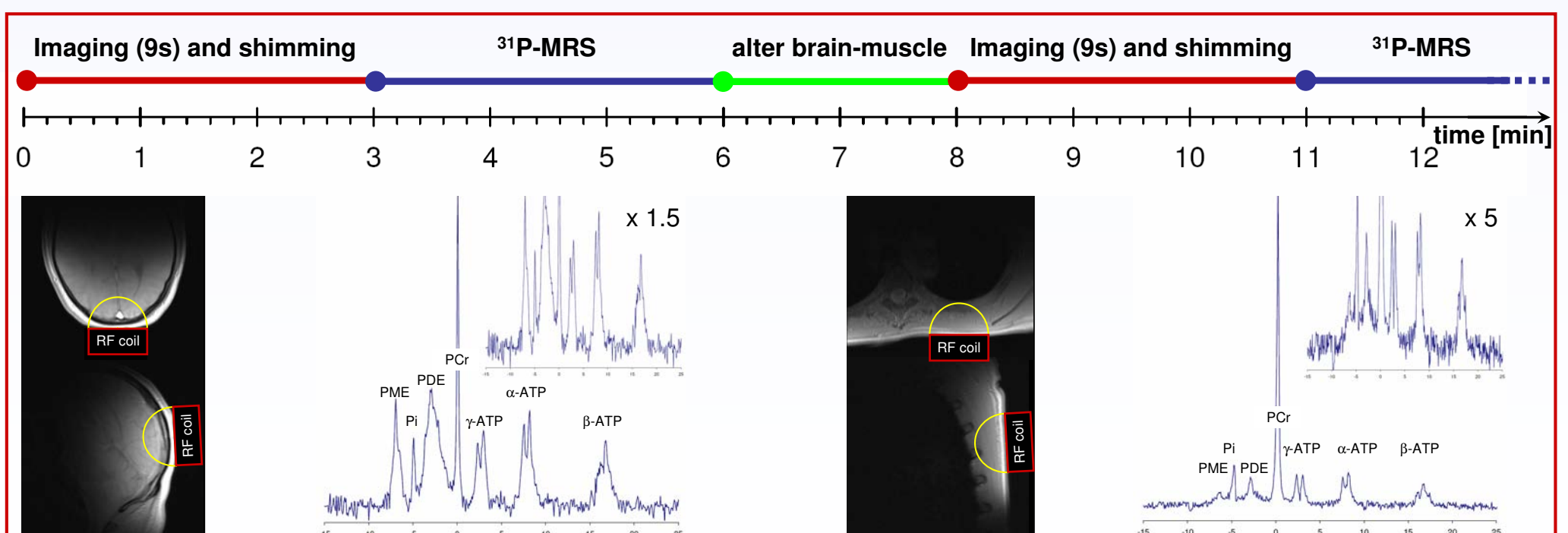
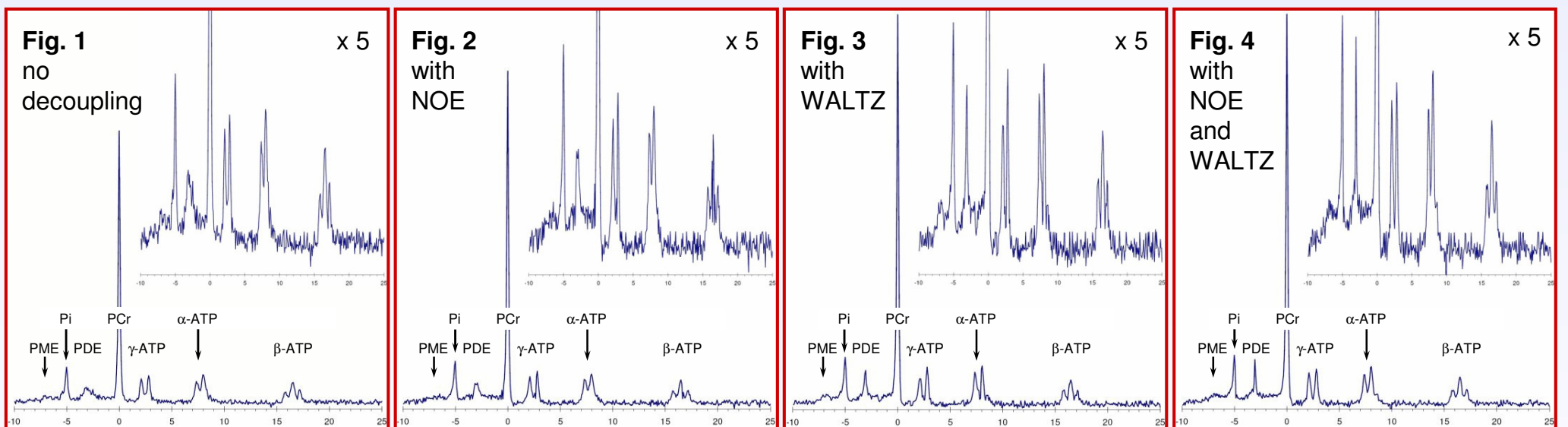
## Table 1

TR:	1500 ms	NEX:	128
NOE pulses:	10	DEX:	4
NOE duration:	10 ms	WALTZ duration :	2 ms
NOE angle:	90°	WALTZ angle:	180°

**Total scan time: 3 min and 18 s**

## Conclusions

The obtained spectral quality was good enough to evaluate the high energy phosphates in brain and muscle tissue in our Selfish Brain project. Our results lead to a time schedule for volunteer experiments (see figure 5). At four time points during the glucose clamp <sup>31</sup>P-MR-spectra from the primary visual cortex and shoulder muscles are obtained according to the shown schedule. The order brain / muscle is changed every second spectrum.



**Fig. 5**

Time schedule with MR images und <sup>31</sup>P-MR-spectra. Left brain, right muscle measurements under hypoglycemia. Base spectra are scaled to same PCr peak height and enlarged spectra to same ATP peak height.