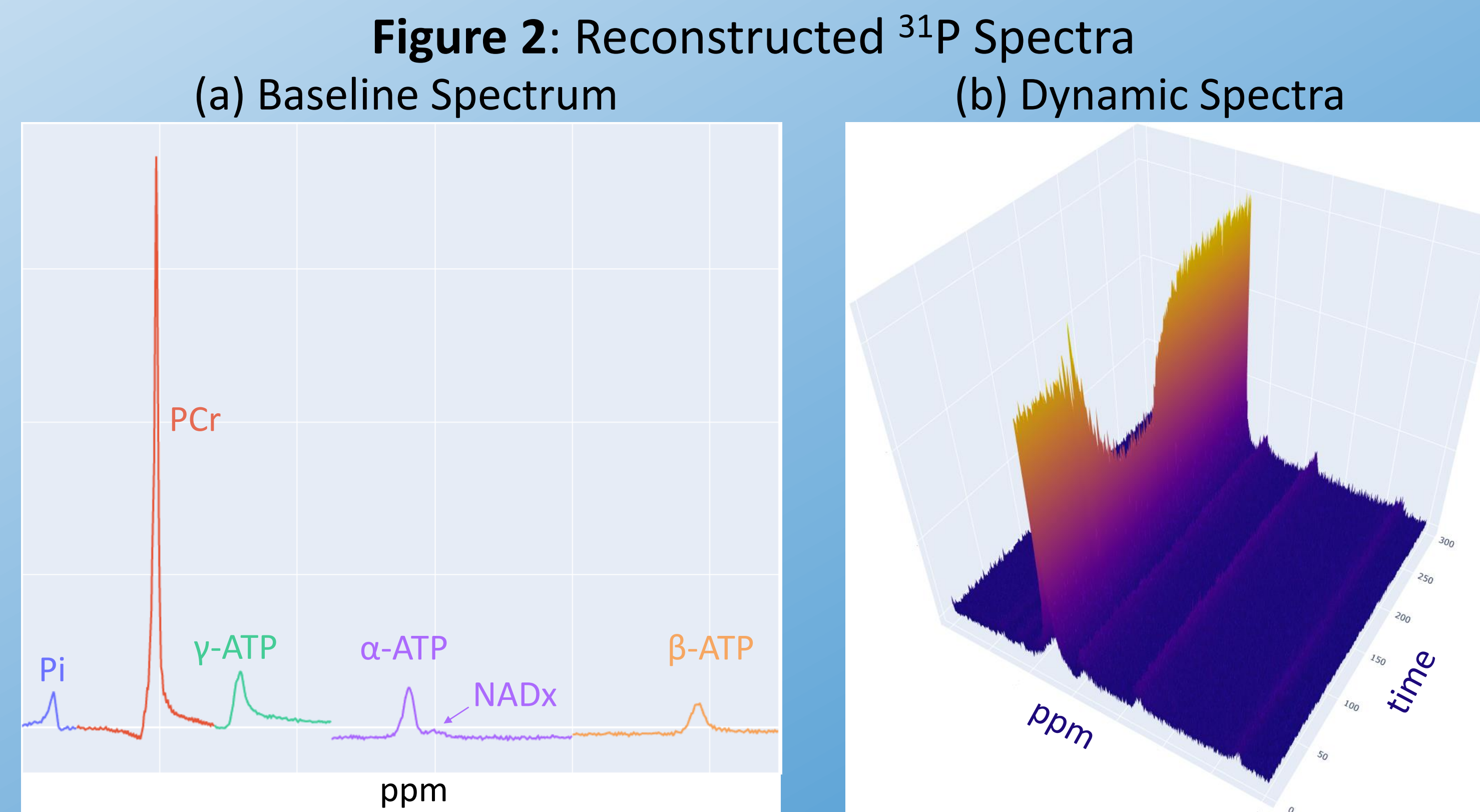


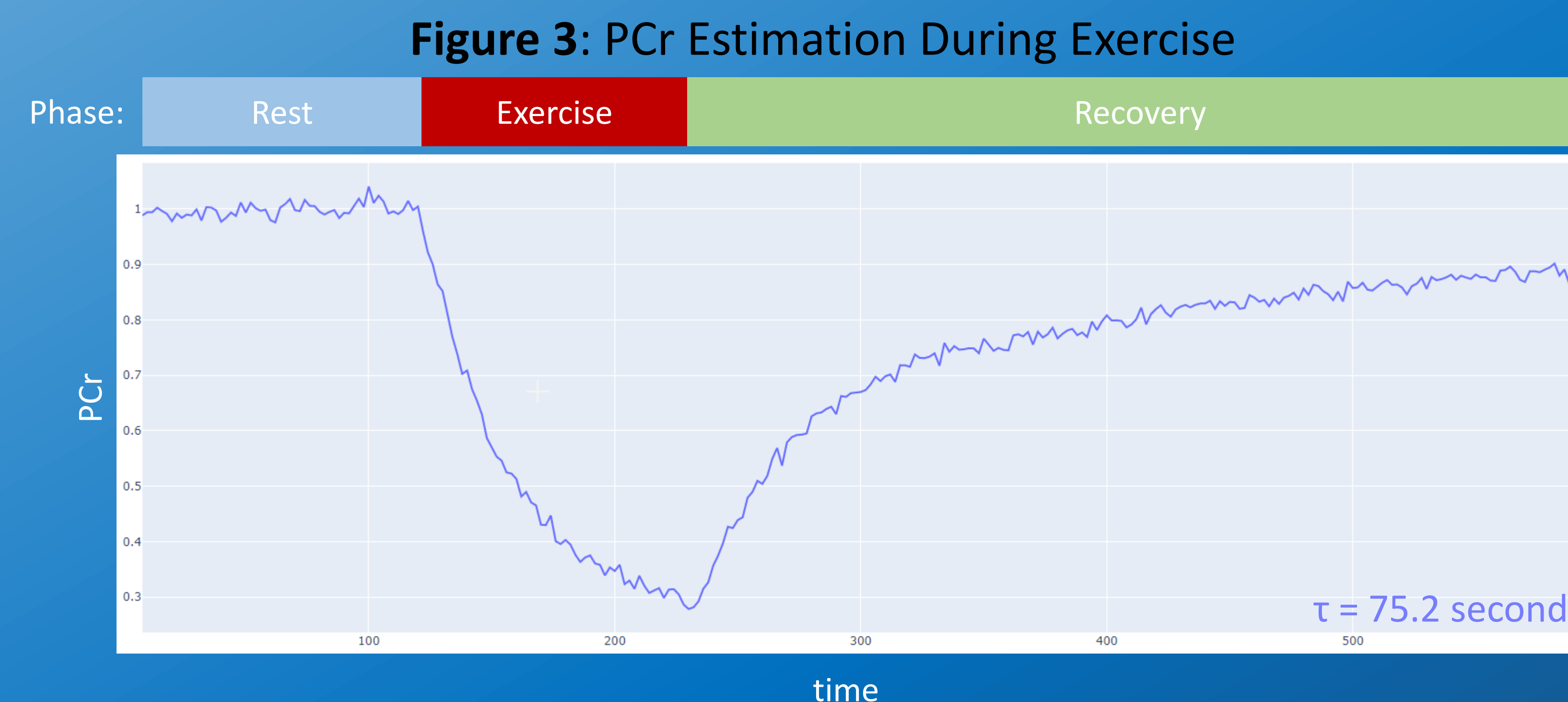
Motivation

- Deficiency in oxidative metabolism is associated with the pathophysiology of many diseases
- Phosphorus-31 (³¹P) MRS provides a noninvasive method of measuring metabolic markers: ATP, Phosphocreatine (PCr), Inorganic Phosphate (Pi), and NADH/NAD+, etc.
- Dynamic measurements of metabolites is possible (e.g., muscle ³¹P MRS during exercise)
- With a 7T MRI system, NADH/NAD+ can be measured
- A supine leg extension ergometer (Figure 1) was developed for a Siemens 7 T Terra MRI system to acquire dynamic ³¹P MRS with simultaneous exercise

PCr Measurement



- The reconstructed ³¹P spectra during the dynamic acquisition are shown in Figure 2b
- The large SNR of the Phosphocreatine (PCr) resonance allows dynamic measurement of this metabolite. Figure 3 shows the plot of the PCr estimate from the dynamic spectra.
- The PCr recovery is quantified by an exponential fit of the recovery phase and estimate of the exponential time constant, τ



NADH/NAD+ Measurement

- From the baseline spectrum (Figure 2a) we can estimate the NADH/NAD+ levels
- With our method the NADH and NAD+ co-resonance (NADx) is separated from the adjacent α -ATP resonance (Figure 4)
- This is achieved by a nonlinear phase correction of the baseline spectrum to obtain a pure absorption spectrum (Figure 2a), which provides better separation between overlapping resonances.
- ATP resonance is fit to a Voigt profile and subtracted out leaving only NADx

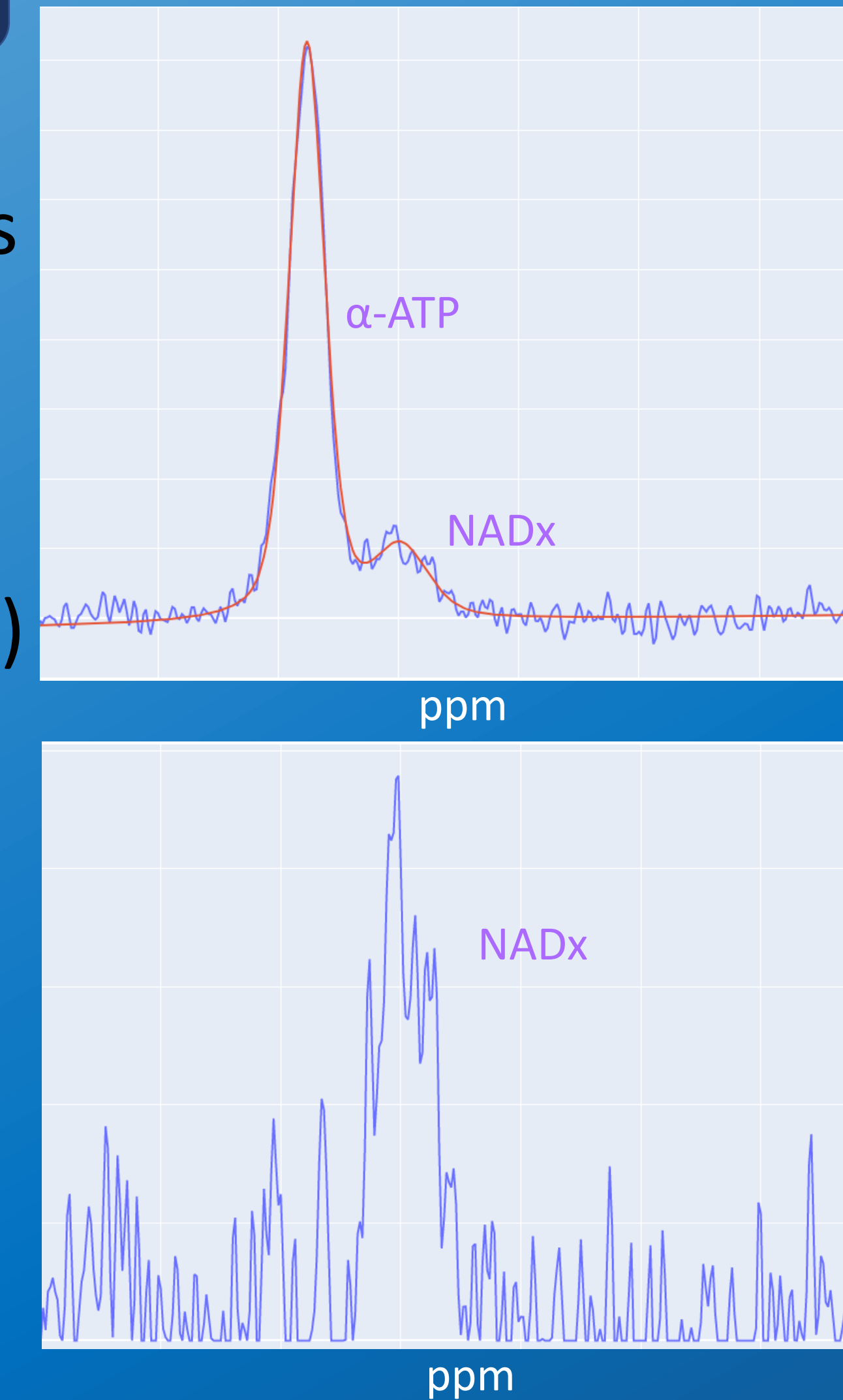


Figure 4: (above) alpha-ATP region of the Static, Long TR; (below) NADx resonance only

Conclusion

- The ergometer proved effective at allowing a wide range of subjects to perform the exercise within the bore of the MRI system
- In a study of a therapeutic agent targeting NADH/NAD+ levels, 55 sessions with 34 subjects were scanned. In another studying Peripheral Artery Disease, a total of 10 sessions with 5 subjects were scanned.
- ³¹P MRS at 7 T provided a noninvasive method to assess skeletal muscle biochemistry – dynamic estimates of PCr and single measurements of NADx are obtainable



Figure 1: Supine Leg Extension Ergometer