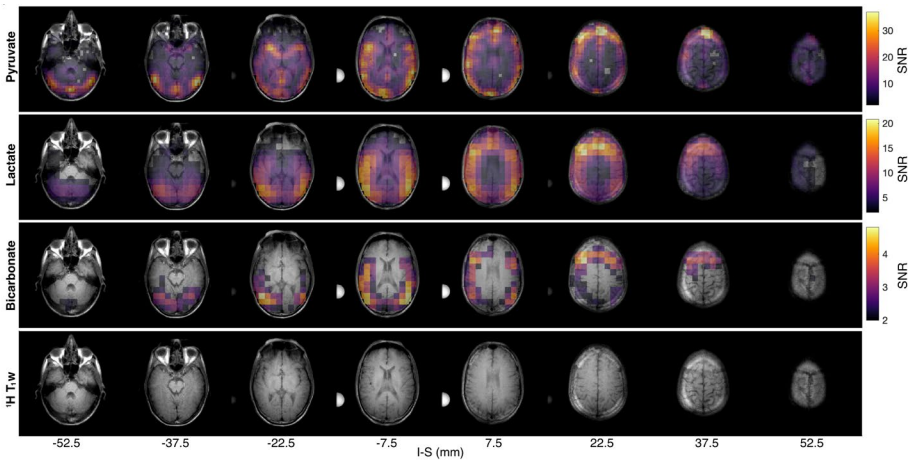
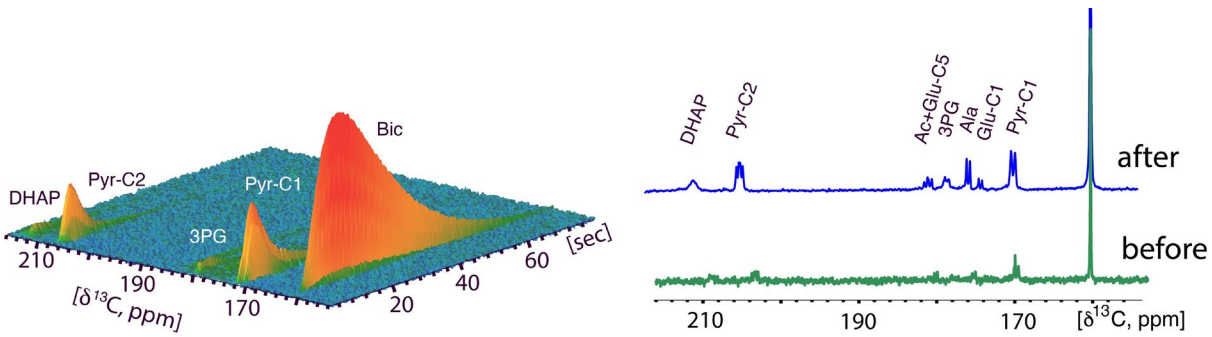
Highlights in 2021

New flexible coil design enables advanced metabolic imaging

To approach the ultimate limit of detection in hyperpolarized MR, several strategies need to be combined both in hardware and sequence development. Tight anatomical fitting (to maximize the received signal amplitude), and parallel imaging (to extract more information of the hyperpolarized signal before it decays), are some of the features that can substantially improve imaging quality. Parallel imaging requires prior knowledge of the coil sensitivity profiles, which are complicated to obtain for hyperpolarized ^{13}C MR, due to its low natural abundance. As a solution to this problem, we have designed a new signal reception technology, with a flexible ^{13}C receive coil with coupling coefficients matched for both ^{13}C and ^{23}Na, which enables sensitivity profiles to be acquired at the ^{23}Na frequency. We have demonstrated this method in two hyperpolarized in vivo experiments involving pig kidneys and human brain using a new two-times accelerated 3D blipped stack-of-spirals sequence with dual-resolution. The results show good SNR, coverage, and resolution. The method is promising for integrating and automating parallel imaging for hyperpolarized ^{13}C MRI in future clinical studies. The figure shows metabolic maps overlaid on anatomical ^{1}H brain images for the healthy human brain of Center Leader, Jan Henrik Ardenkjær-Larsen.



Increased sensitivity of dDNP-NMR for cellular metabolism



dDNP-NMR is one of few analytical tools that provide insight into intracellular reaction kinetics, thermodynamics and regulation. Traditionally, small flip angles are used in dDNP-NMR experiments to distribute the magnetization in a time dependent manner to determine rate constants. Using yeast as a case study we showed that a single scan approach provides orders of magnitude improvements in sensitivity of ^{13}C NMR relative to real-time kinetic measurements. The described gain in sensitivity opens various novel avenues for functional assays in living cells such as; increased time scale of hyperpolarized NMR and lower cell densities becomes tractable under biologically more relevant settings.