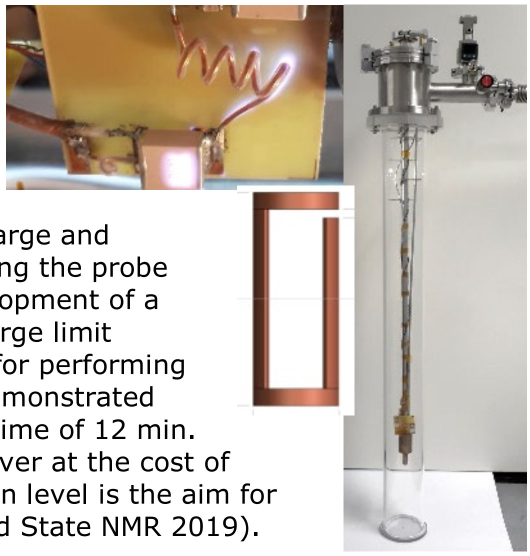
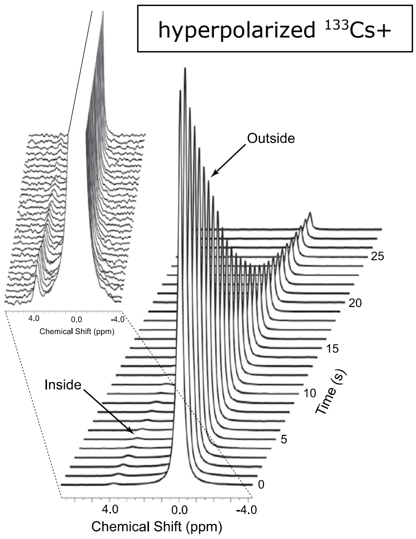
Highlights in 2019

Accelerating nuclear spin polarization



When polarizing samples with nuclear spins with small magnetic moment, combining dynamic nuclear polarization (DNP) with cross-polarization (CP) is often the only option to achieve acceptable polarization. CP in combination with DNP is a very challenging experiment, which requires extremely low temperatures, high amplitude excitation, and low pressure helium gas. The latter causing electrical discharge and breakdown due to ionization of helium atoms surrounding the probe with the sample (see figure). The studies led to a development of a probe for cross-polarization, which increases the discharge limit significantly, providing the signal amplitudes sufficient for performing cross-polarization experiments. Using this probe, we demonstrated 27% carbon polarization with a characteristic build-up time of 12 min. That is ca. 4 times faster than direct carbon DNP, however at the cost of lower final polarization levels. Improving the polarization level is the aim for continued investigations. (Vinther *et al.*, Journal of Solid State NMR 2019).

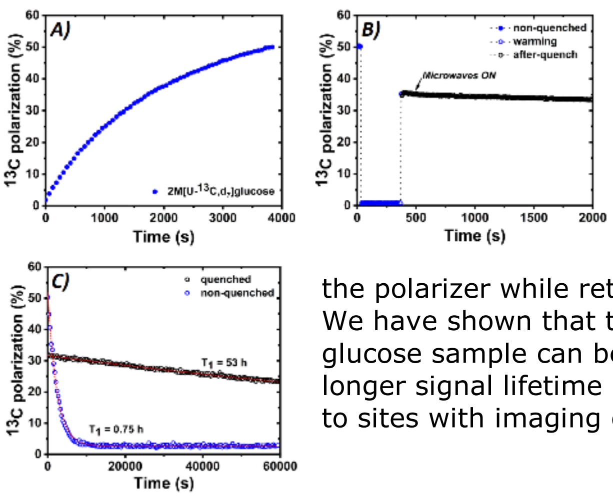
Mechanosensation and shape regulation in living cells



The highly sensitive bio-probe, hyperpolarized $^{133}Cs^{+}$ was applied in a mechanistic elucidation of physiological states of distorted erythrocytes (RBCs), to quantitatively and non-invasively measure factors that regulate shape and volume in RBCs, and by analogy all cells. A device was constructed enabling $^{133}Cs^{+}$ uptake dynamics on a second timescale. The study showed that fluxes of Cs^{+} ions through the RBC Piezo1 ion channels were in the range 4–70 µmol Cs^{+} $(LRBC)^{-1}$ s^{-1}, which is comparable to glucose uptake. The developed methodology and analytical procedures will be applicable to transmembrane cation transport studies in the presence of additional Piezo1 effectors, to other cellular systems, and potentially *in vivo*. (Kuchel *et al.*, Scientific Report 9, 2019).

Transportable hyperpolarized glucose samples

Hyperpolarization life-time after radical destruction



The use of light-induced thermally labile free radicals for dDNP has made it possible to obtain solutions of hyperpolarized compounds free from radicals and their negative post-dissolution effect on the polarization relaxation rates. As the radical centers decompose (quench) at around 190 K it is now possible, by a fast temperature cycling procedure at high field, to remove the radical centers already in the solid state inside the polarizer while retaining the DNP-induced hyperpolarization. We have shown that the UV generated radical in a highly polarized glucose sample can be quenched in solid state leading to many hours longer signal lifetime (T_1) permitting transportation of hyperpolarization to sites with imaging capabilities (Capozzi et al., ISMRM, 2019).