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METANANO 2019
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Compact Metamaterial based Coil-Element for Combined $^{1}H/^{23}Na$ MRI at 7 Tesla

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The Metamaterial Transmission Line

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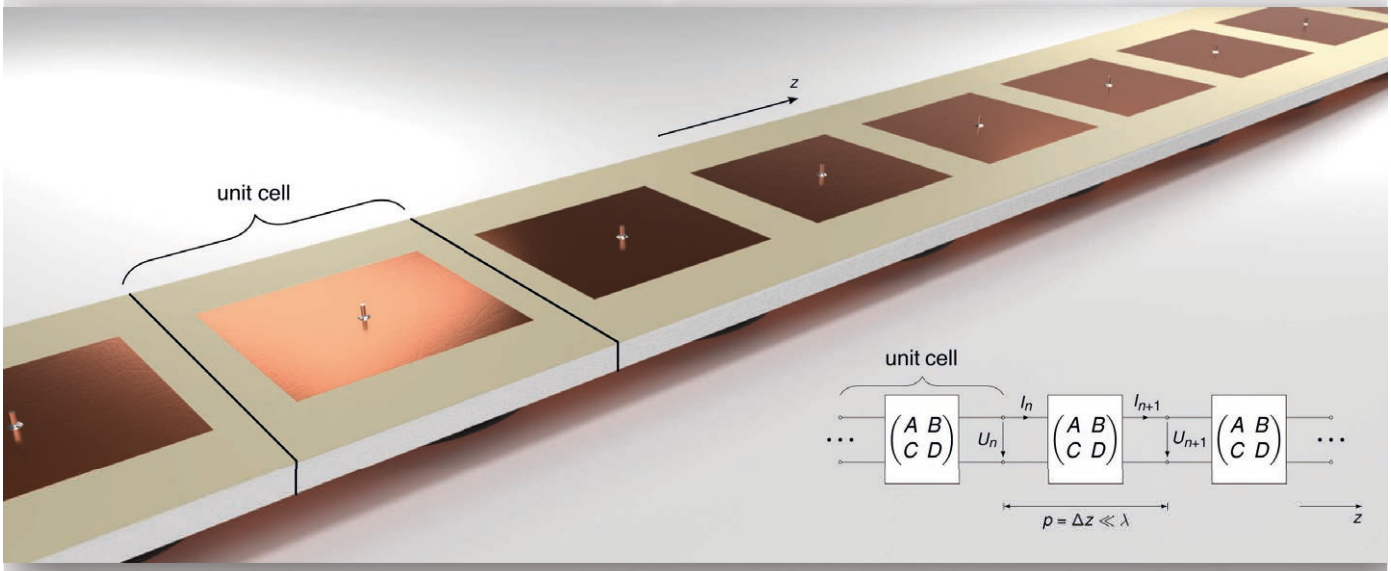
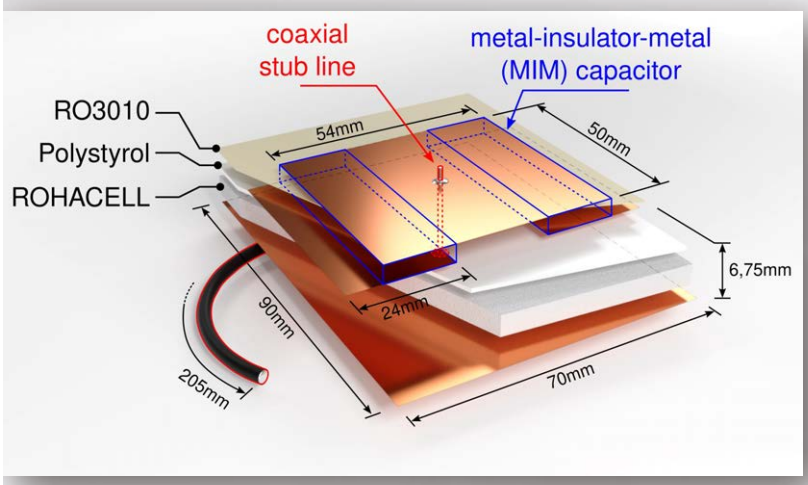
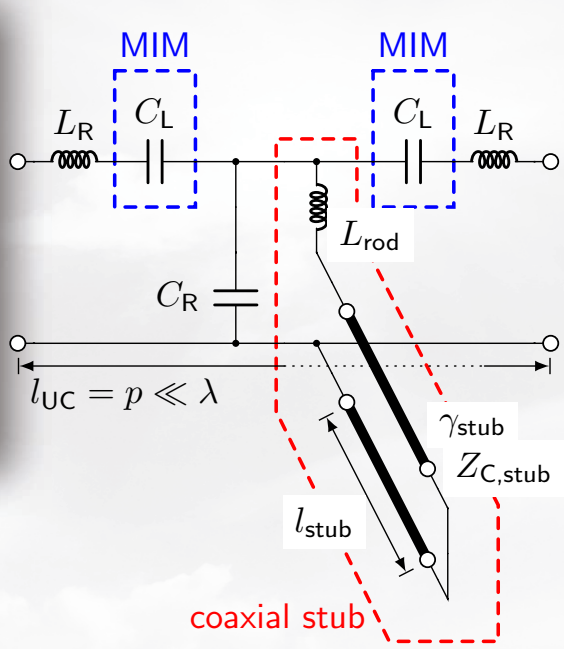
- Composite right-/left-handed (CRLH) transmission line
- Enabled design of dispersion characteristics



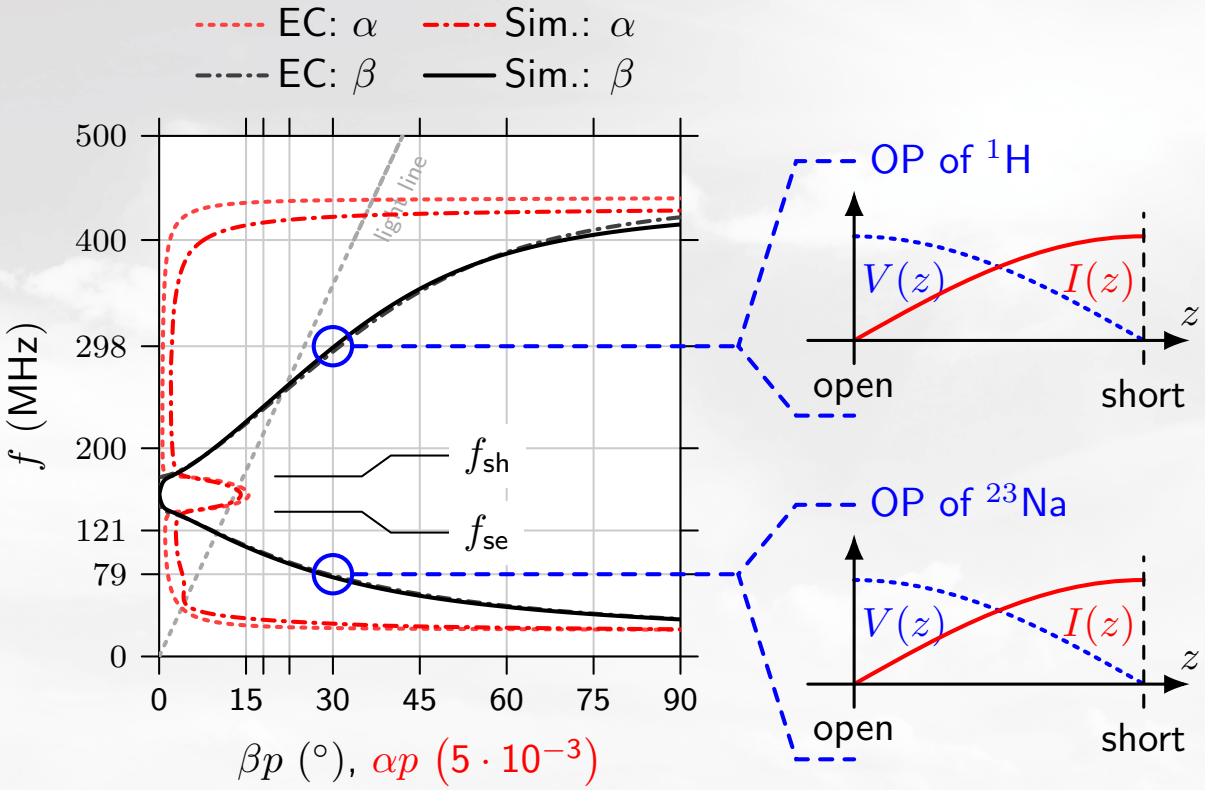
The Utilized Unit Cell





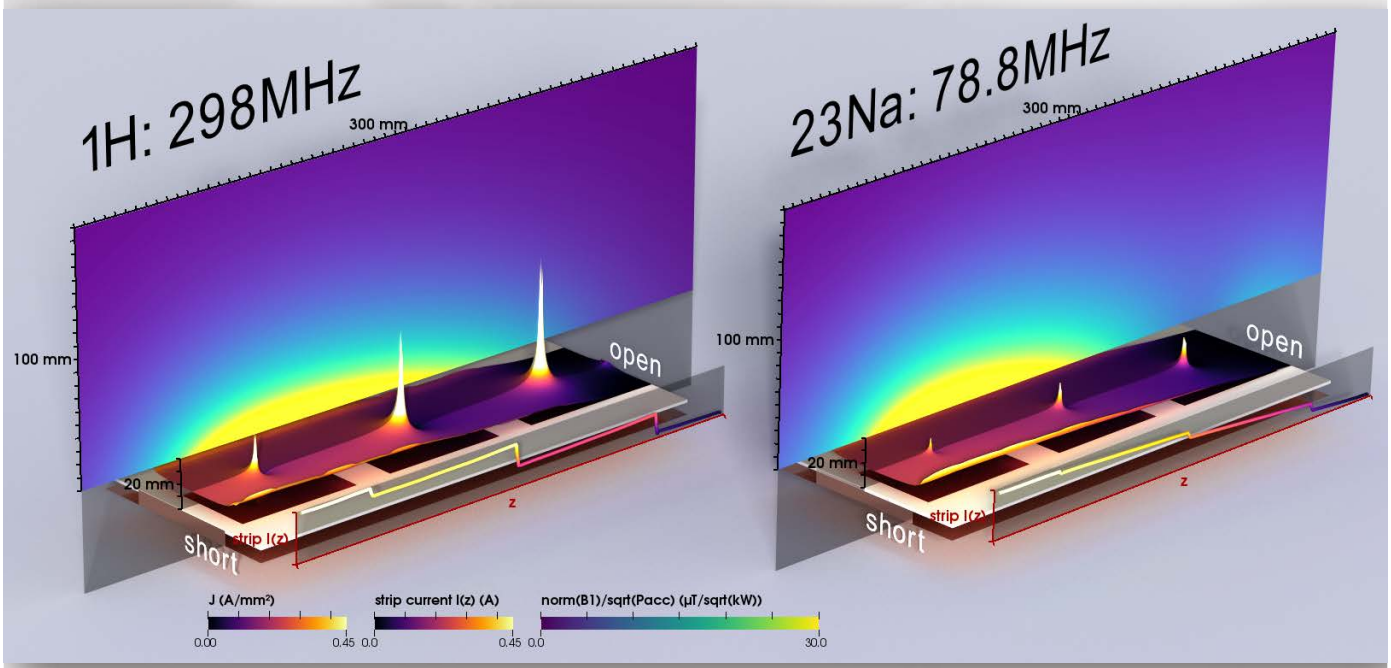
- Augmented microstrip line:
  - Series MIM capacitor
  - Shunt coaxial stub line
    - Inductive impedance below quarter wavelength
    - Capacitive impedance above quarter wavelength

Dispersion Characteristics

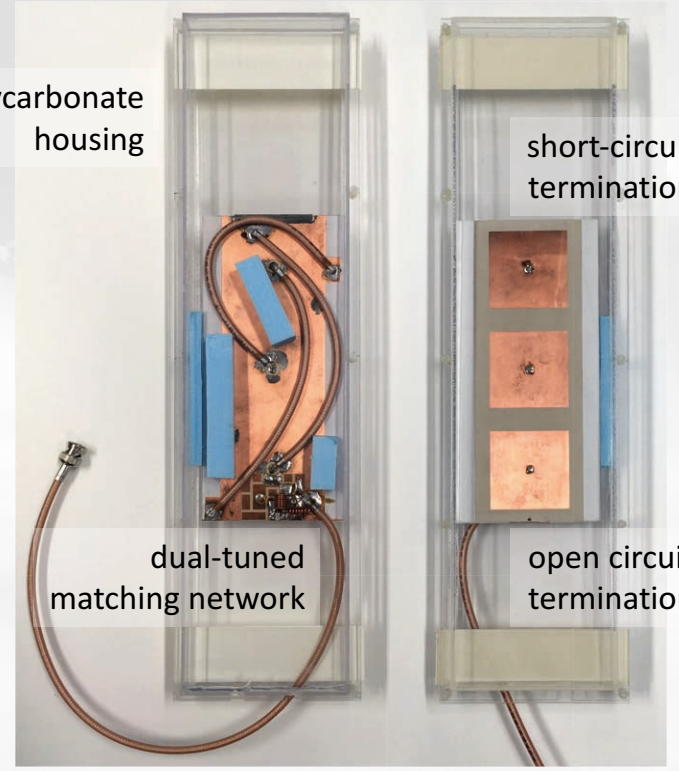


Simulation Results

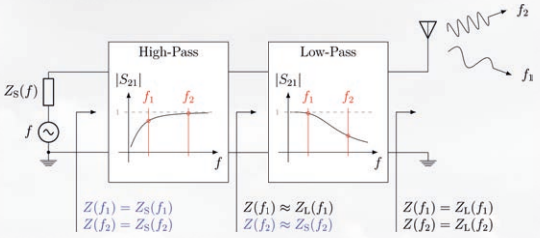
- FDTD Simulation with EMPIRE-XPU
- Congeneric current and field distributions



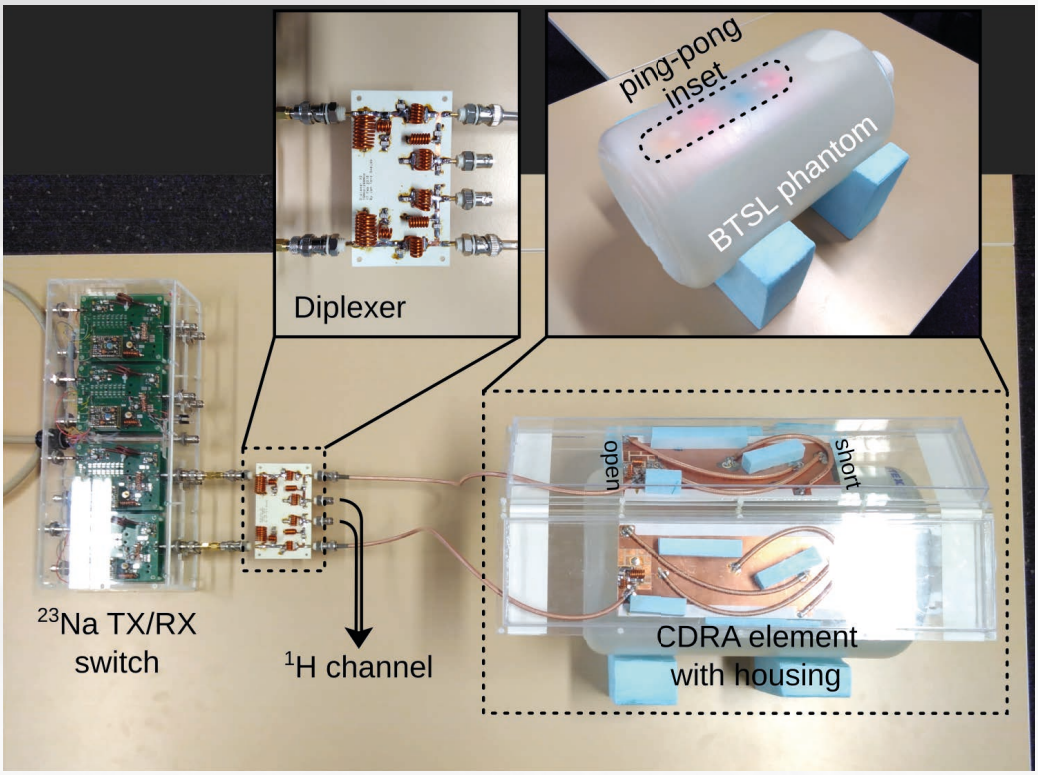
Prototype within Housing



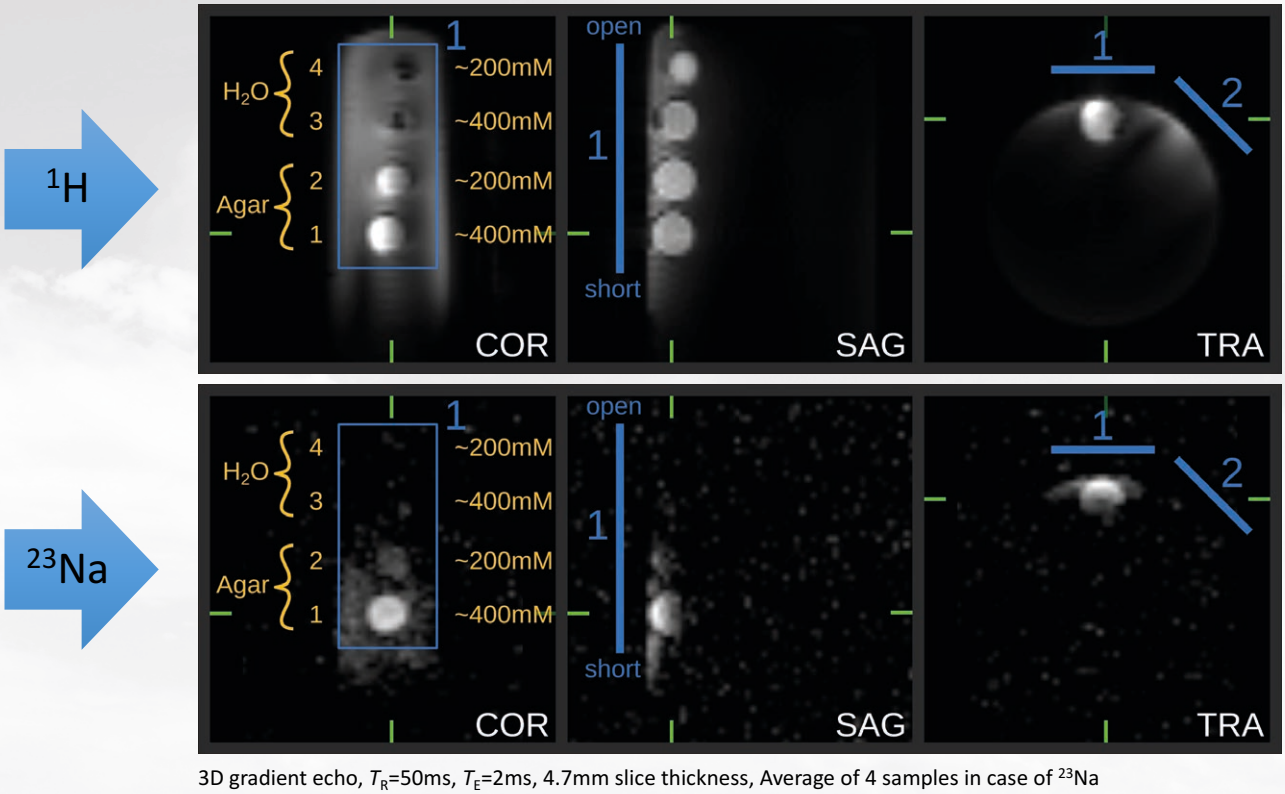
dual-tuned matching network



Setup of MRI Experiment



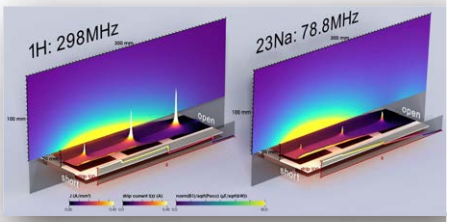
Results of MRI Experiment

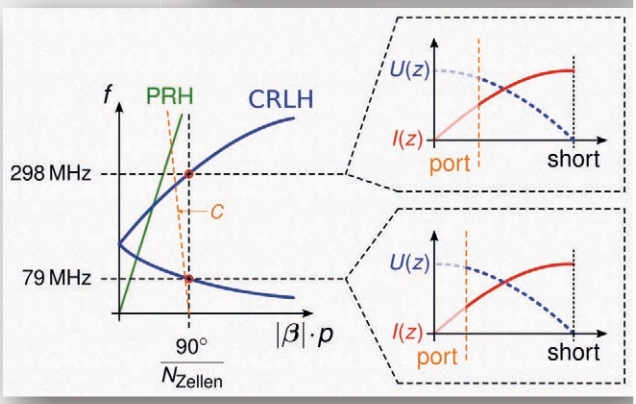


3D gradient echo, T_R=50ms, T_E=2ms, 4.7mm slice thickness, Average of 4 samples in case of ^{23}Na

Conclusion

- Prototype of dual-resonant coil-element proposed
  - For combined $^{1}H/^{23}Na$ MRI
  - Utilizing CRLH dispersion characteristics
- Similar field distributions at 79MHz and 298MHz
  - Good results with Hydrogen
  - Lower SNR in case of Sodium
    - Lower Concentration
    - Resistive losses in coil element
- Low coupling between elements





➢ Reduction of losses in coil-element

➢ Multichannel array arrangement

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