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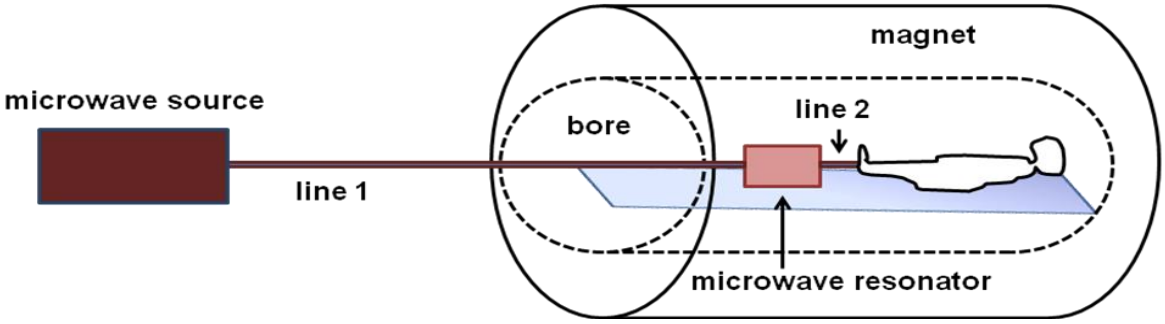
Hyperpolarization device and administration of hyperpolarized liquid contrast agent



Abstract

Magnetic resonance imaging (MRI) is a imaging method that is mainly used in medical diagnostics to display structures and functions of tissues and organs in a body. To increase the sensitivity of MRI hazardous, hyper-polarized contrast agents can be used.

The invention includes a resonator for dynamic nuclear polarization (DNP), which is placed directly in an MRI scanner. Therefore, the local standard magnetic field of 1.5 T can be used to produce a hyperpolarized liquid, an immediately deployable contrast agent. Thus, the new resonator enables a rapid transport of a hyperpolarized contrast agent to patients, so that the usual relaxation polarization losses can be avoided.

Background

Methods for the hyperpolarization of liquid contrast agents employing dynamic nuclear polarization (DNP) are well known. Typically, the contrast agent, which is present in the frozen state, is polarized in a separate and relatively strong static magnetic field of about 3.35 T. Before administration to the patient in the MRI machine, the contrast agent has to be thawed first. After leaving the applied magnetic field, the hyperpolarized contrast agent loses a significant part of the hyperpolarization. This is due to the relaxation process which takes place during the transport from the external magnetic field to the patient.

Invention

The present invention solves the afore-mentioned problem of polarization losses during the transport of a hyperpolarized contrast agent to the patient. The device allows a hyperpolarization procedure carried out by a microwave resonator within the MRI machine.

A liquid contrast agent suitable for hyperpolarization is administered to the patient directly from a reservoir of the microwave resonator. The device includes a thermostat to control the temperature of the contrast agent. A microwave source of approx. 42 GHz is coupled via a copper waveguide to the resonator. This is sufficient to polarize the contrast agent

The inventors have already developed a prototype. In experiments they could show that for water samples an enhancement of -14 under flow conditions and -98 for stationary conditions can be achieved.

Krummenacker et al., Journal of Magnetic Resonance 2012

Denysenkov et al., Scientific Reports 2017

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Customer Benefits

- The contrast agent can be administered to the patient directly after the hyperpolarization in the resonator. This provides short distances, so that there will be no polarization losses during transport.
- The hyperpolarization does not require a separate magnet, because the contrast agent is exposed to the same static magnetic field that is also used for the MRI imaging.
- Amplification factors of the nuclear magnetic resonance signal of about -14 for hyperpolarized contrast agents under flow conditions and -98 for stationary condition.
- Avoidance of excessive heating of the contrast agent by forming a microwave mode.
- Wide range of possible hyperpolarizable contrast agents (^{1}H, pyruvate or other isotopes)

Project Status

Patents have been granted in Germany (DE102010017568), the USA (US9,554,726) and Japan (JP5901621). A patent application in Europe (EP2585843) is pending.

Owner of the IP rights is the Goethe University Frankfurt am Main.

A prototype of the invention has been designed and tested.

The technologies can be licensed or assigned. Moreover, collaborations regarding further development are welcome.

Contact

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