

## **Echoes: A circle from the past to the future**

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While NMR spectroscopy can largely do without echoes, other manifestations of NMR cannot. The primary ones are NMR imaging and NMR relaxometry. Both are central topics of the International Conference on Magnetic Resonance Microscopy. The spectroscopic echo has been discovered by Erwin Hahn and interpreted in terms of time reversal limited by entropy. Echoes are partially blurred mirror images of the past, whereby the irreversible blurring arises from random thermal motion. This lecture echoes personal encounters with echoes generated by nonlinear interference of the response to continuous random excitation, with echoes to probe rotational molecular motion in solids, with solid echoes for line narrowing in spectroscopy, and with gradient echoes for space and flow encoding in MRI. Moreover, echoes enable NMR with simple magnets that do not provide homogeneous magnetic fields. These magnets can be made small, so that the discovery of the echo has led to the miniaturization of NMR magnets and eventually to mobile and to compact NMR instruments. Today's compact NMR spectrometers will become even smaller so that the discovery of the echo has stipulated the development of miniature chemical NMR sensors capable of functioning without echoes.