Of MOUSE and Men: Single-sided NMR in Cultural Heritage

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Nuclear Magnetic Resonance (NMR) is an extraordinary powerful technique for gathering detailed chemical and structural information on a wide range of samples. However, its utility is limited by its tremendous cost and requisite expertise, its fixed placement in a research lab, and severe limitations on sample sizes. New NMR devices, using permanent magnets, can circumvent many of the problems associated with typical NMR experiments. In particular, these devices are single-sided sensors, meaning they can probe samples in a non-destructive, contact-free manner, and they are portable, able to be taken to excavation sites and museums for in situ measurements of cultural heritage objects.

We introduce one single-sided NMR sensor, the NMR-MOUSE (**MO**bile **U**niversal **S**urface **E**xplorer), which has been used in the measurement of many objects of cultural heritage, including paintings, parchment, paper, frescoes, and building materials. The theory and technique of single-sided NMR is presented in context of heritage objects, including measurements of signal intensity, depth profling, relaxometry for the characterization of hardness of materials, and measurements of self-diffusion. In addition, some sample measurements on the curing of paint and the evaluation of the structure of different types of frescoes are presented.