Characterization of NIST/ISMRM MRI System Phantom

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An MRI system phantom has been developed through collaboration between the ISMRM ad-hoc committee on Standards for Quantitative Magnetic Resonance and the National Institute of Standards and Technology (NIST). This will be the first system phantom with SI-traceable components and the first to be monitored by NIST for stability and accuracy. The system phantom, as shown in Fig. 1, is a 200 mm spherical phantom which consists of the following elements: fiducial, *T1*, *T2*, and proton density arrays; resolution, slice profile, and SNR insets. The system phantom is designed to assess scanner performance and quantitative mapping protocols and to easily compare performance with other scanners across the world. Two prototype system phantoms have been imaged extensively at Massachusetts General Hospital and M D Anderson Cancer Center in a variety of 1.5 and 3T scanners. A characterization of the *T1* array using inversion recovery (IR), variable repetition time (VTR), and variable flip angle (VFA) is shown in Fig. 2. Systematic differences in *T1* and *T2* measurements can be identified as a function of protocol and scanner type. Community input is being solicited before the system phantom goes into production and general distribution.

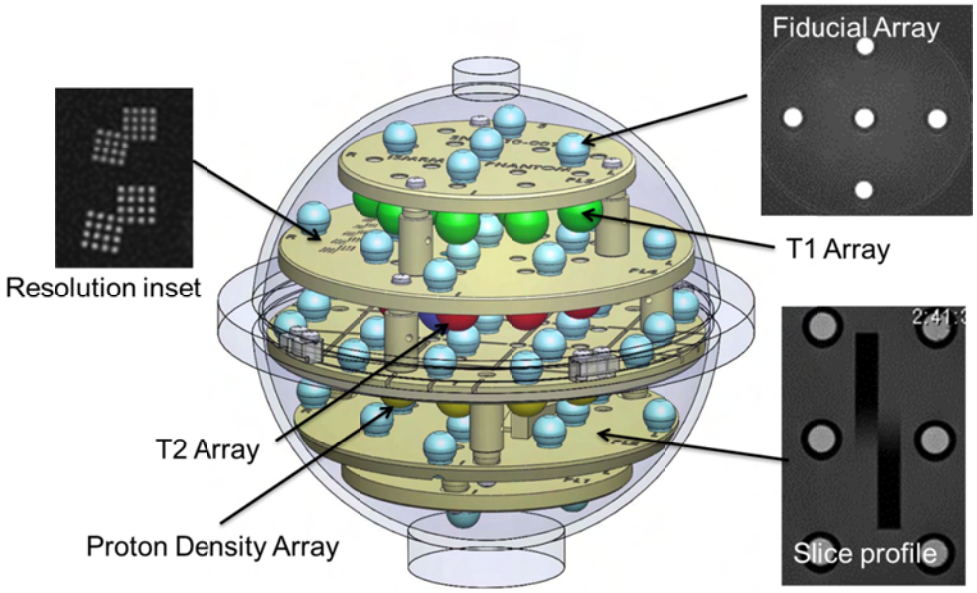

Figure 1 Schematic of system phantom showing *T1*,*T2*, *PD* arrays, resolution and slice profile insets. The 200 mm spherical form allows imaging in most new multichannel head coils. Low cost construction techniques are being developed to allow production at modest cost while maintaining accuracy and stability.

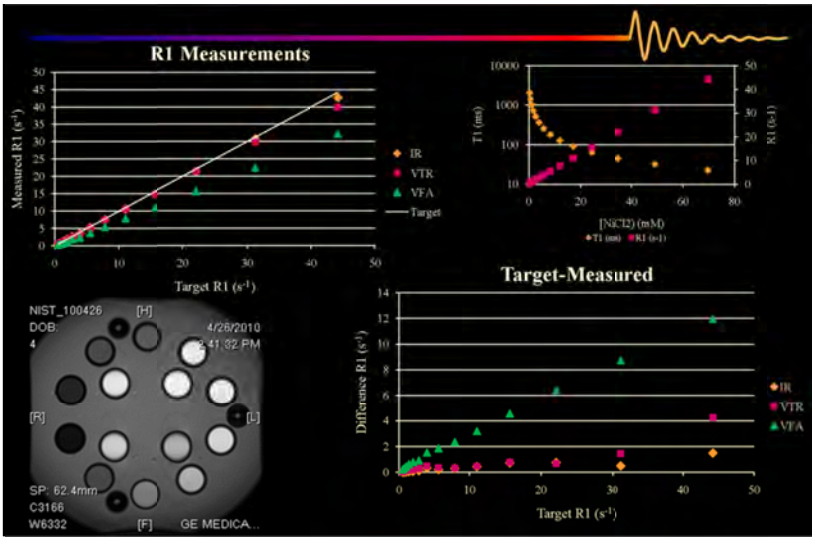

Figure 2 Characterization of the 14 element *T1* array using IR, VTR, and VFA sequences. The *T1* and *T2* arrays cover a large range with *R1* from 0.5 s^{-1} to 45 $s^{-1}$and *R2* from 1.4 s^{-1} to 125 s^{-1}. The solution compositions are verified using inductively coupled plasma mass spectrometry using NIST standard reference materials for SI-traceability. The relaxation times are verified using a NIST variable field NMR system on cassettes of reference samples sealed in quartz tubes.