An endorectal dual frequency 13C-1H receive only probe for operation at 3.0 tesla

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Introduction and Background: NMR of low gamma nuclei in prostate has focussed mostly on phosphorus (*1, 2*); but with the advent of technology for hyperpolarization of isotopically enriched metabolites (*3*), carbon is now also feasible. We therefore report development of an endo-rectal dual tuned carbon-proton receive-only antenna for human prostate at 3.0 T, intended particularly for studies with hyperpolarization, but also affording in the same exam conventional proton images and spectra of diagnostic quality. The device comprises separate radiofrequency receiver coils for each of its two channels, each coil with an active pin diode circuit for blocking an external transmitter at its own operating frequency, as well a passive block at the operating frequency of its neighbor coil. The mechanical body (cf Figs 1a and 1b) is of solid delrin, for re-usability and to minimize susceptibility effects (*4*). A novel circuit layout minimizes extraneous losses by placing all matching and decoupling components proximal to the actual receive coils, so that sections of unmatched transmission line are altogether avoided. Aside from the passive parallel trap for protons, the carbon circuit (Figs 1c and 1d) is a conventional receive-only surface coil design, with shunt match and pin-diode activated trap for transmit blocking. The proton circuit on the other hand (Figs 1e and 1f), uses series match with unconventional inductive imbalance, for the purpose of maximizing the value of the active trap inductor, which would be too small with coventional shunt matching.

Results: Figure 2 shows network analysis of the device, showing good impedance matching at each frequency, and good isolation (> -22dB) between the channels, despite the parallelism and proximity of the coils. Sample images and spectra (from phantoms) were acquired on GE Signa scanners, and are shown in Figs. 3 and 4; for the proton images, excitation was by means of the normal system body coil; for carbon, a special bore-insertable volume resonator was used for excitation.

.**References**:

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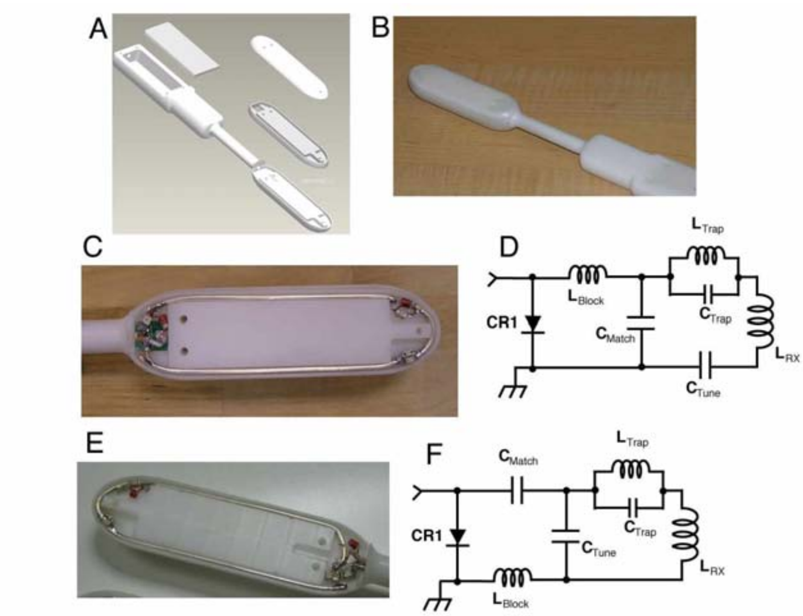

Fig. 1: Mechanical and electrical details. Note circuit components labelled by function.

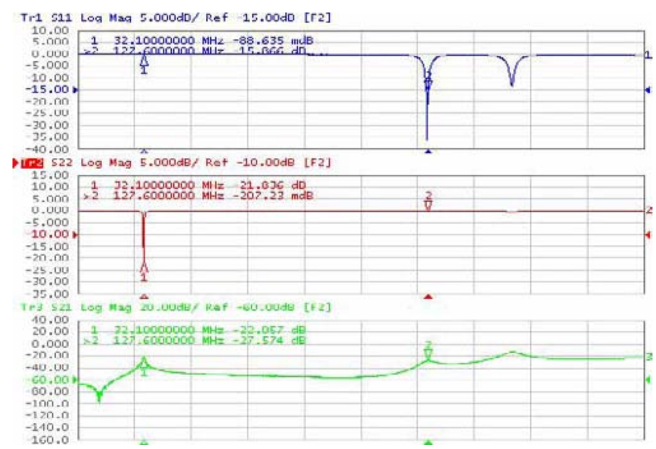

Fig. 2: Network analysis – matching and inter-channel isolation – of device loaded in axila of normal volunteer. Top: 1H match, middle: 13C match, bottom: isolation

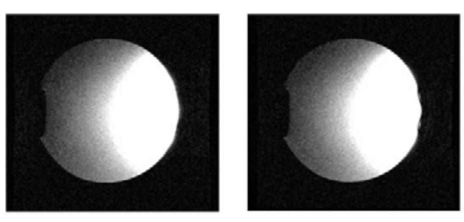

Fig. 3: Sample saggital phantom images from proton channel.

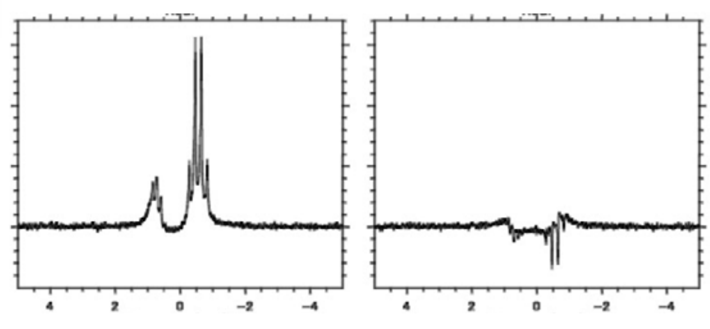

Fig. 4: Signal nulling (pi pulse) from carbon receive channel with external volume transmitter.