

# High SNR Dual Tuned Sodium/Proton Knee Coil

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## INTRODUCTION

Sodium MRI imaging has shown potential in human patellar articular cartilage imaging, clearly distinguishing areas of proteoglycan depletion from areas of healthy cartilage (1). It would also be desirable to perform 1H proton imaging of these regions in the same study without requiring a change of RF coil during the study. A dual tuned cylindrical volume coil capable of imaging 23Na sodium and 1H proton would accomplish this.

## METHODS AND MATERIALS

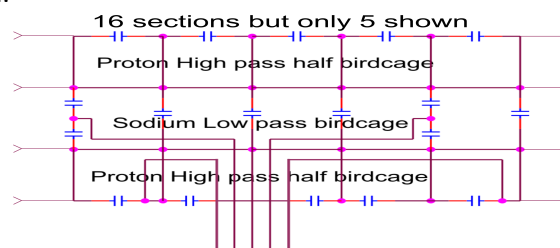
A four ring bird cage (2,3) was employed using a low pass topology for the central sodium section and a pair of high pass half birdcages for the outer proton sections. This has several advantages. First, the low pass sodium section design yields capacitors of lower values than a high pass design and preserves solid non resonant mid rings that are used in the proton half birdcage end sections. Also the combination of low pass center section and the high pass half birdcage end sections allows both sets of quadrature direct drive cables to be brought together to a common shield potential prior to exiting the coil, obviating the need for complicated and lossy baluns or cable traps (4).

## RESULTS

The design resulted in a 16 rung 4 ring birdcage that produced a substantially uniform field at 33.78 MHz and 127.78 MHz, corresponding to sodium and proton NMR frequencies at 3 T. The sodium and proton sections both operated with high efficiency and uniformity with minimal interaction. The proton images had some sensitivity enhancement at the end sections with respect to the center section. The ratio of  $Q_{\text{unloaded}}/Q_{\text{loaded}}$  was 346/61 for sodium and 74/8 for proton. This demonstrates high efficiency and sample noise domination.

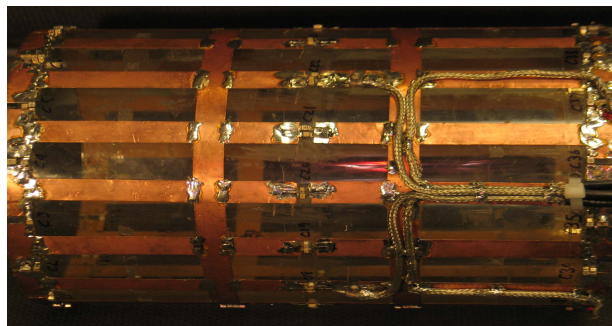
### References :

- (1) Sodium MRI of human articular cartilage in vivo Reddy et.al MRM Vol 39,5 p 697-701 Dec 2005
- (2) Design and evaluation of a novel dual-tuned resonator for spectroscopic imaging, K. Derby, J. Tropp, C. Hawryszko, J. Magn. Reson. 86 (1990) 645-651.
- (3) Two configurations of the four-ring birdcage coil for 1H imaging and 1H-decoupled 31P spectroscopy of the human head. Murphy-Boesch J, et.al. J Magn Reson B. 1994 Feb;103(2):103-14.
- (4) US Patent #4887039 - Method for providing multiple coaxial cable connections to a radio-frequency antenna without baluns, Roemer & Edelstein



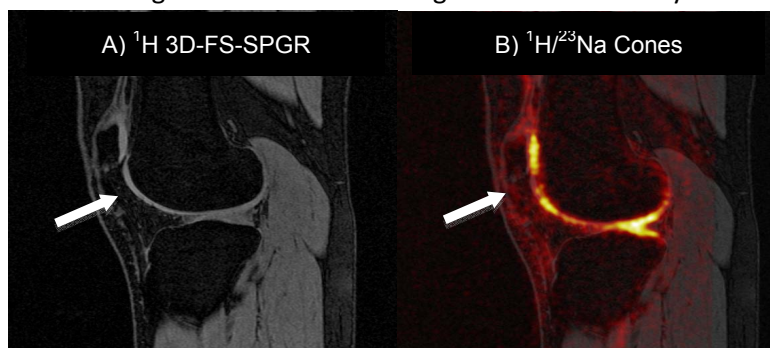
Schematic of 16 rung dual tuned birdcage

Photo of actual coil prototype showing feed lines



1H image

1H image with 23Na overlay



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