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Phosphorus-31 MRI of cell membranes using quadratic echo line-narrowing SEAN BARRETT, MERIDETH FREY, Yale University Physics Dept., JOSEPH MADRI, MICHAEL MICHAUD, Yale University, School of Medicine Dept. of Pathology — Soft biological tissues have phosphorus concentrated in the membranes, metabolites, RNA and DNA of cells. This leads to a complicated, multi-peak ^{31}P nuclear magnetic resonance spectrum (including a broad membrane peak and narrow metabolite peaks), which precludes high-resolution ^{31}P MRI of soft tissues. This long-standing barrier has been overcome by a novel pulse sequence - the quadratic echo - recently discovered in fundamental quantum computation research. Applying time-dependent gradients in synch with a repeating pulse block enables a new route to high spatial resolution, three-dimensional ^{31}P MRI of the soft solid components of cells and tissues. This is a functionally different kind of MR image, since conventional ^{1}H MRI probes the intracellular and extracellular free water, whereas our ^{31}P MRI signal is dominated by the cell membrane contribution, which in turn depends on the density of mitochondria. The unique aspects of the signal should provide new insights into cellular and tissue function that compliment the information revealed by ^{1}H MRI. So far, various *ex vivo* soft tissue samples have been imaged with (sub-mm)^3 voxels. We will describe plans to enhance the spatial resolution in future work, to open a new window into cells.

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