# Sensitivity enhancement in breast tumor imaging with MultiCRAZED experiments

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## INTRODUCTION

Recent studies have demonstrated image detection based on intermolecular multiple quantum coherences (iMQC ).In vivo and in vitro MRI experiments using iMQC (e.g., zero-quantum iZQC and double-quantum iDQC) detection give interesting and novel contrast[1-6]. Such signal provides information on the microscopic tissue structure with spatial resolution better than that commonly available with conventional SQC MR imaging.

Many sequences have evolved in modern iZQC/iDQC experiments based on CRAZED type sequence and Mod-CRAZED. We have recently developed an experimental method, "multiCRAZED" pulse sequence, to collect three iMQC orders (2, 0, -2) and two conventional images in a single pulse sequence[7]. The combination of five images dramatically reduces coregistration issues and permits clean separation of iMQC contrast differences. The purpose of this study is to assess the usefulness of the multiCRAZED in the contrast enhancement

## METHOD

We applied this method in-vitro and in-vivo to characterize novel contrast agents: LHRH (luteinising hormone-releasing hormone)-conjugated nanoparticles targeted to breast tumors. These conjugated nanoparticles represent a new generation of contrast agent that accumulates in breast cancers cells grown in nude mice. Female nude mice are inoculated at age 6 weeks with 0.5 million MDA-MB-435S human breast cancer cells. After 28 days (tumor weight approx. 600 mg), the mouse receive a 350 mg/kg of suspension of LHRH- conjugated nanoparticles or saline, injected into the interscapular region. A series of images acquired in vivo and in vitro with the new method are compared to the standard images

## RESULTS

Figures 1 and 2 represent our previous work in-vitro: standard and multiCRAZED images of a tumor region necropsy, 22hours after injection with the nanoparticles suspension (left tumor in each image) or saline (right). The nanoparticles clusters have a high R2/R1 relaxivity ratio, which causes significant anisotropy in the induced field. The principal effect on the iMQC signal comes on variations in the apparent resonance frequency. Such effects are also seen in the standard $T_2$ or $T_2^*$ weighted images (Fig 1), but are clearly more emphasized with the multiCRAZED imaging methods (Fig 2).

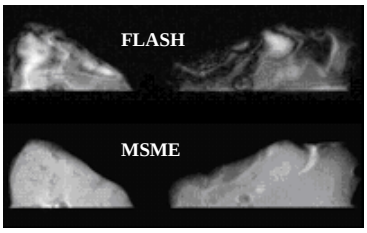


Figure 1: Standard SQC images: $T_2^*$ (FLASH) and $T_2$ (MSME) weighted.

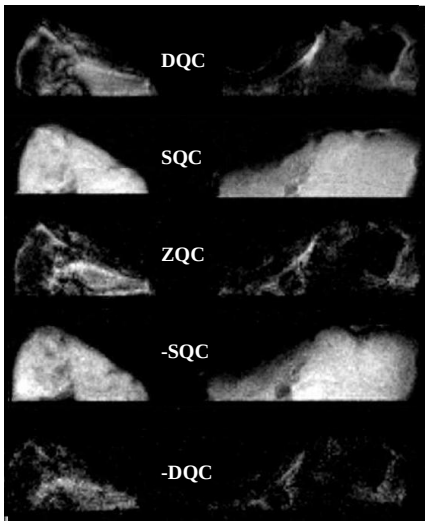


Figure.2: Multi-CRAZED images of a mouse breast tumor embedded with nanoparticles. Unlike the SQC sequence, the multi-CRAZED sequence enhances the contrast between regions with and regions without **nanoparticles.**

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