

# Specific detection of HER-2 positive tumors in mice using superparamagnetic relaxometry (SPMR)

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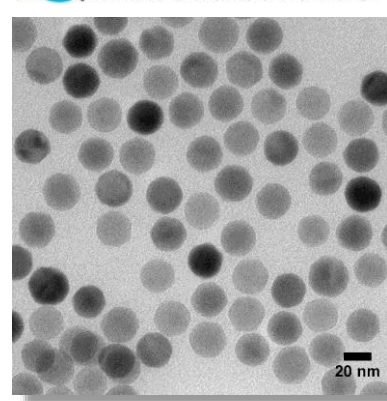
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## Introduction

- The MagSense™ platform consists of superconducting quantum interference devices (SQUIDs) to detect tumor-targeted PrecisionMRX® nanoparticles (NPs) that are specifically bound to cancer cells.
- The detection relies on SQUIDs high sensitivity to magnetic field produced by the superparamagnetic relaxation (SPMR) of the NPs.

PrecisionMRX<sup>™</sup>  
NANOPARTICLES

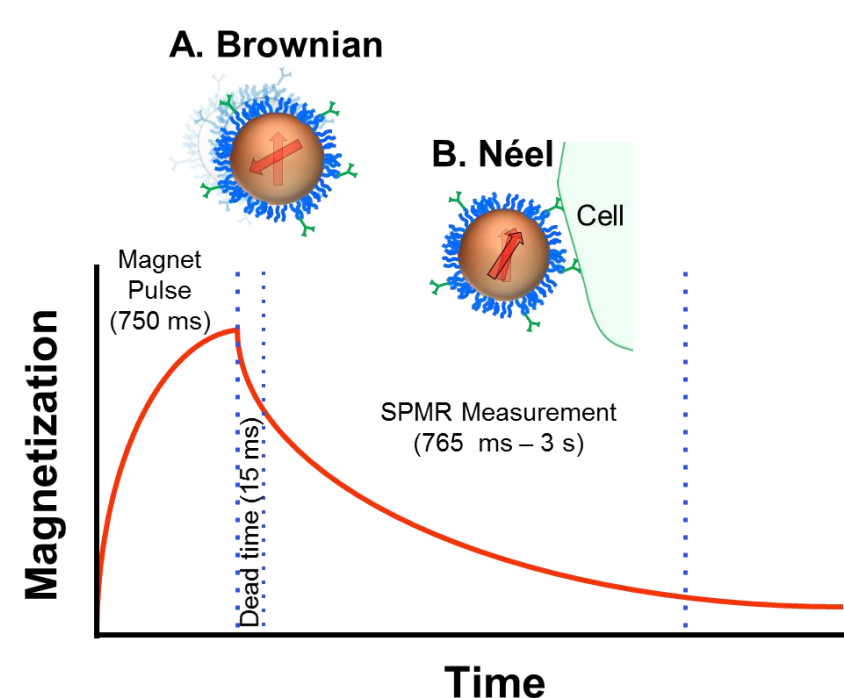


Conceptual MagSense™ clinical instrument

## Objectives

- Imagion Biosystems, Inc. is developing the MagSense™ platform for the sensitive and specific detection of HER2-positive breast cancer.
- Preclinical studies will generate validation data for the first clinical trial, wherein the MagSense-anti-HER2 platform will be used to sensitively and specifically detect HER2-positive breast cancer.

## The SPMR Measurement



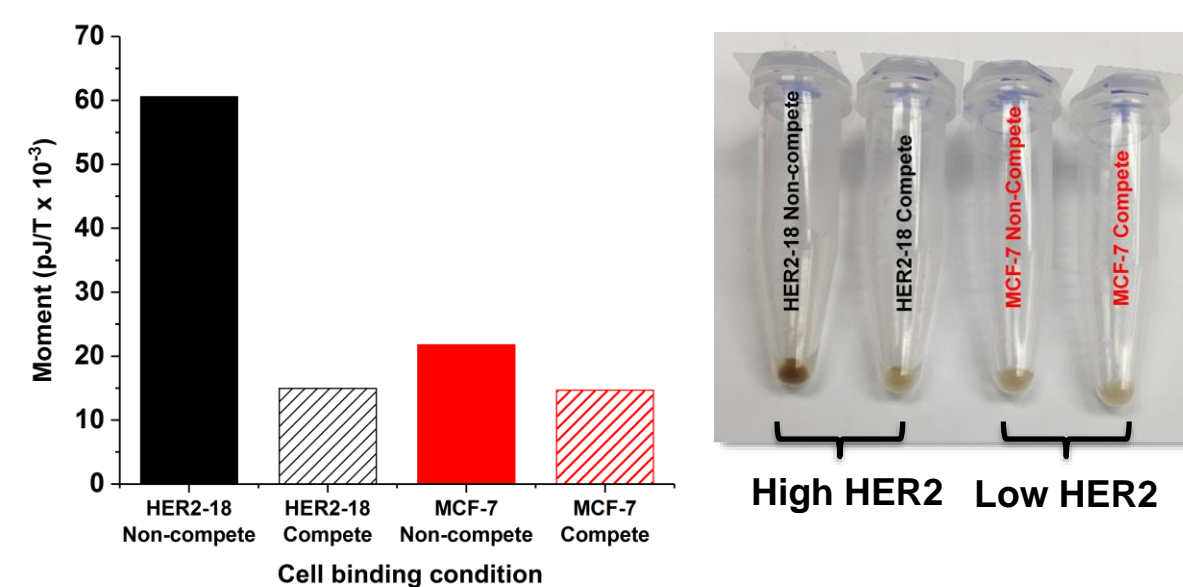
- Inject anti-HER2 NPs
  - Small magnetizing pulse is applied
  - Field turned off
  - NPs relax to their equilibrium states.
- Brownian** motion of unbound NPs (fast and undetectable)
  - Néel** relaxation of NPs bound to cells (slow and detectable)

SPMR only detects nanoparticles bound to cells/tissues

## Characterization of NPs

Analytical Test	Method
Particle Size	Small angle X-ray scattering (SAXS)
Hydrodynamic size	Dynamic light scattering (DLS)
Anti-HER2 Content	Direct ELISA
Specificity	Competition ELISA
Specificity	SPMR, digital photography
Stealth	Zeta potential, agarose gel electrophoresis

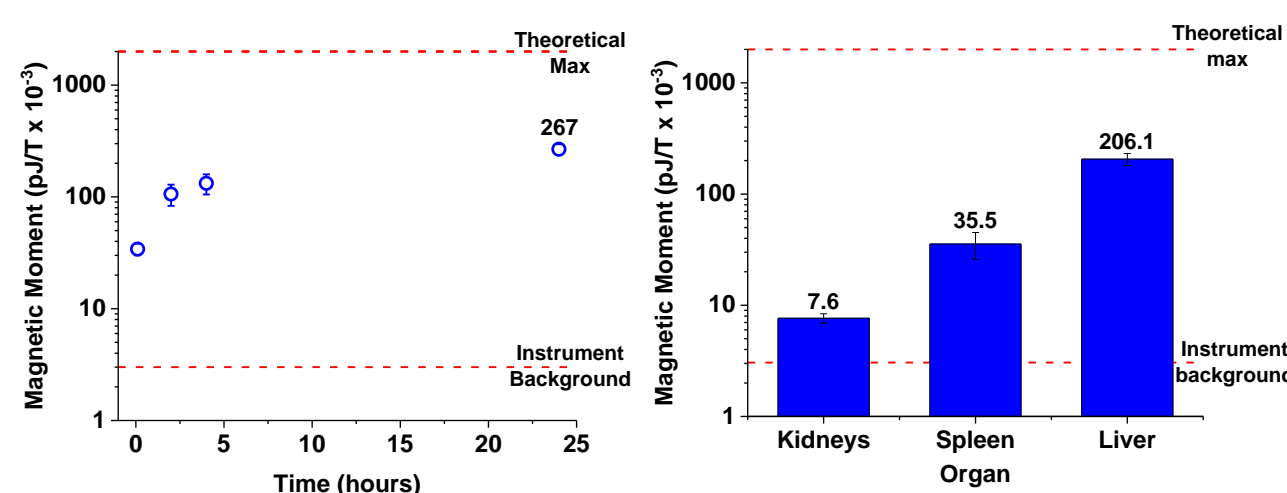
## In Vitro Pharmacology



- Competitive binding of anti-HER2 NPs can be correlated to HER2 cell expression

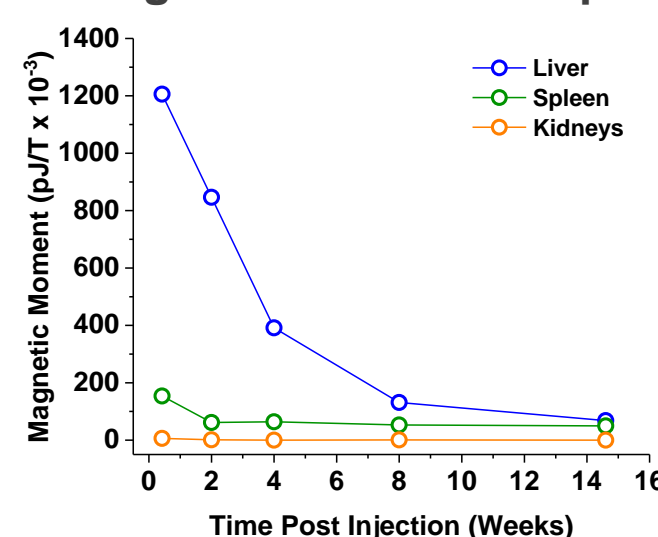
## In Vivo Pharmacology

400 µg PEG NPs injected intravenously

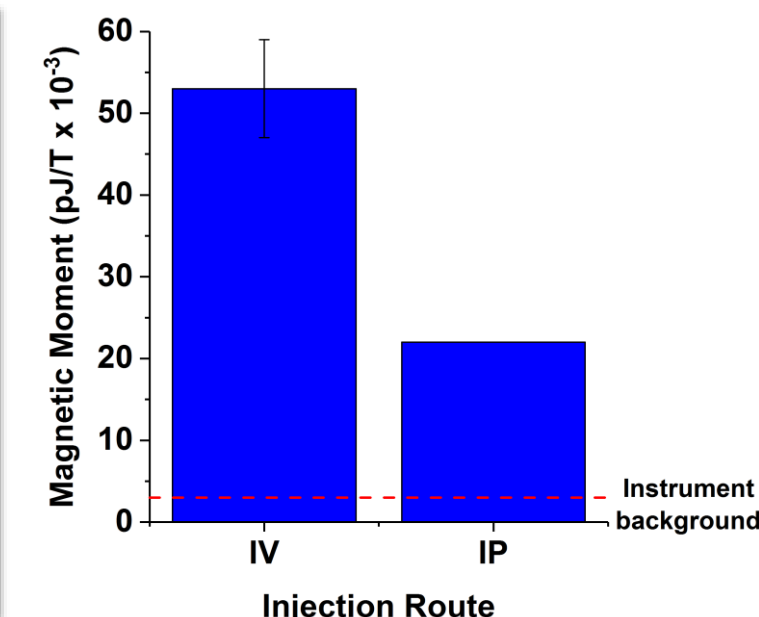
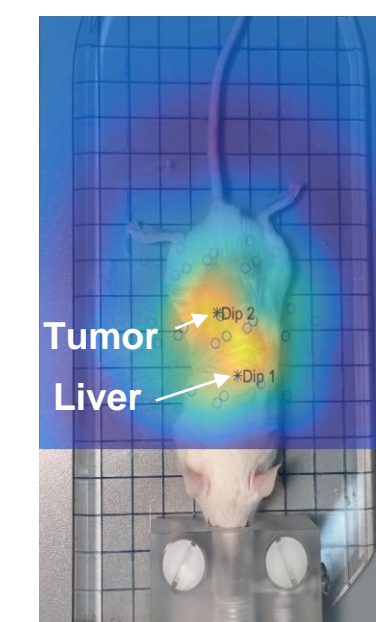


- In vivo SPMR: PEG NPs are ~10% of max signal after 24 hr.
- Ex vivo SPMR data shows distribution of NPs after 24 hr.

PEG NPs degrade 8 – 12 weeks post injection

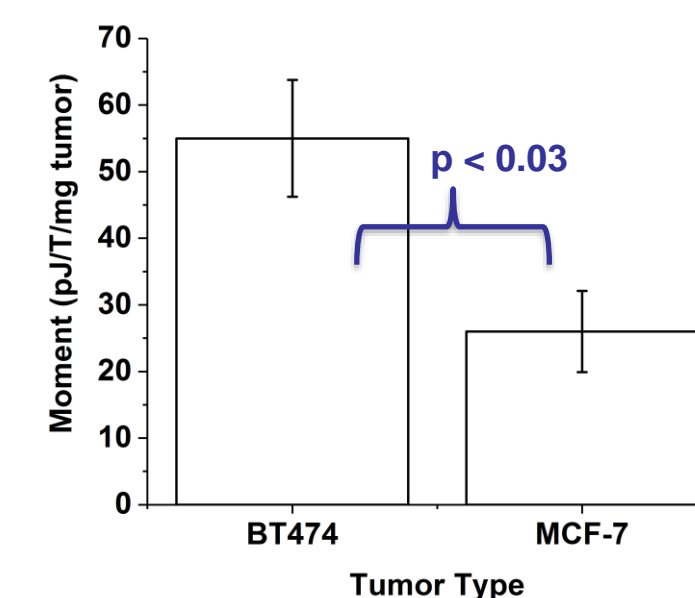


## In Vivo Diagnosis



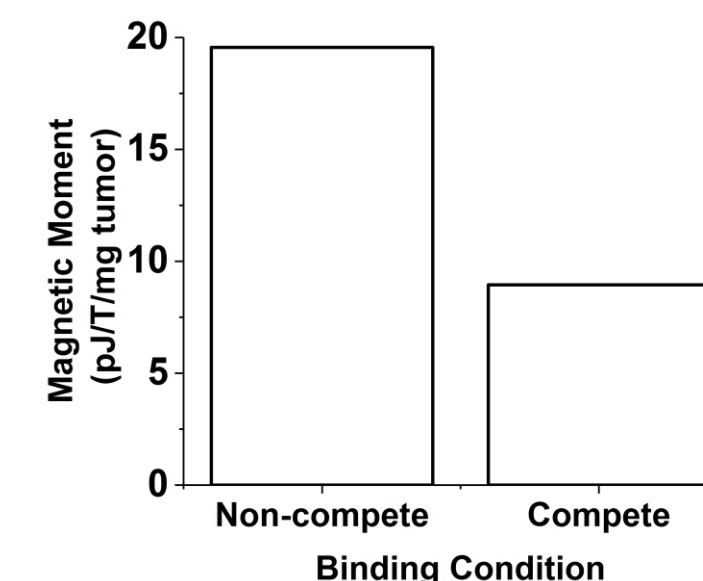
- 4% MSNP delivery to tumor – project detection of 2.5 mm<sup>3</sup> tumor in human

## In vivo specificity



- SPMR signal corresponds with HER2 expression in vivo

## In vivo competition



- ~50% competition of anti-HER2 NPs by native anti-HER2 antibody

## Conclusions and Future Work

- Developed anti-HER2 conjugated, PEGylated NPs that specifically bind to HER2 expressing breast cancer cells in vitro and in vivo and degrade within 8 – 12 weeks.
- Future work is focused on clinical translation of the MagSense™ anti-HER2 platform for detection of breast cancer metastases in the lymph nodes.



University of New Mexico  
Comprehensive Cancer Center