

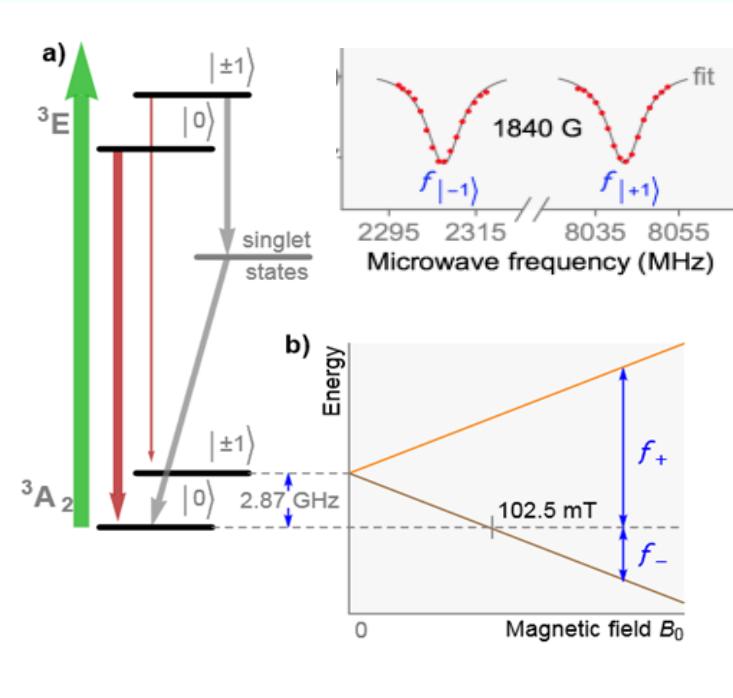
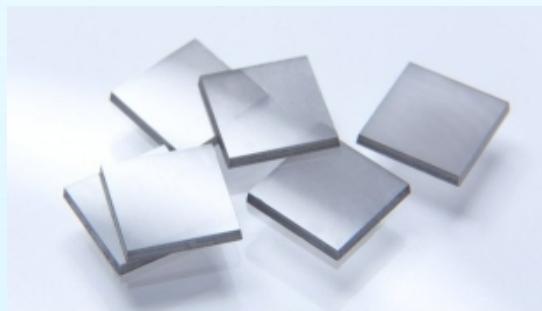
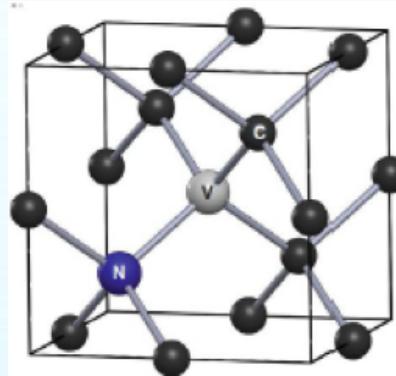
Authors: Nathaniel Ristoff (PhD Candidate in Physics), Victor Acosta (UNM), Dept of Physics, Sandia PI  
Name (Sandia, Org)



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## Introduction and Motivation

### Nitrogen vacancy (NV) center



*Diamond Magnetic Microscopy of Malaria Hemozoin Nanocrystals, Fescenko et al., 2019*

### NV sensing applications

- Squid neuron firing
- Mapping ferromagnetism
- Hemozoin magnetic properties
- NV center NMR

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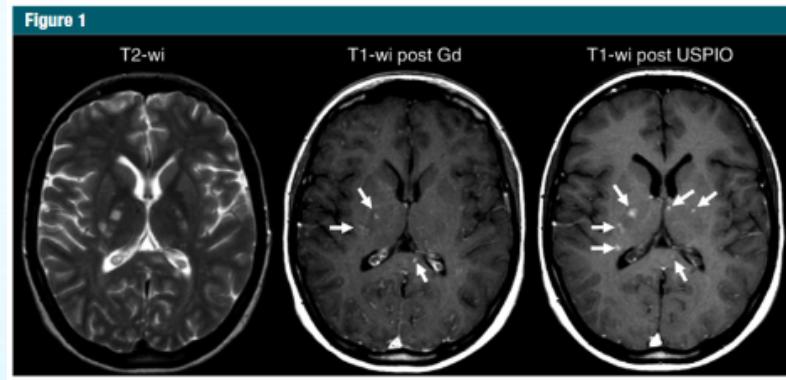


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## Motivation

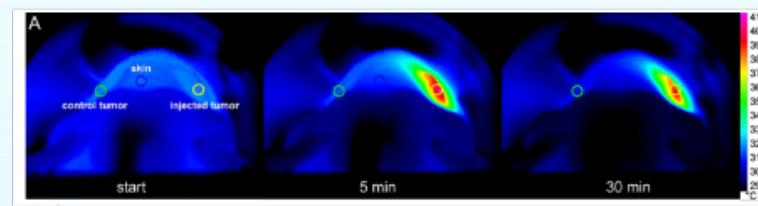
### Superparamagnetic iron oxide nanoparticle (SPION) applications

#### MRI imaging enhancement



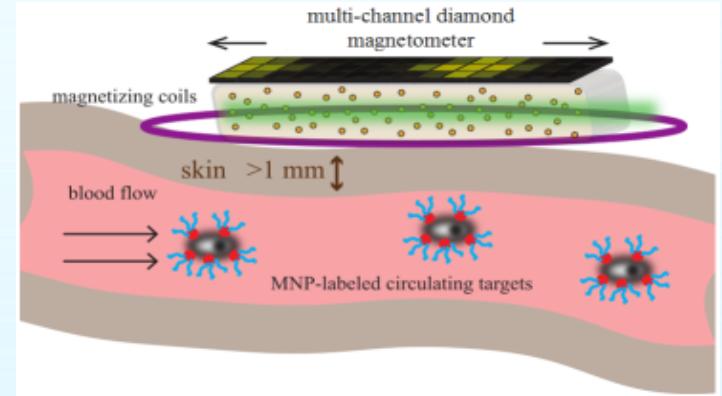
Assessment of disease activity in multiple sclerosis phenotypes with combined gadolinium- and superparamagnetic iron oxide-enhanced MR imaging, Tourdias T, Roggerone S, Filippi M, et al., 2012

#### Hyperthermia



Heat-Generating Iron Oxide Nanocubes: Subtle "Destructructors" of the Tumoral Microenvironment, Jelena Kolosnjaj-Tab et al., 2014

#### Magnetic particle imaging



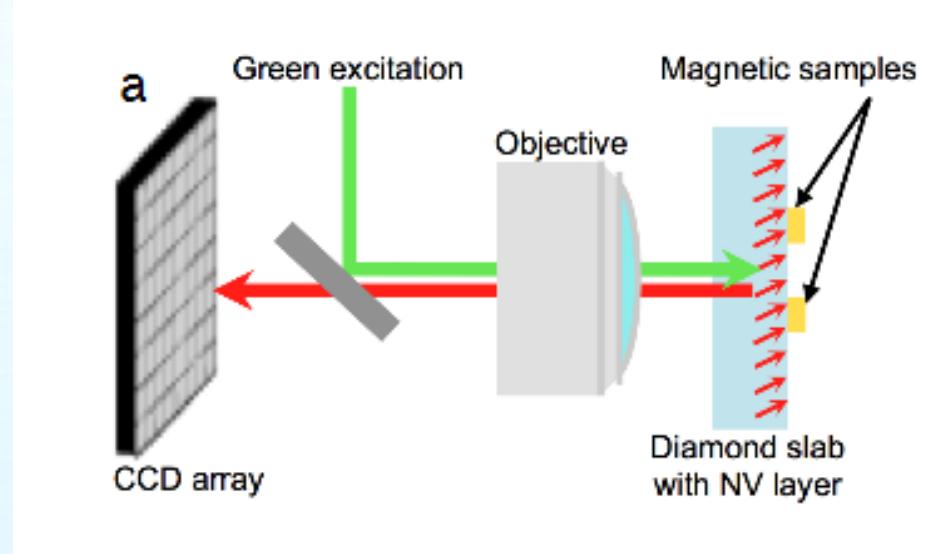
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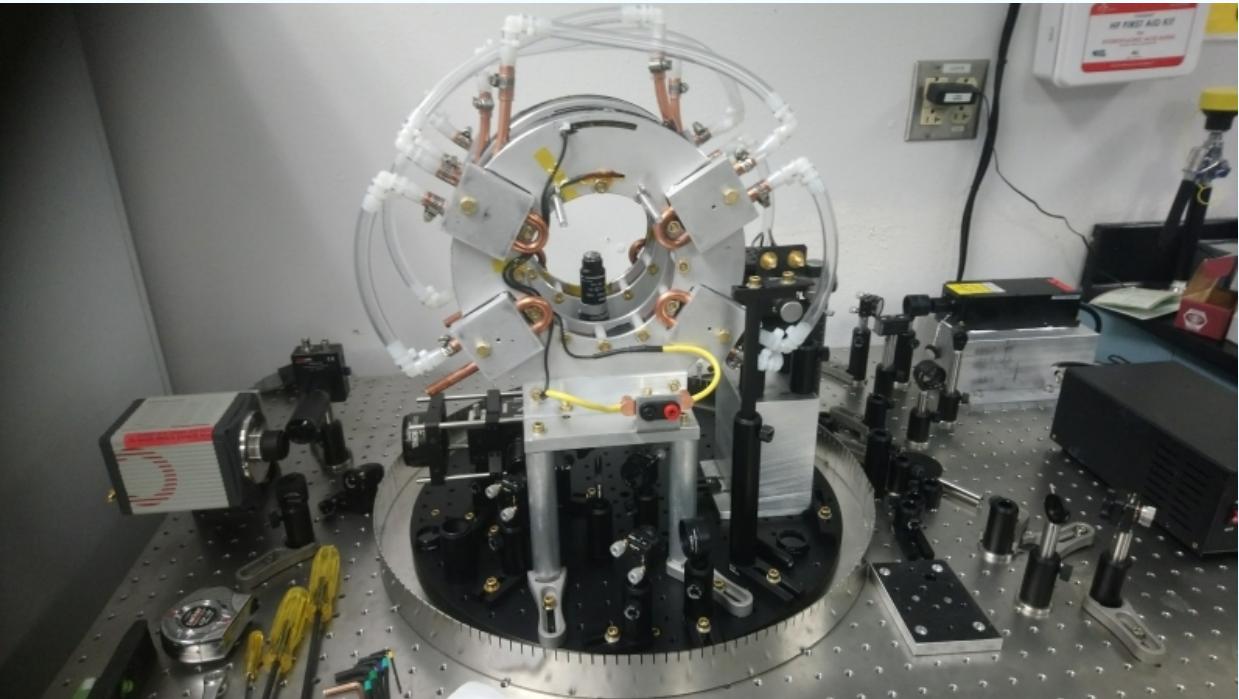
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## Approach

### NV center fluorescence microscope



[arXiv:1311.5214](https://arxiv.org/abs/1311.5214)

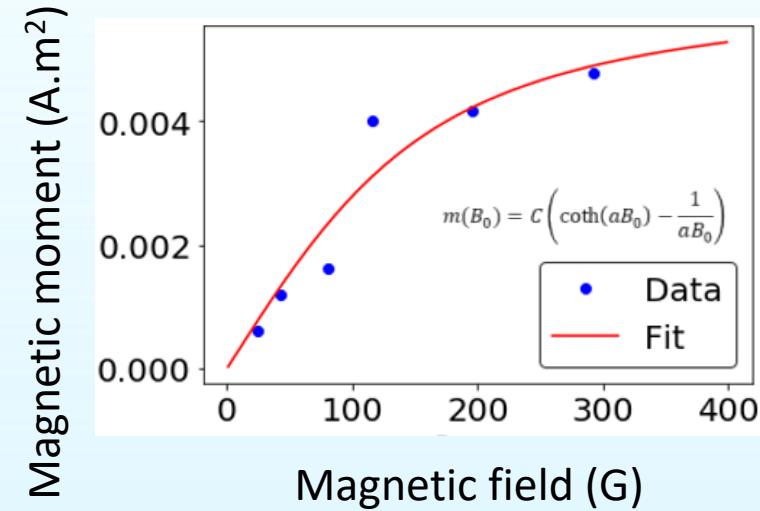
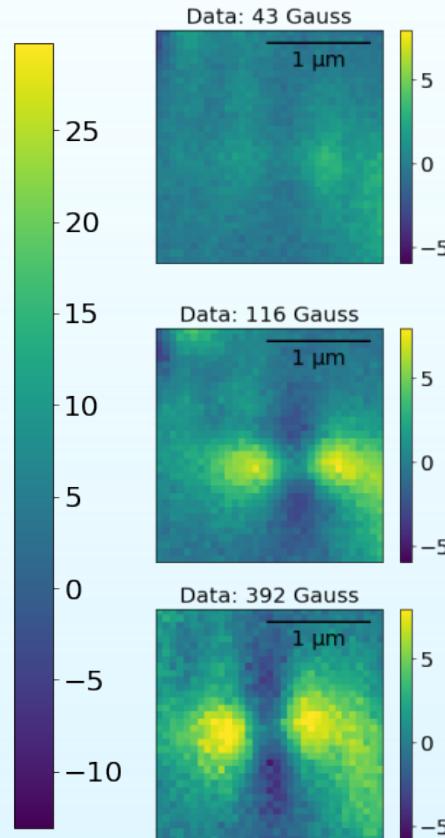
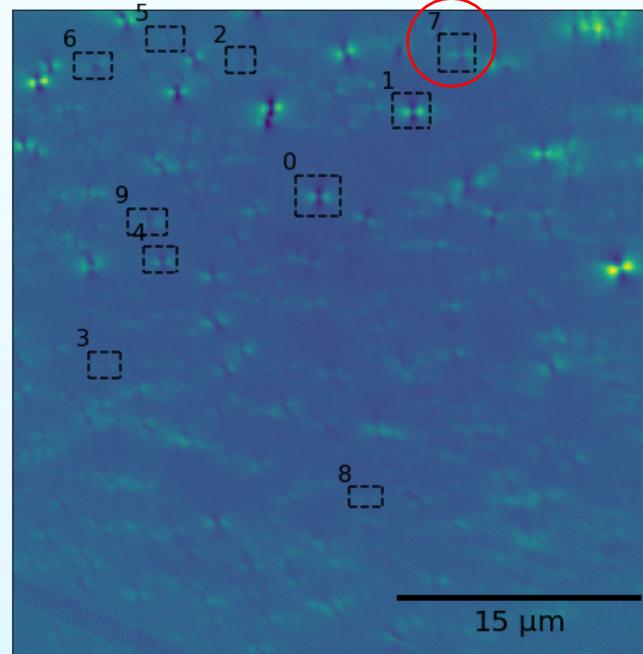


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## Current Status and Results



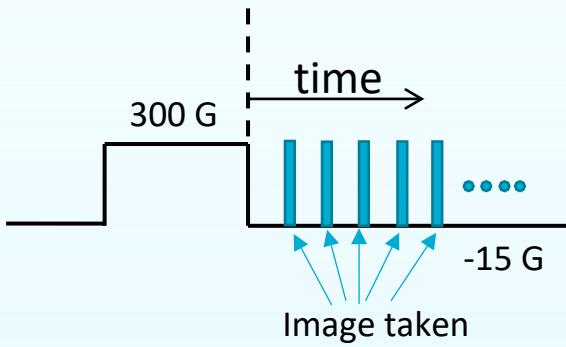
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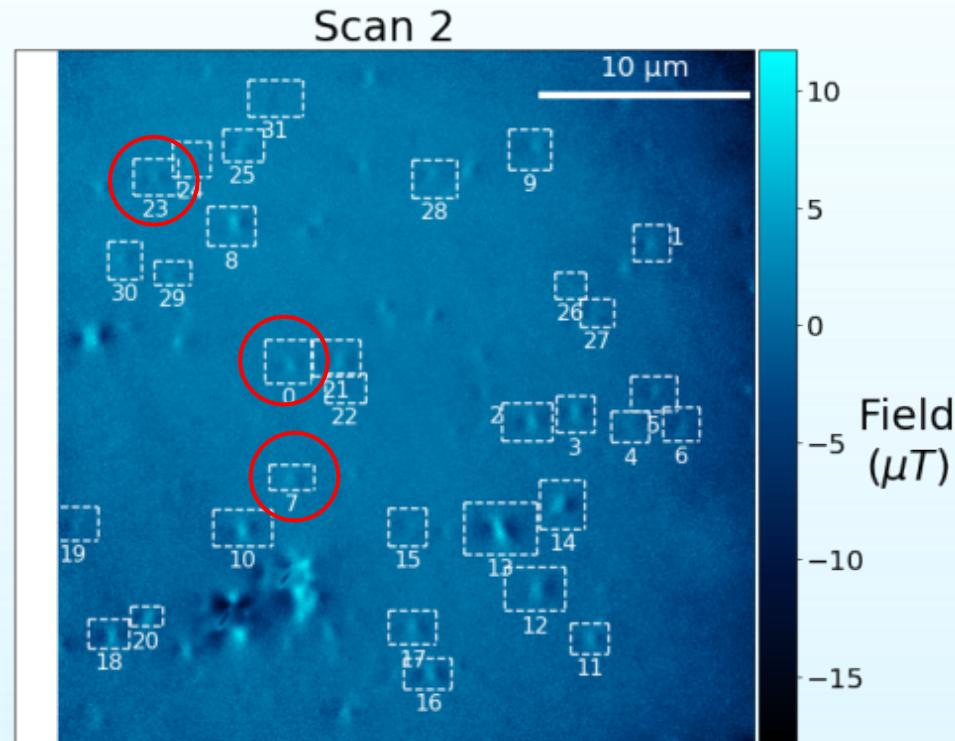
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## Current Status and Results

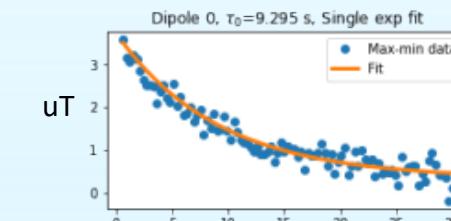
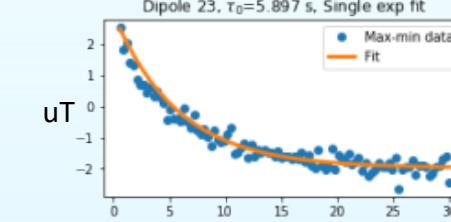
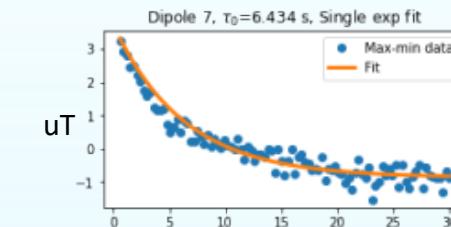
### Neel Relaxation Measurement



- Turn on field to polarize particles
- Turn off field
- Take images at regular intervals and record magnetic images



$$\tau_N = \tau_0 \exp\left(\frac{KV_c}{k_B T}\right)$$



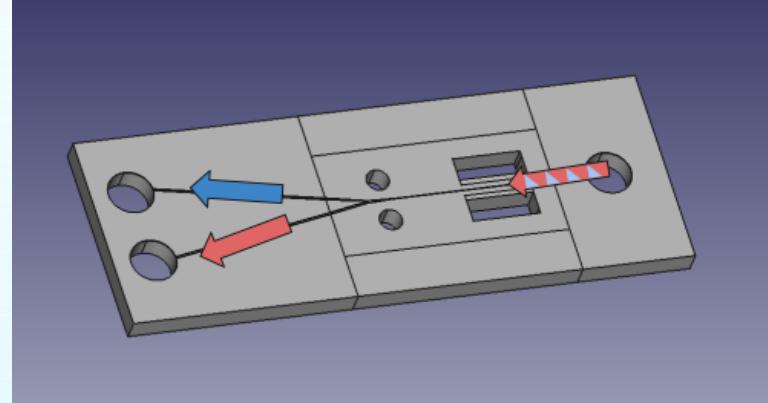
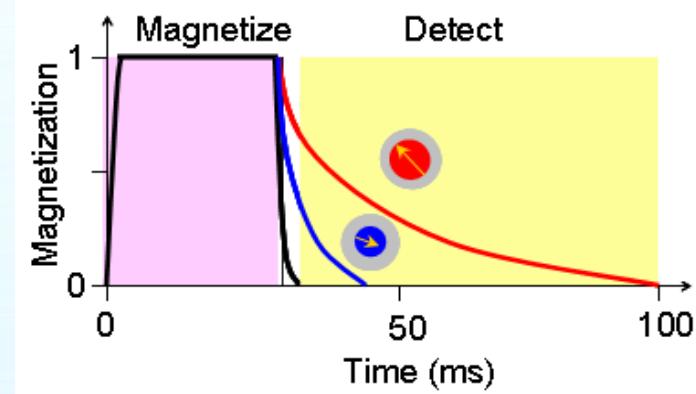
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## Impact of Work

### Super paramagnetic iron-oxide nanoparticles (SPIONs) for early cancer detection



Magnetic relaxometry:  
•external modulation  
•multi “colors”

Sort non-magnetic  
objects tagged with  
spions

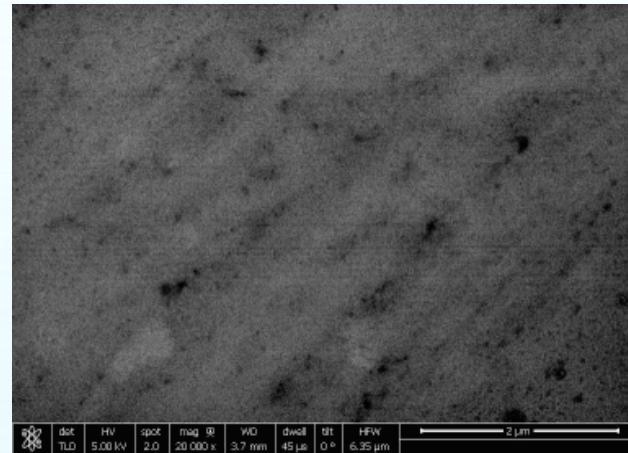
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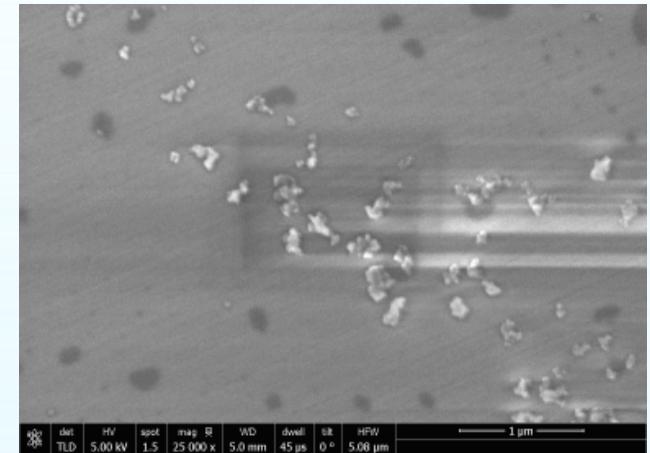
## Challenges and Risks / Next Steps and Future Work

- Produce diamond with optimal SPION density and distribution



Too few SPIONs

- Correlate SEM images with diamond microscope images



SPIONs in clumps