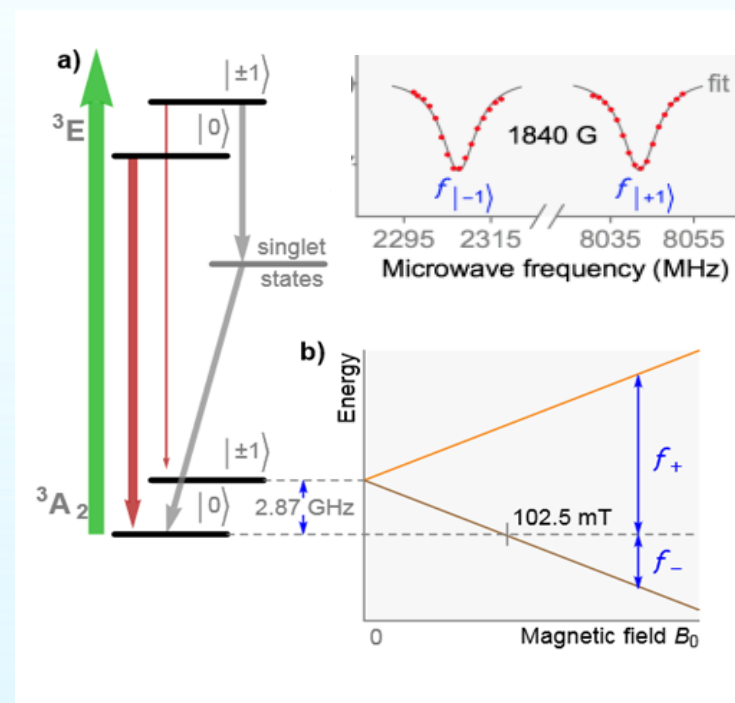
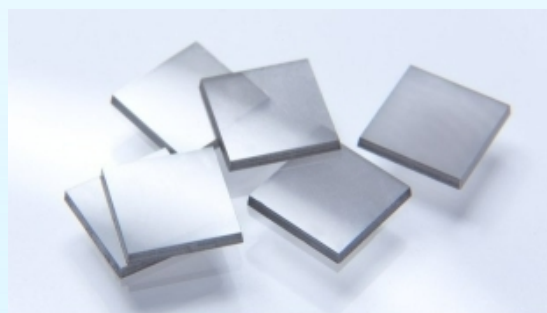
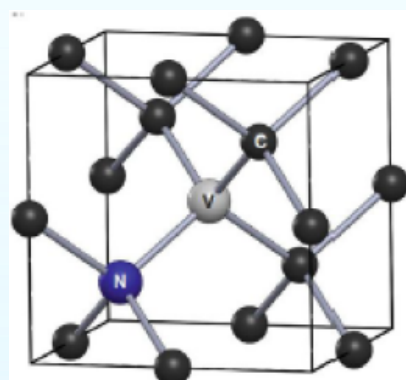


Authors: Nathaniel Ristoff (PhD Candidate in Physics), Victor Acosta (UNM), Dept of Physics, Sandia PI Name (Sandia, Org)

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## Introduction and Motivation

### Nitrogen vacancy (NV) center



### NV sensing applications

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

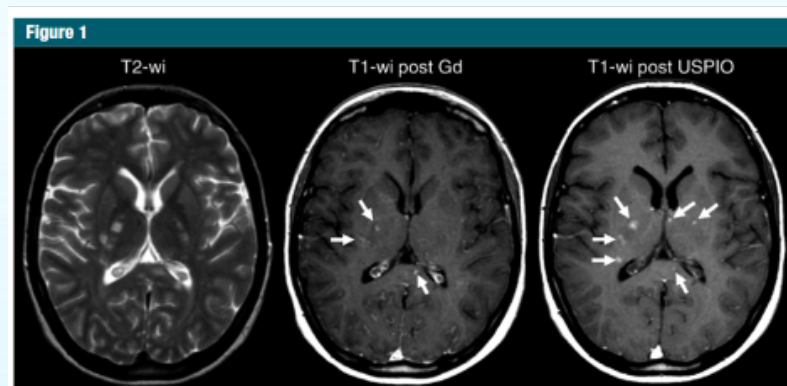
*Diamond Magnetic Microscopy of Malarial Hemozoin Nanocrystals, Fescenko et al., 2019*

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## Motivation

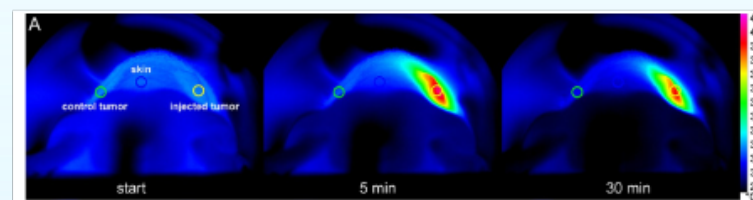
### Superparamagnetic iron oxide nanoparticle (SPION) applications

#### MRI imaging enhancement



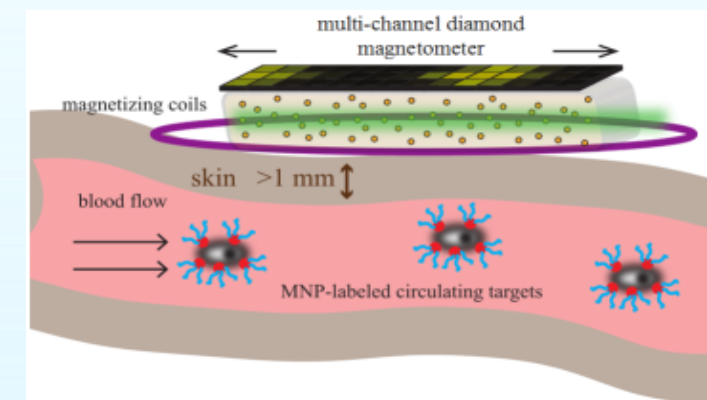
*Assessment of disease activity in multiple sclerosis phenotypes with combined gadolinium- and superparamagnetic iron oxide-enhanced MR imaging, Tourdias T, Roggerone S, Filippi M, et al., 2012*

#### Hyperthermia



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

#### Magnetic particle imaging



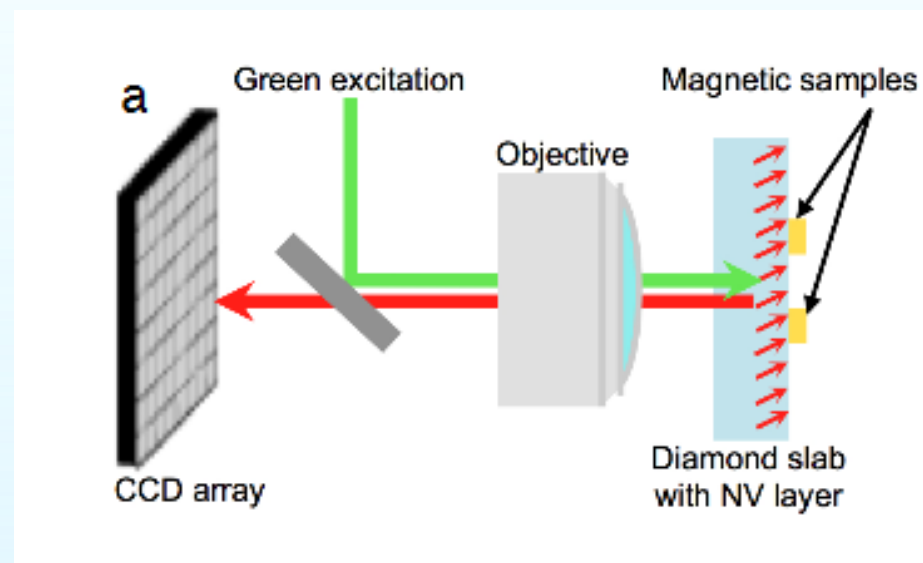


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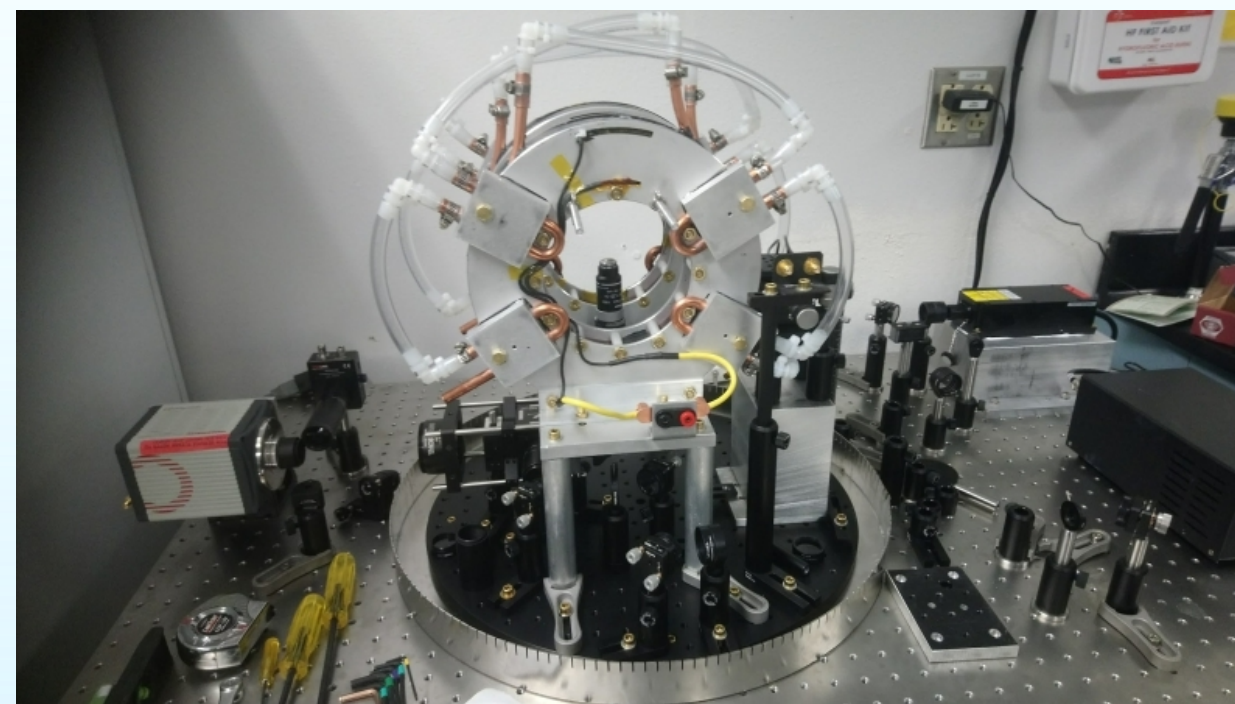
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## Approach

### NV center fluorescence microscope

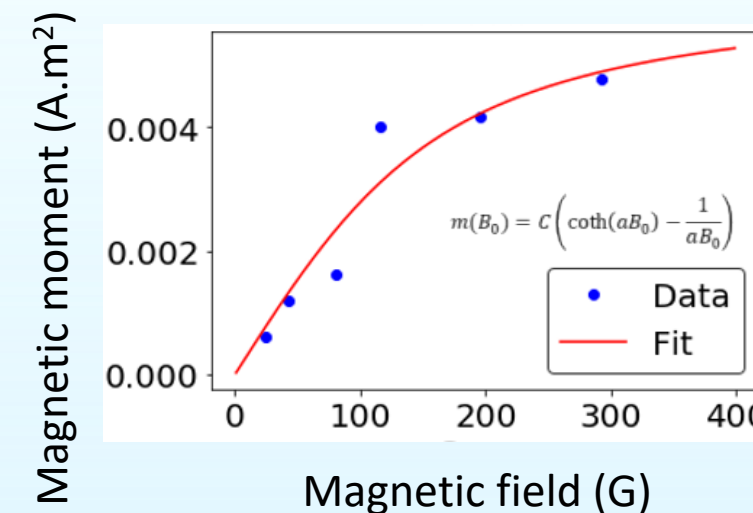
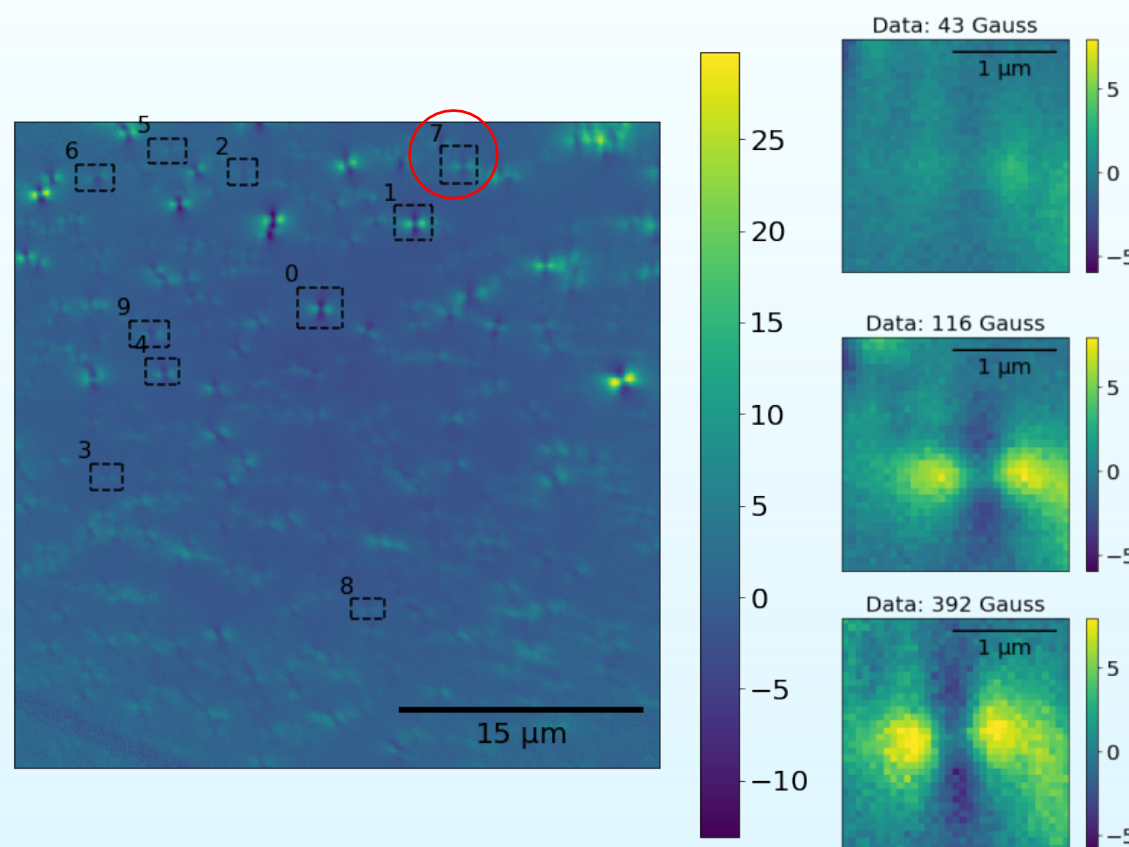


[arXiv:1311.5214](https://arxiv.org/abs/1311.5214)



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## Current Status and Results



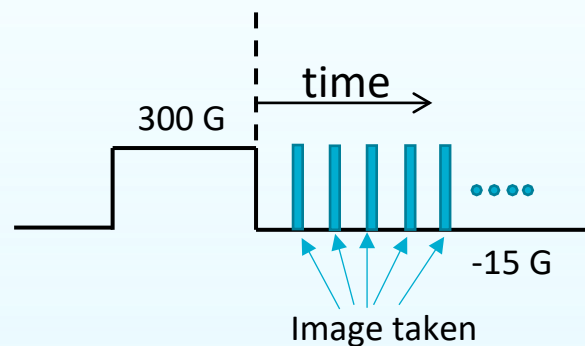


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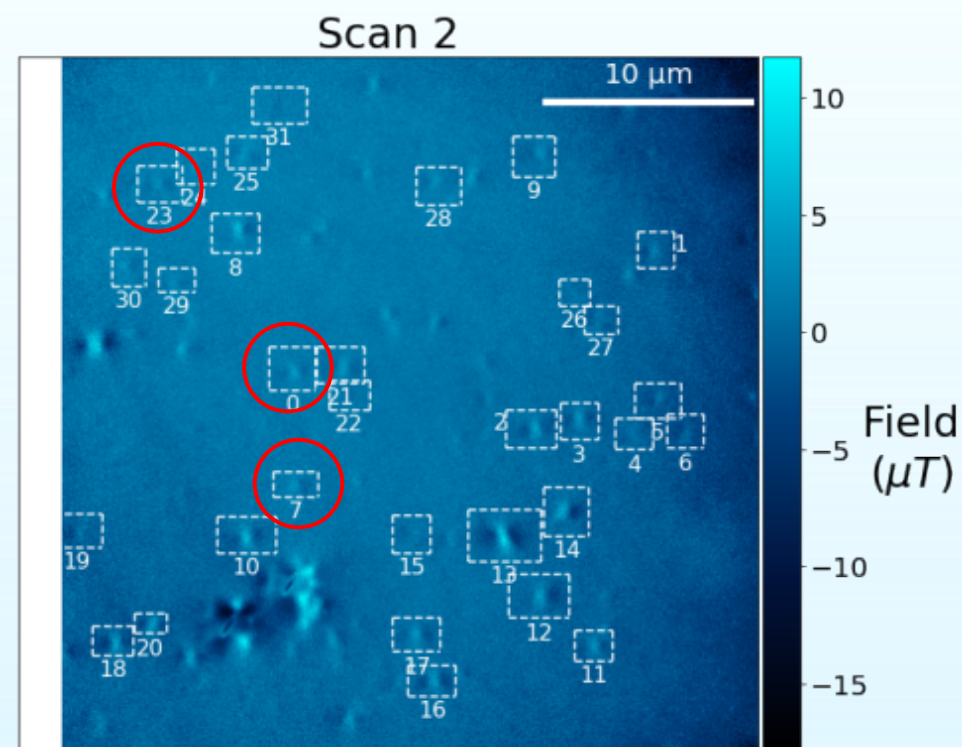
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## Current Status and Results

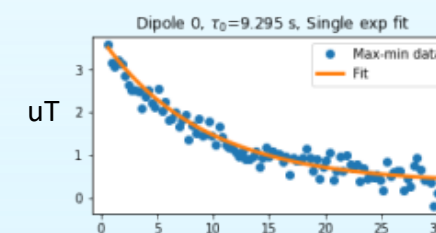
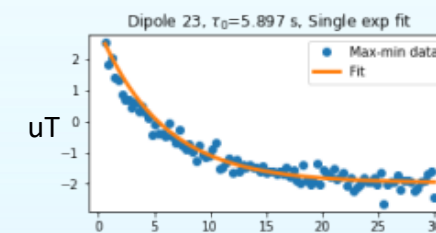
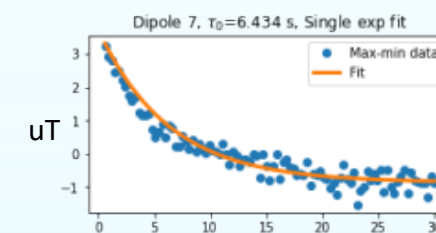
### Neel Relaxation Measurement



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



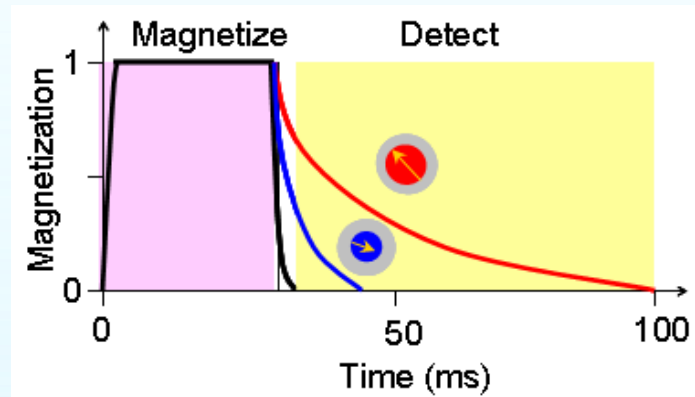
$$\tau_N = \tau_0 \exp\left(\frac{KV_c}{k_B T}\right)$$



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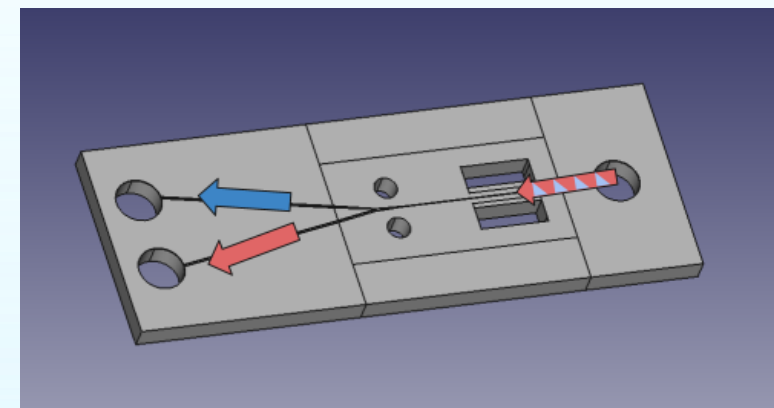
## Impact of Work

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



Magnetic relaxometry:

- external modulation
- multi “colors”



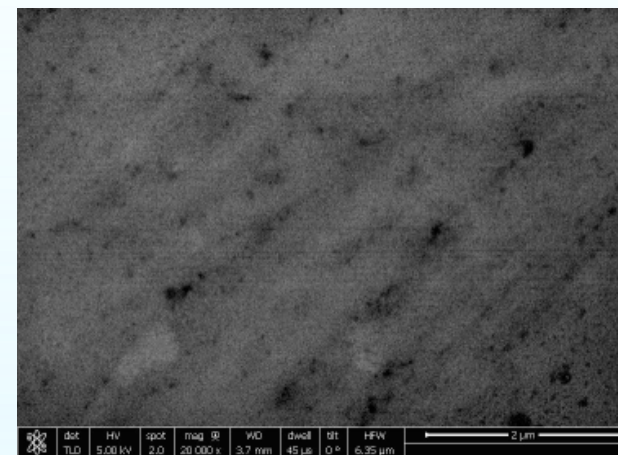
Sort non-magnetic  
objects tagged with  
spions

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Name (Sandia, Org)

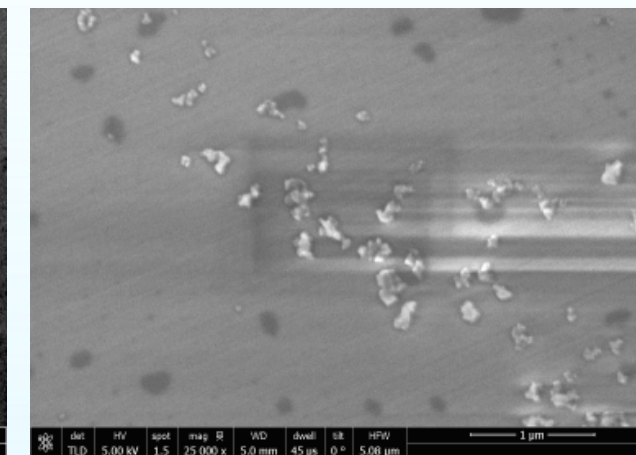
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## Challenges and Risks / Next Steps and Future Work

- Produce diamond with optimal SPION density and distribution
- Correlate SEM images with diamond microscope images



Too few SPIONs



SPIONs in clumps