Moving Vortices with the Scanning SQUID Microscope:

turning a problem into a research tool

Dale J. Van Harlingen

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University of Illinois at Urbana-Champaign

Goal: Develop a scheme for moving vortices controllably with the Scanning SQUID Microscope (SSM) in order to probe vortex pinning and interactions

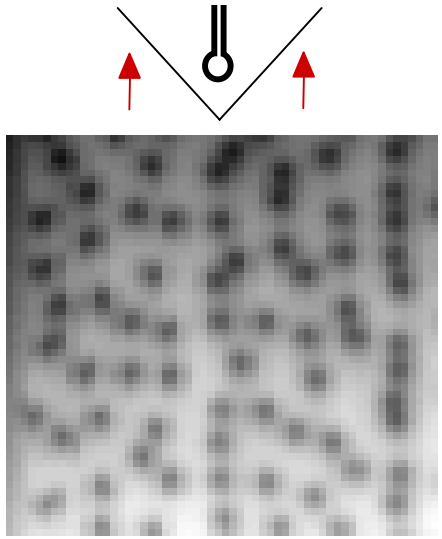
Motivation: We observe the vortex motion induced by the SSM tip in films of the weak-pinning amorphous superconductor MoGe. This causes distortion of the vortex configuration during scanning, but may also provide a way to position vortices controllably.

Approach: Explore behavior and origin of the tip-vortex interaction observed; implement vortex entrapment scheme for pulling on and moving selected vortices.

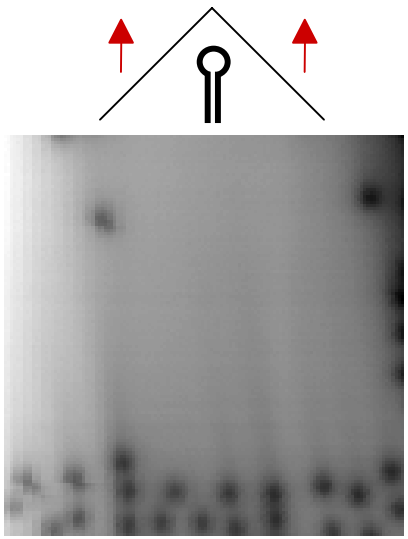
Results:

- Vortex pattern is disrupted when scanning as can be seen from directional scans.
- Interaction occurs at the substrate-sample contact point, not at the SQUID input coil.
- This prevents successive scans of the same area necessary to monitor vortex motion and map the evolution of the lattice with time, field, and current.

Coil-before-tip scanning



Tip-before-coil scanning

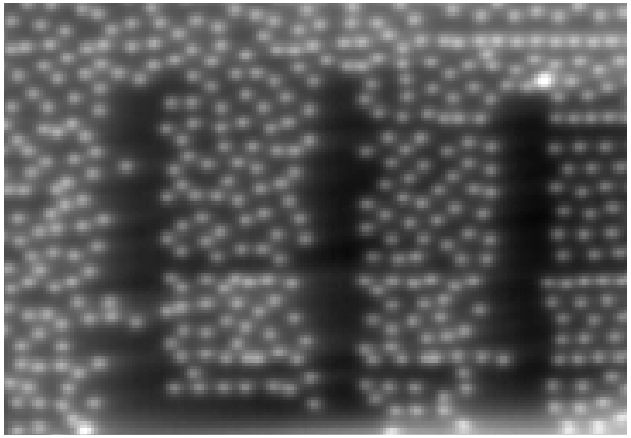


Moving Vortices with the Scanning SQUID Microscope (cont'd)

D. J. Van Harlingen --- University of Illinois at Urbana-Champaign --- NSF-DMR-0107253

Experiments:

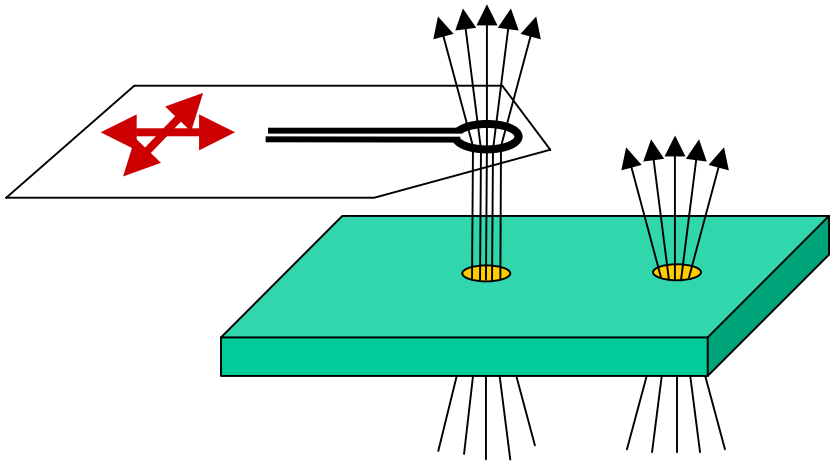
- Vortices can be swept out of the sample in a specific region by scanning the tip



- Modifications to the SSM have been made to test for magnetic substrates, electrostatic charging, and friction --- the origin of the interaction remains unidentified.

Coil entrapment:

- We designed SSM chips with integrated coils for attracting/repelling vortices. Flux is applied parallel to the vortex to capture it and move it against the pinning forces of the film or array.



- The plan is to measure pinning forces and build vortex structures and patterns.

Personnel:

Britton Plourde --- graduate research student (Ph. D. 2001: present address = UC Berkeley)
Micah Stoutimore --- graduate research student

Collaborators:

Peter Kes, Rut Besseling: Leiden (MoGe films)
Adele Ruosi, Maurizio Russo, Carmine Granata: Naples, INFM (SQUIDs)