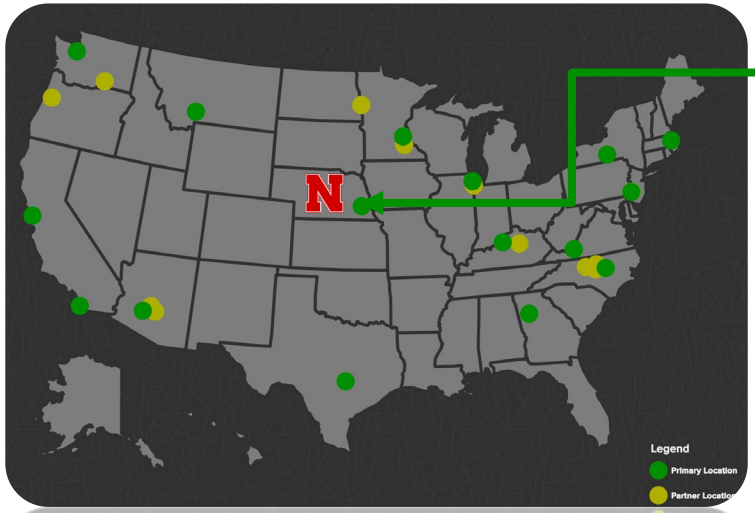
NEBRASKA NANOSCALE FACILITY: NNF

NNCI 2022 Annual Conference

Nexus between impactful research & infrastructure development

Christian Binek*, Jacob John,† Steven Wignall§, Hahn Phan§

*Director: NNF & NCMN, †Coordinator & Program Manager: NNF, §E/O Coordinator: NNF



NNF
NCMN

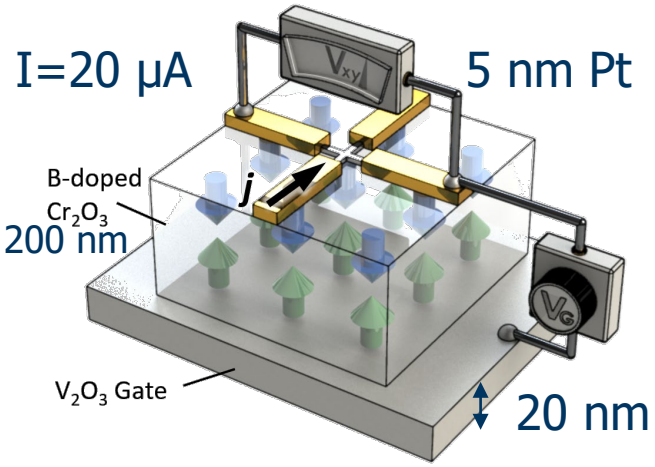
Voelte-Keegan Nanoscience Research Center @ University of Nebraska

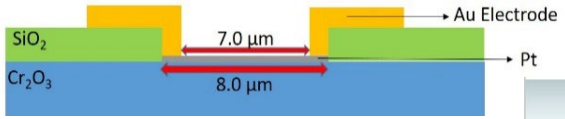
National Nanotechnology Coordinated Infrastructure

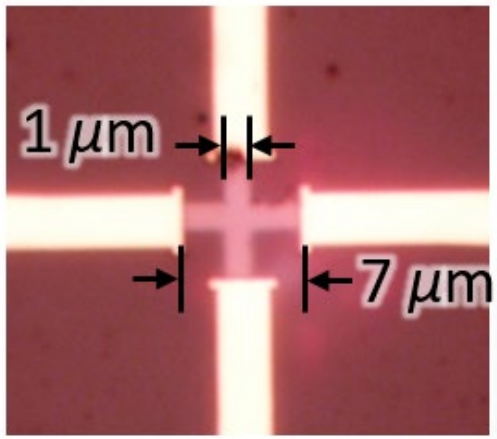
NSF

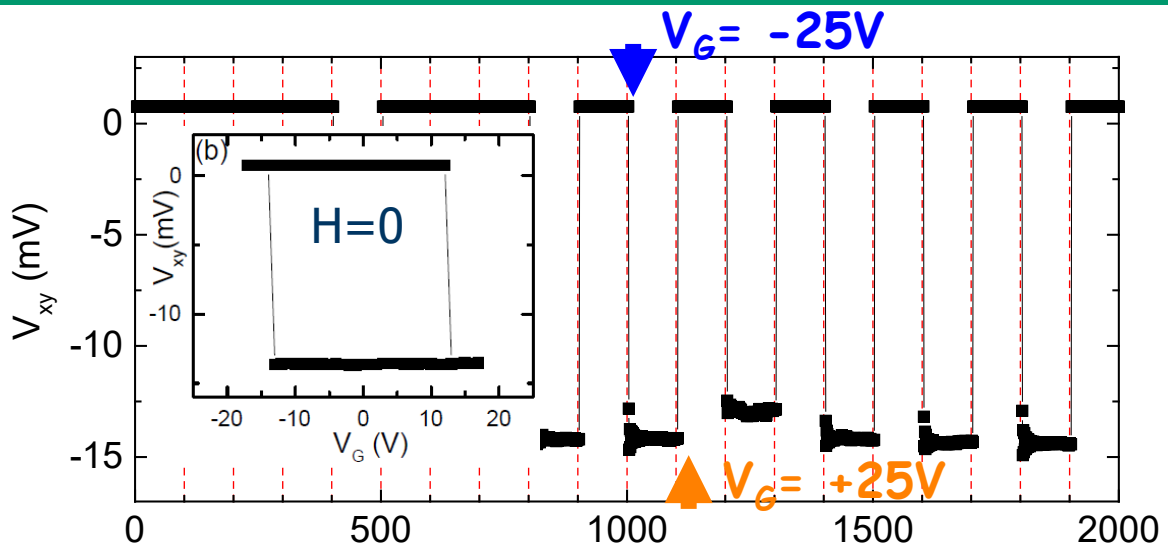
Nebraska Nanoscale Facility

Zero H-field V-controlled Néel vector rotation in $B:Cr_2O_3/Pt$ Hall-bar devices









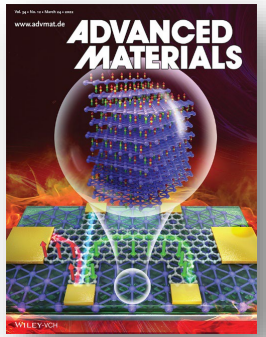
ARTICLE

https://doi.org/10.1038/s41467-021-21872-3 OPEN

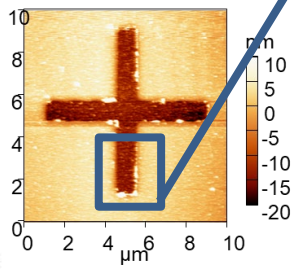
Check for updates

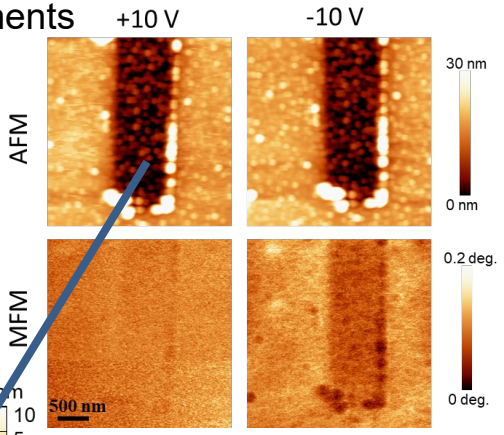
Voltage controlled Néel vector rotation in zero magnetic field

Ather Mahmood[1], Will Echtenkamp[1], Mike Street[1], Jun-Lei Wang[1], Shi Cao[1], Takashi Komesu[1], Peter A. Dowben[1], Pratyush Buragohain[1], Haidong Lu[1], Alexei Gruverman[1], Arun Parthasarathy[2], Shaloo Rakheja[3] & Christian Binek[1]✉



K. He et al., Adv. Mater.,34, 2105023 (2022)





National Nanotechnology Coordinated Infrastructure

Nebraska Nanoscale Facility

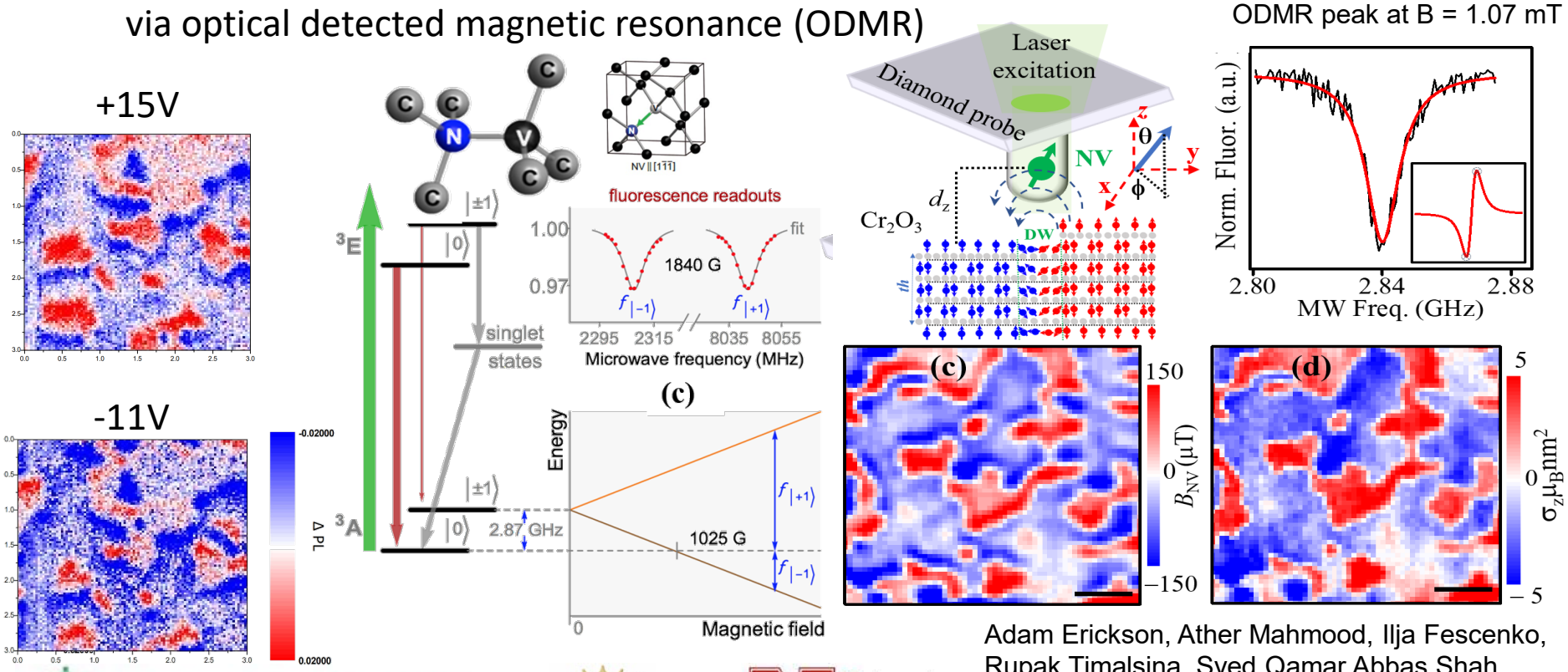
Experimental evidence for switching beyond magnetic force microscopy

- MFM measurements ask for more detailed magnetic scanning probe microscopy (SPM)

➡ Nitrogen vacancy (NV)-SPM

via optical detected magnetic resonance (ODMR)

Home-built RT SPM B<0.1T



Adam Erickson, Ather Mahmood, Ilja Fescenko, Rupak Timalsina, Syed Qamar Abbas Shah, Christian Binek, and Abdelghani Laraoui, (under review)

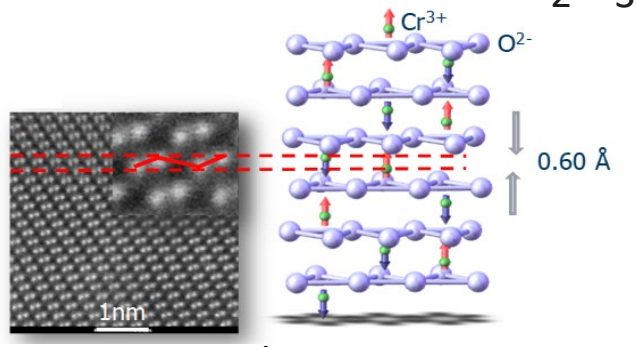
National Nanotechnology Coordinated Infrastructure

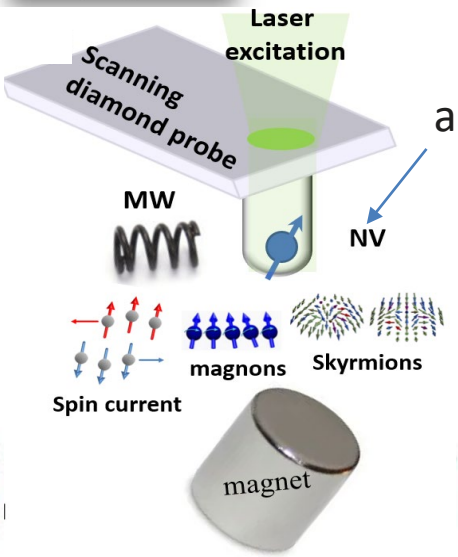
NSF

Nebraska Nanoscale Facility

The case for an NV atomic force and optical confocal microscopes

- Operating from RT down to cryogenic temp at high magnetic fields at unprecedented spatial resolution (< 15 nm) and magnetic sensitivity (< 10 nT Hz-1/2)
- Domain walls in $B:Cr_2O_3$





Award Abstract # 2216155
MRI: Acquisition of optical access in a cryogenic scanning probe microscope for quantum sensing capabilities

NSF Org:	DMR Division Of Materials Research
Awardee:	BOARD OF REGENTS OF THE UNIVERSITY OF NEBRASKA
Initial Amendment Date:	August 17, 2022
Latest Amendment Date:	September 7, 2022
Award Number:	2216155
Award Instrument:	Standard Grant
Program Manager:	Guebre Tessema gtessema@nsf.gov (703)292-4935 DMR Division Of Materials Research MPS Direct For Mathematical & Physical Scien
Start Date:	September 1, 2022

Nebraska Nanoscale Facility

Microelectronics and the CHIPS and Science Act

- How should NNCI react on the CHIPS Act ?

  ➡ Explore what it entails
  - $39 B for new chip manufacturing plants
    e.g 2 chip foundry by Intel in the Midwest (central Ohio)
  - $11 B for R&D
  - Workforce training …

- Find out what that means for NNCI and a post-NNCI infrastructure

  ➡ Almost certainly big role in workforce development

- At NNF there has been strong emphasis on characterization

  ➡ Strengthen fabrication tools for quantum nanofab

New tools for quantum nanofab

- For NNF that means

  ➡ replace 13 year old 30keV e-beam lithography by

a **reliable state-of-the-art lithography tool** (such as Raith EBPG 5150Plus, 100kV e-beam, 50MHz pattern generator, alignment precision <+/- 5nm line width resolution <8nm) allowing high-resolution patterning over large areas and on a large variety of substrates

➡ Workforce training with exposure to:

- nano-electronics,
- nano-photonic
- quantum information science,
- nano-mechanics,
- ano-biology

National Nanotechnology Coordinated Infrastructure

NSF

Nebraska Nanoscale Facility