

Fe_3Sn_2 : Frustrated Kagome Magnet

Yash Anand¹

Mentor: Johnpierre Paglione ¹

¹Quantum Materials Center
Physics Department, University of Maryland

Overview

1 Background

- Definitions
- Crystal Structure of Fe_3Sn_2
- Fe_3Sn_2 Spin Structure

2 Crystal Growth

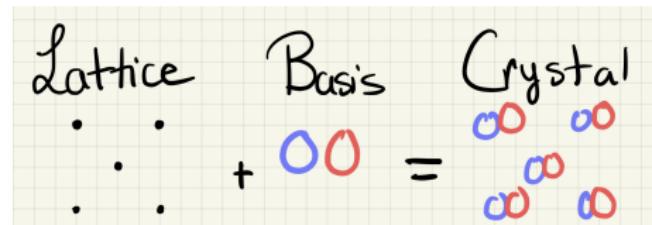
- Methods

3 Crystal Analysis

- Crystals
- X-Ray
- Planned Measurements

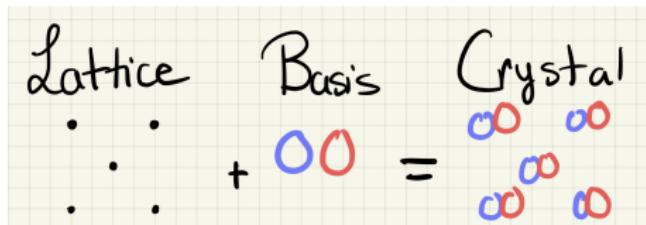
Crystals

- Lattice:
- Basis:
- Crystal:



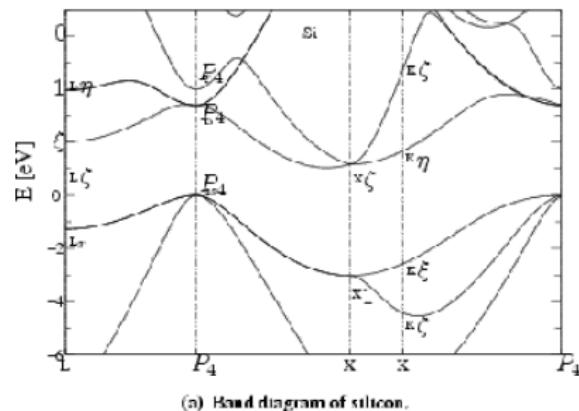
Crystals

- Lattice:
 - Mathematical grid of points
- Basis:
 - group of atoms or molecules attached to a lattice point
- Crystal:
 - Periodic Lattice structure

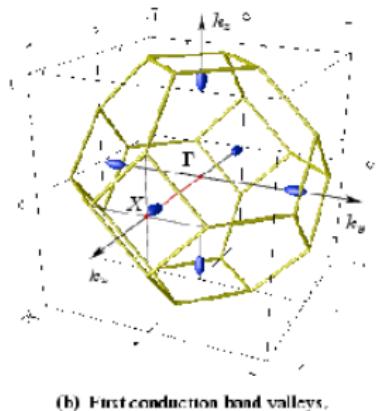


Fermiology

- Reciprocal Space:
- Brillouin Zone:
- Fermi Energy:
- Fermi Surface:



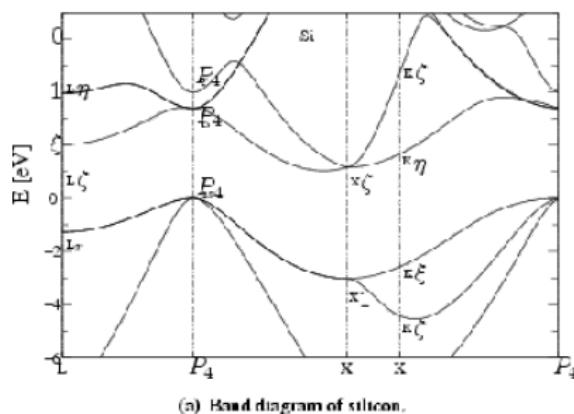
(a) Band diagram of silicon.



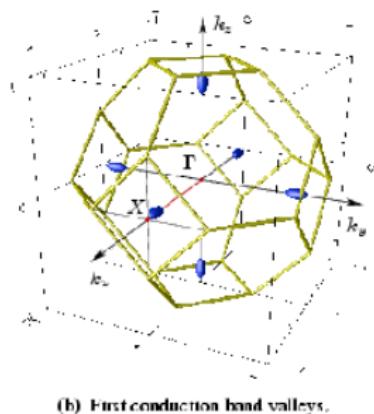
(b) First conduction band valleys.

Fermiology

- Reciprocal Space:
 - Fourier Transform of the real space.
- Brillouin Zone:
 - Repeated sections of the reciprocal lattice.
- Fermi Energy:
 - Highest energy level filled up at 0 Kelvin.
- Fermi Surface:
 - The "structure" of the Fermi Energy.



(a) Band diagram of silicon.



(b) First conduction band valleys.

Fe_3Sn_2 Structure

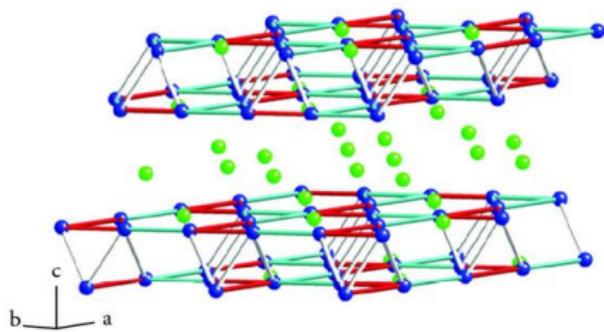


Figure: Fe_3Sn_2 crystal layers. Adapted from D. Boldrin (2012).

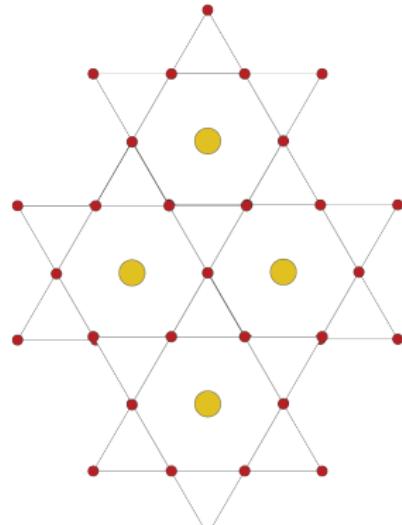


Figure: Kagome Layer of Fe_3Sn_2

Fe_3Sn_2 Spin Structure

- Skyrmiions:

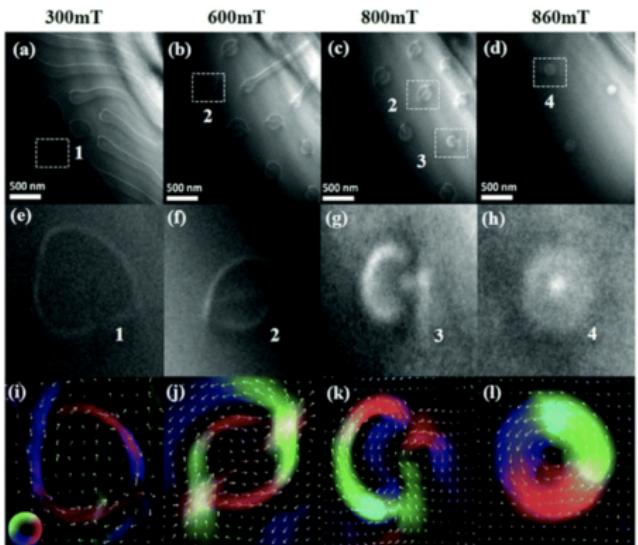


Figure: Skyrmions found in Fe_3Sn_2 by another research group. Adapted from Copyright 2017, John Wiley and Sons

Fe_3Sn_2 Spin Structure

- Skyrmi \circ n \circ s:
 - Stable spin structures that look like vortices.

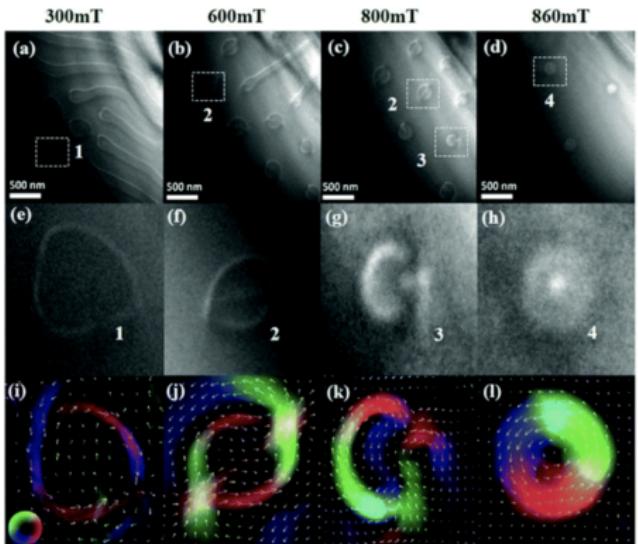


Figure: Skyrmions found in Fe_3Sn_2 by another research group. Adapted from Copyright 2017, John Wiley and Sons

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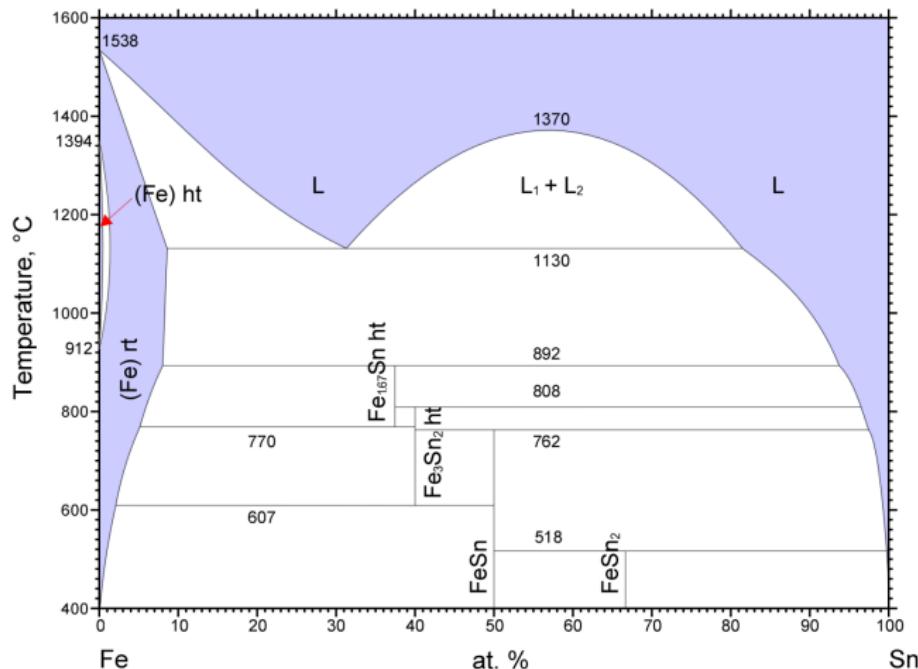
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- Methods

3 Crystal Analysis

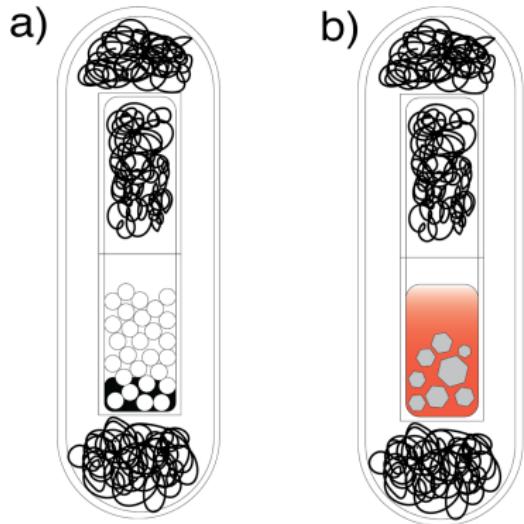
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Fe and Sn Phase Diagram



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Different Methods



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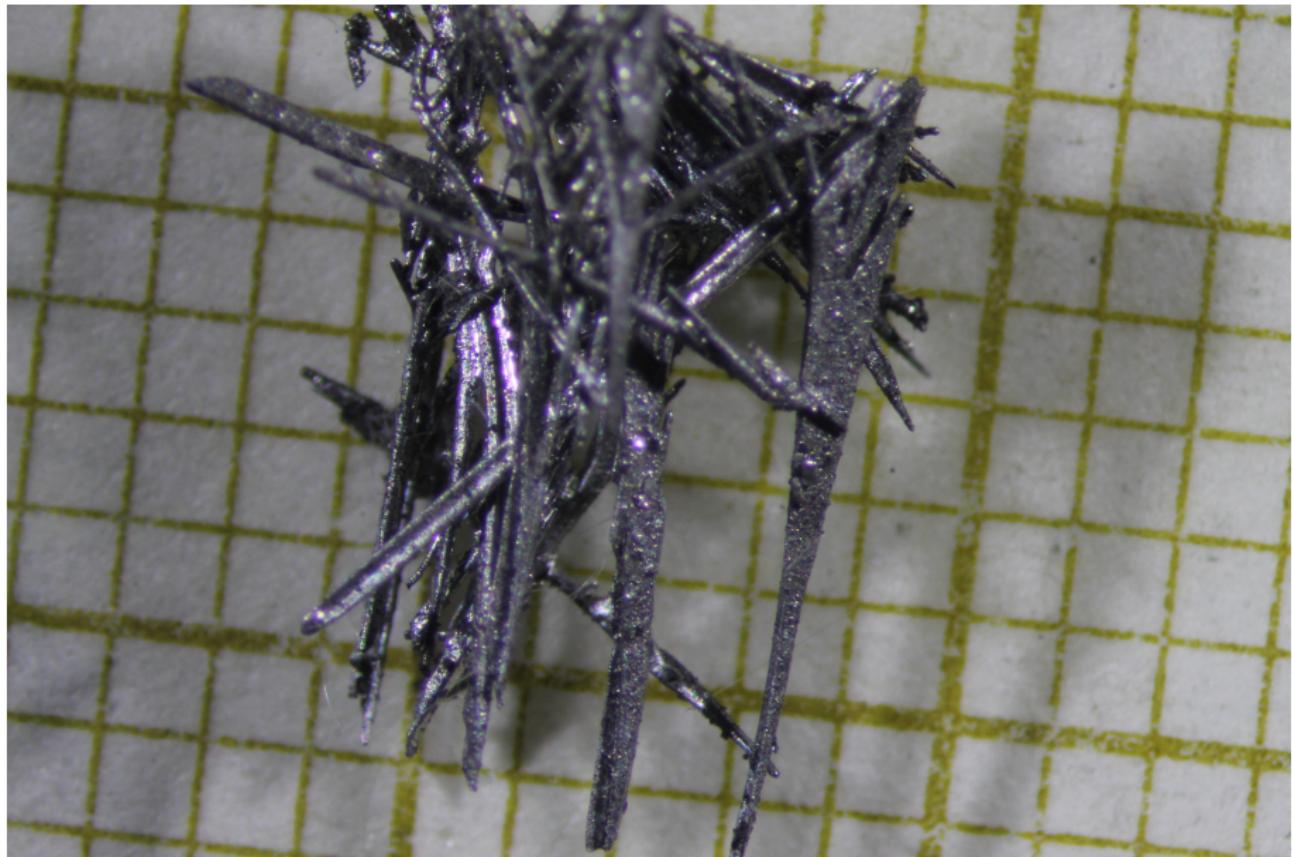
2 Crystal Growth

- Methods

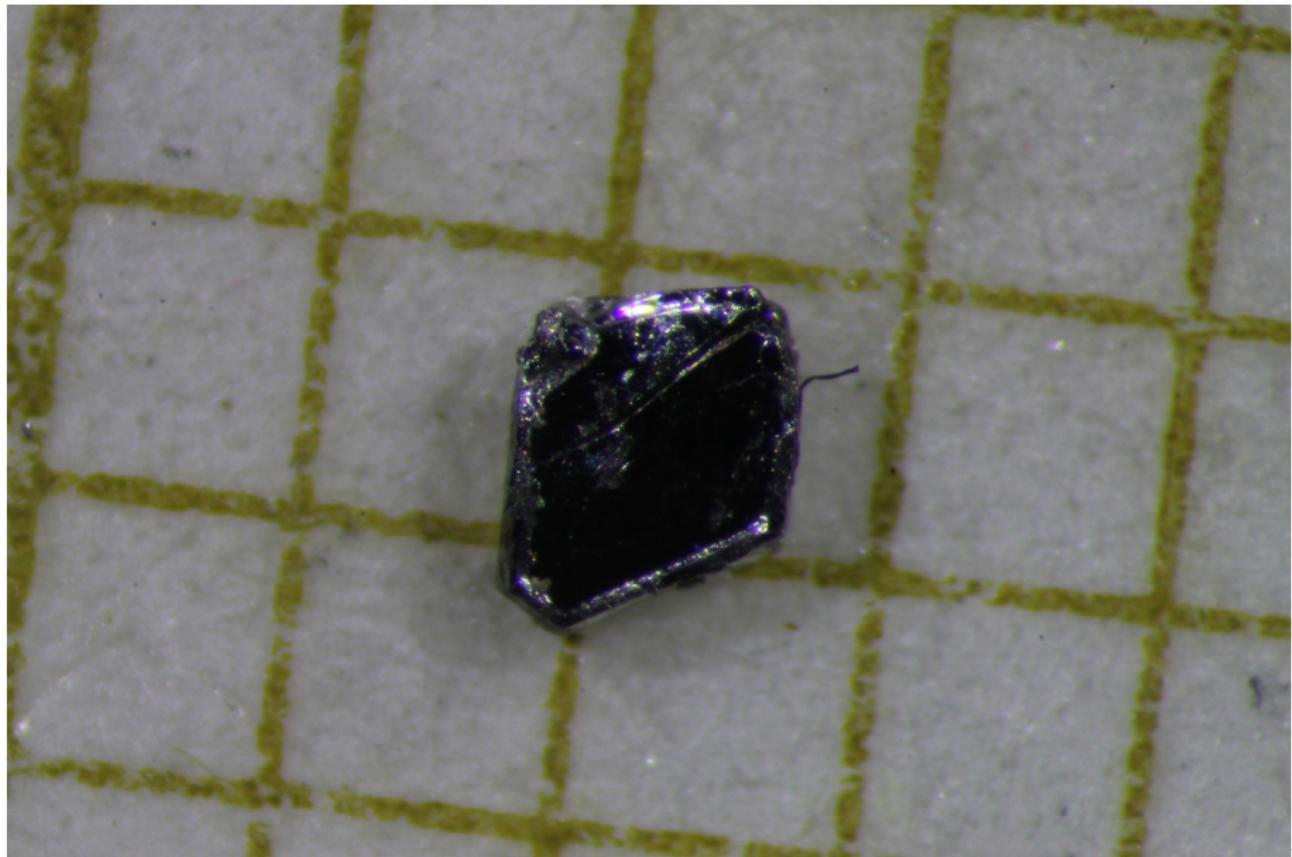
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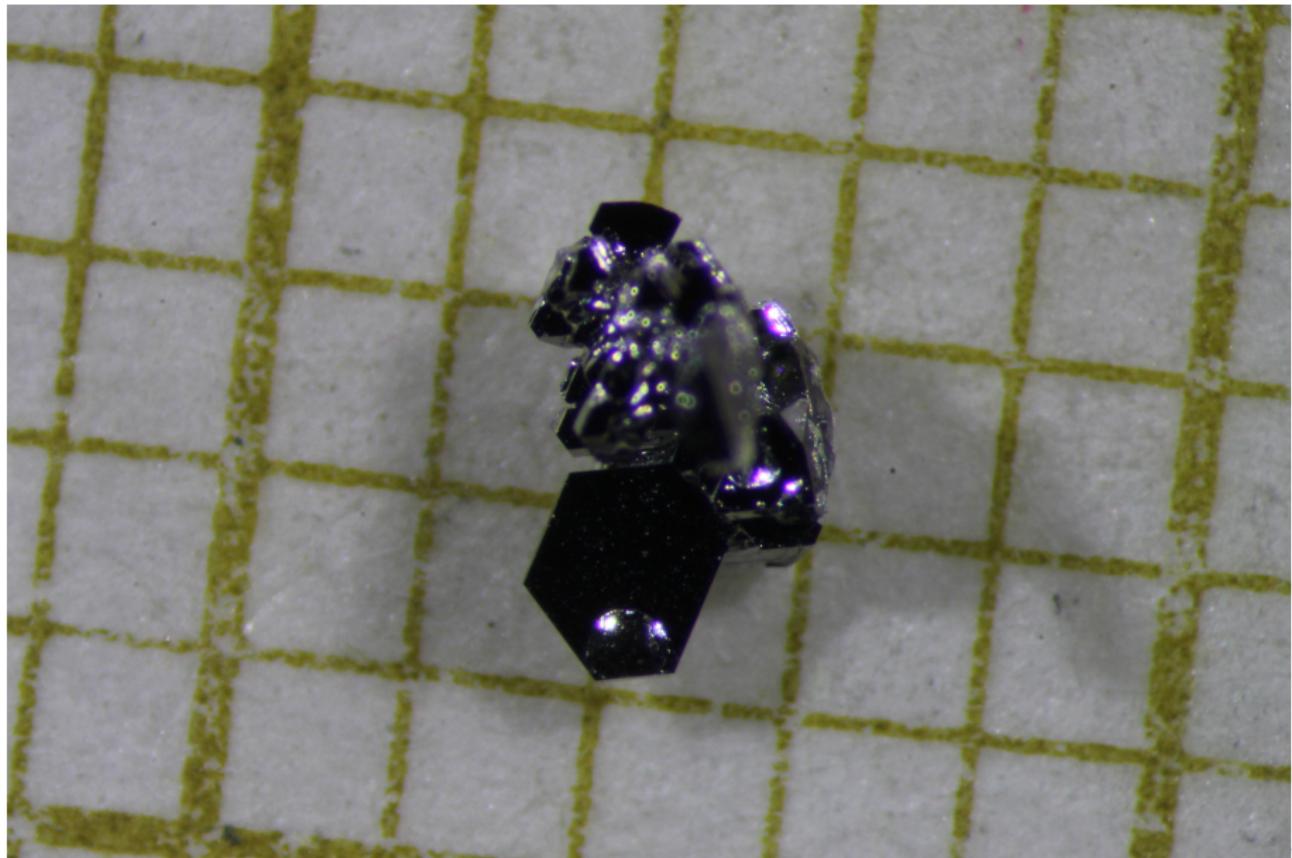
Growth Ya027 (Not Fe_3Sn_2)



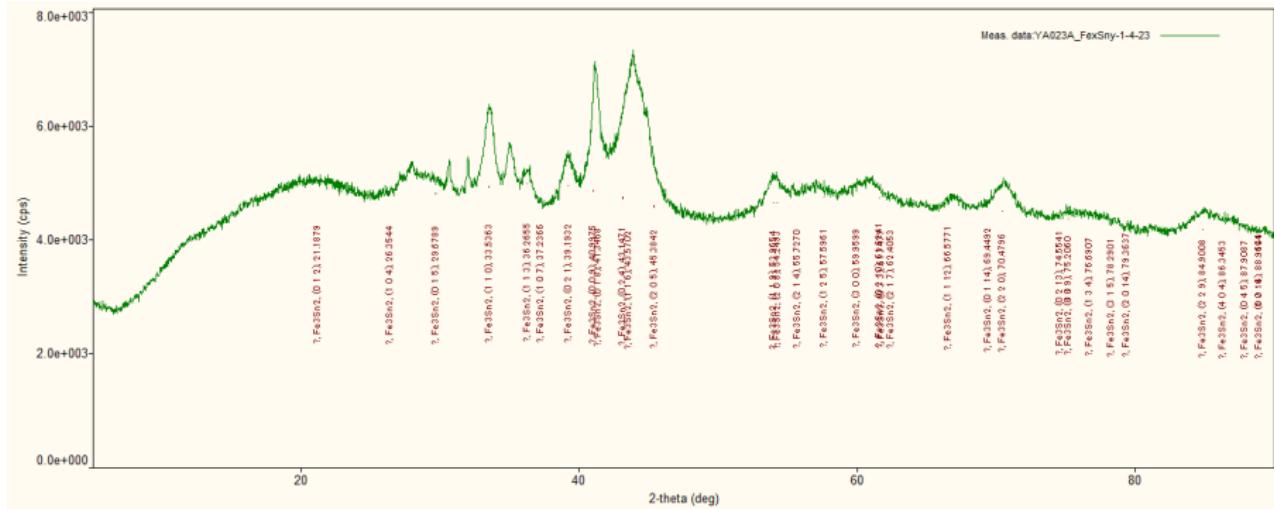
Growth Ya023 Single Crystal



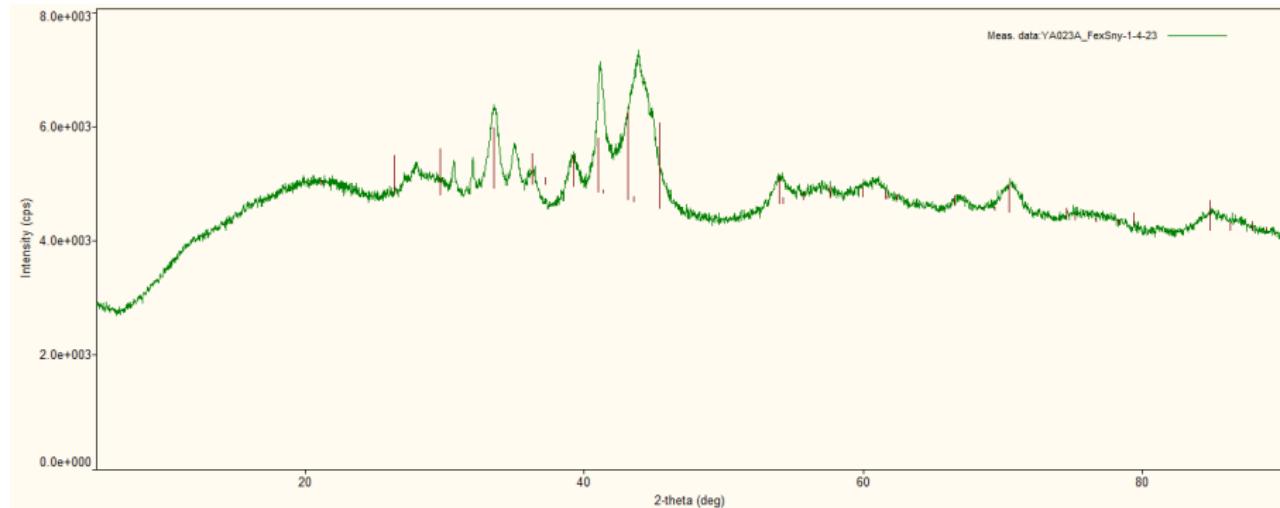
Growth Ya021 Polycrystal



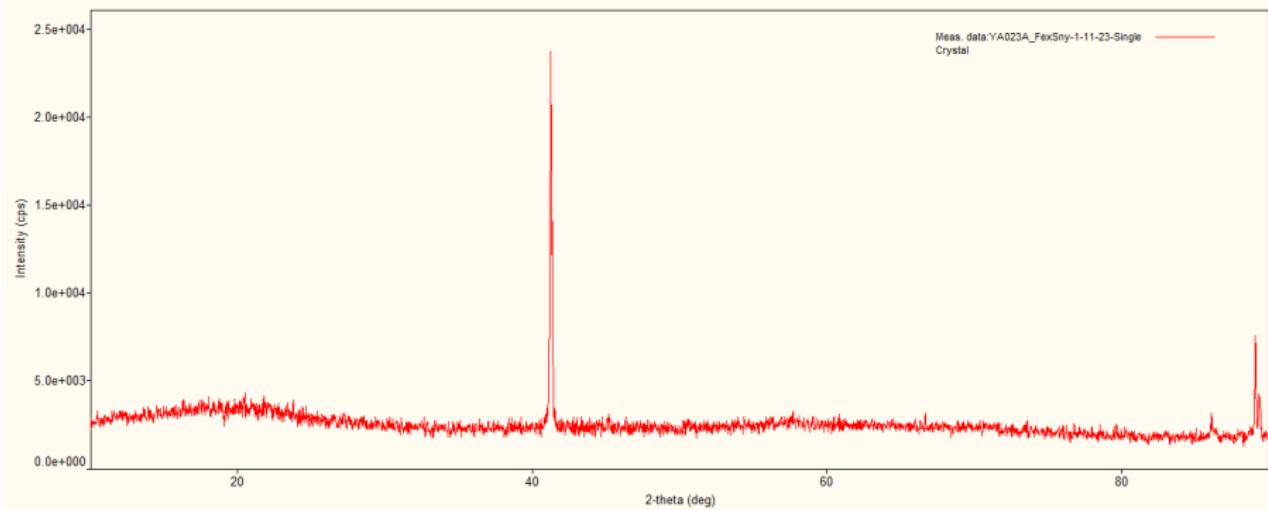
Powder X-ray Data



Powder X-Ray Data



Single Crystal X-Ray Data



Planned Measurements

- Resistivity
 - Cool down to 2 K while measuring the resistance
- Transport
 - Measure classical and quantum Hall effects
- Quantum Oscillations
 - Study the Fermi Surface under a strong magnetic field