Transition of Magnetic Texture in $Fe_{0.7}Co_{0.3}Si$

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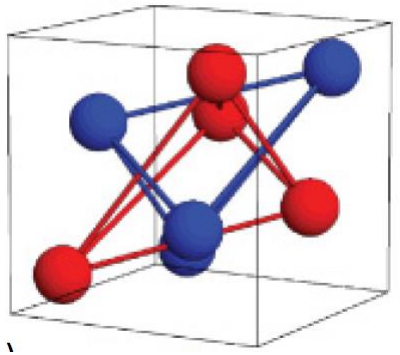
Helical spin order is due to the competition between the antisymmetric exchange (Dzyaloshinskii–Moriya interaction) and ferromagnetic exchange interaction.
Only occurs with the lack of centrosymmetry of the structure

B20 cubic structure ($P2_13$)



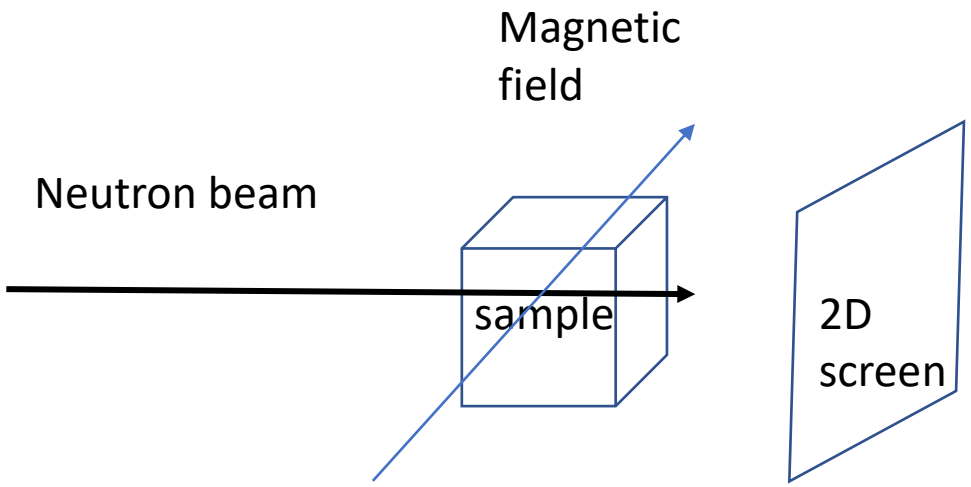
Crystal structure of $Fe_{0.7}Co_{0.3}Si$. Red and blue balls correspond to Fe/Co and Si atoms.

Spin structure of $Fe_{0.7}Co_{0.3}Si$.

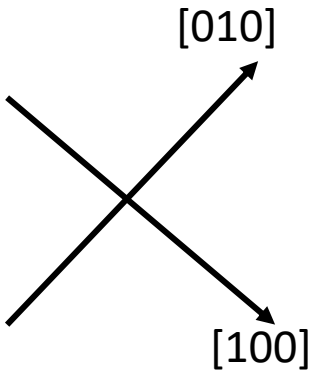
Small angle neutron scattering (SANS)
Neutron wavelength: 0.65 nm

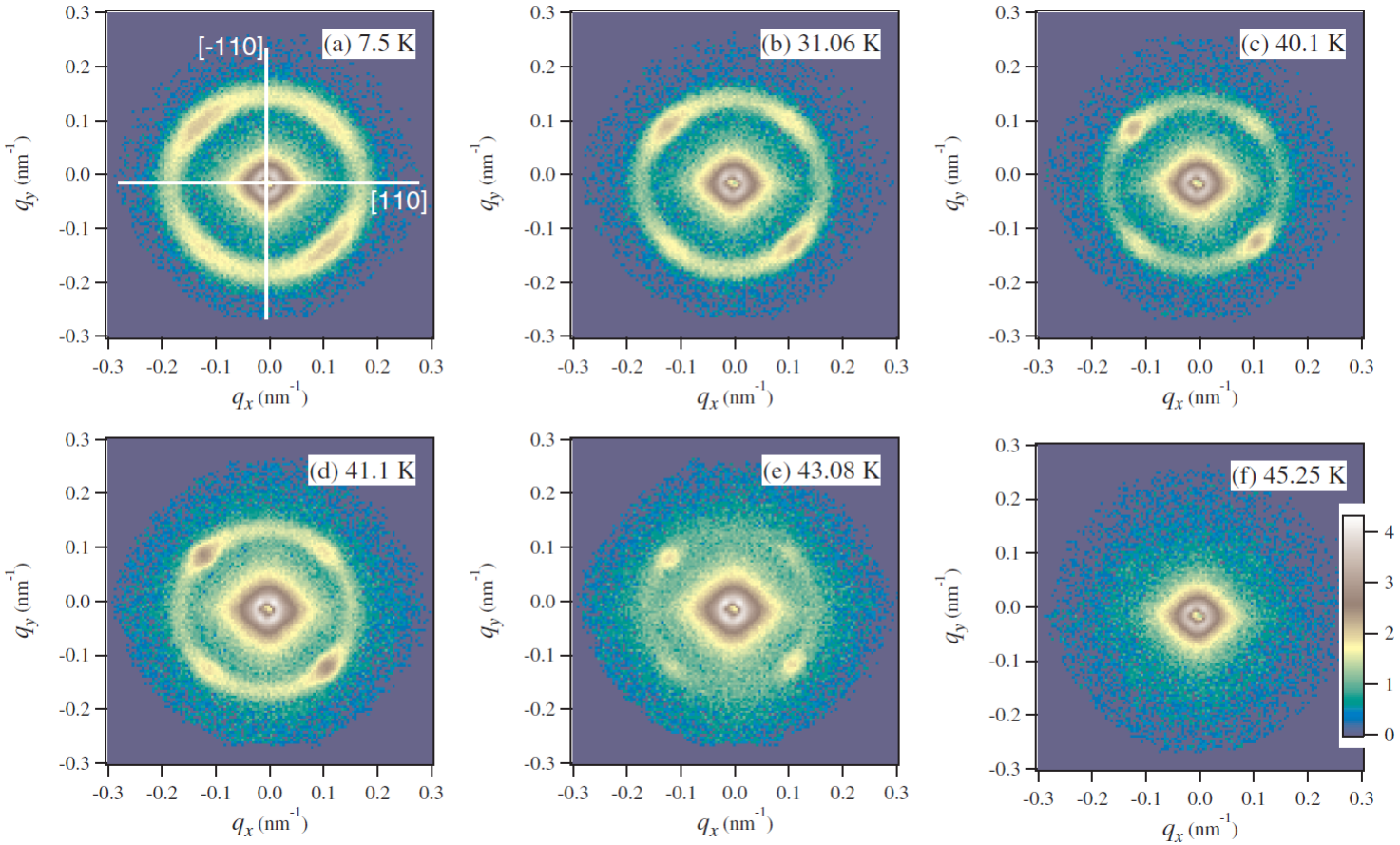
Single crystal $Fe_{0.7}Co_{0.3}Si$ (~0.1 cm^3)

external magnetic field was applied along the horizontal axis perpendicular to the incoming neutron direction

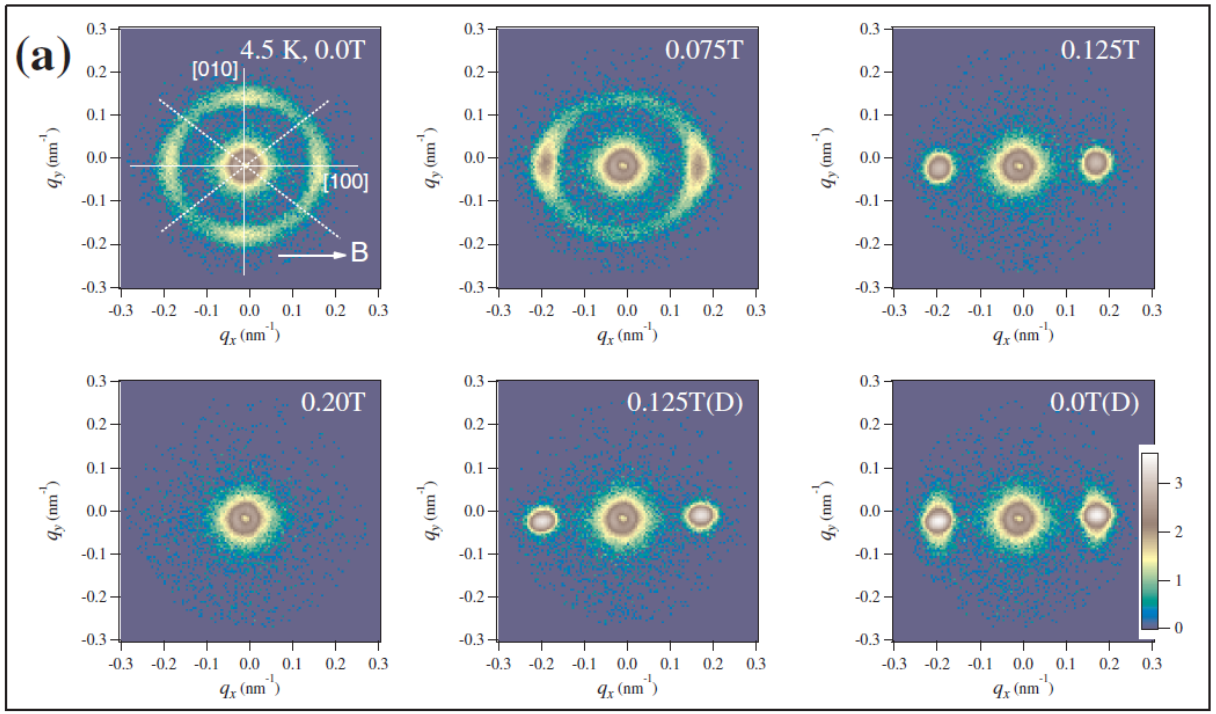


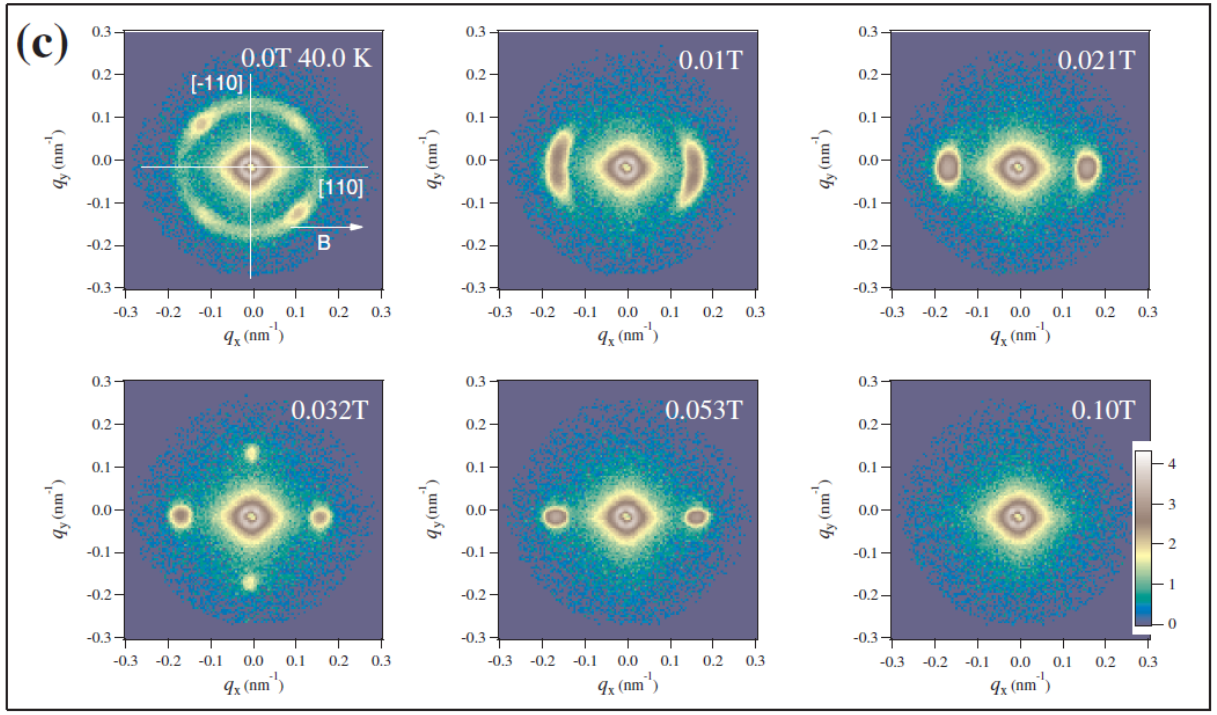
external field: 0 to 0.2 T
Temperature :4K and 60 K

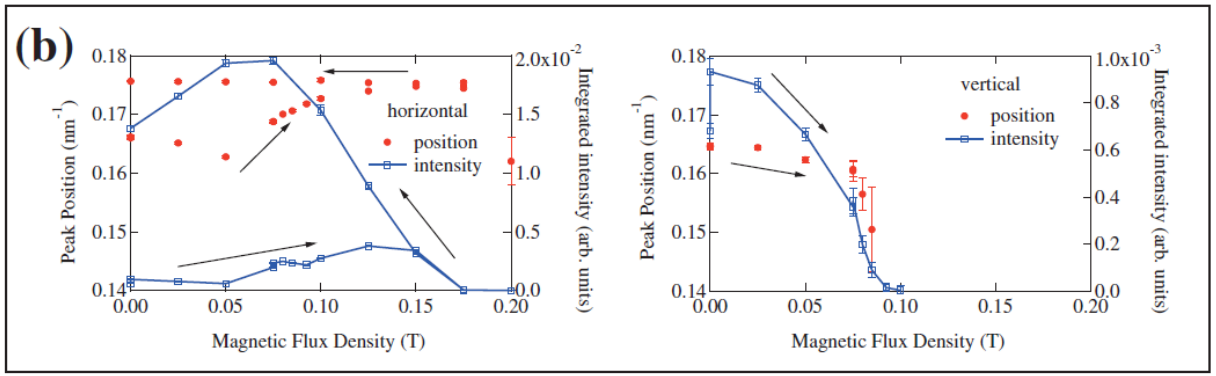


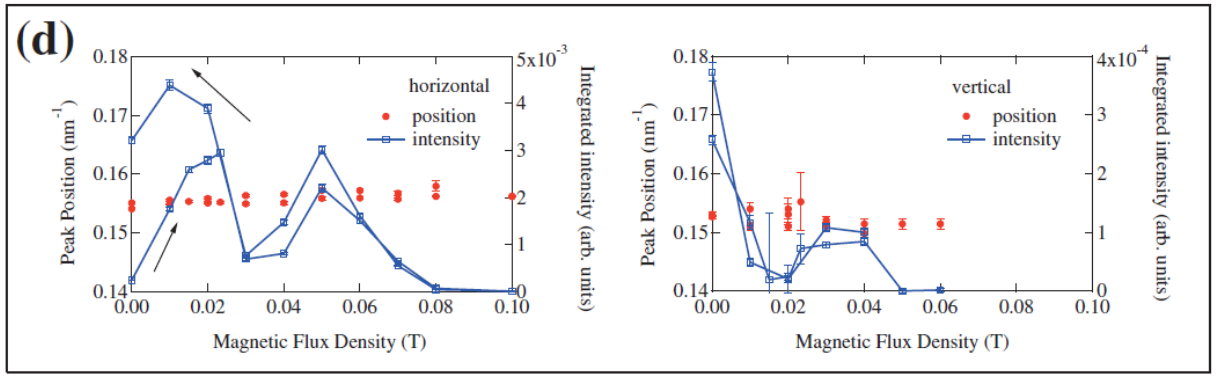


Scattering on the reciprocal plane under a zero external magnetic field
(a) 7.5K, (b) 31.06K, (c) 40.1K, (d) 41.1K, (e) 43.08K, and (f) 45.25 K.

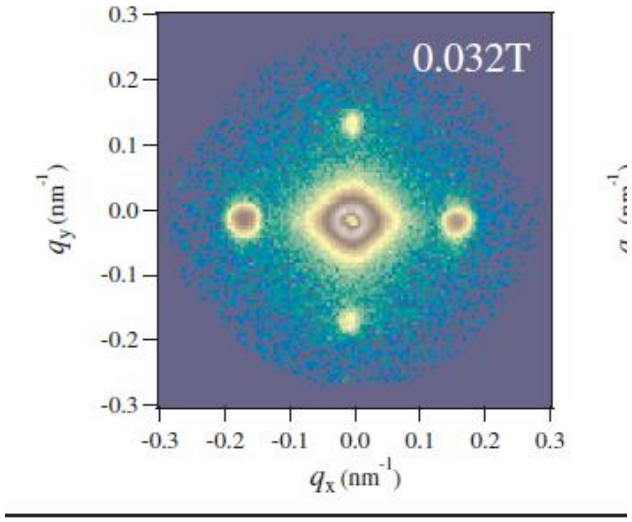






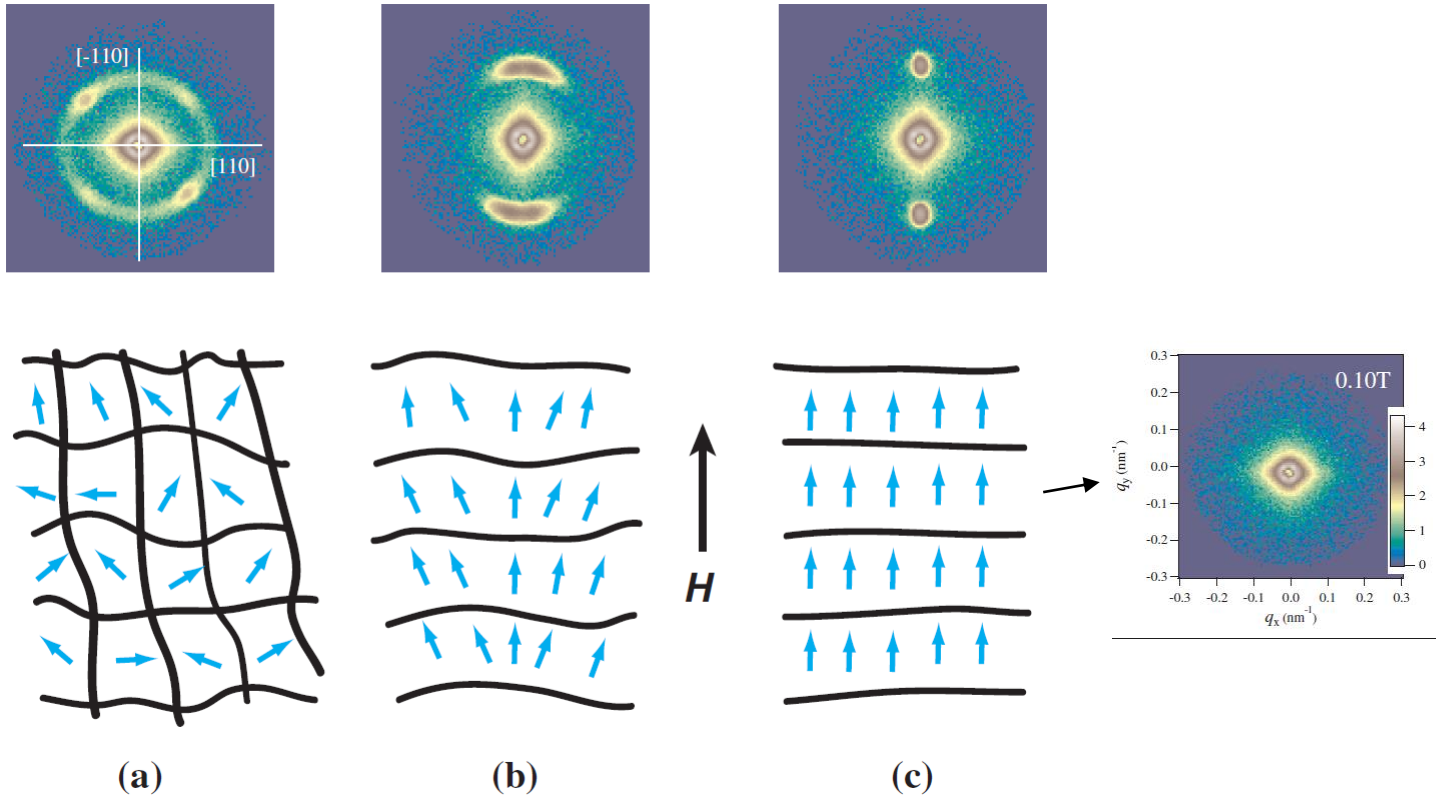


(a)SANS at 4.5K when increasing magnetic field to 0.2T then decreasing to 0T
(c) SANS at 40K when increasing magnetic field to 0.1T
(b),(d) The scattering intensities (solid lines) and wave vector (solid circles) of the maximum scattering intensity along the directions parallel and perpendicular to horizontal axis



This state is known as the ‘‘phase A’’ of FeCoSi,

‘‘phase A’’ is viewed as a skyrmion lattice



SANS patterns (the upper row) with schematic 2D images of the magnetic textures in real space (the lower row). Blue arrows indicate the direction of the propagation vector

Conclusion

The propagation vector has a weak preferred orientation parallel to <100>

The helical spin modulation is changed to the commensurate ferromagnetic order through a conical spin state by applying external magnetic field.

The period of conical spin structure is shorter than the period of helical spin.