Magnetic structures of cubic FeGe

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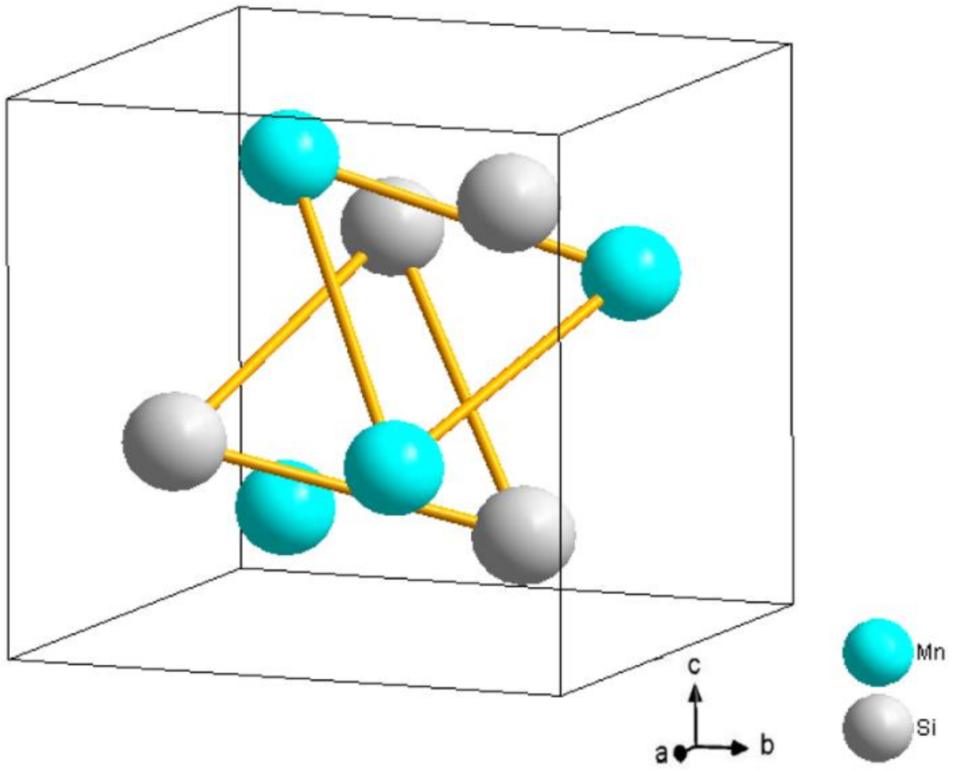
Crystal structure of MnSi



MnSi
T_c=29.5K
Period: λ=18nm
Q=0.036Å^{-1} along <111>
(independent with temperature)

FeGe
T_c=278K
Period: λ= 70nm

Single crystal small angle neutron diffraction

1 mm diameter spherical single crystal
Ris0 National Laboratory (Denmark)
Main part of neutron wavelength:15.8Å
reciprocal lattice area of 0.04Å^{-1}x 0.04Å^{-1}

All scattering directions are perpendicular to the incident beam.

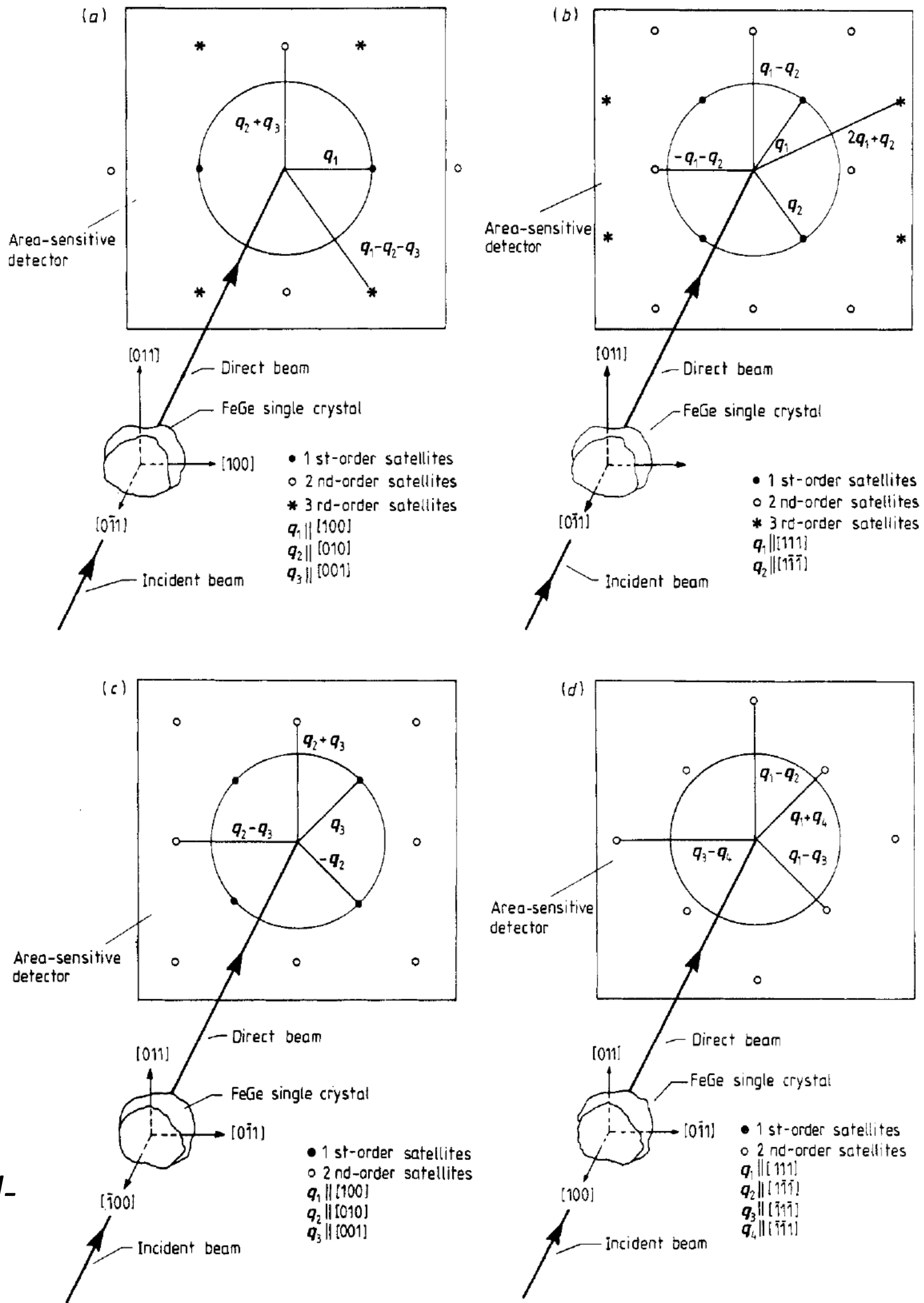
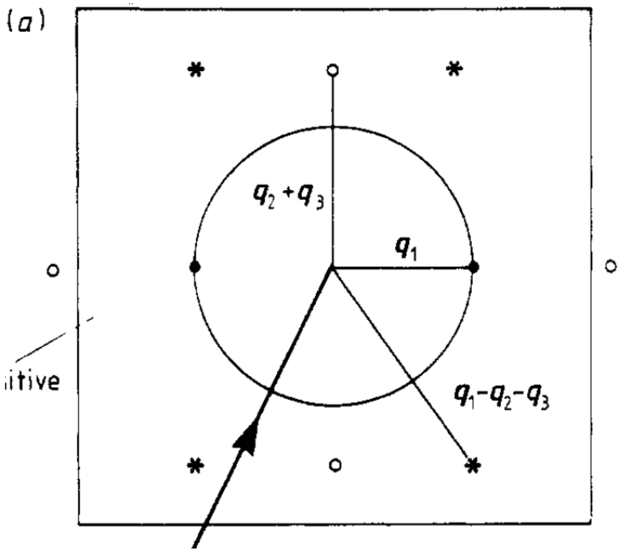


Illustration of the scattering geometry used in the small-angle neutron scattering measurements on cubic FeGe.

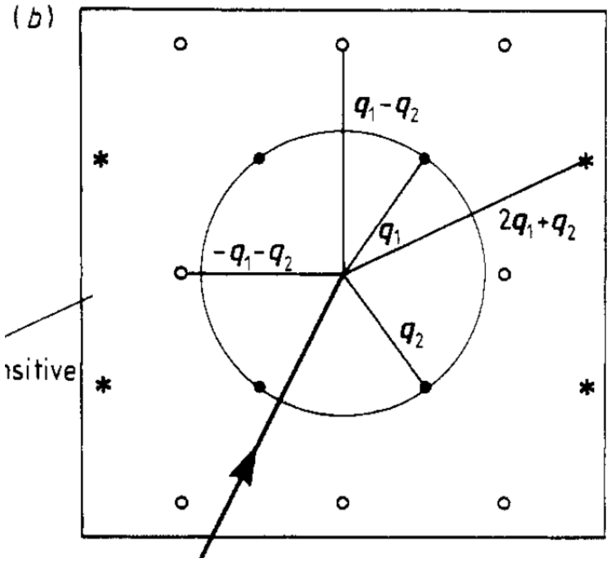
Simulation on plane(0-11)

Q along<100>



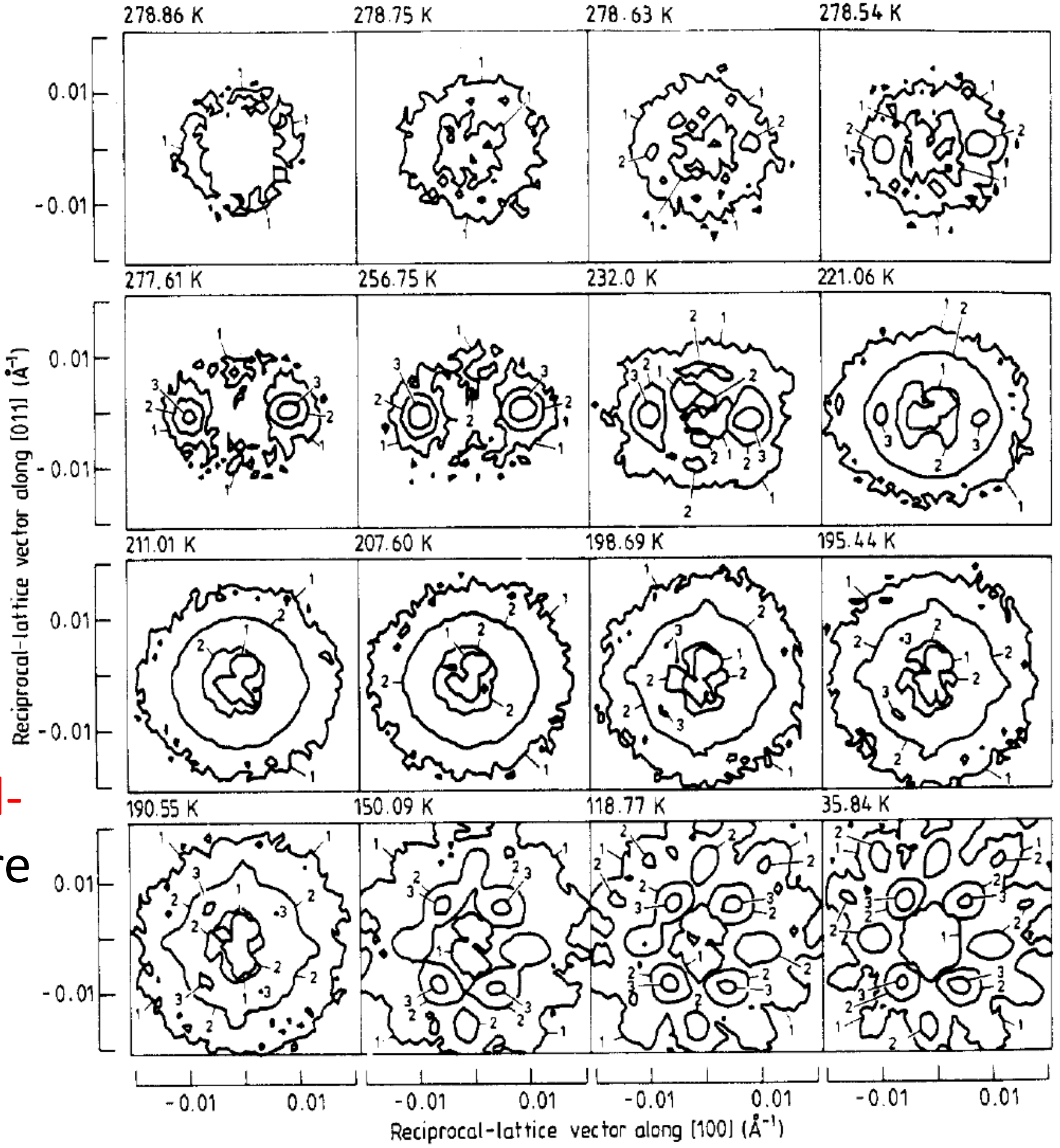
six and eight different magnetic domains at high and low temperatures, respectively.

Q along<111>



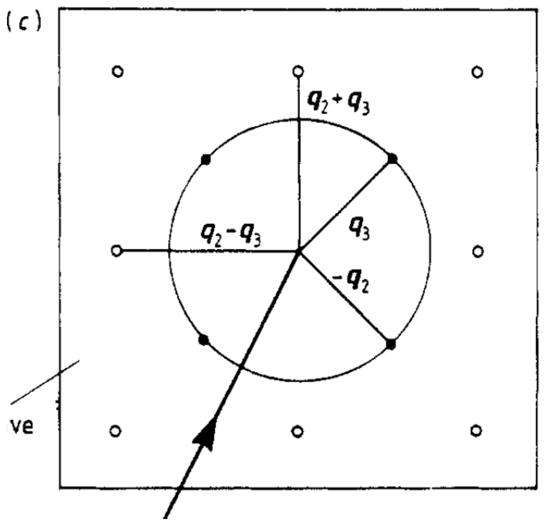
at least first-, second- and third-order satellites are observed at the lowest temperatures.

Experiment (decreasing temperature)

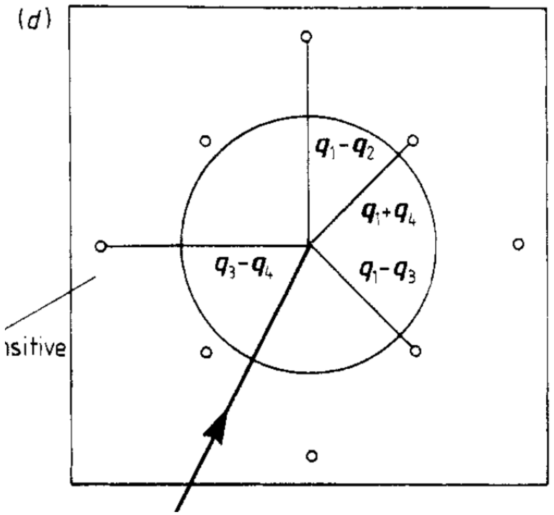


Simulation on plane(100)

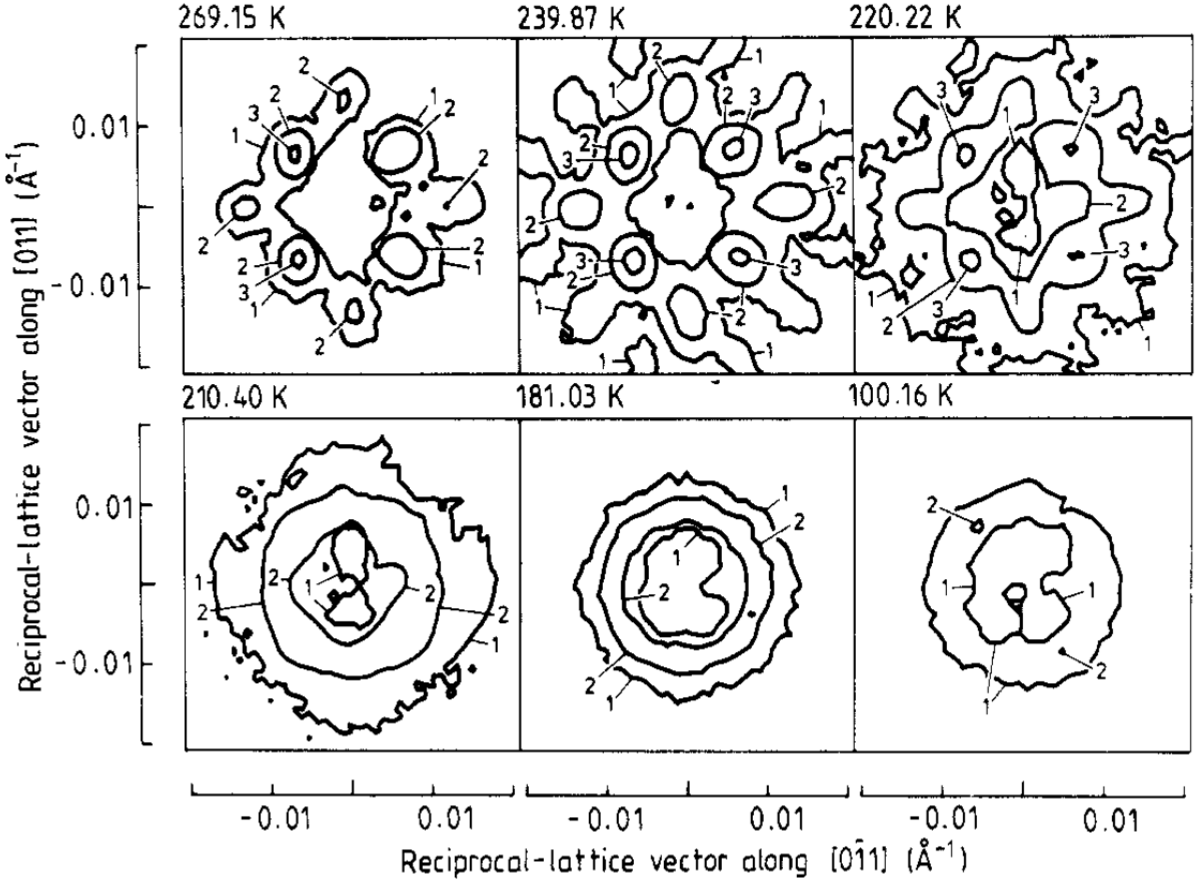
Q along<100>

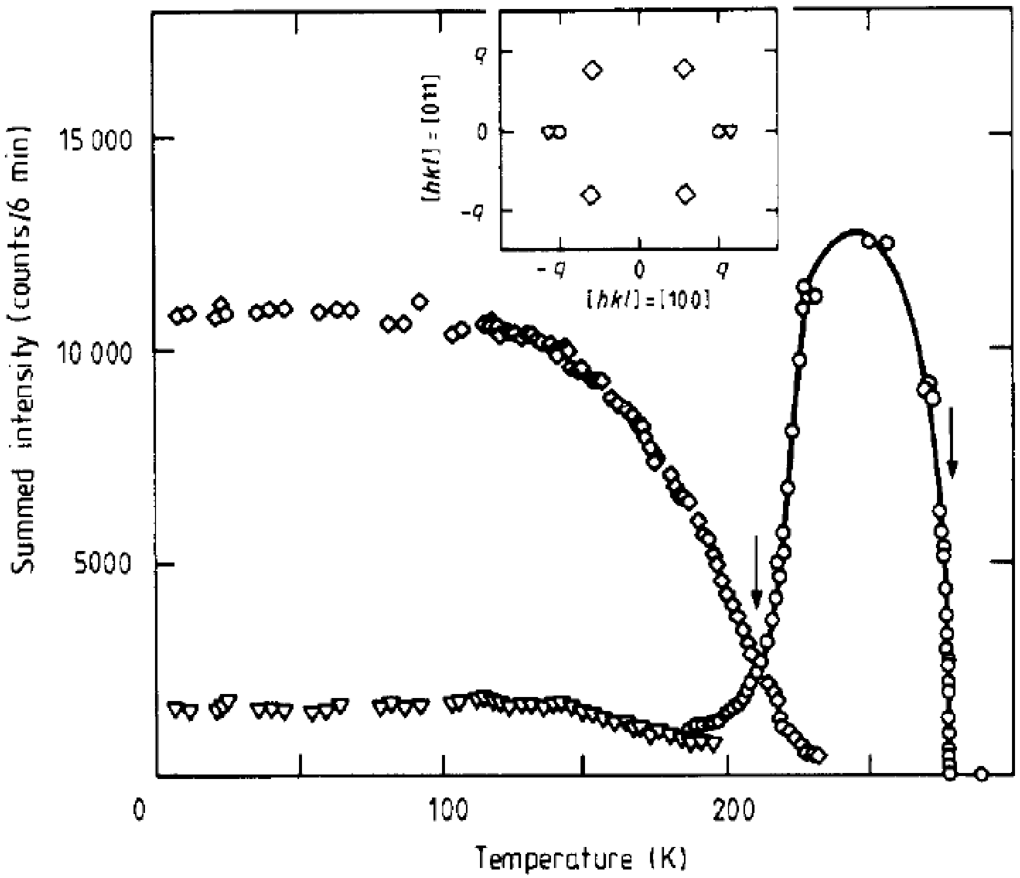


Q along<111>

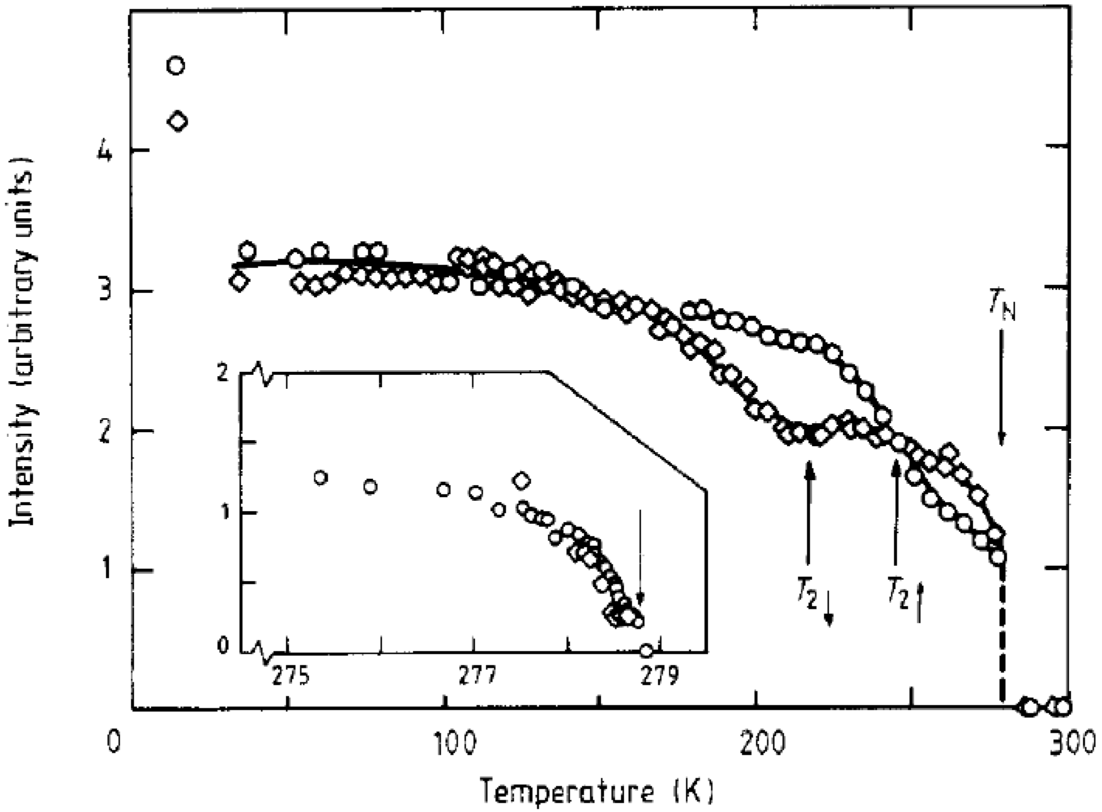


First-, second- and third-order satellites are observed at high temperatures.

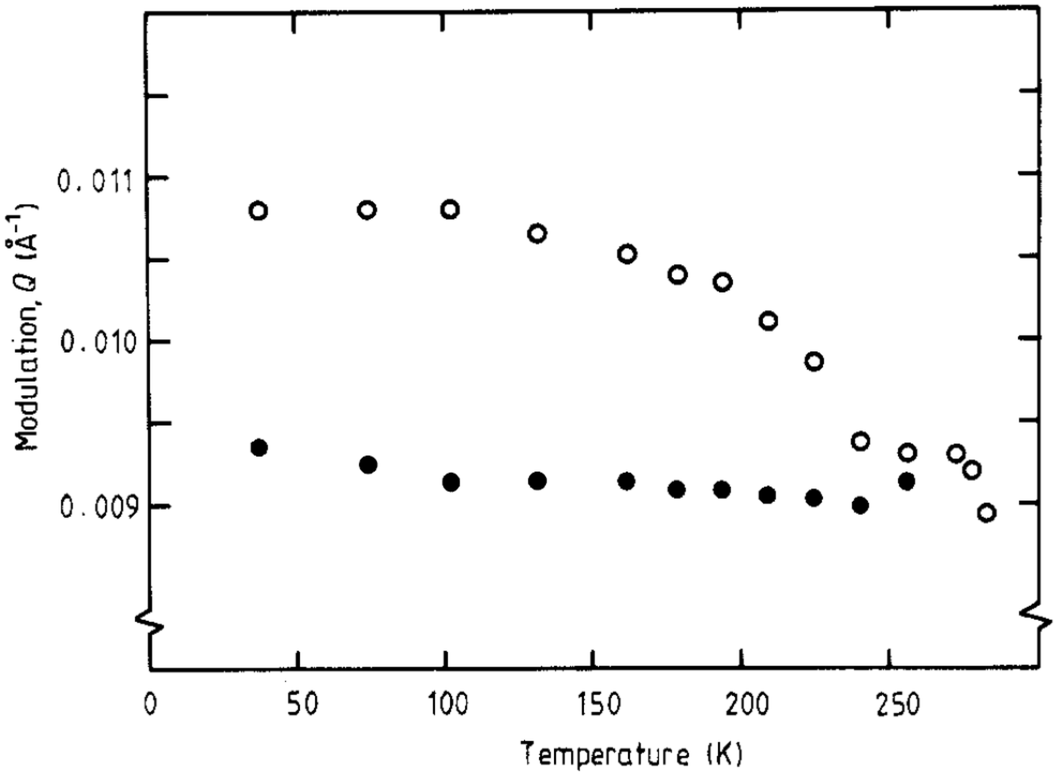




Temperature dependence of the integrated intensity of specific satellites (temperature decreasing)
Square: ±[111] and ± [1-1-1]
Triangle:± ([111]+[1-1-1]) (second order)
Circle:± [100]



Temperature dependence of the total intensity recorded by detector after background subtraction
T2(down)=211K
T2(up)=245K



The temperature dependence of the propagation vector Q (temperature decrease).
empty square =<100> direction
solid square = <111> direction

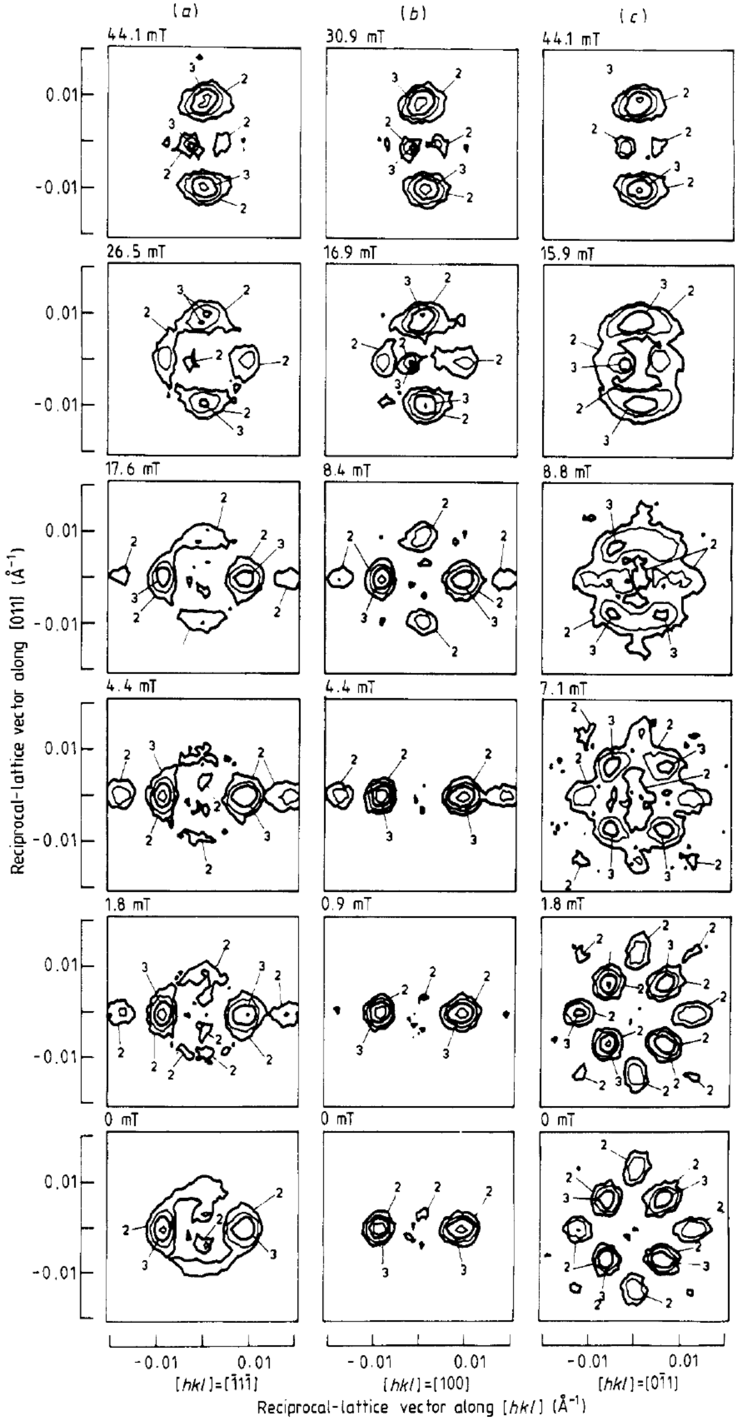
Below T2:

Empty /solid= $2/\sqrt{3} = 1.1547$

Length of propagation vector doesn't change

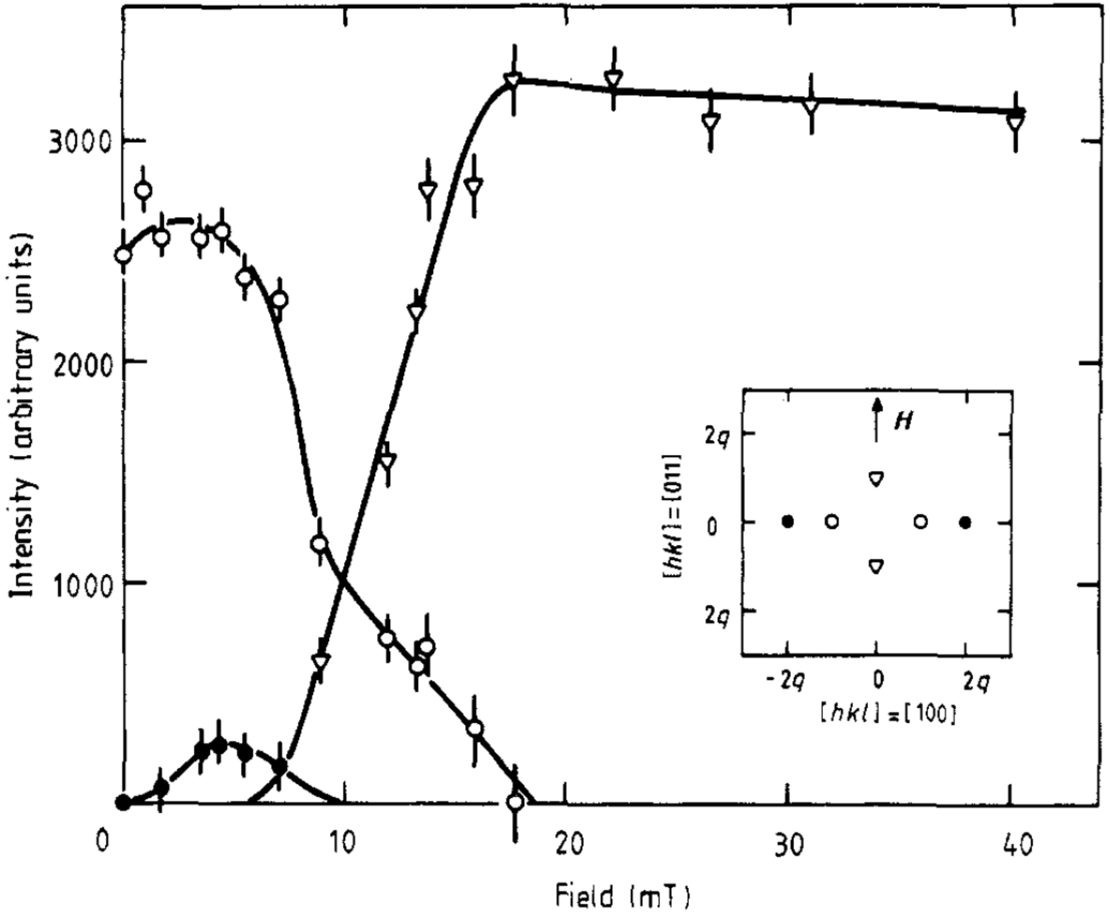
Even small magnetic fields (1 mT)
introduce changes in the spiral magnetic structure.

Magnetic fields of 20-40 mT cause the spiral axis to turn to the direction of the applied field

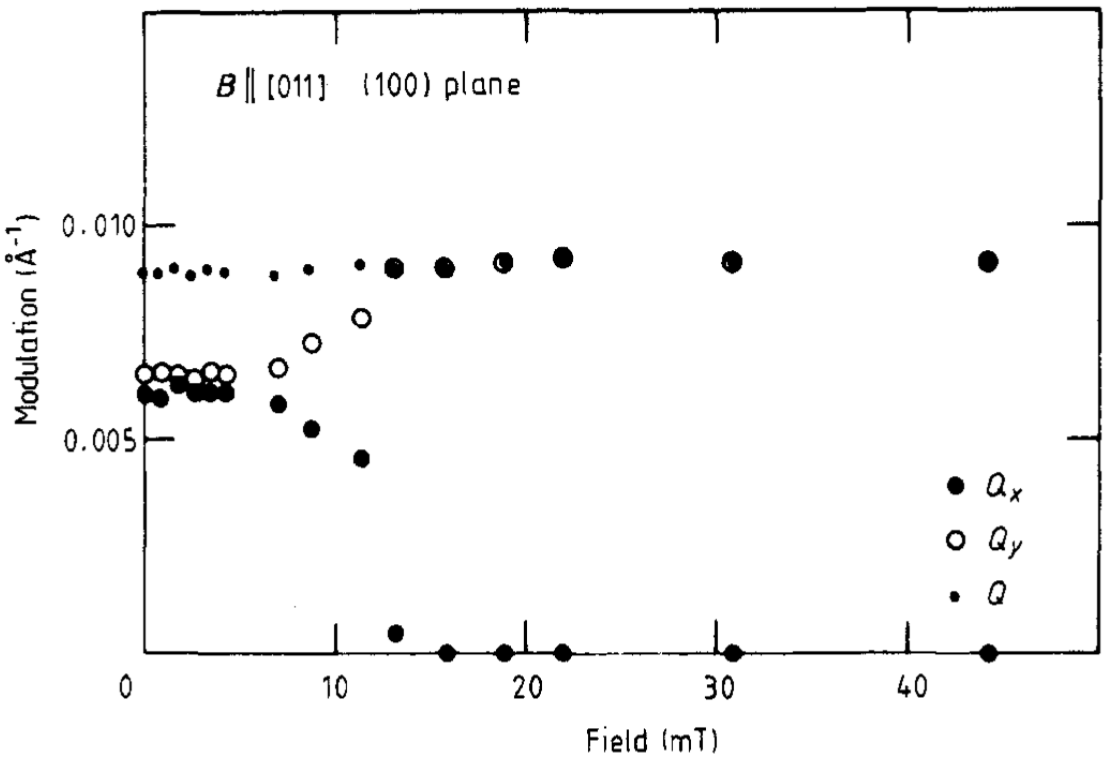


(a) 140K along(21-1)
(b)250K along (0-11)
(c) 250K along (100)

applied field along the [011] vertical direction.



Field dependence (Hl l (011)) at 250K
Solid circle: second order of [100]
Empty circle:[100]
Triangle:[011]



Field dependence of Q vector
Q_x along[0-11]
Q_y along[011]

Conclusion

In zero field, the magnetic structures are long-range spirals which propagate along equivalent (100) directions between *Tc* = 278.7 K and T_2. T_2(down)=211K T_2(up)=245K. (6 directions).

Below T2, the magnetic structures are long-range spirals which propagate along equivalent (111) directions. (8 directions)

Length of propagation vector remain unchanged between to magnetic structure (Q=0.009$Å^{-1}$)

Magnetic fields of -20-40 mT caused the spiral propagation vector to turn into the field direction. The length of the spiral wavevector Q is nearly independent of field.