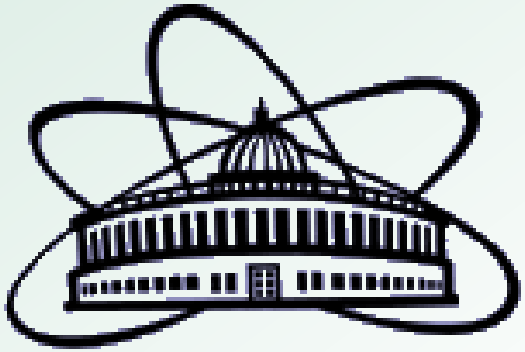


Study of crystal and magnetic structure of spinel ferrites under high pressure

N.M. Belozerova, D.P. Kozlenko, S.E. Kichanov, E.V. Lukin and B.N. Savenko

Plan

1. What are complex oxides of iron?

- Ferrites are perspective compounds
- Brief description of structure and physical properties of complex oxides of iron

2. Caring out an experiment

- Advantages of neutron diffraction.
- Diffractometer DN-6 and additional equipment

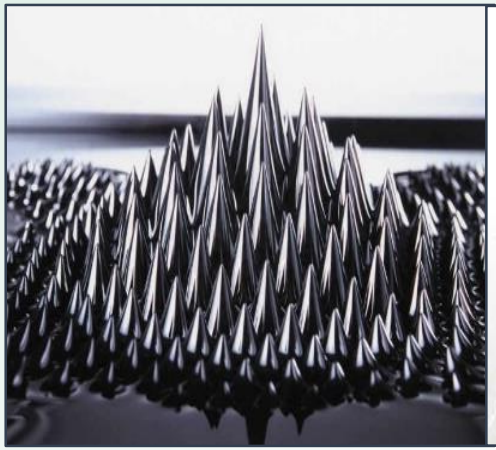
3. Experimental results

- Crystal and magnetic structure of $Zn_{0.3}Cu_{0.7}Fe_{1.5}Ga_{0.5}O_4$ in wide temperature range
- Crystal and magnetic structure of $Zn_{0.3}Cu_{0.7}Fe_{1.5}Ga_{0.5}O_4$ in wide pressure range

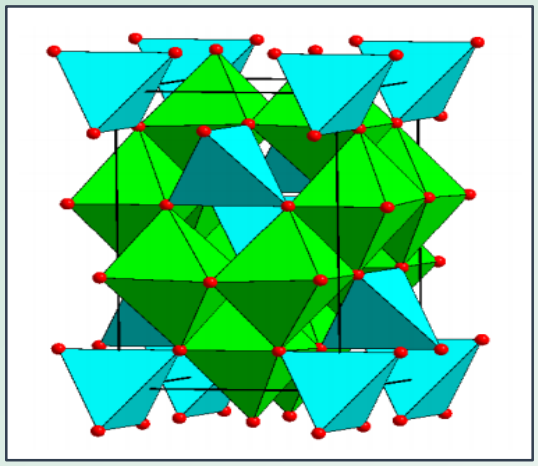
Summary

Complex iron oxides applications

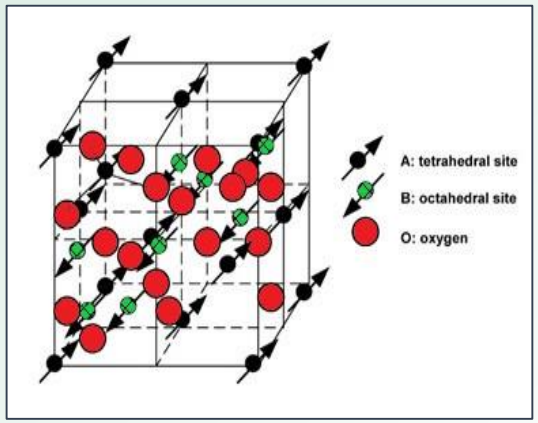
- ✓Significant saturation magnetization
- ✓High electrical resistivity
- ✓Low electrical losses
- ✓High chemical stability




Structure and properties of complex iron oxides



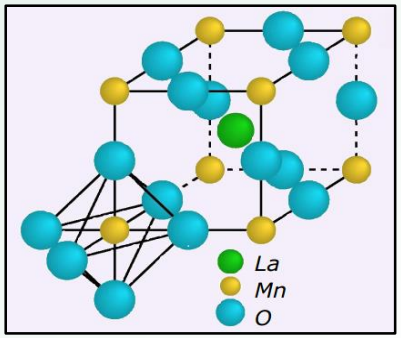
The spinel structure (AB_2O_4) is represented by the densest face-centered cubic lattice. Metal cations are distributed between two crystallographic positions: **tetrahedral (A-site)** and **octahedral (B-site).**



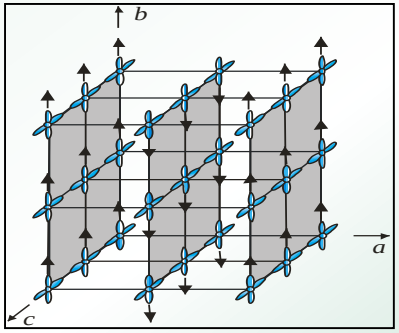
The magnetic properties of spinel ferrites is forming by the exchange interaction between the electrons of the ions in the A and B sublattices. Usually, the **A - B interaction** is the strongest. The **A - A interaction** is almost ten times weaker, and the **B - B interaction** is the weakest. The dominant interaction A - B leads to **ferrimagnetic ordering**.

Experimental method: Neutron Diffraction

- Neutron is **sensitivity to the light atoms** such as oxygen. It is give as opportunity to determine location of oxygen with precision.

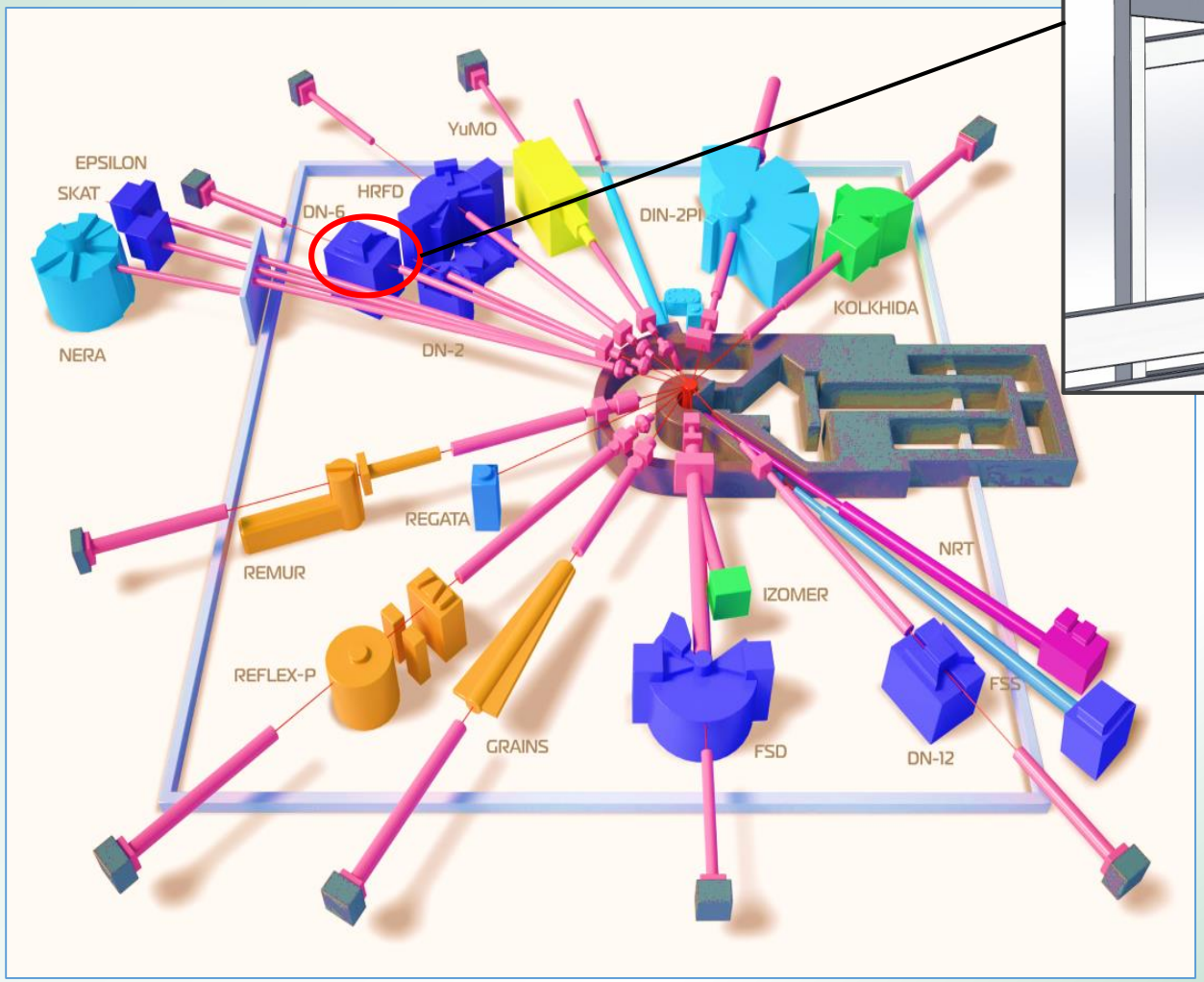


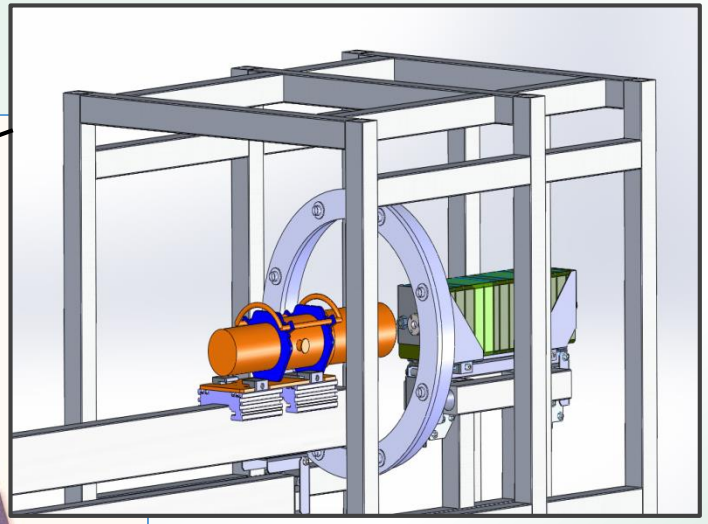
- Another advantage of the neutron is **sensitivity to the magnetic structure** and dynamics of the magnetic substance.



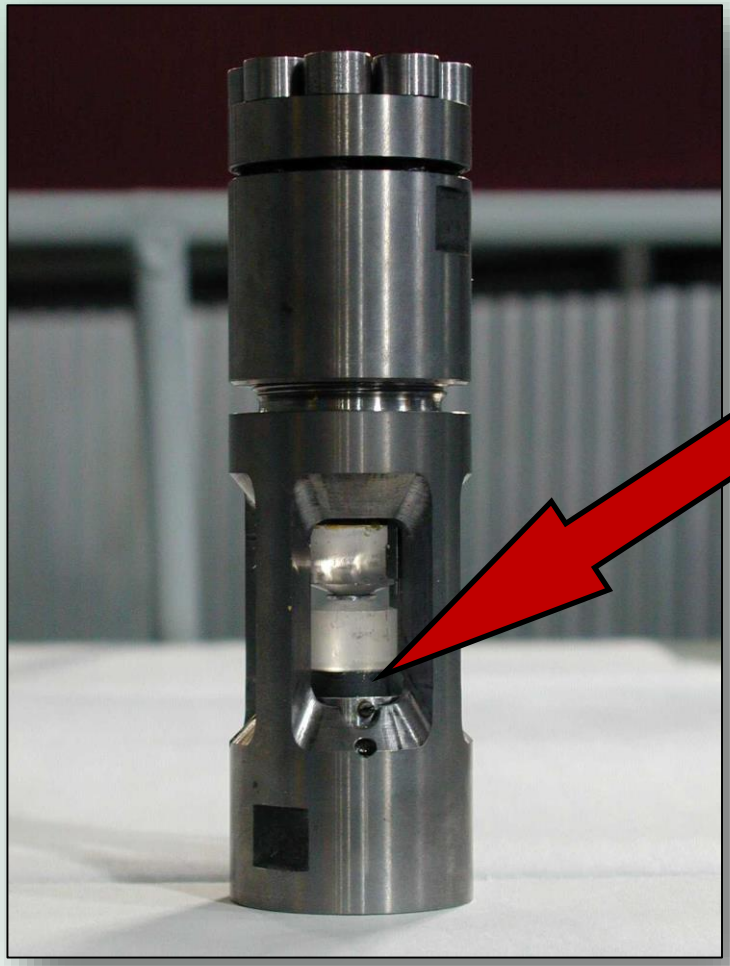
- An important is the **high penetrating power of neutrons**, which gives opportunities for working with high-pressure cells and devices for changing the temperature on the sample.

Experimental method: Neutron diffractometer DN-6



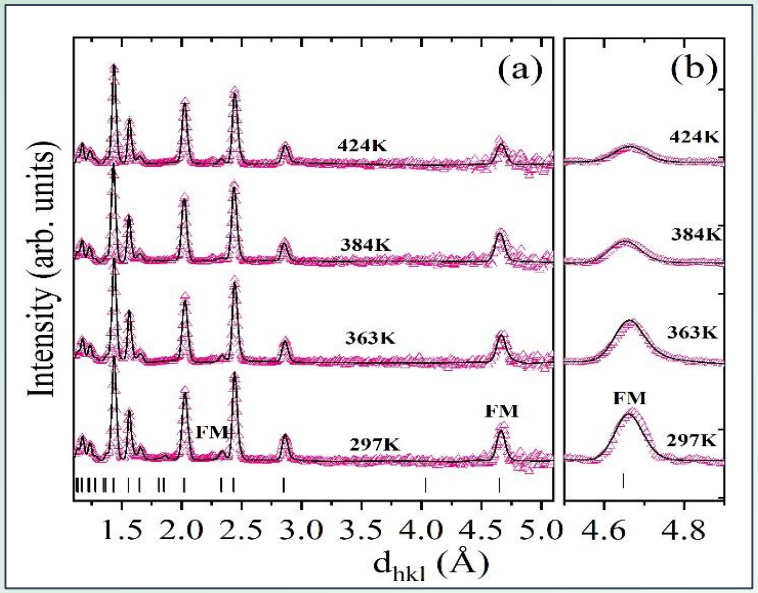


Experimental methods: High pressure cells



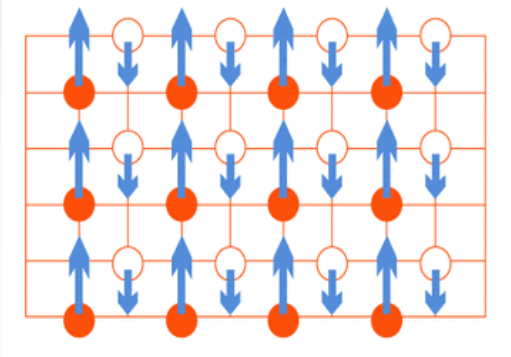
Maximum pressure is 8 GPa

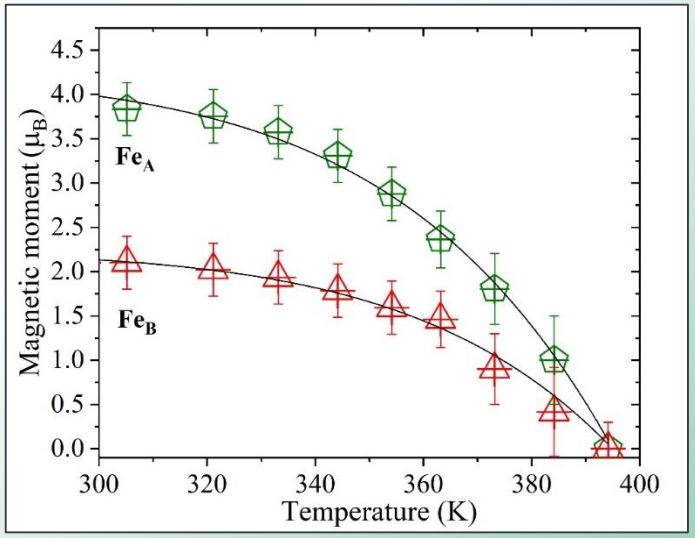
Crystal and magnetic structure of ferrite $Zn_{0.3}Cu_{0.7}Fe_{1.5}Ga_{0.5}O_4$ in wide temperature range



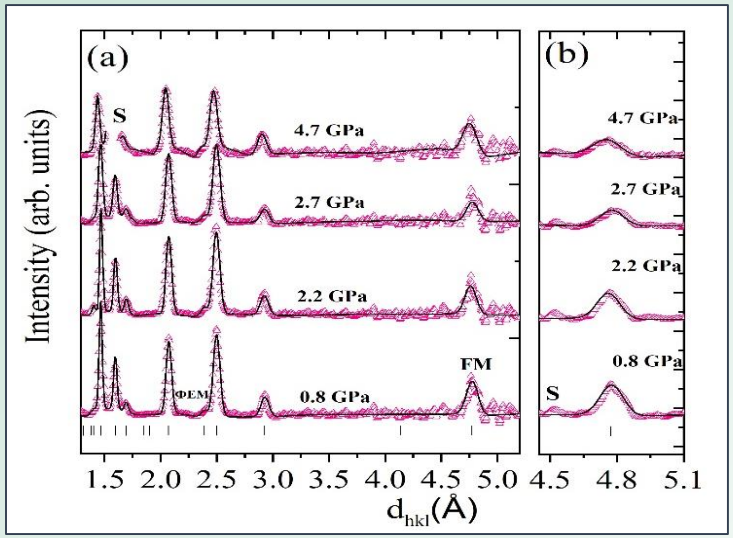
Unit cell parameters		
a, Å		8.331(3)
Atomic occupations		
A site:	Zn	0.30(1)
	Fe	0.68(3)
B site:	Cu	0.70(1)
	Fe	0.82(2)
	Ga	0.50(1)

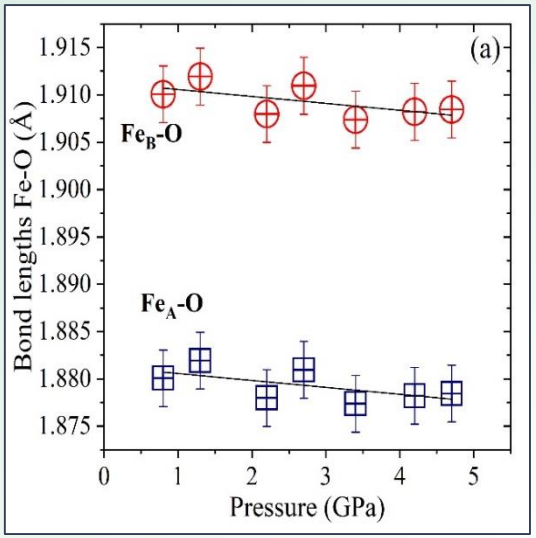
Magnetic moment	
T=300 K	
M_A, μ_B	4.2(4)
M_B, μ_B	2.3(2)
Curie temperature	
T, K	395

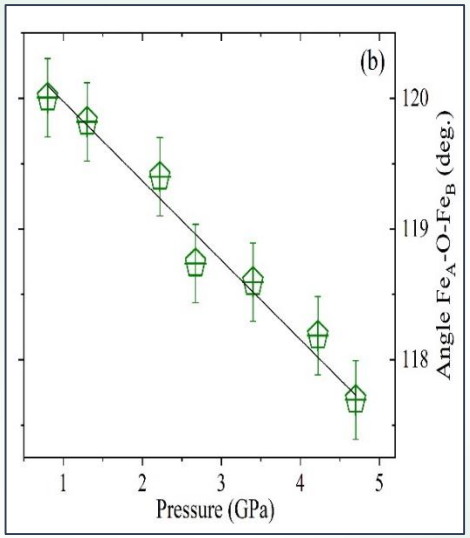


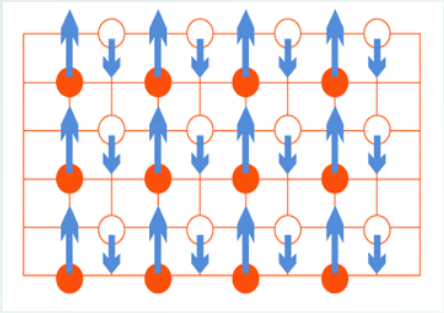


Crystal and magnetic structure of ferrite $Zn_{0.3}Cu_{0.7}Fe_{1.5}Ga_{0.5}O_4$ in wide pressure range

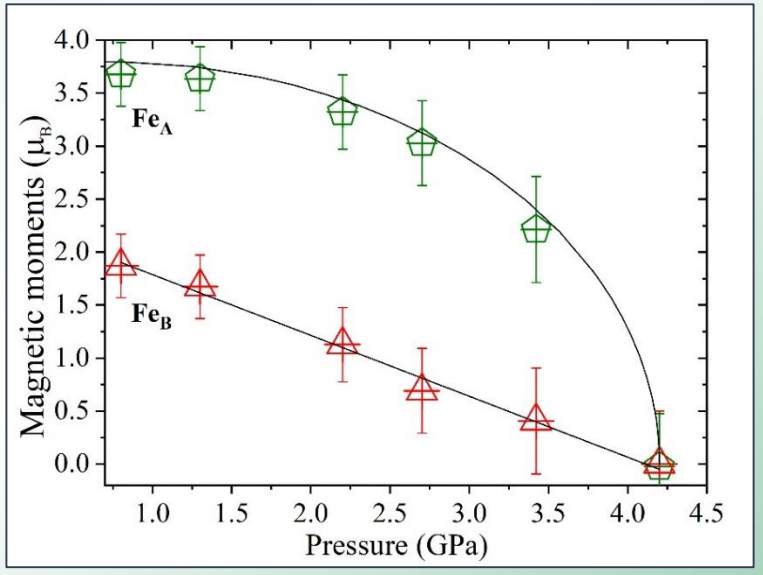








Curie temperature (P = 0 GPa)	
T, K	395
Curie temperature (P > 4 GPa)	
T, K	300



Summary

1. **Crystal structure** of ferrite $Zn_{0.3}Cu_{0.7}Fe_{1.5}Ga_{0.5}O_4$ presented by the normal spinel cubic structure with space group Fd-3m, which **remains stable** in all studied temperature and pressure range. The most important parameters of crystal structure were obtained.
2. By increasing the temperature and the pressure, a **gradual suppression of the magnetic moments** of iron ions in both A and B crystallographic sites was observed. This effect corresponds to a **magnetic phase transition** from the ferrimagnetic state to paramagnetic one.
3. At pressures above 4 GPa, a **suppression of ferrimagnetic phase**, characterized by rapid decrease of the Curie temperature by about 95 K with a pressure coefficient dT_C/dP = -19 K/GPa occur.

Thank you for attention!

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Used article:

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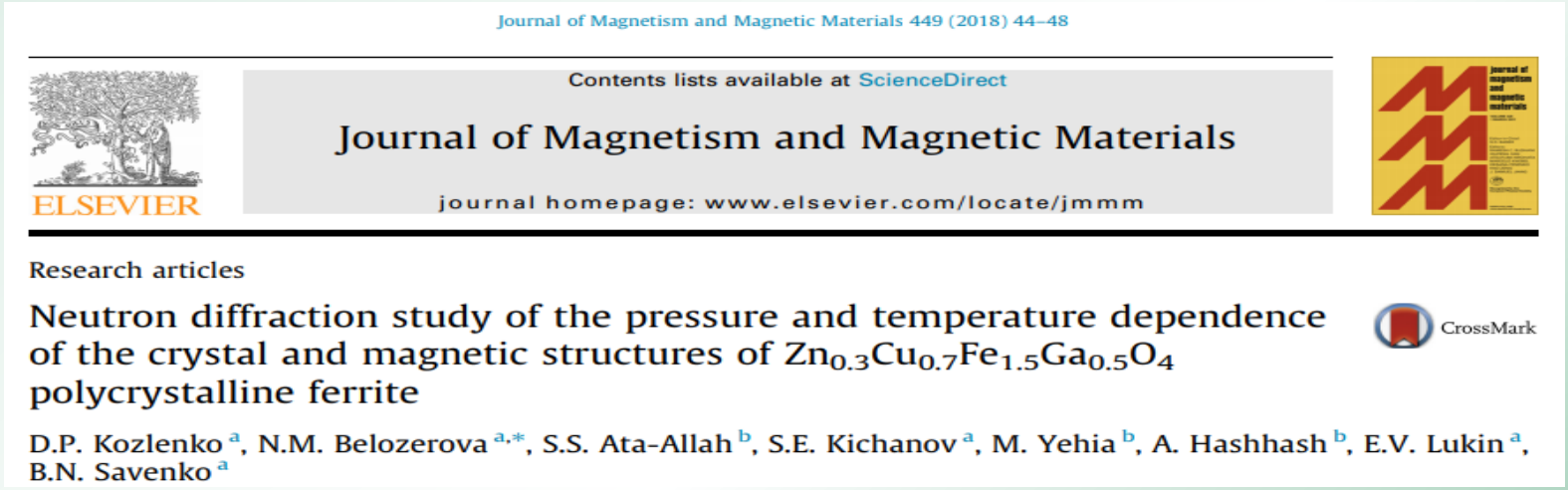

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Research articles

Neutron diffraction study of the pressure and temperature dependence of the crystal and magnetic structures of $Zn_{0.3}Cu_{0.7}Fe_{1.5}Ga_{0.5}O_4$ polycrystalline ferrite

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