Keynote Lecture

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Sixty Five Years of Magnetic Structures. Present and Future of Magnetic Crystallography

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Magnetic Crystallography is a sub-field of Crystallography concerned with the description and determination of the magnetisation density in solids. A magnetic structure corresponds to a particular spatial arrangement of magnetic moments that sets up below the ordering temperature. The determination of magnetic structures is mainly done using neutron diffraction (powder and single crystals) and in special cases the use of polarized neutrons is necessary to solve ambiguities found in the interpretation of magnetic neutron diffraction data. We can consider that Magnetic Crystallography starts with the seminal paper by C.G. Shull and S. Smart on the magnetic structure of MnO published the 29 August 1949 in the Physical Review 76, 1256. The symmetry properties of periodic arrangement of atoms are well described by the 230 space group types in three dimensions, however more complex spatial arrangements of atoms may need to be described by periodicity in higher dimensions. Incommensurate, composite and quasi-crystal structures represent a relatively small part of the huge amount of materials that can be described by conventional Crystallography, however many magnetic structures are non-commensurate: the periodicity of the orientation of the magnetic moments is not commensurate with the underlying crystal structure. The symmetry properties of magnetic structures are traditionally described using two different approaches: the magnetic Shubnikov groups [1] and the group representation analysis [2-3]. In this talk we shall describe how these approaches have been established historically and the advantages of the new trend towards the use of magnetic superspace groups. A review of the most important papers and milestones in magnetic neutron scattering as well as in the symmetry concepts will be presented. The current analytical tools and methods for determining magnetic structures and their symmetry will briefly be described.

[1] *W. Opechowski, Crystallographic and Metacrystallographic Groups, Elsevier Science Publishers B.V., Amsterdam 1986.,* ***[2]*** *E.F. Bertaut, Acta Cryst A24, 1968, 217,* ***[3]*** *Y.A. Izyumov, V.E. Naish and R.P. Ozerov, Neutron diffraction of magnetic materials, Consultants Bureau, Plenum Publishing Corporation, New York 1991.*

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