# Magnonic band gaps in magnetoferritin-based nanocomposites

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9.7 cm

Magnetoferritin is an intensively studied biomimetic magnetic nanoparticle consisting of $Fe_3O_4$-$\gamma$-$Fe_2O_3$ (magnetite/maghemite) grown inside the spherical protein cavity of apoferritin (with the internal diameter of 8 nm and the external diameter of 12 nm). A protein crystallization technique is successfully used for fabricating three-dimensional well-ordered fcc magnetoferritin crystals of the size of hundreds of micrometers. In both theoretical and experimental studies the long-range magnetic order in such crystals has been found to strongly depend on the structural order of the nanoparticles. We present the results of band structure calculations for 3D magnonic crystals with magnetoferritin nanoparticles embedded in a ferromagnetic matrix to increase the stability of the long-range magnetic order and allow the occurrence of an absolute magnonic gap. Our approach is based on Maxwell's equations for magnetostatics, solved by the plane wave method. The interparticle distance proves crucial for the modelling of magnonic gaps. In the small lattice constant range even slight changes in the lattice constant strongly affect the gap width. The gap vanishes completely for a lattice constant dependent on the exchange length in the matrix material.

This work is supported by the European Community's 7th Framework Programme (FP7/2007-2013), Grant Agreements No. 228673 (MAGNONICS).

13.4 cm

**Subject category :**

3. Magnetic Structure and Dynamics

**Presentation mode :**
poster

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