

## Spin-charge coupling in chiral spin systems

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In chiral spin systems there is a coupling of charge and spin degrees of freedom. It means that there is a possibility that we can excite spin and electric degrees of freedom simultaneously by electromagnetic field. Close to the resonance both  $\epsilon$  and  $\mu$  can be independently negative. Magnetic field excites magnetic states and electric field excites electric states. These states are different from each other. Due to the coupling of degrees of freedom there is a possibility that frequencies of electromagnetic field (slightly below the resonance) will result in simultaneous negative values of  $\epsilon$  and  $\mu$ . In such a case refraction index is negative. We evaluated window of  $\omega$ , where refractive index is negative in the case of triangular lattice and toys lattices (ladder, square, "tube"). We found that the window for triangular lattice is narrower than for toys lattices (square), which have equivalent model parameters (lattice constant and exchange interaction between nearest neighbours).

9.7 cm

13.4 cm

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