Photocreating supercooled spiral-spin states in a multiferroic manganite

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I will demonstrate that dynamics of the *ab*-spiral-spin order in a magnetoelectric multiferroic $Eu_{0.55}Y_{0.45}MnO_3$ (EYMO) can be unambiguously probed through optical second harmonic signal, generated via the spin-induced ferroelectric polarization. In case of relatively weak photoexcitation, the ferroelectric and spiral-spin orders remain interlocked while relaxing through spin-lattice relaxation in the non-equilibrium state. When the additional optical pulse illuminating sample is intense enough to induced local phase transition thermally, the system creates a metastable state of *bc*-spiral-spin order (with electric polarization *P//c*) via supercooling across the first-order phase transition between the *ab*- and *bc*-spiral. The supercooled state of *bc*-spiral spin is formed in thermodynamical ground state of the *ab*-spiral (*P//a*), displaying a prolonged lifetime, in particular under its favorable magnetic field along the *a*-axis. [1] The observed photo-switching between the two distinct multiferroic states sheds light on novel photoinduced phenomena in spiral-spin multiferroics.

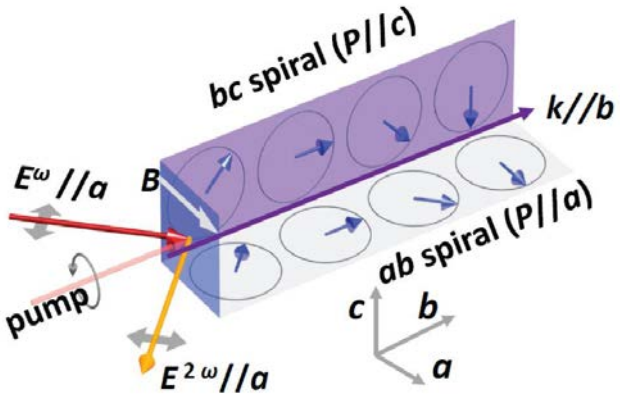

Fig1. The two spiral-spin states in a multiferroic manganite EYMO, and the geometry for time-resolved second harmonic generation that creates the metastable *bc*-spiral state. The associated ferroelectric polarizations are also indicated. [2]

Reference:

1. H. Murakawa, H. Murakawa, Y. Onose, F. Kagawa, S. Ishiwata, Y. Kaneko, and Y. Tokura Phys. Rev. Lett. **101**, 197207 (2008).
2. Y. M. Sheu, N. Ogawa, Y. Kaneko, and Y. Tokura, Phys. Rev. B: Rapid Comms. 94**,** 081107(R) (2016).