Magnetic phase diagram of the high-temperature spiral magnet YBaCuFeO$_5$

J. Lyu$^1$, T. Shang$^{1,2}$, M. Morin$^{1,3}$, M. T. Fernández-Díaz$^4$, M. Medarde$^1$

$^1$Laboratory for Multiscale Materials Experiments, Paul Scherrer Institut, 5232 Villigen PSI, Switzerland, $^2$Key Laboratory of Polar Materials and Devices (MOE), School of Physics and Electronic Science, East China Normal University, Shanghai 200241, China, $^3$Excelsus Structural Solutions (Swiss) AG, PARK innovAARE, 5234 Villigen, Switzerland, $^4$Institut Laue Langevin, 71 avenue des Martyrs, CS 20156, 38042 Grenoble CEDEX 9, France

ejike.lyu@psi.ch

Frustrated magnets with spiral magnetic phases are currently being intensively studied owing to their ability for inducing ferroelectricity. This could potentially be exploited in spintronics and low power memories devices.[1-2] However, the low magnetic order temperatures (typically < 100 K) in most of frustrated magnets greatly restrict their fields of application. One of the most notable exceptions are Cu/Fe-based layered perovskites, featuring magnetic spiral phases whose ordering temperatures can be continuously tuned far beyond RT.[3-5]. However, the influence of magnetic field on the magnetic structures especially spiral phases, imperative for further cross-control of the magnetic and ferroelectric orders, is barely known.

Here, we report a comprehensive description of the evolution of magnetic order in the layered perovskite YBaCuFeO$_5$ under the application of magnetic fields up to 9.0 T and at temperatures between 1.5 K and 300 K. Using bulk magnetization measurements and neutron powder diffraction we reveal the existence of a new incommensurate magnetic phase with a weak ferromagnetic component stable at low magnetic fields. Moreover, we observe a field-induced spin reorientation in the collinear phase. The resulting $H$-$T$ phase diagram of YBaCuFeO$_5$ will be discussed, with emphasis in the magnetic phases with the largest potential to display strong magnetolectric effects. [6]

Figure 1. Left: Crystal structure of YBaCuFeO$_5$ showing the Cu/Fe disorder in the bipyramidal sites. Magnetic structure of the incommensurate spiral phase (Middle) and the commensurate collinear phase (Right).


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