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Driving the magnetic response of $BiFeO_3$ by hydrostatic pressure

C. TOULOUSE, J. BUHOT, Y. GALLAIS, A. SACUTO, Laboratoire Matériaux et Phénomènes Quantiques - Université Paris Diderot-Paris7, A. FORGET, D. COLSON, DSM/DRECAM/SPEC - Service Physique de l'Etat Condensé - CEA Saclay, R. DE SOUSA, Department of Physics and Astronomy - University of Victoria, D. WANG, Electronic Materials Research Laboratory - Xi'an Jiaotong University, L. BELLAICHE, Physics Department and Institute for Nanoscience and Engineering - University of Arkansas, M. BIBÈS, A. BARTHÉLÉMY, Unité Mixte de Recherche CNRS/Thales, M. CAZAYOUS, M. MÉASSON, Laboratoire Matériaux et Phénomènes Quantiques - Université Paris Diderot-Paris7 — $BiFeO_3$ exhibits ferroelectric and magnetic orders at room temperature, which makes it an ideal candidate for spintronics, electro-optics and data storage applications. Most of its properties are related to its ferroelectric character, especially studied under electric or magnetic fields, however the antiferromagnetism has not been extensively investigated, in particular under pressure. Here, we bring insight into the rich spin physics of $BiFeO_3$ in a detailed study of the dynamic magnetic response of bulk $BiFeO_3$ under pressure up to 12GPa measured by Raman spectroscopy. As pressure increases, multiple spin excitations associated to non-collinear cycloidal magnetism collapse into two excitations, which show jump discontinuities at some of the ensuing crystal phase transitions. Using effective hamiltonian simulations of both the structure and the magnetism and Ginzburg-Landau theoretical calculations we show that the pressure controls both the structural phase and the magnetic anisotropy that drives the spin excitations.

Constance Toulouse
Univ de Paris

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