Observation of Mermin-Wagner behavior in LaFeO3/SrTiO3 superlattices

doc. Mgr. Adam Dubroka, Ph.D.
dubroka@physics.muni.cz

Two-dimensional magnetic materials can exhibit new magnetic properties due to the enhanced spin fluctuations that arise in reduced dimension. However, the suppression of the long-range magnetic order in two dimensions due to long-wavelength spin fluctuations, as suggested by the Mermin-Wagner theorem, has been questioned for finite-size laboratory samples. Here we study the magnetic properties of a dimensional crossover in superlattices composed of the antiferromagnetic LaFeO3 and SrTiO3 that, thanks to their large lateral size, allowed examination using a sensitive magnetic probe — muon spin rotation spectroscopy. We show that the iron electronic moments in superlattices with 3 and 2 monolayers of LaFeO3 exhibit a static antiferromagnetic order. In contrast, in the superlattices with single LaFeO3 monolayer, the moments do not order and fluctuate to the lowest measured temperature as expected from the Mermin-Wagner theorem. Our work shows how dimensionality can be used to tune the magnetic properties of ultrathin films.