Spin textures and topological Hall effect in $La_{0.7}Sr_{0.3}MnO_3$ / $SrIrO_3$ bilayers

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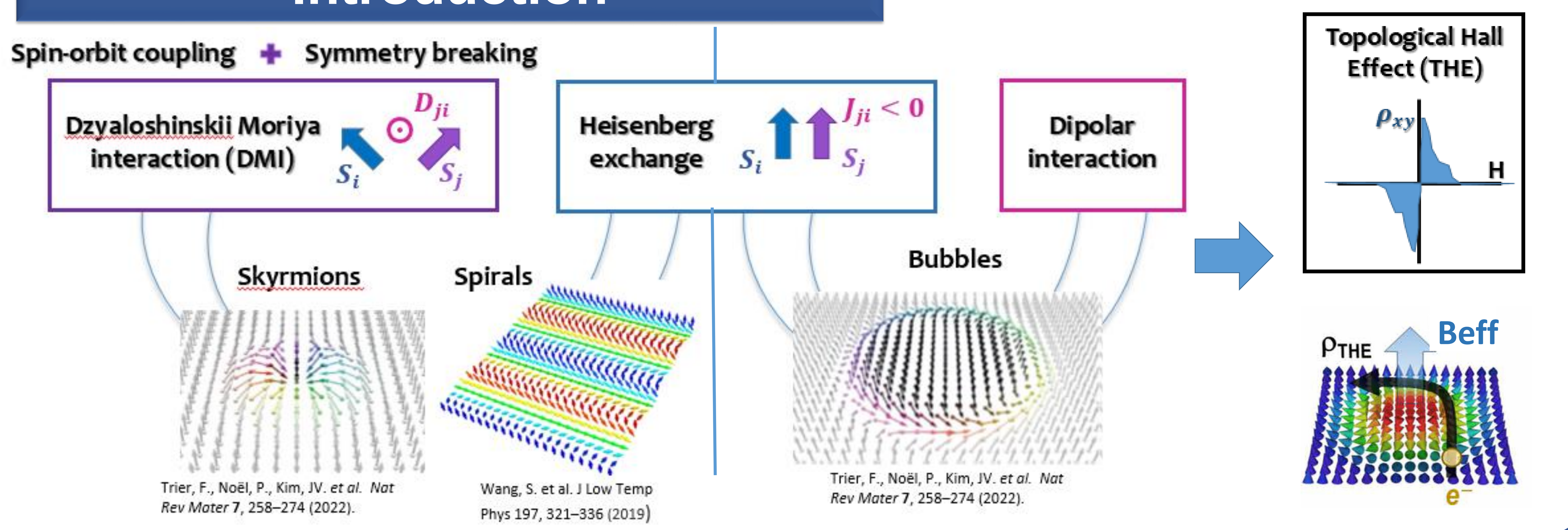
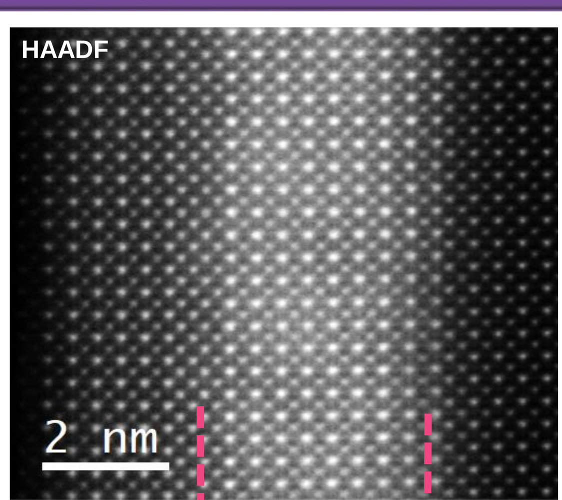
Introduction

Spin configurations such as **magnetic skyrmions** have attracted significant research interest due to their potential application in next-generation logic and memory devices. These magnetic textures give rise to an antisymmetric contribution to the transverse resistivity, the so-called **topological Hall effect** (THE). In this work we report THE in bilayers of $La_{0.7}Sr_{0.3}MnO_3$ and $SrIrO_3$. We also study this bilayers with imaging techniques, getting unexpected results.

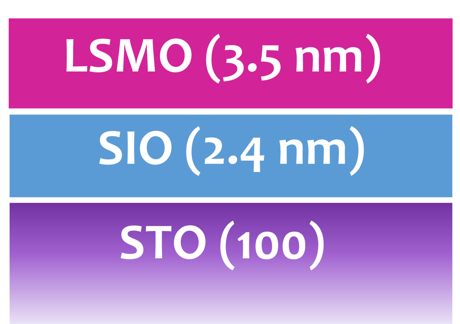


Growth and structural characterizaction

High Angle Annular Dark Field



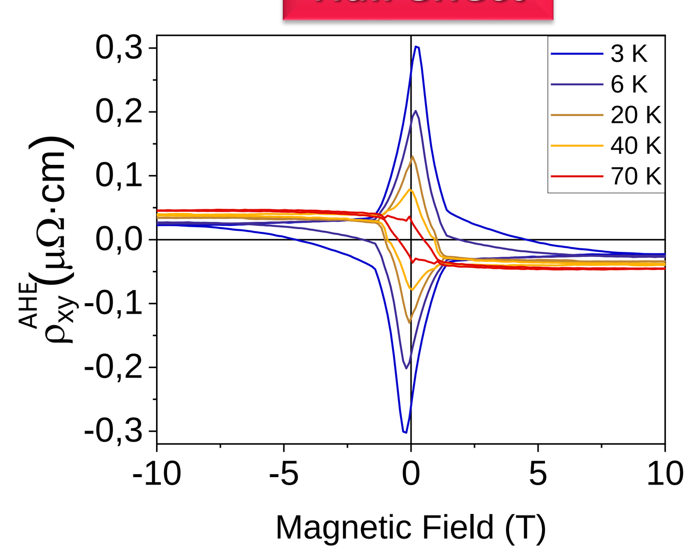
Sample estructure



- 3d ferromagnetic manganite
- 5d iridate in a semimetalic state with strong spin-orbit coupling

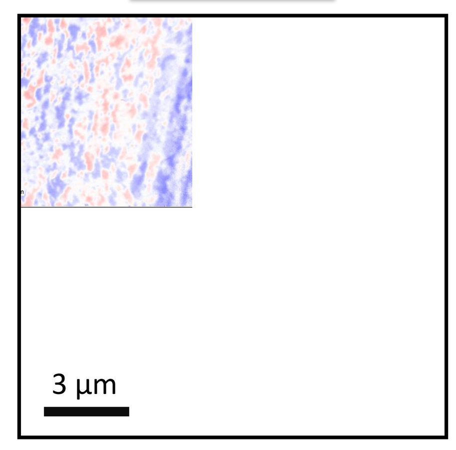
Hall measurements & microscopy images

Hall effect

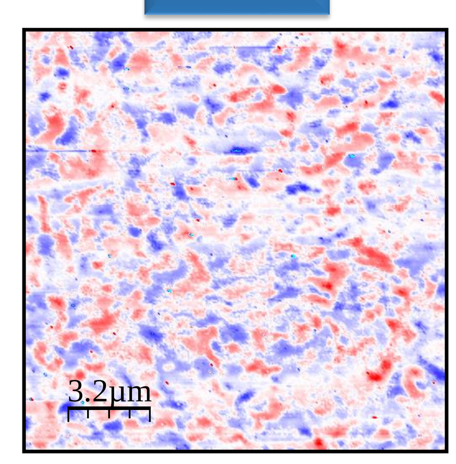


Huge topological Hall effect (THE)

PEEM

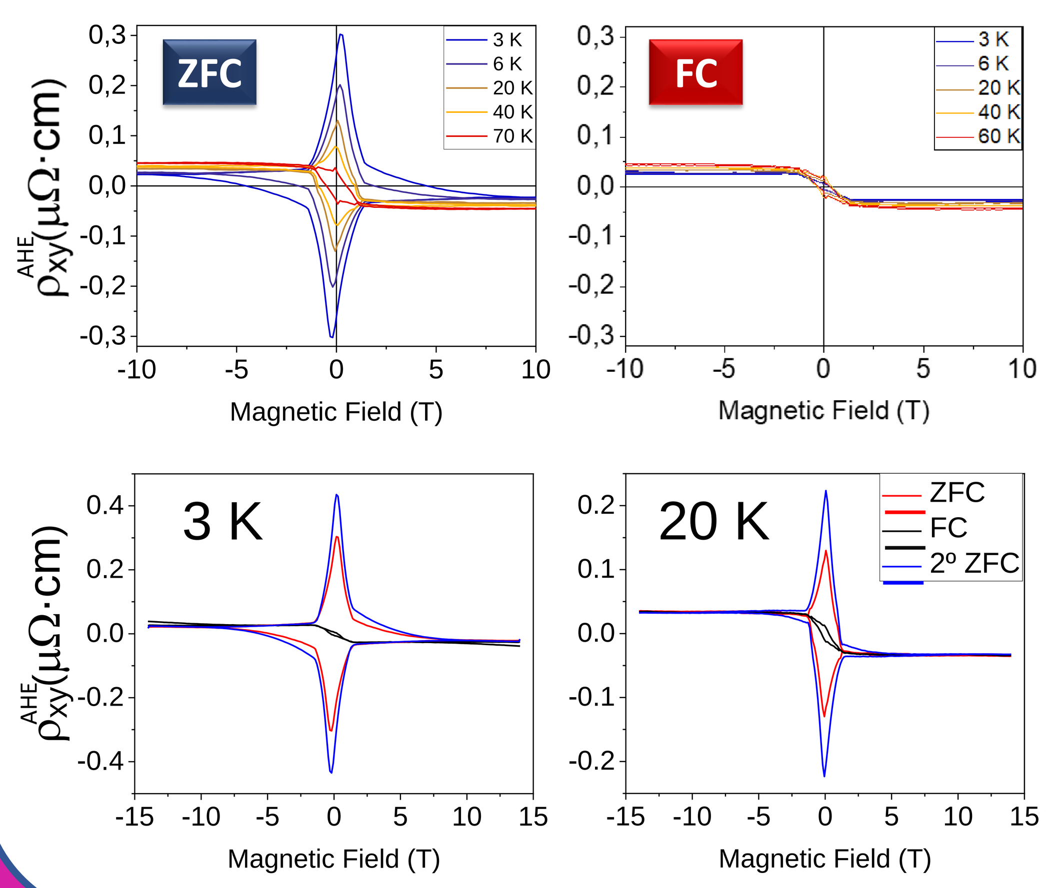


MFM



In good agreement with two different microscopy techniques

Control of the emergence of the THE



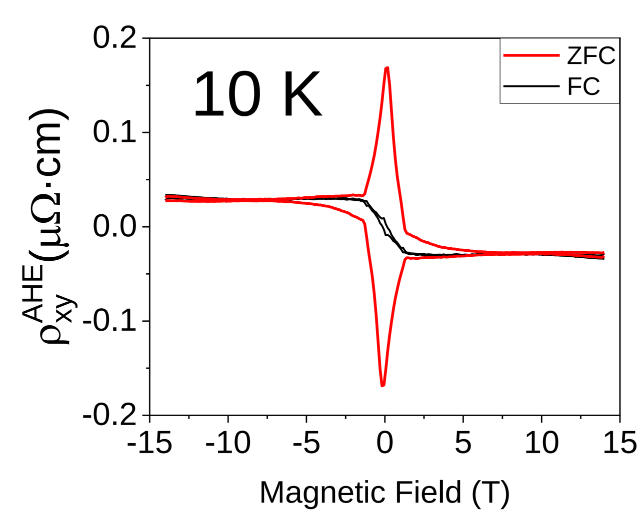
The THE emerge after cooling the system without any magnetic field (ZFC).

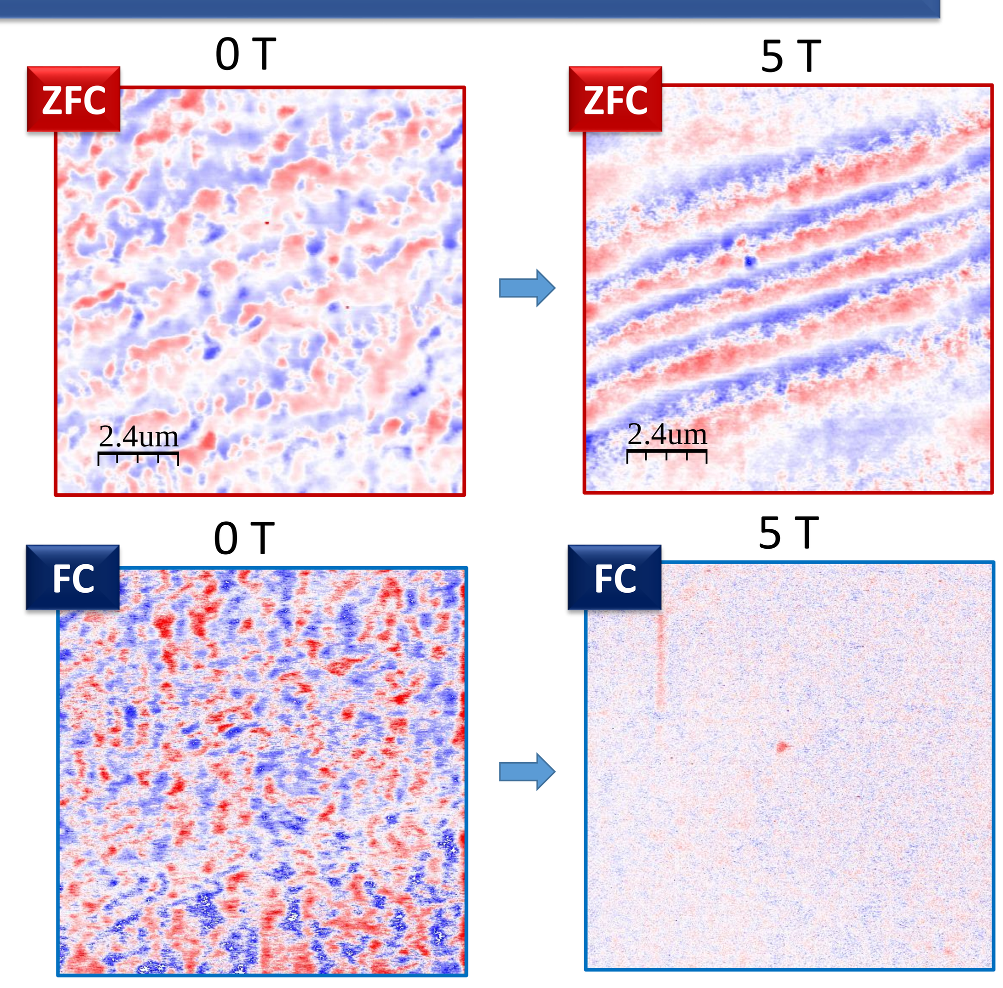
After cooling the system with an out-of-plane magnetic field (FC) the THE disappear.

After another ZFC we recover the THE.

Control of the emergence of the topological peak by the magnetic history

Magnetic force microscopy study





Magnetic textures observed after ZFC and after FC at 0T.

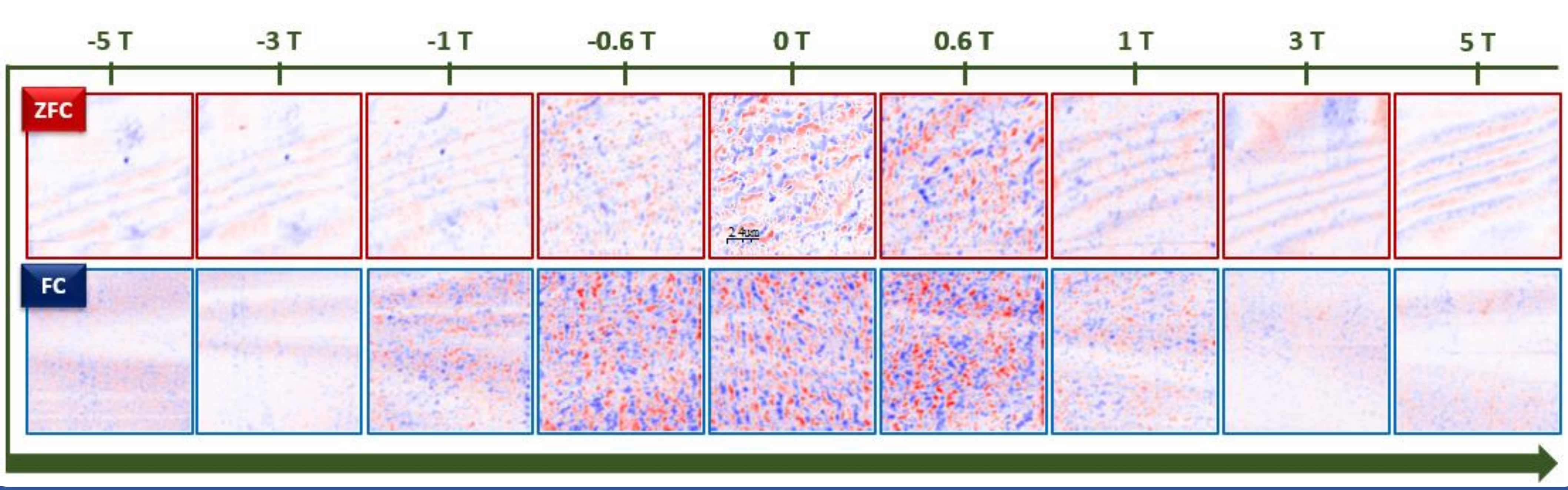
Spin spirals observed after ZFC at 5T.

No spin spirals observed after FC at 5T.

Magnetic textures evolution

Spin spirals induce chiral frontiers in the magnetic texture.

Magnetic texture + Chiral frontiers originate THE.



Conclusions

We have observed topological Hall effect in bilayers of $La_{0.7}Sr_{0.3}MnO_3$ and $SrIrO_3$, indicating the presence of magnetic textures in the system. We are able to control the emergence of the THE by using FZC and FC, never reported in the literature. We observe magnetic textures after ZFC and after FC. This incitates the magnetic textures are not the olny ones responsable for the THE. We suggest that the spin spirals observed at high fieds induce chiral frontier at the magnetic texture, originating the THE. The MFM and PEEM images don't have enough information to connect THE with the magnetic textures.

[1] L. Vistoli, et al. Nature Physics 15,1 (2019).
[2] J. Matsuno, et al., Sci Adv. 2, 7(2016).
[3] Fert, A. et al. Nature Nanotech 8, 152–156 (2013).
[4] D. Kan et al. Physical Review B, 98 180408(R) (2018).

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