Contribution ID: **48** Type: **Oral**

Two-dimensional ferromagnetic extension of a topological insulator

Tuesday, 6 September 2022 17:30 (20 minutes)

As a promising host-system for novel spintronic applications, magnetic topological insulators (TI, MTI's) hosting quantized and spin-polarized transport properties are a highly intriguing research topic. Over the recent years, many design approaches, ranging from magnetic surface coverage over dilute bulk doping up to the use of intrinsic magnetic structures have been tried experimentally, where the key challenge has always been a compromise between strong magnetic order and high crystalline quality [1]. In our work we present the experimental realisation of a novel design approach by magnetically extending the surface of a 3D TI with a 2D layered magnet within the same symmetry class. The magnetic extension approach [2], built up out of the material combination Bi_2Te_3 and $MnBi_2Te_4$ [3] enables a direct overlap between the topological surface state (TSS) density of states and the magnetically active Mn ions, leading to a clear magnetic gap in the TSS as signature of time reversal symmetry breaking while maintaining a highly ordered system.
We present a combined structural and spectroscopic study of this van der Waals heterostructure, facilitating synchrotron based experiments using high resolution angle resolved photoemission (ARPES) x-ray absorption and dichroism (XAS, XMCD) and x-ray diffraction (XRD) on our MBE-grown thin film samples. Together with scanning transmission electron microscopy (STEM) and magnetotransport experiments, we will show a thorough study on the nature of the 2D magnetism in the single sheet of MnBi2Te4, elucidate its direct coupling to the TSS and set the system in perspective to previously studied MTIs and its potential in van der Waals heterostructure design.
[1] K.M. Fijalkowski et al., Nature Commun. **12**, 5599 (2021)
[2] M.M. Otrokov et al., JETP Lett. **105**, 297-302 (2017)
[3] M.M. Otrokov et al., Nature, **576**, pages 416–422 (2019)

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Session Classification: AUSE B - 06/09/22 III