## Stable magnetic singularity in helimagnetic nanostructures containing boundary between grains with different chirality

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Dzyaloshinskii-Moriya interaction (DMI) in helimagnetic materials can give rise to a large number of different non-trivial magnetisation configurations. One of them is the magnetic skyrmion. Recent research showed that confined helimagnetic nanostructures can host ground state skyrmionic states at zero external magnetic field and in the absence of magnetocrystalline anisotropy [1]. However, the fabrication of thin films from which the skyrmion hosting nanostructures should be etched, are usually granular. More precisely, they contain grains with different chirality and consequently different sign of the DMI constant. One of the questions is what magnetisation configurations can emerge in confined geometries containing such boundaries. In order to address this, we perform finite element micromagnetic simulations on a FeGe disk containing grains with different chirality. We use a full three-dimensional model, do not assume any translational invariance of magnetisation, and perform full demagnetisation field computation. We find that for particular grain sizes, a magnetic singularity emerges at the boundary between grains. We find that this magnetic singularity, also known as a Bloch point, is stable at zero external magnetic field. Secondly, we vary the geometry of the confined helimagnetic nanostructure and report the stability of the singularity for a range of sample geometries. Finally, we apply an external magnetic field and spin-polarised current and demonstrate possible ways of manipulating the magnetic singularity. Our demonstration of the stability and manipulation of magnetic singularities, apart from being of fundamental physical interest, suggests a possible use in future spintronics, data storage and processing devices. We acknowledge the financial support from the Horizon 2020 European Research Infrastructures project (676541). The work is also supported by the EPSRC CDT in Next Generation Computational Modelling EP/L015382/1, and the EPSRC grant EP/N032128/1.

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