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Search for orbital magnetism in the kagome metal CsV3Sb5

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Kagome metals of the AV3Sb5 types with A={K,Cs,Rb} are under the spotlight recently due to their non-trivial topological Z^2 nature and their strongly correlated electronic phases at low temperature reminding the ones of High-Tc superconducting Cuprates. For instance, CsV3Sb5 exhibit both a charge density wave phase below 94K with a 2x2 doubling of the unit cell and a superconducting phase below 2.5K [1]. These materials also show strong anomalous Hall effect, but no spin ordering has been found in these compounds both by muon spin spectroscopy and neutrons diffraction. To explain this without relying on spins the possibility of an chiral flux phase / orbital magnetism coming from a chiral flux pahse, emerging alongside the charge density wave, has been theoretically proposed [2,3]. This phase would be similar to the current loop phase predicted in cuprates which can explain the weak magnetism found at [1 0 0] in several cuprates and at [1/2 0 0] in YBaCu3O7-x [4]. To check for the presence of this orbital magnetism in Kagome materials we carry out neutrons diffraction experiment on IN22 triple-axis spectrometer at ILL. Most models predict this chiral flux phase to produce magnetic intensity at M1=[1/2 0 L] or M2=[1/2 1/2 L] reciprocal space positions with L={0,1/2} [2,3]. We investigated both positions by polarised neutrons diffraction. For the first one, no magnetic signal has been observed ruling out the possibility of having a magnetic moment larger than 0.01 uB by vanadium atoms. However, measurement on M2 do not exclude the possibility of a magnetic signal corresponding to a moment of 0.02 ± 0.01 uB by Vanadium atoms. This show that current models have to be refined whether toward a lowering of the expected magnetic moment or toward a different orbital magnetism pattern giving rise to magnetic intensity at different reciprocal space positions to be compatible with our measurements. This work has been experimentally challenging and went close to the limit in precision obtainable with polarised neutron in a reasonable measurement time, Our results are on the process of being published in Physical Review B [5].

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[3] X. Feng et al, Science Bulletin 66, 1384-1388, (2022)
[4] P. Bourges, D. Bounoua and Y. Sidis, Compte Rendu Physique, (2020)
[5] W. Liege et al, arXiv:2407.14391 (2024). doi : https://doi.org/10.48550/arXiv.2407.14391.

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