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Spin dynamics and anomalous anisotropy gap in the metallic perovskite SrRuO₃

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SrRuO₃ is one of the very few perovskite metallic ferromagnets; it exhibits anomalous transport, an invar effect, non-Fermi liquid behavior, a magnetic shape-memory effect and it is an important substrate for various oxide heterostructures. Strong spin-orbit coupling (SOC) is visible in the invar effect and the large magnetic anisotropy. Recently, we could grow large single crystals of SrRuO₃ using the floating-zone technique in an image furnace [1,2]. We report the first inelastic neutron scattering study of the spin dynamics on single crystals. By detwinning the strongly twinned crystals with a magnetic field, it was possible to investigate the dispersion in two orthorhombic directions. Our results yield the expected quadratic spin wave dispersion of a ferromagnet. However the stiffness constant considerably deviates from an earlier inelastic neutron scattering study on powders and it increases with increasing temperature towards TC. We also find a non-monotonous temperature dependence of the anisotropy gap which again disagrees with the powder results. The possible relation of the gap and stiffness parameters of the magnon dispersion with Weyl modes will be discussed.

[1] S. Kunkemöller et al., Chrys. Res Tec. 51, 299 (2016)

[2] S. Kunkemöller et al., PRB 96, 220406(R) (2017)

[3] S. Itoh et al., Nat. Commun. 7, 11788 (2016)

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