Ultrafast magnetization enhancement via the dynamic spin-filter effect of type-II Weyl nodes in Co3Sn2S2

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The magnetic type-II Weyl semimetal (MWSM) Co3Sn2S2 has recently been found to host a variety of remarkable phenomena including surface Fermi- arcs, giant anomalous Hall effect, and negative flat band magnetism. However, the dynamic magnetic properties remain relatively unexplored. Here, we investigate the ultrafast spin dynamics of Co3Sn2S2 crystal using time-resolved magneto-optical Kerr effect and reflectivity spectroscopies. We observe a transient magnetization behavior, consisting of spin-flipping dominated fast demagnetization, slow demagnetization due to overall half-metallic electronic structures, and an unexpected ultrafast magnetization enhancement lasting hundreds of picoseconds upon femtosecond laser excitation. By combining temperature-, pump fluence-, and pump polarization-dependent measure- ments, we unambiguously demonstrate the correlation between the ultrafast magnetization enhancement and the Weyl nodes. Our theoretical modelling suggests that the excited electrons are spin-polarized when relaxing, leading to the enhanced spin-up density of states near the Fermi level and the con- sequently unusual magnetization enhancement. Our results reveal the unique role of the Weyl properties of Co3Sn2S2 in femtosecond laser-induced spin dynamics.

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