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Magnetic order in the topological Kagome metals RMn6Sn6 (R= Dy, Gd, Yb)

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RMn6Sn6 (R=Gd-Lu, and Y) family is a subject of current interest owing to its Mn-Kagome lattice, which can host exotic topological quantum states and frustrated magnetism [1]. Tuning the rare-earth ions in RMn6Sn6, where R is magnetic, can engineer the topological transport properties, including quantum oscillation and the anomalous Hall effect (AHE) [2, 3], thus indicating a close relationship between the localized rare-earth magnetism and topological band structures. In this talk, we will present our recent investigations on three representative systems: for R without spin-orbit coupling L=0 (GdMn6Sn6), for R with spin-orbit coupling J=L+S (DyMn6Sn6), and for R with mixed valances (YbMn6Sn6). We mainly used single-crystal hot-neutron diffraction to solve the magnetic structures to reduce the neutron absorption by the natural Gd and Dy elements. Our refinement of the magnetic structure shows that GdMn6Sn6 exhibits a ferrimagnetic order. Interestingly, the DyMn6Sn6 exhibits ferrimagnetic order with spin reorientation behavior. Distinguishably, neutron diffraction on YbMn6Sn6 (with mixed Yb2+and Yb3+ valances) reveals a ferromagnetic order of the Mn moments, but without the ordering of the Yb ions, indicating that the Yb is non-magnetic. Our studies clearly suggest that the magnetic anisotropy of the rare-earth ion (R) plays a crucial role in controlling the spin orientation of the Mn kagome layers. The solved magnetic structures will help further in gaining more understanding of the underlying physics and its correlation with the topological properties in this family.

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