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Dopant-controlled Competition between Altermagnetism and Local Magnetic Disorder in $FeSb_2$

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Carrier doping has been proposed to transform the correlated narrow-gap semiconductor $FeSb_2$ into an altermagnetic metal, yet the magnetic states of $Cr_{0.15}Fe_{0.85}Sb_2$ and $Co_{0.15}Fe_{0.85}Sb_2$ remain unresolved. We show that the virtual-crystal approximation is qualitatively unreliable: a robust exploration of the magnetic energy landscape using density-functional theory with Hubbard corrections yields weakly ferrimagnetic ground states inconsistent with the nearly spin-compensated experimental magnetization. By contrast, explicit 120-atom alloy supercells stabilize no ferrimagnetic states and reveal a dopant-controlled competition between altermagnetic order and local magnetic disorder. For Cr-induced hole doping, the lowest-energy sampled state is locally disordered and spin compensated, whereas for Co-induced electron doping, the altermagnetic state is lowest in energy. The locally disordered state preserves most local antiparallel spin environments while breaking the symmetry required for long-range altermagnetic order, providing a static first-principles proxy for short-range magnetic disorder. These findings are consistent with the short-range or disordered magnetism observed in $Cr_{0.15}Fe_{0.85}Sb_2$ and the altermagnetic-like optical response of $Co_{0.15}Fe_{0.85}Sb_2$. In the Co-doped alloy, the larger configurational multiplicity of the locally disordered class lowers its restricted free energy and produces a crossover from altermagnetic to locally disordered configurations near 25 K, reflecting competition within a quenched alloy manifold. Our results indicate that long-range altermagnetism is unlikely in $Cr_{0.15}Fe_{0.85}Sb_2$, while supporting an altermagnetic ground state in $Co_{0.15}Fe_{0.85}Sb_2$. This work exposes the limitations of approximate doping treatments and establishes an explicit-alloy benchmark protocol for studying doped metallic altermagnets.