c Research (Grants No.15H05854, No.26107505, and No.26400308) from the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.

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for the MAR16 Meeting of
The American Physical Society

Spin correlations and spin-wave excitations in Dirac-Weyl semimetals YASUFUMI ARAKI, Institute for Materials Research, Tohoku University; Frontier Research Institute for Interdisciplinary Sciences, Tohoku University, KENTARO NOMURA, Institute for Materials Research, Tohoku University — We study correlations among magnetic dopants in three-dimensional Dirac and Weyl semimetals. Effective field theory for localized magnetic moments is derived by integrating out the itinerant electron degrees of freedom. We find that spin correlation in the spatial direction parallel to local magnetization is more rigid than that in the perpendicular direction, reflecting spin-momentum locking nature of the Dirac Hamiltonian. Such an anisotropy becomes stronger for Fermi level close to the Dirac points, due to Van Vleck paramagnetism triggered by spin-orbit coupling. One can expect topologically nontrivial spin textures under this anisotropy, such as a hedgehog around a single point, or a radial vortex around an axis, as well as a uniform ferromagnetic order. We further investigate the characteristics of spin waves in the ferromagnetic state. Spin-wave dispersion also shows a spatial anisotropy, which is less dispersed in the direction transverse to the magnetization than that in the longitudinal direction. The spin-wave dispersion anisotropy can be traced back to the rigidity and flexibility of spin correlations discussed above.

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Date submitted: 06 Nov 2015 Electronic form version 1.4