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Evolution of primordial neutrino helicities in astrophysical magnetic fields[1] GORDON BAYM, JEN-CHIEH PENG, University of Illinois at Urbana-Champaign — Primordial neutrinos decoupled in the early universe predominantly in helicity eigenstates. Their subsequent propagation through the residual cosmic and galactic magnetic fields partially flips their helicities.[2] In view of the report of a possible large effective magnetic moment for solar neutrinos from the XENON1T experiment, we estimate the magnitudes of the helicity flips for primordial Dirac neutrinos both in galactic and cosmic magnetic fields. Majorana neutrinos would not undergo such flips. The helicity flip probability is sensitive not only to the magnetic moment of neutrinos but also to the properties of galactic and cosmic fields, and thus can thus potentially probe astrophysical magnetic fields. We find that even a moment several orders of magnitude smaller than that possibly found by XENON1T could lead to significant helicity changes of Dirac neutrinos as they propagate to detectors on Earth.

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[2]G. Baym and J.-C. Peng, arXiv:2012.12421 [hep-ph].

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