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Discovery of dirac node lines in pure metals of beryllium and magnesium and their potential applications

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Beryllium is a simple alkali earth metal but has been the target of intensive studies for decades because of its unusual electron behaviors at surfaces. Puzzling aspects include severe deviations from the description of the nearly free electron picture, anomalously large electron-phonon coupling effect, and giant Friedal oscillations. The underlying origins for such anomalous surface electron behaviors have been under active debate, but with no consensus. Here, by means of first-principle calculations, we discover that this pure metal system, surprisingly, harbors the Dirac node line (DNL) that in turn helps to rationalize many of the existing puzzles. The DNL is featured by a closed line consisting of linear band crossings and its induced topological surface band agrees well with previous photoemission spectroscopy observation on Be (0001) surface. We further reveal that each of the elemental alkali earth metals of Mg, Ca, and Sr also harbors the DNL, and speculate that the fascinating topological property of DNL might naturally exist in other elemental metals as well.

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