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Emergence of topological semimetals in gap closing in semiconductors without inversion symmetry SHUICHI MURAKAMI, MOTOAKI HIRAYAMA, RYO OKUGAWA, Tokyo Inst of Tech - Tokyo, TAKASHI MIYAKE, AIST, Tsukuba, Japan — In this presentation, we show emergence of topological semimetals in gap closing of any inversion-asymmetric insulators. Namely, we begin with any inversion-asymmetric insulators, and close a gap by changing a parameter in the system; we then show that the system becomes either (i) a Weyl semimetal phase or (ii) a nodal-line semimetal, both are among topological semimetals. In particular, no insulator-to-insulator transition happens, in strong contrast with inversion-symmetric systems. This result also has implications for Z_2 topological number. In a transition between different Z_2 topological phases, a Weyl semimetal phase necessarily appears when inversion symmetry is broken, for materials with any space groups [1,2]. Our theory is applicable to many materials, for example to tellurium (Te) [3]. Tellurium has a unique lattice structure, consisting of helical chains, and therefore lacks inversion and mirror symmetries. At high pressure the band gap of Te decreases and finally it runs into a Weyl semimetal phase, as confirmed by our ab initio calculation. [1] S. Murakami, New J. Phys. 9, 356 (2007). [2] S. Murakami, M. Hirayama, R. Okugawa, T. Miyake, arXiv:1610.07132. [3] M. Hirayama, R. Okugawa, S. Ishibashi, S. Murakami, T. Miyake, Phys. Rev. Lett. 114, 206401 (2015).

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