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Giant anisotropic nonlinear optical response in transition metal monopnictide Weyl semimetals LIANG WU, SHREYAS PATANKAR, TAKAHIRO MORIMOTO, NITYAN NAIR, ERIC THEWALT, ARIELLE LITTLE, JAMES ANALYTIS, JOEL MOORE, JOSEPH ORENSTEIN, Univ of California - Berkeley — Recently Weyl quasiparticles have been observed in transition metal monopnictides (TMMPs) such as TaAs, a class of noncentrosymmetric materials that heretofore received only limited attention. The question that arises now is whether these materials will exhibit novel, enhanced, or technologically applicable electronic properties. The TMMPs are polar metals, a rare subset of inversion-breaking crystals that would allow spontaneous polarization, were it not screened by conduction electrons. Despite the absence of spontaneous polarization, polar metals can exhibit other signatures of inversion-symmetry breaking, most notably second-order nonlinear optical polarizability, $\chi^{(2)}$, leading to phenomena such as optical rectification and second-harmonic generation (SHG). Here we report measurements of SHG that reveal a giant, anisotropic $\chi^{(2)}$ in the TMMPs TaAs, TaP, and NbAs. With the fundamental and second harmonic fields oriented parallel to the polar axis, the value of $\chi^{(2)}$ is larger by almost one order of magnitude than its value in the archetypal electro-optic materials GaAs and ZnTe, and in fact larger than reported in any crystal to date. Reference: arXiv:1609.04894.

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