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**Anharmonic vibrational properties of solids and the metallization of solid helium** BARTOMEU MONSERRAT, University of Cambridge, NEIL D. DRUMMOND, Lancaster University, CHRIS J. PICKARD, University College London, RICHARD J. NEEDS, University of Cambridge — We describe a first-principles method for the calculation of anharmonic vibrational properties in solids. The method is based on a principal axes mapping of the Born-Oppenheimer energy surface and the vibrational self-consistent field scheme, and it allows us to calculate, amongst other quantities, the anharmonic free energy, the band gap renormalizations due to electron-phonon coupling, and the vibrational stress tensor. We exemplify the method by determining the effects of electron-phonon coupling and thermal expansion on the metallization of solid helium. Our results have implications for the cooling of white dwarf stars and suggest a revision of current lower bounds to the age of the Universe as determined within cosmochronology.

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