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Natural Limits on Refractive Index in Multi-Level Systems ROBERT MCCUTCHEON, University of Connecticut, SUSANNE YELIN, University of Connecticut, Harvard University — We consider the refractive indices and electric susceptibilities of two-, three-, and four-level systems. There has been growing interest in finding materials with a high index of refraction, but there are natural limitations on the index that can be attained by controlling basic multi-level systems with external fields. We explain how the ensemble density in a medium is an important practical limitation and use this to calculate a baseline value for the refractive index of a two-level system. We show how the additional transitions and fields in three- and four-level systems give greater control over the refractive index and consider other properties that can, in principle, affect it in linear regimes. An example calculation for a four-level system shows how the frequency of one external field can affect the refractive index experienced by a probe field, and the limits of this method are discussed. These considerations could be useful in proposals for achieving an enhanced refractive index using multi-level systems.

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