Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Surpassing the classical light-trapping limit in thin film solar cells
JEREMY MUNDAY, DENNIS CALLAHAN, HARRY ATWATER, California Institute of Technology — We describe a methodology for designing thin film solar cells that have light-trapping intensity and absorption enhancements that exceed the classical, ergodic light-trapping limit. From thermodynamic arguments, Yablonovitch and Cody determined the maximum absorption enhancement in the ray optics limit for a bulk material to be $4n^2$, where n is the index of refraction of the absorbing layer. Stuart and Hall expanded this approach to study a simple waveguide structure; however, for the waveguide structures they considered, the maximum absorption enhancement was $< 4n^2$. Using a combination of analytical and numerical methods, we describe why these structures do not surpass the ergodic limit and show how to design structures that can. We present here a physical interpretation in terms of the waveguide dispersion relations and optical density of states. We further describe the necessary criteria for surpassing the classical limit and provide examples of waveguide structures with absorption enhancements in excess of $4n^2$.

Jeremy Munday
California Institute of Technology

Date submitted: 19 Nov 2010 Electronic form version 1.4