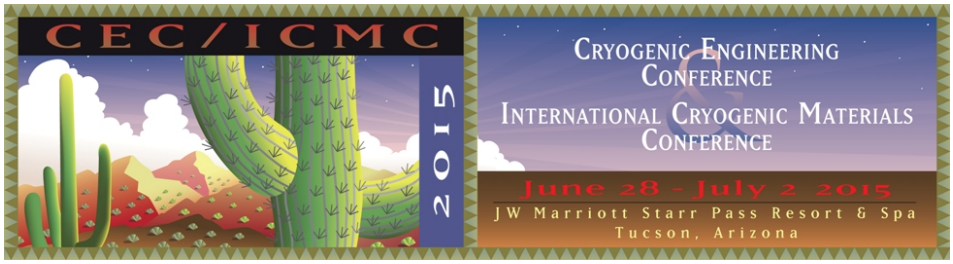

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Modeling Thermal Parasitic Load Lines for an Optical Refrigerator

Monday, June 29, 2015 2:00 PM (2 hours)

Optical refrigeration is currently the only completely solid state cooling method capable of reaching cryogenic temperatures from room temperature. Optical cooling utilizing Yb:YLF as the refrigerant crystal has resulted in temperatures lower than 123K measured via a fluorescence thermometry technique. However, to be useful as a refrigerator this cooling crystal must be attached to a sensor or other payload. The phenomenology behind laser cooling, known as anti-Stokes fluorescence, has a relatively low efficiency which makes the system level optimization and limitation of parasitic losses imperative. We propose and model a variety of potential designs for a final optical refrigerator, enclosure and thermal link; calculate conductive and radiative losses, and estimate direct fluorescence reabsorption. We generate parasitic load-lines; these curves define temperature-dependent minimum heat lift thresholds that must be achieved to generate useful cooling.

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