Contribution ID: **279** Type: **Invited Oral (30min)**

[Invited Oral] Solid-State Optical Cryocoolers

Tuesday, 8 July 2014 16:00 (30 minutes)

Compact, vibration-free solid-state refrigerators, are ideal for cooling infrared sensors, gamma-ray spectrometers and other cryogenic electronics. Such coolers could be integrated into these devices, eliminating the need for liquid cryogens or bulky, noisy mechanical coolers. Currently, the dominant solid-state cooling technology is thermoelectric cooling, which uses the Peltier effect. Despite decades of effort, the lowest achievable temperature for multi-stage thermoelectric coolers (TECs) is around 170 K. Programs at ThermoDynamic Films, LLC, the University of New Mexico and Los Alamos National Laboratory have made important strides developing an entirely different solid-state cooling technology, optical refrigeration. Optical refrigeration removes heat by anti-Stokes fluorescence in which a cooling material absorbs photons at one energy and then remits them at a higher average energy; the energy difference extracts heat from the material. This approach has advanced to the stage where it now cools to temperatures that are much colder than those TECs can currently achieve. Laboratory measurements have demonstrated optical refrigeration cooling from near room temperature to 93 K. This talk will describe the physical principles and current status of optical refrigeration and our goals for the near future. One immediate goal is building lightweight, compact optical refrigerators that can be easily integrated with cryogenic electronics. In parallel, we are developing improved cooling materials that can allow optical refrigeration to cool below the 80 K, enabling it to be used with high-temperature-superconductor electronics. The talk will also describe our longer-term goals and approaches for improving the cooling efficiency to make optical refrigerator at least as efficient as the current generation of mechanical cryocoolers.

Primary author: Dr EPSTEIN, Richard (ThermoDynamic Films, LLC)

Co-authors: Prof. SHEIK-BAHAE, Mansoor (University of New Mexico); Dr HEHLEN, Markus (Los Alamos National Laboratory)

Presenter: Dr EPSTEIN, Richard (ThermoDynamic Films, LLC)

Session Classification: Tue-Af-Orals Session 5

Track Classification: C-14: New devices and novel concepts