Overdriving a Pulse-Tube Coldhead with Twin Pressure-Wave Generators to Approximately Double Its Cooling Capacity

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MVE Biological Solutions, makers of the Fusion self-sustaining 1500-liter biological freezer, have recently demonstrated the feasibility of a larger, 1800-liter model. The larger freezer is enabled by a cryocooler with approximately double the cooling capacity of that used in the original Fusion. To leverage existing components and reduce the development cycle, the cryocooler configuration consists of the same coldhead used in the existing Fusion cryocooler, driven by two Fusion pressure-wave generators (PWG's) in tandem. This concept carries at least two technical risks: first, that the twin PWG's might not operate in perfect synchronization if they are at all mismatched, and second, that higher amplitude in the coldhead might degrade performance due to nonlinear effects. Though such amplitude effects have been observed in larger-scale coldheads (with capacity of ~200W at 80K) prior experience suggests these smaller coldheads, with nominal capacity of ~30W at 80K, might be relatively immune. The data suggest that little or no degradation results from "overdriving" the Fusion coldhead, with double the cooling capacity obtained from double the acoustic power input. Data from these tests will be presented, along with a discussion of possible limitations of using this approach.