CFD-Assisted and Micromanufacturing-Based Bottom-up Design and Development of Smart Regenerators for Large Cryocoolers

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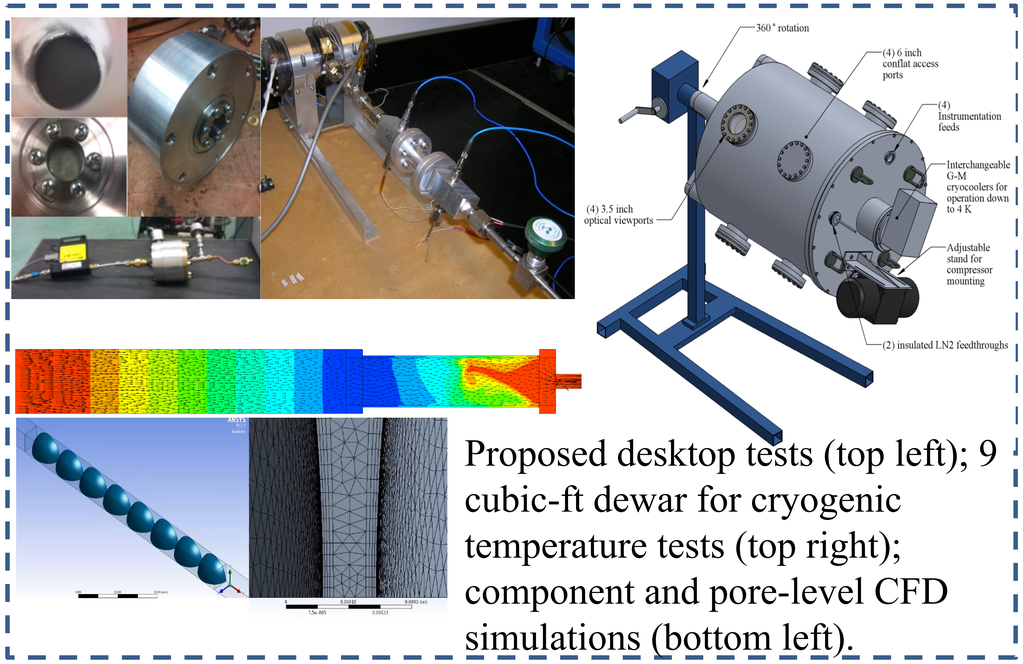

Proposed desktop tests (top left); 9 cubic-ft dewar for cryogenic temperature tests (top right); component and pore-level CFD simulations (bottom left).

Research Objectives
- Develop and demonstrate a CFD-assisted methodology for bottom-up designing of optimized regenerators for large cryocoolers
- Design an optimized regenerator for a 1-stage PTR with 150 W @ 90 K power
- Design optimized regenerator(s) for a 2-stage PTR with 20 W @ 20 K second stage
- Perform experiments at prototypical temperatures and demonstrate

Approach
- Pore-level and component-level CFD simulations
- Micro-structured regenerator fillers
- Selection of pore structures with best performance
- Bottom-up design and fabrication to obtain near-optimal, 1D flow in regenerator
- Elevate the state of art from TRL 1 to TRL 3+.

Potential Impacts
- Scalable and flexible design methodology that can utilize novel manufacturing techniques
- Micromanufacturing techniques for bottom-up fabrication of large regenerators
- Optimized 150 W @ 90 K and 20 W @ 20 K regenerators with minimize losses