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**SESSION 6: GM & GM-Type Pulse Tube  
Cryocoolers**

**Paper No. 6-3 Wednesday Morning 9:30 AM**

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***Contributions of Numerical Simulation in  
Development of Pulse Tube Cryocoolers***

*Chao Wang, Consultant, Manlius, NY*

Numerical simulations of pulse tube cryocoolers revealed the internal operating processes and led to the innovation and improvement of the pulse tube cryocooler. This paper reviews some major contributions of numerical simulation in the development of pulse tube cryocoolers: (1) revealed and confirmed the concept of “gas piston” in the pulse tube; (2) revealed a phase shifting mechanism of an orifice pulse tube cryocooler; (3) revealed the double-inlet functions and helped invent a double-inlet pulse tube cryocooler; (4) discovered and revealed “DC flow” effects in pulse tube cryocoolers; (5) helped understand unique features of 4 K regenerators; (6) helped understand the enthalpy losses in 4 K regenerators and utilize the enthalpy losses for precooling; (7) helped invent and understand new phase shifters for pulse tube cryocoolers.