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## **C2Or2D-02: BAE Hybrid Cryocooler Solution for the ESA Athena Mission**

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Next generation Astrophysics Science Missions seek to interrogate the Far-IR and X-ray wavelengths requiring ADR cooled detectors to 100 mK or less. Operation of these ADR systems requires efficient thermal rejection at 4-5 K coupled with observatory cooling needs at 4-5 K and parasitic load interception at nominally 20 K. One example is the ESA Athena Mission that focuses on X-ray wavelengths. BAE has developed a high efficiency Hybrid Cryocooler Design capable of meeting the thermodynamic, EFT, mass, and power requirements for this mission. The BAE Hybrid Cooler consists of a Two-Stage Stirling Pre-cooler coupled to a J-T stage that provides remote cooling between 4-5 K and 18-20 K. Performance predictions for the BAE Hybrid cooler solution are presented in comparison to the Athena Mission requirements. Additionally, details of a custom BAE J-T cooler test facility used to validate performance predictions for the 4K/20K J-T cooling stages is discussed.

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