Two stage cooler for detector cooling between 30 and 50K

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There has been a trend towards increasing heat loads for cryogenically cooled Earth Observation instruments in recent years. This is the case at both the current operational temperature levels (~50K), as well as at lower operational temperature levels (30-50K). One solution to meet this trend is to use existing pulse tube technology in a double stage configuration. By doing so it is possible to intercept parasitic loads at higher temperature, thereby reducing the load at the lower temperature, and increasing cooling power available for focal plane cooling at lower temperature.

Therefore, the TCBV/CEA/AS consortium has developed a space cryostat actively cooled by a 2-stage high reliability pulse tube cryocooler. This work has been performed in the frame of a ESA Technical Research Program (TRP) (refer 4000109933/14/NL/RA) with a target TRL of 6. The targeted cooler operational temperature is 30-50K (heat lift in the range of 0.5-2.5W) for the second stage and 100-120K (heat lift up to 4W) for the first stage, for a power consumption level similar to that of coolers currently in use.

The first part of the presentation shows the overall equipped cryostat design including lower level assemblies such as the cold finger, compressor and buffer/inertance assembly. Cryostat and cryocooler aspects such as heritage, trade-off criteria, design improvements, interfaces, envelopes and key performance characteristics (e.g. cooling power, off-state parasitics, etc.) of the design will be presented.

Additionally hardware manufacturing and initial test results of various components such as compressor, cold finger and cryocooler are presented.

Final part of the presentation concentrates on the pre-qualification test campaign of the cryocooler, the manufacturing of the cryostat and the equipped cryostat testing. During the equipped cryostat testing the cryocooler is installed in the cryostat in order to perform full end-to-end testing of the cryocooler in a representative system.