Brayton Cycles for Space Applications

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Abstract. Since the early stages of space exploration, several studies have considered the application of closed Brayton cycles, both for dynamic power conversion systems and for cryogenic cooling of sensitive equipment. Its high efficiency, reliability and flexibility to several power ratings and different heat sources (nuclear, solar…) constitute attractive advantages, together with a relatively high Technology Readiness Level. In the past, a number of engines designed for space have been based on closed Brayton cycles, such as Brayton Rotating Units (BRUs) or the Solar Dynamic module. In more recent years, some futuristic solution has also been proposed for high efficiency space-based power plants, absorbing radiation from the Sun, rejecting waste heat to a sink temperature close to 2.7 K and transmitting the resulting energy to the Earth via a laser beam. NASA's Exploration Systems Mission Directorate (ESMD) is even evaluating Brayton cycles for hypothetical manned outposts on the Moon or on Mars. This paper summarises the extra-terrestrial history of this thermodynamic cycle and revises past and future proposals for space applications.