Loop Heat Pipes (LHPs) are high-performance and high-reliable passive capillary two-phase heat transport devices that allow the transport of heat over long distances by the evaporation and condensation of a working fluid that flows around the loop. Its advantages of flexibility and robustness in design and assembly as well as antigravity capability of heat transport have made the LHP a superior thermal management device, among a variety of other options available. A recent advance in LHPs is the design of flat-shaped evaporators, which is better suited to the geometry of discretely mounted electronics components (e.g. microprocessors) and therefore negate the need for an additional transfer surface (saddle) between component and evaporator.

The current trend in LHP research concerns primarily applications operating at near room temperature. However, when it comes to the application of LHPs operating at elevated values of reduced temperatures (i.e. between 500K-700K), a research gap is created. A literature search did not reveal many comparative data for medium-temperature LHPs and is limited to a few outdated papers. Hence, recently no proven working fluids and their chemical compatibility with LHP construction materials have been validated in this temperature range and no live test results are present. Moreover, the extension of the typical LHP operating temperature range is directly driven by the selection of an appropriate working fluid. Compatibility between materials and working fluids is the main benchmark in the LHP design.

This project leads to overcome numerous challenges and scientific problems that exist in the development of LHP with flat evaporator working in elevated values of reduced temperatures, including: **(a)** selection of appropriate working fluid (MOST medium temperature working fluids are toxic, reactive, decompose and degrade when reaching temperatures close to a critical point, generate Non-Condensable Gasses (NCG), are chemically non-compatible with LHP construction materials, have too low or too high vapour density, do not wet the wick properly, their full property data is not available, the majority of the physical properties are predicted, their live tests and environmental impact data are not adequate); **(b)** selection of appropriate construction (i.e. casing or wick) material (there are NO full metal compatibility tables with most of the medium temperature working fluids and the reactivity of fluids significantly limits the choice of potential materials. The major results of incompatibility are the generation of NCG, corrosion and in consequence leakage and termination of LHP operation, blocking wick pores and reduction of LHP performance by the corrosion products, material transport (dissolving components of the casing/wick material in the condenser and carrying and re-deposing the particles in the evaporator). Furthermore, the casing material is supposed to be strong enough to resist the high pressure of the working fluid at elevated temperatures and stress corrosion resistance, which is challenging too; **(c)** construction of a suitable test rig capable of testing at elevated temperatures. Testing such an LHP is an endeavour as the reactivity of medium-temperature fluids and the use of obscure metals create new challenges. Also, some of the working fluids whose operating temperature is between 500K-700K tend to freeze at ambient temperature (LHP is frozen before start-up) or are reactive or toxic which makes additional problems during testing and handling. All together creates multiple challenges in the development of such LHPs; **(d)** development of new testing methods. It is necessary to build a suitable test rig, capable of testing LHP at desired temperatures. Therefore specialist equipment capable of handling temperatures is necessary and new testing methods should be developed); **(e)** evaporators of flat LHP tend to deform due to high internal fluid saturation pressure and uneven stress distribution in the non-circular casing; (**f**) occurrence of heat leak from evaporator heating zone and sidewall into the compensation chamber; (**g**) occurrence of reverse flow through the wick; **(h)** poor performance at start-up.

Incompatibility between the working fluid and LHP materials is directly linked to NCG generation and consequently oscillatory behaviour or termination of operation of LHP. An extensive need exists to perform a full thermodynamic analysis of the behaviour of this capillary two-phase system to understand its thermal and hydraulic processes in the LHPs operating at elevated temperature ranges.

This project will **(1)** complement the knowledge of the NCG influence on LHP operation at elevated temperature ranges and certainly extend the operating range of all capillary-driven thermal management devices; **(2)** complement the knowledge about novel medium-temperature working fluids and their compatibility with LHP components and novel engineering materials; **(3)** complement the knowledge about capillary passive two-phase system's thermal and hydraulic processes and LHPs behaviour operating with NGC at elevated temperatures (publications on the influence of NCG on LHP are rare and are limited to temperatures up to about 350K); **(4)** to manufacture a novel design of flat evaporator LHPs to demonstrate the technology's reliability and flexibility for use in many applications (in particular operating in elevated temperatures); **(5)** develop procedures and testing methods for manufacturing medium temperature LHPs; **(6)** to complement the recent knowledge necessary for developing LHPs possible to use in **APPLICATIONS OPERATING AT ELEVATED TEMPERATURES** (applications suggested by ESA – project scientific partner) such as: space bimodal systems, space systems for the exploration of deep space (i.e. long-term missions), fuel cells thermal management systems, geothermal power applications, solar-thermal power plants, thermal storage applications, waste heat recovery systems, medium-temperature electronic cooling systems (e.g. electronics based on silicon-carbide semiconductors), medium-temperature military laser systems, and etc.