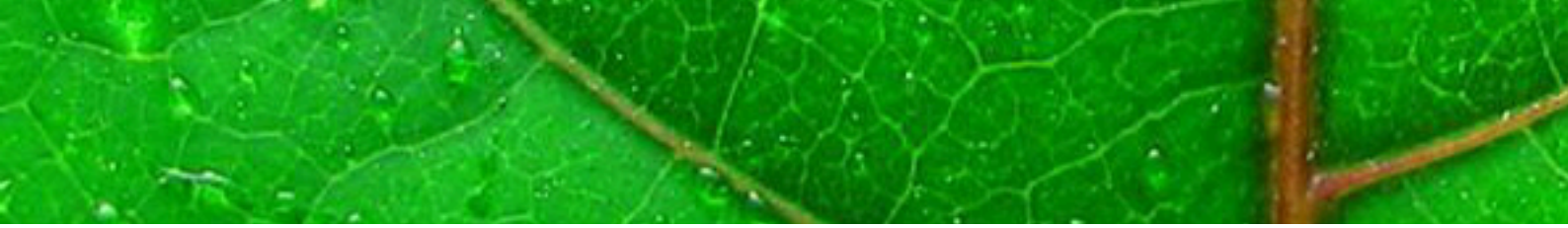

# Capillary pumped loops

**Capillary pumped loops (CPL) have been developed for the space industry for over thirty years.**

Today, they are of interest to a great number of land-based industrial sectors, in particular transportation (rail, aeronautics, automobile), where an increasing number of systems are electric. Because power electronic components are rapidly becoming more efficient, increasing amounts of heat must be evacuated. Heat management has effectively become a major issue due to the miniaturization of these components: currently, the power density of the heat to be dissipated can sometimes stand at around 200 W $cm^{-2}$.

CPL are expected to represent the technological breakthrough that will help meet the severe constraints imposed by the thermal regulation of these new components. These loops are highly efficient and use the phase transition of a refrigerant to transfer heat; their specificity is that they do not require a mechanical power transmission device to set the fluid in motion: it is the surface tension that develops in a porous structure within which the fluid vaporizes which sets the fluid in motion. These systems are therefore passive and modular and can evacuate heat flows of a few watts to several kW over distances of up to several meters.

The aim of the work carried out these past years is to study, both in theory and in practice, the performance of a gravity CPL (Capillary Pumped Loop), both to meet the needs of the aeronautical industry (OPTIMAL project involving the company Liebherr-Aerospace in Toulouse, for which an innovative full-scale device was realized in the frame of a partnership with the GREPH team of LaPLACE in Toulouse) and of the rail transport sector, to improve the behavior of loops manufactured by EHP (Euro Heat Pipe, Belgium) for Alstom Transport, the world's leading company in this area.

Today, the main objective is to push back the limits of these devices, and this entails describing the unstable behavior of the liquid/vapor interface in the pores – of just a few microns – of the porous wick found in the evaporator. This is a crucial issue in order to reach the limits of vapor percolation in the wick, which is one of the main causes of failure of these loops.