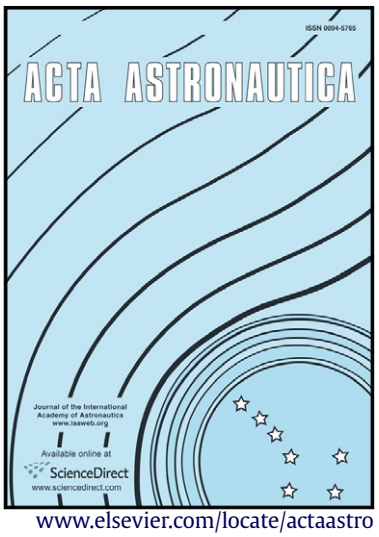

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THE FUTURE OF CRYOGENIC PROPULSION

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Abstract

As the French Space Agency, CNES is funding an ambitious program to identify, develop and evaluate the technologies and skills that will enable to design cost efficient future launchers. This program deals together with, researches for mastering complex physical phenomena, set ups of robust and efficient numerical tools for design and justification, and identification of innovative manufacturing processes and hardware. It starts from low Technical Readiness Level (TRL 2) up to a maturation of TRL 6 with the use of demonstrators, level that allows to be ready for a development.

This paper focuses on cryogenic propulsion activities conducted with Snecma and French laboratories to prepare next generation engines. The physics in that type of hardware addresses a large range of highly complex phenomena, among them subcritical and supercritical combustion and possible associated High Frequency oscillations in combustion devices, tribology in bearings and seals, cavitation and rotordynamics in turbopump. The research activities conducted to master those physical phenomena are presented. Moreover, the operating conditions of these engines are very challenging, both thermally and mechanically. The innovative manufacturing processes and designs developed to cope with these conditions while filling cost reduction requirements are described. Finally, the associated demonstrators put in place to prepare the implementation of these new technologies on future engines are presented.

***Keywords*:** liquid propulsion, research and technology, rocket engine, demonstrator

1. Introduction: future launchers preparation

The existing European launchers family, which will be soon completed with the upcoming Ariane5ME and / or Ariane 6, is able to cover the need to put all foreseeable payloads for the next 15 years. In parallel, CNES is preparing the next generation of launchers, for 2025 and beyond, with an ambitious program of Research and Technology, associated to demonstration programs.

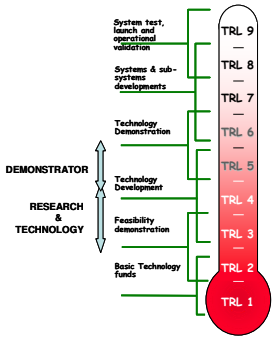

Figure 1 : Technology Readiness Scale