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EUROPEAN SCALABLE "MEGA-HEAVY" LAUNCHER: A KEY ENABLER FOR EUROPE'S SPACE AMBITIONS

Abstract

This paper presents a conceptual framework for a European scalable and modular mega-heavy launcher, designed to address the evolving needs of Europe's space program and the global market. Building upon the foundations laid by ESA's PROTEIN initiative a flexible launch system capable of delivering payloads up to 200 metric tons to Low Earth Orbit (LEO) is proposed. The launcher concept leverages cutting-edge European technologies, such as high-thrust engines developed under the THRUST! project and innovative propulsion systems like the Prometheus engine by ArianeGroup. Employing a modular design, the system can be configured to meet various mission requirements, from supporting the construction of large-scale space infrastructure to enabling deep space exploration. Technical constraints and possibilities of this scalable launcher are examined, focusing on reusability, propulsion efficiency, and innovative materials. The concept aims to close the competitiveness gap with emerging global heavy-lift systems while ensuring European independence for space exploration applications beyond LEO. The paper explores synergies with ongoing European space initiatives, including the ASCEND and SOLARIS programs. It discusses how the mega-heavy launcher could facilitate the deployment of in-space datacenters, solar power stations, and manufacturing facilities, aligning with Europe's goals for space-based solar power and sustainable space infrastructure. Additionally, the potential role in supporting the Interplanetary Sunshade (IPSS) project is analyzed, offering a European alternative to complement international heavy launchers in the global space logistics chain. By addressing multiple use-cases and markets, from institutional missions to commercial satellite deployment and space tourism, the proposed mega-heavy launcher concept aims to position Europe as a key player in the future space economy. The paper concludes by outlining a roadmap for development that aligns with ESA's broader vision of advancing European autonomy, leadership, and responsibility in space.