HELLENIC REPUBLIC
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**DEPARTMENT OF PHYSICS**

**SECTOR OF ASTROPHYSICS**

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## *Forecasting CMEs using Image Processing & Neural Networks*

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In today's research, more and more Artificial Intelligence (A.I.) and Machine Learning (ML) models are being used for various tasks and space physics is no exception. The lack of separately positioned satellites providing data prevents us from creating a fully functioning physics based model on most phenomena and as a result, several space scientists are trying to utilize A.I. models.

In this work, we use images from SDO to forecast possible developments of Coronal Mass Ejections (CMEs) using a Convolution Neural Networks (CNNs). These events are categorized in the LASCO and CACTUS catalogs. A CNN was designed to process SDO data, showing promising results. In specific, an accuracy of 76.6% in the prediction of the CMEs as described in CACTUS catalog was obtained. A similar CNN model was applied to distinguish between halo and non-halo CMEs as shown in LASCO catalog. Its accuracy reached a peak of 83.5%. For the training of the CNN and for the image processing, we implemented HPC techniques using the Flemish Supercomputer Centre (VSC). Finally, a new processing tool, written in python, was implemented to recover SDO solar images and generate "History Maps" that contain, in a 3D matrix, information about the Suns temporal and spatial evolution.

We conclude that a smart use of the available data from the SDO satellite in combination with artificial intelligence algorithms, like CNNs, can be used to forecast CMEs.