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The MPI+CUDA Gaia AVU-GSR Parallel Solver towards next-generation Exascale Infrastructures and new Green Computing frontiers

We ported on the GPU with CUDA the Gaia Astrometric Verification Unit-Global Sphere Reconstruction (AVU-GSR) Parallel Solver. The code aims to find the astrometric parameters of ~10^8 stars, the attitude and the instrumental settings of the Gaia satellite, and the global parameter 𝛾 of the PPN formalism, by solving a system of linear equations, 𝐴 × 𝑥=𝑏, with the LSQR iterative algorithm. The coefficient matrix 𝐴 is large, having ~10^11×10^8 elements, and sparse. The CUDA code accelerates ~10 times compared to the current version of the AVU-GSR code, parallelized on the CPU with MPI+OpenMP and in production since 2014. We obtained this result by running the two codes on the CINECA supercomputer Marconi100, that has 4 V100 GPUs per node. This analysis represents a first step to understand the exascale behaviour of a class of applications that follow the same structure of this code, employed in several contexts. In the next months, we plan to run this code on the pre-exascale platform Leonardo of CINECA, to better investigate this behaviour. Computing on highly parallel devices, such as GPUs, might imply the achievement of a Green Computing milestone. In our study, we aim to evaluate how much power we can save with the CUDA code compared to the original code due to a ~10 times acceleration.

Presenter: CESARE, Valentina (Istituto Nazionale di Astrofisica (INAF))

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