

## Relazione su Tesi di Alessandro Degano da Laura Perini

This thesis studies the reconstruction process of the energy clusters in the Calorimeter Endcaps of the CMS experiment ( High Granularity CALorimeter HGAL ) in the conditions of the phase 2 upgrade, when the pileup will be very important. In these conditions the clustering algorithm will need careful setting up and the computing power involved will be very relevant. The work is aimed at finding an algorithm for the search of the nearest neighbours able to cope with the requests of phase 2 and adapt it for running on a set of parallel GPU's.

In the Chapter 1 a very brief description is given of CMS phase 2 and of the problems of the reconstruction of the calorimeter hits in such environment. Chapter 2 deals with principles of parallel computing, CPU and GPU architectures, specifically NVIDIA brand, and CUDA C programming in GPU's. In chapter 3 and 4 two different implementation of the 3 dimensional binary search tree, with the second implementation that is definitely better than the first one. The implementations are described together with their GPU porting and performance analysis, where performance analysis is specifically intended to evaluate the computing performances of the implemented algorithms, in order to assess if they are fulfilling the phase 2 requirements. Only the second implementation matches the requirements and only for this one a very simple tests on simulated CMS data is performed; the evaluation of the physics performances of the proposed algorithm seems outside the scope of this work. Chapter 5 deals with the power consumption of the different devices, and demonstrates that the algorithm running on GPU not only can result in advantageous computing performance improvements but can also significantly limit the energy required to perform a full nearest neighbours search. The results obtained are interesting and potentially relevant for the CMS phase 2, even if in the long period from here to 2023 important technological advancements are likely to occur, somewhat changing the scenario respect to the one described in this thesis.

The thesis addresses the computing problem with competence and obtains significant results, the more general contest and the more physical aspects of the problem are not really taken into consideration.