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Deterministic Annealing for Vertex Finding at CMS

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CMS and others LHC experiments offer a new challenge for the vertex reconstruction: the elaboration of efficient algorithms at high-luminosity beam collisions. We present here a new algorithm in the vertex finding field : Deterministic Annealing (DA). This algorithm comes from information theory by analogy to statistical physics and has already been used in clustering and classification problems. In our purpose, the main job is to code information of a set of tracks into prototypes which will be our vertices at the end of the process. The advantages of such a technique is to globally search all vertices at one time and a priori knowledge of the expected number of vertices is not required: the algorithm creates new vertices by a phase transition mechanism which will be describe in this contribution. Thus, the first part of this talk is devoted to a short description of the DA algorithm and to the necessary introduction of the concept of apex points which stand for tracks in this method ; then a discussion of vertex reconstruction efficiencies follows consisting finding DA's internal parameters and making a comparison between DA and the most popular vertex finding algorithm. This comparison is done considering 4000 bbar events generated in the detector central region without pile-up in a first approach ; primary and secondary vertices reconstruction results are shown. Then performances of DA in regional vertex search with regional tracks reconstruction is also presented and lead to a short study of 500 bbar event with pile-up at low luminosity.

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