GeVSim MC Event Generator and Flow Analysis for ALICE

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GeVSim [1] is a fast and simple to use Monte-Carlo event generator implemented in AliRoot, the ALICE off-line framework [2]. It can provide events of similar type that can be configured by the user according to the specific needs of a simulation project, in particular that of flow and event-by-event fluctuation studies. It can also be used for detector and physics performance studies and tests of analysis algorithms.

GeVSim is based on the MevSim [4] event generator developed in STAR but does not inherit the code. The latter was written in Fortran while the former is written in C++ and extensively uses the capabilities of Root [3].

It generates a list of particles by randomly sampling a distribution function with no intention to describe the space-time evolution of the system. The azimuthal distribution is factored from the transverse momentum and rapidity distribution.

Momentum spectra can be either selected from a menu of predefined distributions or provided by the user. In GeVSim five models are implemented, four of them as in MevSim and a new one based on Levy distribution suggested in Ref. [5]. Transverse momentum pion distributions for the five models are presented on Fig. 1a. The first three ones [4] are of similar thermal models and describe spectra up to 2 GeV. The thermal model with expansion velocity of 0.5c [4] is shown by open diamonds. The model based on Ref. [5] with internal temperature fluctuation equal 10% is shown by filled circles and goes up to 5 GeV.

The parameters of single particle spectra and their fluctuations are explicitly defined by the user for each particle type separately. Those include the flow coefficients, inverse slope parameter of p_T distributions, rapidity width and particle multiplicity. Custom distributions can be provided by the user either as analytical formulae or by histograms. The possibility to define a distribution as an analytical function can facilitate simulation studies based on different macroscopic (eg. thermal, hydrodynamical) models or fitted distributions of microscopic generators. Using histograms allows to provide experimental data as input to the simulations.

A new event-by-event model was developed in GeVSim thanks to the enhanced potential of object-oriented programming. The model allows fluctuations following an arbitrary analytically defined distribution in addition to the Gaussian distribution provided by MevSim. It is also possible to systematically alter a given parameter to scan the parameter space in one run.

The azimuthal distribution is described by two Fourier coefficients representing directed and elliptic flow, which can either be set to a constant value or parametrized as a function of p_T and rapidity. Two parameterizations are provided: one as in MevSim and a new one reproducing the pion results of STAR [6], which was used for the flow analysis, shown in Fig. 1b.

Azimuthal anisotropies, especially elliptic flow, carry unique information about collective phenomena at low p_T and can probe the saturation scale where hard processes set in at high p_T. Additional information can be obtained studying different heavy ion observables relative to the event plane like HBT and jet quenching.

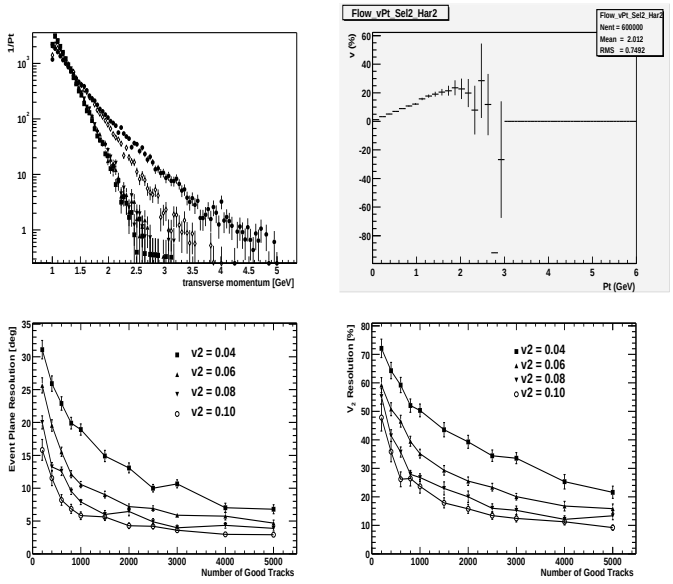

Figure 1: a) p_T distributions implemented in GeVSim and b) reconstructed v_2 as a function of p_T. Resolution of the c) event plane and d) elliptic flow reconstruction in ALICE.

The ALICE capabilities to reconstruct flow and the event plane were studied in AliRoot using events generated by GeVSim. A flow reconstruction and analysis package was developed to analyze a limited number of fully simulated and reconstructed events and a large sample of parametrized ones. Fig. 1c shows the resolution of the event plane reconstruction and Fig. 1d the resolution of the elliptic flow reconstruction, as a function of number of tracks available for the analysis for different values of elliptic flow (v_2). The STAR flow analysis package [6] was interfaced into AliRoot flow analysis chain and Fig. 1 b) shows the reconstructed v_2 as a function of p_T.

GeVSim was made independent from ALICE specific software and included into Root. Work is in progress to implement GeVSim into the STAR off-line framework and for the Compressed Baryonic Matter experiment at the future SIS200 facility at GSI.

References

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