Azimuthal Flow in Heavy Ion Collisions for Events with a high p_T Hadron

Edmundo Garcia, Chicago State University

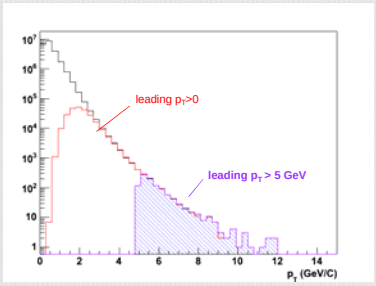
Guy Paic, Instituto de Ciencias Nucleares, UNAM

for the STAR Collaboration

Abstract

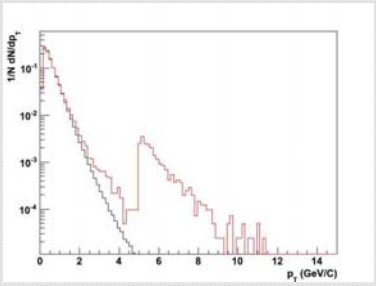
We report a search for a change of azimuthal anisotropy v_2 when events are chosen with a high p_T hadron. We have studied the evolution of v_2 for different cuts on the events leading particle p_T for Au+Au 200 GeV collisions by taking the largest value of p_T from scanning all tracks in one event. We found that there is a noticeable difference between the v_2 of events with no cut on the leading particle p_T and events with the leading particle $p_T > p_T^{cut}$. The average multiplicity of the events with and without the p_T^{cut} is found to be close, although producing a different v_2 which seems counterintuitive. This effect has a dependence on the centrality of the event at a given p_T^{cut}.

Event Selection



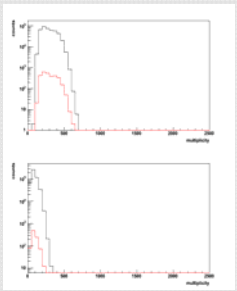
p_T for Au+Au 200 GeV collisions, the spectra for the leading hadron p_T^{lead} (red) and the leading particle spectra for cut $p_T^{lead} > 5$ GeV/c (purple).

p_T spectra



Normalized p_T for Au+Au 200 GeV collisions and the spectra for the events with $p_T^{lead} > 5$ GeV/c (red) for the most peripheral bin (centrality 70 – 80 %)

Multiplicity

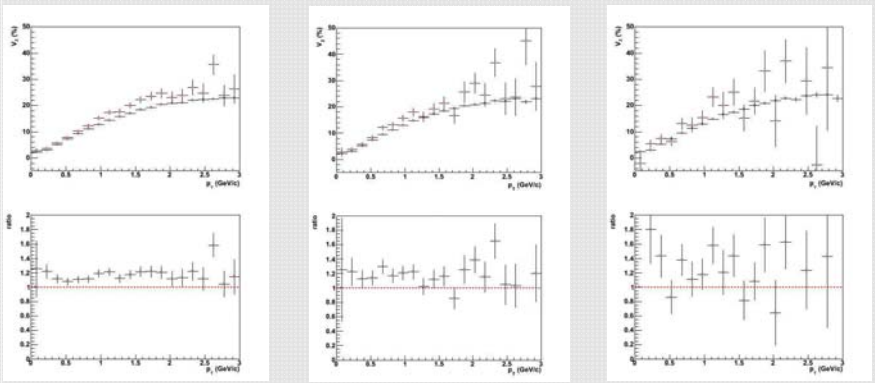


Multiplicity distributions for the events with and without the cut $p_T^{lead} > 5$ GeV/c (red). Top panel is for the centrality bin 70 – 80% and the lower panel for centrality bin 50– 60%.

Average Multiplicity

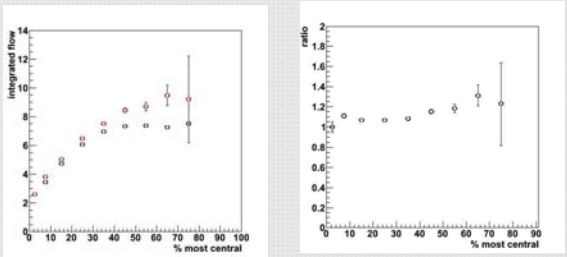
Centrality (%)	No p_T^{cut}	p_T^{cut}>5 GeV/c
70 – 80	87	93
60 – 70	174	179
50 – 60	294	301
40 – 50	469	480
30 – 40	772	784
20 – 30	967	1035
10 - 20	1401	1498
5 - 10	1671	1677
0 - 5	1932	1932

v_2



v_2 as function of pT, for three different cuts in centrality (top) : 40 – 50 % (left), 50 – 60 % (center), and 60 – 70 % (right). The red symbols represent the events with $p_T^{lead} > 5$ GeV/c. In the lower panes is the ratio of the v_2 with and without the cut. The red line is a guide for the eye. The standard cuts to calculate v_2 are applied, thus the leading hadron is excluded in the computation of v_2.

Integrated Flow



Integrated v_2 as function of centrality (right). The red symbols represent the events with $p_T^{lead} > 5$ GeV/c. On the right is the ratio of the integrated flow with and without the cut. The integration of v_2 was over the range 0 to 2.0 GeV/c.

Conclusions

At present it is difficult to pinpoint the exact cause of the increased elliptic flow. Before analyzing the elliptic flow results it is important to note that the selection made for events $p_T^{lead} > 5$ GeV/c results in low pt particles produced by fragmentation, hence a completely different mechanism than for the bulk of the spectrum up to 2 GeV/c as demonstrated by the comparison of the p_T spectra. The intriguing increase in v_2 observed opens different alternatives. The most trivial would be that the shape of the region emitting gets significantly higher eccentricity than for the lower energy . Although this would be an interesting possibility it does not seem to be probable that the eccentricity would increase so drastically, especially bearing in mind that the multiplicity of the events giving way to increased elliptic flow is larger than for the events corresponding to the same centrality bin. Another possibility is that the event selection biases the fluctuations in the calculation of the v_2. Or that the presence of the jet in the selected events has an impact of some magnitude on the medium; again, changing the value of v_2.

The other more interesting interpretation is that the cut is discriminating two components in the spectra: the typical “thermal” spectrum and a small contribution of events with high momentum – produced in hard interactions. I.e. that we are witnessing another process which results from hard collisions with a substantially higher v_2 ($v_2^{integrated}$) indicating really two different phenomena: the bulk which follows the viscous hydrodynamics [1], and another process which results from hard collisions with a substantially higher v_2 ($v_2^{integrated}$) . Further studies underway will help us to interpret this interesting behavior that we have noted.

[1] **arXiv:0902.3663**