Level 0 Word Bit Sets

At Level 0, in the STAR trigger scheme, information from the vertex position detector (VPD), the veto calorimeter (VTC), central trigger barrel (CTB), multiwire counter (MWC) and 16 bit word from the electromagnetic calorimeter (EMC) will be analyzed using the FPGA trees. This will be coupled with busy information from each of the STAR detector subsystems including TPC, SVT, EMC, TOF and XTPC along with a busy from both DAQ and the Level 2 trigger. This coupled information yields a 16 bit Level 0 word which will be passed to the trigger control unit (TCU) where a look-up table will be utilized to make decisions concerning the appropriate trigger action of the individual STAR detector subsystems. Thus it is imperative that we understand the relationship between the bit set of this Level 0 word and the physics which we hope to explore in the STAR experiment.

Information from each of the trigger subsystems enters the trigger data stream at the FPGA level. Each subsystem is analyzed within a given subset of the FPGA tree design. For example, the VPD will produce 48 8 bit words which will be input into 3 FPGA's (16 input channels) where the first analysis stage will be completed. Information from this first stage for each of the 3 FPGA's will be passed to a fourth FPGA where a final analysis will be completed yielding a single positive (1) or negative (0) outcome based on the current beam location threshold. Similar methodologies will be utilized for each of the various trigger subsystem detectors in order to construct the Level 0 word.

In the following analysis we are primarily concerned with the Level 0 trigger information for very central collisions, and we ignore (for now) Level 0 bit sets involving busy detectors or events which are outside the VPD or VTC thresholds. We have assumed

EMC information will be available in the form of a 16 bit word representing global E_t thresholds and 1, 4 (or 9) and 16 tower sum thresholds, in addition to information from the present baseline trigger detectors. The individual bits of this Level 0 word (excluding busies) include:

00	0	0	0	0	000
VTC and VPD threshold	MWC multiplicity threshold	CTB multiplicity threshold	EMC tower sums threshold	EMC global E_t threshold	Moment analysis

At Level 0, trigger decisions are then based upon these subsets of analysis. Of course since level 0 decisions must be made within ~1μsec. only very coarse physics information or global event observables (GEO) can be analyzed. In the present analysis, these GEO's include multiplicity@midrapidity, global E_t, jets/high P_t, fluctuations of multiplicity in $\eta-\varphi$ or $d^2N/d\eta d\varphi$, reduced P_t events and of course combinations of the various subsets. Possible Level 0 bit sets for these GEO's are presented below. We have included the 9 bit analysis, a textual description of information represented by the given bit set and possible physics which might yield such a result. Analysis at Levels 1, 2 and 3 will add to the above bit set so that more detailed information will be available for each triggered event written to tape. A sample flow diagram of this methodology is included in this WWW area under Trigger Bit Flow Diagram.

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Multiplicity@midrapidity

480 111100000
484 111100100 **See trigger bit flow diagram**
488 111101000
492 111101100

Hi P_t -- Jets

400 110010000
401 110010001 **Jets/High Pt, moment analysis**
402 110010010
403 110010011
404 110010100
405 110010101
406 110010110 **Jet energies in di-jet events ==> parton interactions with the medium**
407 110010111 **==> parton information**

Low P_t

450 111000010 **Mwc multiplicity and moment analysis**
451 111000011
452 111000100 **Low P_t π's and K's ====> chiral condensate, Van Hove bubbles**
453 111000101
454 111000110
455 111000111

Multiplicity @ midrapidity & $d^2N/d\eta d\varphi$

425 110101001
426 110101010 **Ctb multiplicity, global E_t and moment analysis**
427 110101011
428 110101100
429 110101101
430 110101110
431 110101111
489 111101001 **Ctb and Mwc mult., global E_t and moment analysis**
490 111101010
491 111101011
492 111101100
493 111101101 **Fluctuations in energy density, entropy density, flow as a function**
494 111101110 **of P_t, multiplicity and azimuth.**
495 111101111

EM/multiplicity

392 110001000 **Global E_t, no multiplicity, no moment analysis**
neutral enhancement ==> Baryochemical potential

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High P_t -- Jets & EM/multiplicity

408 110011000
409 110011001 **Low multiplicity, Global E_t and Jet /High Pt signature**
410 110011010
411 110011011
412 110011100
413 110011101
414 110011110 **Jet energies in di-jet events ==> parton interactions with medium,**
415 110011111 **==> parton information**
432 110110000
472 111011000 **neutral enhancements ==> variations in baryochemical potential**
==> Centauro events

Multiplicity @ midrapidity & High P_t

500 111110100 **High multiplicity and Jet/High P_t and Global E_t signatures**
504 111111000
508 111111100

EM/multiplicity & $d^2N/d\eta d\varphi$

393 110001001 **Global E_t, moment analysis**
394 110001010
395 110001011
396 110001100
397 110001101
398 110001110
399 110001111
457 111001001 **Mwc multiplicity, Global E_t and moment analysis**
458 111001010
459 111001011
460 111001100
461 111001101
462 111001110
463 111001111

High P_t -- Jets & $d^2N/d\eta d\varphi$

465 111010001 **Mwc multiplicity, Jet/High P_t signature and moment analysis**
466 111010010
467 111010011
468 111010100
469 111010101
470 111010110
471 111010111

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Multiplicity@midrapidity & Jets -- High P_t & $d^2N/d\eta d\varphi$

441 110111001
442 110111010 **Ctb multiplicity, Jet/High P_t, Global E_t, moment analysis**
443 110111011
444 110111100
445 110111101
446 110111110
447 110111111
501 111110101
502 111110110
503 111110111
505 111111001
506 111111010 **Ctb + Mwc Multiplicity, Jets Global E_t, moment analysis**
507 111111011
509 111111101
510 111111110
511 111111111

High P_t -- Jets & EM/multiplicity & $d^2N/d\eta d\varphi$

473 111011001
474 111011010 **Mwc multiplicity, Global E_t, Jet/High P_t, moment analysis**
475 111011011
476 111011100
477 111011101
478 111011110
479 111011111

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