081219 HjC
modified 090227 HjC

QT code for Run9:

These 6 systems will share common QT code:
BBC, BBC_large, VDP, ZDC, PP2PP, MTD
The PXZ has its own simpler code.

For BBC, BBCL, ZDC, and VPD we will be comparing the East and West sides in our trigger algorithm, forming sums to indicate multiplicity and a TAC difference to compute vertex.
For PP2PP we will look for hit patterns in EAST and in WEST.
For MTD we will just want "good hit" multiplicity.

All of these will have both ADC and TAC information for each PMT (I call an MTD node a PMT here). Our plan is to divide each QT8 in half, with the top 4 channels taking "anode" signals and producing discriminators signals that go to TAC boards whose outputs are then fed back into the bottom 4 channels of the same QT8. A "hit" will be defined as "good ADC and good TAC" for an input channel ie, an ADC value that passes a threshold and an ADC for the TAC input that satisfies a window condition (lo<TACADC<hi).

For the BBC and VPD each QT8 should pass the ADC_sum and the TAC_max signal for its 4 channels, using only channels that have good hits. The ADC_sum and TAC_max go to the QT32 FPGA, where a board ADC_sum and a TAC_max are produced, or in trickle-down these are produced directly in the QT8s. The 16-bit ADC_sum and the 12-bit TAC_max are then sent to the appropriate DSM with 4 bits to spare. In the DSM we will compute the East-West TAC difference to get the vertex.

For the ZDC and the BBCL, both East and West PMTs will be in the same QT board.

The ZDCs have 3 PMT on each side, the front one going to 1 QT8 and the back 2 going to another QT8, with the PXZ strips between the front and back set. We want to form a sum of the 3 E side PMTs (ZDCE_sum=E1+E2+E3) and compare that to a threshold, producing 1 bit, and the same for the West (W1+W2+W3) forming a second bit. We also want to compare the front (E1 or W1) to a threshold and the back (E2+E3 or W2+W3) to a threshold for both E and W, making 4 more bits. We also want to get the TACE_max (max of E1TAC,E2TAC,E3TAC) and the TACW_max (same) and send them to the DSM. This leaves 2 spare bits (32-12-12-4-2).

The BBCL has 8 PMTs on each side. We do not know about any special requirements for this detector, so we will simply place the ADC and TAC values into the data stream until this becomes better defined.

For the PP2PP we only need to find hit patterns, so we do not need sums or TAC_max values. Thus, each QT8 will just decide which of its 4 inputs satisfies the "good hit" requirement and just pass 1 bit per input (4 bits total) to the QT32. The QT32 then can just pass 16 bits to the DSM to indicate the hit pattern, 8 from East and 8 from West.

For MTD we only need hit counts, with “good hit” defined as above. Thus it can also pass just the 16 "good hit" bits to the DSM, same as the PP2PP.

We will do PP2PP and MTD QT codes after we finish the BBC,BBCL,ZDC,VPD coding.

The PXZ does not contribute to the trigger. All we have to do is read its 28 channels of ADC data.