Calorimeter Trigger Monitoring Proposal for Improvements

- Example of changes to Trigmon and Trigger monitoring in general to improve effectiveness of shift crew
- Make plots clearer
  - Easier to read text
  - Standardize axes and ways of presenting data
  - Present scatter plots of simulation vs data or ratio of simulation vs data
    - Specifically in scatter plots put Data on Y axis and Simulation on X axis
    - This will give errors above the diagonal as “Hot”, below the plot are “Holes”
  - Label axes as “Sim” or “Data” with source bank or board name in parentheses
- Standard approach to presenting of path data through trigger:
  - Occupancy of “Input” data as seen by trigger, compare to simulation from detector bank
  - Occupancy or object distributions for trigger primitives passed to next level of the system (eg XFT tracks to XTRP, towers passing electron cuts, matched Stub+Track), compare to simulation based on “Input” data to system not detector bank.
- Focus on slide show since this is the primary information for shift crew

Calorimeter Slide 1: Trigger Tower Occupancy (L1/L2)

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- Four plots: “EM (HAD) Trigger Tower Occupancy – Data (DCAS)/Sim (ADMEM)”
  - Filled with any tower that has Et > 125 MeV in DCAS
- Upper two have occupancy in data, lower two occupancy in Simulation
- Use YMON PMT occupancy as model of appearance
- Use the same layout for ALL eta-phi maps in Calorimeter trigger
- Normalize occupancy to number of events analyzed. Will be more stable run-to-run. How about normalizing to delta(eta) for the tower?
- Axis labels etc:
  - x – “(West) Trigger Tower Eta (East)”
  - y – “Trigger Tower Wedge (phi)”
  - Add grid lines at tower boundaries for easy of viewing
  - Add a thick vertical line at eta=0 (between towers 11 and 12)
  - On EM plots vertical lines at PEM/PHA boundary (6/7 and 16/17)
  - On Had plots vertical lines at CHA/WHA/PHA boundary (5/6 and 17/18)
- Should we make another set that require Et>1 GeV?

Calorimeter Slide 2: Trigger Tower Validation (L1/L2)

- Four plots: Left column for EM, Right column for HAD
- Upper plots: “Trigger Tower Et: Data vs Sim”
  - Data from DCAS (TC2D) simulation based on ADMEM
  - Axes:

    x – “Tower Et Sim (ADMEM) GeV”

    y – “Tower Et Data (DCAS) GeV”
  - Use color to indicate occupancy
  - Try to put stats boxes in upper left corner or other location that won’t block the plot (needed for overflows)
- Lower plots:“Trigger Tower Errors: Et(Data)!=Et(Sim)”
  - Same axes and labels as tower occupancy plots
  - Remove stats boxes from these plots

Calorimeter Slide 3: L1 Cal Trigger Tower Errors

- Four plots: Left column for EM, Right column for TOT(Jet/Tau)
- eta-phi plots of DIRAC trigger decisions by tower. This is the OR of all 8 EM (electron/photon) or 8 TOT (Jet/Tau) triggers for each tower. Filled by data from TC1D bank from DIRAC cards.
  - Upper plots: “L1 EM(TOTAL) Trigger Occupancy by Tower”
    - Could replace EM with Photon/Electron and Total with Tau/Jet
  - Lower plots: “L1 EM(TOTAL) Trigger Decision != Simulation (DCAS) by Tower”
- Same axes labels as tower occupancy plots
  - No statistics boxes
- Plots for each individual bit will be in expert slide show (16 bits x 3 occupancy lots = 48 plots

Calorimeter Trigger Slide 4: L1 Cal Trigger Decisions

- Again 4 plots: left EM (e, γ), Right TOT(j, τ)
- Comparison of 16 bits at PreFRED between data and Simulation
  - Top 1D histograms of 8 bits each from Data (PreFRED) with Simulation (DIRAC) overlayed
    - Titles: “L1 Electron/Photon (Jet/Tau) Trigger Bits”
    - X – axis labels: “Trigger Bit Number (PreFRED)”
    - Need key for Data (solid) and Sim (Dashed)
  - Bottom 1D histograms of errors where bits did not agree between Data and Sim
    - Titles: “L1 Electron/Photon (Jet/Tau) Trigger Bit Errors
    - X – axis labels: “Trigger Bit Number (PreFRED)”

Calorimeter Slide 5: SUMET Validation (L1)

- Four plots
- Plot 1: “Sum Et Data”
  - Data from TL1D (PreFRED)
  - Axes:
    X – “Sum Et Data (PreFRED) GeV”
    Y – “Events/GeV”
  - Normalize?
- Plots 2-4: “Sum Et Data vs Sim (source)”
  - Data from TL1D, Simulation based on different sources
  - Axes:
    X – “Sum Et – Sim (Source) GeV”
    Y – “Sum Et – Data (PreFRED) GeV”
  - Sources for Simulation: Plot 2 – ADMEM, Plot 2 – DCAS, Plot 3 - DIRAC

Calorimeter Slide 6: Missing Et Validation (L1)

- Plot 1: “Missing Et Data”
  - Data from TL1D (PreFRED)
  - Axes:
    X – “Missing Et Data (PreFRED) GeV”
    Y – “Events/GeV”
  - Normalize?
- Plot 2: “Missing Et Data vs Sim”
  - Data from TL1D, Simulation based on TC2D (DCAS)
  - Axes:
    X – “Missing Et – Sim (DCAS) GeV”
    Y – “Missing Et – Data (PreFRED) GeV”
- Plots 3, 4: Missing Et: Etx (Ety) Data vs Sim”
  - Axes:
    X – “Etx(Ety) – Sim (DCAS) GeV”
    Y – “Etx(Ety) – Data (PreFRED) GeV”

Calorimeter Trigger Slide 7: Cluster Energy Validation

- Four plots: EM Left, Had Right
- Upper Plots: “Cluster EM(HAD) Et: Data vs Sim”
  - Data from TL2D (Alpha), Sim from TC2D (DCAS)
  - Axes:
    x – “Cluster Et Data (TL2D) GeV”
    y – “Cluster Et Sim (TC2D) GeV”
  - Use color to indicate occupancy
  - Axis range to 100 GeV, use Stats box to indicate overflows
- Lower plots: “Cluster EM(HAD) Et Errors: Et(Data)!=Et(Sim)”
  - Eta-phi map of seed tower (Data) of cluster errors
  - Use the same labels and axes as tower occupancy plots

Calorimeter Slide 8: Cluster Validation (L2)

- Four plots. All are Data (TL2D) vs Simulation (TC2D). Rename as follows and reverse Axes:
  - "Number of L2 Clusters: Data vs Sim"
    x axis: "Number of Clusters – Sim (TC2D)"
    y axis: "Number of Clusters – Data (TL2D)"
    Stats on overflows?
  - "Number of Towers per Cluster: Data vs Sim"
    x axis: "Number – Sim (TC2D)"
    y axis: "Number – Data (TL2D)"
    Stats on overflows?
  - "Eta of Seed Tower: Data vs Sim"
    x axis: "Eta – Sim (TC2D)"
    y axis: "Eta – Data (TL2D)"
  - "Phi of Seed Tower: Data vs Sim"
    x axis: "Phi – Sim (TC2D)
    y axis: "Phi – Data (TL2D)"

Calorimeter Trigger Slide 9: Isolation Energy Validation

- Four plots: EM Left, Had Right
- Upper Plots: “Isolation EM(HAD) Et: Data vs Sim”
  - Data from TL2D (Alpha), Sim from TC2D (DCAS). Fill these plots will all 5 sums for each event. Have a similar set of plots in expert plots which separate the 5 sums.
  - Axes:
    x – “Isolation Et Data (TL2D) GeV”
    y – “Isolation Et Sim (TC2D) GeV”
  - Use color to indicate occupancy
  - Axis range to 100 GeV, use Stats box to indicate overflows
- Lower plots: “Isolation EM(HAD) Et Errors: Et(Data)!=Et(Sim)”
  - Eta-phi map of seed tower (Data) of cluster errors
  - Use the same labels and axes as tower occupancy plots

Calorimeter Slide 10: Isolation Cluster Validation (L2)

- Four plots as already exist. All are Data (TL2D) vs Simulation (TC2D). Rename as follows:
  - "Number of L2 Clusters: Data vs Sim"
    X axis: "Number of Clusters – Data (TL2D)"
    y axis: "Number of Clusters – Sim (TC2D)"
  - "Et Sum 1: Data vs Sim"
    X axis: "Et Sum 1 – Data (TL2D)"
    y axis: "Et Sum 1 – Sim (TC2D)"
  - "Eta of Seed Tower: Data vs Sim"
    X axis: "Eta – Data (TL2D)"
    y axis: "Eta – Sim (TC2D)"
  - "Phi of Seed Tower: Data vs Sim"
    X axis: "Phi – Data (TL2D)"
    y axis: "Phi – Sim (TC2D)"

Calorimeter Trigger Criteria for Good Run

- Nothing is known to be bad
- What makes the run “bad” for calorimeter trigger?
  - The Photon trigger is “on” at 1.7MHz because the 32 GeV bit is stuck on for a CEM tower => page L1 Cal, end run, mask the tower and start a new run
  - A run is not “bad” if only a 0.125 GeV bit is stuck on or off
  - A run is bad if >5 towers have bits stuck off for Et>1 GeV
  - More than 5 towers in DIRAC giving incorrect trigger decisions (e.g. whole DIRAC board)
  - Cluster Energies disagree with Sim on >1% of clusters

Calorimeter Trigger: When do problems need to be fixed?

These are for discussion:

- A hot trigger tower must be masked immediately if it increases the overall L1 rate by 20%
- Mask towers should be addressed on a bi-weekly basis or if Nmasked>5 address immediately
- Bad bits (>1 GeV) should be addressed bi-weekly or if Nbad>5
- Bad bits (<1 GeV) should be addressed monthly or if Nbad>10
- If more than 5 towers in DIRAC are giving incorrect triggers this should be addressed immediately