EEMC Codes:
Where we are at and where to go

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Where We Are At

- Various EEMC reconstruction (post-calibration) tasks
  - Cluster towers
  - Cluster SMD strips
  - SMD Point finding
  - Determine number of hits
  - Tower Energy Sharing
  - Making particles from decay products
  - Combination of Sectors
  - PID and signals (γ, π^0, etc.) vs. background
- Many authors have contributed to various parts for many years
  - Jan Balewski, Alice Bridgeman, Weihong He, Jason Webb
  - Many more
- Must recognize much work done by all those previously involved
- But is possible that we have "reinvented the wheel" multiple times
  - To address this, I have began to summarize all the previous methods.
  - See **http://drupal.star.bnl.gov/STAR/blog/sgliske/2011/jun/06/summary-eemc-code**.

Sorting the Many "Wheels"

- We need to know
  - How many "wheels" (i.e. methods) do we have for each task?
  - Are any methods theoretically or physically preferable?
  - Do the methods have any observable results?
    - Intermediate distributions?
    - Resolution on certain variables?
    - Effects on background estimation/subtraction?
    - Final Results?
- Must also decide
  - On criterion for deciding which methods to use
  - Whether there exists "significant" deficiencies in current methods to warrant a new method.
- Some application of manpower seems needed.
- Results could benefit possibly all EEMC analyses—both current and future

My (Possible) Plans

1. Evaluate current methods & develop new methods as needed
   - Goal: have a final answer on which methods ought to be (will be) used for EEMC analyses
   - Input regarding good criterion and whether methods meet criterion will be essential.
2. To facilitate item (1) it is helpful to restructure the software
   - Single framework for all methods
     - Common API with an "uber-class" to collect all methods
     - I.e. allow mixing & matching of any combination of methods per task
   - Extend the idea of `GammaTree`'s
     - Need a TTree output at the post-calibration level (on which to test all the methods)
       An `StEEmcPostCalTree`
     - Need a TTree output at the pre-analysis level (after the above methods)
       An `StEEmcAnalysisTree`
   - Goal: a cohesive package for all relevant methods with all relevant data for all relevant EEMC analyses
3. Finalize some results
   - Goal: Start with π^0, η, $\gamma + X$ cross-section and/or A_{LL} 2006

Particle and Process ID

- A relatively untouched aspect is PID, i.e. electron/hadron/photon identification
  - Need to utilize data from pre-shower and post-shower
  - Any information from TPC could be beneficial
  - A single method for all EEMC analysis is preferable
- Closely related is process identification
  - Decide whether photons are prompt, decay of reconstructable π^0 or η, or background
  - Likewise get most likely pairings of photons for π^0 and η reconstruction
- Tall order, but can use methods and experience of Mike Betancourt
- Also need to ensure everything works across sector boundaries
  - Ensure code still "sees" π^0 & η if decay photons in different sectors
  - Use all three layers of the SMD where present (near the sector boundaries)

Shower Shape Asymmetry

- Assume the characteristic shower radius increases linearly with distance (i.e. is a cone)
  - Distance is measured along center-of-momentum direction
  - Radius is measured perpendicular to center-of-momentum direction
- Define α as the angle of incidence of the particle hitting the EEMC
- Define β as the opening angle of the shower cone
- Asymmetry in left (inside) vs. right (outside) characteristic radial distance is

$$\frac{r_R - r_L}{r_R + r_L} = \frac{\tan(\alpha+\beta) + \tan(\alpha-\beta) - 2\tan\alpha}{\tan(\alpha+\beta) - \tan(\alpha-\beta)}.$$

- If can measure asymmetry in two SMD layers, can solve for α, β and the z position where the shower started.
- Even if large noise in α, β, and z-position, could still be useful inputs to a multivariate algorithm.
- Drupal blog with more details is in preparation.

Conclusion & Outlook

- Summary of EEMC methods posted
  http://drupal.star.bnl.gov/STAR/blog/sgliske/2011/jun/06/summary-eemc-code.
- Careful comparison of the various options warranted.
- Unclear whether given methods sufficient or if further development is needed.
- Some code/tree restructuring is needed:
  1. Put all codes into a "uber-class"
  2. Write out EMC TTrees at two places: post-calibration and pre-analysis.
- I look forward to deciding manpower distribution and discussing all this further at our meeting tomorrow in Bloomington.