SiD Calorimeter Calibration

1) IDAG question:

* Give an outline of the plan for calibrating the energy response of your calorimeter, both from test beams or monitoring signals and *in situ* running. What level of precision is required? How is it obtained ? How do you monitor and maintain it? If operation at the Z pole is part of your strategy, how much data is required?

2) SiD response – concentrate on baseline, gas-RPC digital solution + Si/W ECal. Consider variations for other gas-based digital calorimeters. Leave Scintillator/SiPM and Homogenous dual-readout solution for later. MAPS calibration as alternative for ECal.

3) Digital hadron calorimetry for use with a PFA requires special consideration for calibration – with little (prototypes/test beams) previous experience. The measurement of the energies of e/gamma in the ECal will require a full calibration and merits consideration as a separate part of this exercise.
In principle, the HCal would only be used for the measurement of neutral energy for clusters unassigned to charged tracks. However, there will also be unmatched charged track clusters that will require direct energy measurement. It is also possible that we will have to rely on non-PFA use of the calorimeters for very high energy jets. This may merit a separate approach to calibration.

4) We need to establish, with input from Benchmarking, exactly what our calorimeter calibration requirements are to achieve our discovery and measurement goals.

5) Calibration involves (at least) the following areas:

   a) Front-end internal calibration, charge injection,…?
   b) Front-end thresholds – determining, recording, downloading,…
   c) Pre-calibration of sections/modules in test beams, with sources, cosmics etc. Note: carrying over a calorimeter calibration from test beam to a full detector has had mixed success.
   d) Use of the precise measurement of momenta in the tracking system to aid calorimeter calibration. E/p matching for electrons could help establish the ECal e.m. calibration.

e) Understanding the hits vs. energy relation and saturation effects.
f) Use of physics objects (e.g. Z0's) for calibration. Rate of Z0 production in e+e- events vs. statistics/time needed to maintain calibration.
g) Special runs at the Z pole??
h) Understanding the stability of calibration, need for temperature and other environmental variable monitoring.
i) Possible use of jet-jet ET balancing for e+e- -> qqbar.
j) E.m. calibration for HCal for e.m. shower tails, photons in the HCal,…
k) Calibration needs vs. push-pull running scenario. What would one period of beam exposure allow us to check/achieve for calorimeter calibration?

6) To answer the IDAG question will require focused effort over the next ~6 weeks. Need to form a small group to have regular meetings and draft a response to IDAG.