Elements of beam test plan

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Experimental goals

Different areas are to be investigated at CERN:

1. PSF
2. Effective Area
3. Energy reconstruction
4. Backsplash
5. Hadronic shower
6. Background rejection
7. Benchmarking of GEANT4
8. Characterization of Trigger/Timing…

\+ Calibration

"Tuning" of the Monte-Carlo simulations:

- modeling of physical processes

  ex: selection of a model for hadronic interactions

  test of the range cut-off parameter (δ electrons)

- description of the detector response

  geometry, calibration, non-linearity, limitations in the electronics…

ITEM	Distributions	Beam configuration	Target Precision
TKR cluster sizes	TKR cluster sizes by layer	Positrons (few GeV) and/or tagged gammas (100 MeV, few GeV) at normal incidence and off-axis (~30 degrees)	1%
TKR pulse durations	TOT by layer	Positrons (few GeV) and tagged photons (100 MeV, 1 GeV, 10 GeV) at normal incidence and off-axis (~30 degrees)	5%
CAL nuclear counter effect (direct energy deposition in diodes)	Energy centroid position relative to true particle impact position	Positrons (few GeV or higher) at normal incidence and off axis (~ 30 degrees)	10%
CAL energy topologies	#hit xtals relative to energy centroid and track axis; energy deposition per layer.	Positrons or tagged gammas (100 MeV, few GeV, >10 GeV); side-incident and normal-incident protons	5%
TKR track topologies	Hit distributions at the track vertex; distributions of hits around tracks (inside and outside "roads")	Tagged gammas (100 MeV, few GeV, >10 GeV); at normal incidence and off-axis (~30 deg);protons at normal incidence and off-axis (~30 deg).	1%
TKR-CAL matching	Difference of track projection and CAL energy centroid	Positrons or tagged gammas (100 MeV, few GeV) at normal incidence and off-axis (~30 degrees); side-incident protons	2%
Low energy particle range-outs	Z location of track starts and stops, # tracks, TOT for stubs; fraction of L1Ts produced.	Side-incident protons.	2%
PSF	PSF distribution and 68% and 95% containment values	Tagged gammas (normal incidence and off-axis ~30 degrees)	1%
Systematic photon reconstruction effects (offsets, efficiencies)	Mean reconstructed direction; number of reconstructed photon events compared with tagged rates.	Tagged gammas at 100 MeV and a few GeV, at normal incidence, 5 deg, 30 deg, and 60 deg.	5% on efficiencies
Photon energy reconstruction	Reconstructed energy distributions	Tagged gammas at 100 MeV, normal incidence and at 30 deg, at a few incident positions to explore gaps. Positrons at a few GeV and at >100 GeV effective at normal incidence and at 30 degrees, at a few incident positions to explore gaps.	5%

from
LAT Beam Test Rationale (LAT-TD-02152-02)
S.Ritz, B. Atwood, E. do Couto e Silva, G. Godfrey

"low-level" parameters

"end-to-end" parameters

+ backsplash, characterization of electronics, tests of G4…

Contributions to precision

- statistics

  …after cuts! In principle, should not be a factor (but that's theory).
- uncertainty on the beam characteristics, resolution of the spectrometer

  example: 2.5% energy resolution for the spectrometer at PS;

  This is relative to the *electron* energy, not the tagged gamma-ray one.

  For a 1 GeV electron, this energy resolution translates into

  σ= 25/100=25% for a 100 MeV gamma-ray in coincidence.
- uncertainty in calibration

  example: CAL will be calibrated with MIPS, then the calibration will be extrapolated to higher ranges (using data in overlaping regions of ADC). Maintaining a precision better than of a few % all the way up to the 10s of GeV domain is not easy (but feasible).
- pile-up (i.e. multi-particle events) effects

  At PS, about 10% of the events will have 2 photons with E> 50 MeV, most often seen as one photon with the sum energy. This will create a tail in the PSF distribution in the high-energy bin.
- effect of contamination (electrons in hadron beam and vice-versa)

  distortion of distributions