MICE calorimeter
Spectrum and profile at calorimeter
Calorimeter layout

Scintillating fibers embedded in grooved lead layers

Side view:
2 blocks of 120x60x16 cm³

Readout: 30 PMTs per layer at both ends
Minimum cell size 4x4 cm² due to PMT support
Calorimeter design

120 x 120 cm²
Active Area

30 x 4
Light Guides per Side

MICE EmCal TRD Update
The construction technique consists in embedding 1 mm diameter polystyrene based blue scintillating fibers between thin grooved lead plates, obtained by plastic deformation of 0.3 mm thick lead foil.

Fibers are glued to the lead plates and run parallel to each other with a pitch of 1.35 mm and are mostly orthogonal to the entering particles.

**Fine Grained Calorimeter Option for Muon Identifier**

**Same Construction Technique as KLOE EmCal**

- Density $\approx 3.7 \, \text{g/cm}^3$
- Radiation length $\approx 2.1 \, \text{cm}$
- Moliere radius $\approx 3.4 \, \text{cm}$

(estimate without glue)
Fiber-Lead composite

(MICE)

0.3 mm Lead + 1 mm Fiber
One sampling cell ~ 2 $X_0$

(KLOE)

0.5 mm Lead + 1 mm Fiber
One sampling cell ~ 3 $X_0$
Comparison 0.5 mm vs 0.3 mm lead foils
Test at LNF Metrology Lab

Lead grooved foil

To be done at LNF

Enlarged view

Measurement
Basic elements for calorimeter construction

Lead spool

Big lead shaping machine

The grooving rollers

Rely on LNF for manufacturing
Big swaying machine at RomalII for refurbishing

For mass production at external firms
PMTs and Winston-cone light guides

PMTs recovered from the HARP experiment
- Hamamatsu 1355 PhotoMultiplier and 2624 Voltage Divider
- Box with mu-metal shielding for mechanical housing of two complete readout channels (to be modified)

Some exemplary of Winston come light guides with different length an section
Light guide and PMT support structure
PID support structure

Iron Shield suspended off the tracker solenoid cryostat

TOF 2
Cherenkov 2

EMCalorimeter

PID support can slide in and out of normal anchor position in both X & Z directions

PID support structure
EmCal mounting
EmCal as seen “from outside”

No change in shape
wrt previous
MICE_EmCal_TRD
Alternative EMCAL assembly
Calorimeter simulation and PID

• Calorimeter simulation in G4MICE (by R. Sandstrom)
  – Full geometry (fiber-by-fiber)
  – Detailed digitization
  – Validation from comparison with KLOE data ongoing

• Particle identification: separation of positrons from muons with a Neural Network
  – Input variables: total charge, shower barycenter depth, signal amplitudes in each layer and at both ends
  – Excellent efficiency and purity achieved
PID with a Neural Network
EmCal Summary

- Fine grained calorimeter: scintillating fibers embedded in grooved lead foils
  - Lead layer thickness 0.3 mm
  - Calorimeter size: 120 x 120 x 16 cm³
  - Read-out: 4 Layers, each read out by 30 PMTs at both ends (cell size 4x4 cm²)

- Muon/electron separation based on energy deposition and shower development
  - Identification algorithms studied with G4MICE
  - Using a Neutral Network, muon efficiency is close to 100% with electron contamination <10⁻³

- PID capabilities are adequate for MICE requirements

- Validation of simulation in progress